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MACROECONOMICS

14th Edition

Michael Parkin

MACROECONOMICS

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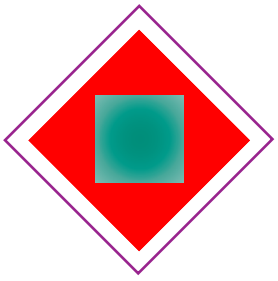

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TO ROBIN

Michael Parkin is Professor Emeritus in the Department of Economics at the University of Western Ontario, Canada. Professor Parkin has held faculty appointments at Brown University, the University of Manchester, the University of Essex, and Bond University. He is a past president of the Canadian Economics Association and has served on the editorial boards of the *American Economic Review* and the *Journal of Monetary Economics* and as managing editor of the *Canadian Journal of Economics*. Professor Parkin's research on macroeconomics, monetary economics, and international economics has resulted in over 160 publications in journals and edited volumes, including the *American Economic Review*, the *Journal of Political Economy*, the *Review of Economic Studies*, the *Journal of Monetary Economics*, and the *Journal of Money, Credit and Banking*. He became most visible to the public with his work on inflation that discredited the use of wage and price controls. Michael Parkin also spearheaded the movement toward European monetary union. Professor Parkin is an experienced and dedicated teacher of introductory economics.

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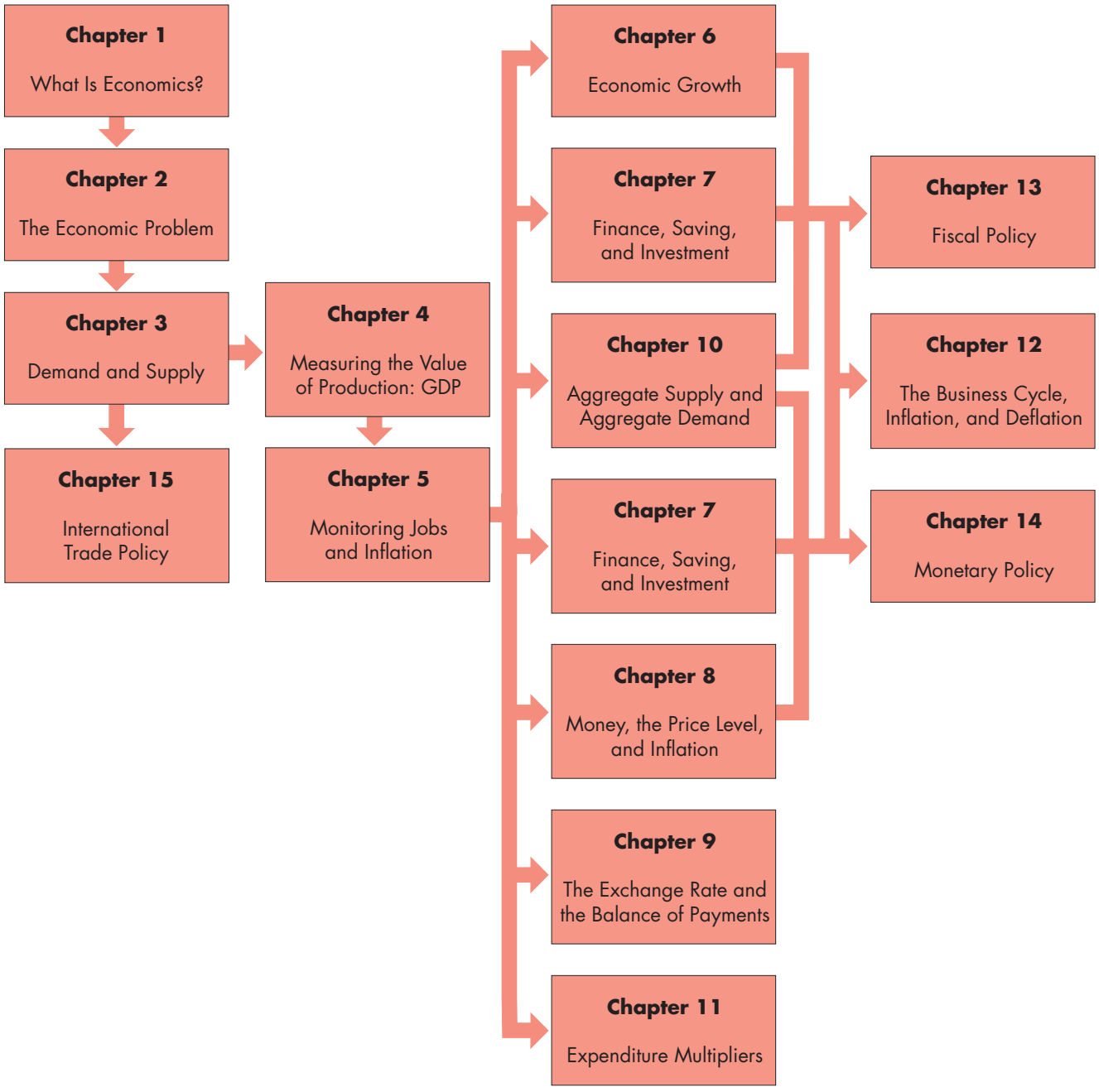
Macro Flexibility



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ECONOMICS 14th Edition

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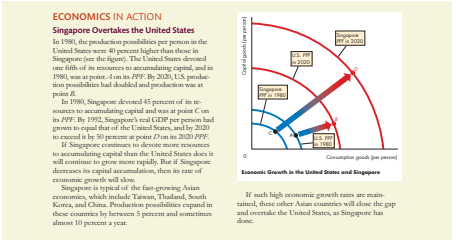


ECONOMICS IN ACTION

Singapore Overtakes the United States

In 1980, the production possibilities per person in the United States were 40 percent higher than those in Singapore (see the figure). The United States devoted one fifth of its resources to accumulating capital, and in 1980, was at point *A* on its *PPF*. By 2020, U.S. production possibilities had doubled and production was at point *B*.

In 1980, Singapore devoted 45 percent of its resources to accumulating capital and was at point *C* on its *PPF*. By 1992, Singapore's real GDP per person had grown to equal that of the United States, and by 2020 to exceed it by 50 percent at point *D* on its 2020 *PPF*.

If Singapore continues to devote more resources to accumulating capital than the United States does it will continue to grow more rapidly. But if Singapore decreases its capital accumulation, then its rate of economic growth will slow.

Singapore is typical of the fast-growing Asian economies, which include Taiwan, Thailand, South Korea, and China. Production possibilities expand in these countries by between 5 percent and sometimes almost 10 percent a year.

Economic Growth in the United States and Singapore

If such high economic growth rates are maintained, these other Asian countries will close the gap and overtake the United States, as Singapore has done.

ECONOMICS IN THE NEWS

The Market for Vanilla Bean

Crop Uncertainty Drives Vanilla Price Back to Record Level

The price of vanilla soared to a record $270 a pound last year after a cyclone hit the Madagascar.

Source: *Financial Times*, March 25, 2018

THE DATA

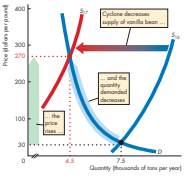
Year	Quantity of vanilla bean (thousands of tons per year)	Price of vanilla bean (dollars per pound)
2015	7.5	30
2017	4.5	270

THE QUESTIONS

- What does the data table tell us?
- Why did the price of vanilla bean rise? Was it because the demand for vanilla bean changed or the supply changed. In which direction did it change?

THE ANSWERS

- The data table tells us that from 2015 to 2017, the quantity of vanilla bean produced decreased and the price of vanilla bean increased sharply.
- An increase in demand brings an increase in the quantity and a rise in the price.
- A decrease in supply brings a decrease in the quantity and a rise in the price.
- Because the quantity of vanilla bean decreased and the price of vanilla bean increased, there must have been a decrease in the supply of vanilla bean.
- The news clip says a cyclone hit Madagascar, which decreased production and brought a decrease in the supply of vanilla bean.
- The figure illustrates the market for vanilla bean in 2015 and 2017. The demand curve *D* shows the demand for vanilla bean.
- In 2015, the supply curve was S_{15}, the price was $30 a pound, and the quantity of vanilla bean traded was 7.5 thousand tons.
- In 2017, the decreased production in Madagascar decreased the supply of vanilla bean to S_{17}.
- The price rose to $270 a pound and the quantity traded decreased to 4.5 thousand tons
- The higher price brought a decrease in the quantity of vanilla bean demanded, which is shown by the movement along the demand curve.



The Market for Vanilla Bean in 2015–2017

TALKING WITH Esther Duflo

ESTHER DUFLO is the Abdul Latif Jameel Professor of Poverty Alleviation and Development Economics at the Massachusetts Institute of Technology. Among her many honors are the 2010 John Bates Clark Medal for the best economist under 40 and the Financial Times and Goldman Sachs Business Book of the Year Award in 2011 for her book (with Abhijit Banerjee) *Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty*. Professor Duflo's research seeks to advance our understanding of the economic choices of the extremely poor by conducting massive real-world experiments.

Professor Duflo was an undergraduate student of history and economics at École Normale Supérieure and completed a master's degree at DELTA in Paris before moving to the United States. She earned her PhD in Economics at MIT in 1999.

Michael Parkin talked with her about her work, which advances our understanding of the economic choices and condition of the very poor.

Professor Duflo, what's the story about how you became an economist and in particular the architect of experiments designed to understand the economic choices of the very poor?

When I was a kid, I was exposed to many stories and images of poor children: through my mother's engagement as a doctor in a small NGO dealing with child victims of war and through books and stories about children living all around the world. I remember asking myself how I could justify my luck of being born where I was. I had a very exaggerated idea of what it was to be poor, but this idea caused sufficient discomfort that I knew I had to do something about it, if I could. Quite by accident, I discovered that economics was the way in which I could actually be useful: While spending a year in Russia teaching French and studying History, I realized that academic economists have the ability to intervene in the world while keeping enough sanity to analyze it. I thought this would be ideal for me and I have never regretted it. I have the best job in the world.

... imagine living on under a dollar a day after your rent is paid in Seattle or Denver. Not easy!

The very poor whom you study are people who live on $1 a day or $2 a day. … Is $1 a day a true measure that includes everything these poor people consume?

For defining the poverty line, we don't include the cost of housing. The poor also get free goods, sometimes of bad quality (education, healthcare) and the value of those is also not included. Other than that, yes, it is everything.

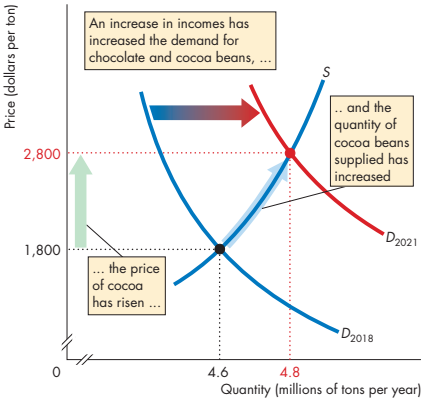
Moreover, you have to realize this is everything, taking into account the fact that life is much cheaper in many poor countries because salaries are lower, so anything that is made and consumed locally (e.g., a haircut) is cheaper.

For example, in India, the purchasing power of a dollar (in terms of the real goods you can buy) is about 3 times what it is in the United States. So the poverty line we use for India is 33 cents per day, not a dollar.

All told, you really have to imagine living on under a dollar a day after your rent is paid in Seattle or Denver. Not easy!

Showing the Action and Telling the Story

Graphs with realistic values; consistent use of color with blended arrows that show action; boxed notes that tell the story; and captions that make each diagram a self-contained object for study and review.



The Market for Cocoa Beans

Learning Interactively

Worked Problem, and new *Economics in the News* video series with linked exercises promote active learning.

WORKED PROBLEM

The table sets out the demand and supply schedules for roses on a normal weekend.

Price (dollars per rose)	Quantity demanded (roses per week)	Quantity supplied (roses per week)
6.00	150	60
7.00	100	100
8.00	70	130
9.00	50	150

Questions

1. If the price of a rose is $6, describe the situation in the rose market. Explain how the price adjusts.
2. If the price of a rose is $9, describe the situation in the rose market. Explain how the price adjusts.
3. What is the market equilibrium?
4. Rose sellers know that Mother's Day is next weekend and they expect the price to be higher, so they withhold 60 roses from the market this weekend. What is the price this weekend?
5. On Mother's Day, demand increases by 160 roses. What is the price of a rose on Mother's Day?

Solutions

1. At $6 a rose, the quantity demanded is 150 and the quantity supplied is 60. The quantity demanded exceeds the quantity supplied and there is a *shortage* of 90 roses. With people lining up and a shortage, the price rises above $6 a rose.

Key Point: When a shortage exists, the price rises.

2. At $9 a rose, the quantity demanded is 50 and the quantity supplied is 150. The quantity supplied exceeds the quantity demanded and there is a *surplus* of 100 roses. With slow sales of roses and a surplus, the price falls to below $9 a rose.

Key Point: When a surplus exists, the price falls.

3. Market equilibrium occurs at the price at which the quantity demanded *equals* the quantity supplied. That price is $7 a rose. The market equilibrium is a price of $7 a rose and 100 roses a week bought and sold, point *A* on the figure.

Key Point: At market equilibrium, there is no shortage or surplus.

4. Sellers expect a higher price next weekend, so they decrease the quantity supplied this weekend by 60 roses at each price. Create the new table:

Price (dollars per rose)	Quantity demanded (roses per week)	Quantity supplied (roses per week)
6.00	150	0
7.00	**100**	**40**
8.00	**70**	**70**
9.00	50	90

At $7 a rose, there is a shortage of 60 roses, so the price rises to $8 a rose, where the quantity demanded equals the quantity supplied. (Point *B*)

Key Point: When supply decreases, the price rises.

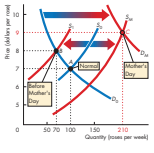
5. Demand increases by 160 roses. Sellers plan to increase the normal supply by the 60 roses withheld last weekend. Create the new table:

Price (dollars per rose)	Quantity demanded (roses per week)	Quantity supplied (roses per week)
6.00	310	120
7.00	**260**	**160**
8.00	230	190
9.00	**210**	**210**

At $7 a rose, there is a shortage of 100 roses, so the price rises until, at $9 a rose, the quantity demanded equals the quantity supplied. The price on Mother's Day is $9 a rose. (Point *C*)

Key Point: When demand increases by more than supply, the price rises.

Key Figure



ECONOMICS IN THE NEWS

The Markets for Chocolate and Cocoa

We're Heading for a Chocolate Crisis

The world is running out of chocolate, and if we don't take some significant action soon, we'll be dealing with a major chocolate shortage in less than a decade. Chocolate is made from cocoa and a cocoa shortage is becoming more and more imminent, with prices rising.

Source: *ZME Science*, February 1, 2021

THE DATA

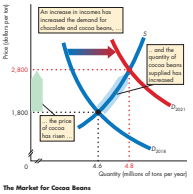
Year	Quantity of cocoa (millions of tons per year)	Price of cocoa (dollars per ton)
2018	4.6	1,800
2021	4.8	2,800

THE QUESTIONS

- What does the data tell us?
- Why did the price of cocoa increase? Was it because the demand for cocoa changed, or the supply changed? In which direction was the change?

THE ANSWERS

- The data table tells us that from 2018 to 2021, both the quantity of cocoa produced and the price of cocoa increased.
- An increase in demand brings an increase in the quantity and a rise in the price.
- An increase in supply brings an increase in the quantity and a fall in the price.
- Because both the quantity of cocoa and the price of cocoa increased, there must have been in increase in the demand for cocoa.
- The cocoa is used to produce chocolate, which is a normal good, so the demand for chocolate and cocoa increases when incomes increase.
- Incomes are increasing, especially in fast-growing China and other Asian countries, so the demand for chocolate has increased, which has increased the demand for cocoa.
- The figure illustrates the market for cocoa in 2018 and 2021. The supply curve *S* shows the supply of cocoa.
- In 2018, the demand curve was D_{2018}, the price was $1,800 per ton, and the quantity of cocoa traded was 4.6 million tons.
- By 2021, the higher incomes in China and other countries had increased the demand for cocoa to D_{2021}.
- The price rose to $2,800 per ton and the quantity traded increased to 4.8 million tons.
- The higher price brought an increase in the quantity of cocoa supplied, which is shown by the movement upward along the supply curve.



The Market for Cocoa Beans

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What's New in This Edition

New in this fourteenth edition revision are: Fine-tuning the content; several notable changes; and an applications video series.

Fine-Tuning the Content

This revision is driven by the drama of the extraordinary period of economic history in which we are living and its rich display of events and forces through which students can be motivated to discover the power of economic models and the economic way of thinking. Chief among these events is the Covid pandemic, its impacts on markets and resource allocation, and the extraordinary fiscal policy and monetary policy responses it has brought.

But Covid isn't an isolated shock in an otherwise tranquil world. Persistent slow economic growth; increasing concentration of wealth; ongoing tensions arising from the loss of American jobs to offshore outsourcing and the political popularity of trade protection; a slowing pace of China's expansion; enhanced concern about carbon emission and climate change; relentless pressure on the federal budget from the demands of an aging population and a sometimes dysfunctional Congress with its associated rising government debt; the dilemma posed by slow, more than decade-long recovery from a global financial crisis and recession and the related question, magnified by Covid, of when and how fast to exit an era of extreme monetary stimulus. All of these events feature at the appropriate points in this new edition.

Every chapter contains many small changes, all designed to enhance clarity, currency, and relevancy and the text and examples are all updated to reflect the most recently available data and events.

Notable Content Changes

Chapter 1, What Is Economics?, has a new section on the diversity challenge in economics. Women and minorities are under-represented in economics at every level: in undergraduate programs, graduate school, faculty appointments, and the broader private and public sector jobs. Under-representation in economics is more persistent and greater than in other subjects that use similar skills.

All the chapters are updated to include the latest data on: the national accounts in Chapter 4; the labor market and price indexes, Chapter 5; economic growth, Chapter 6; interest rates and loanable funds, Chapter 7; banks and the money market, Chapter 8; the exchange rate and balance of payments, Chapter 9; the short-run Phillips curve tradeoff, Chapter 12; fiscal policy, Chapter 13; and monetary policy, Chapter 14.

Ten chapters have an analysis of news reports about the macroeconomic effects of Covid and the policy responses it triggered. These include the effects of the pandemic on the production possibilities frontier, Chapter 2, demand and supply in the hand sanitizer market, Chapter 3, nowcasting GDP in the pandemic, Chapter 4; measuring unemployment, Chapter 5; massive bond buying by the Federal Reserve, Chapter 8; the Covid recession viewed through the lens of the AS-AD model, Chapter 10; inventories in the Covid recession, Chapter 11; post-Covid inflation fears in Chapter 12; and the effects of fiscal and monetary stimulus in the Covid recession in Chapters 13 and 14.

Other changes include an explanation of the Fed's new operating procedures with ample reserves, Chapter 14; a look at China's slowing growth rate, Chapter 6; the growth of "fintec"" in financial markets, Chapter 7; and currency manipulation, Chapter 9.

Notable New Videos

Thirty videos based on *Economics in the News* and *Economics in Action* boxes provide a lively alternative way of applying economic principles to real-world issues and events. Each video runs for around two minutes and is accompanied by a short quiz. Examples of items included in this video series are the rising price of chocolate, the the UN Human Development Index (HDI), unemployment in the Covid recession, money and interest rates, China's currency manipulation, aggregate demand and aggregate supply in action, and the fiscal policy and monetary policy responses to Covid.

THE VISION

To change the way students see the world: this is my goal in teaching economics and in writing this book. Three facts about students are my guiding principles.

First, students want to learn, but they are overwhelmed by the volume of claims on their time and energy. So, they must see the relevance to their lives and future careers of what they are being asked to learn.

Second, students want to get it, and get it quickly. So, they must be presented with clear and succinct explanations.

Third, students want to make sense of today's world and be better prepared for life after school. So, they must be shown how to apply the timeless principles of economics and its models to illuminate and provide a guide to understanding today's events and issues, and the future challenges they are likely to encounter.

The organization, structure, and features of this text arise directly from the three guiding principles, and I will describe them by placing them in four groups:

- Making economics real
- Showing the action and telling the story
- Learning interactively—learning by doing
- Developing employability and citizenship skills

Making Economics Real

The student needs to see economics as a lens that sharpens the focus on real-world issues and events, and not as a series of logical exercises with no real purpose. *Economics in the News*, *At Issue*, and *Economics in Action* are designed to achieve this goal.

Each chapter ends with an *Economics in the News* application that helps students to think like economists by connecting the chapter tools and concepts to the world around them.

In many chapters, an additional briefer *Economics in the News* presents a short news clip, supplemented by data where needed, that poses some questions and walks through the answers.

Four *At Issue* boxes engage the student in debate and controversy. An *At Issue* box introduces an issue and then presents two opposing views. It leaves the matter unsettled so that students and the instructor can continue the argument in class and reach their own conclusions.

Economics in Action boxes make economics real by providing data and information that links models to real-world economic activity. Some of the issues covered in these boxes include the the HDI versus GDP; the fast-growing Asian economies; the home price bubble; banks flush with reserves; and the size of the fiscal stimulus multipliers.

Interviews with leading economist, whose work correlates to what the student is learning, are the final component of making economics real. These interviews explore the education and research of prominent economists and their advice for those who want to continue studying the subject.

This edition has new interviews with Emi Nakamura and Dave Donaldson, two outstanding economists recognized by being awarded the American Economic Association's highest honor for economists under the age of 40.

Showing the Action and Telling the Story

Through the past twelve editions, this book has set the standard of clarity in its diagrams; the thirteenth edition continues to uphold this tradition. My goal is to show "where the economic action is." The diagrams in this book continue to generate an enormously positive response, which confirms my view that graphical analysis is the most powerful tool available for teaching and learning economics at the principles level.

Recognizing that some students find graphs hard to work with, I have developed the entire art program with the study and review needs of the student in mind.

The diagrams feature

- Axes that measure and display concrete real-world data, and where possible and relevant, the most recent data
- Graphs paired with data tables from which curves are plotted
- Original curves consistently shown in blue
- Shifted curves, equilibrium points, and other important features highlighted in red
- Color-blended arrows to indicate movement
- Diagrams labeled with boxed notes that tell the story
- Extended captions that make each diagram and its caption a self-contained object for study and review

Learning Interactively—Learning by Doing

Every chapter section closes with a Review Quiz, which invites the student to rework the section with questions that cover the key ideas.

As part of the chapter review, the student is presented with a Worked Problem, a multi-part problem that covers the core content of the chapter and consists of questions, solutions, key points, and a key figure. This feature increases the incentive for the student to learn-by-doing and review the chapter actively.

Developing Employability and Citizenship Skills

The economic way of thinking is a foundational skill for career and citizenship. Every feature of the text helps the student develop this skill, repeatedly using its central ideas of tradeoff; opportunity cost; the margin; incentives; the gains from voluntary exchange; the forces of demand, supply, and equilibrium; the pursuit of economic rent; and the tension between self-interest and the social interest.

The section of Chapter 1, "Economists in the Economy", identifies a further five general skills that are crucial for getting a job and developing a successful career.

This text lays the foundation for effective citizenship by explaining the principles of welfare economics and the competing ideas about fairness, and repeatedly applying these principles to a comprehensive range of public choice problems.

Organization

I have organized the sequence of topics and chapters in what I think is the most natural order in which to cover the material. But I recognize that there are alternative views on the best order. I have kept this fact and the need for flexibility firmly in mind throughout the text. Many alternative sequences work, and the Flexibility Chart on p. 8 explains the alternative pathways through the chapters. In using the flexibility information, keep in mind that the best sequence is the one in which I present the topics. And even chapters that the flexibility chart identifies as strictly optional are better covered than omitted.

Teaching Resources

Parkin teaching resources include an Instructor's Manual, Solutions Manual, Test Bank, and PowerPoint. Instructors can download these resources at www.pearsonglobaleditions.com.

The Instructor's Manual, authored by Mark Rush, University of Florida, contains chapter-by-chapter overviews; a list of what's new in the fourteenth edition; and ready-to-use lecture notes.

The Solution Manual, authored by Mark Rush, University of Florida, contains solutions to all Review Quizzes; End-of-chapter Problems; and End-of-chapter Additional Problems and Applications.

The Test Bank contains 6,000 questions, authored by Svitlana Malsymenko, University of Pittsburgh, and James K. Self, Lee College and reviewed by Mark Rush, University of Florida to ensure clarity and consistency. The four types of questions are: multiple-choice, short-answer, graphing, and essay. Each question is classified by the term or concept it supports, its level of difficulty: 1 for straight recall, 2 for some analysis, 3 for complex analysis, and its AACSB category. The Association to Advance Collegiate Schools of Business (AACSB) Guidelines propose learning experiences in the following categories of Assurance of Learning Standards: Written and Oral Communication; Ethical Understanding and Reasoning; Analytical Thinking; Interpersonal Relations and Teamwork; Diverse and Multicultural Work Environments; Reflective Thinking; Application of Knowledge; and Integration of Real-World Business Experiences.

The Computerized TestGen allows instructors to customize, save, and generate tests; edit, add, or delete questions from the Test Bank; analyze test results; and organize a database of tests and student results. TestGen offers many options for organizing and displaying tests, along with search and sort features. Instructors can download the software and the Test Bank at www.pearsonglobaleditions.com.

The Instructor's PowerPoint contains ready-made lectures with text figures and tables animated, along with speaking notes from the Instructor's Manual. Large versions of all figures are available for instructors to use in creating their own lectures.

Acknowledgments

I thank my current and former colleagues and friends at the University of Western Ontario who have taught me so much. They are Jim Davies, Jeremy Greenwood, Ig Horstmann, Peter Howitt, Greg Huffman, David Laidler, Phil Reny, Chris Robinson, and John Whalley. I also thank Doug McTaggart and Christopher Findlay, co-authors of an Australian edition, and Melanie Powell and Kent Matthews, co-authors of the European edition. Suggestions arising from their adaptations of earlier editions have been helpful to me in preparing this edition.

I thank the several thousand students whom I have been privileged to teach. The instant response that comes from the look of puzzlement or enlightenment has taught me how to teach economics.

It is a special joy to thank the many outstanding people at Pearson who contributed to the concerted publishing effort that brought this edition to completion. Christopher DeJohn, Content Manager Quantitative Business, and Samantha Lewis, Product Manager, provided direction and overall management of the project. Thomas Hayward, Senior Content Analyst, provided helpful guidance on the priorities for this revision and enthusiastic support. Elaine Page, Senior Content Producer, Economics, managed the production process, and drawing on her earlier career as a development editor gave good advice on the new way news items are presented. Noel Lotz, Digital Content Manager, and Melissa Honig, Digital Studio Producer, directed the production of MyLab content and the eText and ensured that all our media assets were correctly assembled. Ashley DePace, Product Marketing Manager, provided inspired marketing strategy and direction, and Kristin Jobe and Gina Linko, Content Project Managers, kept the project on track on a tight schedule.

I thank all of these wonderful people. It has been inspiring to work with them and to share in creating what I believe is a truly outstanding educational tool.

I thank Catherine Baum, who provided a careful, consistent, and intelligent copy edit and accuracy check.

I especially thank Mark Rush, who yet again played a crucial role in creating another edition of this text and package. Mark has been a constant source of good advice and good humor.

I thank the many exceptional reviewers who have shared their insights through the various editions of this book. Their contribution has been invaluable.

I thank the people who work directly with me. Jeannie Shearer provided outstanding research assistance on many topics, including finding news articles and creating MyLab exercises. Richard Parkin created the electronic art files and offered many ideas that improved the figures in this book. Evan Sauve wrote scripts and worked with Liam Winckel and Richard to make the videos and associated exercises that are new in this edition.

As with the previous editions, this one owes an enormous debt to Robin Bade. I dedicate this book to her and again thank her for her work. I could not have written this book without the tireless and selfless help she has given me. My thanks to her are unbounded.

Classroom experience will test the value of this book. I would appreciate hearing from instructors and students about how I can continue to improve it in future editions.

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PART ONE **INTRODUCTION**

1 WHAT IS ECONOMICS?

After studying this chapter, you will be able to:

- Define economics and distinguish between microeconomics and macroeconomics
- Explain the two big questions of economics
- Explain the key ideas that define the economic way of thinking
- Explain how economists go about their work as social scientists and policy advisers
- Describe the jobs available to a graduate with a major in economics

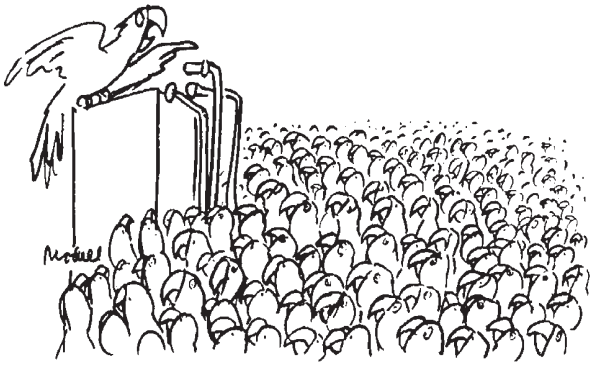
Is economics about money: How people make it and spend it? Is it about business, government, and jobs? Is it about why some people and some nations are rich and others poor?

Economics is about all these things. But its core is the study of *choices* and their *consequences*.

Your life will be shaped by the choices that you make and the challenges that you face. To face those challenges and seize the opportunities they present, you must understand the powerful forces at play. The economics that you're about to learn will become your most reliable guide. This chapter gets you started by describing the questions that economists try to answer and looking at how economists think as they search for the answers.

Definition of Economics

A fundamental fact dominates our lives: We want more than we can get. Our inability to get everything we want is called **scarcity**. Scarcity is universal. It confronts all living things. Even parrots face scarcity!



Not only do I want a cracker—we all want a cracker!

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Think about the things that *you* want and the scarcity that *you* face. You want to go to a good school, college, or university. You want to live in a well-equipped, spacious, and comfortable home. You want the latest smartphone and the fastest Internet connection for your laptop or tablet. You want some sports and recreational gear—perhaps some new running shoes, or a new bike. You want much more time than is available to go to class, do your homework, play sports and games, read novels, go to the movies, listen to music, travel, and hang out with your friends. And you want to live a long and healthy life.

What you can afford to buy is limited by your income and by the prices you must pay. And your time is limited by the fact that your day has 24 hours.

You want some other things that only governments provide. You want to live in a safe neighborhood in a peaceful and secure world, and enjoy the benefits of clean air, lakes, rivers, and oceans.

What governments can afford is limited by the taxes they collect. Taxes lower people's incomes and compete with the other things they want to buy.

What *everyone* can get—what *society* can get—is limited by the productive resources available. These resources are the gifts of nature, human labor and ingenuity, and all the previously produced tools and equipment.

Because we can't get everything we want, we must make *choices*. You can't afford *both* a laptop *and* an iPhone, so you must *choose* which one to buy. You can't spend tonight *both* studying for your next test *and* going to the movies, so again, you must *choose* which one to do. Governments can't spend a tax dollar on *both* national defense *and* environmental protection, so they must *choose* how to spend that dollar.

Your choices must somehow be made consistent with the choices of *others*. If you choose to buy a laptop, someone else must choose to sell it. Incentives reconcile choices. An **incentive** is a reward that encourages an action, or a penalty that discourages one. Prices act as incentives. If the price of a laptop is too high, more will be offered for sale than people want to buy. And if the price is too low, fewer will be offered for sale than people want to buy. But there is a price at which choices to buy and sell are consistent.

> **Economics** is the social science that studies the *choices* that individuals, businesses, governments, and entire societies make as they cope with *scarcity* and the *incentives* that influence and reconcile those choices.

The subject has two parts:

- Microeconomics
- Macroeconomics

Microeconomics is the study of the choices that individuals and businesses make, the way these choices interact in markets, and the influence of governments. Some examples of microeconomic questions are: Why are people streaming more movies? How would a tax on on-line shopping affect Amazon?

Macroeconomics is the study of the performance of the national economy and the global economy. Some examples of macroeconomic questions are: Why does the U.S. unemployment rate fluctuate? Can the Federal Reserve make the unemployment rate fall by keeping interest rates low?

REVIEW QUIZ

1. List some examples of the scarcity that you face.
2. Find examples of scarcity in today's headlines.
3. During the Covid pandemic, what incentives did you face and how did you respond?
4. Find an example of the distinction between microeconomics and macroeconomics in today's headlines.

Two Big Economic Questions

Two big questions summarize the scope of economics:

- How do choices end up determining *what, how,* and *for whom* goods and services are produced?
- Do choices made in the pursuit of *self-interest* also promote the *social interest*?

What, How, and For Whom?

Goods and services are the objects that people value and produce to satisfy wants. *Goods* are physical objects such as smartphones and automobiles. *Services* are tasks performed for people such as wireless service and auto-repair service.

What? *What* we produce varies across countries and changes over time. In the United States today, agriculture accounts for 1 percent of total production, industry (manufactured goods) for 11 percent, and services (retail and wholesale trade, healthcare, and education are the biggest ones) for 80 percent. In contrast, in low-income Ethiopia, agriculture accounts for 35 percent of total production, industry for 22 percent, and services for 44 percent.

Figure 1.1 shows these numbers and also the percentages for China, which fall between those for the United States and Ethiopia.

What determines these patterns of production? How do choices end up determining the quantities of smartphones, automobiles, wireless service, auto-repair service, and the millions of other items that are produced in the United States and around the world?

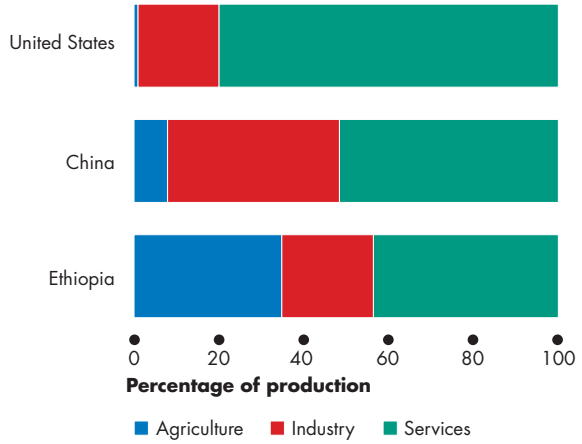
How? *How* we produce is described by the technologies and resources that we use. The resources used to produce goods and services are called **factors of production**, which are grouped into four categories:

- Land
- Labor
- Capital
- Entrepreneurship

Land The "gifts of nature" that we use to produce goods and services are called **land**. In economics, *land* is what in everyday language we call *natural resources*. It includes land in the everyday sense together with minerals, oil, gas, coal, water, air, forests, and fish.

Our land surface and water resources are renewable and some of our mineral resources can be recycled. But the resources that we use to create energy are nonrenewable—they can be used only once.

FIGURE 1.1 What Three Countries Produce



Agriculture and industry are small percentages of production in rich countries such as the United States and large percentages of production in poor countries such as Ethiopia. Most of what is produced in the United States is services. The numbers for China fall between poor countries and rich countries.

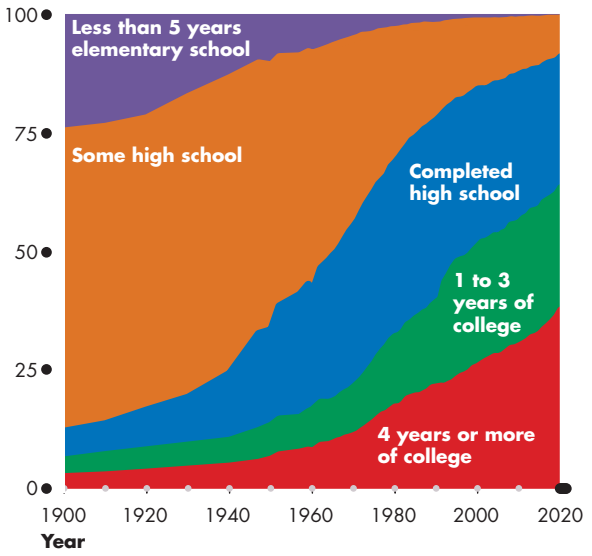
Source of data: The World Bank Group: Data of World Bank 2021.

Labor The work time and work effort that people devote to producing goods and services is called **labor**. Labor includes the physical and mental efforts of all the people who work on farms and construction sites and in factories, shops, and offices.

The *quality* of labor depends on **human capital**, which is the knowledge and skill that people obtain from education, on-the-job training, and work experience. You are building your own human capital right now as you work on your economics course, and your human capital will continue to grow as you gain work experience.

Human capital expands over time. Today, 91 percent of the adult population of the United States have completed high school and 38 percent have a college or university degree. Figure 1.2 shows these measures of human capital in the United States and its growth since 1900.

FIGURE 1.2 A Measure of Human Capital



In 2020, 38 percent of the population aged 25 and older had 4 years or more of college, up from 2 percent in 1900. A further 53 percent had completed high school, up from 12 percent in 1900.

Source of data: U.S. Census Bureau, 2021.

Capital The tools, instruments, machines, buildings, and other constructions that businesses use to produce goods and services are called **capital**.

In everyday language, we talk about money, stocks, and bonds as being "capital." These items are *financial capital*. Financial capital plays an important role in enabling businesses to borrow the funds that they use to buy physical capital. But financial capital is not used to produce goods and services and it is not a factor of production.

Entrepreneurship The human resource that organizes labor, land, and capital is called **entrepreneurship**. Entrepreneurs are the drivers of economic progress. They develop new ideas about what and how to produce, make business decisions, and bear the risks that arise from these decisions.

What determines how the factors of production are used to produce each good and service?

For Whom? *Who* consumes the goods and services that are produced depends on the incomes that people earn. People with large incomes can buy a wide range of goods and services. People with small incomes have fewer options and can afford a smaller range of goods and services.

People earn their incomes by selling the services of the factors of production they own:

- Land earns **rent**.
- Labor earns **wages**.
- Capital earns **interest**.
- Entrepreneurship earns **profit**.

Which factor of production earns the most income? The answer is labor. In 2020, wages were 55 percent of total income and the incomes from land, capital, and entrepreneurship totaled 45 percent. Labor's share has fallen slightly over the past 20 years.

Knowing how income is shared among the factors of production doesn't tell us how it is shared among individuals. And the distribution of income among individuals is extremely unequal. You know of some people who earn very large incomes. In 2019, Stephen Curry earned $74.4 million and LeBron James earned $88.2 million. LeBron joined the Los Angeles Lakers in 2018 under a four-year $153 million contract.

You know of even more people who earn very small incomes. Servers at McDonald's average around $11.50 an hour; checkout clerks, cleaners, and textile and leather workers all earn less than $15 an hour.

You probably know about other persistent differences in the incomes people earn. Men, on average, earn more than women; whites earn more than minorities; college graduates earn more than high-school graduates.

We can get a good sense of who consumes the goods and services produced by looking at the percentages of total income earned by different groups of people. The 20 percent of people with the lowest incomes earn about 5 percent of total income, while the richest 20 percent earn close to 50 percent of total income. So on average, people in the richest 20 percent earn more than 10 times the incomes of those in the poorest 20 percent. There is even huge inequality within the richest 20 percent and the top 1 percent earns almost 15 percent of total income.

Why is the distribution of income so unequal?

Economics provides some answers to all these questions about *what, how*, and *for whom* goods and services are produced and much of the rest of this book will help you to understand those answers.

We're now going to look at the second big question of economics: Do choices made in the pursuit of self-interest also promote the social interest?

Do Choices Made in the Pursuit of Self-Interest also Promote the Social Interest?

Every day, you and 328 million other Americans, along with 7.9 billion people in the rest of the world, make economic choices that result in *what, how*, and *for whom* goods and services are produced. These choices are made by people who are pursuing their self-interest.

Self-Interest You make a choice in your **self-interest** if you think that choice is the best one available for you. All the choices that people make about how to use their time and other resources are made in the pursuit of self-interest. When you allocate your time or your budget, you do what makes the most sense to you. You might think about how your choices affect other people and take into account how you feel about that, but it is how *you* feel that influences your choice. You order a home-delivery pizza because you're hungry, not because the delivery person needs a job. And when the pizza delivery person shows up at your door, he's not doing you a favor. He's pursuing *his* self-interest and hoping for a tip and another call next week.

The big question is: Is it possible that all the choices that each one of us makes in the pursuit of self-interest could end up achieving an outcome that is best for everyone?

Social Interest An outcome is in the **social interest** if it is best for society as a whole. It is easy to see how you decide what is in *your* self-interest. But how do we decide if something is in the social interest? To help you answer this question, imagine a scene like that in *Economics in the News* on p. 34.

Ted, an entrepreneur, creates a new business. He hires a thousand workers and pays them $20 an hour, $1 an hour more than they earned in their old jobs. Ted's business is extremely profitable and his own earnings increase by $1 million per week.

You can see that Ted's decision to create the business is in his self-interest—he gains $1 million a week. You can also see that for Ted's employees, their decisions to work for Ted are in their self-interest—they gain $1 an hour (say $40 a week). And the decisions of Ted's customers must be in their self-interest, otherwise they wouldn't buy from him. But is this outcome in the social interest?

The economist's answer is "Yes." It is in the social interest because it makes everyone better off. There are no losers.

Efficiency and the Social Interest Economists use the everyday word "efficient" to describe a situation that can't be improved upon. Resource use is **efficient** if it is *not* possible to make someone better off without making someone else worse off. If it *is* possible to make someone better off without making anyone worse off, society can be made better off and the situation is not efficient.

In the Ted story everyone is better off, so it improves efficiency and the outcome is in the social interest. But notice that it would also have been efficient if the workers and customers had gained nothing and Ted had gained even more than $1 million a week. But would that efficient outcome be in the social interest?

Many people have trouble seeing the outcome in which Ted is the only winner as being in the social interest. They say that the social interest requires Ted to share some of his gain either with his workers in higher wages or with his customers in lower prices, or with both groups.

Fair Shares and the Social Interest The idea that the social interest requires "fair shares" is a deeply held one. Think about what you regard as a fair share. To help you, imagine the following game.

I put $100 on the table and tell someone you don't know and who doesn't know you to *propose* a share of the money between the two of you. If you *accept* the proposed share, you each get the agreed upon shares. If you don't accept the proposed share, you both get nothing.

It would be efficient—you would both be better off—if the proposer offered to take $99 and leave you with $1 and you accepted that offer.

But would you accept the $1? If you are like most people, the idea that the other person gets 99 times as much as you is just too much to stomach. "No way," you say and the $100 disappears. That outcome is inefficient. You have both given up something.

When the game I've just described is played in a classroom experiment, about half of the players reject offers of below $30.

So fair shares matter. But what is *fair*? There isn't a crisp definition of fairness to match that of efficiency. Reasonable people have a variety of views about it. Almost everyone agrees that too much inequality is unfair. But how much is too much? And inequality of what: income, wealth, or the *opportunity* to work, earn an income, and accumulate wealth?

You will examine efficiency again in Chapter 2 and efficiency and fairness in Chapter 5.

Questions about the social interest are hard ones to answer and they generate discussion, debate, and disagreement. Four issues in today's world put some flesh on these questions. The issues are:

- Globalization
- Information-age monopolies
- Climate change
- The Covid pandemic

Globalization The term *globalization* means the expansion of international trade, borrowing and lending, and investment.

When Nike produces sports shoes, people in Malaysia get work; and when China Airlines buys new airplanes, Americans who work at Boeing in Seattle build them. While globalization brings expanded production and job opportunities for some workers, it destroys many American jobs. Workers across the manufacturing industries must learn new skills, take service jobs, which often pay less, or retire earlier than previously planned.

Globalization is in the self-interest of those consumers who buy low-cost goods and services produced in other countries; and it is in the self-interest of the multinational firms that produce in low-cost regions and sell in high-price regions. But is globalization in the self-interest of the low-wage worker in Malaysia who sews your new running shoes and the displaced shoemaker in Atlanta? Is it in the social interest?

ECONOMICS IN THE NEWS

The Invisible Hand

From Brewer to Bio-Tech Entrepreneur

Kiran Mazumdar-Shaw trained to become a master brewer and learned about enzymes, the stuff from which bio-pharmaceuticals are made. Discovering it was impossible for a woman in India to become a master brewer, the 25-year-old Kiran decided to create a bio-pharmaceutical business.

Kiran's firm, Biocon, employed uneducated workers who loved their jobs and the living conditions made possible by their high wages. But when a labor union entered the scene and unionized the workers, a furious Kiran fired the workers, automated their jobs, and hired a smaller number of educated workers. Biocon continued to grow and today, Kiran's wealth exceeds $1 billion.

Kiran has become wealthy by developing and producing bio-pharmaceuticals that improve people's lives. But Kiran is sharing her wealth in creative ways. She has opened a cancer treatment center to help thousands of patients who are too poor to pay and created a health insurance scheme.

Source: Ariel Levy, "Drug Test," *The New Yorker,* January 2, 2012

THE QUESTIONS

- Whose decisions in the story were taken in self-interest?
- Whose decisions turned out to be in the social interest?
- Did any of the decisions harm the social interest?

THE ANSWERS

- All the decisions—Kiran's, the workers', the union's, and the firm's customers'—are taken in the pursuit of self-interest.
- Kiran's decisions serve the social interest: She creates jobs that benefit her workers and products that benefit her customers. And her charitable work brings yet further social benefits.
- The labor union's decision might have harmed the social interest because it destroyed the jobs of uneducated workers.

Kiran Mazumdar-Shaw, founder and CEO of Biocon

Information-Age Monopolies The technological change of the past forty years has been called the *Information Revolution*. Bill Gates, a co-founder of Microsoft, held a privileged position in this revolution. For many years, Windows was the only available operating system for the PC. The PC and Mac competed, but the PC had a huge market share.

An absence of competition gave Microsoft the power to sell Windows at prices far above the cost of production. With lower prices, many more people would have been able to afford and buy a computer.

The information revolution has clearly served your self-interest: It has provided your smartphone, laptop, loads of handy applications, and the Internet. It has also served the self-interest of Bill Gates who has seen his wealth soar.

But did the information revolution best serve the social interest? Did Microsoft produce the best possible Windows operating system and sell it at a price that was in the social interest? Or was the quality too low and the price too high?

Climate Change Burning fossil fuels to generate electricity and to power airplanes, automobiles, and trucks pours a staggering 28 billion tons—4 tons per person—of carbon dioxide into the atmosphere each year. These carbon emissions, two thirds of which come from the United States, China, the European Union, Russia, and India, bring global warming and climate change.

Every day, when you make self-interested choices to use electricity and gasoline, you leave your carbon footprint. You can lessen this footprint by walking, riding a bike, taking a cold shower, or planting a tree.

But can each one of us be relied upon to make decisions that affect the Earth's carbon-dioxide concentration in the social interest? Must governments change the incentives we face so that our self-interested choices are also in the social interest? How can governments change incentives? How can we encourage the use of wind and solar power to replace the burning of fossil fuels that brings climate change?

The Covid Pandemic Covid-19 spreads through close contact and social interaction. Without some degree of social isolation, one infected person infects more than one other person, each of whom in turn infect more than one other person, leading to an exponential spread of the disease.

A person who socially isolates avoids infection, but also avoids infecting others. People choose their degree of social isolation in their self-interest. But do individual choices serve the social interest?

Most likely not. To control the spread of the virus and ease the pressure on healthcare services, governments, working with economists and epidemiologists, set the rules to best serve the social interest. What are the best rules, and when should they be eased?

We've looked at four topics and asked many questions that illustrate the potential conflict between the pursuit of self-interest and the social interest. We've asked questions but not answered them because we've not yet explained the economic principles needed to do so. We will answer these questions in future chapters.

REVIEW QUIZ

1 Describe the broad facts about *what, how*, and *for whom* goods and services are produced.

2 Give some examples to illustrate the potential for conflict between self-interest and the social interest during the Covid pandemic.

AT ISSUE

The Protest Against Market Capitalism

Market capitalism is an economic system in which individuals own land and capital and are free to buy and sell land, capital, and goods and services in markets. Markets for goods and services, along with markets for land and capital, coordinate billions of self-interested choices, which determine what, how, and for whom goods and services are produced. A few people earn enormous incomes, many times the average income. There is no supreme planner guiding the use of scarce resources and the outcome is unintended and unforeseeable.

Centrally planned socialism is an economic system in which the government owns all the land and capital, directs workers to jobs, and decides what, how, and for whom to produce. The Soviet Union, several Eastern European countries, and China have used this system in the past but have now abandoned it. Only Cuba and North Korea use this system today. A few bureaucrats in positions of great power receive huge incomes, many times that of an average person.

Our economy today is a **mixed economy**, which is market capitalism with government regulation.

The Protest

The protest against market capitalism takes many forms. Historically, **Karl Marx** and other communist and socialist thinkers wanted to replace it with *socialism* and *central planning*. Today, thousands of people who feel let down by the economic system want less market capitalism and more government regulation. The **Occupy Wall Street** movement, with its focus on the large incomes of the top 1 percent, is a visible example of today's protest. Protesters say:

- Big corporations (especially big banks) have too much power and influence on governments.
- Democratically elected governments can do a better job of allocating resources and distributing income than uncoordinated markets.
- More regulation in the social interest is needed—to serve "human need, not corporate greed."
- In a market, for every winner, there is a loser.
- Big corporations are the winners. Workers and unemployed people are the losers.

A Protest against Capitalism

The Economist's Response

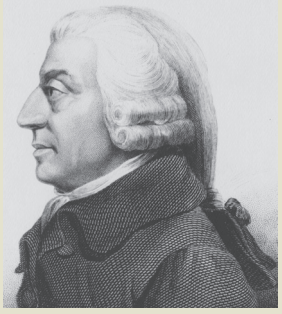
Economists agree that market capitalism isn't perfect. But they argue that it is the best system available and while some government intervention and regulation can help, government attempts to serve the social interest often end up harming it.

Adam Smith (see p. 85), who gave the first systematic account of how market capitalism works, says:

- The self-interest of big corporations is *maximum profit*.
- But an *invisible hand* leads production decisions made in pursuit of self-interest to *unintentionally* promote the social interest.
- Politicians are ill-equipped to regulate corporations or to intervene in markets, and those who think they can improve on the market outcome are most likely wrong.
- In a market, buyers get what they want for less than they would be willing to pay and sellers earn a profit. Both buyers and sellers gain. A market transaction is a "win-win" event.

"It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own interest."

The Wealth of Nations, 1776


Adam Smith

The Economic Way of Thinking

The questions that economics tries to answer tell us about the *scope of economics,* but they don't tell us how economists *think* and go about seeking answers to these questions. You're now going to see how economists go about their work.

We're going to look at six key ideas that define the *economic way of thinking*. These ideas are

- A choice is a *tradeoff*.
- People make *rational choices* by comparing *benefits* and *costs*.
- *Benefit* is what you gain from something.
- *Cost* is what you *must give up* to get something.
- Most choices are "*how-much*" choices made at the *margin*.
- Choices respond to *incentives*.

A Choice Is a Tradeoff

Because we face scarcity, we must make choices. And when we make a choice, we select from the available alternatives. For example, you can spend Saturday night studying for your next economics test or having fun with your friends, but you can't do both of these activities at the same time. You must choose how much time to devote to each. Whatever choice you make, you could have chosen something else.

You can think about your choices as tradeoffs. A **tradeoff** is an exchange—giving up one thing to get something else. When you choose how to spend your Saturday night, you face a tradeoff between studying and hanging out with your friends.

Making a Rational Choice

Economists view the choices that people make as rational. A **rational choice** is one that compares costs and benefits and achieves the greatest benefit over cost for the person making the choice.

Only the wants of the person making a choice are relevant to determine its rationality. For example, you might like your coffee black and strong but your friend prefers his milky and sweet. So it is rational for you to choose espresso and for your friend to choose cappuccino.

The idea of rational choice provides an answer to the first question: *What* goods and services will be produced and in what quantities? The answer is those that people rationally choose to buy!

But how do people choose rationally? Why do more people choose an iPad rather than a Microsoft Surface? Why has the U.S. government chosen to build an interstate highway system and not an interstate high-speed railroad system? The answers turn on comparing benefits and costs.

Benefit: What You Gain

The **benefit** of something is the gain or pleasure that it brings and is determined by **preferences**—by what a person likes and dislikes and the intensity of those feelings. If you get a huge kick out of "League of Legends," that video game brings you a large benefit. If you have little interest in listening to Yo-Yo Ma playing a Vivaldi cello concerto, that activity brings you a small benefit.

Some benefits are large and easy to identify, such as the benefit that you get from being in school. A big piece of that benefit is the goods and services that you will be able to enjoy with the boost to your earning power when you graduate. Some benefits are small, such as the benefit you get from a slice of pizza.

Economists measure benefit as the most that a person is *willing to give up* to get something. You are willing to give up a lot to be in school. But you would give up only an iTunes download for a slice of pizza.

Cost: What You *Must* Give Up

The **opportunity cost** of something is the highest-valued alternative that must be given up to get it.

To make the idea of opportunity cost concrete, think about *your* opportunity cost of being in school. It has two components: the things you can't afford to buy and the things you can't do with your time.

Start with the things you can't afford to buy. You've spent all your income on tuition, residence fees, books, and a laptop. If you weren't in school, you would have spent this money on tickets to ball games and movies and all the other things that you enjoy. But that's only the start of your opportunity cost. You've also given up the opportunity to get a job. Suppose that the best job you could get if you weren't in school is working at Citibank as a teller earning $25,000 a year. Another part of your opportunity cost of being in school is all the things that you could buy with the extra $25,000 you would have.

As you well know, being a student eats up many hours in class time, doing homework assignments, preparing for tests, and so on. To do all these school activities, you must give up many hours of what would otherwise be leisure time spent with your friends.

So the opportunity cost of being in school is all the good things that you can't afford and don't have the spare time to enjoy. You might want to put a dollar value on that cost or you might just list all the items that make up the opportunity cost.

The examples of opportunity cost that we've just considered are all-or-nothing costs—you're either in school or not in school. Most situations are not like this one. They involve choosing *how much* of an activity to do.

How Much? Choosing at the Margin

You can allocate the next hour between studying and chatting online with your friends, but the choice is not all or nothing. You must decide how many minutes to allocate to each activity. To make this decision, you compare the benefit of a little bit more study time with its cost—you make your choice at the **margin**.

The benefit that arises from an increase in an activity is called **marginal benefit**. For example, your marginal benefit from one more night of study before a test is the boost it gives to your grade. Your marginal benefit doesn't include the grade you're already achieving without that extra night of work.

The *opportunity cost* of an *increase* in an activity is called **marginal cost**. For you, the marginal cost of studying one more night is the cost of not spending that night on your favorite leisure activity.

To make your decisions, you compare marginal benefit and marginal cost. If the marginal benefit from an extra night of study exceeds its marginal cost, you study the extra night. If the marginal cost exceeds the marginal benefit, you don't study the extra night.

Choices Respond to Incentives

Economists take human nature as given and view people as acting in their self-interest. All people—you, other consumers, producers, politicians, and public servants—pursue their self-interest.

Self-interested actions are not necessarily *selfish* actions. You might decide to use your resources in ways that bring pleasure to others as well as to yourself. But a self-interested act gets the most benefit for *you* based on *your* view about benefit.

The central idea of economics is that we can predict the self-interested choices that people make by looking at the *incentives* they face. People undertake those activities for which marginal benefit exceeds marginal cost; they reject options for which marginal cost exceeds marginal benefit.

For example, your economics instructor gives you a problem set and tells you these problems will be on the next test. Your marginal benefit from working these problems is large, so you diligently work them. In contrast, your math instructor gives you a problem set on a topic that she says will never be on a test. You get little marginal benefit from working these problems, so you decide to skip most of them.

Economists see incentives as the key to reconciling self-interest and social interest. When our choices are *not* in the social interest, it is because of the incentives we face. One of the challenges for economists is to figure out the incentives that result in self-interested choices being in the social interest.

Economists emphasize the crucial role that institutions play in influencing the incentives that people face as they pursue their self-interest. Laws that protect private property and markets that enable voluntary exchange are the fundamental institutions. You will learn as you progress with your study of economics that where these institutions exist, self-interest can indeed promote the social interest.

REVIEW QUIZ

1. Explain the idea of a tradeoff and think of three tradeoffs that you made today.
2. Explain what economists mean by rational choice and think of three choices that you've made today that are rational.
3. Explain why opportunity cost is the best forgone alternative and provide examples of some opportunity costs that you have faced during the last week.
4. Explain what it means to choose at the margin and illustrate with three choices at the margin that you have made today.
5. Explain why choices you made during the Covid pandemic were in your self-interest. Why might your choices not have been in the social interest?

Economics as Social Science and Policy Tool

Economics is both a social science and a toolkit for advising on policy decisions.

Economist as Social Scientist

As social scientists, economists seek to discover how the economic world works. In pursuit of this goal, like all scientists, economists distinguish between positive and normative statements.

Positive Statements A *positive* statement is about what *is*. It says what is currently believed about the way the world operates. A positive statement might be right or wrong, but we can test it by checking it against the facts. "Our planet is warming because of the amount of coal that we're burning" is a positive statement. We can test whether it is right or wrong.

A central task of economists is to test positive statements about how the economic world works and to weed out those that are wrong. Economics first got off the ground in the late 1700s, so it is a young science compared with, for example, physics, and much remains to be discovered.

Normative Statements A *normative* statement is about what *ought to be*. It depends on values and cannot be tested. Policy goals are normative statements. For example, "We ought to cut our use of coal by 50 percent" is a normative policy statement. You may agree or disagree with it, but you can't test it. It doesn't assert a fact that can be checked.

Unscrambling Cause and Effect Economists are particularly interested in positive statements about cause and effect. Are computers getting cheaper because people are buying them in greater quantities? Or are people buying computers in greater quantities because they are getting cheaper? Or is some third factor causing both the price of a computer to fall and the quantity of computers bought to increase?

To answer such questions, economists create and test economic models. An **economic model** is a description of some aspect of the economic world that includes only those features that are needed for the purpose at hand. For example, an economic model of a wireless network might include features such as the prices of calls, the number of smartphone users, and the volume of calls. But the model would ignore smartphone colors and ringtones.

A model is tested by comparing its predictions with the facts. But testing an economic model is difficult because we observe the outcomes of the simultaneous change of many factors. To cope with this problem, economists look for natural experiments (situations in the ordinary course of economic life in which the one factor of interest is different and other things are equal or similar); conduct statistical investigations to find correlations; and perform economic experiments by putting people in decision-making situations and varying the influence of one factor at a time to discover how they respond.

Economist as Policy Adviser

Economics is useful. It is a toolkit for advising governments and businesses and for making personal decisions. Some of the most famous economists work partly as policy advisers.

Carmen M. Reinhart at the John F. Kennedy School of Government, Harvard University, has written widely on policy issues arising from government debt and international capital markets. Gita Gopinath of Harvard University is currently on leave from her academic job and is serving as Chief Economist at the International Monetary Fund. And Cecilia Elena Rouse of Princeton University is serving as Chief Economic Adviser to President Biden.

All the policy questions on which economists provide advice involve a blend of the positive and the normative. Economics can't help with the normative part—the policy goal. But it can help to clarify the goal. And for a given goal, economics provides the tools for evaluating alternative solutions—comparing marginal benefits and marginal costs and finding the solution that makes the best use of the available resources.

REVIEW QUIZ

1. Distinguish between a positive statement and a normative statement and provide examples associated with the Covid-19 vaccine rollout.
2. What is a model? Can you think of a model that you might use in your everyday life?
3. How do economists try to disentangle cause and effect?
4. How is economics used as a policy tool?

Economists in the Economy

What are the jobs available to an economics major? Is the number of economics jobs expected to grow or shrink? How much do economics graduates earn? And what are the skills needed for an economics job?

Jobs for an Economics Major

A major in economics opens the door to the pursuit of a master's or Ph.D. and a career as an economist. Relatively few people take this path, but for those who do, the challenges are exciting and job satisfaction is high.

Economists work in private firms, government, and international organizations.

The work of economists varies enormously but can generally be described as collecting and analyzing data on the production and use of resources, goods, and services; predicting future trends; and studying ways of using resources more efficiently.

Writing reports and giving talks are a big part of the job of an economist.

An economics major also opens the door to a range of jobs that have the word "analyst" in the title. Three of these jobs, that between them employ almost one million people, are market research analyst, financial analyst, and budget analyst.

A *market research analyst* works with data on buying patterns and tries to forecast the likely success of a product and the price that buyers are willing to pay for it.

A *financial analyst* studies trends and fluctuations in interest rates and stock and bond prices and tries to predict the cost of borrowing and the returns on investments.

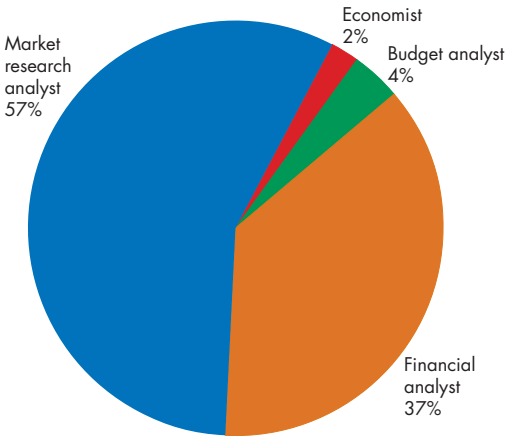
A *budget analyst* keeps track of an organization's cash flow—its receipts and payments—and prepares budget plans that incorporate predictions of future cash flows.

Figure 1.3 shows the scale and distribution of employment across the jobs for an economics major.

Will Jobs for Economics Majors Grow?

The future is always uncertain and things rarely turn out as expected. But we can't avoid trying to peer into the future when we make choices that commit to a long-term plan, and economists at the Bureau of Labor Statistics (the BLS) have done their best to provide some forecasts.

FIGURE 1.3 Economics Jobs



Employment in 2020

Economist	20,500
Budget analyst	55,400
Financial analyst	487,800
Market research analyst	738,100
Total jobs	1,301,800

The pie chart shows the relative number of jobs for economists and analysts that use economic ideas and tools. Most of the jobs for an economics major are in market research (57 percent) and finance (37 percent).

Source of data: Bureau of Labor Statistics.

The BLS has provided forecasts of employment growth from 2019 to 2029 for a large range of jobs and says average job growth will be 3 percent—for every 100 jobs in 2019, there will be 103 in 2029.

Jobs for those with a Ph.D. in economics are forecasted to grow by 14 percent. This growth is much higher than for jobs on average and reflects the fact that economists are valued by private firms as data analysts. Amazon for example employs 150 Ph.D. economists and Uber 30. Google employs about 300 economists and statisticians. Other firms with large economics teams include Facebook, Microsoft, eBay, Airbnb, and Deliveroo.

Budget analyst jobs are expected to grow by a slow 3 percent because this job is easy to replace with artificial intelligence. But jobs for financial analysts are expected to grow by 5 percent and for market research analysts by 18 percent.

These forecasts imply a bright future for people who choose to major in economics.

Earnings of Economics Majors

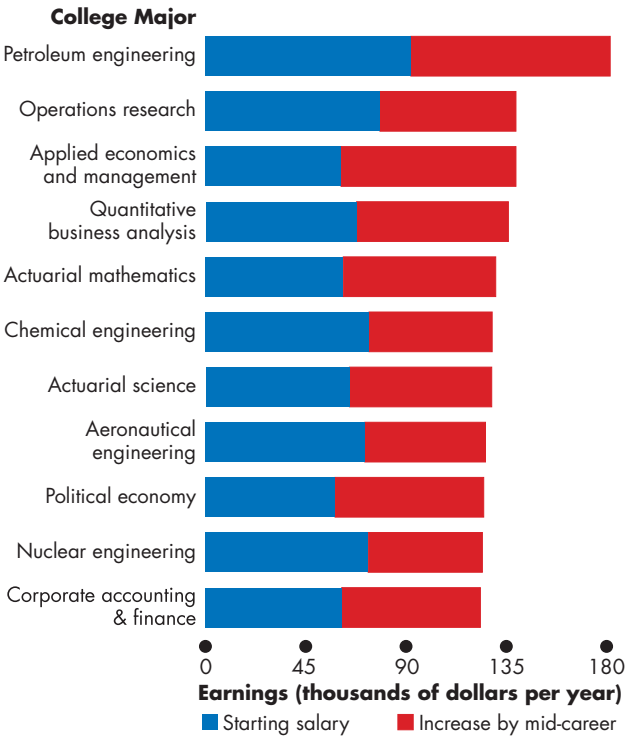
Earnings of economics majors vary a lot depending on the job and the level of qualifications. The Web resource payscale.com reports a pay range for economists of all types from $56,500 to $139,600, with a median of $105,100.

A person who majors in economics and goes on to complete a Ph.D. and gets a job as an economist would expect to earn about $150,000 a year by mid-career. Economists working in finance, insurance, and government jobs earn more than the average.

Pay in "analyst" jobs is lower and ranges from an average of $55,000 a year for market research analysts to $82,000 a year for financial analysts.

These rates of pay put economics graduates near but not at the top of the distribution as you can see in Fig. 1.4. Only graduates who majored in petroleum engineering and operations research have average pay that exceeds that of economists.

FIGURE 1.4 Earnings of College Majors



Economics majors are not the highest earners—petroleum engineers and operations research scientists earn more—but at $140,000 a year in mid-career, economists earn more than most other majors.

Source of data: American Economics Association.

Skills Needed for Economics Jobs

What are the skills that an employer looks for in a candidate for an economics related job? Five skill requirments stand out. They are:

- Critical-thinking skills
- Analytical skills
- Math skills
- Writing skills
- Oral communication skills

Critical-Thinking Skills The ability to clarify and solve problems using logic and relevant evidence

Analytical Skills The use of economic ideas and tools to examine data, notice patterns, and reach a logical conclusion

Math Skills The ability to use mathematical and statistical tools to analyze data and reach valid conclusions

Writing Skills The ability to present ideas, conclusions, and reasons in succinct written reports appropriate for the target audience

Oral Communication Skills The ability to explain ideas, conclusions, and reasons to people with a limited background in economics.

A Diversity Challenge in the Economics Profession

You've seen that an economics major opens a wide range of well-paid jobs and the outlook for job growth and pay is above average. But there is unequal access to these jobs. The economics profession lacks diversity.

We close this account of economists in the economy by looking at the diversity challenge in the economics profession. We begin by looking at some numbers that describe the degree of underrepresentation of women and racial and ethnic minorities. We then look at research that seeks to understand the reasons for the lack of diversity. And we close with a brief account of the efforts that some economists are making to achieve a more diverse profession.

Measuring Underrepresentation With equal representation, 50 percent of economics degrees would go to women and 30 percent to racial and ethnic minorities. In recent years, 30 percent of economics bachelor's and doctorate degrees were awarded to women and 9 percent of doctorates and 15 percent of bachelor's degrees to Blacks, Hispanics, and Native Americans.

Swarthmore economist Amanda Bayer, a leading researcher on diversity in the economics profession, and Princeton University economist Cecilia Rouse, appointed President Biden's chief economic adviser in 2021, have surveyed a very large body of research on the scale and sources of underrepresentation.

Figure 1.5 provides a view of some of what they found. Underrepresentation runs back from doctorate numbers to undergraduate degrees. And minorities and women are less represented in the economics profession than in several other disciplines, most notably in science, technology, engineering and math, the STEM disciplines.

Economics has less diversity than STEM, and while STEM has become increasingly diverse, the lack of diversity in economics has barely changed.

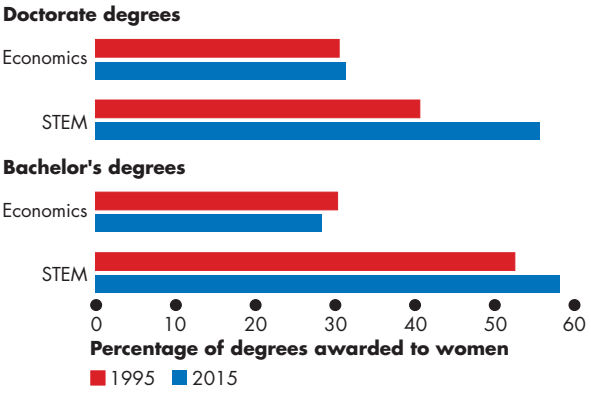
Understanding Underrepresentation Measuring the degree of underrepresentation is easy. Understanding the reasons for a lack of diversity is hard. Partly it is an economics topic, a "what, how, and for whom" question. And economists are working on research projects to better understand the choices and incentives that lead to underrepresentation. But it is also an interdisciplinary topic that draws on the full range of the social sciences.

The most likely main reason for underrepresentation is gender and racial implicit bias in selecting doctoral students and faculty. Low representation at the top of the profession leads to a lack of role models to inspire undergraduate economics students, which translates to low representation in bachelor's degrees.

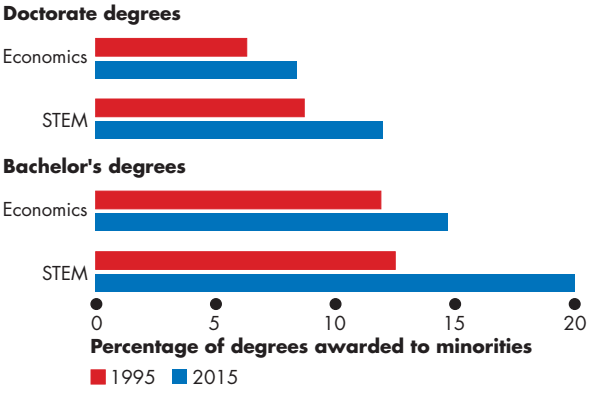
Improving Representation Most economists believe that a more diverse profession would be not only fairer but also more efficient. It would improve the quality of economic research and policy advice.

University of Oklahoma Professor Gary Hoover and Yale Professor Ebonya Washington, co-chairs of an American Economic Association (AEA) committee charged with increasing the representation of minority students in economics, have introduced an undergraduate essay prize, a travel grant, and other programs to better incentivize students. Similar programs seek to increase the representation of women in undergraduate economics.

FIGURE 1.5 Degrees Awarded to Women and Minorities in Economics and STEM



(a) Women



(b) Underrepresented Minorities

In part (a), a constant fewer than 30 percent of economics degrees are awarded to women compared with more than 50 percent of STEM degrees.

In part (b), fewer than 10 percent of minorities get an economics doctorate degree, and fewer than 15 percent of minorities get an economics bachelor's degree.

Source of data: Amanda Bayer and Cecilia Elena Rouse, "Diversity in the Economics Profession: A New Attack on an Old Problem", *Journal of Economic Perspectives*, Fall 2016.

REVIEW QUIZ

1. What types of jobs do economists do?
2. What are the skills needed for an economics job?
3. What is the range and median salary of economists? How do they compare to other college majors?
4. Why is the underrepresentation of women and minorities in economics an economic problem?

SUMMARY

Key Points

Definition of Economics (p. 30)

- All economic questions arise from scarcity—from the fact that wants exceed the resources available to satisfy them.
- Economics is the social science that studies the choices that people make as they cope with scarcity.
- The subject divides into microeconomics and macroeconomics.

Two Big Economic Questions (pp. 31–36)

- Two big questions summarize the scope of economics:
  1. How do choices end up determining *what, how*, and *for whom* goods and services are produced?
  2. When do choices made in the pursuit of *self-interest* also promote the *social interest*?

The Economic Way of Thinking (pp. 37–38)

- Every choice is a tradeoff—exchanging more of something for less of something else.
- People make rational choices by comparing benefit and cost.
- Cost—*opportunity cost*—is what you must give up to get something.
- Most choices are "how much" choices made at the *margin* by comparing marginal benefit and marginal cost.
- Choices respond to incentives.

Economics as Social Science and Policy Tool (p. 39)

- Economists distinguish between positive statements—what is—and normative statements—what ought to be.
- To explain the economic world, economists create and test economic models.
- Economics is a toolkit used to provide advice on government, business, and personal economic decisions.

Economists in the Economy (pp. 40–42)

- Economics majors work in a wide range of jobs as economists and analysts.
- The job growth outlook for economics majors is good and pay is above average.
- Economics has a diversity problem with a significant and persistent underrepresentation of women and minorities.

Key Terms

Benefit, 37
Capital, 32
Economic model, 39
Economics, 30
Efficient, 33
Entrepreneurship, 32
Factors of production, 31
Goods and services, 31
Human capital, 31
Incentive, 30
Interest, 32
Labor, 31
Land, 31
Macroeconomics, 30
Margin, 38
Marginal benefit, 38
Marginal cost, 38
Microeconomics, 30
Opportunity cost, 37
Preferences, 37
Profit, 32
Rational choice, 37
Rent, 32
Scarcity, 30
Self-interest, 33
Social interest, 33
Tradeoff, 37
Wages, 32

PROBLEMS AND APPLICATIONS

Definition of Economics

1. Apple Inc. decides to make iTunes freely available in unlimited quantities.
   a. Does Apple's decision change the incentives that people face?
   b. Is Apple's decision an example of a microeconomic or a macroeconomic issue?

Two Big Economic Questions

2. Which of the following pairs does not match?
   a. Labor and wages
   b. Land and rent
   c. Entrepreneurship and profit
   d. Capital and profit
3. Explain how the following news headlines concern self-interest and the social interest.
   a. Starbucks Expands in China
   b. McDonald's Moves into Online Ordering
   c. Food Must Be Labeled with Nutrition Data

The Economic Way of Thinking

4. The night before an economics test, you decided to go to the movies instead of studying for your test. Your test grade was 50 percent, lower than your usual 70 percent score.
   a. Did you face a tradeoff?
   b. What was the opportunity cost of your evening at the movies?
5. **Olympics Could Cost More Than $26 Billion**

   Japanese media estimate that overall spending on Japan's new expensive national venues is between $26 billion and $28 billion.

   Source: *Los Angeles Times*, December 20, 2019

   What is Japan's opportunity cost of hosting the Olympic Games? Explain your answer.

Economics as Social Science and Policy Tool

6. Which of these statements is positive, which is normative, and why?
   a. The United States should cut its imports.
   b. China imports U.S. pork and soybean.
   c. If the iPhone price rises, iPhone sales will fall.

Economists in the Economy

7. What are the five basic skills needed for an economics job?
8. How is the AEA trying to encourage more women and minorities to study economics?
9. How does the BLS expect jobs for economists to grow in the next decade?

ADDITIONAL PROBLEMS AND APPLICATIONS

Definition of Economics

10. **Swifties, Rejoice! Taylor Swift Will Perform a Free JamFest**

    Source: *USA Today*, November 8, 2019

    When Taylor Swift performs at JamFest, what is free and what is scarce? Explain your answer.

Two Big Economic Questions

11. How does the creation of a successful movie influence *what, how*, and *for whom* goods and services are produced?
12. How does a successful movie illustrate self-interested choices that are also in the social interest?

The Economic Way of Thinking

13. Before starring in *Guardians of the Galaxy*, Chris Pratt had appeared in 11 movies that grossed an average of $7 million on the opening weekend. *Guardians of the Galaxy* grossed $94 million.
    a. How will the success of *Guardians of the Galaxy* influence the opportunity cost of hiring Chris Pratt?
    b. How have the incentives for a movie producer to hire Chris Pratt changed?
14. What might be an incentive for you to take a class in summer school? List some of the benefits and costs involved in your decision. Would your choice be rational?

Economics as Social Science and Policy Tool

15. Look at today's *Wall Street Journal*. What is the leading economic news story? Which big economic questions and tradeoffs does it discuss or imply?
16. Provide two microeconomic and two macroeconomic statements. Classify them as positive or normative, and explain your classifications.

Economists in the Economy

17. What might be an incentive for economics students to do a Ph.D.? What would be the opportunty cost of doing a Ph.D.?

APPENDIX

Graphs in Economics

After studying this appendix, you will be able to:

- Make and interpret a scatter diagram
- Identify linear and nonlinear relationships and relationships that have a maximum and a minimum
- Define and calculate the slope of a line
- Graph relationships among more than two variables

Graphing Data

A graph represents a quantity as a distance on a line. In Fig. A1.1, a distance on the horizontal line represents temperature, measured in degrees Fahrenheit. A movement from left to right shows an increase in temperature. The point 0 represents zero degrees Fahrenheit. To the right of 0, the temperature is positive. To the left of 0, the temperature is negative (as indicated by the minus sign).

A distance on the vertical line represents height above sea level, measured in thousands of feet. The point 0 represents sea level. Points above 0 represent feet above sea level. Points below 0 represent feet below sea level (indicated by a minus sign).

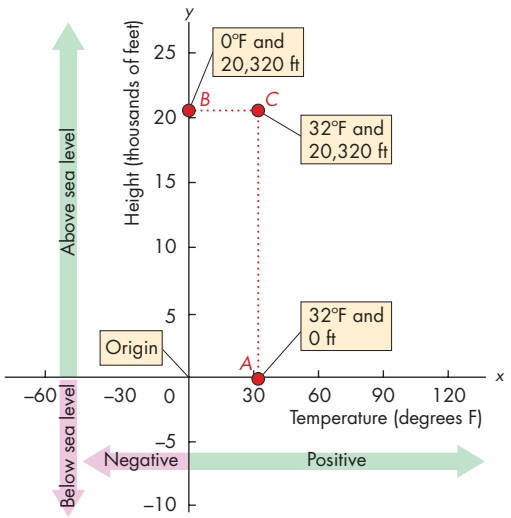
In Fig. A1.1, the two scale lines are perpendicular to each other and are called *axes*. The vertical line is the *y*-axis, and the horizontal line is the *x*-axis. Each axis has a zero point, which is shared by the two axes and called the *origin*.

To make a two-variable graph, we need two pieces of information: the value of the variable *x* and the value of the variable *y*.

Think about a concrete example. Off the coast of Alaska, the temperature is 32 degrees—the value of *x*. A fishing boat is located at 0 feet above sea level—the value of *y*. These two bits of information appear as point *A* in Fig. A1.1.

A climber at the top of Mount McKinley on a cold day is 20,320 feet above sea level in a zero-degree gale. These two pieces of information appear as point *B*. On a warmer day, a climber might be at the peak of Mt. McKinley when the temperature is 32 degrees, at point *C*.

FIGURE A1.1 Making a Graph



Graphs have axes that measure quantities as distances. Here, the horizontal axis (*x*-axis) measures temperature, and the vertical axis (*y*-axis) measures height. Point *A* represents a fishing boat at sea level (0 on the *y*-axis) on a day when the temperature is 32°F. Point *B* represents a climber at the top of Mt. McKinley, 20,320 feet above sea level at a temperature of 0°F. Point *C* represents a climber at the top of Mt. McKinley, 20,320 feet above sea level at a temperature of 32°F.

We can draw two lines, called *coordinates*, from point *C*. One, called the *x*-coordinate, runs from *C* to the vertical axis. This line is called "the *x*-coordinate" because its length is the same as the value marked off on the *x*-axis. The other, called the *y*-coordinate, runs from *C* to the horizontal axis. This line is called "the *y*-coordinate" because its length is the same as the value marked off on the *y*-axis.

We describe a point on a graph by the values of its *x*-coordinate and its *y*-coordinate, in that order. For example, at point *C*, *x* is 32 degrees and *y* is 20,320 feet above sea level.

A graph like that in Fig. A1.1 can be made using any quantitative data on two variables. The graph can show just a few points like Fig. A1.1, or many points.

Before we look at graphs with many points, let's reinforce what you've just learned by looking at a graph made with economic data.

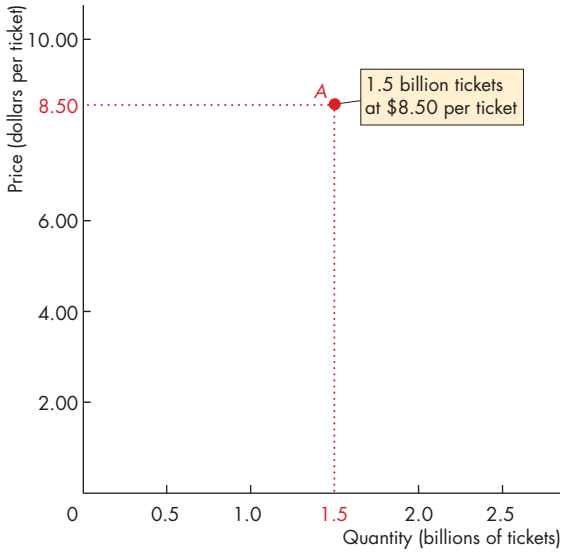
Graphing Economic Data

Economists measure variables that describe *what*, *how*, and *for whom* goods and services are produced. These variables are quantities produced and consumed and their prices.

Figure A1.2 shows an example of an economics graph. This graph provides information about movies in 2020. The *x*-axis measures the quantity of movie tickets sold and the *y*-axis measures the average price of a ticket. Point *A* tells us what the quantity and price were. You can "read" this graph as telling you that in 2020, 1.5 billion movie tickets were sold at an average ticket price of $8.50.

The two graphs that you've just seen show you how to make a graph and how to read a data point on a graph, but they don't improve on the raw data. Graphs become interesting and revealing when they contain a number of data points because then you can visualize the data.

FIGURE A1.2 Making an Economics Graph



When you look at a graph, start by reading the axis labels. In this economics graph, the horizontal axis (*x*-axis) measures the quantity of movie tickets sold, and the vertical axis (*y*-axis) measures the average price of a ticket.

Once you are clear about what is being measured on the axes, look at the data graphed.

Here, there is just one point, *A*. It tells us the data for 2020. In that year, 1.5 billion tickets were sold at an average price of $8.50.

Economists create graphs based on the principles in Figs. A1.1 and A1.2 to reveal, describe, and visualize the relationships among variables. We're now going to look at some examples. These graphs are called scatter diagrams.

Scatter Diagrams

A **scatter diagram** is a graph that plots the value of one variable against the value of another variable for a number of different outcomes. Such a graph reveals whether a relationship exists between two variables and describes their relationship.

The table in Fig. A1.3 shows some data on two variables for ten movies: the production budget for each movie and the worldwide box office revenue from the ticket sales for these movies.

What is the relationship between these two variables? Does a big production budget generate large ticket sales and box office revenue? Or does accurate forecasting of box office success lead to a big production budget? Or is there no connection between these two variables?

We can answer these questions by making a scatter diagram. We do so by graphing the data in the table. In the graph in Fig. A1.3, each point shows the production budget (the *x* variable) and the box office revenue (the *y* variable) of one of the movies. There are ten movies, so there are ten points "scattered" within the graph.

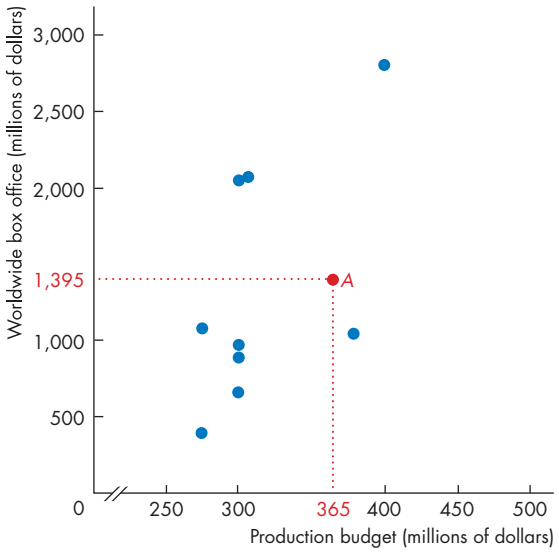
The point labeled *A* tells us that *Avengers: Age of Ultron* cost $365 million to produce and generated $1,395 million of box office revenue.

Avengers: Age of Ultron was the third most costly movie to produce and brought in the fourth most revenue. Find the point in the graph for *Avengers: Endgame*. Notice that it cost more to produce and brought in more revenue than *Avengers: Age of Ultron*. These two points in the graph suggest that large box office sales and a big production budget are related. But look at the other eight points and a different picture emerges. There is no clear pattern formed by these data. If you want to predict a movie's box office success with any confidence, you need to know more than the movie's production budget.

Figure A1.4 shows two scatter diagrams of economic variables. Part (a) shows the relationship between income and expenditure, on average, from 2001 to 2020. Each point represents the data in a given year. For example, point *A* shows that in 2014, income was $40,000 and expenditure was $37,000. This graph shows that as income increases, so does expenditure, and the relationship is a close one.

FIGURE A1.3 A Scatter Diagram

Movie	Production budget (millions of dollars)	Worldwide box office (millions of dollars)
Avengers: Endgame	400	2,798
Pirates of the Caribbean: On Stranger Tides	379	1,046
Avengers: Age of Ultron	365	1,395
Star Wars Ep. VII: The Force Awakens	306	2,065
Pirates of the Caribbean: At World's End	300	961
Spectre	300	880
Avengers: Infinity War	300	2,045
Justice League	300	656
Star Wars: The Rise of Skywalker	275	1,073
Solo: A Star Wars Story	275	393



The table lists the production budget and worldwide box office revenue for ten popular movies.

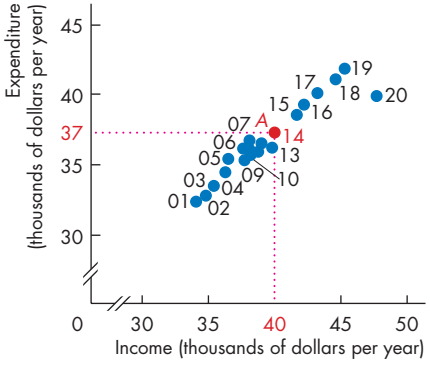
The scatter diagram reveals the relationship between these two variables. Each point shows the values of the variables for a specific movie. For example, point *A* shows the point for *Avengers: Age of Ultron*, which cost $365 million to produce and brought in $1,395 million at the box office.

The pattern formed by the points shows no clear tendency for a larger production budget to bring a greater box office revenue.

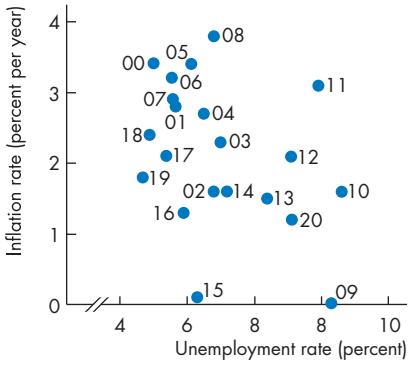
Figure A1.4(b) shows a scatter diagram of U.S. inflation and unemployment from 2000 through 2020. Here, the points show no relationship between the two variables. For example, when unemployment was high, the inflation rate was high in 2011 and low in 2009.

You can see that a scatter diagram conveys a wealth of information, and it does so in much less space than we have used to describe only some of its features. But you do have to "read" the graph to obtain all this information.

FIGURE A1.4 Two Economic Scatter Diagrams



(a) Income and expenditure



(b) Unemployment and inflation

The scatter diagram in part (a) shows the relationship between income and expenditure from 2001 to 2020. Point *A* shows that in 2014, income was $40,000 on the *x*-axis and expenditure was $37,000 on the *y*-axis. This graph shows that as income rises, so does expenditure and the relationship is a close one.

The scatter diagram in part (b) shows a weak relationship between unemployment and inflation in the United States.

Breaks in the Axes The graph in Fig. A1.4(a) has breaks in its axes, as shown by the small gaps. The breaks indicate that there are jumps from the origin, 0, to the first values recorded.

The breaks are used because the lowest value of income exceeds $30,000 and the lowest value of expenditure exceeds $30,000. If we made this graph with no breaks in its axes, there would be a lot of empty space, the points would be crowded into the top right corner, and it would be difficult to see whether a relationship exists between these two variables. By breaking the axes, we are able to bring the relationship into view.

Putting a break in one or both axes is like using a zoom lens to bring the relationship into the center of the graph and magnify it so that the relationship fills the graph.

Misleading Graphs Breaks can be used to highlight a relationship, but they can also be used to mislead—to make a graph that lies. The most common way of making a graph lie is to put a break in the axis and either to stretch or compress the scale. For example, suppose that in Fig. A1.4(a), we remove the break on the *y*-axis and expenditure ran from zero to $50,000 while the *x*-axis was unchanged. The graph would now create the impression that despite a huge increase in income, expenditure had barely changed.

To avoid being misled, it is a good idea to get into the habit of always looking closely at the values and the labels on the axes of a graph before you start to interpret it.

Correlation and Causation A scatter diagram that shows a clear relationship between two variables, such as Fig. A1.4(a), tells us that the two variables have a high correlation. When a high correlation is present, we can predict the value of one variable from the value of the other variable. But correlation does not imply causation.

Sometimes a high correlation does arise from a causal relationship. It is likely that rising income causes rising expenditure (Fig. A1.4a). But a high correlation can mean that two variables have a common cause. For example, ice cream sales and pool drownings are correlated not because one causes the other, but because both are caused by hot weather.

You've now seen how we can use graphs in economics to show economic data and to reveal relationships. Next, we'll learn how economists use graphs to construct and display economic models.

Graphs Used in Economic Models

The graphs used in economics are not always designed to show real-world data. Often they are used to show general relationships among the variables in an economic model.

An *economic model* is a stripped-down, simplified description of an economy or of a component of an economy such as a business or a household. It consists of statements about economic behavior that can be expressed as equations or as curves in a graph. Economists use models to explore the effects of different policies or other influences on the economy in ways that are similar to the use of model airplanes in wind tunnels and models of the climate.

You will encounter many different kinds of graphs in economic models, but there are some repeating patterns. Once you've learned to recognize these patterns, you will instantly understand the meaning of a graph. Here, we'll look at the different types of curves that are used in economic models, and we'll see some everyday examples of each type of curve. The patterns to look for in graphs are the four cases in which

- Variables move in the same direction.
- Variables move in opposite directions.
- Variables have a maximum or a minimum.
- Variables are unrelated.

Let's look at these four cases.

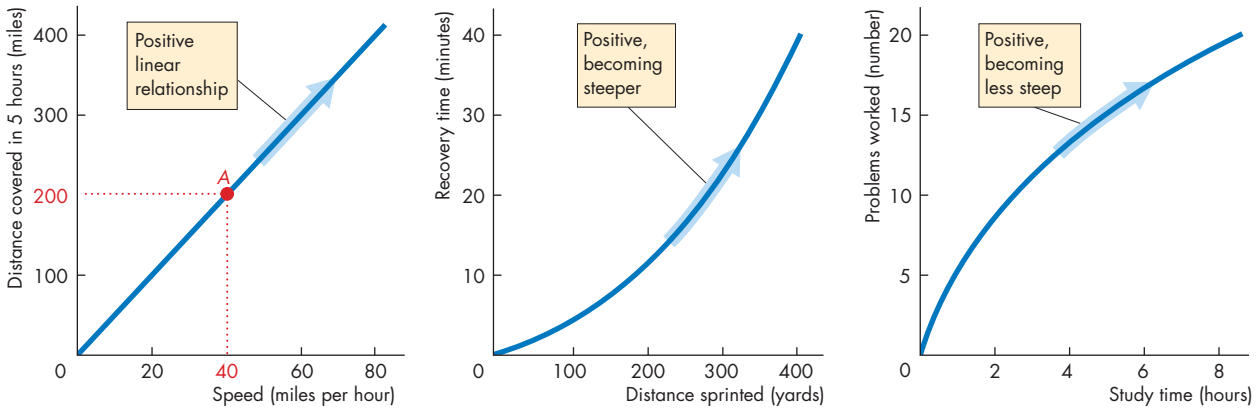
Variables That Move in the Same Direction

Figure A1.5 shows graphs of the relationships between two variables that move up and down together. A relationship between two variables that move in the same direction is called a **positive relationship** or a **direct relationship**. A line that slopes upward shows such a relationship.

Figure A1.5 shows three types of relationships: one that has a straight line and two that have curved lines. All the lines in these three graphs are called curves. Any line on a graph—no matter whether it is straight or curved—is called a *curve*.

A relationship shown by a straight line is called a **linear relationship**. Figure A1.5(a) shows a linear relationship between the number of miles traveled in

FIGURE A1.5 Positive (Direct) Relationships



(a) Positive linear relationship **(b) Positive, becoming steeper** **(c) Positive, becoming less steep**

Each part shows a positive (direct) relationship between two variables. That is, as the value of the variable measured on the *x*-axis increases, so does the value of the variable measured on the *y*-axis. Part (a) shows a linear positive relationship—as the two variables increase together, we move along a straight line.

Part (b) shows a positive relationship such that as the two variables increase together, we move along a curve that becomes steeper.

Part (c) shows a positive relationship such that as the two variables increase together, we move along a curve that becomes flatter.

5 hours and speed. For example, point *A* shows that you will travel 200 miles in 5 hours if your speed is 40 miles an hour. If you double your speed to 80 miles an hour, you will travel 400 miles in 5 hours.

Figure A1.5(b) shows the relationship between distance sprinted and recovery time (the time it takes the heart rate to return to its normal resting rate). This relationship is an upward-sloping one that starts out quite flat but then becomes steeper as we move along the curve away from the origin. The reason this curve becomes steeper is that the additional recovery time needed from sprinting an additional 100 yards increases. It takes less than 5 minutes to recover from sprinting 100 yards but more than 10 minutes to recover from 200 yards.

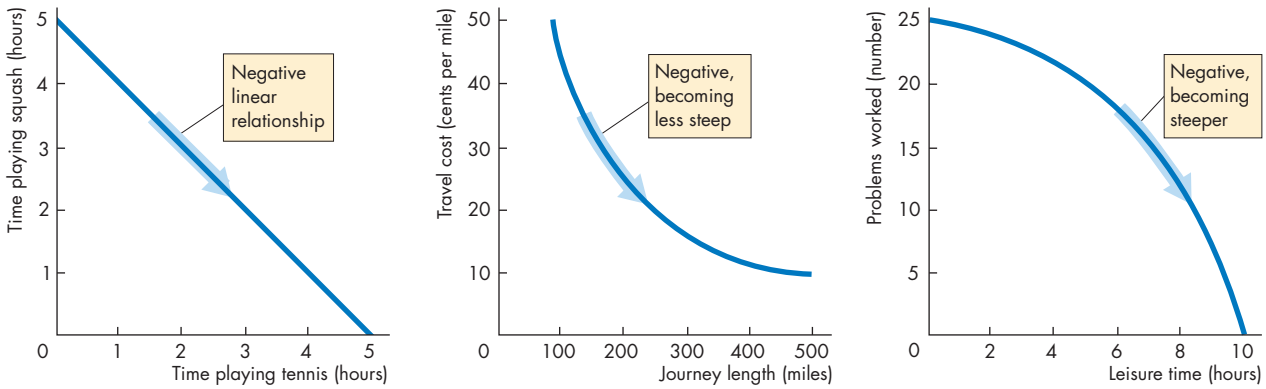
Figure A1.5(c) shows the relationship between the number of problems worked by a student and the amount of study time. This relationship is an upward-sloping one that starts out quite steep and becomes flatter as we move along the curve away from the origin. Study time becomes less productive as the student spends more hours studying and becomes more tired.

Variables That Move in Opposite Directions

Figure A1.6 shows relationships between things that move in opposite directions. A relationship between variables that move in opposite directions is called a **negative relationship** or an **inverse relationship**. Figure A1.6(a) shows the relationship between the hours spent playing squash and the hours spent playing tennis when the total time available is 5 hours. One extra hour spent playing tennis means one hour less spent playing squash and vice versa. This relationship is negative and linear.

Figure A1.6(b) shows the relationship between the cost per mile traveled and the length of a journey. The longer the journey, the lower is the cost per mile. But as the journey length increases, even though the cost per mile decreases, the fall in the cost per mile is smaller the longer the journey. This feature of the relationship is shown by the fact that the curve slopes downward, starting out steep at a short journey length and then becoming flatter as the journey length increases. This relationship arises because some of the costs are fixed, such as auto insurance, and the fixed costs are spread over a longer journey.

FIGURE A1.6 Negative (Inverse) Relationships



(a) Negative linear relationship **(b) Negative, becoming less steep** **(c) Negative, becoming steeper**

Each part shows a negative (inverse) relationship between two variables. Part (a) shows a linear negative relationship. The total time spent playing tennis and squash is 5 hours. As the time spent playing tennis increases, the time spent playing squash decreases, and we move along a straight line.

Part (b) shows a negative relationship such that as the journey length increases, the travel cost decreases as we move along a curve that becomes less steep.

Figure A1.6(c) shows the relationship between the amount of leisure time and the number of problems worked by a student. Increasing leisure time produces an increasingly large reduction in the number of problems worked. This relationship is a negative one that starts out with a gentle slope at a small number of leisure hours and becomes steeper as the number of leisure hours increases. This relationship is a different view of the idea shown in Fig. A1.5(c).

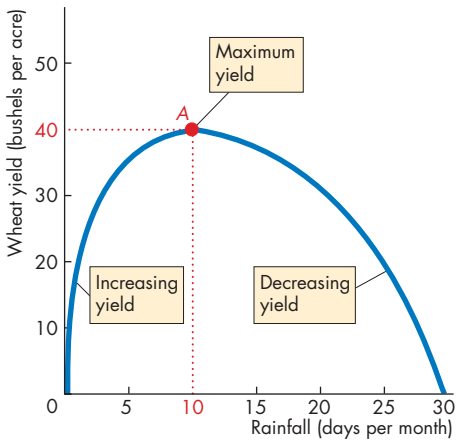
Variables That Have a Maximum or a Minimum

Many relationships in economic models have a maximum or a minimum. For example, firms try to make the maximum possible profit and to produce at the lowest possible cost. Figure A1.7 shows relationships that have a maximum or a minimum.

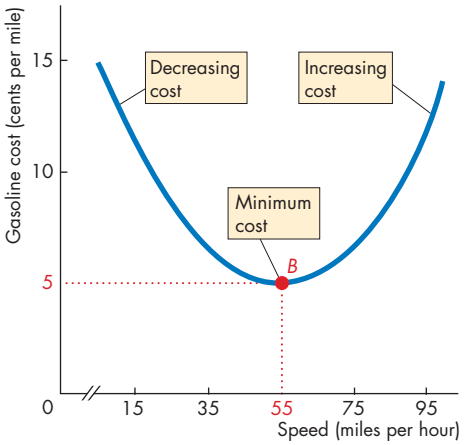
Figure A1.7(a) shows the relationship between rainfall and wheat yield. When there is no rainfall, wheat will not grow, so the yield is zero. As the rainfall increases up to 10 days a month, the wheat yield increases. With 10 rainy days each month, the wheat yield reaches its maximum at 40 bushels an acre (point *A*). Rain in excess of 10 days a month starts to lower the yield of wheat. If every day is rainy, the wheat suffers from a lack of sunshine and the yield decreases to zero. This relationship is one that starts out sloping upward, reaches a maximum, and then slopes downward.

Figure A1.7(b) shows the reverse case—a relationship that begins sloping downward, falls to a minimum, and then slopes upward. Most economic costs are like this relationship. An example is the relationship between the cost per mile and the speed of the car. At low speeds, the car is creeping in a traffic snarl-up. The number of miles per gallon is low, so the cost per mile is high. At high speeds, the car is traveling faster than its efficient speed, using a large quantity of gasoline, and again the number of miles per gallon is low and the cost per mile is high. At a speed of 55 miles an hour, the cost per mile is at its minimum (point *B*). This relationship is one that starts out sloping downward, reaches a minimum, and then slopes upward.

FIGURE A1.7 Maximum and Minimum Points



(a) Relationship with a maximum



(b) Relationship with a minimum

Part (a) shows a relationship that has a maximum point, *A*. The curve slopes upward as it rises to its maximum point, is flat at its maximum, and then slopes downward.

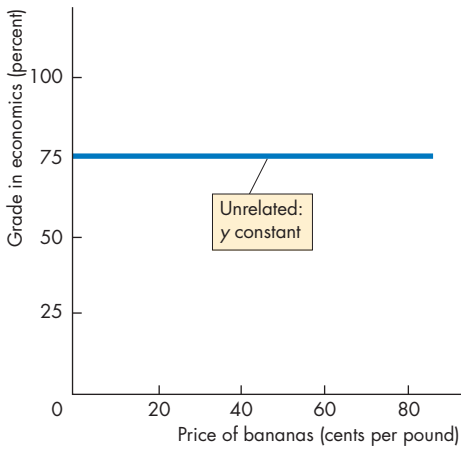
Part (b) shows a relationship with a minimum point, *B*. The curve slopes downward as it falls to its minimum, is flat at its minimum, and then slopes upward.

Variables That Are Unrelated

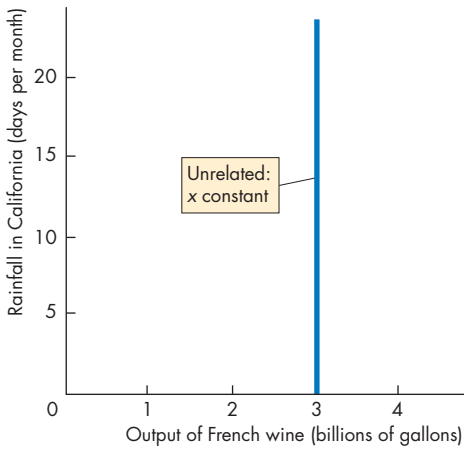
There are many situations in which no matter what happens to the value of one variable, the other variable remains constant. Sometimes we want to show the independence between two variables in a graph, and Fig. A1.8 shows two ways of achieving this.

In describing the graphs in Fig. A1.5 through Fig. A1.7, we have talked about curves that slope upward or slope downward, and curves that become less steep or steeper. Let's spend a little time discussing exactly what we mean by *slope* and how we measure the slope of a curve.

FIGURE A1.8 Variables That Are Unrelated



(a) Unrelated: *y* constant



(b) Unrelated: *x* constant

This figure shows how we can graph two variables that are unrelated. In part (a), a student's grade in economics is plotted at 75 percent on the *y*-axis regardless of the price of bananas on the *x*-axis. The curve is horizontal.

In part (b), the output of the vineyards of France on the *x*-axis does not vary with the rainfall in California on the *y*-axis. The curve is vertical.

The Slope of a Relationship

We can measure the influence of one variable on another by the slope of the relationship. The **slope** of a relationship is the change in the value of the variable measured on the *y*-axis divided by the change in the value of the variable measured on the *x*-axis. We use the Greek letter Δ (*delta*) to represent "change in." Thus Δy means the change in the value of the variable measured on the *y*-axis, and Δx means the change in the value of the variable measured on the *x*-axis. Therefore the slope of the relationship is

$$\text{Slope} = \frac{\Delta y}{\Delta x}.$$

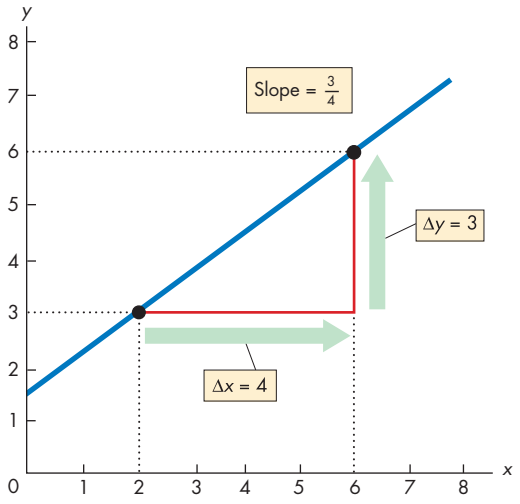
If a large change in the variable measured on the *y*-axis (Δy) is associated with a small change in the variable measured on the *x*-axis (Δx), the slope is large and the curve is steep. If a small change in the variable measured on the *y*-axis (Δy) is associated with a large change in the variable measured on the *x*-axis (Δx), the slope is small and the curve is flat.

We can make the idea of slope clearer by doing some calculations.

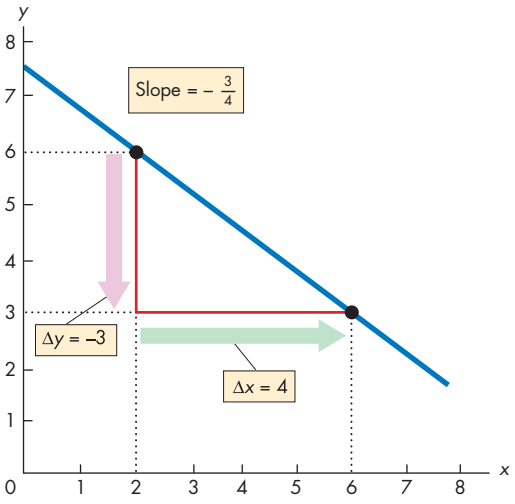
The Slope of a Straight Line

The slope of a straight line is the same regardless of where on the line you calculate it. The slope of a straight line is constant. Let's calculate the slope of the positive relationship in Fig. A1.9. In part (a),

FIGURE A1.9 The Slope of a Straight Line



(a) Positive slope



(b) Negative slope

To calculate the slope of a straight line, we divide the change in the value of the variable measured on the *y*-axis (Δy) by the change in the value of the variable measured on the *x*-axis (Δx) as we move along the line.

Part (a) shows the calculation of a positive slope. When *x* increases from 2 to 6, Δx equals 4. That change in *x* brings about an increase in *y* from 3 to 6, so Δy equals 3. The slope ($\Delta y/\Delta x$) equals 3/4.

Part (b) shows the calculation of a negative slope. When *x* increases from 2 to 6, Δx equals 4. That increase in *x* brings about a decrease in *y* from 6 to 3, so Δy equals -3. The slope ($\Delta y/\Delta x$) equals $-3/4$.

when x increases from 2 to 6, y increases from 3 to 6. The change in x is +4—that is, Δx is 4. The change in y is +3—that is, Δy is 3. The slope of that line is

$$\frac{\Delta y}{\Delta x} = \frac{3}{4}.$$

In part (b), when x increases from 2 to 6, y decreases from 6 to 3. The change in y is *minus* 3—that is, Δy is −3. The change in x is *plus* 4—that is, Δx is 4. The slope of the curve is

$$\frac{\Delta y}{\Delta x} = \frac{-3}{4}.$$

Notice that the two slopes have the same magnitude (3/4), but the slope of the line in part (a) is positive $(+3/+4 = 3/4)$ while that in part (b) is negative $(-3/+4 = -3/4)$. The slope of a positive relationship is positive; the slope of a negative relationship is negative.

The Slope of a Curved Line

The slope of a curved line is trickier. The slope of a curved line is not constant, so the slope depends on where on the curved line we calculate it. There are two ways to calculate the slope of a curved line: You can calculate the slope at a point, or you can calculate the slope across an arc of the curve. Let's look at the two alternatives.

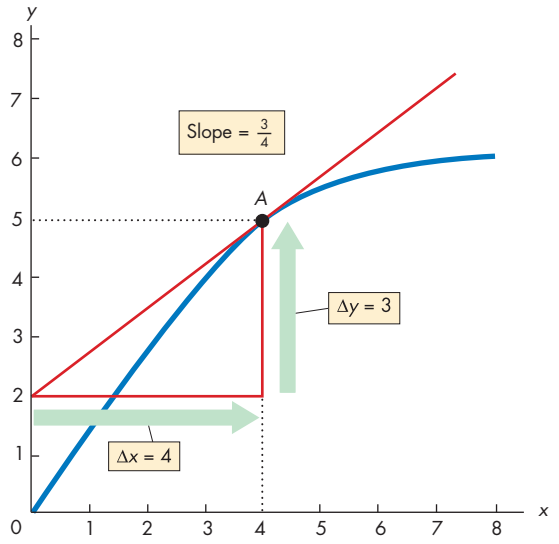
Slope at a Point To calculate the slope at a point on a curve, you need to construct a straight line that has the same slope as the curve at the point in question. Figure A1.10 shows how this is done. Suppose you want to calculate the slope of the curve at point A. Place a ruler on the graph so that the ruler touches point A and no other point on the curve, then draw a straight line along the edge of the ruler. The straight red line is this line, and it is the tangent to the curve at point A. If the ruler touches the curve only at point A, then the slope of the curve at point A must be the same as the slope of the edge of the ruler. If the curve and the ruler do not have the same slope, the line along the edge of the ruler will cut the curve instead of just touching it.

Now that you have found a straight line with the same slope as the curve at point A, you can calculate the slope of the curve at point A by calculating the slope of the straight line. Along the straight line, as x increases from 0 to 4 (Δx is 4) y increases from 2 to 5 (Δy is 3). Therefore the slope of the straight line is

$$\frac{\Delta y}{\Delta x} = \frac{3}{4}.$$

So the slope of the curve at point A is 3/4.

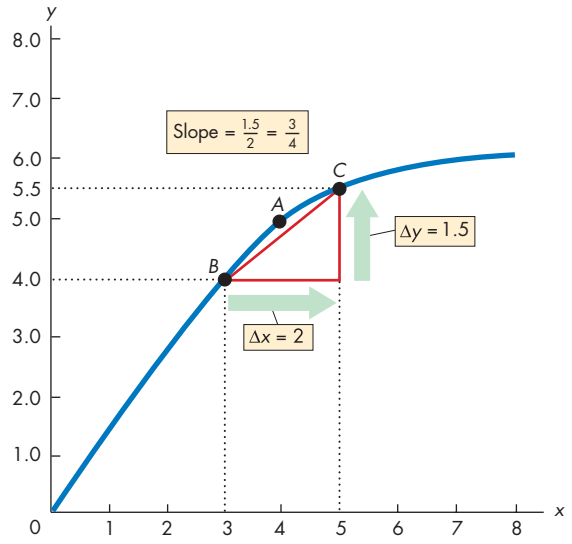
FIGURE A1.10 Slope at a Point



To calculate the slope of the curve at point *A*, draw the red line that just touches the curve at *A*—the tangent. The slope of this straight line is calculated by dividing the change in *y* by the change in *x* along the red line. When *x* increases from 0 to 4, Δx equals 4. That change in *x* is associated with an increase in *y* from 2 to 5, so Δy equals 3. The slope of the red line is 3/4, so the slope of the curve at point *A* is 3/4.

Slope Across an Arc An arc of a curve is a piece of a curve. Figure A1.11 shows the same curve as in Fig. A1.10, but instead of calculating the slope at point A, we are now going to calculate the slope across the arc from point B to point C. You can see that the slope of the curve at point B is greater than at point C. When we calculate the slope across an arc, we are calculating the average slope between two points. As we move along the arc from B to C, x increases from 3 to 5 and y increases from 4.0 to 5.5. The change in x is 2 (Δx is 2), and the change in y is 1.5 (Δy is 1.5).

FIGURE A1.11 Slope Across an Arc



To calculate the average slope of the curve along the arc *BC*, draw a straight line from point *B* to point *C*. The slope of the line *BC* is calculated by dividing the change in *y* by the change in *x*. In moving from *B* to *C*, the increase in *x* is 2 (Δx equals 2) and the change in *y* is 1.5 (Δy equals 1.5). The slope of the line *BC* is 1.5 divided by 2, or 3/4. So the slope of the curve across the arc *BC* is 3/4.

Therefore the slope is

$$\frac{\Delta y}{\Delta x} = \frac{1.5}{2} = \frac{3}{4}.$$

So the slope of the curve across the arc *BC* is 3/4.

This calculation gives us the slope of the curve between points *B* and *C*. The actual slope calculated is the slope of the straight line from *B* to *C*. This slope approximates the average slope of the curve along the arc *BC*. In this particular example, the slope across the arc *BC* is identical to the slope of the curve at point *A*, but the calculation of the slope of a curve does not always work out so neatly. You might have fun constructing some more examples and a few counterexamples.

You now know how to make and interpret a graph. So far, we've limited our attention to graphs of two variables. We're now going to learn how to graph more than two variables.

Graphing Relationships Among More Than Two Variables

We have seen that we can graph the relationship between two variables as a point formed by the *x*- and *y*-coordinates in a two-dimensional graph. You might be thinking that although a two-dimensional graph is informative, most of the things in which you are likely to be interested involve relationships among many variables, not just two. For example, the amount of ice cream consumed depends on the price of ice cream and the temperature. If ice cream is expensive and the temperature is low, people eat much less ice cream than when ice cream is inexpensive and the temperature is high. For any given price of ice cream, the quantity consumed varies with the temperature; and for any given temperature, the quantity of ice cream consumed varies with its price.

Figure A1.12 shows a relationship among three variables. The table shows the number of gallons of ice cream consumed each day at two different temperatures and at a number of different prices of ice cream. How can we graph these numbers?

To graph a relationship that involves more than two variables, we use the *ceteris paribus* assumption.

Ceteris Paribus

Ceteris paribus (often shortened to *cet par*) means "if all other relevant things remain the same." To isolate the relationship of interest in a laboratory experiment, a scientist holds everything constant except for the variable whose effect is being studied. Economists use the same method to graph a relationship that has more than two variables.

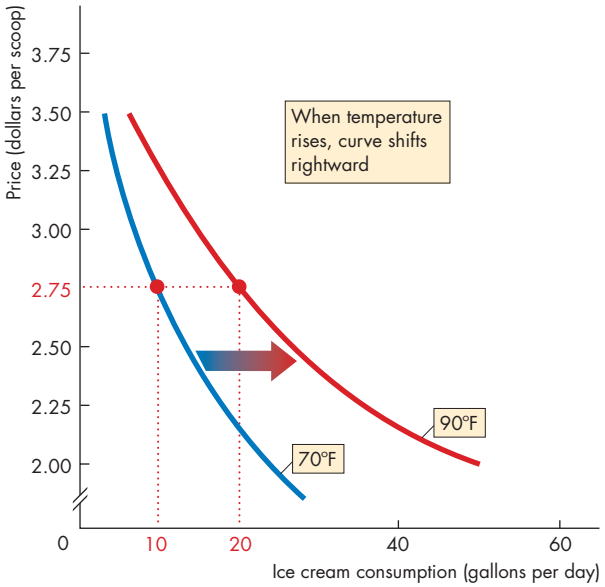
Figure A1.12 shows an example. There, you can see what happens to the quantity of ice cream consumed when the price of ice cream varies but the temperature is held constant.

The curve labeled 70°F shows the relationship between ice cream consumption and the price of ice cream if the temperature remains at 70°F. The numbers used to plot that curve are those in the first two columns of the table. For example, if the temperature is 70°F, 10 gallons are consumed when the price is $2.75 a scoop and 18 gallons are consumed when the price is $2.25 a scoop.

The curve labeled 90°F shows the relationship between ice cream consumption and the price of ice cream if the temperature remains at 90°F. The

FIGURE A1.12 Graphing a Relationship Among Three Variables

Price (dollars per scoop)	Ice cream consumption (gallons per day)	
	70°F	90°F
2.00	25	50
2.25	18	36
2.50	13	26
2.75	**10**	**20**
3.00	7	14
3.25	5	10
3.50	3	6



Ice cream consumption depends on its price and the temperature. The table tells us how many gallons of ice cream are consumed each day at different prices and two different temperatures. For example, if the price is $2.75 a scoop and the temperature is 70°F, 10 gallons of ice cream are consumed.

To graph a relationship among three variables, the value of one variable is held constant. The graph shows the relationship between price and consumption when the temperature is held constant. One curve holds the temperature at 70°F and the other holds it at 90°F.

A change in the price of ice cream brings a movement along one of the curves—along the blue curve at 70°F and along the red curve at 90°F.

When the temperature *rises* from 70°F to 90°F, the curve that shows the relationship between consumption and price *shifts* rightward from the blue curve to the red curve.

numbers used to plot that curve are those in the first and third columns of the table. For example, if the temperature is 90°F, 20 gallons are consumed when the price is $2.75 a scoop and 36 gallons are consumed when the price is $2.25 a scoop.

When the price of ice cream changes but the temperature is constant, you can think of what happens in the graph as a movement along one of the curves. At 70°F there is a movement along the blue curve and at 90°F there is a movement along the red curve.

When Other Things Change

The temperature is held constant along each of the curves in Fig. A1.12, but in reality the temperature changes. When that event occurs, you can think of what happens in the graph as a shift of the curve. When the temperature rises from 70°F to 90°F, the curve that shows the relationship between ice cream consumption and the price of ice cream shifts rightward from the blue curve to the red curve.

You will encounter these ideas of movements along and shifts of curves at many points in your study of economics. Think carefully about what you've just learned and make up some examples (with assumed numbers) about other relationships.

With what you have learned about graphs, you can move forward with your study of economics. There are no graphs in this book that are more complicated than those that have been explained in this appendix.

MATHEMATICAL NOTE

Equations of Straight Lines

If a straight line in a graph describes the relationship between two variables, we call it a linear relationship. Figure 1 shows the *linear relationship* between a person's expenditure and income. This person spends $100 a week (by borrowing or spending previous savings) when income is zero. Out of each dollar earned, this person spends 50 cents (and saves 50 cents).

All linear relationships are described by the same general equation. We call the quantity that is measured on the horizontal axis (or x-axis) x, and we call the quantity that is measured on the vertical axis (or y-axis) y. In the case of Fig. 1, x is income and y is expenditure.

A Linear Equation

The equation that describes a straight-line relationship between x and y is

$$y = a + bx.$$

In this equation, a and b are fixed numbers and they are called *constants*. The values of x and y vary, so these numbers are called *variables*. Because the equation describes a straight line, the equation is called a *linear equation*.

The equation tells us that when the value of x is zero, the value of y is a. We call the constant a the y-axis intercept. The reason is that on the graph the straight line hits the y-axis at a value equal to a. Figure 1 illustrates the y-axis intercept.

For positive values of x, the value of y exceeds a. The constant b tells us by how much y increases above a as x increases. The constant b is the slope of the line.

Slope of Line

As we explain in the chapter, the *slope* of a relationship is the change in the value of y divided by the change in the value of x. We use the Greek letter Δ (delta) to represent "change in." So Δy means the change in the value of the variable measured on the y-axis, and Δx means the change in the value of the variable measured on the x-axis. Therefore the slope of the relationship is

$$\text{Slope} = \frac{\Delta y}{\Delta x}.$$

To see why the slope is b, suppose that initially the value of x is x_1, or $200 in Fig. 2. The corresponding value of y is y_1, also $200 in Fig. 2. The equation of the line tells us that

$$y_1 = a + bx_1. \qquad (1)$$

Now the value of x increases by Δx to $x_1 + \Delta x$ (or $400 in Fig. 2). And the value of y increases by Δy to $y_1 + \Delta y$ (or $300 in Fig. 2).

The equation of the line now tells us that

$$y_1 + \Delta y = a + b(x_1 + \Delta x). \qquad (2)$$

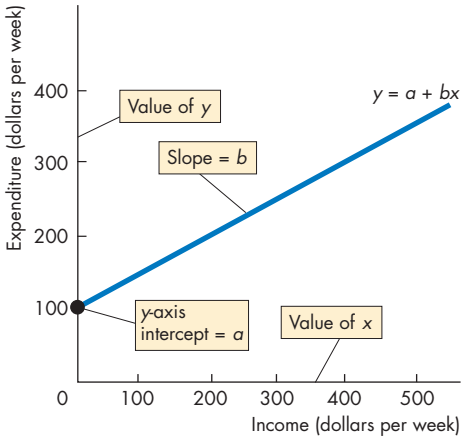


Figure 1 Linear Relationship

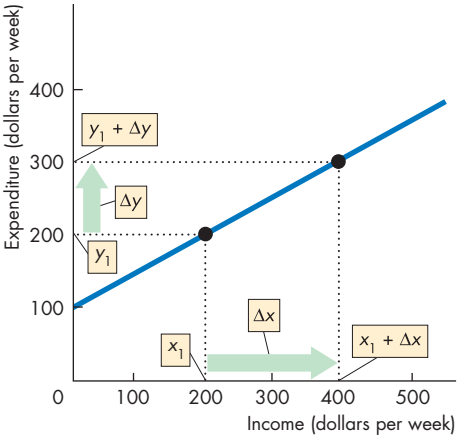


Figure 2 Calculating Slope

To calculate the slope of the line, subtract equation (1) from equation (2) to obtain

$$\Delta y = b\Delta x \qquad (3)$$

and now divide equation (3) by Δx to obtain

$$\Delta y/\Delta x = b.$$

So the slope of the line is b.

Position of Line

The y-axis intercept determines the position of the line on the graph. Figure 3 illustrates the relationship between the y-axis intercept and the position of the line. In this graph, the y-axis measures saving and the x-axis measures income.

When the y-axis intercept, a, is positive, the line hits the y-axis at a positive value of y—as the blue line does. Its y-axis intercept is 100. When the y-axis intercept, a, is zero, the line hits the y-axis at the origin—as the purple line does. Its y-axis intercept is 0. When the y-axis intercept, a, is negative, the line hits the y-axis at a negative value of y—as the red line does. Its y-axis intercept is −100.

As the equations of the three lines show, the value of the y-axis intercept does not influence the slope of the line. All three lines have a slope equal to 0.5.

Positive Relationships

Figure 1 shows a positive relationship—the two variables x and y move in the same direction. All positive relationships have a slope that is positive. In the equation of the line, the constant b is positive. In this example, the y-axis intercept, a, is 100. The slope b equals $\Delta y/\Delta x$, which in Fig. 2 is 100/200 or 0.5. The equation of the line is

$$y = 100 + 0.5x.$$

Negative Relationships

Figure 4 shows a negative relationship—the two variables x and y move in the opposite direction. All negative relationships have a slope that is negative. In the equation of the line, the constant b is negative. In the example in Fig. 4, the y-axis intercept, a, is 30. The slope, b, equals $\Delta y/\Delta x$, which is −20/2 or −10. The equation of the line is

$$y = 30 + (-10)x$$

or

$$y = 30 - 10x.$$

Example

A straight line has a y-axis intercept of 50 and a slope of 2. What is the equation of this line?
The equation of a straight line is

$$y = a + bx$$

where a is the y-axis intercept and b is the slope.
So the equation is

$$y = 50 + 2x.$$

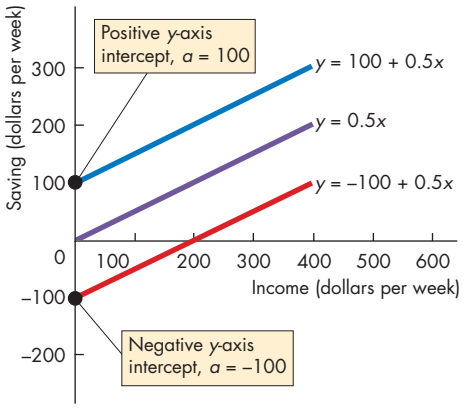


Figure 3 The *y*-Axis Intercept

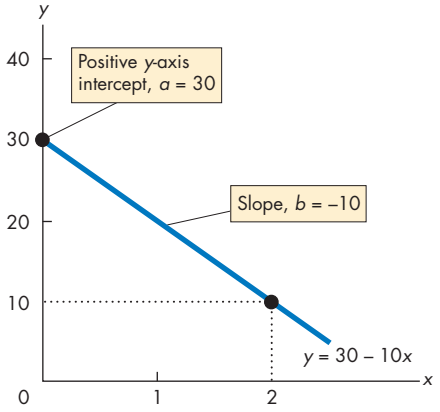


Figure 4 Negative Relationship

REVIEW QUIZ

1 Explain how we "read" the two graphs in Figs. A1.1 and A1.2.
2 Explain what scatter diagrams show and why we use them.
3 Explain how we "read" the three scatter diagrams in Figs. A1.3 and A1.4.
4 Draw a graph to show the relationship between two variables that move in the same direction.
5 Draw a graph to show the relationship between two variables that move in opposite directions.
6 Draw a graph of two variables whose relationship shows (i) a maximum and (ii) a minimum.
7 Which of the relationships in Questions 4 and 5 is a positive relationship and which is a negative relationship?
8 What are the two ways of calculating the slope of a curved line?
9 How do we graph a relationship among more than two variables?
10 In a relationship among three variables, explain what change will bring a *movement along* a curve.
11 Explain what change will bring a *shift* of a curve.
12 Netflix's monthly fee for 1 screen is $8.99, for 2 screens $13.99, and for 4 screens is $17.99. Describe the relationship between the fee and the number of screens.

SUMMARY

Key Points

Graphing Data (pp. 45–48)

- A graph is made by plotting the values of two variables x and y at a point that corresponds to their values measured along the x-axis and the y-axis.
- A scatter diagram is a graph that plots the values of two variables for a number of different values of each.
- A scatter diagram shows the relationship between the two variables. It shows whether they are positively related, negatively related, or unrelated.

Graphs Used in Economic Models (pp. 48–51)

- Graphs are used to show relationships among variables in economic models.
- Relationships can be positive (an upward-sloping curve), negative (a downward-sloping curve), positive and then negative (have a maximum point), negative and then positive (have a minimum point), or unrelated (a horizontal or vertical curve).

The Slope of a Relationship (pp. 52–54)

- The slope of a relationship is calculated as the change in the value of the variable measured on the y-axis divided by the change in the value of the variable measured on the x-axis—that is, $\Delta y/\Delta x$.
- A straight line has a constant slope.
- A curved line has a varying slope. To calculate the slope of a curved line, we calculate the slope at a point or across an arc.

Graphing Relationships Among More Than Two Variables (pp. 54–55)

- To graph a relationship among more than two variables, we hold constant the values of all the variables except two.
- We then plot the value of one of the variables against the value of another.
- A *cet par* change in the value of a variable on an axis of a graph brings a movement along the curve.
- A change in the value of a variable held constant along the curve brings a shift of the curve.

Key Terms

Ceteris paribus, 54
Direct relationship, 48
Inverse relationship, 49
Linear relationship, 48
Negative relationship, 49
Positive relationship, 48
Scatter diagram, 46
Slope, 52

PROBLEMS AND APPLICATIONS

Use the following spreadsheet to work Problems 1 to 3. The spreadsheet provides data on the U.S. economy: Column A is the year, column B is the inflation rate, column C is the interest rate, column D is the growth rate, and column E is the unemployment rate.

	A	B	C	D	E
1	2010	1.6	0.1	2.6	9.6
2	2011	3.1	0.1	1.6	8.9
3	2012	2.1	0.1	2.2	8.1
4	2013	1.5	0.1	1.8	7.4
5	2014	1.6	0.0	2.5	6.2
6	2015	0.1	0.1	3.1	5.3
7	2016	1.3	0.3	1.7	4.9
8	2017	2.1	1.0	2.3	4.4
9	2018	2.4	2.0	3.0	3.9
10	2019	1.8	2.1	2.2	3.7
11	2020	1.2	0.4	–3.5	8.1

1. Draw a scatter diagram of the inflation rate and the interest rate. Describe the relationship.
2. Draw a scatter diagram of the growth rate and the unemployment rate. Describe the relationship.
3. Draw a scatter diagram of the interest rate and the unemployment rate. Describe the relationship.

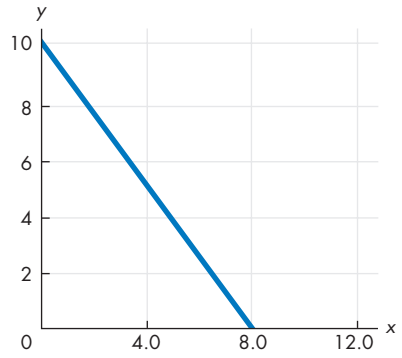
Use the following news clip to work Problems 4 to 6.

***Star Wars* Tops the Box Office**

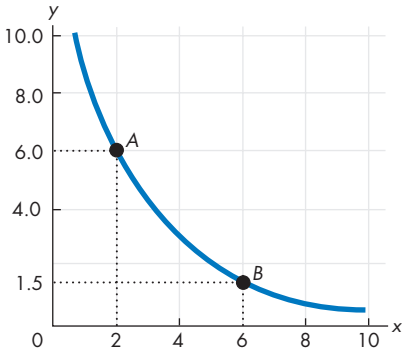
Movie	Theaters (number)	Revenue (dollars per theater)
Star Wars Episode IX: The Rise of Skywalker	4,406	$7,835
Jumanji: The Next Level	4,134	$6,344
Little Women	3,308	$4,114
Frozen II	3,175	$3,733

Source: boxofficemojo.com, Data for weekend of January 3–5, 2020

4. Draw a graph of the relationship between the revenue per theater on the *y*-axis and the number of theaters on the *x*-axis. Describe the relationship.
5. Calculate the slope of the relationship in Problem 4 between 3,308 and 4,134 theaters.
6. Calculate the slope of the relationship in Problem 4 between 3,175 and 4,406 theaters.
7. Calculate the slope of the following relationship.



Use the following relationship to work Problems 8 and 9.



8. Calculate the slope of the relationship at point *A* and at point *B*.
9. Calculate the slope across the arc *AB*.

Use the following table to work Problems 10 and 11. The table gives the price of a balloon ride, the temperature, and the number of rides a day.

Price (dollars per ride)	Balloon rides (number per day)		
	50°F	70°F	90°F
5	32	40	50
10	27	32	40
15	18	27	32

10. Draw a graph to show the relationship between the price and the number of rides when the temperature is 70°F. Describe this relationship.
11. What happens in the graph in Problem 10 if the temperature rises to 90°F?

ADDITIONAL PROBLEMS AND APPLICATIONS

Use the following spreadsheet to work Problems 12 to 14. The spreadsheet provides data on oil and gasoline: Column A is the year, column B is the price of oil (dollars per barrel), column C is the price of gasoline (cents per gallon), column D is U.S. oil production, and column E is the U.S. quantity of gasoline refined (both in millions of barrels per day)

	A	B	C	D	E
1	2010	66	262	5.1	15.6
2	2011	72	284	5.1	15.4
3	2012	100	330	5.0	15.3
4	2013	62	241	5.4	14.8
5	2014	79	284	5.5	15.2
6	2015	95	358	5.6	15.1
7	2016	94	368	6.5	15.5
8	2017	98	358	7.5	15.2
9	2018	93	344	8.8	15.5
10	2019	49	252	9.4	16.6
11	2020	45	225	8.9	16.4

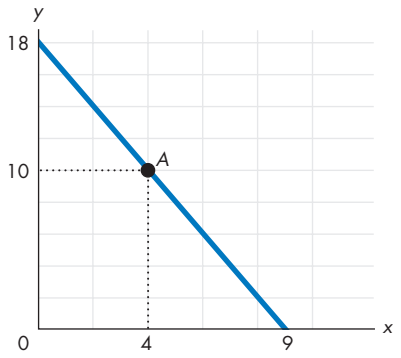
12. Draw a scatter diagram of the price of oil and the quantity of U.S. oil produced. Describe the relationship.
13. Draw a scatter diagram of the price of gasoline and the quantity of gasoline refined. Describe the relationship.
14. Draw a scatter diagram of the quantity of U.S. oil produced and the quantity of gasoline refined. Describe the relationship.

Use the following data to work Problems 15 to 17.

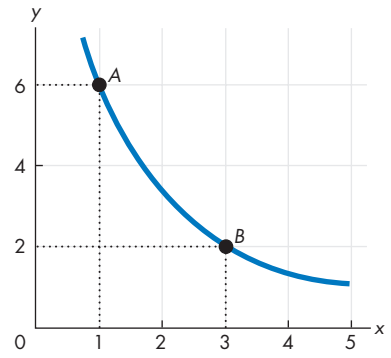
Draw a graph that shows the relationship between the two variables x and y:

x	0	1	2	3	4	5
y	25	24	22	18	12	0

15. a. Is the relationship positive or negative?
    b. Does the slope of the relationship become steeper or flatter as the value of x increases?
    c. Think of some economic relationships that might be similar to this one.
16. Calculate the slope of the relationship between x and y when x equals 3.
17. Calculate the slope of the relationship across the arc as x increases from 4 to 5.
18. Calculate the slope of the curve in the figure in the next column at point A.



Use the following relationship to work Problems 19 and 20.



19. Calculate the slope at point A and at point B.
20. Calculate the slope across the arc AB.

Use the following table to work Problems 21 to 23. The table gives information about umbrellas: price, the number purchased, and rainfall in inches.

Price (dollars per umbrella)	Umbrellas (number purchased per day)		
	0 inches	1 inch	2 inches
20	4	7	8
30	2	4	7
40	1	2	4

21. Draw a graph to show the relationship between the price and the number of umbrellas purchased, holding the amount of rainfall constant at 1 inch. Describe this relationship.
22. What happens in the graph in Problem 21 if the price rises and rainfall is constant?
23. What happens in the graph in Problem 21 if the rainfall increases from 1 inch to 2 inches?

2 THE ECONOMIC PROBLEM

After studying this chapter, you will be able to:

- Define the production possibilities frontier and use it to calculate opportunity cost
- Define preferences and marginal benefit and describe an efficient allocation of resources
- Explain how specialization and trade make resource use more efficient
- Explain how current production choices expand and change future production possibilities
- Describe the economic institutions that coordinate decisions

As the Covid-19 pandemic spread, empty airports told a story of a crash in production and soaring unemployment. The global and U.S. economies took the biggest hit to production since the Great Depression of the 1930s. But unlike the 1930s, an astonishingly rapid development and rollout of vaccines brought recovery. And governments took the opportunity to increase spending on research and infrastructure.

In this chapter, you study an economic model that enables you to understand the changing limits to production. And at the end of the chapter, in *Economics in the News*, we'll apply what you learn to see how President Joe Biden's spending plans will reallocate resources and might expand the U.S. economy.

Production Possibilities and Opportunity Cost

Every working day, in mines, factories, shops, and offices and on farms and construction sites across the United States, 151 million people produce a vast variety of goods and services valued at $73 billion in 2021. But the quantities of goods and services that we can produce are limited by our available resources and by technology. And if we want to increase our production of one good, we must decrease our production of something else—we face a tradeoff. You are now going to study the limits to production.

The **production possibilities frontier** (*PPF*) is the boundary between those combinations of goods and services that can be produced and those that cannot. To illustrate the *PPF*, we look at a *model economy* in which the quantities produced of only two goods change, while the quantities produced of all the other goods and services remain the same.

Let's look at the production possibilities frontier for cola and pizza, which represent *any* pair of goods or services.

Production Possibilities Frontier

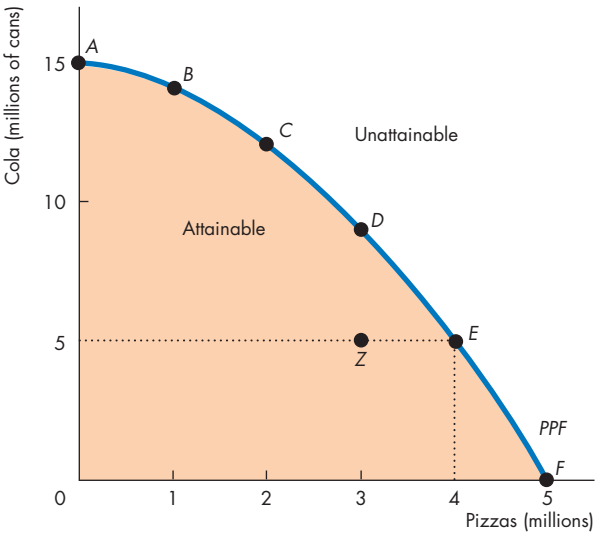
The *production possibilities frontier* for cola and pizza shows the limits to the production of these two goods, given the total resources and technology available to produce them. Figure 2.1 shows this production possibilities frontier. The table lists combinations of the quantities of pizza and cola that can be produced in a month and the figure graphs these combinations. The *x*-axis shows the quantity of pizzas produced, and the *y*-axis shows the quantity of cola produced.

The *PPF* illustrates *scarcity* because the points outside the frontier are *unattainable*. These points describe wants that can't be satisfied.

We can produce at any point *inside* the *PPF* or *on* the *PPF*. These points are *attainable*. For example, we can produce 4 million pizzas and 5 million cans of cola. Figure 2.1 shows this combination as point *E* on the graph and as possibility *E* in the table.

Moving along the *PPF* from point *E* to point *D* (possibility *D* in the table) we produce more cola and less pizza: 9 million cans of cola and 3 million pizzas. Or moving in the opposite direction from point *E* to point *F* (possibility *F* in the table), we produce more pizza and less cola: 5 million pizzas and no cola.

FIGURE 2.1 Production Possibilities Frontier



Possibility	Pizzas (millions)		Cola (millions of cans)
A	0	and	15
B	1	and	14
C	2	and	12
D	3	and	9
E	4	and	5
F	5	and	0

The table lists six production possibilities for cola and pizzas. Row *A* tells us that if we produce no pizzas, the maximum quantity of cola we can produce is 15 million cans. Points *A*, *B*, *C*, *D*, *E*, and *F* in the figure represent the rows of the table. The curve passing through these points is the production possibilities frontier (*PPF*).

The *PPF* separates the attainable from the unattainable. Production is possible at any point *inside* the orange area or *on* the frontier. Points outside the frontier are unattainable. Points inside the frontier, such as point *Z*, are inefficient because resources are wasted or misallocated. At such points, it is possible to use the available resources to produce more of either or both goods.

Production Efficiency

We achieve **production efficiency** if we produce goods and services at the lowest possible cost. This outcome occurs at all the points *on* the *PPF*. At points *inside* the *PPF*, production is inefficient because we are giving up more than necessary of one good to produce a given quantity of the other good.

For example, at point *Z* in Fig. 2.1, we produce 3 million pizzas and 5 million cans of cola, but we have enough resources to produce 3 million pizzas and 9 million cans of cola. Our pizzas cost more cola than necessary. We can get them for a lower cost. Only when we produce *on* the *PPF* do we incur the lowest possible cost of production.

Production inside the *PPF* is *inefficient* because resources are either *unused* or *misallocated* or both.

Resources are *unused* when they are idle but could be working. For example, we might leave some of the factories idle or some workers unemployed.

Resources are *misallocated* when they are assigned to tasks for which they are not the best match. For example, we might assign skilled pizza chefs to work in a cola factory and skilled cola workers to cook pizza in a pizzeria. We could get more pizzas *and* more cola if we reassigned these workers to the tasks that more closely match their skills.

Tradeoff Along the *PPF*

A choice *along* the *PPF* involves a *tradeoff*. Tradeoffs like that between cola and pizza arise in every imaginable real-world situation in which a choice must be made. At any given time, we have a fixed amount of labor, land, capital, and entrepreneurship and a given state of technology. We can employ these resources and technology to produce goods and services, but we are limited in what we can produce.

When doctors want to spend more on AIDS and cancer research, they face a tradeoff: more medical research for less of some other things. When Congress wants to spend more on education and healthcare, it faces a tradeoff: more education and healthcare for less national defense or homeland security. When an environmental group argues for less logging, it is suggesting a tradeoff: greater conservation of endangered wildlife for less paper. When you want a higher grade on your next test, you face a tradeoff: spend more time studying and less leisure or sleep time.

All the tradeoffs you've just considered involve a cost—an opportunity cost.

Opportunity Cost

The **opportunity cost** of an action is the highest-valued alternative forgone. The *PPF* makes this idea precise and enables us to calculate opportunity cost. Along the *PPF*, there are only two goods, so there is only one alternative forgone: some quantity of the other good. To produce more pizzas we must produce less cola. The opportunity cost of producing an additional pizza is the cola we *must* forgo. Similarly, the opportunity cost of producing an additional can of cola is the quantity of pizza we must forgo.

In Fig. 2.1, if we move from point *C* to point *D*, we produce an additional 1 million pizzas but 3 million fewer cans of cola. The additional 1 million pizzas *cost* 3 million cans of cola. Or 1 pizza costs 3 cans of cola. Similarly, if we move from *D* to *C*, we produce an additional 3 million cans of cola but 1 million fewer pizzas. The additional 3 million cans of cola *cost* 1 million pizzas. Or 1 can of cola costs 1/3 of a pizza.

Opportunity Cost Is a Ratio

Opportunity cost is a ratio. It is the decrease in the quantity produced of one good divided by the increase in the quantity produced of another good as we move along the production possibilities frontier.

Because opportunity cost is a ratio, the opportunity cost of producing an additional can of cola is equal to the *inverse* of the opportunity cost of producing an additional pizza. Check this proposition by returning to the calculations we've just done. In the move from *C* to *D*, the opportunity cost of a pizza is 3 cans of cola. And in the move from *D* to *C*, the opportunity cost of a can of cola is 1/3 of a pizza. So the opportunity cost of pizza is the inverse of the opportunity cost of cola.

Increasing Opportunity Cost

The opportunity cost of a pizza increases as the quantity of pizzas produced increases. The outward-bowed shape of the *PPF* reflects increasing opportunity cost. When we produce a large quantity of cola and a small quantity of pizza—between points *A* and *B* in Fig. 2.1—the frontier has a gentle slope. An increase in the quantity of pizzas costs a small decrease in the quantity of cola—the opportunity cost of a pizza is a small quantity of cola.

When we produce a large quantity of pizzas and a small quantity of cola—between points *E* and *F* in Fig. 2.1—the frontier is steep. A given increase in the quantity of pizzas *costs* a large decrease in the quantity of cola, so the opportunity cost of a pizza is a large quantity of cola.

ECONOMICS IN THE NEWS

The Opportunity Cost of Kale

Kale Popularity Puts Pressure on Seed Supply
With kale's surging popularity, kale farmers are taking precautions to avoid wasting seeds. Kale sales are up more than 30 percent and the price has gone up 80 percent over the past three years.

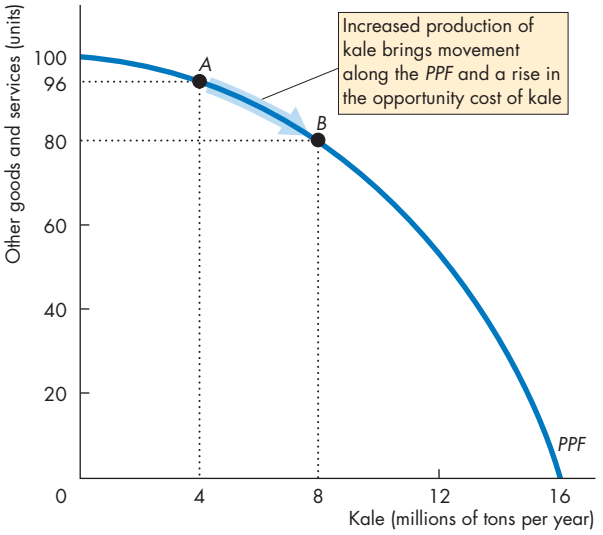
Source: CBS News, January 18, 2016

THE QUESTIONS

- How does the *PPF* illustrate (1) the limits to kale production; (2) the tradeoff we must make to increase kale production; and (3) the effect of increased kale consumption on the cost of producing kale?

THE ANSWERS

- The figure shows the global *PPF* for kale and other goods and services. Point *A* on the *PPF* tells us that if 4 million tons of kale are produced, a maximum of 96 units of other goods and services can be produced.
- The movement along the *PPF* from *A* to *B* illustrates the tradeoff we must make to increase kale production.
- The slope of the *PPF* measures the opportunity cost of kale. If kale production increases from zero to 4 million tons a year, the production of other goods and services decreases from 100 units to 96 units. The opportunity cost of 1 ton of kale is 1 unit of other goods and services.
- But if kale production increases from 4 million tons to 8 million tons a year, the production of other goods and services decreases from 96 units to 80 units. The opportunity cost of 1 ton of kale is now 4 units of other goods and services.
- As resources are moved into producing kale, labor, land, and capital less suited to the task of kale production are used and the cost of the additional kale produced increases.



***PPF* for Kale and Other Goods and Services**

The *PPF* is bowed outward because resources are not all equally productive in all activities. People with many years of experience working for PepsiCo are good at producing cola but not very good at making pizzas. So if we move some of these people from PepsiCo to Domino's, we get a small increase in the quantity of pizzas but a large decrease in the quantity of cola.

Similarly, people who have spent years working at Domino's are good at producing pizzas, but they have no idea how to produce cola. So if we move some of these people from Domino's to PepsiCo, we get a small increase in the quantity of cola but a large decrease in the quantity of pizzas. The more of either good we try to produce, the less productive are the additional resources we use to produce that good and the larger is the opportunity cost of a unit of that good.

How do we choose among the points on the *PPF*? How do we know which point is the best?

REVIEW QUIZ

1. How does the production possibilities frontier illustrate scarcity?
2. How does the production possibilities frontier illustrate production efficiency?
3. How does the production possibilities frontier show that every choice involves a tradeoff?
4. How does the production possibilities frontier illustrate opportunity cost?
5. Why is opportunity cost a ratio?
6. Why does the *PPF* bow outward and what does that imply about the relationship between opportunity cost and the quantity produced?
7. On the global *PPF* of healthcare supplies and other goods and services, how did the production point change as the Covid-19 pandemic spread across the globe?

Using Resources Efficiently

We achieve *production efficiency* at every point on the *PPF*, but which of these points is best? The answer is the point on the *PPF* at which goods and services are produced in the quantities that provide the greatest possible benefit. When goods and services are produced at the lowest possible cost and in the quantities that provide the greatest possible benefit, we have achieved **allocative efficiency**.

The questions that we raised when we reviewed the four big issues in Chapter 1 are questions about allocative efficiency. To answer such questions, we must measure and compare costs and benefits.

The *PPF* and Marginal Cost

The **marginal cost** of a good is the opportunity cost of producing one more unit of it. We calculate marginal cost from the slope of the *PPF*. As the quantity of pizzas produced increases, the *PPF* gets steeper and the marginal cost of a pizza increases. Figure 2.2 illustrates the calculation of the marginal cost of a pizza.

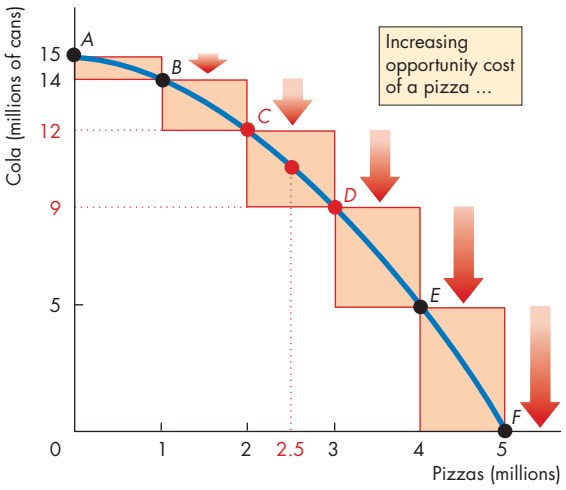
Begin by finding the opportunity cost of pizza in blocks of 1 million pizzas. The cost of the first million pizzas is 1 million cans of cola; the cost of the second million pizzas is 2 million cans of cola; the cost of the third million pizzas is 3 million cans of cola; and so on. The bars in part (a) illustrate these calculations.

The bars in part (b) show the cost of an average pizza in each of the 1 million pizza blocks. Focus on the third million pizzas—the move from *C* to *D* in part (a). Over this range, because 1 million pizzas cost 3 million cans of cola, one of these pizzas, on average, costs 3 cans of cola—the height of the bar in part (b).

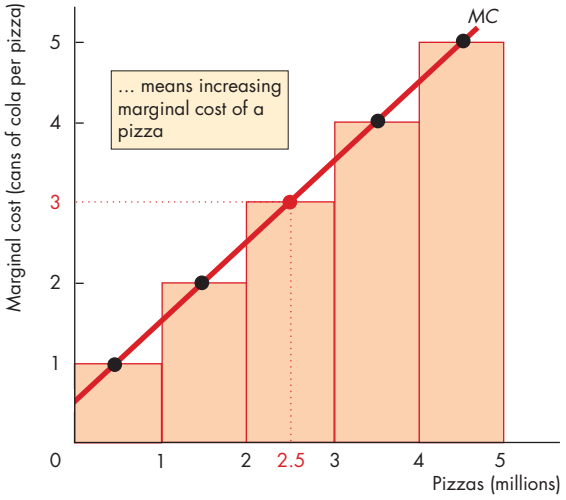
Next, find the opportunity cost of each additional pizza—the marginal cost of a pizza. The marginal cost of a pizza increases as the quantity of pizzas produced increases. The marginal cost at point *C* is less than it is at point *D*. On average over the range from *C* to *D*, the marginal cost of a pizza is 3 cans of cola. But it exactly equals 3 cans of cola only in the middle of the range between *C* and *D*.

The red dot in part (b) indicates that the marginal cost of a pizza is 3 cans of cola when 2.5 million pizzas are produced. Each black dot in part (b) is interpreted in the same way. The red curve that passes through these dots, labeled *MC*, is the marginal cost curve. It shows the marginal cost of a pizza at each quantity of pizzas as we move along the *PPF*.

FIGURE 2.2 The *PPF* and Marginal Cost



(a) *PPF* and opportunity cost



(b) Marginal cost

Marginal cost is calculated from the slope of the *PPF*. As the quantity of pizzas produced increases, the *PPF* gets steeper and the marginal cost of a pizza increases. The bars in part (a) show the opportunity cost of pizza in blocks of 1 million pizzas. The bars in part (b) show the cost of an average pizza in each of these 1 million blocks. The red curve, *MC*, shows the marginal cost of a pizza at each point along the *PPF*. This curve passes through the center of each of the bars in part (b).

Preferences and Marginal Benefit

The **marginal benefit** of a good or service is the benefit received from consuming one more unit of it. This benefit is subjective. It depends on people's **preferences**—people's likes and dislikes and the intensity of those feelings.

Marginal benefit and *preferences* stand in sharp contrast to *marginal cost* and *production possibilities*. Preferences describe what people like and want and the production possibilities describe the limits or constraints on what is feasible.

We need a concrete way of illustrating preferences that parallels the way we illustrate the limits to production using the *PPF*.

The device that we use to illustrate preferences is the **marginal benefit curve**, which is a curve that shows the relationship between the marginal benefit of a good and the quantity consumed of that good. Note that the *marginal benefit curve* is *unrelated* to the *PPF* and cannot be derived from it.

We measure the marginal benefit of a good or service by the most that people are *willing to pay* for an additional unit of it. The idea is that you are willing to pay less for a good than it is worth to you but you are not willing to pay more: The most you are willing to pay for something is its marginal benefit.

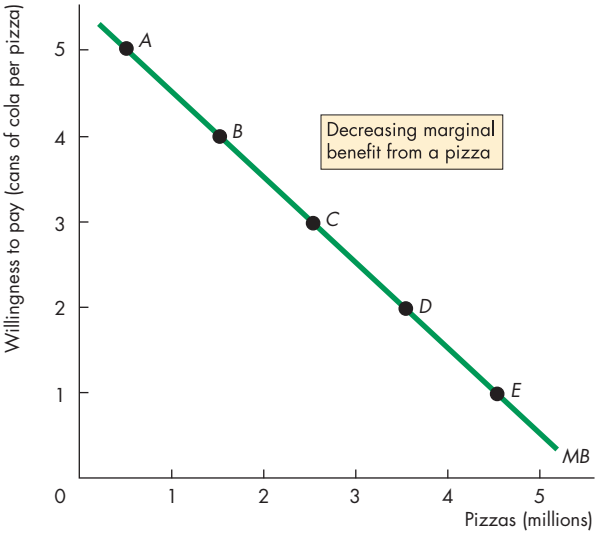
It is a general principle that the more we have of any good or service, the smaller is its marginal benefit and the less we are willing to pay for an additional unit of it. This tendency is so widespread and strong that we call it a principle—the *principle of decreasing marginal benefit*.

The basic reason why marginal benefit decreases is that we like variety. The more we consume of any one good or service, the more we tire of it and would prefer to switch to something else.

Think about your willingness to pay for a pizza. If pizza is hard to come by and you can buy only a few slices a year, you might be willing to pay a high price to get an additional slice. But if pizza is all you've eaten for the past few days, you are willing to pay almost nothing for another slice.

You've learned to think about cost as opportunity cost, not as a dollar cost. You can think about marginal benefit and willingness to pay in the same way. The marginal benefit, measured by what you are willing to pay for something, is the quantity of other goods and services that you are willing to forgo. Let's continue with the example of cola and pizza and illustrate preferences this way.

FIGURE 2.3 Preferences and the Marginal Benefit Curve



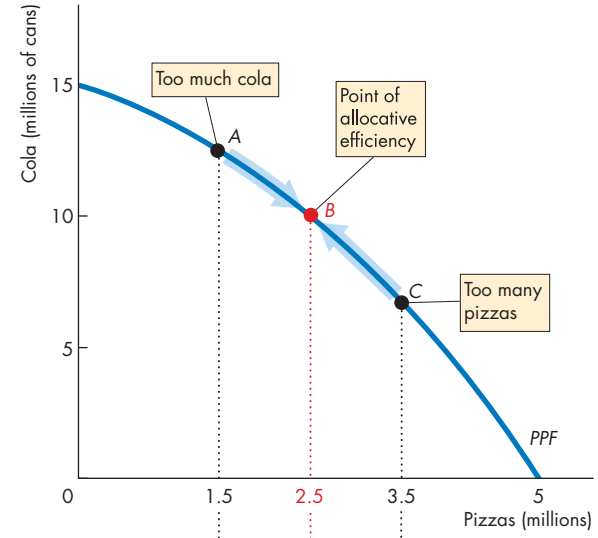
Possibility	Pizzas (millions)	Willingness to pay (cans of cola per pizza)
A	0.5	5
B	1.5	4
C	2.5	3
D	3.5	2
E	4.5	1

The smaller the quantity of pizzas available, the more cola people are willing to give up for an additional pizza. With 0.5 million pizzas available, people are willing to pay 5 cans of cola per pizza. But with 4.5 million pizzas, people are willing to pay only 1 can of cola per pizza. Willingness to pay measures marginal benefit. A universal feature of people's preferences is that marginal benefit decreases.

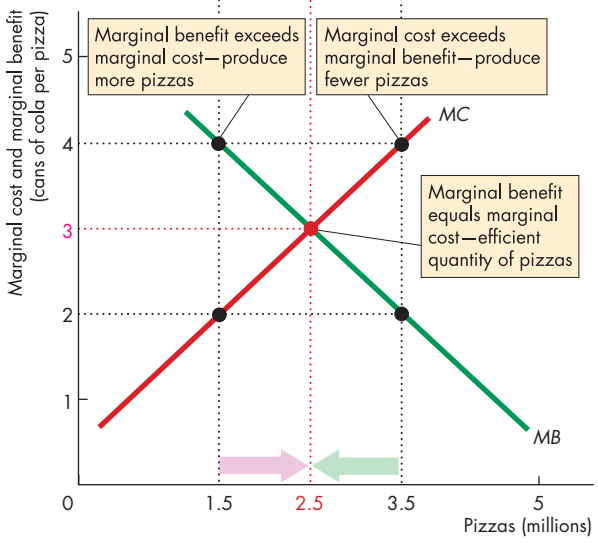
Figure 2.3 illustrates preferences as the willingness to pay for pizza in terms of cola. In row *A*, with 0.5 million pizzas available, people are willing to pay 5 cans of cola per pizza. As the quantity of pizzas increases, the amount that people are willing to pay for a pizza falls. With 4.5 million pizzas available, people are willing to pay only 1 can of cola per pizza.

Let's now use the concepts of marginal cost and marginal benefit to describe allocative efficiency.

FIGURE 2.4 Efficient Use of Resources



(a) On the *PPF*



(b) Marginal benefit equals marginal cost

The greater the quantity of pizzas produced, the smaller is the marginal benefit (*MB*) from pizza—the less cola people are willing to give up to get an additional pizza. But the greater the quantity of pizzas produced, the greater is the marginal cost (*MC*) of a pizza—the more cola people must give up to get an additional pizza. When marginal benefit equals marginal cost, resources are being used efficiently.

Allocative Efficiency

At *any* point on the *PPF*, we cannot produce more of one good without giving up some other good. At the *best* point on the *PPF*, we cannot produce more of one good without giving up some other good that provides greater benefit. We are producing at the point of allocative efficiency—the point on the *PPF* that we prefer above all other points.

Suppose in Fig. 2.4, we produce 1.5 million pizzas. In part (b), the marginal cost of a pizza is 2 cans of cola, and the marginal benefit of a pizza is 4 cans of cola. Because someone values an additional pizza more highly than it costs to produce, we can get more value from our resources by moving some of them out of producing cola and into producing pizza.

Now suppose we produce 3.5 million pizzas. The marginal cost of a pizza is now 4 cans of cola, but the marginal benefit of a pizza is only 2 cans of cola. Because the additional pizza costs more to produce than anyone thinks it is worth, we can get more value from our resources by moving some of them away from producing pizza and into producing cola.

Suppose we produce 2.5 million pizzas. Marginal cost and marginal benefit are now equal at 3 cans of cola. This allocation of resources between pizzas and cola is efficient. If more pizzas are produced, the forgone cola is worth more than the additional pizzas. If fewer pizzas are produced, the forgone pizzas are worth more than the additional cola.

REVIEW QUIZ

1. What is marginal cost? How is it measured?
2. What is marginal benefit? How is it measured?
3. How does the marginal benefit of a good change as the quantity produced of that good increases?
4. What is allocative efficiency and how does it relate to the production possibilities frontier?
5. What conditions must be satisfied if resources are used efficiently?
6. How do you think the Covid-19 pandemic changed the marginal benefit of an effective vaccine?

You now understand the limits to production and the conditions under which resources are used efficiently. Your next task is to see how specialization and trade expand production possibilities.

Gains from Trade

People can produce for themselves all the goods and services that they consume, or they can produce one good or a few goods and trade with others. Producing only one good or a few goods is called *specialization*. We are going to learn how people gain by specializing in the production of the good in which they have a *comparative advantage* and trading with others.

Comparative Advantage and Absolute Advantage

A person has a **comparative advantage** in an activity if that person can perform the activity at a lower opportunity cost than anyone else. Differences in opportunity costs arise from differences in individual abilities and from differences in the characteristics of other resources.

No one excels at everything. One person is an outstanding pitcher but a poor catcher; another person is a brilliant lawyer but a poor teacher. In almost all human endeavors, what one person does easily, someone else finds difficult. The same applies to land and capital. One plot of land is fertile but has no mineral deposits; another plot of land has outstanding views but is infertile. One machine has great precision but is difficult to operate; another is fast but often breaks down.

Although no one excels at everything, some people excel and can outperform others in a large number of activities—perhaps even in all activities. A person who is more productive than others has an **absolute advantage**.

Absolute advantage involves comparing productivities—production per hour—whereas comparative advantage involves comparing opportunity costs.

A person who has an absolute advantage does not have a *comparative* advantage in every activity. John Grisham is a better lawyer and a better author of fast-paced thrillers than most people. He has an absolute advantage in these two activities. But compared to others, he is a better writer than lawyer, so his *comparative* advantage is in writing.

Because ability and resources vary from one person to another, people have different opportunity costs of producing various goods. These differences in opportunity cost are the source of comparative advantage.

Let's explore the idea of comparative advantage by looking at two smoothie bars: one operated by Liz and the other operated by Joe.

Joe's Smoothie Bar Joe produces smoothies and salads in a small, low-tech bar. He has only one blender, and it's a slow, old machine that keeps stopping. Even if Joe uses all his resources to produce smoothies, he can produce only 6 an hour—see Table 2.1. But Joe is good at making salads, and if he uses all his resources in this activity, he can produce 30 salads an hour.

Joe's ability to make smoothies and salads is the same regardless of how he splits an hour between the two tasks. He can make a salad in 2 minutes or a smoothie in 10 minutes. For each additional smoothie Joe produces, he must decrease his production of salads by 5. And for each additional salad he produces, he must decrease his production of smoothies by 1/5 of a smoothie. So

> Joe's opportunity cost of producing 1 smoothie is 5 salads,

and

> Joe's opportunity cost of producing 1 salad is 1/5 of a smoothie.

Joe's customers buy smoothies and salads in equal quantities. So Joe spends 50 minutes of each hour making smoothies and 10 minutes of each hour making salads. With this division of his time, Joe produces 5 smoothies and 5 salads an hour.

Figure 2.5(a) illustrates the production possibilities at Joe's smoothie bar—Joe's *PPF*.

Joe's *PPF* is linear (not outward bowed) because his ability to produce salads and smoothies is the same no matter how he divides his time between the two activities. Joe's opportunity cost of a smoothie is constant—it is the same at all quantities of smoothies produced.

TABLE 2.1 Joe's Production Possibilities

Item	Minutes to produce 1	Quantity per hour
Smoothies	10	6
Salads	2	30

Liz's Smoothie Bar Liz also produces smoothies and salads but in a high-tech bar that is much more productive than Joe's. Liz can turn out either a smoothie or a salad every 2 minutes—see Table 2.2.

If Liz spends all her time making smoothies, she can produce 30 an hour. And if she spends all her time making salads, she can also produce 30 an hour.

Liz's ability to make smoothies and salads, like Joe's, is the same regardless of how she divides her time between the two tasks. She can make a salad in 2 minutes or a smoothie in 2 minutes. For each additional smoothie Liz produces, she must decrease her production of salads by 1. And for each additional salad she produces, she must decrease her production of smoothies by 1. So

> Liz's opportunity cost of producing 1 smoothie is 1 salad,

and

> Liz's opportunity cost of producing 1 salad is 1 smoothie.

TABLE 2.2 Liz's Production Possibilities

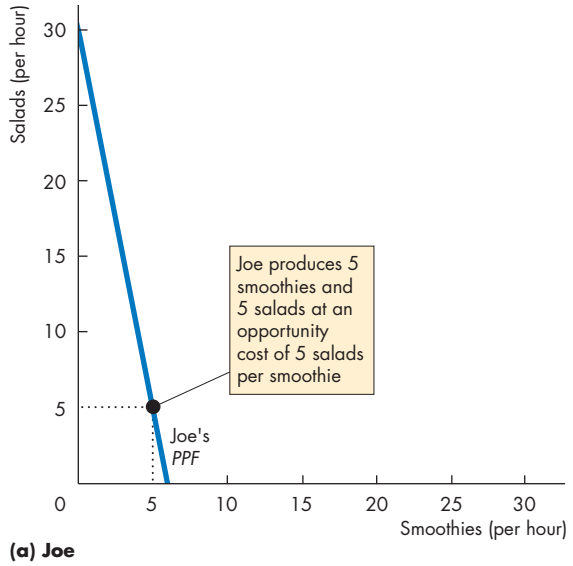
Item	Minutes to produce 1	Quantity per hour
Smoothies	2	30
Salads	2	30

Liz's customers buy smoothies and salads in equal quantities, so she splits her time equally between the two items and produces 15 smoothies and 15 salads an hour.

Figure 2.5(b) illustrates the production possibilities at Liz's smoothie bar—Liz's *PPF*.

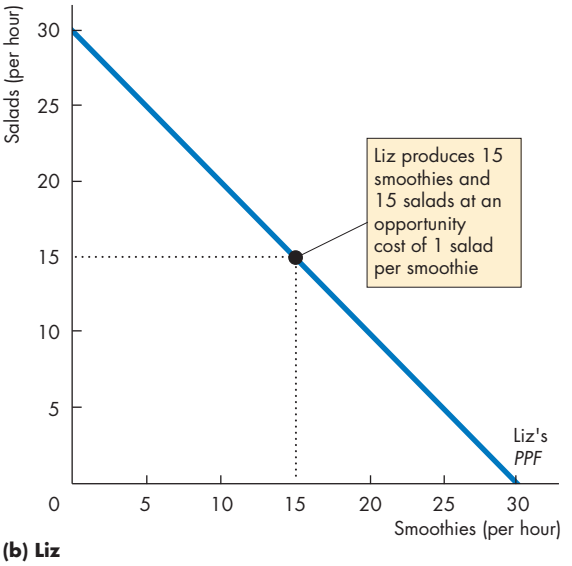
Like Joe's, Liz's *PPF* is linear because her ability to produce salads and smoothies is the same no matter how she divides her time between the two activities. Liz's opportunity cost of a smoothie is 1 salad at all quantities of smoothies produced.

FIGURE 2.5 The Production Possibilities Frontiers



(a) Joe

Joe can produce 30 salads per hour, 1 every two minutes, if he produces no smoothies. Or, he can produce 6 smoothies per hour, 1 every 10 minutes, if he produces no salads. Joe's customers buy equal quantities of salads and smoothies, so Joe produces 5 of each. His opportunity cost of a smoothie is 5 salads.



(b) Liz

Liz, in part (b), can produce 30 salads or 30 smoothies per hour, 1 of either item every two minutes. Liz's customers buy equal quantities of salads and smoothies, so she produces 15 of each. Liz's opportunity cost of a smoothie is 1 salad.

Joe's Comparative Advantage In which of the two activities does Joe have a comparative advantage? To answer this question, first recall the definition of comparative advantage. A person has a comparative advantage when that person's opportunity cost of producing a good is lower than another person's opportunity cost of producing that same good.

Joe's opportunity cost of producing a salad is only 1/5 of a smoothie, while Liz's opportunity cost of producing a salad is 1 smoothie. So Joe has a comparative advantage in producing salads.

Liz's Comparative Advantage If Joe has a comparative advantage in producing salads, Liz must have a comparative advantage in producing smoothies. Check the numbers. For Joe, a smoothie costs 5 salads, and for Liz, a smoothie costs only 1 salad. So Liz has a comparative advantage in making smoothies.

Achieving the Gains from Trade

Liz and Joe run into each other one evening in a singles bar. After a few minutes of getting acquainted, Liz tells Joe about her amazing smoothie business. Her only problem, she tells Joe, is that she would like to produce more because potential customers leave when her lines get too long.

Joe doesn't want to risk spoiling a potential relationship by telling Liz about his own struggling business, but he takes the risk. Joe explains to Liz that he spends 50 minutes of every hour making 5 smoothies and 10 minutes making 5 salads.

Liz's eyes pop. "Have I got a deal for you!" she exclaims.

Liz's Proposal Here's the deal that Liz sketches on a paper napkin.

1. We'll both specialize in producing the good in which we have a comparative advantage.
2. Joe will stop making smoothies and allocate all his time to producing salads.
3. Liz will stop making salads and allocate all her time to producing smoothies.
4. Together we will produce 30 smoothies and 30 salads—see Table 2.3(b).
5. We will then trade. Joe will get smoothies from Liz, and Liz will get salads from Joe.
6. We must agree on a price at which to trade.

Agreeing on a Price Liz is buying salads from Joe, and Joe is buying smoothies from Liz. Normally, in a situation like this one, the trading partners will bargain about the price, with each person trying for the lowest price at which to buy and the highest price at which to sell.

But Liz and Joe like each other and quickly agree on a price that ends up sharing the gains from the new arrangement equally.

The price is not expressed in dollars but in salads per smoothie. The price they agree on is 2 salads per smoothie. For Liz, that is a good deal because she can produce a smoothie at a cost of 1 salad and sell it to Joe for 2 salads. It is also a good deal for Joe because he can produce a salad at a cost of 1/5 of a smoothie and sell it to Liz for 1/2 of a smoothie.

Liz explains that any price above 1 salad per smoothie is good for her and any price below 5 salads per smoothie is good for Joe, so a price of 2 salads per smoothie lets them both gain, as she now describes.

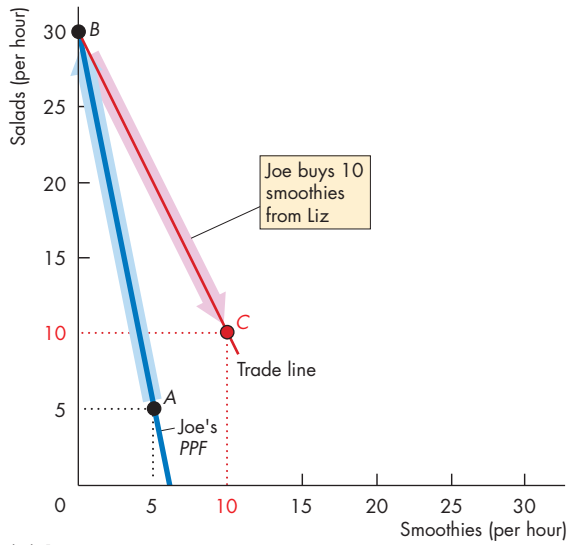
At the proposed price of 2 salads per smoothie, Liz offers to sell Joe 10 smoothies in exchange for 20 salads. Equivalently, Joe sells Liz 20 salads in exchange for 10 smoothies. —see Table 2.3(c).

After this trade, Joe has 10 salads—the 30 salads he produces minus the 20 he sells to Liz. He also has

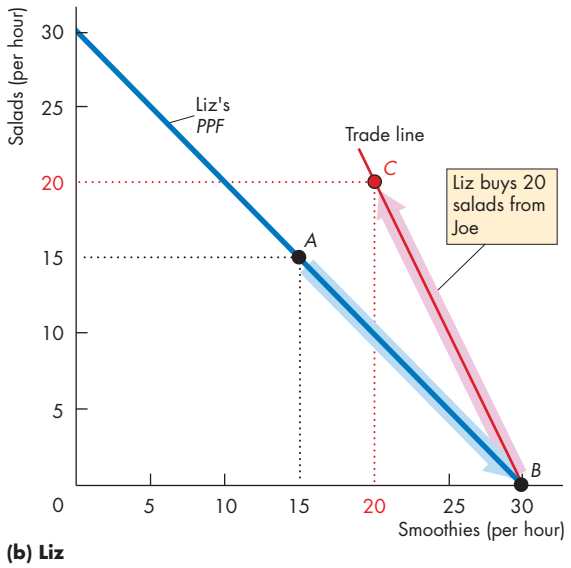
TABLE 2.3 Liz and Joe Gain from Trade

(a) Initially	Liz	Joe
Smoothies	15	5
Salads	15	5
(b) After specialization	**Liz**	**Joe**
Smoothies	30	0
Salads	0	30
(c) Trade	**Liz**	**Joe**
Smoothies	sell 10	buy 10
Salads	buy 20	sell 20
(d) After trade	**Liz**	**Joe**
Smoothies	20	10
Salads	20	10
(e) Gains from trade	**Liz**	**Joe**
Smoothies	+5	+5
Salads	+5	+5

FIGURE 2.6 The Gains from Trade



(a) Joe



(b) Liz

Initially, Joe produces at point *A* on his *PPF* in part (a), and Liz produces at point *A* on her *PPF* in part (b). Joe's opportunity cost of producing a salad is less than Liz's, so Joe has a comparative advantage in producing salads. Liz's opportunity cost of producing a smoothie is less than Joe's, so Liz has a comparative advantage in producing smoothies.

If Joe specializes in making salads, he produces 30 salads and no smoothies at point *B* on his *PPF*. If Liz specializes in making smoothies, she produces 30 smoothies and no salads at point *B* on her *PPF*. They exchange salads for smoothies along the red "Trade line." Liz buys salads from Joe for less than her opportunity cost of producing them. Joe buys smoothies from Liz for less than his opportunity cost of producing them. Each goes to point *C*—a point outside his or her *PPF*. With specialization and trade, Joe and Liz gain 5 smoothies and 5 salads each with no extra resources.

the 10 smoothies that he buys from Liz. So Joe now has increased the quantities of smoothies and salads that he can sell to his customers—see Table 2.3(d).

Liz has 20 smoothies—the 30 she produces minus the 10 she sells to Joe. She also has the 20 salads that she buys from Joe. Liz has increased the quantities of smoothies and salads that she can sell to her customers—see Table 2.3(d). Both Liz and Joe gain 5 smoothies and 5 salads an hour—see Table 2.3(e).

Illustrating Liz's Idea To illustrate her idea, Liz grabs a fresh napkin and draws the graphs in Fig. 2.6. First, she sketches Joe's *PPF* in part (a) and shows the point at which he is producing before they meet. Recall that he is producing 5 smoothies and 5 salads an hour at point *A*.

She then sketches her own *PPF* in part (b), and marks the point *A* at which she is producing 15 smoothies and 15 salads an hour.

She then shows what happens when they each specialize in producing the good in which they have a comparative advantage. Joe specializes in producing salads and produces 30 salads and no smoothies at point *B* on his *PPF*.

Liz specializes in producing smoothies and produces 30 smoothies and no salads at point *B* on her *PPF*.

They then trade smoothies and salads at a price of 2 salads per smoothie or 1/2 of a smoothie per salad. The red "Trade line" that Liz draws on each part of the figure illustrates the tradeoff that each faces at the proposed price.

Liz now shows Joe the amazing outcome of her idea. After specializing and trading, Joe gets 10 smoothies and 10 salads at point *C*—a gain of 5 smoothies and 5 salads. He moves to a point *outside* his *PPF*. And Liz gets 20 smoothies and 20 salads at point *C*—also a gain of 5 smoothies and 5 salads—and moves to a point *outside* her *PPF*.

Despite Liz being more productive than Joe, both gain from specializing in the good in which they have a comparative advantage and trading.

The Liz–Joe Economy and Its *PPF*

With specialization and trade, Liz and Joe get outside their individual *PPF*s. But think about Liz and Joe as representing an entire economy. You know that it isn't possible to produce outside the economy's *PPF*. So, what's going on?

The answer is that although Liz and Joe get outside their individual *PPF*s with specialization, they produce *on* the economy's *PPF*.

Figure 2.7 illustrates the construction of the economy's *PPF*. If both produce only salads, the economy produces 60 salads per hour at point *A*.

If the economy starts to produce smoothies, Liz produces the first 30 at a cost of 1 salad per smoothie.

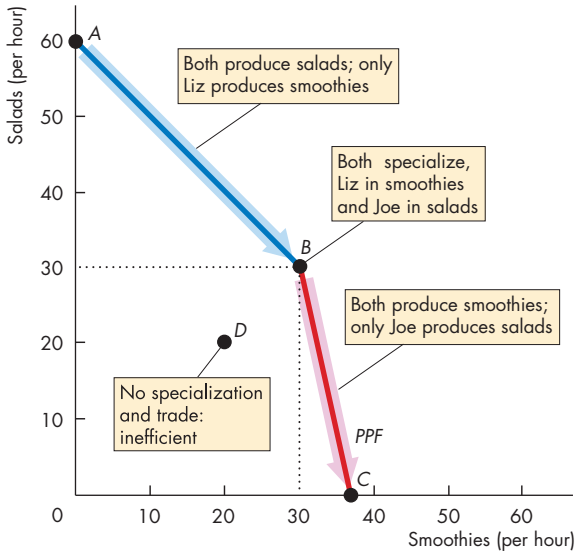
When Liz is using all her resources to produce smoothies, the economy is at point *B*. At this point, both Liz and Joe are specializing in the good for which they have a comparative advantage.

If the economy is to produce more than 30 smoothies, Joe must join Liz in producing some. But the 31st smoothie, produced by Joe, costs 5 salads. If the economy puts all its resources into producing smoothies, it produces 36 per hour at point *C*.

Outward-Bowed *PPF* The outward-kinked curve, *PPF*, is the Liz–Joe economy's production possibilities frontier. Despite Liz and Joe having constant opportunity costs—linear *PPF*s—along the economy's *PPF* the opportunity cost is increasing. For the economy with only two people, the economy's *PPF* is kinked rather than bowed outward. But applying the same ideas that you've seen in the Liz–Joe economy to an economy with millions of people, the *PPF* is outward bowed.

Efficiency and Inefficiency When Liz and Joe specialize, they produce efficiently on the economy's *PPF*. They can also produce efficiently at any other point along their economy's *PPF*. But without specialization and trade, they produce at an inefficient point inside the economy's *PPF*. You can see this fact in Fig. 2.7. If Liz and Joe produce their own smoothies and salads, they produce at point *D* inside the economy's *PPF*. All the economy's resources are fully employed at point *D* but they are misallocated.

FIGURE 2.7 The Liz–Joe Economy's *PPF*



When the economy produces more than 30 salads per hour, both Liz and Joe produce salads but only Liz produces smoothies.

When the economy produces more than 30 smoothies per hour, both Liz and Joe produce smoothies but only Joe produces salads.

When Liz and Joe specialize in their comparative advantage, the economy produces 30 salads and 30 smoothies at an efficient point on the economy's *PPF*.

Without specialization and trade, Liz and Joe produce at an inefficient point inside the economy's *PPF*.

REVIEW QUIZ

1. What gives a person a comparative advantage?
2. Distinguish between comparative advantage and absolute advantage.
3. Why do people specialize and trade?
4. What are the gains from specialization and trade?
5. What is the source of the gains from trade?
6. Why does specialization and the gains from trade make the economy's *PPF* outward bowed?
7. Why is not specializing and reaping the gains from trade inefficient?.
8. How do you think the Covid-19 pandemic influenced Liz's and Joe's gains from trade? Explain your answer.

Economic Growth

During the past 40 years, production per person in the United States has doubled. The expansion of production possibilities is called **economic growth**. Economic growth increases our *standard of living,* but it doesn't overcome scarcity and avoid opportunity cost. To make our economy grow, we face a tradeoff—the faster we make production grow, the greater is the opportunity cost of economic growth.

The Cost of Economic Growth

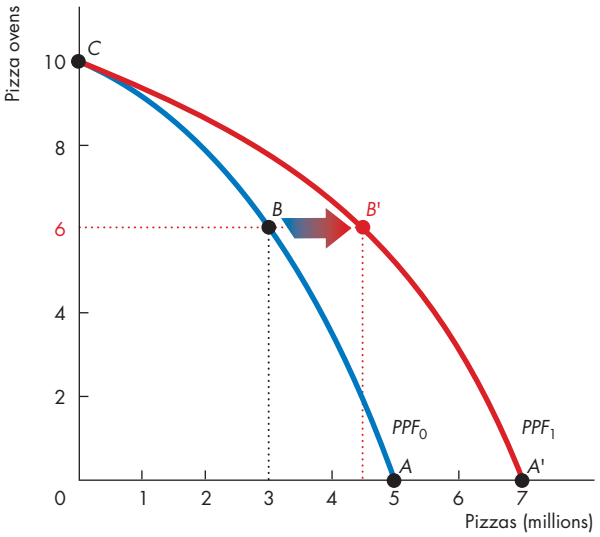
Economic growth comes from technological change and capital accumulation. **Technological change** is the development of new goods and of better ways of producing goods and services. **Capital accumulation** is the growth of capital resources, including *human capital*.

Technological change and capital accumulation have vastly expanded our production possibilities. We can produce automobiles that provide us with more transportation than was available when we had only horses and carriages. We can produce satellites that provide global communications on a much larger scale than that available with the earlier cable technology. But if we use our resources to develop new technologies and produce capital, we must decrease our production of consumption goods and services. New technologies and new capital have an opportunity cost. Let's look at this opportunity cost.

Instead of studying the *PPF* of pizzas and cola, we'll hold the quantity of cola produced constant and examine the *PPF* for pizzas and pizza ovens. Figure 2.8 shows this *PPF* as the blue curve PPF_0. If we devote no resources to producing pizza ovens, we produce at point *A*. If we produce 3 million pizzas, we can produce 6 pizza ovens at point *B*. If we produce no pizza, we can produce 10 ovens at point *C*.

The amount by which our production possibilities expand depends on the resources we devote to technological change and capital accumulation. If we devote no resources to this activity (point *A*), our *PPF* remains the blue curve PPF_0 in Fig. 2.8. If we cut the current pizza production and produce 6 ovens (point *B*), then in the future, we'll have more capital and our *PPF* will rotate outward to the position shown by the red curve PPF_1. The fewer resources we use for producing pizza and the more resources we use for producing ovens, the greater is the expansion of our future production possibilities.

FIGURE 2.8 Economic Growth



PPF_0 shows the limits to the production of pizzas and pizza ovens, with the production of all other goods and services remaining the same. If we devote no resources to producing pizza ovens and produce 5 million pizzas, our production possibilities will remain the same at PPF_0. But if we decrease pizza production to 3 million and produce 6 ovens, at point *B*, our production possibilities expand. After one period, the *PPF* rotates outward to PPF_1 and we can produce at point *B′*, a point outside the original PPF_0. We can rotate the *PPF* outward, but we cannot avoid opportunity cost. The opportunity cost of producing more pizzas in the future is fewer pizzas today.

Economic growth brings enormous benefits in the form of increased consumption in the future, but economic growth is not free and it doesn't abolish scarcity.

In Fig. 2.8, to make economic growth happen we must use some resources to produce new ovens, which leaves fewer resources to produce pizzas. To move to *B′* in the future, we must move from *A* to *B* today. The opportunity cost of more pizzas in the future is fewer pizzas today. Also, on the new *PPF*, we still face a tradeoff and opportunity cost.

The ideas about economic growth that we have explored in the setting of the pizza industry also apply to nations. Singapore and the United States provide a striking case study.

ECONOMICS IN ACTION

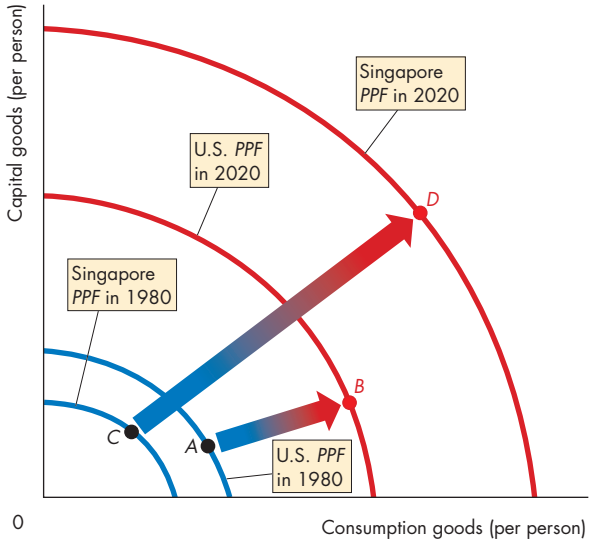
Singapore Overtakes the United States

In 1980, the production possibilities per person in the United States were 40 percent higher than those in Singapore (see the figure). The United States devoted one fifth of its resources to accumulating capital, and in 1980, was at point *A* on its *PPF*. By 2020, U.S. production possibilities had doubled and production was at point *B*.

In 1980, Singapore devoted 45 percent of its resources to accumulating capital and was at point *C* on its *PPF*. By 1992, Singapore's real GDP per person had grown to equal that of the United States, and by 2020 to exceed it by 50 percent at point *D* on its 2020 *PPF*.

If Singapore continues to devote more resources to accumulating capital than the United States does it will continue to grow more rapidly. But if Singapore decreases its capital accumulation, then its rate of economic growth will slow.

Singapore is typical of the fast-growing Asian economies, which include Taiwan, Thailand, South Korea, and China. Production possibilities expand in these countries by between 5 percent and sometimes almost 10 percent a year.



Economic Growth in the United States and Singapore

If such high economic growth rates are maintained, these other Asian countries will close the gap and overtake the United States, as Singapore has done.

A Nation's Economic Growth

The experiences of the United States and Singapore make a striking example of the effects of our choices about consumption and capital accumulation on the rate of economic growth.

If an economy devotes all its factors of production to producing consumption goods and services and none to advancing technology and accumulating capital, its production possibilities in the future will be the same as they are today.

To expand production possibilities in the future, a nation or an economy must devote fewer resources to producing current consumption goods and services and some resources to accumulating capital and developing new technologies. As production possibilities expand, consumption in the future can increase. The decrease in today's consumption is the opportunity cost of tomorrow's increase in consumption.

When production possibilities expand, the pattern of what is produced changes. Let's see how and why.

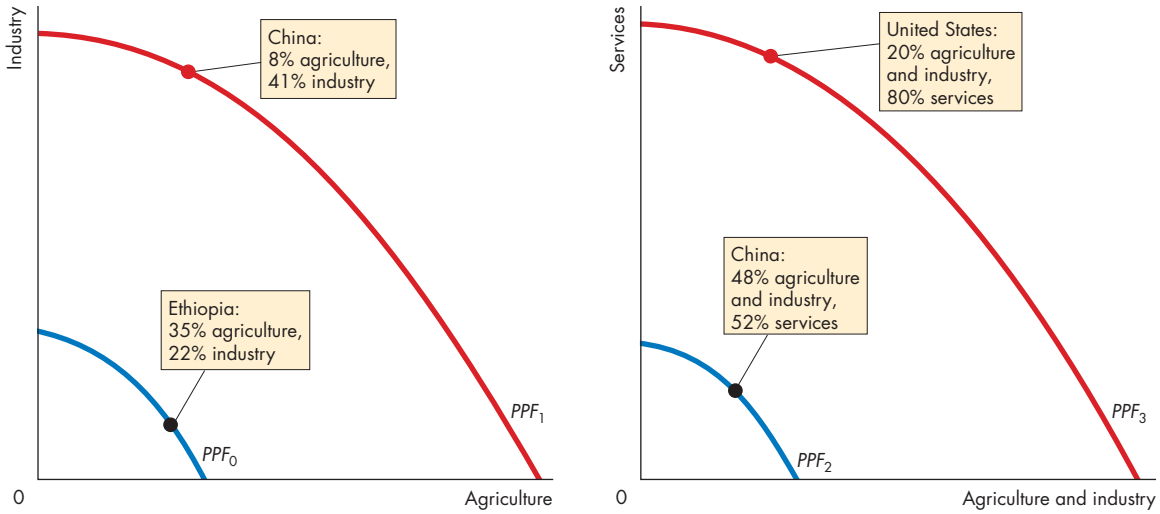
Changes in What We Produce

You saw in Chapter 1 that there are large differences in what is produced in a poor country like Ethiopia, a middle income country like China, and a rich country like the United States. Economic growth brings these changes, and the model that you've learned about in this chapter enables you to understand the differences in the patterns of production.

In a low-income country, just producing enough food is a high priority, and the marginal benefit of food is high. So in Ethiopia, agriculture accounts for a large 35 percent of total production.

As a country invests in capital and uses more advanced technologies, its production possibilities expand and it can easily satisfy the want for food, so most of the increase in production is in industry (manufactured goods). In China, where production per person is 7 times that of Ethiopia, agriculture shrinks to 8 percent of total production and industry expands to 41 percent.

FIGURE 2.9 How Economic Growth Changes What We Produce



(a) From low to middle income

(b) From middle to high income

Ethiopia, a low-income country, has production possibilities per person on PPF_0. More than one-third of its production, 35 percent, is from agriculture; and 22 percent from industry.

Investment in capital and more productive technology expands production possibilities to the middle-income level in China on PPF_1. Industry increases to 41 percent of production and agriculture shrinks to 8 percent.

In part (b), at China's level of production on PPF_2, production is divided equally between services and a combination of agriculture and industry.

When investment in capital and more productive technology expands production possibilities to the high-income level in the United States on PPF_3, most of the increased production is of services, which increases to 80 percent.

Further investment in capital and in advanced robot technologies expand production possibilities to the level in the United States, which today is 4 times (per person) its level in China. Most of the advances in technology are in manufacturing, which means that industrial production increases, but the industrial labor force shrinks. The labor released from industrial jobs is the source of expanded production possibilites in services. And it is the production of services that expands most. The share of agriculture shrinks to 1 percent of total production, industry shrinks to 19 percent, and services expand to 80 percent.

Figure 2.9 illustrates the contrasts between Ethiopia and China (part a) and China and the United States (part b).

If the pace of industrial jobs loss and service jobs creation is rapid, as it has been in the United States over the past 40 years, serious problems arise for the workers whose jobs disappear. Many of these workers lack the skills needed for the new jobs, so training in new skills is necessary. Most of the new jobs are in different places from those in which jobs are lost, so to get a new job, a person must uproot and make a new home. Job training and relocating are costly and slow activities, so a large number of people avoid those costs and remain unemployed, placing the economy inside its *PPF*.

REVIEW QUIZ

1. What generates economic growth?
2. How does economic growth influence the production possibilities frontier?
3. What is the opportunity cost of economic growth?
4. Explain why Singapore has experienced faster economic growth than the United States.
5. Does economic growth overcome scarcity?
6. How does economic growth change the patterns of production?
7. Why does economic growth destroy some jobs and create new jobs?

Economic Coordination

For 7 billion people to specialize and produce millions of different goods and services, individual choices must somehow be coordinated. Two competing coordination systems have been used: central economic planning and markets (see *At Issue*, p. 36).

Central economic planning works badly because economic planners don't know people's production possibilities and preferences, so production ends up *inside* the *PPF* and the wrong things are produced.

Decentralized coordination works best but to do so it needs four complementary social institutions. They are

- Firms
- Markets
- Property rights
- Money

Firms

A **firm** is an economic unit that hires factors of production and organizes them to produce and sell goods and services.

Firms coordinate a huge amount of economic activity. For example, Walmart buys or rents large buildings, equips them with storage shelves and checkout lanes, and hires labor. Walmart directs the labor and decides what goods to buy and sell.

But Sam Walton would not have become one of the wealthiest people in the world if Walmart produced everything that it sells. He became rich by specializing in providing retail services and buying from other firms that specialize in producing goods (just as Liz and Joe did). This trade needs markets.

Markets

In ordinary speech, the word *market* means a place where people buy and sell goods such as fish, meat, fruits, and vegetables.

In economics, a **market** is any arrangement that enables buyers and sellers to get information and to do business with each other. An example is the world oil market, which is not a place but a network of producers, consumers, wholesalers, and brokers who buy and sell oil. In the world oil market, decision makers make deals by using the Internet. Enterprising individuals and firms, each pursuing their own self-interest, have profited by making markets—by standing ready to buy or sell items in which they specialize. But markets can work only when property rights exist.

Property Rights

The social arrangements that govern the ownership, use, and disposal of anything that people value are called **property rights**. *Real property* includes land and buildings—the things we call property in ordinary speech—and durable goods such as plant and equipment. *Financial property* includes stocks and bonds and money in the bank. *Intellectual property* is the intangible product of creative effort. This type of property includes books, music, computer programs, and inventions of all kinds and is protected by copyrights and patents.

Where property rights are enforced, people have the incentive to specialize and produce the goods and services in which they have a comparative advantage. Where people can steal the production of others, resources are devoted not to production but to protecting possessions.

Money

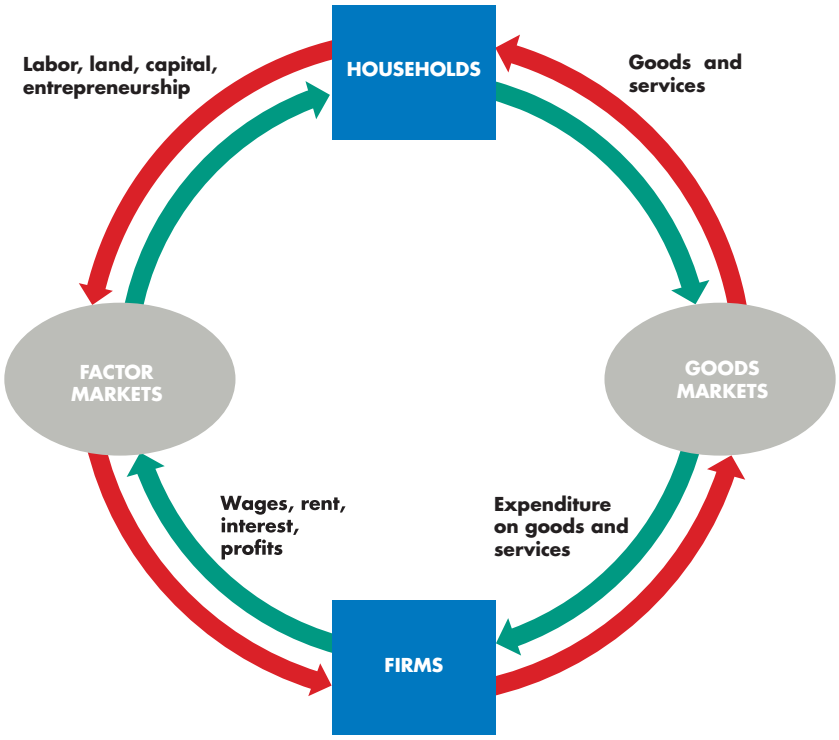
Money is any commodity or token that is generally acceptable as a means of payment. Liz and Joe don't need money. They can exchange salads and smoothies. In principle, trade in markets can exchange any item for any other item. But you can perhaps imagine how complicated life would be if we exchanged goods for other goods. The "invention" of money makes trading in markets much more efficient.

Circular Flows Through Markets

Trading in markets for goods and services and factors of production creates a circular flow of expenditures and incomes. Figure 2.10 shows the circular flows. Households specialize and choose the quantities of labor, land, capital, and entrepreneurial services to sell or rent to firms. Firms choose the quantities of factors of production to hire. These (red) flows go through the *factor markets*. Households choose the quantities of goods and services to buy, and firms choose the quantities to produce. These (red) flows go through the *goods markets*. Households receive incomes and make expenditures on goods and services (the green flows).

How do markets coordinate all these decisions?

FIGURE 2.10 Circular Flows in the Market Economy



Households and firms make economic choices and markets coordinate these choices.

Households choose the quantities of labor, land, capital, and entrepreneurial services to sell or rent to firms in exchange for wages, rent, interest, and profits. Households also choose how to spend their incomes on the various types of goods and services available.

Firms choose the quantities of factors of production to hire and the quantities of goods and services to produce.

Goods markets and factor markets coordinate these choices of households and firms.

The counterclockwise red flows are real flows—the flow of factors of production from households to firms and the flow of goods and services from firms to households.

The clockwise green flows are the payments for the red flows. They are the flow of incomes from firms to households and the flow of expenditure on goods and services from households to firms.

Coordinating Decisions

Markets coordinate decisions through price adjustments. Suppose that some people who want to buy hamburgers are not able to do so. To make buying and selling plans the same, either more hamburgers must be offered for sale or buyers must scale down their appetites (or both). A rise in the price of a hamburger produces this outcome. It encourages producers to offer more hamburgers for sale and encourages some people to change their lunch plans. When the price is right, buying plans and selling plans match.

Alternatively, suppose that more hamburgers are available than people want to buy. In this case, more hamburgers must be bought or fewer hamburgers must be offered for sale (or both). A fall in the price of a hamburger achieves this outcome. It encourages people to buy more hamburgers and it encourages firms to produce a smaller quantity of hamburgers.

REVIEW QUIZ

1 Why are social institutions such as firms, markets, property rights, and money necessary?
2 What are the main functions of markets?
3 What are the flows in the market economy that go from firms to households and the flows from households to firms?.

You have now begun to see how economists approach economic questions. You can see all around you the lessons you've learned in this chapter. *Economics in the News* on pp. 78–79 provides an opportunity to apply the *PPF* model to deepen your understanding of how Covid-19 and the government's response to it has changed production possibilities.

Production Possibilities in and after Covid-19

President Joe Biden has some big spending plans that created headlines like the ones below. How will implementing these plans reallocate resources? What will be the cost of these plans? Read these headlines and news clips and then use the *PPF* to analyse the effects of these plans.

Treasury Sec. Yellen Promises 'Big Return' From Biden's $6 Trillion Spending Proposals—But 'We Should Pay For Them'

President Joe Biden's three big economic plans—$1.9 trillion for the American Rescue Plan signed in March, $2.3 trillion for the American Jobs Plan proposed in March and $1.8 trillion for the American Families Plan unveiled last week.

Forbes, May 2, 2021

Biden's Budget Would Raise Spending by $2 Trillion

The proposal, set for public release on Friday, offers a full accounting of Bilden's previously disclosed plans of trillions of dollars in . . .
Bloomberg, May 27, 2021

Money is Cheap, Let's Spend It —White House $6 Trillion Budget

"President Biden's proposal would drown American families in debt, deficits, and inflations" McConnell said in a Tweet. PAID FOR IN 15 YEARS
Reuters, May 28, 2021

Republicans Counter Biden's Infrastructure Plans

President Biden will release his full $6 trillion budget proposal for . . . resources at our disposal," said Ms. Yellenin prepared remarks
New York Times, May 28, 2012

ESSENCE OF THE STORY

- President Joe Biden wants to spend $6 trillion spread evenly over the next eight to 10 years on three big economic plans–$1.9 trillion for the American Rescue Plan, $2.3 trillion for the American Jobs Plan, and $1.8 trillion for the American Families Plan.
- Tax increases will pay for this spending.
- Treasury Secretary Janet Yellen believes there will be a big return from investing in research and development and enabling families to participate in the workforce.

ECONOMIC ANALYSIS

- The Covid-19 pandemic brought massive changes to production possibilities and to the allocation of scarce resources. Restrictions on social interaction like stay-at-home orders decreased production, and the rapid development of effective vaccines increased production.
- The *PPF* model illustrates these changes and the possible effects of government responses to them.
- The two figures below show the U.S. production possibilities frontiers before, during, and after the Covid-19 pandemic. The *y*-axis shows the quantity of private goods and services produced and the *x*-axis shows the quantity of government goods and services produced
- In 2019, the production possibilities frontier was PPF_{19} in Fig. 1 and the economy produced at point *A*.
- As the pandemic spread in 2020 and restrictions on social interaction came into effect, production possibilities shrank and the *PPF* shifted inward to PPF_{20}.
- Production moved to point *B*. Some government goods and services like airport security decreased, but others, like vaccine research and production increased, and total government goods and services didn't change. Private goods and services like vacation travel and meals in restaurants decreased.
- In 2021, as the vaccination rollout gathered pace, production possibilities expanded, but at the start of the year, production was still at point *B in* Fig. 2.
- As unemployment fell, production of private goods and services increased and the economy moved to point *C* on the 2021 *PPF*.
- At point *C*, the quantity of government goods and services is the same in 2021 as it was in 2019 and 2020.
- The $6 trillion plan of President Biden increases the quantity of government goods and services, but it doesn't expand production possibilities.
- Tax increases to pay for the increased government share of production decrease the quantity of private goods and services in a movement along PPF_{21} to point *D*.
- Some of the items in the $6 trillion Biden plan are capital goods that include transportation infrastructure, research and development, and education.
- The increase in the production of these items increases production possibilities.
- The view of Janet Yellen reported in the news article is illustrated by the outward shift of production possibilities to PPF_{24}.
- If production possibilities do increase to PPF_{24}, the quantities of both private and government goods and services can increase in a move to a point like *E*.
- The effect of the big expansion of government depends on how much goes to capital goods that increase production.

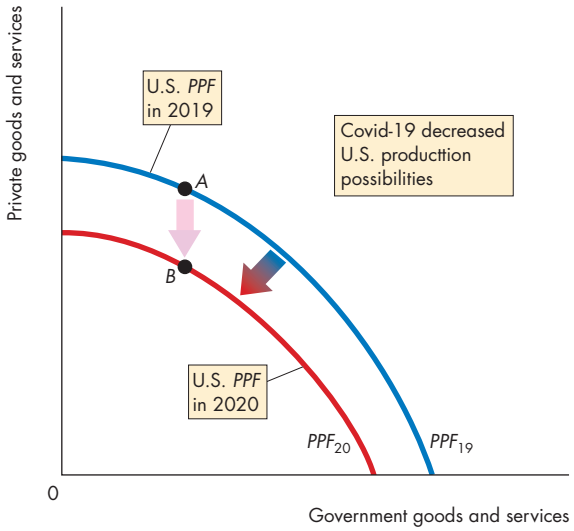


Figure 1 The Covid-19 Decrease in Production Possibilities

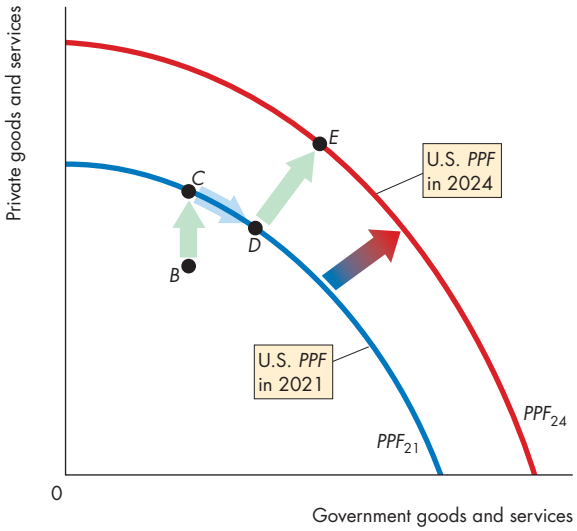


Figure 2 The Biden Plan

WORKED PROBLEM

Leisure Island has 50 hours of labor a day that it can use to produce entertainment and good food. The table shows the maximum quantity of each good that it can produce with different quantities of labor.

Labor (hours)	Entertainment (shows per week)		Good food (meals per week)
0	0	or	0
10	2	or	5
20	4	or	9
30	6	or	12
40	8	or	14
50	10	or	15

Questions

1. Can Leisure Island produce 4 shows and 14 meals a week?
2. If Leisure Island produces 4 shows and 9 meals a week, is production efficient?
3. If Leisure Island produces 8 shows and 5 meals a week, does it face a tradeoff?
4. Suppose that Leisure Island produces 4 shows and 12 meals a week. Calculate the opportunity cost of producing 2 extra shows a week.

Solutions

1. To produce 4 shows it would use 20 hours and to produce 14 meals it would use 40 hours, so to produce 4 shows and 14 meals a week, Leisure Island would use 60 hours of labor. Leisure Island has only 50 hours of labor available, so it cannot produce 4 shows and 14 meals a week.

Key Point: Production is *unattainable* if it uses more resources than are available.

2. When Leisure Island produces 4 shows it uses 20 hours of labor and when it produces 9 meals it uses 20 hours. In total, it uses 40 hours, which is *less than* the 50 hours of labor available. So Leisure Island's production is not efficient.

Key Point: Production is *efficient* only if the economy uses all its resources.

3. When Leisure Island produces 8 shows and 5 meals, it uses 50 hours of labor. Leisure Island is using all its resources, so to produce more of either good, it would face a tradeoff.

Key Point: An economy faces a *tradeoff* only when it uses all the available resources.

4. When Leisure Island produces 4 shows and 12 meals a week, it uses 50 hours of labor. To produce 2 more shows a week, Leisure Island faces a tradeoff and incurs an opportunity cost.

To produce 2 extra shows a week, Leisure Island moves 10 hours of labor from good food production, which decreases the quantity of meals from 12 to 9 a week—a decrease of 3 meals. That is, to get 2 extra shows a week, Leisure Island *must give up* 3 meals a week. The opportunity cost of the 2 extra shows is 3 meals a week.

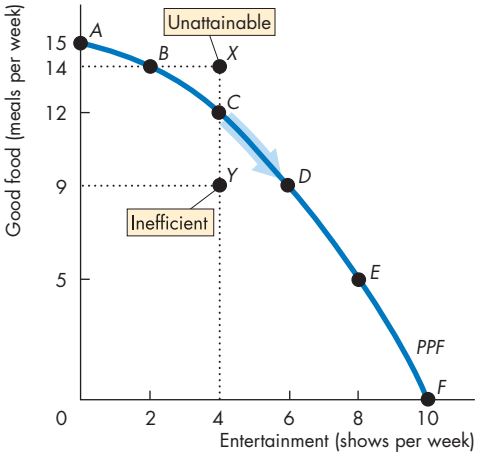
Key Point: When an economy is using all its resources and it decides to increase production of one good, it incurs an opportunity cost equal to the quantity of the good that it *must* forgo.

Key Figure

Each row of the following table sets out the combination of shows and meals that Leisure Island can produce when it uses 50 hours of labor.

	Entertainment (shows per week)		Good food (meals per week)
A	0	and	15
B	2	and	14
C	4	and	12
D	6	and	9
E	8	and	5
F	10	and	0

On the figure, points *A* through *F* plot the combinations in the rows in the table. The blue curve shows Leisure Island's *PPF*. Point *X* (4 shows and 14 meals in Question 1) is unattainable; Point *Y* (4 shows and 9 meals in Question 2) is inefficient. Point *E* (8 shows and 5 meals in Question 3) is on the *PPF*. The arrow illustrates the tradeoff and from it you can calculate the opportunity cost of 2 extra shows a week.



SUMMARY

Key Points

Production Possibilities and Opportunity Cost

(pp. 62–64)

- The production possibilities frontier is the boundary between production levels that are attainable and those that are unattainable when all the available resources are used to their limits.
- Production efficiency occurs at points on the production possibilities frontier.
- Along the production possibilities frontier, the opportunity cost of producing more of one good is the amount of the other good that must be given up.
- The opportunity cost of all goods increases as the production of the good increases.

Using Resources Efficiently (pp. 65–67)

- Allocative efficiency occurs when goods and services are produced at the least possible cost and in the quantities that bring the greatest possible benefit.
- The marginal cost of a good is the opportunity cost of producing one more unit of it.
- The marginal benefit of a good is the benefit received from consuming one more unit of it and is measured by the willingness to pay for it.
- The marginal benefit of a good decreases as the amount of the good available increases.
- Resources are used efficiently when the marginal cost of each good is equal to its marginal benefit.

Gains from Trade (pp. 68–72)

- A person has a comparative advantage in producing a good if that person can produce the good at a lower opportunity cost than everyone else.
- People gain by specializing in the activity in which they have a comparative advantage and trading with others.

Economic Growth (pp. 73–75)

- Economic growth, which is the expansion of production possibilities, results from capital accumulation and technological change.
- The opportunity cost of economic growth is forgone current consumption.
- The benefit of economic growth is increased future consumption.

Economic Coordination (pp. 76–77)

- Firms coordinate a large amount of economic activity, but there is a limit to the efficient size of a firm.
- Markets coordinate the economic choices of people and firms.
- Markets can work efficiently only when property rights exist.
- Money makes trading in markets more efficient.

Key Terms

Absolute advantage, 68
Allocative efficiency, 65
Capital accumulation, 73
Comparative advantage, 68
Economic growth, 73
Firm, 76
Marginal benefit, 66
Marginal benefit curve, 66
Marginal cost, 65
Market, 76
Money, 76
Opportunity cost, 63
Preferences, 66
Production efficiency, 63
Production possibilities frontier, 62
Property rights, 76
Technological change, 73

PROBLEMS AND APPLICATIONS

Production Possibilities and Opportunity Cost

Use the following data to work Problems 1 to 3.

Brazil produces ethanol from sugar, and the land used to grow sugar can be used to grow food crops. The table sets out Brazil's production possibilities for ethanol and food crops:

Ethanol (barrels per day)		Food crops (tons per day)
70	and	0
64	and	1
54	and	2
40	and	3
22	and	4
0	and	5

1. a. Draw a graph of Brazil's *PPF* and explain how your graph illustrates scarcity.
   b. If Brazil produces 40 barrels of ethanol a day, how much food must it produce to achieve production efficiency?
   c. Why does Brazil face a tradeoff on its *PPF*?
2. a. If Brazil increases ethanol production from 40 barrels per day to 54 barrels a day, what is the opportunity cost of the additional ethanol?
   b. If Brazil increases food production from 2 tons per day to 3 tons per day, what is the opportunity cost of the additional food?
   c. What is the relationship between your answers to parts (a) and (b)?
3. Does Brazil face an increasing opportunity cost of ethanol? What feature of Brazil's *PPF* illustrates increasing opportunity cost?

Using Resources Efficiently

Use the table above to work Problems 4 and 5.

4. Define marginal cost and calculate Brazil's marginal cost of producing a ton of food when the quantity produced is 2.5 tons per day.
5. Define marginal benefit. Explain how it is measured and why the data in the table does not enable you to calculate Brazil's marginal benefit of food.
6. Distinguish between *production efficiency* and *allocative efficiency*. Explain why many production possibilities achieve production efficiency but only one achieves allocative efficiency.

Gains from Trade

Use the following data to work Problems 7 and 8.

In an hour, Marco can produce 5 cups of pesto sauce or 15 platters of pasta and Giorgia can produce 8 cups of pesto sauce or 20 platters of pasta.

7. a. Calculate Marco's opportunity cost of producing a cup of pesto sauce.
   b. Calculate Giorgia's opportunity cost of producing a cup of pesto sauce.
   c. Who has a comparative advantage in producing pesto sauce?
   d. If Marco and Giorgia specialize in producing the good in which they have a comparative advantage, and then trade 11 platters of pasta for 4 cups of pesto sauce, who gains from the specialization and trade?
8. Suppose that Giorgia finds a new way to cook pasta that enables her to make 30 platters an hour. (She can still make only 8 cups of pesto sauce an hour.)
   a. Who now has a comparative advantage in producing pasta?
   b. Can Marco and Giorgia still gain from trade?
   c. Would Marco and Giorgia still be willing to trade 11 platters of pasta for 4 cups of pesto sauce? Explain your answer.

Economic Growth

9. A farm grows corn and produces eggs. The marginal cost of producing each of these products increases as more of it is produced.
   a. Make a graph that illustrates the farm's *PPF*.
   b. The farm adopts a genetically modified method that allows it to increase its corn yield. On your graph, sketch the impact of this new method on the farm's *PPF*.
   c. With the farm using the new method described in part (b), has the opportunity cost of producing a carton of eggs increased, decreased, or remained the same? Explain and illustrate your answer.
   d. Is the farm more efficient with the new method of genetic engineering than it was without it? Why?

Economic Coordination

10. For 50 years, Cuba had a centrally planned economy in which the government makes the big decisions on how resources will be allocated.
    a. Why would you expect Cuba's production possibilities (per person) to be smaller than those of the United States?
    b. What are the social institutions that Cuba might lack that help the United States to achieve allocative efficiency?

ADDITIONAL PROBLEMS AND APPLICATIONS

Production Possibilities and Opportunity Cost

Use the following table to work Problems 11 and 12.

Suppose that Yucatan's production possibilities are

Food (pounds per month)		Sunscreen (gallons per month)
300	and	0
200	and	50
100	and	100
0	and	150

11. a. Draw a graph of Yucatan's *PPF* and explain how your graph illustrates a tradeoff.
    b. If Yucatan produces 150 pounds of food per month, how much sunscreen must it produce if it achieves production efficiency?
    c. What is Yucatan's opportunity cost of producing (i) 1 pound of food and (ii) 1 gallon of sunscreen?
    d. What is the relationship between your answers to part (c)?
12. What feature of a *PPF* illustrates increasing opportunity cost? Explain why Yucatan's opportunity cost does or does not increase.

Using Resources Efficiently

13. In problem 11, what is the marginal cost of 1 pound of food in Yucatan when the quantity produced is 150 pounds per day? What is special about the marginal cost of food in Yucatan?
14. The table describes the preferences in Yucatan.

Sunscreen (gallons per month)	Willingness to pay (pounds of food per gallon)
25	3
75	2
125	1

    a. What is the marginal benefit of sunscreen and how is it measured?
    b. Using the table in Problem 11, what does Yucatan produce to achieve allocative efficiency?
15. **Up To 10,000 Retail Stores Could Close This Year**

    Up to 10,000 U.S. storefronts could disappear by the end of 2021. Consumers prefer the safety of shopping online during the Covid-19 pandemic.

    Source: *CBS News*, January 28, 2021

    a. Draw the *PPF* curves for storefront and online retailers before and after the Covid-19 pandemic.
    b. Draw the marginal cost and marginal benefit curves for storefront retailers and online retailers before and after the Internet became an option.
    c. Explain how changes in production possibilities, preferences, or both have changed the way in which goods are retailed.

Use the following news clip to work Problems 16 and 17.

Defeat Malaria in a Generation—Here's How

The world could be free of malaria within a generation, a major report says. Malaria eradication within a generation is ambitious, achievable, and necessary. The report estimates around $4.3bn is spent on malaria every year. But it would need a further $2bn a year to rid the world of malaria by 2050.

Source: *BBC News*, September 9, 2019

16. Does the report describe production efficiency or allocative efficiency or both?
17. Make a graph with the percentage of malaria cases eliminated on the *x*-axis and the marginal cost and marginal benefit of driving down malaria cases on the *y*-axis. On your graph,
    (i) Draw curves to show the marginal cost and marginal benefit of malaria eradication.
    (ii) Identify the percentage of malaria cases eradicated that achieves allocative efficiency.

Gains from Trade

Use the following data to work Problems 18 and 19.

Fadi can produce 10 baklavas (a Turkish pastry) or 250 bars of chocolate an hour. Hania can produce 30 baklavas or 90 bars of chocolate an hour.

18. a. Calculate Fadi's opportunity cost of a baklava and Hania's opportunity cost of a baklava.
    b. If each spends 30 minutes of each hour baking baklavas and 30 minutes producing chocolate bars, how many baklavas and chocolate bars does each produce?
    c. Who has a comparative advantage in producing (i) baklavas and (ii) chocolate bars?
19. a. Draw a graph of Fadi's *PPF* and Hania's *PPF* and show the point at which each produces when they spend 30 minutes of each hour producing baklavas and 30 minutes producing chocolate bars.
    b. On your graph, show what Fadi produces and what Hania produces when they specialize.
    c. When they specialize and trade, what are the total gains from trade?
    d. If Fadi and Hania share the total gains equally, what trade takes place between them?

20. Pierre and Antoinette produce cellos and double basses. The tables show their production possibilities. Pierre produces 30 cellos and 50 basses a month; Antoinette produces 40 cellos and 10 basses a month.

Pierre's Production Possibilities

Cellos (units per month)		Basses (units per month)
50	and	0
40	and	25
30	and	50
20	and	75
10	and	100
0	and	125

Antoinette's Production Possibilities

Cellos (units per month)		Basses (units per month)
80	and	0
40	and	10
0	and	20

a. Who has a comparative advantage in producing (i) cellos and (ii) double basses?

b. If Pierre and Antoinette specialize and trade 1 cello for 1 double bass, what are the gains from the trade?

Economic Growth

21. Capital accumulation and technological change bring economic growth: Production that was unattainable yesterday becomes attainable today; production that is unattainable today will become attainable tomorrow. Why doesn't economic growth bring an end to scarcity one day?

22. **SpaceX Plans to Send Three Tourists to the International Space Station Next Year**

SpaceX CEO Elon Musk announced that SpaceX has plans to send three tourists on a 10-day trip to the International Space Station in 2021.

Source: *The Verge*, March 5, 2020

a. What is the opportunity cost of creating the technology for trips to the International Space Station?

b. Sketch SpaceX's *PPF* for trips to the Internatonal Space Station and other goods and services and show SpaceX's planned production in 2021.

Economic Coordination

23. On a graph of the circular flows in the market economy, indicate the real and money flows in which the following items belong:

a. You buy an iPad from the Apple Store.

b. Apple Inc. pays the designers of the iPad.

c. Apple Inc. decides to expand and rents an adjacent building.

d. You buy a new e-book from Amazon.

e. Apple Inc. hires a student to work as an intern during the summer.

Economics in the News

24. After you have studied *Economics in the News* on pp. 78–79, answer the following questions.

a. How did Covid-19 change U.S. production possibilities in 2020?

b. How did the rapid development and rollout of vaccines change the U.S. production possibilities in 2021?

c. How do productive resources get reallocated between private and government goods and services?

d. How might the Biden spending packages change U.S. production possibilities after 2021?

25. **Disney Hopes Wall Street Bets on New Global Streaming Service**

Walt Disney Co. unveiled details of a family-friendly streaming service on Thursday with TV shows and movies from some of the world's most popular entertainment franchises. Disney says its new streaming service, Disney Plus, will cost $6.99 US per month.

Source: Reuters, April 11, 2019

a. How has live streaming changed the production possibilities of video entertainment and other goods and services?

b. Sketch a *PPF* for video entertainment and other goods and services before live streaming.

c. Show how the arrival of inexpensive live streaming has changed the *PPF*.

d. Sketch a marginal benefit curve and marginal cost curve for video entertainment before and after live streaming.

e. Explain how the efficient quantity of video entertainment has changed.

3 DEMAND AND SUPPLY

After studying this chapter, you will be able to:

- Describe a competitive market and think about a price as an opportunity cost
- Explain the influences on demand
- Explain the influences on supply
- Explain how demand and supply determine prices and quantities bought and sold
- Use the demand and supply model to make predictions about changes in prices and quantities

How did the economy respond to the Covid-19 pandemic? How did the use of scarce resources change? The demand and supply model answers questions like these. This model that you're about to study is the main tool of economics. It explains how prices are determined and how they guide the use of resources to influence *What*, *How*, and *For Whom* goods and services are produced.

Economics in the News at the end of the chapter looks at the market for hand sanitizer—an item massively influenced by Covid-19.

Markets and Prices

When you need a new pair of running shoes, want a bagel and a latte, plan to upgrade your smartphone, or need to fly home for Thanksgiving, you must find a place where people sell those items or offer those services. The place in which you find them is a *market*. You learned in Chapter 2 (p. 76) that a market is any arrangement that enables buyers and sellers to get information and to do business with each other.

A market has two sides: buyers and sellers. There are markets for *goods* such as apples and hiking boots, for *services* such as haircuts and tennis lessons, for *factors of production* such as computer programmers and earthmovers, and for other manufactured *inputs* such as memory chips and auto parts. There are also markets for money such as Japanese yen and for financial securities such as Yahoo! stock. Only our imagination limits what can be traded in markets.

Some markets are physical places where buyers and sellers meet and where an auctioneer or a broker helps to determine the prices. Examples of this type of market are the New York Stock Exchange and the wholesale fish, meat, and produce markets.

Some markets are groups of people spread around the world who never meet and know little about each other but are connected through the Internet or by telephone and fax. Examples are the e-commerce markets and the currency markets.

But most markets are unorganized collections of buyers and sellers. You do most of your trading in this type of market. An example is the market for basketball shoes. The buyers in this $3-billion-a-year market are the 45 million Americans who play basketball (or who want to make a fashion statement). The sellers are the tens of thousands of retail sports equipment and footwear stores. Each buyer can visit several different stores, and each seller knows that the buyer has a choice of stores.

Markets vary in the intensity of competition that buyers and sellers face. In this chapter, we're going to study a **competitive market**—a market that has many buyers and many sellers, so no single buyer or seller can influence the price.

Producers offer items for sale only if the price is high enough to cover their opportunity cost. And consumers respond to changing opportunity cost by seeking cheaper alternatives to expensive items.

We are going to study how people respond to *prices* and the forces that determine prices. But to pursue these tasks, we need to understand the relationship between a price and an opportunity cost.

In everyday life, the *price* of an object is the number of dollars that must be given up in exchange for it. Economists refer to this price as the **money price**.

The *opportunity cost* of an action is the highest-valued alternative forgone. If, when you buy a cup of coffee, the highest-valued thing you forgo is some gum, then the opportunity cost of the coffee is the *quantity* of gum forgone. We can calculate the quantity of gum forgone from the money prices of the coffee and the gum.

If the money price of coffee is $1 a cup and the money price of gum is 50¢ a pack, then the opportunity cost of one cup of coffee is two packs of gum. To calculate this opportunity cost, we divide the price of a cup of coffee by the price of a pack of gum and find the *ratio* of one price to the other. The ratio of one price to another is called a **relative price**, and a *relative price is an opportunity cost.*

We can express the relative price of coffee in terms of gum or any other good. The normal way of expressing a relative price is in terms of a "basket" of all goods and services. To calculate this relative price, we divide the money price of a good by the money price of a "basket" of all goods (called a *price index*). The resulting relative price tells us the opportunity cost of the good in terms of how much of the "basket" we must give up to buy it.

The demand and supply model that we are about to study determines *relative prices,* and the word "price" means *relative* price. When we predict that a price will fall, we do not mean that its *money* price will fall—although it might. We mean that its *relative* price will fall. That is, its price will fall *relative* to the average price of other goods and services.

REVIEW QUIZ

1. What is the distinction between a money price and a relative price?
2. Explain why a relative price is an opportunity cost.
3. Think of examples of goods whose relative price has risen or fallen by a large amount.
4. Describe a competitive market in which you buy or sell a good or service.

Let's begin our study of demand and supply, starting with demand.

Demand

If you demand something, then you

1. Want it.
2. Can afford it.
3. Plan to buy it.

Wants are the unlimited desires or wishes that people have for goods and services. How many times have you thought that you would like something "if only you could afford it" or "if it weren't so expensive"? Scarcity guarantees that many—perhaps most—of our wants will never be satisfied. Demand reflects a decision about which wants to satisfy.

The **quantity demanded** of a good or service is the amount that consumers plan to buy during a given time period at a particular price. The quantity demanded is not necessarily the same as the quantity actually bought. Sometimes the quantity demanded exceeds the amount of goods available, so the quantity bought is less than the quantity demanded.

The quantity demanded is measured as an amount per unit of time. For example, suppose that you buy one cup of coffee a day. The quantity of coffee that you demand can be expressed as 1 cup per day, 7 cups per week, or 365 cups per year.

Many factors influence buying plans, and one of them is the price. We look first at the relationship between the quantity demanded of a good and its price. To study this relationship, we keep all other influences on buying plans the same and we ask: How, other things remaining the same, does the quantity demanded of a good change as its price changes?

The law of demand provides the answer.

The Law of Demand

The **law of demand** states:

> Other things remaining the same, the higher the price of a good, the smaller is the quantity demanded; and the lower the price of a good, the greater is the quantity demanded.

Why does a higher price reduce the quantity demanded? For two reasons:

- Substitution effect
- Income effect

Substitution Effect When the price of a good rises, other things remaining the same, its *relative* price—its opportunity cost—rises. Although each good is unique, it has *substitutes*—other goods that can be used in its place. As the opportunity cost of a good rises, the incentive to economize on its use and switch to a substitute becomes stronger.

Income Effect When a price rises, other things remaining the same, the price rises *relative* to income. Faced with a higher price and an unchanged income, people cannot afford to buy all the things they previously bought. They must decrease the quantities demanded of at least some goods and services. Normally, the good whose price has increased will be one of the goods that people buy less of.

To see the substitution effect and the income effect at work, think about the effects of a change in the price of an energy bar. Several different goods are substitutes for an energy bar. For example, an energy drink could be consumed instead of an energy bar.

Suppose that an energy bar initially sells for $3 and then its price falls to $1.50. People now substitute energy bars for energy drinks—the substitution effect. And with a budget that now has some slack from the lower price of an energy bar, people buy even more energy bars—the income effect. The quantity of energy bars demanded increases for these two reasons.

Now suppose that an energy bar initially sells for $3 and then the price doubles to $6. People now buy fewer energy bars and more energy drinks—the substitution effect. And faced with a tighter budget, people buy even fewer energy bars—the income effect. The quantity of energy bars demanded decreases for these two reasons.

Demand Curve and Demand Schedule

You are now about to study one of the two most used curves in economics: the demand curve. You are also going to encounter one of the most critical distinctions: the distinction between *demand* and *quantity demanded*.

The term **demand** refers to the entire relationship between the price of a good and the quantity demanded of that good. Demand is illustrated by the demand curve and the demand schedule. The term *quantity demanded* refers to a point on a demand curve—the quantity demanded at a particular price.

Figure 3.1 shows the demand curve for energy bars. A **demand curve** shows the relationship between the quantity demanded of a good and its price when all other influences on consumers' planned purchases remain the same.

The table in Fig. 3.1 is the demand schedule for energy bars. A *demand schedule* lists the quantities demanded at each price when all the other influences on consumers' planned purchases remain the same. For example, if the price of a bar is 50¢, the quantity demanded is 22 million a week. If the price is $2.50, the quantity demanded is 5 million a week. The other rows of the table show the quantities demanded at prices of $1.00, $1.50, and $2.00.

We graph the demand schedule as a demand curve with the quantity demanded on the *x*-axis and the price on the *y*-axis. The points on the demand curve labeled *A* through *E* correspond to the rows of the demand schedule. For example, point *A* on the graph shows a quantity demanded of 22 million energy bars a week at a price of 50¢ a bar.

Willingness and Ability to Pay Another way of looking at the demand curve is as a willingness-and-ability-to-pay curve. The willingness and ability to pay is a measure of *marginal benefit*.

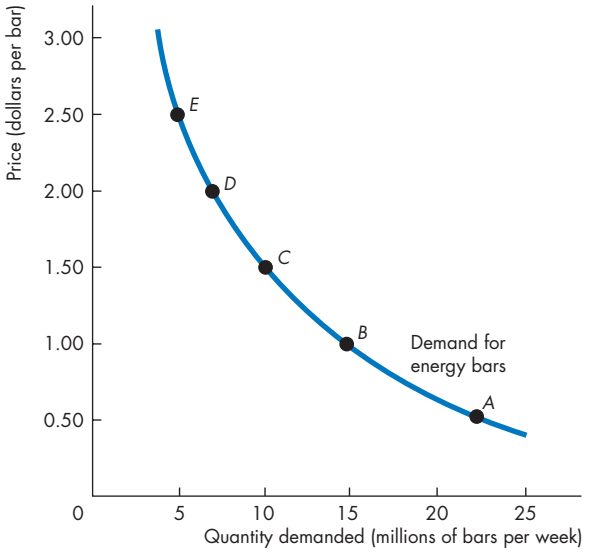
If a small quantity is available, the highest price that someone is willing and able to pay for one more unit is high. But as the quantity available increases, the marginal benefit of each additional unit falls and the highest price that someone is willing and able to pay also falls along the demand curve.

In Fig. 3.1, if only 5 million energy bars are available each week, the highest price that someone is willing to pay for the 5 millionth bar is $2.50. But if 22 million energy bars are available each week, someone is willing to pay 50¢ for the last bar bought.

A Change in Demand

When any factor that influences buying plans changes, other than the price of the good, there is a **change in demand**. Figure 3.2 illustrates an increase in demand. When demand increases, the demand curve shifts rightward and the quantity demanded at each price is greater. For example, at $2.50 a bar, the quantity demanded on the original (blue) demand curve is 5 million energy bars a week. On the new (red) demand curve, at $2.50 a bar, the quantity demanded is 15 million bars a week. Look closely at the numbers in the table and check that the quantity demanded at each price is greater.

FIGURE 3.1 The Demand Curve

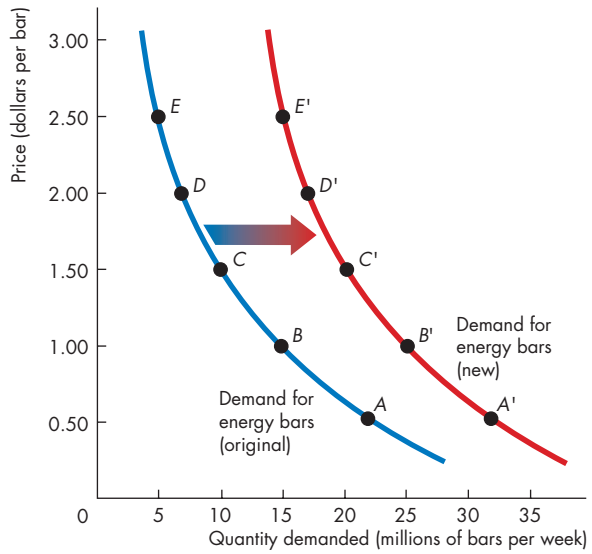


	Price (dollars per bar)	Quantity demanded (millions of bars per week)
A	0.50	22
B	1.00	15
C	1.50	10
D	2.00	7
E	2.50	5

The table shows a demand schedule for energy bars. At a price of 50¢ a bar, 22 million bars a week are demanded; at a price of $1.50 a bar, 10 million bars a week are demanded. The demand curve shows the relationship between quantity demanded and price, other things remaining the same. The demand curve slopes downward: As the price falls, the quantity demanded increases.

The demand curve can be read in two ways. For a given price, the demand curve tells us the quantity that people plan to buy. For example, at a price of $1.50 a bar, people plan to buy 10 million bars a week. For a given quantity, the demand curve tells us the maximum price that consumers are willing and able to pay for the last bar available. For example, the maximum price that consumers will pay for the 15 millionth bar is $1.00.

FIGURE 3.2 An Increase in Demand



Original demand schedule Original income			New demand schedule New higher income		
	Price (dollars per bar)	Quantity demanded (millions of bars per week)		Price (dollars per bar)	Quantity demanded (millions of bars per week)
A	0.50	22	*A'*	0.50	32
B	1.00	15	*B'*	1.00	25
C	1.50	10	*C'*	1.50	20
D	2.00	7	*D'*	2.00	17
E	2.50	5	*E'*	2.50	15

A change in any influence on buying plans other than the price of the good itself results in a new demand schedule and a shift of the demand curve. A change in income changes the demand for energy bars. At a price of $1.50 a bar, 10 million bars a week are demanded at the original income (row *C* of the table) and 20 million bars a week are demanded at the new higher income (row *C'*). A rise in income increases the demand for energy bars. The demand curve shifts *rightward*, as shown by the shift arrow and the resulting red curve.

Six main factors bring changes in demand. They are changes in

- The prices of related goods
- Expected future prices
- Income
- Expected future income and credit
- Population
- Preferences

Prices of Related Goods The quantity of energy bars that consumers plan to buy depends in part on the prices of substitutes for energy bars. A **substitute** is a good that can be used in place of another good. For example, a bus ride is a substitute for a train ride; a hamburger is a substitute for a hot dog; and an energy drink is a substitute for an energy bar. If the price of a substitute for an energy bar rises, people buy less of the substitute and more energy bars. For example, if the price of an energy drink rises, people buy fewer energy drinks and more energy bars. The demand for energy bars increases.

The quantity of energy bars that people plan to buy also depends on the prices of complements with energy bars. A **complement** is a good that is used in conjunction with another good. Hamburgers and fries are complements, and so are energy bars and exercise. If the price of an hour at the gym falls, people buy more gym time *and more* energy bars.

Expected Future Prices If the expected future price of a good rises and if the good can be stored, the opportunity cost of obtaining the good for future use is lower today than it will be in the future when people expect the price to be higher. So people retime their purchases—they substitute over time. They buy more of the good now before its price is expected to rise (and less afterward), so the demand for the good today increases.

For example, suppose that a Florida frost damages the season's orange crop. You expect the price of orange juice to rise, so you fill your freezer with enough frozen juice to get you through the next six months. Your current demand for frozen orange juice has increased, and your future demand has decreased.

Similarly, if the expected future price of a good falls, the opportunity cost of buying the good today is high relative to what it is expected to be in the future. So again, people retime their purchases. They buy less of the good now before its price is expected

to fall, so the demand for the good decreases today and increases in the future.

Computer prices are constantly falling, and this fact poses a dilemma. Will you buy a new computer now, in time for the start of the school year, or will you wait until the price has fallen some more? Because people expect computer prices to keep falling, the current demand for computers is less (and the future demand is greater) than it otherwise would be.

Income Consumers' income influences demand. When income increases, consumers buy more of most goods; and when income decreases, consumers buy less of most goods. Although an increase in income leads to an increase in the demand for *most* goods, it does not lead to an increase in the demand for *all* goods. A **normal good** is one for which demand increases as income increases. An **inferior good** is one for which demand decreases as income increases. As incomes increase, the demand for air travel (a normal good) increases and the demand for long-distance bus trips (an inferior good) decreases.

Expected Future Income and Credit When expected future income increases or credit becomes easier to get, demand for a good might increase now. For example, a salesperson gets the news that she will receive a big bonus at the end of the year, so she goes into debt and buys a new car right now, rather than waiting until she receives the bonus.

Population Demand also depends on the size and the age structure of the population. The larger the population, the greater is the demand for all goods and services; the smaller the population, the smaller is the demand for all goods and services.

For example, the demand for parking spaces, running shoes, movies, or just about anything that you can imagine is much greater in New York City (population 8.3 million) than it is in Boise, Idaho (population 212,000).

Also, the larger the proportion of the population in a given age group, the greater is the demand for the goods and services used by that age group.

For example, during the 1990s, a decrease in the college-age population decreased the demand for college places. During those same years, the number of Americans aged 85 years and over increased by more than 1 million. As a result, the demand for nursing home services increased.

TABLE 3.1 The Demand for Energy Bars

The Law of Demand

The quantity of energy bars demanded

Decreases if:	*Increases if:*
■ The price of an energy bar rises	■ The price of an energy bar falls

Changes in Demand

The demand for energy bars

Decreases if:	*Increases if:*
■ The price of a substitute falls	■ The price of a substitute rises
■ The price of a complement rises	■ The price of a complement falls
■ The expected future price of an energy bar falls	■ The expected future price of an energy bar rises
■ Income falls*	■ Income rises*
■ Expected future income falls or credit becomes harder to get*	■ Expected future income rises or credit becomes easier to get*
■ The population decreases	■ The population increases

*An energy bar is a normal good.

Preferences Demand depends on preferences. *Preferences* determine the value that people place on each good and service. Preferences depend on such things as the weather, information, and fashion. For example, greater health and fitness awareness has shifted preferences in favor of energy bars, so the demand for energy bars has increased.

Table 3.1 summarizes the influences on demand and the direction of those influences.

A Change in the Quantity Demanded Versus a Change in Demand

Changes in the influences on buying plans bring either a change in the quantity demanded or a change in demand. Equivalently, they bring either a movement along the demand curve or a shift of the demand curve. The distinction between a change in

the quantity demanded and a change in demand is the same as that between a movement along the demand curve and a shift of the demand curve.

A point on the demand curve shows the quantity demanded at a given price, so a movement along the demand curve shows a **change in the quantity demanded**. The entire demand curve shows demand, so a shift of the demand curve shows a *change in demand*. Figure 3.3 illustrates these distinctions.

Movement Along the Demand Curve If the price of the good changes but no other influence on buying plans changes, we illustrate the effect as a movement along the demand curve.

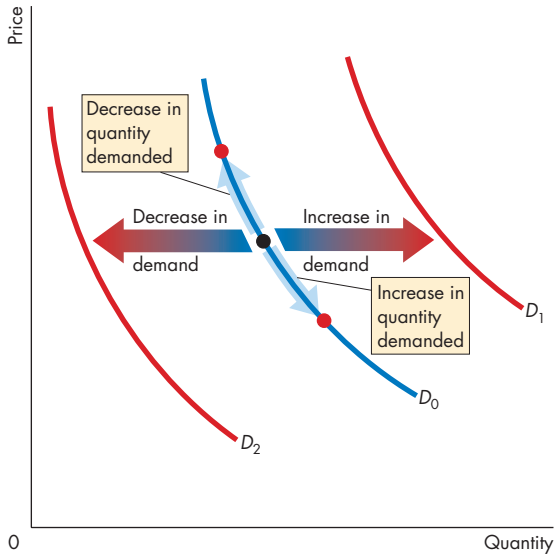
A fall in the price of a good increases the quantity demanded of it. In Fig. 3.3, we illustrate the effect of a fall in price as a movement down along the demand curve D_0.

A rise in the price of a good decreases the quantity demanded of it. In Fig. 3.3, we illustrate the effect of a rise in price as a movement up along the demand curve D_0.

A Shift of the Demand Curve If the price of a good remains constant but some other influence on buying plans changes, there is a change in demand for that good. We illustrate a change in demand as a shift of the demand curve. For example, if more people work out at the gym, consumers buy more energy bars regardless of the price of a bar. That is what a rightward shift of the demand curve shows—more energy bars are demanded at each price.

In Fig. 3.3, there is a *change in demand* and the demand curve shifts when any influence on buying plans changes, other than the price of the good. Demand *increases* and the demand curve *shifts rightward* (to the red demand curve D_1) if the price of a substitute rises, the price of a complement falls, the expected future price of the good rises, income increases (for a normal good), expected future income or credit increases, or the population increases. Demand *decreases* and the demand curve *shifts leftward* (to the red demand curve D_2) if the price of a substitute falls, the price of a complement rises, the expected future price of the good falls, income decreases (for a normal good), expected future income or credit decreases, or the population decreases. (For an inferior good, the effects of changes in income are in the opposite direction to those described above.)

FIGURE 3.3 A Change in the Quantity Demanded Versus a Change in Demand



When the price of the good changes, there is a movement along the demand curve and *a change in the quantity demanded*, shown by the blue arrows on demand curve D_0. When any other influence on buying plans changes, there is a shift of the demand curve and a *change in demand*. An increase in demand shifts the demand curve rightward (from D_0 to D_1). A decrease in demand shifts the demand curve leftward (from D_0 to D_2).

REVIEW QUIZ

1. Define the quantity demanded of a good or service.
2. What is the law of demand and how do we illustrate it?
3. What does the demand curve tell us about the price that consumers are willing to pay?
4. List all the influences on buying plans that change demand, and for each influence, say whether it increases or decreases demand.
5. Why does demand not change when the price of a good changes with no change in the other influences on buying plans?
6. During the Covid-19 lockdown, yeast's popularity increased as millennials and home chefs were willing and able to spend more time cooking. Did yeast's increased popularity increase demand or the quantity of yeast demanded?

Supply

If a firm supplies a good or service, the firm

1. Has the resources and technology to produce it.
2. Can profit from producing it.
3. Plans to produce it and sell it.

A supply is more than just having the *resources* and the *technology* to produce something. *Resources and technology* are the constraints that limit what is possible.

Many useful things can be produced, but they are not produced unless it is profitable to do so. Supply reflects a decision about which technologically feasible items to produce.

The **quantity supplied** of a good or service is the amount that producers plan to sell during a given time period at a particular price. The quantity supplied is not necessarily the same amount as the quantity actually sold. Sometimes the quantity supplied is greater than the quantity demanded, so the quantity sold is less than the quantity supplied.

Like the quantity demanded, the quantity supplied is measured as an amount per unit of time. For example, suppose that GM produces 1,000 cars a day. The quantity of cars supplied by GM can be expressed as 1,000 a day, 7,000 a week, or 365,000 a year. Without the time dimension, we cannot tell whether a particular quantity is large or small.

Many factors influence selling plans, and again one of them is the price of the good. We look first at the relationship between the quantity supplied of a good and its price. Just as we did when we studied demand, to isolate the relationship between the quantity supplied of a good and its price, we keep all other influences on selling plans the same and ask: How does the quantity supplied of a good change as its price changes when other things remain the same?

The law of supply provides the answer.

The Law of Supply

The **law of supply** states:

> Other things remaining the same, the higher the price of a good, the greater is the quantity supplied; and the lower the price of a good, the smaller is the quantity supplied.

Why does a higher price increase the quantity supplied? It is because *marginal cost increases*. As the quantity produced of any good increases, the marginal cost of producing the good increases. (See Chapter 2, p. 65 to review marginal cost.)

It is never worth producing a good if the price received for the good does not at least cover the marginal cost of producing it. When the price of a good rises, other things remaining the same, producers are willing to incur a higher marginal cost, so they increase production. The higher price brings forth an increase in the quantity supplied.

Let's now illustrate the law of supply with a supply curve and a supply schedule.

Supply Curve and Supply Schedule

You are now going to study the second of the two most used curves in economics: the supply curve. You're also going to learn about the critical distinction between *supply* and *quantity supplied*.

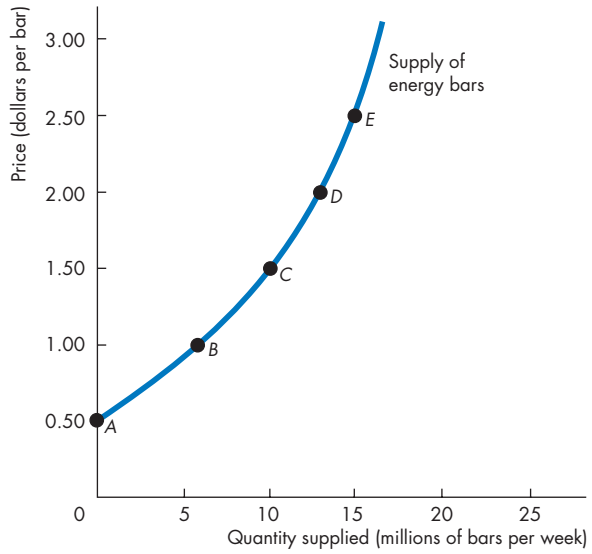
The term **supply** refers to the entire relationship between the price of a good and the quantity supplied of it. Supply is illustrated by the supply curve and the supply schedule. The term *quantity supplied* refers to a point on a supply curve—the quantity supplied at a particular price.

Figure 3.4 shows the supply curve of energy bars. A **supply curve** shows the relationship between the quantity supplied of a good and its price when all other influences on producers' planned sales remain the same. The supply curve is a graph of a supply schedule.

The table in Fig. 3.4 sets out the supply schedule for energy bars. A *supply schedule* lists the quantities supplied at each price when all the other influences on producers' planned sales remain the same. For example, if the price of an energy bar is 50¢, the quantity supplied is zero—in row *A* of the table. If the price of an energy bar is $1.00, the quantity supplied is 6 million energy bars a week—in row *B*. The other rows of the table show the quantities supplied at prices of $1.50, $2.00, and $2.50.

To make a supply curve, we graph the quantity supplied on the *x*-axis and the price on the *y*-axis. The points on the supply curve labeled *A* through *E* correspond to the rows of the supply schedule. For example, point *A* on the graph shows a quantity supplied of zero at a price of 50¢ an energy bar. Point *E* shows a quantity supplied of 15 million bars at $2.50 an energy bar.

FIGURE 3.4 The Supply Curve



	Price (dollars per bar)	Quantity supplied (millions of bars per week)
A	0.50	0
B	1.00	6
C	1.50	10
D	2.00	13
E	2.50	15

The table shows the supply schedule of energy bars. For example, at a price of $1.00, 6 million bars a week are supplied; at a price of $2.50, 15 million bars a week are supplied. The supply curve shows the relationship between the quantity supplied and the price, other things remaining the same. The supply curve slopes upward: As the price of a good increases, the quantity supplied increases.

A supply curve can be read in two ways. For a given price, the supply curve tells us the quantity that producers plan to sell at that price. For example, at a price of $1.50 a bar, producers are planning to sell 10 million bars a week. For a given quantity, the supply curve tells us the minimum price at which producers are willing to sell one more bar. For example, if 15 million bars are produced each week, the lowest price at which a producer is willing to sell the 15 millionth bar is $2.50.

Minimum Supply Price The supply curve can be interpreted as a minimum-supply-price curve—a curve that shows the lowest price at which someone is willing to sell. This lowest price is the *marginal cost*.

If a small quantity is produced, the lowest price at which someone is willing to sell one more unit is low. But as the quantity produced increases, the marginal cost of each additional unit rises, so the lowest price at which someone is willing to sell an additional unit rises along the supply curve.

In Fig. 3.4, if 15 million bars are produced each week, the lowest price at which someone is willing to sell the 15 millionth bar is $2.50. But if 10 million bars are produced each week, someone is willing to accept $1.50 for the last bar produced.

A Change in Supply

When any factor that influences selling plans other than the price of the good changes, there is a **change in supply**. Six main factors bring changes in supply. They are changes in

- The prices of factors of production
- The prices of related goods produced
- Expected future prices
- The number of suppliers
- Technology
- The state of nature

Prices of Factors of Production The prices of the factors of production used to produce a good influence its supply. To see this influence, think about the supply curve as a minimum-supply-price curve. If the price of a factor of production rises, the lowest price that a producer is willing to accept for that good rises, so supply decreases. For example, during 2008, as the price of jet fuel increased, the supply of air travel decreased. Similarly, a rise in the minimum wage decreases the supply of hamburgers.

Prices of Related Goods Produced The prices of related goods that firms produce influence supply. For example, if the price of an energy drink rises, firms switch production from sugary drinks to energy drinks. The supply of sugary drinks decreases. Sugary drinks and energy drinks are *substitutes in production*—goods that can be produced by using the same resources. If the price of beef rises, the supply of cowhide increases. Beef and cowhide are *complements in production*—goods that must be produced together.

Expected Future Prices If the expected future price of a good rises, the return from selling the good in the future increases and is higher than it is today. So supply decreases today and increases in the future.

The Number of Suppliers The larger the number of firms that produce a good, the greater is the supply of the good. As new firms enter an industry, the supply in that industry increases. As firms leave an industry, the supply in that industry decreases.

Technology The term "technology" is used broadly to mean the way that factors of production are used to produce a good. A technology change occurs when a new method is discovered that lowers the cost of producing a good. For example, new methods used in the factories that produce computer chips have lowered the cost and increased the supply of chips.

The State of Nature The state of nature includes all the natural forces that influence production. It includes the state of the weather and, more broadly, the natural environment. Good weather can increase the supply of many agricultural products and bad weather can decrease their supply. Extreme natural events such as earthquakes, tornadoes, and hurricanes can also influence supply.

Figure 3.5 illustrates an increase in supply. When supply increases, the supply curve shifts rightward and the quantity supplied at each price is larger. For example, at $1.00 per bar, on the original (blue) supply curve, the quantity supplied is 6 million bars a week. On the new (red) supply curve, the quantity supplied is 15 million bars a week. Look closely at the numbers in the table in Fig. 3.5 and check that the quantity supplied is larger at each price.

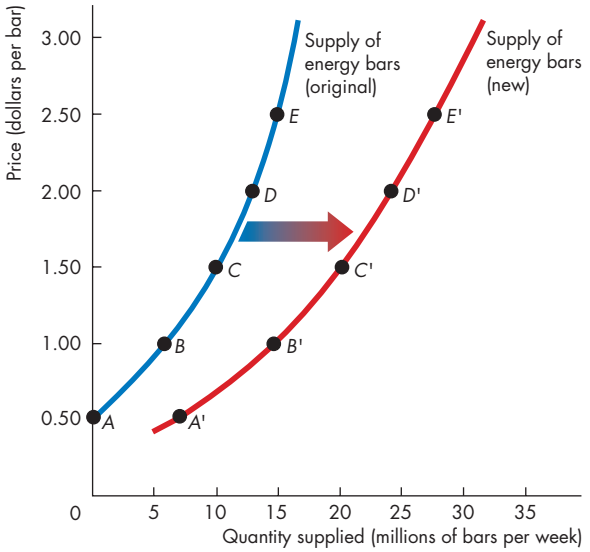
Table 3.2 summarizes the influences on supply and the directions of those influences.

A Change in the Quantity Supplied Versus a Change in Supply

Changes in the influences on selling plans bring either a change in the quantity supplied or a change in supply. Equivalently, they bring either a movement along the supply curve or a shift of the supply curve.

A point on the supply curve shows the quantity supplied at a given price. A movement along the supply curve shows a **change in the quantity supplied**. The entire supply curve shows supply. A shift of the supply curve shows a *change in supply*.

FIGURE 3.5 An Increase in Supply



Original supply schedule Old technology			New supply schedule New technology		
	Price (dollars per bar)	Quantity supplied (millions of bars per week)		Price (dollars per bar)	Quantity supplied (millions of bars per week)
A	0.50	0	*A'*	0.50	7
B	1.00	6	*B'*	1.00	15
C	1.50	10	*C'*	1.50	20
D	2.00	13	*D'*	2.00	25
E	2.50	15	*E'*	2.50	27

A change in any influence on selling plans other than the price of the good itself results in a new supply schedule and a shift of the supply curve. For example, a new, cost-saving technology for producing energy bars changes the supply of energy bars. At a price of $1.50 a bar, 10 million bars a week are supplied when producers use the old technology (row *C* of the table) and 20 million energy bars a week are supplied when producers use the new technology (row *C'*). An advance in technology *increases* the supply of energy bars. The supply curve shifts *rightward*, as shown by the shift arrow and the resulting red curve.

Figure 3.6 illustrates and summarizes these distinctions. If the price of the good changes and other things remain the same, there is a *change in the quantity supplied* of that good. If the price of the good falls, the quantity supplied decreases and there is a movement down along the supply curve S_0. If the price of the good rises, the quantity supplied increases and there is a movement up along the supply curve S_0. When any other influence on selling plans changes, the supply curve shifts and there is a *change in supply*. If supply increases, the supply curve shifts rightward to S_1. If supply decreases, the supply curve shifts leftward to S_2.

TABLE 3.2 The Supply of Energy Bars

The Law of Supply

The quantity of energy bars supplied

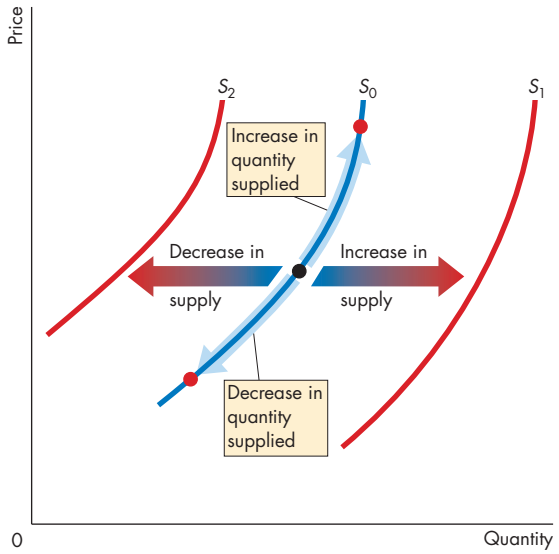
Decreases if:	*Increases if:*
■ The price of an energy bar falls	■ The price of an energy bar rises

Changes in Supply

The supply of energy bars

Decreases if:	*Increases if:*
■ The price of a factor of production used to produce energy bars rises	■ The price of a factor of production used to produce energy bars falls
■ The price of a substitute in production rises	■ The price of a substitute in production falls
■ The price of a complement in production falls	■ The price of a complement in production rises
■ The expected future price of an energy bar rises	■ The expected future price of an energy bar falls
■ The number of suppliers of bars decreases	■ The number of suppliers of bars increases
■ A technology change decreases energy bar production	■ A technology change increases energy bar production
■ A natural event decreases energy bar production	■ A natural event increases energy bar production

FIGURE 3.6 A Change in the Quantity Supplied Versus a Change in Supply



When the price of the good changes, there is a movement along the supply curve and a *change in the quantity supplied,* shown by the blue arrows on supply curve S_0. When any other influence on selling plans changes, there is a shift of the supply curve and a *change in supply*. An increase in supply shifts the supply curve rightward (from S_0 to S_1), and a decrease in supply shifts the supply curve leftward (from S_0 to S_2).

REVIEW QUIZ

1. Define the quantity supplied of a good or service.
2. What is the law of supply and how do we illustrate it?
3. What does the supply curve tell us about the producer's minimum supply price?
4. List all the influences on selling plans, and for each influence, say whether it changes supply.
5. What happens to the quantity of smartphones supplied and the supply of smartphones if the price of a smartphone falls?
6. The price of the cheese that goes on top of a burger rose 18 percent during 2020. Did this higher price change the quantity of burgers supplied or the supply of burgers?

Now we're going to combine demand and supply and see how prices and quantities are determined.

Market Equilibrium

We have seen that when the price of a good rises, the quantity demanded *decreases* and the quantity supplied *increases*. We are now going to see how the price adjusts to coordinate buying plans and selling plans and achieve an equilibrium in the market.

An *equilibrium* is a situation in which opposing forces balance each other. Equilibrium in a market occurs when the price balances buying plans and selling plans. The **equilibrium price** is the price at which the quantity demanded equals the quantity supplied. The **equilibrium quantity** is the quantity bought and sold at the equilibrium price. A market moves toward its equilibrium because

- Price regulates buying and selling plans.
- Price adjusts when plans don't match.

Price as a Regulator

The price of a good regulates the quantities demanded and supplied. If the price is too high, the quantity supplied exceeds the quantity demanded. If the price is too low, the quantity demanded exceeds the quantity supplied. There is one price at which the quantity demanded equals the quantity supplied. Let's work out what that price is.

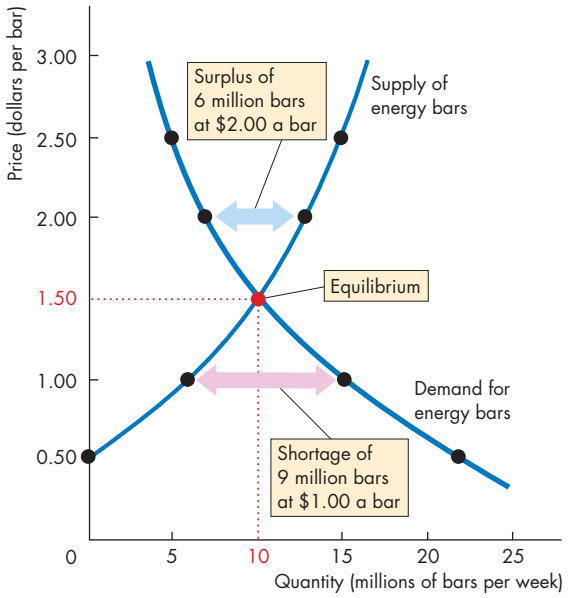
Figure 3.7 shows the market for energy bars. The table shows the demand schedule (from Fig. 3.1) and the supply schedule (from Fig. 3.4). If the price is 50¢ a bar, the quantity demanded is 22 million bars a week but no bars are supplied. There is a shortage of 22 million bars a week. The final column of the table shows this shortage. At a price of $1.00 a bar, there is still a shortage but only of 9 million bars a week.

If the price is $2.50 a bar, the quantity supplied is 15 million bars a week but the quantity demanded is only 5 million. There is a surplus of 10 million bars a week.

The one price at which there is neither a shortage nor a surplus is $1.50 a bar. At that price, the quantity demanded equals the quantity supplied: 10 million bars a week. The equilibrium price is $1.50 a bar, and the equilibrium quantity is 10 million bars a week.

Figure 3.7 shows that the demand curve and the supply curve intersect at the equilibrium price of $1.50 a bar. At each price *above* $1.50 a bar, there is a surplus of bars. For example, at $2.00 a bar, the surplus is 6

FIGURE 3.7 Equilibrium



Price (dollars per bar)	Quantity demanded	Quantity supplied	Shortage (–) or surplus (+)
	(millions of bars per week)		
0.50	22	0	–22
1.00	15	6	–9
1.50	**10**	**10**	**0**
2.00	7	13	+6
2.50	5	15	+10

The table lists the quantity demanded and the quantity supplied as well as the shortage or surplus of bars at each price. If the price is $1.00 a bar, 15 million bars a week are demanded and 6 million bars are supplied. There is a shortage of 9 million bars a week, and the price rises.

If the price is $2.00 a bar, 7 million bars a week are demanded and 13 million bars are supplied. There is a surplus of 6 million bars a week, and the price falls.

If the price is $1.50 a bar, 10 million bars a week are demanded and 10 million bars are supplied. There is neither a shortage nor a surplus, and the price does not change. The price at which the quantity demanded equals the quantity supplied is the equilibrium price, and 10 million bars a week is the equilibrium quantity.

million bars a week, as shown by the blue arrow. At each price *below* $1.50 a bar, there is a shortage of bars. For example, at $1.00 a bar, the shortage is 9 million bars a week, as shown by the red arrow.

Price Adjustments

You've seen that if the price is below equilibrium, there is a shortage; and if the price is above equilibrium, there is a surplus. But can we count on the price to change and eliminate a shortage or a surplus? We can, because such price changes are beneficial to both buyers and sellers. Let's see why the price changes when there is a shortage or a surplus.

A Shortage Forces the Price Up Suppose the price of an energy bar is $1. Consumers plan to buy 15 million bars a week, and producers plan to sell 6 million bars a week. Consumers can't force producers to sell more than they plan, so the quantity that is actually offered for sale is 6 million bars a week. In this situation, powerful forces operate to increase the price and move it toward the equilibrium price. Some producers, noticing lines of unsatisfied consumers, raise the price. Some producers increase their output. As producers push the price up, the price rises toward its equilibrium. The rising price reduces the shortage because it decreases the quantity demanded and increases the quantity supplied. When the price has increased to the point at which there is no longer a shortage, the forces moving the price stop operating and the price comes to rest at its equilibrium.

A Surplus Forces the Price Down Suppose the price of a bar is $2. Producers plan to sell 13 million bars a week, and consumers plan to buy 7 million bars a week. Producers cannot force consumers to buy more than they plan, so the quantity that is actually bought is 7 million bars a week. In this situation, powerful forces operate to lower the price and move it toward the equilibrium price. Some producers, unable to sell the quantities of energy bars they planned to sell, cut their prices. In addition, some producers scale back production. As producers cut the price, the price falls toward its equilibrium. The falling price decreases the surplus because it increases the quantity demanded and decreases the quantity supplied. When the price has fallen to the point at which there is no longer a surplus, the forces moving the price stop operating and the price comes to rest at its equilibrium.

The Best Deal Available for Buyers and Sellers When the price is below equilibrium, it is forced upward. Why don't buyers resist the increase and refuse to buy at the higher price? The answer is because they value the good more highly than its current price and they can't satisfy their demand at the current price. In some markets—for example, the markets that operate on eBay—the buyers might even be the ones who force the price up by offering to pay a higher price.

When the price is above equilibrium, it is bid downward. Why don't sellers resist this decrease and refuse to sell at the lower price? The answer is because their minimum supply price is below the current price and they cannot sell all they would like to at the current price. Sellers willingly lower the price to gain market share.

At the price at which the quantity demanded and the quantity supplied are equal, neither buyers nor sellers can do business at a better price. Buyers pay the highest price they are willing to pay for the last unit bought, and sellers receive the lowest price at which they are willing to supply the last unit sold.

When people freely make offers to buy and sell and when demanders try to buy at the lowest possible price and suppliers try to sell at the highest possible price, the price at which trade takes place is the equilibrium price—the price at which the quantity demanded equals the quantity supplied. The price coordinates the plans of buyers and sellers, and no one has an incentive to change it.

REVIEW QUIZ

1. What is the equilibrium price of a good or service?
2. Over what range of prices does a shortage arise? What happens to the price when there is a shortage?
3. Over what range of prices does a surplus arise? What happens to the price when there is a surplus?
4. Why is the price at which the quantity demanded equals the quantity supplied the equilibrium price?
5. Why is the equilibrium price the best deal available for both buyers and sellers?

Predicting Changes in Price and Quantity

The demand and supply model that we have just studied provides us with a powerful way of analyzing influences on prices and the quantities bought and sold. According to the model, a change in price stems from a change in demand, a change in supply, or a change in both demand and supply. Let's look first at the effects of a change in demand.

An Increase in Demand

If more people join health clubs, the demand for energy bars increases. The table in Fig. 3.8 shows the original and new demand schedules for energy bars as well as the supply schedule of energy bars.

The increase in demand creates a shortage at the original price, and to eliminate the shortage the price must rise.

Figure 3.8 shows what happens. The figure shows the original demand for and supply of energy bars. The original equilibrium price is $1.50 an energy bar, and the equilibrium quantity is 10 million energy bars a week. When demand increases, the demand curve shifts rightward. The equilibrium price rises to $2.50 an energy bar, and the quantity supplied increases to 15 million energy bars a week, as highlighted in the figure. There is an *increase in the quantity supplied* but *no change in supply*—a movement along, but no shift of, the supply curve.

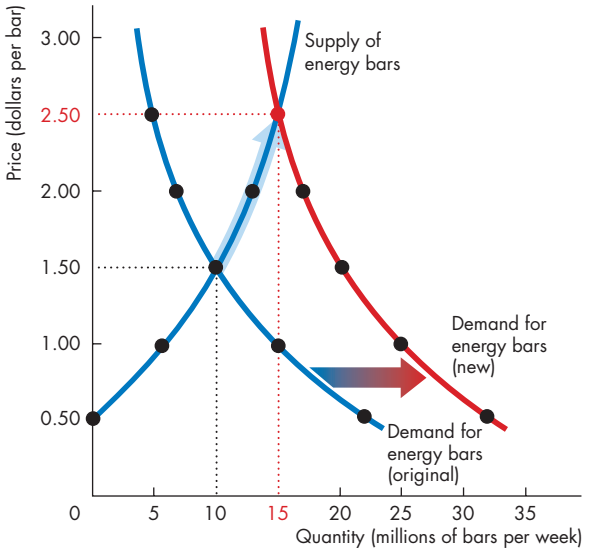
A Decrease in Demand

We can reverse this change in demand. Start at a price of $2.50 a bar with 15 million energy bars a week being bought and sold, and then work out what happens if demand decreases to its original level. Such a decrease in demand might arise if people switch to energy drinks (a substitute for energy bars). The decrease in demand shifts the demand curve leftward. The equilibrium price falls to $1.50 a bar, the quantity supplied decreases, and the equilibrium quantity decreases to 10 million bars a week.

We can now make our first two predictions:

1. When demand increases, the price rises and the quantity increases.
2. When demand decreases, the price falls and the quantity decreases.

FIGURE 3.8 The Effects of a Change in Demand



Price (dollars per bar)	Quantity demanded (millions of bars per week)		Quantity supplied (millions of bars per week)
	Original	New	
0.50	22	32	0
1.00	15	25	6
1.50	**10**	20	**10**
2.00	7	17	13
2.50	5	**15**	**15**

Initially, the demand for energy bars is the blue demand curve. The equilibrium price is $1.50 a bar, and the equilibrium quantity is 10 million bars a week. When more health-conscious people do more exercise, the demand for energy bars increases and the demand curve shifts rightward to become the red curve.

At $1.50 a bar, there is now a shortage of 10 million bars a week. The price of a bar rises to a new equilibrium of $2.50. As the price rises to $2.50, the quantity supplied increases—shown by the blue arrow on the supply curve—to the new equilibrium quantity of 15 million bars a week. Following an increase in demand, the quantity supplied increases but supply does not change—the supply curve does not shift.

ECONOMICS IN THE NEWS

The Markets for Chocolate and Cocoa

We're Heading for a Chocolate Crisis

The world is running out of chocolate, and if we don't take some significant action soon, we'll be dealing with a major chocolate shortage in less than a decade. Chocolate is made from cocoa and a cocoa shortage is becoming more and more imminent, with prices rising.

Source: *ZME Science*, February 1, 2021

THE DATA

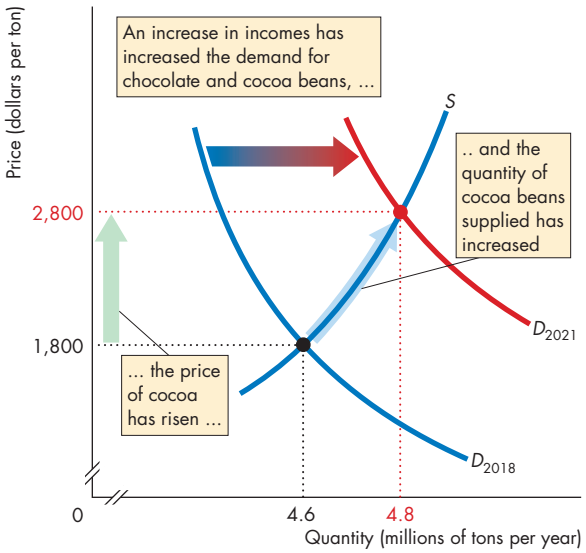
Year	Quantity of cocoa (millions of tons per year)	Price of cocoa (dollars per ton)
2018	4.6	1,800
2021	4.8	2,800

THE QUESTIONS

- What does the data tell us?
- Why did the price of cocoa increase? Was it because the demand for cocoa changed, or the supply changed? In which direction was the change?

THE ANSWERS

- The data table tells us that from 2018 to 2021, both the quantity of cocoa produced and the price of cocoa increased.
- An increase in demand brings an increase in the quantity and a rise in the price.
- An increase in supply brings an increase in the quantity and a fall in the price.
- Because both the quantity of cocoa and the price of cocoa increased, there must have been in increase in the demand for cocoa.
- The cocoa is used to produce chocolate, which is a normal good, so the demand for chocolate and cocoa increases when incomes increase.
- Incomes are increasing, especially in fast-growing China and other Asian countries, so the demand for chocolate has increased, which has increased the demand for cocoa.
- The figure illustrates the market for cocoa in 2018 and 2021. The supply curve *S* shows the supply of cocoa.
- In 2018, the demand curve was D_{2018}, the price was $1,800 per ton, and the quantity of cocoa traded was 4.6 million tons.
- By 2021, the higher incomes in China and other countries had increased the demand for cocoa to D_{2021}.
- The price rose to $2,800 per ton and the quantity traded increased to 4.8 million tons.
- The higher price brought an increase in the quantity of cocoa supplied, which is shown by the movement upward along the supply curve.



The Market for Cocoa Beans

An Increase in Supply

When Nestlé (the producer of PowerBar) and other energy bar producers switch to a new cost-saving technology, the supply of energy bars increases. Figure 3.9 shows the new supply schedule (the same one that was shown in Fig. 3.5). What are the new equilibrium price and quantity? The price falls to $1.00 a bar, and the quantity increases to 15 million bars a week. You can see why by looking at the quantities demanded and supplied at the old price of $1.50 a bar. The new quantity supplied at that price is 20 million bars a week, and there is a surplus. The price falls. Only when the price is $1.00 a bar does the quantity supplied equal the quantity demanded.

Figure 3.9 illustrates the effect of an increase in supply. It shows the demand curve for energy bars and the original and new supply curves. The initial equilibrium price is $1.50 a bar, and the equilibrium quantity is 10 million bars a week. When supply increases, the supply curve shifts rightward. The equilibrium price falls to $1.00 a bar, and the quantity demanded increases to 15 million bars a week, highlighted in the figure. There is an *increase in the quantity demanded* but *no change in demand*—a movement along, but no shift of, the demand curve.

A Decrease in Supply

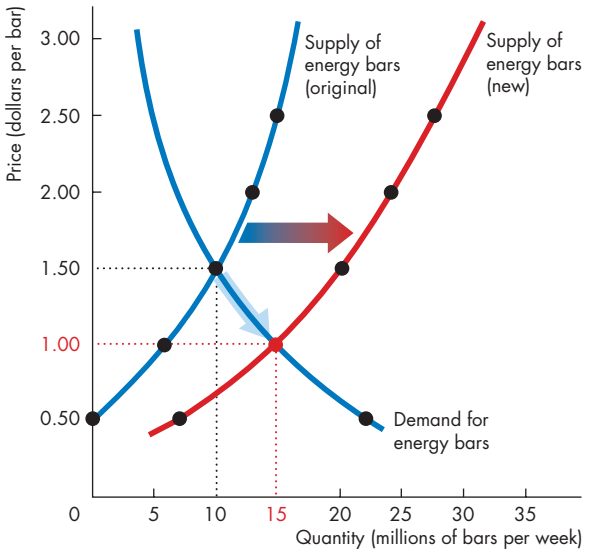
Start out at a price of $1.00 a bar with 15 million bars a week being bought and sold. Then suppose that the cost of labor or raw materials rises and the supply of energy bars decreases. The decrease in supply shifts the supply curve leftward. The equilibrium price rises to $1.50 a bar, the quantity demanded decreases, and the equilibrium quantity decreases to 10 million bars a week.

We can now make two more predictions:

1. When supply increases, the price falls and the quantity increases.
2. When supply decreases, the price rises and the quantity decreases.

You've now seen what happens to the price and the quantity when either demand or supply changes while the other one remains unchanged. In real markets, both demand and supply can change together. When this happens, to predict the changes in price and quantity, we must combine the effects that you've just seen. That is your final task in this chapter.

FIGURE 3.9 The Effects of a Change in Supply



Price (dollars per bar)	Quantity demanded (millions of bars per week)	Quantity supplied (millions of bars per week)	
		Original	New
0.50	22	0	7
1.00	**15**	6	**15**
1.50	**10**	**10**	20
2.00	7	13	25
2.50	5	15	27

Initially, the supply of energy bars is shown by the blue supply curve. The equilibrium price is $1.50 a bar, and the equilibrium quantity is 10 million bars a week. When the new cost-saving technology is adopted, the supply of energy bars increases and the supply curve shifts rightward to become the red curve.

At $1.50 a bar, there is now a surplus of 10 million bars a week. The price of an energy bar falls to a new equilibrium of $1.00 a bar. As the price falls to $1.00, the quantity demanded increases—shown by the blue arrow on the demand curve—to the new equilibrium quantity of 15 million bars a week. Following an increase in supply, the quantity demanded increases but demand does not change—the demand curve does not shift.

ECONOMICS IN THE NEWS

The Market for Vanilla Bean

Crop Uncertainty Drives Vanilla Price Back to Record Level

The price of vanilla soared to a record $270 a pound last year after a cyclone hit the Madagascar.

Source: *Financial Times*, March 25, 2018

THE DATA

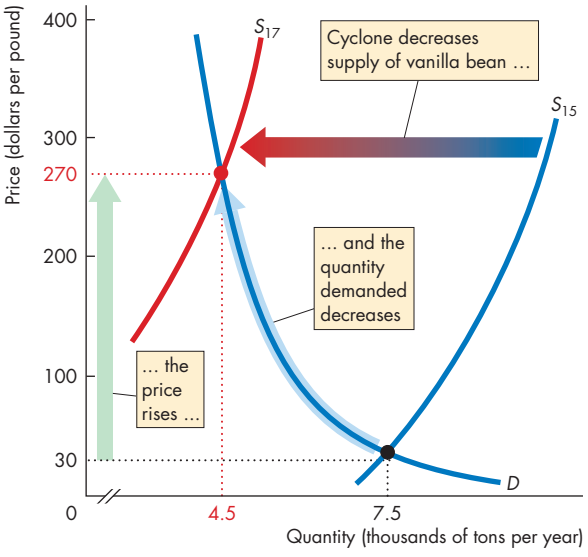
Year	Quantity of vanilla bean (thousands of tons per year)	Price of vanilla bean (dollars per pound)
2015	7.5	30
2017	4.5	270

THE QUESTIONS

- What does the data table tell us?
- Why did the price of vanilla bean rise? Was it because the demand for vanilla bean changed or the supply changed. In which direction did it change?

THE ANSWERS

- The data table tells us that from 2015 to 2017, the quantity of vanilla bean produced decreased and the price of vanilla bean increased sharply.
- An increase in demand brings an increase in the quantity and a rise in the price.
- A decrease in supply brings a decrease in the quantity and a rise in the price.
- Because the quantity of vanilla bean decreased and the price of vanilla bean increased, there must have been a decrease in the supply of vanilla bean.
- The news clip says a cyclone hit Madagascar, which decreased production and brought a decrease in the supply of vanilla bean.
- The figure illustrates the market for vanilla bean in 2015 and 2017. The demand curve *D* shows the demand for vanilla bean.
- In 2015, the supply curve was S_{15}, the price was $30 a pound, and the quantity of vanilla bean traded was 7.5 thousand tons.
- In 2017, the decreased production in Madagascar decreased the supply of vanilla bean to S_{17}.
- The price rose to $270 a pound and the quantity traded decreased to 4.5 thousand tons
- The higher price brought a decrease in the quantity of vanilla bean demanded, which is shown by the movement along the demand curve.



The Market for Vanilla Bean in 2015–2017

Changes in Both Demand and Supply

You now know how a change in demand or a change in supply changes the equilibrium price and quantity. But sometimes, events occur that change both demand and supply. When both demand and supply change, we find the resulting change in the equilibrium price and equilibrium quantity by combining the separate cases you've just studied.

Four cases need to be considered. Both demand and supply increase or decrease, or either demand or supply increases and the other decreases.

Demand and Supply Change in the Same Direction

When demand and supply change in the same direction, the equilibrium quantity changes in that same direction, but to predict whether the price rises or falls, we need to know the magnitudes of the changes in demand and supply.

If demand increases by more than supply, the price rises. But if supply increases by more than demand, the price falls.

Figure 3.10(a) shows the case when both demand and supply increase and by the same amount. The equilibrium quantity increases. But because the increase in demand equals the increase in supply, neither a shortage nor a surplus arises so the price doesn't change. A bigger increase in demand would have created a shortage and a rise in the price; a bigger increase in supply would have created a surplus and a fall in the price.

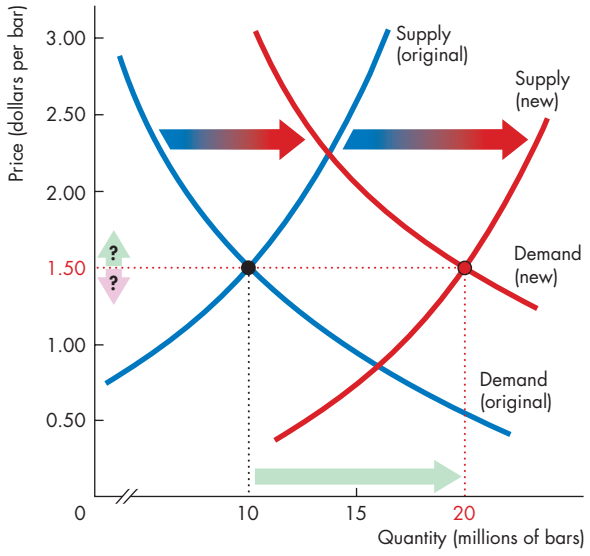
Figure 3.10(b) shows the case when both demand and supply decrease by the same amount. Here the equilibrium quantity decreases and again the price might either rise or fall.

Demand and Supply Change in Opposite Directions

When demand and supply change in opposite directions, we can predict how the price changes, but we need to know the magnitudes of the changes in demand and supply to say whether the equilibrium quantity increases or decreases.

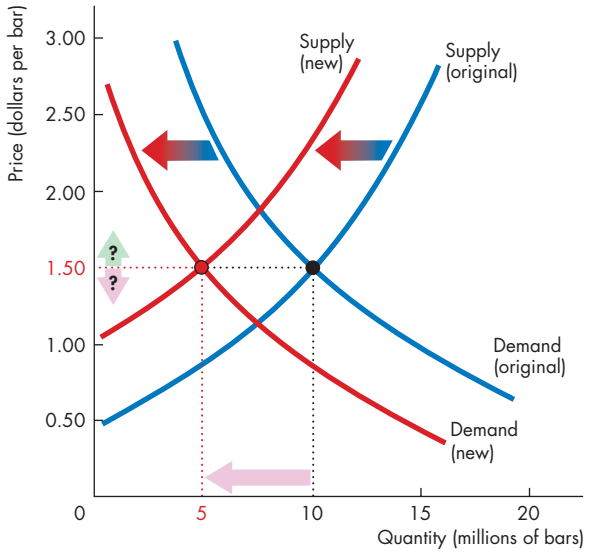
If demand changes by more than supply, the equilibrium quantity changes in the same direction as the change in demand. But if supply changes by more than demand, the equilibrium quantity changes in the same direction as the change in supply.

FIGURE 3.10 The Effects of Changes in Demand and Supply in the Same Direction



(a) Increase in both demand and supply

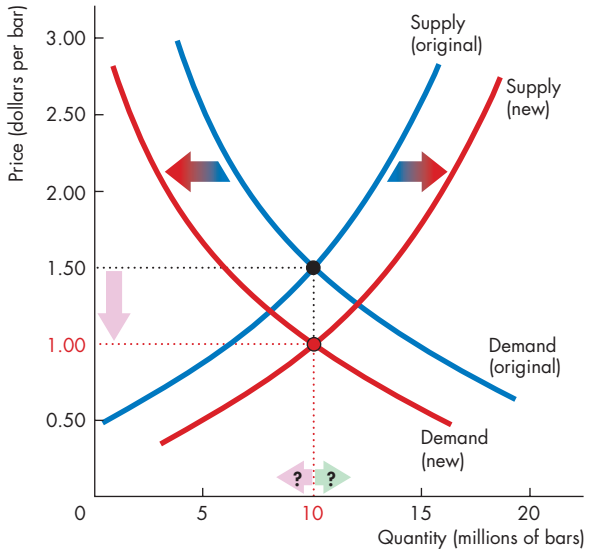
An increase in demand shifts the demand curve rightward to become the red new demand curve and an increase in supply shifts the supply curve rightward to become the red new supply curve. The price might rise or fall, but the quantity increases.



(b) Decrease in both demand and supply

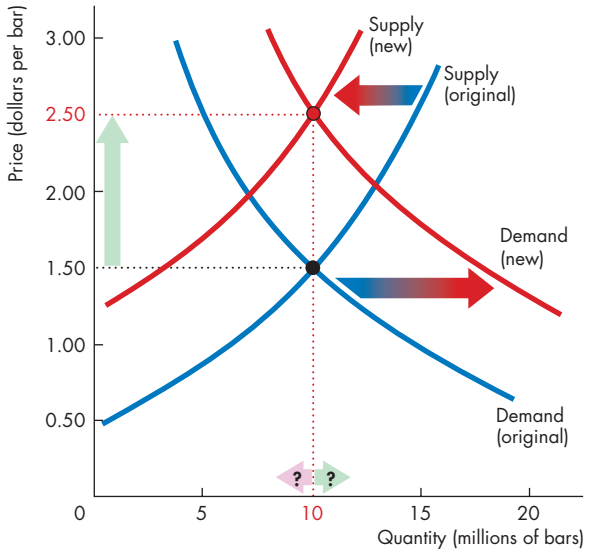
A decrease in demand shifts the demand curve leftward to become the red new demand curve and a decrease in supply shifts the supply curve leftward to become the red new supply curve. The price might rise or fall, but the quantity decreases.

FIGURE 3.11 The Effects of Changes in Demand and Supply in Opposite Directions



(a) Decrease in demand; increase in supply

A decrease in demand shifts the demand curve leftward to become the red new demand curve and an increase in supply shifts the supply curve rightward to become the red new supply curve. The price falls, but the quantity might increase or decrease.



(b) Increase in demand; decrease in supply

An increase in demand shifts the demand curve rightward to become the red new demand curve and a decrease in supply shifts the supply curve leftward to become the red new supply curve. The price rises, but the quantity might increase or decrease.

Figure 3.11(a) illustrates what happens when demand decreases and supply increases by the same amount. At the initial price, there is a surplus, so the price falls. A decrease in demand decreases the quantity and an increase in supply increases the quantity, so when these changes occur together, we can't say what happens to the quantity unless we know the magnitudes of the changes.

Figure 3.11(b) illustrates what happens when demand increases and supply decreases by the same amount. In this case, at the initial price, there is a shortage, so the price rises. An increase in demand increases the quantity and a decrease in supply decreases the quantity, so again, when these changes occur together, we can't say what happens to the quantity unless we know the magnitudes of the changes in demand and supply.

For all the cases in Fig. 3.10 and Fig. 3.11 where you "can't say" what happened to the price or the quantity, draw some examples that go in each direction.

REVIEW QUIZ

What is the effect on the price and quantity of smartphones if:

1. The price of a music-streaming subscription falls or the price of a wireless plan rises? (Draw the diagrams!)
2. More firms produce smartphones or electronics workers' wages rise? (Draw the diagrams!)
3. Any two of the events in questions 1 and 2 occur together? (Draw the diagrams!)

To complete your study of demand and supply, take a look at *Economics in the News* on pp. 104–105, which explains what has happened in the market for hand sanitizer as the Covid-19 pandemic spread. Try to get into the habit of using the demand and supply model to understand the changes in prices in your everyday life.

Demand for and Supply of Hand Sanitizer

Hand Sanitizer on Tap

EconEye
Catherine Baum
March 20, 2020

Breweries and distilleries, from small operations like Bluegrass Distillers in Lexington, Kentucky, to giants like AB InBev, maker of Budweiser Beer, are working to provide hand sanitizer to hospitals and other first responders during the Covid-19 pandemic.

Back in January 2020, you could have added a case of Purell hand sanitizer to your Amazon cart for around $30 according to Keepa, which tracks Amazon prices. By the beginning of March, those same 12 8-ounce bottles of Purell would have set you back close to $160—and that's assuming you could find any.

According to Adobe Analytics, which monitors e-commerce transactions of 80 of the top 100 U.S. retailers, the virus protection category, which includes things like hand sanitizer, gloves, masks, and antibacterial sprays, saw a surge in online purchases of 817 percent as Covid-19 gripped the world.

The combination of panic buying and stockpiling meant that shelves in brick-and-mortar stores were soon bare, and online stores showed "out of stock."

A reported 40 percent of distillery sales are to bars and restaurants. As shelter-in-place orders went into effect, closing down bars, restaurants, and sporting and concert venues, brewers and distillers both large and small went to work, switching their production from bottling booze to bottling hand sanitizer.

Pernod Ricard USA, which owns Absolut Vodka, Jameson Irish Whiskey, and many other brands, is producing hand sanitizer at multiple sites across the United States.

AB InBev used the technology from its non-alcoholic beer brewing process to turn surplus alcohol into disinfectant and worked with local partners to turn some of that disinfectant into hand sanitizer.

The Distilled Spirits Council of the United States (DISCUS) and the Brewers Association are working closely with regulators to overcome regulatory hurdles and follow all guidelines. And the World Health Organization provided the formula for making hand sanitizer to ensure that the global shortage was met with a safe, effective product.

ESSENCE OF THE STORY

- About 40 percent of a distillery's business comes from bars and restaurants.
- In the coronavirus pandemic, the price of hand sanitizer skyrocketed; one brand increased from $30 to almost $160 for a dozen 8-ounce bottles.
- Hoarding hand sanitizer has contributed to the soaring price.
- Distilleries decreased production of spirits and used high-proof alcohol to produce hand sanitizer, using a recipe from the World Health Organization.

(c) Econ Blog

ECONOMIC ANALYSIS

- The Covid-19 pandemic brought changes in prices and quantities in many markets, and one that saw enormous changes is the market for hand sanitizers.
- The expert advice, presented in social media and the news media, was to wash your hands with soap or use a hand sanitizer.
- As this message was heard, ever more loudly and clearly, consumer preferences changed and the demand for hand sanitizers soared.
- The first effect of the increase in demand was a shortage of hand sanitizer.
- A hand sanitizer is made from alcohol like that in vodka or gin or whiskey—products made by distilleries.
- So, hand sanitizer and spirits like vodka are substitutes in production.
- When the price of hand sanitizer increased, the supply of spirits, a substitute in production for hand sanitizer, decreased. And the quantity supplied of hand sanitizer increased.
- The figures illustrate this sequence of events.
- In Fig. 1, before the coronavirus pandemic, the demand for hand sanitizer was D_0 and supply was S.
- The equilibrium price was $100 a gallon and 25 million gallons per day were consumed. (The numbers are examples.)
- When people got the message to keep their hands clean, the demand for hand sanitizer increased and the demand curve shifted rightward to D_1. At the original price, a shortage, shown by the double-headed arrow, arose.
- Figure 2 shows what happened next.
- The shortage raised the price of hand sanitizer and as distilleries (and others) increased production, the quantity supplied increased.
- The quantity demanded decreased, and the market equilibrium was restored. In this example, both the price and the quantity doubled. (We don't know the actual changes, but they were large).

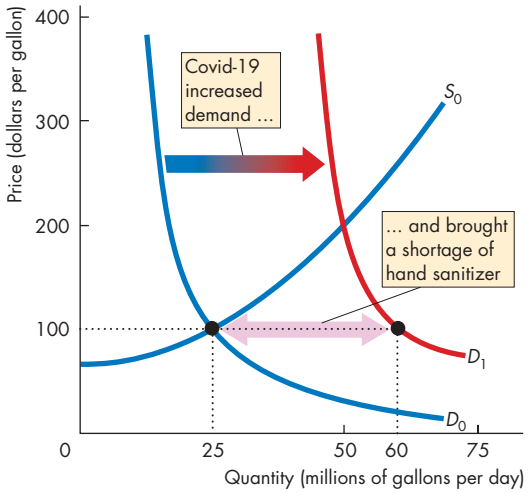


Figure 1 Increase in Demand and Shortage

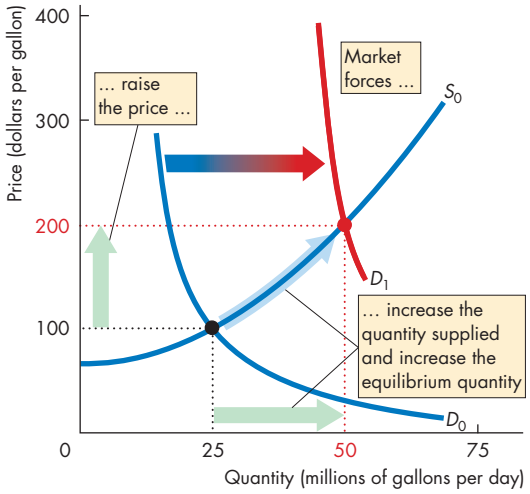


Figure 2 Price Rise Restores Equilibrium

MATHEMATICAL NOTE

Demand, Supply, and Equilibrium

Demand Curve

The law of demand says that as the price of a good or service falls, the quantity demanded of that good or service increases. We can illustrate the law of demand by drawing a graph of the demand curve or writing down an equation. When the demand curve is a straight line, the following equation describes it:

$$P = a - bQ_D,$$

where P is the price and Q_D is the quantity demanded. The a and b are positive constants.

The demand equation tells us three things:

1. The price at which no one is willing to buy the good (Q_D is zero). That is, if the price is a, then the quantity demanded is zero. You can see the price a in Fig. 1. It is the price at which the demand curve hits the y-axis—what we call the demand curve's "y-intercept."
2. As the price falls, the quantity demanded increases. If Q_D is a positive number, then the price P must be less than a. As Q_D gets larger, the price P becomes smaller. That is, as the quantity increases, the maximum price that buyers are willing to pay for the last unit of the good falls.
3. The constant b tells us how fast the maximum price that someone is willing to pay for the good falls as the quantity increases. That is, the constant b tells us about the steepness of the demand curve. The equation tells us that the slope of the demand curve is $-b$.

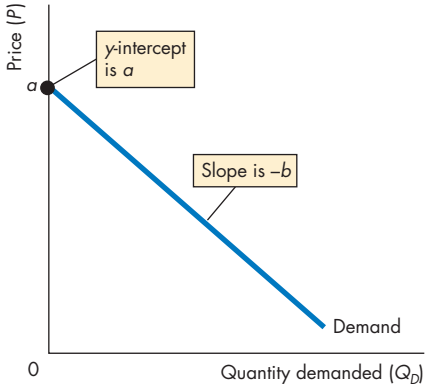


Figure 1 Demand Curve

Supply Curve

The law of supply says that as the price of a good or service rises, the quantity supplied of that good or service increases. We can illustrate the law of supply by drawing a graph of the supply curve or writing down an equation. When the supply curve is a straight line, the following equation describes it:

$$P = c + dQ_S,$$

where P is the price and Q_S is the quantity supplied. The c and d are positive constants.

The supply equation tells us three things:

1. The price at which sellers are not willing to supply the good (Q_S is zero). That is, if the price is c, then no one is willing to sell the good. You can see the price c in Fig. 2. It is the price at which the supply curve hits the y-axis—what we call the supply curve's "y-intercept."
2. As the price rises, the quantity supplied increases. If Q_S is a positive number, then the price P must be greater than c. As Q_S increases, the price P becomes larger. That is, as the quantity increases, the minimum price that sellers are willing to accept for the last unit rises.
3. The constant d tells us how fast the minimum price at which someone is willing to sell the good rises as the quantity increases. That is, the constant d tells us about the steepness of the supply curve. The equation tells us that the slope of the supply curve is d.

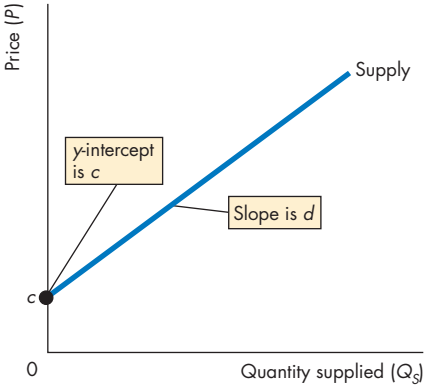


Figure 2 Supply Curve

Market Equilibrium

Demand and supply determine market equilibrium. Figure 3 shows the equilibrium price (P^*) and equilibrium quantity (Q^*) at the intersection of the demand curve and the supply curve.

We can use the equations to find the equilibrium price and equilibrium quantity. The price of a good adjusts until the quantity demanded Q_D equals the quantity supplied Q_S. So at the equilibrium price (P^*) and equilibrium quantity (Q^*),

$$Q_D = Q_S = Q^*.$$

To find the equilibrium price and equilibrium quantity, substitute Q^* for Q_D in the demand equation and Q^* for Q_S in the supply equation. Then the price is the equilibrium price (P^*), which gives

$$P^* = a - bQ^*$$
$$P^* = c + dQ^*.$$

Notice that

$$a - bQ^* = c + dQ^*.$$

Now solve for Q^*:

$$a - c = bQ^* + dQ^*$$
$$a - c = (b + d)Q^*$$
$$Q^* = \frac{a - c}{b + d}.$$

To find the equilibrium price P^*, substitute for Q^* in either the demand equation or the supply equation.

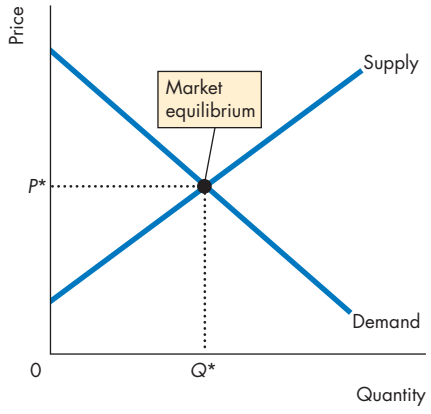


Figure 3 Market Equilibrium

Using the demand equation, we have

$$P^* = a - b\left(\frac{a - c}{b + d}\right)$$
$$P^* = \frac{a(b + d) - b(a - c)}{b + d}$$
$$P^* = \frac{ad + bc}{b + d}.$$

Alternatively, using the supply equation, we have

$$P^* = c + d\left(\frac{a - c}{b + d}\right)$$
$$P^* = \frac{c(b + d) + d(a - c)}{b + d}$$
$$P^* = \frac{ad + bc}{b + d}.$$

An Example

The demand for ice-cream cones is

$$P = 800 - 2Q_D.$$

The supply of ice-cream cones is

$$P = 200 + 1Q_S.$$

The price of a cone is expressed in cents, and the quantities are expressed in cones per day.

To find the equilibrium price (P^*) and equilibrium quantity (Q^*), substitute Q^* for Q_D and Q_S and P^* for P. That is,

$$P^* = 800 - 2Q^*$$
$$P^* = 200 + 1Q^*$$

Now solve for Q^*:

$$800 - 2Q^* = 200 + 1Q^*$$
$$600 = 3Q^*$$
$$Q^* = 200.$$

And

$$P^* = 800 - 2(200)$$
$$= 400.$$

The equilibrium price is \$4 a cone, and the equilibrium quantity is 200 cones per day.

WORKED PROBLEM

The table sets out the demand and supply schedules for roses on a normal weekend.

Price (dollars per rose)	Quantity demanded (roses per week)	Quantity supplied (roses per week)
6.00	150	60
7.00	100	100
8.00	70	130
9.00	50	150

Questions

1. If the price of a rose is $6, describe the situation in the rose market. Explain how the price adjusts.
2. If the price of a rose is $9, describe the situation in the rose market. Explain how the price adjusts.
3. What is the market equilibrium?
4. Rose sellers know that Mother's Day is next weekend and they expect the price to be higher, so they withhold 60 roses from the market this weekend. What is the price this weekend?
5. On Mother's Day, demand increases by 160 roses. What is the price of a rose on Mother's Day?

Solutions

1. At $6 a rose, the quantity demanded is 150 and the quantity supplied is 60. The quantity demanded exceeds the quantity supplied and there is a *shortage* of 90 roses. With people lining up and a shortage, the price rises above $6 a rose.

Key Point: When a shortage exists, the price rises.

2. At $9 a rose, the quantity demanded is 50 and the quantity supplied is 150. The quantity supplied exceeds the quantity demanded and there is a *surplus* of 100 roses. With slow sales of roses and a surplus, the price falls to below $9 a rose.

Key Point: When a surplus exists, the price falls.

3. Market equilibrium occurs at the price at which the quantity demanded *equals* the quantity supplied. That price is $7 a rose. The market equilibrium is a price of $7 a rose and 100 roses a week bought and sold, point *A* on the figure.

Key Point: At market equilibrium, there is no shortage or surplus.

4. Sellers expect a higher price next weekend, so they decrease the quantity supplied this weekend by 60 roses at each price. Create the new table:

Price (dollars per rose)	Quantity demanded (roses per week)	Quantity supplied (roses per week)
6.00	150	0
7.00	**100**	**40**
8.00	**70**	**70**
9.00	50	90

At $7 a rose, there is a shortage of 60 roses, so the price rises to $8 a rose, where the quantity demanded equals the quantity supplied. (Point *B*)

Key Point: When supply decreases, the price rises.

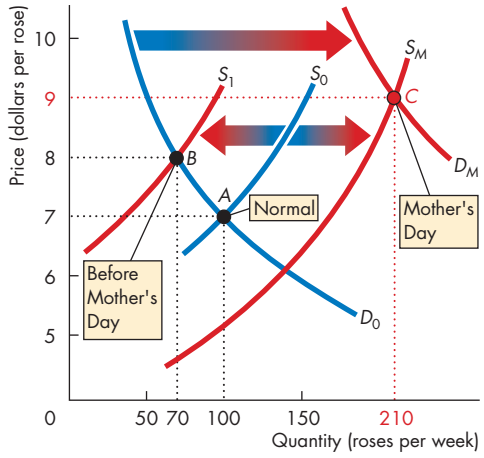
5. Demand increases by 160 roses. Sellers plan to increase the normal supply by the 60 roses withheld last weekend. Create the new table:

Price (dollars per rose)	Quantity demanded (roses per week)	Quantity supplied (roses per week)
6.00	310	120
7.00	**260**	**160**
8.00	230	190
9.00	**210**	**210**

At $7 a rose, there is a shortage of 100 roses, so the price rises until, at $9 a rose, the quantity demanded equals the quantity supplied. The price on Mother's Day is $9 a rose. (Point *C*)

Key Point: When demand increases by more than supply, the price rises.

Key Figure



SUMMARY

Key Points

Markets and Prices (p. 86)

- A competitive market is one that has so many buyers and sellers that no single buyer or seller can influence the price.
- Opportunity cost is a relative price.
- Demand and supply determine relative prices.

Demand (pp. 87–91)

- Demand is the relationship between the quantity demanded of a good and its price when all other influences on buying plans remain the same.
- The higher the price of a good, other things remaining the same, the smaller is the quantity demanded—the law of demand.
- Demand depends on the prices of related goods (substitutes and complements), expected future prices, income, expected future income and credit, the population, and preferences.

Supply (pp. 92–95)

- Supply is the relationship between the quantity supplied of a good and its price when all other influences on selling plans remain the same.
- The higher the price of a good, other things remaining the same, the greater is the quantity supplied—the law of supply.
- Supply depends on the prices of factors of production used to produce a good, the prices of related goods produced, expected future prices, the number of suppliers, technology, and the state of nature.

Market Equilibrium (pp. 96–97)

- At the equilibrium price, the quantity demanded equals the quantity supplied.
- At any price above the equilibrium price, there is a surplus and the price falls.
- At any price below the equilibrium price, there is a shortage and the price rises.

Predicting Changes in Price and Quantity (pp. 98–103)

- An increase in demand brings a rise in the price and an increase in the quantity supplied. A decrease in demand brings a fall in the price and a decrease in the quantity supplied.
- An increase in supply brings a fall in the price and an increase in the quantity demanded. A decrease in supply brings a rise in the price and a decrease in the quantity demanded.
- An increase in demand and an increase in supply bring an increased quantity but an uncertain price change. An increase in demand and a decrease in supply bring a higher price but an uncertain change in quantity.

Key Terms

Change in demand, 88
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Law of supply, 92
Money price, 86
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Quantity supplied, 92
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Substitute, 89
Supply, 92
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PROBLEMS AND APPLICATIONS

Markets and Prices

1. In 2015, the money price of a dozen eggs in Canada was C$3.32 and the price of a kilo of carrots was C$2.22. Calculate the relative price of a kilo of carrots in terms of eggs.

   Source: Living in Canada website

Demand

2. The price of food increased during the past year.
   a. Explain why the law of demand applies to food just as it does to other goods and services.
   b. Explain how the substitution effect influences food purchases when the price of food rises and other things remain the same.
   c. Explain how the income effect influences food purchases and provide some examples of the income effect.
3. Which of the following goods are likely substitutes and which are likely complements? (You may use an item more than once):

   coal, oil, natural gas, wheat, corn, pasta, pizza, sausage, skateboard, roller blades, video game, laptop, iPad, smartphone, text message, email
4. As the average income in China continues to increase, explain how the following will change:
   a. The demand for beef
   b. The demand for rice

Supply

5. In 2017, the price of cotton rose in Egypt and some farmers planned to switch from growing rice to growing cotton.
   a. Does this fact illustrate the law of demand or the law of supply? Explain your answer.
   b. Why would rice cultivation decrease?

   Source: Reuters, February 13, 2017
6. Dairies make low-fat milk from full-cream milk, and in the process they produce cream, which is made into ice cream. The following events occur one at a time:
   (i) The wage rate of dairy workers rises.
   (ii) The price of cream rises.
   (iii) The price of low-fat milk rises.
   (iv) With a drought forecasted, dairies raise their expected price of low-fat milk next year.
   (v) New technology lowers the cost of producing ice cream.

   Explain the effect of each event on the supply of low-fat milk.

Market Equilibrium

7. The demand and supply schedules for gum are

Price (cents per pack)	Quantity demanded (millions of packs a week)	Quantity supplied (millions of packs a week)
20	180	60
40	140	100
60	100	140
80	60	180

   a. Suppose that the price of gum is 70¢ a pack. Describe the situation in the gum market and explain how the price adjusts.
   b. Suppose that the price of gum is 30¢ a pack. Describe the situation in the gum market and explain how the price adjusts.

Predicting Changes in Price and Quantity

8. The following events occur one at a time:
   (i) The price of crude oil rises.
   (ii) The price of a car rises.
   (iii) All speed limits on highways are abolished.
   (iv) Robots cut car production costs.

   Explain the effect of each of these events on the market for gasoline.
9. In Problem 7, a fire destroys some factories that produce gum and the quantity of gum supplied decreases by 40 million packs a week at each price.
   a. Explain what happens in the market for gum and draw a graph to illustrate the changes.
   b. At the same time as the fire, the teenage population increases and the quantity of gum demanded increases by 40 million packs a week at each price. What is the new market equilibrium? Show the changes on your graph.
10. **Rare Late Bumper British Crop to Last Until Halloween**

    The strawberry season in Britain usually lasts until September, but a mini heat wave and an unseasonably warm autumn have created enough supply to last until the end of October.

    Source: Tesco PLC, October 17, 2017

    Make a graph to illustrate the market for strawberries before and after the unseasonably warm autumn in Britain.

ADDITIONAL PROBLEMS AND APPLICATIONS

Markets and Prices

11. What features of the world market for crude oil make it a competitive market?
12. The money price of a Persian rug is $100 and the money price of an Egyptian kaftan is $25.
    a. What is the opportunity cost of a Persian rug in terms of an Egyptian kaftan?
    b. What is the relative price of an Egyptian kaftan in terms of Persian rugs?

Demand

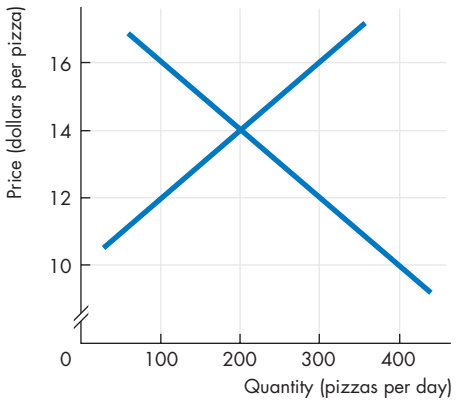
13. The price of gasoline has increased during the past year.
    a. Explain why the law of demand applies to gasoline just as it does to all other goods and services.
    b. Explain how the substitution effect influences gasoline purchases and provide some examples of substitutions that people might make when the price of gasoline rises and other things remain the same.
    c. Explain how the income effect influences gasoline purchases and provide some examples of the income effects that might occur when the price of gasoline rises and other things remain the same.
14. Think about the demand for the three game consoles: Xbox Series X, Sony PlayStation 5, and Wii U. Explain the effect of each of the following events on the demand for Xbox Series X games and the quantity of Xbox Series X games demanded, other things remaining the same. The events are
    a. The price of an Xbox Series X falls.
    b. The prices of a PlayStation 5 and a Wii U fall.
    c. The number of people writing and producing Xbox Series X games increases.
    d. Consumers' incomes increase.
    e. Programmers who write code for Xbox Series X games become more costly to hire.
    f. The expected future price of an Xbox Series X game falls.
    g. A new game console that is a close substitute for Xbox Series X comes onto the market.

Supply

15. Classify the following pairs of goods and services as substitutes in production, complements in production, or neither.
    a. Lumber and sawdust
    b. Condominiums and bungalows
    c. Cheeseburger and fries
    d. Cars and gasoline
    e. Cappuccino and latte
16. When a farmer uses raw milk to produce skim milk, he/she/they also produces cream, which is used to make butter.
    a. Explain how a rise in the price of cream influences the supply of skim milk.
    b. Explain how a rise in the price of cream influences the supply of butter.
17. **Cost of Greenhouse Lighting**
    Between 2008 and 2015, extremely high electricity taxes in Denmark particularly affected nurseries using greenhouse lighting.
    Source: hortipoint.nl, September 1, 2017
    Other things remaining the same, would imposing a higher tax on electricity in 2008 have caused a change in the supply or in the quantity supplied of plants in nurseries that use greenhouse lighting? Explain.

Market Equilibrium

Use the following figure to work Problems 18 and 19.



18. a. Label the curves. Which curve shows the willingness to pay for a pizza?
    b. If the price is $16 a pizza, does a shortage or a surplus arise? Does the price rise or fall?
    c. Sellers want the highest possible price, so why would they be willing to accept less than $16 a pizza?

19. a. If the price of a pizza is $12, is there a shortage or a surplus and does the price rise or fall?
    b. Buyers want to pay the lowest possible price, so why would they be willing to pay more than $12 for a pizza?
20. The demand and supply schedules for potato chips are

Price (cents per bag)	Quantity demanded (millions of bags per week)	Quantity supplied (millions of bags per week)
50	160	130
60	150	140
70	140	150
80	130	160
90	120	170
100	110	180

    a. Draw a graph of the potato chip market and mark in the equilibrium price and quantity.
    b. If the price is 60¢ a bag, is there a shortage or a surplus, and how does the price adjust?

Predicting Changes in Price and Quantity

21. In Problem 20, a new dip increases the quantity of potato chips that people want to buy by 30 million bags per week at each price.
    a. Does the demand for chips change? Does the supply of chips change? Describe the change.
    b. How do the equilibrium price and equilibrium quantity of chips change?
22. In Problem 20, if a virus destroys potato crops and the quantity of potato chips produced decreases by 40 million bags a week at each price, how does the supply of chips change?
23. If the virus in Problem 22 hits just as the new dip in Problem 21 comes onto the market, how do the equilibrium price and equilibrium quantity of chips change?
24. **Ethical Awareness Reduces Demand for Animal Ingredients**

    Animal-based ingredients such as lanolin are being substituted by plant-based ingredients in the production of cosmetics, particularly in Europe and India. Following a rise in global awareness of the use of animal-based ingredients, consumers across the world are switching to cosmetics manufactured through ethical methods.

    Source: in-cosmetics.com, August 2, 2016

    a. Describe the changes in the global market for cosmetics containing animal ingredients.
    b. Explain whether the decrease in lanolin production in Europe and India is a change in supply or in quantity supplied.
25. **Why Is the Covid-19 Pandemic Causing a Ketchup Shortage?**

    More takeout orders mean more ketchup packets. A ketchup shortage caused packet prices to rise 13% since January 2020. Heinz is working to increase production to 12 billion packets a year.

    Source: abc7news.com, April 7, 2021

    a. Explain the effect of more takeout orders on the market for ketchup.
    b. Why did a ketchup shortage raise the price?
    c. How will Heinz's increased production change the ketchup market?
26. **Bulgaria Leads EU in Lavender Production**

    Europe is the world's primary producer of lavender and lavender oil. Bulgaria increased its lavender production in 2008, causing the price of lavender oil to fall. In 2015, it replaced France, which has been facing problems related to crop disease and pests, as the EU leader of lavender production.

    Source: bta.bg, October 4, 2016

    Explain the effect of falling lavender prices on the market for lavender oil.
27. **Supply and Demand: Shortages Across America Run Deep**

    Microchip shortages are limiting production of new cars and sending prices of used cars soaring. Car dealerships across the country are now in a dog eat dog fight to buy up used cars.

    Source: abcactionnews.com, May 11, 2021

    Explain the effect of microchip shortages on the market for new cars and the market for used cars.

Economics in the News

28. After you have studied *Economics in the News* on pp. 104–105, answer the following questions.
    a. Why are spirits and hand sanitizer substitutes in production?
    b. Why did the increase in demand for hand sanitizer increase the quantity supplied and not increase supply?
    c. What would have happened to the supply of hand sanitizer if the price of spirits had fallen?
    d. How would the supply of spirits have changed when the price of hand sanitizer increased?
    e. What are the powerful market forces that operated in the market for hand sanitizer?

Your Economic Revolution

PART ONE **WRAP-UP**

UNDERSTANDING THE SCOPE OF ECONOMICS

Three periods in human history stand out as ones of economic revolution. The first, the *Agricultural Revolution,* occurred 10,000 years ago. In what is today Iraq, people learned to domesticate animals and plant crops. People stopped roaming in search of food and settled in villages, towns, and cities where they specialized in the activities in which they had a comparative advantage and developed markets in which to exchange their products. Wealth increased enormously.

Economics was born during the *Industrial Revolution,* which began in England during the 1760s. For the first time, people began to apply science and create new technologies for the manufacture of textiles and iron, to create steam engines, and to boost the output of farms.

You are studying economics at a time that future historians will call the *Information Revolution*. Over the entire world, people are embracing new information technologies and prospering on an unprecedented scale.

During all three economic revolutions, many have prospered but others have been left behind. It is the range of human progress that poses the greatest question for economics and the one that Adam Smith addressed in the first work of economic science: What causes the differences in wealth among nations?

Many people had written about economics before **Adam Smith**, *but he made economics a science. Born in 1723 in Kirkcaldy, a small fishing town near Edinburgh, Scotland, Smith was the only child of the town's customs officer. Lured from his professorship (he was a full professor at 28) by a wealthy Scottish duke who gave him a pension of £300 a year—ten times the average income at that time—Smith devoted ten years to writing his masterpiece:* An Inquiry into the Nature and Causes of the **Wealth of Nations**, *published in 1776.*

Why, Adam Smith asked, are some nations wealthy while others are poor? He was pondering these questions at the height of the Industrial Revolution, and he answered by emphasizing the power of the division of labor and free markets in raising labor productivity.

To illustrate his argument, Adam Smith described two pin factories. In the first, one person, using the hand tools available in the 1770s, could make 20 pins a day. In the other, by using those same hand tools but breaking the process into a number of individually small operations in which people specialize—by the division of labor—ten people could make a staggering 48,000 pins a day. One draws out the wire, another straightens it, a third cuts it, a fourth points it, a fifth grinds it. Three specialists make the head, and a fourth attaches it. Finally, the pin is polished and packaged.

Every individual who intends only his own gain is led by an invisible hand to promote an end (the public good) which was no part of his intention.

ADAM SMITH
The Wealth of Nations

But a large market is needed to support the division of labor: One factory employing ten workers would need to sell more than 15 million pins a year to stay in business!

TALKING WITH Esther Duflo

ESTHER DUFLO is the Abdul Latif Jameel Professor of Poverty Alleviation and Development Economics at the Massachusetts Institute of Technology. Among her many honors are the 2010 John Bates Clark Medal for the best economist under 40 and the Financial Times and Goldman Sachs Business Book of the Year Award in 2011 for her book (with Abhijit Banerjee) *Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty.* Professor Duflo's research seeks to advance our understanding of the economic choices of the extremely poor by conducting massive real-world experiments.

Professor Duflo was an undergraduate student of history and economics at École Normale Supérieure and completed a master's degree at DELTA in Paris before moving to the United States. She earned her PhD in Economics at MIT in 1999.

Michael Parkin talked with her about her work, which advances our understanding of the economic choices and condition of the very poor.

Professor Duflo, what's the story about how you became an economist and in particular the architect of experiments designed to understand the economic choices of the very poor?

When I was a kid, I was exposed to many stories and images of poor children: through my mother's engagement as a doctor in a small NGO dealing with child victims of war and through books and stories about children living all around the world. I remember asking myself how I could justify my luck of being born where I was. I had a very exaggerated idea of what it was to be poor, but this idea caused sufficient discomfort that I knew I had to do something about it, if I could. Quite by accident, I discovered that economics was the way in which I could actually be useful: While spending a year in Russia teaching French and studying History, I realized that academic economists have the ability to intervene in the world while keeping enough sanity to analyze it. I thought this would be ideal for me and I have never regretted it. I have the best job in the world.

... imagine living on under a dollar a day after your rent is paid in Seattle or Denver. Not easy!

The very poor whom you study are people who live on $1 a day or $2 a day. … Is $1 a day a true measure that includes everything these poor people consume?

For defining the poverty line, we don't include the cost of housing. The poor also get free goods, sometimes of bad quality (education, healthcare) and the value of those is also not included. Other than that, yes, it is everything.

Moreover, you have to realize this is everything, taking into account the fact that life is much cheaper in many poor countries because salaries are lower, so anything that is made and consumed locally (e.g., a haircut) is cheaper.

For example, in India, the purchasing power of a dollar (in terms of the real goods you can buy) is about 3 times what it is in the United States. So the poverty line we use for India is 33 cents per day, not a dollar.

All told, you really have to imagine living on under a dollar a day after your rent is paid in Seattle or Denver. Not easy!

PART TWO **MACROECONOMIC DATA**

4 MEASURING THE VALUE OF PRODUCTION: GDP

After studying this chapter, you will be able to:

- Define GDP and explain why GDP equals aggregate expenditure and aggregate income
- Explain how the Bureau of Economic Analysis measures U.S. GDP
- Explain the uses and limitations of GDP as a measure of economic well-being

Will our economy keep expanding as it recovers from the Covid-19 recession, or will it fall into recession again? Amazon, Facebook, and every other U.S. firm wants the answer. Forecasts of GDP give the answer. What is GDP? And what does it tell us about the state of the economy?

How is our standard of living changing? Is it stagnating or improving? GDP per person is one measure, but is it a reliable measure? In this chapter, you will find out how economic statisticians at the Bureau of Economic Analysis measure GDP. You will also learn about the uses and the limitations of GDP.

In *Economics in the News* at the end of the chapter, you will see how some economists are trying to nowcast GDP—estimate its level as it happens.

Gross Domestic Product

What exactly is GDP, how is it calculated, what does it mean, and why do we care about it? You are going to discover the answers to these questions in this chapter. First, what *is* GDP?

GDP Defined

GDP, or **gross domestic product**, is the market value of the final goods and services produced within a country in a given time period. This definition has four parts:

- Market value
- Final goods and services
- Produced within a country
- In a given time period

We'll examine each in turn.

Market Value To measure total production, we must add together the production of apples and oranges, or computers and popcorn. Just counting the items doesn't get us very far. For example, which is the greater total production: 100 apples and 50 oranges or 50 apples and 100 oranges?

GDP answers this question by valuing items at their *market values*—the prices at which items are traded in markets. If the price of an apple is 10 cents, then the market value of 50 apples is $5. If the price of an orange is 20 cents, then the market value of 100 oranges is $20. By using market prices to value production, we can add the apples and oranges together. The market value of 50 apples and 100 oranges is $5 plus $20, or $25.

Final Goods and Services To calculate GDP, we value the *final goods and services* produced. A **final good** (or service) is an item that is bought by its final user during a specified time period. It contrasts with an **intermediate good** (or service), which is an item that is produced by one firm, bought by another firm, and used as a component of a final good or service.

For example, a Ford truck is a final good, but a Firestone tire on the truck is an intermediate good. An iPad is a final good, but an Apple M1 chip inside it is an intermediate good.

If we were to add the value of intermediate goods and services produced to the value of final goods and services, we would count the same thing many times—a problem called *double counting*. The value of a truck already includes the value of the tires, and the value of an iPad already includes the value of the chip inside it.

Some goods can be an intermediate good in some situations and a final good in other situations. For example, the ice cream that you buy on a hot summer day is a final good, but the ice cream that a restaurant buys and uses to make sundaes is an intermediate good. The sundae is the final good. So whether a good is an intermediate good or a final good depends on what it is used for, not what it is.

The purchase of a secondhand good—for example, a used car or existing home—isn't part of GDP. It was part of GDP in the year in which it was produced.

Produced Within a Country Only goods and services that are produced *within a country* count as part of that country's GDP. Nike Corporation, a U.S. firm, produces sneakers in Vietnam, and the market value of those shoes is part of Vietnam's GDP, not part of U.S. GDP. Toyota, a Japanese firm, produces automobiles in Georgetown, Kentucky, and the value of this production is part of U.S. GDP, not part of Japan's GDP.

In a Given Time Period GDP measures the value of production *in a given time period*—normally either a quarter of a year—called the quarterly GDP data—or a year—called the annual GDP data.

GDP and the Circular Flow of Expenditure and Income

GDP is a measure of the value of total production. We can measure this value either by the total income earned producing GDP or the total expenditure on GDP. The equality between the value of total production and total income is important because it shows the direct link between productivity and living standards. Our standard of living rises when our incomes rise and we can afford to buy more goods and services. But we must produce more goods and services if we are to be able to buy more goods and services.

Rising incomes and a rising value of production go together. They are two aspects of the same phenomenon. You're now going to see why.

The Circular Flow Model Figure 4.1 illustrates the circular flow model. The economy consists of households, firms, governments, and the rest of the world (the rectangles), which trade in factor markets and goods (and services) markets. We focus first on households and firms.

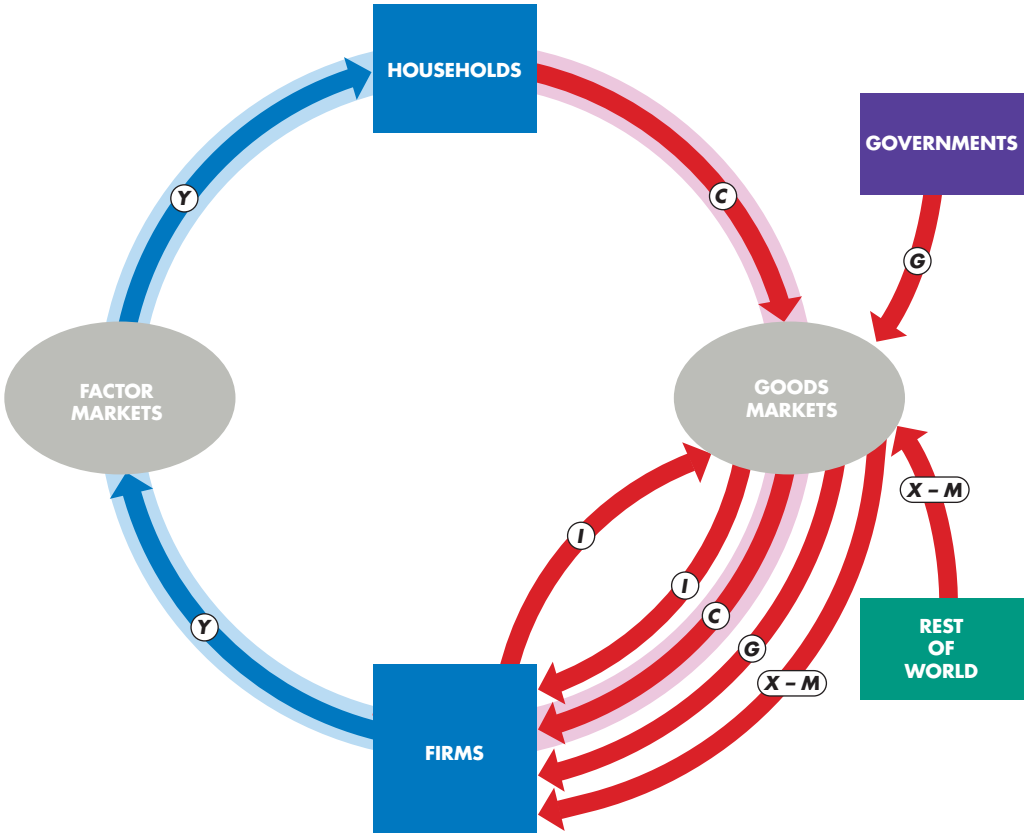
Households and Firms Households sell and firms buy the services of labor, capital, and land in factor markets. For these factor services, firms pay income to households: wages for labor services, interest for the use of capital, and rent for the use of land. A fourth factor of production, entrepreneurship, receives profit.

Firms' retained earnings—profits that are not distributed to households—are part of the household sector's income. You can think of retained earnings as being income that households save and lend back to firms. Figure 4.1 shows the total income—*aggregate income*—received by households, including retained earnings, as the blue flow labeled *Y*.

Firms sell and households buy consumer goods and services in goods markets. The total payment for these goods and services is **consumption expenditure**, shown by the red flow labeled *C*.

Firms buy and sell new capital equipment—such as computer systems, airplanes, trucks, and assembly line equipment—in goods markets. Some of what firms produce is not sold but is added to inventory. For example, if GM produces 1,000 cars and sells 950 of them, the other 50 cars remain in GM's inventory of unsold cars, which increases by 50 cars. When a firm adds unsold output to inventory, we can think of the firm as buying goods from itself. The purchase of new plant, equipment, and buildings and the additions to inventories are **investment**, shown by the red flow labeled *I*.

FIGURE 4.1 The Circular Flow of Expenditure and Income



Households make consumption expenditures (*C*); firms make investments (*I*); governments buy goods and services (*G*); and the rest of the world buys net exports (*X* − *M*). Firms pay incomes (*Y*) to households. Aggregate income equals aggregate expenditure.

Billions of dollars in 2020	
C	= 14,145
I	= 3,605
G	= 3,831
X − *M*	= −645
Y	= 20,936

Source of data: U.S. Department of Commerce, Bureau of Economic Analysis.

Governments Governments buy goods and services from firms—**government expenditure**. In Fig. 4.1, government expenditure is shown as the red flow *G*.

Governments finance their expenditure with taxes and make financial transfers to households, such as Social Security benefits and unemployment benefits, and pay subsidies to firms. But taxes and financial transfers are not part of the circular flow of expenditure and income.

Rest of the World Firms in the United States sell goods and services to the rest of the world—**exports**—and buy goods and services from the rest of the world—**imports**. The value of exports (X) minus the value of imports (M) is called **net exports**, the red flow $X - M$ in Fig 4.1. If net exports are positive, the net flow is from U.S. firms to the rest of the world. If net exports are negative, the net flow is from the rest of the world to U.S. firms.

GDP Equals Expenditure Equals Income Gross domestic product can be measured in two ways: By the total expenditure on goods and services or by the total income earned producing goods and services.

The total expenditure—*aggregate expenditure*—is the sum of the red flows in Fig. 4.1. Aggregate expenditure equals consumption expenditure plus investment plus government expenditure plus net exports.

Aggregate income is equal to the total amount paid for the services of the factors of production used to produce final goods and services—wages, interest, rent, and profit. The blue flow in Fig. 4.1 shows aggregate income. Because firms pay out as incomes (including retained profits) everything they receive from the sale of their output, aggregate income (the blue flow) equals aggregate expenditure (the sum of the red flows). That is,

$$Y = C + I + G + X - M.$$

The table in Fig. 4.1 shows the value of each expenditure in 2020 and that their sum is $20,936 billion, which also equals aggregate income.

Because aggregate expenditure equals aggregate income, the two methods of measuring GDP give the same answer. So

> GDP equals aggregate expenditure and equals aggregate income.

The circular flow model is the foundation on which the national economic accounts are built.

Why "Domestic" and Why "Gross"?

What do the words "domestic" and "gross" mean in the term gross domestic product?

Domestic *Domestic* product is production *within a country*. It contrasts with a related concept, *national* product, which is the value of goods and services produced anywhere in the world by the residents of a nation. For example, Nike's income from shoe factories that it owns in Vietnam is part of U.S. national product. But it is part of Vietnam's domestic product. Gross national product, GNP, equals GDP plus net income from factors of production owned in other countries.

Gross *Gross* means before subtracting the depreciation of capital. The opposite of gross is *net*, which means after subtracting the depreciation of capital.

Depreciation is the decrease in the value of a firm's capital that results from wear and tear and obsolescence. The total amount spent both buying new capital and replacing depreciated capital is called **gross investment**. The amount by which the value of capital increases is called **net investment**. Net investment equals gross investment minus depreciation.

Gross investment is one of the expenditures included in the expenditure approach to measuring GDP. So the resulting value of total product is a gross measure.

Gross profit, which is a firm's profit before subtracting depreciation, is one of the incomes included in the income approach to measuring GDP. So again, the resulting value of total product is a gross measure.

REVIEW QUIZ

1. Define GDP and distinguish between a final good and an intermediate good. Provide examples.
2. Why does GDP equal aggregate income and also equal aggregate expenditure?
3. What are the distinctions between domestic and national, and gross and net?

Let's now see how the ideas that you've just studied are used in practice. We'll see how GDP and its components are measured in the United States today.

Measuring U.S. GDP

The Bureau of Economic Analysis (BEA) uses the concepts in the circular flow model to measure GDP and its components in the *National Income and Product Accounts*. Because the value of aggregate production equals aggregate expenditure and aggregate income, there are two approaches available for measuring GDP, and both are used. They are

- The expenditure approach
- The income approach

The Expenditure Approach

The *expenditure approach* measures GDP as the sum of consumption expenditure (C), investment (I), government expenditure on goods and services (G), and net exports of goods and services ($X - M$). These expenditures correspond to the red flows through the goods markets in the circular flow model in Fig. 4.1 and Fig. 4.2. Table 4.1 shows these expenditures and GDP for 2020.

Personal consumption expenditures (the red flow C in Fig. 4.2) are the expenditures by U.S. households on goods and services produced in the United States and in the rest of the world. They include goods such as soda and books and services such as banking and legal advice. They also include the purchase of consumer durable goods such as TVs and microwave ovens.

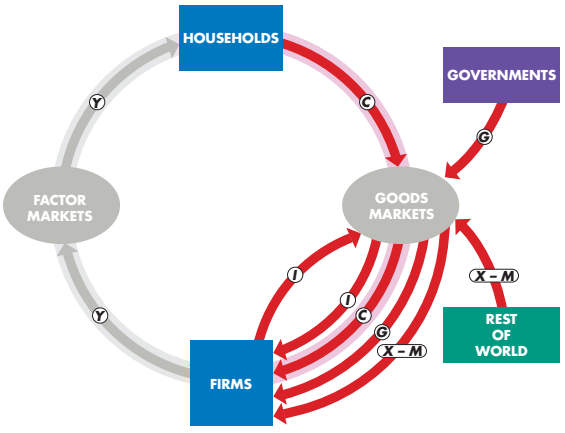
TABLE 4.1 GDP: The Expenditure Approach

Item	Symbol	Amount in 2020 (billions of dollars)	Percentage of GDP
Personal consumption expenditures	C	14,145	67.6
Gross private domestic investment	I	3,605	17.2
Government expenditure on goods and services	G	3,831	18.3
Net exports of goods and services	$X-M$	−645	−3.1
Gross domestic product	**Y**	**20,936**	**100.0**

The expenditure approach measures GDP as the sum of personal consumption expenditures, C, gross private domestic investment, I, government expenditure on goods and services, G, and net exports, $X - M$. In 2020, GDP measured by the expenditure approach was $20,936 billion. Expenditure on personal consumption goods and services is more than two-thirds of aggregate expenditure.

Source of data: U.S. Department of Commerce, Bureau of Economic Analysis

FIGURE 4.2 Aggregate Expenditure



Aggregate expenditure is the sum of the red flows.

But they do *not* include the purchase of new homes, which the BEA counts as part of investment.

Gross private domestic investment (the red flow I in Fig. 4.2) is expenditure on capital equipment and buildings by firms and the additions to business inventories. It also includes expenditure on new homes by households.

Government expenditure on goods and services (the red flow G in Fig. 4.2) is the expenditure by all levels of government on goods and services such as national defense and garbage collection. It does *not* include *transfer payments*, such as unemployment benefits, because they are not expenditures on goods and services.

Net exports of goods and services (the red flow $X - M$ in Fig. 4.2) is the value of exports minus the value of imports. This item includes the value of airplanes that Boeing sells to British Airways (a U.S. export), and the value of Japanese smart TVs that Best Buy purchases from Sony (a U.S. import).

The Income Approach

The *income approach* measures GDP by summing the incomes that firms pay households for the services of the factors of production they hire—wages for labor, interest for capital, rent for land, and profit for entrepreneurship. These incomes correspond to the blue flows through the factor markets in the circular flow model in Fig. 4.1 and Fig. 4.3. Table 4.2 shows these incomes and GDP for 2020.

Compensation of employees (the blue flow *W* in Fig. 4.3) is the payment for labor services. It includes net wages and salaries (called "take-home pay") that workers receive plus taxes withheld on earnings plus fringe benefits such as Social Security and pension fund contributions. This item is more than 50 percent of total income.

Net interest, rental income, corporate profits, and proprietors' income are earned by capital, land, and entrepreneurship. These other factor incomes are the blue flow *OFI* in Fig. 4.3.

The factor incomes sum to *net domestic income at factor cost*, which is the cost of the factors of production used to produce final goods. The *expenditures* on final goods are valued at *market prices*, which differ from factor cost because of indirect taxes and subsidies.

An *indirect tax* is a tax such as a sales tax or a tax on gasoline. Market price includes indirect taxes, so market price exceeds factor cost. A *subsidy* is a payment, such as a farm subsidy, by the government to a producer. Subsidies make market price less than factor cost.

TABLE 4.2 GDP: The Income Approach

Item	Amount in 2020 (billions of dollars)	Percentage of GDP
Compensation of employees	11,501	54.9
Net interest	836	4.0
Rental income	802	3.8
Corporate profits	1,689	8.1
Proprietors' income	1,695	8.1
Net domestic income at factor cost	16,523	78.9
Indirect taxes *less* subsidies	881	4.2
Net domestic income at market prices	17,404	83.1
Depreciation	3,559	17.0
GDP (income approach)	**20,963**	**100.1**
Statistical discrepancy	–27	–0.1
GDP (expenditure approach)	**20,936**	**100.0**

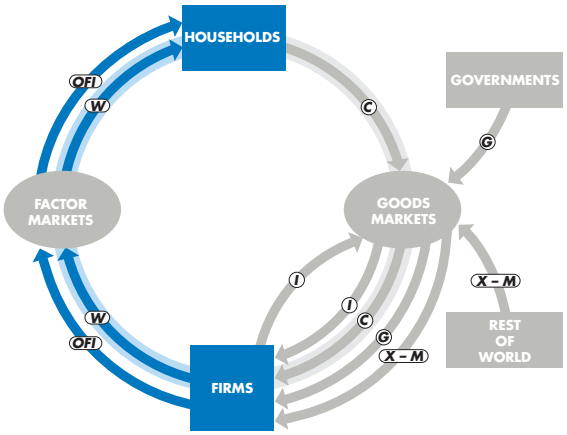
The sum of factor incomes equals *net domestic income at factor cost*. GDP equals net domestic income at factor cost plus indirect taxes minus subsidies plus depreciation.

Compensation of employees—labor income—is by far the largest component of aggregate income.

In 2020, GDP measured by the income approach was $20,963 billion. This amount is $27 billion more than GDP measured by the expenditure approach—a statistical discrepancy of –$27 billion.

Source of data: U.S. Department of Commerce, Bureau of Economic Analysis.

FIGURE 4.3 Aggregate Income



Aggregate income is the sum of the blue flows.

To get from factor cost to market price, we add indirect taxes and subtract subsidies and get *net domestic income at market prices*. We still must get from a *net* to a *gross* measure.

Total expenditure is a *gross* number because it includes *gross* investment. Net domestic income at market prices is a net income measure because corporate profits are measured *after deducting depreciation*. They are a *net* income measure. To get from net income to gross income, we must *add depreciation*.

We've now arrived at GDP using the income approach. This number is not exactly the same as GDP using the expenditure approach because all the numbers are estimates. The gap between the two measures of GDP, called the *statistical discrepancy,* is never large. In 2020, it was 0.1 percent of GDP.

Nominal GDP and Real GDP

Often, we want to *compare* GDP in two periods, say 2012 and 2021. In 2012, GDP was $16,197 billion and in 2021, it was $22,026 billion—36 percent higher than in 2012. This increase in GDP is a combination of an increase in production and a rise in prices. To isolate the increase in production from the rise in prices, we distinguish between *real* GDP and *nominal* GDP.

Real GDP is the value of final goods and services produced in a given year when *valued at the prices of a reference base year*. By comparing the value of production in the two years at the same prices, we reveal the change in production.

Currently, the reference base year is 2012 and we describe real GDP as measured in 2012 dollars—in terms of what the dollar would buy in 2012.

Nominal GDP is the value of final goods and services produced in a given year when valued at the prices of that year. Nominal GDP is just a more precise name for GDP.

Economists at the Bureau of Economic Analysis calculate real GDP using the method described in the Mathematical Note on pp. 132–133. Here, we'll explain the basic idea but not the technical details.

Calculating Real GDP

We'll calculate real GDP for an economy that produces one consumption good, one capital good, and one government service. Net exports are zero.

Table 4.3 shows the quantities produced and the prices in 2012 (the base year) and in 2021. In part (a), we calculate nominal GDP in 2012. For each item, we multiply the quantity produced in 2012 by its price in 2012 to find the total expenditure on the item. We sum the expenditures to find nominal GDP, which in 2012 is $100 million. Because 2012 is the base year, both real GDP and nominal GDP equal $100 million.

In Table 4.3(b), we calculate nominal GDP in 2021, which is $300 million. Nominal GDP in 2021 is three times its value in 2012. But by how much has production increased? Real GDP will tell us.

In Table 4.3(c), we calculate real GDP in 2021. The quantities of the goods and services produced are those of 2021, as in part (b). The prices are those in the reference base year—2012, as in part (a).

For each item, we multiply the quantity produced in 2021 by its price in 2012. We then sum these expenditures to find real GDP in 2021, which is $160 million. This number is what total expenditure would have been in 2021 if prices had remained the same as they were in 2012.

Nominal GDP in 2021 was 3 times its value in 2012, but real GDP in 2021 was only 1.6 times its 2012 value—a 60 percent increase in production.

TABLE 4.3 Calculating Nominal GDP and Real GDP

	Item	Quantity (millions)	Price (dollars)	Expenditure (millions of dollars)
(a) In 2012				
C	T-shirts	10	5	50
I	Computer chips	3	10	30
G	Security services	1	20	20
Y	Real GDP in 2012			100
(b) In 2021				
C	T-shirts	4	5	20
I	Computer chips	2	20	40
G	Security services	6	40	240
Y	Nominal GDP in 2021			300
(c) Quantities of 2021 valued at prices of 2012				
C	T-shirts	4	5	20
I	Computer chips	2	10	20
G	Security services	6	20	120
Y	Real GDP in 2021			160

In 2012, the reference base year, real GDP equals nominal GDP and was $100 million. In 2021, nominal GDP increased to $300 million, but real GDP, which is calculated by using the quantities in 2021 in part (b) and the prices in 2012 in part (a), was only $160 million—a 60 percent increase from 2012.

REVIEW QUIZ

1. What is the expenditure approach to measuring GDP?
2. What is the income approach to measuring GDP?
3. What adjustments must be made to total income to make it equal GDP?
4. What is the distinction between nominal GDP and real GDP?
5. How is real GDP calculated?

The Uses and Limitations of GDP

Economists use estimates of GDP for two main purposes:

- To compare the standard of living over time
- To compare the standard of living across countries

The Standard of Living Over Time

To compare the standard of living over time we calculate real GDP per person in different years. **Real GDP per person** is real GDP divided by the population. Real GDP per person tells us the value of goods and services that the average person can enjoy. By using *real* GDP, we remove any influence that rising prices and a rising cost of living might have had on our comparison.

We're interested in both the long-term trends and the shorter-term cycles in the standard of living.

Long-Term Trend A handy way of comparing real GDP per person over time is to express it as a ratio of some reference year. For example, in 1960, real GDP per person was $18,047 and in 2020, it was $55,822. So real GDP per person in 2020 was 3.1 times its 1960 level ($55,822 ÷ $18,047 = 3.1). To the extent that real GDP per person measures the standard of living, people were 3.1 times as well off in 2020 as their grandparents had been in 1960.

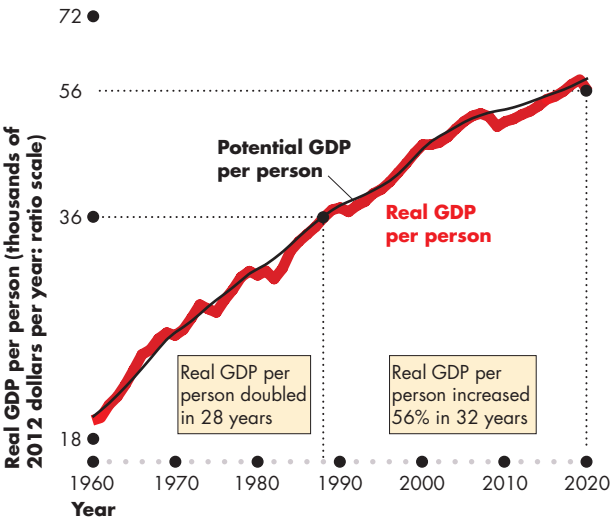
Figure 4.4 shows the path of U.S. real GDP per person for the 60 years from 1960 to 2020 and highlights two features of our expanding living standard:

- The growth of potential GDP per person
- Fluctuations of real GDP per person

The Growth of Potential GDP **Potential GDP** is the maximum level of real GDP that can be produced while avoiding shortages of labor, capital, land, and entrepreneurial ability that would bring rising inflation. Potential GDP per person, the smoother black line in Fig. 4.4, grows at a steady pace because the quantities of the factors of production and their productivities grow at a steady pace.

But potential GDP per person doesn't grow at a *constant* pace. During the 1960s, it grew at 2.8 percent per year but slowed to only 2.3 percent per year during the 1970s. This slowdown might seem small, but it had big consequences, as you'll soon see.

FIGURE 4.4 Rising Standard of Living in the United States



Real GDP per person in the United States doubled between 1960 and 1988 and tripled between1960 and 2020. Real GDP per person, the red line, fluctuates around potential GDP per person, the black line. (The *y*-axis is a ratio scale—see the Appendix, pp. 130–131.)

Sources of data: U.S. Department of Commerce, Bureau of Economic Analysis; and Congressional Budget Office.

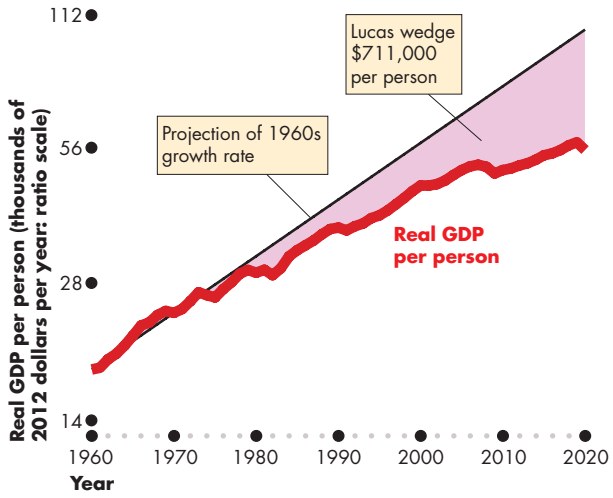
Fluctuations of Real GDP You can see that real GDP, shown by the red line in Fig. 4.4, fluctuates around potential GDP, and sometimes real GDP shrinks.

Let's take a closer look at the two features of our expanding living standard that we've just outlined.

Productivity Growth Slowdown How costly was the slowdown in productivity growth after 1970? The answer is provided by the *Lucas wedge*, which is the dollar value of the accumulated gap between what real GDP per person would have been if the 1960s growth rate had persisted and what real GDP per person turned out to be. (Nobel Laureate Robert E. Lucas Jr. drew attention to this gap.)

Figure 4.5 illustrates the Lucas wedge. The wedge started out small during the 1970s, but by 2020 real GDP per person was $47,900 per year lower than it would have been with no growth slowdown, and the accumulated gap was an astonishing $711,000 per person.

FIGURE 4.5 The Cost of Slower Growth: The Lucas Wedge



The black line projects the 1960s growth rate of real GDP per person to 2020. The Lucas wedge arises from the slowdown of productivity growth that began during the 1970s. The cost of the slowdown is $711,000 per person.

Sources of data: U.S. Department of Commerce, Bureau of Economic Analysis, Congressional Budget Office, and author's calculations.

Real GDP Fluctuations–The Business Cycle We call the fluctuations in the pace of expansion of real GDP the business cycle. The **business cycle** is a periodic but irregular up-and-down movement of total production and other measures of economic activity. The business cycle isn't a regular predictable cycle like the phases of the moon, but every cycle has two phases:

1. Expansion
2. Recession

and two turning points:

1. Peak
2. Trough

Figure 4.6 shows these features of the U.S. business cycle between 2006 and 2020.

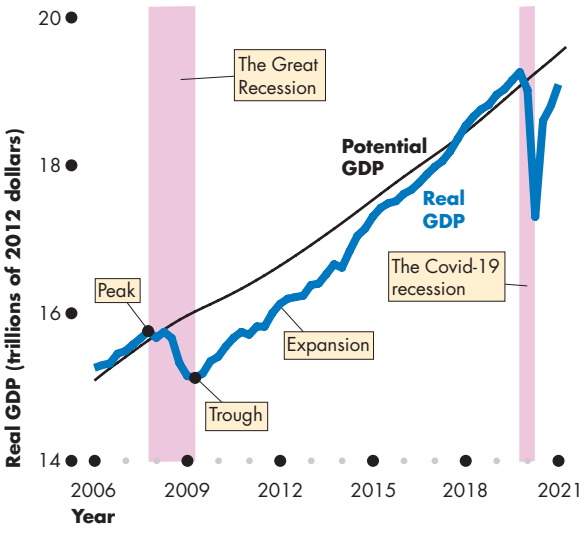
An **expansion** is a period during which real GDP increases. In the early stage of an expansion, real GDP returns to potential GDP; and as the expansion progresses, potential GDP grows and real GDP eventually exceeds potential GDP.

A common definition of **recession** is a period during which real GDP decreases—its growth rate is negative—for at least two successive quarters. The definition used by the National Bureau of Economic Research, which dates the U.S. business cycle phases and turning points, is "a period of significant decline in total output, income, employment, and trade, usually lasting from six months to a year, and marked by contractions in many sectors of the economy."

An expansion ends and recession begins at a business cycle *peak*, which is the highest level that real GDP has attained up to that time. A recession ends at a *trough*, when real GDP reaches a temporary low point and from which the next expansion begins.

Figure 4.6 shows the two most recent recessions, the Great Recession of 2008-2009 and the Covid-19 recession of 2020. The expansion following the Great Recession was slow and long drawn out. In contrast, the expansion following the Covid-19 recession was fast and strong.

FIGURE 4.6 The Most Recent U.S. Business Cycle



The Great Recession began at a peak in the fourth quarter of 2007 and ended at a trough in the second quarter of 2009. A slow expansion then began. The Covid-19 recession began in the first quarter of 2020 and ended at a trough two quarters later to be followed by a strong expansion.

Sources of data: U.S. Department of Commerce, Bureau of Economic Analysis; Congressional Budget Office; and National Bureau of Economic Research.

The Standard of Living Across Countries

Two problems arise in using GDP to compare living standards across countries. First, the GDP of one country must be converted into the same currency units as the GDP of the other country. Second, the goods and services in both countries must be valued at the same prices. Comparing the United States and China provides a striking example of these two problems.

China and the United States in U.S. Dollars In 2020, GDP per person in the United States was $65,252 and in China it was 71,168 yuan. The yuan is the currency of China and the price at which the dollar and the yuan exchanged, the *market exchange rate*, was 6.7 yuan per $1 U.S. Using this exchange rate, 71,168 yuan converts to $10,622. Based on these numbers, GDP per person in the United States in 2020 was 6.1 times that in China.

China and the United States at PPP The prices of some goods are higher in the United States than in China, so these items get a smaller weight in the calculation of China's GDP than they get in U.S. GDP. An example is a Big Mac that costs $5.66 in Chicago. In Shanghai, a Big Mac costs 22.40 yuan, which is the equivalent of $3.34. So in China's GDP, a Big Mac gets about half the weight that it gets in U.S. GDP. Some prices in China are higher than in the United States but more prices are lower, so Chinese prices put a lower value on China's production than do U.S. prices.

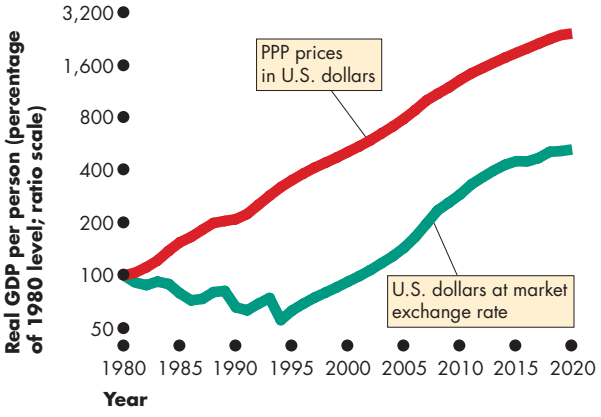
Purchasing power parity, or *PPP* comparisons use the same prices for both countries, and when China's production is valued at U.S. prices, GDP per person in the United States in 2020 was 4 times that of China, not 6.1 times.

China and the United States over Time To compare the standard of living across countries over time, we use PPP prices in a common base year, currently 2017. Figure 4.7 shows this measures of real GDP per person in China from 1980 to 2020 and contrasts it with a market exchange rate measure (graphed as percentages of their levels in 1980).

You've seen how real GDP is used to make standard of living comparisons over time and across countries. But real GDP isn't a perfect measure of the standard of living and we'll now examine its limitations.

In July 2020, a Big Mac cost $5.66 in Chicago and 22.40 yuan or $3.34 in Shanghai. To compare GDP in China and the United States, we must value China's Big Macs at the $5.66 U.S. price—the PPP price.

FIGURE 4.7 Two Views of Real GDP in China



Real GDP per person in China has grown rapidly. But how rapidly it has grown and to what level depends on how GDP is valued. When GDP in 2020 is valued at the market exchange rate, U.S. GDP per person is 6.1 times that in China. China looks like a poor developing country. But this comparison is misleading. When GDP is valued at purchasing power parity prices (PPP), U.S. GDP per person is only 4 times that in China.

Source of data: International Monetary Fund, *World Economic Outlook Database*, April 2021.

Limitations of GDP

GDP measures the value of goods and services that are bought in markets. Some of the factors that influence the standard of living and that are not part of GDP are

- Household production
- Underground economic activity
- Leisure time
- Environmental quality

Household Production Preparing meals, changing a light bulb, cutting grass, and caring for a child are all examples of household production. Because these productive activities are not traded in markets, they are not included in GDP.

The omission of household production from GDP means that GDP *underestimates* total production. But it also means that the growth rate of GDP *overestimates* the growth rate of total production. The reason is that some of the growth rate of market production (included in GDP) is a replacement for home production. So part of the increase in GDP arises from a decrease in home production.

Underground Economic Activity The *underground economy* is the part of the economy that is purposely hidden from the view of the government to avoid taxes and regulations or because the goods and services being produced are illegal.

Because underground economic activity is unreported, it is omitted from GDP. The underground economy in the United States ranges between 11 and 12 percent of GDP ($2.3 trillion to $2.5 trillion).

Leisure Time Leisure time is an economic good that adds to our economic well-being and the standard of living. Other things remaining the same, the more leisure we have, the better off we are. Our working time is valued as part of GDP, but our leisure time is not. Yet that leisure time must be at least as valuable to us as the wage that we earn for the last hour worked. If it were not, we would work instead of taking leisure.

Over the years, leisure time has steadily increased. The workweek has become shorter, more people take early retirement, and the number of vacation days has increased. These improvements in economic well-being are not reflected in GDP.

Environmental Quality Economic activity directly influences the quality of the environment. Burning oil and coal brings global warming and climate change. Depleting nonrenewable resources, clearing forests, and polluting lakes and rivers are other environmental consequences of industrial production.

Resources used to protect the environment are valued as part of GDP. For example, the value of catalytic converters that help to protect the atmosphere from automobile emissions is part of GDP. But the cost of pollution is not subtracted from GDP.

An industrial society possibly produces more atmospheric pollution than an agricultural society does. But pollution does not always increase as we become wealthier. Wealthy people value a clean environment and are willing to pay for one. Compare the pollution in China today with pollution in the United States. China, a poor country, pollutes its rivers, lakes, and atmosphere in a way that is unimaginable in the United States.

Whose production is more valuable: the chef's whose work gets counted in GDP…

…or the family's dinner preparation and childcare that don't get counted?

AT ISSUE

Should GNNP Replace GDP?

The standard view of economists is that despite its limitations, GDP is a useful measure of the value of production and the overall level of economic activity in a country or region.

But a prominent economist, Joseph Stiglitz, has argued that GDP is dangerously misleading and needs to be replaced by a measure that he calls Green Net National Product (or GNNP).

Let's look at both sides of this issue.

Joe Stiglitz says ...

- GDP has passed its use-by date.
- A *gross* measure is wrong because it ignores the depreciation of assets.
- A *domestic* measure is wrong because it ignores the incomes paid to foreigners who exploit a nation's resources.
- A *green* measure is needed to take account of the environmental damage that arises from production.
- GNNP subtracts from GDP incomes paid to foreigners, depreciation, the value of depleted natural resources, and the cost of a degraded environment.
- The existence of a market price for carbon emissions makes it possible to measure the cost of these emissions and subtract them from GDP.
- A bad accounting framework is likely to lead to bad decisions.
- America's "drain America first" energy policy is an example of a bad decision. It increases GDP but decreases GNNP and makes us poorer.

Bad accounting frameworks are likely to lead to bad decisions. A government focused on GDP might be encouraged to give away mining or oil concessions; a focus on green NNP might make it realize that the country risks being worse off.

Joseph Stiglitz,
"Good Numbers Gone Bad,"
Fortune, September 25, 2006

The Mainstream View

- As a measure of the value of market production in an economy, GDP does a good job.
- GDP is used to track the ups and downs of economic activity and it is a useful indicator for making macroeconomic stabilization policy decisions.
- GDP is *not* used to measure net national economic well-being nor to guide microeconomic resource allocation decisions.
- There is no disagreement that a *net national* measure is appropriate for measuring national economic well-being.
- There is no disagreement that "negative externalities" arising from carbon emissions and other pollution detract from economic well-being.
- The omissions from GDP of household production and underground production are *bigger* problems than those emphasized by Stiglitz.
- It isn't clear that depleting oil and coal resources is costly and misguided because advances in green energy technology will eventually make oil and coal of little value. The stone-age didn't end because we ran out of stone, and the carbon-age won't end because we run out of oil and coal!

When Anglo-Australian company BHP Billiton mines copper in Papua New Guinea, the country's GDP rises, but profits go abroad and the 40,000 people who live by a polluted river lose their means of earning a living. GNNP measures that loss.

ECONOMICS IN ACTION

A Broader Indicator of Economic Well-Being

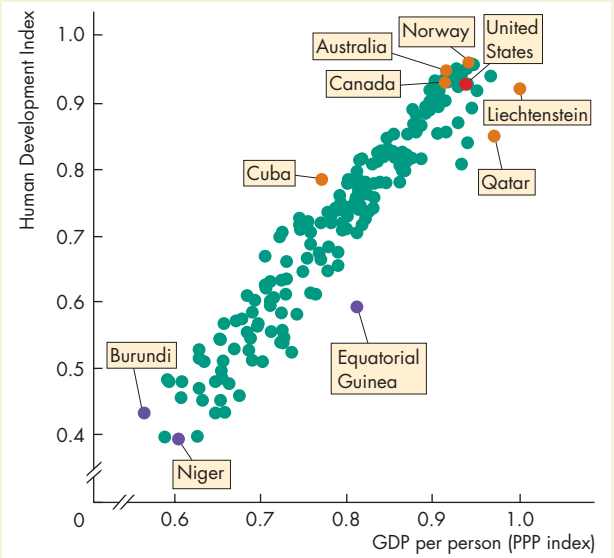
The limitations of GDP reviewed in this chapter affect the standard of living and general well-being of every country. So to make international comparisons of the general state of economic well-being, we must look at GDP and other indicators.

The United Nations has constructed a broader measure called the Human Development Index (HDI), which combines GDP, life expectancy and health, and education. GDP per person (measured on the PPP basis) is a major component of the HDI so, as you can see in the figure, the two are strongly correlated.

The figure shows the data for 2019. In that year, Norway had the highest HDI, but Liechtenstein had the highest GDP per person. The United States had the seventeenth highest HDI.

The HDI of the United States is below that of some other countries because the people of those countries live longer and have better access to healthcare and education than do Americans.

African nations have the lowest levels of economic well-being. The figure shows that Niger had the lowest HDI and Burundi has the lowest GDP per person. The biggest outlier is Equatorial Guinea with a high (but unequally shared) GDP and average HDI.



The Human Development Index

Source of data: United Nations hdr.undp.org/en/statistics/data.

The Bottom Line Do we get the wrong message about the level and growth in economic well-being and the standard of living by looking at the growth of real GDP? The influences that are omitted from real GDP are probably large. Developing countries have a larger amount of household production than do developed countries, so the gap between their living standards is exaggerated. Also, as real GDP grows, part of the growth is a switch from home production to market production. This switch overstates the growth in economic well-being and the improvement in the standard of living.

It is possible to construct broader measures that combine the many influences that contribute to human happiness. The United Nations' Human Development Index or HDI (above), and Green Net National Product or GNNP (previous page) are two examples of dozens of other measures that have been proposed.

Despite all the alternatives, real GDP per person remains the most widely used indicator of economic well-being.

REVIEW QUIZ

1. Distinguish between real GDP and potential GDP and describe how each grows over time.
2. How does the growth rate of GDP contribute to an improved standard of living?
3. What is a business cycle and what are its phases and turning points?
4. What is PPP and how does it help us to make valid international comparisons of GDP?
5. Explain why GDP might be an unreliable indicator of the standard of living.

You now know how economists measure GDP and what the GDP data tell us. *Economics in the News* on pp. 128–129 looks at GDP through the Covid-19 recession and the efforts of economists to measure GDP in real time.

Nowcasting During the Covid Recession

The coronavirus pandemic began in the first quarter of 2020, and early in the second quarter it was becoming clear that the economy was going to take a big hit. But how big a hit? The fall in real GDP provides a measure, and economists at the New York Fed tried to get an early answer.

Read these news releases and analysis to find the answers.

GDP, 2nd Quarter 2020 (New York Fed Staff Nowcasts)

On April 3, as the second quarter started, the New York Fed's real GDP Nowcast was a fall of 0.37 percent. On June 26, as the quarter approached its end, the Nowcast was a fall of 16.33 percent.
Data extracted from New York Fed Staff Nowcasts Archive

GDP, 2nd Quarter 2020 (Advance Estimate)

Real gross domestic product (GDP) decreased at an annual rate of 32.9 percent in the second quarter of 2020, according to the "advance" estimate released by the Bureau of Economic Analysis. The GDP estimate released today is based on source data that are incomplete or subject to further revision.

Bureau of Economic Analysis News release, July 30, 2020

GDP, 2nd Quarter 2020 (Second Estimate)

Real gross domestic product (GDP) decreased at an annual rate of 31.7 percent in the second quarter of 2020, according to the "second" estimate released by the Bureau of Economic Analysis. The GDP estimate released today is based on more complete source data than were available for the "advance" estimate issued last month.

Bureau of Economic Analysis News release, August 27, 2020

GDP, 2nd Quarter 2020 (Third Estimate)

Real gross domestic product (GDP) decreased at an annual rate of 31.4 percent in the second quarter of 2020, according to the "third" estimate released by the Bureau of Economic Analysis. The "third" estimate of GDP released today is based on more complete source data than were available for the "second" estimate issued last month.

Bureau of Economic Analysis News release, September 30, 2020

ESSENCE OF THE STORY

- On April 3, before the scale of the pandemic was felt, New York Fed economists nowcasted the fall in real GDP at 0.37 percent.
- By June 26, the Nowcast was a fall of 16.33 percent.
- The Bureau of Economic Analysis advance estimate, released on July 30, was a decrease of 32.9 percent, revised to 31.7 percent on August 27, and to 31.4 percent on September 30.

ECONOMIC ANALYSIS

- On July 30, 2020, the Bureau of Economic Analysis (BEA) published its advanced estimate of the real GDP growth rate in the second quarter (April 1 to June 30), a decrease of 32.9 percent expressed as an annual rate.
- This fall in real GDP was and remains the largest ever recorded.
- Was the fall foreseen? And what was going to happen in the third quarter of 2020?
- To answer questions like these and to provide the most accurate possible picture of the current state of the economy, economists at the Federal Reserve Bank of New York (the NY Fed) "nowcast" real GDP.
- A real GDP nowcast is an estimate of real GDP in the current quarter as it happens and before all the data have been gathered and used by the BEA to calculate the official measure of real GDP.
- To make a nowcast, economists feed real-time data into a statistical model to produce frequently updated nowcasts of the current quarter growth rate of real GDP.
- Figure 1 summarizes the NY Fed nowcasts and the BEA estimates of the real GDP growth rate during the second and third quarters of 2020.
- The small dots in Fig. 1 show the sequence of nowcasts made by the NY Fed.
- In the second quarter (Q2), as employment data and business outlook data became available, the NY Fed nowcast estimated an ever-larger fall in real GDP.
- But later in the second quarter, as employment picked up and consumer spending data showed an improvement, the nowcast estimated a smaller fall in real GDP.
- The large dots show the BEA advanced, revised, and third estimates, which are made one, two, and three months after the quarter ends.
- The NY Fed started nowcasting in 2002 and Fig. 2 shows how the final nowcast for each quarter compares with the BEA final estimate.

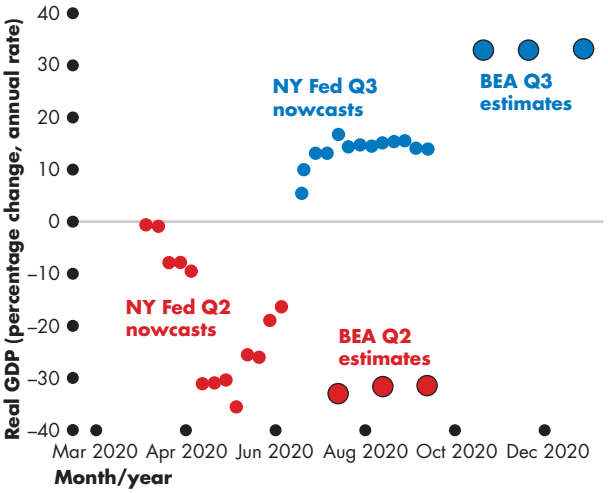


Figure 1 Nowcast and Actual Real GDP through Covid-19 Recession

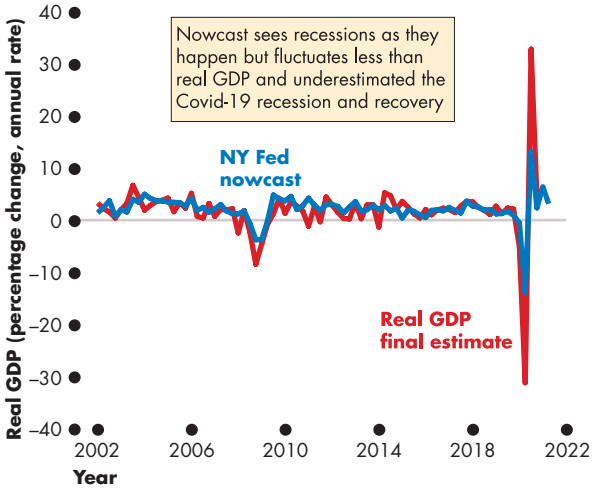


Figure 2 Nowcast and Actual Real GDP: 2002–2021

APPENDIX

Graphs in Macroeconomics

After studying this appendix, you will be able to:

- Make and interpret a time-series graph
- Make and interpret a graph that uses a ratio scale

The Time-Series Graph

In macroeconomics we study the fluctuations and trends in the key variables that describe macroeconomic performance and policy. These variables include GDP and its expenditure and income components that you've learned about in this chapter. They also include variables that describe the labor market and consumer prices that you study in Chapter 5.

Regardless of the variable of interest, we want to be able to compare its value today with that in the past, and we want to describe how the variable has changed over time. The most effective way to do these things is to make a time-series graph.

Making a Time-Series Graph

A **time-series graph** measures time (for example, years, quarters, or months) on the *x*-axis and the variable or variables in which we are interested on the *y*-axis. Figure A4.1 is an example of a time-series graph. It provides some information about unemployment in the United States since 2008. In this figure, we measure time in years starting in 2008. We measure the unemployment rate (the variable that we are interested in) on the *y*-axis.

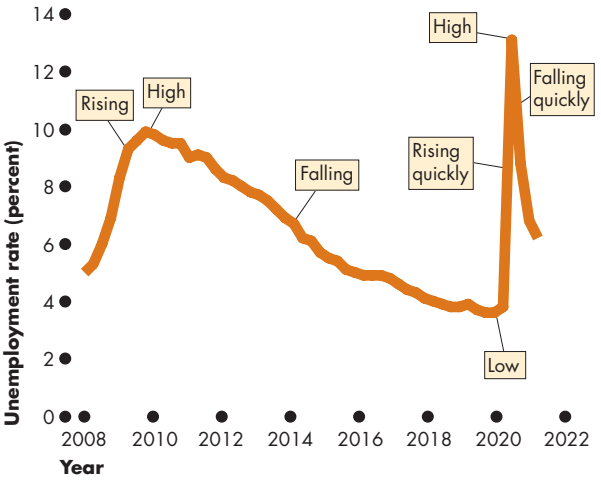
A time-series graph enables us to visualize how a variable has changed over time and how its value in one period relates to its value in another period. It conveys an enormous amount of information quickly and easily.

Let's see how to "read" a time-series graph.

Reading a Time-Series Graph

To practice reading a time-series graph, take a close look at Fig. A4.1. The graph shows the level, change, and speed of change of the variable.

FIGURE A4.1 A Time-Series Graph



A time-series graph plots the level of a variable on the *y*-axis against time (here measured in years) on the *x*-axis. This graph shows the unemployment rate each year from 2008 to 2020. The graph shows when unemployment was high, when it was low, when it increased, when it decreased, and when it changed quickly and slowly.

- The *level* of the variable: It tells us when unemployment is *high* and *low*. When the line is a long distance above the *x*-axis, the unemployment rate is high, as it was, for example, in 2010 and 2020. When the line is close to the *x*-axis, the unemployment rate is low, as it was, for example, at the beginning of 2020.
- The *change* in the variable: It tells us how unemployment *changes*—whether it *increases* or *decreases*. When the line slopes upward, as it did in 2008 and 2009, the unemployment rate is rising. When the line slopes downward, as it did in 2010 through 2019, the unemployment rate is falling.
- The *speed of change* in the variable: It tells us whether the unemployment rate is rising or falling *quickly* or *slowly*. If the line is very steep, then the unemployment rate increases or decreases quickly. If the line is not steep, the unemployment rate increases or decreases slowly. For example, the unemployment rate rose quickly in 2021 and slowly in 2008 and it fell quickly in 2021 and slowly from 2010 to 2020.

Ratio Scale Reveals Trend

A time-series graph also reveals whether a variable has a **cycle**, which is a tendency for a variable to alternate between upward and downward movements, or a **trend**, which is a tendency for a variable to move in one general direction.

The unemployment rate in Fig. A4.1 has a cycle but no trend. When a trend is present, a special kind of time-series graph, one that uses a ratio scale on the *y*-axis, reveals the trend.

A Time-Series with a Trend

Many macroeconomic variables, among them GDP and the average level of prices, have an upward trend. Figure A4.2 shows an example of such a variable: the average prices paid by consumers.

In Fig. A4.2(a), consumer prices since 1975 are graphed on a normal scale. In 1975 the level is 100. In other years, the average level of prices is measured as a percentage of the 1975 level.

The graph clearly shows the upward trend of prices. But it doesn't tell us when prices were rising fastest or whether there was any change in the trend. Just looking at the upward-sloping line in Fig. A4.2(a) gives the impression that the pace of growth of consumer prices was constant.

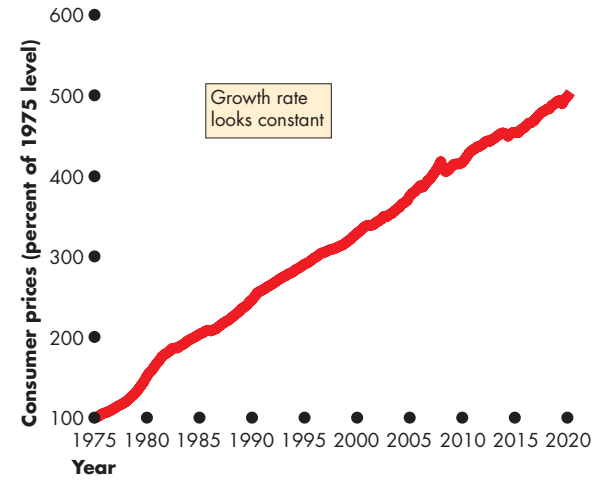
Using a Ratio Scale

On a graph axis with a normal scale, the gap between 100 and 200 is the same as that between 300 and 400. On a graph axis with a ratio scale, the gap between 100 and 200 is the same as that between 200 and 400. The ratio 200 to 100 equals the ratio 400 to 200. By using a ratio scale, we can "see" when the growth rate (the percentage change) changes.

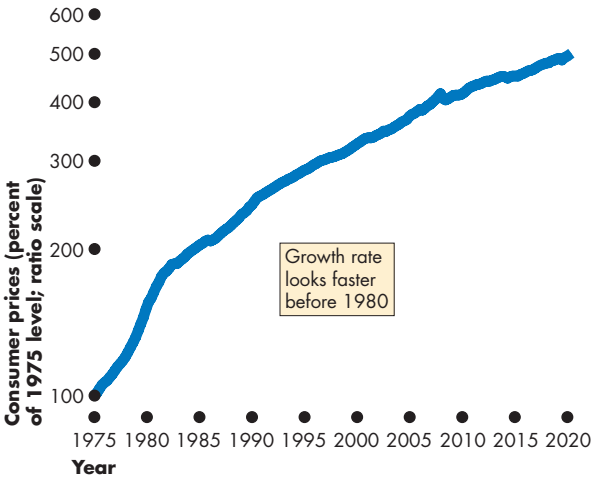
Figure A4.2(b) shows an example of a ratio scale. Notice that the values on the *y*-axis get closer together but the gap between 400 and 200 equals the gap between 200 and 100: The ratio gaps are equal.

Graphing the data on a ratio scale reveals the trends. In the case of consumer prices, the trend is much steeper during the 1970s and early 1980s than in the later years. The steeper the line in the ratio-scale graph in part (b), the faster are prices rising. Prices rose rapidly during the 1970s and early 1980s and more slowly in the later 1980s and 1990s. The ratio-scale graph reveals this fact. We use ratio-scale graphs extensively in macroeconomics.

FIGURE A4.2 Ratio Scale Reveals Trend



(a) Normal scale



(b) Ratio scale

The graph shows the average of consumer prices from 1975 to 2020. The level is 100 in 1975, and the values for the other years are percentages of the 1975 level. Consumer prices normally rise each year, so the line slopes upward. In part (a), where the *y*-axis scale is normal, the rate of increase appears to be constant.

In part (b), where the *y*-axis is a ratio scale (the ratio of 400 to 200 equals the ratio 200 to 100), prices rose faster during the 1970s and early 1980s and slower in the later years. The ratio scale reveals this trend.

MATHEMATICAL NOTE

Chained-Dollar Real GDP

In the real GDP calculation on p. 121, real GDP in 2021 is 1.6 times its value in 2012. But suppose that we use 2021 as the reference base year and value real GDP in 2021 at 2021 prices. If you do the math, you will see that real GDP in 2012 is $150 million at 2021 prices. GDP in 2021 is $300 million (in 2021 prices), so now the numbers say that real GDP has doubled. Which is correct: Did real GDP increase 1.6 times or double from 2012 to 2021? Should we use the prices of 2012 or 2021? The answer is that we need to use *both* sets of prices.

The Bureau of Economic Analysis uses a measure of real GDP called *chained-dollar real GDP*. Three steps are needed to calculate this measure:

- Value production in the prices of adjacent years
- Find the average of two percentage changes
- Link (chain) back to the reference base year

Value Production in Prices of Adjacent Years

The first step is to value production in *adjacent* years at the prices of *both* years. We'll make these calculations for 2021 and its preceding year, 2020.

Table 1 shows the quantities produced and prices in the two years. Part (a) shows the nominal GDP calculation for 2020—the quantities produced in 2020 valued at the prices of 2020. Nominal GDP in 2020 is $168 million. Part (b) shows the nominal GDP calculation for 2021—the quantities produced in 2021 valued at the prices of 2021. Nominal GDP in 2021 is $300 million. Part (c) shows the value of the quantities produced in 2021 at the prices of 2020. This total is $172 million. Finally, part (d) shows the value of the quantities produced in 2020 at the prices of 2021. This total is $295 million.

TABLE 1 Real GDP Calculation Step 1: Value Production in Adjacent Years at Prices of Both Years

	Item	Quantity (millions)	Price (dollars)	Expenditure (millions of dollars)
(a) In 2020				
C	T-shirts	3	4	12
I	Computer chips	2	15	30
G	Security services	6	21	126
Y	Nominal GDP in 2020			**168**
(b) In 2021				
C	T-shirts	4	5	20
I	Computer chips	2	20	40
G	Security services	6	40	240
Y	Nominal GDP in 2021			**300**
(c) Quantities of 2021 valued at prices of 2020				
C	T-shirts	4	4	16
I	Computer chips	2	15	30
G	Security services	6	21	126
Y	2021 production at 2020 prices			**172**
(d) Quantities of 2020 valued at prices of 2021				
C	T-shirts	3	5	15
I	Computer chips	2	20	40
G	Security services	6	40	240
Y	2020 production at 2021 prices			**295**

Step 1 is to value the production of adjacent years at the prices of both years. Here, we value the production of 2020 and 2021 at the prices of both 2020 and 2021. The value of 2020 production at 2020 prices, in part (a), is nominal GDP in 2020. The value of 2021 production at 2021 prices, in part (b), is nominal GDP in 2021. Part (c) calculates the value of 2021 production at 2020 prices, and part (d) calculates the value of 2020 production at 2021 prices. We use these numbers in Step 2.

Find the Average of Two Percentage Changes

The second step is to find the percentage change in the value of production based on the prices in the two adjacent years. Table 2 summarizes these calculations.

Part (a) shows that, valued at the prices of 2020, production increased from $168 million in 2020 to $172 million in 2021, an increase of 2.4 percent.

Part (b) shows that, valued at the prices of 2021, production increased from $295 million in 2020 to $300 million in 2021, an increase of 1.7 percent. Part (c) shows that the average of these two percentage changes in the value of production is 2.0. That is, $(2.4 + 1.7) \div 2 = 2.0$.

This average percentage change is the *growth rate* of real GDP in 2021. This growth rate depends only on production and prices in 2020 and 2021.

The final step is to find the *level* of real GDP.

TABLE 2 Real GDP Calculation Step 2: Find Average of Two Percentage Changes

Value of Production	Millions of dollars	
(a) At 2020 prices		
Nominal GDP in 2020	168	
2021 production at 2020 prices	172	
Percentage change in production at 2020 prices		2.4
(b) At 2021 prices		
2020 production at 2021 prices	295	
Nominal GDP in 2021	300	
Percentage change in production at 2021 prices		1.7
(c) Average percentage change in 2021		**2.0**

Using the numbers calculated in Step 1, the change in production from 2020 to 2021 valued at 2020 prices is 2.4 percent, in part (a). The change in production from 2020 to 2021 valued at 2021 prices is 1.7 percent, in part (b). The average of these two percentage changes is 2.0 percent in part (c).

Link (Chain) to the Base Year

The *level* of real GDP depends on the choice of a *base year*. To see how, we'll continue with our example and suppose that the base year is 2020.

By definition, real GDP and nominal GDP are equal in the base year. So real GDP in 2020 (in 2020 dollars) is $168 million (in Table 1).

In 2021, real GDP grew by 2.0 percent, so real GDP in 2021 (in 2020 dollars) is 2.0 percent greater than $168 million, which equals $171 million. (Check the calculation: Real GDP increased by $3 million, which is 2.0 percent of $168 million.)

Today in the United States, the base year is 2012, and to calculate real GDP in other years, both before and after 2012, more calculations are needed.

The BEA must calculate the percentage change in real GDP for *each* pair of years from the base year to the most recent year. And to find real GDP for years before the base year, the BEA must calculate the growth rates for each pair of years back to the earliest one for which it has data.

Finally, using the average percentage changes it has calculated, the BEA calculates real GDP in each year at 2012 prices by linking them to the value of real GDP in 2012.

To illustrate this third step, we'll assume that the BEA has used the method we've described to calculate the percentage changes of real GDP for the years 2011 through 2021. Figure 1 shows these percentage changes and illustrates the chain-link calculations.

In the reference base year, 2012, real GDP equals nominal GDP, which we'll assume is $112 million. The growth rate in 2013 was 5 percent, so real GDP in 2013 is 5 percent higher than it was in 2012, which means that real GDP in 2013 is $118 million ($112 \times 1.05 = 118$).

The growth rate in 2014 was 6 percent, so real GDP in 2014 is 6 percent higher than it was in 2013, which means that real GDP in 2014 is $125 million ($118 \times 1.06 = 125$).

By repeating these calculations for each year, we obtain the *chained-dollar real GDP* in 2012 dollars for each year.

For 2020, the *chained-dollar real GDP* in 2012 dollars is $170 million. So the 2.0 percent growth rate in 2021 that we calculated in Table 2 means that real GDP in 2021 is $173 million ($170 \times 1.02 = 173$).

Notice that the growth rates are independent of the reference base year, so changing the reference base year does not change the growth rates.

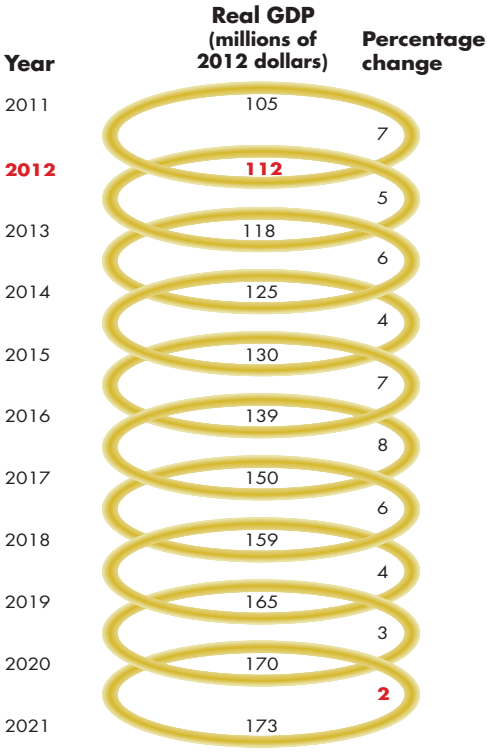


Figure 1 Real GDP Calculation Step 3: Link (Chain) to Base Year

WORKED PROBLEM

Dreamland's national accounts include the following entries:

- Government expenditure on goods and services: $600
- Consumption expenditure: $1,950
- Rent and interest: $400
- Indirect taxes less subsidies: $350
- Investment: $550
- Wages: $1,600
- Profit: $500
- Net exports: $200
- Depreciation: $450

Questions

1. Use the expenditure approach to calculate GDP.
2. Calculate net domestic income at factor cost.
3. Calculate net domestic income at market prices.
4. Use the income approach to calculate GDP.

Solutions

1. The expenditure approach sums the expenditure on final goods and services. That is, GDP is the sum of consumption expenditure, investment, government expenditure, and net exports. That is, GDP = $1,950 + $550 + $600 + $200 = $3,300.

Key Point: GDP equals the sum of consumption expenditure, investment, government expenditure on goods and services, and net exports. See the figure.

2. Net domestic income at factor cost is the income paid to factors of production: wages, rent, interest, and profit. Net domestic income at factor cost equals $1,600 + $400 + $500 = $2,500.

Key Point: The incomes earned by the factors of production (labor, land, capital, and entrepreneurship) sum to net domestic income at factor cost. See the figure.

3. Expenditure on goods and services equals the quantity bought multiplied by the market price. Incomes are total factor costs. The market price of a good or service equals the cost of the factors of production used to produce it if production is not subsidized and sale of the good is not taxed.

   If the producer of a good receives a subsidy, then the market price of the good is less than the cost of producing it. If a tax is imposed on the sale of the good, then the market price exceeds the cost of producing it. So

   Market price = Factor cost + Indirect taxes less subsidies.

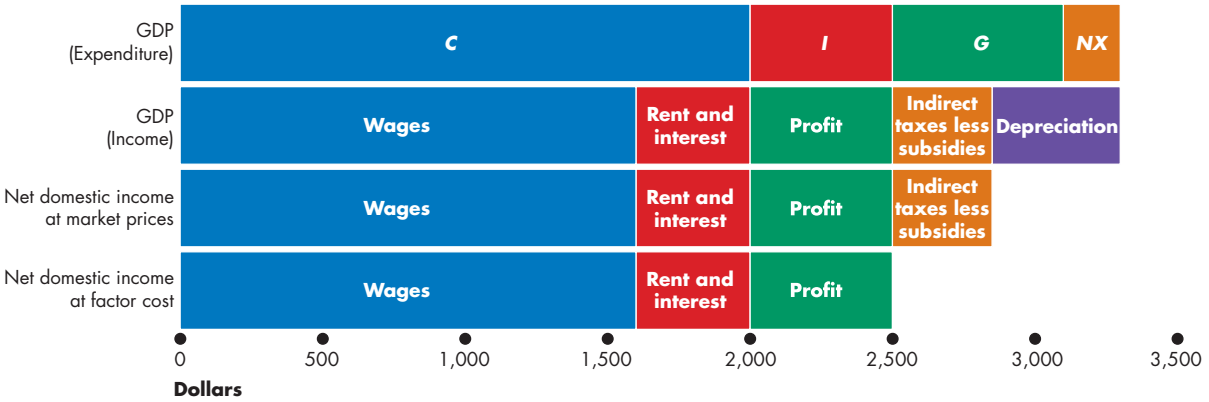
   Net domestic income at factor cost is $2,500, so net domestic income at market prices equals $2,500 + $350 = $2,850.

Key Point: To convert from factor cost to market prices add indirect taxes less subsidies. See the figure.

4. GDP is a gross measure of total production at market prices while net domestic income at market prices is a net measure. So using the income approach to measuring GDP, depreciation must be added to net domestic income at market prices to convert it to GDP. That is, using the income approach, GDP = $2,850 + $450 = $3,300.

Key Point: To convert net domestic income at market prices into GDP, add depreciation. See the figure.

Key Figure



SUMMARY

Key Points

Gross Domestic Product (pp. 116–118)

- GDP, or gross domestic product, is the market value of all the final goods and services produced in a country during a given period.
- A final good is an item that is bought by its final user, and it contrasts with an intermediate good, which is a component of a final good.
- GDP is calculated by using either the expenditure or income totals in the circular flow model.
- Aggregate expenditure on goods and services equals aggregate income and GDP.

Measuring U.S. GDP (pp. 119–121)

- Because aggregate expenditure, aggregate income, and the value of aggregate production are equal, we can measure GDP by using the expenditure approach or the income approach.
- The expenditure approach sums consumption expenditure, investment, government expenditure on goods and services, and net exports.
- The income approach sums wages, interest, rent, and profit (plus indirect taxes less subsidies plus depreciation).
- Real GDP is measured using a common set of prices to remove the effects of inflation from GDP.

The Uses and Limitations of GDP (pp. 122–127)

- GDP is used to compare the standard of living over time and across countries.
- GDP per person grows and fluctuates around the more smoothly growing potential GDP.
- A slowing of the growth rate of GDP per person during the 1970s has lowered incomes by a large amount.
- International GDP comparisons use PPP prices.
- GDP is not a perfect measure of the standard of living because it excludes household production, the underground economy, leisure time, and environmental quality.

Key Terms

Business cycle, 123
Consumption expenditure, 117
Cycle, 131
Depreciation, 118
Expansion, 123
Exports, 118
Final good, 116
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Gross domestic product (GDP), 116
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Net investment, 118
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Real GDP, 121
Real GDP per person, 122
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Time-series graph, 130
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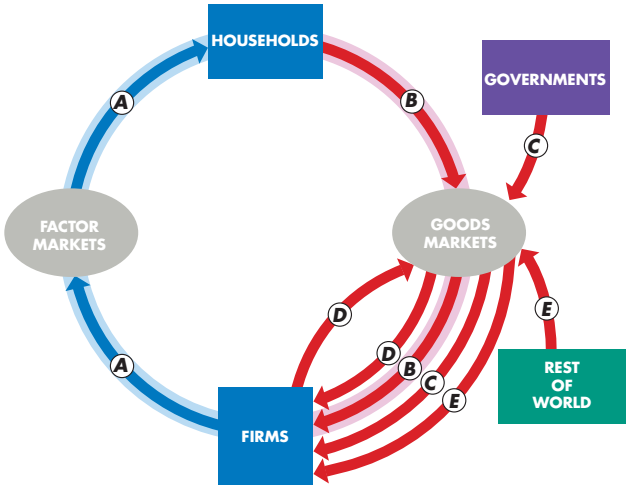
PROBLEMS AND APPLICATIONS

Gross Domestic Product

1. Classify each of the following items as a final good or service or an intermediate good or service and identify each item as a component of consumption expenditure, investment, or government expenditure on goods and services:
   - A new Renault car bought for your birthday
   - Weapons bought by the Russian government
   - Tortillas bought by a Mexican fast-food stand
   - Glass bottles purchased by Perrier
   - A new house on the Caribbean island bought by Argentina's president
2. The following figure illustrates the circular flow model.



During 2021, flow *A* was $13.0 trillion, flow *B* was $9.1 trillion, flow *D* was $3.3 trillion, and flow *E* was −$0.8 trillion. Calculate (i) GDP and (ii) government expenditure.

3. Use the following data to calculate aggregate expenditure and imports of goods and services.
   - Government expenditure: $20 billion
   - Aggregate income: $100 billion
   - Consumption expenditure: $67 billion
   - Investment: $21 billion
   - Exports of goods and services: $30 billion

Measuring U.S. GDP

4. The table in the next column lists some national accounts data for the United States in 2019.
   a. Calculate U.S. GDP in 2019.

Item	Billions of dollars
Wages	11,317
Consumption expenditure	14,266
Other factor incomes	4,935
Investment	3,784
Government expenditure	3,683
Net exports	−634
Depreciation	3,402

   b. Explain the approach (expenditure or income) you used to calculate GDP.

Use the following data to work Problems 5 and 6.

Tropical Republic produces only bananas and coconuts. The base year is 2021, and the table gives the quantities produced and the market prices.

Quantities	2021	2022
Bananas	800 bunches	900 bunches
Coconuts	400 bunches	500 bunches
Prices	**2021**	**2022**
Bananas	$2 a bunch	$4 a bunch
Coconuts	$10 a bunch	$5 a bunch

5. Calculate nominal GDP in 2021 and 2022.
6. Calculate real GDP in 2022 expressed in base-year prices.

The Uses and Limitations of GDP

7. Use the following data to work out the year in which the U.S. standard of living (i) increased and (ii) decreased. Explain your answer.

Year	Real GDP	Population
2017	$18.1 trillion	325.1 million
2018	$18.7 trillion	326.7 million
2019	$19.1 trillion	328.5 million
2020	$18.4 trillion	330.1 million

Mathematical Note

8. An agricultural economy produces only potatoes and tomatoes.

Quantities	2016	2017
Potatoes	2,000 tons	2,300 tons
Tomatoes	900 tons	1,000 tons
Prices	**2016**	**2017**
Potatoes	€27 a ton	€33 a ton
Tomatoes	€14 a ton	€12 a ton

Calculate the country's chained-euro real GDP in 2017 expressed in 2016 euros.

ADDITIONAL PROBLEMS AND APPLICATIONS

Gross Domestic Product

9. Classify each of the following items as a final or an intermediate good or service, and identify which is a component of consumption expenditure, investment, or government expenditure on goods and services:
   - Financial services bought by China Investment Corporation.
   - Desktop computers bought by Barclays.
   - New taximeters imported from China by the London Taxi Company.
   - New DVD bought by a student from Virgin Megastore.

Use the figure in Problem 2 to work Problems 10 and 11.

10. In 2020, flow *A* was $1,000 billion, flow *C* was $250 billion, flow *B* was $650 billion, and flow *E* was $50 billion. Calculate investment.
11. In 2021, flow *D* was $2 trillion, flow *E* was −$1 trillion, flow *A* was $10 trillion, and flow *C* was $4 trillion. Calculate consumption expenditure.

Use the following information to work Problems 12 and 13.

Naval Group, a French company, provides parts and equipment for Brazilian submarines. Renault do Brasil, the Brazilian subsidiary of the French car manufacturer Renault, produces cars for the Brazilian market in Paraná.

12. Explain where these activities appear in the Brazilian National Income and Product Accounts.
13. Explain where these activities appear in France's National Income and Product Accounts.

Use the following news clip to work Problems 14 and 15, and use the circular flow model to illustrate your answers.

Gannett Outsourcing Nearly 500 Jobs to India

Gannett (the largest U.S. newspaper publisher by daily circulation) is outsourcing 485 jobs to India.

Source: newjerseyglobe.com, December 11, 2020

14. Explain how Gannett's outsourcing to India will change India's GDP.
15. Explain how Gannett's outsourcing to India will change U.S. GDP.

Measuring U.S. GDP

Use the following data to work Problems 16 and 17.

The table lists some macroeconomic data for the United States in 2016.

Item	Billions of dollars
Wages	9,908
Consumption expenditure	12,498
Other factor incomes	4,567
Investment	3,037
Government expenditure	3,254
Net exports	−507

16. Calculate U.S. GDP in 2016.
17. Explain the approach (expenditure or income) that you used to calculate GDP.

Use the following data to work Problems 18 and 19.

An economy produces only apples and oranges. The base year is 2022, and the table gives the quantities produced and the prices.

Quantities	2022	2023
Apples	60	160
Oranges	80	220
Prices	**2022**	**2023**
Apples	$0.50	$1.00
Oranges	$0.25	$2.00

18. Calculate nominal GDP in 2022 and 2023.
19. Calculate real GDP in 2022 and 2023 expressed in base-year prices.

Use the following news clip to work Problems 20 and 21.

China's Economy Accelerates as Retail, Investment Pick Up

China's real GDP increased 6.9 percent in the first quarter of 2017 from a year earlier. Investment grew by 9.2 percent and retail sales by 10.9 percent. In current prices, GDP increased by 11.8 percent from a year earlier.

Source: *Bloomberg News*, April 17, 2017

20. Explain how China's real GDP can grow at a 6.9 percent rate when consumption and investment grew faster than 6.9 percent.
21. Explain why the growth rate of GDP in current prices does not provide information about how quickly the economy is really growing.

The Uses and Limitations of GDP

22. The United Nations' Human Development Index (HDI) is based on GDP per person, life expectancy at birth, and indicators of the quality and quantity of education.
    a. Explain why the HDI might be better than GDP as a measure of economic welfare.
    b. Which items in the HDI are part of GDP and which items are not in GDP?
    c. Do you think the HDI should be expanded to include items such as pollution, resource depletion, and political freedom? Explain.
    d. What other items should be included in a comprehensive measure of economic welfare?

Use the following information to work Problems 23 and 24.

Comparing GDP Per Person

The International Monetary Fund reported the following data on gross domestic product per capita, measured in U.S. dollars at market exchange rates in 2019: Canada $46,400, China $10,243, United Kingdom $42,417, and United States $65,254.

Source: International Monetary Fund, World Economic Outlook Database, April 2021

23. Explain the special complications involved with attempting to compare the economic welfare in China and the United States by using the GDP for each country.
24. Explain why the data reported here might be a poor indicator of the differences in economic welfare among Canada, the United Kingdom, and the United States, but nevertheless provide the correct ranking of the countries.
25. **The Forbes Billionaires List: Africa's Billionaires 2020**

    Africa's billionaires are richer than a year ago. As a group, the continent's 20 billionaires are worth $73.4 billion, an increase of $4.7 billion from a year ago.

    Source: cnbcafrica.com, February 21, 2020

    One-third of Africans earn about $2 a day.

    a. Why might GDP per person misrepresent the standard of living of the average African?
    b. Why might $2 a day underestimate the standard of living of the poorest Africans?

Economics in the News

26. After you have studied *Economics in the News* on pp. 128–129, answer the following questions.
    a. How did the BEA estimates of the real GDP growth rate in the second and third quarters of 2020 change from the advanced estimate to the third estimate?
    b. How did the NY Fed nowcast of the second quarter growth rate change through the quarter?
    c. How did the NY Fed nowcast of the third quarter growth rate change through the quarter?
    d. Describe the common feature of the relationship between the BEA and the NY Fed estimates of real GDP present since 2002 and visible in the second and third quarters of 2020.
27. **GDP Outdated, Here Are the Alternatives**

    A panel of high-profile economists suggest measuring the economic well-being of families and removing the emphasis on GDP growth. Some economists propose including a value on housework and making better estimates of healthcare improvements. Nobel Laureate Angus Deaton suggests conducting a survey to ask people how happy they are.

    Source: weforum.org, February 10, 2020

    Suppose that a new index is calculated using the suggestions in the news clip.

    a. Would the new index be a better measure of the standard of living than GDP per person? Explain your answer.
    b. Explain the challenges involved in trying to incorporate the new index.
    c. Explain how the United Nations' Human Development Index compares with the new index.
    d. Is there likely to be a high correlation between GDP per person and the new index? Why or why not?

Mathematical Note

28. Use the information in Problem 18 to calculate the chained-dollar real GDP in 2023 expressed in 2022 dollars.

5 MONITORING JOBS AND INFLATION

After studying this chapter, you will be able to:

- Explain why unemployment is a problem and how we measure the unemployment rate and other labor market indicators
- Explain why unemployment occurs and why it is present even at full employment
- Explain why inflation is a problem and how we measure the inflation rate

Each month, we chart the course of unemployment and inflation as measures of U.S. economic health. How do we measure the unemployment rate and the inflation rate, and are they reliable vital signs for the economy?

As the U.S. economy expanded after the Great Recession of 2008 and 2009, job growth was weak and the health of the labor market became a major issue for many families. But after a deeper Covid-induced recession in 2020, jobs bounced back rapidly. *Economics in the News*, at the end of this chapter, puts the spotlight on the labor market in 2020 as the economy crashed and unemployment soared.

Employment and Unemployment

What kind of job market will you enter when you graduate? Will there be plenty of good jobs to choose among, or will jobs be so hard to find that you end up taking one that doesn't use your education and pays a low wage? The answer depends, to a large degree, on the total number of jobs available and on the number of people competing for them.

The class of 2021 faced a challenging job market, but a better market than those of the decade that preceded it. In May 2021, 9 million Americans wanted a job but couldn't find one. That number is down from 15 million at the end of 2009 and 23 million in 2020.

Unemployment is kept in check because the U.S. economy is an incredible job-creating machine. Even in 2009 with 15 million unemployed, 139 million people had jobs—22 million more than in 1989. And in 2019 before Covid, job growth had created another 20 million jobs taking the total to 159 million.

Why Unemployment Is a Problem

Unemployment is a serious personal and social economic problem for two main reasons. It results in

- Lost incomes and production
- Lost human capital

Lost Incomes and Production The loss of a job brings a loss of income and lost production. These losses are devastating for the people who bear them and they make unemployment a frightening prospect for everyone. Unemployment benefits create a safety net, but they don't fully replace lost earnings.

Lost production means lower consumption and a lower investment in capital, which lowers the living standard in both the present and the future.

Lost Human Capital Prolonged unemployment permanently damages a person's job prospects by destroying human capital.

ECONOMICS IN ACTION

What Kept Ben Bernanke Awake at Night

The Great Depression began in October 1929, when the U.S. stock market crashed. It reached its deepest point in 1933, when 25 percent of the labor force was unemployed, and lasted until 1941, when the United States entered World War II. The depression quickly spread globally to envelop most nations.

The 1930s were and remain the longest and worst period of high unemployment in history. Failed banks, shops, farms, and factories left millions of Americans without jobs, homes, and food. Without the support of government and charities, millions would have starved.

The Great Depression was an enormous political event: It fostered the rise of the German and Japanese militarism that were to bring the most devastating war humans have ever fought. It also led to President Franklin D. Roosevelt's "New Deal," which enhanced the role of government in economic life and made government intervention in markets popular and the market economy unpopular.

The Great Depression also brought a revolution in economics. British economist John Maynard Keynes published his *General Theory of Employment, Interest, and Money* and created what we now call macroeconomics.

Many economists have studied the Great Depression and tried to determine why what started out as an ordinary recession became so devastating. Among them is Ben Bernanke, the former Chairman of the Federal Reserve.

One of the reasons the Fed was so aggressive in cutting interest rates during 2007–2008 and saving banks from going under is that Ben Bernanke was vividly aware of the horrors of total economic collapse and was determined to avoid any risk of a repeat of the Great Depression.

Think about a manager who loses his job when his employer downsizes. The only work he can find is driving a taxi. After a year in this work, he discovers that he can't compete with new MBA graduates. Eventually, he gets hired as a manager but in a small firm and at a lower wage than before. He has lost some of his human capital.

The cost of unemployment is spread unequally, which makes it a highly charged political problem as well as a serious economic problem.

Governments make strenuous efforts to measure unemployment accurately and to adopt policies to moderate its level and ease its pain. Here, we'll learn how the U.S. government monitors unemployment.

Current Population Survey

Every month, the U.S. Census Bureau surveys 60,000 households and asks a series of questions about the age and job market status of the members of each household. This survey is called the Current Population Survey (or CPS). The Census Bureau uses the answers to chart the course of the labor force.

Figure 5.1 shows the population categories used by the Census Bureau and the relationships among the categories.

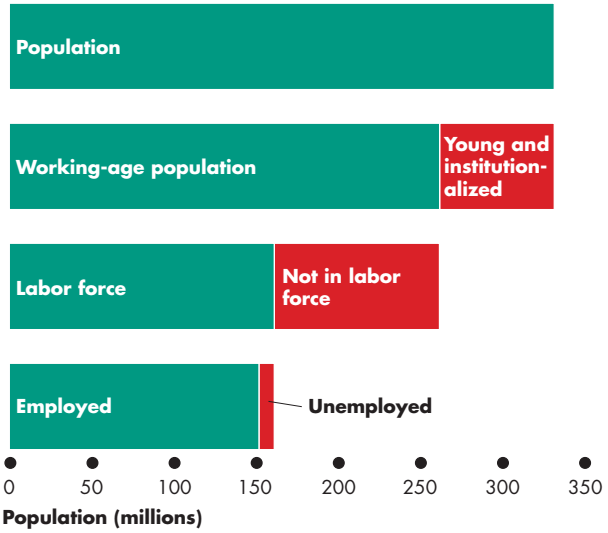
The population divides into two broad groups: the working-age population and others who are too young to work or who live in institutions and are unable to work. The **working-age population** is the total number of people aged 16 years and over who are not in jail, hospital, or some other form of institutional care.

The Census Bureau divides the working-age population into two groups: those in the labor force and those not in the labor force. It also divides the labor force into two groups: the employed and the unemployed. So the **labor force** is the sum of the employed and the unemployed.

To be counted as employed in the Current Population Survey, a person must have either a full-time job or a part-time job. To be counted as *un*employed, a person must be available for work and must be in one of three categories:

1. Without work but has made specific efforts to find a job within the previous four weeks
2. Waiting to be called back to a job from which he or she has been laid off
3. Waiting to start a new job within 30 days

FIGURE 5.1 Population Labor Force Categories



The total population is divided into the working-age population and the young and institutionalized. The working-age population is divided into those in the labor force and those not in the labor force. The labor force is divided into the employed and the unemployed.

Source of data: The Bureau of Labor Statistics.

Anyone surveyed who satisfies one of these three criteria is counted as unemployed. People in the working-age population who are neither employed nor unemployed are classified as *not in the labor force*.

In May 2021, the population of the United States was 331 million; the working-age population was 261 million. Of this number, 100 million were not in the labor force. Most of these people were in school full time or had retired from work. The remaining 161 million people made up the U.S. labor force. Of these, 152 million were employed and 9 million were unemployed.

Three Labor Market Indicators

The Bureau of labor Statistics (BLS) calculates three indicators of the state of the labor market. They are

- The unemployment rate
- The employment-to-population ratio
- The labor force participation rate

The Unemployment Rate The amount of unemployment is an indicator of the extent to which people who want jobs can't find them. The **unemployment rate** is the percentage of the people in the labor force who are unemployed. That is,

$$\text{Unemployment rate} = \frac{\text{Number of people unemployed}}{\text{Labor force}} \times 100$$

and

$$\text{Labor force} = \text{Number of people employed} + \text{Number of people unemployed.}$$

In May 2021, the number of people employed was 151.6 million and the number unemployed was 9.3 million. By using the above equations, you can verify that the labor force was 160.9 million (151.6 million plus 9.3 million) and the unemployment rate was 5.8 percent (9.3 million divided by 160.9 million, multiplied by 100).

Figure 5.2 shows the unemployment rate from 1981 to 2021. The average unemployment rate during this period is 6.2 percent—equivalent to 10 million people being unemployed in 2021.

The unemployment rate fluctuates over the business cycle and reaches a peak value after a recession ends.

Each peak unemployment rate in the recessions of 1982, 1990–1991, and 2001 was lower than the previous one. But the recessions of 2008–2009 and 2020 ended the downward trend.

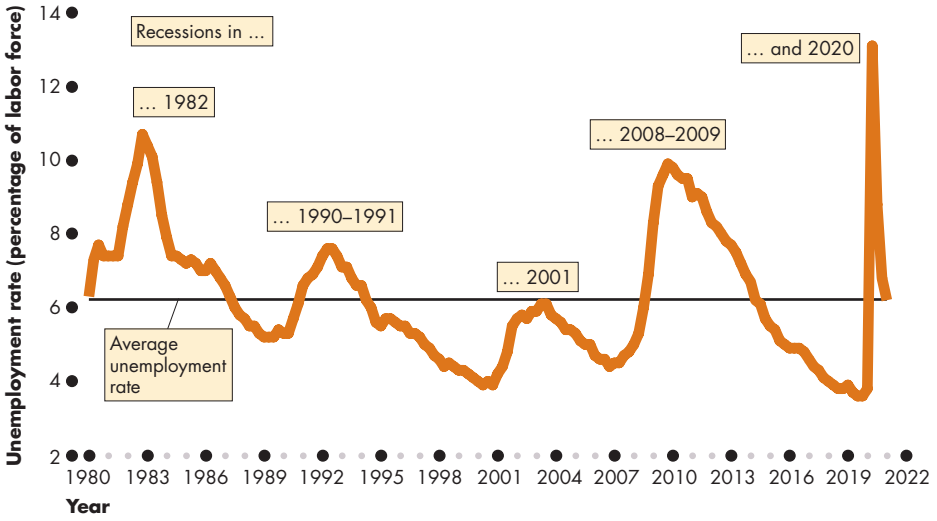
The Employment-to-Population Ratio The number of people of working age who have jobs is an indicator of both the availability of jobs and the degree of match between people's skills and jobs. The **employment-to-population ratio** is the percentage of people of working age who have jobs. That is,

$$\text{Employment-to-population ratio} = \frac{\text{Number of people employed}}{\text{Working-age population}} \times 100.$$

In May 2021, the number of people employed was 151.6 million and the working-age population was 261.3 million. By using the above equation, you can verify that the employment-to-population ratio was 58 percent (151.6 million divided by 261.3 million, multiplied by 100).

Figure 5.3 shows the employment-to-population ratio. This indicator followed an upward trend before 2000 and then a downward trend. The increase before 2000 means that the U.S. economy created

FIGURE 5.2 The Unemployment Rate: 1981–2021

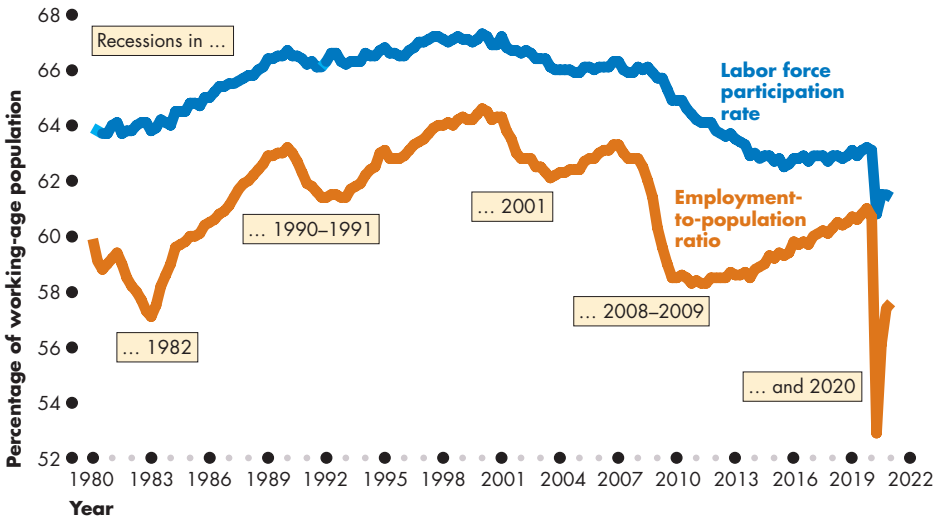


Source of data: Bureau of Labor Statistics.

The average unemployment rate from 1981 to 2021 was 6.2 percent. The unemployment rate increases in a recession, peaks after the recession ends, and decreases in an expansion.

The peak unemployment rate during a recession was on a downward trend before the 2008–2009 recession, with each successive recession having a lower unemployment rate. The recessions of 2008–2009 and 2020 broke this trend.

FIGURE 5.3 Labor Force Participation and Employment-to Population Ratio: 1981–2021



Source of data: Bureau of Labor Statistics.

The trend in the labor force participation rate and the employment-to-population ratio is upward before 2000 and downward after 2000.

The employment-to-population ratio fluctuates more than the labor force participation rate over the business cycle and reflects cyclical fluctuations in the unemployment rate.

The fall in both variables was steep during the 2008–2009 and 2020 recessions.

jobs at a faster rate than the working-age population grew. This indicator also fluctuates: It falls during a recession and increases during an expansion.

The Labor Force Participation Rate The number of people in the labor force is an indicator of the willingness of people of working age to take jobs. The **labor force participation rate** is the percentage of the working-age population who are members of the labor force. That is,

$$\text{Labor force participation rate} = \frac{\text{Labor force}}{\text{Working-age population}} \times 100.$$

In May 2021, the labor force was 160.9 million and the working-age population was 261.3 million. By using the above equation, you can verify that the labor force participation rate was 61.6 percent (160.9 million divided by 261.3 million, multiplied by 100).

Figure 5.3 shows the labor force participation rate. Like the employment-to-population ratio, this indicator has an upward trend before 2000 and then a downward trend. The fall in each variable was steep during 2008 and 2009 and crashes during the 2020 pandemic when unsuccessful job seekers left the labor force.

Other Definitions of Unemployment

Do fluctuations in the labor force participation rate over the business cycle mean that people who leave the labor force during a recession should be counted as unemployed? Or are they correctly counted as being not in the labor force?

The Bureau of Labor Statistics believes that the official unemployment definition gives the correct measure. But it provides data on two types of *underemployed* labor excluded from the official measure. They are

- Marginally attached workers
- Part-time workers who want full-time jobs

Marginally Attached Workers A **marginally attached worker** is a person who currently is neither working nor looking for work but has indicated that he or she wants and is available for a job and has looked for work sometime in the recent past. A marginally attached worker who has stopped looking for a job because of repeated failure to find one is called a **discouraged worker**.

The official unemployment measure excludes marginally attached workers because they haven't made specific efforts to find a job within the past four weeks. In all other respects, they are unemployed.

Part-Time Workers Who Want Full-Time Jobs Many part-time workers want to work part time. This arrangement fits in with the other demands on their time. But some part-time workers would like full-time jobs and can't find them. In the official statistics, these workers are called economic part-time workers and they are partly unemployed.

Most Costly Unemployment

All unemployment is costly, but the most costly is long-term unemployment that results from job loss.

People who are unemployed for a few weeks and then find another job bear some costs of unemployment. But these costs are low compared to the costs borne by people who remain unemployed for many weeks.

Also, people who are unemployed because they voluntarily quit their jobs to find better ones or because they have just entered or reentered the labor market bear some costs of unemployment. But these costs are lower than those borne by people who lose their job and are forced back into the job market.

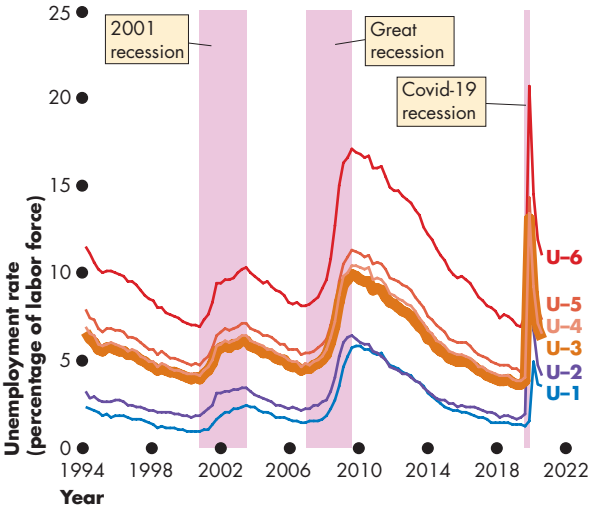
The unemployment rate doesn't distinguish among these different categories of unemployment. If most of the unemployed are long-term job losers, the situation is much worse than if most are short-term voluntary job searchers.

Alternative Measures of Unemployment

To provide information about the aspects of unemployment that we've just discussed, the Bureau of Labor Statistics reports six alternative measures of the unemployment rate: two that are narrower than the official measure and three that are broader. The narrower measures focus on the personal cost of unemployment and the broader measures focus on assessing the full amount of underemployed labor resources.

Figure 5.4 shows these measures from 1994 (the first year for which all six are available) to 2021. U–3 is the official unemployment rate. Long-term unemployment (U–1) and unemployed job losers (U–2) are about 40 percent of the unemployed on average but 60 percent in a deep recession. Adding discouraged workers (U–4) makes very little difference to the unemployment rate, but adding all other marginally attached workers (U–5) adds one percentage point. A big difference is made by adding the economic part-time workers (U–6). In May 2021, after adding these workers the *underemployment rate* was 11 percent.

FIGURE 5.4 Six Alternative Measures of Unemployment



U–1 are those unemployed for 15 weeks or more, and U–2 are job losers. U–3 is the official unemployment rate. U–4 adds discouraged workers, and U–5 adds all other marginally attached workers. The broadest measure, U–6, adds part-time workers who want full-time jobs. Fluctuations in all the alternative measures are similar to those in the official measure, U–3.

Source of data: Bureau of Labor Statistics.

REVIEW QUIZ

1. What determines if a person is in the labor force?
2. What distinguishes an unemployed person from one who is not in the labor force?
3. Describe the trends and fluctuations in the U.S. unemployment rate from 1981 to 2021.
4. Describe the trends and fluctuations in the U.S. employment-to-population ratio and the labor force participation rate from 1981 to 2021.
5. Describe the alternative measures of the unemployment rate.

You've seen how we measure employment and unemployment. Your next task is to see what we mean by full employment and how unemployment and real GDP fluctuate over the business cycle.

Unemployment and Full Employment

There is always someone without a job who is searching for one, so there is always some unemployment. The key reason is that the economy is a complex mechanism that is always changing—it experiences frictions, structural change, and cycles.

Frictional Unemployment

There is an unending flow of people into and out of the labor force as people move through the stages of life—from being in school, to finding a job, to working, perhaps to becoming unhappy with a job and looking for a new one, and finally, to retiring from full-time work.

There is also an unending process of job creation and job destruction as new firms are born, firms expand or contract, and some firms fail and go out of business.

The flows into and out of the labor force and the processes of job creation and job destruction create the need for people to search for jobs and for businesses to search for workers. Businesses don't usually hire the first person who applies for a job, and unemployed people don't usually take the first job that comes their way. Instead, both firms and workers spend time searching for what they believe will be the best available match. By this process of search, people can match their own skills and interests with the available jobs and find a satisfying job and a good income.

The unemployment that arises from the normal labor turnover we've just described—from people entering and leaving the labor force and from the ongoing creation and destruction of jobs—is called **frictional unemployment**. Frictional unemployment is a permanent and healthy phenomenon in a dynamic, growing economy.

Structural Unemployment

The unemployment that arises when changes in technology or international competition change the skills needed to perform jobs or change the locations of jobs is called **structural unemployment**. Structural unemployment usually lasts longer than frictional unemployment because workers must retrain and possibly relocate to find a job. When a steel plant in Gary, Indiana, is automated, some jobs in that city disappear. Meanwhile, new jobs for security guards, retail clerks, and life-insurance salespeople are created in Chicago and Indianapolis. The unemployed former steelworkers remain unemployed for several months until they move, retrain, and get one of these jobs. Structural unemployment is painful, especially for older workers for whom the best available option might be to retire early or take a lower-skilled, lower-paying job.

Cyclical Unemployment

The higher than normal unemployment at a business cycle trough and the lower than normal unemployment at a business cycle peak is called **cyclical unemployment**. A worker who is laid off because the economy is in a recession and who gets rehired some months later when the expansion begins has experienced cyclical unemployment.

"Natural" Unemployment

Natural unemployment is the unemployment that arises from frictions and structural change when there is no cyclical unemployment—when all the unemployment is frictional and structural. Natural unemployment as a percentage of the labor force is called the **natural unemployment rate**.

Full employment is defined as a situation in which the unemployment rate equals the natural unemployment rate.

What determines the natural unemployment rate? Is it constant or does it change over time?

The natural unemployment rate is influenced by many factors but the most important ones are

- The age distribution of the population
- The scale of structural change
- The real wage rate
- Unemployment benefits

The Age Distribution of the Population An economy with a young population has a large number of new job seekers every year and has a high level of frictional unemployment. An economy with an aging population has fewer new job seekers and a low level of frictional unemployment.

The Scale of Structural Change The scale of structural change is sometimes small. The same jobs using the same machines remain in place for many years. But sometimes there is a technological upheaval. The

old ways are swept aside and millions of jobs are lost and the skill to perform them loses value. The amount of structural unemployment fluctuates with the pace and volume of technological change and the change driven by fierce international competition, especially from fast-changing Asian economies.

A high level of structural unemployment is present in many parts of the United States today as advances in robotics and other technologies destroy jobs.

The Real Wage Rate The natural unemployment rate is influenced by the level of the real wage rate. Real wage rates that bring unemployment are a *minimum wage* and an *efficiency wage*. An *efficiency wage* is a wage set above the going market wage to enable firms to attract the most productive workers, get them to work hard, and discourage them from quitting.

Unemployment Benefits Unemployment benefits increase the natural unemployment rate by lowering the opportunity cost of job search. European countries have more generous unemployment benefits and higher natural unemployment rates than the United States. Extending unemployment benefits increases the natural unemployment rate.

There is no controversy about the existence of a natural unemployment rate. Nor is there disagreement that the natural unemployment rate changes. But economists don't know its exact size or the extent to which it fluctuates. The Congressional Budget Office estimates the natural unemployment rate and its estimate for 2021 was 4.5 percent—about 70 percent of the actual unemployment in that year.

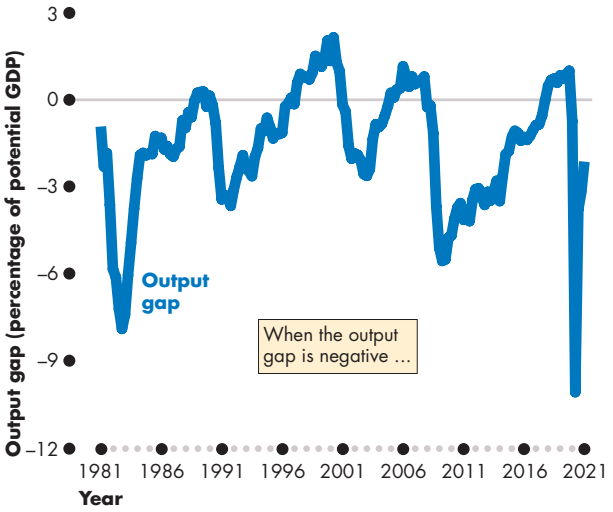
Real GDP and Unemployment over the Cycle

The quantity of real GDP at full employment is *potential GDP* (Chapter 4, p. 122). Over the business cycle, real GDP fluctuates around potential GDP. The gap between real GDP and potential GDP is called the **output gap**. As the output gap fluctuates over the business cycle, the unemployment rate fluctuates around the natural unemployment rate.

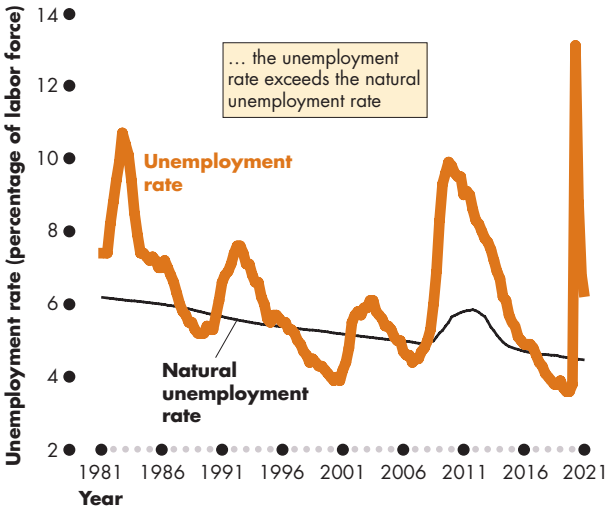
Figure 5.5 illustrates these fluctuations in the United States between 1981 and 2021—the output gap in part (a) and the unemployment rate and natural unemployment rate in part (b).

When the economy is at full employment, the unemployment rate equals the natural unemployment rate and real GDP equals potential GDP, so

FIGURE 5.5 The Output Gap and the Unemployment Rate



(a) Output gap



(b) Unemployment rate

As real GDP fluctuates around potential GDP in part (a), the unemployment rate fluctuates around the natural unemployment rate in part (b). In recessions, cyclical unemployment increases and the output gap becomes negative. At business cycle peaks, the unemployment rate falls below the natural rate and the output gap becomes positive. The natural unemployment rate decreased during the 1980s and 1990s but increased after 2008 and peaked in 2012.

Sources of data: Bureau of Economic Analysis, Bureau of Labor Statistics, and Congressional Budget Office.

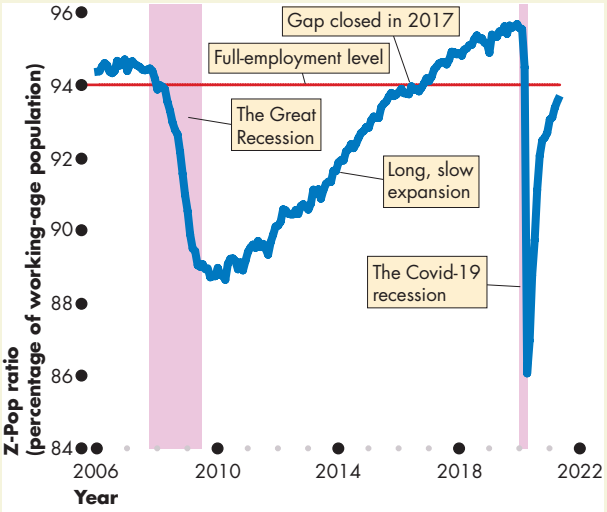
ECONOMICS IN ACTION

Another Look at Full Employment

Are we at full employment? One way of answering this question is to see if the unemployment rate equals the natural unemployment rate. But the natural unemployment rate is only an estimate. Also, the employment-to-population ratio and the labor force participation rate data point to a different answer to the full-employment question. Both measures fell by 3 percentage points between 2008 and 2017. Three percent of the working-age population had disappeared from the labor force. Where did these people go? Do they represent hidden unemployment?

A way of answering this question has been suggested by economists at the Federal Reserve Bank of Atlanta. Their idea is to use an indicator they call the *Z-Pop ratio*, which is the percentage of the working-age population that is fully utilized. The people counted as fully utilized are those working full-time, those working part-time for a noneconomic reason, and those who say they don't want a job.

The figure shows the Z-Pop ratio. Before the Great Recession, 94 percent of the population was fully utilized by this definition. The number fell to 89 percent during the Great Recession and then slowly climbed. In 2017, 94 percent of the population was fully utilized and on this measure, the economy was at full employment. The Z-Pop ratio was above its full-employment level when the Covid recession began. In mid-2021, the Z-Pop ratio was still below its full-employment level.



Z-Pop: The Percentage of the Population That Is Fully Utilized

the output gap is zero. When the unemployment rate is below the natural unemployment rate, real GDP exceeds potential GDP and the output gap is positive. And when the unemployment rate exceeds the natural unemployment rate, real GDP is less than potential GDP and the output gap is negative.

Figure 5.5(b) shows the natural unemployment rate estimated by the Congressional Budget Office. This estimate puts the natural unemployment rate at 6.2 percent in 1981 and falling steadily through the 1980s and 1990s to 5.0 percent by the early 2000s and rising after the Great Recession to reach almost 6 percent in 2012 before continuing its downward trend.

Your next task is to see how we monitor the price level and its changes—inflation and deflation. You will learn about the Consumer Price Index (CPI), which is monitored every month. You will also learn about other measures of the price level and how to calculate the inflation rate.

REVIEW QUIZ

1. Why does unemployment arise and what makes some unemployment unavoidable?
2. Define frictional unemployment, structural unemployment, and cyclical unemployment. Give examples of each type of unemployment.
3. What is the natural unemployment rate?
4. How does the natural unemployment rate change and what factors might make it change?
5. Why is the unemployment rate never zero, even at full employment?
6. What is the output gap? How does it change when the economy goes into recession?
7. How does the unemployment rate fluctuate over the business cycle?

The Price Level, Inflation, and Deflation

What will it *really* cost you to pay off your student loan? What will your parents' life savings buy when they retire? The answers depend on what happens to the **price level**, the average level of prices, and the value of money. A persistently rising price level is called **inflation**; a persistently falling price level is called **deflation**.

We are interested in the price level, inflation, and deflation for two main reasons. First, we want to measure the annual percentage change of the price level—the inflation rate or deflation rate. Second, we want to distinguish between the money values and real values of economic variables such as your student loan and your parents' savings.

We begin by explaining why inflation and deflation are problems. Then we'll look at how we measure the price level and the inflation rate. Finally, we'll return to the task of distinguishing real values from money values.

Why Inflation and Deflation Are Problems

Low, steady, and anticipated inflation or deflation isn't a problem, but an unexpected burst of inflation or period of deflation brings big problems and costs. An unexpected inflation or deflation

- Redistributes income
- Redistributes wealth
- Lowers real GDP and employment
- Diverts resources from production

Redistributes Income Workers and employers sign wage contracts that last for a year or more. An unexpected burst of inflation raises prices but doesn't immediately raise the wages. Workers are worse off because their wages buy less than they bargained for and employers are better off because their profits rise.

An unexpected period of deflation has the opposite effect. Wage rates don't fall but the prices fall. Workers are better off because their fixed wages buy more than they bargained for and employers are worse off with lower profits.

Redistributes Wealth People enter into loan contracts that are fixed in money terms and that pay an interest rate agreed as a percentage of the money borrowed and lent. With an unexpected burst of inflation, the money that the borrower repays to the lender buys less than the money originally loaned. The borrower wins and the lender loses. The interest paid on the loan doesn't compensate the lender for the loss in the value of the money loaned. With an unexpected deflation, the money that the borrower repays to the lender buys *more* than the money originally loaned. The borrower loses and the lender wins.

Lowers Real GDP and Employment Unexpected inflation that raises firms' profits brings a rise in investment and a boom in production and employment. Real GDP rises above potential GDP and the unemployment rate falls below the natural rate. But this situation is *temporary*. Profitable investment dries up, spending falls, real GDP falls below potential GDP and the unemployment rate rises. Avoiding these swings in production and jobs means avoiding unexpected swings in the inflation rate.

An unexpected deflation has even greater consequences for real GDP and jobs. Businesses and households that are in debt (borrowers) are worse off and they cut their spending. A fall in total spending brings a recession and rising unemployment.

Diverts Resources from Production Unpredictable inflation or deflation turns the economy into a casino and diverts resources from productive activities to forecasting inflation. It can become more profitable to forecast the inflation rate or deflation rate correctly than to invent a new product. Doctors, lawyers, accountants, farmers—just about everyone—can make themselves better off, not by specializing in the profession for which they have been trained but by spending more of their time dabbling as amateur economists and inflation forecasters and managing their investments.

From a social perspective, the diversion of talent that results from unpredictable inflation is like throwing scarce resources onto a pile of garbage. This waste of resources is a cost of inflation.

At its worst, inflation becomes **hyperinflation**—an inflation rate of 50 percent a month or higher that grinds the economy to a halt and causes a society to collapse. Hyperinflation is rare, but Zimbabwe in recent years and several European and Latin American countries have experienced it.

We pay close attention to the inflation rate, even when its rate is low, to avoid its consequences. We monitor the price level every month and devote considerable resources to measuring it accurately. You're now going to see how we do this.

The Consumer Price Index

Every month, the Bureau of Labor Statistics (BLS) measures the price level by calculating the **Consumer Price Index (CPI)**, which is a measure of the average of the prices paid by urban consumers for a fixed basket of consumer goods and services. What you learn here will help you to make sense of the CPI and relate it to your own economic life. The CPI tells you about the *value* of the money in your pocket.

Reading the CPI Numbers

The CPI is defined to equal 100 for a period called the *reference base period*. Currently, the reference base period is 1982–1984. That is, for the average of the 36 months from January 1982 through December 1984, the CPI equals 100.

In May 2021, the CPI was 269.2. This number tells us that the average of the prices paid by urban consumers for a fixed market basket of consumer goods and services was 169.2 percent *higher* in May 2021 than it was on average during 1982–1984.

Constructing the CPI

Constructing the CPI involves three stages:

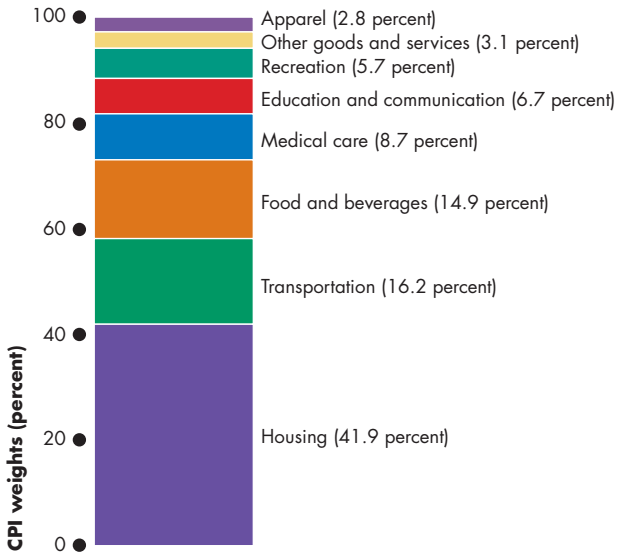
- Selecting the CPI basket
- Conducting the monthly price survey
- Calculating the CPI

The CPI Basket The first stage in constructing the CPI is to select what is called the *CPI basket*. This basket contains the goods and services represented in the index, each weighted by its relative importance. The idea is to make the relative importance of the items in the CPI basket the same as that in the budget of an average urban household. For example, because people spend more on housing than on bus rides, the CPI places more weight on the price of housing than on the price of a bus ride.

To determine the CPI basket, the BLS conducts a Consumer Expenditure Survey. Today's CPI basket is based on data gathered in the Consumer Expenditure Survey of 2019.

Figure 5.6 shows the CPI basket. As you look at the relative importance of the items in the CPI basket, remember that it applies to the *average* household. *Individual* households' baskets are spread around the average. Think about what you buy and compare your basket with the CPI basket.

FIGURE 5.6 The CPI Basket



The CPI basket consists of the items that an average urban household buys. It consists mainly of housing (41.9 percent), transportation (16.2 percent), and food and beverages (14.9 percent). All other items sum to 27.0 percent of the total.

Source of data: Bureau of Labor Statistics.

The Monthly Price Survey Each month, BLS employees check the prices of the 80,000 goods and services in the CPI basket in 30 metropolitan areas. Because the CPI aims to measure price *changes*, it is important that the prices recorded each month refer to exactly the same item. For example, suppose the price of a box of jelly beans has increased but a box now contains more beans. Has the price of jelly beans increased? The BLS employee must record the details of changes in quality or packaging so that price changes can be isolated from other changes.

Once the raw price data are in hand, the next task is to calculate the CPI.

Calculating the CPI To calculate the CPI, we

1. Find the cost of the CPI basket at base-period prices.
2. Find the cost of the CPI basket at current-period prices.
3. Calculate the CPI for the base period and the current period.

We'll work through these three steps for the simple artificial economy in Table 5.1, which shows the quantities in the CPI basket and the prices in the base period (2021) and current period (2022).

Part (a) contains the data for the base period. In that period, consumers bought 10 oranges at $1 each and 5 haircuts at $8 each. To find the cost of the CPI basket in the base-period prices, multiply the quantities in the CPI basket by the base-period prices. The cost of oranges is $10 (10 at $1 each), and the cost of haircuts is $40 (5 at $8 each). So the total cost of the CPI basket in the base period at base-period prices is $50 ($10 + $40).

Part (b) contains the price data for the current period. The price of an orange increased from $1 to $2, which is a 100 percent increase—($1 ÷ $1) × 100 = 100. The price of a haircut increased from $8 to $10, which is a 25 percent increase—($2 ÷ $8) × 100 = 25.

The CPI provides a way of averaging these price increases by comparing the cost of the basket rather than the price of each item. To find the cost of the CPI basket in the current period, 2022, multiply the quantities in the basket by their 2022 prices. The cost of oranges is $20 (10 at $2 each), and the cost of haircuts is $50 (5 at $10 each). So total cost of the fixed CPI basket at current-period prices is $70 ($20 + $50).

You've now taken the first two steps toward calculating the CPI: calculating the cost of the CPI basket in the base period and the current period. The third step uses the numbers you've just calculated to find the CPI for 2021 and 2022.

The formula for the CPI is

$$\text{CPI} = \frac{\text{Cost of CPI basket at current prices}}{\text{Cost of CPI basket at base-period prices}} \times 100.$$

In Table 5.1, you established that in 2021 (the base period), the cost of the CPI basket was $50 and in 2022, it was $70. If we use these numbers in the CPI formula, we can find the CPI for 2021 and 2022. For 2021, the CPI is

$$\text{CPI in 2021} = \frac{\$50}{\$50} \times 100 = 100.$$

For 2022, the CPI is

$$\text{CPI in 2022} = \frac{\$70}{\$50} \times 100 = 140.$$

The principles that you've applied in this simplified CPI calculation apply to the more complex calculations performed every month by the BLS.

TABLE 5.1 The CPI: A Simplified Calculation

(a) The cost of the CPI basket at base-period prices: 2021

CPI basket			
Item	**Quantity**	**Price**	**Cost of CPI Basket**
Oranges	10	$1.00	$10
Haircuts	5	$8.00	$40
Cost of CPI basket at base-period prices			$50

(b) The cost of the CPI basket at current-period prices: 2022

CPI basket			
Item	**Quantity**	**Price**	**Cost of CPI Basket**
Oranges	10	$2.00	$20
Haircuts	5	$10.00	$50
Cost of CPI basket at current-period prices			$70

Measuring the Inflation Rate

A major purpose of the CPI is to measure changes in the cost of living and in the value of money. To measure these changes, we calculate the *inflation rate* as the annual percentage change in the CPI. To calculate the inflation rate, we use the formula:

$$\text{Inflation rate} = \frac{\text{CPI this year} - \text{CPI last year}}{\text{CPI last year}} \times 100.$$

We can use this formula to calculate the inflation rate in 2021. The CPI in May 2020 was 257.9, and the CPI in May 2021 was 261.0. So the inflation rate during the 12 months to May 2021 was

$$\text{Inflation rate} = \frac{(261.0 - 257.9)}{257.9} \times 100 = 1.2\%.$$

Distinguishing High Inflation from a High Price Level

Figure 5.7 shows the CPI and the inflation rate in the United States between 1971 and 2021. The two parts of the figure are related and emphasize the distinction between high inflation and high prices.

When the price level in part (a) *rises rapidly*, (1971 through 1982), the inflation rate in part (b) is *high*. When the price level in part (a) *rises slowly*, (after 1982), the inflation rate in part (b) is *low*.

A high inflation rate means that the price level is rising rapidly. A high price level means that there has been a sustained period of rising prices.

When the price level in part (a) *falls* (2009), the inflation rate in part (b) is negative—deflation.

The CPI is not a perfect measure of the price level and changes in the CPI probably overstate the inflation rate. Let's look at the sources of bias.

The Biased CPI

The main sources of bias in the CPI are

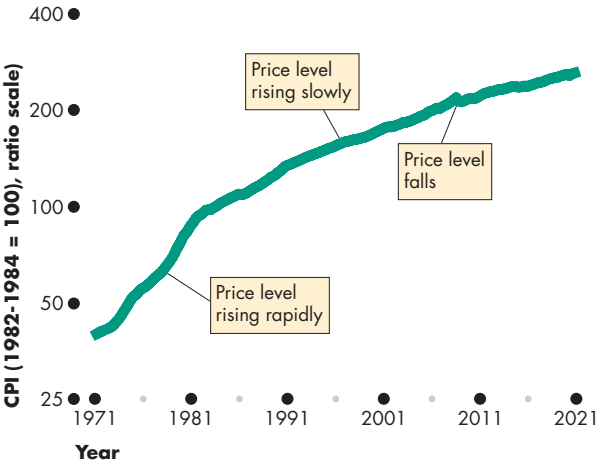
- Quality change bias
- Commodity substitution bias
- Outlet substitution bias
- New goods bias

Quality Change Bias Cars and many other goods get better every year. Part of the rise in the prices of these goods is a payment for improved quality and is not inflation. But the CPI counts the entire price rise as inflation, so the CPI overstates inflation.

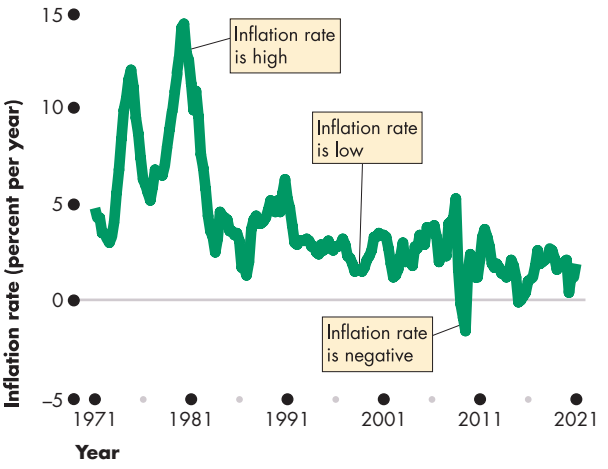
Commodity Substitution Bias Changes in relative prices lead consumers to change the items they buy. For example, if the price of beef rises and the price of chicken remains unchanged, people buy more chicken and less beef. This switch from beef to chicken might provide the same amount of meat and the same enjoyment as before and expenditure is the same as before. The price of meat has not changed. But because the CPI ignores the substitution of chicken for beef, it says the price of meat has increased.

Outlet Substitution Bias When confronted with higher prices, people use discount stores more frequently and convenience stores less frequently. This phenomenon is called *outlet substitution*. The CPI survey does not monitor outlet substitutions.

FIGURE 5.7 The CPI and the Inflation Rate



(a) CPI



(b) Inflation rate

When the price level rises rapidly, the inflation rate is high; when the price level rises slowly, the inflation rate is low. When the price level falls, the inflation rate is negative.

From 1971 through 1982, the price level increased rapidly in part (a) and the inflation rate was high in part (b). After 1982, the price level rose slowly in part (a) and the inflation rate was low in part (b). In 2009, the price level fell and the inflation rate was negative—there was deflation.

Source of data: Bureau of Labor Statistics.

New Goods Bias The constant stream of arrival of new goods makes it impossible to compare the price level today with that of a few decades earlier. We must somehow compare the prices of goods that no longer exist with today's prices of new goods that have replaced them. *Economics in Action* below provides an example.

Consequences and Magnitude of Bias

The CPI is used to adjust tax brackets, Social Security checks, wage rates, and rents. A bias of just 1 percent a year accumulated over a decade adds up to almost a trillion dollars of additional government expenditures. So, how big is the CPI bias?

This question was answered by a Congressional Advisory Commission, which said that the CPI overstates inflation by 1.1 percentage points a year. That is, if the CPI rises by 3.1 percent a year, most likely the inflation rate is 2 percent a year.

But this estimate of bias was made in 1996, and the BLS has now corrected much of the bias with more frequent expenditure surveys to avoid substitution bias and by using statistical methods to lessen new goods and quality change bias. The bias in today's CPI is almost certainly less than it was in 1996, but some remains.

Alternative Price Indexes

The CPI is just one of many alternative price level index numbers and because of the bias in the CPI, other measures are used for some purposes. We'll describe three alternatives to the CPI and explain when and why they might be preferred to the CPI. The alternatives are

- Chained CPI
- Personal consumption expenditure deflator
- GDP deflator

Chained CPI The *chained CPI* is a price index that is calculated using a similar method to that used to calculate *chained-dollar real GDP* described in Chapter 4 (see pp. 132–133).

The chained CPI overcomes the sources of CPI bias because it incorporates substitutions and new goods bias by using current and previous period quantities rather than fixed earlier quantities.

The chained CPI measure of the inflation rate is lower, on average, than the standard CPI. Between 2000 and 2021, the average inflation rate as measured by the chained CPI was 0.3 percentage point lower than the standard CPI—1.8 percent versus 2.1 percent per year.

Personal Consumption Expenditure Price Index **Personal Consumption Expenditure Price Index (PCEPI)** is a measure of the average of the prices of all the items included in the personal consumption expenditures component of GDP. When the Bureau of Economic Analysis calculates *real GDP*, it also calculates the real values of its expenditure components: real consumption expenditure, real investment, real government expenditure, and real net exports. These calculations are done in the same way as that for real GDP described in simplified terms on p. 121 and more technically in Chapter 4, pp. 132–133.

ECONOMICS IN ACTION

Another Look at Prices

If you want to compare the price level in 2021 with that in 1991, you must compare the $200 price of a smartphone with the prices of all the things you would have had to buy in 1991 to perform the tasks that today's smartphone performs. Has the price of this basket of 13 goods fallen by $3,500?

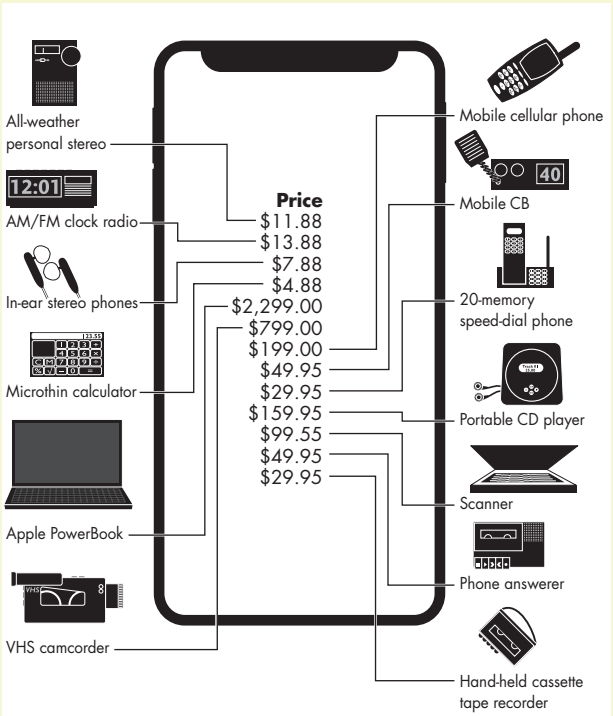


Figure 1 Thirteen Items on a $200 Smartphone

To calculate the PCEPI, we use the formula:

$$\text{PCEPI} = (\text{Nominal}\,C \div \text{Real}\,C) \times 100,$$

where C is personal consumption expenditure.

The basket of goods and services included in the PCEPI is broader than that in the CPI because it includes all consumption expenditure, not only the items bought by a typical urban family.

The difference between the PCEPI and the CPI is small. Since 2000, the inflation rate measured by the PCEPI is 1.8 percent per year, 0.3 percentage point lower than the CPI inflation rate.

GDP Deflator The *GDP deflator* is a bit like the PCEPI except that it includes all the goods and services that are counted as part of GDP. So it is an index of the prices of the items in consumption, investment, government expenditure, and net exports.

$$\text{GDP deflator} = (\text{Nominal GDP} \div \text{Real GDP}) \times 100.$$

This broader price index is appropriate for macroeconomics because it is a comprehensive measure of the cost of the real GDP basket of goods and services.

Since 2000, the GDP deflator has increased at an average rate of 1.9 percent per year, 0.2 percentage point below the CPI inflation rate.

Core Inflation

No matter whether we calculate the inflation rate using the CPI, the chained CPI, the PCEPI, or the GDP deflator, the number bounces around a good deal from month to month or quarter to quarter. To determine the trend in the inflation rate, we need to strip the raw numbers of their volatility.

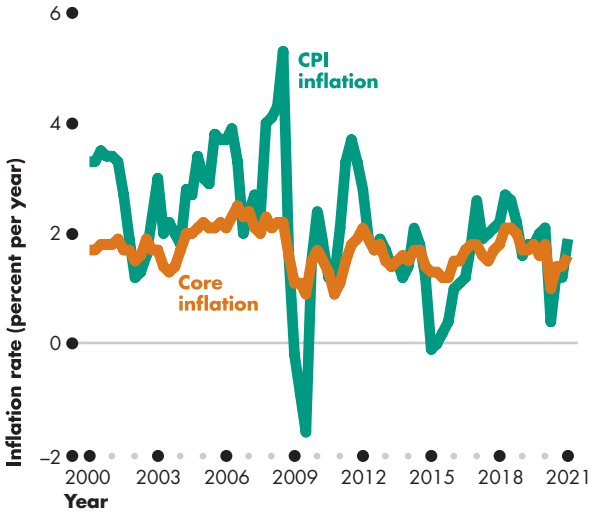
The most widely used is the **core inflation rate**, which is a measure of the inflation rate that excludes volatile prices. (The inflation rate that *includes* all prices is called the *headline* inflation rate.)

As a practical matter, the core inflation rate is calculated as the percentage change in the PCEPI excluding the prices of food and fuel. The prices of these two items are among the most volatile.

While the core PCEPI inflation rate removes the volatile elements in inflation, it can give a misleading view of the true underlying inflation rate. If the relative prices of the excluded items are changing, the percentage change in the core PCEPI will give a biased measure of the inflation rate.

Figure 5.8 graphs the core and CPI inflation rates since 2000 and shows how the core inflation rate removes the extreme swings in CPI inflation. It also shows that core inflation is biased downward.

FIGURE 5.8 Core Inflation



The core inflation rate has mostly been below the CPI inflation rate because the relative prices of food and fuel have been rising.

Source of data: Bureau of Labor Statistics and the Federal Reserve Bank of Atlanta.

REVIEW QUIZ

1. What is the price level?
2. What is the CPI and how is it calculated?
3. How do we calculate the inflation rate and what is its relationship with the CPI?
4. What are the four main ways in which the CPI is an upward-biased measure of the price level?
5. What problems arise from the CPI bias?
6. What are the alternative measures of the price level and how do they address the problem of bias in the CPI?

You've now completed your study of the measurement of macroeconomic performance. Your next task is to learn what determines that performance and how policy actions might improve it. But first, take another look at the return to full employment in *Economics in the News* on pp. 154–155.

Jobs in the Covid-19 Pandemic

Coronavirus Pandemic Makes Unemployment Calculation Harder

Every month, the Bureau of Labor Statistics (BLS) releases news on the preceding month's labor market status from the Labor Force Survey. In its April, May, and June 2020 releases, as the Covid-19 pandemic was gripping America, its numbers contained a classification error that made the unemployment rate look lower than it really was.

The misclassified workers were those on temporary layoff. They were classified as employed but absent from work and should have been classified as unemployed.

What would the unemployment rate have been if these misclassified workers had been counted as unemployed?

The surprise was the number of workers counted as employed but absent from work for "other reasons." The BLS assumed that the number of these workers misclassified equaled the number in excess of the average in the same month during 2016 through 2019. In May, that number was 4.9 million workers. Moving these workers from employed to unemployed increases unemployment from 20.5 million to 25.4 million, but leaves the labor force unchanged at 158.0 million. The resulting unemployment rate for May would be 16.1 percent, compared with the official estimate of 13.0 percent. (Seasonally adjusted, 16.3 percent compared with 13.3 percent.)

Doing a similar calculation, the BLS estimates that the true unemployment rate in April was 19.7 percent and not the reported official rate of 14.7 percent.

The BLS reports a broader underemployment rate called U-6. The underemployed are the unemployed plus all persons marginally attached to the labor force plus those employed part time for economic reasons. U-6 equals the underemployed as a percentage of the employed plus the underemployed. This measure rose to a record high of 22.8 percent in April and fell to 21.2 percent in May. But this broader measure contains the misclassification, so the true U-6 was 27.8 percent in April and 24.3 percent in May.

Source: The Bureau of Labor, July 2, 2020

ESSENCE OF THE STORY

- A classification error occurred in the Labor Force Survey with respondents incorrectly reporting themselves as "employed but absent from work."
- Those who worked zero hours should have been counted as unemployed.
- The reported unemployment rate in May was 13.3 percent, but it would have been 16.3 percent without the error.
- The reported April unemployment rate was 14.7 percent, but without the error it would have been 19.7 percent.
- The broad U-6 unemployment measure rose to a record high of 22.8 percent in April, but it would have been 27.8 percent without the misclassification.

ECONOMIC ANALYSIS

How high was the unemployment rate in April and May 2020?

- The unemployment rate is the number of people unemployed as a percentage of the labor force, and the labor force is the number of people employed plus the number unemployed.
- People are counted as employed if they are not working but have jobs from which they are temporarily absent. People are counted as unemployed if they are waiting to be recalled to jobs from which they have been laid off.
- The National Bureau of Economic Research (NBER) Business Cycle Dating Committee determined that the U.S. economy went into recession in February 2020 before the unemployment rate started to rise.
- By April 2020, the unemployment rate was rising sharply, but many people reported they were temporarily absent (employed) when they were actually waiting to be recalled (unemployed).
- So, the unemployment rate in April was reported as 14.7 percent when on the standard definition of unemployment, it was 19.7 percent.
- In May, the unemployment rate and the reporting error fell slightly.
- Figure 1 shows the standard unemployment rate, known as U-3, and the classification error.
- The figure also shows a broader measure, U-6, which counts as unemployed everyone who wants a job but doesn't have one and part-time workers who want full-time work.
- On this broader definition, 22.8 percent of the labor force was unemployed in April 2020, the highest rate since the BLS started measuring U-6 in 1994.
- The April U-6 unemployment rate was not only high, it was also the most rapid climb, increasing to that level in a single month.

Who were the unemployed?

- The Covid-19 surge in unemployment was unequally distributed and Figure 2 shows some details.
- Women, Hispanic, and Black workers, and those who did not complete high school or a college degree were hit with higher than average unemployment.

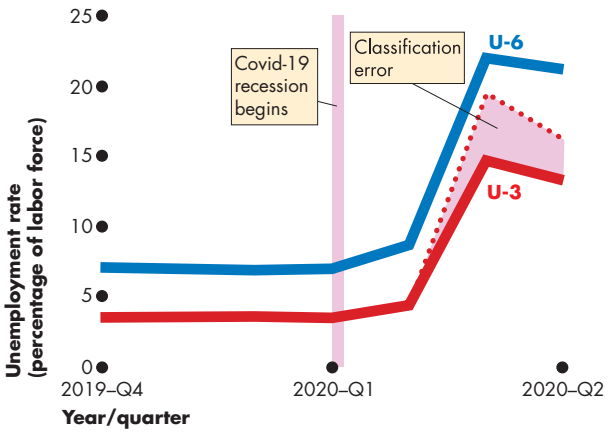


Figure 1 The Unemployment Problem

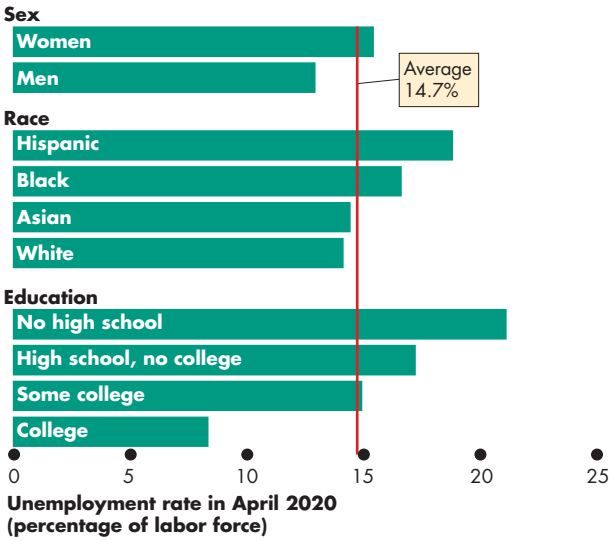


Figure 2 The People Unemployed

- The people worst affected were travel, hospitality, and nonessential retail workers, all of whom suffered when stay-at-home orders went into effect and social distancing was encouraged.

WORKED PROBLEM

The Current Population Survey reported the following situations in July 2021:

- Sarah works 10 hours a week at McDonald's. She is available to work more hours but hasn't looked for extra work.
- Kevin spent the first six months of 2021 actively searching for a job, but he didn't get hired. He believes there are no jobs, so he has given up looking.
- Pat quit the job he had for the past two years and is actively looking for a better paying job. He is available to work and is still searching for a job.
- Mary is a new graduate who was hired while she was a student to start a job in August.
- Johnnie quit his band in June, had no job in July, and is not looking for work.

Questions

1. Who does the BLS classify as being unemployed, a part-time worker, an employed person, a discouraged worker, and not in the labor force? Explain your classification.
2. How will the labor force change if Sarah starts a second job, Pat finds a good job and is hired, and Mary takes a job at McDonald's while she waits to start her new job?
3. How will the unemployment rate change if Sarah quits and starts to search for a full-time job?
4. How will the labor force participation rate change if Kevin starts creating football apps in his garage and they turn out to be very popular?

Solutions

1. Sarah is a part-time worker. As a part-time worker, BLS classifies Sarah as employed. She does not need to be looking for extra work.

   Kevin is a discouraged worker. He spent time looking for work but could not find a job, so he has given up the search. He is not unemployed because he didn't look for work, was not laid off, and is not waiting to start a job. The labor force includes those employed and those unemployed, so Kevin is not in the labor force. He is a marginally attached worker who has stopped searching for a job.

   Pat is unemployed. He doesn't have a job but is available and looked for a job during July.

   Mary doesn't have a job, but she is available for work. Because she will start a job within 30 days, she is classified as unemployed.

   Johnnie is a marginally attached worker. When he played in the band he was employed. But now he is not unemployed because he is not looking, not laid off, and not waiting to start a new job.

Key Point: To be in the labor force a person must be either employed or unemployed. To be counted as employed, a person must have a job or be starting one within 30 days. To be counted as unemployed, a person must have looked for a job in the last 30 days and be available for work.

2. The labor force consists of the people who are counted by the BLS survey as employed or unemployed.

   Sarah is already counted as employed, so when she starts a second job the labor force does not change.

   Pat is currently unemployed, so when he is hired he transfers from being unemployed to being employed. So his change of status does not change the labor force.

   Mary is currently counted as unemployed, so taking on a part-time job at McDonald's while she waits to start the new job does not change the labor force.

Key Point: The labor force increases if working-age people who are not currently in the labor force start to look for work and become unemployed or start a job and become employed.

3. The unemployment rate is the percentage of the labor force who are classified as unemployed. If Sarah quits her job and searches for a full-time job, she becomes unemployed. The labor force doesn't change, so the unemployment rate rises.

Key Point: The unemployment rate rises as people quit or are laid off and start searching for a new job.

4. The labor force participation rate is the percentage of the working-age population who are in the labor force. Kevin is currently not in the labor force because he is a discouraged worker. When Kevin starts creating football apps in his garage and they turn out to be very popular, Kevin becomes employed. He is now in the labor force, so the labor force participation rate rises.

Key Point: The labor force participation rate changes as working-age people enter and exit the labor force.

SUMMARY

Key Points

Employment and Unemployment (pp. 140–144)

- Unemployment is a serious personal, social, and economic problem because it results in lost output and income and a loss of human capital.
- The unemployment rate averaged 6.2 percent between 1981 and 2021. It increases in recessions and decreases in expansions.
- The labor force participation rate and the employment-to-population ratio had an upward trend before 2000, a downward trend after 2000, and both fluctuate with the business cycle.
- Two alternative measures of unemployment, narrower than the official measure, count the long-term unemployed and unemployed job losers.
- Three alternative measures of unemployment, broader than the official measure, count discouraged workers, other marginally attached workers, and part-time workers who want full-time jobs.

Unemployment and Full Employment (pp. 145–147)

- Some unemployment is unavoidable because people are constantly entering and leaving the labor force and losing or quitting jobs; also firms that create jobs are constantly being born, expanding, contracting, and dying.
- Unemployment can be frictional, structural, or cyclical.
- When all unemployment is frictional and structural, the unemployment rate equals the natural unemployment rate, the economy is at full employment, and real GDP equals potential GDP.
- Over the business cycle, real GDP fluctuates around potential GDP and the unemployment rate fluctuates around the natural unemployment rate.

The Price Level, Inflation, and Deflation (pp. 148–153)

- Inflation and deflation that are unexpected redistribute income and wealth and divert resources from production.
- The Consumer Price Index (CPI) is a measure of the average of the prices paid by urban consumers for a fixed basket of consumer goods and services.
- The CPI is defined to equal 100 for a reference base period—currently 1982–1984.
- The inflation rate is the percentage change in the CPI from one period to the next.
- Changes in the CPI probably overstate the inflation rate because of the bias that arises from new goods, quality changes, commodity substitution, and outlet substitution.
- The bias in the CPI distorts private contracts and increases government outlays.
- Alternative price level measures such as the PCEPI and GDP deflator avoid the bias of the CPI but do not make a large difference to the measured inflation rate.

Key Terms

Consumer Price Index (CPI), 149
Core inflation rate, 153
Cyclical unemployment, 145
Deflation, 148
Discouraged worker, 143
Employment-to-population ratio, 142
Frictional unemployment, 145
Full employment, 145
Hyperinflation, 148
Inflation, 148
Labor force, 141
Labor force participation rate, 143
Marginally attached worker, 143
Natural unemployment rate, 145
Output gap, 146
Personal Consumption Expenditure Price Index (PCEPI), 152
Price level, 148
Structural unemployment, 145
Unemployment rate, 142
Working-age population, 141

PROBLEMS AND APPLICATIONS

Employment and Unemployment

1. The BLS reported for January 2021:

   Labor force: 159 million

   Employment: 148 million

   Working-age population: 261 million

   Calculate the

   a. Unemployment rate.

   b. Labor force participation rate.

   c. Employment-to-population ratio.

2. In July 2021, in the economy of Sandy Island, 10,000 people were employed, 1,000 were unemployed, and 5,000 were not in the labor force. During August 2021, 80 people lost their jobs and didn't look for new ones, 20 people quit their jobs and retired, 150 unemployed people were hired, 50 people quit the labor force, and 40 people entered the labor force to look for work. Calculate for July 2021:

   a. The unemployment rate.

   b. The employment-to-population ratio.

   And calculate for the end of August 2021

   c. The number of people unemployed.

   d. The number of people employed.

   e. The unemployment rate.

Use the following data to work Problems 3 and 4.
In June 2015, the U.S. unemployment rate was 5.2 percent. In June 2017, the unemployment rate was 4.4 percent.

3. Predict what happened to unemployment between June 2015 and June 2017, if the labor force was constant.

4. Predict what happened to the labor force between June 2015 and June 2017, if unemployment was constant.

5. **April's Expected Hiring Boom Goes Bust**

   Although the unemployment rate didn't fall as much as expected in April, the measure of unemployment that includes discouraged workers and workers holding part-time jobs for economic reasons decreased to its lowest level in over a year.

   Source: cnbc, May 7, 2021

   What is a discouraged worker? Explain how a decrease in discouraged workers influences the official unemployment rate and a broader measure. What is the broader measure?

Unemployment and Full Employment

Use the following news clip to work Problems 6 and 7.

Singapore's Unemployment Is Set to Increase

Singapore has been facing increasing unemployment due to a slowdown in economic growth and disruptive technological advances. However, officials are more worried about the latter, which is widening the gap between skills employees have and skills employers need. Employers are laying off employees due to the slowing economy and, at the same time, struggling to fill positions.

Source: Channel News Asia, May 5, 2017

6. What are the two types of unemployment described in the news clip? Why is one of them more worrying for officials in Singapore?

7. Which types of unemployment could not have been prevented even if Singapore's economy did not slow down and the labor market was working properly?

The Price Level, Inflation, and Deflation

Use the following data to work Problems 8 and 9.

The people on Coral Island buy only juice and cloth. The CPI basket contains the quantities bought in 2020. The average household spent $60 on juice and $30 on cloth in 2020 when juice was $2 a bottle and cloth was $5 a yard. In 2021, juice is $4 a bottle and cloth is $6 a yard.

8. Calculate the CPI basket and the percentage of the household's budget spent on juice in 2020.

9. Calculate the CPI and the inflation rate in 2021.

Use the following data to work Problems 10 and 11.

The BLS reported the following CPI data:

June 2019	256.1
June 2020	257.8
June 2021	271.7

10. Calculate the inflation rates for the years ended June 2020 and June 2021. How did the inflation rate change in 2021?

11. Why might these CPI numbers be biased? How can alternative price indexes avoid this bias? Which alternative index might be least biased and why?

ADDITIONAL PROBLEMS AND APPLICATIONS

Employment and Unemployment

12. What is the unemployment rate supposed to measure and why is it an imperfect measure?
13. The BLS reported for February 2019:

    Labor force participation rate: 63 percent

    Working-age population: 258 million

    Employment-to-population ratio: 60.4

    Calculate the

    a. Labor force.

    b. Employment.

    c. Unemployment rate.
14. **Trend Reversal of Old-Age Labor Force Participation in Germany**

    While life expectancy has significantly increased almost everywhere in the world, most industrialized economies had been witnessing a fall in retirement age since 1970. However, since the late 1990s, this trend has been reversing. In 2017, 69 percent of Germany's population in the 55–64 age group was employed compared to the low level of 38 percent in 2000.

    Source: Vox, January 26, 2018

    a. Explain how the labor force and unemployment rates changed in Germany between the 1970s and the 1990s.

    b. Explain how the labor force and unemployment rates have changed in Germany since the 1990s.
15. The BLS reported that in the second quarter of 2016, employment increased by 100,000 to 150,959,000 and the unemployment rate fell from 5 percent to 4.9 percent. About 1.3 million people were marginally attached workers and 0.6 million of them were discouraged.

    a. Calculate the change in unemployment in the second quarter of 2016.

    b. With 1.3 million marginally attached workers and 0.6 million of them discouraged workers, what are the characteristics of the other 0.7 million marginally attached workers?
16. A high unemployment rate tells us that a large percentage of the labor force is unemployed but not why the unemployment rate is high. What unemployment measure tells us if (i) people are searching longer than usual to find a job, (ii) more people are economic part-time workers, or (iii) more unemployed people are job losers?
17. Why might the unemployment rate underestimate the underutilization of labor resources?

Unemployment and Full Employment

18. **Low Unemployment Rates in Dubai**

    Dubai's unemployment rate stood at 0.4 percent in 2015, increasing by 0.1 percent from its 0.3 percent level in 2014. Despite this increase, Dubai has one of the lowest unemployment rates in the world. The reasons for this include a high cost of living that reduces frictional unemployment; most jobseekers being based abroad; and expats requiring an employment visa to be able to live in Dubai.

    Source: *Gulf News*, August 28, 2016

    a. Using the information in the news clip, what can you conclude about the labor force participation rate, employment-to-population ratio, and unemployment rate in Dubai?

    b. If the government of Dubai relaxed employment visa requirements to make it easier for foreign nationals to seek a job in Dubai, how would the unemployment rate in the news clip change? Why?

Use the following data to work Problems 19 to 21. The IMF *World Economic Outlook* reports the following unemployment rates:

Region	2015	2016
United States	5.3	4.9
Spain	22.1	19.6
Venezuela	7.4	21.2
Singapore	1.9	2.1

19. What do these numbers tell us about the phase of the business cycle in these countries in 2016?
20. What do these numbers tell us about the relative size of their natural unemployment rates?
21. Do these numbers tell us anything about the relative size of their labor force participation rates and employment-to-population ratios?
22. **Retail Workforce Could Face Permanent Decline**

    The pandemic has caused seismic changes for the retail industry. Many stores permanently closed their doors as growing numbers of customers shifted to online shopping. Analysts believe that even after the pandemic, retail jobs won't rebound.

    Source: cncb.com, July 22, 2020

    What types of unemployment is the news clip discussing?

23. **More Call For Retraining as Many Jobs Might Not Return**

Job postings for administrative assistants, human resources personnel, food service workers, beauty consultants, and pet groomers have dwindled. Two-thirds of those unemployed are considering switching occupations, which in many cases will mean retraining.

Source: bizjournals.com, February 18, 2021

a. What is the main type of unemployment that retraining programs seek to avoid? Explain.

b. How might government funded retraining influence the natural unemployment rate? Explain.

The Price Level, Inflation, and Deflation

24. A typical family on Sandy Island consumes only juice and cloth. Last year, which was the base year, the family spent $40 on juice and $25 on cloth. In the base year, juice was $4 a bottle and cloth was $5 a length. This year, juice is $4 a bottle and cloth is $6 a length. Calculate:

a. The CPI basket.

b. The CPI in the current year.

c. The inflation rate in the current year.

25. A firm agreed to pay its workers $20 an hour in 2019 and $22 an hour in 2020. The price level for these years was 256 in 2019 and 260 in 2020. Calculate the real wage rate in each year. What is the increase in the real wage received by these workers in 2020??

26. **News release**

In the first quarter of 2020, real personal consumption expenditure was $13,117 billion and the PCEPI (the deflator) was 110.88. In the first quarter of 2021, real personal consumption expenditure was $13,353 billion and (nominal) personal consumption expenditure was $15,070 billion.

Source: BEA, July 24, 2021

Calculate personal consumption expenditure in the first quarter of 2020 and the PCEPI in the first quarter of 2021. Was the percentage increase in real personal consumption expenditure greater or smaller than that in personal consumption expenditure?

27. **India's Growth, Wages, and Inflation**

As a result of India's fast economic growth, the inflation rate stood at 5 percent in 2016. In the same year, an average increase in wages of 10.3 percent across all industries was expected.

Source: *Forbes*, February 23, 2016

By what percentage did the real wage increase in India in 2016?

Economics in the News

28. After you have studied *Economics in the News* on pp. 154–155, answer the following questions.

a. How did the unemployment rate change during the Covid recession?

b. Which measure of unemployment, U-3 or U-6, was measured incorrectly because of a classification error?

c. What was the classification error and did it understate or overstate the unemployment rate?

d. Classified by sex, race, and education, who experienced the highest unemployment rate and why?

e. Classified by sex, race, and education, who experienced the lowest unemployment rate and why?

29. **Older Workers Are Being Pushed Out of the Job Market**

Compared to pre-pandemic levels, the number of people aged 55 and over who are in the labor force has decreased by 2 million. Corporate trends like the abandonment of middle-management jobs tend to eliminate older workers. As these jobs are cut, the older, higher-paid workers are fired and their jobs restructured for younger, lower-paid workers.

Source: forbes.com, February 16, 2021

a. What type of unemployment might older workers be more prone to experience?

b. Explain how the unemployment rate of older workers is influenced by the business cycle.

c. Why might older unemployed workers become marginally attached or discouraged workers?

The Big Picture

PART TWO **WRAP-UP**

MONITORING MACROECONOMIC PERFORMANCE

Macroeconomics is a large and controversial subject that is interlaced with political ideological disputes. And it is a field in which charlatans as well as serious thinkers have much to say.

You have just learned in Chapters 4 and 5 how we monitor and measure the main macroeconomic variables. We use real GDP to calculate the rate of economic growth and business cycle fluctuations. And we use the CPI and other measures of the price level to calculate the inflation rate and to "deflate" nominal values to find *real* values.

In the chapters that lie ahead, you will learn the theories that economists have developed to explain economic growth, fluctuations, and inflation.

First, in Chapters 6 through 9, you will study the long-term trends. This material is central to the oldest question in macroeconomics that Adam Smith tried to answer: What are the causes of the wealth of nations? You will also study three other old questions that Adam Smith's contemporary and friend David Hume first addressed: What causes inflation? What causes international deficits and surpluses? And why do exchange rates fluctuate?

In Chapters 10 through 12, you will study macroeconomic fluctuations.

Finally, in Chapters 13, 14 and 15, you will study the policies that the federal government and Federal Reserve might adopt to make the economy perform well.

David Hume, *a Scot who lived from 1711 to 1776, did not call himself an economist. "Philosophy and general learning" is how he described the subject of his life's work. Hume was an extraordinary thinker and writer. Published in 1742, his* Essays, Moral and Political, *range across economics, political science, moral philosophy, history, literature, ethics, and religion and explore such topics as love, marriage, divorce, suicide, death, and the immortality of the soul!*

His economic essays provide astonishing insights into the forces that cause inflation, business cycle fluctuations, balance of payments deficits, and interest rate fluctuations; and they explain the effects of taxes and government deficits and debts.

Data were scarce in Hume's day, so he was not able to draw on detailed evidence to support his analysis. But he was empirical. He repeatedly appealed to experience and observation as the ultimate judge of the validity of an argument. Hume's fundamentally empirical approach dominates macroeconomics today.

"... in every kingdom into which money begins to flow in greater abundance than formerly, everything takes a new face: labor and industry gain life; the merchant becomes more enterprising, the manufacturer more diligent and skillful, and even the farmer follows his plow with greater alacrity and attention."

DAVID HUME
Essays, Moral and Political

TALKING WITH Dave Donaldson

DAVE DONALDSON is a Professor of Economics at MIT. He received a master's degree in physics from the University of Oxford in 2001, after which he became a graduate student at the London School of Economics where he earned a diploma in 2002, M.Sc. in 2003, and a Ph.D. in 2009.

Professor Donaldson is an empirical trade and development economist who uses rich data resources and state-of-the-art statistical techniques to discover the sources and effects of trade both inside and among nations. His work has looked at the impact of changes in transportation infrastructure on trade, and the effects of trade on climate change, food security, and famine.

Among his many honors is the 2017 John Bates Clark Medal, which is awarded annually by the American Economic Association to an economist under the age of 40 who has "made a significant contribution to economic thought and knowledge."

Michael Parkin talked with Dave Donaldson about his work, his path from physics to economics, the sources of data available to economists, and his thoughts on the courses you should take if you want to proceed further with your study of economics.

Professor Donaldson, what is the story about how a physics undergraduate became an economist?

My first exposure to economics was in high school. I did enjoy the subject then but nowhere near as much as I enjoyed physics. The main appeal of physics to me came from using mathematical models to penetrate through the fog of an incredibly complicated world—and overlaying this with data, both from controlled experiments in a lab and from uncontrolled experiments as they do in astrophysics.

But throughout my time in college, I became increasingly interested in global social and economic problems. This was the late 1990s, and it was hard to read the news without encountering fierce debate about whether globalization was a force for good or evil in the world around us—whether poorer countries like India were benefiting from opening their markets to world trade.

Around the same time, I became aware of just how economically unequal the world is—and how puzzling a fact that is. How could such inequality exist? Why can't anyone figure out how to help families in India to be more productive in whatever they do so that they can put food and medicine into their children's mouths in the same way that we take for granted in richer countries? How could it be that a barber in Nigeria, who delivers the same quality of haircut as a barber in New York, has to work 20 times longer to buy a loaf of bread than the barber in New York? (Spoiler alert: If I've learned one thing in my twenty years of studying economics, it's that answering these big economic questions is hard!)

I kept wondering: How could it be possible that we don't have concrete, confident, scientific answers to these questions? And I wanted to be part of the effort to figure this stuff out.

... answering these big economic questions is hard!

Around the same time, I realized that economics can be just as mathematically intensive and data-driven as some areas of physics are. And so eventually I just came to the realization that being an economist might be a bit like being a physicist—but with the fun and important twist that all the work would be directed toward trying to understand and solve some of the world's most important social problems.

PART THREE **MACROECONOMIC TRENDS**

6 ECONOMIC GROWTH

After studying this chapter, you will be able to:

- Define and calculate the economic growth rate and explain the implications of sustained growth
- Describe the economic growth trends in the United States and other countries and regions
- Explain what makes potential GDP grow
- Explain the sources of labor productivity growth
- Explain the theories of economic growth and policies to increase its rate

U.S. real GDP per person and the standard of living doubled between 1980 and 2020. We see even more dramatic change in China, where incomes have doubled not once but four times in that same 40 years. But real GDP growth in both the United States and China has been slower in recent years.

In this chapter, we study the forces that make real GDP grow; and in *Economics in the News* at the end of the chapter, we look at China's slowing growth rate.

The Basics of Economic Growth

Economic growth is the expansion of production possibilities. A rapid pace of economic growth maintained over a number of years can transform a poor nation into a rich one. Such have been the stories of Hong Kong, South Korea, and some other Asian economies. Slow economic growth or the absence of growth can condemn a nation to devastating poverty. Such has been the fate of Sierra Leone, Somalia, Zambia, and much of the rest of Africa.

The goal of this chapter is to help you to understand why some economies expand rapidly and others stagnate. We'll begin by learning how to calculate a growth rate, by distinguishing between economic growth and a business cycle expansion, and by discovering the magic of sustained growth.

Calculating Growth Rates

We express a **growth rate** as the annual percentage change of a variable—the change in the level expressed as a percentage of the initial level. The growth rate of real GDP, for example, is calculated as:

$$\text{Real GDP growth rate} = \frac{\text{Real GDP in current year} - \text{Real GDP in previous year}}{\text{Real GDP in previous year}} \times 100.$$

Using some numbers, if real GDP in the current year is $11 trillion and if real GDP in the previous year was $10 trillion, then the economic growth rate is 10 percent.

The growth rate of real GDP tells us how rapidly the *total* economy is expanding. This measure is useful for telling us about potential changes in the balance of economic power among nations. But it does not tell us about changes in the standard of living.

The standard of living depends on **real GDP per person** (also called *per capita* real GDP), which is real GDP divided by the population. So the contribution of real GDP growth to the change in the standard of living depends on the growth rate of real GDP per person. We use the above formula to calculate this growth rate, replacing real GDP with real GDP per person.

Suppose, for example, that in the current year, when real GDP is $11 trillion, the population is 202 million. Then real GDP per person is $11 trillion divided by 202 million, which equals $54,455.

And suppose that in the previous year, when real GDP was $10 trillion, the population was 200 million. Then real GDP per person in that year was $10 trillion divided by 200 million, which equals $50,000.

Use these two values of real GDP per person with the growth formula above to calculate the growth rate of real GDP per person. That is,

$$\text{Real GDP per person growth rate} = \frac{\$54{,}455 - \$50{,}000}{\$50{,}000} \times 100 = 8.9 \text{ percent}.$$

The growth rate of real GDP per person can also be calculated (approximately) by subtracting the population growth rate from the real GDP growth rate. In the example you've just worked through, the growth rate of real GDP is 10 percent. The population changes from 200 million to 202 million, so the population growth rate is 1 percent. The growth rate of real GDP per person is approximately equal to 10 percent minus 1 percent, which equals 9 percent.

Real GDP per person grows only if real GDP grows faster than the population grows. If the growth rate of the population exceeds the growth rate of real GDP, then real GDP per person falls.

Economic Growth Versus Business Cycle Expansion

Real GDP can increase for two distinct reasons: The economy might be returning to full employment in an expansion phase of the business cycle or *potential* GDP might be increasing.

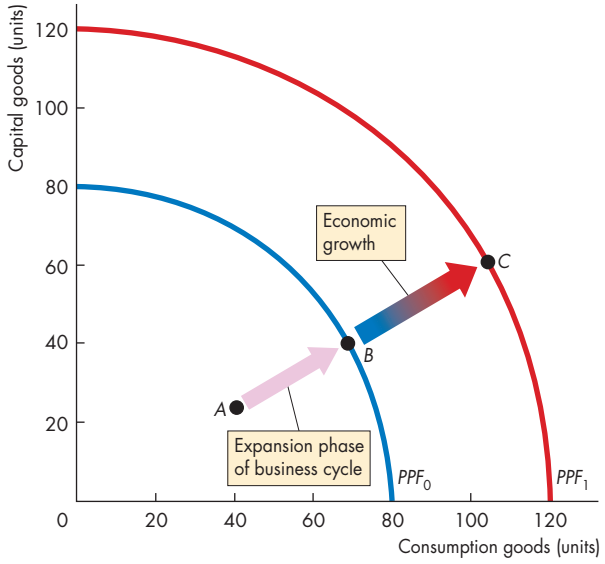
The return to full employment in an expansion phase of the business cycle isn't economic growth. It is just taking up the slack that resulted from the previous recession. The expansion of potential GDP is economic growth.

Figure 6.1 illustrates this distinction using the production possibilities frontier (the *PPF* that you studied in Chapter 2). A return to full employment in a business cycle expansion is a movement from *inside* the *PPF* at a point such as *A* to a point *on* the *PPF* such as *B*.

Economic growth is the expansion of production possibilities. It is an outward movement of the *PPF* such as the shift from PPF_0 to PPF_1 and the movement from point *B* on PPF_0 to point *C* on PPF_1.

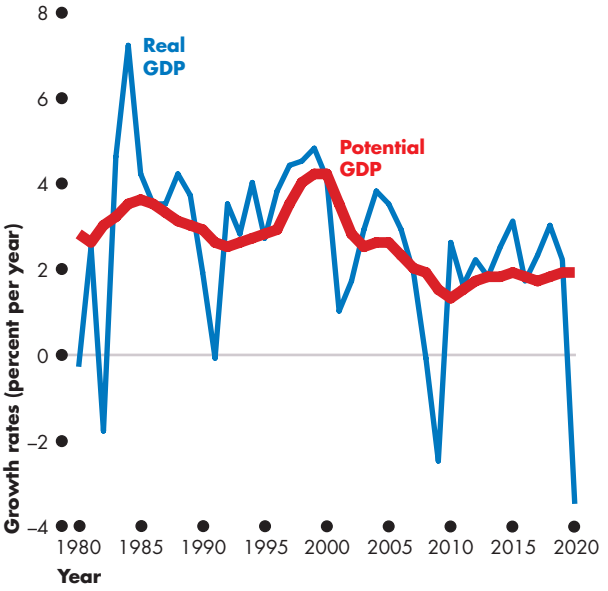
The growth rate of potential GDP measures the pace of expansion of production possibilities and

FIGURE 6.1 Economic Growth and a Business Cycle Expansion



The increase in aggregate production in the move from point *A* inside PPF_0 to point *B on* PPF_0 is an expansion phase of the business cycle and it occurs with no change in production possibilities. Such an expansion is not economic growth. The increase in aggregate production in the move from point *B* on PPF_0 to point *C* on PPF_1 is economic growth—an expansion of production possibilities shown by an outward shift of the *PPF*.

FIGURE 6.2 Growth Rates of Real GDP and Potential GDP



The annual growth rate of real GDP fluctuates widely over the business cycle and masks changes in the underlying trend growth rate. The annual growth rate of potential GDP provides information about changes in the trend growth rate. Both the growth rate of potential GDP and the trend growth rate of real GDP have fallen since 2000.

Sources of data: Real GDP: Bureau of Economic Analysis; Potential GDP: Congressional Budget Office.

smooths out the business cycle fluctuations in the growth rate of real GDP.

Figure 6.2 shows how the growth rate of potential GDP (red curve) smooths the more erratic fluctuations in the growth rate of real GDP. Business cycle fluctuations in the real GDP growth rate mask the underlying *trend* growth rate revealed by the growth rate of *potential* GDP.

The Magic of Sustained Growth

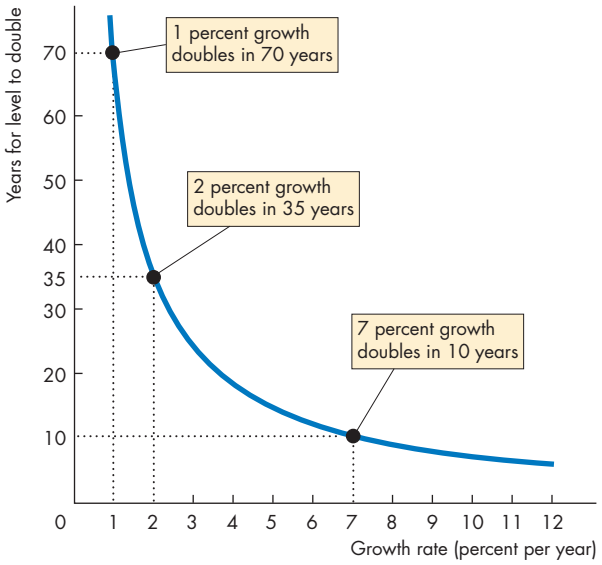
Sustained growth of real GDP per person can transform a poor society into a wealthy one. The reason is that economic growth is like compound interest.

Compound Interest Suppose that you put $100 in the bank and earn 5 percent a year interest on it. After one year, you have $105. If you leave that $105 in the bank for another year, you earn 5 percent interest on the original $100 *and on the $5 interest that you earned last year*. You are now earning interest on interest! The next year, things get even better. Then you earn 5 percent on the original $100 and on the interest earned in the first year and the second year. You are even earning interest on the interest that you earned on the interest of the first year.

Your money in the bank is growing at a rate of 5 percent a year. Before too many years have passed, your initial deposit of $100 will have grown to $200. But after how many years?

The answer is provided by a formula called the **Rule of 70**, which states that the number of years it takes for the level of any variable to double is approximately

FIGURE 6.3 The Rule of 70



Growth rate (percent per year)	Years for level to double
1	70.0
2	35.0
3	23.3
4	17.5
5	14.0
6	11.7
7	10.0
8	8.8
9	7.8
10	7.0
11	6.4
12	5.8

The number of years it takes for the level of a variable to double is approximately 70 divided by the annual percentage growth rate of the variable.

70 divided by the annual percentage growth rate of the variable. Using the Rule of 70, you can now calculate how many years it takes your $100 to become $200. It is 70 divided by 5, which is 14 years.

Applying the Rule of 70

The Rule of 70 applies to any variable, so it applies to real GDP per person. Figure 6.3 shows the doubling time for growth rates of 1 percent per year to 12 percent per year.

You can see that real GDP per person doubles in 70 years (70 divided by 1)—an average human life span—if the growth rate is 1 percent a year. It doubles in 35 years if the growth rate is 2 percent a year and in just 10 years if the growth rate is 7 percent a year.

We can use the Rule of 70 to answer other questions about economic growth. For example, in 2010, U.S. real GDP per person was approximately 4 times that of China. China's recent growth rate of real GDP per person was 10 percent a year. If this growth rate were maintained, how long would it take China's real GDP per person to reach that of the United States in 2010? The answer, provided by the Rule of 70, is 14 years. China's real GDP per person doubles in 7 years (70 divided by 10). It doubles again to 4 times its 2010 level in another 7 years. So after 14 years of growth at 10 percent a year, China's real GDP per person is 4 times its 2010 level and equals that of the United States in 2010.

Of course, after 14 years, U.S. real GDP per person would have increased, so China would still not have caught up to the United States. But at these growth rates, China's real GDP per person would equal that of the United States in 2010 by 2024.

REVIEW QUIZ

1. What is economic growth and how do we calculate its rate?
2. What is the relationship between the growth rate of real GDP and the growth rate of real GDP per person?
3. Use the Rule of 70 to calculate the growth rate that leads to a doubling of real GDP per person in 20 years.

Long-Term Growth Trends

You have just seen the power of economic growth to increase incomes. At a 1 percent growth rate, it takes a human life span to double the standard of living. But at a 7 percent growth rate, the standard of living doubles every decade. How fast has our economy grown over the long term? How fast are other economies growing? Are poor countries catching up to rich ones, or do the gaps between the rich and poor persist or even widen?

Long-Term Growth in the U.S. Economy

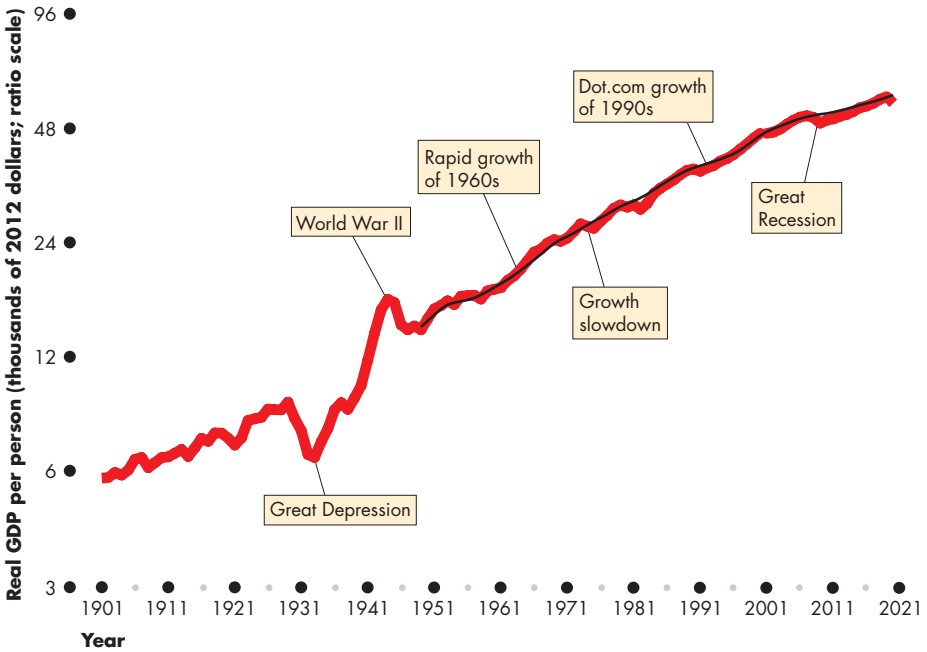
Figure 6.4 shows real GDP per person in the United States for the 120 years from 1901 to 2021. The red line is actual real GDP and the black line (that starts in 1949) is potential GDP. The trend in potential GDP tells us about economic growth. Fluctuations around potential GDP tell us about the business cycle.

Two extraordinary events dominate the graph: the Great Depression of the 1930s, when growth stopped for a decade, and World War II of the 1940s, when growth briefly exploded.

For the century as a whole, the average growth rate was 2 percent a year. But the growth rate has not remained constant. From 1910 to the onset of the Great Depression in 1929, the average growth rate was a bit lower than the century average at 1.8 percent a year. Between 1930 and 1950, averaging out the Great Depression and World War II, the growth rate was 2.4 percent a year. After World War II, the growth rate started out at 2 percent a year. It then increased and growth averaged 3 percent a year during the 1960s. In 1973, and lasting for a decade, the growth rate slowed. Growth picked up somewhat during the 1980s and even more during the dot.com expansion of the 1990s. But the growth rate never returned to the pace achieved during the fast-growing 1960s.

A major goal of this chapter is to explain why our economy grows and why the growth rate changes. Another goal is to explain variations in the economic growth rate across countries. Let's now look at some other countries' growth rates.

FIGURE 6.4 One Hundred and Twenty Years of Economic Growth in the United States



During the 120 years from 1901 to 2021, real GDP per person in the United States grew by 2 percent a year, on average. The growth rate was greater after World War II than it was before the Great Depression. Growth was most rapid during the 1960s. It slowed during the 1970s and sped up again during the 1980s and 1990s, slowed again in the Great Recession, but it never returned to its rapid rate of the 1960s.

Sources of data: GDP (GNP) 1901–1928: Christina D. Romer, "World War I and the Postwar Depression: A Reinterpretation Based on Alternative Estimates of GNP," *Journal of Monetary Economics*, 22, 1988; 1929–2021: Bureau of Economic Analysis; Population data: Census Bureau; Potential GDP: Congressional Budget Office.

Real GDP Growth in the World Economy

Figure 6.5 shows real GDP per person in the United States and in other countries between 1980 and 2020. Part (a) looks at the seven richest countries—known as the G7 nations. Among these nations, the United States has the highest real GDP per person. In 2020, Canada had the second-highest real GDP per person, ahead of Japan and France, Germany, Italy, and the United Kingdom (collectively Europe Big 4).

During the 40 years shown here, the United States has grown slightly faster than Canada, Europe Big 4, and Japan. But starting from a long way below, Japan grew fastest during the 1980s. It caught up to Canada in 1991, but after the mid-1990s, Japan's economy grew more slowly than the United Sates, Canada, and Europe Big 4.

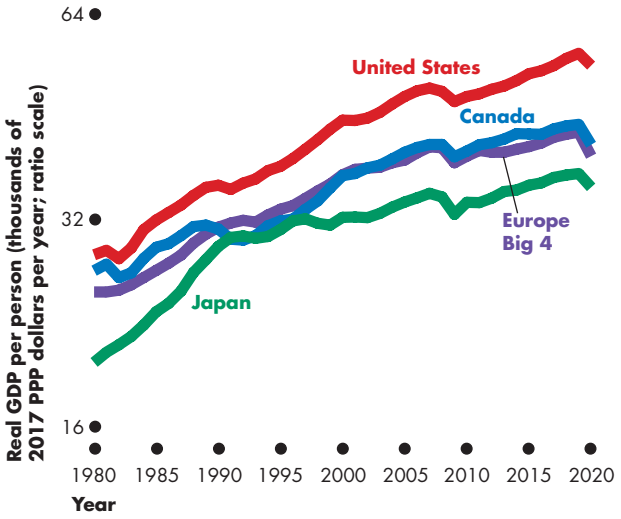
Many other countries are growing more slowly than, and falling farther behind, the United States. Figure 6.5(b) looks at some of these countries.

Real GDP per person in Mexico was 48 percent of the U.S. level in 1980. But it grew more slowly than the United States and by 2020 it had fallen to 30 percent of the U.S. level.

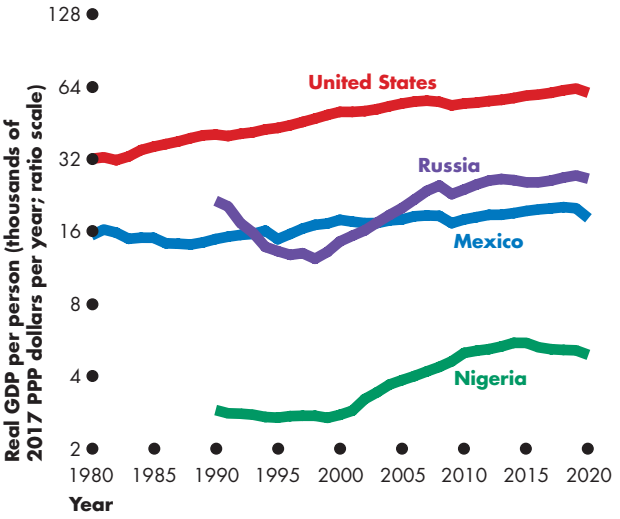
Russia's data on real GDP per person start in 1990, when it stood at 53 percent of the U.S. level. After six years of shrinking, the Russian economy enjoyed a decade of more rapid growth, but it has stagnated since 2008 and by 2020 its real GDP per person was only 44 percent of the U.S. level.

Nigeria's data also start in 1990 and show that Nigeria has grown slightly more quickly than the United States. Nigeria was 7 percent of the U.S. level in 1990 and by 2020 it was 8 percent.

FIGURE 6.5 Economic Growth Around the World: Catch-Up or Not?



(a) Constant gaps



(b) Wider gaps

Real GDP per person has grown throughout the world. Among the rich industrial countries in part (a), real GDP per person has grown slightly faster in the United States than in Canada and the four big countries of Europe (France, Germany, Italy, and the United Kingdom). Japan had the fastest growth rate before 1990, but after the mid-1990s Japan's economy grew more slowly than the rest of the G7 nations.

In part (b), Mexico's growth rate has been lower than that of the United States. The growth rates of Russia and Nigeria have fluctuated, but since 2000 they have grown slightly faster than the United States. So, the gap between the real GDP per person in the United States and Mexico has widened while since 2000, the gaps for Russia and Nigeria have narrowed slightly.

Source of data: World Economic Outlook Database, International Monetary Fund, April 2021.

ECONOMICS IN ACTION

Fast Trains on the Same Track

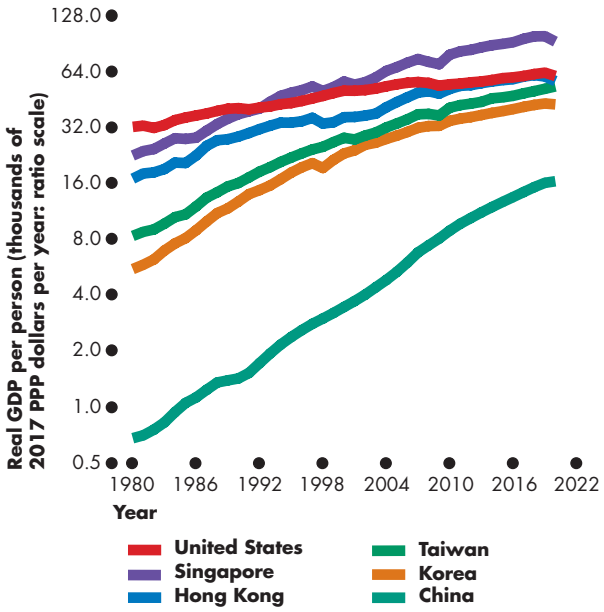
Five Asian economies, Hong Kong, Korea, Singapore, Taiwan, and China, have experienced spectacular growth, which you can see in the figure. In 1980, real GDP per person ranged from 2 percent (China) to 70 percent (Singapore) of that in the United States. By 2020, real GDP per person in Singapore exceeded that of the United States and China had climbed to 27 percent of the U.S. level.

The Asian economies shown here are like fast trains running on the same track at similar speeds and with a roughly constant gap between them. Singapore is the lead train, which runs about 6 years ahead of Hong Kong, 16 years ahead of Taiwan, 20 years ahead of Korea, and 46 years ahead of China.

Real GDP per person in Korea in 2020 was similar to that in Singapore in 1993, and real GDP in China in 2020 was similar to that of Hong Kong in 1980. Between 1980 and 2020, Hong Kong and Singapore transformed themselves from middle-income economies into two of the richest economies in the world.

The rest of China is now doing what Hong Kong has done. China has a population almost 200 times that of Hong Kong and more than 4 times that of the United States. So if China continues its rapid growth, the world economy will change dramatically.

As these fast-growing Asian economies catch up with the United States, we can expect their growth rates to slow. But it will be surprising if China's growth rate slows to that of the United States before the gap has narrowed.



Closing the Gap

Source of data: World Economic Outlook Database, International Monetary Fund, April 2021.

Even modest differences in economic growth rates sustained over a number of years bring enormous differences in the standard of living. And some of the differences that you've just seen are enormous. So the facts about economic growth in the United States and around the world raise some big questions.

What are the preconditions for economic growth? What sustains economic growth once it gets going? How can we identify the sources of economic growth and measure the contribution that each source makes? What can we do to increase the sustainable rate of economic growth?

We're now going to address these questions and discover the causes of economic growth. We start by seeing how potential GDP is determined and what makes it grow. You will see that labor productivity growth is the key to rising living standards and go on to explore the sources of this growth.

REVIEW QUIZ

1. What has been the average growth rate of U.S. real GDP per person over the past 120 years? In which periods was growth most rapid and in which periods was it slowest?
2. Describe the gaps between real GDP per person in the United States and in other countries. For which countries is the gap narrowing? For which is it widening? For which is it the same?
3. Compare the growth rates in Hong Kong, Korea, Singapore, Taiwan, China, and the United States. In terms of real GDP per person, how far is China behind these others?

How Potential GDP Grows

Economic growth occurs when real GDP increases. But a one-shot rise in real GDP or a recovery from recession isn't economic growth. Economic growth is a sustained, year-after-year increase in *potential GDP*.

So what determines potential GDP and what are the forces that make it grow?

What Determines Potential GDP?

Labor, capital, land, and entrepreneurship produce real GDP, and the productivity of the factors of production determines the quantity of real GDP that can be produced.

The quantity of land is fixed and on any given day, the quantities of entrepreneurial ability and capital are also fixed and their productivities are given. The quantity of labor employed is the only *variable* factor of production. Potential GDP is the level of real GDP when the quantity of labor employed is the full-employment quantity.

To determine potential GDP, we use a model with two components:

- An aggregate production function
- An aggregate labor market

Aggregate Production Function When you studied the limits to production in Chapter 2 (see p. 62), you learned that the *production possibilities frontier* is the boundary between the combinations of goods and services that can be produced and those that cannot. We're now going to think about the production possibilities frontier for two special "goods": real GDP and the quantity of leisure time.

Think of real GDP as a number of big shopping carts. Each cart contains some of each kind of different goods and services produced, and one cartload of items costs $1 trillion. To say that real GDP is $20 trillion means that it is 20 very big shopping carts of goods and services.

The quantity of leisure time is the number of hours spent not working. Each leisure hour could be spent working. If we spent all our time taking leisure, we would do no work and produce nothing. Real GDP would be zero. The more leisure we forgo, the greater is the quantity of labor we supply and the greater is the quantity of real GDP produced.

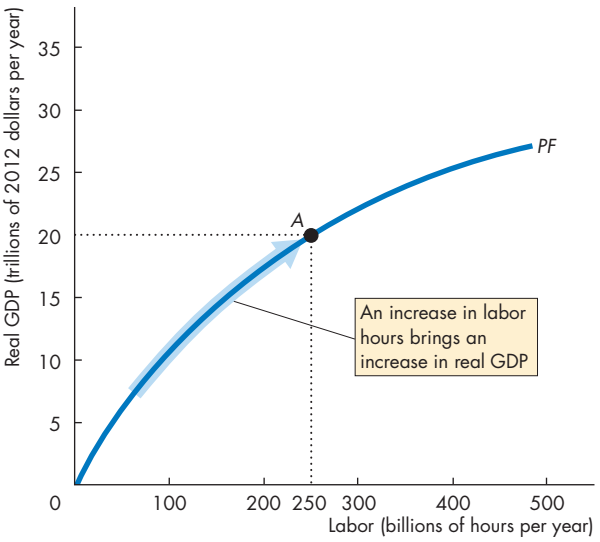
But labor hours are not all equally productive. We use our most productive hours first, and as more hours are worked, these hours are increasingly less productive. So for each additional hour of leisure forgone (each additional hour of labor), real GDP increases but by successively smaller amounts.

The **aggregate production function** is the relationship that tells us how real GDP changes as the quantity of labor changes when all other influences on production remain the same. Figure 6.6 shows this relationship—the curve labeled *PF*. An increase in the quantity of labor (and a corresponding decrease in leisure hours) brings a movement along the production function and an increase in real GDP.

Aggregate Labor Market In macroeconomics, we pretend that there is one large labor market that determines the quantity of labor employed and the quantity of real GDP produced. To see how this aggregate labor market works, we study the demand for labor, the supply of labor, and labor market equilibrium.

The Demand for Labor The *demand for labor* is the relationship between the quantity of labor demanded and the real wage rate. The quantity of labor demanded is the number of labor hours hired by all the firms in the economy during a given period. This

FIGURE 6.6 The Aggregate Production Function



At point *A* on the aggregate production function *PF*, 250 billion hours of labor produce $20 trillion of real GDP.

quantity depends on the price of labor, which is the real wage rate.

The **real wage rate** is the money wage rate divided by the price level. The real wage rate is the quantity of goods and services that an hour of labor earns. It contrasts with the money wage rate, which is the number of dollars that an hour of labor earns.

The *real* wage rate influences the quantity of labor demanded because what matters to firms is not the number of dollars they pay (money wage rate) but how much output they must sell to earn those dollars.

The quantity of labor demanded *increases* as the real wage rate *decreases*—the demand for labor curve slopes downward. Why? The answer lies in the shape of the production function.

You've seen that along the production function, each additional hour of labor increases real GDP by successively smaller amounts. This tendency has a name: the *law of diminishing returns*. Because of diminishing returns, firms will hire more labor only if the real wage rate falls to match the fall in the extra output produced by that labor.

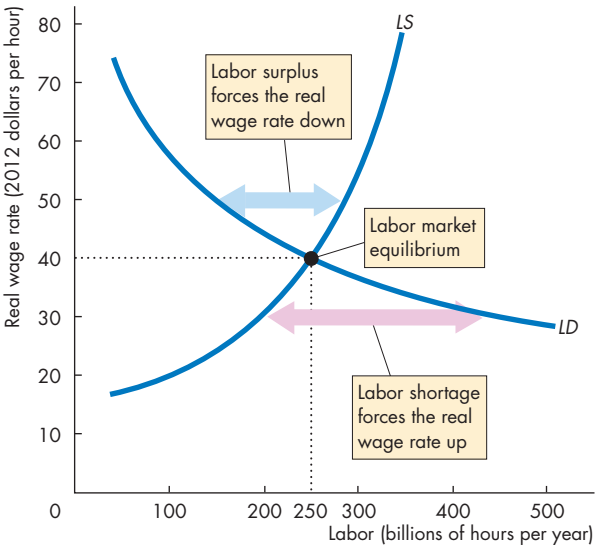
The Supply of Labor The *supply of labor* is the relationship between the quantity of labor supplied and the real wage rate. The quantity of labor supplied is the number of labor hours that all the households in the economy plan to work during a given period. This quantity depends on the real wage rate.

The *real* wage rate influences the quantity of labor supplied because what matters to households is not the number of dollars they earn (money wage rate) but what they can buy with those dollars.

The quantity of labor supplied *increases* as the real wage rate *increases*—the supply of labor curve slopes upward. At a higher real wage rate, more people choose to work and more people choose to work longer hours if they can earn more per hour.

Labor Market Equilibrium The price of labor is the real wage rate. The forces of supply and demand operate in labor markets just as they do in the markets for goods and services to eliminate a shortage or a surplus. But a shortage or a surplus of labor brings only a gradual change in the real wage rate. If there is a shortage of labor, the real wage rate rises to eliminate it; and if there is a surplus of labor, the real wage rate eventually falls to eliminate it. When there is neither a shortage nor a surplus, the labor market is in equilibrium—a full-employment equilibrium.

FIGURE 6.7 Labor Market Equilibrium



Labor market equilibrium occurs when the quantity of labor demanded equals the quantity of labor supplied. The equilibrium real wage rate is $40 an hour, and equilibrium employment is 250 billion hours per year.

At a wage rate above $40 an hour, there is a surplus of labor and the real wage rate falls to eliminate the surplus. At a wage rate below $40 an hour, there is a shortage of labor and the real wage rate rises to eliminate the shortage.

Figure 6.7 illustrates labor market equilibrium. The demand for labor curve is *LD* and the supply of labor curve is *LS*. This labor market is in equilibrium at a real wage rate of $40 an hour and 250 billion hours a year are employed.

If the real wage rate exceeds $40 an hour, the quantity of labor supplied exceeds the quantity demanded and there is a surplus of labor. When there is a surplus of labor, the real wage rate falls toward the equilibrium real wage rate where the surplus is eliminated.

If the real wage rate is less than $40 an hour, the quantity of labor demanded exceeds the quantity supplied and there is a shortage of labor. When there is a shortage of labor, the real wage rate rises toward the equilibrium real wage rate where the shortage is eliminated.

If the real wage rate is $40 an hour, the quantity of labor demanded equals the quantity supplied and

there is neither a shortage nor a surplus of labor. In this situation, there is no pressure in either direction on the real wage rate. So the real wage rate remains constant and the market is in equilibrium. At this equilibrium real wage rate and level of employment, the economy is at *full employment*.

Potential GDP You've seen that the production function tells us the quantity of real GDP that a given amount of labor can produce—see Fig. 6.6. The quantity of real GDP produced increases as the quantity of labor increases. At the equilibrium quantity of labor, the economy is at full employment, and the quantity of real GDP at full employment is potential GDP. So the full-employment quantity of labor produces potential GDP.

Figure 6.8 illustrates the determination of potential GDP. Part (a) shows labor market equilibrium. At the equilibrium real wage rate, equilibrium employment is 250 billion hours. Part (b) shows the production function. With 250 billion hours of labor, the economy can produce a real GDP of $20 trillion. This amount is potential GDP.

What Makes Potential GDP Grow?

We can divide all the forces that make potential GDP grow into two categories:

- Growth of the supply of labor
- Growth of labor productivity

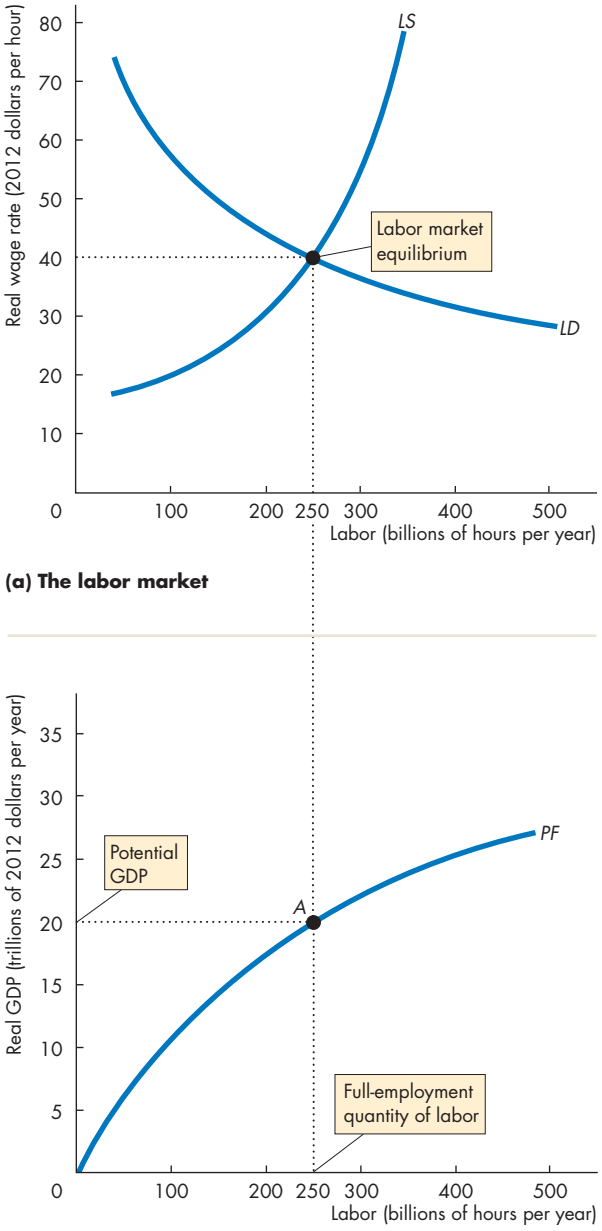
Growth of the Supply of Labor When the supply of labor grows, the supply of labor curve shifts rightward. The quantity of labor at a given real wage rate increases.

The quantity of labor is the number of workers employed multiplied by average hours per worker. The number employed equals the employment-to-population ratio multiplied by the working-age population, divided by 100 (see Chapter 5, p. 142). So the quantity of labor changes as a result of changes in

1. Average hours per worker
2. The employment-to-population ratio
3. The working-age population

Average hours per worker have decreased as the workweek has become shorter, and the employment-to-population ratio has increased as more women have entered the labor force. The combined effect of

FIGURE 6.8 The Labor Market and Potential GDP



The economy is at full employment when the quantity of labor demanded equals the quantity of labor supplied, in part (a). The real wage rate is $40 an hour, and employment is 250 billion hours a year. Part (b) shows potential GDP. It is the quantity of real GDP determined by the production function at the full-employment quantity of labor.

these two factors has kept the average hours per working-age person (approximately) constant.

Growth in the supply of labor has come from growth in the working-age population. In the long run, the working-age population grows at the same rate as the total population.

The Effects of Population Growth Population growth brings growth in the supply of labor, but it does not change the demand for labor or the production function. The economy can produce more output by using more labor, but there is no change in the quantity of real GDP that a given quantity of labor can produce.

With an increase in the supply of labor and no change in the demand for labor, the real wage rate falls and the equilibrium quantity of labor increases. The increased quantity of labor produces more output and potential GDP increases.

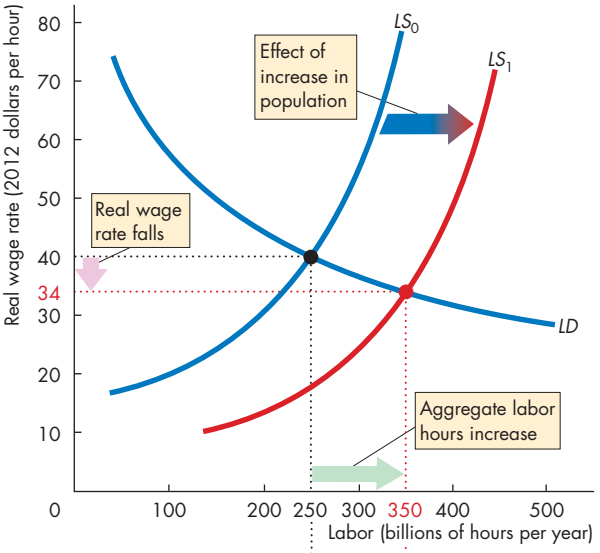
Illustrating the Effects of Population Growth Figure 6.9 illustrates the effects of an increase in the population. In Fig. 6.9(a), the demand for labor curve is *LD* and initially the supply of labor curve is LS_0. The equilibrium real wage rate is $40 an hour and the quantity of labor is 250 billion hours a year. In Fig. 6.9(b), the production function (*PF*) shows that with 250 billion hours of labor employed, potential GDP is $20 trillion at point *A*.

An increase in the population increases the supply of labor and the supply of labor curve shifts rightward to LS_1. At a real wage rate of $40 an hour, there is now a surplus of labor. So the real wage rate falls. In this example, the real wage rate will fall until it reaches $34 an hour. At $34 an hour, the quantity of labor demanded equals the quantity of labor supplied. The equilibrium quantity of labor increases to 350 billion hours a year.

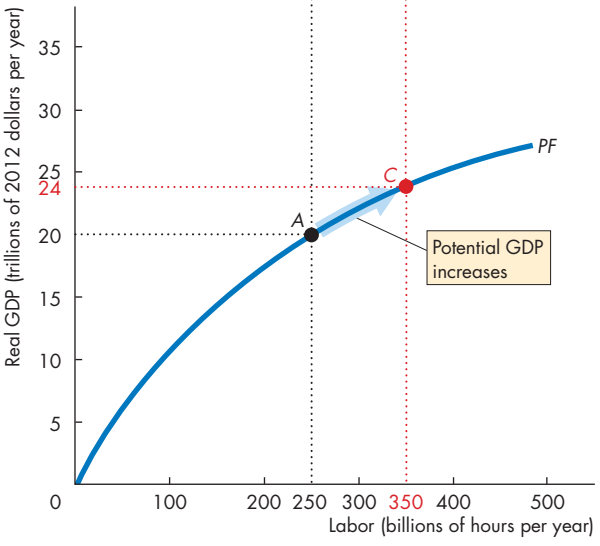
Figure 6.9(b) shows the effect on real GDP. As the equilibrium quantity of labor increases from 250 billion to 350 billion hours, potential GDP increases along the production function from $20 trillion to $24 trillion at point *C*.

So an increase in the population increases the full-employment quantity of labor, increases potential GDP, and lowers the real wage rate. But the population increase *decreases* potential GDP per hour of labor. Initially, it was $80 ($20 trillion divided by 250 billion). With the population increase, potential GDP per hour of labor is $68.57 ($24 trillion divided by 350 billion). Diminishing returns are the source of the decrease in potential GDP per hour of labor.

FIGURE 6.9 The Effects of an Increase in Population



(a) The labor market



(b) Potential GDP

An increase in the population increases the supply of labor. In part (a), the supply of labor curve shifts rightward. The real wage rate falls and aggregate labor hours increase. In part (b), the increase in aggregate labor hours brings an increase in potential GDP. But diminishing returns bring a decrease in potential GDP per hour of labor.

Growth of Labor Productivity **Labor productivity** is the quantity of real GDP produced by an hour of labor. It is calculated by dividing real GDP by aggregate labor hours. For example, if real GDP is $20 trillion and aggregate hours are 250 billion, labor productivity is $80 per hour.

When labor productivity grows, real GDP per person grows and brings a rising standard of living. Let's see how an increase in labor productivity changes potential GDP.

Effects of an Increase in Labor Productivity If labor productivity increases, production possibilities expand. The quantity of real GDP that any given quantity of labor can produce increases. If labor is more productive, firms are willing to pay more for a given number of hours of labor so the demand for labor also increases.

With an increase in the demand for labor and *no change in the supply of labor*, the real wage rate rises and the quantity of labor supplied increases. The equilibrium quantity of labor also increases.

So an increase in labor productivity increases potential GDP for two reasons: Labor is more productive and more labor is employed.

Illustrating the Effects of an Increase in Labor Productivity Figure 6.10 illustrates the effects of an increase in labor productivity.

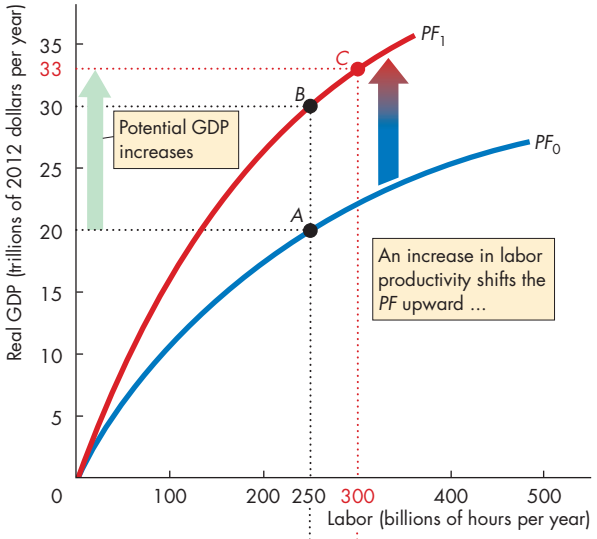
In part (a), the production function initially is PF_0. With 250 billion hours of labor employed, potential GDP is $20 trillion at point *A*.

In part (b), the demand for labor curve is LD_0 and the supply of labor curve is *LS*. The real wage rate is $40 an hour, and the equilibrium quantity of labor is 250 billion hours a year.

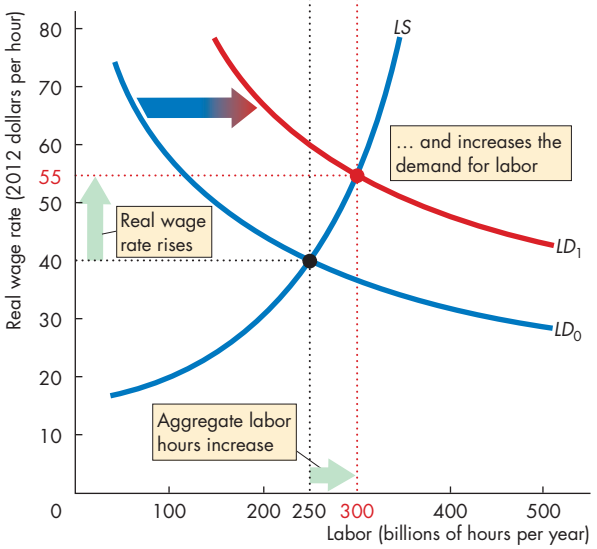
Now labor productivity increases. In Fig. 6.10(a), the increase in labor productivity shifts the production function upward to PF_1. At each quantity of labor, more real GDP can be produced. For example, at 250 billion hours, the economy can now produce $30 trillion of real GDP at point *B*.

In Fig. 6.10(b), the increase in labor productivity increases the demand for labor and the demand for labor curve shifts rightward to LD_1. At the initial real wage rate of $40 an hour, there is now a shortage of labor. The real wage rate rises. In this example, the real wage rate will rise until it reaches $55 an hour. At $55 an hour, the quantity of labor demanded equals the quantity of labor supplied and the equilibrium quantity of labor is 300 billion hours a year.

FIGURE 6.10 The Effects of an Increase in Labor Productivity



(a) Potential GDP



(b) The labor market

An increase in labor productivity shifts the production function upward from PF_0 to PF_1 in part (a) and shifts the demand for labor curve rightward from LD_0 to LD_1 in part (b). The real wage rate rises to $55 an hour, and aggregate labor hours increase from 250 billion to 300 billion. Potential GDP increases from $20 trillion to $33 trillion.

Figure 6.10(a) shows the effects of the increase in labor productivity on potential GDP. There are two effects. At the initial quantity of labor, real GDP increases to point *B* on the new production function. But as the equilibrium quantity of labor increases from 250 billion to 300 billion hours, potential GDP increases to $33 trillion at point *C*.

Potential GDP per hour of labor also increases. Initially, it was $80 ($20 trillion divided by 250 billion). With the increase in labor productivity, potential GDP per hour of labor is $110 ($33 trillion divided by 300 billion).

The increase in aggregate labor hours that you have just seen is a consequence of an increase in labor productivity. This increase in aggregate labor hours and labor productivity is an example of the interaction effects that economists seek to identify in their search for the ultimate *causes* of economic growth. In the case that we've just studied, aggregate labor hours increase but that increase is a *consequence*, not a cause, of the growth of potential GDP. The source of the increase in potential GDP is an increase in labor productivity.

Labor productivity is the key to increasing output per hour of labor and rising living standards. But what brings an increase in labor productivity? The next section answers this question.

REVIEW QUIZ

1. What is the aggregate production function?
2. What determines the demand for labor, the supply of labor, and labor market equilibrium?
3. What determines potential GDP?
4. What are the two broad sources of potential GDP growth?
5. What are the effects of an increase in the population on potential GDP, the quantity of labor, the real wage rate, and potential GDP per hour of labor?
6. What are the effects of an increase in labor productivity on potential GDP, the quantity of labor, the real wage rate, and potential GDP per hour of labor?

Why Labor Productivity Grows

You've seen that labor productivity growth makes potential GDP grow; and you've seen that labor productivity growth is essential if real GDP per person and the standard of living are to grow. But why does labor productivity grow? What are the preconditions that make labor productivity growth possible and what are the forces that make it grow? Why does labor productivity grow faster at some times and in some places than others?

Preconditions for Labor Productivity Growth

The fundamental precondition for labor productivity growth is the *incentive* system created by firms, markets, property rights, and money. These four social institutions are the same as those described in Chapter 2 (see pp. 76–77) that enable people to gain by specializing and trading.

It was the presence of secure property rights in Britain in the middle 1700s that got the Industrial Revolution going (see *Economics in Action* on p. 176). And it is their absence in some parts of Africa today that is keeping labor productivity stagnant.

With the preconditions for labor productivity growth in place, three things influence its pace:

- Physical capital growth
- Human capital growth
- Technological advances

Physical Capital Growth

As the amount of capital per worker increases, labor productivity also increases. Production processes that use hand tools can create beautiful objects, but production methods that use large amounts of capital per worker are much more productive. The accumulation of capital on farms, in textile factories, in iron foundries and steel mills, in coal mines, on building sites, in chemical plants, in auto plants, in banks and insurance companies, and in shopping malls has added incredibly to the labor productivity of our economy. The next time you see a movie that is set in the Old West or colonial times, look carefully at the small amount of capital around. Try to imagine how productive you would be in such circumstances compared with your productivity today.

ECONOMICS IN ACTION

Intellectual Property Rights Propel Growth

In 1760, when the states that 16 years later would become the United States of America were developing agricultural economies, England was on the cusp of an economic revolution, the *Industrial Revolution*.

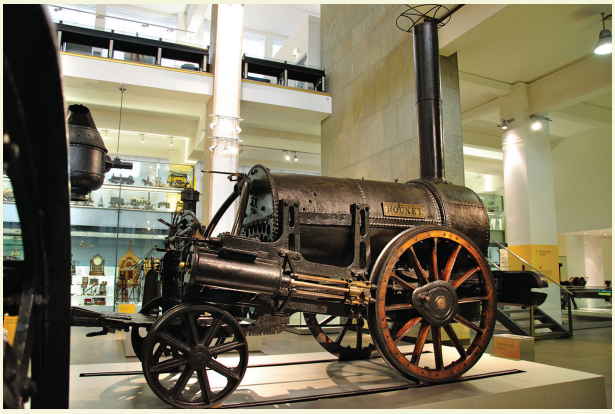
For 70 dazzling years, technological advances in the use of steam power; in the manufacture of cotton, wool, iron, and steel; and in transportation—accompanied by massive capital investment associated with these technologies—transformed the economy of England. Incomes rose and brought an explosion in an increasingly urbanized population.

By 1825, advances in steam technology had reached a level of sophistication that enabled Robert Stevenson to build the world's first steam-powered rail engine (the Rocket, pictured here in the Science Museum, London) and the birth of the world's first railroad.

Why did the Industrial Revolution happen? Why did it start in 1760? And why in England?

Economic historians say that intellectual property rights—England's patent system—provides the answer.

England's patent system began with the Statute of Monopolies of 1624, which gave inventors a monopoly to use their idea for a term of 14 years. For about 100 years, the system was used to reward friends of the royal court rather than true inventors. But from around 1720 onward, the system started to work well. To be granted a 14-year monopoly, an inventor only had to pay the required £100 fee (about $22,000 in today's money) and register his or her invention. The inventor was not required to describe the invention in too much detail, so registering and getting a patent didn't mean sharing the invention with competitors.



This patent system, which is essentially the same as today's, aligned the self-interest of entrepreneurial inventors with the social interest and unleashed a flood of inventions, the most transformative of which was steam power and, by 1825, the steam locomotive.

Human Capital Growth

Human capital—the accumulated skill and knowledge of human beings—is the fundamental source of labor productivity growth. Human capital grows when a new discovery is made and it grows as more and more people learn how to use past discoveries.

The development of one of the most basic human skills—writing—was the source of some of the earliest major gains in productivity. The ability to keep written records made it possible to reap ever-larger gains from specialization and trade. Imagine how hard it would be to do any kind of business if all the accounts, invoices, and agreements existed only in people's memories.

Later, the development of mathematics laid the foundation for the eventual extension of knowledge about physical forces and chemical and biological processes. This base of scientific knowledge was the foundation for the technological advances of the Industrial Revolution and of today's information revolution.

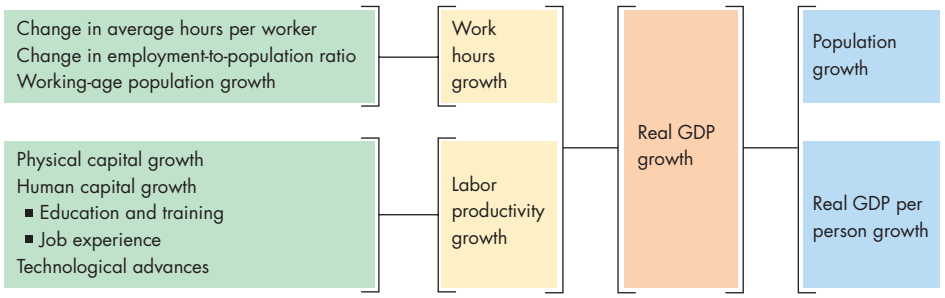
But a lot of human capital that is extremely productive is much more humble. It takes the form of millions of individuals learning and becoming remarkably more productive by repetitively doing simple production tasks. One much-studied example of this type of human capital growth occurred in World War II. With no change in physical capital, thousands of workers and managers in U.S. shipyards learned from experience and accumulated human capital that more than doubled their productivity in less than two years.

Technological Advances

The accumulation of physical capital and human capital has made a large contribution to labor productivity growth. But technological change—the discovery and the application of new technologies—has made an even greater contribution.

Labor is many times more productive today than it was 100 years ago but not because we have more steam engines and more horse-drawn carriages per

FIGURE 6.11 The Sources of Economic Growth



Work hours growth and labor productivity growth combine to determine real GDP growth. Real GDP per person growth depends on real GDP growth and population growth.

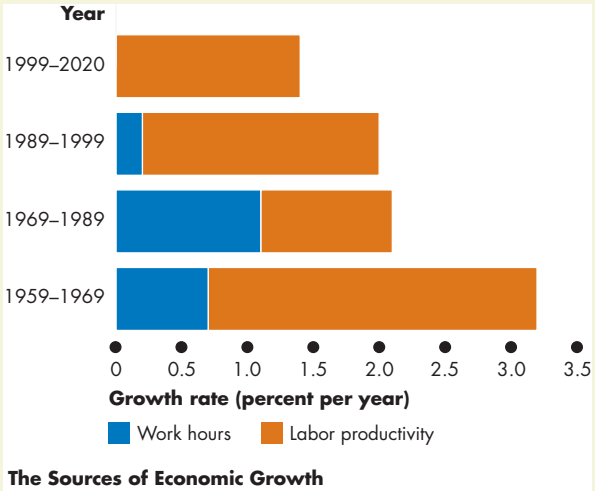
ECONOMICS IN ACTION

The Source of the Growth Slowdown

You saw in Fig. 6.4 that real GDP per person grew at around 3 percent a year during the 1960s and then slowed. What was the source of the growth slowdown?

Figure 6.11 above identifies two major sources of real GDP growth, work hours and labor productivity, and the figure below shows how the sources changed over the past almost six decades.

Labor productivity growth was most rapid during the 1960s and the dot.com revolution of the 1990s. The growth in work hours was greatest during the 1970s and 1980s, two decades of growth in the employment-to-population ratio, first as the baby-boomer generation entered the labor force and second and most persistently, as the female labor force participation rate increased. During the 2000s, work hours contributed nothing to real GDP growth and the labor productivity growth rate slowed to barely 1 percent a year.



The Sources of Economic Growth

person. Rather, it is because we have transportation equipment that uses technologies that were unknown 100 years ago and that are more productive than the old technologies were.

Technological advance arises from formal research and development programs and from informal trial and error, and it involves discovering new ways of getting more out of our resources.

To reap the benefits of technological change, capital must increase. Some of the most powerful and far-reaching fundamental technologies are embodied in human capital—for example, language, writing, and mathematics. But most technologies are embodied in physical capital. For example, to reap the benefits of the internal combustion engine, millions of horse-drawn carriages had to be replaced with automobiles; and to reap the benefits of digital music, millions of Discmans had to be replaced by smartphones.

Figure 6.11 summarizes the sources of labor productivity growth and more broadly, of real GDP growth. The figure also emphasizes that for real GDP per person to grow, real GDP must grow faster than the population.

Economics in the News on p. 178 provides an example of today's labor productivity growth arising from the spread of robotic technologies.

REVIEW QUIZ

1. What are the preconditions for labor productivity growth?
2. Describe the sources of economic growth and identify the source of the growth slowdown.
3. Explain the influences on the pace of labor productivity growth.

ECONOMICS IN THE NEWS

Robots Raise Labor Productivity

Thousands of Robots Improve Human Efficiency at an Amazon Ohio Facility

Thousands of robots move pallets of goods at Amazon's distribution centers and perform other tasks that make workers more productive.

Source: bizjournals.com, July 24, 2017

SOME FACTS

"The Robot Report" (www.therobotreport.com) says the auto industry has been the main customer for industrial robots but the scene is changing. Robot manufacturers are creating equipment tailored to the requirements of firms like Amazon and producers of a wide range of items, just a few of which are metals, food and drink, glass, pharmaceuticals, medical devices, and solar panels.

Around 600 firms worldwide specialize in the design and production of robots and hundreds of start-up companies enter this industry each year. More than 2,000 firms have some connection with industrial robots.

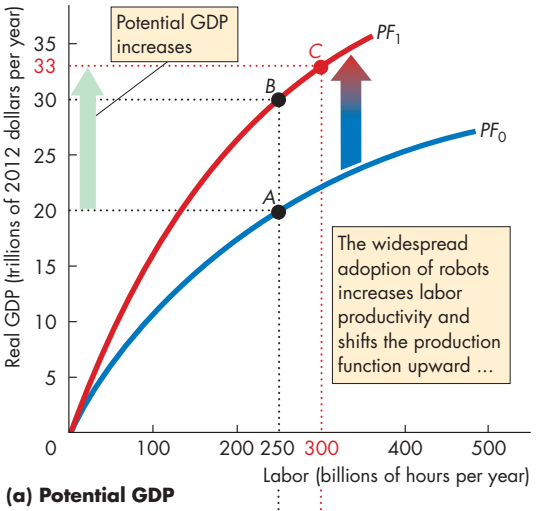
THE QUESTIONS

- How will the adoption of industrial robots change employment, the real wage rate, and potential GDP?
- Do robots kill jobs and create unemployment?

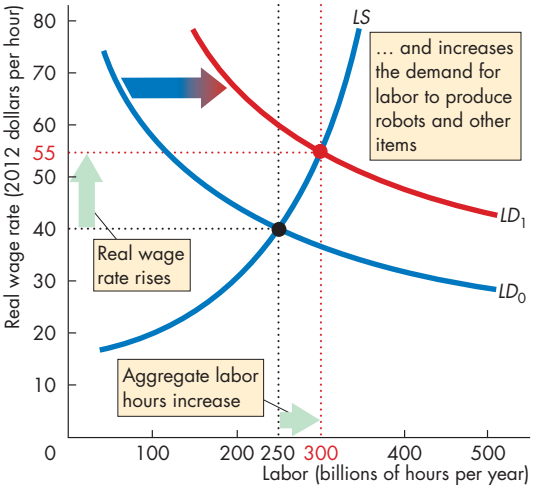
THE ANSWERS

- Robots make workers more productive. One person working with a robot can produce as much as hundreds of workers with non-robot technology.
- Robots replace some workers but create a demand for other workers to design, produce, install, and maintain robots.
- In aggregate, robots increase the productivity of labor. The production function shifts upward and the demand for labor curve shifts rightward.
- The equilibrium real wage rate rises, employment increases, and potential GDP increases.
- As robot production technologies spread, many jobs will disappear but many new jobs will be created.
- Some displaced workers will take new jobs with lower wages. Others will take jobs as skilled robot technicians and producers with higher wages. Average wages will rise.

A robot moves goods around an Amazon facility.



(a) Potential GDP



(b) The labor market

The Effects of Robots on Employment and GDP

Is Economic Growth Sustainable? Theories, Evidence, and Policies

You've seen how population growth and labor productivity growth make potential GDP grow. You've also seen that the growth of physical capital and human capital and technological advances make labor productivity grow. But what *causes* economic growth? Why do growth rates vary? How do population growth, capital accumulation, and technological change interact to determine the economic growth rate? What can we say about the future of economic growth? Is growth sustainable? Will the rich economies and the economies of the developing world keep growing, or will growth end to be followed by stagnation or even a falling standard of living?

Economists have wrestled with these questions for the past 250 years and made progress in answering them. We're now going to look at the evolution of ideas about the sustainability of economic growth and the policies that might achieve faster growth.

We start by studying the three main theories about the process of economic growth:

- Classical growth theory
- Neoclassical growth theory
- New growth theory

Classical Growth Theory

Classical growth theory is the view that the growth of real GDP per person is temporary and that when it rises above the subsistence level, a population explosion eventually brings it back to the subsistence level. Adam Smith, Thomas Robert Malthus, and David Ricardo—the leading economists of the late eighteenth and early nineteenth centuries—proposed this theory, but the view is most closely associated with the name of Malthus and is sometimes called the *Malthusian theory*. Charles Darwin's ideas about evolution by natural selection were inspired by the insights of Malthus.

Modern-Day Malthusians Many people today are Malthusians. They say that if today's global population of 7.8 billion explodes to 11 billion by 2050 and perhaps 35 billion by 2300, we will run out of resources, real GDP per person will decline, and we will return to a primitive standard of living. We must, say Malthusians, contain population growth.

Modern-day Malthusians also point to global warming and climate change as reasons to believe that, eventually, real GDP per person will decrease.

Neoclassical Growth Theory

Neoclassical growth theory is the proposition that real GDP per person grows because technological change induces saving and investment that make capital per hour of labor grow. Growth ends if technological change stops because of diminishing marginal returns to both labor and capital. Robert Solow of MIT suggested the most popular version of this growth theory in the 1950s.

Neoclassical growth theory's big break with its classical predecessor is its view about population growth.

Neoclassical Theory of Population Growth The population explosion of eighteenth century Europe that created the classical theory of population growth eventually ended. The birth rate fell, and while the population continued to increase, its rate of increase moderated.

The key economic influence that slowed the population growth rate is the opportunity cost of a woman's time. As women's wage rates increase and their job opportunities expand, the opportunity cost of having children increases. Faced with a higher opportunity cost, families choose to have fewer children and the birth rate falls.

Technological advances that bring higher incomes also bring advances in healthcare that extend lives. So as incomes increase, both the birth rate and the death rate decrease. These opposing forces offset each other and result in a slowly rising population.

This modern view of population growth and the historical trends that support it contradict the views of the classical economists. They also call into question the modern doomsday view that the planet will be swamped with more people than it can support.

Technological Change and Diminishing Returns In neoclassical growth theory, the pace of technological change influences the economic growth rate but economic growth does not influence the pace of technological change. Neoclassical growth theory assumes that technological change results from chance. When we're lucky, we have rapid technological change, and when bad luck strikes, the pace of technological advance slows.

To understand neoclassical growth theory, imagine the world of the mid-1950s, when Robert Solow is explaining his idea. Income per person is around $12,000 a year in today's money. The population is growing at about 1 percent a year. Saving and investment are about 20 percent of GDP, which is enough to keep the quantity of capital per hour of labor constant. Income per person is growing but not very quickly.

Then technology begins to advance at a more rapid pace across a range of activities. The transistor revolutionizes an emerging electronics industry. New plastics revolutionize the manufacture of household appliances. The interstate highway system revolutionizes road transportation. Jet airliners start to replace piston-engine airplanes and speed air transportation.

These technological advances bring new profit opportunities. Businesses expand, and new businesses are created to exploit the newly available profitable technologies. Investment and saving increase. The economy enjoys new levels of prosperity and growth. But will the prosperity last? And will the growth last? Neoclassical growth theory says that the *prosperity* will last but the *growth* will not last unless technology keeps advancing.

According to neoclassical growth theory, the prosperity will persist because there is no classical population growth to induce the wage rate to fall. So the gains in income per person are permanent.

But growth will eventually stop if technology stops advancing because of diminishing marginal returns to capital. The high profit rates that result from technological change bring increased saving and capital accumulation. But as more capital is accumulated, more and more projects are undertaken that have lower rates of return—diminishing marginal returns. As the return on capital falls, the incentive to keep investing weakens. With weaker incentives to save and invest, saving decreases and the rate of capital accumulation slows. Eventually, the pace of capital accumulation slows so that it is only keeping up with population growth. Capital per worker remains constant.

A Problem with Neoclassical Growth Theory

All economies have access to the same technologies, and capital is free to roam the globe, seeking the highest available real interest rate. Capital will flow across regions until rates of return are equal, and rates of return will be equal when capital per hour of labor is equal. Real GDP growth rates and income levels per person around the world will converge. Figure 6.5 on p. 168 shows that while there is some sign of convergence among the rich countries in part (a), convergence is slow, and part (b) shows that it does not appear to be imminent for all countries. New growth theory overcomes this shortcoming of neoclassical growth theory. It also explains what determines the pace of technological change.

New Growth Theory

New growth theory holds that real GDP per person grows because of the choices people make in the pursuit of profit and that growth will persist indefinitely. Paul Romer of Stanford University developed this theory during the 1980s, based on ideas of Joseph Schumpeter during the 1930s and 1940s.

According to the new growth theory, the pace at which new discoveries are made—and at which technology advances—is not determined by chance. It depends on how many people are looking for a new technology and how intensively they are looking. The search for new technologies is driven by incentives.

Profit is the spur to technological change. The forces of competition squeeze profits, so to increase profit, people constantly seek either lower-cost methods of production or new and better products for which people are willing to pay a higher price. Inventors can maintain a profit for several years by taking out a patent or a copyright, but eventually, a new discovery is copied, and profits disappear. So more research and development is undertaken in the hope of creating a new burst of profitable investment and growth.

Two facts about discoveries and technological knowledge play a key role in the new growth theory: Discoveries are (at least eventually) a public capital good; and knowledge is capital that is not subject to diminishing marginal returns.

Economists call a good a *public good* when no one can be excluded from using it and when one person's use does not prevent others from using it. National defense is the classic example of a public good. The programming language used to write apps for the iPhone is another.

Because knowledge is a public good, as the benefits of a new discovery spread, free resources become available. Nothing is given up when they are used: They have a zero opportunity cost. When a student in Austin writes a new iPhone app, his use of the programming language doesn't prevent another student in Seattle from using it.

Knowledge is even more special because it is *not* subject to diminishing returns. But increasing the stock of knowledge makes both labor and machines more productive. Knowledge capital does not bring diminishing returns. Biotech knowledge illustrates this idea well. Biologists have spent a lot of time developing DNA sequencing technology. As more

has been discovered, the productivity of this knowledge capital has relentlessly increased. In 1990, it cost about $50 to sequence one DNA base pair. That cost had fallen to $1 by 2000 and to 1/10,000th of a penny by 2010.

The implication of this simple and appealing observation is astonishing. Unlike the other two theories, new growth theory has no growth-stopping mechanism. As physical capital accumulates, the return to capital—the real interest rate—falls. But the incentive to innovate and earn a higher profit becomes stronger. So innovation occurs, capital becomes more productive, the demand for capital increases, and the real interest rate rises again.

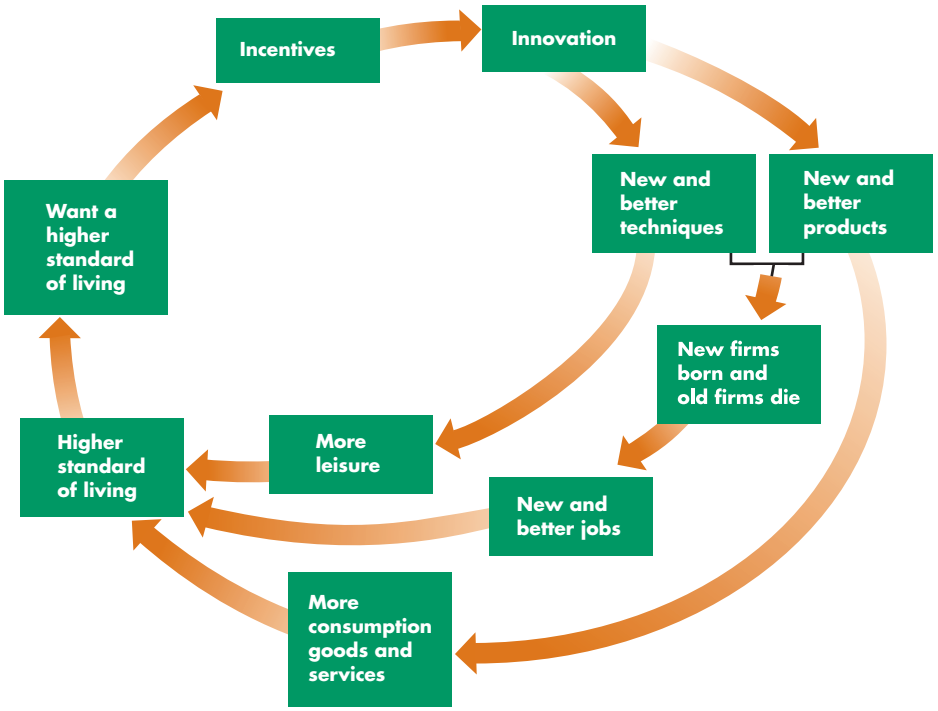
Labor productivity grows indefinitely as people discover new technologies that yield a higher real interest rate. The growth rate depends only on people's incentives and ability to innovate.

A Perpetual Motion Economy New growth theory sees the economy as a perpetual motion machine, which Fig. 6.12 illustrates.

No matter how rich we become, our wants exceed our ability to satisfy them. We always want a higher standard of living. In the pursuit of a higher standard of living, human societies have developed incentive systems—markets, property rights, and money—that enable people to profit from innovation. Innovation leads to the development of new and better techniques of production and new and better products. To take advantage of new techniques and to produce new products, new firms start up and old firms go out of business—firms are born and die. As old firms die and new firms are born, some jobs are destroyed and others are created. The new jobs created are better than the old ones and they pay higher real wage rates. Also, with higher wage rates and more productive techniques, leisure increases. New and better jobs and new and better products lead to more consumption goods and services and, combined with increased leisure, bring a higher standard of living.

But our insatiable wants are still there, so the process continues: Wants and incentives create innovation, new and better products, and a yet higher standard of living.

FIGURE 6.12 A Perpetual Motion Machine



People want a higher standard of living and are spurred by profit incentives to make the innovations that lead to new and better techniques and new and better products.

These new and better techniques and products, in turn, lead to the birth of new firms and the death of some old firms, new and better jobs, and more leisure and more consumption goods and services.

The result is a higher standard of living, but people want a still higher standard of living, and the growth process continues.

Source: Based on a similar figure in *These Are the Good Old Days: A Report on U.S. Living Standards*, Federal Reserve Bank of Dallas 1993 Annual Report.

New Growth Theory Versus Malthusian Theory

The contrast between the Malthusian theory and new growth theory couldn't be more sharp. Malthusians see the end of prosperity as we know it today and new growth theorists see unending plenty. The contrast becomes clearest by thinking about the differing views about population growth.

To a Malthusian, population growth is part of the problem. To a new growth theorist, population growth is part of the solution. People are the ultimate economic resource. A larger population brings forth more wants, but it also brings a greater amount of scientific discovery and technological advance. So rather than being the source of falling real GDP per person, population growth generates faster labor productivity growth and rising real GDP per person. Resources are limited, but the human imagination and ability to increase productivity are unlimited.

Sorting Out the Theories

Which theory is correct? None of them tells us the whole story, but each teaches us something of value.

Classical growth theory reminds us that our physical resources are limited and that without advances in technology, we must eventually hit diminishing returns.

Neoclassical growth theory reaches the same conclusion but not because of a population explosion. Instead, it emphasizes diminishing returns to capital and reminds us that we cannot keep growth going just by accumulating physical capital. We must also advance technology and accumulate human capital. We must become more creative in our use of scarce resources.

New growth theory emphasizes the capacity of human resources to innovate at a pace that offsets diminishing returns. New growth theory fits the facts of today's world more closely than do either of the other two theories.

The Empirical Evidence on the Causes of Economic Growth

Economics makes progress by the interplay between theory and empirical evidence. A theory makes predictions about what we will observe if the theory is correct. Empirical evidence, the data generated by history and the natural experiments that it performs, provides the data for testing the theory.

Economists have done an enormous amount of research confronting theories of growth with the empirical evidence. The way in which this research has been conducted has changed over the years.

In 1776, when Adam Smith wrote about "the nature and causes of the Wealth of Nations" in his celebrated book, empirical evidence took the form of carefully selected facts described in words and stories. Today, large databases, sophisticated statistical methods, and fast computers provide numerical measurements of the causes of economic growth.

Economists have looked at the growth rate data for more than 100 countries for the period since 1960 and explored the correlations between the growth rate and more than 60 possible influences on it. The conclusion of this data crunching is that most of these possible influences have variable and unpredictable effects, but a few of them have strong and clear effects. Table 6.1 summarizes these more robust influences. They are arranged in order of difficulty (or in the case of region, impossibility) of changing. Political and economic systems are hard to change, but market distortions, investment, and openness to international trade are features of a nation's economy that can be influenced by policy.

Let's now look at growth policies.

Policies for Achieving Faster Growth

Growth theory supported by empirical evidence tells us that to achieve faster economic growth, we must increase the growth rate of physical capital, the pace of technological advance, the growth rate of human capital and openness to international trade.

The main suggestions for achieving these objectives are

- Stimulate saving
- Stimulate research and development
- Improve the quality of education
- Provide international aid to developing nations
- Encourage international trade

Stimulate Saving Saving finances investment so stimulating saving increases economic growth. The East Asian economies have the highest growth rates and the highest saving rates. Some African economies have the lowest growth rates and the lowest saving rates.

Tax incentives can increase saving. Individual Retirement Accounts (IRAs) are a tax incentive to save. Economists claim that a tax on consumption rather than income provides the best saving incentive.

TABLE 6.1 The Influences on Economic Growth

Influence	Good for Economic Growth	Bad for Economic Growth
Region	■ Far from equator	■ Sub-Saharan Africa
Politics	■ Rule of law	■ Revolutions
	■ Civil liberties	■ Military coups
		■ Wars
Economic system	■ Capitalist	
Market distortions		■ Exchange rate distortions
		■ Price controls and black markets
Investment	■ Human capital	
	■ Physical capital	
International trade	■ Open to trade	

Source of data: Xavier Sala-i-Martin, "I Just Ran Two Million Regressions," *The American Economic Review*, Vol. 87, No. 2, (May 1997), pp. 206–211.

Stimulate Research and Development Everyone can use the fruits of *basic* research and development efforts. For example, all biotechnology firms can use advances in gene-splicing technology. Because basic inventions can be copied, the inventor's profit is limited and the market allocates too few resources to this activity. Governments can direct public funds toward financing basic research, but this solution is not foolproof. It requires a mechanism for allocating the public funds to their highest-valued use.

Improve the Quality of Education The free market produces too little education because it brings benefits beyond those valued by the people who receive the education. By funding basic education and by ensuring high standards in basic skills such as language, mathematics, and science, governments can contribute to a nation's growth potential. Education can also be stimulated and improved by using tax incentives to encourage improved private provision.

Provide International Aid to Developing Nations It seems obvious that if rich countries give financial aid to developing countries, investment and growth will increase in the recipient countries. Unfortunately, the obvious does not routinely happen. A large amount of data-driven research on the effects of aid on growth has turned up a zero and even negative effect. Aid often gets diverted and spent on consumption.

Encourage International Trade Trade, not aid, stimulates economic growth. It works by extracting the available gains from specialization and trade. The fastest-growing nations are those most open to trade. If the rich nations truly want to aid economic development, they will lower their trade barriers against developing nations, especially in farm products. The World Trade Organization's efforts to achieve more open trade are being resisted by the richer nations.

REVIEW QUIZ

1 What is the key idea of classical growth theory that leads to the dismal outcome?
2 What, according to neoclassical growth theory, is the fundamental cause of economic growth?
3 What is the key proposition of new growth theory that makes economic growth persist?

To complete your study of economic growth, take a look at *Economics in the News* on pp. 184–185, which examines China's slowing growth rate and recovery from the Covid-19 pandemic.

China's Economic Growth

Behind the Recovery, China's Economy Is Wobbling

The Financial Times
July 16, 2020

China's headline economic data released on Thursday showed growth of 3.2 percent in the second quarter, a strong rebound from the first three months of the year when the country reported its first contraction since the end of the Cultural Revolution in the mid-1970s.

That puts the overall decline for the first half of the year at just 1.6 percent—an enviable performance compared with most big economies still struggling with the pandemic that began in the central Chinese city of Wuhan.

The "fundamentals" of China's growth "have not changed and will not change," state media quoted President Xi Jinping as saying after Thursday's figures were published.

But therein lies the problem.

The solid rebound was only achieved with Herculean effort from an interventionist state falling back on the same tools it has relied on since the financial crisis of 2008.

Even before the first virus cases were discovered in Wuhan, the economy was struggling with massive over-investment, mounting bad debt, growing dominance of inefficient state enterprises and chronic underconsumption.

The government's response to the collapse of growth in the first quarter has exacerbated all these problems.

Financial regulators are warning of a flood of new bad loans and a surge in unregulated shadow banking. ...

The build-up of debt ... in the aftermath of the 2008 crisis was the fastest and biggest in history and the pace has accelerated to record highs since the start of the pandemic. …

Thursday's data release reveals investment by state-owned enterprises in the first half of the year rose by 2.1 percent, while investment by private companies fell by 7.3 percent.

Source: *The Financial Times*, July 16, 2020.

ESSENCE OF THE STORY

- China's real GDP fell in the first quarter of 2020 and bounced back in the second quarter to finish the first half of 2020 down by 1.6 percent.
- China's economy has been struggling since 2008 with the effects of the global financial crisis—over-investment, mounting bad debt, inefficient state enterprises, and low consumption expenditure.
- The government's response to the Covid-19 pandemic has exacerbated all these problems.
- In the first half of 2020, investment by private companies fell by 7.3 percent and investment by state-owned enterprises rose by 2.1.

ECONOMIC ANALYSIS

- In 1978, under the leadership of Deng Xiaoping, China embarked on a program of economic reform.
- Gradually, state-owned monopolies were replaced by private competitive businesses, often financed by foreign capital and operated as joint ventures with foreign firms.
- By the early 1980s, China's economy had opened to rapidly expanding international trade and its real GDP was growing at the fastest rate in the world, and at the fastest rate ever known.
- Figure 1 shows the growth rate of real GDP since 1970 and our estimate of the growth rate of China's potential GDP.
- Note the increase in the growth rate of potential GDP (the red line) from around 6 percent per year during the 1970s to 10 percent per year through the next three decades.
- This extraordinary growth came from a high and rising level of investment.
- In 1980, China invested 32 percent of GDP in new capital, rising to 52 percent by 2008.
- And there was plenty of productive capital to invest in, such as airports, high-speed trains, and a host of manufacturing plants to produce profitable exports.
- During those 28 years, China's real GDP grew at an annual rate of 9.7 percent, doubling almost 4 times.
- Figure 2 shows the enormous increases in labor productivity that made China's real GDP grow so rapidly between 1980 and 2008.
- China's aggregate production function shifted upward from PF_0 in 1980 to PF_1 in 2008.
- In 1980, 1,650 billion hours of labor produced 3 trillion yuan of real GDP. By 2008, the same quantity of labor could produce a real GDP of 40 trillion yuan.
- The world economy went into a deep recession in 2008, caused by the bursting of a bubble in house and financial asset prices in the United States.
- To avoid the consequences of the global recession, China increased its investment rate to 52 percent of GDP.
- But much of the new investment was less-productive government investment and it created an increase in debt.
- China's economy continued to expand after 2008, but at a slower rate of 6.7 percent a year.
- Between 2008 and 2020, China's aggregate production function shifted upward from PF_1 to PF_2.

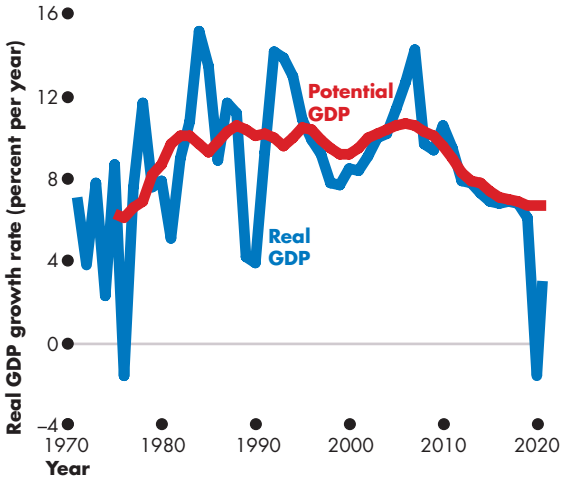


Figure 1 China's Real GDP Growth Rates

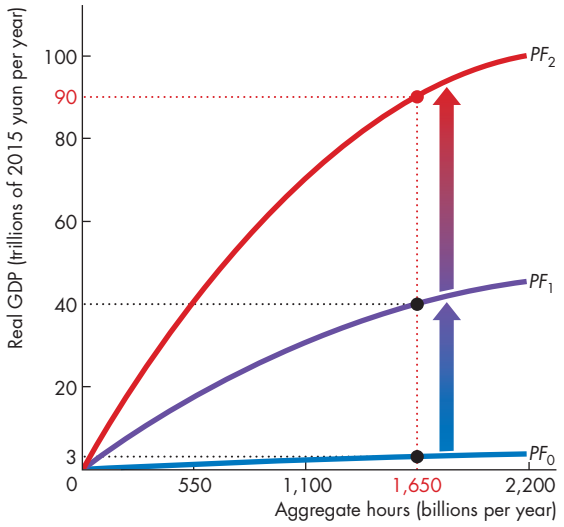


Figure 2 China's Shifting Aggregate Production Function

- In 2020, 1,650 billion hours of labor produced 90 trillion yuan of real GDP, a bit more than double the 40 trillion yuan of 2008.
- The coronavirus pandemic brought a decrease in China's real GDP—the first decrease since the 1970s—but it is too soon to determine its effect on the growth rate of potential GDP.
- If the decrease in investment reported in the news article persists, potential GDP growth will slow further.

WORKED PROBLEM

The *World Economic Outlook* reports the following information:

- China's real GDP was 89.28 trillion yuan in 2019 and 91.31 trillion yuan in 2020.
- China's population was 1,400 million in 2019 and 1,404 million in 2020.

Questions

1. Calculate China's real GDP growth rate and its population growth rate during 2020.
2. Calculate the growth rate of China's standard of living during 2020.
3. If the growth rate of China's standard of living during 2020 is maintained, how many years will it take to double?

Solutions

1. The growth of a variable equals the change in the value from 2019 to 2020 calculated as a percentage of the value in 2019.

   China's growth rate of real GDP during 2020 equals (91.31 trillion yuan – 89.28 trillion yuan) divided by 89.28 trillion yuan, multiplied by 100.

   That is, China's real GDP growth rate equals

   $$(2.03 \div 89.28) \times 100 = 2.27 \text{ percent.}$$

   China's population growth rate equals (1,404 million – 1,400 million) divided by 1,400 million, multiplied by 100. That is,

   China's population which equals

   $$(4 \div 1{,}400) \times 100 = 0.29 \text{ percent.}$$

Key Point: The growth rate of a variable equals the annual percentage change in the value of the variable.

2. Real GDP per person measures the standard of living.

   In 2019, real GDP per person was 89.28 trillion yuan divided by 1,400 million, which equals 63,771 yuan.

   In 2020, real GDP per person was 91.31 trillion yuan divided by 1,404 million, which equals 65,036 yuan.

   The growth rate of real GDP per person equals (65,036 yuan – 63,771 yuan) ÷ 63,771 yuan, multiplied by 100.

   That is, the growth rate of real GDP per person equals (1,265 ÷ 63,771) × 100, which is 1.98 percent.

   So during 2020, China's standard of living increased by 1.98 percent.

   An alternative way of calculating the growth rate of the standard of living is to compare the growth rates of real GDP and the population.

   Notice that a higher real GDP growth rate increases the growth rate of real GDP per person, but a higher population growth rate lowers the growth rate of real GDP per person.

   So when real GDP grows by 2.27 percent and the population doesn't change, the standard of living grows by 2.27 percent.

   When the population grows by 0.29 percent and real GDP doesn't change, the standard of living falls by 0.29 percent.

   That is, the growth rate of China's standard of living during 2020 is approximately equal to the growth rate of real GDP minus the population growth rate, which equals 2.27 percent minus 0.29 percent, or 1.98 percent.

Key Point: The growth rate of the standard of living equals the growth rate of real GDP minus the growth rate of the population.

3. The number of years it will take for the standard of living to double its 2019 level is given by the Rule of 70.

   In 2020, China's standard of living is growing at 1.98 percent a year. The Rule of 70 says that if this growth rate is sustained, China's standard of living will double in 70 years divided by 1.98, which equals 35.4 years.

   China's standard of living will be twice what it was in 2020 sometime during 2056.

Key Point: The time it takes for the standard of living to double equals 70 years divided by the sustained growth rate of the standard of living.

Exercise: During the Covid recession of 2020, China was the only country whose standard of living increased. But in 2015 its standard of living increased by 6.1 percent. If that growth rate had been sustained, in how many years would it have doubled?

SUMMARY

Key Points

The Basics of Economic Growth (pp. 164–166)

- Economic growth is the sustained expansion of production possibilities and is measured as the annual percentage rate of change of real GDP.
- The Rule of 70 tells us the number of years in which real GDP doubles—70 divided by the annual percentage growth rate.

Long-Term Growth Trends (pp. 167–169)

- Real GDP per person in the United States grows at an average rate of 2 percent a year. Growth was most rapid during the 1960s and the 1990s.
- The gap in real GDP per person between the United States and Mexico has widened. The gaps between the United States and Hong Kong, Korea, and China have narrowed. The gap between the United States and Russia and Nigeria narrowed after 2000.

How Potential GDP Grows (pp. 170–175)

- The aggregate production function and equilibrium in the aggregate labor market determine potential GDP.
- Potential GDP grows if the labor supply grows or if labor productivity grows.
- Only labor productivity growth makes real GDP per person and the standard of living grow.

Why Labor Productivity Grows (pp. 175–178)

- Labor productivity growth requires an incentive system created by firms, markets, property rights, and money.
- The sources of labor productivity growth are growth of physical capital and human capital and advances in technology.

Is Economic Growth Sustainable? Theories, Evidence, and Policies (pp. 179–183)

- In classical theory, real GDP per person keeps returning to the subsistence level.
- In neoclassical growth theory, diminishing returns to capital limit economic growth.
- In new growth theory, economic growth persists indefinitely at a rate determined by decisions that lead to innovation and technological change.
- Policies for achieving faster growth include stimulating saving and research and development, encouraging international trade, and improving the quality of education.

Key Terms

Aggregate production function, 170
Classical growth theory, 179
Economic growth, 164
Growth rate, 164
Labor productivity, 174
Neoclassical growth theory, 179
New growth theory, 180
Real GDP per person, 164
Real wage rate, 171
Rule of 70, 165

PROBLEMS AND APPLICATIONS

The Basics of Economic Growth

1. Mexico's real GDP was 18,163 billion pesos in 2017 and 18,526 billion pesos in 2018. Mexico's population was 123.5 million in 2017 and 124.7 million in 2018. Calculate:
   a. The growth rate of real GDP.
   b. The growth rate of real GDP per person.
   c. The approximate number of years it takes for real GDP per person in Mexico to double if the 2017 growth rate of real GDP and the population growth rate are maintained.
2. The IMF projects that China's real GDP per person will be 57,163 yuan in 2017 and 60,334 yuan in 2018 and that India's real GDP per person will be 98,028 rupees in 2017 and 104,191 rupees in 2018. By maintaining their current growth rates, which country will be first to double its standard of living and when will that happen?

Long-Term Growth Trends

3. China was the largest economy for centuries because everyone had the same type of economy—subsistence—so the country with the most people was economically biggest. Then the Industrial Revolution sent the West on a more prosperous path. Now the world is returning to a common economy, this time technology- and information-based, so again population triumphs.
   a. Why was China the world's largest economy until 1890?
   b. Why did the United States surpass China in 1890 to become the world's largest economy?

How Potential GDP Grows

Use the tables in the next column to work Problems 4 to 6.

The first table describes an economy's labor market in 2020 and the second table describes its production function in 2020.

Real wage rate (dollars per hour)	Labor hours supplied	Labor hours demanded
80	45	5
70	40	10
60	35	15
50	30	20
40	25	25
30	20	30
20	15	35

Labor (hours)	Real GDP (2012 dollars)
5	425
10	800
15	1,125
20	1,400
25	1,625
30	1,800
35	1,925
40	2,000

4. What are the equilibrium real wage rate, the quantity of labor employed in 2020 labor productivity, and potential GDP in 2020?
5. In 2021, the population increases and labor hours supplied increase by 10 at each real wage rate. What are the equilibrium real wage rate, labor productivity, and potential GDP in 2021?
6. In 2021, the population increases and labor hours supplied increase by 10 at each real wage rate. Does the standard of living in this economy increase in 2021? Explain why or why not.

Why Labor Productivity Grows

7. **Productivity and Costs**
   The BLS reported the following data for year ended March 2021: In the nonfarm sector, output increased 1.1 percent and labor productivity increased 4.1 percent. In the manufacturing sector, output decreased by 0.9 percent and labor productivity increased by 1.8 percent.
   Source: bls.gov/news.release, June 3, 2021
   Did the quantity of labor (aggregate hours) increase or decrease in the nonfarm sector and the mamufacturing sector? In which sector was the change in the quantity of labor larger?

Is Economic Growth Sustainable? Theories, Evidence, and Policies

8. Explain the processes that will bring the growth of real GDP per person to a stop according to:
   a. Classical growth theory.
   b. Neoclassical growth theory.
   c. New growth theory.

ADDITIONAL PROBLEMS AND APPLICATIONS

The Basics of Economic Growth

9. In 2018 Brazil's real GDP is growing at 1.7 percent a year and its population is growing at 0.7 percent a year. If these growth rates continue, in what year will Brazil's real GDP per person be twice what it is in 2018?
10. Canada's real GDP was $1,830 billion in 2017 and $1,866 billion in 2018. Canada's population was 36.7 million in 2017 and 37.1 million in 2018. Calculate:
    a. The growth rate of real GDP.
    b. The growth rate of real GDP per person.
    c. The approximate number of years it takes for real GDP per person in Canada to double if the 2018 growth rate of real GDP and the population growth rate are maintained.
11. Australia's real GDP was $1,730 billion in 2017 and $1,782 billion in 2018. Australia's population was 24.6 million in 2017 and 25.0 million in 2018. Calculate:
    a. The growth rate of real GDP.
    b. The growth rate of real GDP per person.
    c. The approximate number of years it will take for real GDP per person in Australia to double if the current real GDP growth rate and population growth rate are maintained.

Long-Term Growth Trends

12. **A Shifting Global Economic Landscape**

    Global growth for 2016 is estimated at 3.1 percent. Advanced economies are projected to grow by 1.9 percent in 2017 and 2.0 percent in 2018. The primary factor underlying the strengthening global outlook over 2017–18 is the projected pickup in developing economies' growth estimated at 4.1 percent in 2016, and projected to reach 4.5 percent for 2017. A further pickup in growth to 4.8 percent is projected for 2018. Notably, the growth forecast for 2017 was revised up for China to 6.5 percent.

    Source: IMF, January 2017

    Do the growth rates projected by the IMF indicate that gaps in real GDP per person around the world are shrinking, growing, or staying the same? Explain.

How Potential GDP Grows

13. If a large increase in investment increases labor productivity, explain what happens to:
    a. Potential GDP.
    b. Employment.
    c. The real wage rate.
14. If a severe drought decreases labor productivity, explain what happens to:
    a. Potential GDP.
    b. Employment.
    c. The real wage rate.

Use the following tables to work Problems 15 to 17. The first table describes an economy's labor market in 2021 and the second table describes its production function in 2021.

Real wage rate (dollars per hour)	Labor hours supplied	Labor hours demanded
80	55	15
70	50	20
60	45	25
50	40	30
40	35	35
30	30	40
20	25	45

Labor (hours)	Real GDP (2012 dollars)
15	1,425
20	1,800
25	2,125
30	2,400
35	2,625
40	2,800
45	2,925
50	3,000

15. What are the equilibrium real wage rate and the quantity of labor employed in 2021?
16. What are labor productivity and potential GDP in 2021?
17. Suppose that labor productivity increases in 2022. What effect does the increased labor productivity have on the demand for labor, the supply of labor, potential GDP, and real GDP per person?

Why Labor Productivity Grows

18. **Why Is India's Labor Productivity Growth Faltering?**

India's labor productivity grew by more than 14 percent a year between 2004 and 2008. But between 2016 and 2018, labor productivity grew by only 3.7 percent a year. Between 2001 and 2018, capital intensity increased, that is capital used per worker increased but the value of output per unit of capital decreased.

Source: indianexpress.com, November 4, 2019

What is happening to India's labor productivity and capital productivity? How does this influence India's economic growth?

Is Economic Growth Sustainable? Theories, Evidence, and Policies

19. **Has the Ideas Machine Broken Down?**

According to economist Robert Gordon, the last two centuries of economic growth might actually amount to just "one big wave" of dramatic change rather than a new era of uninterrupted progress, and the world is now returning to extensive growth, which is a matter of adding more and/or better labor, capital, and resources.

Source: *The Economist*, January 12, 2013

Which of the growth theories that you've studied in this chapter best corresponds Mr. Gordon's statement?

20. Is faster economic growth always a good thing? Argue the case for faster growth and the case for slower growth. Then reach a conclusion on whether growth should be increased or slowed.

21. **How Prosperity Depends on Ideas**

According to economist Paul Romer, ideas and technological discoveries unlock the mystery of growth. He argues that ideas, especially those that can be contained in a piece of software, codified in a chemical formula, or used to improve the organization of an assembly line, don't obey the law of diminishing returns. Ideas and knowledge build on each other and can be reproduced cheaply.

Source: *The Wall Street Journal*, January 21, 1997

Explain which growth theory best describes the news clip.

22. What is the fundamental fact that drives the new growth theory perpetual motion machine and keeps it in motion?

23. Describe the components of the new growth theory perpetual motion machine and explain the role played by incentives in keeping the machine in motion.

24. Why and how does new growth theory imply that technological change, even robots and artificial intelligence, will create as many jobs as it will destroy?

25. **Coronavirus Vaccine: When Will We Have One?**

Under normal circumstances the vaccine creation process takes years, but with 200 groups of researchers committed to the task, an effective vaccine is expected to be available in months.

Source: bbc.com, July 20, 2020

Explain how new growth theory explains this news clip.

Economics in the News

26. After you have studied *Economics in the News* on pp. 184–185, answer the following questions.
    a. Distinguish between economic growth and recovery from recession and identify two years in Fig. 1 when China was recovering from recession rather than growing faster.
    b. Over which years did China's growth rate of potential GDP increase, what were the high growth rate years, and when did growth begin to slow?
    c. At its peak growth rate, how many years did it take for China's real GDP to double?
    d. What did the government of China do in 2008 to avoid recession in the global financial crisis?
    e. Why did China's growth rate slow down despite an increase in investment?

27. **Historic Drought in India Is So Severe That It's Now Visible from Space**

India is facing a country-wide drought. Chennai, a major automotive producing city, has 99 percent less water than a year ago. Its factories must cut production to save water.

Source: globalnews.ca, June 24, 2019

Explain the effect of the drought on India's labor productivity, potential GDP, and employment.

7 FINANCE, SAVING, AND INVESTMENT

After studying this chapter, you will be able to:

- Describe the flows of funds in financial markets
- Explain how financial decisions are made and the risks that arise from these decisions
- Explain how lending and borrowing decisions interact in financial markets
- Explain how governments influence financial markets

Interest rates fell in 2008 following a global financial meltdown in which billions of dollars were lost. After a few years of calm, interest rates fell again in 2020 as financial markets responded to the coronavirus pandemic.

Behind the drama and headlines that interest rates create, financial markets play a crucial role funneling funds from savers and lenders to investors and borrowers. This chapter explains how financial markets work, and *Economics in the News* at the end of the chapter looks at the ways in which information technology is changing financial institutions and markets.

Financial Markets and Financial Institutions

The financial markets and financial institutions that we study in this chapter provide the channels that saving flows through to finance the investment in new capital that makes the economy grow. To understand how these markets and institutions work, we distinguish between

- Finance and money
- Capital and financial capital

Finance and Money

We use the term *finance* to describe lending and borrowing. The study of finance looks at how lending and borrowing decisions are made and how these decisions interact in markets to determine interest rates, asset prices, and macroeconomic performance.

Money is what we use to pay for goods and services and for the services of factors of production and to make financial transactions. The study of money looks at how households and firms use it, how much of it they hold, how banks create and manage it, and how its quantity influences the economy.

Finance and money are closely interrelated and some of the main financial institutions, such as banks, provide both financial services and monetary services. Nevertheless, by distinguishing between *finance* and *money* and studying them separately, we will better understand our financial and monetary markets and institutions.

For the rest of this chapter, we study finance. Money is the topic of the next chapter.

Capital and Financial Capital

Capital consists of *physical capital*—tools, instruments, machines, buildings, and inventories—and *human capital*. When economists use the term capital, they mean physical capital.

Financial capital consists of the funds that firms use to buy physical capital and that households use to buy a home or to invest in human capital.

You're going to see, in this chapter, how investment, saving, borrowing, and lending decisions influence the quantity of capital and make it grow and, as a consequence, make real GDP grow.

We begin by describing the links between capital and investment and between wealth and saving.

Capital and Investment

The quantity of capital changes because of investment and depreciation. *Investment* increases the quantity of capital and *depreciation* decreases it (see Chapter 4, p. 118). The total amount spent on new capital is called **gross investment**. The change in the value of capital is called **net investment**. Net investment equals gross investment minus depreciation.

Figure 7.1 illustrates these terms. On January 1, 2022, Ace Bottling Inc. had machines worth $30,000—Ace's initial capital. During 2022, the market value of Ace's machines fell by 67 percent—$20,000. After this depreciation, Ace's machines were valued at $10,000. During 2022, Ace spent $30,000 on new machines. This amount is Ace's gross investment. By December 31, 2022, Ace Bottling had capital valued at $40,000, so its capital had increased by $10,000. This amount is Ace's net investment. Ace's net investment equals its gross investment of $30,000 minus depreciation of its initial capital of $20,000.

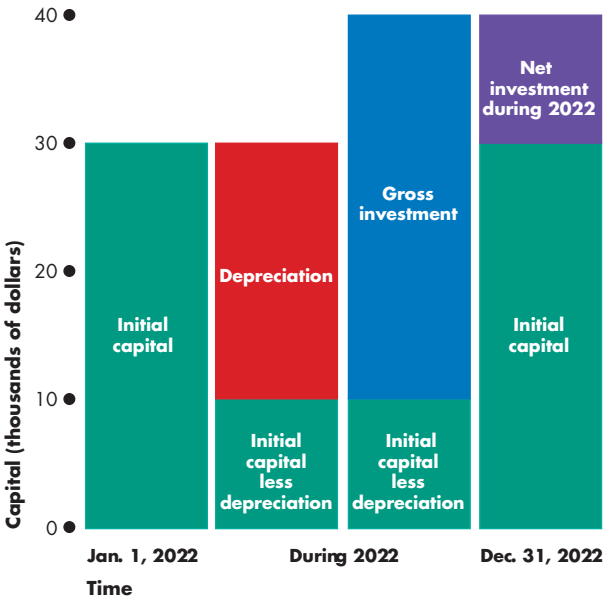
Wealth and Saving

Wealth is the value of the things that people *own*. It contrasts with *income*, which is what people *earn* during a given time period from supplying the services of the resources they own. **Saving** is the amount of income that is not paid in taxes or spent on consumption goods and services. Saving increases wealth. Wealth also increases when the market value of assets rises—called *capital gains*—and decreases when the market value of assets falls—called *capital losses*.

For example, if at the end of the school year you have $250 in the bank and a coin collection worth $300, then your wealth is $550. During the summer, suppose that you earn $5,000 (net of taxes) and spend $1,000 on consumption goods and services, so your saving is $4,000. Your bank account increases to $4,250 and your wealth becomes $4,550. The $4,000 increase in wealth equals saving. If coins rise in value and your coin collection is now worth $500, you have a capital gain of $200, which is also added to your wealth.

National wealth and national saving work like this personal example. The wealth of a nation at the end of a year equals its wealth at the start of the year plus its saving during the year, which equals income minus consumption expenditure.

FIGURE 7.1 Capital and Investment



On January 1, 2022, Ace Bottling had capital worth $30,000. During the year, the value of Ace's capital fell by $20,000—depreciation—and Ace spent $30,000 on new capital—gross investment. Ace's net investment was $10,000 ($30,000 gross investment minus $20,000 depreciation) so that at the end of 2022, Ace had capital worth $40,000.

To make real GDP grow, saving and wealth must be transformed into investment and capital. This transformation takes place in the markets for financial capital and through the activities of financial institutions. We're now going to describe these markets and institutions.

Financial Capital Markets

Saving is the source of the funds that are used to finance investment, and these funds are supplied and demanded in three types of financial markets:

- Loan markets
- Bond markets
- Stock markets

Loan Markets Businesses often want short-term finance to buy inventories or to extend credit to their customers. Sometimes they get this finance in the form of a loan from a bank. Households often need finance to purchase big ticket items, such as automobiles or household furnishings and appliances. They get this finance as bank loans, often in the form of outstanding credit card balances.

Households also get finance to buy new homes. (Expenditure on new homes is counted as part of investment.) These funds are usually obtained as a loan that is secured by a **mortgage**—a legal contract that gives ownership of a home to the lender in the event that the borrower fails to meet the agreed loan payments (repayments and interest).

All of these types of financing take place in loan markets.

Bond Markets When Walmart expands its business and opens new stores, it gets the finance it needs by selling bonds. Governments—federal, state, and municipal—also raise finance by issuing bonds.

A **bond** is a promise to make specified payments on specified dates. For example, you can buy a Walmart bond that promises to pay $5.00 every year until 2024 and then to make a final payment of $100 in 2025.

The buyer of a bond from Walmart makes a loan to the company and is entitled to the payments promised by the bond. When a person buys a newly issued bond, he or she may hold the bond until the borrower has repaid the amount borrowed or sell it to someone else. Bonds issued by firms and governments are traded in the **bond market**.

The term of a bond, called the *term to maturity*, might be long (decades) or short (just a month or two) and the interest rate on a bond varies with its term to maturity. The relationship between the term of a bond and the interest rate is called the *yield curve*. Usually, the longer the term, the higher is the interest rate, so the yield curve slopes upward.

Bond interest rates also vary with the level of risk that the borrower will not meet the agreed payment schedule. Governments are the least risky borrowers and government bonds pay the lowest interest rates. (See *Economics in Action*, p. 194.)

Mortgage lenders create bonds called **mortgage-backed securities**, which entitle their holders to the income from a package of mortgages. These securities were at the center of the storm in the financial markets in 2007–2008. (See *Economics in Action*, p. 195.)

ECONOMICS IN ACTION

Interest Rate Patterns

In July 2021, the U.S. government could borrow for 3 months at an interest rate of 0.05 percent per year, for 10 years at 1.37 percent, for 30 years at 2 percent. Why the difference? Interest rates were expected to rise.

When the U.S government could borrow for 10 years at an interest rate of 1.37 percent, the safest Aaa corporations paid 2.54 percent, riskier Baa corporations paid 3.27 percent, and the riskiest Ccc corporations paid 6.61 percent. These interest rates reflect the risk of default—failure to repay a loan.

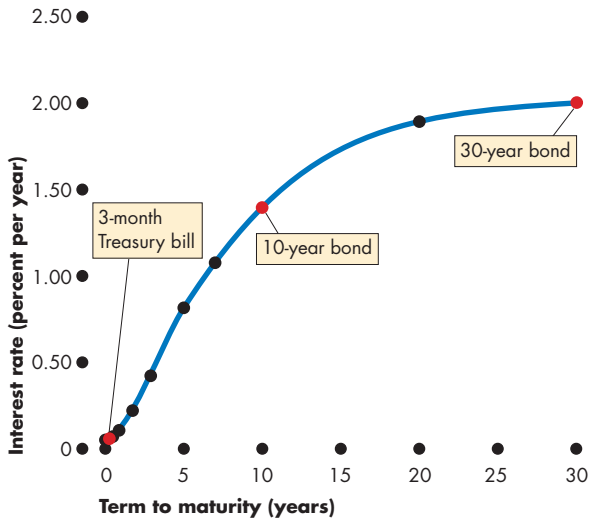


Figure 1 The Yield Curve

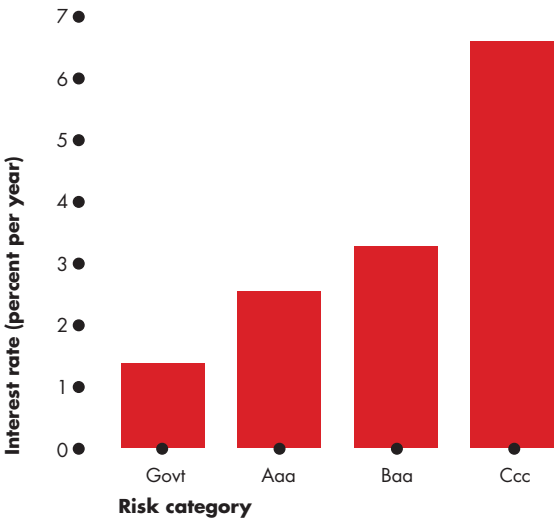


Figure 2 The Risk Premiums

Sources of data: Federal Reserve and Ychart.com.

Stock Markets When Boeing wants to expand its airplane building business and needs finance, it issues stock. A **stock** is a certificate of ownership and claim to the firm's profits. Boeing has issued about 900 million shares of its stock. So if you owned 900 Boeing shares, you would own 1 millionth of Boeing and be entitled to receive 1 millionth of its profits.

Unlike a stockholder, a bondholder does not own part of the firm that issued the bond.

A **stock market** is a financial market in which shares of stocks of corporations are traded. The New York Stock Exchange, the London Stock Exchange (in England), the Tokyo Stock Exchange (in Japan), and the Frankfurt Stock Exchange (in Germany) are all examples of stock markets.

Financial Institutions

Financial markets are highly competitive because of the role played by financial institutions in those markets. A **financial institution** is a firm that operates on *both* sides of the markets for financial capital. A financial institution is a borrower in one market and a lender in another.

Financial institutions also stand ready to trade so that households with funds to lend and firms or households seeking funds can always find someone on the other side of the market with whom to trade. The key financial institutions are

- Commercial banks
- Government-sponsored mortgage lenders
- Mutual funds
- Pension funds
- Insurance companies

Commercial Banks Commercial banks are financial institutions that accept deposits, provide payment services, and make loans to firms and households. The bank that you use for your own banking services and that issues your credit card is a commercial bank. These institutions play a central role in the monetary system.

ECONOMICS IN ACTION

The Global Financial Crisis

Bear Stearns: absorbed by JPMorgan Chase. Lehman Brothers: gone. Home mortgage companies Fannie Mae and Freddie Mac: taken into government oversight. Merrill Lynch: absorbed by Bank of America. AIG: given an $85 billion lifeline and sold off in parcels to financial institutions around the world. Wachovia: taken over by Wells Fargo. Washington Mutual: taken over by JPMorgan Chase. Morgan Stanley: 20 percent bought by Mitsubishi, a large Japanese bank. These are some of the events in the financial crisis of 2008.

What Was Going On?

Between 2002 and 2006, U.S. mortgage borrowing to buy a home exploded and home prices rocketed. You can see the rise in U.S. mortgage borrowing in Fig. 1. Mortgages increased from 65 percent of income in 2000 to more than 100 percent in 2006. And you can see the rocketing home prices in Fig. 2. Between 2000 and 2006, home prices doubled. In 2007, they crashed.

Mortgage lenders sold their loans to Fannie Mae, Freddie Mac, and other large banks, which bundled them into mortgage-backed securities and sold them to eager buyers around the world.

When home prices began to fall in 2007, many home owners discovered their mortgage was bigger than the value of their home. The mortage default rate jumped and the prices of mortage-backed securities and other more widely-held assets fell sharply. Financial institutions took big losses. Some losses were too big to bear and big-name institutions went out of business.

Is this pattern going to repeat? Will house prices crash again? They might, but mortgage debt is lower today (as a percentage of income) than in 2007.

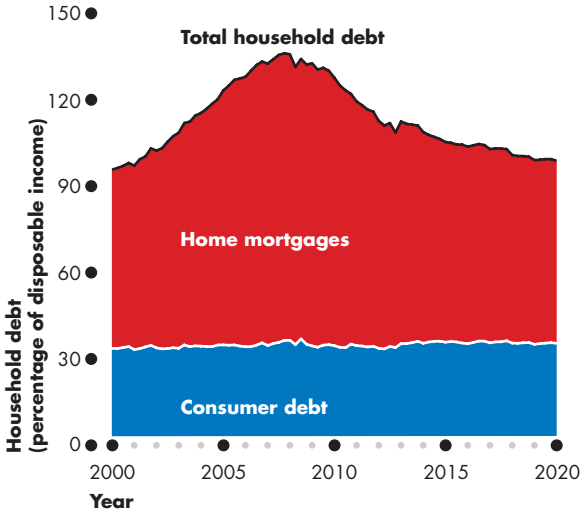


Figure 1 U.S. Household Debt

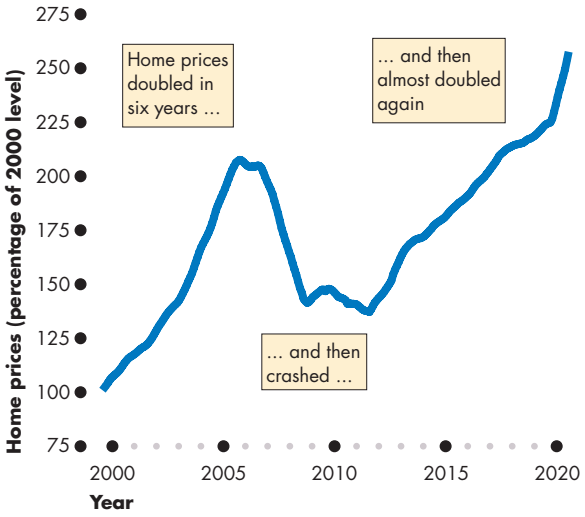


Figure 2 U.S. House Price Index

Sources of data: Federal Reserve and S&P Case-Shiller Housing Index.

Government-Sponsored Mortgage Lenders Two large financial institutions, the Federal National Mortgage Association, or Fannie Mae, and the Federal Home Loan Mortgage Corporation, or Freddie Mac, are enterprises that buy mortgages from banks, package them into mortgage-backed securities, and sell them.

Mutual Funds Mutual funds are financial institutions that buy assets using funds provided by individual savers.

Pension Funds Pension funds are financial institutions that use the pension contributions of firms and workers to buy bonds and stocks. The mortgage-backed securities of Fannie Mae and Freddie Mac are among the assets of pension funds. Some pension funds are very large, and they play an active role in the firms whose stock they hold.

Insurance Companies Insurance companies enable households and firms to cope with risks such as accident, theft, fire, ill health, and a host of other misfortunes. Insurance companies receive premiums from their customers and pay claims. Insurance companies use the funds they have received but not paid out as claims to buy bonds and stocks on which they earn interest.

Funds That Finance Investment

The circular flow model of Chapter 4 (see p. 117) can be extended to include flows in the loanable funds market that finance investment, and Fig. 7.2 shows these flows. They come from three sources:

1. Household saving
2. Government budget surplus
3. Borrowing from the rest of the world

Household income, Y, is spent on consumption goods and services, C, saved, S, or paid in net taxes, T. **Net taxes** are the taxes paid to governments minus the cash transfers received from governments (such as Social Security and unemployment benefits). So income is equal to the sum of consumption expenditure, saving, and net taxes:

$$Y = C + S + T.$$

You saw in Chapter 4 (p. 118) that Y also equals the sum of the items of aggregate expenditure: consumption expenditure, C, investment, I, government expenditure, G, and exports, X, minus imports, M. That is:

$$Y = C + I + G + X - M.$$

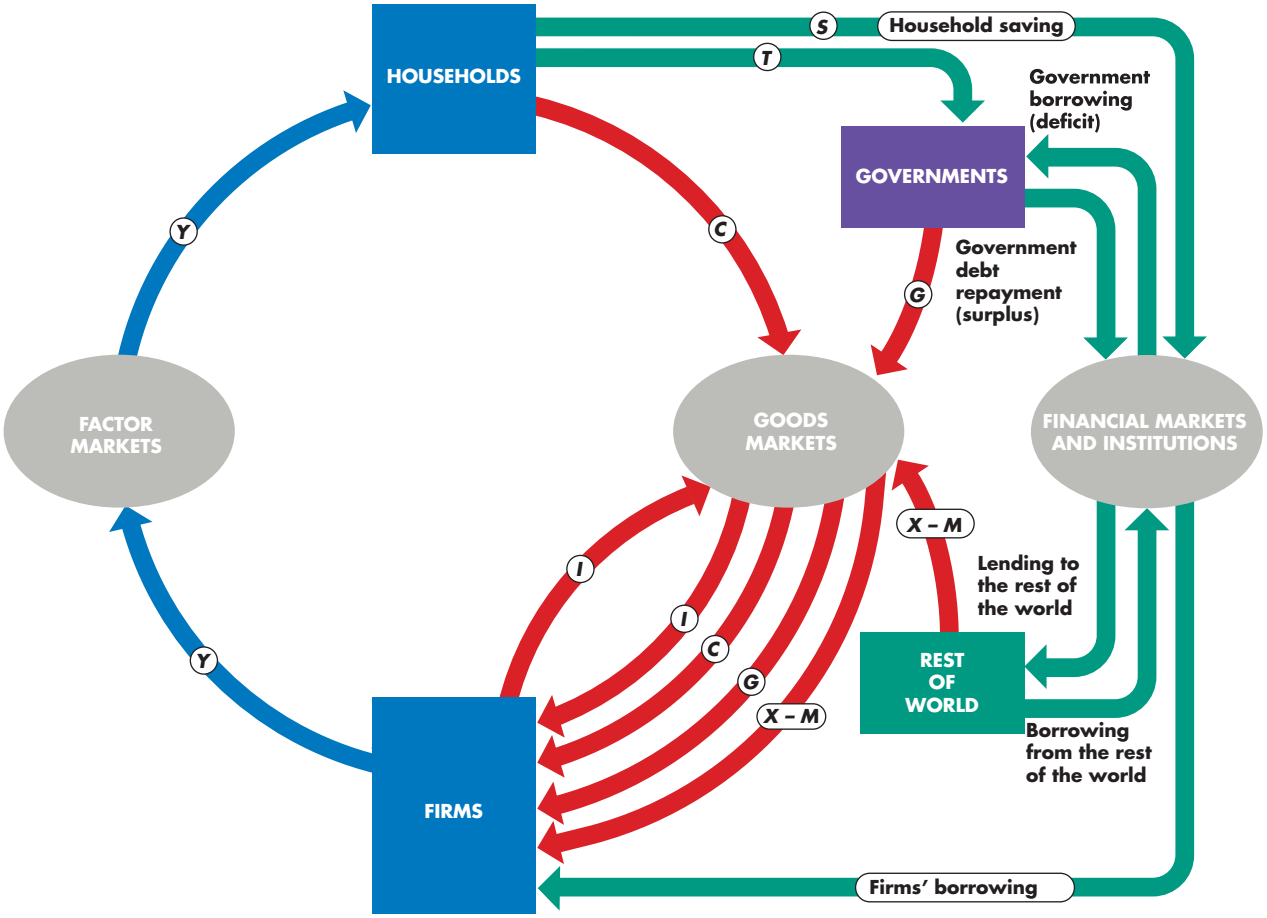
By using these two equations, you can see that

$$I + G + X = M + S + T.$$

Subtract G and X from both sides of the last equation to obtain

$$I = S + (T - G) + (M - X).$$

FIGURE 7.2 Financial Flows and the Circular Flow of Expenditure and Income



Households use their income for consumption expenditure (C), saving (S), and paying net taxes (*T*). Firms borrow to finance their investment expenditure. Governments borrow to finance a budget deficit or repay debt if they have a budget surplus. The rest of the world borrows to finance its deficit or lends its surplus.

ECONOMICS IN ACTION

Financial Institutions and Flows

Figure 1 shows that at the end of 2020, the financial institutions held financial assets valued at $121 trillion. That's about $368,000 per person. These assets are held by commercial banks, pension funds, mutual funds, insurance companies, and others.

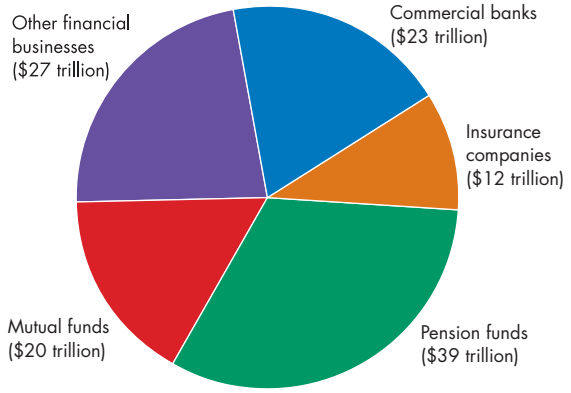


Figure 1 Financial Institutions Scale of Lending

Source of data: Federal Reserve.

Figure 2 shows the flows of funds that finance investment. Private saving pays for most of the investment, but foreign funds have paid for an increasing share as a government deficit has taken a larger share of private saving.

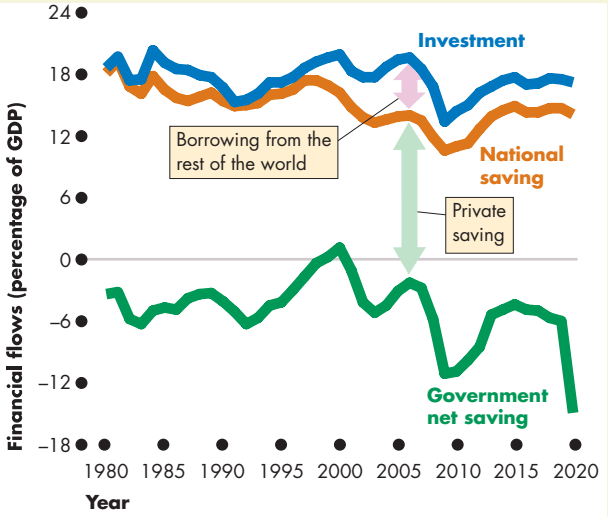


Figure 2 Financial Flows History

Source of data: Bureau of Economics Analysis.

The last equation tells us that investment, I, is financed by household saving, S, the government budget surplus, $(T - G)$, and borrowing from the rest of the world, $(M - X)$.

The sum of private saving, S, and government saving, $(T - G)$, is called **national saving**. National saving and foreign borrowing finance investment.

In 2020, U.S. investment was $3.6 trillion. Governments (federal, state, and local combined) had a deficit of $3.1 trillion. This total of $6.7 trillion was financed by private saving of $6.1 trillion and borrowing from the rest of the world (negative net exports) of $0.6 trillion.

In the rest of this chapter, we focus on the influences on national saving and the effects of a government budget deficit (or surplus) in the loanable funds market.

You're going to see how investment, financed by firms' borrowing of funds that come from household saving, is determined.

You are also going to see how the loanable funds market determines an equilibrium price. That price is an interest rate. In the loanable funds market, there is just one interest rate, which is an average of the interest rates on all the different types of financial securities that we described earlier.

But first, we look at a tool that all financial decision makers need and that shows the crucial role played by the interest rate in financial decisions.

REVIEW QUIZ

1. Distinguish between physical capital and financial capital and give two examples of each.
2. What is the distinction between gross investment and net investment?
3. What are the three main types of markets for financial capital?
4. Explain the flows of funds that finance business investment.

Financial Decisions and Risks

Financial markets and institutions enable us to make decisions about the timing of our use of scarce resources, and to manage the risks that arise from these decisions.

When you decide whether to spend and borrow today and pay off a loan at a future date, or the opposite, to cut today's spending and save so that you can spend more in the future, you must compare the value to you of a dollar today with its value at a future date. Similarly, when a business decides whether to invest in some new capital equipment, it must compare a present expenditure with the future revenue it expects the new equipment to generate. Both decisions compare the value of current and future dollars.

The Time Value of Money

To compare current and future dollars, we convert future dollars, called "future value," to current dollars, called "present value." The present value of a future dollar is the amount that will grow to be as large as that future value when the interest that it will earn is considered. The calculation that we use to convert a future amount of money to its present value is called discounting.

To find the present value of an amount 1 year in the future, we divide the future amount by $(1 + r)$, where r is the interest rate expressed as a proportion. (If the interest rate is 10 percent, $r = 0.1$).

That is,

$$\text{Present value} = \frac{\text{Future value}}{(1 + r)}$$

Let's check that we can use the present value formula by calculating the present value of $110 one year from now when the interest rate is 10 percent a year. The answer is $110 divided by 1.1, which is $100. And notice that $100 invested today at 10 percent a year becomes $110 in one year.

To calculate the present value of an amount of money 2 years in the future, we use the formula:

$$\text{Present value} = \frac{\text{Future value}}{(1 + r)^2}$$

Using this formula to calculate the present value of $121 in 2 years from now at an interest rate of 10 percent a year is $121 divided by $(1.1)^2$, which equals $121 divided by 1.21, or $100. Notice that $100 invested today at 10 percent a year becomes $110 in one year; and 10 percent of $110 is $11, so the original $100 grows to $121 after two years.

We calculate the present value of an amount of money n years in the future by using the general formula

$$\text{Present value} = \frac{\text{Future value}}{(1 + r)^n}$$

For example, if the interest rate is 10 percent a year, $100 received 10 years in the future has a present value of $38.55. That is, if $38.55 is invested today at 10 percent a year it will accumulate to $100 in 10 years.

Net Present Value

Net present value is the present value of all the future flows of money that arise from a financial decision, minus the initial cost of the decision. For example, Jack can make a game bot for $500 and sell it after two years for $2,420. The interest rate is 10 percent a year. The net present value of Jack's bot is $1,500. The present value of $2,420 two years in the future is $2,420 divided by 1.1^2, which is $2,000, and the net present value equals $2,000 – $500, or $1,500.

The Decision Rule

The financial decision rule is: If the net present value is positive, do it! If the net present value is negative, don't do it!

Following this decision rule maximizes wealth when the future money flows are not risky. In the more usual situation where the future is uncertain, the rule is modified to: Do it if the net present value is large enough to make a loss sufficiently unlikely.

In either case, the decision turns on the size of net present value. And the net present value of every decision is influenced by the interest rate. If the interest rate rises, and other things remain the same, the present value of a project falls. You can see why by looking at the formula. Present value equals future value *divided by* $(1 + r)$, so a higher interest rate, r, lowers the present value.

Financial Risk: Insolvency and Illiquidity

A financial institution's **net worth** is the market value of what it has lent minus the market value of what it has borrowed. If net worth is positive, the institution is solvent. But if net worth is negative, the institution is insolvent and must go out of business. The owners of an insolvent financial institution—usually its stockholders—bear the loss.

A financial institution both borrows and lends, so it is exposed to the risk that its net worth might become negative. To limit that risk, financial

institutions are regulated and a minimum amount of their lending must be backed by their net worth.

Sometimes, a financial institution is solvent but illiquid. A firm is illiquid if it has made long-term loans with borrowed funds and is faced with a sudden demand to repay more of what it has borrowed than its available cash. In normal times, a financial institution that is illiquid can borrow from another institution. But if all the financial institutions are short of cash, the market for loans among financial institutions dries up.

Both insolvency and illiquidity were at the core of the financial meltdown of 2007–2008.

Market Risk: Interest Rates and Asset Prices

Stocks, bonds, short-term securities, and loans are collectively called financial assets. The interest rate on a financial asset is the dollar amount earned expressed as a proportion of the price of the asset.

An asset price and the interest rate are inversely related: A rise in the interest rate lowers the asset price, and a fall in the interest rate raises the asset price.

The concept of present value explains this inverse relationship. Think about a bond that promises to pay its holder $105 after one year. Suppose the interest rate in the bond market is 5 percent a year. Discounted at 5 percent, the present value of this bond is $100, which is the price of the bond in a competitive market.

Now suppose the interest rate in the bond market rises to 10 percent a year. The present value of the bond that pays $105 after one year becomes $105 divided by 1.1, which equals $95.45. If investors can get a 10 percent return in the bond market, they will sell the $105 one-year bond and its price will fall to the new lower present value.

The relationship between the price of an asset and the interest rate is not a causal relationship: The asset price and interest rate are determined simultaneously—one implies the other. This relationship means that fluctuations in interest rates and asset prices make all financial markets risky. The relationship also means that when interest rates rise, the asset prices fall and debts become harder to pay. In extreme situations, a previously unexpected large rise in the interest rate can send the net worth of a financial institution negative and leave the institution insolvent.

Getting Real

An economy with inflation has two interest rates: the nominal interest rate and the real interest rate.

The **nominal interest rate** is the number of dollars that a borrower pays and a lender receives in interest in a year expressed as a percentage of the number of dollars borrowed and lent. For example, if you lend a friend $100 and you are repaid $105 a year later, then nominal interest rate is 5 percent per year.

The **real interest rate** is the nominal interest rate adjusted to remove the effects of inflation on the buying power of money. The real interest rate is approximately equal to the nominal interest rate minus the inflation rate.

To see why, think about what your $105 in the above example will buy if the inflation rate is 2 percent per year. To buy what $100 would have bought when you made the loan, you need $102. You've got $105, so you've really earned only $3 or 3 percent. So the real interest rate equals the nominal interest rate of 5 percent minus the 2 percent inflation rate.

If future money flows are measured in today's prices, the interest rate used to calculate the present value is the real interest rate. If future money flows are measured in future inflated prices, the interest rate used to calculate the present value is the nominal interest rate. Both calculations get the same real present value answer.

The real interest rate is the opportunity cost of borrowing and lending. The real interest *paid* on borrowed funds is the opportunity cost of borrowing. And the real interest rate *forgone* when funds are used either to buy consumption goods and services or to invest in new capital goods is the opportunity cost of not saving or not lending those funds.

In the next part of this chapter, we learn how the real interest rate and asset prices are determined in financial markets.

REVIEW QUIZ

1. Define and distinguish between future value and present value.
2. What is the present value of $500, three years in the future if the interest rate is 5 percent?
3. What is net present value and how is it used in financial decisions?
4. Explain the relationship between asset prices and the interest rate.
5. Explain why the real interest rate is the opportunity cost of loanable funds.

The Loanable Funds Market

The **loanable funds market** is the aggregate of all the individual finanacial markets. We're now going to see how the loanable funds market determines the real interest rate, the quantity of funds loaned, saving, and investment. In this section, we will ignore the government and the rest of the world and focus on the interaction of the decisions of households and firms in the loanable funds market. We will study

- The demand for loanable funds
- The supply of loanable funds
- Equilibrium in the loanable funds market

The Demand for Loanable Funds

The *quantity of loanable funds demanded* is the total quantity of funds demanded to finance investment, the government budget deficit, and international investment or lending during a given period. Our focus here is on investment. We'll bring the government budget deficit into the picture later in this chapter.

What determines investment and the demand for loanable funds to finance it? Many details influence this decision, but we can summarize them in two factors:

1. The real interest rate
2. Expected profit

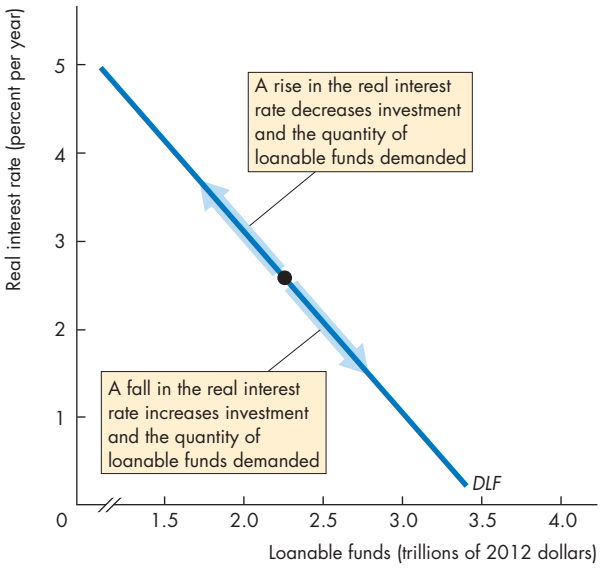
Firms invest in capital only if they expect to earn a profit and fewer projects are profitable—have a positive net present value—at a high real interest rate than at a low real interest rate, so

> Other things remaining the same, the higher the real interest rate, the smaller is the quantity of loanable funds demanded; and the lower the real interest rate, the greater the quantity of loanable funds demanded.

Demand for Loanable Funds Curve The **demand for loanable funds** is the relationship between the quantity of loanable funds demanded and the real interest rate, when all other influences on borrowing plans remain the same. The demand curve *DLF* in Fig. 7.3 is a demand for loanable funds curve.

To understand the demand for loanable funds, think about Amazon.com's decision to borrow $100 million to build some new warehouses. If Amazon expects to receive $2 million a year from this investment before paying interest costs and the real interest rate is less than 2 percent a year, Amazon would make a profit, so it builds the warehouses. But if the interest rate is more than 2 percent a year, Amazon would incur a loss, so it doesn't build the warehouses. The quantity of loanable funds demanded is greater the lower is the real interest rate.

FIGURE 7.3 The Demand for Loanable Funds



A change in the real interest rate changes the quantity of loanable funds demanded and brings a movement along the demand for loanable funds curve.

Changes in the Demand for Loanable Funds When the expected profit changes, the demand for loanable funds changes and the demand curve shifts. Other things remaining the same, as the expected profit from new capital increases the amount of investment increases and the demand for loanable funds increases.

The Supply of Loanable Funds

The *quantity of loanable funds supplied* is the total funds available from private saving and the government budget surplus during a given period. Our focus here is on saving. We'll bring the government budget into the picture in the next part of the chapter.

How do you decide how much of your income to save and supply in the loanable funds market? Your decision is influenced by many factors, but chief among them are

1. The real interest rate
2. Disposable income
3. Expected future income
4. Wealth
5. Default risk

We begin by focusing on the real interest rate.

Other things remaining the same, the higher the real interest rate, the greater is the quantity of loanable funds supplied; and the lower the real interest rate, the smaller is the quantity of loanable funds supplied.

The Supply of Loanable Funds Curve The **supply of loanable funds** is the relationship between the quantity of loanable funds supplied and the real interest rate when all other influences on lending plans remain the same. The curve *SLF* in Fig. 7.4 is a supply of loanable funds curve.

Think about a student's decision to save some of what she earns from her summer job. With a real interest rate of 2 percent a year, she decides that it is not worth saving much—better to spend the income and take a student loan if funds run out during the semester. But if the real interest rate jumped to 5 percent a year, the payoff from saving would be high enough to encourage her to cut back on spending and increase the amount she saves.

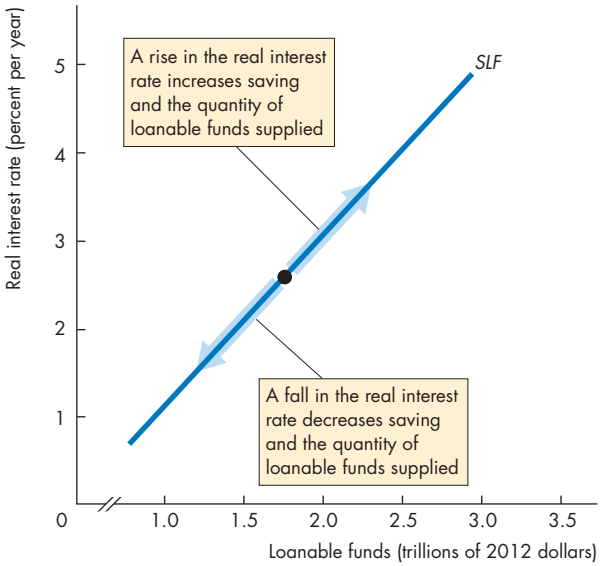
Changes in the Supply of Loanable Funds A change in disposable income, expected future income, wealth, or default risk changes the supply of loanable funds.

Disposable Income A household's *disposable income* is the income earned minus net taxes. When disposable income increases, other things remaining the same, consumption expenditure increases but by less than the increase in income. Some of the increase in income is saved. So the greater a household's disposable income, other things remaining the same, the greater is its saving.

Expected Future Income As a household's expected future income increases, other things remaining the same, the smaller is its saving today.

Wealth As a household's wealth increases, other things remaining the same, the smaller is its saving. If a person's wealth increases because of a capital gain, the person sees less need to save. For example, from 2002 through 2006, when house prices were rising rapidly, wealth increased despite the fact that personal saving dropped close to zero.

FIGURE 7.4 The Supply of Loanable Funds



A change in the real interest rate changes the quantity of loanable funds supplied and brings a movement along the supply of loanable funds curve.

Default Risk The risk that a loan will not be repaid is called **default risk**. The greater that risk, the higher is the interest rate needed to induce a person to lend and the smaller is the supply of loanable funds.

Shifts of the Supply of Loanable Funds Curve When any of the four influences on the supply of loanable funds changes, the supply of loanable funds changes and the supply curve shifts. An increase in disposable income, a decrease in expected future income, a decrease in wealth, or a fall in default risk increases saving and increases the supply of loanable funds.

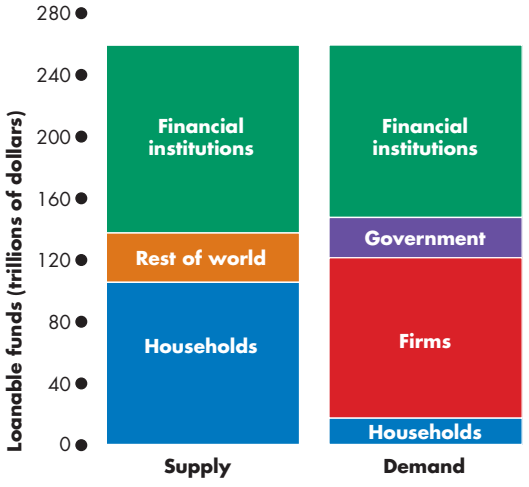
Equilibrium in the Loanable Funds Market

You've seen that other things remaining the same, the higher the real interest rate, the greater is the quantity of loanable funds supplied and the smaller

ECONOMICS IN ACTION

The Total Quantities Supplied and Demanded

In 2021, about $260 trillion of loanable funds were supplied and demanded. The figure shows who supplies the funds and who demands them. Households supply 41 percent of the loanable funds supplied and demand 7 percent. Firms demand 40 percent of available funds.



Supply and Demand in the Loanable Funds Market

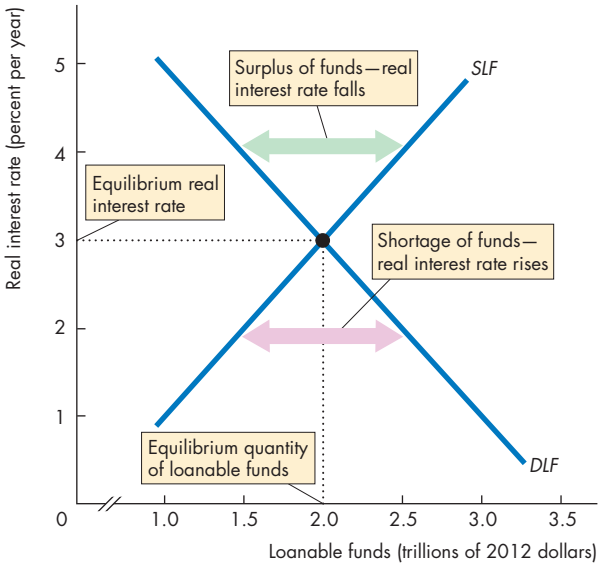
Source of data: Federal Reserve.

is the quantity of loanable funds demanded. There is one real interest rate at which the quantities of loanable funds demanded and supplied are equal, and that interest rate is the equilibrium real interest rate.

Figure 7.5 shows how the demand for and supply of loanable funds determine the real interest rate. The *DLF* curve is the demand curve and the *SLF* curve is the supply curve. If the real interest rate exceeds 3 percent a year, the quantity of loanable funds supplied exceeds the quantity demanded—a surplus of funds. Borrowers find it easy to get funds, but lenders are unable to lend all the funds they have available. The real interest rate falls and continues to fall until the quantity of funds supplied equals the quantity of funds demanded.

If the real interest rate is less than 3 percent a year, the quantity of loanable funds supplied is less than the quantity demanded—a shortage of funds. Borrowers can't get the funds they want, but lenders are able to lend all the funds they have. So the real interest rate

FIGURE 7.5 Equilibrium in the Loanable Funds Market



A surplus of funds lowers the real interest rate and a shortage of funds raises it. At an interest rate of 3 percent a year, the quantity of funds demanded equals the quantity supplied and the market is in equilibrium.

rises and continues to rise until the quantity of funds supplied equals the quantity demanded.

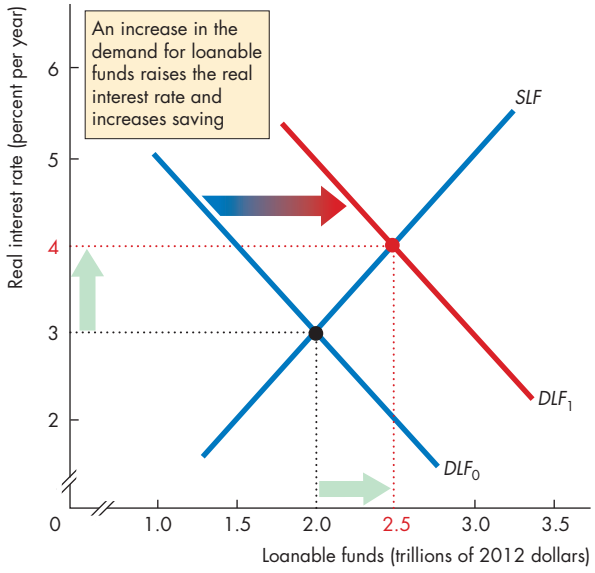
Regardless of whether there is a surplus or a shortage of loanable funds, the real interest rate changes and is pulled toward an equilibrium level. In Fig. 7.5, the equilibrium real interest rate is 3 percent a year. At this real interest rate, there is neither a surplus nor a shortage of loanable funds. Borrowers can get the funds they want, and lenders can lend all the funds they have available. The investment plans of borrowers and the saving plans of lenders are consistent with each other.

Changes in Demand and Supply

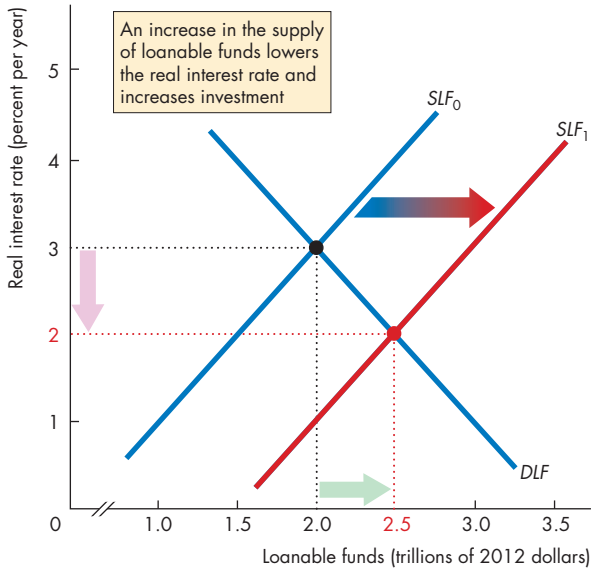
Financial markets are highly volatile in the short run but remarkably stable in the long run. Volatility in the market comes from fluctuations in either the demand for loanable funds or the supply of loanable funds. These fluctuations bring fluctuations in the real interest rate and in the equilibrium quantity of funds lent and borrowed. They also bring fluctuations in asset prices.

Here we'll illustrate the effects of *increases* in demand and supply in the loanable funds market.

FIGURE 7.6 Changes in Demand and Supply



(a) An increase in demand



(b) An increase in supply

In part (a), the demand for loanable funds increases and supply doesn't change. The real interest rate rises (financial asset prices fall) and the quantity of funds increases.
In part (b), the supply of loanable funds increases and demand doesn't change. The real interest rate falls (financial asset prices rise) and the quantity of funds increases.

An Increase in Demand If the profits that firms expect to earn increase, they increase their planned investment and increase their demand for loanable funds to finance that investment. With an increase in the demand for loanable funds, but no change in the supply of loanable funds, there is a shortage of funds. As borrowers compete for funds, the interest rate rises and lenders increase the quantity of funds supplied.

Figure 7.6(a) illustrates these changes. An increase in the demand for loanable funds shifts the demand curve rightward from DLF_0 to DLF_1. With no change in the supply of loanable funds, there is a shortage of funds at a real interest rate of 3 percent a year. The real interest rate rises until it is 4 percent a year. Equilibrium is restored and the equilibrium quantity of funds has increased.

An Increase in Supply If one of the influences on saving plans changes and increases saving, the supply of loanable funds increases. With no change in the demand for loanable funds, the market is flush with loanable funds. Borrowers find bargains and lenders find themselves accepting a lower interest rate. At the lower interest rate, borrowers find additional investment projects profitable and increase the quantity of loanable funds that they borrow.

Figure 7.6(b) illustrates these changes. An increase in supply shifts the supply curve rightward from SLF_0 to SLF_1. With no change in demand, there is a surplus of funds at a real interest rate of 3 percent a year. The real interest rate falls until it is 2 percent a year. Equilibrium is restored and the equilibrium quantity of funds has increased.

REVIEW QUIZ

1. What is the loanable funds market?
2. How do firms make investment decisions?
3. What determines the demand for loanable funds and what makes it change?
4. How do households make saving decisions?
5. What determines the supply of loanable funds and what makes it change?
6. How do changes in the demand for and supply of loanable funds change the real interest rate and quantity of loanable funds?

Government in the Loanable Funds Market

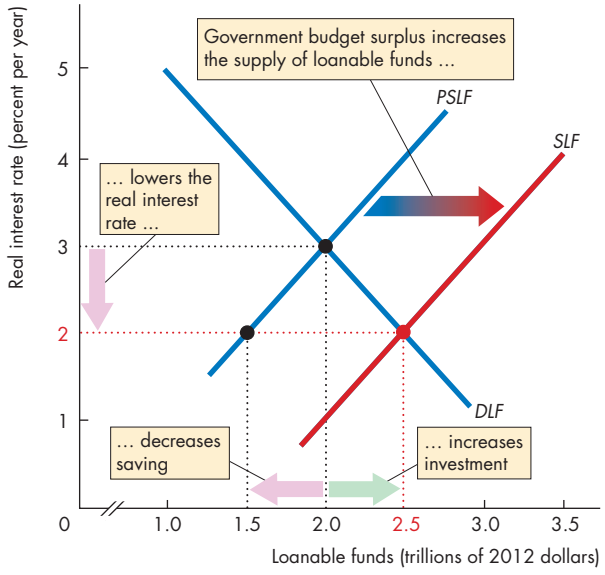
Government enters the loanable funds market when it has a budget surplus or budget deficit. A budget surplus increases the supply of loanable funds and contributes to financing investment; a budget deficit increases the demand for loanable funds and competes with businesses for funds.

Let's study the effects of government on the loanable funds market.

A Government Budget Surplus

A government budget surplus increases the supply of loanable funds. The real interest rate falls, which decreases household saving and decreases the quantity of private funds supplied. The lower real interest rate increases the quantity of loanable funds demanded, and increases investment.

FIGURE 7.7 A Government Budget Surplus



A government budget surplus of $1 trillion adds to private saving and the private supply of loanable funds curve, *PSLF*, to determine the supply of loanable funds curve, *SLF*. The real interest rate falls to 2 percent a year. Private saving decreases to $1.5 trillion, but investment increases to $2.5 trillion.

Figure 7.7 shows these effects of a government budget surplus. The private supply of loanable funds curve is *PSLF*. The supply of loanable funds curve, *SLF*, shows the sum of private supply and the government budget surplus. Here, the government budget surplus is $1 trillion, so at each real interest rate the *SLF* curve lies $1 trillion to the right of the *PSLF* curve. That is, the horizontal distance between the *PSLF* curve and the *SLF* curve equals the government budget surplus.

With no government surplus, the real interest rate is 3 percent a year, the quantity of loanable funds is $2 trillion a year, and investment is $2 trillion a year. But with the government surplus of $1 trillion a year, the equilibrium real interest rate falls to 2 percent a year and the equilibrium quantity of loanable funds increases to $2.5 trillion a year.

The fall in the interest rate decreases private saving to $1.5 trillion, but investment increases to $2.5 trillion, which is financed by private saving plus the government budget surplus (government saving).

A Government Budget Deficit

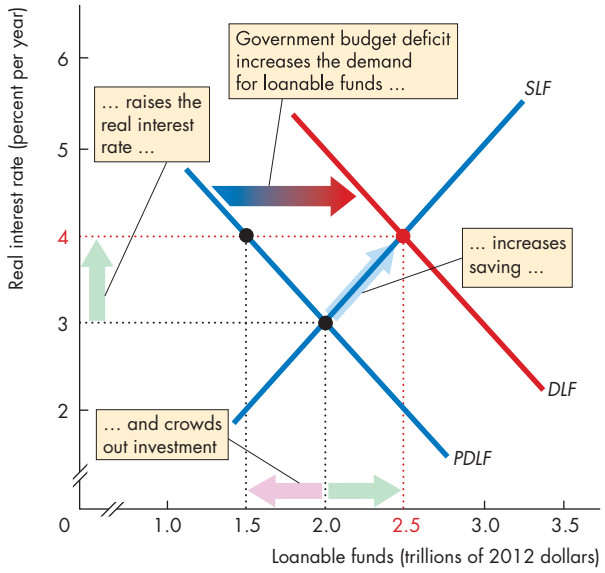
A government budget deficit increases the demand for loanable funds. The real interest rate rises, which increases household saving and increases the quantity of private funds supplied. But the higher real interest rate decreases investment and the quantity of loanable funds demanded by firms to finance investment.

Figure 7.8 shows these effects of a government budget deficit. The private demand for loanable funds curve is *PDLF*. The demand for loanable funds curve, *DLF*, shows the sum of private demand and the government budget deficit. Here, the government budget deficit is $1 trillion, so at each real interest rate the *DLF* curve lies $1 trillion to the right of the *PDLF* curve. That is, the horizontal distance between the *PDLF* curve and the *DLF* curve equals the government budget deficit.

With no government deficit, the real interest rate is 3 percent a year, the quantity of loanable funds is $2 trillion a year and investment is $2 trillion a year. But with the government budget deficit of $1 trillion a year, the equilibrium real interest rate rises to 4 percent a year and the equilibrium quantity of loanable funds increases to $2.5 trillion a year.

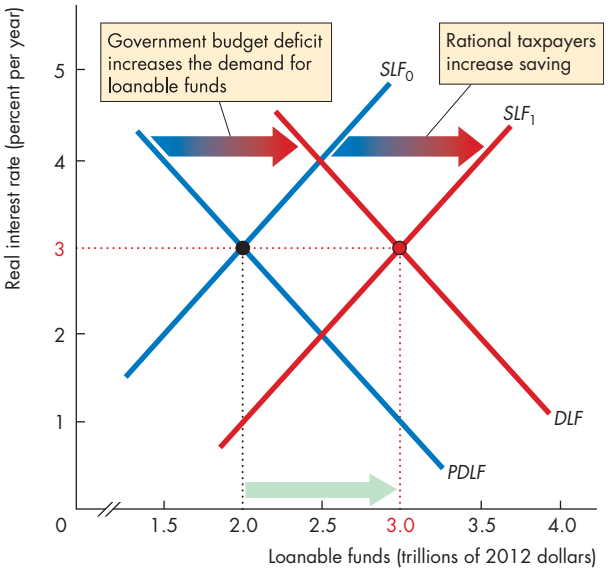
The rise in the real interest rate increases private saving to $2.5 trillion, but investment decreases to $1.5 trillion because $1 trillion of private saving must finance the government budget deficit.

FIGURE 7.8 A Government Budget Deficit



A government budget deficit adds to the private demand for loanable funds curve, *PDLF*, to determine the demand for loanable funds curve, *DLF*. The real interest rate rises, saving increases, but investment decreases—a crowding-out effect.

FIGURE 7.9 The Ricardo-Barro Effect



A budget deficit increases the demand for loanable funds. Rational taxpayers increase saving, which shifts the supply of loanable funds curve from SLF_0 to SLF_1. Crowding out is avoided: Increased saving finances the budget deficit.

The Crowding-Out Effect The tendency for a government budget deficit to raise the real interest rate and decrease investment is called the **crowding-out effect**. The crowding-out effect does not decrease investment by the full amount of the government budget deficit because a higher real interest rate induces an increase in private saving that partly contributes toward financing the deficit.

The Ricardo-Barro Effect First suggested by the English economist David Ricardo in the eighteenth century and refined by Robert J. Barro of Harvard University, the Ricardo-Barro effect holds that both of the effects we've just shown are wrong and the government budget has no effect on either the real interest rate or investment.

Barro says that taxpayers are rational and can see that a budget deficit today means that future taxes must be higher and future disposable incomes smaller. With smaller expected future disposable incomes, saving increases today. The private supply of loanable funds increases to match the quantity of loanable funds demanded by the government. So the budget deficit has no effect on either the real interest rate or investment. Figure 7.9 shows this outcome.

Most economists regard the Ricardo-Barro view as extreme. But there might be some change in private saving that goes in the direction suggested by the Ricardo-Barro effect that lessens the crowding-out effect.

REVIEW QUIZ

1. How does a government budget surplus or deficit influence the loanable funds market?
2. What is the crowding-out effect and how does it work?
3. What is the Ricardo-Barro effect and how does it modify the crowding-out effect?

To complete your study of financial markets, take a look at *Economics in the News* on pp. 206–207 and see how information technology is changing the market for loanable funds.

Fintech in the Loanable Funds Market

Household debt and credit is growing to record levels but the share of the market held by banks, credit unions, and traditional finance companies is shrinking as fintech expands. Read these news clips and economic analysis on the impact of fintech in the loanable funds market.

Total Household Debt Climbs Boosted by Growth in Mortgages and Auto Loans

According to the latest Quarterly Report on Household Debt and Credit, total household debt rose by $313 billion (2.1 percent) to reach $14.96 trillion in the second quarter of 2021. Mortgage balances—the largest component of household debt—rose by $282 billion and auto loans increased by $33 billion.

Credit card balances ticked up by $17 billion while student loan debt decreased by $14 billion. Mortgage originations, which include mortgage refinances, reached $1.2 trillion, surpassing the volumes seen in the preceding three quarters. Auto loan originations, which include both loans and leases, reached a record $202 billion.

Source: newyorkfed.org, Press Release: Total Household Debt Climbs in Q2 2021.

FinTechs Continue to Drive Personal Loan Growth

Q4 2018 Industry Insights Report found that personal loan balances increased $21 billion in the last year to close 2018 at a record high of $138 billion. Much of this growth was driven by online loans originated by FinTechs. ...

FinTech loans now comprise 38% of all unsecured personal loan balances, the largest market share compared to banks, credit unions, and traditional finance companies. Five years ago, FinTechs accounted for just 5% of outstanding balances. As a result of FinTech entry to the market, bank balance share decreased to 28% from 40% in 2013, while credit union share has declined from 31% to 21% during this time.

"FinTechs have helped make personal loans a credit product that is recognized as both a convenient and simple way to obtain funding online," said Jason Laky, senior vice president and TransUnion's consumer lending line of business leader.

Copyright newsroom.transunion.com, February 21, 2019.

ESSENCE OF THE STORY

- Total household debt was a record almost $15 trillion in the second quarter of 2021.
- In 2018, fintech loans were 38 percent of unsecured personal loans compared to 5 percent in 2013.
- Over the same five years, bank loans decreased from 40 percent to 28 percent and credit union loans fell from 31 percent to 21 percent.
- Fintechs have made it more convenient and simpler to get a personal loan.

ECONOMIC ANALYSIS

- A fintech company is a firm that provides Internet-based financial services and customized apps, which automate transactions.
- You use fintech when you make a payment with your smartphone or Venmo a friend.
- When fintech started it was used only by the big banks and other financial institutions to deliver improved customer service.
- Today, in a rapidly expanding world of new businesses that deliver a wide range of financial services, the traditional institutions' share of the loanable funds market is shrinking.
- Figure 1 shows the market share of traditional financial institutions, measured by their percentage of total financial assets, from 2000 to 2018.
- Of the many financial services provided by fintech companies, unsecured personal loans have seen spectacular growth.
- At the end of 2018, 20 million Americans had personal loans that totaled $138 billion, up $89 billion on five years earlier.
- Figure 2(a) illustrates the growth of personal loans and fintech's expanding share.
- Traditional financial institutions had a $39 billion increase in loans, and new fintech firms had a $50 billion increase.
- Applied for and granted online, fintech loans are easier and faster to get than loans from traditional financial institutions.
- Figure 2(b) shows why fintech personal loans also provide a better deal for borrowers.
- For low-risk and medium-risk borrowers, fintech loans have an interest rate 4 percentage points lower than the rate charged by traditional lenders, as Fig. 2(b) shows.
- Even for high-risk borrowers, fintech loans have a lower interest rate than that charged by traditional lenders.

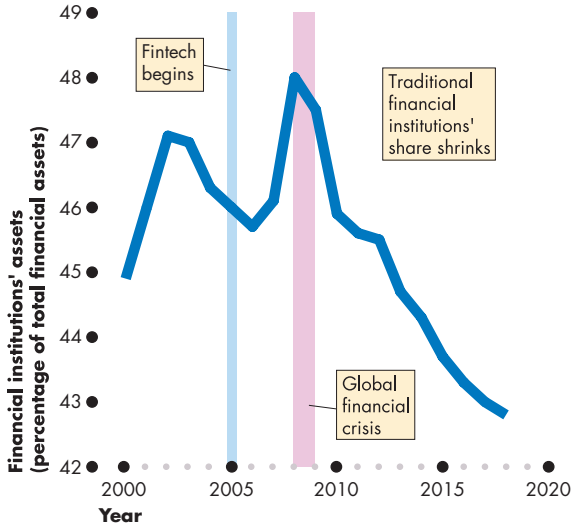
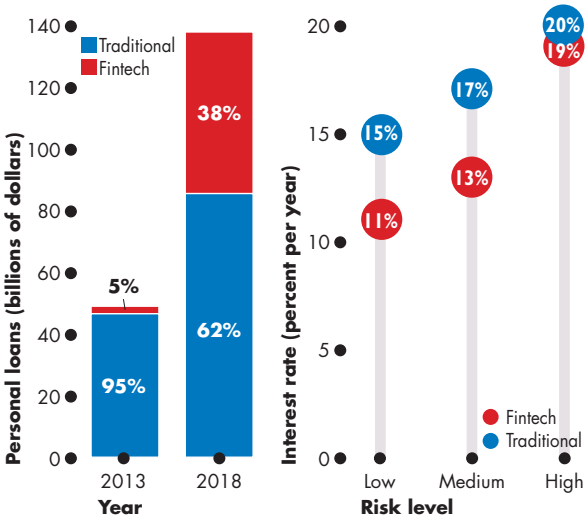


Figure 1 Financial Institutions' Share of Loanable Funds



(a) Shares of Loans **(b) Interest Rates**

Figure 2 Fintech in the Personal Loans Market

WORKED PROBLEM

The following items are (approximate) facts about the U.S. economy between 2005 and 2009:

- In 2005, the nominal interest rate on bonds was 5 percent a year and the real interest rate was 2 percent a year. Investment was $2.7 trillion and the government budget deficit was $0.5 trillion.
- By 2009, the real interest rate had increased to 5 percent a year, but the nominal interest rate was unchanged at 5 percent a year. Investment had crashed to $1.8 trillion and the government budget deficit had climbed to $1.8 trillion.

Assume that the private demand for and private supply of loanable funds did not change between 2005 and 2009.

Questions

1. What was the inflation rate in 2005 and 2009? How do you know?
2. What happened to the price of a bond between 2005 and 2009? How do you know?
3. What happened to the demand for loanable funds between 2005 and 2009? How do you know?
4. Did the change in the government budget deficit crowd out some investment?
5. What happened to the quantity of saving and investment?

Solutions

1. The real interest rate equals the nominal interest rate minus the inflation rate. So the inflation rate equals the nominal interest rate minus the real interest rate. The inflation rate was 3 percent a year in 2005 and zero in 2009.

Key Point: The nominal interest rate minus the real interest rate equals the inflation rate.

2. The price of a bond is inversely related to the nominal interest rate. Between 2005 and 2009, the nominal interest rate did not change—it remained at 5 percent a year. With the constant nominal interest rate, the bond price was unchanged.

Key Point: The price of a bond is inversely related to the nominal interest rate.

3. The demand for loanable funds is the relationship between the quantity of loanable funds demanded and the real interest rate.

   An increase in the government budget deficit increases the demand for loanable funds.

   Between 2005 and 2009, the government budget deficit increased from $0.5 trillion to $1.8 trillion, so the demand for loanable funds increased.

Key Point: An increase in the government budget deficit increases the demand for loanable funds.

4. The increase in the government budget deficit increased the demand for loanable funds. With no change in the supply of loanable funds, the real interest rate increases.

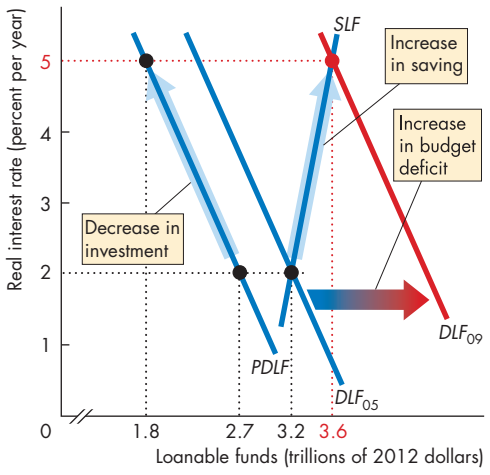
   Between 2005 and 2009, the real interest rate increased from 2 percent a year to 5 percent a year. As the real interest rate increased, the quantity of loanable funds demanded by firms decreased from $2.7 trillion to $1.8 trillion. Crowding out occurred.

Key Point: With a given supply of loanable funds, an increase in the government budget deficit increases the real interest rate and crowds out investment.

5. Saving and investment plans depend on the real interest rate. Between 2005 and 2009, the real interest rate increased, which increased saving and decreased investment. The increase in saving increased the quantity supplied of loanable funds. The decrease in investment decreased the quantity demanded of loanable funds.

Key Point: A change in the real interest rate does not change the supply of or demand for loanable funds: It changes the quantities supplied and demanded.

Key Figure



Source: Bureau of Economics Analysis.

SUMMARY

Key Points

Financial Markets and Financial Institutions

(pp. 192–197)

- Capital (*physical* and *human capital*) is a real productive resource; financial capital is the funds used to buy capital.
- Gross investment increases the quantity of capital and depreciation decreases it. Saving increases wealth.
- The markets for financial capital are the markets for loans, bonds, and stocks.
- Financial institutions ensure that borrowers and lenders can always find someone with whom to trade.
- Investment in capital is financed by household saving, a government budget surplus, and funds from the rest of the world.

Financial Decisions and Risks (pp. 198–199)

- Borrowing and lending decisions compare the value of current dollars and future dollars by calculating net present value.
- Projects with positive net present value increase wealth.
- The price of an asset and the interest rate on the asset are inversely related.
- To calculate the value of a future sum at today's prices, we use the real interest rate.

The Loanable Funds Market (pp. 200–203)

- The quantity of loanable funds demanded depends negatively on the real interest rate; and the demand for loanable funds changes when profit expectations change.
- The quantity of loanable funds supplied depends positively on the real interest rate; and the supply of loanable funds changes when disposable income, expected future income, wealth, and default risk change.
- Equilibrium in the loanable funds market determines the real interest rate and quantity of funds.

Government in the Loanable Funds Market

(pp. 204–205)

- A government budget deficit increases the demand for loanable funds, raises the real interest rate, and increases the equilibrium quantity of loanable funds, but decreases investment in a crowding-out effect.
- A government budget surplus increases the supply of loanable funds, lowers the real interest rate, and increases investment and the equilibrium quantity of loanable funds.
- The Ricardo-Barro effect is the response of rational taxpayers to a budget deficit: private saving increases to finance the budget deficit. The real interest rate remains constant and the crowding-out effect is avoided.

Key Terms

Bond, 193
Bond market, 193
Crowding-out effect, 205
Default risk, 201
Demand for loanable funds, 200
Financial capital, 192
Financial institution, 194
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Real interest rate, 199
Saving, 192
Stock, 194
Stock market, 194
Supply of loanable funds, 201
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PROBLEMS AND APPLICATIONS

Financial Markets and Financial Institutions

Use the following data to work Problems 1 and 2.

Michael, an Internet service provider, bought an existing business worth $400,000 on December 31, 2021. During 2022, his business grew and he bought $500,000 of new servers. The market value of his older servers fell by $100,000.

1. What was Michael's gross investment, depreciation, and net investment during 2022?
2. What is the value of Michael's capital at the end of 2022?
3. Lori is a student who teaches golf on Saturdays. In a year, she earns $20,000 after paying her taxes. At the beginning of 2021, Lori owned $1,000 worth of books, clothes, and golf clubs and she had $5,000 in a savings account at the bank. During 2021, the interest on her savings account was $300 and she spent a total of $15,300 on consumption goods and services. There was no change in the market values of her books, clothes, and golf clubs.
   a. How much did Lori save in 2021?
   b. What was her wealth at the end of 2021?

Financial Decisions and Risks

4. Tom took out a $2,000 loan to buy a boat at an interest rate of 10 percent a year. He plans to repay the loan after 2 years. How much will he have to pay?
5. Joe has a term deposit that pays 10 percent a year and its value after two years will be $5,000. What is the present value of Joe's term deposit?

The Loanable Funds Market

Use the following data to work Problems 6 and 7.

First Call, Inc., a smartphone company, plans to build a factory—one that costs $10 million if the real interest rate is 6 percent a year; a larger factory that costs $12 million if the real interest rate is 5 percent a year; or a smaller one that costs $8 million if the real interest rate is 7 percent a year.

6. Draw a graph of First Call's demand for loanable funds curve.
7. First Call expects its profit to double next year. Explain how this increase in expected profit influences First Call's demand for loanable funds.
8. The table sets out the data for an economy when the government's budget is balanced.

Real interest rate (percent per year)	Loanable funds demanded (trillions of 2012 dollars)	Loanable funds supplied (trillions of 2012 dollars)
4	8.5	5.5
5	8.0	6.0
6	7.5	6.5
7	7.0	7.0
8	6.5	7.5
9	6.0	8.0
10	5.5	8.5

   a. Calculate the equilibrium real interest rate, investment, and private saving.
   b. If planned saving increases by $0.5 trillion at each real interest rate, explain the change in the real interest rate.
   c. If planned investment increases by $1 trillion at each real interest rate, explain the change in saving and the real interest rate.

Government in the Loanable Funds Market

Use the data in Problem 8 along with news that the government now has a budget deficit of $1 trillion to work Problems 9 and 10.

9. What is the real interest rate? How much investment occurs? Does crowding out occur?
10. If the Ricardo-Barro effect occurs, what are the real interest rate and investment?

Use the loanable funds data in Problem 8 and the following data to work Problems 11 and 12.

Suppose that the quantity demanded increases by $1 trillion at each real interest rate and the quantity supplied increases by $2 trillion at each interest rate.

11. If the government budget remains balanced, what are the real interest rate, investment, and private saving? Does any crowding out occur?
12. If the government's budget is a deficit of $1 trillion, what are the real interest rate and investment? Does any crowding out occur?

ADDITIONAL PROBLEMS AND APPLICATIONS

Financial Markets and Financial Institutions

13. On January 1, 2022, Terry's Towing Service owned 4 tow trucks valued at $300,000. During 2022, Terry's bought 2 new trucks for a total of $180,000. At the end of 2022, the market value of all of the firm's trucks was $400,000. What was Terry's gross investment? Calculate Terry's depreciation and net investment.

Use the following information to work Problems 14 and 15.

The Bureau of Economic Analysis reported that the U.S. capital stock was $64.8 trillion at the end of 2017, $68.2 trillion at the end of 2018, and $70.7 trillion at the end of 2019. Depreciation in 2018 was $3.3 trillion, and gross investment during 2019 was $3.8 trillion.

14. Calculate U.S. net investment and gross investment during 2018.
15. Calculate U.S. depreciation and net investment during 2019.
16. Annie runs a fitness center. On December 31, 2021, she bought an existing business with exercise equipment and a building worth $300,000. During 2022, business improved and she bought some new equipment for $50,000. At the end of 2022, her equipment and buildings were worth $325,000. Calculate Annie's gross investment, depreciation, and net investment during 2022.

Financial Decisions and Risks

17. Karrie is a golf pro, and after she paid taxes, her income from golf and interest on her financial assets was $1,500,000 in 2020. At the beginning of 2020, she owned $900,000 worth of financial assets. At the end of 2020, Karrie's financial assets were worth $1,900,000.
    a. How much did Karrie save during 2020?
    b. How much did she spend on consumption goods and services?
18. The composition of total savings in India has been changing during the last few years, the biggest rise being in mutual funds and equity schemes. The average Indian household now prefers the more rewarding equity market over the stagnating real estate market or durable goods that used to signify wealth. While this new development can fuel economic growth, it is risky because a collapse in the stock market would lead to households losing a larger proportion of their savings and lower future savings.

    Source: scroll.in, September 30, 2017

    a. How is the purchase of durable goods mentioned in the news clip different from the purchase of equity? Explain your answer.
    b. Why are households in India moving toward investing in equity instead of real estate or durable goods, and how is it riskier?

The Loanable Funds Market

19. Draw a graph to illustrate the effect of an increase in the demand for loanable funds and an even larger increase in the supply of loanable funds on the real interest rate and the equilibrium quantity of loanable funds.
20. Draw a graph to illustrate how an increase in the supply of loanable funds and a decrease in the demand for loanable funds can lower the real interest rate and leave the equilibrium quantity of loanable funds unchanged.

Use the following data to work Problems 21 and 22.

In 2020, the Lee family had disposable income of $80,000, wealth of $140,000, and an expected future income of $80,000 a year. At a real interest rate of 4 percent a year, the Lee family saves $15,000 a year; at a real interest rate of 6 percent a year, they save $20,000 a year; and at a real interest rate of 8 percent, they save $25,000 a year.

21. Draw a graph of the Lee family's supply of loanable funds curve.
22. In 2021 suppose that the stock market crashes and the default risk increases. Explain how this increase in default risk influences the Lee family's supply of loanable funds curve.
23. **Vodafone's Expected Profits Down**

    The British telecom company Vodafone has lowered its expectations of profit growth for the year in the face of revenue losses owing to fierce competition in India and the United Kingdom.

    Source: *Financial Times*, February 2, 2017

    On a graph, show the effect of the British Vodafone's negative expectations of future profits. Explain the effect on the real interest rate, private saving, and investment.

24. The table sets out the data for an economy when the government's budget is balanced.

Real interest rate (percent per year)	Loanable funds demanded (trillions of 2012 dollars)	Loanable funds supplied (trillions of 2012 dollars)
2	8.0	4.0
3	7.0	5.0
4	6.0	6.0
5	5.0	7.0
6	4.0	8.0
7	3.0	9.0
8	2.0	10.0

a. Calculate the equilibrium real interest rate, investment, and private saving.

b. If planned saving decreases by $1 trillion at each real interest rate, explain the change in the real interest rate and investment.

c. If planned investment decreases by $1 trillion at each real interest rate, explain the change in saving and the real interest rate.

Government in the Loanable Funds Market

Use the following information to work Problems 25 to 27.

India's Fiscal Deficit Widens to 4.6% of GDP in 2019–20

India's government budget deficit is 4.6 percent of GDP in 2019–2020. The government projected a deficit of 3.8 percent of GDP in 2020–2021, but experts think 6–7 percent is more likely because of the effects of Covid-19.

Source: economictimes.indiatimes.com, May 29, 2020

25. How will the outcomes in the loanable funds market differ if India's government budget deficit is 3.8 percent or 7 percent of GDP?

26. What is the effect of Covid-19 on India's supply of loanable funds?

27. If India's economic growth slows and incomes grow more slowly, and if the government budget deficit increases, what will be the outcome in the loanable funds market?

28. **Government Budget Surplus in Kuwait**

Despite a substantial decline in government revenues following a sustained decline in oil prices, Kuwait continues to report budget surpluses because of decreased government expenditure.

Source: *Gulf News*, July 2, 2017

Explain the effect of Kuwait's budget surplus on its investment, real interest rate, and economic growth.

Economics in the News

29. After you have studied *Economics in the News* on pp. 206–207, answer the following questions.

a. What is fintech, when did it begin, and how has it grown?

b. In the market for personal loans, does fintech mainly change the demand for loanable funds or the supply of loanable funds? Draw a graph to illustrate your answer.

c. In the market for personal loans, how does fintech change interest rates and the quantities of loanable funds demanded and supplied? Draw a graph to illustrate your answer.

d. Explain why personal loans from traditional financial institutions have not grown as quickly as those from fintech companies.

30. **State Loans for Students in the United Kingdom**

In 2013, around 53,000 students received around £675 million a year in state loans, up from around £52 million for 6,574 students in 2010.

Source: BBC, January 26, 2015

a. How would have these state loans influenced the government's budget?

b. If there is a budget deficit, how would you expect it to influence the demand for loanable funds and the equilibrium real interest rate?

8 MONEY, THE PRICE LEVEL, AND INFLATION

After studying this chapter, you will be able to:

- Define money and describe its functions
- Explain the economic functions of banks
- Describe the structure and functions of the Federal Reserve System (the Fed)
- Explain how the banking system creates money
- Explain what determines the quantity of money and the nominal interest rate
- Explain how the quantity of money influences the price level and the inflation rate

Money, like fire and the wheel, has been around for a long time, and it has taken many forms. It was beads made from shells for North American Indians and tobacco for early American colonists. Today, we use dollar bills, swipe a card, or tap a smartphone. Are all these things money?

In this chapter, we study money, its functions, how it gets created, how the Federal Reserve regulates its quantity, and what happens when its quantity changes. In *Economics in the News* at the end of the chapter, we look at the massive injections of money into the economy resulting from the Fed's response to the global financial crisis and Great Recession of 2008 and the Covid pandemic of 2020.

What Is Money?

What do wampum, tobacco, and nickels and dimes have in common? They are all examples of **money**, which is defined as any commodity or token that is generally acceptable as a means of payment. A **means of payment** is a method of settling a debt. When a payment has been made, there is no remaining obligation between the parties to a transaction. So what wampum, tobacco, and nickels and dimes have in common is that they have served (or still do serve) as the means of payment. Money serves three other functions:

- Medium of exchange
- Unit of account
- Store of value

Medium of Exchange

A *medium of exchange* is any object that is generally accepted in exchange for goods and services. Without a medium of exchange, goods and services must be exchanged directly for other goods and services—an exchange called *barter*. Barter requires a *double coincidence of wants*, a situation that rarely occurs. For example, if you want a hamburger, you might offer a book in exchange for it. But you must find someone who is selling hamburgers and wants your book.

A medium of exchange overcomes the need for a double coincidence of wants. Money acts as a medium of exchange because people with something to sell will always accept money in exchange for it. But money isn't the only medium of exchange. You can buy with a credit card, but a credit card isn't money. It doesn't make a final payment, and the debt it creates must eventually be settled by using money.

Unit of Account

A *unit of account* is an agreed measure for stating the prices of goods and services. To get the most out of your budget, you have to figure out whether seeing one more movie is worth its opportunity cost. But that cost is not dollars and cents. It is the number of ice-cream cones, sodas, or cups of coffee that you must give up. It's easy to do such calculations when all these goods have prices in terms of dollars and cents (see Table 8.1). If the price of a movie is $8 and the price of a cappuccino is $4, you know right away that seeing one movie costs you 2 cappuccinos.

TABLE 8.1 The Unit of Account Function of Money Simplifies Price Comparisons

Good	Price in money units	Price in units of another good
Movie	$8.00 each	2 cappuccinos
Cappuccino	$4.00 each	2 ice-cream cones
Ice cream	$2.00 per cone	2 packs of jelly beans
Jelly beans	$1.00 per pack	2 sticks of gum
Gum	$0.50 per stick	

Money as a unit of account: The price of a movie is $8 and the price of a stick of gum is 50¢, so the opportunity cost of a movie is 16 sticks of gum ($8.00 ÷ 50 = 16).

No unit of account: You go to a movie theater and learn that the cost of seeing a movie is 2 cappuccinos. You go to a grocery store and learn that a pack of jelly beans costs 2 sticks of gum. But how many sticks of gum does seeing a movie cost you? To answer that question, you go to the coffee shop and find that a cappuccino costs 2 ice-cream cones. Now you head for the ice-cream shop, where an ice-cream cone costs 2 packs of jelly beans. Now you get out your pocket calculator: 1 movie costs 2 cappuccinos, or 4 ice-cream cones, or 8 packs of jelly beans, or 16 sticks of gum!

If jelly beans are $1 a pack, one movie costs 8 packs of jelly beans. You need only one calculation to figure out the opportunity cost of any pair of goods and services.

Imagine how troublesome it would be if your local movie theater posted its price as 2 cappuccinos, the coffee shop posted the price of a cappuccino as 2 ice-cream cones, the ice-cream shop posted the price of an ice-cream cone as 2 packs of jelly beans, and the grocery store priced a pack of jelly beans as 2 sticks of gum! Now how much running around and calculating will you have to do to find out how much that movie is going to cost you in terms of the cappuccinos, ice-cream cones, jelly beans, or gum that you must give up to see it? You get the answer for cappuccinos right away from the sign posted on the movie theater. But for all the other goods, you're going to have to visit many different stores to establish the

price of each good in terms of another and then calculate the prices in units that are relevant for your own decision. The hassle of doing all this research might be enough to make a person swear off movies! You can see how much simpler it is if all the prices are expressed in dollars and cents.

Store of Value

Money is a *store of value* in the sense that it can be held and exchanged later for goods and services. If money were not a store of value, it could not serve as a means of payment.

Money is not alone in acting as a store of value. A house, a car, and a work of art are other examples.

The more stable the value of a commodity or token, the better it can act as a store of value and the more useful it is as money. No store of value has a completely stable value. The value of a house, a car, or a work of art fluctuates over time. The values of the commodities and tokens that are used as money also fluctuate over time.

Inflation lowers the value of money and the values of other commodities and tokens that are used as money. To make money as useful as possible as a store of value, a low inflation rate is needed.

Money in the United States Today

In the United States today, money consists of:

- Currency
- Deposits at banks and other depository institutions

Currency The notes and coins held by individuals and businesses are called **currency**. Notes are money because the government declares them so with the words "This note is legal tender for all debts, public and private." You can see these words on every dollar bill. The notes and coins *inside* banks are not counted as currency because they are not held by individuals and businesses.

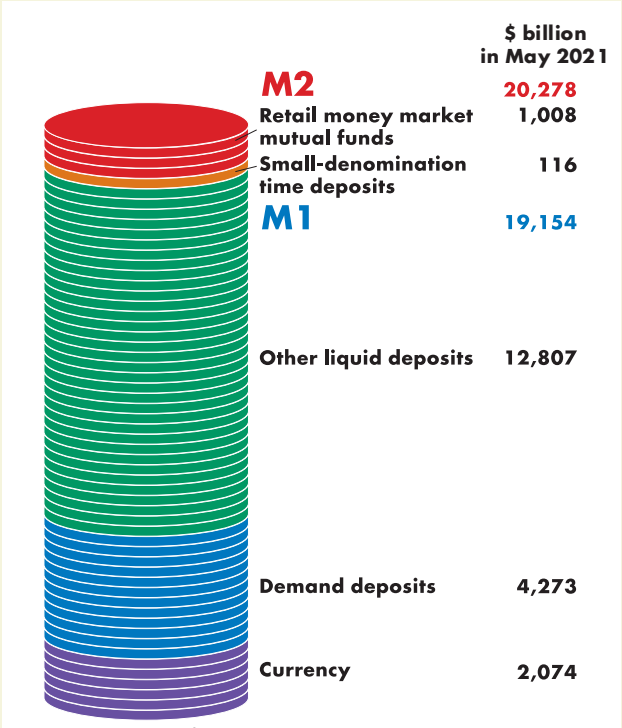
Deposits Deposits of individuals and businesses at banks and other depository institutions, such as savings and loan associations, are also counted as money. Deposits are money because the owners of the deposits can use them to make payments.

Official Measures of Money Two official measures of money in the United States today are known as M1 and M2. **M1** consists of currency plus demand deposits and other liquid deposits owned by individuals and businesses that can be withdrawn on demand. M1 does not include notes and coins held by banks, and it does not include notes and coins and checking deposits owned by the U.S. government. **M2** consists of M1 plus small-denomination time deposits and retail money market mutual funds.

ECONOMICS IN ACTION

Official Measures of U.S. Money

The figure shows the relative magnitudes of the items that make up M1 and M2. Notice that M1 and M2 are almost equal and that currency is a small part of money.



Two Measures of Money

Source of data: Federal Reserve. The data are for May 2021.

M1
- Currency
- Demand deposits
- Other liquid deposits

M2
- M1
- Small-denomination time deposits
- Retail money market mutual funds

Are M1 and M2 Really Money? Money is the means of payment. So, the test of whether an asset is money is whether it serves as a means of payment. Currency passes the test. But what about deposits? Demand deposits are money because they can be transferred from one person to another by writing a check or using a debit card. Such a transfer of ownership is equivalent to handing over currency. So, the currency and demand deposits components of M1 are a means of payment and *M1 is money*.

But what about "Other liquid deposits"? Are they money? These deposits are savings account balances in banks and other institutions. They are called *liquid deposits* because they are easily convertible into a means of payment without loss in value. Some of these deposits *are* a means of payment and are money, but others function as money.

M2 adds small-denomination time deposits and retail money market funds, which although not a means of payment are quickly and easily converted into a means of payment, so they are counted as money.

Deposits Are Money but Checks and Debit Cards Are Not We count deposits as money, but we don't count checks or debit cards as money. Why are deposits money and checks and debit cards not?

To see why, think about what happens when Colleen buys some roller-blades for $100 from Rocky's Rollers. When Colleen goes to Rocky's shop, she has $500 in her deposit account at the Laser Bank. Rocky has $1,000 in his deposit account—at the same bank, as it happens. The deposits of these two people total $1,500. Colleen either writes a check for $100 or swipes her debit card. When Rocky takes the check to the bank, or when the debit card is swiped, Rocky's bank balance rises from $1,000 to $1,100, and Colleen's balance falls from $500 to $400. The deposits of Colleen and Rocky still total $1,500. Rocky now has $100 more and Colleen has $100 less.

This transaction has transferred money from Colleen to Rocky, but the check or debit card was not money. There wasn't an extra $100 of money while the check was in circulation. The check or card swipe instructs the bank to transfer money from Colleen to Rocky.

If Colleen and Rocky use different banks, there is an extra step. Rocky's bank credits $100 to Rocky's account and then takes the check to a check-clearing center. The check is then sent to Colleen's bank, which pays Rocky's bank $100 and then debits Colleen's account $100. This process can take a few days, but the principles are the same as when two people use the same bank.

Credit Cards and Mobile Wallets Are Not Money You've just seen that checks and debit cards are not money, but what about credit cards and mobile wallets? Isn't having a credit card and swiping it to pay for your roller-blades the same thing as using money? Why aren't credit cards somehow valued and counted as part of the quantity of money?

When you pay by check, you might be asked to prove your identity by showing your driver's license. You would never think of your driver's license as money. It's just an ID card. A credit card is also an ID card, but one that lets you get a loan at the instant you buy something. When you swipe your credit card you are saying, "I agree to pay for these goods when the credit card company bills me." Once you get your statement from the credit card company, you must make at least the minimum payment due. To make that payment, you need money—you need to have currency or a demand deposit. So your credit card is not the *means of payment* and it is not money.

A *mobile wallet* is an electronic version of a physical wallet. It is a smartphone, tablet, or smartwatch app that stores and accesses credit card or debit card data to make purchases. Examples are Apple Pay, Samsung Pay, Android Pay, and Current C. So, like the credit cards and debit cards whose data it stores, a mobile wallet isn't money.

REVIEW QUIZ

1. What makes something money? What functions does money perform? Why do you think packs of chewing gum don't serve as money?
2. What are the problems that arise when a commodity is used as money?
3. What are the main components of money in the United States today?
4. What are the official measures of money? Are all the measures really money?
5. Why are checks, debit cards, and credit cards not money?

We've seen that the main component of money in the United States is deposits at banks and other depository institutions. Let's take a closer look at these institutions.

Depository Institutions

A **depository institution** is a financial firm that takes deposits from households and firms. These deposits are components of M1 and M2. You will learn what these institutions are, what they do, the economic benefits they bring, how they are regulated, and how they have innovated to create new financial products.

Types of Depository Institutions

Deposits at three types of financial firms make up the nation's money. They are

- Commercial banks
- Thrift institutions
- Money market mutual funds

Commercial Banks A *commercial bank* is a firm that is licensed to receive deposits and make loans. In 2017, about 4,983 commercial banks operated in the United States but mergers make this number fall each year as small banks disappear and big banks expand.

A few very large commercial banks offer a wide range of banking services and have extensive international operations. The largest of these banks are JPMorgan Chase, Bank of America, Wells Fargo, and Citigroup. Most commercial banks are small and serve their regional and local communities.

The deposits at commercial banks represent more than two-thirds of M1 and M2.

Thrift Institutions Savings and loan associations, savings banks, and credit unions are *thrift institutions*.

Savings and Loan Association A *savings and loan association* (S&L) is a depository institution that receives deposits and makes personal, commercial, and home-purchase loans.

Savings Bank A *savings bank* is a depository institution that accepts savings deposits and makes mostly home-purchase loans.

Credit Union A *credit union* is a depository institution owned by a social or economic group, such as a firm's employees, that accepts savings deposits and makes mostly personal loans.

The deposits at the thrift institutions represent a small percentage of M1 and M2.

Money Market Mutual Funds A *money market mutual fund* is a fund operated by a financial institution that sells shares in the fund and holds assets such as U.S. Treasury bills and short-term commercial bills.

Money market mutual fund shares act like bank deposits. Shareholders can write checks on their money market mutual fund accounts, but there are restrictions on most of these accounts. For example, the minimum deposit accepted might be $2,500, and the smallest check a depositor is permitted to write might be $500.

Money market mutual funds do not feature in M1 and represent 5 percent of M2.

What Depository Institutions Do

Depository institutions provide services such as check clearing, account management, and credit cards, all of which provide an income from service fees.

But depository institutions earn most of their income by using the funds they receive from depositors to buy securities and make loans that earn a higher interest rate than that paid to depositors. In this activity, a depository institution must perform a balancing act weighing return against risk. To see this balancing act, we'll focus on the commercial banks.

A commercial bank puts the funds it receives from depositors and other funds that it borrows into three types of assets:

- Cash assets
- Securities
- Loans

Cash Assets A bank's cash assets consist of notes and coins in the bank's vault (called *vault cash*), a deposit account at the Federal Reserve (the Fed), and loans to other banks. The first two items, vault cash and deposits at the Fed, are the bank's **reserves**. Loans to other banks earn interest and the interest rate on these loans is called the **federal funds rate**. The Fed sets a target for this interest rate to influence the economy. We explain how and why in Chapter 14.

A bank holds cash assets as a first line of funds to ensure that it is always able to meet depositors' currency withdrawals and make payments to other banks. In normal times, a bank kept about a half of one percent of deposits as cash assets. But today, these assets earn interest and their quantity has swollen to 21.1 percent of total deposits.

Securities A bank holds U.S. government Treasury bills and commercial bills that earn a low but risk-free return, and U.S. government bonds and mortgage-backed securities that earn a higher but riskier return. Securities would be sold and converted into cash assets if a bank ran short of reserves.

Loans A loan is an advance of funds for a specified period of time to businesses to finance investment and to households to finance the purchase of homes, cars, and other durable goods. The outstanding balances on credit card accounts are also bank loans. Loans are a bank's riskiest and highest-earning assets: They can't be converted into cash assets until they are due to be repaid, and some borrowers default and never repay. To spread the risk on loans, some get converted to securities.

Table 8.2 provides a snapshot of the sources and uses of funds of the commercial banks in June 2021 and serves as a summary of what they do.

Economic Benefits Provided by Depository Institutions

You've seen that a depository institution earns part of its profit by paying a lower interest rate on deposits than what it earns on loans. What benefits do these institutions provide that make depositors willing to accept a lower interest rate than what borrowers are willing to pay?

Depository institutions provide four benefits:

- Create liquidity
- Pool risk
- Lower the cost of borrowing
- Lower the cost of monitoring borrowers

Create Liquidity Depository institutions create liquidity by *borrowing short and lending long*—taking deposits and standing ready to repay them on short notice or on demand and making loan commitments that run for terms of many years.

Pool Risk A loan might not be repaid—a default. If you lend to one person who defaults, you lose the entire amount loaned. If you lend to 1,000 people (through a bank) and one person defaults, you lose almost nothing. Depository institutions pool risk.

Lower the Cost of Borrowing Imagine there are no depository institutions and a firm is looking for $1 million to buy a new factory. It hunts for several dozen people from whom to borrow the funds. Depository institutions lower the cost of this search. The firm gets its $1 million from a single institution that gets deposits from a large number of people, which lowers the firm's cost of borrowing.

Lower the Cost of Monitoring Borrowers By monitoring borrowers, a lender can encourage good decisions that prevent defaults. But this activity is costly. Imagine how costly it would be if each household that lent money to a firm incurred the costs of monitoring that firm directly. Depository institutions can perform this task at a much lower cost.

TABLE 8.2 Commercial Banks: Sources and Uses of Funds

	Funds (billions of dollars)	Percentage of deposits
Total funds	21,355	125.6
Sources		
Deposits	17,003	100.0
Borrowing	1,505	8.9
Own capital and other sources (net)	2,847	16.7
Uses		
Cash assets	3,582	21.1
Securities	5,267	31.0
Loans	10,353	60.9
Other assets	2,153	12.7

Commercial banks get most of their funds from depositors and use most of them to make loans. In normal times, banks hold less than 1 percent of deposits as reserves. But in 2021, reserves (cash assets) were 21 percent of deposits, most of which were at the Fed earning a low interest rate.

Source of data: Federal Reserve. The data are for June 2021.

How Depository Institutions Are Regulated

Depository institutions are engaged in a risky business, and a failure, especially of a large bank, would have damaging effects on the entire financial system and the economy. To make the risk of failure small, depository institutions are required to hold levels of reserves and owners' capital that equal or surpass ratios laid down by regulation. If a depository institution fails, its deposits are guaranteed up to $250,000 per depositor per bank by the *Federal Deposit Insurance Corporation* or FDIC. The FDIC can take over management of a bank that appears to be heading toward failure.

AT ISSUE

Fractional-Reserve Banking Versus 100 Percent Reserve Banking

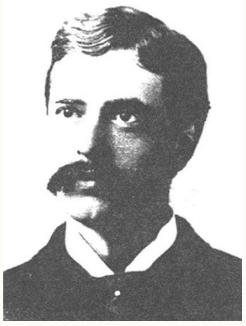
Fractional-reserve banking, a system in which banks keep a fraction of their depositors' funds as a cash reserve and lend the rest, was invented by goldsmiths in sixteenth-century Europe and is the only system in use today.

This system contrasts with **100 percent reserve banking**, a system in which banks keep the full amount of their depositors' funds as a cash reserve.

The 2008 global financial crisis raised the question: Should banks be required to keep 100 percent cash reserves to prevent them from failing and bringing recession?

Yes

- The most unrelenting advocates of 100 percent reserve banking are a group of economists known as the *Austrian School*, who say that fractional-reserve banking violates property rights.
- Because a deposit is owned by the depositor and not the bank, the bank has no legal right to lend the deposit to someone else.
- Mainstream economists Irving Fisher in the 1930s and Milton Friedman in the 1950s supported 100 percent reserve banking.
- They said it enables the central bank to exercise more precise control over the quantity of money as well as eliminating the risk of a bank running out of cash.



Irving Fisher of Yale University supported 100 percent reserve banking.

No

- The requirement to hold 100 percent reserves would prevent the banks making loans and lower their profits.
- Lower bank profits weaken rather than strengthen the banks.
- The demand for loans would be met by a supply from unregulated institutions, and they might be riskier than the current fractional-reserve banks.
- Nonetheless, banks do need to be regulated.
- In 2010, Congress passed the Dodd-Frank Wall Street Reform and Consumer Protection Act, which sought to impose regulations and rules designed to prevent financial crises like the one in 2008.
- This act created the Financial Stability Oversight Council and Orderly Liquidation Authority to monitor the financial stability of banks and other major financial firms regarded as being "too big to fail."

Mark Carney, Former Chairman of the Financial Stability Board and Former Governor of the Bank of England.

"Our destination should be one where financial institutions and markets play critical—and complementary—roles to support long-term economic prosperity. This requires institutions that are adequately capitalized, with sufficient liquidity buffers to manage shocks."
Mark Carney, remarks at the Institute of International Finance, Washington, D.C., September 25, 2011

ECONOMICS IN ACTION

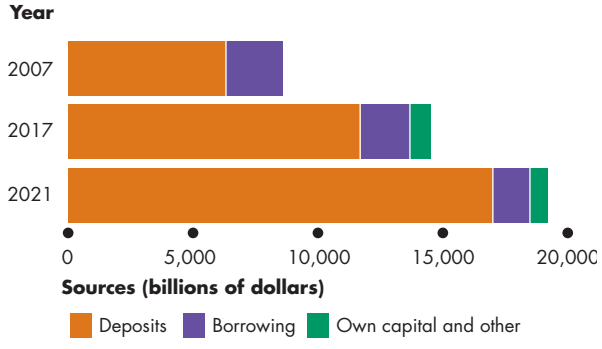
Commercial Banks Flush with Reserves

The figure shows the commercial banks' sources and uses of funds in 2007, 2017, and 2021.

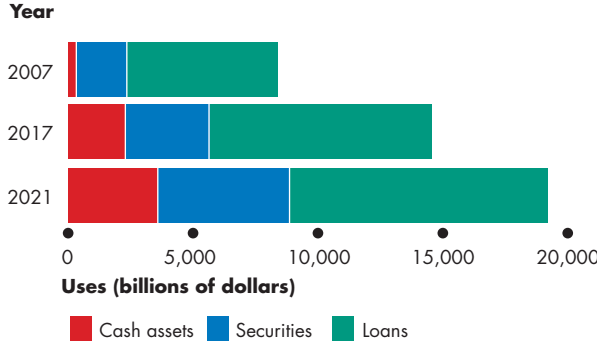
The 2007 data describe the banks in a normal time, when they held very small cash assets (5 percent of deposits) in the confidence that they could borrow overnight for an interest rate barely above the rate they earn on safe Treasury bills.

Normal times ended in 2008 with the Global Financial Crisis and the Great Recession. The 2017 data describe the banks after almost a decade of abundant reserves. Deposits were double their 2007 value and cash assets were 20 percent of deposits.

When the Covid-19 pandemic hit the U.S. economy in 2020 with the largest shock since the Great Depression, the Federal Reserve injected more cash into the banks. The 2021 data describe the banks after this injection of cash.



(a) Sources of commercial bank funds



(b) Uses of commercial bank funds

Changes in the Sources and Uses of Commercial Bank Funds

Source of data: Federal Reserve.

Financial Technology

In the pursuit of larger profit, depository institutions are constantly seeking ways to improve their products in a process called *financial innovation*.

During the late 1970s, a high inflation rate sent the interest rate on home-purchase loans to 15 percent a year. Traditional fixed interest rate mortgages became unprofitable and variable interest rate mortgages were introduced.

During the 2000s, when interest rates were low and depository institutions were flush with funds, sub-prime mortgages were developed. To avoid the risk of carrying these mortgages, mortgage-backed securities were developed. The original lending institution sold these securities, lowered their own exposure to risk, and obtained funds to make more loans.

The development of low-cost computing and communication brought financial innovations such as credit cards and daily interest deposit accounts.

Financial innovation has brought changes in the composition of money, two of them surprising. The use of currency has not decreased and demand deposits, especially at thrift institutions, have become an increasing percentage of M1. Other liquid deposits have decreased as a percentage of money, while money market mutual funds have expanded.

REVIEW QUIZ

1. What are depository institutions?
2. What are the functions of depository institutions?
3. How do depository institutions balance risk and return?
4. How do depository institutions create liquidity, pool risks, and lower the cost of borrowing?
5. How have depository institutions made innovations that have influenced the composition of money?

You now know what money is. Your next task is to learn about the Federal Reserve System and the ways in which it can influence the quantity of money.

The Federal Reserve System

The **Federal Reserve System** (usually called the **Fed**) is the central bank of the United States. A **central bank** is a bank's bank and a public authority that regulates a nation's depository institutions and conducts *monetary policy*, which means that it adjusts the quantity of money in circulation and influences interest rates.

We begin by describing the structure of the Fed.

The Structure of the Fed

Three key elements of the Fed's structure are

- The Board of Governors
- The regional Federal Reserve banks
- The Federal Open Market Committee

The Board of Governors A seven-member board appointed by the President of the United States and confirmed by the Senate governs the Fed. Members have 14-year (staggered) terms and one seat on the board becomes vacant every two years. The President appoints one board member as chairman for a 4-year renewable term—currently Jerome Powell, a former investment banker and Fed board member.

The Federal Reserve Banks The nation is divided into 12 Federal Reserve districts (shown in Fig. 8.1). Each district has a Federal Reserve bank that provides check-clearing services to commercial banks and issues bank notes.

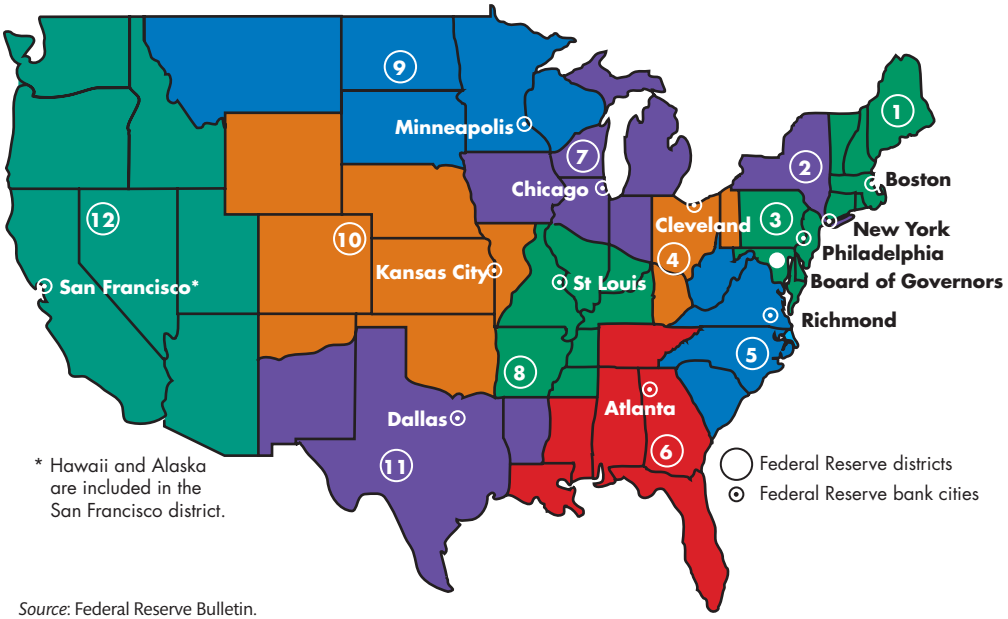
The Federal Reserve Bank of New York (known as the New York Fed) occupies a special place in the Federal Reserve System because it implements the Fed's policy decisions in the financial markets.

The Federal Open Market Committee The **Federal Open Market Committee** (FOMC) is the main policy-making organ of the Federal Reserve System. The FOMC consists of the following voting members:

- The chairman and the other six members of the Board of Governors
- The president of the Federal Reserve Bank of New York
- The presidents of the other regional Federal Reserve banks (of whom, on a yearly rotating basis, only four vote)

The FOMC meets approximately every six weeks to review the state of the economy and to decide the actions to be carried out by the New York Fed.

FIGURE 8.1 The Federal Reserve System



The nation is divided into 12 Federal Reserve districts, each having a Federal Reserve bank. (Some of the larger districts also have branch banks.) The Board of Governors of the Federal Reserve System is located in Washington, D.C.

Source: Federal Reserve Bulletin.

The Fed's Balance Sheet

The Fed influences the economy through the size and composition of its balance sheet—the assets that the Fed owns and the liabilities that it owes.

The Fed's Assets The Fed has two main assets:

1. U.S. government securities
2. Mortgage-backed securities

U.S. Government Securities The U.S. government securities held by the Fed are Treasury bonds. The Fed buys and sells these bonds in the *loanable funds market* (see p. 200). The Fed does not buy bonds directly from the U.S. government.

Mortgage-Backed Securities Traditionally, the Fed held only U.S. government securities. But in recent years, the Fed has purchased large quantities of mortgage-backed securities to increase the supply of *loanable funds* (see p. 201).

The Fed's Liabilities The Fed has two liabilities:

1. Currency
2. Reserves of depository institutions

Currency Currency is the notes and coins that households and firms use in their daily transactions and is a component of M1. Banks and other depository institutions hold some notes and coins in their vaults and cash machines, which is called *vault cash*. Coins are not a liability of the Fed. They are issued by the U.S. Mint.

Reserves of Depository Institutions The Fed is the banker for the banks and the reserves that the banks deposit at the Fed are a liability of the Fed.

The Monetary Base The Fed's total liabilities make up the monetary base. That is, the **monetary base** is the sum of currency and the reserves of depository institutions.

The Fed's assets are the sources of the monetary base. They are also called the backing for the monetary base. The Fed's liabilities are the uses of the monetary base as currency and bank reserves. Table 8.3 provides a snapshot of the sources and uses of the monetary base in June 2021.

When the Fed changes the monetary base, the quantity of money and interest rate change. You're going to see how these changes come about later in this chapter. First, we'll look at the Fed's tools that enable it to influence money and interest rates.

TABLE 8.3 The Sources and Uses of the Monetary Base

Sources (billions of dollars)		Uses (billions of dollars)	
U.S. government securities	5,163	Currency	2,180
Mortgage-backed securities	2,354	Reserves of depository institutions	3,766
Other securities	634	Other deposits at the Fed	2,205
Reserve Bank credit	8,151	Use of reserve funds	8,151
		Monetary base = Currency + Reserves of depository institutions	5,946

Source of data: Federal Reserve. The data are for June 2021.

The Fed's Policy Tools

The Fed influences the quantity of money and interest rates by using three tools:

- Open market operations
- Discount window and discount rate
- Interest on reserves rate

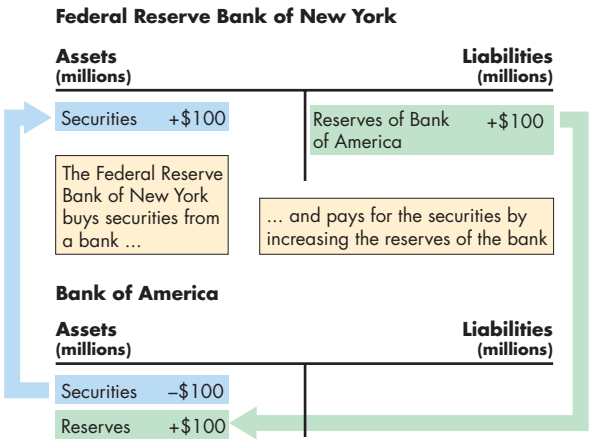
Open Market Operations An **open market operation** is the purchase or sale of securities by the Fed in the *loanable funds market*. When the Fed buys securities, it pays for them with newly created bank reserves. When the Fed sells securities, the Fed is paid with reserves held by banks. So open market operations directly influence the reserves of banks. By changing the quantity of bank reserves, the Fed changes the quantity of monetary base, which influences the quantity of money.

An Open Market Purchase To see how an open market operation changes bank reserves, suppose the Fed buys $100 million of government securities from Bank of America. When the Fed makes this transaction, two things happen:

1. Bank of America has $100 million less securities, and the Fed has $100 million more securities.
2. The Fed pays for the securities by placing $100 million in Bank of America's deposit account at the Fed.

Figure 8.2 shows the effects of these actions on the balance sheets of the Fed and Bank of America. Ownership of the securities passes from Bank of America to the Fed, so Bank of America's

FIGURE 8.2 The Fed Buys Securities in the Open Market



When the Fed buys securities in the open market, it creates bank reserves. The Fed's assets and liabilities increase, and Bank of America exchanges securities for reserves.

assets decrease by $100 million and the Fed's assets increase by $100 million, as shown by the blue arrow running from Bank of America to the Fed.

The Fed pays for the securities by placing $100 million in Bank of America's reserve account at the Fed, as shown by the green arrow running from the Fed to Bank of America.

The Fed's assets and liabilities increase by $100 million. Bank of America's total assets are unchanged: It sold securities to increase its reserves.

An Open Market Sale If the Fed sells $100 million of government securities to Bank of America in the open market,

1. Bank of America has $100 million more securities, and the Fed has $100 million less securities.
2. Bank of America pays for the securities by using $100 million of its reserve deposit at the Fed.

You can follow the effects of these actions on the balance sheets of the Fed and Bank of America by reversing the arrows and the plus and minus signs in Fig. 8.2. Ownership of the securities passes from the Fed to Bank of America, so the Fed's assets decrease by $100 million and Bank of America's assets increase by $100 million.

Bank of America uses $100 million of its reserves to pay for the securities.

ECONOMICS IN ACTION

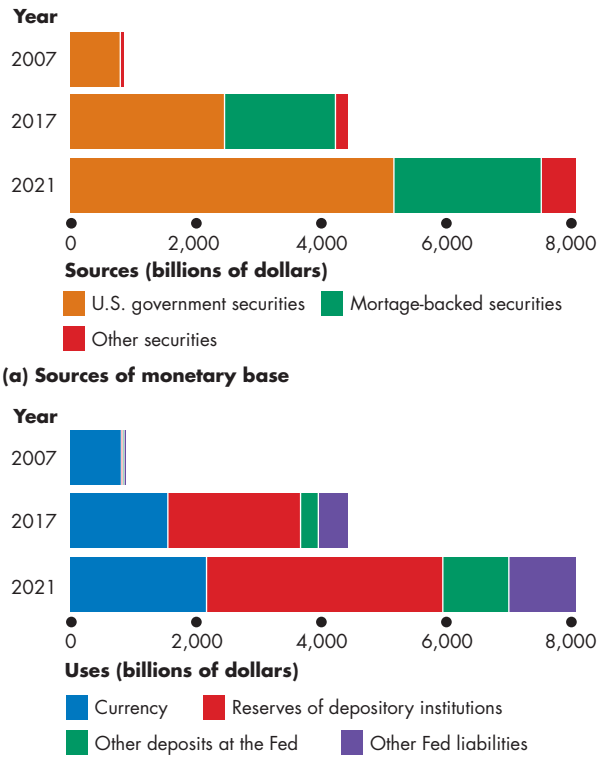
The Fed's Balance Sheet Explodes

The Fed's balance sheet underwent some remarkable changes following the Great Recession and again during the Covid-19 pandemic. The figure shows the effects of these events on the size and composition of the Fed's balance sheet by comparing the situation in 2017 and 2021 with that of 2007.

In a normal year, 2007, the Fed's holdings of securities are entirely U.S. government securities (orange bar) and they almost equal the monetary base (blue and red bar), which is almost entirely currency.

But between 2007 and 2017, the Fed more than quadrupled the monetary base by buying both U.S. government and mortgage-backed securities. Currency increased, but bank reserves increased by much more.

The data for 2021 show the effects of the Fed's response to the Covid-19 pandemic.



Changes in the Sources and Uses of Monetary Base

Source of data: Federal Reserve.

Both the Fed's assets and liabilities decrease by $100 million. Bank of America's total assets are unchanged: It has used reserves to buy securities.

The New York Fed conducts these open-market transactions on directions from the FOMC.

Discount Window and Discount Rate The "discount window" is an imaginary window that is always open and through which the Fed makes loans to commercial banks and other depository institutions. These "last-resort loans" ensure that banks are always able to meet withdrawals by their customers. The **discount rate** is the interest rate paid by discount window borrowers. The Fed's Board of Governors sets this interest rate.

Interest on Reserves Rate Economists have long recommended that the Fed (and all central banks) pay interest to commercial banks on the reserves they are required to hold. But only after the Financial Services Regulatory Relief Act of 2006 became law did the Fed have the authority to pay this interest.

The **interest on reserves rate** is the interest rate that banks earn on their reserves held on deposit at the Fed. In 2021, the Federal Reserve Board announced a simpler rule that the Federal Reserve Banks pay interest on all reserve balances, both required reserves and excess reserve. Like the discount rate, the Board of Governors sets this interest rate.

REVIEW QUIZ

1. What is the central bank of the United States and what functions does it perform?
2. What is the monetary base and how does it relate to the Fed's balance sheet?
3. What are the Fed's three policy tools?
4. What is the Federal Open Market Committee and what are its main functions?
5. How does an open market operation change the monetary base?

Next, we're going to see how the banking system—the banks and the Fed—creates money and how the quantity of money changes when the Fed changes the monetary base.

How Banks Create Money

Banks create money. But this doesn't mean that they have smoke-filled back rooms in which counterfeiters are busily working. Remember, money is both currency and bank deposits. What banks create is deposits, and they do so by making loans.

Creating Deposits by Making Loans

The easiest way to see that banks create deposits is to think about what happens when Andy, who has a Visa card issued by Citibank, uses his card to buy a tank of gas from Chevron. When Andy swipes his card, two financial transactions occur. First, Andy takes a loan from Citibank and obligates himself to repay the loan at a later date. Second, a message is transmitted to Chevron's bank and the bank credits Chevron's account with the amount of Andy's purchase (minus the bank's commission).

For now, let's assume that Chevron, like Andy, banks at Citibank so that the two transactions we've just described both occur at the one bank.

You can see that these transactions have created a bank deposit and a loan. Andy has increased the size of his loan (his credit card balance), and Chevron has increased the size of its bank deposit. Because bank deposits are money, Citibank has created money.

If, as we've just assumed, Andy and Chevron use the same bank, no further transactions take place. But if two banks are involved, there is another transaction. To see this additional transaction and its effects, assume that Chevron's bank is Bank of America. To fully settle the payment for Andy's gas purchase, Citibank must pay Bank of America.

To make this payment, Citibank uses its reserves. Citibank's reserves decrease by the amount of its loan to Andy; Bank of America's reserves increase by the amount that Chevron's deposit increases. Payments like this one between the banks are made at the end of the business day. So, at the end of the business day the banking system as a whole has an increase in loans and deposits but no change in reserves.

Three factors limit the quantity of loans and deposits that the banking system can create through transactions like Andy's. They are

- The monetary base
- Desired reserves
- Desired currency holding

The Monetary Base You've seen that the *monetary base* is the sum of Federal Reserve notes, coins, and banks' deposits at the Fed. The size of the monetary base limits the total quantity of money that the banking system can create. The reason is that banks have a desired level of reserves, households and firms have a desired holding of currency, and both of these desired holdings of the monetary base depend on the quantity of deposits.

Required and Desired Reserves *Required reserves* are the minimum reserves that a bank *must* hold (currently set at zero). *Desired reserves* are the reserves that a bank *plans* to hold, and **unplanned reserves** are actual reserves minus desired reserves. The quantity of desired reserves depends on the amount of deposits and is determined by the **desired reserve ratio**—the ratio of reserves to deposits that the banks *plan* to hold. The *desired* reserve ratio exceeds the required reserve ratio by an amount that the banks determine to be prudent.

Desired Currency Holding The proportions of money held as currency and bank deposits—the ratio of currency to deposits—depend on how households and firms choose to make payments: Whether they plan to use currency or debit cards and checks.

Choices about how to make payments change slowly, so the ratio of desired currency to deposits also changes slowly, and at any given time this ratio is fixed. If bank deposits increase, desired currency holding also increases. For this reason, when banks make loans that increase deposits, some currency leaves the banks—the banking system leaks reserves. We call the leakage of bank reserves into currency the *currency drain*, and we call the ratio of currency to deposits the **currency drain ratio**.

We've sketched the way that a loan creates a deposit and described the three factors that limit the amount of loans and deposits that can be created. We're now going to examine the money creation process more closely and discover a money multiplier.

The Money Creation Process

The money creation process begins with an increase in the monetary base, which occurs if the Fed conducts an open market operation in which it buys securities from banks and other institutions. The Fed pays for the securities it buys with newly created bank reserves.

When the Fed buys securities from a bank, the bank's reserves increase but its deposits don't change. So the bank has unplanned reserves.

When a bank has unplanned reserves, it makes loans and creates deposits. When the entire banking system has unplanned reserves, total loans and deposits increase and the quantity of money increases.

One bank can make a loan and get rid of unplanned reserves. But the banking system as a whole can't get rid of unplanned reserves so easily. When the banks make loans and create deposits, the extra deposits lower unplanned reserves for two reasons. First, the increase in deposits increases desired reserves. Second, a currency drain decreases total reserves. But unplanned reserves don't completely disappear. So the banks lend some more and the process repeats.

As the process of making loans and increasing deposits repeats, desired reserves increase, total reserves decrease through the currency drain, and eventually enough new deposits have been created to use all the new monetary base.

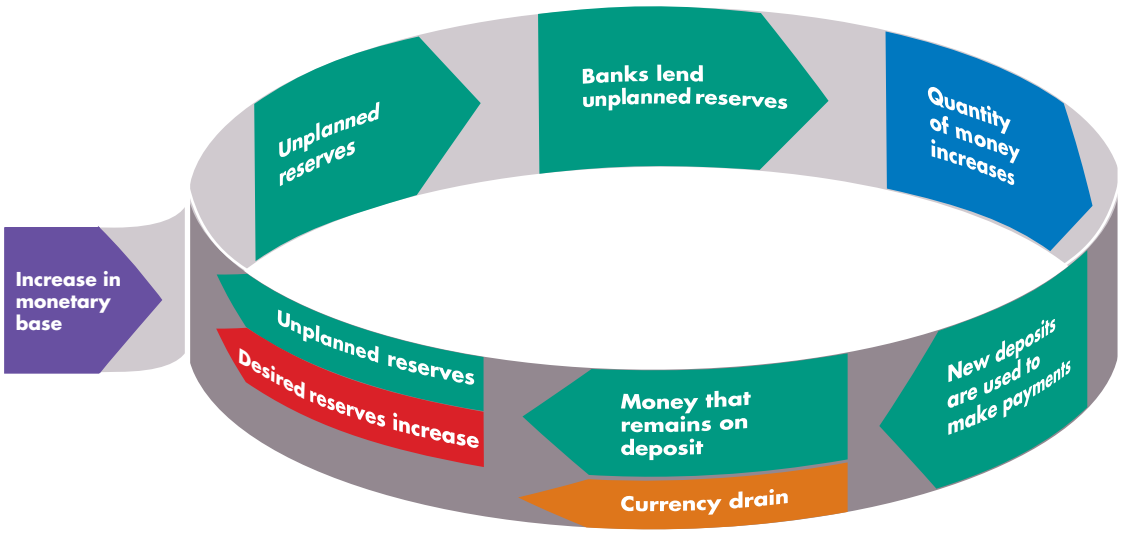
Figure 8.3 summarizes one round in the process we've just described. The sequence has the following eight steps:

1. Banks have unplanned reserves.
2. Banks lend unplanned reserves.
3. The quantity of money increases.
4. New money is used to make payments.
5. Some of the new money remains on deposit.
6. Some of the new money is a *currency drain*.
7. Desired reserves increase because deposits have increased.
8. Unplanned reserves decrease.

If the Fed *sells* securities in an open market operation, then banks have negative unplanned reserves—they are short of reserves. When the banks are short of reserves, loans and deposits decrease and the process we've described above works in a downward direction until desired reserves plus desired currency holding has decreased by an amount equal to the decrease in the monetary base.

A money multiplier determines the change in the quantity of money that results from a change in the monetary base.

FIGURE 8.3 How the Banking System Creates Money by Making Loans



The Federal Reserve increases the monetary base, which increases bank reserves and creates unplanned reserves. Banks lend the unplanned reserves, which creates new deposits. The quantity of money increases. New deposits are used to make payments. Some of the new money remains on deposit at banks and some leaves the banks in a currency drain. The increase in bank deposits increases banks' desired reserves. But the banks still have unplanned reserves, though less than before. The process repeats until unplanned reserves have been eliminated.

ECONOMICS IN ACTION

The Variable Money Multipliers

We can measure the money multiplier, other things remaining the same, as the ratio of the quantity of money (M1 or M2) to the monetary base. In normal times, these ratios (and the money multipliers) change slowly.

In 2007, before the global financial crisis, the M1 multiplier—the ratio of M1 to the monetary base—was 1.7 and the M2 multiplier—the ratio of M2 to the monetary base—was 8.8.

Starting in 2008, an unprecedented increase in the monetary base has been willingly held by banks as reserves—desired reserves increased by a similar amount to the increase in actual reserves. The quantity of M1 changed by a bit more than the change in monetary base and by 2020, the M1 multiplier had increased to 2.8. But the quantity of M2 changed by much less than the change in monetary base and by 2020, the M2 multiplier had decreased to 3.8.

The Money Multiplier

The **money multiplier** is the ratio of the change in the quantity of money to the change in monetary base. For example, if a $1 million increase in the monetary base increases the quantity of money by $2.5 million, then the money multiplier is 2.5.

The smaller the banks' desired reserve ratio and the smaller the currency drain ratio, the larger is the money multiplier. (See the Mathematical Note on pp. 236–237 for details on the money multiplier).

REVIEW QUIZ

1. How do banks create money?
2. What limits the quantity of money that the banking system can create?
3. A bank manager tells you that she doesn't create money. She just lends the money that people deposit. Explain why she's wrong.
4. If the desired reserve ratio and the currency drain ratio increase, how does the money multiplier change?

ECONOMICS IN THE NEWS

A Massive Open Market Operation

QE2 Is No Silver Bullet

The Federal Reserve's $600 billion bond-buying program initiated last year, known as the second round of quantitative easing or QE2, will end on schedule this month with a mixed legacy, having proved to be neither the economy's needed elixir nor the scourge that critics describe.

Source: *The Wall Street Journal*, June 22, 2011

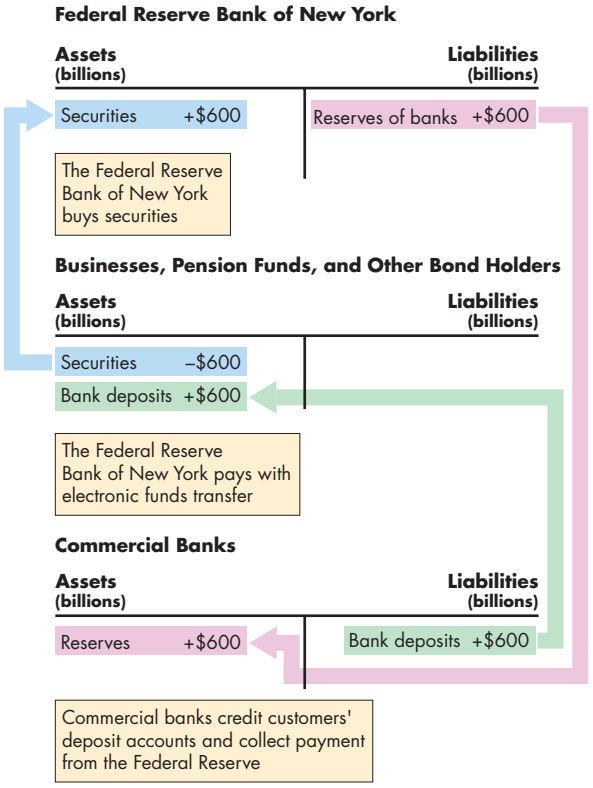
The New York Fed building where open market operations are conducted.

THE QUESTIONS

- What is *quantitative easing*? What transactions does the Fed undertake in a period of quantitative easing?
- How did QE2 affect the quantity of reserves, loans, and deposits of the commercial banks?
- Why was QE2 neither "elixir" nor "scourge"?

THE ANSWERS

- *Quantitative easing* or QE is an open market purchase of securities by the Fed. QE2 was the purchase of $600 billion of long-term securities from businesses, pension funds, and other holders.
- The purchase was an open market operation similar to that described in Fig. 8.2 on p. 223 but with one more step because the Fed bought the securities from holders who were not banks.
- The figure illustrates the QE2 open market operation and the extra step in the chain of transactions.
- When the Fed buys securities, its assets increase. Its liabilities also increase because the Fed creates monetary base to pay for the securities.
- For the businesses that sell bonds, their assets change: Securities decrease and bank deposits increase.
- For the commercial banks, deposit liabilities increase and reserves, an asset, also increase.
- You saw on p. 220 that banks are flush with reserves, so they held on to the new reserves created by QE2. There was no multiplier effect on loans and deposits.
- QE2 would have been an "elixir" if it had boosted bank lending, business investment, and economic expansion. It didn't have these effects mainly because the banks held on to the newly created reserves.
- QE2 would have been a "scourge" if it had caused inflation. That didn't happen.



The QE2 Transactions

The Money Market

The money market is a virtual market in which households and businesses demand money, the Fed and the banks supply money, and an equilibrium quantity of money and interest rate are determined.

The Demand for Money

The **demand for money** is the relationship between the quantity of money demanded and the nominal interest rate when all other influences on the amount of money that people wish to hold remain the same.

The *quantity of money demanded* is the inventory of money that people plan to hold on any given day. It is the quantity of money in our wallets and in our deposit accounts at banks. This quantity depends on the opportunity cost of holding money.

The alternative to holding money is to hold a savings bond or Treasury bill that earns interest. By holding money, you forgo the interest that you otherwise would have received. Money loses value because of inflation, so why isn't the inflation rate part of the cost of holding money? It is. Other things remaining the same, the higher the expected inflation rate, the higher is the nominal interest rate.

Figure 8.4 shows a demand for money curve, *MD*. When the interest rate rises, other things remaining the same, the quantity of money demanded decreases—there is a movement up along the demand for money curve. Similarly, when the interest rate falls, the quantity of money demanded increases—there is a movement down along the demand for money curve.

When any influence on money holding other than the interest rate changes, the demand for money changes. Let's examine these other influences.

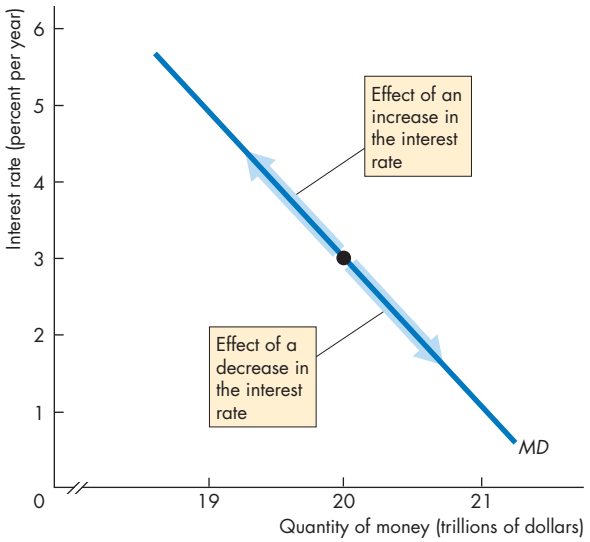
Changes in the Demand for Money

The demand for money changes when any of the following change:

- The price level
- Real GDP
- Financial technology

The Price Level The quantity of money that households and businesses plan to hold is proportional to the price level, other things remaining the same. If the price level rises by 10 percent, people will plan to hold 10 percent more money.

FIGURE 8.4 The Demand for Money



The demand for money curve, *MD*, shows the relationship between the quantity of money that people plan to hold and the nominal interest rate, other things remaining the same. The interest rate is the opportunity cost of holding money. A change in the interest rate brings a movement along the demand for money curve.

Suppose that you hold an average of $40 to finance your weekly purchases of coffee and soda. Now imagine that the prices of these goods and of all other goods and your income rise by 10 percent. You now keep $44 on hand to finance your higher weekly expenditure.

Real GDP The quantity of money that households and firms plan to hold depends on the amount they are spending. The quantity of money demanded in the economy as a whole depends on aggregate expenditure—real GDP.

Again, suppose that you hold an average of $40 to finance your weekly purchases of coffee and soda. Now imagine that the prices of these goods and of all other goods remain constant but your income increases. As a consequence, you now buy more goods and services and you also keep a larger amount of money on hand to finance your higher volume of expenditure.

Financial Technology Technological change and the arrival of new financial products influence the quantity of money held. Financial innovations include Internet banking which enables automatic transfers

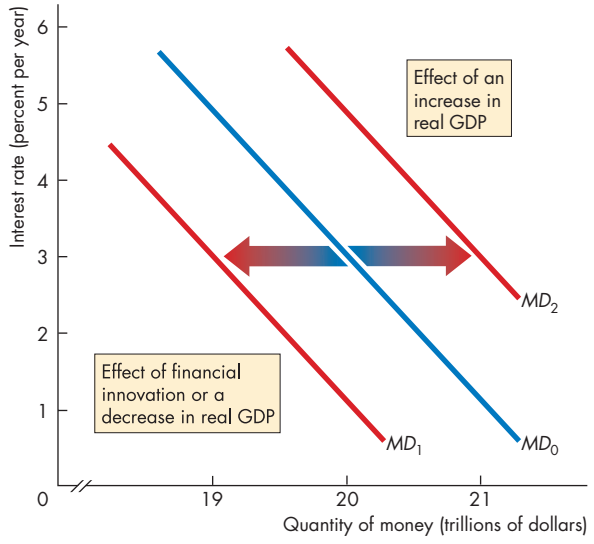
between bank deposits, online payment of bills, automatic teller machines, tap-and-go credit cards and debit cards, mobile wallets, and smartwatches.

These innovations have occurred because increased computing power has lowered the cost of calculations and record keeping, which has changed the demand for money. The influence of financial innovation on the demand for money is complicated. It decreases the demand for currency and might increase the demand for some types of deposits and decrease the demand for others. But generally, financial innovation decreases the demand for money.

A change in the price level, real GDP, or financial technology changes the demand for money and shifts the demand for money curve. Figure 8.5 illustrates changes in the demand for money.

A fall in the price level, a decrease in real GDP, or a financial innovation that economizes on money decreases the demand for money and shifts the demand for money curve leftward from MD_0 to MD_1. A rise in the price level or an increase in real GDP has the opposite effect: It increases the demand for money and shifts the demand for money curve rightward from MD_0 to MD_2.

FIGURE 8.5 Changes in the Demand for Money



A decrease in real GDP or a fall in the price level decreases the demand for money and shifts the demand for money curve leftward from MD_0 to MD_1. An increase in real GDP or a rise in the price level increases the demand for money and shifts the demand for money curve rightward from MD_0 to MD_2. Financial innovation generally decreases the demand for money.

The Supply of Money

The **supply of money** is the relationship between the quantity of money supplied and the nominal interest rate when all other influences on the amount of money that the Fed and banks wish to create remain the same.

The *quantity of money supplied* is the quantity of currency and deposits that the Fed and the banks plan to create on any given day.

The Fed is the most powerful player in the money market, so the supply of money depends on the Fed's monetary policy strategy. In conducting its monetary policy, the Fed can target the:

- Monetary base
- Nominal interest rate
- Quantity of money

Target the Monetary Base If the Fed targets and sets the monetary base, a rise in the nominal interest rate increases the quantity of money supplied. Why? Because a rise in the interest rate makes loans more profitable for the banks and decreases their desired reserve ratio. With a smaller desired reserve ratio, the banks increase loans, which increases the quantity of money supplied by a given monetary base.

A change in the monetary base that results from the Fed conducting an open market operation changes the supply of money. An open market purchase increases the supply of money and an open market sale decreases the supply of money.

Target the Nominal Interest Rate If the Fed targets the nominal interest rate, a change in the demand for money that places upward or downward pressure on the interest rate is accompanied by a change in the monetary base that keeps the interest rate on target. An increase in the demand for money is met with a Fed open market purchase which increases the quantity of money supplied to prevent the interest rate from rising. Similarly, a decrease in the demand for money is met with a Fed open market sale which decreases the quantity of money supplied to prevent the interest rate from falling.

Target the Quantity of Money If the Fed targets the quantity of money, a change in the demand for money that places upward or downward pressure on the equilibrium quantity of money is accompanied by an open market transaction that keeps the quantity of money on target. An increase in the demand for

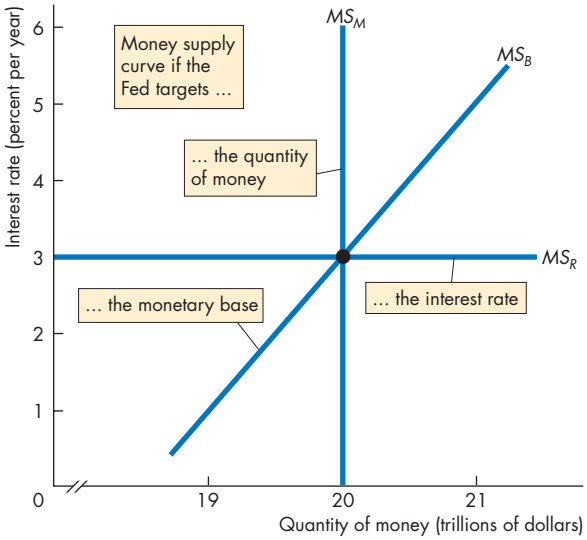
money is met with a Fed open market sale that decreases the monetary base and keeps the quantity of money on target. Similarly, a decrease in the demand for money is met with a Fed open market purchase that increases the monetary base and keeps the quantity of money on target.

Figure 8.6 shows the supply of money curves for each regime. If the Fed targets the monetary base, the supply curve slopes upward. The Fed targeting the interest rate makes the supply curve horizontal and targeting the quantity of money makes the supply curve vertical.

Money Market Equilibrium

Money market equilibrium occurs when the quantity of money demanded equals the quantity of money supplied. In the short run, the adjustments that occur to bring money market equilibrium depend on the money supply regime. And the adjustments that occur are fundamentally different in the short run and the long run.

FIGURE 8.6 The Supply of Money



The supply of money curve, *MS*, depends on the Fed's choice of monetary policy regime. If the Fed targets the quantity of money, the supply of money curve is MS_M. If the Fed targets the monetary base, the supply of money curve is MS_B. And if the Fed targets the interest rate, the supply of money curve is MS_R.

Short-Run Equilibrium If the Fed targets the monetary base or the quantity of money, the money market is in equilibrium when the interest rate has adjusted to the level at which the quantity of money demanded equals the quantity of money supplied.

In Fig. 8.7, the Fed targets the monetary base and the supply curve is *MS*. With demand for money curve *MD*, the equilibrium interest rate is 3 percent and the quantity of money is $20 trillion. If the interest rate were 2 percent a year, people would want to hold more money than is available.

They would sell bonds, bid down their price, and the interest rate would rise. If the interest rate were 4 percent a year, people would want to hold less money than is available. They would buy bonds, bid up their price, and the interest rate would fall.

A similar adjustment process would bring equilibrium if the Fed targeted the quantity of money with a vertical money supply curve.

If the Fed targets the interest rate and the money supply curve is horizontal, the Fed's open market operations determine the interest rate and the quantity of money adjusts to equal the quantity demanded.

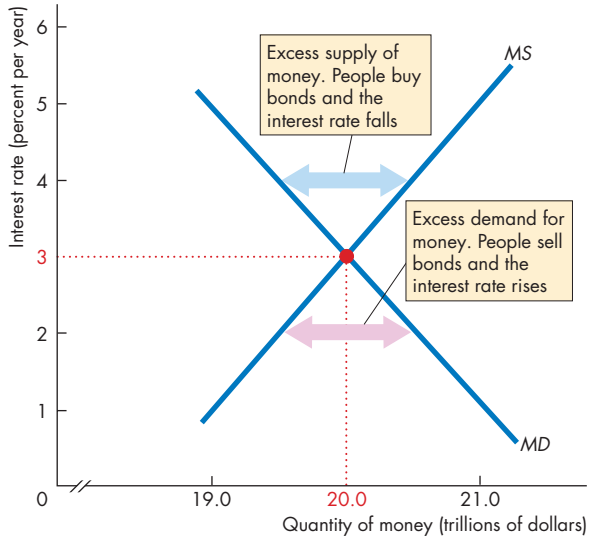
The Short-Run Effect of a Change in the Quantity of Money Starting from a short-run equilibrium, if the Fed increases the quantity of money, people find themselves holding more money than the quantity demanded. With a surplus of money holding, people enter the loanable funds market and buy bonds. The increase in demand for bonds raises the price of a bond and lowers the interest rate (refresh your memory by looking at Chapter 7, p. 199).

If the Fed decreases the quantity of money, people find themselves holding less money than the quantity demanded. They now enter the loanable funds market to sell bonds. The decrease in the demand for bonds lowers their price and raises the interest rate.

Figure 8.8 illustrates the effects of the changes in the quantity of money that we've just described. When the supply of money curve shifts rightward from MS_0 to MS_1, the interest rate falls to 2 percent a year; when the supply of money curve shifts leftward to MS_2, the interest rate rises to 4 percent a year.

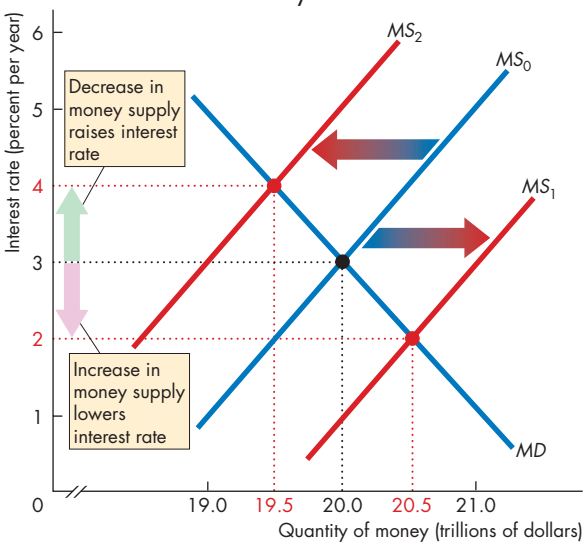
Long-Run Equilibrium You learned in Chapter 7 (on p. 202) that the real interest rate is determined in the loanable funds market at the level that makes the quantity of loanable funds demanded equal the quantity of loanable funds supplied. You also learned in Chapter 7 (on p. 199) that the real interest rate equals the nominal interest rate minus the inflation rate.

FIGURE 8.7 Money Market Equilibrium



Money market equilibrium occurs when the quantity of money demanded equals the quantity supplied. The demand for money curve is *MD* and the supply of money curve, *MS*. The interest rate adjusts to achieve equilibrium, here 3 percent a year.

FIGURE 8.8 A Change in the Supply of Money



An increase in the quantity of money increases the supply of money. The supply of money curve shifts from MS_0 to MS_1 and the interest rate falls. A decrease in the quantity of money decreases the supply of money. The supply of money curve shifts from MS_0 to MS_2 and the interest rate rises.

When the inflation rate equals the expected (or forecasted) inflation rate and when real GDP equals potential GDP, the money market, the loanable funds market, the goods market, and the labor market are in long-run equilibrium—the economy is in long-run equilibrium.

If in long-run equilibrium, the Fed increases the supply of money, eventually a new long-run equilibrium is reached in which nothing real has changed. Real GDP, employment, the real quantity of money, and the real interest rate all return to their original levels. But something does change: the price level. The price level rises by the same percentage as the increase in the quantity of money. Why does this outcome occur in the long run?

The reason is that real GDP is determined by the real forces described in Chapter 6 (pp. 170–172); and the real interest rate is determined by the demand for and supply of (real) loanable funds—the real forces described in Chapter 7 (pp. 200–203). The only variable that is free to respond to a change in the supply of money in the long run is the price level, which changes by the same percentage as the change in the quantity of money.

REVIEW QUIZ

1. What are the main influences on the quantity of money that people and businesses plan to hold?
2. Show the effects of a change in the nominal interest rate and a change in real GDP using the demand for money curve.
3. How is the supply of money determined and how does it depend on the Fed's monetary policy strategy?
4. How is money market equilibrium determined in the short run?
5. How does a change in the supply of money change the interest rate in the short run?
6. What is the effect of a change in the supply of money in the long run?

Let's explore the long-run link between money and the price level a bit further.

The Quantity Theory of Money

In the long run, the price level adjusts to make the quantity of money demanded equal the quantity supplied. A special theory of the price level and inflation—the quantity theory of money—explains this long-run adjustment of the price level.

The **quantity theory of money** is the proposition that in the long run, an increase in the quantity of money brings an equal percentage increase in the price level. To explain the quantity theory of money, we first need to define *the velocity of circulation*.

The **velocity of circulation** is the average number of times a dollar of money is used annually to buy the goods and services that make up GDP. But GDP equals the price level (P) multiplied by *real* GDP (Y). That is,

$$GDP = PY.$$

Call the quantity of money M. The velocity of circulation, V, is determined by the equation

$$V = PY/M.$$

For example, if GDP is $1,000 billion ($PY$ = $1,000 billion) and the quantity of money is $250 billion, then the velocity of circulation is 4.

From the definition of the velocity of circulation, the *equation of exchange* tells us how M, V, P, and Y are connected. This equation is

$$MV = PY.$$

Given the definition of the velocity of circulation, the equation of exchange is always true—it is true by definition. It becomes the quantity theory of money if the quantity of money does not influence the velocity of circulation or real GDP. In this case, the equation of exchange tells us that in the long run, the price level is determined by the quantity of money. That is,

$$P = M(V/Y),$$

where (V/Y) is independent of M. So a change in M brings a proportional change in P.

We can also express the equation of exchange in growth rates,[1] in which form it states that

$$\text{Money growth rate} + \text{Rate of velocity change} = \text{Inflation rate} + \text{Real GDP growth rate}$$

ECONOMICS IN ACTION

Does the Quantity Theory Work?

On average, as predicted by the quantity theory of money, the inflation rate fluctuates in line with fluctuations in the money growth rate minus the real GDP growth rate. Figure 1 shows the relationship between money growth (M2 definition) and inflation in the United States. You can see a clear relationship between the two variables.

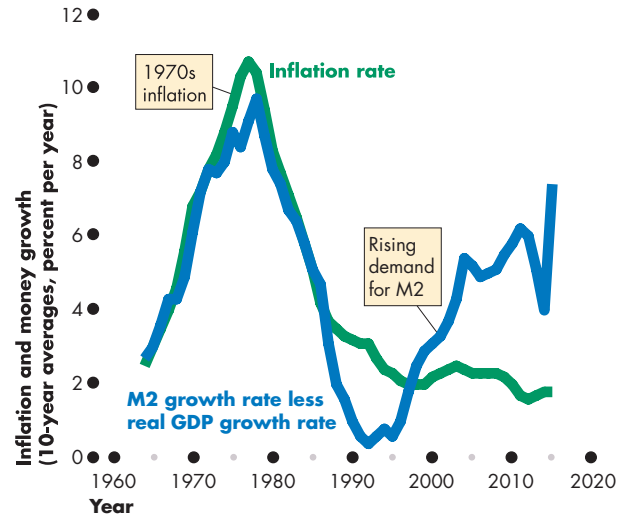


Figure 1 U.S. Money Growth and Inflation

Sources of data: Federal Reserve and Bureau of Labor Statistics.

Solving this equation for the inflation rate gives

$$\text{Inflation rate} = \text{Money growth rate} + \text{Rate of velocity change} - \text{Real GDP growth rate}$$

In the long run, the rate of velocity change is not influenced by the money growth rate. More strongly, in the long run, the rate of velocity change is

[1] To obtain this equation, begin with

$$MV = PY.$$

Then changes in these variables are related by the equation

$$V\Delta M + M\Delta V = Y\Delta P + P\Delta Y.$$

Divide this equation by the equation of exchange to obtain

$$\Delta M/M + \Delta V/V = \Delta P/P + \Delta Y/Y.$$

The term $\Delta M/M$ is the money growth rate, $\Delta V/V$ is the rate of velocity change, $\Delta P/P$ is the inflation rate, and $\Delta Y/Y$ is the real GDP growth rate.

International data also support the quantity theory. Figure 2 shows a scatter diagram of the inflation rate and the money growth rate in 174 countries and Fig. 3 shows the inflation rate and money growth rate in countries with inflation rates below 20 percent a year. You can see a general tendency for money growth and inflation to be correlated, but the quantity theory (the red line) does not predict inflation precisely.

The correlation between money growth and inflation isn't perfect, and the correlation does not tell us that money growth *causes* inflation. Money growth might cause inflation; inflation might cause money growth; or some third variable might cause both inflation and money growth. Other evidence does confirm, though, that causation runs from money growth to inflation.

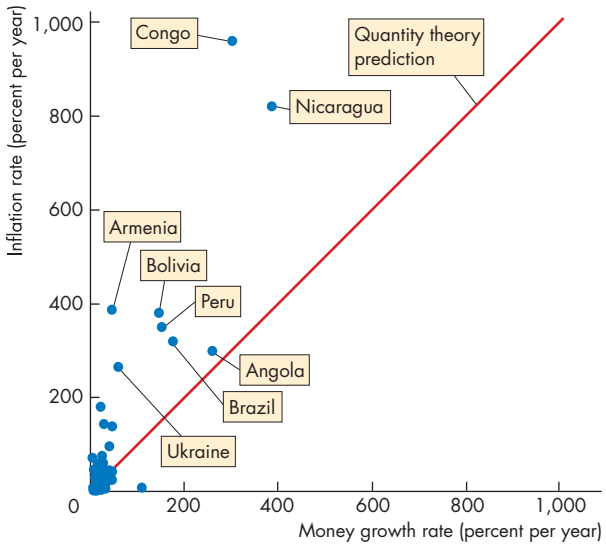


Figure 2 174 Countries: 1980–2016

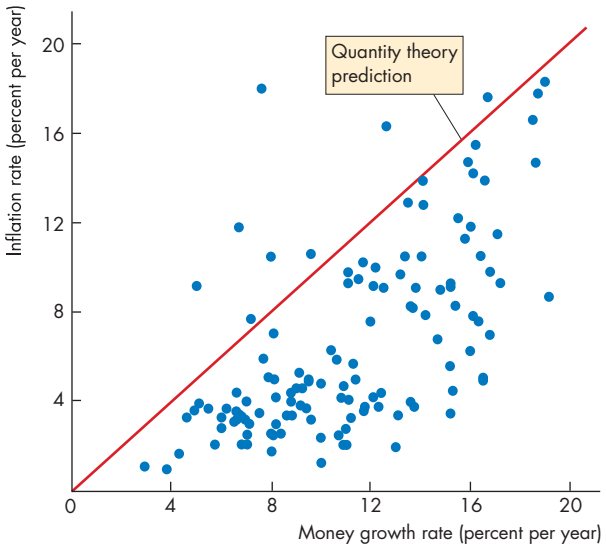


Figure 3 Lower-Inflation Countries: 1980–2016

Sources of data: *International Financial Statistics Yearbook*, 2017; and International Monetary Fund, *World Economic Outlook*, October 2017.

approximately zero. With this assumption, the inflation rate in the long run is determined as

$$\text{Inflation rate} = \text{Money growth rate} - \text{Real GDP growth rate}$$

In the long run, fluctuations in the money growth rate minus the real GDP growth rate bring equal fluctuations in the inflation rate.

Also, in the long run, with the economy at full employment, real GDP equals potential GDP, so the real GDP growth rate equals the potential GDP growth rate. This growth rate might be influenced by inflation, but the influence is most likely small and the quantity theory assumes that it is zero. So the real GDP growth rate is given and doesn't change when the money growth rate changes—inflation is correlated with money growth.

REVIEW QUIZ

1 What is the quantity theory of money?
2 How is the velocity of circulation calculated?
3 What is the equation of exchange?
4 Does the quantity theory correctly predict the effects of money growth on inflation?

You now know what money is, how the banks create it, and how the quantity of money, the nominal interest rate and the price level are determined in the short run and the long run. *Economics in the News* on pp. 234–235 looks at some massive injections of money.

Money and the Interest Rate

Fed Cuts U.S. Interest Rates to Zero as Part of Sweeping Crisis Measures

Financial Times

March 16, 2020

The Federal Reserve cut U.S. interest rates to zero before financial markets opened on Sunday and joined forces with other central banks in a bid to prevent a severe economic downturn caused by the coronavirus pandemic.

After three weeks of chaotic drops in global stock markets and alarming signs of dysfunction in the U.S. government bond market, the Fed stepped in with tools it has not used since the financial crisis.

The sweeping measures underscore the severity of the damage that the coronavirus has already caused to economic growth, and the threat the outbreak poses to financial stability.

The Fed dropped its policy rate by a full percentage point to a range of 0–0.25 percent, a level not seen since 2015. It also announced wide-ranging actions to support financial markets, including an additional $700bn in asset purchases, expanded repurchase operations, dollar swap lines with foreign banks and a credit facility for commercial banks to ease household and business lending.

"The coronavirus outbreak has harmed communities and disrupted economic activity in many countries, including the United States. Global financial conditions have also been significantly affected," read a statement from the Fed's Open Market Committee. "The Federal Reserve is prepared to use its full range of tools.

The moves follow a brutal spell in global markets . . . since the financial crisis of 2008, amid mounting fears the coronavirus pandemic would lead to a global recession.

On Sunday the Fed said it would increase its holdings of Treasury securities by at least $500bn and its holdings of agency mortgage-backed securities by at least $200bn, in order to "support the smooth functioning of markets" for "securities that are central to the flow of credit to households and businesses".

Source: The Financial Times, March 16, 2020.

ESSENCE OF THE STORY

- On Sunday, March 14, 2020, the Federal Reserve announced actions aimed at easing the effects of the coronavirus pandemic on the economy.
- One action was a cut in the federal funds rate to between zero and 0.25 percent.
- Another action was the launch of a new round of quantitative easing, which entails buying $700 billion worth of Treasury securities and mortgage-backed securities.

ECONOMIC ANALYSIS

- Quantitative easing, QE, is an open market operation that increases the size of the Fed's balance sheet.
- The Fed's assets increase by the amount of the securities it purchases, and its liabilities increase by the bank reserves and monetary base it creates to pay for the securities.
- The Fed started QE operations in the Great Recession in 2008 and followed that with two further rounds in 2010 and 2012. These episodes were known as QE1, QE2, and QE3.
- The Covid QE operation that started in March 2020 was on a much larger scale that the three earlier ones.
- Figure 1 shows the Fed's assets since 2006 and the years through 2007 show the Fed in pre-crisis normal times with assets (and matching monetary base liabilities) of around $600 billion ($0.6 trillion).
- QE1 more than doubled the Fed's balance sheet, the combined QE2 and QE3 doubled it again, and the Covid QE doubled it in less than a year. In 2021, the Fed's assets totaled $7.9 trillion, almost 10 times as large as its pre-QE size.
- The composition of the Fed's assets also changed. Before QE, the Fed held only U.S. Treasury securities. With QE, mortgage-backed and other securities became around one-half of the Fed's assets.
- When the Fed buys securities, the monetary base and the quantity of money increase. In normal times, the scale of purchases makes the quantity of money grow at a similar rate to the growth rate of nominal GDP, around 4 percent per year.
- At times when the Fed is conducting QE, the quantity of money grows more rapidly, and Fig. 2 shows just how rapidly the quantity of money grows.
- QE2 and QE3 took the M2 growth rate to 10 percent per year, and Covid QE increased it to 25 percent per year.
- Why don't these unusually fast growth rates that are many times greater than the growth rate of GDP bring inflation?
- The answer is visible in Fig. 2. The velocity of circulation decreased and M2 increased at a similar rate. Why has velocity decreased so much?
- Figure 3 answers this question. Before 2015, the demand curve for M2 was MD_0. A rising and falling 3-month Treasury bill rate brought movements up and down that demand curve, changing the velocity of circulation.
- But between 2015 and 2019, as interest rates increased, the demand for M2 also increased. It is not clear why the demand for M2 increased but it clearly did, and the demand curve shifted rightward to MD_1.
- When interest rates start to rise, the quantity of money demanded will decrease and the velocity of circulation will increase (or decrease more slowly).

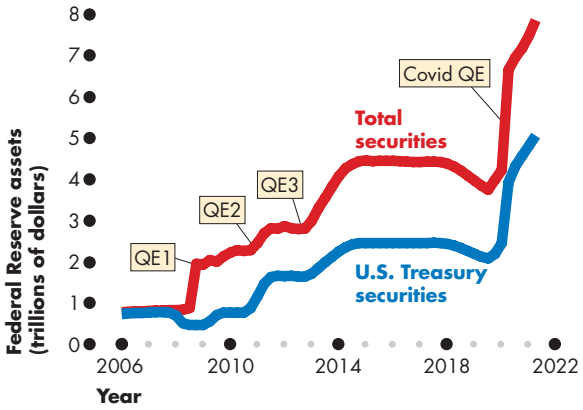


Figure 1 The Federal Reserve's Assets

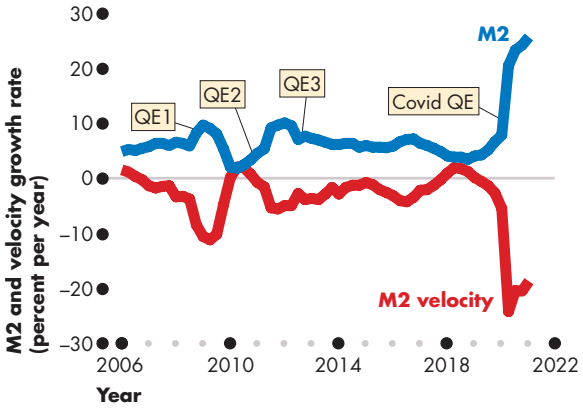


Figure 2 M2 and Its Velocity of Circulation

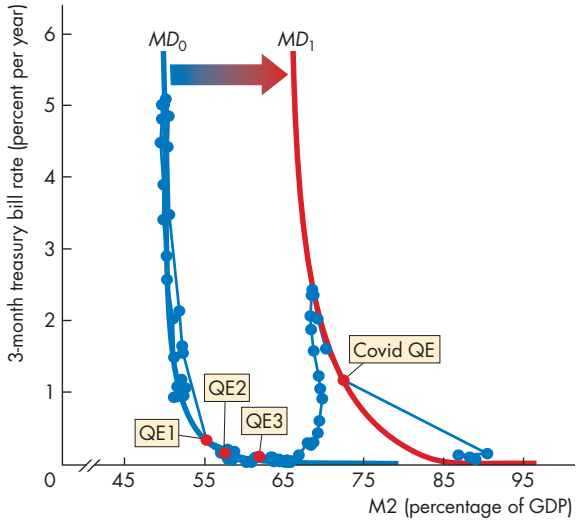


Figure 3 The Demand for M2

MATHEMATICAL NOTE

The Money Multiplier

This note explains the basic math of the money multiplier and shows how the value of the multiplier depends on the banks' desired reserve ratio and the currency drain ratio.

To make the process of money creation concrete, we work through an example for a banking system in which each bank has a desired reserve ratio of 10 percent of deposits and the currency drain ratio is 50 percent of deposits. (Although these ratios are larger than the ones in the U.S. economy, they make the process end more quickly and enable you to see more clearly the principles at work.)

The figure keeps track of the numbers. Before the process begins, all the banks have no unplanned reserves. Then the monetary base increases by $100,000 and one bank has unplanned reserves of this amount.

The bank lends the $100,000 of unplanned reserves. When this loan is made, new money increases by $100,000.

Some of the new money will be held as currency and some as deposits. With a currency drain ratio of 50 percent of deposits, one third of the new money will be held as currency and two-thirds will be held as deposits. That is, $33,333 drains out of the banks as currency and $66,667 remains in the banks as deposits. The increase in the quantity of money of $100,000 equals the increase in deposits plus the increase in currency holdings.

The increased bank deposits of $66,667 generate an increase in desired reserves of 10 percent of that amount, which is $6,667. Actual reserves have increased by the same amount as the increase in deposits: $66,667. So the banks now have unplanned reserves of $60,000.

The process we've just described repeats but begins with unplanned reserves of $60,000. The figure shows the next two rounds. At the end of the process, the quantity of money has increased by a multiple of the increase in the monetary base. In this case, the increase is $250,000, which is 2.5 times the increase in the monetary base.

The sequence in the figure shows the first stages of the process that finally reaches the total shown in the final row of the "money" column.

To calculate what happens at the later stages in the process and the final increase in the quantity of

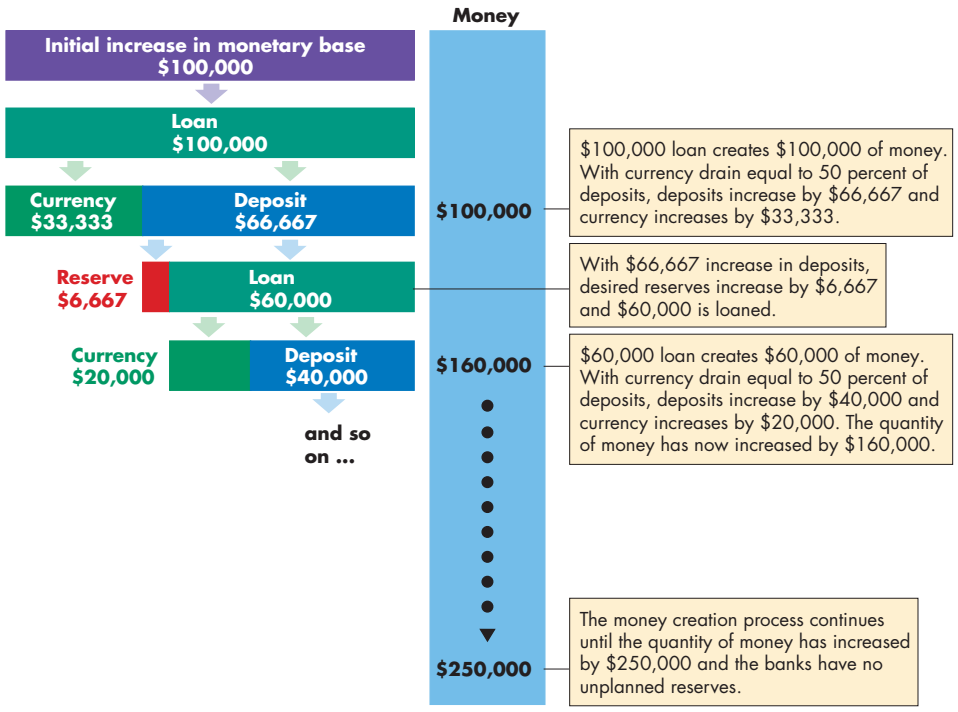


Figure 1 The Money Creation Process

money, look closely at the numbers in the figure. The initial increase in reserves is $100,000 (call it A). At each stage, the loan is 60 percent (0.6) of the previous loan and the quantity of money increases by 0.6 of the previous increase. Call that proportion L ($L = 0.6$). We can write down the complete sequence for the increase in the quantity of money as

$$A + AL + AL^2 + AL^3 + AL^4 + AL^5 + \cdots.$$

Remember, L is a fraction, so at each stage in this sequence, the amount of new loans and new money gets smaller. The total value of loans made and money created at the end of the process is the sum of the sequence, which is[1]

$$A/(1 - L).$$

If we use the numbers from the example, the total increase in the quantity of money is

$$\begin{aligned}
&\$100,000 + 60,000 + 36,000 + \cdots \\
&= \$100,000\ (1 + 0.6 + 0.36 + \cdots) \\
&= \$100,000\ (1 + 0.6 + 0.6^2 + \cdots) \\
&= \$100,000 \times 1/(1 - 0.6) \\
&= \$100,000 \times 1/(0.4) \\
&= \$100,000 \times 2.5 \\
&= \$250,000.
\end{aligned}$$

The magnitude of the money multiplier depends on the desired reserve ratio and the currency drain ratio. Let's explore this relationship

The money multiplier is the ratio of money to the monetary base. Call the money multiplier *mm*, the quantity of money M, and the monetary base MB.

[1]The sequence of values is called a convergent geometric series. To find the sum of a series such as this, begin by calling the sum S. Then write the sum as

$$S = A + AL + AL^2 + AL^3 + AL^4 + AL^5 + \cdots.$$

Multiply by L to get

$$LS = AL + AL^2 + AL^3 + AL^4 + AL^5 + \cdots$$

and then subtract the second equation from the first to get

$$S(1 - L) = A$$

or

$$S = A/(1 - L).$$

Then

$$mm = M/MB.$$

Next recall that money, M, is the sum of deposits and currency. Call deposits D and currency C. Then

$$M = D + C.$$

Finally, recall that the monetary base, MB, is the sum of banks' reserves and currency. Call banks' reserves R. Then

$$MB = R + C.$$

Use the equations for M and MB in the *mm* equation to give:

$$mm = M/MB = (D + C)\ /(R + C).$$

Now divide all the variables on the right side of the equation by D to give:

$$mm = M/MB = (1 + C/D)/(R/D + C/D).$$

In this equation, C/D is the currency drain ratio and R/D is the banks' reserve ratio. If we use the values in the example on the previous page, C/D is 0.5 and R/D is 0.1, and

$$mm = (1 + 0.5)/(0.1 + 0.5).$$

$$= 1.5/0.6 = 2.5.$$

The U.S. Money Multiplier

The money multiplier in the United States can be found by using the formula above along with the values of C/D and R/D in the U.S. economy.

Because we have two definitions of money, M1 and M2, we have two money multipliers. Call the M1 deposits D_1 and call the M_2 deposits D_2.

The numbers for M1 in June 2021are $C/D_1 = 0.13$ and $R/D_1 = 0.222$. So

$$\text{M1 multiplier} = (1 + 0.13)/(0.222 + 0.13) = 3.21.$$

The numbers for M2 in June 2021 are $C/D_2 = 0.12$ and $R/D_2 = 0.208$, so

$$\text{M2 multiplier} = (1 + 0.12)/(0.208 + 0.12) = 3.41.$$

WORKED PROBLEM

In June 2022, individuals and businesses held:

- $50 billion in currency
- $1,000 billion in demand deposits
- $5,000 billion in other liquid deposits
- $500 billion in small-denomination time deposits
- $250 billion in retail money market funds.

In June 2022, depository institutions held:

- $550 billion in reserves at the central bank
- $800 billion in loans to households and businesses

Questions

1. Calculate the M1 and M2 measures of money.
2. Calculate the monetary base.
3. What are the currency drain ratio and the banks' reserve ratio?
4. What are the M1 and M2 money multipliers?
5. How is the money multiplier influenced by the banks' reserve ratio?

Solutions

1. M1 is the quantity of money held by individuals and businesses in the form of currency, demand deposits, and other liquid deposits.

   M1 = $50 billion + $1,000 billion + $5,000 billion = $6,050 billion.

   M2 is M1 plus small-denomination time deposits and retail money market mutual funds.

   M2 = $6,050 billion + $500 billion + $250 billion = $6,800 billion.

Key Point: M1 is a narrow measure of money that consists of currency, demand deposits, and other liquid deposits held by individuals and businesses.
M2 is a broad measure of money that consists of M1 plus small-denomination time deposits and retail money market mutual funds.

2. Monetary base is the sum of reserves held at the central bank plus currency.

   Monetary base = $550 billion + $50 billion
   = $600 billion

Key Point: Monetary base equals bank reserves of depository institutions held at the central bank and currency.

3. Currency drain ratio = Currency ÷ Deposits.

   Currency drain ratio = $50 billion ÷ $6,000 billion
   = 0.0083.

   Reserve ratio = Reserves ÷ Deposits.
   = $550 billion ÷ $6,000 billion
   = 0.09.

Key Point: Currency drain ratio is the ratio of currency to deposits held by individuals and businesses. Reserve ratio is the ratio of reserves to deposits.

4. M1 money multiplier = M1 ÷ Monetary base.

   M1 money multiplier = $6,050 billion ÷ $600 billion = 10.08.

   M2 money multiplier = M2 ÷ Monetary base.

   M2 money multiplier = $6,800 billion ÷ $600 billion = 11.33.

Key Point: The money multiplier is the number by which the monetary base is multiplied to equal the quantity of money.

5. Money M is the sum of deposits D and currency C held by individuals and businesses.

   Monetary base MB is the sum of reserves R and currency C.

   Money multiplier = $(C + D) \div (R + C)$

   An increase in the banks' reserves R with no change in D increases the banks' reserve ratio and decreases the money multiplier.

   Dividing all terms by D gives

   Money multiplier = $(1 + C/D) \div (R/D + C/D)$

   As the blanks' reserve ratio R/D rises, the money multiplier decreases.

Key Point: The money multiplier equals $(1 + C/D) \div (R/D + C/D)$. where C/D is the currency drain ratio and R/D is the banks' reserve ratio. An increase in the banks' reserve ratio decreases the money multiplier.

SUMMARY

Key Points

What Is Money? (pp. 214–216)

- Money is the means of payment. It functions as a medium of exchange, a unit of account, and a store of value.
- Today, money consists of currency and deposits held by individuals and businesses.

Depository Institutions (pp. 217–220)

- Commercial banks, S&Ls, savings banks, credit unions, and money market mutual funds are depository institutions whose deposits are money.
- Depository institutions provide four main economic services: They create liquidity, pool risks, lower the cost of borrowing, and lower the cost of monitoring borrowers.

The Federal Reserve System (pp. 221–224)

- The Federal Reserve System is the central bank of the United States.
- The Fed influences the quantity of money by conducting open market operations.
- When the Fed buys securities in an open market operation, the monetary base increases; when the Fed sells securities, the monetary base decreases.

How Banks Create Money (pp. 224–227)

- Banks create money by making loans.
- The total quantity of money that can be created depends on the monetary base, the desired reserve ratio, and the currency drain ratio.

The Money Market (pp. 228–231)

- The quantity of money demanded is the amount of money that people plan to hold.
- The quantity of money supplied is the amount of money that the Fed and banks plan to create on a given day.
- The nominal interest rate makes the quantity of money demanded equal the quantity supplied.
- The quantity of money demanded depends on the nominal interest rate, real GDP, and financial technology.
- The quantity of money supplied depends on the Fed's monetary policy strategy.
- The Fed's monetary policy targets either the monetary base, the nominal interest rate, or the quantity of money.
- When the demand for money increases, the Fed conducts an open market operation to hits its target.

The Quantity Theory of Money (pp. 232–233)

- The quantity theory of money is the proposition that money growth and inflation move up and down together in the long run.

Key Terms

Central bank, 221
Currency, 215
Currency drain ratio, 225
Demand for money, 228
Depository institution, 217
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Federal funds rate, 217
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Velocity of circulation, 232

PROBLEMS AND APPLICATIONS

What Is Money?

1. Money in the United States today includes which of the following items? Cash in Citibank's cash machines; U.S. dollar bills in your wallet; your Visa card; your loan to pay your college tuition.
2. In May 2020, currency was $1,824 billion; demand deposits were $2,126 billion; other liquid deposits were $12,234 billion; small-denomination time deposits were $466 billion; and retail money market funds were $1,142 billion. Calculate M1 and M2 in May 2020.

Depository Institutions

3. **The Fed Will Not Extend a Pandemic-Crisis Rule**

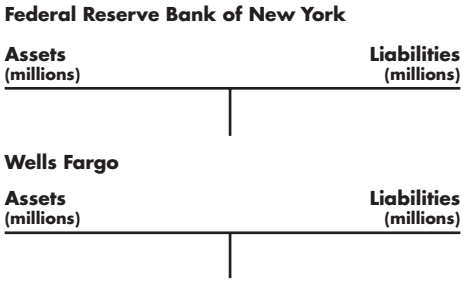
   The Federal Reserve has decided against extending a pandemic-era rule that relaxed the amount of capital banks had to hold.

   Source: cnbc.com, March 19, 2021

   What is the "capital" in the news clip? How did the requirement to hold less capital help the U.S. economy during the pandemic?

The Federal Reserve System

4. The FOMC sells $20 million of securities to Wells Fargo. Enter the transactions that take place to show the changes in the following balance sheets.



How Banks Create Money

5. In the economy of Nocoin, bank deposits are $300 billion. Bank reserves are $15 billion, of which two-thirds are deposits with the central bank. Households and firms hold $30 billion in bank notes. There are no coins. Calculate
   a. The monetary base and quantity of money.
   b. The banks' desired reserve ratio and the currency drain ratio (as percentages).
6. **China PBOC Lowers Banks' Reserve Requirements to Encourage Lending**

   The People's Bank of China will cut the required reserve ratio by 0.5 percent to 8.9 percent.

   Source: marketwatch.com, May 21, 2021

   Explain how the money multiplier will change.

The Money Market

7. The spreadsheet provides data about the demand for money in Minland. Columns A and B show the demand for money schedule when real GDP (Y_0) is $10 billion and Columns A and C show the demand for money schedule when real GDP (Y_1) is $20 billion. The quantity of money is $3 billion.

	A	B	C
1	r	Y_0	Y_1
2	7	1.0	1.5
3	6	1.5	2.0
4	5	2.0	2.5
5	4	2.5	3.0
6	3	3.0	3.5
7	2	3.5	4.0
8	1	4.0	4.5

   What is the interest rate when real GDP is $10 billion? Explain what happens in the money market in the short run if real GDP increases to $20 billion.

The Quantity Theory of Money

8. In year 1, an economy is at full employment and real GDP is £350 million, the GDP deflator is 220 (price level is 2.2) and the quantity of money is £50 million. In year 2, the quantity of money is halved. If the quantity theory of money holds, calculate the velocity of circulation in year 1 and the quantity of money, the GDP deflator, real GDP, and the velocity of circulation in year 2.

Mathematical Note

9. In Problem 5, the banks have no unplanned reserves. Suppose that the central bank in Nocoin increases bank reserves by $0.5 billion.
   a. Explain the change in the quantity of money and why it is not equal to the change in the monetary base.
   b. Calculate the money multiplier.

ADDITIONAL PROBLEMS AND APPLICATIONS

What Is Money?

10. Kristin deposits $5,000 in cash into her savings account at the First National Bank. What is the immediate change in M1 and M2?
11. Rapid inflation in Brazil in the early 1990s caused the cruzeiro to lose its ability to function as money. Which of the following commodities would most likely have taken the place of the cruzeiro in the Brazilian economy? Explain why.
    a. Tractor parts
    b. Packs of cigarettes
    c. Loaves of bread
    d. Impressionist paintings
    e. Baseball trading cards
12. **Trading Up: One Woman's Quest to Swap a Hairpin**

    Demi Skipper is going to get a house by trading for it. She traded a hairpin for a pair of earrings, the earrings for four margarita glasses, and the glasses for a vacuum cleaner. Now she is looking to trade a Chipotle celebrity card that gives unlimited free Chipotle food for a year.

    Source: theguardian.com, May 12, 2021

    Is barter a means of payment? Is barter just as efficient as money? Explain?

Depository Institutions

Use the following news clip to work Problems 13 and 14.

U.S. Bank Profits Rose 29%

U.S. bank profits rose during the first quarter of 2021, up $58.3 billion from a year ago. Loan balances decreased and deposits increased. Total assets increased. No banks failed during the first quarter of 2021. The number of institutions on the problem bank list of the FDIC (Federal Deposit insurance Corporation) decreased by one to 55 from the previous quarter.

Source: reuters.com, May 26, 2021

13. Explain the role of loans in the balancing act that a bank performs in the pursuit of profit.
14. Explain how the pursuit of profit can sometimes lead to bank failures.

The Federal Reserve System

15. Explain the distinction between a central bank and a commercial bank.
16. If the Fed makes an open market sale of $1 million of securities to a bank, what initial changes occur in the economy?
17. Set out the transactions that the Fed undertakes to increase the quantity of money.
18. Describe the Fed's assets and liabilities. What is the monetary base and how does it relate to the Fed's balance sheet?
19. **Fed's Mary Daly Says Tapering of Bond Purchases May Start This Year**

    San Francisco Federal Reserve President Mary Daly says that with a strong recovery, the Fed will slow its asset purchases. The Fed has previously resisted calls to pull back on quantitative easing.

    Source: cnbc.com, July 13, 2021

    a. What actions would the Fed pursue to "pull back on quantitative easing"?
    b. How would the monetary base change, and how would bank reserves change?

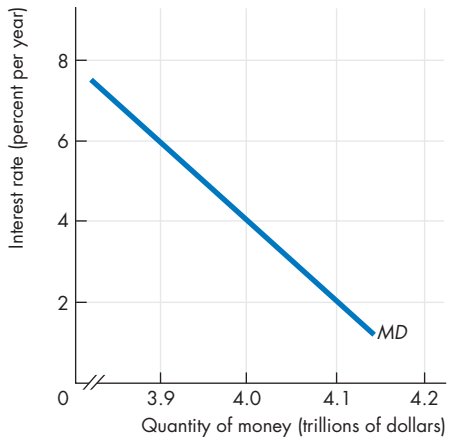
How Banks Create Money

20. Banks in New Transylvania have a desired reserve ratio of 10 percent of deposits and no unplanned reserves. The currency drain ratio is 50 percent of deposits. Now suppose that the central bank increases the monetary base by $1,200 billion.
    a. How much do the banks lend in the first round of the money creation process?
    b. How much of the initial amount lent flows back to the banking system as new deposits?
    c. How much of the initial amount lent does not return to the banks but is held as currency?
    d. Why does a second round of lending occur?

The Money Market

21. Explain the change in the nominal interest rate in the short run if
    a. Real GDP increases.
    b. The money supply increases.
    c. The price level rises.

22. The figure shows the demand for money curve.



If the quantity of money decreases from $4 trillion to $3.9 trillion, explain how the price of a bond will change.

23. Use the data in Problem 7 to work this problem. The interest rate is 4 percent a year. Suppose that real GDP decreases from $20 billion to $10 billion and the quantity of money remains unchanged. Do people buy bonds or sell bonds? Explain how the interest rate changes.

The Quantity Theory of Money

24. The table provides some data for the United States in the first decade following the Civil War.

	1869	1879
Quantity of money	$1.3 billion	$1.7 billion
Real GDP (1929 dollars)	$7.4 billion	*Z*
Price level	*X*	54
Velocity of circulation	4.50	4.61

Source of data: Milton Friedman and Anna J. Schwartz, *A Monetary History of the United States 1867–1960*

a. Calculate the value of *X* in 1869.

b. Calculate the value of *Z* in 1879.

c. Are the data consistent with the quantity theory of money? Explain your answer.

25. When he was the U.S. Federal Reserve chairman, Ben Bernanke said that financial innovation and the spread of U.S. currency throughout the world had broken down the relationships between money, inflation, and output growth, which made monetary aggregates less useful gauges for policy makers. Some other central banks use monetary aggregates as a guide to policy decisions, but Bernanke believed reliance on monetary aggregates would be unwise. He said that there are differences between the United States and Europe in terms of the stability of money demand.

a. Explain how the debate surrounding the quantity theory of money could make "monetary gauges a less useful tool for policy makers."

b. What do Ben Bernanke's statements reveal about his view on the accuracy of the quantity theory of money?

Economics in the News

26. After you have studied *Economics in the News* on pp. 234–235, answer the following questions.

a. What changes in the Fed's assets occurred between 2006 and 2021?

b. How did M2 and its velocity of circulation change between 2006 and 2021?

c. How does the nominal interest rate influence the velocity of circulation and why?

Mathematical Note

27. In the United Kingdom, the currency drain ratio is 38 percent of deposits and the reserve ratio is 2 percent of deposits. In Australia, the quantity of money is $150 billion, the currency drain ratio is 33 percent of deposits, and the reserve ratio is 8 percent of deposits.

a. Calculate the U.K. money multiplier.

b. Calculate the monetary base in Australia.

9 THE EXCHANGE RATE AND THE BALANCE OF PAYMENTS

After studying this chapter, you will be able to:

- Explain how the exchange rate is determined
- Explain interest rate parity and purchasing power parity
- Describe the alternative exchange rate policies and explain their effects
- Describe the balance of payments accounts and explain what causes an international deficit

The dollar ($), the euro (€), and the yen (¥) are three of the world's monies and most international payments are made using one of them. What determines the value of the dollar in terms of other kinds of money?

For forty years, the United States has had a deficit in its international trade and foreign entrepreneurs have roamed the country with giant, virtual shopping carts buying U.S. businesses. Why?

In this chapter, you're going to discover the answers to these questions. And in *Economics in the News* at the end of the chapter, we'll look at the way in which a country can manipulate the value of its currency on the foreign exchange market.

The Foreign Exchange Market

When Walmart imports smart TVs from Japan, it pays for them using Japanese yen. And when Japan Airlines buys an airplane from Boeing, it pays using U.S. dollars. When you take a European vacation, you pay for the vacation with E.U. euros. Whenever people buy things from another country, they use the currency of that country to make the transaction. It doesn't make any difference what the item is that is being traded internationally. It might be a smart TV, an airplane, an international vacation, insurance or banking services, real estate, the stocks and bonds of a government or corporation, or even an entire business.

Foreign money is just like U.S. money. It consists of notes and coins issued by a central bank and mint and deposits in banks and other depository institutions. When we described U.S. money in Chapter 8, we distinguished between currency (notes and coins) and deposits. But when we talk about foreign money, we refer to it as foreign currency. **Foreign currency** is the money of other countries regardless of whether that money is in the form of notes, coins, or bank deposits.

We buy these foreign currencies and foreigners buy U.S. dollars in the foreign exchange market.

Trading Currencies

The currency of one country is exchanged for the currency of another in the **foreign exchange market**. The foreign exchange market is not a place like a downtown flea market or a fruit and vegetable market. The foreign exchange market is made up of thousands of people—importers and exporters, banks, international investors and speculators, international travelers, and specialist traders called *foreign exchange brokers*.

The foreign exchange market opens on Monday morning in Sydney, Australia, and Hong Kong, which is still Sunday evening in New York. As the day advances, markets open in Singapore, Tokyo, Bahrain, Frankfurt, London, New York, Chicago, and San Francisco. As the West Coast markets close, Sydney is already open for the next day of business. The sun doesn't set in the foreign exchange market. Dealers around the world are in continual Internet contact, and on a typical day in 2021, $6.6 trillion (of all currencies) were traded in the foreign exchange market—that's more than $76 million every second.

Exchange Rates

An **exchange rate** is the price at which one currency exchanges for another currency in the foreign exchange market. For example, on July 22, 2021, $1 would buy 110 Japanese yen or 85 euro cents. So the exchange rate was 110 yen per dollar or, equivalently, 85 euro cents per dollar.

The exchange rate fluctuates. Sometimes it rises and sometimes it falls. A rise in the exchange rate is called an *appreciation* of the dollar, and a fall in the exchange rate is called a *depreciation* of the dollar. For example, when the exchange rate rises from 109 yen to 110 yen per dollar, the dollar appreciates against the yen; when the exchange rate falls from 110 yen to 109 yen per dollar, the dollar depreciates against the yen.

Economics in Action on p. 245 shows the fluctuations of the U.S. dollar against three currencies from 2000 to 2021.

Questions About the U.S. Dollar Exchange Rate

The performance of the U.S. dollar in the foreign exchange market raises a number of questions that we address in this chapter.

First, how is the exchange rate determined? Why does the U.S. dollar sometimes appreciate and at other times depreciate?

Second, how do the Fed and other central banks operate in the foreign exchange market? In particular, how was the exchange rate between the U.S. dollar and the Chinese yuan fixed and why did it remain constant for many years?

Third, how do exchange rate fluctuations influence our international trade and international payments? In particular, could we eliminate, or at least decrease, our international deficit by changing the exchange rate? Would an appreciation of the yuan change the balance of trade and payments between the United States and China?

We begin by learning how trading in the foreign exchange market determines the exchange rate.

An Exchange Rate Is a Price

An exchange rate is a price—the price of one currency in terms of another. And like all prices, an exchange rate is determined in a market—the *foreign exchange market*.

The U.S. dollar trades in the foreign exchange market and is supplied and demanded by tens of

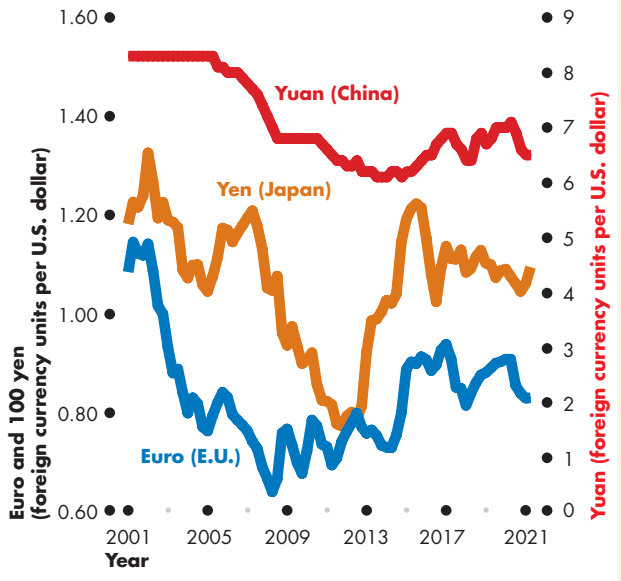
ECONOMICS IN ACTION

The U.S. Dollar: More Down Than Up

The figure shows the U.S. dollar exchange rate against the three currencies that feature prominently in U.S. imports between 2000 and 2021.

Against the Chinese yuan, the dollar was constant before 2005. It then depreciated until 2014, when it started to trend upward. Against the Japanese yen, the dollar appreciated before 2002, depreciated strongly through 2012, appreciated equally strongly through 2015, and then depreciated. Against the E.U. euro, the dollar depreciated from 2002 through 2008 and then trended upward.

Notice the high-frequency fluctuations (rapid brief up and down movements) of the dollar against the euro and the yen compared to the smooth changes against the yuan. Think about why that might be, and we'll check your answer later in this chapter.



The U.S. Dollar Against Three Currencies

Source of data: Pacific Exchange Rate Service.

thousands of traders every hour of every business day. Because it has many traders and no restrictions on who may trade, the foreign exchange market is a *competitive market*.

In a competitive market, demand and supply determine the price. So to understand the forces that determine the exchange rate, we need to study the factors that influence demand and supply in the foreign exchange market. But there is a feature of the foreign exchange market that makes it special.

The Demand for One Money Is the Supply of Another Money

When people who are holding the money of some other country want to exchange it for U.S. dollars, they demand U.S. dollars and supply that other country's money. And when people who are holding U.S. dollars want to exchange them for the money of some other country, they supply U.S. dollars and demand that other country's money.

So the factors that influence the demand for U.S. dollars also influence the supply of E.U. euros, or Japanese yen, or Chinese yuan. And the factors that influence the demand for that other country's money also influence the supply of U.S. dollars.

We'll first look at the influences on the demand for U.S. dollars in the foreign exchange market.

Demand in the Foreign Exchange Market

People buy U.S. dollars in the foreign exchange market so that they can buy U.S.-produced goods and services—U.S. exports. They also buy U.S. dollars so that they can buy U.S. assets such as bonds, stocks, businesses, and real estate or so that they can keep part of their money holding in a U.S. dollar bank account.

The quantity of U.S. dollars demanded in the foreign exchange market is the amount that traders plan to buy during a given time period at a given exchange rate. This quantity depends on many factors, but the main ones are

1. The exchange rate
2. World demand for U.S. exports
3. Interest rates in the United States and other countries
4. The expected future exchange rate

We look first at the relationship between the quantity of U.S. dollars demanded in the foreign exchange market and the exchange rate when the other three influences remain the same.

The Law of Demand for Foreign Exchange The law of demand applies to U.S. dollars just as it does to anything else that people value. Other things remaining the same, the higher the exchange rate, the smaller is the quantity of U.S. dollars demanded in the foreign exchange market. For example, if the market price of the U.S. dollar rises from 100 yen to 120

yen but nothing else changes, the quantity of U.S. dollars that people plan to buy in the foreign exchange market decreases. The exchange rate influences the quantity of U.S. dollars demanded for two reasons:

- Exports effect
- Expected profit effect

Exports Effect The larger the value of U.S. exports, the larger is the quantity of U.S. dollars demanded by the buyers of U.S. exports in the foreign exchange market. But the value of U.S. exports depends on the prices of U.S.-produced goods and services *expressed in the currency of the foreign buyer*. And these prices depend on the exchange rate. The lower the exchange rate, other things remaining the same, the lower are the prices of U.S.-produced goods and services to foreigners and the greater is the volume of U.S. exports. So if the exchange rate falls (and other influences remain the same), the quantity of U.S. dollars demanded in the foreign exchange market increases.

To see the exports effect at work, think about orders for Boeing's new 777X. If the price of this airplane is $100 million and the exchange rate is 90 euro cents per U.S. dollar, its price to KLM, a European airline, is €90 million. KLM decides that this price is too high, so it doesn't buy a 777X. If the exchange rate falls to 80 euro cents per U.S. dollar and other things remain the same, the price of a 777X falls to €80 million, so KLM decides to buy one and enters the foreign exchange market to buy 100 million U.S. dollars.

Expected Profit Effect The larger the expected profit from holding U.S. dollars, the greater is the quantity of U.S. dollars demanded in the foreign exchange market. But expected profit depends on the exchange rate. For a given expected future exchange rate, the lower the exchange rate today, the larger is the expected profit from buying U.S. dollars today and holding them, so the greater is the quantity of U.S. dollars demanded in the foreign exchange market today. Let's look at an example.

Suppose that Mitsubishi Bank, a Japanese bank, expects the exchange rate to be 120 yen per U.S. dollar at the end of the year. If today's exchange rate is also 120 yen per U.S. dollar, Mitsubishi Bank expects no profit from buying U.S. dollars and holding them until the end of the year. But if today's exchange rate is 100 yen per U.S. dollar and Mitsubishi Bank buys U.S. dollars, it expects to sell those dollars at the end of the year for 120 yen per dollar and make a profit of 20 yen on each U.S. dollar bought.

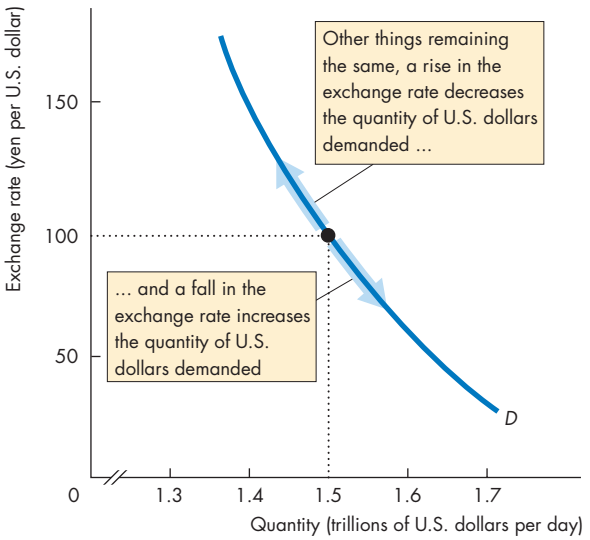
The lower the exchange rate today, other things remaining the same, the greater is the expected profit from holding U.S. dollars, so the greater is the quantity of U.S. dollars demanded in the foreign exchange market today.

Demand Curve for U.S. Dollars

Figure 9.1 shows the demand curve for U.S. dollars in the foreign exchange market. A change in the exchange rate, other things remaining the same, brings a change in the quantity of U.S. dollars demanded and a movement along the demand curve. The arrows show such movements.

We will look at the factors that *change* demand in the next section of this chapter. Before doing that, let's see what determines the supply of U.S. dollars.

FIGURE 9.1 The Demand for U.S. Dollars



The quantity of U.S. dollars demanded depends on the exchange rate. Other things remaining the same, if the exchange rate rises, the quantity of U.S. dollars demanded decreases and there is a movement up along the demand curve for U.S. dollars. If the exchange rate falls, the quantity of U.S. dollars demanded increases and there is a movement down along the demand curve for U.S. dollars.

Supply in the Foreign Exchange Market

People and businesses sell U.S. dollars and buy other currencies so that they can buy foreign-produced goods and services—U.S. imports. They also sell U.S. dollars and buy foreign currencies so that they can buy foreign assets such as bonds, stocks, businesses, and real estate or so that they can hold part of their money in bank deposits denominated in a foreign currency.

The quantity of U.S. dollars supplied in the foreign exchange market is the amount that traders plan to sell during a given time period at a given exchange rate. This quantity depends on many factors, but the main ones are

1. The exchange rate
2. U.S. demand for imports
3. Interest rates in the United States and other countries
4. The expected future exchange rate

Let's look at the law of supply in the foreign exchange market—the relationship between the quantity of U.S. dollars supplied in the foreign exchange market and the exchange rate when the other three influences remain the same.

The Law of Supply of Foreign Exchange Other things remaining the same, the higher the exchange rate, the greater is the quantity of U.S. dollars supplied in the foreign exchange market. For example, if the exchange rate rises from 100 yen to 120 yen per U.S. dollar and other things remain the same, the quantity of U.S. dollars that people plan to sell in the foreign exchange market increases.

The exchange rate influences the quantity of dollars supplied for two reasons:

- Imports effect
- Expected profit effect

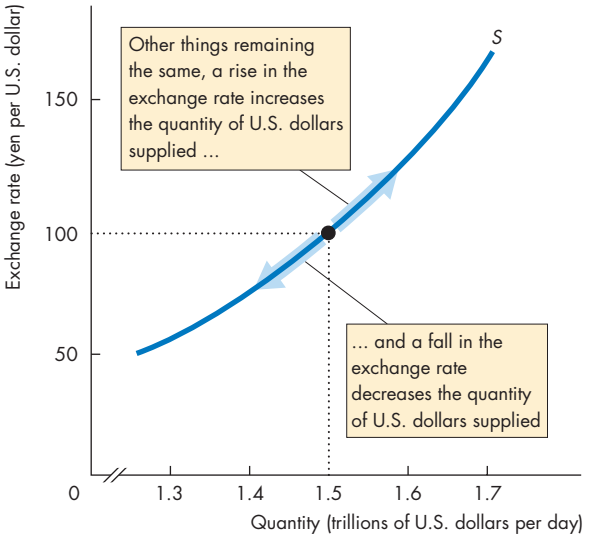
Imports Effect The larger the value of U.S. imports, the larger is the quantity of U.S. dollars supplied in the foreign exchange market. But the value of U.S. imports depends on the prices of foreign-produced goods and services *expressed in U.S. dollars*. These prices depend on the exchange rate. The higher the exchange rate, other things remaining the same, the lower are the prices of foreign-produced goods and services to Americans and the greater is the volume of U.S. imports. So if the exchange rate rises (and other influences remain the same), the quantity of U.S. dollars supplied in the foreign exchange market increases.

Expected Profit Effect This effect works just like that on the demand for the U.S. dollar but in the opposite direction. The higher the exchange rate today, other things remaining the same, the larger is the expected profit from selling U.S. dollars today and holding foreign currencies, so the greater is the quantity of U.S. dollars supplied in the foreign exchange market.

Supply Curve for U.S. Dollars

Figure 9.2 shows the supply curve of U.S. dollars in the foreign exchange market. A change in the exchange rate, other things remaining the same, brings a change in the quantity of U.S. dollars supplied and a movement along the supply curve. The arrows show such movements.

FIGURE 9.2 The Supply of U.S. Dollars



The quantity of U.S. dollars supplied depends on the exchange rate. Other things remaining the same, if the exchange rate rises, the quantity of U.S. dollars supplied increases and there is a movement up along the supply curve of U.S. dollars. If the exchange rate falls, the quantity of U.S. dollars supplied decreases and there is a movement down along the supply curve of U.S. dollars.

Market Equilibrium

Equilibrium in the foreign exchange market depends on how the Federal Reserve and other central banks operate. Here, we will study equilibrium when central banks keep out of the foreign exchange market and examine the effects of alternative central bank actions later (on pp. 255–257).

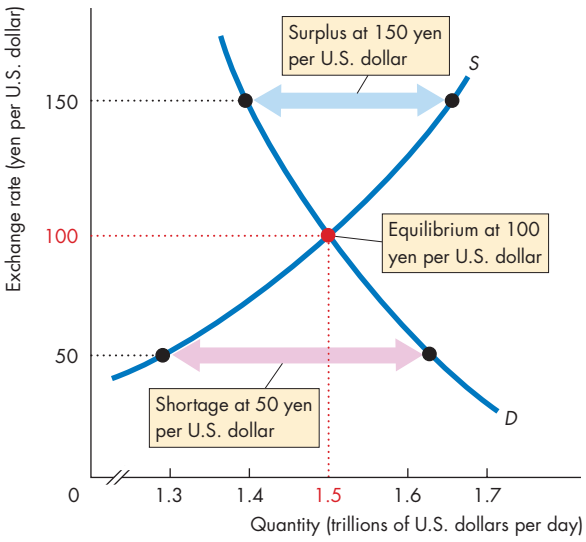
Figure 9.3 shows the demand curve for U.S. dollars, *D*, from Fig. 9.1, the supply curve of U.S. dollars, *S*, from Fig. 9.2, and the equilibrium exchange rate. The exchange rate acts as a regulator of the quantities demanded and supplied. If the exchange rate is too high, there is a surplus of dollars. For example, in Fig. 9.3, if the exchange rate is 150 yen per U.S. dollar, there is a surplus of U.S. dollars. If the exchange rate is too low, there is a shortage of dollars. For example, if the exchange rate is 50 yen per U.S. dollar, there is a shortage of U.S. dollars.

At the equilibrium exchange rate, there is neither a shortage nor a surplus—the quantity supplied equals the quantity demanded. In Fig. 9.3, the equilibrium exchange rate is 100 yen per U.S. dollar. At this exchange rate, the quantity demanded and the quantity supplied are each $1.5 trillion a day.

The foreign exchange market is constantly pulled to its equilibrium by foreign exchange traders who are constantly looking for the best price they can get. If they are selling, they want the highest price available. If they are buying, they want the lowest price available. Information flows from trader to trader through a worldwide computer network, and the price adjusts minute by minute to keep the exchange rate at its equilibrium.

But as you've seen (in *Economics in Action* on p. 245), the U.S. dollar fluctuates a lot against other currencies. Changes in the demand for U.S. dollars or the supply of U.S. dollars bring these exchange rate fluctuations. We'll now look at the factors that make demand and supply change, starting with the demand side of the market.

FIGURE 9.3 Equilibrium Exchange Rate



The demand curve for U.S. dollars is *D*, and the supply curve of U.S. dollars is *S*. If the exchange rate is 150 yen per U.S. dollar, there is a surplus of U.S. dollars and the exchange rate falls. If the exchange rate is 50 yen per U.S. dollar, there is a shortage of U.S. dollars and the exchange rate rises. If the exchange rate is 100 yen per U.S. dollar, there is neither a shortage nor a surplus of U.S. dollars and the exchange rate remains constant. The foreign exchange market is in equilibrium.

Changes in the Demand for U.S. Dollars

The demand for U.S. dollars in the foreign exchange market changes when there is a change in

- World demand for U.S. exports
- U.S. interest rate relative to the foreign interest rate
- The expected future exchange rate

World Demand for U.S. Exports An increase in world demand for U.S. exports increases the demand for U.S. dollars. To see this effect, think about Boeing's airplane sales. An increase in demand for air travel in Australia sends that country's airlines on a global shopping spree. They decide that the 777X is the ideal product, so they order 50 airplanes from Boeing. The demand for U.S. dollars now increases.

U.S. Interest Rate Relative to the Foreign Interest Rate People and businesses buy financial assets to make a return. The higher the interest rate that people can make on U.S. assets compared with foreign assets, the more U.S. assets they buy.

What matters is not the *level* of the U.S. interest rate, but the U.S. interest rate relatative to the foreign interest rate—the U.S. interest rate minus the foreign

interest rate, which is called the **U.S. interest rate differential**. If the U.S. interest rate rises and the foreign interest rate remains constant, the U.S. interest rate differential increases. The larger the U.S. interest rate differential, the greater is the demand for U.S. assets and the greater is the demand for U.S. dollars in the foreign exchange market.

The Expected Future Exchange Rate For a given current exchange rate, other things remaining the same, a rise in the expected future exchange rate increases the profit that people expect to make by holding U.S. dollars and the demand for U.S. dollars increases today.

Figure 9.4 summarizes the influences on the demand for U.S. dollars. An increase in the demand for U.S. exports, a rise in the U.S. interest rate differential, or a rise in the expected future exchange rate increases the demand for U.S. dollars today and shifts the demand curve rightward from D_0 to D_1. A decrease in the demand for U.S. exports, a fall in the U.S. interest rate differential, or a fall in the expected future exchange rate decreases the demand for U.S. dollars today and shifts the demand curve leftward from D_0 to D_2.

Changes in the Supply of U.S. Dollars

The supply of U.S. dollars in the foreign exchange market changes when there is a change in

- U.S. demand for imports
- U.S. interest rate relative to the foreign interest rate
- The expected future exchange rate

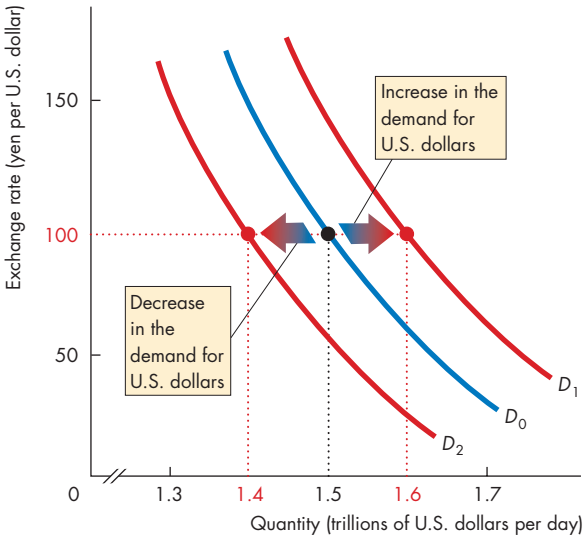
U.S. Demand for Imports An increase in the U.S. demand for imports increases the supply of U.S. dollars in the foreign exchange market. To see why, think about Walmart's purchase of smart TVs. An increase in the demand for smart TVs sends Walmart out on a global shopping spree. Walmart decides that Sony smart TVs produced in Japan are the best buy, so Walmart increases its purchases of these TVs. The supply of U.S. dollars now increases as Walmart goes to the foreign exchange market for Japanese yen to pay Sony.

U.S. Interest Rate Relative to the Foreign Interest Rate The effect of the U.S. interest rate differential on the supply of U.S. dollars is the opposite of its effect on the demand for U.S. dollars. The larger the U.S. interest rate differential, the *smaller* is the supply of U.S. dollars in the foreign exchange market.

With a higher U.S. interest rate differential, people decide to keep more of their funds in U.S. dollar assets and less in foreign currency assets. They buy a smaller quantity of foreign currency and sell a smaller quantity of dollars in the foreign exchange market.

So, a rise in the U.S. interest rate, other things remaining the same, decreases the supply of U.S. dollars in the foreign exchange market.

FIGURE 9.4 Changes in the Demand for U.S. Dollars



A change in any influence on the quantity of U.S. dollars that people plan to buy, other than the exchange rate, brings a change in the demand for U.S. dollars.

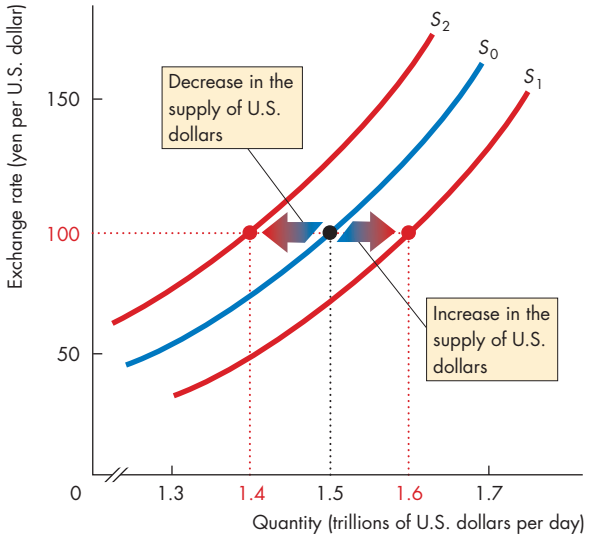
The demand for U.S. dollars

Increases if:	*Decreases if:*
■ World demand for U.S. exports increases	■ World demand for U.S. exports decreases
■ The U.S. interest rate differential rises	■ The U.S. interest rate differential falls
■ The expected future exchange rate rises	■ The expected future exchange rate falls

The Expected Future Exchange Rate For a given current exchange rate, other things remaining the same, a fall in the expected future exchange rate decreases the profit that can be made by holding U.S. dollars and decreases the quantity of U.S. dollars that people and businesses want to hold. To reduce their holdings of U.S. dollar assets, people and businesses must sell U.S. dollars. When they do so, the supply of U.S. dollars in the foreign exchange market increases.

Figure 9.5 summarizes the influences on the supply of U.S. dollars. If the supply of U.S. dollars increases, the supply curve shifts rightward from S_0 to S_1. And if the supply of U.S. dollars decreases, the supply curve shifts leftward from S_0 to S_2.

FIGURE 9.5 Changes in the Supply of U.S. Dollars



A change in any influence on the quantity of U.S. dollars that people plan to sell, other than the exchange rate, brings a change in the supply of dollars.

The supply of U.S. dollars

Increases if:	*Decreases if:*
■ U.S. import demand increases	■ U.S. import demand decreases
■ The U.S. interest rate differential falls	■ The U.S. interest rate differential rises
■ The expected future exchange rate falls	■ The expected future exchange rate rises

Changes in the Exchange Rate

The exchange rate changes when either the demand for dollars or the supply of dollars changes.

If the demand for U.S. dollars increases and the supply does not change, the exchange rate rises. If the demand for U.S. dollars decreases and the supply does not change, the exchange rate falls.

Similarly, if the supply of U.S. dollars decreases and the demand does not change, the exchange rate rises. If the supply of U.S. dollars increases and the demand does not change, the exchange rate falls.

These predictions are exactly the same as those for any other market. Two episodes in the life of the U.S. dollar (see p. 251) illustrate these predictions.

Two of the influences on demand and supply—the U.S. interest rate differential and the expected future exchange rate—change both sides of the foreign exchange market simultaneously. A rise in the U.S. interest rate differential or a rise in the expected future exchange rate increases demand, decreases supply, and raises the exchange rate. Similarly, a fall in the U.S. interest rate differential or a fall in the expected future exchange rate decreases demand, increases supply, and lowers the exchange rate.

We take a closer look at the interest rate differential and expectations in the next section.

REVIEW QUIZ

1 What are the influences on the demand for U.S. dollars in the foreign exchange market?
2 What are the influences on the supply of U.S. dollars in the foreign exchange market?
3 How is the equilibrium exchange rate determined?
4 What happens if there is a shortage or a surplus of U.S. dollars in the foreign exchange market?
5 What makes the demand for U.S. dollars change?
6 What makes the supply of U.S. dollars change?
7 What makes the U.S. dollar exchange rate fluctuate?

ECONOMICS IN ACTION

The Dollar on a Roller Coaster

The foreign exchange market is a striking example of a competitive market. The expectations of thousands of traders around the world influence this market minute-by-minute throughout the 24-hour global trading day.

Demand and supply rarely stand still and their fluctuations bring a fluctuating exchange rate. Two episodes in the life of the dollar illustrate these fluctuations: 2007–2012, when the dollar depreciated and 2012–2015, when the dollar appreciated.

A Depreciating U.S. Dollar: 2007–2012 Between July 2007 and August 2012, the U.S. dollar depreciated against the yen. It fell from 120 yen to 77 yen per U.S. dollar. Part (a) of the figure provides a possible explanation for this depreciation.

In 2007, the demand and supply curves were those labeled D_{07} and S_{07}. The exchange rate was 120 yen per U.S. dollar.

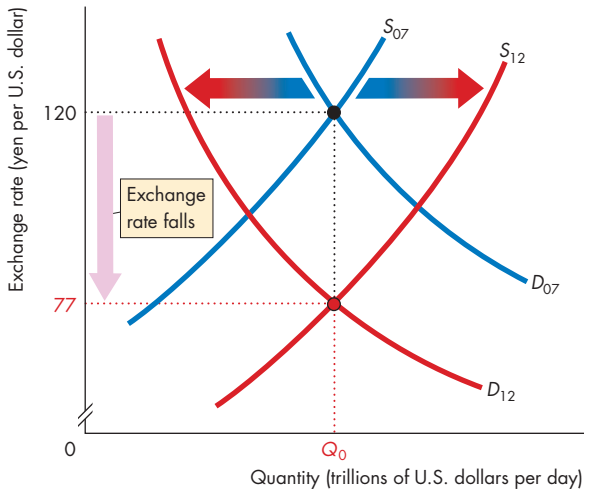
During the last quarter of 2007 and the first three quarters of 2008, the U.S. economy entered a severe credit crisis. The Federal Reserve cut the interest rate in the United States, but the Bank of Japan kept the interest rate unchanged in Japan. With a narrowing of the U.S. interest rate differential, funds flowed out of the United States. Also, currency traders expected the U.S. dollar to depreciate against the yen. The demand for U.S. dollars decreased and the supply of U.S. dollars increased.

In part (a) of the figure, the demand curve shifted leftward from D_{07} to D_{12}, the supply curve shifted rightward from S_{07} to S_{12}, and the exchange rate fell to 77 yen per U.S. dollar.

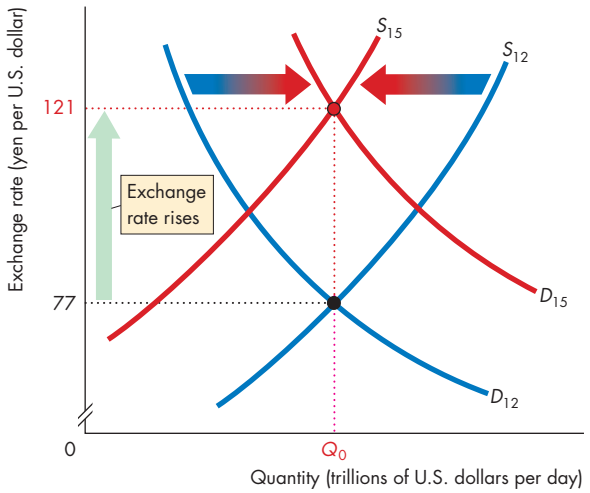
An Appreciating U.S. Dollar: 2012–2015 Between January 2012 and July 2015, the U.S. dollar appreciated against the yen. It rose from 77 yen to 121 yen per U.S. dollar. Part (b) of the figure provides an explanation for this appreciation. The demand and supply curves labeled D_{12} and S_{12} are the same as in part (a).

During 2013–2015, the Federal Reserve kept the U.S. interest rate low, but traders began to expect a future interest rate rise. Interest rates in Japan were even lower than in the United States, and the Bank of Japan, the central bank, embarked on a policy of expanding the Japanese money supply. With an expected future increase in U.S. interest rates and a lessened prospect of a rise in Japanese interest rates, the U.S. interest rate differential was expected to increase, so the dollar was expected to appreciate. The demand for U.S. dollars increased, and the supply of U.S. dollars decreased.

In the figure, the demand curve shifted rightward from D_{12} to D_{15}, the supply curve shifted leftward from S_{12} to S_{15}, and the exchange rate rose to 121 yen per U.S. dollar



(a) 2007–2012



(b) 2012–2015

The Falling and Rising U.S. Dollar

Arbitrage, Speculation, and Market Fundamentals

You've just seen how an exchange rate is determined. In our example, we used the U.S. dollar–Japanese yen exchange rate, but exchange rates between the U.S. dollar and all other currencies are determined in a similar way. So are the exchange rates *among* the other currencies such as that of the E.U. euro and U.K. pound. Exchange rates are kept in alignment with each other by a process called *arbitrage*.

Arbitrage

Arbitrage is the practice of seeking to profit by buying in one market and selling for a higher price in another related market. Arbitrage in the foreign exchange market and international loans markets and goods markets achieves three outcomes:

- The law of one price
- No round-trip profit
- Interest rate parity
- Purchasing power parity

The Law of One Price The *law of one price* states that if an item is traded in more than one place, the price will be the same in all locations. An example of this law is that the exchange rate between the U.S. dollar and the U.K. pound is the same in New York as it is in London.

You can see why arbitrage brings about this outcome by imagining that the exchange rate in London is 0.60 U.K. pounds per dollar and the price in New York is 0.61 U.K. pounds per dollar. In this imaginary situation, a trader who buys dollars in London and sells them in New York makes a profit of 0.01 U.K. pounds on every dollar traded. A trade of 1 million dollars brings a profit of 10,000 U.K. pounds.

Within a few seconds, the demand for U.K. pounds increases in London and the supply of U.K. pounds increases in New York. These changes in demand and supply raise the exchange rate in London and lower it in New York and make it equal in both markets—removing the profit opportunity.

No Round-Trip Profit A round trip is using currency *A* to buy currency *B*, and then using *B* to buy *A*. A round trip might involve more stages, using *B* to buy *C* and then using *C* to buy *A*.

Arbitrage removes profit from all transactions of this type. Any fleeting profit is taken, and the changes in supply and demand induced by the momentarily available profit snap the exchange rates back to levels that remove the profit.

Interest Rate Parity Borrowers and lenders must choose the currency in which to denominate their assets and debts. **Interest rate parity**, which means equal rates of return across currencies, means that for risk-free transactions, there is no gain from choosing one currency over another.

To see why interest rate parity always prevails, suppose a Brazilian real bank deposit in Rio de Janeiro earns 10 percent a year and a U.S. dollar bank deposit in New York earns 1 percent a year. Why wouldn't people move their funds from New York to Rio?

The answer begins with the fact that to earn 10 percent in Rio, funds must be converted from U.S. dollars to reals at the beginning of the year and from reals back to dollars at the end of the year. This transaction can be done without risk by selling reals for U.S. dollars today for delivery one year from today at an exchange rate agreed today. Such a transaction is called a *future* or *forward* transaction and it takes place at the *one-year forward exchange rate*.

Suppose that today's exchange rate is 2.30 reals per dollar, and you convert $100 to 230 reals. In one year, you will have 253 reals—your deposit of 230 reals plus interest of 23 reals. If the one-year forward exchange rate is 2.50 reals per U.S. dollar, you can contract today to sell 253 reals for $101 for delivery in one year. But that is exactly the amount you can earn by putting your $100 in the New York bank and earning 1 percent a year.

If for a few seconds, interest rate parity did not hold and it was possible to profit from buying and holding Brazilian reals, traders would flock to the profit opportunity, supply dollars and demand reals, and drive the exchange rate to its interest rate parity level.

Purchasing Power Parity Suppose a camera costs 10,000 yen in Tokyo and $100 in New York. If the exchange rate is 100 yen per dollar, the two monies have the same value. You can buy the camera in either Tokyo or New York for the same price. You can express that price as either 10,000 yen or $100, but the price is the same in the two currencies.

The situation we've just described is called **purchasing power parity** (or PPP), which means *equal value of money*. PPP is an example of the law of one price, and if it does not prevail, arbitrage forces go to work. To see these forces, suppose that the price of the camera in New York is $120, but in Tokyo

it remains at 10,000 yen and the exchange rate remains at 100 yen per dollar. In this case, the camera in Tokyo still costs 10,000 yen or $100, but in New York, it costs $120 or 12,000 yen. Money buys more in Japan than in the United States. Money is *not* of equal value in the two countries.

Arbitrage now kicks in. With the camera cheaper in Toyko than in New York, the demand for cameras in Tokyo increases and the supply of cameras in New York increases. The New York price falls and the Tokyo price rises to eliminate the price difference and restore purchasing power parity.

If most goods and services cost more in one country than another, the currency of the first country is said to be *overvalued*: a depreciation of the currency would restore PPP. Similarly, the currency of the country with the lower prices is said to be *undervalued*: an appreciation of that currency would restore PPP. When goods and services cost the same in two countries, their currencies are said to be at their PPP levels.

Determining whether a currency is overvalued or undervalued based on PPP is not easy, and testing PPP by looking at individual prices requires care to ensure that the goods compared are identical. What is identical isn't always immediately obvious (see *Economics in Action* below).

Speculation

Speculation is trading on the *expectation* of making a profit. Speculation contrasts with arbitrage, which is trading on the certainty of making a profit. Most foreign exchange transactions are based on speculation, which explains why the expected future exchange rate plays such a central role in the foreign exchange market.

The expected future exchange rate influences both supply and demand, so it influences the current equilibrium exchange rate. But what determines the expected future exchange rate?

The Expected Future Exchange Rate An expectation is a forecast. Exchange rate forecasts, like weather forecasts, are made over horizons that run from a few hours to many months and perhaps years. Also, like weather forecasters, exchange rate forecasters use scientific models and data to make their predictions.

But exchange rate forecasting differs from weather forecasting in three ways. First, exchange rate forecasts are hedged with a lot of uncertainty; second, there are many divergent forecasts; and third, the forecasts influence the outcome.

The dependence of today's exchange rate on forecasts of tomorrow's exchange rate can give rise to exchange rate volatility in the short run.

ECONOMICS IN ACTION

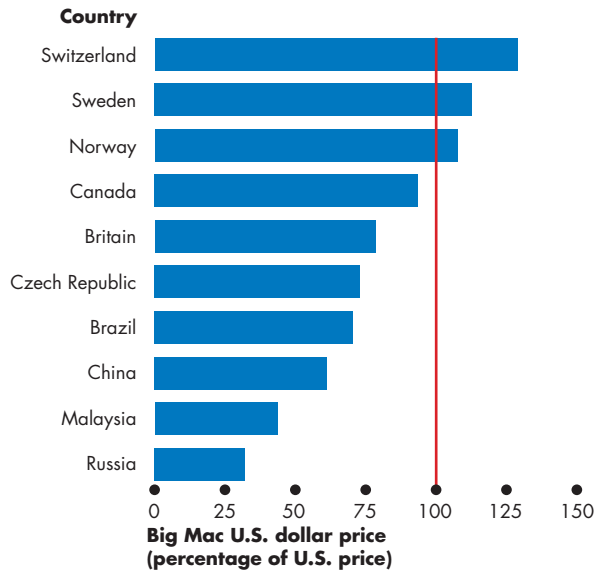
A Big Mac Index

Because a Big Mac is the same in Chicago as in Beijing, *The Economist* magazine wondered if its price in these cities might tell us how far China's yuan is from its PPP level. In July 2021, the price of a Big Mac was $5.66 in the United States and 22.34 yuan or $3.46 in China. Does this difference in the two dollar prices mean that the yuan is undervalued?

The Big Mac price comparison doesn't answer this question. A Big Mac *looks* the same in all places but most of its value is in its *service*, not its *appearance*.

The figure shows the price of a Big Mac as a percentage of the U.S. price in July 2021. It shows that the price is above the U.S. price in a few rich countries and below the U.S. price in lower-income countries.

The price differences arise from different relative prices of services that arise from different costs of labor, and not from over- or undervalued currencies.



The U.S. Dollar Price of a Big Mac in 10 Countries

Source of data: economist.com/content/big-mac-index, July 2021.

Exchange Rate Volatility An exchange rate might rise one day and fall the next, as news about the influences on the exchange rate change the expected future exchange rate. For example, news that the Fed is going to start to raise U.S. interest rates next month brings an immediate increase in the demand for U.S. dollars, decrease in the supply of U.S. dollars, and appreciation of the U.S. dollar. As the news is digested and its expected consequences revised, expectations are revised, sometimes upward and sometimes downward, bringing further changes in the exchange rate.

The influences of expectations and the constant arrival of news about the influences on supply and demand, make day-to-day and week-to-week changes in the exchange rate impossible to predict. But trends around which the exchange rate fluctuates are predictable and depend on market fundamentals.

Market Fundamentals

The demand for U.S. dollars depends on world demand for U.S. exports, the supply of U.S. dollars depends on U.S. demand for imports, and both demand and supply depend on the U.S. interest rate differential. These are the market fundamentals that influence the exchange rate. But how they influence the exchange rate is different in the short run and the long run. The short-run influences are those described in the previous section of this chapter. To understand the long run, we need to define and understand the role played by the real exchange rate.

The Real Exchange Rate The **real exchange rate** is the relative price of U.S.-produced goods and services to foreign-produced goods and services. It is a measure of the quantity of the real GDP of other countries that a unit of U.S. real GDP buys. For example, the real Japanese yen exchange rate, *RER*, is

$$RER = (E \times P) \div P^*,$$

where E is the exchange rate (yen per U.S. dollar), P is the U.S. price level, and P^* is the Japanese price level.

To understand the real exchange rate, suppose that the exchange rate E is 100 yen per dollar. The United States produces only computer chips priced at \$150 each, so P equals \$150 and $E \times P$ equals 15,000 yen. Japan produces only iPods priced at 5,000 yen each, so P^* equals 5,000 yen. Then the real Japanese yen exchange rate is

$$RER = (100 \times 150) \div 5{,}000 = 3 \text{ iPods per chip.}$$

If Japan and the United States produced identical goods, the real exchange rate would equal 1 unit of U.S. real GDP per unit of Japanese real GDP.

In reality, U.S. real GDP is a different bundle of goods and services from Japanese real GDP. So the real exchange rate is not 1 and it changes over time. The forces of demand and supply in the markets for the millions of goods and services that make up real GDP determine the relative price of Japanese and U.S. real GDP and the real exchange rate.

Price Levels and Money We can turn the real exchange rate equation around and determine the exchange rate as

$$E = RER \times P^* \div P.$$

This equation says that the exchange rate equals the real exchange rate multiplied by the foreign price level, divided by the domestic price level.

In the long run, the quantity of money determines the price level. But the quantity theory of money applies to all countries, so the quantity of money in Japan determines the price level in Japan, and the quantity of money in the United States determines the price level in the United States.

For a given real exchange rate, a change in the quantity of money brings a change in the price level *and* a change in the exchange rate.

The market fundamentals that determine the exchange rate in the long run are the real exchange rate and the quantities of money in each economy.

REVIEW QUIZ

1. What is arbitrage and what are its effects in the foreign exchange market?
2. What is interest rate parity and what happens when this condition doesn't hold?
3. What makes an exchange rate hard to predict?
4. What is purchasing power parity and what happens when this condition doesn't hold?
5. What determines the real exchange rate and the nominal exchange rate in the short run?
6. What determines the real exchange rate and the nominal exchange rate in the long run?

Exchange Rate Policy

Because the exchange rate is the price of a country's money in terms of another country's money, governments and central banks must have a policy toward the exchange rate. Three possible exchange rate policies are

- Flexible exchange rate
- Fixed exchange rate
- Crawling peg

Flexible Exchange Rate

A **flexible exchange rate** is an exchange rate that is determined by demand and supply in the foreign exchange market with no direct intervention by the central bank.

Most countries, including the United States, operate a flexible exchange rate, and the foreign exchange market that we have studied so far in this chapter is an example of a flexible exchange rate regime.

But even a flexible exchange rate is influenced by central bank actions. If the Fed raises the U.S. interest rate and other countries keep their interest rates unchanged, the demand for U.S. dollars increases, the supply of U.S. dollars decreases, and the exchange rate rises. (Similarly, if the Fed lowers the U.S. interest rate, the demand for U.S. dollars decreases, the supply increases, and the exchange rate falls.)

In a flexible exchange rate regime, when the central bank changes the interest rate, its purpose is not usually to influence the exchange rate, but to achieve some other monetary policy objective. (We return to this topic at length in Chapter 14.)

Fixed Exchange Rate

A **fixed exchange rate** is an exchange rate that is determined by a decision of the government or the central bank and is achieved by central bank intervention in the foreign exchange market to block the unregulated forces of demand and supply.

The world economy operated a fixed exchange rate regime from the end of World War II to the early 1970s. China had a fixed exchange rate until recently. Hong Kong has had a fixed exchange rate for many years and continues with that policy today.

Active intervention in the foreign exchange market is required to achieve a fixed exchange rate.

If the Fed wanted to fix the U.S. dollar exchange rate against the Japanese yen, the Fed would have to sell U.S. dollars to prevent the exchange rate from rising above the target value and buy U.S. dollars to prevent the exchange rate from falling below the target value.

There is no limit to the quantity of U.S. dollars that the Fed can *sell*. The Fed creates U.S. dollars and can create any quantity it chooses. But there is a limit to the quantity of U.S. dollars the Fed can *buy*. That limit is set by U.S. official foreign currency reserves because to buy U.S. dollars the Fed must sell foreign currency. Intervention to buy U.S. dollars stops when U.S. official foreign currency reserves run out.

Let's look at the foreign exchange interventions that the Fed can make.

Suppose the Fed wants the exchange rate to be steady at 100 yen per U.S. dollar. If the exchange rate rises above 100 yen, the Fed sells dollars. If the exchange rate falls below 100 yen, the Fed buys dollars. By these actions, the Fed keeps the exchange rate close to its target rate of 100 yen per U.S. dollar.

Figure 9.6 shows the Fed's intervention in the foreign exchange market. The supply of dollars is S and initially the demand for dollars is D_0. The equilibrium exchange rate is 100 yen per dollar. This exchange rate is also the Fed's target exchange rate, shown by the horizontal red line.

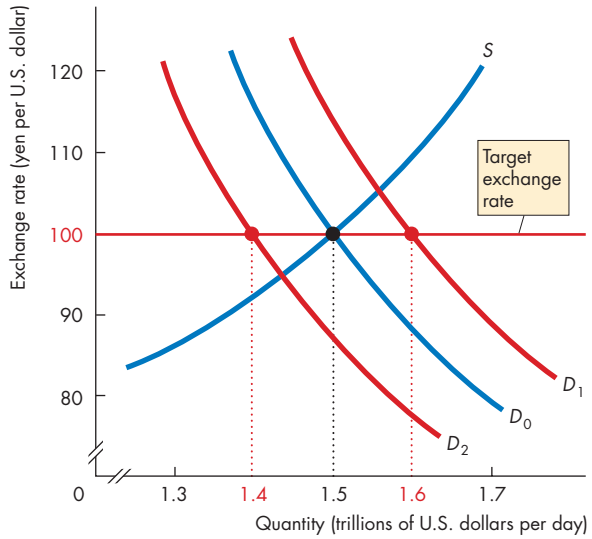
When the demand for U.S. dollars increases and the demand curve shifts rightward to D_1, the Fed sells $100 billion. This action prevents the exchange rate from rising. When the demand for U.S. dollars decreases and the demand curve shifts leftward to D_2, the Fed buys $100 billion. This action prevents the exchange rate from falling.

If the demand for U.S. dollars fluctuates between D_1 and D_2 and on average is D_0, the Fed can repeatedly intervene in the way we've just seen. Sometimes the Fed buys and sometimes it sells but, on average, it neither buys nor sells.

But suppose the demand for U.S. dollars *increases permanently* from D_0 to D_1. To maintain the exchange rate at 100 yen per U.S. dollar, the Fed must sell dollars and buy foreign currency, so U.S. official foreign currency reserves would be increasing. At some point, the Fed would abandon the exchange rate of 100 yen per U.S. dollar and stop piling up foreign currency reserves.

Now suppose the demand for U.S. dollars *decreases permanently* from D_0 to D_2. In this situation, the Fed

FIGURE 9.6 Foreign Exchange Market Intervention



Initially, the demand for U.S. dollars is D_0, the supply of U.S. dollars is S, and the exchange rate is 100 yen per U.S. dollar. The Fed can intervene in the foreign exchange market to keep the exchange rate close to its target rate (100 yen in this example). If the demand for U.S. dollars increases and the demand curve shifts from D_0 to D_1, the Fed sells dollars. If the demand for U.S. dollars decreases and the demand curve shifts from D_0 to D_2, the Fed buys dollars. Persistent intervention on one side of the market cannot be sustained.

cannot maintain the exchange rate at 100 yen per U.S. dollar indefinitely. To hold the exchange rate at 100 yen, the Fed must *buy* U.S. dollars. When the Fed buys U.S. dollars in the foreign exchange market, it uses U.S. official foreign currency reserves. So the Fed's action decreases its foreign currency reserves. Eventually, the Fed would run out of foreign currency and would then have to abandon the target exchange rate of 100 yen per U.S. dollar.

Crawling Peg

A **crawling peg** is an exchange rate that follows a path determined by a decision of the government or the central bank and is achieved in a similar way to a fixed exchange rate by central bank intervention in the foreign exchange market. A crawling peg works like a fixed exchange rate except that the target value changes. The target might change at fixed intervals (daily, weekly, monthly) or at random intervals.

The Fed has never operated a crawling peg, but some prominent countries do use this system. When China abandoned its fixed exchange rate, it replaced it with a crawling peg. Developing countries might use a crawling peg as a method of trying to control inflation—of keeping the inflation rate close to target.

The ideal crawling peg sets a target for the exchange rate equal to the equilibrium exchange rate

ECONOMICS IN ACTION

The People's Bank of China in the Foreign Exchange Market

You saw in the figure on p. 245 that the exchange rate between the U.S. dollar and the Chinese yuan was constant for several years. The reason for this constant exchange rate is that China's central bank, the People's Bank of China, intervened to operate a *fixed exchange rate policy*. From 1997 until 2005, the yuan was pegged at 8.28 yuan per U.S. dollar. Since 2005, the yuan has appreciated slightly, but it has not been permitted to fluctuate freely. Since 2005, the yuan has been on a crawling peg.

How China Manages Its Exchange Rate The People's Bank manages the exchange rate between the yuan and the U.S. dollar by intervening in the foreign exchange market, buying or selling U.S. dollars. When it buys U.S. dollars, its reserves increase, and when it sells U.S. dollars, its reserves decrease.

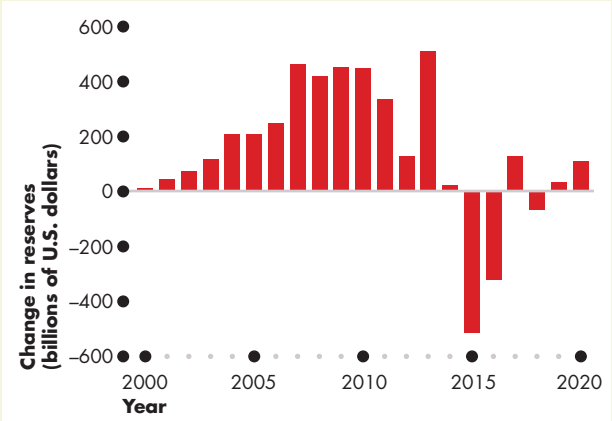
Part (a) of the figure shows the changes in reserves that resulted from China's intervention in the foreign exchange market. You can see that China's reserves increased in most years, and by a record $510 billion in 2013.

The demand and supply curves in part (b) of the figure illustrate what happened in 2013 in the market for yuan and explains why China's reserves increased. The demand curve D_{13} and supply curve S_{13} intersect at 23 U.S. cents per yuan. If the People's Bank of China takes no actions in the market, this exchange rate is the equilibrium rate (an assumed value). To keep the exchange rate at 16 U.S. cents per yuan, the People's Bank bought $510 billion.

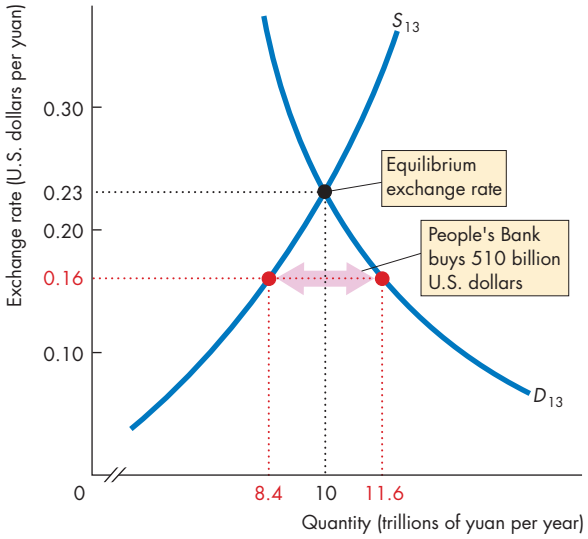
The demand and supply curves in part (c) of the figure illustrate what happened in 2015 in the market

for yuan and explains why China's reserves *decreased* in that year. The demand curve D_{15} and supply curve S_{15} intersect at 11 U.S. cents per yuan. If the People's Bank of China takes no actions in the market, this exchange rate is the equilibrium rate (an assumed value). To keep the exchange rate at 16 U.S. cents per yuan, the People's Bank sold $512 billion.

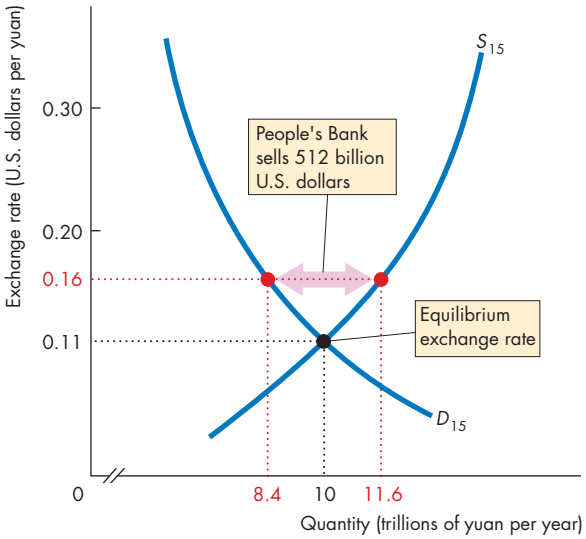
The consequence of the fixed (and crawling peg) yuan exchange rate is that China's foreign exchange reserves fluctuate. Between 2000 and 2014, China's official foreign currency reserves grew by $3.7 trillion! Then, in 2015 and 2016, when the People's Bank sold dollars, its reserves fell by $830 billion.



(a) Changes in U.S. dollar reserves



(b) Lowering the yuan



(c) Raising the yuan

China's Foreign Exchange Market Intervention

Source of data: The People's Bank of China.

on average. The peg seeks only to prevent large swings in the expected future exchange rate that change demand and supply and make the exchange rate fluctuate too wildly.

A crawling peg departs from the ideal if, as often happens with a fixed exchange rate, the target rate departs from the equilibrium exchange rate for too long. When this happens, the country either runs out of reserves or piles up reserves.

In the final part of this chapter, we explain how the balance of international payments is determined.

REVIEW QUIZ

1. What is a flexible exchange rate and how does it work?
2. What is a fixed exchange rate and how is its value fixed?
3. What is a crawling peg and how does it work?
4. How has China operated in the foreign exchange market, why, and with what effect?

Financing International Trade

You now know how the exchange rate is determined, but what is the effect of the exchange rate? How does currency depreciation or currency appreciation influence our international trade and payments? We're going to lay the foundation for addressing these questions by looking at the scale of international trading, borrowing, and lending and at the way in which we keep our records of international transactions. These records are called the *balance of payments accounts*.

Balance of Payments Accounts

A country's **balance of payments accounts** record its international trading, borrowing, and lending in three accounts:

1. Current account
2. Capital and financial account
3. Official settlements account

The **current account** records receipts from exports of goods and services sold abroad, payments for imports of goods and services from abroad, net interest income paid abroad, and net transfers abroad (such as foreign aid payments). The *current account balance* equals the sum of exports minus imports, net interest income, and net transfers.

The **capital and financial account** records foreign investment in the United States minus U.S. investment abroad. (This account also has a statistical discrepancy that arises from errors and omissions in measuring international capital transactions.)

The **official settlements account** records the change in **U.S. official reserves**, which are the government's holdings of foreign currency. If U.S. official reserves *increase*, the official settlements account balance is *negative*. The reason is that holding foreign money is like investing abroad. U.S. investment abroad is a minus item in the capital and financial account and in the official settlements account.

The sum of the balances on the three accounts *always* equals zero. That is, to pay for our current account deficit, we must either borrow more from abroad than we lend abroad or use our official reserves to cover the shortfall.

Table 9.1 shows the U.S. balance of payments accounts in 2020. Items in the current account and the capital and financial account that provide foreign currency to the United States have a plus sign; items that cost the United States foreign currency have a minus sign. The table shows that in 2020, U.S. imports exceeded U.S. exports and the current account had a deficit of $616 billion. How do we pay for imports that exceed the value of our exports? That is, how do we pay for our current account deficit?

We pay by borrowing from the rest of the world. The capital account tells us by how much. We borrowed $1,457 billion (foreign investment in the United States) but made loans of $800 billion (U.S. investment abroad). Our *net* foreign borrowing was $1,457 billion minus $800 billion, which equals $657 billion.

There is almost always a statistical discrepancy between capital and financial account and current account transactions, and in 2020, the discrepancy was –$32 billion. Combining the discrepancy with the measured net foreign borrowing gives a capital and financial account balance of $625 billion.

TABLE 9.1 U.S. Balance of Payments Accounts in 2020

Current account	Billions of dollars
Exports of goods and services	+2,134
Imports of goods and services	–2,811
Net interest income	+197
Net transfers	–136
Current account balance	–616
Capital and financial account	
Foreign investment in the United States	+1,457
U.S. investment abroad	–800
Statistical discrepancy	–32
Capital and financial account balance	+625
Official settlements account	
Official settlements account balance	–9

Source of data: Bureau of Economic Analysis.

The capital and financial account balance plus the current account balance equals the change in U.S. official reserves. In 2020, the capital and financial account balance of $625 billion plus the current account balance of −$616 billion equaled $9 billion. Official reserves *increased* in 2020 by $9 billion. Holding more foreign reserves is like lending to the rest of the world, so this amount appears in the official settlements account in Table 9.1 as −$9 billion. The sum of the balances on the three balance of payments accounts equals zero.

To see more clearly what the nation's balance of payments accounts mean, think about your own balance of payments accounts. They are similar to the nation's accounts.

An Individual's Balance of Payments Accounts An individual's current account records the income from supplying the services of factors of production and the expenditure on goods and services. Consider Jackie, for example. She worked in 2020 and earned an income of $25,000. Jackie has $10,000 worth of investments that earned her an interest income of $1,000. Jackie's current account shows an income of $26,000. Jackie spent $18,000 buying consumption goods and services. She also bought a new house, which cost her $60,000. So Jackie's total expenditure was $78,000. Jackie's expenditure minus her income is $52,000 ($78,000 minus $26,000). This amount is Jackie's current account deficit.

ECONOMICS IN ACTION

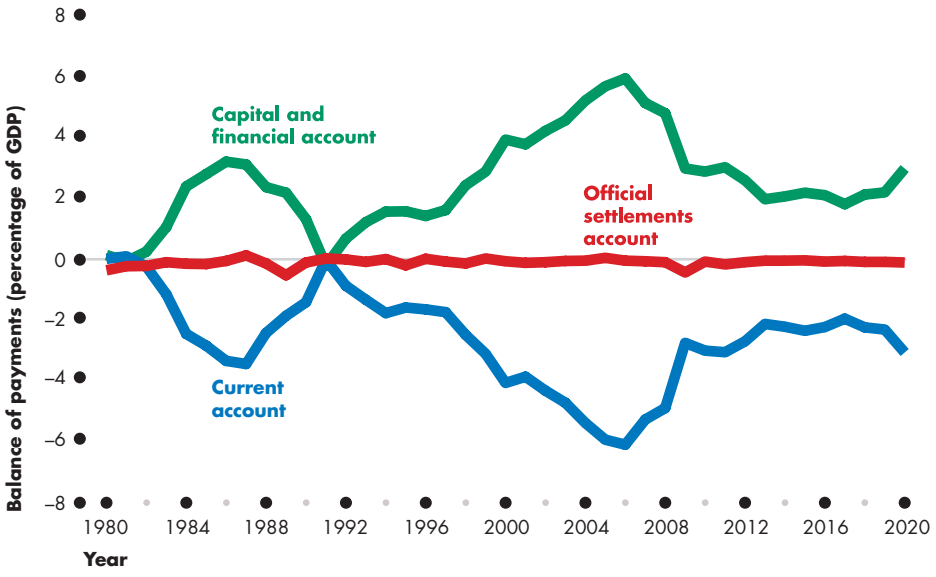
Three Decades of Deficits

The numbers that you reviewed in Table 9.1 give a snapshot of the balance of payments accounts in 2020. The figure below puts that snapshot into perspective by showing the balance of payments between 1980 and 2020.

Because the economy grows and the price level rises, changes in the dollar value of the balance of payments do not convey much information. To remove the influences of economic growth and inflation, the figure shows the balance of payments expressed as a percentage of nominal GDP.

As you can see, a large current account deficit emerged during the 1980s but declined from 1987 to 1991. The current account deficit then increased through 2006, decreased again through 2014, and then remained steady.

The capital and financial account balance is almost a mirror image of the current account balance. The official settlements balance is very small in comparison with the balances on the other two accounts.



The U.S. Balance of Payments

Source of data: Bureau of Economic Analysis.

To pay for expenditure of $52,000 in excess of her income, Jackie must either use the money that she has in the bank or take out a loan. Suppose that Jackie took out a loan of $50,000 to help buy her house and that this loan was the only borrowing that she did. Borrowing is an *inflow* in the capital account, so Jackie's capital account *surplus* was $50,000. With a current account deficit of $52,000 and a capital account surplus of $50,000, Jackie was still $2,000 short. She got that $2,000 from her own bank account. Her cash holdings decreased by $2,000.

Jackie's income from her work is like a country's income from its exports. Her income from her investments is like a country's interest income from foreigners. Her purchases of goods and services, including her purchase of a house, are like a country's imports. Jackie's loan—borrowing from someone else—is like a country's borrowing from the rest of the world. The change in Jackie's bank account is like the change in the country's official reserves.

Borrowers and Lenders

A country that is borrowing more from the rest of the world than it is lending to the rest of the world is called a **net borrower**. Similarly, a **net lender** is a country that is lending more to the rest of the world than it is borrowing from the rest of the world.

The United States is a net borrower, but it has not always been in this situation. Throughout the 1960s and most of the 1970s, the United States was a net lender to the rest of the world—the United States had a current account surplus and a capital account deficit. But from the early 1980s, with the exception of only a single year, 1991, the United States has been a net borrower from the rest of the world. And during the years since 1992, the scale of U.S. borrowing has mushroomed.

Most countries are net borrowers like the United States. But a few countries, including China, Japan, and oil-rich Saudi Arabia, are net lenders. In 2020, when the United States borrowed more than $625 billion from the rest of the world, China alone lent more than $200 billion.

International borrowing and lending takes place in the global market for loanable funds. You studied the loanable funds market in Chapter 7, but there, we didn't take explicit account of the effects of the balance of payments and international borrowing and lending on the market. That's what we will now do.

The Global Loanable Funds Market

Figure 9.7(a) illustrates the demand for loanable funds, DLF_W, and the supply of loanable funds, SLF_W, in the global loanable funds market. The world equilibrium real interest rate makes the quantity of funds supplied in the world as a whole equal to the quantity demanded. In this example, the equilibrium real interest rate is 3 percent a year and the quantity of funds is $10 trillion.

An International Borrower Figure 9.7(b) shows the loanable funds market in a country that borrows from the rest of the world. The country's domestic demand for loanable funds, DLF_D, is part of the world demand in Fig. 9.7(a) and its domestic supply of loanable funds, SLF_D, is part of the world supply.

If this country were isolated from the global market, the real interest rate would be 4 percent a year (where the DLF_D and SLF_D curves intersect). But if the country is integrated into the global economy, with an interest rate of 4 percent a year, funds would *flood into* it. With a real interest rate of 3 percent a year in the global market, suppliers of loanable funds would seek the higher return in this country. In effect, the country faces the supply of loanable funds curve, *SLF*, which is horizontal at the world equilibrium real interest rate.

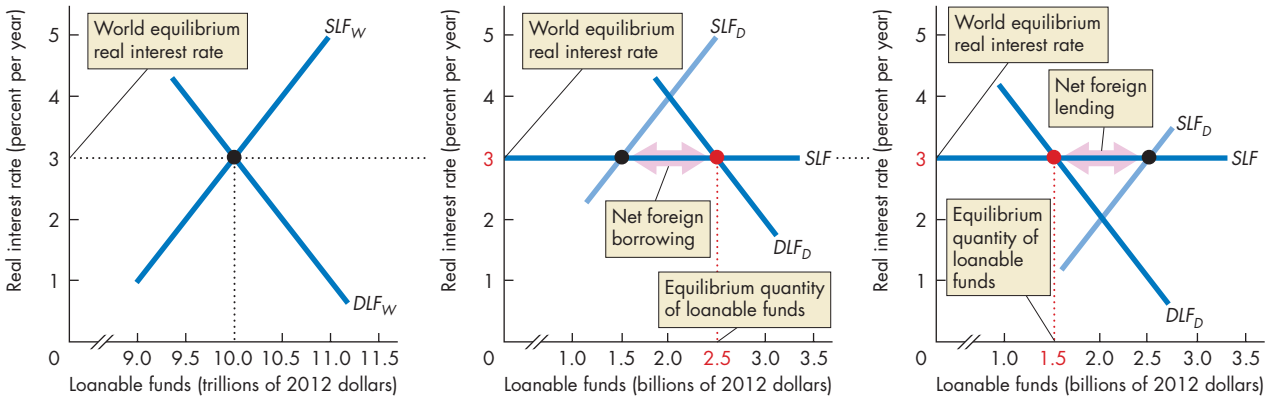
The country's demand for loanable funds and the world interest rate determine the equilibrium quantity of loanable funds—$2.5 billion in Fig. 9.7(b).

An International Lender Figure 9.7(c) shows the situation in a country that lends to the rest of the world. As before, the country's domestic demand for loanable funds, DLF_D, is part of the world demand and its domestic supply of loanable funds, SLF_D, is part of the world supply in Fig. 9.7(a).

If this country were isolated from the global market, the real interest rate would be 2 percent a year (where the DLF_D and SLF_D curves intersect). But if this country is integrated into the global economy, with an interest rate of 2 percent a year, funds would quickly *flow out* of it. With a real interest rate of 3 percent a year in the rest of the world, domestic suppliers of loanable funds would seek the higher return in other countries. Again, the country faces the supply of loanable funds curve, *SLF*, which is horizontal at the world equilibrium real interest rate.

The country's demand for loanable funds and the world interest rate determine the equilibrium quantity of loanable funds—$1.5 billion in Fig. 9.7(c).

FIGURE 9.7 Borrowing and Lending in the Global Loanable Funds Market



(a) The global market **(b) An international borrower** **(c) An international lender**

In the global loanable funds market in part (a), the demand for loanable funds curve, DLF_W, and the supply of loanable funds curve, SLF_W, determine the world real interest rate. Each country can get funds at the world real interest rate and it faces the (horizontal) supply curve *SLF* in parts (b) and (c).

At the world real interest rate, borrowers in part (b) want more funds than the quantity supplied by domestic lenders, $1.5 million on the domestic supply curve SLF_D. The shortage is made up by net foreign borrowing.

Domestic suppliers of funds in part (c) want to lend more than domestic borrowers demand. The excess quantity supplied goes to foreign borrowers.

Debtors and Creditors

A net borrower might be decreasing its net assets held in the rest of the world, or it might be going deeper into debt. A nation's total stock of foreign investment determines whether it is a debtor or a creditor. A **debtor nation** is a country that during its entire history has borrowed more from the rest of the world than it has lent to it. It has a stock of outstanding debt to the rest of the world that exceeds the stock of its own claims on the rest of the world. A **creditor nation** is a country that during its entire history has invested more in the rest of the world than other countries have invested in it.

The United States was a debtor nation through the nineteenth century as we borrowed from Europe to finance our westward expansion, railroads, and industrialization. We paid off our debt and became a creditor nation for most of the twentieth century. But following a string of current account deficits, we became a debtor nation again in 1986.

Since 1986, the total stock of U.S. borrowing from the rest of the world has exceeded U.S. lending to the rest of the world. The largest debtor nations are the capital-hungry developing countries (such as the United States was during the nineteenth century). The international debt of these countries grew from less than a third to more than a half of their gross domestic product during the 1980s and created what was called the "Third World debt crisis."

Should we be concerned that the United States is a net borrower and a debtor? The answer depends on whether the borrowing is financing investment that in turn is generating economic growth and higher income, or financing consumption expenditure. If the borrowed money is used to finance consumption, it will eventually have to be reduced, and the longer it goes on, the greater is the reduction in consumption that will eventually be necessary.

Is U.S. Borrowing for Consumption?

In 2020, the United States borrowed $625 billion from abroad. In that year, private investment in buildings, plant, and equipment was $3,605 billion and government investment in defense equipment and social projects was $342 billion. All this investment added to the nation's capital and increased productivity. Government also spends on education and healthcare services, which increase *human capital*. U.S. international borrowing is financing private and public investment, not consumption.

Current Account Balance

What determines a country's current account balance and net foreign borrowing? You've seen that net exports (NX) is the main item in the current account. We can define the current account balance (CAB) as

$$CAB = NX + \text{Net interest income} + \text{Net transfers}.$$

We can study the current account balance by looking at what determines net exports because the other two items are small and do not fluctuate much.

Net Exports

Net exports are determined by the government budget and private saving and investment. To see how net exports are determined, we need to recall some of the things that we learned in Chapter 7 about the flows of funds that finance investment. Table 9.2 refreshes your memory and summarizes some calculations.

Part (a) lists the national income variables that are needed, with their symbols. Part (b) defines three balances: net exports, the government sector balance, and the private sector balance.

Net exports is exports of goods and services minus imports of goods and services.

The **government sector balance** is equal to net taxes minus government expenditure on goods and services. If that number is positive, a government sector surplus is lent to other sectors; if that number is negative, a government deficit must be financed by borrowing from other sectors. The government sector deficit is the sum of the deficits of the federal, state, and local governments.

The **private sector balance** is saving minus investment. If saving exceeds investment, a private sector surplus is lent to other sectors. If investment exceeds saving, a private sector deficit is financed by borrowing from other sectors.

Part (b) also shows the values of these balances for the United States in 2020. As you can see, net exports were −$645 billion, a deficit of $645 billion. The government sector's revenue from *net* taxes was $739 billion and its expenditure was $3,831 billion, so the government sector balance was −$3,092 billion—a deficit of $3,092 billion. The private sector saved $6,052 billion and invested $3,605 billion, so its balance was $2,447 billion—a surplus of $2,447 billion.

Part (c) shows the relationship among the three balances. From the *National Income and Product Accounts*, we know that real GDP, Y, is the sum of consumption expenditure (C), investment (I), government expenditure (G), and net exports ($X - M$). Real GDP also equals the sum of consumption expenditure (C), saving (S), and net taxes (T). Rearranging these equations tells us that net exports is the sum of the government sector balance and the private sector balance. In the United States in 2020, the government sector balance was −$3,092 billion and the private sector balance was $2,447 billion. The government sector balance plus the private sector balance equaled net exports of −$645 billion.

TABLE 9.2 Net Exports, the Government Budget, Saving, and Investment

	Symbols and equations	United States in 2020 (billions of dollars)
(a) Variables		
Exports*	X	2,127
Imports*	M	2,772
Government expenditure	G	3,831
Net taxes	T	739
Investment	I	3,605
Saving	S	6,052
(b) Balances		
Net exports	$X - M$	2,127 – 2,772 = –645
Government sector	$T - G$	739 – 3,831 = –3,092
Private sector	$S - I$	6,052 – 3,605 = +2,447
(c) Relationship among balances		
National accounts	$Y = C + I + G + X - M$	
	$= C + S + T$	
Rearranging:	$X - M = S - I + T - G$	
Net exports	$X - M$	–645
equals:		
Government sector	$T - G$	–3,092
plus		
Private sector	$S - I$	+2,447

Source of data: Bureau of Economic Analysis. The data are for 2020.

*The *National Income and Product Accounts* measures of exports and imports are slightly different from the balance of payments accounts measures in Table 9.1 on p. 258.

ECONOMICS IN ACTION

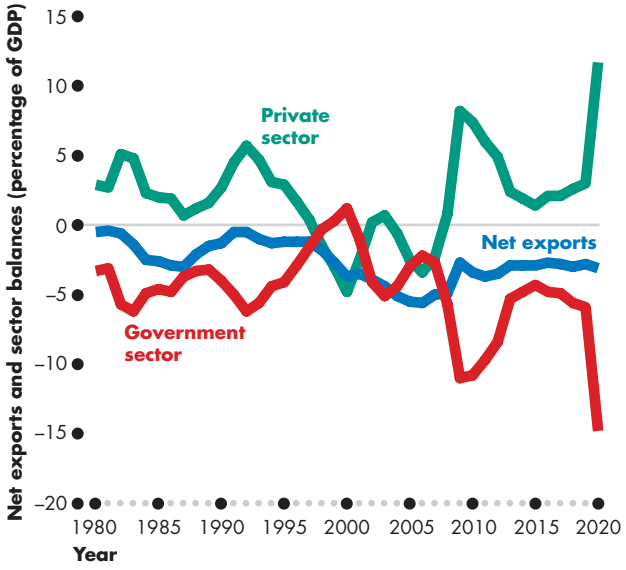
The Three Sector Balances

You've seen that net exports equal the sum of the government sector balance and the private sector balance. How do these three sector balances fluctuate over time?

The figure answers this question. It shows the government sector balance (the red line), net exports (the blue line), and the private sector balance (the green line).

The private sector balance and the government sector balance move in opposite directions. When the government sector deficit increased during the late 1980s and early 1990s, the private sector surplus increased. And when the government sector deficit decreased and became a surplus during the late 1990s and early 2000s, the private sector's surplus decreased and became a deficit. And when the government deficit increased yet again from 2007 to 2009, the private sector deficit shrank and became a surplus.

Sometimes, when the government sector deficit increases, as it did during the first half of the 1980s, net exports become more negative. But after the early 1990s, net exports did not follow the government sector balance closely. Rather, net exports respond to the *sum* of the government sector and private sector balances. When both the private sector and the government sector have a deficit, net exports are negative and the combined private and government deficit is financed by borrowing from the rest of the world. But the dominant trend in net exports is negative.



The Three Sector Balances

Source of data: Bureau of Economic Analysis.

Where Is the Exchange Rate?

We haven't mentioned the exchange rate while discussing the balance of payments. Doesn't it play a role? The answer is that in the short run it does but in the long run it doesn't.

In the short run, a fall in the dollar lowers the real exchange rate, which makes U.S. imports more costly and U.S. exports more competitive. A higher price of imported consumption goods and services might induce a decrease in consumption expenditure and an increase in saving. A higher price of imported capital goods might induce a decrease in investment. Other things remaining the same, an increase in saving or a decrease in investment decreases the private sector deficit and decreases the current account deficit. But in the long run, a change in the nominal exchange rate leaves the real exchange rate unchanged and plays no role in influencing the current account balance.

REVIEW QUIZ

1. What are the transactions that the balance of payments accounts record?
2. Is the United States a net borrower or a net lender? Is it a debtor or a creditor nation?
3. How are net exports and the government sector balance linked?

Economics in the News on pp. 264–265 looks at the way in which Switzerland has engaged in currency manipulation.

Manipulating the Exchange Rate

U.S. Stops Short of Labeling Taiwan a Currency Manipulator

Financial Times
April 17, 2021

The U.S. Treasury has stopped short of formally designating Taiwan as a currency manipulator, but put it on notice and said it would begin engaging with the country to address the issue. The Biden administration also removed currency manipulation designations for Vietnam and Switzerland, which were added last December by the Trump administration.

The previous administration had last year accused the two countries of pushing their currencies lower to prevent "effective balance of payments adjustments" and in the case of Vietnam "for gaining unfair competitive advantage in international trade."

In its semi-annual report, the U.S. said Taiwan, Switzerland, and Vietnam met all three criteria under a 2015 U.S. law used ... to evaluate whether a country is debasing its currency. However, ... it concluded there was "insufficient evidence" to find that any of the three was manipulating its currency to gain trade advantages.

"The Covid impacts for the year 2020 make it more challenging to understand what appropriate policies there should have been," a Treasury official said. "We need to better understand the policy choices that were available to our major trading partners so that we can make more informed judgment," the official said.

The latest Treasury report ... also "makes it clear that there are many countries that have been actively managing their currencies to avoid appreciation that would hurt their export competitiveness, although China is the least of the offenders even though it runs a large goods trade surplus with the United States."

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ESSENCE OF THE STORY

- Vietnam and Switzerland have been removed from the list of currency manipulators but, along with Taiwan, will be monitored.
- Vietnam and Switzerland had been accused of lowering their currencies to gain an unfair competitive advantage in international trade.
- The U.S. Treasury Department reported to Congress that no country was engaged in currency manipulation (in mid-2021).
- A currency manipulator sells its own currency and buys U.S. dollars to avoid appreciation of its currency and make its exports cheaper and its imports more expensive.
- Many countries manage their currencies but China is the least of the currency manipulators.

ECONOMIC ANALYSIS

- A central bank can use its country's foreign exchange reserves to manipulate the exchange rate of its currency.
- If we define a country's exchange rate as U.S. dollars per unit of its currency, a country's currency depreciates when the exchange rate falls.
- To raise its exchange rate and appreciate its currency on the foreign exchange market, a central bank uses some U.S. dollars to buy its own currency. The increase in demand for the country's currency raises the exchange rate and appreciates the country's currency.
- To lower its exchange rate and depreciate its currency on the foreign exchange market, a central bank uses its own currency to buy U.S. dollars. The increase in supply of the country's currency lowers the exchange rate and depreciates the country's currency.
- Switzerland has repeatedly and persistently intervened in the foreign exchange market and influenced the exchange rate of the Swiss franc and the U.S. dollar.
- Figure 1 shows the scale of intervention in the foreign exchange market. Between 2013 and 2020, the Swiss National Bank (Switzerland's central bank) used Swiss francs to buy more than a half a trillion U.S. dollars.
- Figure 2 shows that the Swiss franc depreciated from 2014 to 2016 and then was fixed at between 1.01 and 1.02 U.S. dollars before appreciating in 2020.
- Figure 3 focusses on the foreign exchange market for the Swiss franc in 2017.
- In that year, the (assumed) demand for Swiss francs was D_{17}. and supply wasS_{17}. The equilibrium exchange rate was 1.17 U.S. dollars.
- Switzerland did not want its exchange rate to rise, so the central bank bought 132 billion U.S dollars (and sold 130 billion Swiss francs).
- With this intervention in the market, the exchange rate was 1.02 U.S. dollars per Swiss franc.
- In 2019, market intervention lowered the exchange rate, but in 2020, despite efforts by the Swiss National Bank to increase the supply of francs, an increase in demand raised the exchange rate to 1.07 U.S. dollars.

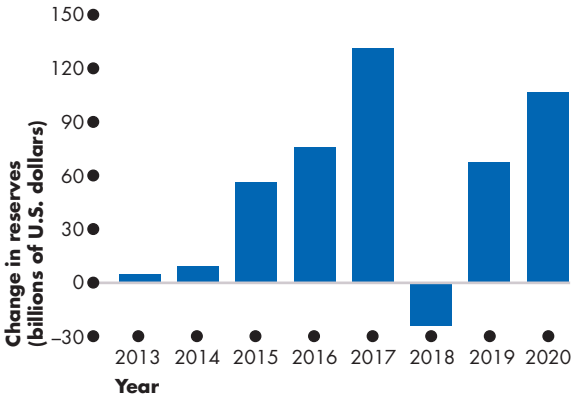

Figure 1 Changes in Switzerland's U.S. Dollar Reserves

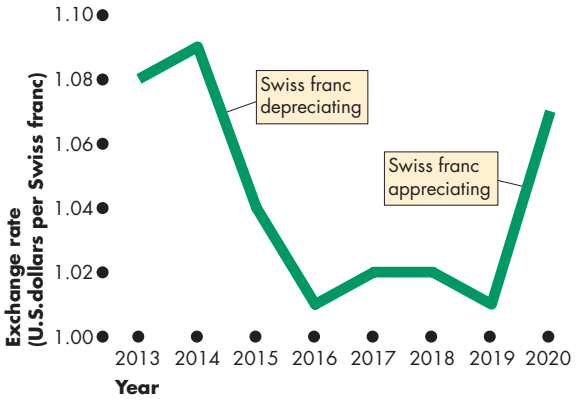

Figure 2 The Swiss Franc Exchange Rate

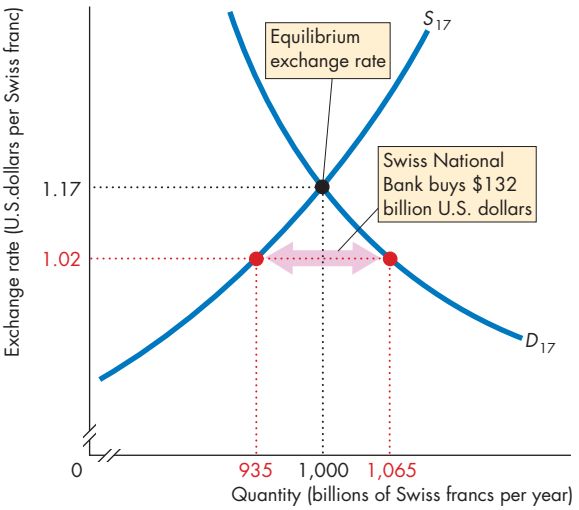

Figure 3 Lowering the Swiss Franc

WORKED PROBLEM

On June 1, 2015, the exchange rate was 101 yen per U.S. dollar. During that day, the Fed made a surprise announcement that it would raise the interest rate next month by 1 percentage point. At the same moment, the Bank of Japan announced that it would lower the interest rate next month.

On June 2, 2015, the exchange rate was 99 yen per U.S. dollar.

Questions

1. Explain the effect of the Fed's announcement on the demand for and supply of U.S. dollars.
2. Explain the effect of the Bank of Japan's announcement on the demand for and supply of U.S. dollars.
3. Explain the effect of the two announcements on the U.S. dollar–yen exchange rate: Would the U.S. dollar appreciate or depreciate?
4. Could the change in the exchange rate on June 2 have resulted from the two announcements or must some other influence have changed too? If so, what might that influence have been?

Solutions

1. The Fed's announcement of a 1 percentage point rise in the U.S. interest rate next month means that, other interest rates remaining the same, the U.S. interest rate differential will increase next month.

   An increase in the U.S. interest rate differential next month will increase the demand for U.S. dollars and decrease the supply of U.S. dollars next month. The exchange rate next month will increase.

   With the increase in the exchange rate expected next month, the demand for U.S. dollars will increase and the supply of U.S. dollars will decrease on June 2.

Key Point: An expected *future* rise in the interest rate differential increases the demand for U.S. dollars and decreases the supply of U.S. dollars immediately through its effect on the expected future exchange rate.

2. The Bank of Japan's announcement that it will lower the interest rate in Japan next month has the same effect on the U.S. interest rate differential as a rise in the U.S. interest rate.

   So the effect of a Japanese interest rate cut reinforces that of a U.S. interest rate increase.

   The even-larger increase in the interest rate differential next month will bring a larger increase in the demand for U.S. dollars and decrease in the supply of U.S. dollars next month, and a larger increase in the exchange rate next month.

   The larger increase in the exchange rate expected next month will bring a larger increase in the demand for U.S. dollars and decrease the supply of U.S. dollars on June 2.

Key Point: A fall in the foreign interest rate has the same effects on the demand for and supply of U.S. dollars as a rise in the U.S. interest rate.

3. The two interest rate announcements have the same effects: They increase the demand for U.S. dollars and decrease the supply of U.S. dollars.

   An increase in the demand for U.S. dollars raises the exchange rate and a decrease in the supply of U.S. dollars raises the exchange rate, so the announcements would make the dollar appreciate.

Key Point: An increase in demand and a decrease in supply have the same effect on price: They raise the price. The exchange rate is a price.

4. When the U.S. dollar fell from 101 yen on June 1 to 99 yen on June 2, the U.S. dollar depreciated.

   Other things remaining the same, the two central bank announcements would have appreciated the U.S. dollar.

   Because the exchange rate fell—the dollar depreciated—either the demand for U.S. dollars must have decreased or the supply of U.S. dollars must have increased.

   The influences on demand and supply that might have changed are U.S. exports or U.S. imports.

   A decrease in U.S. exports would have decreased the demand for U.S. dollars.

   An increase in U.S. imports would have increased the supply of U.S. dollars.

Key Point: When the exchange rate falls, either the demand for U.S. dollars has decreased or the supply of U.S. dollars has increased or both have occurred.

SUMMARY

Key Points

The Foreign Exchange Market (pp. 244–251)

- Foreign currency is obtained in exchange for domestic currency in the foreign exchange market.
- Demand and supply in the foreign exchange market determine the exchange rate.
- The higher the exchange rate, the smaller is the quantity of U.S. dollars demanded and the greater is the quantity of U.S. dollars supplied.
- The equilibrium exchange rate makes the quantity of U.S. dollars demanded equal the quantity of U.S. dollars supplied.
- Changes in the demand for U.S. exports change the demand for U.S. dollars and changes in the U.S. demand for imports change the supply of U.S. dollars.
- Changes in the U.S. interest rate differential or the expected future exchange rate change *both* the demand for and supply of U.S. dollars, but in opposite directions.

Arbitrage, Speculation, and Market Fundamentals (pp. 252–254)

- Arbitrage in the foreign exchange market achieves interest rate parity and purchasing power parity.
- Speculation in the foreign exchange market can bring excess volatility to the exchange rate.
- In the long run, the exchange rate is determined by the real exchange rate and the relative quantities of money.

Exchange Rate Policy (pp. 255–257)

- An exchange rate can be flexible, fixed, or a crawling peg.
- To achieve a fixed or a crawling exchange rate, a central bank must either buy or sell foreign currency in the foreign exchange market.

Financing International Trade (pp. 258–263)

- A country's international transactions are recorded in its current account, capital and financial account, and official settlements account.
- The current account balance is similar to net exports and is determined by the government sector balance plus the private sector balance.
- International borrowing and lending take place in the global loanable funds market.

Key Terms

Arbitrage, 252
Balance of payments accounts, 258
Capital and financial account, 258
Crawling peg, 256
Creditor nation, 261
Current account, 258
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Exchange rate, 244
Fixed exchange rate, 255
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U.S. interest rate differential, 249
U.S. official reserves, 258

PROBLEMS AND APPLICATIONS

The Foreign Exchange Market

Use the following data to work Problems 1 to 3.

The U.S. dollar exchange rate increased from $1.24 Canadian in June 2015 to $1.29 Canadian in June 2016, and it decreased from 121 Japanese yen in June 2015 to 108 yen in June 2016.

1. Did the U.S. dollar appreciate or depreciate against the Canadian dollar? Did the U.S. dollar appreciate or depreciate against the yen?
2. What was the value of the Canadian dollar in terms of U.S. dollars in June 2015 and June 2016? Did the Canadian dollar appreciate or depreciate against the U.S. dollar over the year June 2015 to June 2016?
3. What was the value of 100 yen in terms of U.S. dollars in June 2015 and June 2016? Did the yen appreciate or depreciate against the U.S. dollar over the year June 2015 to June 2016?
4. On June 23, 2016, the U.S. dollar was trading at 0.68 U.K. pounds per U.S. dollar on the foreign exchange market. On June 25, the U.S. dollar was trading at 0.76 U.K. pounds per U.S. dollar.
   a. What events could have brought this change in the value of the U.S. dollar?
   b. Did the events you've described change the demand for U.S. dollars, the supply of U.S. dollars, or both demand and supply in the foreign exchange market?
5. Colombia is the world's biggest producer of roses. The global demand for roses increases and at the same time Columbia's central bank increases the interest rate. In the foreign exchange market for Colombian pesos, what happens to:
   a. The demand for pesos?
   b. The supply of pesos?
   c. The quantity of pesos demanded?
   d. The quantity of pesos supplied?
   e. The peso–U.S. dollar exchange rate?

Arbitrage, Speculation, and Market Fundamentals

6. If a euro deposit in France earns 4 percent a year and a yen deposit in Japan earns 0.5 percent a year, all other things remaining the same, what is the exchange rate expectation of the Japanese yen against the E.U. euro?
7. The U.K. pound is trading at 1.50 U.S. dollars per U.K. pound and purchasing power parity holds. The U.S. interest rate is 1 percent a year and the U.K. interest rate is 3 percent a year.
   a. Calculate the U.S. interest rate differential.
   b. What is the U.K. pound expected to be worth in terms of U.S. dollars one year from now?
   c. Which country more likely has the lower inflation rate? How can you tell?
8. The U.S. price level is 115, the Japanese price level is 92, and the real exchange rate is 98.75 units of Japanese real GDP per unit of U.S. real GDP. What is the nominal exchange rate?

Exchange Rate Policy

9. Lebanon has maintained the same exchange rate between the Lebanese pound and the U.S. dollar for more than 20 years. While some argue that continuing with this system is unsustainable for the central bank, others fear that Lebanon's political situation might lead to a crisis if this system is discontinued.

   Source: executive-magazine.com, July 16, 2015

   a. What is Lebanon's current exchange rate policy?
   b. Why might this policy be unsustainable for the central bank? What could be the consequences of changing it amid political instability?

Financing International Trade

10. The table gives some information about U.S. international transactions in 2015.

Item	Billions of U.S. dollars
Imports of goods and services	2,764
Foreign investment in the United States	502
Exports of goods and services	2,264
U.S. investment abroad	175
Net interest income	193
Net transfers	−127
Statistical discrepancy	101

   a. Calculate the balance on the three balance of payments accounts.
   b. Was the United States a net borrower or a net lender? Explain your answer.

ADDITIONAL PROBLEMS AND APPLICATIONS

The Foreign Exchange Market

11. Suppose that yesterday, the U.S. dollar was trading on the foreign exchange market at 0.75 euros per U.S. dollar and today the U.S. dollar is trading at 0.80 euros per U.S. dollar. Which of the two currencies (the U.S. dollar or the euro) has appreciated and which has depreciated today?
12. Suppose that the exchange rate fell from 80 yen per U.S. dollar to 70 yen per U.S. dollar. What is the effect of this change on the quantity of U.S. dollars that people plan to buy in the foreign exchange market?
13. Suppose that the exchange rate rose from 80 yen per U.S. dollar to 90 yen per U.S. dollar. What is the effect of this change on the quantity of U.S. dollars that people plan to sell in the foreign exchange market?
14. Today's exchange rate between the Lebanese pound and the U.S. dollar is 1,500 pounds per dollar and the central bank of Lebanon is buying U.S. dollars in the foreign exchange market. If the central bank of Lebanon did not purchase U.S. dollars, would there be excess demand or excess supply of U.S. dollars in the foreign exchange market? Would the exchange rate remain at 1,500 pounds per U.S. dollar? If not, which currency would appreciate?
15. Yesterday, the current exchange rate was $1.05 Canadian per U.S. dollar and traders expected the exchange rate to remain unchanged for the next month. Today, with new information, traders now expect the exchange rate next month to fall to $1 Canadian per U.S. dollar. Explain how the revised expected future exchange rate influences the demand for U.S. dollars, or the supply of U.S. dollars, or both in the foreign exchange market.
16. In 2016, the exchange rate changed from 108 yen per U.S. dollar in April to 104 yen per U.S. dollar in May, and to 109 yen per dollar in June. What information would you need to determine the factors that caused these changes in the exchange rate? Which factors would change *both* demand and supply?
17. Australia produces natural resources (coal, iron ore, natural gas, and others), the demand for which has increased rapidly as China and other emerging economies expand.
    a. Explain how growth in the demand for Australia's natural resources would affect the demand for Australian dollars in the foreign exchange market.
    b. Explain how the supply of Australian dollars would change.
    c. Explain how the value of the Australian dollar would change.
    d. Illustrate your answer with a graphical analysis.

Arbitrage, Speculation, and Market Fundamentals

Use the following news clip to work Problems 18 and 19.

Rio's Foreign Property Investors Score Deals on Currency Woes

For foreign investors, a 21% fall in the Brazilian real since the start of 2020 has encouraged the purchase of real estate. Before the 2016 Summer Olympics, Rio's real estate market was compared to that of New York or Paris. After the games, property prices fell and the real depreciated nearly 37%. Now real estate in Rio is heating up after a slash in interest rates.

Source: Bloomberg.com, June 4, 2021

18. Explain why the depreciation of the Brazilian real has led to foreign investment in Rio's real estate.
19. What is the effect of a slash in interest rates on foreign investment in Rio?

Use the following information to work Problems 20 and 21.

Is the Loonie Going Up or Down?

The price of a Big Mac is $C6.88 in Toronto and $5.71 in New York. The exchange rate is $C1.36 per U.S. dollar. The 3-month interest rate is 0.17 percent in Canada and 0.10 percent in the United States.

Source: *The Economist*, The Federal Reserve System, and the Bank of Canada, June 2020

20. Does purchasing power parity hold? If not, does PPP predict that the $C (loonie) will appreciate or depreciate against the U.S. dollar? Explain.
21. Does interest rate parity hold? If not, why not? Will the Canadian dollar depreciate further or appreciate against the U.S. dollar if the Fed raises the interest rate while the Canadian interest rate remains at 0.17 percent a year?

22. **Over- or Undervalued?**
The *Economist* magazine uses the price of a Big Mac to determine whether a currency is undervalued or overvalued. In June 2020, the price of a Big Mac was $5.71 in New York, 21.70 yuan in Beijing, and 6.50 Swiss francs in Geneva. The exchange rates were 6.9 yuan per U.S. dollar and 0.94 Swiss francs per U.S. dollar.
Source: www.economist.com, June 2020
a. Was the yuan undervalued or overvalued relative to purchasing power parity?
b. Was the Swiss franc undervalued or overvalued relative to purchasing power parity?
c. Do Big Mac prices in different countries provide a valid test of purchasing power parity?

Exchange Rate Policy

Use the following news clip to work Problems 23 to 25.

U.S. Says China Is No Longer a Currency Manipulator

China's designation as a currency manipulator has been officially removed by the Trump administration. As part of a new trade deal, China and the United States agree they will not devalue their currencies to achieve trade advantages.
Source: nytimes.com, January 13, 2020

23. What was the exchange rate policy adopted by China until July 2005? Explain how it worked. Draw a graph to illustrate your answer.
24. What was the exchange rate policy adopted by China after July 2005? Explain how it works.
25. Explain how fixed and crawling peg exchange rates can be used to manipulate trade balances in the short run, but not the long run.
26. **Hong Kong Is Keeping Its Currency Peg**
Hong Kong's central bank intervened 40 times in 2020 to keep its currency pegged to the U.S. dollar at 7.8 Hong Kong dollars per U.S. dollar. The U.S. dollar dropped sharply in 2020, due in part to low interest rates. To date, Hong Kong's central bank has bought 152 billion Hong Kong dollars ($19.6 billion) this year.
Source: businessinsider.com, September 3, 2020
a. What is Hong Kong's exchange rate policy?
b. Is the Hong Kong central bank trying to raise or lower the value of the Hong Kong dollar? How do you know?
c. What is happening to Hong Kong's official reserves?

Financing International Trade

Use the following table to work Problems 27 and 28. The table gives some data about the U.K. economy:

Item	Billions of U.K. pounds
Consumption expenditure	721
Exports of goods and services	277
Government expenditures	230
Net taxes	217
Investment	181
Saving	162

27. Calculate the private sector and government sector balances.
28. What is the relationship between the government sector balance and net exports?

Economics in the News

29. After you have studied *Economics in the News* on pp. 264–265, answer the following questions.
a. In which year or years did the Swiss National Bank not intervene in the foreign exchange market to lower the franc exchange rate? How can you tell?
b. What did the Swiss National Bank do in 2018? Make a graph like Fig. 3 on p. 265 to illustrate your answer.
c. The news article identifies Vietnam as a country that might be a currency manipulator. What data would you need to check that claim?
d. In 2021, Vietnam's foreign exchange reserves increased by $18 billion and the dong (Vietnam's currency) depreciated from 43 to 42 U.S. cents per 10,000 dongs. What made that happen?
e. Make a graph like Fig. 3 on p. 265 to illustrate the effect of the $18 billion increase in Vietnam's foreign exchange reserves and depreciation of the dong in 2021.

Expanding the Frontier

PART THREE **WRAP UP**

UNDERSTANDING MACROECONOMIC TRENDS

Economics is about how we cope with scarcity. We cope as individuals by making choices that balance marginal benefits and marginal costs so that we use our scarce resources efficiently. We cope as societies by creating incentive systems and social institutions that encourage specialization and exchange.

These choices and the incentive systems that guide them determine what we specialize in; how much work we do; how hard we work at school to learn the mental skills that form our human capital and determine the kinds of jobs we get and the incomes we earn; how much we save for future big-ticket expenditures; how much businesses and governments spend on new capital—on auto assembly lines, computers and fiber cables for improved Internet services, shopping malls, highways, bridges, and tunnels; how intensively existing capital and natural resources are used and how quickly they wear out or are used up; and the problems that scientists, engineers, and other inventors work on to develop new technologies.

All the choices we've just described combine to determine the standard of living and the rate at which it improves—the economic growth rate.

Money that makes specialization and exchange in markets possible is a huge contributor to economic growth. But too much money brings a rising cost of living with no improvement in the standard of living.

Joseph Schumpeter, *the son of a textile factory owner, was born in Austria in 1883. He moved from Austria to Germany during the tumultuous 1920s when those two countries experienced hyperinflation. In 1932, in the depths of the Great Depression, he came to the United States and became a professor of economics at Harvard University.*

This creative economic thinker wrote about economic growth and development, business cycles, political systems, and economic biography. He was a person of strong opinions who expressed them forcefully and delighted in verbal battles.

Schumpeter saw the development and diffusion of new technologies by profit-seeking entrepreneurs as the source of economic progress. But he saw economic progress as a process of creative destruction—the creation of new profit opportunities and the destruction of currently profitable businesses. For Schumpeter, economic growth and the business cycle were a single phenomenon.

"Economic progress, in capitalist society, means turmoil."

JOSEPH SCHUMPETER
Capitalism, Socialism, and Democracy
Routledge, 1976

TALKING WITH Xavier Sala-i-Martin

XAVIER SALA-I-MARTIN is Professor of Economics at Columbia University. He is also a Research Associate at the National Bureau of Economic Research, Senior Economic Advisor to the World Economic Forum, Associate Editor of the *Journal of Economic Growth*, founder and CEO of Umbele Foundation: A Future for Africa, and President of the Economic Commission of the Barcelona Football Club.

Professor Sala-i-Martin was an undergraduate at Universitat Autonoma de Barcelona and a graduate student at Harvard University, where he obtained his Ph.D. in 1990.

In 2004, he was awarded the Premio Juan Carlos I de Economía, a biannual prize given by the Bank of Spain to the best economist in Spain and Latin America. With Robert Barro, he is the author of *Economic Growth* Second Edition (MIT Press, 2003), the definitive graduate level text on this topic.

Michael Parkin talked with Xavier Sala-i-Martin about his work and the progress that economists have made in understanding economic growth.

How did economic growth become your major field of research?

I studied economics. I liked it. I studied mathematical economics. I liked it too, and I went to graduate school. In my second year at Harvard, Jeffrey Sachs hired me to go to Bolivia. I saw poor people for the first time in my life. I was shocked. I decided I should try to answer the question "Why are these people so poor and why are we so rich, and what can we do to turn their state into our state?" We live in a bubble world in the United States and Europe, and we don't realize how poor people really are. When you see poverty at first hand, it is very hard to think about something else. So I decided to study economic growth. Coincidentally, when I returned from Bolivia, I was assigned to be Robert Barro's teaching assistant. He was teaching economic growth, so I studied with him and eventually wrote books and articles with him.

If there's no investment, there's no growth. ... Incentives are important.

What do we know today about the nature and causes of the wealth of nations that Adam Smith didn't know?

Actually, even though over the last two hundred years some of the best minds have looked at the question, we know surprisingly little. We have some general principles that are not very easy to apply in practice. We know, for example, that markets are good. We know that for the economy to work, we need property rights to be guaranteed. If there are thieves—government or private thieves—that can steal the proceeds of the investment, there's no investment and there's no growth. We know that the incentives are very important.

These are general principles. Because we know these principles we should ask: How come Africa is still poor? The answer is, it is very hard to translate "Markets are good" and "Property rights work" into practical actions. We know that Zimbabwe has to guarantee property rights. With the government it has, that's not going to work. The U.S. Constitution works in the United States. If you try to copy the Constitution and impose the system in Zimbabwe, it's not going to work.

PART FOUR **MACROECONOMIC FLUCTUATIONS**

10 AGGREGATE SUPPLY AND AGGREGATE DEMAND

After studying this chapter, you will be able to:

- Explain what determines aggregate supply in the long run and in the short run
- Explain what determines aggregate demand
- Explain how real GDP and the price level are determined and what causes growth, inflation, and cycles
- Describe the main schools of thought in macroeconomics today

Real GDP grew at a record 33.4 percent annual pace in the third quarter of 2020 after crashing in the previous quarter. The inflation rate also edged upward. Why do real GDP and inflation fluctuate?

This chapter explains the economic fluctuations that we call the business cycle. You will study the *aggregate supply–aggregate demand model* or *AS-AD model*—a model of real GDP and the price level. And in *Economics in the News* at the end of the chapter, you will use that model to interpret and explain the state of the U.S. economy in 2020.

Aggregate Supply

The purpose of the aggregate supply–aggregate demand model that you study in this chapter is to explain how real GDP and the price level are determined and how they interact. The model uses similar ideas to those that you encountered in Chapter 3 when you learned how the quantity and price in a competitive market are determined. But the *aggregate* supply–*aggregate* demand model (*AS-AD* model) isn't just an application of the competitive market model. Some differences arise because the *AS-AD* model is a model of an imaginary market for the total of all the final goods and services that make up real GDP. The quantity in this "market" is real GDP and the price is the price level measured by the GDP deflator.

One thing that the *AS-AD* model shares with the competitive market model is that both distinguish between *supply* and the *quantity supplied*. We begin by explaining what we mean by the quantity of real GDP supplied.

Quantity Supplied and Supply

The *quantity of real GDP supplied* is the total quantity of goods and services, valued in constant base year (2012) dollars, that firms plan to produce during a given period. This quantity depends on the quantity of labor employed, the quantity of physical and human capital, and the state of technology.

At any given time, the quantity of capital and the state of technology are fixed. They depend on decisions that were made in the past. The population is also fixed. But the quantity of labor is not fixed. It depends on decisions made by households and firms about the supply of and demand for labor.

The labor market can be in any one of three states: at full employment, above full employment, or below full employment. At full employment, the quantity of real GDP supplied is *potential GDP*, which depends on the full-employment quantity of labor (see Chapter 6, pp. 170–172). Over the business cycle, employment fluctuates around full employment and the quantity of real GDP supplied fluctuates around potential GDP.

Aggregate supply is the relationship between the quantity of real GDP supplied and the price level. This relationship is different in the long run than in the short run and to study aggregate supply, we distinguish between two time frames:

- Long-run aggregate supply
- Short-run aggregate supply

Long-Run Aggregate Supply

Long-run aggregate supply is the relationship between the quantity of real GDP supplied and the price level when the money wage rate changes in step with the price level to maintain full employment. The quantity of real GDP supplied at full employment equals potential GDP and this quantity is the same regardless of the price level.

The long-run aggregate supply curve in Fig. 10.1 illustrates long-run aggregate supply as the vertical line at potential GDP labeled *LAS*. Along the long-run aggregate supply curve, as the price level changes, the money wage rate also changes so the real wage rate remains at the full-employment equilibrium level and real GDP remains at potential GDP. The long-run aggregate supply curve is always vertical and is always located at potential GDP.

The long-run aggregate supply curve is vertical because potential GDP is independent of the price level. The reason for this independence is that a movement along the *LAS* curve is accompanied by a change in *two* sets of prices: the prices of goods and services—the price level—and the prices of the factors of production, most notably, the money wage rate. A 10 percent increase in the prices of goods and services is matched by a 10 percent increase in the money wage rate. Because the price level and the money wage rate change by the same percentage, the *real wage rate* remains unchanged at its full-employment equilibrium level. So when the price level changes and the real wage rate remains constant, employment remains constant and real GDP remains constant at potential GDP.

Production at a Pepsi Plant You can see more clearly why real GDP is unchanged when all prices change by the same percentage by thinking about production decisions at a Pepsi bottling plant. How does the quantity of Pepsi supplied change if the price of Pepsi changes and the wage rate of the workers and prices of all the other resources used vary by the same percentage? The answer is that the quantity supplied doesn't change. The firm produces the quantity that maximizes profit. That quantity depends on the price of Pepsi relative to the cost of producing it. With no change in price *relative to cost*, production doesn't change.

Short-Run Aggregate Supply

Short-run aggregate supply is the relationship between the quantity of real GDP supplied and the price level *when the money wage rate, the prices of other resources, and potential GDP remain constant*. Fig. 10.1 illustrates this relationship as the short-run aggregate supply curve *SAS* and the short-run aggregate supply schedule. Each point on the *SAS* curve corresponds to a row of the short-run aggregate supply schedule. For example, point *A* on the *SAS* curve and row *A* of the schedule tell us that if the price level is 100, the quantity of real GDP supplied is $19 trillion. In the short run, a rise in the price level brings an increase in the quantity of real GDP supplied. The short-run aggregate supply curve slopes upward.

With a given money wage rate, there is one price level at which the real wage rate is at its full-employment equilibrium level. At this price level, the quantity of real GDP supplied equals potential GDP and the *SAS* curve intersects the *LAS* curve. In this example, that price level is 110. If the price level rises above 110, the quantity of real GDP supplied increases along the *SAS* curve and exceeds potential GDP; if the price level falls below 110, the quantity of real GDP supplied decreases along the *SAS* curve and is less than potential GDP.

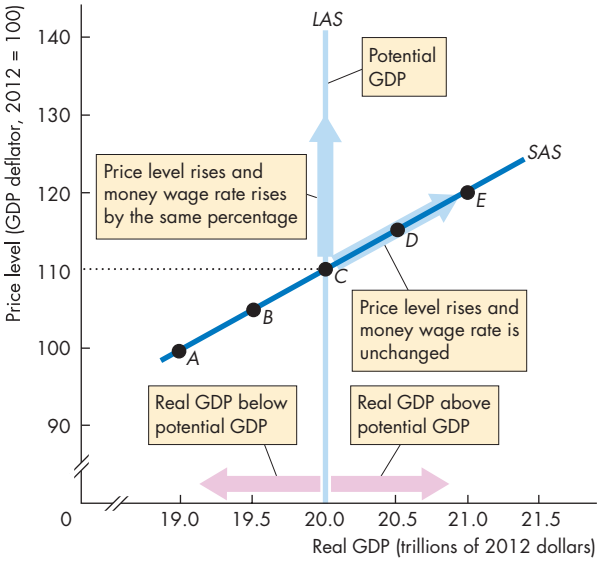
Back at the Pepsi Plant You can see why the short-run aggregate supply curve slopes upward by returning to the Pepsi bottling plant. If production increases, marginal cost rises and if production decreases, marginal cost falls (see Chapter 2, p. 65).

If the price of Pepsi rises with no change in the money wage rate and other costs, Pepsi can increase profit by increasing production. Pepsi is in business to maximize its profit, so it increases production.

Similarly, if the price of Pepsi falls while the money wage rate and other costs remain constant, Pepsi can avoid a loss by decreasing production. The lower price weakens the incentive to produce, so Pepsi decreases production.

What's true for Pepsi bottlers is true for the producers of all goods and services. When all prices rise, the *price level rises*. If the price level rises and the money wage rate and other factor prices remain constant, all firms increase production and the quantity of real GDP supplied increases. A fall in the price level has the opposite effect and decreases the quantity of real GDP supplied.

FIGURE 10.1 Long-Run and Short-Run Aggregate Supply



	Price level (GDP deflator)	Real GDP supplied (trillions of 2012 dollars)
A	100	19.0
B	105	19.5
C	**110**	**20.0**
D	115	20.5
E	120	21.0

In the long run, the quantity of real GDP supplied is potential GDP and the *LAS* curve is vertical at potential GDP. In the short run, the quantity of real GDP supplied increases if the price level rises, while all other influences on supply plans remain the same.

The short-run aggregate supply curve, *SAS*, slopes upward. The short-run aggregate supply curve is based on the aggregate supply schedule in the table. Each point *A* through *E* on the curve corresponds to the row in the table identified by the same letter.

When the price level is 110, the quantity of real GDP supplied is $20 trillion, which is potential GDP. If the price level rises above 110, the quantity of real GDP supplied increases and exceeds potential GDP; if the price level falls below 110, the quantity of real GDP supplied decreases and is below potential GDP.

Changes in Aggregate Supply

A change in the price level changes the quantity of real GDP supplied, which is illustrated by a movement along the short-run aggregate supply curve. It does not change aggregate supply. Aggregate supply changes when an influence on production plans other than the price level changes. These other influences include changes in potential GDP and changes in the money wage rate. Let's begin by looking at a change in potential GDP.

Changes in Potential GDP When potential GDP changes, aggregate supply changes. An increase in potential GDP increases both long-run aggregate supply and short-run aggregate supply.

Figure 10.2 shows the effects of an increase in potential GDP. Initially, the long-run aggregate supply curve is LAS_0 and the short-run aggregate supply curve is SAS_0. If potential GDP increases to $21 trillion, long-run aggregate supply increases and the long-run aggregate supply curve shifts rightward to LAS_1. Short-run aggregate supply also increases, and the short-run aggregate supply curve shifts rightward to SAS_1. The two supply curves shift by the same amount only if the full-employment price level remains constant, which we will assume to be the case.

Potential GDP can increase for any of three reasons:

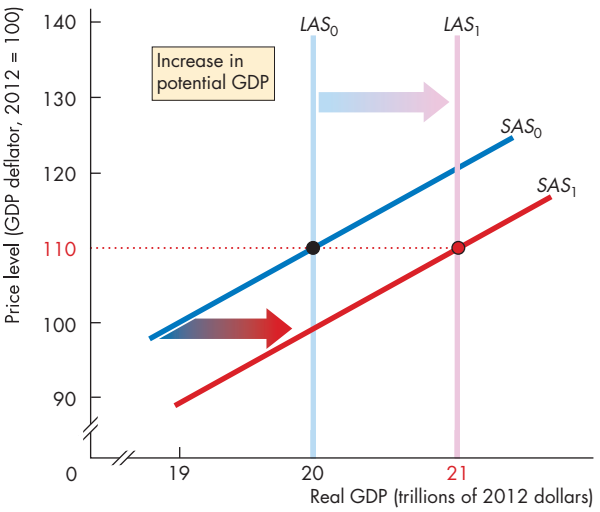
- An increase in the full-employment quantity of labor
- An increase in the quantity of capital
- An advance in technology

Let's look at these influences on potential GDP and the aggregate supply curves.

An Increase in the Full-Employment Quantity of Labor A Pepsi bottling plant that employs 100 workers bottles more Pepsi than does an otherwise identical plant that employs 10 workers. The same is true for the economy as a whole. The larger the quantity of labor employed, the greater is real GDP.

Over time, potential GDP increases because the labor force increases. But (with constant capital and technology) *potential* GDP increases only if the full-employment quantity of labor increases. Fluctuations in employment over the business cycle bring fluctuations in real GDP. But these changes in real GDP are fluctuations around potential GDP. They are not changes in potential GDP and long-run aggregate supply.

FIGURE 10.2 A Change in Potential GDP



An increase in potential GDP increases both long-run aggregate supply and short-run aggregate supply. The long-run aggregate supply curve shifts rightward from LAS_0 to LAS_1 and the short-run aggregate supply curve shifts from SAS_0 to SAS_1.

An Increase in the Quantity of Capital A Pepsi bottling plant with two production lines bottles more Pepsi than does an otherwise identical plant that has only one production line. For the economy, the larger the quantity of capital, the more productive is the labor force and the greater is its potential GDP. Potential GDP per person in the capital-rich United States is vastly greater than that in capital-poor China or Russia.

Capital includes *human capital*. One Pepsi plant is managed by an economics major with an MBA and has a labor force with an average of 10 years of experience. This plant produces a larger output than does an otherwise identical plant that is managed by someone with no business training or experience and that has a young labor force that is new to bottling. The first plant has a greater amount of human capital than the second. For the economy as a whole, the larger the quantity of *human capital*—the skills that people have acquired in school and through on-the-job training—the greater is potential GDP.

An Advance in Technology A Pepsi plant that has pre-computer-age machines produces less than one that uses the latest robot technology. Technological change enables firms to produce more from any given amount of factors of production. So even with fixed quantities of labor and capital, improvements in technology increase potential GDP.

Technological advances are by far the most important source of increased production over the past two centuries. As a result of technological advances, one farmer in the United States today can feed 100 people and in a year one autoworker can produce almost 14 cars and trucks.

Let's now look at the effects of changes in the money wage rate.

Changes in the Money Wage Rate When the money wage rate (or the money price of any other factor of production such as oil) changes, short-run aggregate supply changes but long-run aggregate supply does not change.

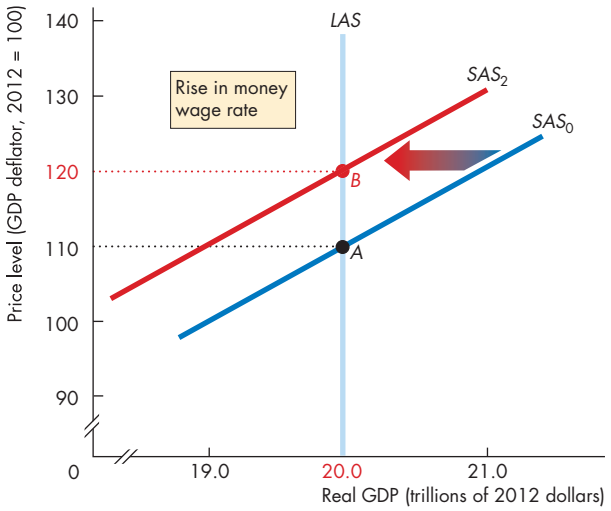
Figure 10.3 shows the effect of an increase in the money wage rate. Initially, the short-run aggregate supply curve is SAS_0. A rise in the money wage rate *decreases* short-run aggregate supply and shifts the short-run aggregate supply curve leftward to SAS_2.

A rise in the money wage rate decreases short-run aggregate supply because it increases firms' costs. With increased costs, the quantity that firms are willing to supply at each price level decreases, which is shown by a leftward shift of the *SAS* curve.

A change in the money wage rate does not change long-run aggregate supply because on the *LAS* curve, the change in the money wage rate is accompanied by an equal percentage change in the price level. With no change in *relative* prices, firms have no incentive to change production and real GDP remains constant at potential GDP. With no change in potential GDP, the long-run aggregate supply curve *LAS* does not shift.

What Makes the Money Wage Rate Change? The money wage rate can change for two reasons: departures from full employment and expectations about inflation. Unemployment above the natural rate puts downward pressure on the money wage rate, and unemployment below the natural rate puts upward pressure on it. An expected rise in the inflation rate makes the money wage rate rise faster, and an expected fall in the inflation rate slows the rate at which the money wage rate rises.

FIGURE 10.3 A Change in the Money Wage Rate



A rise in the money wage rate decreases short-run aggregate supply and shifts the short-run aggregate supply curve leftward from SAS_0 to SAS_2. A rise in the money wage rate does not change potential GDP, so the long-run aggregate supply curve does not shift.

REVIEW QUIZ

1. If the price level and the money wage rate rise by the same percentage, what happens to the quantity of real GDP supplied? Along which aggregate supply curve does the economy move?
2. If the price level rises and the money wage rate remains constant, what happens to the quantity of real GDP supplied? Along which aggregate supply curve does the economy move?
3. If potential GDP increases, what happens to aggregate supply? Does the *LAS* curve shift or is there a movement along the *LAS* curve? Does the *SAS* curve shift or is there a movement along the *SAS* curve?
4. If the money wage rate rises and potential GDP remains the same, does the *LAS* curve or the *SAS* curve shift or is there a movement along the *LAS* curve or the *SAS* curve?

Aggregate Demand

The quantity of real GDP demanded (Y) is the sum of real consumption expenditure (C), investment (I), government expenditure (G), and exports (X) minus imports (M). That is,

$$Y = C + I + G + X - M$$

The *quantity of real GDP demanded* is the total amount of final goods and services produced in the United States that people, businesses, governments, and foreigners plan to buy.

These buying plans depend on many factors. Some of the main ones are

1. The price level
2. Expectations
3. Fiscal policy and monetary policy
4. The world economy

We first focus on the relationship between the quantity of real GDP demanded and the price level. To study this relationship, we keep all other influences on buying plans the same and ask: How does the quantity of real GDP demanded vary as the price level varies?

The Aggregate Demand Curve

Other things remaining the same, the higher the price level, the smaller is the quantity of real GDP demanded. This relationship between the quantity of real GDP demanded and the price level is called **aggregate demand**. Aggregate demand is described by an *aggregate demand schedule* and an *aggregate demand curve*.

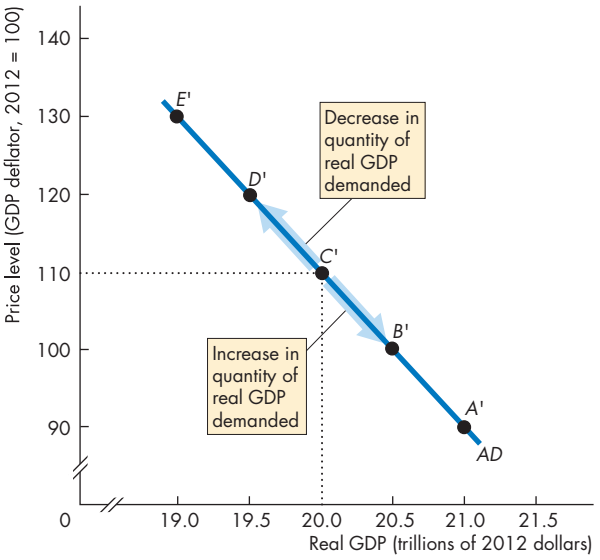
Figure 10.4 shows an aggregate demand curve (AD) and an aggregate demand schedule. Each point on the AD curve corresponds to a row of the schedule. For example, point C' on the AD curve and row C' of the schedule tell us that if the price level is 110, the quantity of real GDP demanded is $20 trillion.

The aggregate demand curve slopes downward for two reasons:

- Wealth effect
- Substitution effects

Wealth Effect When the price level rises but other things remain the same, *real* wealth decreases. Real wealth is the amount of money in the bank, bonds, stocks, and other assets that people own, measured not in dollars but in terms of the goods and services that the money, bonds, and stocks will buy.

FIGURE 10.4 Aggregate Demand



	Price level (GDP deflator)	Real GDP demanded (trillions of 2012 dollars)
A'	90	21.0
B'	100	20.5
C'	**110**	**20.0**
D'	120	19.5
E'	130	19.0

The aggregate demand curve (*AD*) shows the relationship between the quantity of real GDP demanded and the price level. The aggregate demand curve is based on the aggregate demand schedule in the table. Each point *A'* through *E'* on the curve corresponds to the row in the table identified by the same letter. When the price level is 110, the quantity of real GDP demanded is $20 trillion, as shown by point C' in the figure. A change in the price level, when all other influences on aggregate buying plans remain the same, brings a change in the quantity of real GDP demanded and a movement along the *AD* curve.

People save and hold money, bonds, and stocks for many reasons. One reason is to build up funds for education expenses. Another reason is to build up enough funds to meet possible medical expenses or other big bills. But the biggest reason is to build up enough funds to provide a retirement income.

If the price level rises, real wealth decreases. People then try to restore their wealth. To do so, they must increase saving and, equivalently, decrease current consumption. Such a decrease in consumption is a decrease in aggregate demand.

Maria's Wealth Effect You can see how the wealth effect works by thinking about Maria's buying plans. Maria lives in Moscow, Russia. She has worked hard all summer and saved 20,000 rubles (the ruble is the currency of Russia), which she plans to spend attending graduate school when she has finished her economics degree. So Maria's wealth is 20,000 rubles. Maria has a part-time job, and her income from this job pays her current expenses. The price level in Russia rises by 100 percent, and now Maria needs 40,000 rubles to buy what 20,000 once bought. To try to make up some of the fall in value of her savings, Maria saves even more and cuts her current spending to the bare minimum.

Substitution Effects When the price level rises and other things remain the same, interest rates rise. The reason is related to the wealth effect that you've just studied. A rise in the price level decreases the real value of the money in people's pockets and bank accounts. With a smaller amount of real money around, banks and other lenders can get a higher interest rate on loans. But faced with a higher interest rate, people and businesses delay plans to buy new capital and consumer durable goods and cut back on spending.

This substitution effect involves changing the timing of purchases of capital and consumer durable goods and is called an *intertemporal* substitution effect—a substitution across time. Saving increases to increase future consumption.

To see this intertemporal substitution effect more clearly, think about your own plan to buy a new computer. At an interest rate of 5 percent a year, you might borrow $1,000 and buy the new computer. But at an interest rate of 10 percent a year, you might decide that the payments would be too high. You don't abandon your plan to buy the computer, but you decide to delay your purchase.

A second substitution effect works through international prices. When the U.S. price level rises and other things remain the same, U.S.-made goods and services become more expensive relative to foreign-made goods and services. This change in *relative prices* encourages people to spend less on U.S.-made items and more on foreign-made items. For example, if the U.S. price level rises relative to the Japanese price level, Japanese drivers buy fewer U.S.-made cars (U.S. exports decrease) and U.S. drivers buy more Japanese-made cars (U.S. imports increase). U.S. GDP decreases.

Maria's Substitution Effects In Moscow, Russia, Maria makes some substitutions. She was planning to trade in her old motor scooter and get a new one. But with a higher price level and a higher interest rate, she decides to make her old scooter last one more year. Also, with the prices of Russian goods sharply increasing, Maria substitutes a low-cost dress made in Malaysia for the Russian-made dress she had originally planned to buy.

Changes in the Quantity of Real GDP Demanded

When the price level rises and other things remain the same, the quantity of real GDP demanded decreases—a movement up along the *AD* curve as shown by the arrow in Fig. 10.4. When the price level falls and other things remain the same, the quantity of real GDP demanded increases—a movement down along the *AD* curve.

We've now seen how the quantity of real GDP demanded changes when the price level changes. How do other influences on buying plans affect aggregate demand?

Changes in Aggregate Demand

A change in any factor that influences buying plans other than the price level brings a change in aggregate demand. The main factors are

- Expectations
- Fiscal policy and monetary policy
- The world economy

Expectations An increase in expected future income increases the amount of consumption goods (especially big-ticket items such as cars) that people plan to buy today and increases aggregate demand.

An increase in the expected future inflation rate increases aggregate demand today because people decide to buy more goods and services at today's relatively lower prices.

An increase in expected future profits increases the investment that firms plan to undertake today and increases aggregate demand.

Fiscal Policy and Monetary Policy The government's attempt to influence the economy by setting and changing taxes, making transfer payments, and purchasing goods and services is called **fiscal policy**. A tax cut or an increase in transfer payments—for example, unemployment benefits or welfare payments—increases aggregate demand. Both of these influences operate by increasing households' *disposable* income. **Disposable income** is aggregate income minus taxes plus transfer payments. The greater the disposable income, the greater is the quantity of consumption goods and services that households plan to buy and the greater is aggregate demand.

Government expenditure on goods and services is one component of aggregate demand. So if the government spends more on spy satellites, schools, and highways, aggregate demand increases.

The Federal Reserve's (Fed's) attempt to influence the economy by changing interest rates and the quantity of money is called **monetary policy**. The Fed influences the quantity of money and interest rates by using the tools and methods described in Chapter 8.

An increase in the quantity of money increases aggregate demand through two main channels: It lowers interest rates and makes it easier to get a loan.

With lower interest rates, businesses plan a greater level of investment in new capital and households plan greater expenditure on new homes, on home improvements, on automobiles, and a host of other consumer durable goods. Banks and others eager to lend lower their standards for making loans and more people are able to get home loans and other consumer loans.

A decrease in the quantity of money has the opposite effects and lowers aggregate demand.

The World Economy Two main influences that the world economy has on aggregate demand are the exchange rate and foreign income. The *exchange rate* is the amount of a foreign currency that you can buy with a U.S. dollar. Other things remaining the same, a rise in the exchange rate decreases aggregate

ECONOMICS IN ACTION

World Economy Tailwinds

As the U.S. economy expanded in 2021, it got some help from the global economy.

Although the U.S. economy is the world's second-largest and it can generate much of its growth from consumer spending and business investment, the United States gets help from the other large economies: China, the European Union, and Japan.

In 2021, real GDP growth in the Euro area picked up some speed, real GDP accelerated in Japan, and growth exceeded 8 percent in China.

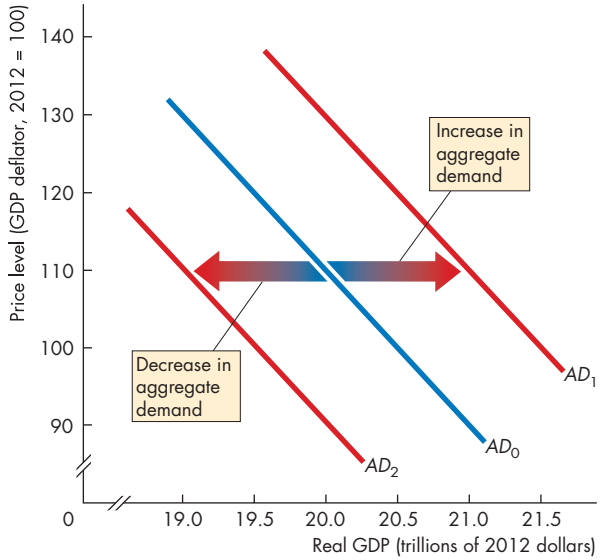
Additionally, the U.S. dollar depreciated making U.S. exporters and producers of import-competing goods and services more competitive.

A stronger world economy and a weaker dollar increases U.S. exports growth; closes the recessionary gap; and increases capacity utilization at ports such as the one at Long Beach, California.

European Central Bank, Frankfurt, Germany

Port of Long Beach, California

FIGURE 10.5 Changes in Aggregate Demand



Aggregate demand

Decreases if:

- Expected future income, inflation, or profit decreases
- Fiscal policy decreases government expenditure, increases taxes, or decreases transfer payments
- Monetary policy decreases the quantity of money and increases interest rates
- The exchange rate increases or foreign income decreases

Increases if:

- Expected future income, inflation, or profit increases
- Fiscal policy increases government expenditure, decreases taxes, or increases transfer payments
- Monetary policy increases the quantity of money and decreases interest rates
- The exchange rate decreases or foreign income increases

demand. To see how the exchange rate influences aggregate demand, suppose that the exchange rate is 1.20 euros per U.S. dollar. An Airbus plane made in France costs 120 million euros, and an equivalent Boeing airplane made in the United States costs $110 million. In U.S. dollars, the Airbus plane costs $100 million, so airlines both in the United States and around the world buy the cheaper airplane from France. Now suppose the exchange rate falls to 1 euro per U.S. dollar. The Airbus airplane now costs $120 million and is more expensive than the Boeing airplane. Airlines will switch from Airbus to Boeing. U.S. exports will increase and U.S. imports will decrease, so U.S. aggregate demand will increase.

An increase in foreign income increases U.S. exports and increases U.S. aggregate demand. For example, an increase in income in Japan and Germany increases Japanese and German consumers' and producers' planned expenditures on U.S.-produced goods and services.

Shifts of the Aggregate Demand Curve When aggregate demand changes, the aggregate demand curve shifts. Figure 10.5 shows two changes in aggregate demand and summarizes the factors that bring about such changes.

Aggregate demand increases and the *AD* curve shifts rightward from AD_0 to AD_1 when expected future income, inflation, or profit increases; government expenditure on goods and services increases; taxes are cut; transfer payments increase; the quantity of money increases and the interest rate falls; the exchange rate falls; or foreign income increases.

Aggregate demand decreases and the *AD* curve shifts leftward from AD_0 to AD_2 when expected future income, inflation, or profit decreases; government expenditure on goods and services decreases; taxes increase; transfer payments decrease; the quantity of money decreases and the interest rate rises; the exchange rate rises; or foreign income decreases.

REVIEW QUIZ

1. What does the aggregate demand curve show? What factors change and what factors remain the same when there is a movement along the aggregate demand curve?
2. Why does the aggregate demand curve slope downward?
3. How do changes in expectations, fiscal policy and monetary policy, and the world economy change aggregate demand and the aggregate demand curve?

Explaining Macroeconomic Trends and Fluctuations

The purpose of the *AS-AD* model is to explain changes in real GDP and the price level. The model's main purpose is to explain business cycle fluctuations in these variables. But the model also aids our understanding of economic growth and inflation trends. We begin by combining aggregate supply and aggregate demand to determine real GDP and the price level in equilibrium. Just as there are two time frames for aggregate supply, there are two time frames for macroeconomic equilibrium: a long-run equilibrium and a short-run equilibrium. We'll first look at short-run equilibrium.

Short-Run Macroeconomic Equilibrium

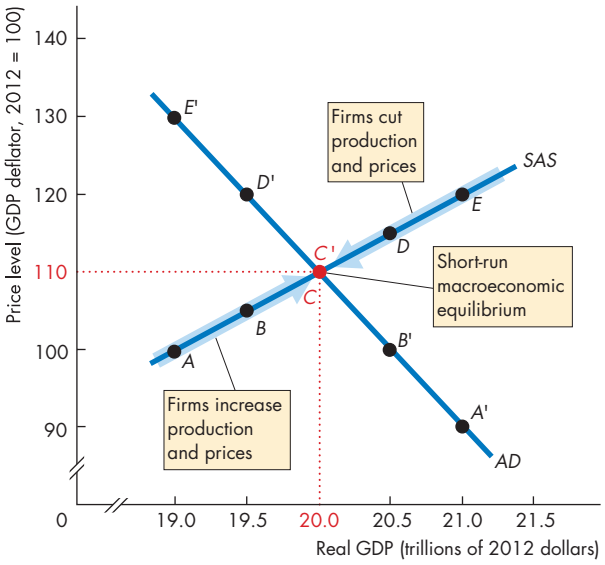
The aggregate demand curve tells us the quantity of real GDP demanded at each price level, and the short-run aggregate supply curve tells us the quantity of real GDP supplied at each price level. **Short-run macroeconomic equilibrium** occurs when the quantity of real GDP demanded equals the quantity of real GDP supplied. That is, short-run macroeconomic equilibrium occurs at the point of intersection of the *AD* curve and the *SAS* curve.

Figure 10.6 shows such an equilibrium at a price level of 110 and real GDP of $20 trillion (points *C* and *C'*).

To see why this position is the equilibrium, think about what happens if the price level is something other than 110. Suppose, for example, that the price level is 120 and that real GDP is $21 trillion (at point *E* on the *SAS* curve). The quantity of real GDP demanded is less than $21 trillion, so firms are unable to sell all their output. Unwanted inventories pile up, and firms cut both production and prices. Production and prices are cut until firms can sell all their output. This situation occurs only when real GDP is $20 trillion and the price level is 110.

Now suppose the price level is 100 and real GDP is $19 trillion (at point *A* on the *SAS* curve). The quantity of real GDP demanded exceeds $19 trillion, so firms are unable to meet the demand for their output. Inventories decrease, and customers clamor for goods and services, so firms increase production and raise prices. Production and prices increase until firms can meet the demand for their output. This situation occurs only when real GDP is $20 trillion and the price level is 110.

FIGURE 10.6 Short-Run Equilibrium



Short-run macroeconomic equilibrium occurs when real GDP demanded equals real GDP supplied—at the intersection of the aggregate demand curve (*AD*) and the short-run aggregate supply curve (*SAS*).

In the short run, the money wage rate is fixed. It does not adjust to move the economy to full employment. So in the short run, real GDP can be greater than or less than potential GDP. But in the long run, the money wage rate adjusts and real GDP moves toward potential GDP. Let's look at the long-run equilibrium and see how we get there.

Long-Run Macroeconomic Equilibrium

Long-run macroeconomic equilibrium occurs when real GDP equals potential GDP—equivalently, when the economy is on its *LAS* curve.

When the economy is away from long-run equilibrium, the money wage rate adjusts. If the money wage rate is too high, short-run equilibrium is below potential GDP and the unemployment rate is above the natural rate. With an excess supply of labor, the money wage rate falls. If the money wage rate is too low, short-run equilibrium is above potential GDP and the unemployment rate is below the natural rate.

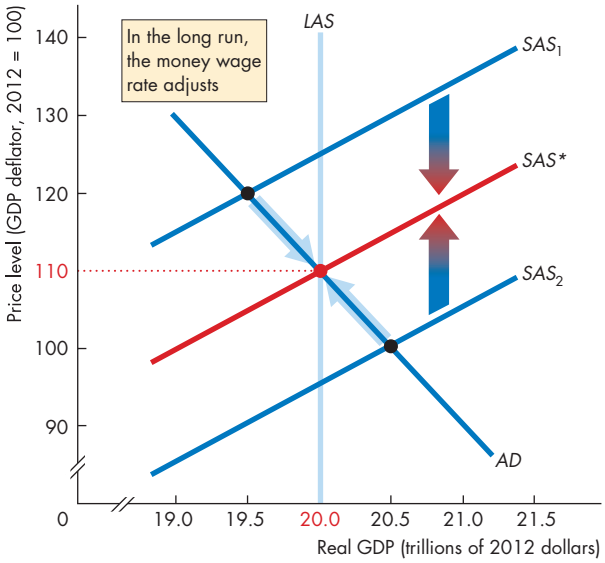
With an excess demand for labor, the money wage rate rises.

Figure 10.7 shows the long-run equilibrium and how it comes about. If the short-run aggregate supply curve is SAS_1, the money wage rate is too high to achieve full employment. A fall in the money wage rate shifts the *SAS* curve to *SAS** and brings full employment. If the short-run aggregate supply curve is SAS_2, the money wage rate is too low to achieve full employment. Now, a rise in the money wage rate shifts the *SAS* curve to *SAS** and brings full employment.

In long-run equilibrium, potential GDP determines real GDP, and potential GDP and aggregate demand together determine the price level. The money wage rate adjusts until the *SAS* curve passes through the long-run equilibrium point.

Let's now see how the *AS-AD* model helps us to understand economic growth and inflation.

FIGURE 10.7 Long-Run Equilibrium



In long-run macroeconomic equilibrium, real GDP equals potential GDP. So long-run equilibrium occurs where the aggregate demand curve, *AD*, intersects the long-run aggregate supply curve, *LAS*. In the long run, aggregate demand determines the price level and has no effect on real GDP. The money wage rate adjusts in the long run, so that the *SAS* curve intersects the *LAS* curve at the long-run equilibrium price level.

Economic Growth and Inflation in the *AS-AD* Model

Economic growth results from a growing supply of labor and increasing labor productivity, which together make potential GDP grow (see Chapter 6, pp. 172–175). Inflation results from a growing quantity of money that outpaces the growth of potential GDP (Chapter 8, pp. 232–233).

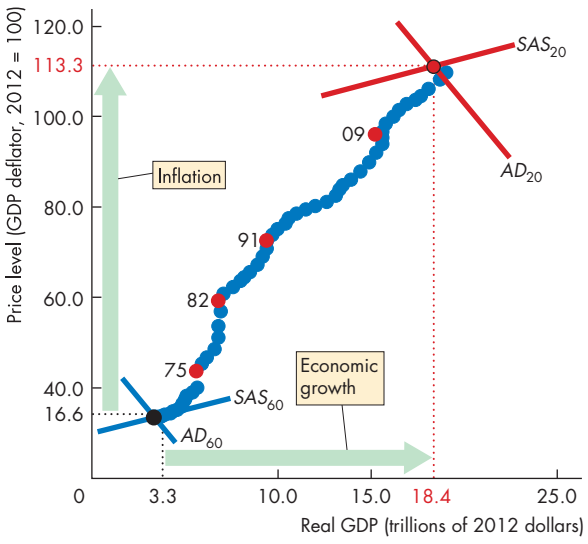
The *AS-AD* model explains and illustrates economic growth and inflation. It explains economic growth as increasing long-run aggregate supply and it explains inflation as a persistent increase in aggregate

ECONOMICS IN ACTION

U.S. Economic Growth and Inflation

The figure is a *scatter diagram* of U.S. real GDP and the price level. The graph has the same axes as those of the *AS-AD* model. Each dot represents a year between 1960 and 2020. The pattern formed by the dots shows the combination of economic growth and inflation. The red dots are recession years in which real GDP decreased.

The *AS-AD* model interprets each dot as being at the intersection of the *SAS* and *AD* curves.



The Path of Real GDP and the Price Level

Source of data: Bureau of Economic Analysis.

demand at a faster pace than that of the increase in potential GDP.

Figure 10.8 illustrates this explanation in terms of the shifting *LAS* and *AD* curves.

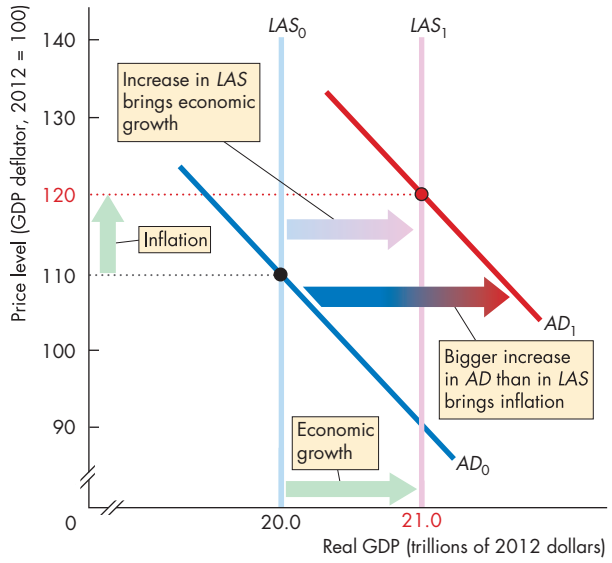
When the *LAS* curve shifts rightward from LAS_0 to LAS_1, potential GDP grows from $20 trillion to $21 trillion. And in long-run equilibrium, real GDP also grows to $21 trillion.

When the *AD* curve shifts rightward from AD_0 to AD_1 and the growth of aggregate demand outpaces the growth of potential GDP, the price level rises from 110 to 120.

If aggregate demand were to increase at the same pace as long-run aggregate supply, real GDP would grow with no inflation.

Our economy experiences periods of growth and inflation, like those shown in Fig. 10.8, but it does not experience *steady* growth and *steady* inflation. Real GDP fluctuates around potential GDP in a business cycle. When we study the business cycle, we ignore economic growth and focus on the fluctuations around the trend growth rate. By doing so, we see the business cycle more clearly. Let's now see how the *AS-AD* model explains the business cycle.

FIGURE 10.8 Economic Growth and Inflation



Economic growth results from a persistent increase in potential GDP—a rightward shift of the *LAS* curve. Inflation results from persistent growth in the quantity of money that shifts the *AD* curve rightward at a faster pace than the real GDP growth rate.

The Business Cycle in the *AS-AD* Model

The business cycle occurs because aggregate demand and short-run aggregate supply fluctuate but the money wage rate does not adjust quickly enough to keep real GDP at potential GDP. Figure 10.9 shows three types of short-run equilibrium.

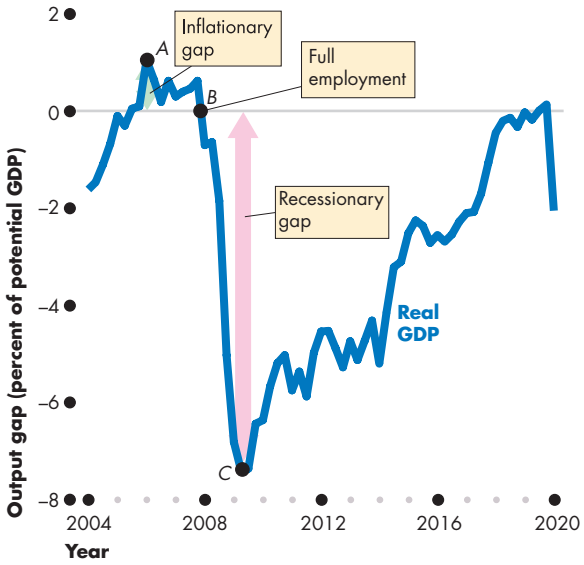
Figure 10.9(a) shows an above full-employment equilibrium. An **above full-employment equilibrium** is an equilibrium in which real GDP exceeds potential GDP. The gap between real GDP and potential GDP is the **output gap**. When real GDP exceeds potential GDP, the output gap is called an **inflationary gap**.

The above full-employment equilibrium shown in Fig. 10.9(a) occurs where the aggregate demand

ECONOMICS IN ACTION

The U.S. Business Cycle

The U.S. economy had an inflationary gap in 2005 (at *A* in the figure), full employment in 2007 (at *B*), and a recessionary gap in 2009 (at *C*). The fluctuating output gap in the figure is the real-world version of Fig. 10.9(d) and is generated by fluctuations in aggregate demand and short-run aggregate supply.



The U.S. Output Gap

Sources of data: Bureau of Economic Analysis and Congressional Budget Office.

curve AD_0 intersects the short-run aggregate supply curve SAS_0 at a real GDP of $20.2 trillion. There is an inflationary gap of $0.2 trillion.

In Fig. 10.9(b), real GDP equals potential GDP and there is a **full-employment equilibrium**. In this example, the equilibrium occurs where the aggregate demand curve AD_1 intersects the short-run aggregate supply curve SAS_1 at a real GDP and potential GDP of $20 trillion.

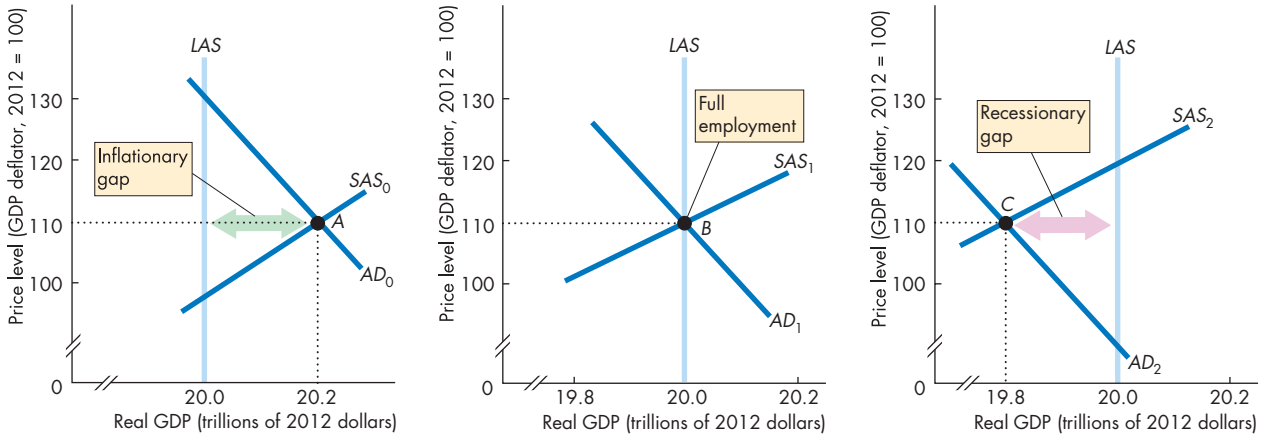
In part (c), there is a below full-employment equilibrium. A **below full-employment equilibrium** is an equilibrium in which potential GDP exceeds real GDP. When potential GDP exceeds real GDP, the output gap is called a **recessionary gap**.

The below full-employment equilibrium shown in Fig. 10.9(c) occurs where the aggregate demand curve AD_2 intersects the short-run aggregate supply curve SAS_2 at a real GDP of $19.8 trillion. Potential GDP is $20 trillion, so the recessionary gap is $0.2 trillion.

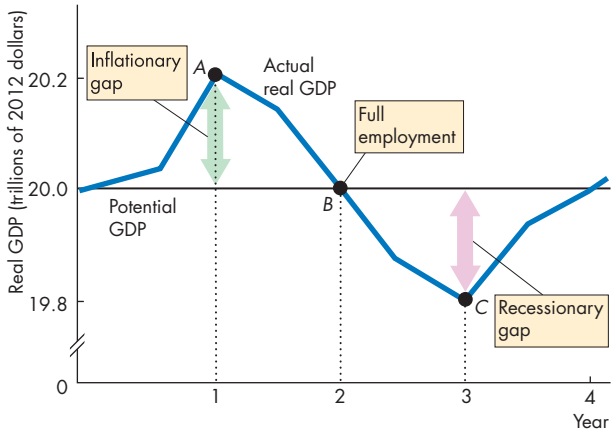
The economy moves from one type of macroeconomic equilibrium to another as a result of fluctuations in aggregate demand and in short-run aggregate supply. These fluctuations produce fluctuations in real GDP. Figure 10.9(d) shows how real GDP fluctuates around potential GDP.

Let's now look at some of the sources of these fluctuations around potential GDP.

FIGURE 10.9 The Business Cycle



(a) Above full-employment equilibrium **(b) Full-employment equilibrium** **(c) Below full-employment equilibrium**



(d) Fluctuations in real GDP

Part (a) shows an above full-employment equilibrium in year 1; part (b) shows a full-employment equilibrium in year 2; and part (c) shows a below full-employment equilibrium in year 3. Part (d) shows how real GDP fluctuates around potential GDP in a business cycle during year 1, year 2, and year 3.

In year 1, an inflationary gap exists and the economy is at point *A* in parts (a) and (d). In year 2, the economy is at full employment and the economy is at point *B* in parts (b) and (d). In year 3, a recessionary gap exists and the economy is at point *C* in parts (c) and (d).

Fluctuations in Aggregate Demand

One reason real GDP fluctuates around potential GDP is that aggregate demand fluctuates. Let's see what happens when aggregate demand increases.

Figure 10.10(a) shows an economy at full employment. The aggregate demand curve is AD_0, the short-run aggregate supply curve is SAS_0, and the long-run aggregate supply curve is LAS. Real GDP equals potential GDP at $20 trillion, and the price level is 110.

Now suppose that the world economy expands and that the demand for U.S.-produced goods increases in Asia and Europe. The increase in U.S. exports increases aggregate demand in the United States, and the aggregate demand curve shifts rightward from AD_0 to AD_1 in Fig. 10.10(a).

Faced with an increase in demand, firms increase production and raise prices. Real GDP increases to $20.5 trillion, and the price level rises to 115. The economy is now in an above full-employment equilibrium. Real GDP exceeds potential GDP, and there is an inflationary gap.

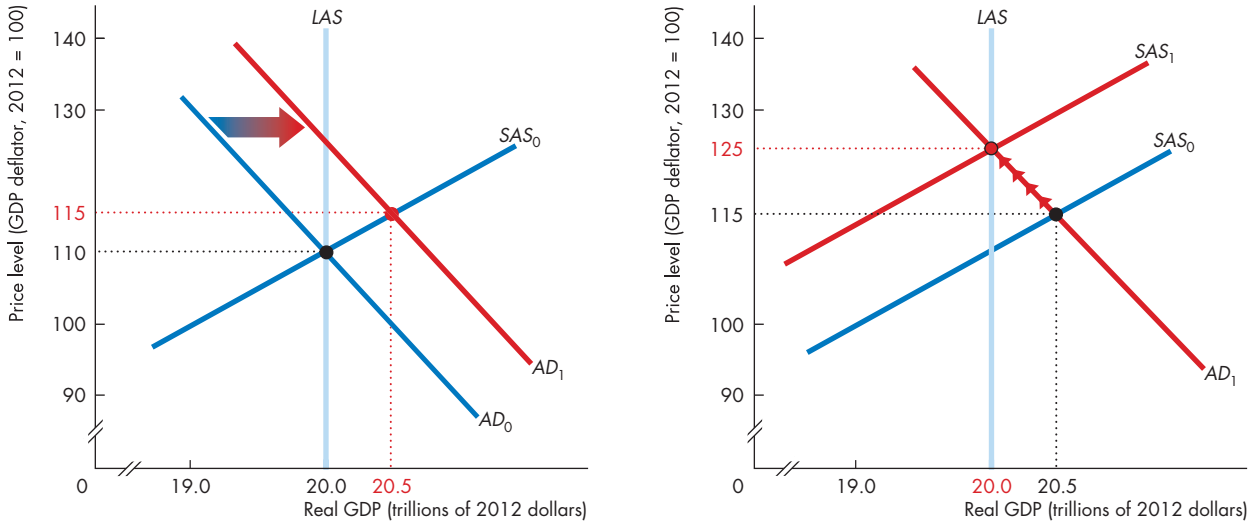
The increase in aggregate demand has increased the prices of all goods and services. Faced with higher prices, firms increase their output rates. At this stage, prices of goods and services have increased but the money wage rate has not changed. (Recall that as we move along the *SAS* curve, the money wage rate is constant.)

The economy cannot produce in excess of potential GDP forever. Why not? What are the forces at work that bring real GDP back to potential GDP?

Because the price level has increased and the money wage rate is unchanged, workers have experienced a fall in the buying power of their wages and firms' profits have increased. Under these circumstances, workers demand higher wages and firms, anxious to maintain their employment and output levels, meet those demands. If firms do not raise the money wage rate, they will either lose workers or have to hire less productive ones.

As the money wage rate rises, the short-run aggregate supply begins to decrease. In Fig. 10.10(b), the short-run aggregate supply curve begins to shift from

FIGURE 10.10 An Increase in Aggregate Demand



(a) Short-run effect **(b) Long-run effect**

An increase in aggregate demand shifts the aggregate demand curve from AD_0 to AD_1. In short-run equilibrium, real GDP increases to $20.5 trillion and the price level rises to 115. In this situation, an inflationary gap exists. In the long run in part (b), the money wage rate starts to rise and short-run aggregate supply starts to decrease. The *SAS* curve gradually shifts from SAS_0 toward SAS_1, intersecting the aggregate demand curve AD_1 at higher price levels, and real GDP decreases. Eventually, the price level has risen to 125 and real GDP has decreased to $20 trillion—potential GDP.

SAS_0 toward SAS_1. The rise in the money wage rate and the shift in the *SAS* curve produce a sequence of new equilibrium positions. Along the adjustment path, real GDP decreases and the price level rises. The economy moves up along its aggregate demand curve as shown by the arrows in the figure.

Eventually, the money wage rate rises by the same percentage as the price level. At this time, the aggregate demand curve AD_1 intersects SAS_1 at a new full-employment equilibrium. The price level has risen to 125, and real GDP is back where it started, at potential GDP.

A decrease in aggregate demand has effects similar but opposite to those of an increase in aggregate demand. That is, a decrease in aggregate demand shifts the aggregate demand curve leftward. Real GDP decreases to less than potential GDP, and a recessionary gap emerges. Firms cut prices. The lower price level increases the purchasing power of wages and increases firms' costs relative to their output prices because the money wage rate is unchanged. Eventually, the money wage rate falls and the short-run aggregate supply increases.

Let's now work out how real GDP and the price level change when aggregate supply changes.

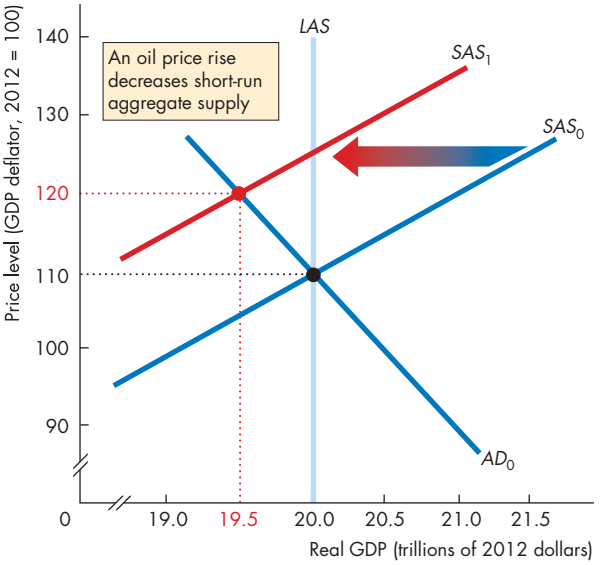
Fluctuations in Aggregate Supply

Fluctuations in short-run aggregate supply can bring fluctuations in real GDP around potential GDP. Suppose that initially real GDP equals potential GDP. Then there is a large but temporary rise in the price of oil. What happens to real GDP and the price level?

Figure 10.11 answers this question. The aggregate demand curve is AD_0, the short-run aggregate supply curve is SAS_0, and the long-run aggregate supply curve is *LAS*. Real GDP is $20 trillion, which equals potential GDP, and the price level is 110. Then the price of oil rises. Faced with higher energy and transportation costs, firms decrease production. Short-run aggregate supply decreases, and the short-run aggregate supply curve shifts leftward to SAS_1. The price level rises to 120, and real GDP decreases to $19.5 trillion. Because real GDP decreases, the economy experiences recession. Because the price level increases, the economy experiences inflation. A combination of recession and inflation is called **stagflation**. The United States experienced stagflation in the mid-1970s and early 1980s, but events like this are not common.

When the price of oil returns to its original level, the economy returns to full employment.

FIGURE 10.11 A Decrease in Aggregate Supply



An increase in the price of oil decreases short-run aggregate supply and shifts the short-run aggregate supply curve from SAS_0 to SAS_1. Real GDP decreases from $20 trillion to $19.5 trillion, and the price level rises from 110 to 120. The economy experiences stagflation.

REVIEW QUIZ

1. Does economic growth result from increases in aggregate demand, short-run aggregate supply, or long-run aggregate supply?
2. Does inflation result from increases in aggregate demand, short-run aggregate supply, or long-run aggregate supply?
3. Describe three types of short-run macroeconomic equilibrium.
4. How do fluctuations in aggregate demand and short-run aggregate supply bring fluctuations in real GDP around potential GDP?

We can use the *AS-AD* model to explain and illustrate the views of the alternative schools of thought in macroeconomics. That is your next task.

Macroeconomic Schools of Thought

Macroeconomics is an active field of research, and much remains to be learned about the forces that make our economy grow and fluctuate. There is a greater degree of consensus and certainty about economic growth and inflation—the longer-term trends in real GDP and the price level—than there is about the business cycle—the short-term fluctuations in these variables. Here, we'll look only at differences of view about short-term fluctuations.

The *AS-AD* model that you've studied in this chapter provides a good foundation for understanding the range of views that macroeconomists hold about this topic. But what you will learn here is just a first glimpse at the scientific controversy and debate. We'll return to these issues at various points later in the text and deepen your appreciation of the alternative views.

Classification usually requires simplification, and classifying macroeconomists is no exception to this general rule. The classification that we'll use here is simple, but it is not misleading. We're going to divide macroeconomists into three broad schools of thought and examine the views of each group in turn. The groups are

- Classical
- Keynesian
- Monetarist

The Classical View

A **classical** macroeconomist believes that the economy is self-regulating and always at full employment. The term "classical" derives from the name of the founding school of economics that includes Adam Smith, David Ricardo, and John Stuart Mill.

A **new classical** view is that business cycle fluctuations are the efficient responses of a well-functioning market economy that is bombarded by shocks that arise from the uneven pace of technological change.

The classical view can be understood in terms of beliefs about aggregate demand and aggregate supply.

Aggregate Demand Fluctuations In the classical view, technological change is the most significant influence on both aggregate demand and aggregate supply. For this reason, classical macroeconomists don't use the *AS-AD* framework. But their views can be interpreted in this framework. A technological change that increases the productivity of capital brings an increase in aggregate demand because firms increase their expenditure on new plant and equipment. A technological change that lengthens the useful life of existing capital decreases the demand for new capital, which decreases aggregate demand.

Aggregate Supply Response In the classical view, the money wage rate that lies behind the short-run aggregate supply curve is instantly and completely flexible. The money wage rate adjusts so quickly to maintain equilibrium in the labor market that real GDP always adjusts to equal potential GDP.

Potential GDP itself fluctuates for the same reasons that aggregate demand fluctuates: technological change. When the pace of technological change is rapid, potential GDP increases quickly and so does real GDP. And when the pace of technological change slows, so does the growth rate of potential GDP.

Classical Policy The classical view of policy emphasizes the potential for taxes to stunt incentives and create inefficiency. Minimizing the disincentive effects of taxes will allow employment, investment, and technological advance to be at their efficient levels and the economy to expand at an appropriate and rapid pace.

The Keynesian View

A **Keynesian** macroeconomist believes that left alone, the economy would rarely operate at full employment and that to achieve and maintain full employment, active help from fiscal policy and monetary policy is required.

The term "Keynesian" derives from the name of one of the twentieth century's most famous economists, John Maynard Keynes (see p. 351).

The Keynesian view is based on beliefs about the forces that determine aggregate demand and short-run aggregate supply.

Aggregate Demand Fluctuations In the Keynesian view, *expectations* are the most significant influence on aggregate demand. Those expectations are based on herd instinct, or what Keynes himself called "animal spirits." A wave of pessimism about future profit prospects can lead to a fall in aggregate demand and plunge the economy into recession.

Aggregate Supply Response In the Keynesian view, the money wage rate that lies behind the short-run aggregate supply curve is extremely sticky in the downward direction. Basically, the money wage rate doesn't fall. So if there is a recessionary gap, there is no automatic mechanism for getting rid of it. If it were to happen, a fall in the money wage rate would increase short-run aggregate supply and restore full employment. But the money wage rate doesn't fall, so the economy remains stuck in recession.

A modern version of the Keynesian view, known as the **new Keynesian** view, holds not only that the money wage rate is sticky but also that prices of goods and services are sticky. With a sticky price level, the short-run aggregate supply curve is horizontal at a fixed price level.

Policy Response Needed The Keynesian view calls for fiscal policy and monetary policy to actively offset changes in aggregate demand that bring recession.

By stimulating aggregate demand in a recession, full employment can be restored.

The Monetarist View

A **monetarist** is a macroeconomist who believes that the economy is self-regulating and that it will normally operate at full employment, provided that monetary policy is not erratic and that the pace of money growth is kept steady.

The term "monetarist" was coined by an outstanding twentieth-century economist, Karl Brunner, to describe his own views and those of Milton Friedman (see p. 404).

The monetarist view can be interpreted in terms of beliefs about the forces that determine aggregate demand and short-run aggregate supply.

Aggregate Demand Fluctuations In the monetarist view, *the quantity of money* is the most significant influence on aggregate demand. The quantity of money is determined by the Federal Reserve (the Fed). If the Fed keeps money growing at a steady pace, aggregate demand fluctuations will be minimized and the economy will operate close to full employment. But if the Fed decreases the quantity of money or even just slows its growth rate too abruptly, the economy will go into recession. In the monetarist view, all recessions result from inappropriate monetary policy.

Aggregate Supply Response The monetarist view of short-run aggregate supply is the same as the Keynesian view: the money wage rate is sticky. If the economy is in recession, it will take an unnecessarily long time for it to return unaided to full employment.

Monetarist Policy The monetarist view of fiscal policy is the same as the classical view. Taxes should be kept low to avoid disincentive effects that decrease potential GDP. Provided that the quantity of money is kept on a steady growth path, no active stabilization is needed to offset changes in aggregate demand.

The Way Ahead

In the chapters that follow, you're going to encounter Keynesian, classical, and monetarist views again. In the next chapter, we study the original Keynesian model of aggregate demand. This model remains useful today because it explains how expenditure fluctuations are magnified and bring changes in aggregate demand that are larger than the changes in expenditure. We then go on to apply the *AS-AD* model to a deeper look at the business cycle, inflation, and deflation.

Our attention then turns to macroeconomic policy—the fiscal policy of the Administration and Congress and the monetary policy of the Fed.

REVIEW QUIZ

1 What are the defining features of classical macroeconomics and what policies do classical macroeconomists recommend?
2 What are the defining features of Keynesian macroeconomics and what policies do Keynesian macroeconomists recommend?
3 What are the defining features of monetarist macroeconomics and what policies do monetarist macroeconomists recommend?

To complete your study of the *AS-AD* model, *Economics in the News* on pp. 290–291 looks at the U.S. economy in the Covid-19 pandemic through the eyes of this model.

Aggregate Supply and Aggregate Demand in Action

Recession Caused by Covid-19 Lasted Two Months, the Shortest Downturn on Record

USA Today
July 20, 2021

The National Bureau of Economic Research (NBER) said Monday that economic activity reached "a trough," or bottom, in April 2020, economic jargon for stating that the recession ended. …

Since NBER declared last year that the downturn began in March 2020, ending the longest expansion in U.S. history at about 10½ years, the two-month slump was the shortest on record, it said. That also means May 2020 marked the start of the current expansion, the nonprofit organization said. …

How do you know when a recession starts?

To make its assessments, NBER considers data like inflation-adjusted gross domestic product and income, employment, industrial production and wholesale and retail sales, the agency said. …

… gross domestic product plunged at a record 31.4% annual rate in the second quarter before growing a most-ever 33.4% the following quarter.

Normally, a recession is defined as more than a few months of declining activity. The previous shortest recession lasted six months in the first half of 1980, NBER said. That suggests the COVID-19 slump was so short it may not meet the criteria for a recession.

"In deciding whether to identify a recession, the committee weighs the depth of the contraction, its duration, and whether economic activity declined broadly across the economy," NBER said. "The committee concluded that the unprecedented magnitude of the decline in employment and production, and its broad reach across the entire economy, warranted the designation of this episode as a recession, even though the downturn was briefer than earlier contractions."…

Copyright Paul Davidson, *USA Today*, July 20, 2021.

ESSENCE OF THE STORY

- The NBER declared March 2020 as the start of the Covid-19 recession and the end of the longest expansion in U.S. history at 10½ years.
- The NBER says the Covid-19 recession ended at a trough in April 2020, making it the shortest ever recession.
- Normally, a recession is defined as more than six months of declining activity, but the Covid-19 slump was so deep it was judged to meet the criteria for a recession.
- Real GDP fell at a record 31.4 percent annual rate in the second quarter and grew at a record 33.4 percent in the third quarter.

ECONOMIC ANALYSIS

- When the coronavirus hit the United States in March 2020, social interaction restrictions delivered a large negative shock to the economy.
- In the second quarter, April through June, real GDP shrank at a record 31.4 percent annual rate and the price level, measured as the GDP deflator, fell by 0.5 percent.
- But as the news article reports, the economic collapse was short lived.
- In the third quarter, July through September, real GDP grew at a record 33.4 percent and the price level (GDP deflator) rose by almost 1 percent.
- The economy had made a dramatic V-shaped recovery, which Fig.1 shows. Note that the percentage increase exceeded the percentage decrease but from a smaller base, so in the third quarter, real GDP was still lower than its first quarter level.
- The *AS-AD* model explains these changes in real GDP and the price level.
- Figure 2 shows the economy before and in the Covid-19 contraction.
- In the first quarter of 2020, aggregate demand was AD_1 and short-run aggregate supply was SAS_1 so real GDP was $19 trillion and the price level was 113.4. The economy was close to full employment.
- Restrictions on social interaction and stay-at-home orders decreased both aggregate demand and aggregate supply and the two curves shifted leftward to AD_2 and SAS_2 so real GDP shrank to $17.3 trillion and the price level fell to 112.8.
- Both real GDP and the price level fell because the decrease in aggregate demand exceeded the decrease in aggregate supply.
- Figure 3 starts at the trough and shows the recovery.
- As restrictions on social interaction and stay-at-home orders eased, both aggregate demand and aggregate supply increased and the two curves shifted rightward to AD_3 and SAS_3 so real GDP increased to $18.6 trillion and the price level rose to 113.8.
- Both real GDP and the price level increased because the increase in aggregate demand exceeded the increase in aggregate supply.

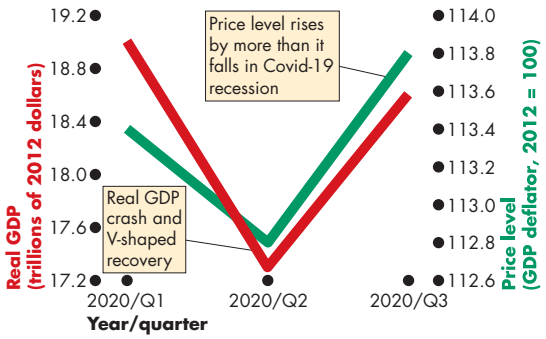


Figure 1 A V-Shaped Recession and Recovery

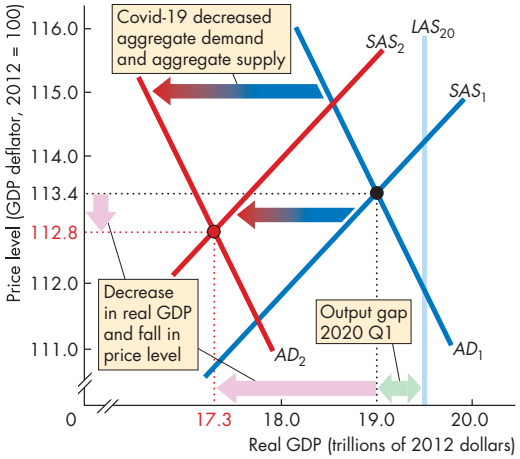


Figure 2 *AS-AD* in the First and Second Quarter of 2020

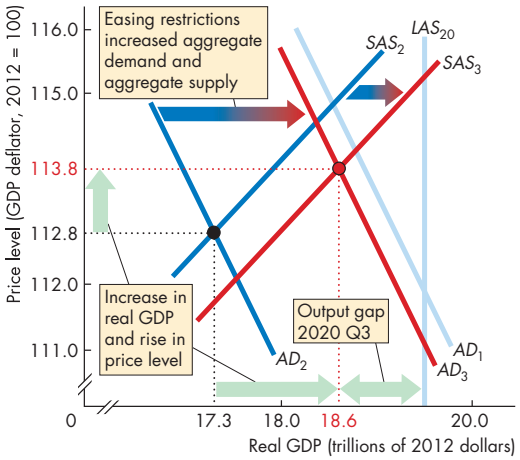


Figure 3 *AS-AD* in the Second and Third Quarter of 2020

WORKED PROBLEM

The table shows the aggregate demand and short-run aggregate supply schedules of Lizard Island in which potential GDP is $600 billion.

Price level	Real GDP demanded (billions of 2012 dollars)	Real GDP supplied in the short run (billions of 2012 dollars)
100	600	550
110	575	575
120	550	600
130	525	625

Questions

1. Calculate the short-run equilibrium real GDP and price level.
2. Does the country have an inflationary gap or a recessionary gap and what is its magnitude?
3. If real GDP demanded at each price level increases by $50 billion, what is the new short-run macroeconomic equilibrium and the output gap?

Solutions

1. Short-run macroeconomic equilibrium occurs at the price level at which the quantity of real GDP demanded equals the quantity of real GDP supplied.

   At a price level of 110, the quantity of real GDP demanded is $575 billion and the quantity of real GDP supplied is $575 billion, so equilibrium real GDP is $575 billion and the price level is 110. See the equilibrium in the figure.

Key Point: Aggregate demand and aggregate supply determine the short-run macroeconomic equilibrium.

2. The output gap is the gap between equilibrium real GDP and potential GDP. Equilibrium real GDP is $575 billion and potential GDP is $600 billion, so the output gap is $25 billion. Because potential GDP exceeds equilibrium real GDP, the economy is in a below full-employment equilibrium and the output gap is a recessionary gap.

Key Point: A recessionary gap occurs when the economy is in a below full-employment equilibrium. When the economy is in an above full-employment equilibrium, the output gap is an inflationary gap.

3. The table below shows the new aggregate demand schedule when real GDP demanded increases by $50 billion at each price level.

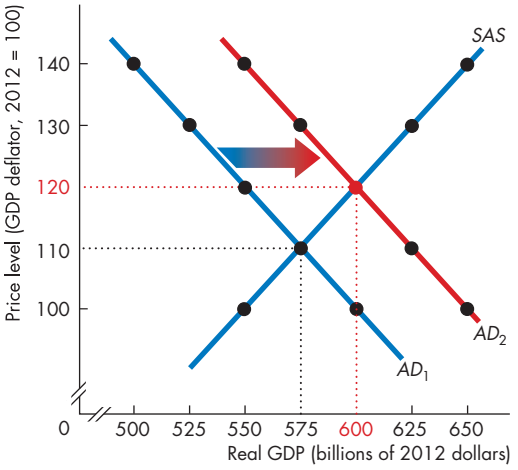
Price level	Real GDP demanded (billions of 2012 dollars)	Real GDP supplied in the short run (billions of 2012 dollars)
100	650	550
110	625	575
120	600	600
130	575	675

At a price level of 110, the quantity of real GDP demanded ($625 billion) exceeds the quantity of real GDP supplied ($575 billion). Firms are unable to meet the demand for their output, so inventories start to decline. As people clamor for goods and services, firms increase production and start to raise their prices. Production and prices will continue to increase until a new short-run equilibrium is reached.

At the new equilibrium, real GDP is $600 billion and the price level is 120. Because equilibrium real GDP equals potential GDP of $600 billion, the economy is at full employment and there is no output gap. See the new short-run equilibrium in the figure.

Key Point: An increase in aggregate demand with no change in aggregate supply increases the price level and increases equilibrium real GDP.

Key Figure



SUMMARY

Key Points

Aggregate Supply (pp. 274–277)

- In the long run, the quantity of real GDP supplied is potential GDP.
- In the short run, a rise in the price level increases the quantity of real GDP supplied.
- A change in potential GDP changes long-run and short-run aggregate supply. A change in the money wage rate changes only short-run aggregate supply.

Aggregate Demand (pp. 278–281)

- A rise in the price level decreases the quantity of real GDP demanded.
- Changes in expected future income, inflation, and profits; in fiscal policy and monetary policy; and in foreign income and the exchange rate change aggregate demand.

Explaining Macroeconomic Trends and Fluctuations (pp. 282–287)

- Aggregate demand and short-run aggregate supply determine real GDP and the price level.
- In the long run, real GDP equals potential GDP and aggregate demand determines the price level.
- The business cycle occurs because aggregate demand and aggregate supply fluctuate.

Macroeconomic Schools of Thought (pp. 288–289)

- Classical economists believe that the economy is self-regulating and always at full employment.
- Keynesian economists believe that full employment can be achieved only with active policy.
- Monetarist economists believe that recessions result from inappropriate monetary policy.

Key Terms

Above full-employment equilibrium, 284
Aggregate demand, 278
Below full-employment equilibrium, 285
Classical, 288
Disposable income, 280
Fiscal policy, 280
Full-employment equilibrium, 285
Inflationary gap, 284
Keynesian, 288
Long-run aggregate supply, 274
Long-run macroeconomic equilibrium, 282
Monetarist, 289
Monetary policy, 280
New classical, 288
New Keynesian, 289
Output gap, 284
Recessionary gap, 285
Short-run aggregate supply, 275
Short-run macroeconomic equilibrium, 282
Stagflation, 287

PROBLEMS AND APPLICATIONS

Aggregate Supply

1. Explain the influence of each of the following events on the quantity of real GDP supplied and aggregate supply in India and use a graph to illustrate.
   - U.S. firms move their call handling, IT, and data functions to India.
   - Fuel prices rise.
   - Walmart and Starbucks open in India.
   - Universities in India increase the number of engineering graduates.
   - The money wage rate rises.
   - The price level in India increases.
2. Labor productivity is rising at a rapid rate in China and wages are rising at a similar rate. Explain how a rise in labor productivity and wages in China will influence the quantity of real GDP supplied and aggregate supply in China.

Aggregate Demand

3. Canada trades with the United States. Explain the effect of each of the following events on Canada's aggregate demand.
   - The government of Canada cuts income taxes.
   - The United States experiences strong economic growth.
   - Canada sets new environmental standards that require power utilities to upgrade their production facilities.
4. The European Central Bank (ECB) increases the quantity of money and all other things remain the same. Explain the effect of the increase in the quantity of money on aggregate demand in the short run.
5. **Japan's Gross Domestic Product for the Third Quarter of 2017**

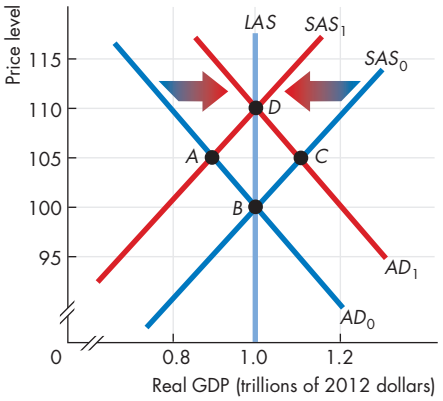
   Japan's GDP rose by 0.3 percent in the third quarter, primarily because of an increase in exports and a slow increase in investment. Personal consumption fell for the first time in two years, imports rose, and government spending decreased to ¥ 106331.80 billion.

   Source: tradingeconomics.com, December 3, 2017

   Explain how the items in the news clip influence Japan's aggregate demand.

Explaining Macroeconomic Trends and Fluctuations

Use the following graph to work Problems 6 to 8. Initially, the short-run aggregate supply curve is SAS_0 and the aggregate demand curve is AD_0.



6. Some events change aggregate demand from AD_0 to AD_1. Describe two events that could have created this change in aggregate demand. What is the equilibrium after aggregate demand changed? If potential GDP is $1 trillion, the economy is at what type of macroeconomic equilibrium?
7. Some events change aggregate supply from SAS_0 to SAS_1. Describe two events that could have created this change in aggregate supply. What is the equilibrium after aggregate supply changed? If potential GDP is $1 trillion, does the economy have an inflationary gap, a recessionary gap, or no output gap?
8. Some events change aggregate demand from AD_0 to AD_1 and aggregate supply from SAS_0 to SAS_1. What is the new macroeconomic equilibrium?

Macroeconomic Schools of Thought

9. Describe the policy change that a classical macroeconomist, a Keynesian, and a monetarist would recommend for policymakers in a European country to adopt in response to each of the following events:
   a. Inflation rises rapidly.
   b. Growth in the world economy accelerates.
   c. The world price of oil falls.

ADDITIONAL PROBLEMS AND APPLICATIONS

Aggregate Supply

10. Explain for each event whether it changes the quantity of real GDP supplied, short-run aggregate supply, long-run aggregate supply, or a combination of them.
    - Automotive firms in the United States switch to a new technology that raises productivity.
    - Toyota and Honda build additional plants in the United States.
    - The prices of auto parts imported from China rise.
    - Autoworkers agree to a lower money wage rate.
    - The U.S. price level rises.

Aggregate Demand

11. Explain for each event whether it changes the quantity of real GDP demanded or aggregate demand in Japan.
    - The Japanese price level rises.
    - A depreciation of the yen attracts more tourists to Japan.
    - Japan's coal consumption rises due to a prolonged shut down of nuclear plants.
    - Japan's sales tax rises.
12. **Changes in Inventory Investment**

    When real GDP increased in the first quarter of 2015, personal consumption expenditure, private inventory investment, and imports increased while exports, nonresidential fixed investment, and government spending decreased.

    Source: Bureau of Economic Analysis, April 29, 2015

    Explain how the increase in private inventory investment affected U.S. aggregate demand.
13. **France's Exports and Imports**

    Seasonally adjusted trade data for France showed that exports of goods and services decreased by 2.4 percent in the first quarter of 2017, compared with an increase of 0.4 percent in the fourth quarter of 2016. Imports of goods and services to France increased 2 percent in the first quarter of 2017, compared with a decrease of 1.2 percent in the fourth quarter of 2016.

    Source: www.oecd.org, 2017

    a. Explain how the changes in exports and imports reported here influence the quantity of real GDP demanded and aggregate demand.

    b. In which of the two quarters reported did exports and imports make the greater impact on aggregate demand?

Explaining Macroeconomic Trends and Fluctuations

Use the following information to work Problems 14 to 16.

The following events were reported in the East Asia and Pacific Economic Update published by the World Bank in April 2015:

- Global economic recovery supports a moderate increase in China's exports.
- China benefits from a fall in the world price of oil.
- The Chinese government will cut excess capacity in heavy industry.
- U.S. firms will relocate their labor-intensive manufacturing industries to low-cost countries.

14. Explain for each event whether it changes China's short-run aggregate supply, long-run aggregate supply, aggregate demand, or some combination of them.
15. Explain how each factor separately affects China's real GDP and the price level, starting from a position of long-run equilibrium.
16. Explain the combined effects of these factors on China's real GDP and the price level, starting from a position of long-run equilibrium.

Use the following information to work Problems 17 and 18.

In Japan, potential GDP is 600 trillion yen and the table shows the aggregate demand and short-run aggregate supply schedules.

Price level	Real GDP demanded	Real GDP supplied in the short run
	(trillions of 2009 yen)	
75	600	400
85	550	450
95	500	500
105	450	550
115	400	600
125	350	650
135	300	700

17. a. Draw a graph of the aggregate demand curve and the short-run aggregate supply curve.

    b. What is the short-run equilibrium real GDP and price level?
18. Does Japan have an inflationary gap or a recessionary gap and what is its magnitude?

Use the following news clip to work Problems 19 and 20.

Gen Z, the Pandemic, and How They Pay

A 2018 study estimated Gen Z's spending power to be significant. Is this still the case? The pandemic destroyed many of the jobs that Gen Z seek, so like other predictions coming out of the pandemic, we're waiting to see how the new reality affects Gen Z financially in the long term.

Source: forbes.com, January 21, 2021

19. Suppose that Gen Z comes strongly out of the pandemic. Explain the effect of a rise in expenditure by Gen Z on real GDP and the price level in the short run.
20. Describe the macroeconomic equilibrium after an increase in spending by Gen Z:
    a. If the economy had been operating below full-employment equilibrium.
    b. If the economy had been operating at a full-employment equilibrium.
    c. Explain and draw a graph to illustrate how the economy adjusts in the two situations described in parts a and b.
21. Suppose the E.U. economy goes into an expansion. Explain the effect of the expansion on U.S. real GDP and unemployment in the short run.
22. Explain why changes in consumer spending and business investment play a large role in the business cycle.
23. **Federal Reserve Slashes Interest Rates to Zero**

    The Fed is dropping its interest rate to zero percent. The Fed wants to keep borrowing costs as low as possible as it sees the economy falling into recession. This announcement follows a previous interest rate cut less than two weeks ago.

    Source: washingtonpost.com, March 15, 2020

    a. Describe the process by which the Fed's action in the news clip flows through the economy.
    b. Draw a graph to illustrate the state of the economy that prompted the Fed to take the action described in the news clip.
    c. Draw a graph to illustrate the Fed's action and its effect.

Macroeconomic Schools of Thought

24. **Cut Taxes and Boost Spending? Raise Taxes and Cut Spending? Cut Taxes and Cut Spending?**

    This headline expresses three views about what to do to get the U.S. economy growing more rapidly and contribute to closing the recessionary gap.

    Economists from which macroeconomic school of thought would recommend pursuing policies described by each of these views?

Economics in the News

25. After you have studied *Economics in the News* on pp. 290–291, answer the following questions.
    a. What were the main features of the U.S. economy in the first quarter of 2020? Did the United States have a recessionary gap or an inflationary gap? How do you know?
    b. Use the *AS-AD* model to show the changes in aggregate demand and aggregate supply that occurred in the second quarter of 2020.
    c. Use the *AS-AD* model to show the changes in aggregate demand and aggregate supply that occurred in the third quarter of 2020.
    d. Use the *AS-AD* model to show the changes in aggregate demand and aggregate supply that would have occurred without the federal government's Covid stimulus.
    e. Use the *AS-AD* model to show the changes in aggregate demand and aggregate supply that would occur if the federal government's stimulus was exactly the right size to restore full employment.
    f. Use the *AS-AD* model to show the changes in aggregate demand and aggregate supply that would occur if the federal government's stimulus was too large and brought an inflationary gap. Show the short-run and the long-run effects.
26. **Eurozone Out of Recession After Economy Grows 2%**

    The Eurozone economy grew 2 percent in the second quarter of 2021, moving the economy out of recession. Consumer expenditure made a large contribution to the growth of the economies of France, Germany, and Spain. Eurozone real GDP remains down 3 percent from its pre-pandemic level in 2019.

    Source: bbc.com, July 30, 2020

    a. Assuming that the Eurozone was at full employment prior to the pandemic, explain its current macroeconomic equilibrium.
    b. Draw a diagram to illustrate the state of the Eurozone economy in the second quarter of 2021.

11 EXPENDITURE MULTIPLIERS

After studying this chapter, you will be able to:

- Explain how expenditure plans are determined when the price level is fixed
- Explain how real GDP is determined when the price level is fixed
- Explain the expenditure multiplier
- Explain the relationship between aggregate expenditure and aggregate demand

Investment and inventories fluctuate like the volume of a rock singer's voice and the uneven surface of a New York City street. How does the economy react to those fluctuations? Does it behave like an amplifier, blowing up the fluctuations and spreading them out to affect the many millions of participants in an economic rock concert? Or does it react like a limousine, absorbing the shocks and providing a smooth ride for the economy's passengers?

You will explore these questions in this chapter and in *Economics in the News* at the end of the chapter, you will see the mechanisms at work during 2020 as GDP shrank in the Covid-19 pandemic.

Fixed Prices and Expenditure Plans

In the model that we study in this chapter, all the firms are like your grocery store: They set their prices and sell the quantities their customers are willing to buy. If they persistently sell more than they plan to and keep running out of inventory, they eventually raise their prices. And if they persistently sell less than they plan to and have inventories piling up, they eventually cut their prices. But on any given day, their prices are fixed and the quantities they sell depend on demand, not supply.

Because each firm's prices are fixed, for the economy as a whole

1. The *price level* is fixed, and
2. *Aggregate demand* determines real GDP.

We call this model the *Keynesian model* because it was first suggested by John Maynard Keynes (see p. 351) as a model of persistent depression.

We begin by identifying the forces that determine expenditure plans.

Expenditure Plans

Aggregate expenditure has four components: consumption expenditure, investment, government expenditure on goods and services, and net exports (exports *minus* imports). These four components sum to real GDP (see Chapter 4, pp. 117–118).

Aggregate planned expenditure is equal to the sum of the *planned* levels of consumption expenditure, investment, government expenditure on goods and services, and exports minus imports. Two of these components of planned expenditure, consumption expenditure and imports, change when income changes and so they depend on real GDP.

A Two-Way Link Between Aggregate Expenditure and Real GDP There is a two-way link between aggregate expenditure and real GDP. Other things remaining the same,

- An increase in real GDP increases aggregate expenditure, and
- An increase in aggregate expenditure increases real GDP.

You are now going to study this two-way link.

Consumption and Saving Plans

Several factors influence consumption expenditure and saving plans. The more important ones are

1. Disposable income
2. Real interest rate
3. Wealth
4. Expected future income

Disposable income is aggregate income minus taxes plus transfer payments. Aggregate income equals real GDP, so disposable income depends on real GDP. To explore the two-way link between real GDP and planned consumption expenditure, we focus on the relationship between consumption expenditure and disposable income when the other three factors listed above are constant.

Consumption Expenditure and Saving Figure 11.1 illustrates the link. We begin with the table, which lists the consumption expenditure and the saving that people plan at each level of disposable income. Households cannot spend more than their disposable income, so planned consumption expenditure plus planned saving *always* equals disposable income.

The relationship between consumption expenditure and disposable income, other things remaining the same, is called the **consumption function**. The relationship between saving and disposable income, other things remaining the same, is called the **saving function**.

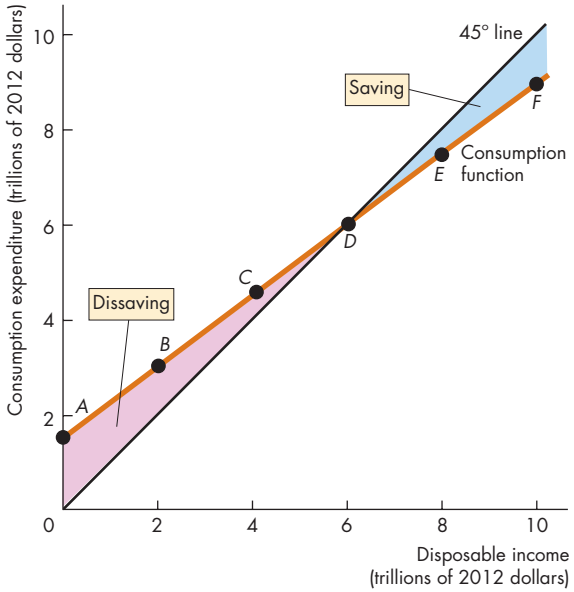
Consumption Function Figure 11.1(a) shows a consumption function. The y-axis measures consumption expenditure, and the x-axis measures disposable income. Along the consumption function, the points labeled A through F correspond to the rows of the table. For example, point E shows that when disposable income is $8 trillion, consumption expenditure is $7.5 trillion. As disposable income increases, consumption expenditure also increases.

At point A on the consumption function, consumption expenditure is $1.5 trillion even though disposable income is zero. This consumption expenditure is called *autonomous consumption*, and it is the consumption expenditure that would take place in the short run even if people had no current income. Consumption expenditure in excess of this amount is called *induced consumption*, which is the consumption expenditure that is induced by an increase in disposable income.

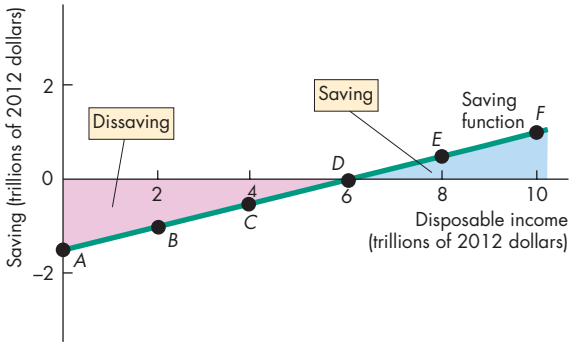
45° Line Figure 11.1(a) also contains a 45° line, the height of which measures disposable income. At each point on this line, consumption expenditure equals disposable income. Between points *A* and *D*, consumption expenditure exceeds disposable income, between points *D* and *F* consumption expenditure is less than disposable income, and at point *D*, consumption expenditure equals disposable income.

Saving Function Figure 11.1(b) shows a saving function. Again, the points *A* through *F* correspond to the rows of the table. For example, point *E* shows that when disposable income is $8 trillion, saving is $0.5 trillion. As disposable income increases, saving increases. Notice that when consumption expenditure exceeds disposable income in part (a), saving is negative, called *dissaving*, in part (b).

FIGURE 11.1 Consumption Function and Saving Function



(a) Consumption function



(b) Saving function

	Disposable income	Planned consumption expenditure	Planned saving
	(trillions of 2012 dollars)		
A	0	1.5	−1.5
B	2	3.0	−1.0
C	4	4.5	−0.5
D	6	6.0	0
E	8	7.5	0.5
F	10	9.0	1.0

The table shows consumption expenditure and saving plans at various levels of disposable income. Part (a) of the figure shows the relationship between consumption expenditure and disposable income (the consumption function). The height of the consumption function measures consumption expenditure at each level of disposable income. Part (b) shows the relationship between saving and disposable income (the saving function). The height of the saving function measures saving at each level of disposable income. Points *A* through *F* on the consumption and saving functions correspond to the rows in the table.

The height of the 45° line in part (a) measures disposable income. So along the 45° line, consumption expenditure equals disposable income. Consumption expenditure plus saving equals disposable income. When the consumption function is above the 45° line, saving is negative (dissaving occurs). When the consumption function is below the 45° line, saving is positive. At the point where the consumption function intersects the 45° line, all disposable income is spent on consumption and saving is zero.

Marginal Propensities to Consume and Save

The **marginal propensity to consume** (*MPC*) is the fraction of a *change* in disposable income that is spent on consumption. It is calculated as the *change* in consumption expenditure (ΔC) divided by the *change* in disposable income (ΔYD). The formula is

$$MPC = \frac{\Delta C}{\Delta YD}.$$

In the table in Fig. 11.1, when disposable income increases by $2 trillion, consumption expenditure increases by $1.5 trillion. The *MPC* is $1.5 trillion divided by $2 trillion, which equals 0.75.

The **marginal propensity to save** (*MPS*) is the fraction of a *change* in disposable income that is saved. It is calculated as the *change* in saving (ΔS) divided by the *change* in disposable income (ΔYD). The formula is

$$MPS = \frac{\Delta S}{\Delta YD}.$$

In the table in Fig. 11.1, when disposable income increases by $2 trillion, saving increases by $0.5 trillion. The *MPS* is $0.5 trillion divided by $2 trillion, which equals 0.25.

Because an increase in disposable income is either spent on consumption or saved, the marginal propensity to consume plus the marginal propensity to save equals 1. You can see why by using the equation:

$$\Delta C + \Delta S = \Delta YD.$$

Divide both sides of the equation by the change in disposable income to obtain

$$\frac{\Delta C}{\Delta YD} + \frac{\Delta S}{\Delta YD} = 1.$$

$\Delta C/\Delta YD$ is the marginal propensity to consume (*MPC*), and $\Delta S/\Delta YD$ is the marginal propensity to save (*MPS*), so

$$MPC + MPS = 1.$$

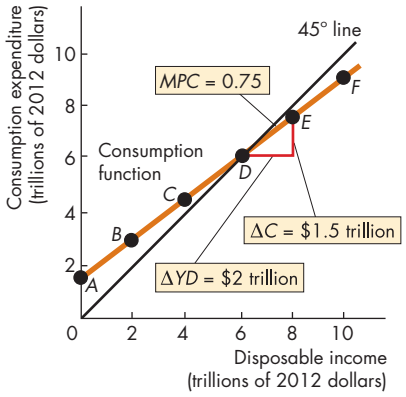
Slopes and Marginal Propensities

The slope of the consumption function is the marginal propensity to consume, and the slope of the saving function is the marginal propensity to save.

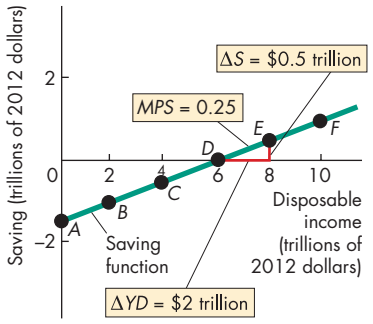
Figure 11.2(a) shows the *MPC* as the slope of the consumption function. An increase in disposable income of $2 trillion is the base of the red triangle. The increase in consumption expenditure that results from this increase in disposable income is $1.5 trillion and is the height of the triangle. The slope of the consumption function is given by the formula "slope equals rise over run" and is $1.5 trillion divided by $2 trillion, which equals 0.75—the *MPC*.

Figure 11.2(b) shows the *MPS* as the slope of the saving function. An increase in disposable income of $2 trillion (the base of the red triangle) increases saving by $0.5 trillion (the height of the triangle). The slope of the saving function is $0.5 trillion divided by $2 trillion, which equals 0.25—the *MPS*.

FIGURE 11.2 The Marginal Propensities to Consume and Save



(a) Consumption function



(b) Saving function

The marginal propensity to consume, *MPC*, is equal to the change in consumption expenditure divided by the change in disposable income, other things remaining the same. It is measured by the slope of the consumption function. In part (a), the *MPC* is 0.75.

The marginal propensity to save, *MPS*, is equal to the change in saving divided by the change in disposable income, other things remaining the same. It is measured by the slope of the saving function. In part (b), the *MPS* is 0.25.

ECONOMICS IN ACTION

The U.S. Consumption Function

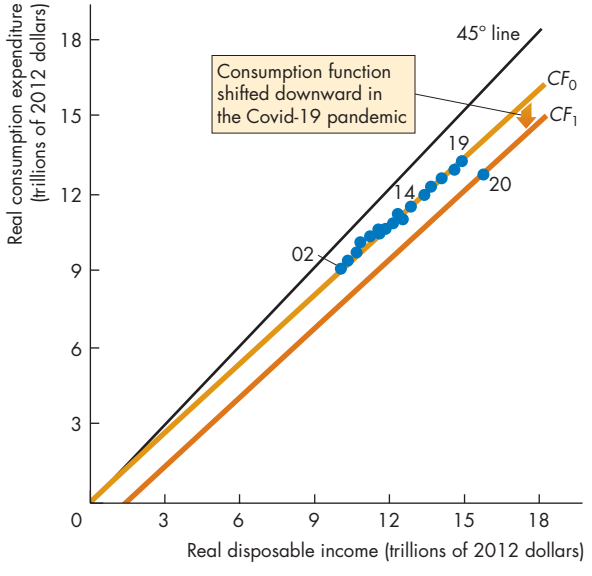
The figure shows the U.S. consumption function. Each point identified by a blue dot represents consumption expenditure and disposable income for a particular year. (The dots are for the years 2002 to 2020, and the dots for some of those years are identified in the figure.)

The U.S. consumption function is CF_0 in 2002 and CF_1 in 2020.

The slope of the consumption function in the figure is 0.9, which means that a $1 increase in disposable income increases consumption expenditure by 90 cents. This slope, which is an estimate of the marginal propensity to consume, is an assumption that is at the upper end of the range of values that economists have estimated for the marginal propensity to consume.

The consumption function shifts over time as other influences on consumption expenditure change. Of these other influences, the real interest rate and wealth fluctuate and so bring upward and downward shifts in the consumption function.

The largest influence on consumption expenditure in 2020 was the restrictions put in place to limit the spread of Covid-19, which shifted the consumption function downward.



The U.S. Consumption Function

Source of data: Bureau of Economic Aanalysis.

Consumption as a Function of Real GDP

Consumption expenditure changes when disposable income changes and disposable income changes when real GDP changes. So consumption expenditure depends not only on disposable income but also on real GDP. We will use this link between consumption expenditure and real GDP to determine equilibrium expenditure. But before we do so, we need to look at one further component of aggregate expenditure: imports. Like consumption expenditure, imports are influenced by real GDP.

Import Function

Of the many influences on U.S. imports in the short run, U.S. real GDP is the main influence. Other things remaining the same, an increase in U.S. real GDP increases the quantity of U.S. imports.

The relationship between imports and real GDP is determined by the **marginal propensity to import**, which is the fraction of an increase in real GDP that is spent on imports. It is calculated as the change in imports divided by the change in real GDP, other things remaining the same. For example, if an increase in real GDP of $1 trillion increases imports by $0.25 trillion, the marginal propensity to import is 0.25.

REVIEW QUIZ

1. Which components of aggregate expenditure are influenced by real GDP?
2. Define and explain how we calculate the marginal propensity to consume and the marginal propensity to save.
3. How do we calculate the effects of real GDP on consumption expenditure and imports by using the marginal propensity to consume and the marginal propensity to import?

Real GDP influences consumption expenditure and imports, which in turn influence real GDP. Your next task is to study this second piece of the two-way link between aggregate expenditure and real GDP and see how all the components of aggregate planned expenditure interact to determine real GDP.

Real GDP with a Fixed Price Level

You are now going to see how, at a given price level, aggregate expenditure plans determine real GDP. We start by looking at the relationship between aggregate planned expenditure and real GDP. This relationship can be described by an aggregate expenditure schedule or an aggregate expenditure curve. The *aggregate expenditure schedule* lists aggregate planned expenditure generated at each level of real GDP. The *aggregate expenditure curve* is a graph of the aggregate expenditure schedule.

Aggregate Planned Expenditure

Figure 11.3 constructs the *AE* curve. The table in the figure sets out an aggregate expenditure schedule. To calculate aggregate planned expenditure at a given real GDP, we add the expenditure components together. The first column of the table shows real GDP, and the second column shows the planned consumption at each level of real GDP. A $1 trillion increase in real GDP increases consumption expenditure by $0.7 trillion—the *MPC* is 0.7.

The next two columns show investment and government expenditure on goods and services, both of which are independent of real GDP. Investment depends on the real interest rate and the expected profit (see Chapter 7, p. 199). At a given point in time, these factors generate a given level of investment. Suppose this level of investment is $3.2 trillion. Also, suppose that government expenditure is $3.3 trillion.

The next two columns show exports and imports. Exports are influenced by events in the rest of the world, prices of foreign-produced goods and services relative to the prices of similar U.S.-produced goods and services, and exchange rates. But they are not directly affected by U.S. real GDP. Exports are a constant $3.5 trillion. Imports increase as U.S. real GDP increases. A $1 trillion increase in U.S. real GDP generates a $0.2 trillion increase in imports—the marginal propensity to import is 0.2.

The final column shows aggregate planned expenditure—the sum of planned consumption expenditure, investment, government expenditure on goods and services, and exports minus imports.

Figure 11.3 plots an aggregate expenditure curve. Real GDP is shown on the *x*-axis, and aggregate planned expenditure is shown on the *y*-axis. The aggregate expenditure curve is the red line *AE*. Points *A* through *F* on that curve correspond to the rows of the table. The *AE* curve is a graph of aggregate planned expenditure (the last column) plotted against real GDP (the first column).

Figure 11.3 shows the components of aggregate expenditure. The constant components— investment (I), government expenditure on goods and services (G), and exports (X)—are shown by the horizontal lines in the figure. Consumption expenditure (C) is the vertical gap between the lines labeled $I + G + X$ and $I + G + X + C$.

To construct the *AE* curve, subtract imports (M) from the $I + G + X + C$ line. Aggregate expenditure is expenditure on U.S.-produced goods and services. But the components of aggregate expenditure—*C, I,* and *G*—include expenditure on imported goods and services. For example, if you buy a new smartphone, your expenditure is part of consumption expenditure. But if the smartphone is a Samsung made in Korea, your expenditure on it must be subtracted from consumption expenditure to find out how much is spent on goods and services produced in the United States—U.S. real GDP. Money paid to Samsung for smartphone imports from Korea does not add to aggregate expenditure in the United States.

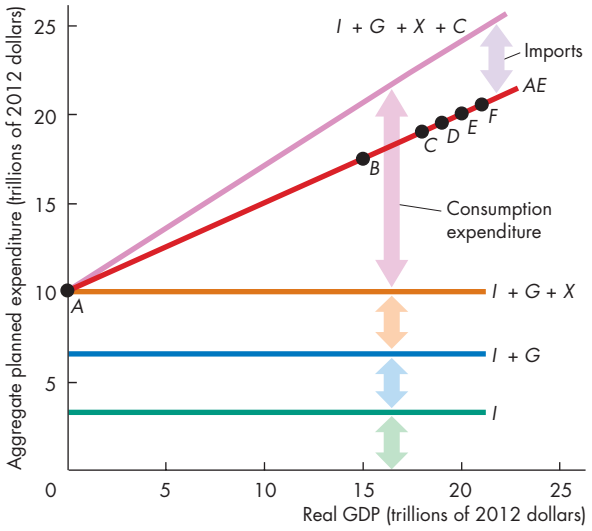
Because imports are only a part of aggregate expenditure, when we subtract imports from the other components of aggregate expenditure, aggregate planned expenditure still increases as real GDP increases, as you can see in Fig. 11.3.

The sum of the components that vary with real GDP—consumption expenditure minus imports— is called **induced expenditure**. The sum of investment, government expenditure, and exports, which does not vary with real GDP, is called **autonomous expenditure**. Consumption expenditure and imports can also have an autonomous component—a component that does not vary with real GDP. Another way of thinking about autonomous expenditure is that it would be the level of aggregate planned expenditure if real GDP were zero.

In Fig. 11.3, autonomous expenditure is $10 trillion—aggregate planned expenditure when real GDP is zero (point *A*). For each $1 trillion increase in real GDP, induced expenditure increases by $0.5 trillion.

The aggregate expenditure curve summarizes the relationship between aggregate *planned* expenditure and real GDP. But what determines the point on the aggregate expenditure curve at which the economy operates? What determines *actual* aggregate expenditure?

FIGURE 11.3 Aggregate Planned Expenditure: The AE Curve



Aggregate planned expenditure is the sum of planned consumption expenditure, investment, government expenditure on goods and services, and exports minus imports. For example, in row *C* of the table, when real GDP is $18 trillion, planned consumption expenditure is $12.6 trillion, planned investment is $3.2 trillion, planned government expenditure is $3.3 trillion, planned exports are $3.5 trillion, and planned imports are $3.6 trillion. So when real GDP is $18 trillion, aggregate planned expenditure is $19 trillion (12.6 + 3.2 + 3.3 + 3.5 − 3.6).

The schedule shows that aggregate planned expenditure increases as real GDP increases. This relationship is graphed as the aggregate expenditure curve *AE*.

The components of aggregate expenditure that increase with real GDP are consumption expenditure and imports. The other components—investment, government expenditure, and exports—do not vary with real GDP.

		Planned expenditure					
	Real GDP (*Y*)	Consumption expenditure (*C*)	Investment (*I*)	Government expenditure (*G*)	Exports (*X*)	Imports (*M*)	Aggregate planned expenditure (*AE* = *C* + *I* + *G* + *X* − *M*)
	(trillions of 2012 dollars)						
A	0	0.0	3.2	3.3	3.5	0.0	10.0
B	15	10.5	3.2	3.3	3.5	3.0	17.5
C	18	12.6	3.2	3.3	3.5	3.6	19.0
D	19	13.3	3.2	3.3	3.5	3.8	19.5
E	20	14.0	3.2	3.3	3.5	4.0	20.0
F	21	14.7	3.2	3.3	3.5	4.2	20.5

Actual Expenditure, Planned Expenditure, and Real GDP

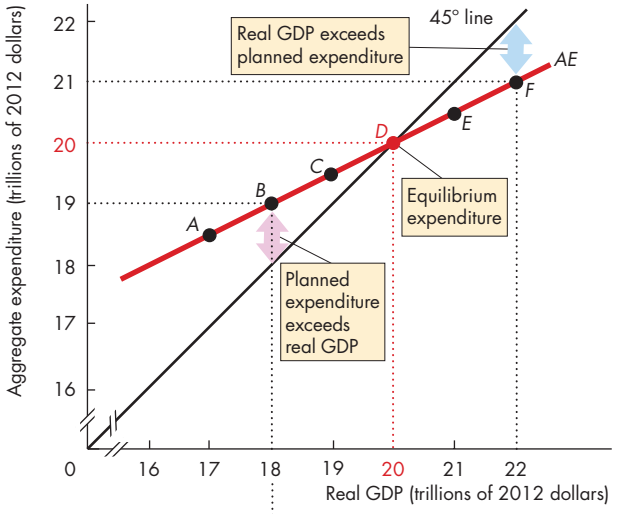
Actual aggregate expenditure is always equal to real GDP, as we saw in Chapter 4 (p. 118). But aggregate *planned* expenditure is not always equal to actual aggregate expenditure and therefore is not always equal to real GDP. How can actual expenditure and planned expenditure differ? The answer is that firms can end up with inventories that are greater or smaller than *planned*. People carry out their consumption expenditure plans, the government implements its planned expenditure on goods and services, and net exports are as planned. Firms carry out their plans to purchase new buildings, plant, and equipment. But one component of investment is the change in firms' inventories. If aggregate planned expenditure is less than real GDP, firms sell less than they planned to sell and end up with *unplanned* inventories. If aggregate planned expenditure exceeds real GDP, firms sell more than they planned to sell and end up with smaller inventories than they had planned.

Equilibrium Expenditure

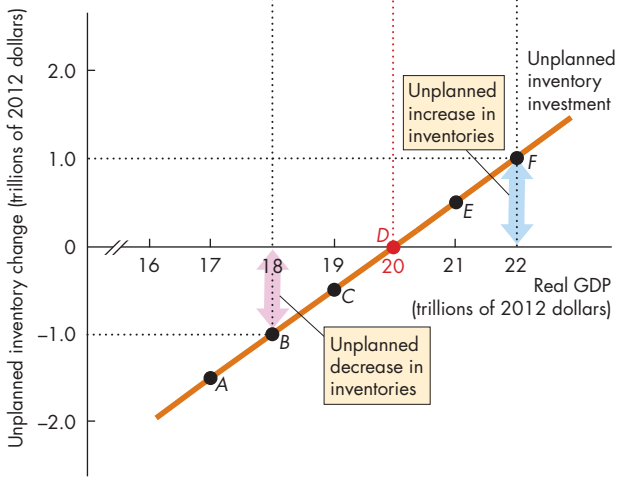
Equilibrium expenditure is the level of aggregate expenditure that occurs when aggregate *planned* expenditure equals real GDP. Equilibrium expenditure is a level of aggregate expenditure and real GDP at which spending plans are fulfilled. At a given price level, equilibrium expenditure determines real GDP. When aggregate planned expenditure and actual aggregate expenditure are unequal, a process of convergence toward equilibrium expenditure occurs. Throughout this process, real GDP adjusts. Let's examine equilibrium expenditure and the process that brings it about.

Figure 11.4(a) illustrates equilibrium expenditure. The table sets out aggregate planned expenditure at various levels of real GDP. These values are plotted as

FIGURE 11.4 Equilibrium Expenditure



(a) Equilibrium expenditure



(b) Unplanned inventory changes

	Real GDP (*Y*)	Aggregate planned expenditure (*AE*)	Unplanned inventory change (*Y* − *AE*)
	(trillions of 2012 dollars)		
A	17	18.5	−1.5
B	18	19.0	−1.0
C	19	19.5	−0.5
D	**20**	**20.0**	**0**
E	21	20.5	0.5
F	22	21.0	1.0

The table shows expenditure plans at different levels of real GDP. When real GDP is $20 trillion, aggregate planned expenditure equals real GDP.

Part (a) of the figure illustrates equilibrium expenditure, which occurs when aggregate planned expenditure equals real GDP at the intersection of the 45° line and the *AE* curve. Part (b) of the figure shows the forces that bring about equilibrium expenditure.

When aggregate planned expenditure exceeds real GDP, inventories decrease—for example, at point *B* in both parts of the figure. So, firms increase production, and real GDP increases.

When aggregate planned expenditure is less than real GDP, inventories increase—for example, at point *F* in both parts of the figure. So, firms cut production, and real GDP decreases.

When aggregate planned expenditure equals real GDP, there are no unplanned inventory changes and real GDP remains constant at equilibrium expenditure.

points *A* through *F* along the *AE* curve. The 45° line shows all the points at which aggregate planned expenditure equals real GDP. So where the *AE* curve lies above the 45° line, aggregate planned expenditure exceeds real GDP; where the *AE* curve lies below the 45° line, aggregate planned expenditure is less than real GDP; and where the *AE* curve intersects the 45° line, aggregate planned expenditure equals real GDP. Point *D* illustrates equilibrium expenditure. At this point, real GDP is $20 trillion.

Convergence to Equilibrium

What are the forces that move aggregate expenditure toward its equilibrium level? To answer this question, we must look at a situation in which aggregate expenditure is away from its equilibrium level.

From Below Equilibrium Suppose that in Fig. 11.4, real GDP is $18 trillion. With real GDP at $18 trillion, actual aggregate expenditure is also $18 trillion, but aggregate *planned* expenditure is $19 trillion, point *B* in Fig. 11.4(a). Aggregate planned expenditure exceeds *actual* expenditure. When firms produce goods and services worth $18 trillion and people spend $19 trillion, firms sell more goods and services than they had planned. Firms' inventories *decrease* by $1 trillion, point *B* in Fig. 11.4(b). Because the change in inventories is part of investment, *actual* investment is $1 trillion less than *planned* investment.

Real GDP doesn't remain at $18 trillion for very long. Firms have inventory targets based on their sales. When inventories fall below target, firms respond by hiring additional labor and increasing production to restore inventories to the target level.

To increase inventories, firms hire additional labor and increase production. Suppose that they increase production in the next period by $1 trillion. Real GDP increases by $1.0 trillion to $19.0 trillion. But again, aggregate planned expenditure exceeds real GDP. When real GDP is $19.0 trillion, aggregate planned expenditure is $19.5 trillion, point *C* in Fig. 11.4(a). Again, inventories decrease, but this time by less than before. With real GDP of $19.0 trillion and aggregate planned expenditure of $19.5 trillion, inventories decrease by $0.5 trillion, point *C* in Fig. 11.4(b). Again, firms hire additional labor and production increases; real GDP increases yet further.

The process that we've just described—planned expenditure exceeds real GDP, inventories decrease, and production increases to restore inventories—ends when real GDP has reached $20 trillion. At this real GDP, there is equilibrium. Unplanned inventory changes are zero. Firms do not change production.

From Above Equilibrium If in Fig. 11.4, real GDP is $22 trillion, the process that we've just described works in reverse. With real GDP at $22 trillion, actual aggregate expenditure is also $22 trillion, but aggregate *planned* expenditure is $21 trillion, point *F* in Fig. 11.4(a). Actual expenditure exceeds planned expenditure. When firms produce goods and services worth $22 trillion and people spend $21 trillion, firms' inventories rise by $1 trillion, point *F* in Fig. 11.4(b). Firms respond by cutting production and real GDP begins to decrease. As long as actual expenditure exceeds planned expenditure, inventories rise, and firms cut production. Again, the process ends when real GDP has reached $20 trillion, the equilibrium at which unplanned inventory changes are zero and firms do not change their production.

REVIEW QUIZ

1. What is the relationship between aggregate planned expenditure and real GDP at equilibrium expenditure?
2. How does equilibrium expenditure come about? What adjusts to achieve equilibrium?
3. If real GDP and aggregate expenditure are less than equilibrium expenditure, what happens to firms' inventories? How do firms change their production? And what happens to real GDP?
4. If real GDP and aggregate expenditure are greater than equilibrium expenditure, what happens to firms' inventories? How do firms change their production? And what happens to real GDP?

We've learned that when the price level is fixed, real GDP is determined by equilibrium expenditure. And we have seen how unplanned changes in inventories and the production response they generate bring a convergence toward equilibrium expenditure. We're now going to study *changes* in equilibrium expenditure and discover an economic amplifier called the *multiplier*.

The Multiplier

Investment and exports can change for many reasons. A fall in the real interest rate might induce firms to increase their planned investment. A wave of innovation, such as occurred with the spread of multimedia computers in the 1990s, might increase expected future profits and lead firms to increase their planned investment. An economic boom in Western Europe and Japan might lead to a large increase in their expenditure on U.S.-produced goods and services—on U.S. exports. These are all examples of increases in autonomous expenditure.

When autonomous expenditure increases, aggregate expenditure increases and so does equilibrium expenditure and real GDP. But the increase in real GDP is *larger* than the change in autonomous expenditure. The **multiplier** is the amount by which a change in autonomous expenditure is magnified or multiplied to determine the change in equilibrium expenditure and real GDP.

To get the basic idea of the multiplier, we'll work with an example economy in which there are no income taxes and no imports. So we'll first assume that these factors are absent. Then, when you understand the basic idea, we'll bring these factors back into play and see what difference they make to the multiplier.

The Basic Idea of the Multiplier

Suppose that investment increases. The additional expenditure by businesses means that aggregate expenditure and real GDP increase. The increase in real GDP increases disposable income, and with no income taxes, real GDP and disposable income increase by the same amount. The increase in disposable income brings an increase in consumption expenditure. And the increased consumption expenditure adds even more to aggregate expenditure. Real GDP and disposable income increase further, and so does consumption expenditure. The initial increase in investment brings an even bigger increase in aggregate expenditure because it induces an increase in consumption expenditure. The *multiplier* determines the magnitude of the increase in aggregate expenditure that results from an increase in autonomous expenditure. Figure 2.8.5 illustrates the *multiplier*.

The table in Fig. 11.5 sets out two aggregate planned expenditure schedules. Initially, when real GDP is $19 trillion, aggregate planned expenditure is $19.25 trillion. For each $1 trillion increase in real GDP, aggregate planned expenditure increases by $0.75 trillion. This aggregate expenditure schedule is shown in the figure as the aggregate expenditure curve AE_0. Equilibrium expenditure is $20 trillion. You can see this equilibrium in row *B* of the table and in the figure where the curve AE_0 intersects the 45° line at the point marked *B*.

Now suppose that autonomous expenditure increases by $0.5 trillion. What happens to equilibrium expenditure? You can see the answer in Fig. 11.5. When this increase in autonomous expenditure is added to the original aggregate planned expenditure, aggregate planned expenditure increases by $0.5 trillion at each level of real GDP. The new aggregate expenditure curve is AE_1. The new equilibrium expenditure, highlighted in the table (row *D'*), occurs where AE_1 intersects the 45° line and is $22 trillion (point *D'*). At this real GDP, aggregate planned expenditure equals real GDP.

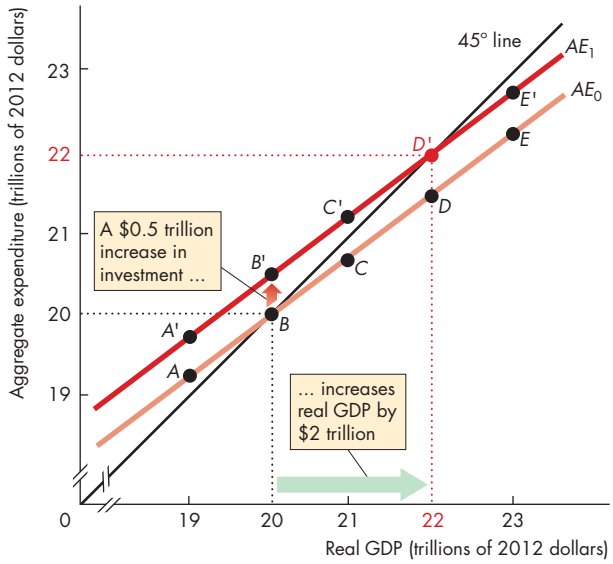
The Multiplier Effect

In Fig. 11.5, the increase in autonomous expenditure of $0.5 trillion increases equilibrium expenditure by $2 trillion. That is, the change in autonomous expenditure leads, like a rock singer's electronic equipment, to an amplified change in equilibrium expenditure. This amplified change is the *multiplier effect*—equilibrium expenditure increases by *more than* the increase in autonomous expenditure. The multiplier is greater than 1.

Initially, when autonomous expenditure increases, aggregate planned expenditure exceeds real GDP. As a result, inventories decrease. Firms respond by increasing production so as to restore their inventories to the target level. As production increases, so does real GDP. With a higher level of real GDP, *induced expenditure* increases. Equilibrium expenditure increases by the sum of the initial increase in autonomous expenditure and the increase in induced expenditure. In this example, equilibrium expenditure increases by $2 trillion following the increase in autonomous expenditure of $0.5 trillion, so induced expenditure increases by $1.5 trillion.

Although we have just analyzed the effects of an *increase* in autonomous expenditure, this analysis also applies to a decrease in autonomous expenditure. If initially the aggregate expenditure curve is AE_1, equilibrium expenditure and real GDP are $22 trillion. A decrease in autonomous expenditure of $0.5 trillion shifts the aggregate expenditure curve downward by

FIGURE 11.5 The Multiplier



Real GDP (Y)	Aggregate planned expenditure: Original (AE_0)		New (AE_1)	
(trillions of 2012 dollars)				
19	*A*	19.25	*A'*	19.75
20	***B***	**20.00**	*B'*	20.50
21	*C*	20.75	*C'*	21.25
22	*D*	21.50	***D'***	**22.00**
23	*E*	22.25	*E'*	22.75

A $0.5 trillion increase in autonomous expenditure shifts the *AE* curve upward by $0.5 trillion from AE_0 to AE_1. Equilibrium expenditure increases by $2 trillion from $20 trillion to $22 trillion. The increase in equilibrium expenditure is 4 times the increase in autonomous expenditure, so the multiplier is 4.

$0.5 trillion to AE_0. Equilibrium expenditure decreases from $22 trillion to $20 trillion. The decrease in equilibrium expenditure ($2 trillion) is larger than the decrease in autonomous expenditure that brought it about ($0.5 trillion).

Why Is the Multiplier Greater Than 1?

We've seen that equilibrium expenditure increases by more than the increase in autonomous expenditure. This makes the multiplier greater than 1. How come? Why does equilibrium expenditure increase by more than the increase in autonomous expenditure?

The multiplier is greater than 1 because induced expenditure increases—an increase in autonomous expenditure *induces* further increases in expenditure. The NASA space program costs about $23 billion a year. This expenditure adds $23 billion a year directly to real GDP. But that is not the end of the story. Astronauts and engineers now have more income, and they spend part of the extra income on goods and services. Real GDP now rises by the initial $23 billion plus the extra consumption expenditure induced by the $23 billion increase in income. The producers of cars, TVs, vacation cruises, and other goods and services now have increased incomes, and they, in turn, spend part of the increase in their incomes on consumption goods and services. Additional income induces additional expenditure, which creates additional income.

How big is the multiplier effect?

The Size of the Multiplier

Suppose that the economy is in a recession. Profit prospects start to look better, and firms are planning a large increase in investment. The world economy is also heading toward expansion. The question on everyone's lips is: How strong will the expansion be? This is a hard question to answer, but an important ingredient in the answer is the size of the multiplier.

The *multiplier* is the amount by which a change in autonomous expenditure is multiplied to determine the change in equilibrium expenditure that it generates. To calculate the multiplier, we divide the change in equilibrium expenditure by the change in autonomous expenditure.

Let's calculate the multiplier for the example in Fig. 11.5. Initially, equilibrium expenditure is $20 trillion. Then autonomous expenditure increases by $0.5 trillion, and equilibrium expenditure increases by $2 trillion, to $22 trillion. Then

$$\text{Multiplier} = \frac{\text{Change in equilibrium expenditure}}{\text{Change in autonomous expenditure}}$$

$$\text{Multiplier} = \frac{\$2 \text{ trillion}}{\$0.5 \text{ trillion}} = 4.$$

The Multiplier and the Slope of the *AE* Curve

The magnitude of the multiplier depends on the slope of the *AE* curve. In Fig. 11.6, the *AE* curve in part (a) is steeper than the *AE* curve in part (b), and the multiplier is larger in part (a) than in part (b). To see why, let's do a calculation.

Aggregate expenditure and real GDP change because induced expenditure and autonomous expenditure change. The change in real GDP (ΔY) equals the change in induced expenditure (ΔN) plus the change in autonomous expenditure (ΔA). That is,

$$\Delta Y = \Delta N + \Delta A.$$

But the change in induced expenditure is determined by the change in real GDP and the slope of the *AE* curve. To see why, begin with the fact that the slope of the *AE* curve equals the "rise," ΔN, divided by the "run," ΔY. That is,

$$\text{Slope of } AE \text{ curve} = \Delta N \div \Delta Y.$$

So

$$\Delta N = \text{Slope of } AE \text{ curve} \times \Delta Y.$$

Now, use this equation to replace ΔN in the first equation above to give

$$\Delta Y = \text{Slope of } AE \text{ curve} \times \Delta Y + \Delta A.$$

To solve for ΔY, begin by rearranging the equation as

$$(1 - \text{Slope of } AE \text{ curve}) \times \Delta Y = \Delta A$$

Now rearrange the equation to give

$$\Delta Y = \frac{\Delta A}{1 - \text{Slope of } AE \text{ curve}}.$$

Finally, divide both sides of this equation by ΔA to give

$$\text{Multiplier} = \frac{\Delta Y}{\Delta A} = \frac{1}{1 - \text{Slope of } AE \text{ curve}}.$$

If we use the example in Fig. 11.5, the slope of the *AE* curve is 0.75, so

$$\text{Multiplier} = \frac{1}{1 - 0.75} = \frac{1}{0.25} = 4.$$

Where there are no income taxes and no imports, the slope of the *AE* curve equals the marginal propensity to consume (*MPC*). So

$$\text{Multiplier} = \frac{1}{1 - MPC}.$$

But $(1 - MPC)$ equals *MPS*. So another formula is

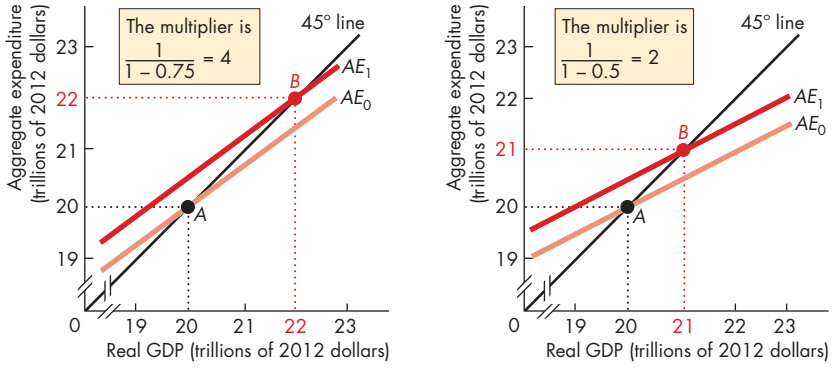
$$\text{Multiplier} = \frac{1}{MPS}.$$

Again using the numbers in Fig. 11.5, we have

$$\text{Multiplier} = \frac{1}{0.25} = 4.$$

Because the marginal propensity to save (*MPS*) is a fraction—a number between 0 and 1—the multiplier is greater than 1.

FIGURE 11.6 The Multiplier and the Slope of the *AE* Curve



(a) Multiplier is 4 **(b) Multiplier is 2**

Imports and income taxes make the *AE* curve less steep and reduce the value of the multiplier. In part (a), with no imports and no income taxes, the slope of the *AE* curve is 0.75 (the marginal propensity to consume) and the multiplier is 4. But with imports and income taxes, the slope of the *AE* curve is less than the marginal propensity to consume. In part (b), the slope of the *AE* curve is 0.5. In this case, the multiplier is 2.

Imports and Income Taxes

Imports and income taxes influence the size of the multiplier and make it smaller than it otherwise would be.

To see why imports make the multiplier smaller, think about what happens following an increase in investment. The increase in investment increases real GDP, which in turn increases consumption expenditure. But part of the increase in expenditure is on imported goods and services. Only expenditure on U.S.-produced goods and services increases U.S. real GDP. The larger the marginal propensity to import, the smaller is the change in U.S. real GDP.

Income taxes also make the multiplier smaller than it otherwise would be. Again, think about what happens following an increase in investment. The increase in investment increases real GDP. Income tax payments increase so disposable income increases by less than the increase in real GDP and consumption expenditure increases by less than it would if taxes had not changed. The larger the income tax rate, the smaller is the change in real GDP.

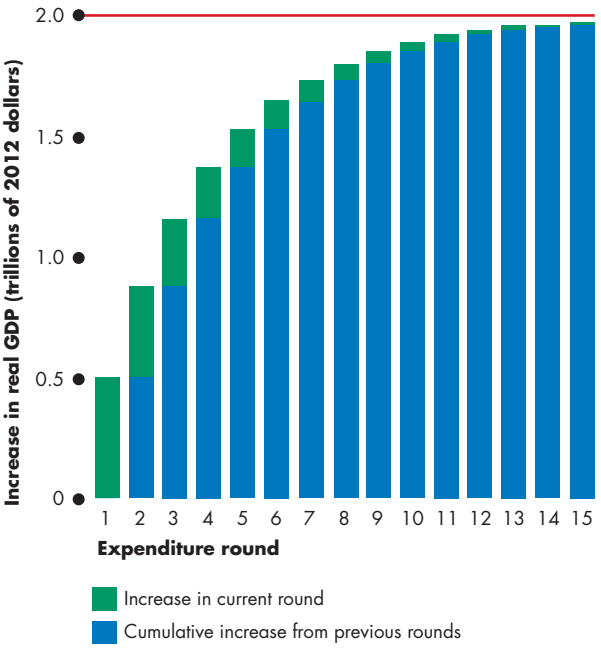
The marginal propensity to import and the income tax rate together with the marginal propensity to consume determine the multiplier. And their combined influence determines the slope of the *AE* curve. The Mathematical Note on pp. 318–321 shows the effects of imports and income taxes on the multiplier.

Over time, the value of the multiplier changes as tax rates change and as the marginal propensity to consume and the marginal propensity to import change. These ongoing changes make the multiplier hard to predict. But they do not change the fundamental fact that an initial change in autonomous expenditure leads to a magnified change in aggregate expenditure and real GDP.

The Multiplier Process

The multiplier effect isn't a one-shot event. It is a process that plays out over a few months. Figure 11.7 illustrates the multiplier process. Autonomous expenditure increases by $0.5 trillion and real GDP increases by $0.5 trillion (the green bar in round 1). This increase in real GDP increases induced expenditure in round 2. With the slope of the *AE* curve equal to 0.75, induced expenditure increases by 0.75 times the increase in real GDP, so the increase in real GDP of $0.5 trillion induces a further increase in expenditure of $0.375 trillion. This change in induced expenditure (the green bar in round 2) when added to the previous increase in expenditure (the blue bar in round 2) increases real GDP by $0.875 trillion. The round 2 increase in real GDP induces a round 3 increase in induced expenditure. The process repeats through successive rounds. Each increase in real GDP is 0.75 times the previous increase and eventually real GDP increases by $2 trillion.

FIGURE 11.7 The Multiplier Process



Autonomous expenditure increases by $0.5 trillion. In round 1, real GDP increases by the same amount. With the slope of the *AE* curve equal to 0.75, each additional dollar of real GDP induces an additional 0.75 of a dollar of induced expenditure. The round 1 increase in real GDP brings an increase in induced expenditure of $0.375 trillion in round 2.

At the end of round 2, real GDP has increased by $0.875 trillion. The extra $0.375 trillion of real GDP in round 2 brings a further increase in induced expenditure of $0.281 trillion in round 3.

At the end of round 3, real GDP has increased by $1.156 trillion. This process continues with real GDP increasing by ever-smaller amounts. When the process comes to an end, real GDP has increased by a total of $2 trillion.

ECONOMICS IN ACTION

The Multiplier in the Great Depression

The aggregate expenditure model and its multiplier were developed during the 1930s by John Maynard Keynes to understand the most traumatic event in economic history, the *Great Depression*.

In 1929, the U.S. and global economies were booming. U.S. real GDP and real GDP per person had never been higher. By 1933, real GDP had fallen to 73 percent of its 1929 level and more than a quarter of the labor force was unemployed.

The table below shows the GDP numbers and components of aggregate expenditure in 1929 and 1933.

Autonomous expenditure collapsed as investment fell from $17 billion to $3 billion and exports fell by $3 billion. Government expenditure held steady.

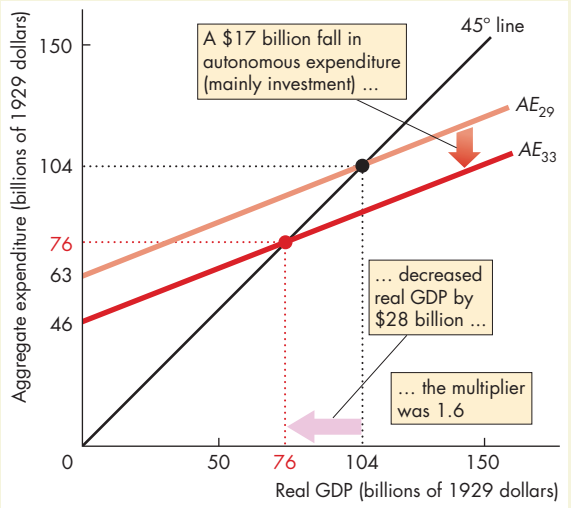
	1929		1933	
	(billions of 1929 dollars)			
Induced consumption	47		34	
Induced imports	−6		−4	
Induced expenditure		41		30
Autonomous consumption	30		30	
Investment	17		3	
Government expenditure	10		10	
Exports	6		3	
Autonomous expenditure		63		46
GDP		**104**		**76**

Source of data: Bureau of Economic Analysis.

The figure uses the *AE* model to illustrate the Great Depression. In 1929, with autonomous expenditure of $63 billion, the *AE* curve was AE_{29}. Equilibrium expenditure and real GDP were $104 billion.

By 1933, autonomous expenditure had fallen by $17 billion to $46 billion and the *AE* curve had shifted downward to AE_{33}. Equilibrium expenditure and real GDP had fallen to $76 billion.

The decrease in autonomous expenditure of $17 billion brought a decrease in real GDP of $28 billion. The multiplier was $28/$17 = 1.6. The slope of the *AE* curve is 0.39—the fall in induced expenditure, $11 billion, divided by the fall in real GDP, $28 billion. The multiplier formula, $1/(1 - \text{Slope of } AE \text{ curve})$, delivers a multiplier equal to 1.6.



Aggregate Expenditure in the Great Depression

Business Cycle Turning Points

At business cycle turning points, the economy moves from expansion to recession or from recession to expansion. Economists understand these turning points as seismologists understand earthquakes. They know quite a lot about the forces and mechanisms that produce them, but they can't predict them. The forces that bring business cycle turning points are the swings in autonomous expenditure, such as investment and exports. The multiplier that you've just studied is the mechanism that gives momentum to the economy's new direction.

REVIEW QUIZ

1. What is the multiplier? What does it determine? Why does it matter?
2. How do the marginal propensity to consume, the marginal propensity to import, and the income tax rate influence the multiplier?
3. How do fluctuations in autonomous expenditure influence real GDP?

The Multiplier and the Price Level

We have just considered adjustments in spending that occur in the very short run when the price level is fixed. In this time frame, the economy's cobblestones, which are changes in investment and exports, are not smoothed by shock absorbers like those on a limousine. Instead, they are amplified like a rock singer's voice. But these outcomes occur only when the price level is fixed. We now investigate what happens after a long enough time lapse for the price level to change.

Adjusting Quantities and Prices

When firms can't keep up with sales and their inventories fall below target, they increase production, but at some point, they raise their prices. Similarly, when firms find unwanted inventories piling up, they decrease production, but eventually they cut their prices. So far, we've studied the macroeconomic consequences of firms changing their production levels when their sales change, but we haven't looked at the effects of price changes. When individual firms change their prices, the economy's price level changes.

To study the simultaneous determination of real GDP and the price level, we use the *AS-AD model*, which is explained in Chapter 10. But to understand how aggregate demand adjusts, we need to work out the connection between the *AS-AD* model and the aggregate expenditure model that we've used in this chapter. The key to understanding the relationship between these two models is the distinction between the aggregate *expenditure* and aggregate *demand* and the related distinction between the aggregate *expenditure curve* and the aggregate *demand curve*.

Aggregate Expenditure and Aggregate Demand

The aggregate expenditure curve is the relationship between the aggregate planned expenditure and real GDP, all other influences on aggregate planned expenditure remaining the same. The aggregate demand curve is the relationship between the aggregate quantity of goods and services demanded and the price level, all other influences on aggregate demand remaining the same. Let's explore the links between these two relationships.

Deriving the Aggregate Demand Curve

When the price level changes, aggregate planned expenditure changes and the quantity of real GDP demanded changes. The aggregate demand curve slopes downward. Why? There are two main reasons:

- Wealth effect
- Substitution effects

Wealth Effect Other things remaining the same, the higher the price level, the smaller is the purchasing power of wealth. For example, suppose you have $100 in the bank and the price level is 105. If the price level rises to 125, your $100 buys fewer goods and services. You are less wealthy. With less wealth, you will probably want to try to spend a bit less and save a bit more. The higher the price level, other things remaining the same, the lower is aggregate planned expenditure.

Substitution Effects For a given expected future price level, a rise in the price level today makes current goods and services more expensive relative to future goods and services and results in a delay in purchases—an *intertemporal substitution*. A rise in the U.S. price level, other things remaining the same, makes U.S.-produced goods and services more expensive relative to foreign-produced goods and services. As a result, U.S. imports increase and U.S. exports decrease—an *international substitution*.

When the price level rises, each of these effects reduces aggregate planned expenditure at each level of real GDP. As a result, when the price level *rises*, the aggregate expenditure curve shifts *downward*. A fall in the price level has the opposite effect. When the price level *falls*, the aggregate expenditure curve shifts *upward*.

Figure 11.8(a) shows the shifts of the *AE* curve. When the price level is 110, the aggregate expenditure curve is AE_0, which intersects the 45° line at point *B*. Equilibrium expenditure is $20 trillion. If the price level rises to 130, the aggregate expenditure curve shifts *downward* to AE_1, which intersects the 45° line at point *A*. Equilibrium expenditure

decreases to $19 trillion. If the price level falls to 90, the aggregate expenditure curve shifts *upward* to AE_2, which intersects the 45° line at point *C*. Equilibrium expenditure increases to $21 trillion.

We've just seen that when the price level changes, other things remaining the same, the aggregate expenditure curve *shifts* and the equilibrium expenditure changes. But when the price level changes and other things remain the same, there is a *movement along* the aggregate demand curve.

Figure 11.8(b) shows the movements along the aggregate demand curve. At a price level of 110, the aggregate quantity of goods and services demanded is $20 trillion—point *B* on the *AD* curve. If the price level rises to 130, the aggregate quantity of goods and services demanded decreases to $19 trillion and there is a movement up along the aggregate demand curve to point *A*. If the price level falls to 90, the aggregate quantity of goods and services demanded increases to $21 trillion and there is a movement down along the aggregate demand curve to point *C*.

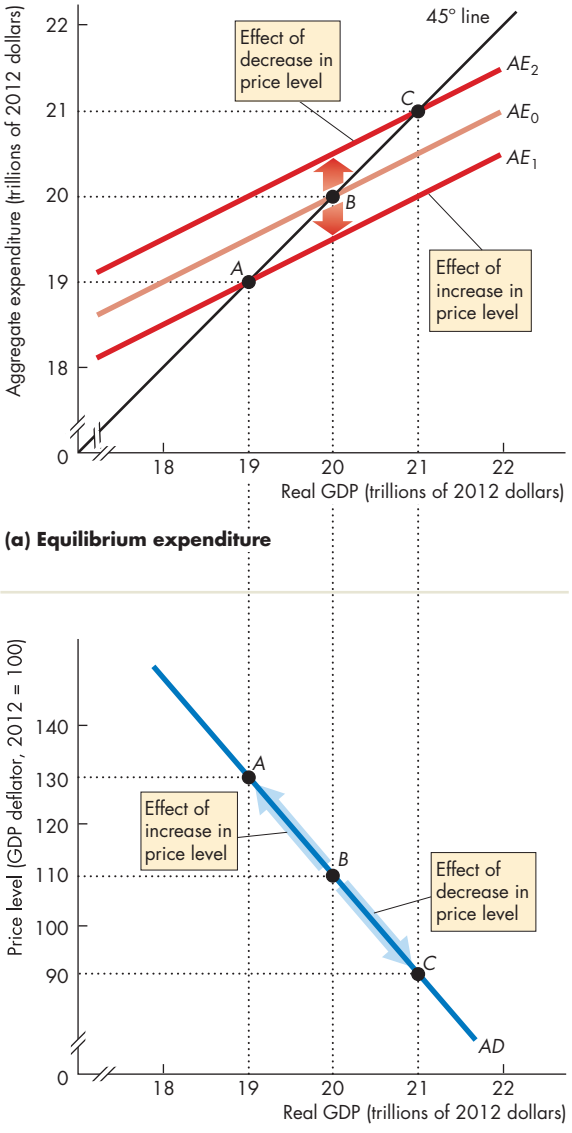
Each point on the aggregate demand curve corresponds to a point of equilibrium expenditure. The equilibrium expenditure points *A, B*, and *C* in Fig. 11.8(a) correspond to the points *A, B*, and *C* on the aggregate demand curve in Fig. 11.8(b).

Changes in Aggregate Expenditure and Aggregate Demand

When any influence on aggregate planned expenditure other than the price level changes, both the aggregate expenditure curve and the aggregate demand curve shift. For example, an increase in investment or exports increases both aggregate planned expenditure and aggregate demand and shifts both the *AE* curve and the *AD* curve. Figure 11.9 illustrates the effect of such an increase.

Initially, the aggregate expenditure curve is AE_0 in part (a) and the aggregate demand curve is AD_0 in part (b). The price level is 110, real GDP is $20 trillion, and the economy is at point *A* in both parts of Fig. 11.9. Now suppose that investment increases by $1 trillion. At a constant price level of 110, the aggregate expenditure curve shifts upward to AE_1. This curve intersects the 45° line at an equilibrium expenditure of $22 trillion (point *B*). This equilibrium expenditure of $22 trillion is the aggregate quantity of goods and services demanded at a price level of 110, as shown by point *B* in part (b). Point *B* lies

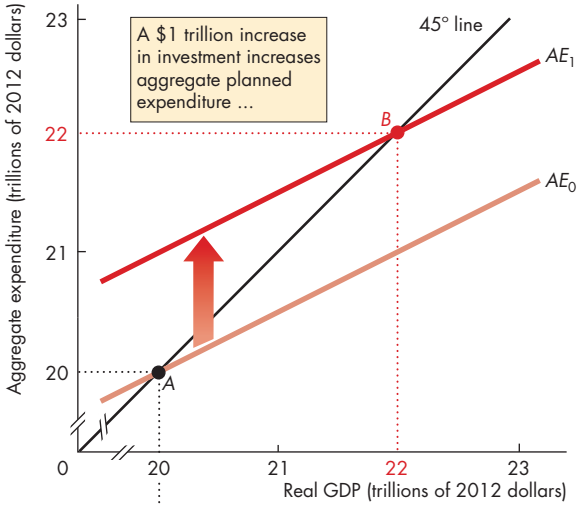
FIGURE 11.8 Equilibrium Expenditure and Aggregate Demand



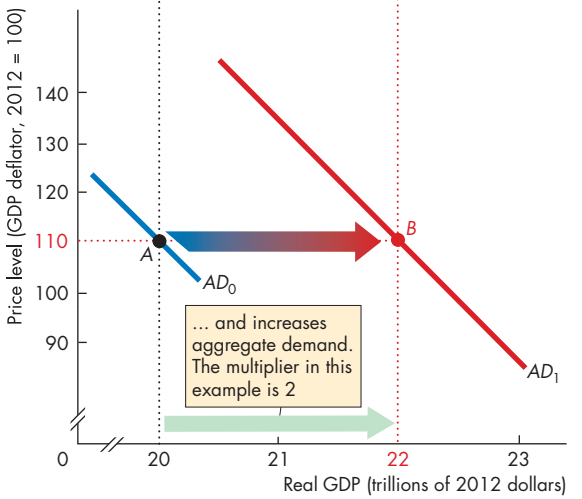
A change in the price level *shifts* the *AE* curve and results in a *movement along* the *AD* curve. When the price level is 110, the *AE* curve is AE_0 and equilibrium expenditure is $20 trillion at point *B*.

A rise in the price level to 130 shifts the *AE* curve downward to AE_1. Equilibrium expenditure decreases to $19 trillion at point *A*. A fall in the price level from 110 to 90 shifts the *AE* curve upward to AE_2. Equilibrium expenditure increases to $21 trillion at point *C*. Points *A*, *B*, and *C* on the *AD* curve in part (b) correspond to the equilibrium expenditure points *A*, *B*, and *C* in part (a).

FIGURE 11.9 A Change in Aggregate Demand



(a) Aggregate expenditure



(b) Aggregate demand

An increase in autonomous expenditure increases aggregate demand. The price level is 110. When the aggregate expenditure curve is AE_0 in part (a), the aggregate demand curve is AD_0 in part (b). The economy is at point *A* in both parts of the figure.

An increase in autonomous expenditure shifts the *AE* curve upward to AE_1. The new equilibrium expenditure is \$22 trillion at point *B* in part (a). Because the quantity of real GDP demanded at a price level of 110 increases from \$20 trillion to \$22 trillion, the *AD* curve shifts rightward to AD_1.

on a new aggregate demand curve. The aggregate demand curve has shifted rightward to AD_1 to pass through point *B*.

But how do we know by how much the *AD* curve shifts? The multiplier determines the answer. The larger the multiplier, the larger is the shift in the aggregate demand curve that results from a given change in autonomous expenditure. In this example, the multiplier is 2. A \$1 trillion increase in investment produces a \$2 trillion increase in the aggregate quantity of goods and services demanded at each price level. That is, a \$1 trillion increase in autonomous expenditure shifts the aggregate demand curve rightward by \$2 trillion.

A decrease in autonomous expenditure shifts the aggregate expenditure curve downward and shifts the aggregate demand curve leftward. You can see these effects by reversing the change that we've just described. If the economy is initially at point *B* on the aggregate expenditure curve AE_1 and on the aggregate demand curve AD_1, a decrease in autonomous expenditure shifts the aggregate expenditure curve downward to AE_0. The aggregate quantity of goods and services demanded decreases from \$22 trillion to \$20 trillion, and the aggregate demand curve shifts leftward to AD_0.

Let's summarize what we have just discovered:

> If some factor other than a change in the price level increases autonomous expenditure, then the *AE* curve shifts upward and the *AD* curve shifts rightward. The size of the *AD* curve shift equals the change in autonomous expenditure multiplied by the multiplier.

Equilibrium Real GDP and the Price Level

In Chapter 10, we learned that aggregate demand and short-run aggregate supply determine equilibrium real GDP and the price level. We've now put aggregate demand under a more powerful microscope and have discovered that a change in investment (or in any component of autonomous expenditure) changes aggregate demand and shifts the aggregate demand curve. The magnitude of the shift depends on the multiplier. But whether a change in autonomous expenditure results ultimately in a change in real GDP, a change in the price level, or a combination of the two depends on aggregate supply. There are two time frames to consider: the short run and the long run. First we'll see what happens in the short run.

An Increase in Aggregate Demand in the Short Run

Figure 11.10 describes the economy. Initially, in part (a), the aggregate expenditure curve is AE_0 and equilibrium expenditure is $20 trillion—point *A*. In part (b), aggregate demand is AD_0 and the short-run aggregate supply curve is *SAS*. (Chapter 10, pp. 275–277, explains the *SAS* curve.) Equilibrium is at point *A* in part (b), where the aggregate demand and short-run aggregate supply curves intersect. The price level is 110, and real GDP is $20 trillion.

Now suppose that investment increases by $1 trillion. With the price level fixed at 110, the aggregate expenditure curve shifts upward to AE_1. Equilibrium expenditure increases to $22 trillion—point *B* in part (a). In part (b), the aggregate demand curve shifts rightward by $2 trillion, from AD_0 to AD_1. How far the aggregate demand curve shifts is determined by the multiplier when the price level is fixed.

But with this new aggregate demand curve, the price level does *not* remain fixed. The price level rises, and as it does, the aggregate expenditure curve shifts downward. The short-run equilibrium occurs when the aggregate expenditure curve has shifted downward to AE_2 and the new aggregate demand curve, AD_1, intersects the short-run aggregate supply curve at point *C* in both part (a) and part (b). Real GDP is $21.3 trillion, and the price level is 123.

When price level effects are taken into account, the increase in investment still has a multiplier effect on real GDP, but the multiplier is smaller than it would be if the price level were fixed. The steeper the slope of the short-run aggregate supply curve, the larger is the increase in the price level and the smaller is the multiplier effect on real GDP.

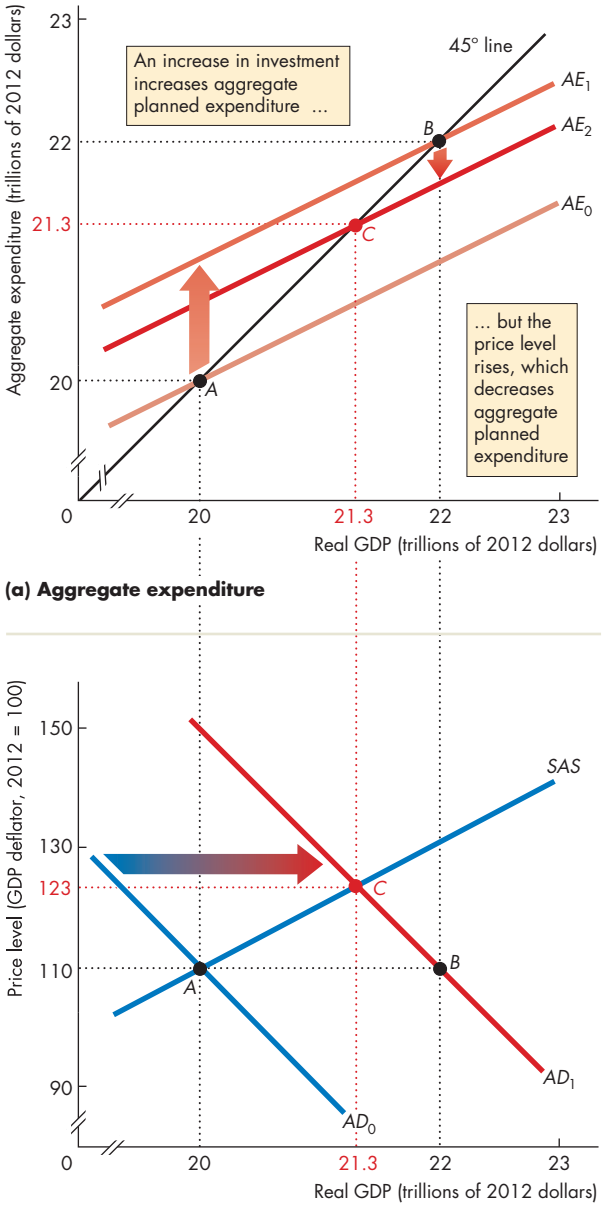
An Increase in Aggregate Demand in the Long Run

Figure 11.11 illustrates the long-run effect of an increase in aggregate demand. In the long run, real GDP equals potential GDP and there is full employment. Potential GDP is $20 trillion, and the long-run aggregate supply curve is *LAS*. Initially, the economy is at point *A* in parts (a) and (b).

Investment increases by $1 trillion. In Fig. 11.11, the aggregate expenditure curve shifts to AE_1 and the aggregate demand curve shifts to AD_1.

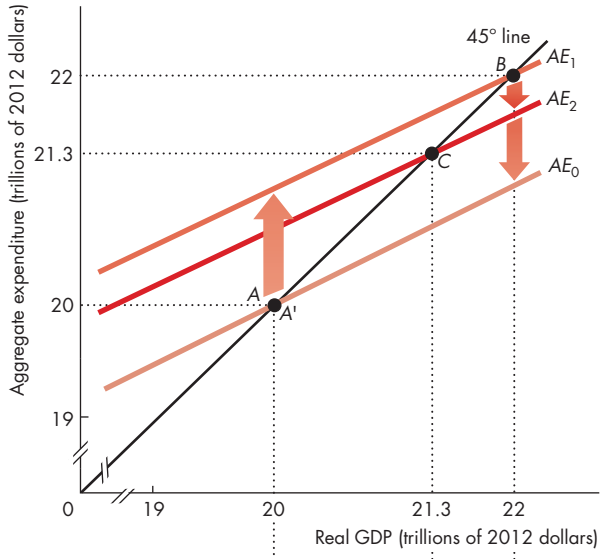
With no change in the price level, the economy would move to point *B* and real GDP would increase to $22 trillion. But you saw in the short run, that the price level rises to 123. That higher price level shifts the *AE* curve downward from AE_1 to AE_2 and

FIGURE 11.10 The Multiplier in the Short Run

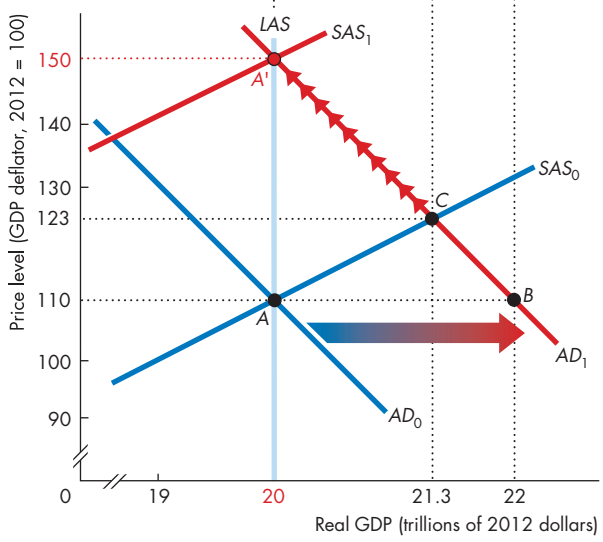


An increase in investment shifts the *AE* curve from AE_0 to AE_1 and the *AD* curve from AD_0 to AD_1. The price level rises, and the higher price level shifts the *AE* curve downward from AE_1 to AE_2. The economy moves to point *C* in both parts. In the short run, when prices are flexible, the multiplier effect is smaller than when the price level is fixed.

FIGURE 11.11 The Multiplier in the Long Run



(a) Aggregate expenditure



(b) Aggregate demand

Starting from point *A*, an increase in investment shifts the *AE* curve to AE_1 and the *AD* curve to AD_1. In the short run at point *C* the economy is in an above full-employment equilibrium. In the long run, the money wage rate rises and the *SAS* curve shifts to SAS_1. As the price level rises, the *AE* curve shifts down to AE_0 and the economy moves to point *A'*. In the long run, the multiplier is zero.

real GDP increases to only $21.3 trillion. The economy is now in a short-run equilibrium at point *C* in part (a) and part (b).

Real GDP now exceeds potential GDP. The labor force is more than fully employed, and in the long run, shortages of labor increase the money wage rate.

The higher money wage rate increases firms' costs, which decreases short-run aggregate supply and shifts the *SAS* curve leftward to SAS_1. The price level rises above 123 and real GDP decreases. There is a movement along AD_1, and the *AE* curve shifts downward from AE_2 toward AE_0. When the money wage rate and the price level have increased by the same percentage, real GDP is again equal to potential GDP and the economy is at point *A'*. In the long run, the multiplier is zero.

REVIEW QUIZ

1. How does a change in the price level influence the *AE* curve and the *AD* curve?
2. If autonomous expenditure increases with no change in the price level, what happens to the *AE* curve and the *AD* curve? Which curve shifts by an amount that is determined by the multiplier and why?
3. How does an increase in autonomous expenditure change real GDP in the short run? Does real GDP change by the same amount as the change in aggregate demand? Why or why not?
4. How does real GDP change in the long run when autonomous expenditure increases? Does real GDP change by the same amount as the change in aggregate demand? Why or why not?

You are now ready to build on what you've learned about aggregate expenditure fluctuations. We'll study the business cycle and the roles of fiscal policy and monetary policy in smoothing the business cycle while achieving price stability and sustained economic growth.

In Chapter 12 we study the U.S. business cycle and inflation, and in Chapters 13 and 14 we study fiscal policy and monetary policy, respectively. But before you leave the current topic, look at *Economics in the News* on pp. 316–317 and see the aggregate expenditure model in action during the Covid-19 pandemic.

Expenditure Changes in the 2020 Contraction

Gross Domestic Product Falls at Record Rate

Bureau of Economic Analysis News Release

September 30, 2020

Real gross domestic product (GDP) decreased at an annual rate of 31.4 percent in the second quarter of 2020, according to the "third" estimate released by the Bureau of Economic Analysis. In the first quarter, real GDP decreased 5.0 percent.

The decline in second quarter GDP reflected the response to Covid-19, as "stay-at-home" orders issued in March and April were partially lifted in some areas of the country in May and June, and government pandemic assistance payments were distributed to households and businesses. This led to rapid shifts in activity, as businesses and schools continued remote work and consumers and businesses canceled, restricted, or redirected their spending.

The decrease in real GDP reflected decreases in personal consumption expenditure (PCE), exports, nonresidential fixed investment, private inventory investment, residential fixed investment, and state and local government spending.

Federal government spending increased, and imports, which are a subtraction in the calculation of GDP, decreased.

The decrease in PCE reflected decreases in services (led by health care) and goods (led by clothing and footwear). The decrease in exports primarily reflected a decrease in goods (led by capital goods). The decrease in nonresidential fixed investment primarily reflected a decrease in equipment (led by transportation equipment). The decrease in private inventory investment primarily reflected a decrease in retail (led by motor vehicle dealers). The decrease in residential investment primarily reflected decreases in new single-family housing.

Source: Bureau of Economic Analysis News Release, September 30, 2020

ESSENCE OF THE STORY

- Real GDP decreased at an annual rate of 31.4 percent in the second quarter of 2020.
- The decrease was the response to Covid-19, as "stay-at-home" orders went into effect.
- Personal consumption expenditure, exports, investment, inventory investment, and state and local government spending decreased.
- Motor vehicle dealers and most retailers decreased their inventories.

ECONOMIC ANALYSIS

- The BEA news release reports that real GDP decreased in the second quarter of 2020 at a record rate and every component of aggregate expenditure fell except government expenditure. Business inventories decreased by $287 billion.
- Table 1 shows the real GDP and aggregate expenditure numbers for the first two quarters of 2020 along with the change in the second quarter.
- Figure 1 shows the changes in inventories and real GDP during 2020. Some inventory changes are planned and some are unplanned.
- Figure 2 interprets the data for 2020 Q1 and Q2 using the Keynesian model of equilibrium expenditure.
- In 2020 Q1, the *AE* curve was AE_0 and real GDP was $19 trillion, which we assume to be an expenditure equilibrium.
- The slope of the *AE* curve is 0.74 (an assumption).
- In Fig. 2(a), a Covid-19 induced decrease in autonomous expenditure shifted the *AE* curve downward to AE_1 and real GDP temporarily exceeded aggregate planned expenditure.
- Figure 2(b) shows the unplanned increase in inventories.
- As real GDP decreased toward its second quarter equilibrium of $17.3 trillion, unplanned inventories get smaller.
- When real GDP reached its second quarter equilibrium, unplanned inventory changes had returned to zero.

Table 1 The Components of Aggregate Expenditure

Item	2020 Q1	2020 Q2	Change
	(billions of 2012 dollars)		
Consumption expenditure	13,118	11,860	−1,258
Investment	3,334	2,850	−484
Government expenditure	3,348	3,369	21
Exports	2,495	1,927	−568
Imports	3,283	2,703	−580
Real GDP*	**19,011**	**17,303**	**−1,708**

*Chained-dollar real variables are calculated for each expenditure component independently of chained-dollar real GDP and the components don't exactly sum to real GDP.

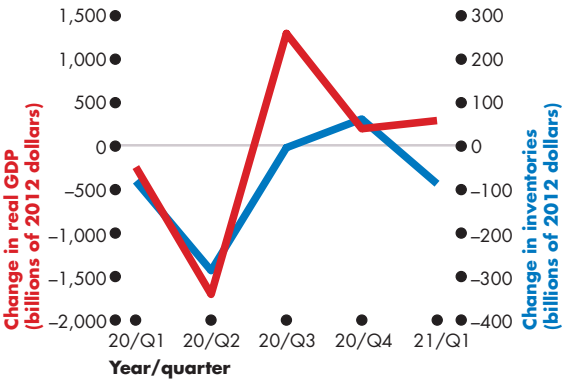
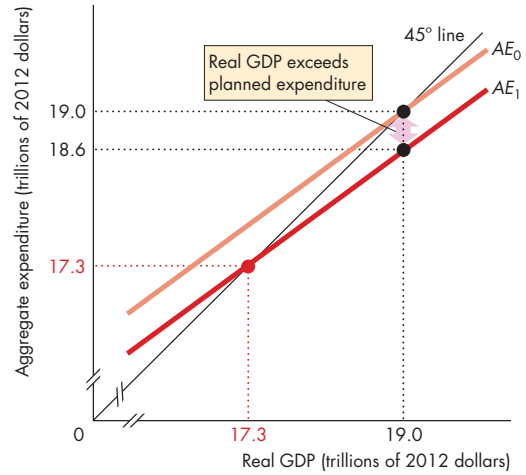
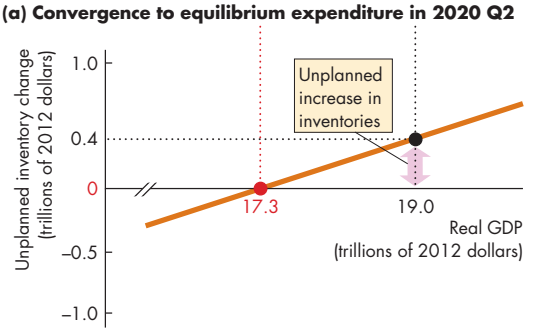


Figure 1 Inventories and Real GDP



(a) Convergence to equilibrium expenditure in 2020 Q2



(b) Unplanned inventory change in 2020 Q2

Figure 2 Equilibrium Expenditure in 2020 Q2

MATHEMATICAL NOTE

The Algebra of the Keynesian Model

This mathematical note derives formulas for equilibrium expenditure and the multipliers when the price level is fixed. The variables are

- Aggregate planned expenditure, AE
- Real GDP, Y
- Consumption expenditure, C
- Disposable income, YD
- Investment, I
- Government expenditure, G
- Exports, X
- Imports, M
- Net taxes, T
- Autonomous consumption expenditure, a
- Autonomous taxes, T_a
- Marginal propensity to consume, b
- Marginal propensity to import, m
- Marginal tax rate, t
- Autonomous expenditure, A

Aggregate Expenditure

Aggregate planned expenditure (AE) is the sum of the planned amounts of consumption expenditure (C), investment (I), government expenditure (G), and exports (X) minus the planned amount of imports (M).

$$AE = C + I + G + X - M.$$

Consumption Function Consumption expenditure (C) depends on disposable income (YD), and we write the consumption function as

$$C = a + bYD.$$

Disposable income (YD) equals real GDP minus net taxes ($Y - T$). So if we replace YD with $(Y - T)$, the consumption function becomes

$$C = a + b(Y - T).$$

Net taxes, T, equal autonomous taxes (that are independent of income), T_a, plus induced taxes (that vary with income), tY.

So we can write net taxes as

$$T = T_a + tY.$$

Use this last equation to replace T in the consumption function. The consumption function becomes

$$C = a - bT_a + b(1 - t)Y.$$

This equation describes consumption expenditure as a function of real GDP.

Import Function Imports depend on real GDP, and the import function is

$$M = mY.$$

Aggregate Expenditure Curve Use the consumption function and the import function to replace C and M in the AE equation. That is,

$$AE = a - bT_a + b(1 - t)Y + I + G + X - mY.$$

Collect the terms that involve Y on the right side of the equation to obtain

$$AE = (a - bT_a + I + G + X) + [b(1 - t) - m]Y.$$

Autonomous expenditure (A) is $(a - bT_a + I + G + X)$, and the slope of the AE curve is $[b(1 - t) - m]$. So the equation for the AE curve, which is shown in Fig. 1, is

$$AE = A + [b(1 - t) - m]Y.$$

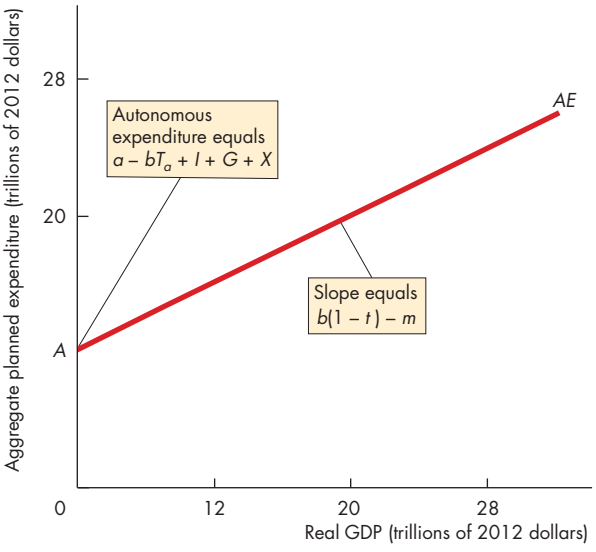


Figure 1 The *AE* Curve

Equilibrium Expenditure

Equilibrium expenditure occurs when aggregate planned expenditure (AE) equals real GDP (Y). That is,

$$AE = Y.$$

In Fig. 2, the scales of the x-axis (real GDP) and the y-axis (aggregate planned expenditure) are identical, so the 45° line shows the points at which aggregate planned expenditure equals real GDP.

Figure 2 shows the point of equilibrium expenditure at the intersection of the AE curve and the 45° line.

To calculate equilibrium expenditure, solve the equations for the AE curve and the 45° line for the two unknown quantities AE and Y. So starting with

$$AE = A + [b(1-t) - m]Y$$

$$AE = Y,$$

replace AE with Y in the AE equation to obtain

$$Y = A + [b(1-t) - m]Y.$$

The solution for Y is

$$Y = \frac{1}{1 - [b(1-t) - m]} A.$$

The Multiplier

The *multiplier* equals the change in equilibrium expenditure and real GDP (Y) that results from a change in autonomous expenditure (A) divided by the change in autonomous expenditure.

A change in autonomous expenditure (ΔA) changes equilibrium expenditure and real GDP by

$$\Delta Y = \frac{1}{1 - [b(1-t) - m]} \Delta A.$$

$$\text{Multiplier} = \frac{1}{1 - [b(1-t) - m]}.$$

The size of the multiplier depends on the slope of the AE curve, $b(1-t) - m$. The larger the slope, the larger is the multiplier. So the multiplier is larger,

- The greater the marginal propensity to consume (b)
- The smaller the marginal tax rate (t)
- The smaller the marginal propensity to import (m)

An economy with no imports and no income taxes has $m = 0$ and $t = 0$. In this special case, the multiplier equals $1/(1-b)$. If b is 0.75, then the multiplier is 4, as shown in Fig. 3.

In an economy with imports and income taxes, if $b = 0.75$, $t = 0.2$, and $m = 0.1$, the multiplier equals 1 divided by $\big([1 - 0.75(1 - 0.2) - 0.1]\big)$, which equals 2. Make up some more examples to show the effects of b, t, and m on the multiplier.

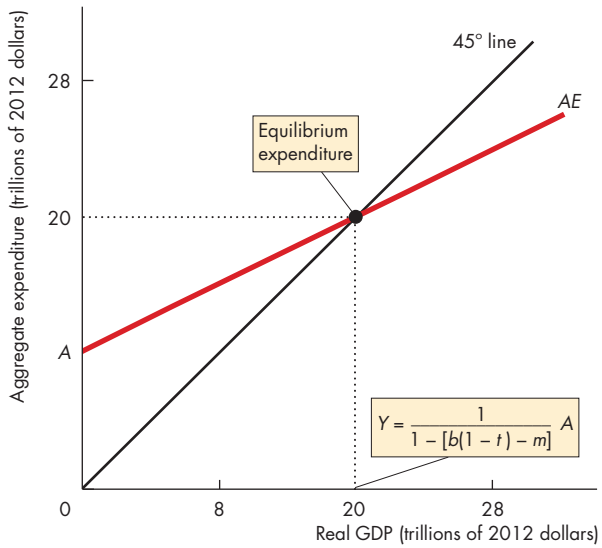


Figure 2 Equilibrium Expenditure

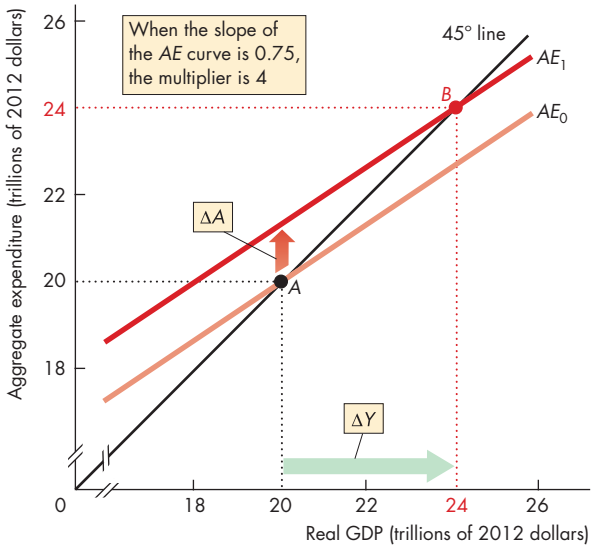


Figure 3 The Multiplier

Government Expenditure Multiplier

The **government expenditure multiplier** equals the change in equilibrium expenditure and real GDP (Y) that results from a change in government expenditure (G) divided by the change in government expenditure. Because autonomous expenditure is equal to

$$A = a - bT_a + I + G + X,$$

the change in autonomous expenditure equals the change in government expenditure. That is,

$$\Delta A = \Delta G.$$

You can see from the solution for equilibrium expenditure Y that

$$\Delta Y = \frac{1}{1-[b(1-t)-m]}\Delta G.$$

The government expenditure multiplier equals

$$\frac{1}{1-[b(1-t)-m]}.$$

In an economy in which $t = 0$ and $m = 0$, the government expenditure multiplier is $1/(1-b)$. With $b = 0.75$, the government expenditure multiplier is 4, as Fig. 4 shows. Make up some examples and use the above formula to show how b, m, and t influence the government expenditure multiplier.

Autonomous Tax Multiplier

The **autonomous tax multiplier** equals the change in equilibrium expenditure and real GDP (Y) that results from a change in autonomous taxes (T_a) divided by the change in autonomous taxes. Because autonomous expenditure is equal to

$$A = a - bT_a + I + G + X,$$

the change in autonomous expenditure equals $-b$ multiplied by the change in autonomous taxes. That is,

$$\Delta A = -b\Delta T_a.$$

You can see from the solution for equilibrium expenditure Y that

$$\Delta Y = \frac{-b}{1-[b(1-t)-m]}\Delta T_a.$$

The autonomous tax multiplier equals

$$\frac{-b}{1-[b(1-t)-m]}.$$

In an economy in which $t = 0$ and $m = 0$, the autonomous tax multiplier is $-b(1-b)$. In this special case, with $b = 0.75$, the autonomous tax multiplier equals -3, as Fig. 5 shows. Make up some examples and use the above formula to show how b, m, and t influence the autonomous tax multiplier.

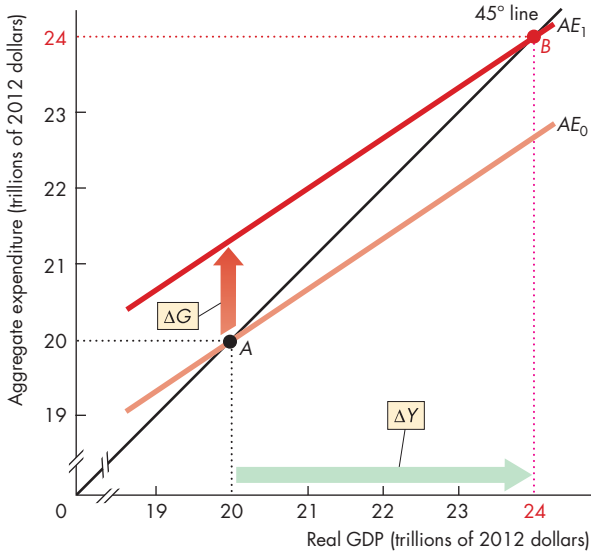


Figure 4 Government Expenditure Multiplier

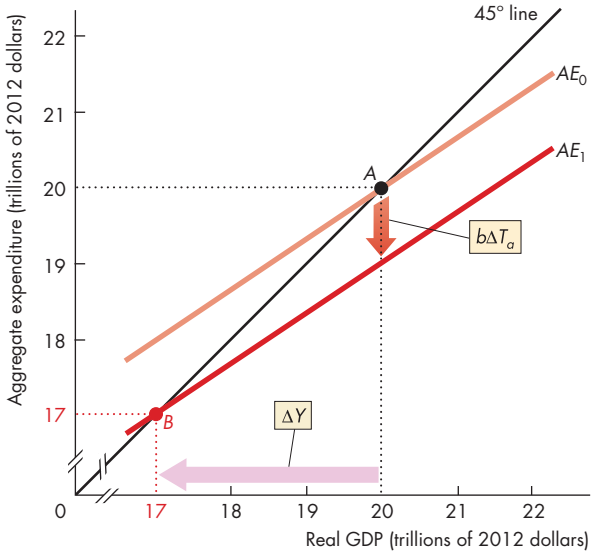


Figure 5 Autonomous Tax Multiplier

Balanced Budget Multiplier

The **balanced budget multiplier** equals the change in equilibrium expenditure and real GDP (Y) that results from equal changes in government expenditure and autonomous taxes divided by the change in government expenditure. Because government expenditure and autonomous taxes change by the same amount, the budget balance does not change.

The change in equilibrium expenditure that results from the change in government expenditure is

$$\Delta Y = \frac{1}{1-[b(1-t)-m]}\Delta G.$$

And the change in equilibrium expenditure that results from the change in autonomous taxes is

$$\Delta Y = \frac{-b}{1-[b(1-t)-m]}\Delta T_a.$$

So the change in equilibrium expenditure resulting from the changes in government expenditure and autonomous taxes is

$$\Delta Y = \frac{-1}{1-[b(1-t)-m]}\Delta G + \frac{-b}{1-[b(1-t)-m]}\Delta T_a.$$

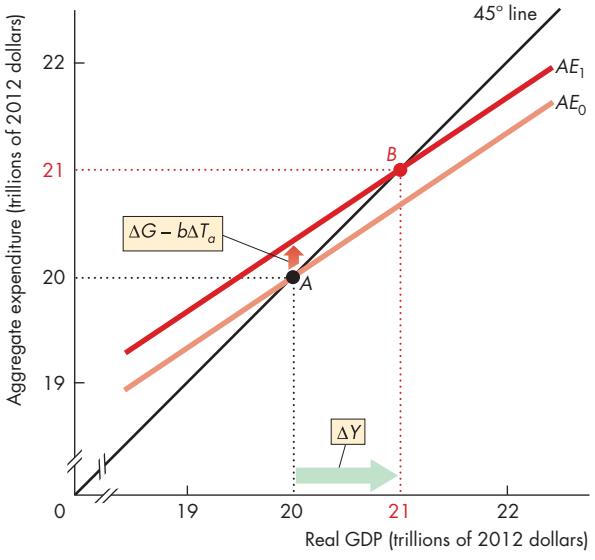


Figure 6 Balanced Budget Multiplier

Notice that

$$\frac{1}{1-[b(1-t)-m]}$$

is common to both terms on the right side. So we can rewrite the equation as

$$\Delta Y = \frac{1}{1-[b(1-t)-m]}(\Delta G - b\Delta T_a).$$

The AE curve shifts upward by $\Delta G - b\Delta T_a$ as shown in Fig. 6.

But the change in government expenditure equals the change in autonomous taxes. That is,

$$\Delta G = \Delta T_a.$$

So we can write the equation as

$$\Delta Y = \frac{1-b}{1-[b(1-t)-m]}\Delta G.$$

The balanced budget multiplier equals

$$\frac{1-b}{1-[b(1-t)-m]}.$$

In an economy in which $t = 0$ and $m = 0$, the balanced budget multiplier is $(1-b)/(1-b)$, which equals 1, as Fig. 6 shows. Make up some examples and use the above formula to show how b, m, and t influence the balanced budget multiplier.

Exercise

In an economy, autonomous consumption expenditure is \$50 billion, investment is \$200 billion, and government expenditure is \$250 billion. The marginal propensity to consume is 0.7 and net taxes are \$250 billion. Exports are \$500 billion and imports are \$450 billion. Assume that net taxes and imports are autonomous and the price level is fixed.

a. What is the consumption function?
b. What is the equation of the AE curve?
c. Calculate equilibrium expenditure.
d. Calculate the multiplier.
e. If investment decreases to \$150 billion, what is the change in equilibrium expenditure?
f. Describe the process in part (e) that moves the economy to its new equilibrium expenditure.

WORKED PROBLEM

You are given the following data about an economy that has a fixed price level, no imports, and no taxes.

Disposable income	Consumption expenditure
(billions of dollars per year)	
0	5
100	80
200	155
300	230
400	305

Questions

1. Calculate the marginal propensity to consume.
2. Calculate autonomous consumption expenditure.
3. Calculate saving at each level of disposable income and the marginal propensity to save.
4. Calculate the multiplier.
5. Calculate the increase in real GDP when autonomous spending increases by $5 billion. Why does real GDP increase by more than $5 billion?

Solutions

1. The marginal propensity to consume equals the fraction of an increase in disposable income that is spent on consumption.

   When disposable income increases from $100 billion to $200 billion, consumption expenditure increases from $80 billion to $155 billion. The increase in disposable income of $100 billion increases consumption expenditure by $75 billion. The marginal propensity to consume equals $75 billion ÷ $100 billion, which equals 0.75.

Key Point: The marginal propensity to consume is the fraction of an increase in disposable income that is spent on consumption.

2. Autonomous consumption expenditure is the amount of consumption expenditure when disposabale income is zero. From the table, autonomous consumption expenditure is $5 billion.

Key Point: Autonomous consumption expenditure is the amount of consumption expenditure that depends on things other than disposable income.

3. Disposable income is spent on consumption or it is saved.

$$\text{Saving} = \text{Disposable income} - \text{Consumption expenditure}.$$

For example, when disposable income is $100 billion, consumption expenditure is $80 billion, so saving is $20 billion.

The table below sets out saving at each level of disposable income.

Disposable income	Saving
(billions of dollars per year)	
0	−5
100	20
200	45
300	70
400	95

The marginal propensity to save equals the fraction of an increase in disposable income that is saved. When disposable income increases by $100 billion, saving increases by $25 billion, so the marginal propensity to save equals 0.25.

Key Point: The marginal propensity to consume plus the marginal propensity to save equals 1.

4. When the price level is fixed, the multiplier equals $1/(1 - \text{Slope of the } AE \text{ curve})$. With no income taxes, the slope of the AE curve equals the marginal propensity to consume (MPC), which is 0.75.

   The multiplier $= 1 - /(1 - 0.75) = 1/0.25 = 4$.

   Because $(1 - MPC) = MPS$, the multiplier also equals $1/MPS$.

Key Point: With a fixed price level, the multiplier equals $1/(1 - MPC)$ or $1/MPS$.

5. The increase in real GDP when the price level is fixed equals the change in autonomous spending multiplied by the multiplier. That is,

$$\begin{aligned}\text{Change in real GDP} &= \text{Change in autonomous spending} \times \text{Multiplier}\\ \text{Change in real GDP} &= \$5 \text{ billion} \times 4\\ &= \$20 \text{ billion}.\end{aligned}$$

   An increase in autonomous spending increases income, which increases induced consumption, which in turn increases income. The quantity of real GDP demanded increases.

Key Point: With a fixed price level, real GDP increases by more than the increase in autonomous spending because induced consumption expenditure increases.

SUMMARY

Key Points

Fixed Prices and Expenditure Plans (pp. 298–301)

- When the price level is fixed, expenditure plans determine real GDP.
- Consumption expenditure is determined by disposable income, and the marginal propensity to consume (*MPC*) determines the change in consumption expenditure brought about by a change in disposable income. Real GDP determines disposable income.
- Imports are determined by real GDP, and the marginal propensity to import determines the change in imports brought about by a change in real GDP.

Real GDP with a Fixed Price Level (pp. 302–305)

- Aggregate *planned* expenditure depends on real GDP.
- Equilibrium expenditure occurs when aggregate planned expenditure equals actual expenditure and real GDP.

The Multiplier (pp. 306–310)

- The multiplier is the magnified effect of a change in autonomous expenditure on equilibrium expenditure and real GDP.
- The multiplier is determined by the slope of the *AE* curve.
- The slope of the *AE* curve is influenced by the marginal propensity to consume, the marginal propensity to import, and the income tax rate.

The Multiplier and the Price Level (pp. 311–315)

- The *AD* curve is the relationship between the quantity of real GDP demanded and the price level, other things remaining the same.
- The *AE* curve is the relationship between aggregate planned expenditure and real GDP, other things remaining the same.
- At a given price level, there is a given *AE* curve. A change in the price level changes aggregate planned expenditure and shifts the *AE* curve. A change in the price level also creates a movement along the *AD* curve.
- A change in autonomous expenditure that is not caused by a change in the price level shifts the *AE* curve and shifts the *AD* curve. The magnitude of the shift of the *AD* curve depends on the multiplier and on the change in autonomous expenditure.
- The multiplier decreases as the price level changes, and the long-run multiplier is zero.

Key Terms

Aggregate planned expenditure, 298
Autonomous expenditure, 302
Autonomous tax multiplier, 320
Balanced budget multiplier, 321
Consumption function, 298
Disposable income, 298
Equilibrium expenditure, 304
Government expenditure multiplier, 320
Induced expenditure, 302
Marginal propensity to consume, 300
Marginal propensity to import, 301
Marginal propensity to save, 300
Multiplier, 306
Saving function, 298

PROBLEMS AND APPLICATIONS

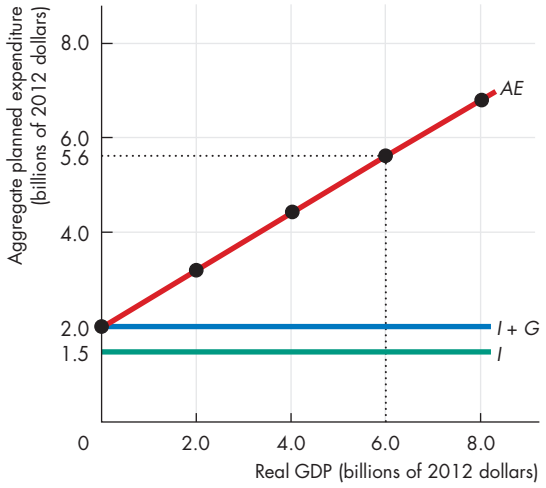
Fixed Prices and Expenditure Plans

1. In an economy, when income increases from $400 billion to $500 billion, consumption expenditure changes from $420 billion to $500 billion. Calculate the marginal propensity to consume, the change in saving, and the marginal propensity to save.

Real GDP with a Fixed Price Level

Use the following figure to work Problems 2 and 3.

The figure illustrates the components of aggregate planned expenditure on Turtle Island. Turtle Island has no imports or exports, no incomes taxes, and the price level is fixed.



2. Calculate autonomous expenditure and the marginal propensity to consume.
3. a. What is aggregate planned expenditure when real GDP is $6 billion?
   b. If real GDP is $4 billion, what is happening to inventories?
   c. If real GDP is $6 billion, what is happening to inventories?
4. Explain the difference between induced consumption expenditure and autonomous consumption expenditure. Why isn't all consumption expenditure induced expenditure?
5. Explain how an increase in business investment at a constant price level changes equilibrium expenditure.

The Multiplier

Use the following data to work Problems 6 and 7.

An economy has a fixed price level, no imports, and no income taxes. *MPC* is 0.80, and real GDP is $150 billion. Businesses increase investment by $5 billion.

6. Calculate the multiplier and the change in real GDP.
7. Calculate the new real GDP and explain why real GDP increases by more than $5 billion.
8. An economy has a fixed price level, no imports, and no income taxes. An increase in autonomous expenditure of $2 trillion increases equilibrium expenditure by $8 trillion. Calculate the multiplier and explain what happens to the multiplier if an income tax is introduced.

The Multiplier and the Price Level

Use the following data to work Problems 9 to 13.

Suppose that the economy is at full employment, the price level is 100, and the multiplier is 2. Investment increases by $100 billion.

9. What is the change in equilibrium expenditure if the price level remains at 100?
10. a. What is the immediate change in the quantity of real GDP demanded?
    b. In the short run, does real GDP increase by more than, less than, or the same amount as the immediate change in the quantity of real GDP demanded?
11. In the short run, does the price level remain at 100? Explain why or why not.
12. a. In the long run, does real GDP increase by more than, less than, or the same amount as the immediate increase in the quantity of real GDP demanded?
    b. Explain how the price level changes in the long run.
13. Are the values of the multipliers in the short run and the long run larger or smaller than 2?

Mathematical Note

14. Use the data in the Worked Problem on p. 322 to calculate the change in equilibrium expenditure when investment decreases by $150 billion.

ADDITIONAL PROBLEMS AND APPLICATIONS

Fixed Prices and Expenditure Plans

Use the following data for the Australian economy to work Problems 15 and 16.

Disposable income	Saving
(billions of dollars per year)	
0	0
100	25
200	50
300	75
400	100

15. Calculate the marginal propensity to save.
16. Calculate consumption at each level of disposable income. Calculate the marginal propensity to consume.

Use the following news clip to work Problems 17 to 19.

Greek Households Lost 40 Percent of Their Wealth

The Bank of Greece reported that during the economic crisis between 2009 and 2014, household wealth declined by 40 percent. This was mainly due to a fall in the value of real estate in Greece. During the same time period, household income also decreased by 26 percent due to heavy taxation.

Sources: greece.greekreporter.com, July 20, 2017

17. Explain and draw a graph to illustrate how the fall in household wealth would have influenced the consumption function and saving function.
18. Based on the news clip, do you expect the actual consumption of Greek households to have changed only because of the decreased wealth between 2009 and 2014?
19. Draw a graph of a consumption function and show at what points consumers would actually be operating as a result of the information in the news clip. Make the necessary assumptions and explain your answer.

Real GDP with a Fixed Price Level

Use the spreadsheet to work Problems 20 and 21. The spreadsheet lists real GDP (Y) and the components of aggregate planned expenditure in billions of dollars.

	A	B	C	D	E	F	G
1		*Y*	*C*	*I*	*G*	*X*	*M*
2	*A*	100	110	50	60	60	15
3	*B*	200	170	50	60	60	30
4	*C*	300	230	50	60	60	45
5	*D*	400	290	50	60	60	60
6	*E*	500	350	50	60	60	75
7	*F*	600	410	50	60	60	90

20. Calculate autonomous expenditure. Calculate the marginal propensity to consume.
21. a. What is aggregate planned expenditure when real GDP is $200 billion?
    b. If real GDP is $200 billion, explain the process that moves the economy toward equilibrium expenditure.
    c. If real GDP is $500 billion, explain the process that moves the economy toward equilibrium expenditure.
22. **U.S. Wholesale Inventories Rise Solidly**

    The Commerce Department reports that U.S. wholesale inventories rose 0.8% in March with businesses replenishing stocks to meet pent-up demand.

    Source: reuters.com, June 9, 2021

    Explain why an increase in inventories might bolster economic growth, while a fall in inventories might be a sign of recession. In your explanation, distinguish between planned and unplanned changes in business inventories.

The Multiplier

23. **South Korea Plans $29-Billion Virus Stimulus**

    The government of South Korea announced a $29 billion (35.3 trillion won) fiscal stimulus package. The goal is to create 550,000 new jobs and boost social safety nets.

    Source: asiatimesfinancial.com, June 3, 2020

    If the slope of the *AE* curve is 0.7, calculate the immediate change in aggregate planned expenditure and the change in real GDP in the short run if the price level remains unchanged.
24. **Japan Mulls New Cash Handout for Needy Households As Pandemic Drags On**

    In 2020, Japan's government gave ¥100,000 each to its 126 million residents to ease the effects of the Covid-19 pandemic. Now the government is considering another similar program.

    Source: japantimes.co.jp, May 26, 2021

    Suppose Japan changes its stimulus payments from all cash handouts to half as cash payments and half as investment in infrastructure projects. Which of these expenditures would have the larger effect on equilibrium expenditure, other things remaining the same?

The Multiplier and the Price Level

Use the following news item to work Problems 25 to 27.

Pakistan reported a decrease in its exports from an equivalent of $19 billion between January and October, 2015, to an equivalent $18 billion for the same period in 2016.

25. Explain and draw a graph to illustrate the effect of a decrease in exports on equilibrium expenditure in the short run.
26. Explain and draw a graph to illustrate the effect of a decrease in exports on equilibrium real GDP in the short run.
27. Explain and draw a graph to illustrate the effect of the initial decrease in exports on equilibrium real GDP in the long run.
28. Compare the multiplier in the short run and the long run and explain why they are not identical.

Use the following news clip to work Problems 29 to 31.

Japan's Economy Grows Faster Than Expected

Japan's economy has witnessed an encouraging growth in GDP in the first quarter. This growth was driven by private consumption, which had long remained an obstacle in the country's economic recovery whereas capital expenditure rose for the first time in four quarters.

Source: CNBC, May 19, 2015

29. Is capital expenditure part of induced expenditure or autonomous expenditure? Explain.
30. Examine how Japan's real GDP increases due to a movement along the aggregate demand curve and a shift in the aggregate demand curve. Illustrate your answer using a graph.
31. Explain using a graph how in the Keynesian model, keeping the price level fixed, an increase in private consumption influences aggregate expenditure and aggregate demand.
32. **U.S. Business Investment Drops 3% in Third Quarter Amid Trade War Uncertainty**

    Business investment for the third quarter dropped 3%, after falling 1% in the previous quarter.

    Source: cnbc.com, October 30, 2019

    If the United States was in a long-run equilibrium in 2019, describe the change in real GDP that occurs in the long run as a result of the decrease in business investment.

Economics in the News

33. After you have studied *Economics in the News* on pp. 316–317, answer the following questions about the second quarter of 2020.
    a. What was the *planned* change in inventories when the *unplanned* change in inventories was $400 billion ($0.4 trillion)?
    b. The BEA data show that exports of goods and services decreased by $568 billion and imports of goods and services decreased by $645 billion. Were these changes in exports and imports changes in autonomous expenditure or changes in induced expenditure, and how do they influence the magnitude of the multiplier?
    c. Using the assumptions made in Fig. 2 on p. 317, what is the value of the autonomous expenditure multiplier?

Mathematical Note

34. In an economy with a fixed price level, autonomous spending is $20 trillion and the slope of the *AE* curve is 0.6.
    a. What is the equation of the *AE* curve?
    b. Calculate equilibrium expenditure. What is the value of induced expenditure at equilibrium expenditure?
    c. Calculate the multiplier.
    d. Calculate equilibrium expenditure if investment increases by $1 trillion.
    e. Calculate the shift of the aggregate demand curve if investment increases by $1 trillion.
35. The spreadsheet lists real GDP (*Y*) and the components of aggregate planned expenditure in billions of dollars. Calculate the slope of the *AE* curve and the multiplier.

	A	B	C	D	E	F	G
1		*Y*	*C*	*I*	*G*	*X*	*M*
2	*A*	100	110	50	60	60	15
3	*B*	200	170	50	60	60	30
4	*C*	300	230	50	60	60	45
5	*D*	400	290	50	60	60	60
6	*E*	500	350	50	60	60	75
7	*F*	600	410	50	60	60	90

12 THE BUSINESS CYCLE, INFLATION, AND DEFLATION

After studying this chapter, you will be able to:

- Explain how aggregate demand shocks and aggregate supply shocks create the business cycle
- Explain how demand-pull and cost-push forces bring cycles in inflation and output
- Explain the causes and consequences of deflation
- Explain the short-run and long-run tradeoff between inflation and unemployment

We worry about inflation because it raises our cost of living. And we fear deflation because it brings stagnant incomes and high unemployment. We want low inflation, low unemployment, and rapid income growth. But can we have all these things at the same time? Or do we face a tradeoff among them? As this chapter explains, we face a tradeoff in the short run but not in the long run.

At the end of the chapter in *Economics in the News*, we examine concerns about the outlook for inflation as the U.S. economy emerges from the Covid recession.

The Business Cycle

The business cycle is easy to describe but hard to explain and the next peak or trough is impossible to predict. We'll look at two approaches to understanding the business cycle:

- Mainstream business cycle theory
- Real business cycle theory

Mainstream Business Cycle Theory

The mainstream business cycle theory is that potential GDP grows at a steady rate while aggregate demand grows at a fluctuating rate. Because the money wage rate is sticky, if aggregate demand grows faster than potential GDP, real GDP moves above potential GDP and an inflationary gap emerges. And if aggregate demand grows slower than potential GDP, real GDP moves below potential GDP and a recessionary gap emerges. If aggregate demand decreases, real GDP also decreases in a recession.

Figure 12.1 illustrates this business cycle theory. Initially, potential GDP is $17 trillion. The long-run aggregate supply curve is LAS_0, the aggregate demand curve is AD_0, and the price level is 100. The economy is at full employment at point *A*.

An expansion occurs when potential GDP increases and the *LAS* curve shifts rightward to LAS_1. During an expansion, aggregate demand also increases, and usually by more than potential GDP, so the price level rises. Assume that in the current expansion, the price level is expected to rise to 110 and the money wage rate has been set based on that expectation. The short-run aggregate supply curve is SAS_1.

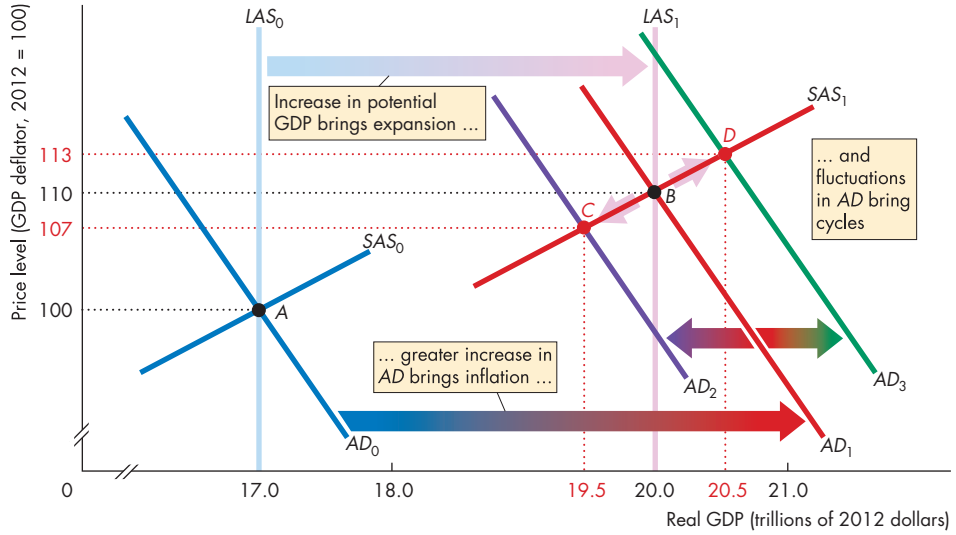
If aggregate demand increases to AD_1, real GDP increases from $17 trillion to $20 trillion, the new level of potential GDP, and the price level rises, as expected, to 110. The economy remains at full employment but now at point *B*.

If aggregate demand increases more slowly to AD_2, real GDP grows by less than potential GDP and the economy moves to point *C*, with real GDP at $19.5 trillion and the price level at 107. Real GDP growth is slower and inflation is lower than expected.

If aggregate demand increases more quickly to AD_3, real GDP grows by more than potential GDP and the economy moves to point *D*, with real GDP at $20.5 trillion and the price level at 113. Real GDP growth is faster and inflation is higher than expected.

Growth, inflation, and the business cycle arise from the relentless increases in potential GDP, faster (on average) increases in aggregate demand, and fluctuations in the pace of aggregate demand growth.

FIGURE 12.1 The Mainstream Business Cycle Theory



In a business cycle expansion, potential GDP increases and the *LAS* curve shifts rightward from LAS_0 to LAS_1. A greater than expected increase in aggregate demand brings inflation.

If the aggregate demand curve shifts to AD_1, the economy remains at full employment. If the aggregate demand curve shifts to AD_2, a recessionary gap arises. If the aggregate demand curve shifts to AD_3, an inflationary gap arises.

This mainstream theory comes in a number of special forms that differ regarding the source of fluctuations in aggregate demand growth and the source of money wage stickiness.

Keynesian Cycle Theory In **Keynesian cycle theory**, fluctuations in investment driven by fluctuations in business confidence—summarized by the phrase "animal spirits"—are the main source of fluctuations in aggregate demand.

Monetarist Cycle Theory In **monetarist cycle theory**, fluctuations in both investment and consumption expenditure, driven by fluctuations in the growth rate of the quantity of money, are the main source of fluctuations in aggregate demand.

Both the Keynesian and monetarist cycle theories simply assume that the money wage rate is rigid and don't explain that rigidity.

Two newer theories seek to explain money wage rate rigidity and to be more careful about working out its consequences.

New Classical Cycle Theory In **new classical cycle theory**, the rational expectation of the price level, which is determined by potential GDP and *expected* aggregate demand, determines the money wage rate and the position of the *SAS* curve. In this theory, only *unexpected* fluctuations in aggregate demand bring fluctuations in real GDP around potential GDP.

New Keynesian Cycle Theory The **new Keynesian cycle theory** emphasizes the fact that today's money wage rates were negotiated at many past dates, which means that *past* rational expectations of the current price level influence the money wage rate and the position of the *SAS* curve. In this theory, both unexpected and currently expected fluctuations in aggregate demand bring fluctuations in real GDP around potential GDP.

The mainstream cycle theories don't rule out the possibility that aggregate supply shocks might occur. An oil price rise, a widespread drought, a major hurricane, or another natural disaster, could, for example, bring a recession. But supply shocks are not the normal source of fluctuations in the mainstream theories. In contrast, real business cycle theory puts supply shocks at center stage.

Real Business Cycle Theory

The newest theory of the business cycle, known as **real business cycle theory** (or RBC theory), regards random fluctuations in productivity as the main source of economic fluctuations. These productivity fluctuations are assumed to result mainly from fluctuations in the pace of technological change, but they might also have other sources, such as international disturbances, climate fluctuations, or natural disasters. The origins of RBC theory can be traced to the rational expectations revolution set off by Robert E. Lucas, Jr., but the first demonstrations of the power of this theory were given by Edward Prescott and Finn Kydland and by John Long and Charles Plosser. Today, RBC theory is part of a broad research agenda called dynamic general equilibrium analysis, and hundreds of young macroeconomists do research on this topic.

We'll explore RBC theory by looking first at its impulse and then at the mechanism that converts that impulse into a cycle in real GDP.

The RBC Impulse The impulse in RBC theory is the growth rate of productivity that results from technological change. RBC theorists believe this impulse to be generated mainly by the process of research and development that leads to the creation and use of new technologies (see *Economics in Action* on p. 330).

The pace of technological change and productivity growth is not constant. Sometimes productivity growth speeds up, sometimes it slows, and occasionally it even *falls*—labor and capital become less productive, on average. A period of rapid productivity growth brings a business cycle expansion, and a slowdown or fall in productivity triggers a recession.

It is easy to understand why technological change brings productivity growth. But how does it *decrease* productivity? All technological change eventually increases productivity. But if initially, technological change makes a sufficient amount of existing capital—especially human capital—obsolete, productivity can temporarily fall. At such a time, more jobs are destroyed than created and more businesses fail than start up.

The RBC Mechanism Two effects follow from a change in productivity that sparks an expansion or a contraction: Investment demand changes and the demand for labor changes. We'll study these effects and their consequences during a recession. In an

ECONOMICS IN ACTION

The Real Business Cycle Impulse

To isolate the Real Business Cycle (RBC) impulse, economists measure the change in the combined productivity of capital and labor—called *total factor productivity*. The figure shows the RBC impulse for the United States from 1950 through 2020.

You can see that the fluctuations in the productivity growth rate are correlated with fluctuations in the growth rate of real GDP.

You can also see that the fluctuations in real GDP growth have wider swings than those of productivity growth.

Real business cycle theory explains these facts.

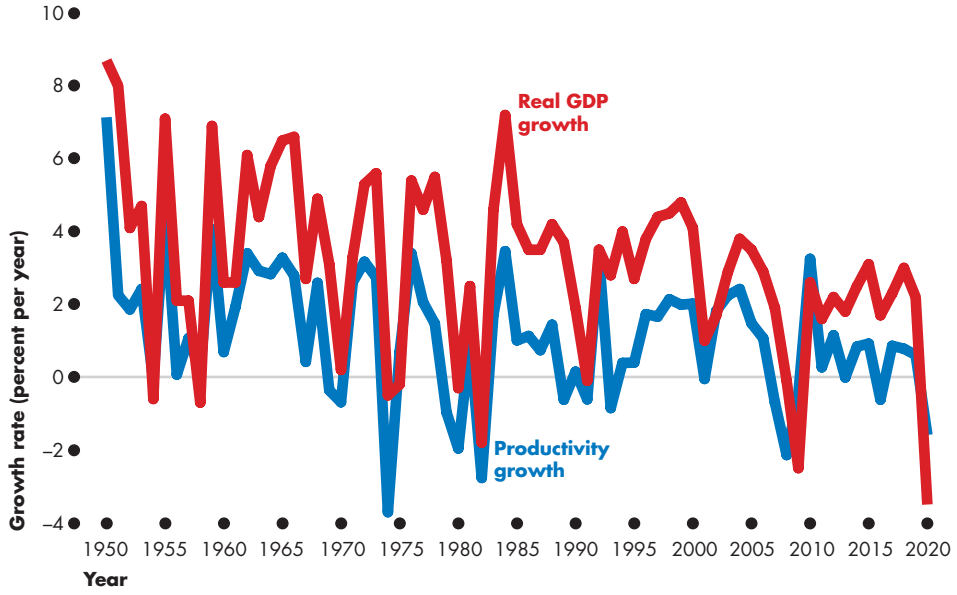


Figure 1 Productivity Growth and Real GDP Fluctuations

Sources of data: Real GDP, Bureau of Economic Analysis; Productivity growth, Federal Reserve Bank of San Francisco.

expansion, they work in the direction opposite to what is described here.

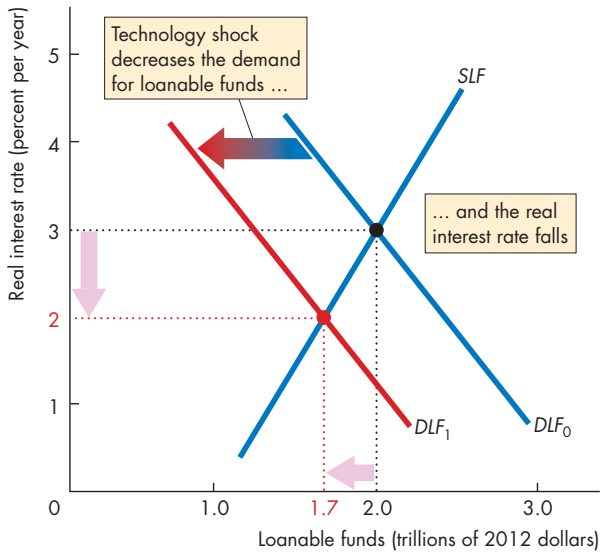
Technological change makes some existing capital obsolete and temporarily decreases productivity. Firms expect the future profits to fall and see their labor productivity falling. With lower profit expectations, they cut back their purchases of new capital, and with lower labor productivity, they plan to lay off some workers. So the initial effect of a temporary fall in productivity is a decrease in investment demand and a decrease in the demand for labor.

Figure 12.2 illustrates these two initial effects of a decrease in productivity. Part (a) shows the effects of a decrease in investment demand in the loanable funds market. The demand for loanable funds curve is *DLF* and the supply of loanable funds curve is *SLF* (both of which are explained in Chapter 7, pp. 199–201). Initially, the demand for loanable funds curve is DLF_0 and the equilibrium quantity of funds is $2 trillion at a real interest rate of 3 percent a year. A decrease in productivity decreases investment demand, and the demand for loanable funds curve shifts leftward from DLF_0 to DLF_1. The real interest rate falls to 2 percent a year, and the equilibrium quantity of loanable funds decreases to $1.7 trillion.

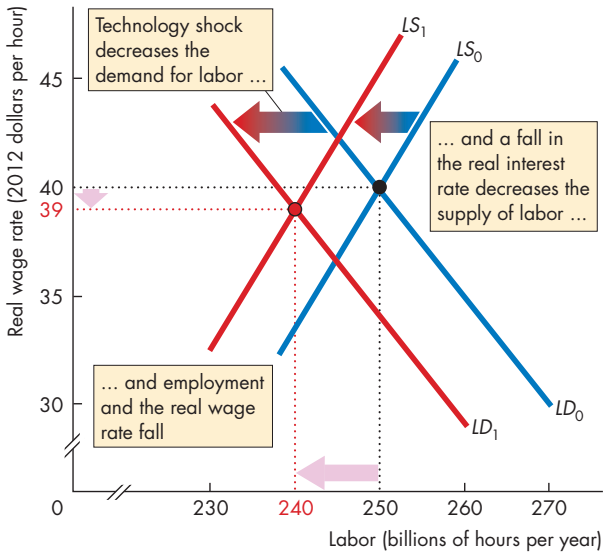
Figure 12.2(b) shows the demand for labor and supply of labor (which are explained in Chapter 6, pp. 170–171). Initially, the demand for labor curve is LD_0, the supply of labor curve is LS_0, and equilibrium employment is 250 billion hours a year at a real wage rate of $40 an hour. The decrease in productivity decreases the demand for labor, and the demand for labor curve shifts leftward from LD_0 to LD_1.

Before we can determine the new level of employment and real wage rate, we need to look at a ripple effect—the key effect in RBC theory.

FIGURE 12.2 Loanable Funds and Labor Markets in a Real Business Cycle



(a) Loanable funds and interest rate



(b) Labor and wage rate

In part (a), the supply of loanable funds *SLF* and the initial demand for loanable funds DLF_0 determine the real interest rate at 3 percent a year. In part (b), the initial demand for labor LD_0 and the supply of labor LS_0 determine the real wage rate at $40 an hour and employment at 250 billion hours. A technological change temporarily decreases productivity, and both the demand for loanable funds and the demand for labor decrease. The two demand curves shift leftward to DLF_1 and LD_1. In part (a), the real interest rate falls to 2 percent a year. In part (b), the fall in the real interest rate decreases the supply of labor (the when-to-work decision) and the supply of labor curve shifts leftward to LS_1. Employment decreases to 240 billion hours, and the real wage rate falls to $39 an hour. A recession is under way.

The Key Decision: When to Work? According to RBC theory, people decide *when* to work by doing a cost-benefit calculation. They compare the return from working in the current period with the *expected* return from working in a later period. You make such a comparison every day in school. Suppose your goal in this course is to get an A. To achieve this goal, you work hard most of the time. But during the few days before the midterm and final exams, you work especially hard. Why? Because you believe that the return from studying close to the exam is greater than the return from studying when the exam is a long time away. So during the term, you take time off for the movies and other leisure pursuits, but at exam time, you study every evening and weekend.

RBC theory says that workers behave like you. They work fewer hours, sometimes zero hours, when the real wage rate is temporarily low, and they work more hours when the real wage rate is temporarily high. But to properly compare the current wage rate with the expected future wage rate, workers must use the real interest rate. If the real interest rate is 3 percent a year, a real wage of $1 an hour earned this week will become $1.03 a year from now. If the real wage rate is expected to be $1.02 an hour next year, today's real wage of $1 looks good. By working longer hours now and shorter hours a year from now, a person can get a 1 percent higher real wage. But suppose the real interest rate is 2 percent a year. In this case, $1 an hour earned this year will become $1.02 an hour next year. With the expected real wage rate next year of $1.02 an hour, there is no incentive to work fewer hours now and more next year.

So the when-to-work decision depends on the real interest rate. A fall in the real interest rate, other things remaining the same, decreases the supply of labor today. Many economists believe this *intertemporal substitution* effect to be of negligible size. RBC

theorists believe that the effect is large, and it is the key feature of the RBC mechanism.

You saw in Fig. 12.2(a) that the decrease in the demand for loanable funds lowers the real interest rate. This fall in the real interest rate lowers the return to current work and decreases the supply of labor.

In Fig. 12.2(b), the labor supply curve shifts leftward to LS_1. The effect of the decrease in productivity on the demand for labor is larger than the effect of the fall in the real interest rate on the supply of labor. That is, the demand curve shifts farther leftward than does the supply curve. As a result, the real wage rate falls to $39 an hour and employment decreases to 240 billion hours. A recession has begun and is intensifying.

What Happened to Money? The name *real* business cycle theory is no accident. It reflects the central prediction of the theory. Real things, not nominal or monetary things, cause the business cycle. If the quantity of money changes, aggregate demand changes. But if there is no real change—with no change in the use of resources and no change in potential GDP—the change in the quantity of money changes only the price level. In RBC theory, this outcome occurs because the aggregate supply curve is the *LAS* curve, which pins real GDP down at potential GDP, so when aggregate demand changes, only the price level changes.

Cycles and Growth The shock that drives the business cycle of RBC theory is the same as the force that generates economic growth: technological change. On average, as technology advances, productivity grows; but as you saw in *Economics in Action* on p. 330, it grows at an uneven pace. Economic growth arises from the upward trend in productivity growth and, according to RBC theory, the mostly positive but occasionally negative higher frequency shocks to productivity bring the business cycle.

Criticisms and Defenses of RBC Theory The three main criticisms of RBC theory are that

1. The money wage rate *is* sticky, and to assume otherwise is at odds with a clear fact.
2. Intertemporal substitution is too weak a force to account for large fluctuations in labor supply and employment with small real wage rate changes.
3. Productivity shocks are as likely to be caused by *changes in aggregate demand* as by technological change.

If aggregate demand fluctuations cause the fluctuations in productivity, then the traditional aggregate demand theories are needed to explain them. Fluctuations in productivity do not cause the business cycle but are caused by it!

Building on this theme, the critics point out that the so-called productivity fluctuations that growth accounting measures are correlated with changes in the growth rate of money and other indicators of changes in aggregate demand.

The defenders of RBC theory claim that the theory explains the macroeconomic facts about the business cycle and is consistent with the facts about economic growth. In effect, a single theory explains *both growth and the business cycle*. The growth accounting exercise that explains slowly changing trends also explains the more frequent business cycle swings. Its defenders also claim that RBC theory is consistent with a wide range of *micro*economic evidence about labor supply decisions, labor demand and investment demand decisions, and information on the distribution of income between labor and capital.

REVIEW QUIZ

1. Explain the mainstream theory of the business cycle.
2. What are the four special forms of the mainstream theory of the business cycle and how do they differ?
3. According to RBC theory, what is the source of the business cycle? What is the role of fluctuations in the rate of technological change?
4. According to RBC theory, how does a fall in productivity growth influence investment demand, the market for loanable funds, the real interest rate, the demand for labor, the supply of labor, employment, and the real wage rate?
5. What are the main criticisms of RBC theory and how do its supporters defend it?

In this first section, we've focussed on the cycles in real GDP and the loanable funds and labor markets. Next, we're going to look at the causes and effects of cycles in the inflation rate.

Inflation Cycles

In the long run, inflation is a monetary phenomenon. It occurs if the quantity of money grows faster than potential GDP. But in the short run, many factors can start an inflation, and real GDP and the price level interact. To study these interactions, we distinguish between two sources of inflation:

- Demand-pull inflation
- Cost-push inflation

Demand-Pull Inflation

An inflation that starts because aggregate demand increases is called **demand-pull inflation**. Demand-pull inflation can be kicked off by *any* of the factors that change aggregate demand. Examples are a cut in the interest rate, an increase in the quantity of money, an increase in government expenditure, a tax cut, an increase in exports, or an increase in investment stimulated by an increase in expected future profits.

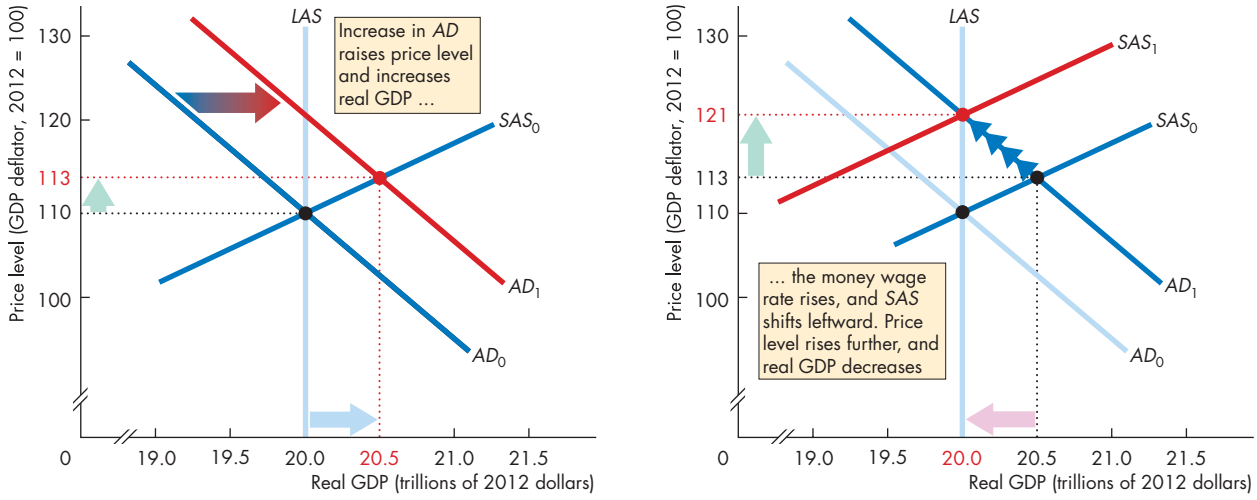
Initial Effect of an Increase in Aggregate Demand

Suppose that last year the price level was 110, real GDP was $20 trillion, and potential GDP was also $20 trillion. Figure 12.3(a) illustrates this situation. The aggregate demand curve is AD_0, the short-run aggregate supply curve is SAS_0, and the long-run aggregate supply curve is *LAS*.

Now suppose that the Fed cuts the interest rate. The quantity of money increases and the aggregate demand curve shifts from AD_0 to AD_1. With no change in potential GDP and no change in the money wage rate, the long-run aggregate supply curve and the short-run aggregate supply curve remain at *LAS* and SAS_0, respectively.

The price level and real GDP are determined at the point where the aggregate demand curve AD_1 intersects the short-run aggregate supply curve. The price level rises to 113, and real GDP increases above potential GDP to $20.5 trillion. Unemployment falls below its natural unemployment rate. The economy is at an above full-employment equilibrium and there is an inflationary gap. The next step in the unfolding story is a rise in the money wage rate.

FIGURE 12.3 A Demand-Pull Rise in the Price Level



(a) Initial effect

In part (a), the aggregate demand curve is AD_0, the short-run aggregate supply curve is SAS_0, and the long-run aggregate supply curve is *LAS*. The price level is 110, and real GDP is $20 trillion, which equals potential GDP. Aggregate demand increases to AD_1. The price level rises to 113, and real GDP increases to $20.5 trillion.

(b) The money wage rate adjusts

In part (b), starting from the above full-employment equilibrium, the money wage rate begins to rise and the short-run aggregate supply curve shifts leftward toward SAS_1. The price level rises further, and real GDP returns to potential GDP.

Money Wage Rate Response Real GDP cannot remain above potential GDP forever. With unemployment below the natural unemployment rate, there is a shortage of labor. In this situation, the money wage rate begins to rise. As it does so, short-run aggregate supply decreases and the *SAS* curve starts to shift leftward. The price level rises further, and real GDP begins to decrease.

With no further change in aggregate demand—that is, the aggregate demand curve remains at AD_1—this process ends when the short-run aggregate supply curve has shifted to SAS_1 in Fig. 12.3(b). At this time, the price level has increased to 121 and real GDP has returned to potential GDP of $20 trillion, the level at which it started.

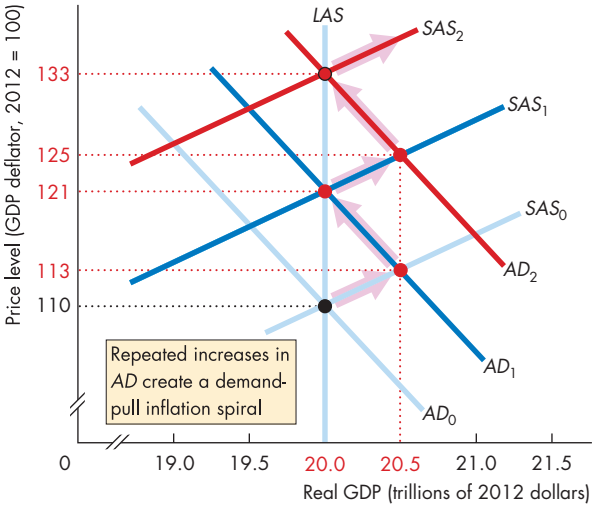
A Demand-Pull Inflation Process The events that we've just described bring a *one-time rise in the price level*, not an inflation. For inflation to proceed, aggregate demand must *persistently* increase.

The only way in which aggregate demand can persistently increase is if the quantity of money persistently increases. Suppose the government has a budget deficit that it finances by selling bonds. Also suppose that the Fed buys some of these bonds. When the Fed buys bonds, it creates more money. In this situation, aggregate demand increases year after year. The aggregate demand curve keeps shifting rightward. This persistent increase in aggregate demand puts continual upward pressure on the price level. The economy now experiences demand-pull inflation.

Figure 12.4 illustrates the process of demand-pull inflation. The starting point is the same as that shown in Fig. 12.3. The aggregate demand curve is AD_0, the short-run aggregate supply curve is SAS_0, and the long-run aggregate supply curve is *LAS*. Real GDP is $20 trillion, and the price level is 110. Aggregate demand increases, shifting the aggregate demand curve to AD_1. Real GDP increases to $20.5 trillion, and the price level rises to 113. The economy is at an above full-employment equilibrium. There is a shortage of labor, and the money wage rate rises. The short-run aggregate supply curve shifts to SAS_1. The price level rises to 121, and real GDP returns to potential GDP.

But the Fed increases the quantity of money again, and aggregate demand continues to increase. The aggregate demand curve shifts rightward to AD_2. The price level rises further to 125, and real GDP again exceeds potential GDP at $20.5 trillion. Yet again,

FIGURE 12.4 A Demand-Pull Inflation Spiral



Each time the quantity of money increases, aggregate demand increases and the aggregate demand curve shifts rightward from AD_0 to AD_1 to AD_2, and so on. Each time real GDP increases above potential GDP, the money wage rate rises and the short-run aggregate supply curve shifts leftward from SAS_0 to SAS_1 to SAS_2, and so on. The price level rises from 110 to 113, 121, 125, 133, and so on. There is a demand-pull inflation spiral. Real GDP fluctuates between $20 trillion and $20.5 trillion.

the money wage rate rises and short-run aggregate supply decreases. The *SAS* curve shifts to SAS_2, and the price level rises further to 133. As the quantity of money continues to grow, aggregate demand increases and the price level rises in an ongoing demand-pull inflation process.

The process you have just studied generates inflation—a persisently rising price level.

Demand-Pull Inflation in Kalamazoo You may better understand the inflation process that we've just described by considering what is going on in an individual part of the economy, such as a Kalamazoo soda-bottling plant. Initially, when aggregate demand increases, the demand for soda increases and the price of soda rises. Faced with a higher price, the soda plant works overtime and increases production. Conditions

are good for workers in Kalamazoo, and the soda factory finds it hard to hang on to its best people. To do so, it offers a higher money wage rate. As the wage rate rises, so do the soda factory's costs.

What happens next depends on aggregate demand. If aggregate demand remains constant, the firm's costs increase but the price of soda does not increase as quickly as its costs. In this case, the firm cuts production. Eventually, the money wage rate and costs increase by the same percentage as the rise in the price of soda. In real terms, the soda factory is in the same situation as it was initially. It produces the same amount of soda and employs the same amount of labor as before the increase in demand.

But if aggregate demand continues to increase, so does the demand for soda and the price of soda rises at the same rate as wages. The soda factory continues to operate at above full employment and there is a persistent shortage of labor. Prices and wages chase each other upward in a demand-pull inflation spiral.

Demand-Pull Inflation in the United States A demand-pull inflation like the one you've just studied occurred in the United States during the late 1960s. In 1960, inflation was a moderate 2 percent a year, but its rate increased slowly to 3 percent a year by 1966. Then, in 1967, a large increase in government expenditure on the Vietnam War and an increase in spending on social programs, together with an increase in the growth rate of the quantity of money, increased aggregate demand more quickly. Consequently, the rightward shift of the aggregate demand curve accelerated and the price level increased more quickly. Real GDP increased to above potential GDP, and the unemployment rate fell below the natural unemployment rate.

With unemployment below the natural unemployment rate, the money wage rate started to rise more quickly and the short-run aggregate supply curve shifted leftward. The Fed responded with a further increase in the money growth rate, and a demand-pull inflation spiral unfolded. By 1970, the inflation rate had reached 5 percent a year.

For the next few years, aggregate demand grew even more quickly and the inflation rate kept rising. By 1974, the inflation rate had reached 11 percent a year.

Next, let's see how shocks to aggregate supply can create cost-push inflation.

Cost-Push Inflation

An inflation that is kicked off by an increase in firms' costs is called **cost-push inflation**. The two main sources of cost increases are:

1. An increase in the money wage rate
2. An increase in the money prices of raw materials

At a given price level, as the cost of production rises, the amount that firms are willing to produce decreases. So if the money wage rate rises or if the prices of raw materials (for example, oil) rise, firms decrease their supply of goods and services. Aggregate supply decreases, and the short-run aggregate supply curve shifts leftward.[1]

Let's trace the effects of such a decrease in short-run aggregate supply on the price level and real GDP.

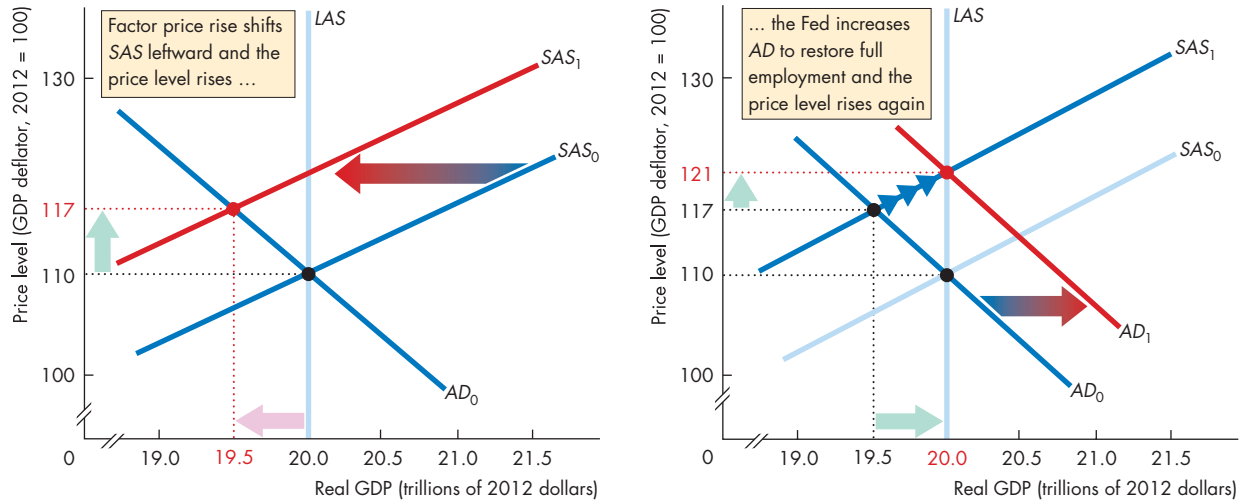
Initial Effect of a Decrease in Aggregate Supply

Suppose that last year the price level was 110 and real GDP was $20 trillion. Potential real GDP was also $20 trillion. Figure 12.5(a) illustrates this situation. The aggregate demand curve was AD_0, the short-run aggregate supply curve was SAS_0, and the long-run aggregate supply curve was LAS. In the current year, the world's oil producers form a price-fixing organization that strengthens their market power and increases the relative price of oil. They raise the price of oil, and this action decreases short-run aggregate supply. The short-run aggregate supply curve shifts leftward to SAS_1. The price level rises to 117, and real GDP decreases to $19.5 trillion. The economy is at a below full-employment equilibrium and there is a recessionary gap.

This event is a *one-time rise in the price level*. It is not inflation. In fact, a supply shock on its own cannot cause inflation. Something more must happen to enable a one-time supply shock, which causes a one-time rise in the price level, to be converted into a process of ongoing inflation. The quantity of money must *persistently* increase. Sometimes it does increase, as you will now see.

[1]Some cost-push forces, such as an increase in the price of oil accompanied by a decrease in the availability of oil, can also decrease long-run aggregate supply. We'll ignore such effects here and examine cost-push factors that change only short-run aggregate supply. Later in the chapter, we study the effects of shocks to long-run aggregate supply.

FIGURE 12.5 A Cost-Push Rise in the Price Level



(a) Initial cost push

(b) The Fed responds

Initially, the aggregate demand curve is AD_0, the short-run aggregate supply curve is SAS_0, and the long-run aggregate supply curve is *LAS*. A decrease in aggregate supply (for example, resulting from a rise in the world price of oil) shifts the short-run aggregate supply curve to SAS_1. The economy moves to the point where the short-run aggregate supply curve SAS_1 intersects the aggregate demand curve AD_0. The price level rises to 117, and real GDP decreases to $19.5 trillion.

In part (b), if the Fed responds by increasing aggregate demand to restore full employment, the aggregate demand curve shifts rightward to AD_1. The economy returns to full employment, but the price level rises further to 121.

Aggregate Demand Response When real GDP decreases, unemployment rises above the natural unemployment rate. In such a situation, there is often an call for action to restore full employment. Suppose that the Fed cuts the interest rate and increases the quantity of money. Aggregate demand increases. In Fig. 12.5(b), the aggregate demand curve shifts rightward to AD_1 and full employment is restored. But the price level rises further to 121.

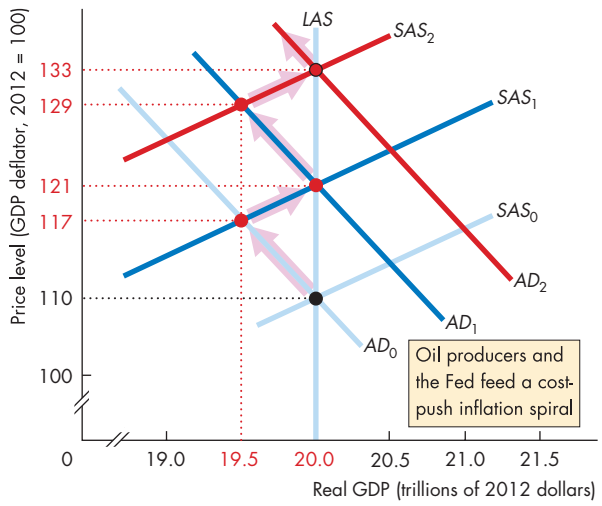
A Cost-Push Inflation Process The oil producers now see the prices of everything they buy increasing, so oil producers increase the price of oil again to restore its new high relative price. Figure 12.6 continues the story. The short-run aggregate supply curve now shifts to SAS_2. The price level rises and real GDP decreases.

The price level rises further, to 129, and real GDP decreases to $19.5 trillion. Unemployment increases above the natural unemployment rate. If the Fed responds yet again with an increase in the quantity of money, aggregate demand increases and the aggregate demand curve shifts to AD_2. The price level rises even higher—to 133—and full employment is again restored. A cost-push inflation spiral results. The combination of a rising price level and decreasing real GDP is called **stagflation**.

You can see that the Fed has a dilemma. If it does not respond when producers raise the oil price, the economy remains below full employment. If the Fed increases the quantity of money to restore full employment, it invites another oil price hike that will call forth yet a further increase in the quantity of money.

If the Fed responds to each oil price hike by increasing the quantity of money, inflation will rage along at a rate decided by oil producers. But if the Fed keeps the lid on money growth, the economy remains below full employment.

FIGURE 12.6 A Cost-Push Inflation Spiral



Each time a cost increase occurs, the short-run aggregate supply curve shifts leftward from SAS_0 to SAS_1 to SAS_2, and so on. Each time real GDP decreases below potential GDP, the Fed increases the quantity of money and the aggregate demand curve shifts rightward from AD_0 to AD_1 to AD_2, and so on. The price level rises from 110 to 117, 121, 129, 133, and so on. There is a cost-push inflation spiral. Real GDP fluctuates between $20 trillion and $19.5 trillion.

Cost-Push Inflation in Kalamazoo What is going on in the Kalamazoo soda-bottling plant when the economy is experiencing cost-push inflation?

When the oil price increases, so do the costs of bottling soda. These higher costs decrease the supply of soda, increasing its price and decreasing the quantity produced. The soda plant lays off some workers.

This situation persists until either the Fed increases the quantity of money, which increases aggregate demand, or the price of oil falls. If the Fed increases aggregate demand, the demand for soda increases and so does its price. The higher price of soda brings higher profits, and the bottling plant increases its production. The soda factory rehires the laid-off workers.

Cost-Push Inflation in the United States A cost-push inflation like the one you've just studied occurred in the United States during the 1970s. It began in 1974 when the Organization of the Petroleum Exporting Countries (OPEC) raised the price of oil fourfold. The higher oil price increased firms' costs, which decreased aggregate supply. The price level started to rise more quickly and real GDP to shrink. The Fed then faced a dilemma: Would it increase the quantity of money and accommodate the cost-push forces, or would it keep aggregate demand growth in check by limiting money growth? In 1975, 1976, and 1977, the Fed repeatedly allowed the quantity of money to grow quickly and inflation proceeded at a rapid rate.

In 1979 and 1980, OPEC was again able to push oil prices higher. On that occasion, the Fed decided not to respond to the oil price hike with an increase in the quantity of money. The result was a recession but also, eventually, a fall in inflation.

Expected Inflation

If inflation is expected, the fluctuations in real GDP that accompany demand-pull and cost-push inflation that you've just studied don't occur. Instead, inflation proceeds as it does in the long run, with real GDP equal to potential GDP and unemployment at the natural unemployment rate. Figure 12.7 explains why.

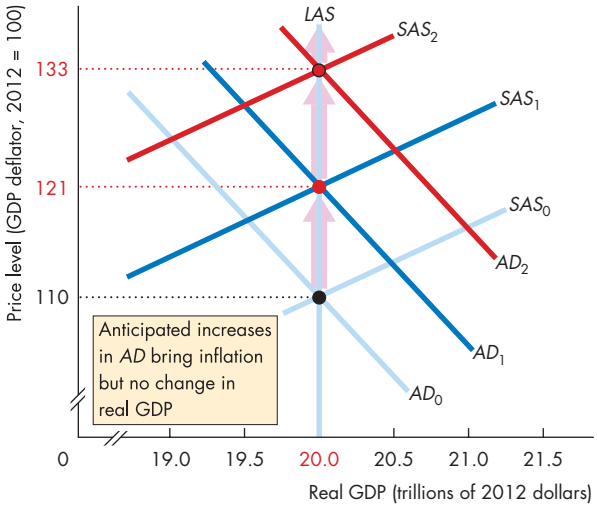
Suppose that last year the aggregate demand curve was AD_0, the aggregate supply curve was SAS_0, and the long-run aggregate supply curve was LAS. The price level was 110, and real GDP was $20 trillion, which is also potential GDP.

To keep things as simple as possible, suppose that potential GDP does not change, so the LAS curve doesn't shift. Also suppose that aggregate demand is *expected to increase* to AD_1.

In anticipation of this increase in aggregate demand, the money wage rate rises and the short-run aggregate supply curve shifts leftward. If the money wage rate rises by the same percentage as the price level is expected to rise, the short-run aggregate supply curve for next year is SAS_1.

If aggregate demand turns out to be the same as expected, the aggregate demand curve is AD_1. The short-run aggregate supply curve, SAS_1, and AD_1 determine the actual price level at 121. Between last year and this year, the price level increased from 110 to 121 and the economy experienced an inflation rate equal to that expected. If this inflation is ongoing, aggregate demand increases (as expected) in the following year and the aggregate demand curve shifts to AD_2. The money wage rate rises to reflect the expected inflation, and the short-run aggregate

FIGURE 12.7 Expected Inflation



Potential real GDP is $20 trillion. Last year, aggregate demand was AD_0 and the short-run aggregate supply curve was SAS_0. The actual price level was the same as the expected price level: 110. This year, aggregate demand is expected to increase to AD_1 and the price level is expected to rise from 110 to 121. As a result, the money wage rate rises and the short-run aggregate supply curve shifts to SAS_1. If aggregate demand actually increases as expected, the actual aggregate demand curve AD_1 is the same as the expected aggregate demand curve. Real GDP is $20 trillion, and the actual price level rises to 121. The inflation is expected. Next year, the process continues with aggregate demand increasing as expected to AD_2 and the money wage rate rising to shift the short-run aggregate supply curve to SAS_2. Again, real GDP remains at $20 trillion, and the price level rises, as expected, to 133.

supply curve shifts to SAS_2. The price level rises, as expected, to 133.

What caused this inflation? The immediate answer is that because people expected inflation, the money wage rate increased and the price level increased. But the expectation was correct. Aggregate demand was expected to increase, and it did increase. It is the actual and expected increase in aggregate demand that caused the inflation.

An expected inflation at full employment is exactly the process that the quantity theory of money predicts. To review the quantity theory of money, see Chapter 8, pp. 232–233.

This broader account of the inflation process and its short-run effects shows why the quantity theory of money doesn't explain the *fluctuations* in inflation. The economy follows the course described in Fig. 12.7, but as predicted by the quantity theory, only if aggregate demand growth is forecasted correctly.

Forecasting Inflation

To anticipate inflation, people must forecast it. Some economists who work for macroeconomic forecasting agencies, banks, insurance companies, labor unions, and large corporations specialize in inflation forecasting.

The best forecast available is one that is based on all the relevant information and is called a **rational expectation**. A rational expectation is not necessarily a correct forecast. It is simply the best forecast with the information available. It will often turn out to be wrong, but no other forecast that could have been made with the information available could do better.

Inflation and the Business Cycle

When the inflation forecast is correct, the economy operates at full employment. If aggregate demand grows faster than expected, real GDP rises above potential GDP, the inflation rate exceeds its expected rate, and the economy behaves like it does in a demand-pull inflation. If aggregate demand grows more slowly than expected, real GDP falls below potential GDP and the inflation rate slows.

REVIEW QUIZ

1. How does demand-pull inflation begin?
2. What must happen to create a demand-pull inflation spiral?
3. How does cost-push inflation begin?
4. What must happen to create a cost-push inflation spiral?
5. What is stagflation and why does cost-push inflation cause stagflation?
6. How does expected inflation occur?
7. How do real GDP and the price level change if the forecast of inflation is incorrect?

Deflation

An economy experiences *deflation* when it has a persistently *falling* price level. Equivalently, during a period of deflation, the inflation rate is negative.

In most economies and for most of the time, the inflation rate is positive—the price level is rising—and deflation is rare. But deflation does happen, and most recently it was present in Japan (see *Economics in Action* on p. 748).

We're going to answer three questions about deflation:

- What causes deflation?
- What are the consequences of deflation?
- How can deflation be ended?

What Causes Deflation?

The starting point for understanding the cause of deflation is to distinguish between a one-time fall in the price level and a persistently falling price level. A one-time *fall* in the price level is not deflation. Deflation is a persistent and ongoing *falling* price level.

A One-Time Fall in the Price Level The price level can fall either because aggregate demand decreases or because short-run aggregate supply increases. So any of the influences on aggregate demand and short-run aggregate supply that you studied in Chapter 10 can bring a one-time fall in the price level.

Some examples on the demand side are a fall in global demand for a country's exports, or a fall in profit expectations that lowers business investment. Some examples on the supply side are an increase in capital or an advance in technology that increases potential GDP, or (unlikely but possible) a fall in the money wage rate.

But none of these sources of a decrease in aggregate demand or increase in aggregate supply can bring a persistently falling price level.

A Persistently Falling Price Level The price level falls persistently if aggregate demand increases at a persistently slower rate than aggregate supply. The trend rate of increase in aggregate supply is determined by the forces that make potential GDP grow. These forces are the growth rates of the labor force and the capital stock and the growth rate of productivity that results from technological change. Notice that all these variables are real, not monetary, and they have trends that change slowly.

In contrast, the forces that drive aggregate demand include the quantity of money. And this quantity can grow as quickly or as slowly as the central bank chooses.

In most situations, the central bank doesn't have a target for the money stock or its growth rate and instead sets the interest rate. But the money stock is under central bank control, and its growth rate has a powerful effect on the growth rate of aggregate demand. To see the effect of growth in the money stock in the long term, we need to return to the quantity theory of money.

The Quantity Theory and Deflation The quantity theory of money explains the trends in inflation by focusing on the trend influences on aggregate supply and aggregate demand.

The foundation of the quantity theory is the *equation of exchange* (see Chapter 8, p. 232), which in its growth rate version and solved for the inflation rate states

$$\text{Inflation rate} = \text{Money growth rate} + \text{Rate of velocity change} - \text{Real GDP growth rate}$$

This equation, true by definition, derives from the fact that the amount of money spent on real GDP, MV, equals the money value of GDP, PY. (M is the money stock, V is its velocity of circulation, P is the price level, and Y is real GDP.)

The quantity theory adds two propositions to the equation of exchange. First, the trend rate of change in the velocity of circulation does not depend on the money growth rate and is determined by decisions about the quantity of money to hold and to spend. Second, the trend growth rate of real GDP equals the growth rate of potential GDP and, again, is independent of the money growth rate.

With these two assumptions, the equation of exchange becomes the quantity theory of money and predicts that a change in the money growth rate brings an equal change in the inflaton rate.

For example, suppose velocity increases by 2 percent per year and potential GDP grows by 3 percent per year. Then the quantity theory predicts that the trend inflation rate equals the money growth rate minus 1 percent. If the central bank makes the quantity of money grow by 1 percent, the inflation rate will be zero. If money grows at a rate faster than 1 percent, the economy will experience inflation. And if money grows at a slower rate than 1 percent, the economy will experience deflation.

ECONOMICS IN ACTION

Fifteen Years of Deflation in Japan

Japan experienced deflation for the 15 years from 1998 to 2013.

Japan's Deflation Rate

Figure 1 shows the inflation rate in Japan from 1995 to 2020. During the deflation years, the inflation rate fluctuated between −1 percent and −2 percent per year and accumulated to a 17 percent fall in the price level.

Cause of Japan's Deflation

Deflation, like its opposite, inflation, is primarily a monetary phenomenon. Japan's money stock grew too slowly during the deflation years.

Figure 2 shows the facts about inflation and money growth in Japan from 1995 to 2020. The relevant money growth rate that brings inflation or deflation is that of money itself *plus* the trend rate of change in the velocity of circulation *minus* the growth rate of potential GDP. That is the money growth rate shown in Fig. 2. The inflation rate from 1995 to 2013 was negative, which means that Japan's money stock did not grow fast enough to accommodate the growth of potential GDP and the trend rise in velocity.

Consequences of Japan's Deflation

At first, Japan's deflation was unexpected and the loan and wage contracts entered into had anticipated an ongoing low but positive inflation rate. So when the price level started to fall, the real value of debt increased and the real wage rate increased.

With higher real debt and wages, businesses cut back on both investment and hiring labor and cut production. Real GDP fell and the recessionary gap increased.

Because investment decreased, the capital stock increased more slowly and the growth rate of potential GDP slowed. From being one of the world's most dynamic rich economies, Japan became the world's most sluggish.

Figure 3 tells the story. In the 1960s, real GDP in Japan doubled in seven years. The growth rate slowed in the 1970s and 1980s but remained one of the world's fastest. Then, during the deflation years, the growth rate dropped to 1.5 percent in the 1990s, 0.8 percent in the 2000s, and 0.6 percent in the 2010s.

Japan's money growth rate increased in 2013 and the inflation rate turned positive in 2014. With sustained higher money growth, Japan ended its deflation.

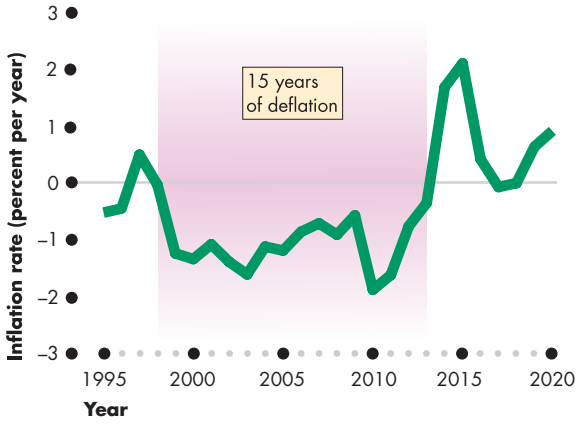


Figure 1 Japan's Long Deflation

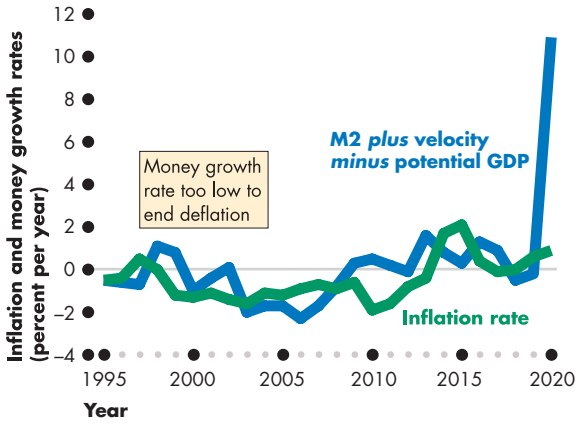


Figure 2 Money Growth Rate Too Low

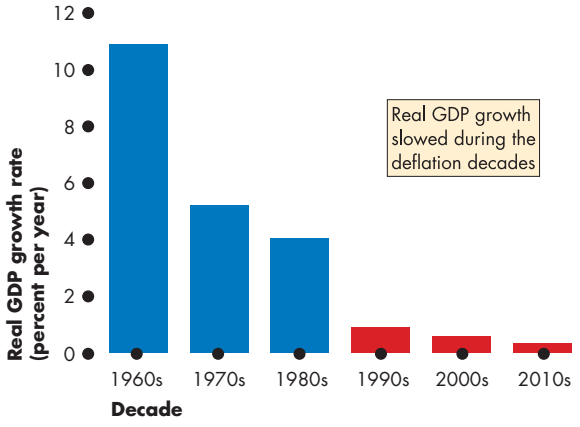


Figure 3 Japan's Decade Average Real GDP Growth Rates

Sources of data: Financial Statistics and *World Economic Outlook*, International Monetary Fund, Washington, DC.

Japan Example In the example of Japan during the 1990s and 2000s (see *Economics in Action* on p. 340), the money (M2) growth rate during the 15 years 1998–2013 was 2.6 percent per year. The velocity growth rate was negative and it *decreased* at a rate of 2.7 percent per year. Potential GDP grew at an average rate of 0.8 percent per year. Combining these numbers, the quantity theory predicts an inflation rate equal to –0.9 percent per year:

$$2.6 - 2.7 - 0.8 = -0.9.$$

In fact, the average inflation rate was −1.2 percent per year. So the quantity theory prediction is not exact. The quantity theory becomes a prediction only if the real GDP growth and the velocity growth are independent of the growth rate of money.

You now know what causes deflation. Let's turn to its consequences.

What Are the Consequences of Deflation?

Chapter 5, (p. 148) discusses why deflation and inflation are problems. But with what you now know about aggregate supply and aggregate demand and the determinants of potential GDP and its growth rate, you can gain deeper insight into the costs of deflation (and the related costs of inflation).

The effects of deflation (like those of inflation) depend on whether it is anticipated or unanticipated. But because inflation is normal and deflation is rare, when deflation occurs, it is usually unanticipated.

Unanticipated deflation redistributes income and wealth, lowers real GDP and employment, and diverts resources from production.

Workers with long-term wage contracts find their real wages rising. But on the other side of the labor market, employers respond to a higher and rising real wage by hiring fewer workers. So the level of employment and output falls.

With lower output and profits, firms re-evaluate their investment plans and cut back on projects that they now see as unprofitable. This fall in investment slows the pace of capital accumulation and slows the growth rate of potential GDP.

Another consequence of deflation is a low nominal interest rate, which, in turn, brings an increase in the quantity of money that people plan to hold and a decrease in the velocity of circulation. A lower velocity adds to the deflationary forces and, if unattended to, lowers the inflation rate yet further.

So, what is the cure for deflation?

How Can Deflation Be Ended?

Deflation can be ended by removing its cause: The quantity of money is growing too slowly. If the central bank ensures that the quantity of money grows at the target inflation rate *plus* the growth rate of potential GDP *minus* the growth rate of the velocity of circulation, then, on average, the inflation rate will turn out to be close to target.

In the example of Japan, if the Bank of Japan, the central bank, wanted to get a 2 percent inflation rate, and other things remaining the same, it would have needed to make the quantity of money grow at an annual average rate of 5.5 percent. (Money growth of 5.5 *plus* velocity growth of −2.7 *minus* potential GDP growth of 0.8 equals target inflation of 2 percent.) If raising the inflation rate brought faster potential GDP growth, a yet higher money growth rate would be needed to sustain the higher inflation rate.

Money Growth, Not Quantity Notice that it is an increase in the *growth rate* of the money stock, not a one-time increase in the quantity of money, that is required to end deflation. Central banks sometimes increase the quantity of money and fail to increase its growth rate. An increase in the *level* with no change in the *growth rate* brings a temporary inflation as the price level adjusts but not ongoing inflation, so it does not end deflation.

REVIEW QUIZ

1. What is deflation?
2. What is the distinction between deflation and a one-time fall in the price level?
3. What causes deflation?
4. How does the quantity theory of money help us to understand the process of deflation?
5. What are the consequences of deflation?
6. How can deflation be ended?

In the final section of this chapter, we're going to look at an alternative model of short-run fluctuations that focuses on inflation and unemployment.

The Phillips Curve

The *Phillips curve* is a relationship between inflation and unemployment. It is so named because it was first suggested by New Zealand economist A.W. (Bill) Phillips. We distinguish between two time frames for the Phillips curve (similar to the two aggregate supply time frames). We study:

- The short-run Phillips curve
- The long-run Phillips curve

The Short-Run Phillips Curve

The **short-run Phillips curve** is the relationship between inflation and unemployment, holding constant

1. The expected inflation rate
2. The natural unemployment rate

Expected inflation is the best available forecast of future inflation (see p. 338) and natural unemployment is frictional and structural unemployment (see Chapter 5, pp. 145–146).

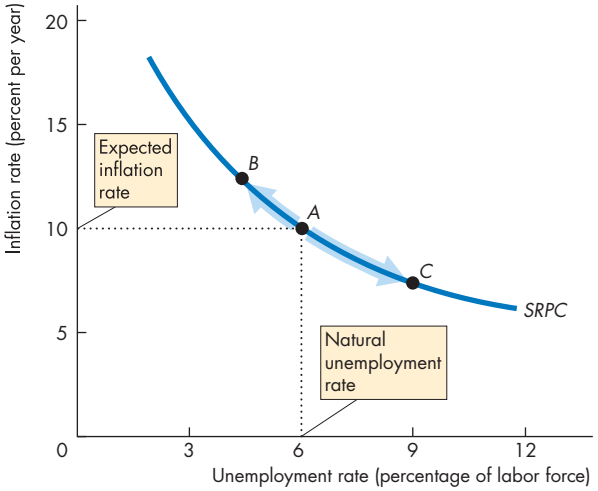
Figure 12.8 shows a short-run Phillips curve, *SRPC*. Suppose that the expected inflation rate is 10 percent a year and the natural unemployment rate is 6 percent, point *A* in the figure. A short-run Phillips curve passes through this point. If inflation rises above its expected rate, unemployment falls below the natural unemployment rate in a movement up along the short-run Phillips curve from point *A* to point *B*. Similarly, if inflation falls below its expected rate, unemployment rises above the natural unemployment rate in a movement down along the short-run Phillips curve from point *A* to point *C*.

The Long-Run Phillips Curve

The **long-run Phillips curve** is the relationship between inflation and unemployment when the actual inflation rate equals the expected inflation rate. The long-run Phillips curve is vertical at the natural unemployment rate because, in the long run, any expected inflation rate is possible. In Fig. 12.9(a), the long-run Phillips curve is the vertical line *LRPC*.

Change in Expected Inflation A change in the expected inflation rate shifts the short-run Phillips curve, but it does not shift the long-run Phillips curve. In Fig. 12.9(a), if the expected inflation rate is 10 percent a year, the short-run Phillips curve is $SRPC_0$. If the expected inflation rate falls to 6 percent a year, the short-run Phillips curve shifts downward to

FIGURE 12.8 A Short-Run Phillips Curve



The short-run Phillips curve, *SRPC*, is the relationship between inflation and unemployment at a given expected inflation rate and a given natural unemployment rate. Here, the expected inflation rate is 10 percent a year and the natural unemployment rate is 6 percent at point *A*.

A change in the actual inflation rate brings a movement along the short-run Phillips curve from *A* to *B* or from *A* to *C*.

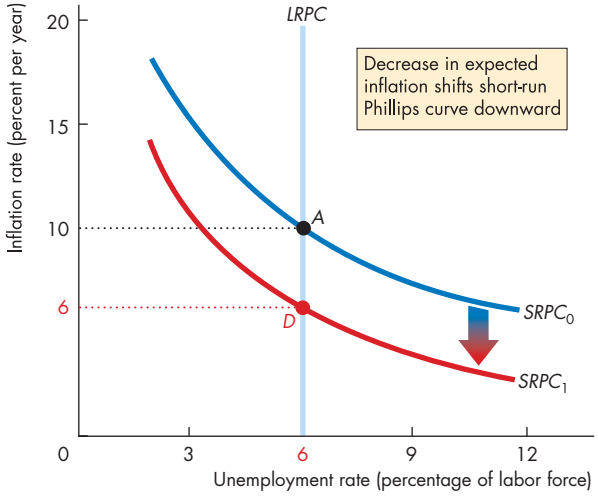
$SRPC_1$. The vertical distance by which the short-run Phillips curve shifts from point *A* to point *D* is equal to the change in the expected inflation rate. If the actual inflation rate also falls from 10 percent to 6 percent, there is a movement down the long-run Phillips curve from *A* to *D*. An increase in the expected inflation rate has the opposite effect to that shown in Fig. 12.9(a).

The other source of a shift in the Phillips curve is a change in the natural unemployment rate.

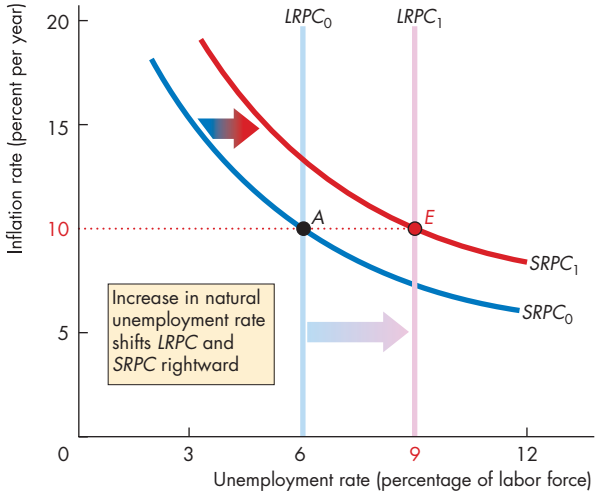
Change in Natural Unemployment Rate A change in the natural unemployment rate shifts both the short-run and long-run Phillips curves. Figure 12.9(b) illustrates such shifts.

If the natural unemployment rate increases from 6 percent to 9 percent, the long-run Phillips curve shifts from $LRPC_0$ to $LRPC_1$, and if expected inflation is constant at 10 percent a year, the short-run Phillips curve shifts from $SRPC_0$ to $SRPC_1$. Because the expected inflation rate is constant, $SRPC_1$ intersects the long-run curve $LRPC_1$ (point *E*) at the same inflation rate at which $SRPC_0$ intersects the long-run curve $LRPC_0$ (point *A*).

FIGURE 12.9 Short-Run and Long-Run Phillips Curves



(a) A change in expected inflation



(b) A change in natural unemployment

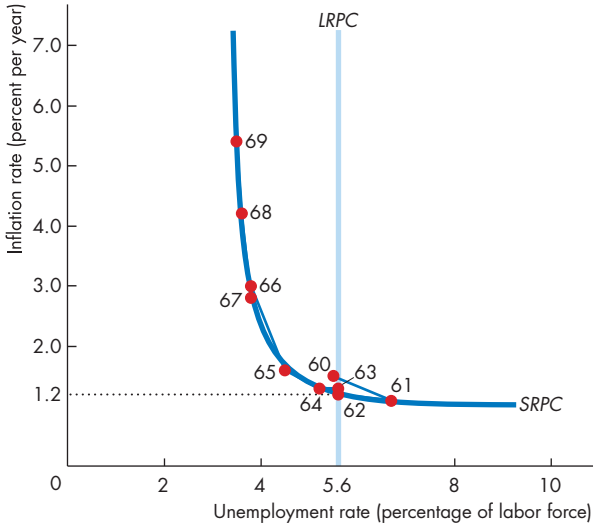
In part (a), the long-run Phillips curve is *LRPC*. A fall in expected inflation shifts the short-run Phillips curve downward from $SRPC_0$ to $SRPC_1$. The long-run Phillips curve does not shift. In part (b), a change in the natural unemployment rate shifts both the short-run and long-run Phillips curves.

Economics in Action in the next column looks at the U.S. Phillips curve during the 1960s, a period through which the expected inflation rate and the natural unemployment rate didn't change much.
Over longer periods, big changes in the expected inflation rate have shifted the U.S. Phillips curve.

ECONOMICS IN ACTION

The U.S. Phillips Curve

The figure below is a scatter diagram of the U.S. inflation rate (measured by the GDP deflator) and the unemployment rate during the 1960s. *LRPC* is at a natural unemployment rate of 5.6 percent and *SRPC* at an expected inflation rate of 1.2 percent. The dots for each year (some of which are identified) show a remarkably stable *SRPC*, which looked like an inflation-unemployment tradeoff.



The U.S. Phillips Curve in the 1960s

Sources of data: Bureau of Labor Statistics and Bureau of Economic Analysis.

REVIEW QUIZ

1. How would you use the Phillips curve to illustrate an unexpected change in inflation?
2. If the expected inflation rate increases by 10 percentage points, how do the short-run Phillips curve and the long-run Phillips curve change?
3. If the natural unemployment rate increases, what happens to the short-run Phillips curve and the long-run Phillips curve?
4. If actual inflation departs from the expected inflation rate, how is the labor market changing?

Economics in the News on pp. 344–345 looks at inflation as the U.S. economy emerges from the Covid recession.

Covid-19 Inflation?

How Much To Worry — And Not Worry — About Inflation

vox.com
May 12, 2021

When it comes to fears about the economy, inflation is the new monster hiding under the bed. But there isn't a real consensus among economists about just how concerned people should be about inflation—and how likely it is to show up on a sustained basis. The economy has started to get a little warmer, but inflation isn't spiraling out of control.

There's a smallish but growing chorus of economists and policymakers sounding the alarm about inflation. They warn that a combination of government stimulus and the impending economic snapback will cause prices to overheat. A lot of regular people might be confused by this. After all, the country is still in the middle of the Covid-19 outbreak, the economy is far from back to normal, and we're still millions of jobs short from where we were pre-pandemic. …

The debate about inflation—how it works, where it is showing up, and why—is a longstanding one in macroeconomics. There are always doomsayers warning that rapid inflation is around the corner, and there are always people telling them to settle down. Alarmists often hark back to the 1970s as an example of U.S. inflation spun out of control, warning that a similar scenario might be on the horizon.

But in recent years, the more puzzling question for many economists has been why inflation has remained so stubbornly low (lower than the Federal Reserve's 2 percent target), even when unemployment fell significantly. That makes it harder to predict what's going to happen next. And a lot of inflation is an expectations game, anyway.

Copyright Emily Stewart, vox.com, May 12, 2021.

ESSENCE OF THE STORY

- There is no consensus among economists about the likelihood of a sustained high inflation.
- A small but growing number of economists worry that government stimulus will bring inflation.
- Alarmists say the 1970s, when U.S. inflation spun out of control, will repeat.
- Many economists are puzzled that inflation has remained so low when unemployment has also been low.
- Inflation is an expectations game.

ECONOMIC ANALYSIS

- In the pandemic year from March 2020 to March 2021, the U.S. inflation rate averaged 1.2 percent per year.
- But the inflation rate jumped to 4.2 percent in April, 4.9 percent in May, and 5.6 percent in June.
- Was this rise in the inflation rate a short-term blip or the start of a sustained and higher inflation?
- There was no consensus among economists about the answer, but some worried that government stimulus would bring inflation.
- The stimulus was large. The quantity of money had grown by 24 percent and a monthly government budget deficit of $277 billion had accumulated an increase in government debt of $3.9 trillion.
- Figure 1 shows what the alarmists feared. After tracking upward along a stable Phillips curve in the 1960s, U.S. inflation soared. The figure shows inflation and unemployment in a series of clockwise loops reaching a peak inflation rate in 1981 and peak unemployment in 1982.
- Although many economists were puzzled that inflation has remained so low when unemployment has also been low, Figure 2 shows why this fact isn't puzzling.
- The figure shows the relationship between inflation and unemployment from 2010 to 2020 alongside the 1960s Phillips curve. The dots are close to the flat section of the curve and bounce around as inflation expectations change.
- Figure 3 shows another reason why economists were puzzled. It is a graph of decade averages of excess money growth and inflation.
- Excess money growth is money growth minus real GDP growth, and during the 1960s, 70s, and 80s, it was closely correlated with inflation.
- But in the 1990s, inflation exceeded money growth and during the 2000s and 2010s, rapid money growth has been accompanied by low inflation. That is a puzzle.
- As the news article says, inflation is an expectations game, and whether the inflation of 2021 is a blip or the start of a 1970s rerun depends on how inflation expectations change.

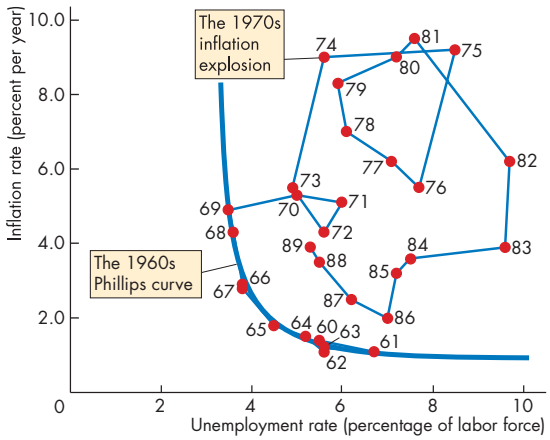


Figure 1 1960 to 1989

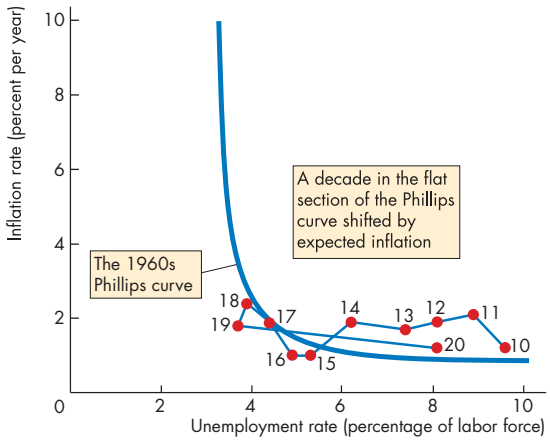


Figure 2 The 2010s

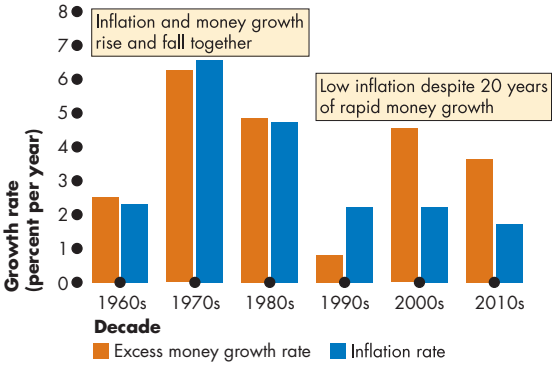


Figure 3 Inflation and Money Growth Rate

WORKED PROBLEM

The table shows the aggregate demand and short-run aggregate supply schedules of Shell Island in which potential GDP is $600 billion. The economy is at full employment.

Price level	Real GDP demanded	Real GDP supplied in the short run
	(billions of 2012 dollars)	
100	650	550
110	625	575
120	600	600
130	575	625
140	550	650

Questions

1. An unexpected increase in exports increases aggregate demand by $50 billion. What happens to the price level and real GDP? Has Shell Island experienced inflation or deflation and what type of output gap does it now have?
2. Starting from full employment, the price of oil falls unexpectedly and aggregate supply increases by $50 billion. What type of output gap appears? If the central bank responds to close the output gap, does Shell Island experience inflation or deflation?
3. Starting from full employment, the government announces an increase in spending of $50 billion a year and the central bank will increase the quantity of money to pay for the spending. Does the economy go into a boom? Will there be inflation?

Solutions

1. When aggregate demand increases by $50 billion, the price level rises from 120 to 130 and real GDP increases from $600 billion to $625 billion. The economy is at an above full-employment equilibrium.

   Shell Island experiences a one-time change in the price level and *not* inflation. The output gap is an inflationary gap, but it was unexpected. Demand-pull inflation does not take off until businesses respond to the labor shortage by raising the money wage rate.

Key Point: For an increase in aggregate demand to create demand-pull inflation, the shortage of labor must put pressure on the money wage rate to rise to close the inflationary gap.

2. When the price of oil falls unexpectedly, aggregate supply increases. The price level falls from 120 to 110 and real GDP increases from $600 billion to $625 billion. The economy is at an above full-employment equilibrium. An inflationary gap arises. Shell Island experiences a one-time change in the price level and not inflation.

   If the central bank responds to close the output gap, it cuts the quantity of money. Aggregate demand shifts leftward and a cost-push deflation is created. See the figure.

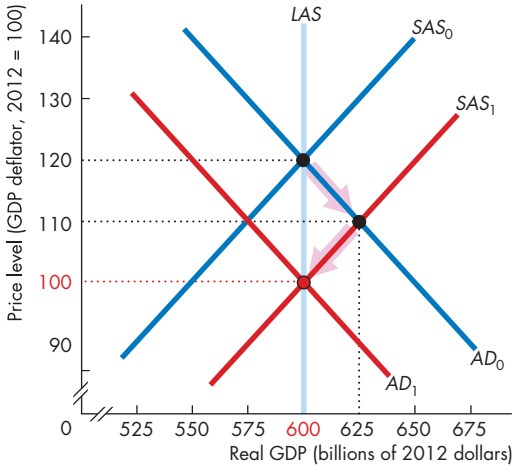
Key Point: Cost-push deflation is created if the central bank responds to a fall in costs by decreasing the quantity of money.

3. When the government announces an increase in spending of $50 billion a year, aggregate demand increases and the increase in aggregate demand is anticipated. Because the central bank increases the quantity of money, businesses anticipate the rise in the price level, so the money wage rises. Aggregate supply decreases.

   Real GDP remains at $600 billion and no output gap is created, but an anticipated inflation occurs.

Key Point: An anticipated increase in aggregate demand accompanied by an increase in the quantity of money creates an anticipated inflation spiral with the economy at full employment.

Key Figure



SUMMARY

Key Points

The Business Cycle (pp. 328–332)

- The mainstream business cycle theory explains the business cycle as fluctuations of real GDP around potential GDP and as arising from a steady expansion of potential GDP combined with an expansion of aggregate demand at a fluctuating rate.
- Real business cycle theory explains the business cycle as fluctuations of potential GDP, which arise from fluctuations in the influence of technological change on productivity growth.

Inflation Cycles (pp. 333–338)

- Demand-pull inflation is triggered by an increase in aggregate demand and fueled by ongoing money growth. Real GDP cycles above full employment.
- Cost-push inflation is triggered by an increase in the money wage rate or raw material prices and is fueled by ongoing money growth. Real GDP cycles below full employment in a stagflation.
- When the forecast of inflation is correct, real GDP remains at potential GDP..

Deflation (pp. 339–341)

- Deflation is a falling price level or negative inflation rate.
- Deflation is caused by a money growth rate that is too low to accommodate the growth of potential GDP and changes in the velocity of circulation.
- Unanticipated deflation redistributes income and wealth, lowers real GDP and employment, and diverts resources from production.
- Deflation can be ended by increasing the money growth rate to a rate that accommodates the growth of potential GDP and changes in the velocity of circulation.

The Phillips Curve (pp. 342–343)

- The short-run Phillips curve shows the tradeoff between inflation and unemployment when the expected inflation rate and the natural unemployment rate are constant.
- The long-run Phillips curve, which is vertical, shows that when the actual inflation rate equals the expected inflation rate, the unemployment rate equals the natural unemployment rate.

Key Terms

Cost-push inflation, 335
Demand-pull inflation, 333
Keynesian cycle theory, 329
Long-run Phillips curve, 342
Monetarist cycle theory, 329
New classical cycle theory, 329
New Keynesian cycle theory, 329
Rational expectation, 338
Real business cycle theory, 329
Short-run Phillips curve, 342
Stagflation, 336

PROBLEMS AND APPLICATIONS

The Business Cycle

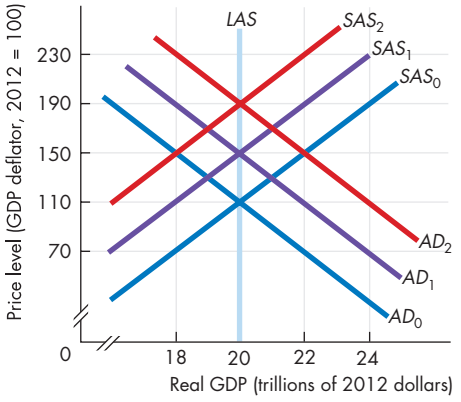
1. **Debate on Causes of Unemployment**
   Two economists are debating the cause of a high unemployment rate. One economist argues that there is not enough government spending. The other says high unemployment is a structural problem—people who can't move to take new jobs because they are tied down to burdensome mortgages or firms that can't find workers with the skills they need to fill job openings.
   a. Which business cycle theory would say that the first economist is correct and why?
   b. Which business cycle theory would say that the second economist is correct and why?

Inflation Cycles

2. **Higher Gas, Energy Prices Boost Consumer Inflation**
   Over half of the increase in inflation has been driven by gasoline, electricity, and natural gas prices. And with the decrease in the number of coronavirus cases, restrictions have eased and household spending has increased.
   Source: wsj.com, March 20, 2021
   Explain what type of inflation the news clip is describing and provide a graphical analysis of it.

Use the following figure to work Problems 3 to 5.

The economy starts out on the curves labeled AD_0 and SAS_0.



3. Some events occur and the economy experiences a demand-pull inflation. What might those events have been? Describe their initial effects and explain how a demand-pull inflation spiral results.
4. Some events occur and the economy experiences a cost-push inflation.What might those events have been? Describe their initial effects and explain how a cost-push inflation spiral develops.
5. Some events occur and the economy is expected to experience inflation.What might those events have been? Describe their initial effects and what happens as an expected inflation proceeds.

Deflation

6. Suppose that the velocity of circulation of money is constant and real GDP is growing at 3 percent a year.
   a. To achieve an inflation target of 2 percent a year, at what rate would the central bank grow the quantity of money?
   b. At what growth rate of the quantity of money would deflation be created?

The Phillips Curve

7. **Federal Reserve Moves to Keep Stock Market Elevated**
   During the last 20 years, Japan had low growth and low inflation. So did the European Union over the past decade. In the last expansion, the Fed was surprised to see falling unemployment with no increase in inflation.
   Source: seekingalpha.com, August 3, 2020
   a. What does the Phillips curve model say about the relationship between the unemployment rate and the inflation rate?
   b. Given the information in the news clip, what is happening to the short-run and long-run Phillips curves?
8. **Sweden's Economic Expectations**
   The Swedish economy's growth rate in 2017 was better than expected, mainly because of an easy monetary policy. Growth prospects for 2018 look up as well, with unemployment expected to decline over the next two years. While a near-zero inflation rate has been a cause of concern, consumer prices are expected to go up in 2018 and 2019.
   Source: Reuters, January 18, 2018
   Is the news clip predicting that the Swedish economy will move along a short-run Phillips curve or that the short-run Phillips curve will shift through 2018 and 2019? Explain.

ADDITIONAL PROBLEMS AND APPLICATIONS

The Business Cycle

Use the following information to work Problems 9 to 11.

Suppose that the business cycle in the United States is best described by RBC theory and that a new technology increases productivity.

9. Draw a graph to show the effect of the new technology in the market for loanable funds.
10. Draw a graph to show the effect of the new technology in the labor market.
11. Explain the when-to-work decision when technology advances.
12. **IT Job Wages Are No Longer 'Exceptional'**

    Information technology jobs were among the fastest rising during the 1990s, bolstered by the dot-com boom. But now, wage growth in IT jobs is relatively moderate. Although IT wages remain high relative to many other occupations, they are no longer "exceptional."

    Source: forbes.com, February 16, 2021

    Explain the relationship between wages and technology in this news clip in terms of real business cycle theory.

Inflation Cycles

Use the following information to work Problems 13 and 14.

Food Costs Are Stoking Asia Inflation

Prices of foodstuffs, including essential items such as rice and milk, have risen in recent months, causing higher inflation rates in Asian countries, such as India, China, Thailand, and Indonesia. In Indonesia, food prices in January rose by 3.72% compared to the 2.78% rate of increase recorded in December. Indonesia's central bank has kept its benchmark interest rate steady as it believes that the rise in food prices, especially rice, is pushing the level of inflation. It expects the coming rice harvest to increase supply and ease the pressure on food prices. An unexpected bad harvest, however, would pose serious problems for the government.

Source: *The Wall Street Journal*, February 11, 2010

13. What type of inflation process is referred to in this news clip? Explain how the Indonesian central bank's decision to keep the benchmark interest rate constant could be effective in curbing the inflation.
14. Explain what would happen to the economy if inflationary expectations are formed on the basis of a prolonged shortage in supply and increasing food prices.

Deflation

15. **Eurozone Slides Into Deflation for the First Time in Four Years**

    Deflation occurred in 12 of the 19 eurozone countries in August. Analysts blamed the fall in part on lower oil prices and the delay of heavily discounted summer clothing sales in France, Italy, and Belgium from July until August.

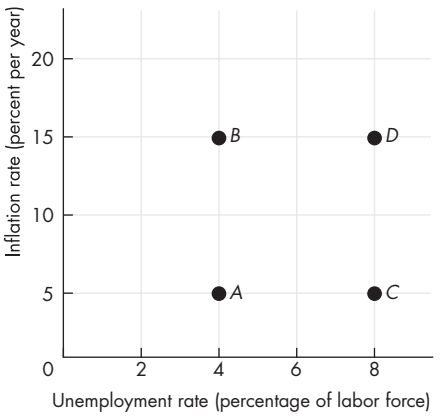
    Source: ft.com, September 1, 2020

    a. Explain the process by which deflation occurs.
    b. How might Europe boost its aggregate demand? Might the boost to aggregate demand create demand-pull inflation?

The Phillips Curve

Use the following graph to work Problems 16 and 17.

An economy has an unemployment rate of 4 percent and an inflation rate of 5 percent a year at point *A*. Some events occur and the economy moves from *A* to *B* to *D* to *C* and back to *A*.



16. Describe the events that could create this sequence. Has the economy experienced demand-pull inflation, cost-push inflation, expected inflation, or none of these?
17. Draw in the figure the sequence of the economy's short-run and long-run Phillips curves.

Use the following information to work Problems 18 and 19.

The Reserve Bank of New Zealand signed an agreement with the New Zealand government in which the Bank agreed to maintain inflation inside a low target range. Failure to achieve the target would result in the governor of the Bank (the equivalent of the chairman of the Fed) losing his job.

18. Explain how this arrangement might have influenced New Zealand's short-run Phillips curve.
19. Explain how this arrangement might have influenced New Zealand's long-run Phillips curve.
20. **The Fed Abandons the Idea Low Unemployment Stokes Inflation**

    The long-held view is that we can't have a tight labor market without wage growth and rising prices. This relationship encourages central bankers to hike interest rates in the expectation that inflation will appear with labor market strength. But today's Phillips Curve is flat because wage growth is weak.

    Source: ft.com, September 3, 2020

    a. Evaluate the claim that the Phillips curve has gone flat.
    b. How does the Phillips curve model account for the facts reported in the news clip?

Use the following information to work Problems 21 and 22.

In 2017, the French government announced a plan to pour a five-year fund of €57 billion into reviving its sluggish economy. Later in the year it was revealed that French president Emmanuel Macron planned to tighten unemployment benefits, which were long blamed for the chronically high unemployment rate in France.

21. Explain how the €57 billion investment might influence the short-run and long-run Phillips curves. Will the influence come from changes in the expected inflation rate, the natural unemployment rate, or both?
22. Explain how the tightening of unemployment benefits might influence the short-run and long-run Phillips curves. Will the influence come from changes in the expected inflation rate, the natural unemployment rate, or both?

Economics in the News

23. After you have studied *Economics in the News* on pp. 344–345, answer the following questions.
    a. Why is there no consensus among economists about the likelihood of a sustained high inflation?
    b. Why do some economists worry that government stimulus will bring inflation?
    c. What happened to U.S inflation in the 1970s that alarms some economists?
    d. Use the *AS-AD* model and the Phillips curve to explain why inflation has remained so low when unemployment has also been low.
    e. Use the *AS-AD* model and the Phillips curve to show why inflation is an expectations game.
24. **Britain's New Record: A Recession Worse Than in Europe and North America**

    Britain is experiencing a deep recession. The U.K. depends heavily on consumer spending. In the second quarter, spending on accommodations and food services fell 87 percent. Britain's recovery will need consumers to feel confident enough to spend.

    Source: nytimes.com, August 12, 2020

    a. How does a decrease in consumption expenditure influence Britain's aggregate demand, aggregate supply, unemployment, and inflation?
    b. Use the *AS-AD* model to illustrate your answer to part (a).
    c. Use the Phillips curve model to illustrate your answer to part (a).
    d. What does the news clip mean by "Britain is experiencing a deep recession"?
    e. Use the *AS-AD* model to illustrate your answer to part (d).
    f. Use the Phillips curve model to illustrate your answer to part (d).

Boom and Bust

To cure a disease, doctors must first understand how the disease responds to different treatments. It helps to understand the mechanisms that operate to cause the disease, but sometimes a workable cure can be found even before the full story of the causes has been told.

Curing economic ills is similar to curing our medical ills. We need to understand how the economy responds to the treatments we might prescribe for it. And sometimes, we want to try a cure even though we don't fully understand the reasoning behind the problem we're trying to control.

You've seen how the pace of capital accumulation and technological change determine the long-term growth trend. You've learned how fluctuations around the long-term trend can be generated by changes in aggregate demand and aggregate supply. And you've learned about the key sources of fluctuations in aggregate demand and aggregate supply.

The *AS-AD* model explains the forces that determine real GDP and the price level in the short run. The model also enables us to see the big picture or grand vision of the different schools of macroeconomic thought concerning the sources of aggregate fluctuations. The Keynesian aggregate expenditure model provides an account of the factors that determine aggregate demand and make it fluctuate.

An alternative real business cycle theory puts all the emphasis on fluctuations in long-run aggregate supply. According to this theory, money changes aggregate demand and the price level but leaves the real economy untouched. The events that unfold as the Covid-19 pandemic comes under control will provide a powerful test of this theory.

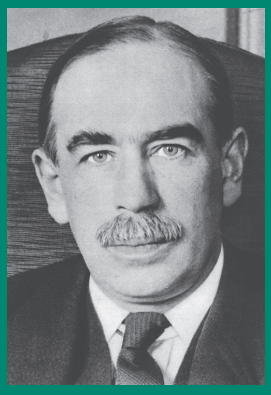
John Maynard Keynes, *born in England in 1883, was one of the outstanding minds of the twentieth century. He represented Britain at the Versailles peace conference at the end of World War I, was a master speculator on international financial markets (an activity he conducted from bed every morning and which made and lost him several fortunes), and played a prominent role in creating the International Monetary Fund.*

He was a member of the Bloomsbury Group, a circle of outstanding artists and writers that included E. M. Forster, Bertrand Russell, and Virginia Woolf.

Keynes was a controversial and quick-witted figure. A critic once complained that Keynes had changed his opinion on some matter, to which Keynes retorted: "When I discover I am wrong, I change my mind. What do you do?"

Keynes' book, The General Theory of Employment, Interest and Money, *written during the Great Depression and published in 1936, revolutionized macroeconomics.*

"The ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood. Indeed the world is ruled by little else."



JOHN MAYNARD KEYNES
The General Theory of Employment, Interest and Money

TALKING WITH Emi Nakamura

EMI NAKAMURA is Chancellor's Professor of Economics at the University of California, Berkeley, and has held this position since 2018. She was an economics undergraduate at Princeton University and earned her Ph.D. at Harvard University.

Professor Nakamura is an empirical macroeconomist. The strength and special feature of her work is its creative use of non-standard data—some regionally disaggregated, some high-frequency, and some covering a long time period—to test and provide quantitative content to macroeconomic models.

Among her many honors is the 2019 John Bates Clark Medal, which is awarded annually by the American Economic Association to an American economist under the age of 40 who has "made a significant contribution to economic thought and knowledge."

Michael Parkin talked with Professor Nakamura about her work, her passion for new sources of data to test macroeconomic models, and her advice for you if you want to go further with economics.

Many observers divide macroeconomics into schools of thought. Do you fit into one of these schools of thought?

I see myself as an empiricist first and foremost. Ideological wars tend to burn most brightly in the absence of clear evidence supporting one theory or another. But, much of my empirical work has come to conclusions consistent with Keynesian views, showing that prices adjust sluggishly to shocks, so the economy responds strongly to demand shocks, and they can be an important driver of recessions.

Let's talk about the challenge of unscrambling cause and effect in macroeconomics: Why is it hard?

Clearly a major challenge is the lack of real experiments. Take the case of trying to estimate the effects of monetary policy on the economy. We don't have randomized trials to figure this out. Probably for good reason, we're not allowed to experiment with the interest rate, for scientific purposes. And even worse: the Fed is a very technocratic institution, so in a sense, you have hundreds of Fed economists making the interest rate exactly as "un-random" as it can be.

... we're not allowed to experiment with the interest rate for scientific purposes.

For example, during the Covid crisis, the Fed lowered interest rates sharply. Can we interpret the recession that followed as an indication that lower interest rates cause recessions? Of course not. The interest rate reduction was caused by the Covid crisis, which had a direct (and very negative) effect on the economy. This makes it much more difficult to definitively answer questions about the effect of monetary policy. Sometimes, however, it is possible to find "natural experiments" that can help us to overcome these challenges of causation—this is an important tool for empirical analysis in macroeconomics.

A nice example of the way you get the data to talk is your work that studies fiscal multipliers. What did you show, and where does it leave our knowledge of the causes of macroeconomic fluctuations?

Jon Steinsson and I looked at how military spending affected different U.S. states differently over time using very detailed military procurement data. For example, in the Carter-Reagan military buildup, there was a big increase in government spending for the country as a whole on average. But the effect falls much more on California, basically because they build airplanes, than it does on Illinois, where basically nothing happens. So this provides a natural experiment. We ask whether this translates into a bigger increase in output in California versus Illinois. Our conclusion is that when relative spending in a state increases by 1 percent of GDP, relative state GDP rises by 1.5 percent.

PART FIVE **MACROECONOMIC POLICY**

13 FISCAL POLICY

After studying this chapter, you will be able to:

- Describe the federal budget process and the recent history of outlays, receipts, deficits, and debt
- Explain the effects of fiscal policy on potential GDP and economic growth
- Explain how fiscal policy redistributes benefits and burdens across generations
- Explain how fiscal stimulus is used to speed recovery from recession

The United States federal government has a budget deficit and growing debt. Current tax rates and spending commitments will make the deficit grow to an ever larger percentage of GDP.

How do government deficits and debt influence the economy? Do they create jobs, or do they destroy them? Do they slow economic growth? Do they impose a burden on future generations?

This chapter studies these fiscal policy questions in the U.S. economy today. In *Economics in the News* at the end of the chapter, we look at the fiscal policy response to the Covid pandemic and its effects on real GDP and the price level.

The Federal Budget

The **federal budget** is an annual statement of the outlays and receipts of the government of the United States together with the laws and regulations that approve and support them. The federal budget has two purposes:

1. To finance federal government programs and activities, and
2. To achieve macroeconomic objectives

The first purpose of the federal budget was its only purpose before the Great Depression of the 1930s. The second purpose arose as a reaction to the Great Depression and the rise of the ideas of economist John Maynard Keynes. The use of the federal budget to achieve macroeconomic objectives such as full employment, sustained economic growth, and price level stability is called **fiscal policy**. It is this aspect of the budget that is the focus of this chapter.

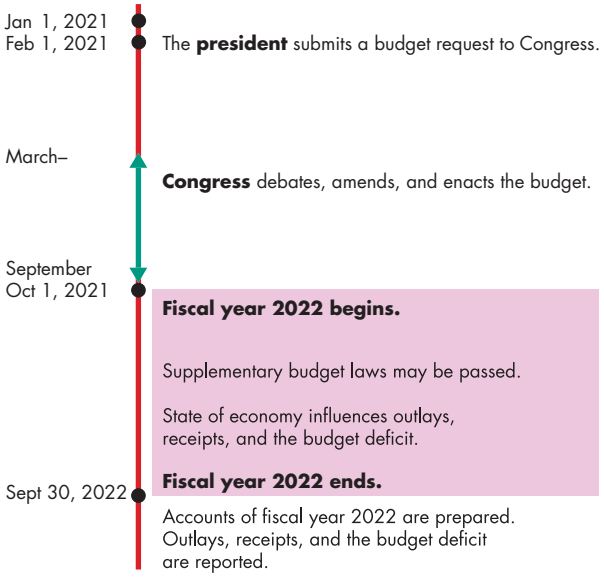
The Institutions and Laws

Fiscal policy is made by the president and Congress on an annual timeline that is shown in Fig. 13.1 for the 2022 budget.

The Roles of the President and Congress The president *proposes* a budget to Congress each February. Congress debates the proposed budget and passes the budget acts in September. The president either signs those acts into law or vetoes the *entire* budget bill. The president does not have the veto power to eliminate specific items in a budget bill and approve others—known as a *line-item veto*. Many state governors have long had line-item veto authority. Congress attempted to grant these powers to the president of the United States in 1996, but in a 1998 Supreme Court ruling, the line-item veto for the president was declared unconstitutional. Although the president proposes and ultimately approves the budget, the task of making the tough decisions on spending and taxes rests with Congress.

Congress begins its work on the budget with the president's proposal. The House of Representatives and the Senate develop their own budget ideas in their respective House and Senate Budget Committees. Formal conferences between the two houses eventually resolve differences of view, and a series of spending

FIGURE 13.1 The Federal Budget Timeline in Fiscal 2022



The federal budget process begins with the president's request in February. Congress debates and amends the request and enacts a budget before the start of the fiscal year on October 1. The president signs the budget acts into law or vetoes the entire budget bill. Throughout the fiscal year, Congress might pass supplementary budget laws. The budget outcome is calculated after the end of the fiscal year.

acts and an overall budget act are usually passed by both houses before the start of the fiscal year. A *fiscal year* is a year that runs from October 1 to September 30 in the next calendar year. *Fiscal* 2022 is the fiscal year that *begins* on October 1, 2021.

During a fiscal year, Congress often passes supplementary budget laws, and the budget outcome is influenced by the evolving state of the economy. For example, if a recession begins, tax revenues fall and welfare payments increase.

The Employment Act of 1946 Fiscal policy operates within the framework of the landmark *Employment Act of 1946* in which Congress declared that

> . . . it is the continuing policy and responsibility of the Federal Government to use all practicable means . . . to coordinate and utilize all its plans, functions, and resources . . . to promote maximum employment, production, and purchasing power.

This act recognized a role for government actions to keep unemployment low, the economy expanding, and inflation in check. The *Full Employment and Balanced Growth Act of 1978*, more commonly known as the *Humphrey-Hawkins Act*, went farther than the Employment Act of 1946 and set a specific target of 4 percent for the unemployment rate. But this target has never been treated as an unwavering policy goal. Under the 1946 Act, the president must describe the current economic situation and the policies he believes are needed in the annual *Economic Report of the President*, which the Council of Economic Advisers writes.

The Council of Economic Advisers The president's **Council of Economic Advisers** was established by the Employment Act of 1946 to monitor the economy and keep the President and the public informed about its current state and the best available forecasts of where it is heading.

The Council consists of a chairperson and two other members, all of whom are distinguished economists on a one- or two-year leave from their regular university or public service jobs. In January 2021, President Biden appointed Cecilia Rouse chair of the Council of Economic Advisers.

The work of the Council of Economic Advisers is one source of data that informs the budget-making process. Let's look at the most recent federal budget.

Highlights of the 2022 Budget

Table 13.1 shows the main items in the federal budget proposed by President Biden for 2022. The numbers are projected amounts for the fiscal year beginning on October 1, 2021—Fiscal 2022. Notice the three main parts of the table: *Receipts* are the government's tax revenues, *outlays* are the government's payments, and the *deficit* is the amount by which the government's outlays exceed its receipts.

Receipts Receipts were projected to be $4,174 billion in Fiscal 2022. These receipts come from four sources:

1. Personal income taxes
2. Social Security taxes
3. Corporate income taxes
4. Indirect taxes and other receipts

The largest source of receipts is *personal income taxes*, which in 2022 are expected to be $2,039 billion. These taxes are paid by individuals on their incomes. The second largest source is *Social Security taxes*. These taxes are paid by workers and their employers to finance the government's Social Security programs. Third in size are *corporate income taxes*. These taxes are paid by companies on their profits. Finally, the smallest source of federal receipts is what are called *indirect taxes*. These taxes are on the sale of gasoline, alcoholic beverages, and a few other items.

Outlays Outlays are classified into three categories:

1. Transfer payments
2. Expenditure on goods and services
3. Debt interest

The largest item of outlays, *transfer payments*, is the payment to individuals, businesses, other levels of government, and the rest of the world. In 2022, this item is expected to be $4,018 billion. It includes Social Security benefits, Medicare and Medicaid, unemployment checks, welfare payments, farm subsidies, grants to state and local governments, and payments to international agencies. It also includes massive payments to individuals and businesses for

TABLE 13.1 Federal Budget in Fiscal 2022

Item	Projections (billions of dollars)	
Receipts	**4,174**	
Personal income taxes		2,039
Social Security taxes		1,462
Corporate income taxes		371
Indirect taxes and other receipts		302
Outlays	**6,011**	
Transfer payments		4,018
Expenditure on goods and services		1,688
Debt interest		305
Deficit	**1,837**	

Source of data: Budget of the United States Government, Fiscal Year 2022.

Covid relief under the CARES Act and the American Rescue Plan Act.

Expenditure on goods and services is the expenditure on final goods and services, and in 2022 it is expected to total $1,688 billion. This expenditure, which includes that on national defense, homeland security, research on Covid vaccines, computers for the Internal Revenue Service, government cars and trucks, and federal highways, has decreased in recent years. This component of the federal budget is the *government expenditure on goods and services* that appears in the circular flow of expenditure and income and in the National Income and Product Accounts (see Chapter 4, pp. 117–118).

Debt interest is the interest on the government debt. In 2022, this item is expected to be $305 billion—5 percent of total outlays. This interest payment is large because the government has a debt of $28 trillion, which has arisen from many years of budget deficits going all the way back to the 1970s.

Surplus or Deficit The government's budget balance is equal to receipts minus outlays.

$$\text{Budget balance} = \text{Receipts} - \text{Outlays}.$$

If receipts exceed outlays, the government has a **budget surplus**. If outlays exceed receipts, the government has a **budget deficit**. If receipts equal outlays, the government has a **balanced budget**. For Fiscal 2022, with projected outlays of $6,011 billion and receipts of $4,174 billion, the government projected a budget deficit of $1,837 billion.

Big numbers like these are hard to visualize and hard to compare over time. To get a better sense of the magnitude of receipts, outlays, and the deficit, we often express them as percentages of GDP. Expressing them in this way lets us see how large government is relative to the size of the economy, and it also helps us to study *changes* in the scale of government over time.

How typical is the federal budget of Fiscal 2022? Let's look at the recent history of the budget.

The Budget in Historical Perspective

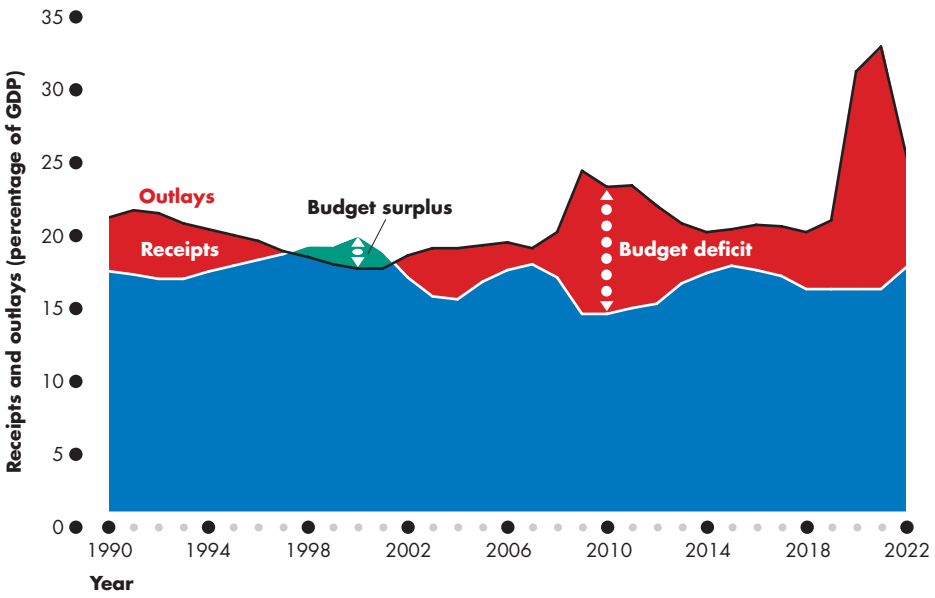
Figure 13.2 shows the government's receipts, outlays, and budget surplus or deficit since 1990. You can see that except for the four years around 2000, the budget has been in persistent deficit.

You can also see that in 2020 and 2021, the deficit arising from the Covid pandemic was extraordinarily large at more than 15 percent of GDP.

The recession of 2008 also brought a large deficit of almost 10 percent of GDP.

An earlier large deficit in 1991 gradually shrank through the 1990s expansion and in 1997 the first

FIGURE 13.2 The Budget Surplus and Deficit



The figure records the federal government's outlays, receipts, and budget balance from 1990 to 2022. Except for the four years 1997 through 2000, the budget has been in deficit. The deficit reached an all-time high in 2021 when outlays surged during the Covid recession. As percentages of GDP, both receipts and outlays have fluctuated but have displayed no trend.

Source of data: Budget of the United States Government, Fiscal Year 2022, Historical Table 1.2.

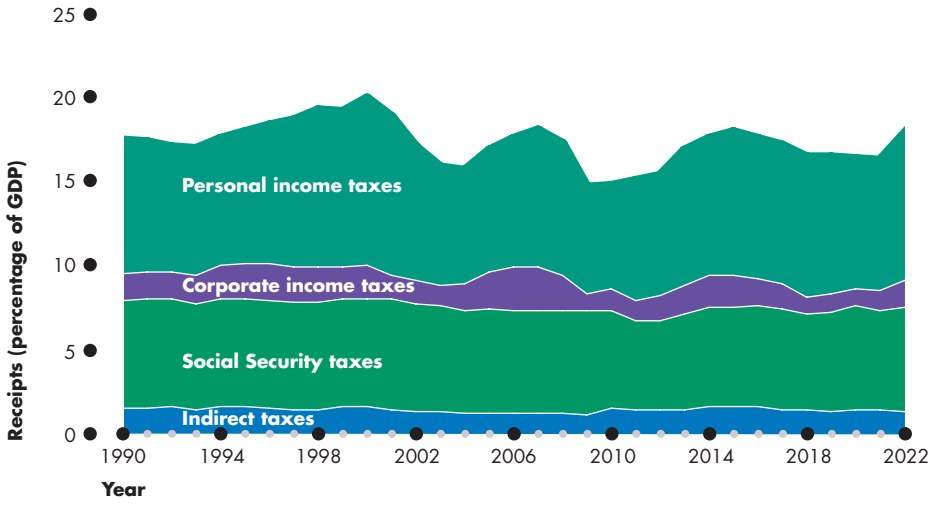
budget surplus since 1969 emerged. But by 2002, the budget was again in deficit and during the 2008–2009 recession, the deficit reached a new all-time high.

Why did the budget deficit grow during the early 1990s, vanish in the late 1990s, and re-emerge in the 2000s? Did outlays increase, or did receipts shrink, and which components of outlays and receipts changed most to swell and then shrink the deficit? Let's look at receipts and outlays in a bit more detail.

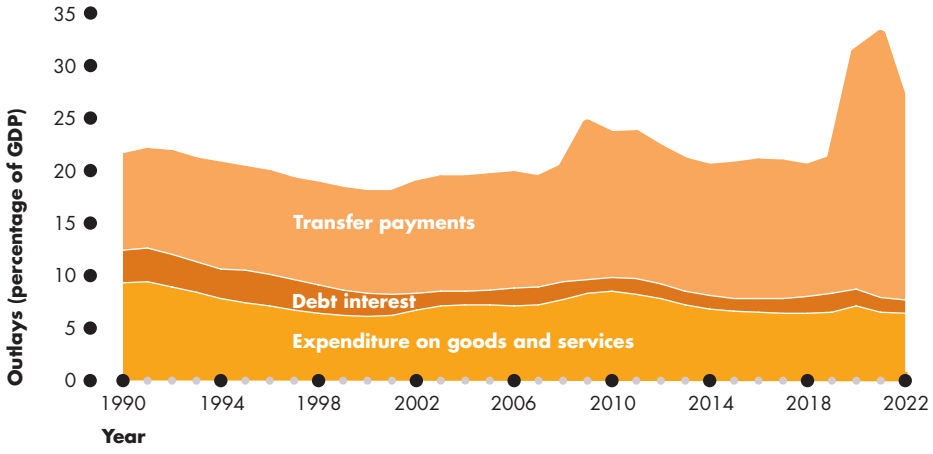
Receipts Figure 13.3(a) shows the components of government receipts as percentages of GDP from 1990 to 2022. Total receipts fluctuate because personal income taxes and corporate income taxes fluctuate. Other receipts (Social Security taxes and indirect taxes) are a near-constant percentage of GDP.

Personal and corporate income tax receipts trended upward during the 1990s, downward during the 2000s, and then upward again after 2010.

FIGURE 13.3 Federal Government Receipts and Outlays



(a) Receipts



(b) Outlays

In part (a), receipts from personal and corporate income taxes (as a percentage of GDP) increased during the 1990s, and fluctuated wildly during the 2000s. The other components of receipts remained steady. Over the entire period, receipts had no trend.

In part (b), expenditure on goods and services as a percentage of GDP decreased through 2001 but then increased because expenditure on security-related goods and services increased sharply after 2001.

Transfer payments exploded to an all-time high percentage of GDP in 2008 and again in 2020.

Debt interest increased during the early 1990s and decreased in the 2000s, helped by a shrinking budget deficit during the 1990s and low interest rates after 2008.

Source of data: Budget of the United States Government, Fiscal Year 2022, Tables 2.3 and 6.1.

Outlays Figure 13.3(b) shows the components of government outlays as percentages of GDP from 1990 to 2022. Two features of government outlays stand out. First, expenditure on goods and services decreased from 1990 through 2000 and then increased. The increase after 2000 was mainly on security-related goods and services in the wake of the attacks that occurred on September 11, 2001, and defense expenditure on wars in Iraq and Afghanistan. Second, transfer payments exploded in 2008 to rescue failing financial institutions and in 2020 to keep people and businesses afloat in the pandemic.

You've seen that the U.S. government budget deficit is large. But how does it compare to the deficits of other countries? The answer: As a percentage of GDP, the U.S. government deficit is the largest of the major economies as *Economics in Action* (p. 359) shows.

Deficits bring debts, as you will now see.

Budget Balance and Debt

When the government has a budget deficit it borrows, and when it has a budget surplus it makes loan repayments. **Government debt** is the total amount that the government has borrowed. It is the sum of past budget deficits minus the sum of past budget surpluses. A government budget deficit increases government debt. A persistent budget deficit feeds itself: It leads to increased borrowing, which leads to larger interest payments, which in turn lead to a larger deficit. That is the story of an increasing budget deficit during the 1970s and 1980s and again today.

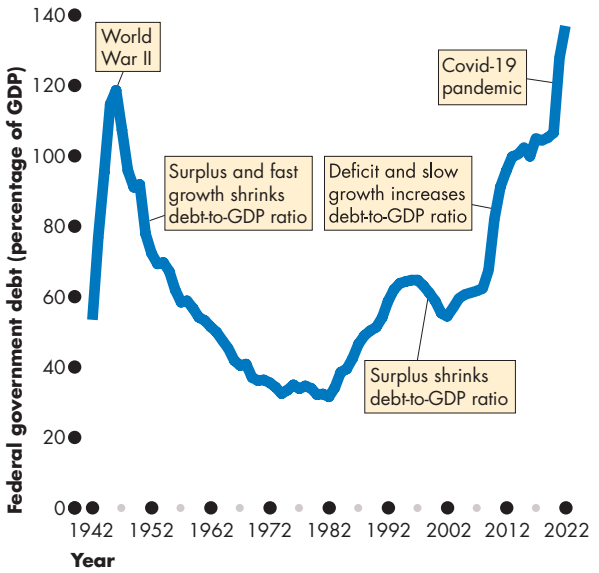
Figure 13.4 shows government debt since 1942, measured as a percentage of GDP—the debt-to-GDP ratio. The large Covid-induced budget deficits have taken this ratio to an all-time high 140 percent, exceeding its previous high at the end of World War II.

Budget surpluses and rapid economic growth, especially during the 1960s, lowered the debt-to-GDP ratio through 1974. Small budget deficits increased the ratio slightly through the 1970s, and large budget deficits increased it dramatically during the 1980s and the 1990–1991 recession.

The growth rate of the debt-to-GDP ratio slowed as the economy expanded during the mid-1990s and fell when the budget went into surplus in the late 1990s and early 2000s.

After the global financial crisis of 2008, when the budget deficit reached a record high for peacetime and real GDP stopped growing, the debt-to-GDP ratio climbed again, and steeply.

FIGURE 13.4 The Federal Government Debt



Government debt (the accumulation of past budget deficits minus past budget surpluses) is higher today than at the end of World War II. Debt as a percentage of GDP fell through 1974 but then started to increase. After a further brief decline during the 1990s, it exploded during the 2010s.

Source of data: Budget of the United States Government, Fiscal Year 2022, Table 7.1.

Debt and Capital Businesses and individuals incur debts to buy capital—assets that yield a return. In fact, the main point of debt is to enable people to buy assets that will earn a return that exceeds the interest paid on the debt. The government is similar to individuals and businesses in this regard. Much state government debt is used to finance purchases of public assets such as highways, public schools, and universities that yield a social return greater than the interest rate on the debt.

Federal government assets, most of which are national defense capital, were valued at $3.6 trillion in 2019. But federal debt, at $28 trillion, is almost eight times the value of the Federal government's assets. So some government debt has been incurred to finance public consumption expenditure and transfer payments, which do not have a social return. Future generations bear the cost of this debt.

ECONOMICS IN ACTION

The U.S. Government Budget in Global Perspective

How does the U.S. government budget deficit compare with those of other major economies?

Comparing Like with Like

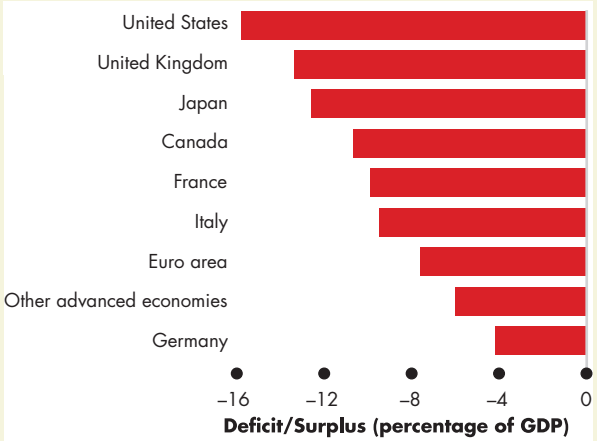
To compare the budget deficits of governments across economies, we must take into account the fact that some countries, and the United States is one of them, have large state and local governments, while others, and the United Kingdom is one, have a large central government and small local governments. These differences make the international comparison more valid at the level of total government.

Deficits Everywhere

The figure shows the budget balances of all levels of government in nine economies in 2021. Massive increases in government spending to provide support for individuals and businesses during the Covid pandemic resulted in deficits everywhere, and in many countries, the largest deficits ever seen.

The United States had the largest deficit, followed by the United Kingdom, Japan, Canada, and France.

Italy, the euro area, other advanced economies as a group, which includes the newly industrialized economies of Asia (Hong Kong, South Korea, Singapore, and Taiwan), and Germany had the smallest deficits.



Government Budgets Around the World

Source of data: International Monetary Fund, *World Economic Outlook*, April 2021.

State and Local Budgets

The *total government* sector of the United States includes state and local governments as well as the federal government. In Fiscal 2022, when federal government outlays were $6,011 billion, state and local outlays were a further $3,200 billion. Most of these expenditures were on public schools, colleges, and universities ($1,400 billion); local police and fire services; and roads.

It is the combination of federal, state, and local government receipts, outlays, and budget deficits that influences the economy. But state and local budgets are not designed to stabilize the aggregate economy. So sometimes, when the federal government cuts taxes or outlays, state and local governments do the reverse and, to a degree, cancel out the effects of the federal actions. For example, federal tax cuts in the early 2000s were offset by state and local government tax increases.

REVIEW QUIZ

1. What is fiscal policy, who makes it, and what is it designed to influence?
2. What special role does the president play in creating fiscal policy?
3. What special roles do the Budget Committees of the House of Representatives and the Senate play in creating fiscal policy?
4. What is the timeline for the U.S. federal budget each year? When does a fiscal year begin and end?
5. Is the federal government budget today in surplus or deficit?

Now that you know what the federal budget is and what the main components of receipts and outlays are, it is time to study the *effects* of fiscal policy. We begin by learning about the effects of taxes on employment, aggregate supply, and potential GDP. Then we see how fiscal policy brings redistribution across generations. Finally, we look at fiscal stimulus and see how it might be used to speed recovery from recession and stabilize the business cycle.

Supply-Side Effects of Fiscal Policy

How do taxes on personal and corporate income affect real GDP and employment? The answer to these questions is controversial. Some economists, known as *supply-siders*, believe these effects to be large and an accumulating body of evidence suggests that they are correct. To see why these effects might be large, we'll begin with a refresher on how full employment and potential GDP are determined in the absence of taxes. Then we'll introduce an income tax and see how it changes the economic outcome.

Full Employment and Potential GDP

You learned in Chapter 6 (pp. 170–172) how the full-employment quantity of labor and potential GDP are determined. At full employment, the real wage rate adjusts to make the quantity of labor demanded equal the quantity of labor supplied. Potential GDP is the real GDP that the full-employment quantity of labor produces.

Figure 13.5 illustrates a full-employment situation. In part (a), the demand for labor curve is *LD* and the supply of labor curve is *LS*. At a real wage rate of $40 an hour, 300 billion hours of labor a year are employed and the economy is at full employment.

In Fig. 13.5(b), the production function is *PF*. When 300 billion hours of labor are employed, real GDP—which is also potential GDP—is $30 trillion.

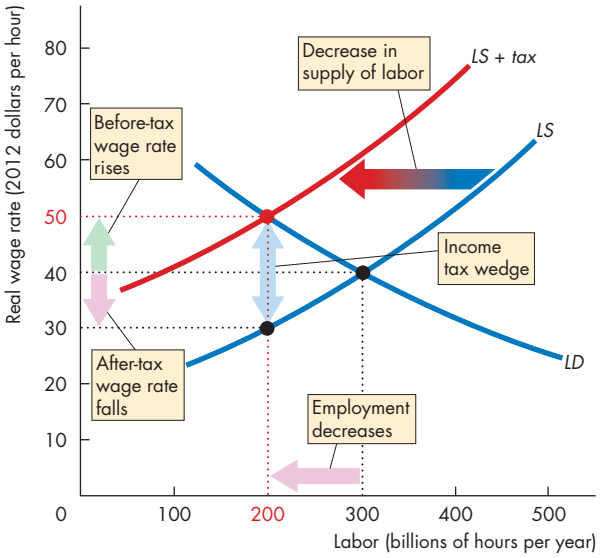
Let's now see how an income tax changes potential GDP.

The Effects of the Income Tax

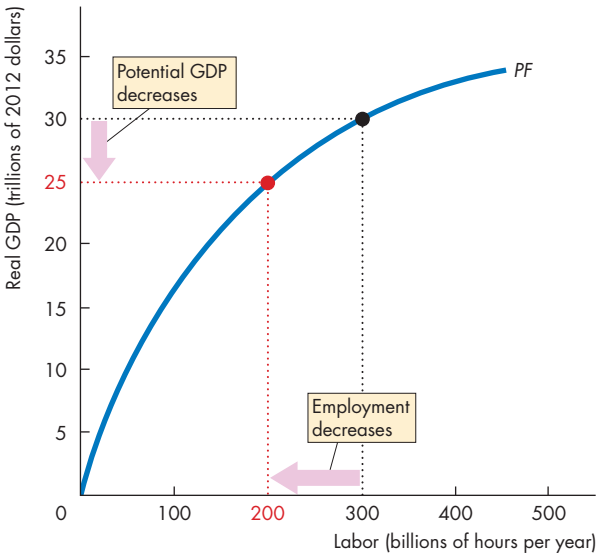
The tax on labor income influences potential GDP by changing the full-employment quantity of labor. The income tax weakens the incentive to work and drives a wedge between the take-home wage of workers and the cost of labor to businesses. The result is a smaller quantity of labor employed and a smaller potential GDP.

Figure 13.5 shows this outcome. In the labor market, the income tax has no effect on the demand for labor, which remains at *LD*. The reason is that the quantity of labor that businesses plan to hire depends only on how productive labor is and what it costs—its real wage rate.

FIGURE 13.5 The Effects of the Income Tax on Aggregate Supply



(a) Income tax and the labor market



(b) Income tax and potential GDP

In part (a), with no income tax, the real wage rate is $40 an hour and employment is 300 billion hours. In part (b), potential GDP is $30 trillion. An income tax shifts the supply of labor curve leftward to *LS* + *tax*. The before-tax wage rate rises to $50 an hour, the after-tax wage rate falls to $30 an hour, and the quantity of labor employed decreases to 200 billion hours. With less labor, potential GDP decreases.

But the supply of labor *does* change. With no income tax, the real wage rate is $40 an hour and 300 billion hours of labor a year are employed. An income tax weakens the incentive to work and decreases the supply of labor. The reason is that for each dollar of before-tax earnings, workers must pay the government an amount determined by the income tax code. So workers look at the after-tax wage rate when they decide how much labor to supply. An income tax shifts the supply curve leftward to $LS + tax$. The vertical distance between the LS curve and the $LS + tax$ curve measures the amount of income tax. With the smaller supply of labor, the *before-tax* wage rate rises to $50 an hour but the *after-tax* wage rate falls to $30 an hour. The gap created between the before-tax and after-tax wage rates is called the **tax wedge**.

The new equilibrium quantity of labor employed is 200 billion hours a year—less than in the no-tax case. Because the full-employment quantity of labor decreases, so does potential GDP. And a decrease in potential GDP decreases aggregate supply.

In this example, the tax rate is high—$20 tax on a $50 wage rate is a tax rate of 40 percent. A lower tax rate would have a smaller effect on employment and potential GDP.

An increase in the tax rate to above 40 percent would decrease the supply of labor by more than the decrease shown in Fig. 13.5. Equilibrium employment and potential GDP would also decrease still further. A tax cut would increase the supply of labor, increase equilibrium employment, and increase potential GDP.

Taxes on Expenditure and the Tax Wedge

The tax wedge that we've just considered is only a part of the wedge that affects labor-supply decisions. Taxes on consumption expenditure add to the tax wedge. The reason is that a tax on consumption raises the prices paid for consumption goods and services and is equivalent to a cut in the real wage rate.

The incentive to supply labor depends on the quantity of goods and services that an hour of labor can buy. The higher the taxes on goods and services and the lower the after-tax wage rate, the greater is the tax wedge, which weakens the incentive to supply labor. If the income tax rate is 25 percent and the tax rate on consumption expenditure is 10 percent, a dollar earned buys only 65 cents worth of goods and services. The tax wedge is 35 percent.

ECONOMICS IN ACTION

Some Real-World Tax Wedges

Edward C. Prescott of Arizona State University, who shared the 2004 Nobel Prize for Economic Science, has estimated the tax wedges for a number of countries, among them the United States, the United Kingdom, and France.

The U.S. tax wedge is a combination of 13 percent tax on consumption and 32 percent tax on incomes. The income tax component of the U.S. tax wedge includes Social Security taxes and is the *marginal* tax rate—the tax rate paid on the marginal dollar earned.

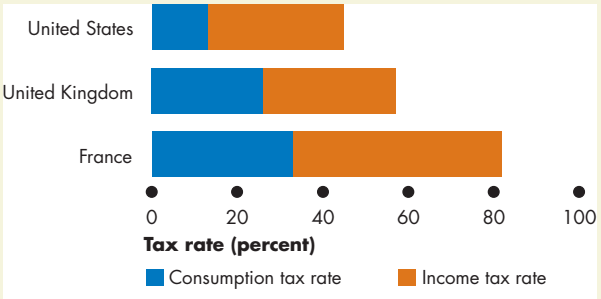
Prescott estimates that in France, tax rates on consumption are 33 percent and on incomes are 49 percent.

The estimates for the United Kingdom fall between those for the United States and France. The figure shows these components of the tax wedges in the three countries.

Does the Tax Wedge Matter?

According to Prescott's estimates, the tax wedge has a powerful effect on employment and potential GDP. Potential GDP in France is 30 percent below that of the United States (per person), and the entire difference can be attributed to the difference in the tax wedge in the two countries.

Potential GDP in the United Kingdom is 28 percent below that of the United States (per person), and about a third of the difference arises from the different tax wedges. (The rest is due to different productivities.)



Three Tax Wedges

Source of data: Edward C. Prescott, "*Prosperity and Depression*," *The American Economic Review*, Vol. 92, No. 2, Papers and Proceedings (May, 2002), pp. 29–43.

Taxes and the Incentive to Save and Invest

A tax on interest income weakens the incentive to save and drives a wedge between the after-tax interest rate earned by savers and the interest rate paid by firms. These effects are analogous to those of a tax on labor income. But they are more serious for two reasons.

First, a tax on labor income lowers the quantity of labor employed and lowers potential GDP, while a tax on capital income lowers the quantity of saving and investment and *slows the growth rate of real GDP*.

Second, the true tax rate on interest income is much higher than that on labor income because of the way in which inflation and taxes on interest income interact. Let's examine this interaction.

Effect of Tax Rate on Real Interest Rate The interest rate that influences investment and saving plans is the *real after-tax interest rate*. The real *after-tax* interest rate subtracts the income tax rate paid on interest income from the real interest rate. But the taxes depend on the nominal interest rate, not the real interest rate. So the higher the inflation rate, the higher is the true tax rate on interest income. Here is an example. Suppose the real interest rate is 4 percent a year and the tax rate is 40 percent.

If there is no inflation, the nominal interest rate equals the real interest rate. The tax on 4 percent interest is 1.6 percent (40 percent of 4 percent), so the real after-tax interest rate is 4 percent minus 1.6 percent, which equals 2.4 percent.

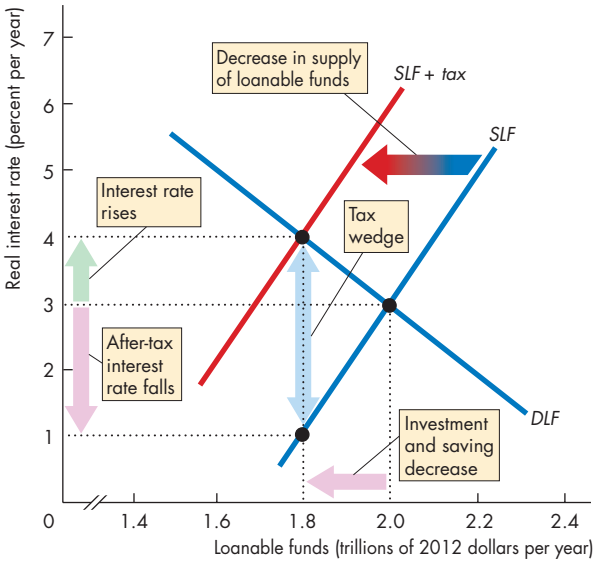
If the inflation rate is 6 percent a year, the nominal interest rate is 10 percent. The tax on 10 percent interest is 4 percent (40 percent of 10 percent), so the real after-tax interest rate is 4 percent minus 4 percent, which equals zero. The true tax rate in this case is not 40 percent but 100 percent!

Effect of Income Tax on Saving and Investment In Fig. 13.6, initially there are no taxes. Also, the government has a balanced budget. The demand for loanable funds curve, which is also the investment demand curve, is *DLF*. The supply of loanable funds curve, which is also the saving supply curve, is *SLF*. The equilibrium interest rate is 3 percent a year, and the quantity of funds borrowed and lent is $2 trillion a year.

A tax on interest income has no effect on the demand for loanable funds. The quantity of investment and borrowing that firms plan to undertake depends only on how productive capital is and what it costs—its real interest rate. But a tax on interest income weakens the incentive to save and lend and decreases the supply of loanable funds. For each dollar of before-tax interest, savers must pay the government an amount determined by the tax code. So savers look at the after-tax real interest rate when they decide how much to save.

When a tax is imposed, saving decreases and the supply of loanable funds curve shifts leftward to *SLF + tax*. The amount of tax payable is measured by the vertical distance between the *SLF* curve and the *SLF + tax* curve. With this smaller supply of loanable funds, the interest rate rises to 4 percent a year but the *after-tax* interest rate falls to 1 percent a year. A tax wedge is driven between the interest rate and the after-tax interest rate, and the equilibrium quantity of loanable funds decreases. Saving and investment also decrease.

FIGURE 13.6 The Effects of a Tax on Capital Income



The demand for loanable funds and investment demand curve is *DLF*, and the supply of loanable funds and saving supply curve is *SLF*. With no income tax, the real interest rate is 3 percent a year and investment is $2 trillion. An income tax shifts the supply curve leftward to *SLF + tax*. The interest rate rises to 4 percent a year, the after-tax interest rate falls to 1 percent a year, and investment decreases to $1.8 trillion. With less investment, the real GDP growth rate decreases.

Tax Revenues and the Laffer Curve

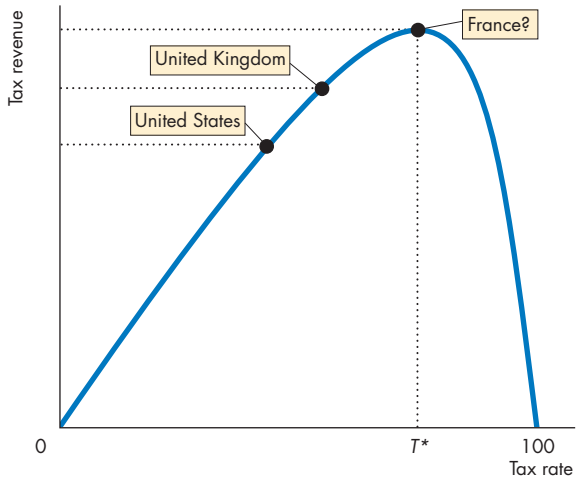
An interesting consequence of the effect of taxes on employment and saving is that a higher tax *rate* does not always bring greater tax *revenue*. A higher tax rate brings in more revenue per dollar earned. But because a higher tax rate decreases the number of dollars earned, two forces operate in opposite directions on the tax revenue collected.

The relationship between the tax rate and the amount of tax revenue collected is called the **Laffer curve**. The curve is so named because Arthur B. Laffer, a member of President Reagan's Economic Policy Advisory Board, drew such a curve on a table napkin and launched the idea that tax *cuts* could *increase* tax revenue.

Figure 13.7 shows a Laffer curve. The tax *rate* is on the *x*-axis, and total tax *revenue* is on the *y*-axis. For tax rates below T^*, an increase in the tax rate increases tax revenue; at T^*, tax revenue is maximized; and a tax rate increase above T^* decreases tax revenue.

Most people think that the United States is on the upward-sloping part of the Laffer curve; so is the United Kingdom. But France might be close to the maximum point or perhaps even beyond it.

FIGURE 13.7 A Laffer Curve



A Laffer curve shows the relationship between the tax rate and tax revenues. For tax rates below T^*, an increase in the tax rate increases tax revenue. At the tax rate T^*, tax revenue is maximized. For tax rates above T^*, an increase in the tax rate decreases tax revenue.

The Supply-Side Debate

Before 1980, few economists paid attention to the supply-side effects of taxes on employment and potential GDP. Then, when Ronald Reagan took office as president, a group of supply-siders began to argue the virtues of cutting taxes. Arthur Laffer was one of them. Laffer and his supporters were not held in high esteem among mainstream economists, but they were influential for a period. They correctly argued that tax cuts would increase employment and increase output. But they incorrectly argued that tax cuts would increase tax revenues and decrease the budget deficit. For this prediction to be correct, the United States would have had to be on the "wrong" side of the Laffer curve. Given that U.S. income tax rates are among the lowest in the industrial world, it is unlikely that this condition was met. And when the Reagan administration did cut taxes, the budget deficit increased, a fact that reinforces this view.

Supply-side economics became tarnished because of its association with Laffer and came to be called "voodoo economics." But mainstream economists, including Martin Feldstein, a Harvard professor who was Reagan's chief economic adviser, recognized the power of tax cuts as incentives but took the standard view that tax cuts without spending cuts would swell the budget deficit and bring further serious problems. This view is now widely accepted by economists of all political persuasions.

REVIEW QUIZ

1. How does a tax on labor income influence the equilibrium quantity of employment?
2. How does the tax wedge influence potential GDP?
3. Why are consumption taxes relevant for measuring the tax wedge?
4. Why are income taxes on capital income more powerful than those on labor income?
5. What is the Laffer curve and why is it unlikely that the United States is on the "wrong" side of it?

You now know how taxes influence potential GDP and saving and investment. Next we look at the generational effects of fiscal policy.

Generational Effects of Fiscal Policy

Is a budget deficit a burden on future generations? If it is, how will the burden be borne? And is the budget deficit the only burden on future generations? What about the deficit in the Social Security fund? Does it matter who owns the bonds that the government sells to finance its deficit? What about the bonds owned by foreigners? Won't repaying those bonds impose a bigger burden than repaying bonds owned by Americans?

To answer questions like these, we use a tool called **generational accounting**—an accounting system that measures the lifetime tax burden and benefits of each generation. This accounting system was developed by Alan Auerbach of the University of Pennsylvania and Laurence Kotlikoff of Boston University. Generational accounts for the United States have been prepared by Jagadeesh Gokhale of the Cato Institute and Kent Smetters of the Wharton School at the University of Pennsylvania.

Generational Accounting and Present Value

Income taxes and Social Security taxes are paid by people who have jobs. Social Security benefits are paid to people after they retire. So to compare taxes and benefits, we must compare the value of taxes paid by people during their working years with the benefits received in their retirement years. To compare the value of an amount of money at one date with that at a later date, we use the concept of present value. A *present value* is an amount of money that, if invested today, will grow to equal a given future amount when the interest that it earns is taken into account. We can compare dollars today with dollars in 2072 or any other future year by using present values.

For example, if the interest rate is 5 percent a year, $1,000 invested today will grow, with interest, to $11,467 after 50 years. So the present value (in 2022) of $11,467 in 2072 is $1,000.

By using present values, we can assess the magnitude of the government's debts to older Americans in the form of pensions and medical benefits.

But the assumed interest rate and growth rate of taxes and benefits critically influence the answers we get. For example, at an interest rate of 3 percent a year, the present value (in 2022) of $11,467 in 2072 is $2,616. The lower the interest rate, the greater is the present value of a given future amount.

Because there is uncertainty about the proper interest rate to use to calculate present values, plausible alternative numbers are used to estimate a range of present values.

Using generational accounting and present values, economists have studied the situation facing the federal government arising from its Social Security obligations, and they have found a time bomb!

The Social Security Time Bomb

When Social Security was introduced in the New Deal of the 1930s, today's demographic situation was not foreseen. The age distribution of the U.S. population today is dominated by the surge in the birth rate after World War II that created what is called the "baby boom generation." There are 77 million "baby boomers."

The first of the baby boomers started collecting Social Security pensions in 2008 and in 2011 they became eligible for Medicare benefits. By 2030, all the baby boomers will have reached retirement age and the population supported by Social Security and Medicare benefits will have doubled.

Under the existing laws, the federal government has an obligation to this increasing number of citizens to pay pensions and Medicare benefits on an already declared scale. These obligations are a debt owed by the government and are just as real as the bonds that the government issues to finance its current budget deficit.

To assess the full extent of the government's obligations, economists use the concept of fiscal imbalance. **Fiscal imbalance** is the present value of the government's commitments to pay benefits *minus* the present value of its tax revenues. Fiscal imbalance is an attempt to measure the scale of the government's true liabilities.

Jagadeesh Gokhale estimates that the Social Security and Medicare fiscal imbalance was $68 trillion in 2014. To put the $68 trillion in perspective, note that U.S. GDP in 2014 was $17 trillion. So the fiscal imbalance was 4 times the value of one year's production. Furthermore, the fiscal imbalance grows every year by an amount that in 2014 was approaching $2 trillion.

These are enormous numbers and point to a catastrophic future. How can the federal government meet its Social Security obligations? Gokhale and

Smetters consider four alternatives. They are

- Raise income taxes
- Raise Social Security taxes
- Cut Social Security benefits
- Cut federal government discretionary spending

Gokhale and Smetters estimate that if we had started in 2003 and made only one of these changes, income taxes would need to be raised by 69 percent, or Social Security taxes raised by 95 percent, or Social Security benefits cut by 56 percent. Even if the government stopped all its discretionary spending, including that on national defense, it would not be able to pay its bills. By combining the four measures, the pain from each could be lessened, but the pain would still be severe.

A further way of meeting these obligations is to pay by printing money. As you learned in Chapter 8 (see pp. 232–233), the consequence of this solution would be a seriously high inflation rate.

Generational Imbalance

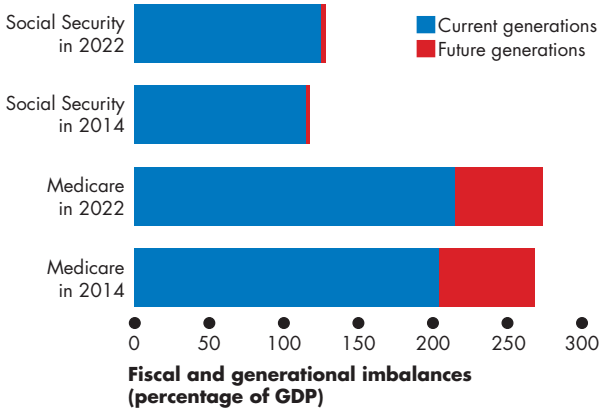
A fiscal imbalance must eventually be corrected and when it is, people either pay higher taxes or receive lower benefits. The concept of generational imbalance tells us who will pay. **Generational imbalance** is the division of the fiscal imbalance between the current and future generations, assuming that the current generation will enjoy the existing levels of taxes and benefits.

Figure 13.8 shows an estimate of how the fiscal imbalance is distributed across the current generation (those born before 1988) and the future generation (those born in or after 1988). The generational imbalance also shows that the major source of the imbalance is Medicare. Social Security pension benefits create a fiscal imbalance, but these benefits will be more than fully paid for by the current generation. But the current generation will not pay for all its Medicare costs, and the balance will fall on future generations. If we sum all the items, the current generation will pay 83 percent and future generations will pay 17 percent of the fiscal imbalance.

Because the estimated fiscal imbalance is so large, it is not possible to predict how it will be resolved. But we can predict that the outcome will involve both lower benefits and higher taxes, or paying bills with new money and creating inflation.

The Fed would have to cooperate if inflation were to be used to deal with the imbalance, and this cooperation might be hard to obtain.

FIGURE 13.8 Fiscal and Generational Imbalances



The bars show the scale of the fiscal imbalance. The largest component at more than 250 percent of GDP is Medicare benefits. These benefits are also the main component of the generational imbalance. Social Security pensions are paid for almost entirely by the current generation.

Source of data: Jagadeesh Gokhale, *The Government Debt Iceberg*, The Institute of Economic Affairs, London, 2014.

International Debt

So far in our discussion of the government deficit and debt, we've ignored the role played by the rest of the world. We'll conclude this discussion by considering the role and magnitude of international debt.

You've seen that borrowing from the rest of the world is one source of loanable funds (Chapter 9, pp. 160–163) and that this source of funds increased during the late 1990s and 2000s.

How large is the contribution of the rest of the world? How much business investment has been paid for by borrowing from the rest of the world? And how much U.S. government debt is held abroad?

Table 13.2 answers these questions. In March 2021, the United States had a net debt to the rest of the world of $33.4 trillion. Of that debt, $7 trillion was U.S. government borrowing. That $7 trillion is about 26 percent of total U.S. government debt. U.S. corporations had used $17.8 trillion of foreign funds (in bonds and equities).

The international debt of the United States is important because, when that debt is repaid, the United States will transfer real resources to the rest of

TABLE 13.2 What the United States Owed the Rest of the World in March 2021

	$ trillions
(a) U.S. liabilities	
Deposits in U.S. banks	2.0
U.S. government securities	7.0
U.S. corporate bonds and equities	17.8
Other items (net)	6.6
Total	**33.4**
(b) U.S. government securities	
Held by rest of world	7.0
Held in the United States	19.8
Total	**26.8**

Source of data: Federal Reserve Board.

the world. Instead of running a large net exports deficit, the United States will need a surplus of exports over imports. To make a surplus possible, U.S. saving must increase and consumption must decrease. Some tough choices lie ahead.

REVIEW QUIZ

1 What is a present value?
2 Distinguish between fiscal imbalance and generational imbalance.
3 How large is the estimated U.S. fiscal imbalance and how does it divide between current and future generations?
4 What is the source of the U.S. fiscal imbalance and what are the painful choices that we face?
5 How much of U.S. government debt is held by the rest of the world?

You now know how the supply-side effects of fiscal policy work and you've seen the shocking scale of fiscal imbalance. We conclude this chapter by looking at fiscal policy as a tool for fighting a recession.

Fiscal Stimulus

The 2008–2009 recession brought Keynesian macroeconomic ideas (see Chapter 10, pp. 288–289) back into fashion and put a spotlight on **fiscal stimulus**—the use of fiscal policy to increase production and employment. But whether fiscal policy is truly stimulating, and if so, how stimulating, are questions that generate much discussion and disagreement. You're now going to explore these questions.

Fiscal stimulus can be either *automatic* or *discretionary*. A fiscal policy action that is triggered by the state of the economy with no action by government is called **automatic fiscal policy**. The increase in total unemployment benefits triggered by the massive rise in the unemployment rate through 2009 is an example of automatic fiscal policy.

A fiscal policy action initiated by an act of Congress is called **discretionary fiscal policy**. It requires a change in a spending program or in a tax law. A fiscal stimulus act passed by Congress in 2009 (see *Economics in Action* on p. 368) is an example of discretionary fiscal policy.

Whether automatic or discretionary, an increase in government outlays or a decrease in government receipts can stimulate production and jobs. An increase in expenditure on goods and services directly increases aggregate expenditure. And an increase in transfer payments (such as unemployment benefits) or a decrease in tax revenues increases disposable income, which enables people to increase consumption expenditure. Lower taxes also strengthen the incentives to work and invest.

We'll begin by looking at automatic fiscal policy and the interaction between the business cycle and the budget balance.

Automatic Fiscal Policy and Cyclical and Structural Budget Balances

Two items in the government budget change automatically in response to the state of the economy. They are *tax revenues* and *needs-tested spending*.

Automatic Changes in Tax Revenues The tax laws that Congress enacts don't legislate the number of tax *dollars* the government will raise. Rather they define the tax *rates* that people must pay. Tax dollars paid depend on tax rates and incomes. But incomes vary with real GDP, so tax revenues depend on real GDP. When real GDP increases in a business cycle

expansion, wages and profits rise, so tax revenues from these incomes rise. When real GDP decreases in a recession, wages and profits fall, so tax revenues fall.

Needs-Tested Spending The government creates programs that pay benefits to qualified people and businesses. The spending on these programs results in transfer payments that depend on the economic state of individual citizens and businesses. When the economy is in an expansion, unemployment falls, the number of people experiencing economic hardship decreases, so needs-tested spending decreases. When the economy is in a recession, unemployment is high and the number of people experiencing economic hardship increases, and so needs-tested spending on unemployment benefits and food stamps increases.

Automatic Stimulus Because government receipts fall and outlays increase in a recession, the budget provides automatic stimulus that helps to shrink the recessionary gap. Similarly, because receipts rise and outlays decrease in a boom, the budget provides automatic restraint to shrink an inflationary gap.

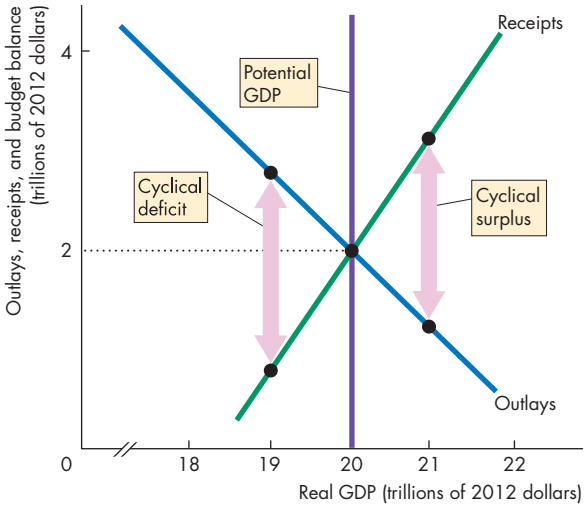
Cyclical and Structural Budget Balances To identify the government budget deficit that arises from the business cycle, we distinguish between the **structural surplus or deficit**, which is the budget balance that would occur if the economy were at full employment, and the **cyclical surplus or deficit**, which is the actual surplus or deficit *minus* the structural surplus or deficit.

Figure 13.9 illustrates these concepts. Outlays *decrease* as real GDP *increases*, so the outlays curve slopes downward; and receipts *increase* as real GDP *increases*, so the receipts curve slopes upward.

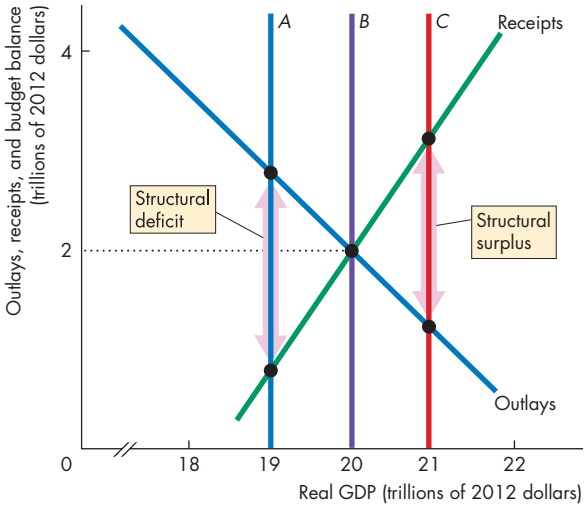
In Fig. 13.9(a), potential GDP is $20 trillion and if real GDP equals potential GDP, the government has a *balanced budget*. There is no structural surplus or deficit. But there might be a cyclical surplus or deficit. If real GDP is less than potential GDP at $19 trillion, outlays exceed receipts and there is a *cyclical deficit*. If real GDP is greater than potential GDP at $21 trillion, outlays are less than receipts and there is a *cyclical surplus*.

In Fig. 13.9(b), if potential GDP equals $20 trillion (line *B*), the *structural balance is zero*. But if potential GDP is $19 trillion (line *A*), the government budget has a *structural deficit*. And if potential GDP is $21 trillion (line *C*), the government budget has a *structural surplus*.

FIGURE 13.9 Cyclical and Structural Surpluses and Deficits



(a) Cyclical deficit and cyclical surplus



(b) Structural deficit and structural surplus

In part (a), potential GDP is $20 trillion. When real GDP is less than potential GDP, the budget is in deficit and it is a *cyclical deficit*. When real GDP exceeds potential GDP, the budget is in surplus and it is a *cyclical surplus*. The government has a *balanced budget* when real GDP equals potential GDP.

In part (b), if potential GDP is $19 trillion, the budget deficit is a *structural deficit* and if potential GDP is $21 trillion, the budget surplus is a *structural surplus*. If potential GDP is $20 trillion, the budget is in structural balance.

U.S. Structural Budget Balance in 2020 The U.S. federal budget in 2020 had a deficit of $3,213 billion and the economy's gap between real GDP and potential GDP was a recessionary gap of $440 billion. With a large recessionary gap, you would expect some of the deficit to be cyclical. But how much of the 2020 deficit was cyclical and how much was structural?

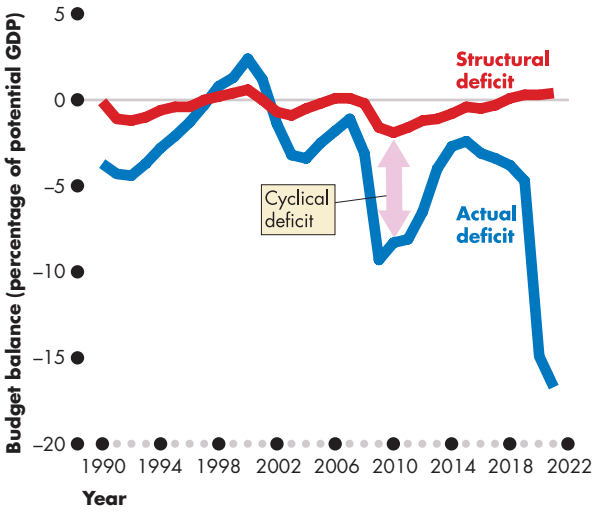
The Congressional Budget Office (CBO) answers this question by analyzing the detailed items in the budget. According to the CBO, the structural balance in 2020 was a surplus of $55 billion, so the cyclical deficit was $3,268 billion.

Figure 13.10 shows the actual and structural deficits between 1990 and 2020 as percentages of potential GDP. The vertical gap between the actual and structural deficit is the cyclical deficit.

You can see that the cyclical deficit was small in 2007, increased in 2008, and exploded in 2009. The 2009 fiscal stimulus package (see *Economics in Action*) created most of this structural deficit.

In 2020, the cyclical deficit soared to an all-time high of more than 17 percent of potential GDP. This deficit will be self-correcting as the economy returns to full employment, but it will leave a large accumulated debt.

FIGURE 13.10 U.S. Cyclical and Structural Budget Balance



As real GDP shrank in the 2008–2009 and 2020 recessions, receipts fell, outlays increased, and the budget deficit increased. The structural deficit is small.

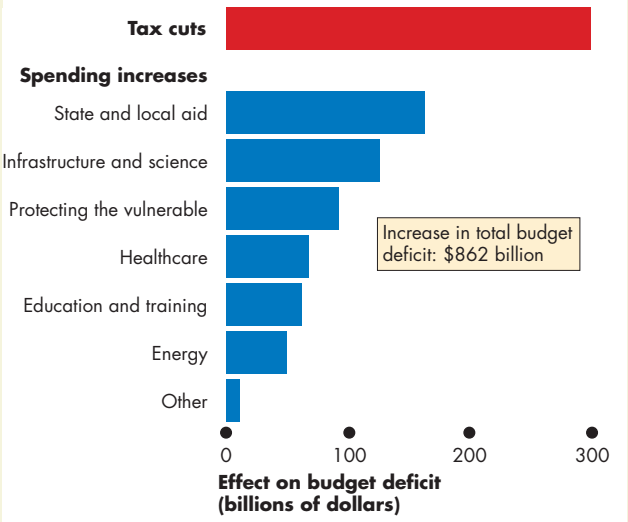
Source of data: Congressional Budget Office and author calculations..

ECONOMICS IN ACTION

The 2009 Fiscal Stimulus Package

Congress passed the *American Recovery and Reinvestment Act of 2009* (the 2009 Fiscal Stimulus Act) in February 2009, and President Obama signed it into law at an economic forum he hosted in Denver. This act was the third and most ambitious in a series of stimulus packages and its purpose was to increase investment and consumer expenditure and lead to the creation of jobs.

The total package added $862 billion to the federal government's budget deficit: $288 billion from tax cuts and the rest from increased spending. The spending increases included payments to state and local governments ($144 billion); spending on infrastructure and science projects ($111 billion); and programs in healthcare ($59 billion), education and training ($53 billion), and energy ($43 billion).



The Components of the 2009 Fiscal Stimulus Act

The president signs the 2009 fiscal stimulus act.

Discretionary Fiscal Stimulus

Most discussion of *discretionary* fiscal stimulus focuses on its effects on aggregate demand. But you've seen (on pp. 360–362) that taxes influence aggregate supply and that the balance of taxes and spending—the government budget deficit—can crowd out investment and slow the pace of economic growth. So discretionary fiscal stimulus has both supply-side and demand-side effects that end up determining its overall effectiveness.

We're going to begin our examination of discretionary fiscal stimulus by looking at its effects on aggregate demand.

Fiscal Stimulus and Aggregate Demand Changes in government expenditure and changes in taxes change aggregate demand by their influence on spending plans, and they also have multiplier effects.

Let's look at the two main fiscal policy multipliers: the government expenditure and tax multipliers.

The **government expenditure multiplier** is the quantitative effect of a change in government expenditure on real GDP. Because government expenditure is a component of aggregate expenditure, an increase in government spending increases aggregate expenditure and real GDP. But does a $1 billion increase in government expenditure increase real GDP by $1 billion, or more than $1 billion, or less than $1 billion?

When an increase in government expenditure increases real GDP, incomes rise and the higher incomes bring an increase in consumption expenditure. If this were the only consequence of increased government expenditure, the government expenditure multiplier would be greater than 1.

But an increase in government expenditure increases government borrowing (or decreases government lending if there is a budget surplus) and raises the real interest rate. With a higher cost of borrowing, investment decreases, which partly offsets the increase in government spending. If this were the only consequence of increased government expenditure, the multiplier would be less than 1.

The actual multiplier depends on which of the above effects is stronger and the consensus is that the crowding-out effect is strong enough to make the government expenditure multiplier less than 1.

The **tax multiplier** is the quantitative effect of a change in taxes on real GDP. The demand-side effects of a tax cut are likely to be smaller than an equivalent increase in government expenditure. The reason is that a tax cut influences aggregate demand by increasing disposable income, only part of which gets spent. So the initial injection of expenditure from a $1 billion tax cut is less than $1 billion.

A tax cut has similar crowding-out consequences to a spending increase. It increases government borrowing (or decreases government lending), raises the real interest rate, and cuts investment.

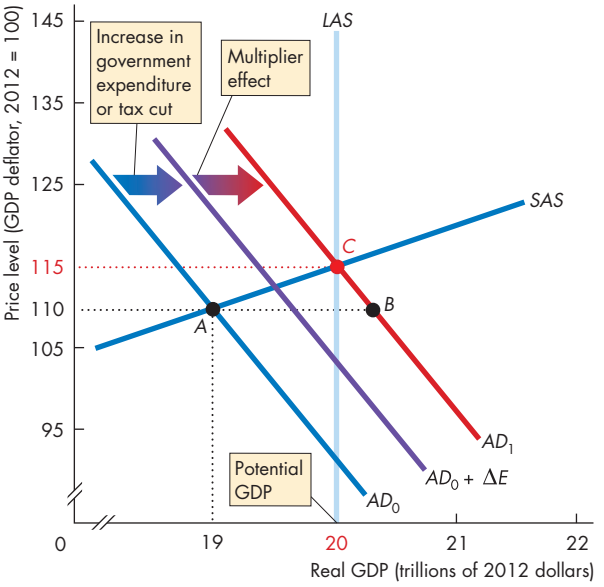
The tax multiplier effect on aggregate demand depends on these two opposing effects and is probably quite small.

Graphical Illustration of Fiscal Stimulus Figure 13.11 shows how fiscal stimulus is supposed to work if it is perfectly executed and has its desired effects.

Potential GDP is $20 trillion and real GDP is below potential at $19 trillion so the economy has a recessionary gap of $1 trillion.

To restore full employment, the government passes a fiscal stimulus package. An increase in

FIGURE 13.11 Expansionary Fiscal Policy



Potential GDP is $20 trillion, real GDP is $19 trillion, and there is a $1 trillion recessionary gap. An increase in government expenditure or a tax cut increases aggregate expenditure by ΔE. The multiplier increases consumption expenditure. The *AD* curve shifts rightward to AD_1, the price level rises to 115, real GDP increases to $20 trillion, and the recessionary gap is eliminated.

government expenditure or a tax cut increases aggregate expenditure by ΔE. If this were the only change in spending plans, the *AD* curve would shift rightward to become the curve labeled $AD_0 + \Delta E$ in Fig. 13.11. But if fiscal stimulus sets off a multiplier process that increases consumption expenditure, and does not crowd out much investment expenditure, aggregate demand increases further and the *AD* curve shifts to AD_1.

With no change in the price level, the economy would move from point *A* to point *B* on AD_1. But the increase in aggregate demand brings a rise in the price level along the upward-sloping *SAS* curve and the economy moves to point *C*.

At point *C*, the economy returns to full employment and the recessionary gap is eliminated.

Fiscal Stimulus and Aggregate Supply You've seen earlier in this chapter that taxes influence aggregate supply. A tax on labor income (on wages) drives a wedge between the cost of labor and the take-home pay of workers, which lowers employment and decreases real GDP (pp. 360–361). A tax on capital income (on interest) drives a wedge between the cost of borrowing and the return to lending, which decreases saving and investment (p. 362). With less saving and investment, the real GDP growth rate slows.

These negative effects of taxes on real GDP and its growth rate and on employment mean that a tax *cut* increases real GDP and its growth rate and increases employment.

These supply-side effects of a tax cut occur along with the demand-side effects and are probably much larger than the demand-side effects and make the overall tax multiplier much larger than the government expenditure multiplier—see *Economics in Action* in the next column.

An increase in government expenditure financed by borrowing increases the demand for loanable funds and raises the real interest rate, which in turn decreases investment. This cut in investment is the main reason why the government expenditure multiplier is so small and why a deficit-financed increase in government spending ends up making only a small contribution to job creation. And because government expenditure crowds out investment, it decreases future real GDP.

So a fiscal stimulus package that is heavy on tax cuts and light on government spending works. But an increase in government expenditure alone is not an effective way to stimulate production and create jobs.

The description of the effects of discretionary fiscal stimulus and its graphical illustration in Fig. 13.11 make it look easy: Calculate the recessionary gap and the multipliers, change government expenditure or taxes, and eliminate the gap. In reality, things are not that easy.

Getting the magnitude and the timing right is difficult, and we'll now examine this challenge.

Magnitude of Stimulus Economists have diverging views about the size of the government spending and tax multipliers because there is insufficient empirical evidence on which to pin their size with accuracy. This fact makes it impossible for Congress to determine the amount of stimulus needed to close a given

ECONOMICS IN ACTION

How Big Are the Fiscal Stimulus Multipliers?

When the 2009 fiscal stimulus package cut taxes by $300 billion and increased government spending by a little over $500 billion, by how much did aggregate expenditure and real GDP change? How big were the fiscal policy multipliers? Was the government expenditure multiplier larger than the tax multiplier? These questions are about the multiplier effects on *equilibrium real GDP*, not just on aggregate demand.

President Obama's chief economic adviser in 2009, Christina Romer, a University of California, Berkeley, professor, expected the government expenditure multiplier to be about 1.5. So she was expecting the spending increase of $500 billion to go a long way toward closing the $1 trillion output gap by some time in 2010.

Robert Barro, a professor at Harvard University, says this multiplier number is not in line with previous experience. Based on his calculations, an additional $500 billion of government spending would increase aggregate expenditure by only $250 billion because it would lower private spending in a crowding-out effect by $250 billion—the multiplier is 0.5.

Harald Uhlig, a professor at the University of Chicago, says that the government expenditure multiplier on real GDP is even smaller and lies between 0.3 and 0.4, so that a $500 billion increase in government spending increases aggregate expenditure by between $150 billion and $200 billion.

output gap. Further, the actual output gap is not known and can only be estimated with error. For these two reasons, discretionary fiscal policy is risky.

Time Lags Discretionary fiscal stimulus actions are also seriously hampered by three time lags:

- Recognition lag
- Law-making lag
- Impact lag

Recognition Lag The recognition lag is the time it takes to figure out that fiscal policy actions are needed. This process involves assessing the current state of the economy and forecasting its future state.

Law-Making Lag The *law-making lag* is the time it takes Congress to pass the laws needed to change taxes or spending. This process takes time because each member of Congress has a different idea about what is the best tax or spending program to change, so long debates and committee meetings are needed to reconcile conflicting views. The economy might benefit from fiscal stimulus today, but by the time Congress acts, a different fiscal medicine might be needed.

Impact Lag The *impact lag* is the time it takes from passing a tax or spending change to its effects on real GDP being felt. This lag depends partly on the speed with which government agencies can act and partly on the timing of changes in spending plans by households and businesses. These changes are spread out over a number of quarters and possibly a number of years.

Economic forecasting is steadily improving, but it remains inexact and subject to error. The range of uncertainty about the magnitudes of the spending and tax multipliers make discretionary fiscal stimulus an imprecise tool for boosting production and creating jobs while its crowding-out consequences raise serious questions about its effects on long-term economic growth.

There is greater agreement about tax multipliers. Because tax cuts strengthen the incentive to work and to invest, they increase aggregate supply as well as aggregate demand.

These multipliers get bigger as more time elapses. Harald Uhlig says that after one year, the tax multiplier is 0.5 so that the $300 billion tax cut would increase real GDP by about $150 billion by early 2010. But with two years of time to respond, real GDP would be $600 billion higher—a multiplier of 2. And after three years, the tax multiplier builds up to more than 6.

The implications of the work of Barro and Uhlig are that tax cuts are a powerful way to stimulate real GDP and employment but spending increases are not effective.

Christina Romer agrees that the economy hasn't performed in line with a multiplier of 1.5 but says other factors deteriorated and without the fiscal stimulus, the outcome would have been even worse.

Christina Romer: 1.5

Robert Barro: 0.5

Harald Uhlig: 0.4

REVIEW QUIZ

1. What is the distinction between automatic and discretionary fiscal policy?
2. How do taxes and needs-tested spending programs work as automatic fiscal policy to dampen the business cycle?
3. How do we tell whether a budget deficit needs discretionary action to remove it?
4. How can the federal government use discretionary fiscal policy to stimulate the economy?
5. Why might fiscal stimulus crowd out investment?

To complete your review of fiscal policy, look at *Economics in the News* on pp. 372–373, which examines the effects of the federal government's response to the Covid pandemic on real GDP and the price level.

Fiscal Policy Response to Covid

House of Representatives Passes $1.9tn Covid Stimulus Package

Financial Times

February 28, 2021

The House of Representatives has passed a $1.9tn coronavirus relief package, as U.S. president Joe Biden cleared the first big hurdle on the way to securing congressional approval for his economic stimulus bill.

The Democratic-controlled House passed the expansive legislation, which includes $1,400 direct payments, an extension of federal top-ups to unemployment insurance, and another $350bn for state and local governments, early on Saturday morning with the support of the vast majority of Democratic lawmakers.

Biden pleaded for "quick action" from the Senate on the stimulus bill.

"We have no time to waste. If we act now decisively, quickly and boldly, we can finally get ahead of this virus. We can finally get our economy moving again. And the people of this country have suffered far too much for too long. We need to relieve that suffering," he said on Saturday.

The vote was a significant milestone for Biden, who has made the stimulus package his top legislative priority for his first 100 days in the White House. Biden last week said the U.S. economy would come "roaring back" if Congress approved his proposals, while Treasury secretary Janet Yellen this week told G20 finance ministers that they should also "go big" with fiscal support to help the pandemic-ravaged global economy. …

The stimulus package needs to pass both the House and the Senate—which Democrats control by the smallest of margins—if it is going to be sent to Biden's desk to be signed into law. Democrats have set themselves a deadline of mid-March, when the current round of emergency unemployment benefits runs out.

Copyright Lauren Fedor and James Politi, "House of Representatives passes $1.9tn Covid stimulus package," *The Financial Times*, February 28, 2021

ESSENCE OF THE STORY

- The U.S. House of Representatives passed a $1.9 trillion coronavirus relief package.
- The package includes $1,400 direct payments, unemployment insurance top-ups, and $350 billion for state and local governments.
- The stimulus package needs to pass both the House and the Senate and the president asked for "quick action" by the Senate.
- Treasury secretary Janet Yellen told G20 finance ministers that they should also "go big" with fiscal stimulus.

ECONOMIC ANALYSIS

- During the Covid crisis that started in March 2020, the federal government sent three rounds of checks to individual Americans, provided unemployment assistance, and helped families who care for children and those unable to pay rent or utilities.
- The federal government also gave tax credits and other help to small and large businesses, with special help to the transportation sectors.
- Total federal government expenditure on Covid programs was $3.18 trillion, which was around 15 percent of GDP.
- How did the Covid pandemic change real GDP and the price level? And what was the effect of the federal Covid relief programs?
- The table shows real GDP and the price level before Covid, at its trough, and in mid-2021.
- At its trough in the second quarter of 2020, real GDP had fallen by $1.9 trillion (2012 dollars) and the price level hadn't changed.
- We don't know how big the fall would have been without fiscal stimulus, but it would have been greater than $1.9 trillion.
- And we don't know how big the recovery in 2021 would have been, but it would have been less than it was.
- Figure 1 illustrates a possible outcome with no stimulus in which aggregate demand falls from AD_0 to AD_1 and aggregate supply falls from SAS_0 to SAS_1 taking real GDP to $16 trillion.
- But fiscal stimulus lessened the severity of recession and Fig. 2 illustrates its effects. Stimulus increased aggregate demand from AD_1 to AD_2 and increased aggregate supply from SAS_1 to SAS_2 taking real GDP to $17.3 trillion.
- Figure 3 illustrates the recovery in 2021. Ongoing fiscal stimulus increased aggregate demand from AD_2 to AD_3 but rising costs decreased aggregate supply from SAS_2 to SAS_3 taking real GDP to $19.4 trillion and raising the price level from 113 to 117, an inflation rate of 3.5 percent.

Date	Real GDP (trillions of 2012 dollars)	GDP deflator (2012 = 100)
2019 Q4	19.2	113
2020 Q2	17.3	113
2021 Q2	19.4	117

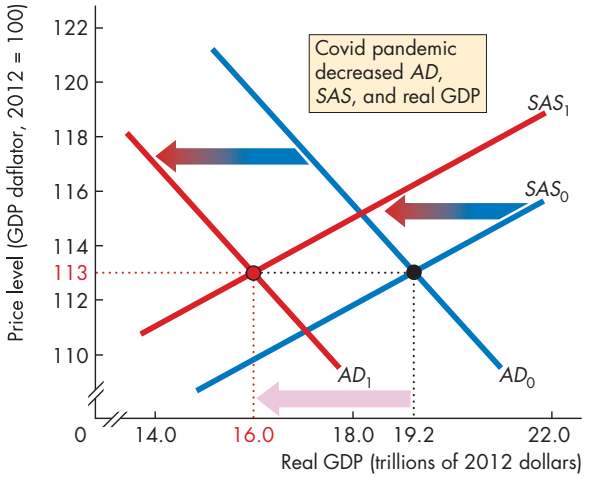


Figure 1 In 2020 Without Fiscal Stimulus

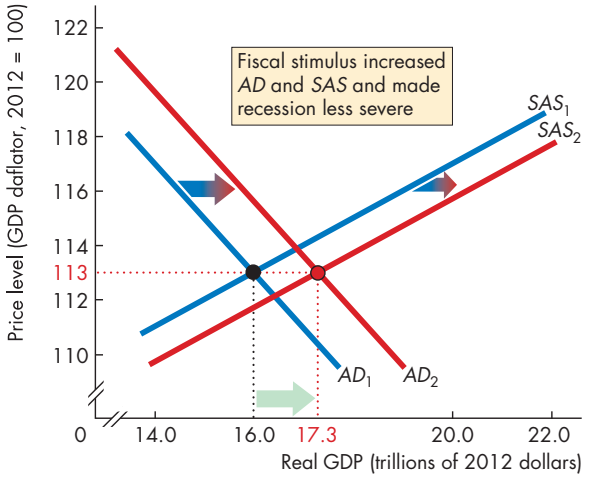


Figure 2 In 2020 With Fiscal Stimulus

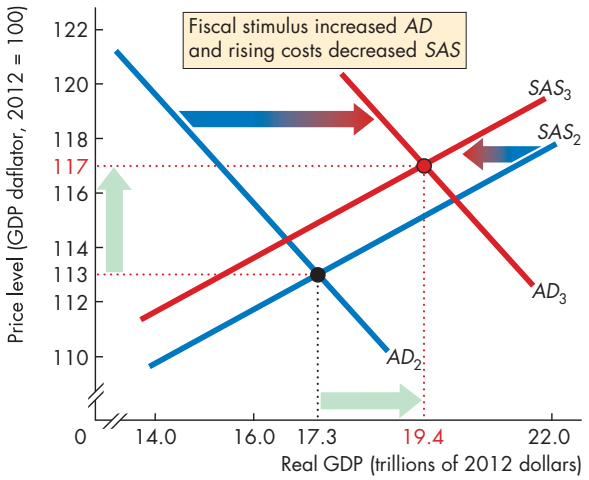


Figure 3 In 2021 With Fiscal Stimulus

WORKED PROBLEM

The economy is at full employment, the inflation rate is 2 percent a year, and the federal budget deficit is 3.5 percent of GDP. Congress wants to make real GDP grow faster and is debating whether to spend more on infrastructure or to cut income taxes.

Questions

1. What would be the short-run effects of new infrastructure expenditure?
2. What would be the long-run effects of new infrastructure expenditure?
3. How would lower income taxes change the macroeconomic variables?
4. Which policy would increase the economic growth rate?

Solutions

1. With no change in government receipts, the infrastructure expenditure will increase government outlays and the budget deficit. To fund the infrastructure work, the government goes to the loanable funds market. The demand for loanable funds increases and, with no change in the supply of loanable funds, the real interest rate rises. A higher real interest rate increases private saving and decreases private investment. The increased government expenditure crowds out some private investment.

   Aggregate demand increases by an amount equal to the infrastructure expenditure minus the crowded-out private investment plus the induced increase in consumption expenditure. With no change in aggregate supply, real GDP increases to above full employment and creates an inflationary gap.

Key Point: In the short run, a change in government expenditure changes the budget balance, the real interest rate, and the quantities of private saving and private investment, which change aggregate demand, real GDP, and the output gap.

2. Two further things change in the long run. (1) An inflationary gap makes the money wage rate rise, and (2) the increase in infrastructure capital increases potential GDP.

   The higher money wage rate decreases short-run aggregate supply and the increase in potential GDP lessens that decrease. The price level rises, and real GDP decreases to its new, higher, full-employment level.

Key Point: An output gap brings changes in the labor market and the goods market, and increased capital increases potential GDP. In the long run, real GDP is at a higher full-employment equilibrium.

3. A cut in the tax rate on wage income increases the supply of labor, increases the quantity of labor employed, and increases potential GDP. A cut in the tax rate on interest income increases saving and investment, increases the quantity of capital, and increases potential GDP.

   Lower tax receipts increase the budget deficit, which sends the government to the loanable funds market. The demand for loanable funds increases, which lessens the effect of the cut in the tax on interest income.

   In the short run, the tax cut increases aggregate demand and brings an inflationary gap, which increases the money wage rate and decreases short-run aggregate supply.

   In the long run, the economy returns to full-employment equilibrium, but one in which more people are employed and real GDP is larger.

Key Point: A change in the income tax rate changes the labor market equilibrium and the loanable funds market equilibrium. Employment, private investment, and potential GDP change.

4. A change in the real GDP growth rate is a long-run effect.

   In the long run, an increase in infrastructure capital increases potential GDP and crowds out private investment, which decreases potential GDP. If the crowding out is incomplete, a larger capital stock increases potential GDP. To make real GDP grow faster, capital must keep increasing at a faster pace. A one-shot expenditure on new infrastructure does not have this effect.

   A lower tax rate on interest income increases private investment, which increases the rate of capital accumulation and increases the growth rate of real GDP.

Key Point: A one-shot investment in infrastructure increases real GDP but not economic growth. A cut in the tax rate on interest income increases investment, which increases the rate of capital accumulation and the real GDP growth rate.

SUMMARY

Key Points

The Federal Budget (pp. 354–359)

- The federal budget is used to achieve macroeconomic objectives.
- Tax revenues can exceed, equal, or fall short of outlays—the budget can be in surplus, balanced, or in deficit.
- Budget deficits create government debt.

Supply-Side Effects of Fiscal Policy (pp. 360–363)

- Fiscal policy has supply-side effects because taxes weaken the incentive to work and decrease employment and potential GDP.
- The U.S. labor market tax wedge is large, but it is small compared to those of other industrialized countries.
- Fiscal policy has supply-side effects because taxes weaken the incentive to save and invest, which lowers the growth rate of real GDP.
- The Laffer curve shows the relationship between the tax rate and the amount of tax revenue collected.

Generational Effects of Fiscal Policy (pp. 364–366)

- Generational accounting measures the lifetime tax burden and benefits of each generation.
- A major study estimated the U.S. fiscal imbalance in 2014 to be $68 trillion—4 times the value of that year's production.
- Future generations will pay for 17 percent of the benefits of the current generation.
- About 48 percent of U.S. government debt is held by the rest of the world.

Fiscal Stimulus (pp. 366–371)

- Fiscal policy can be automatic or discretionary.
- Automatic fiscal policy might moderate the business cycle by stimulating demand in recession and restraining demand in a boom.
- Discretionary fiscal stimulus influences aggregate demand *and* aggregate supply.
- Discretionary changes in government expenditure or taxes have multiplier effects of uncertain magnitude but the tax multiplier is likely the larger one.
- Fiscal stimulus policies are hampered by uncertainty about the multipliers and by time lags (law-making lags and the difficulty of correctly diagnosing and forecasting the state of the economy).

Key Terms

Automatic fiscal policy, 366
Balanced budget, 356
Budget deficit, 356
Budget surplus, 356
Council of Economic Advisers, 355
Cyclical surplus or deficit, 367
Discretionary fiscal policy, 366
Federal budget, 354
Fiscal imbalance, 364
Fiscal policy, 354
Fiscal stimulus, 366
Generational accounting, 364
Generational imbalance, 365
Government debt, 358
Government expenditure multiplier, 369
Laffer curve, 363
Structural surplus or deficit, 367
Tax multiplier, 369
Tax wedge, 361

PROBLEMS AND APPLICATIONS

The Federal Budget

Use the following news clip to work Problems 1 and 2.

U.S. Budget Deficit Hits $1.7 Trillion in the First Half of the Fiscal Year

In the first half of fiscal 2021, the U.S. government spent $3.4 trillion, giving it a deficit of $1.7 trillion.

Source: nytimes.com, April 12, 2021

1. What were tax revenues in the first half of fiscal 2021? How much did U.S. government debt change in the first half of fiscal 2021?
2. What would Congress do if it wanted to stop the government's debt from increasing?

Supply-Side Effects of Fiscal Policy

3. The government is considering raising the tax rate on labor income. Explain the supply-side effects of such an action and use appropriate graphs to show the *directions* of change, not exact magnitudes. What will happen to:
   a. The supply of labor and why?
   b. The demand for labor and why?
   c. Equilibrium employment and why?
   d. The equilibrium before-tax wage rate and why?
   e. The equilibrium after-tax wage rate and why?
   f. Potential GDP?
4. What fiscal policy action might increase investment and speed economic growth? Explain how the policy action would work.
5. Suppose that instead of taxing *nominal* capital income, the government taxed *real* capital income. Use appropriate graphs to explain and illustrate the effect that this change would have on:
   a. The tax rate on capital income.
   b. The supply of and demand for loanable funds.
   c. Investment and the real interest rate.

Generational Effects of Fiscal Policy

6. During the 2016 elections in Northern Ireland, candidates focused on fiscal issues with many promising lower corporate taxes. It was estimated that if Northern Ireland were independent, its fiscal deficit would be more than 8 times higher than the EU ceiling.
   a. What are the dangers associated with a fiscal imbalance? Do you think the promise of the election candidates would help decrease it?
   b. If Northern Ireland were an independent state, how would your answer to part (a) influence the generational imbalance?

Fiscal Stimulus

7. The economy is in a recession, and the recessionary gap is large.
   a. Describe the discretionary and automatic fiscal policy actions that might occur.
   b. Describe a discretionary fiscal stimulus package that could be used that would *not* bring an increase in the budget deficit.
   c. Explain the risks of discretionary fiscal policy in this situation.
8. An economy is in a recession with a large recessionary gap and a government budget deficit.
   a. Is the government budget deficit a structural deficit or a cyclical deficit? Explain.
   b. Explain how automatic fiscal policy is changing the output gap.
   c. If the government increases its discretionary expenditure, explain how the structural deficit might change.

Use the following news clip and fact to work Problems 9 to 11.

The Trump Tax Cut Wasn't Just For the Rich

Suppose the Trump tax cuts remain in place. Compared to a situation with no tax change, the Tax Policy Center estimates that after-tax incomes of households in the bottom fifth will rise 0.4%; the second fifth, up 0.9%; the middle fifth, up 1.3%; fourth fifth, up 1.4%; and the top fifth up 2.3%.

Source: Bloomberg.com, October 27, 2020

Fact: Middle and low-income earners spend almost all their disposable incomes. High-income earners save a significant part of their disposable incomes.

9. a. Explain how the income tax cut influences agggregate demand. Draw a graph to illustrate the intended effect.
   b. Explain why the effect of tax cuts depends on who receives them.
10. Which tax cuts would have a larger effect on aggregate demand: tax cuts to everyone; to the middle-class only; or to high-income earners only? Compare each alternative with no tax cuts but an equivalent increase in government expenditure.
11. Compare the impact on equilibrium real GDP of a same-sized decrease in taxes and increase in government expenditure on goods and services.

ADDITIONAL PROBLEMS AND APPLICATIONS

The Federal Budget

12. **U.S. Economy Shrank 5% In the First Quarter**
The Commerce Department reported that gross domestic product fell at an annual rate of 5% in the first quarter.

Source: cnbc.com, May 28, 2020

How does an unexpected decrease in the economic growth rate influence federal government (a) outlays and (b) revenues?

Supply-Side Effects of Fiscal Policy

Use the following information to work Problems 13 and 14.

Suppose that investment is $1,600 billion, saving is $1,400 billion, government expenditure on goods and services is $1,500 billion, exports are $2,000 billion, and imports are $2,500 billion.

13. Calculate the amount of tax revenue and the government budget balance.
14. a. Explain the impact of the government budget balance on investment.
    b. What fiscal policy action might increase investment and speed economic growth? Explain how the policy action would work.
15. Suppose that capital income taxes are based on nominal interest rates. If the inflation rate decreases by 2 percent a year, explain and use appropriate graphs to illustrate the effect of the fall in inflation on:
    a. The tax rate on capital income.
    b. The supply of loanable funds.
    c. The demand for loanable funds.
    d. Equilibrium investment.
    e. The equilibrium real interest rate.

Use the following news clip to work Problems 16 and 17.

Singapore Budget 2015: Parliament Passes Record $79.9 Billion Budget

New schemes announced by the government's budget statement include ten new hawker centers by 2027, a third desalination plant, Skills Future initiative to support life-long learning for adults, and a second edition of Construction Productivity Roadmap to boost the industry's capabilities.

Source: *The Straits Times*, March 13, 2015

16. Explain the supply-side effects of building ten new hawker centers and a third desalination plant.
17. a. Explain the potential supply-side and demand-side effects of Skills Future initiative.
    b. Explain the potential supply-side and demand-side effects of adopting new technologies to boost productivity in the construction industry.
    c. Draw a graph to illustrate the combined demand-side and supply-side effect of the fiscal policy measures in part (a).

Use the following news clip to work Problems 18 and 19.

Switzerland Reduces Its Value-Added Tax

In 2017, Swiss voters rejected the continued funding of the 2020 Old-Age and Survivors Insurance reform. As a result, Switzerland is reducing its value-added tax (VAT) from 8 percent to 7.7 percent and the special VAT rate from 3.8 percent to 3.7 percent, which will be effective starting January 1, 2018.

Source: blogs.deloitte.ch, September 26, 2017

18. Explain the potential supply-side effects of the VAT reduction on the Swiss economy.
19. Use the information in the news clip to explain which side of the Laffer curve the Swiss economy is placed.

Generational Effects of Fiscal Policy

20. **Budget of the U.S. Government**
In Fiscal 2021, mandatory spending on the three entitlement programs—Social Security, Medicare, and Medicaid—was 11.1 percent of GDP. This expenditure was projected to rise to 12.6 percent of GDP by 2031. Over that same period, discretionary expenditure on national defense was projected to fall from 3.4 percent of GDP to 2.5 percent of GDP. The deficit was projected to fall from 14.9 percent of GDP to 4.7 percent of GDP.

Source: whitehouse.gov, Fiscal Year 2022

If politicians continue to avoid legislating changes that lower the projected increases in the three big entitlement programs, how do you think the fiscal imbalance will change? If Congress introduced changes that slowed the growth of expenditure on the three entitlement programs, who would benefit and who would pay?

Fiscal Stimulus

21. The economy is in a boom and the inflationary gap is large.
    a. Describe the discretionary and automatic fiscal policy actions that might occur.
    b. Describe a discretionary fiscal restraint package that could be used that would not produce serious negative supply-side effects.
    c. Explain the risks of discretionary fiscal policy in this situation.
22. The economy is growing slowly, the inflationary gap is large, and there is a budget deficit.
    a. Do we know whether the budget deficit is structural or cyclical? Explain your answer.
    b. Do we know whether automatic fiscal policy is increasing or decreasing aggregate demand? Explain your answer.
    c. If a discretionary decrease in government expenditure occurs, what happens to the structural budget balance? Explain your answer.

Use the following news clip to work Problems 23 to 25.

Struggling Americans Blast Stimulus Bill as Too Little, Too Late

People are expressing deep disappointment with the $600 Covid relief checks approved by Congress. The help is too little, too late, say Americans who are having difficulty paying their bills during the pandemic.

Source: cnn.com, December 23, 2020

23. Are the Covid relief checks discretionary fiscal stimulus or automatic fiscal stimulus?
24. Do the Covid relief checks have a similar effect on aggregate demand as a tax cut? What has a greater effect on aggregate demand—issuing Covid checks or government expenditure of the same amount? Explain your answer.
25. What are the fiscal policy time lags evident in the news clip?

Economics in the News

26. After you have studied *Economics in the News* on pp. 372–373, answer the following questions.
    a. What was the scale of federal government expenditure on Covid relief programs?
    b. How did the Covid pandemic change aggregate demand and aggregate supply? Draw a graph to illustrate your answer.
    c. How did the fiscal policy response to Covid change aggregate demand and aggregate supply? Draw a graph to illustrate your answer.
    d. As the economy recovered from the Covid recession in 2021, what happened to aggregate demand and aggregate supply, and how can we tell? Draw a graph to illustrate your answer.
27. **More Fiscal Stimulus Needed?**

    In *New York Times* articles and in blogs, economists Paul Krugman and Joseph Stiglitz say there is a need for more fiscal stimulus in both the United States and Europe despite the large federal budget deficit and large deficits in some European countries.
    a. Do you agree with Krugman and Stiglitz? Why?
    b. What are the dangers of not engaging in further fiscal stimulus?
    c. What are the dangers of embarking on further fiscal stimulus when the budget is in deficit?
28. **U.S. Senate Passes Biden's $1T Bipartisan Infrastructure Plan**

    The infrastructure plan includes funding to rebuild roads and bridges, shore up coastlines, modernize the electric grid, and update public transit, airports, and freight rail. There is also $65 billion allocated to expand broadband and make it more affordable.

    Source: globalnews.ca, August 10, 2021

    a. Explain how $1 trillion of infrastructure spending could be paid for.
    b. Explain the effects of $1 trillion in infrastructure spending on employment and unemployment.

14 MONETARY POLICY

After studying this chapter, you will be able to:

- Describe the objectives of U.S. monetary policy and the framework for setting and achieving them
- Explain how the Federal Reserve makes its interest rate decision and achieves its interest rate target
- Explain the transmission channels through which the Federal Reserve influences real GDP, jobs, and inflation
- Describe the Fed's actions and macroprudential regulations prompted by the 2008 financial crisis

At eight regularly scheduled meetings a year and in an emergency between regular meetings, the Federal Reserve decides whether to change its interest rate target or the scale of its bond purchases or sales. How does the Fed make its decisions? Can the Fed lower unemployment by lowering the interest rate and can it keep inflation in check by raising the interest rate? What special measures can the Fed take in a financial crisis like the one that engulfed the U.S. and global economies in 2008?

This chapter answers these questions, and *Economics in the News* at the end of the chapter looks at the Fed's actions to achieve its policy goals in the Covid pandemic.

Monetary Policy Objectives and Framework

A nation's monetary policy objectives and the framework for setting and achieving those objectives stem from the relationship between the central bank and the government.

We'll describe the objectives of U.S. monetary policy and the framework and assignment of responsibility for achieving those objectives.

Monetary Policy Objectives

The objectives of U.S. monetary policy are set out in the mandate of the Board of Governors of the Federal Reserve System, which is defined by the Federal Reserve Act of 1913 and its subsequent amendments, the most recent of which were passed in 2000.

Federal Reserve Act The Fed's mandate was most recently clarified in amendments to the Federal Reserve Act passed by Congress in 2000. The 2000 law states that mandate in the following words:

> The Board of Governors of the Federal Reserve System and the Federal Open Market Committee shall maintain long-run growth of the monetary and credit aggregates commensurate with the economy's long-run potential to increase production, so as to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates.

Means and Goals This description of the Fed's mandate has two parts: a prescription of the means by which the Fed is to pursue its goals, and a statement of the goals.

Means for Achieving the Goals The 2000 law instructs the Fed to pursue its goals by "maintain[ing] long-run growth of the monetary and credit aggregates commensurate with the economy's long-run potential to increase production." You perhaps recognize this statement as being consistent with the quantity theory of money that you studied in Chapter 8 (see pp. 232–233). The "economy's long-run potential to increase production" is the growth rate of potential GDP. The "monetary and credit aggregates" are the quantities of money and loans. By keeping the growth rate of the quantity of money in line with the growth rate of potential GDP, the Fed is expected to be able to achieve its policy goals.

Fed Monetary Policy Goals: A Dual Mandate The Fed's mandated goals are "maximum employment, stable prices, and moderate long-term interest rates." Although three goals are stated, they are usually called the **Fed's dual mandate**—a mandate to achieve stable prices and full employment.

In the long run, these goals are in harmony and reinforce each other. But in the short run, these goals might come into conflict. Let's examine these goals a bit more closely.

Achieving the goal of "stable prices" means keeping the inflation rate low (and perhaps close to zero). And achieving the goal of "moderate long-term interest rates" means keeping the long-term *nominal* interest rate close to (or even equal to) the long-term *real* interest rate. So the interest rate goal is the same as the price stability goal.

Achieving the goal of "maximum employment" means attaining the maximum sustainable growth rate of potential GDP and keeping real GDP close to potential GDP. It also means keeping the unemployment rate close to the natural unemployment rate.

Price stability is the key goal. It is the source of maximum employment and moderate long-term interest rates. Price stability provides the best available environment for households and firms to make the saving and investment decisions that bring economic growth. So price stability encourages the maximum sustainable growth rate of potential GDP.

Price stability delivers moderate long-term interest rates because the nominal interest rate reflects the inflation rate. The nominal interest rate equals the real interest rate plus the inflation rate. With stable prices, the nominal interest rate is close to the real interest rate, and most of the time, this interest rate is likely to be moderate.

In the short run, the Fed faces a tradeoff between inflation and interest rates and between inflation and real GDP, employment, and unemployment. Taking an action that is designed to lower the inflation rate and achieve stable prices might mean raising interest rates, which lowers employment and real GDP and increases the unemployment rate in the short run.

To pursue the goals of monetary policy, the Fed must make the general concepts of price stability and maximum employment precise and operational.

Operational "Stable Prices" Goal

The Fed calls its pursuit of stable prices "flexible average inflation targeting," which it pursues by choosing three things:

- A measure of the price level
- A target inflation rate
- A time period over which to average inflation

Price Level Measure The Fed measures the price level by using the personal consumption expenditure price index (PCEPI). This price level measure is a monthly chain-linked index, which means that it is calculated using the current month and previous month's baskets of goods and services and is free from the bias of the Consumer Price Index (CPI).

Target Inflation Rate The Fed's stable-prices target, first announced in 2012, is an inflation rate of 2 percent, as measured by the annual change in the PCEPI. Before 2012, there was no explicit target but an inflation rate of between 1 and 2 percent was regarded as being in the Fed's comfort zone.

Although today's 2 percent target seems to be rigid and precise, it gets flexibility from the time period over which inflation is averaged.

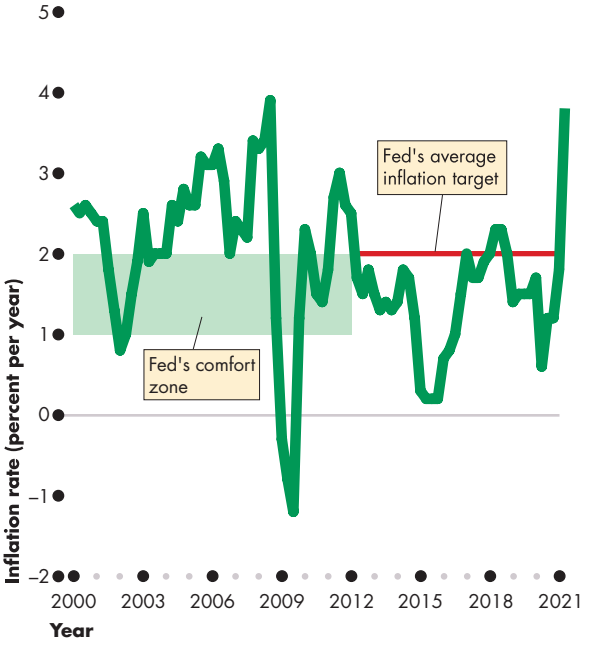
Time Period Over Which Inflation Is Averaged The Fed's stable-prices target is not an inflation rate of 2 percent every month: It is the inflation rate averaged over an unspecified period. After a period of below 2 percent inflation, the Fed will permit a period of above 2 percent, so long as the higher rate does not increase the expected inflation rate. Anchoring inflation expectations at 2 percent is the centerpiece of the Fed's stable prices goal.

Figure 14.1 shows the PCEPI inflation rate since 2000 along with the Fed's 2 percent target. You can see that most of the time since 2012 when the 2 percent target was adopted, the inflation rate has been below 2 percent. Only between 2004 and 2008, a period during which a major financial crisis occured, was inflation persistently above 2 percent.

Operational "Maximum Employment" Goal

Maximum employment is the highest level of employment and lowest level of unemployment that can be attained while avoiding sustained inflation above the target 2 percent rate.

FIGURE 14.1 Operational Price Stability Goal: Average Inflation



Before 2012, the Fed regarded an inflation rate between 1 and 2 percent a year as being in its comfort zone. Starting in 2012, the Fed's target has been an average inflation rate of 2 percent.

The PCEPI inflation rate was below the 2 percent target most of the time after 2012, and persistently above 2 percent only beween 2004 and 2008. The inflation of 2021 might be a spike or the start of a longer period of inflation above 2 percent.

Source of data: Bureau of Economic Analysis.

Information about FOMC members' estimates of indicators of maximum employment are published four times a year and in mid-2020, the median estimate of the FOMC members is that maximum employment would be attained when the unemployment rate had fallen to 4.4 percent.

But the Fed's maximum employment goal is not a fixed numerical target. It changes over time as changing and sometimes unmeasurable non-monetary factors affect the labor market. Consequently, the FOMC looks at a wide range of indicators that include the labor force participation rate, the unemployment rate, and measures of capacity utilization, to estimate the gap between employment and its maximum level.

Responsibility for Monetary Policy

Who is responsible for monetary policy in the United States? What are the roles of the Fed, Congress, and the President?

The Role of the Fed The Federal Reserve Act makes the Board of Governors of the Federal Reserve System and the Federal Open Market Committee (FOMC) responsible for the conduct of monetary policy. We described the composition of the FOMC in Chapter 8 (see p. 221). The FOMC makes a monetary policy decision at eight scheduled meetings each year and communicates its decision with a brief explanation. Three weeks after an FOMC meeting, the full minutes are published.

The Role of Congress Congress plays no role in making monetary policy decisions but the Federal Reserve Act requires the Board of Governors to report on monetary policy to Congress. The Fed makes two reports each year, one in February and another in July. These reports and the Fed chair's testimony before Congress along with the minutes of the FOMC communicate the Fed's thinking on monetary policy to lawmakers and the public.

The Role of the President The formal role of the President of the United States is limited to appointing the members and the chair of the Board of Governors. But some presidents—Donald Trump was one—have publicly criticized Fed decisions.

REVIEW QUIZ

1. What are the objectives of monetary policy?
2. Are the goals of monetary policy in harmony or in conflict (a) in the long run and (b) in the short run?
3. What is the PCEPI inflation rate and how does it differ from the CPI inflation rate?
4. Who is responsible for U.S. monetary policy and what are the roles of the Fed, Congress, and the President?

You now know the objectives of monetary policy and can describe the framework and assignment of responsibility for achieving those objectives. Your next task is to see how the Federal Reserve conducts its monetary policy.

The Conduct of Monetary Policy

To explain how the Fed conducts its monetary policy, we'll answer three questions:

- What are the Fed's monetary policy instruments?
- How does the Fed make its policy decisions?
- How does the Fed implement its policy decisions?

The Monetary Policy Instruments

A **monetary policy instrument** is a variable that a central bank can directly control or very closely target and that influences the economy in desirable ways.

The Federal Reserve's policy instruments are the quantity of bank reserves and three interest rates at which banks can borrow, hold, or lend reserves overnight.

Reserves The quantity of **reserves** is vault cash held by banks plus the balance on their reserve accounts at the Fed. The Fed changes the quantity of reserves when it conducts an open market operation—when it buys or sells securities such as U.S. Treasury bills and bonds and mortgage-backed securities in the open market. When the Fed buys securities, it pays for them with newly created bank reserves, so the quantity of reserves increases. And when the Fed sells securities, the buyer pays for them with bank reserves, so the quantity of reserves decreases.

Interest Rates The Fed's interest rate instruments are the *federal funds rate*, the *discount rate*, and the *interest on reserves rate*.

When a bank is short of reserves, it can borrow from other banks, and when a bank has more reserves than it wants to hold, it can lend to other banks. These inter-bank loans of reserves are made in the *federal funds market*, and the **federal funds rate** is the interest rate on overnight loans of reserves among banks. This interest rate is market determined and the FOMC sets the target range for it.

When a bank is short of reserves and no other banks are lending reserves, it can borrow from the Fed. The interest rate at which the Fed makes this loan is the **discount rate**. The Fed's Board of Governors sets this interest rate.

The Fed pays interest to banks on their reserves held on deposit at the Fed at the **interest on reserves rate**. Like the discount rate, the Board of Governors sets this interest rate.

Although the FOMC sets the target for the federal funds rate and the Board of Governors sets the other

two interest rates, the members of the Board of Governors are also members of the FOMC and the three rates are set together and change together.

Interest Rate Corridor The discount rate and the interest on reserves rate create a "corridor" that limits the movement of the federal funds rate. Because a bank can borrow from the Fed at the discount rate, it will not borrow from another bank unless the interest rate is lower than or equal to that rate. So, the discount rate acts as a cap on the federal funds rate. And because a bank earns interest on its reserves, it will not lend reserves to another bank unless the interest rate is higher than or equal to the interest on reserves rate. So, the interest on reserves rate acts as a floor on the federal funds rate.

Monetary Policy Decisions

The Fed sets its policy instruments to achieve its stable-prices and maximum employment goals. When the forecast is low unemployment and an inflationary gap, the FOMC seeks to moderate the build-up of inflation pressures by raising its federal funds rate target. And when the forecast is recession and high unemployment, it seeks to avoid this unwanted outcome by lowering its federal funds rate target.

The FOMC doesn't respond symmetrically to inflation and unemployment risks. When the FOMC is concerned about rising inflation, it raises the federal funds rate target in small steps over many months. But when the FOMC is concerned about recession and rising unemployment, it lowers the federal funds rate target quickly in large steps.

When the economy is hit with a large negative shock like the global financial crisis of 2008-2009 and Covid in 2020-2021, the Fed adds massive bond purchases to its war chest, which increase bank reserves.

Let's look at the Fed's decisions, starting with its interest rate setting.

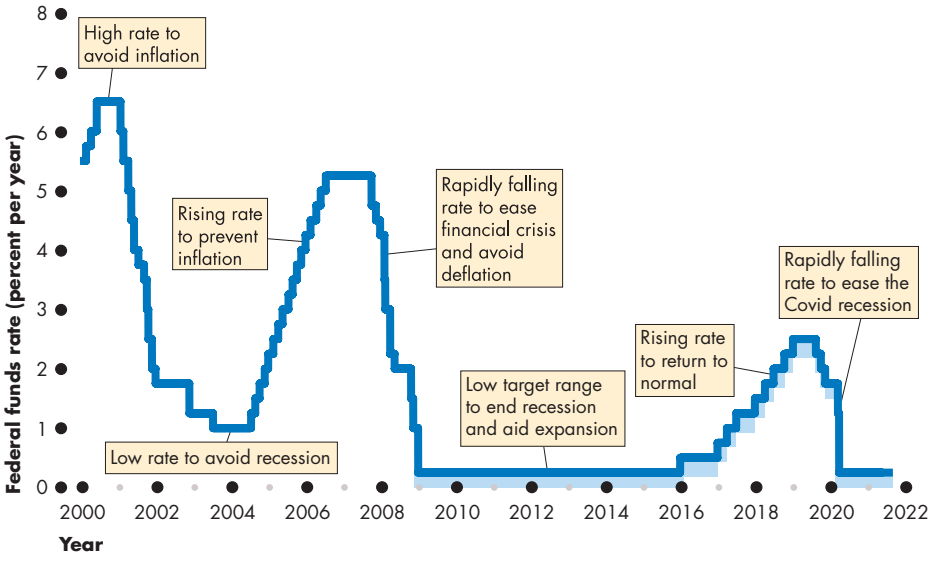
Interest Rate Decisions Figure 14.2 shows the federal funds rate from 2000 to 2008 and its target range after 2008.

From 2000 to 2008, the economy experienced normal and small fluctuations. The federal funds rate was high at 6.5 percent in 2000 and 5.25 percent in 2006 to lower the inflation rate, and low at 1 percent in 2004 to stimulate employment.

In 2008, with the risk of a collapse of the banking and financial system, the Fed slashed the federal funds rate to historically low levels with a target range of zero to 0.25 percent. Inflation was close to or below 2 percent a year, and the Fed was less concerned about inflation than it was about recession and high unemployment. So it set a low interest rate to fight recession.

Interest rates remained close to zero for eight years and only started to rise in 2016. By 2019 they had reached 2.5 percent and then Covid and its high unemployment sent the federal funds rate back to zero.

FIGURE 14.2 The Federal Funds Rate



Before 2008, the Fed set a target for the federal funds rate and then took actions to keep the rate close to its target. Since 2008, the Fed has set a target range.

When the Fed wants to slow inflation, it raises the federal funds rate. When inflation is low and the Fed wants to avoid recession, it lowers the federal funds rate.

Source of data: Board of Governors of the Federal Reserve System.

Reserves Decisions You've just seen that at the end of 2008, the Fed switched from setting a target level to a target range for the federal funds rate. That's not the only policy change.

From the mid-1980s to 2007, the U.S. and global economies enjoyed what came to be called the *Great Moderation*—a period of low business cycle volatility and stable financial markets.

In this era of calm, monetary policy was conducted with **limited reserves**—the minimum level of reserves at which a bank can function. The Fed paid no interest on reserves, limited the quantity of reserves to a few billion dollars, and conducted daily open market operations to hit the federal funds rate target.

During the 2008-2009 recession, in a successful attempt to avoid the bank failures of the Great Depression, the Fed began to conduct monetary policy with **ample reserves**—a volume of reserves well in excess of the volume needed to conduct business. It also started to pay interest on reserves held at the Fed and engaged in **quantitative easing**—large open market purchases to increase the quantity of reserves. By 2014, the Fed had created reserves of almost $3 trillion.

As recession fears eased after 2014, the Fed engaged in **quantitative tightening**—large open market sales to decrease the quantity of reserves. By 2019, reserves had fallen to a little more than $1 trillion.

Then the Covid pandemic crashed the economy. To avoid yet another depression, the Fed unleashed a new round of quantitative easing that increased reserves to almost $4 trillion.

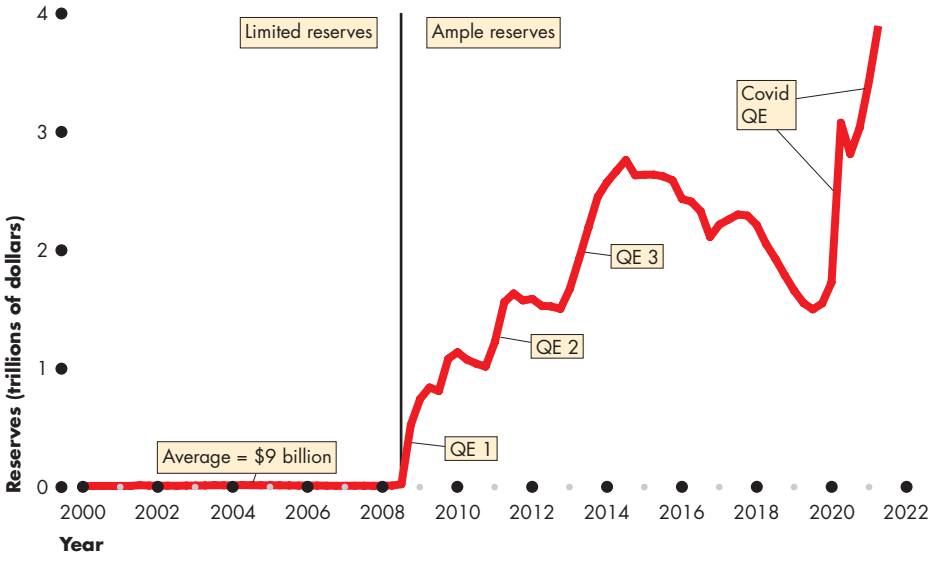
Figure 14.3 shows the quantity of bank reserves in the two eras: from 2000 to mid-2008 and from mid-2008 to 2021. Notice the tiny volume of reserves before mid-2008 and the four rounds of quantitative easing: QE1 (November 2008), QE2 (November 2010), QE3 (September 2012), and Covid QE (2020).

Why Do Banks Hold Ample Reserves? Why hasn't the massive increase in reserves started a money creation multiplier process? The answer is that the amount that a bank can lend is limited by its capital. A bank's capital is its assets (loans, securities, and reserves) minus its liabilities (deposits), which equals its net worth or equity value to its stockholders.

Prompted by the 2008 financial crisis, the U.S. Congress passed the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010. This act requires U.S. banks to maintain a minimum capital adequacy ratio, which means their ratio of capital to assets must not be less than a specified percentage.

In 2021, U.S. banks had capital adequacy ratios that ranged from 12 to 17 percent. Although these ratios give the banks scope to increase lending, banks act with caution preferring to operate with a large margin of safety and hold ample reserves.

FIGURE 14.3 Bank Reserves in Two Eras



Before mid-2008, banks operated with limited reserves. The Fed used open market operations to adjust the quantity of reserves.

Since mid-2008, the Fed has conducted a series of quantitative easing—large-scale asset purchases which increased bank reserves from around $9 billion to almost $4 trillion.

Source of data: Board of Governors of the Federal Reserve System.

Hitting the Federal Funds Rate Target

Having decided the target for the federal funds rate, how does the Fed move the rate to its target level? The answer is by using open market operations (see Chapter 8, pp. 222–226) to adjust the quantity of bank reserves.

To see how an open market operation changes the federal funds rate, we can look at two equivalent markets:

- The federal funds market
- The market for bank reserves

The Federal Funds Market In the federal funds market, the higher the federal funds rate, the greater is the quantity of overnight loans supplied and the smaller is the quantity of overnight loans demanded. The equilibrium federal funds rate balances the quantities demanded and supplied.

The Market for Bank Reserves Lending in the federal funds market is an alternative to holding larger reserves. And borrowing in the federal funds market is an alternative to holding smaller reserves. So, lending and borrowing in the federal funds market is the flip side of the demand for reserves.

The federal funds rate balances the quantities demanded and supplied of bank reserves. Banks hold reserves to meet the required reserve ratio and hold excess reserves so they can make payments. But because reserves can be loaned in the federal funds market and earn the federal funds rate, they are costly to hold. So, the higher the federal funds rate, the smaller is the quantity of reserves demanded.

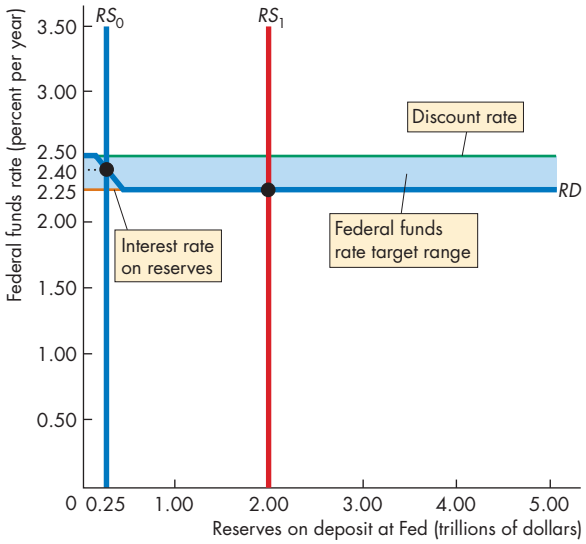
By conducting an open market operation, the Fed can change the quantity of reserves supplied and move the federal funds rate to its target level.

The size of the federal funds rate corridor is 0.25 percentage points. When the interest on reserves rate is 2.25 percent, the discount rate is 2.50 percent.

In normal times, the Fed sets the federal funds rate target in the center of the corridor. But since 2008, the Fed has set the federal funds rate target at the bottom of the corridor, equal to the interest on reserves rate.

Figure 14.4 illustrates the market for bank reserves, both in normal times and more recently. The demand curve for reserves is *RD*. The discount rate is 2.50 percent and the interest on reserves rate is 2.25 percent. These two interest rates create the federal funds rate corridor shown in the figure.

FIGURE 14.4 The Market for Reserves



The demand curve for reserves is *RD*. The discount rate is 2.50 percent and the interest on reserves rate is 2.25 percent. In normal times, reserves are limited, the supply curve is RS_0, and the federal funds rate is inside the target range. With ample reserves, the supply curve is RS_1.

If, as in normal times, reserves are limited, the federal funds rate target is in the center of the corridor and the Fed uses open market operations to make the supply curve of reserves RS_0 and the federal funds rate is between 2.25 and 2.50 percent.

If reserves are ample, as in recent years, the federal funds rate target is at the bottom of the corridor, the Fed makes the supply curve of reserves RS_1 at $2 trillion and the federal funds rate is 2.25 percent.

REVIEW QUIZ

1. What are the Fed's monetary policy instruments?
2. What are the main influences on the FOMC federal funds rate decision?
3. How is the federal funds rate determined in the market for bank reserves?

We next look at the transmission of monetary policy and see how the Fed achieves its goals.

AT ISSUE

FOMC Inflation Hawks and Doves

At an FOMC meeting held in July 2021, the FOMC decided to maintain the target range for the federal funds rate at zero to 0.25 percent and to keep buying bonds at a pace of $120 billion per month. All the FOMC members supported this action and no one voted against it. But some members and some regional Fed presidents—the inflation hawks—were becoming increasingly concerned about inflation, while others—the inflation doves—remained more concerned about restoring maximum employment.

Let's look at both sides of this issue.

The Doves say ...

- The Fed's mandate is to foster maximum employment and price stability.
- Inflation has been below 2 percent for many months and can now comfortably run above 2 percent.
- Unemployment is high and real GDP growth cannot be assured.
- Further risks to growth are coming from the delta variant of Covid.
- Because inflation isn't a threat and unemployment is still high, monetary stimulus is still needed.
- The federal funds rate should remain close to zero, and bond purchases should continue until maximum employment is achieved and inflation has averaged 2 percent for some time.

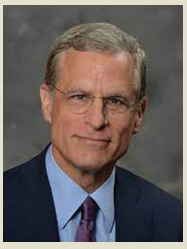
Economic disparities disproportionately affect low-income workers and people of color, which holds back progress toward reaching maximum employment, says Fed Governor Michelle Bowman.

Interest rates should be kept at near zero until at least the end of 2023 in order to "really achieve maximum employment", says Minneapolis Fed President Neel Kashkari.

The Hawks say ...

- Recent high inflation data, the highest rate since 2008, cannot be ignored.
- Inflation pressures are broad.
- The inflation rate is likely to run above the 2 percent target through 2022.
- The Fed risks being caught off guard and having to tighten policy more aggressively later on.
- The views of the inflation hawks are consistent with the fact that the time lags in the effects of interest rate changes are long and variable.
- Today's interest rate and bond buying will influence the inflation rate around two years in the future, so the Fed must set the interest rate based on the expected future inflation rate, not on today's inflation.

The economy can withstand a little less help from the Fed. Inflation and excess risk taking has led to distortions in financial markets, says Robert Kaplan, president of the Dallas Fed.



The Fed should avoid overheating the economy, says Esther George of the Kansas City Fed.

Monetary Policy Transmission

You've seen that the Fed's goals are to achieve stable prices (keep the average inflation rate at 2 percent a year) and maximum employment (keep the unemployment rate as low as possible without raising inflation). And you've seen how the Fed can use its power to set the federal funds rate and the reserves of banks at their desired levels. We're now going to trace the events that follow a change in the federal funds rate and bank reserves and see the ripple effects that lead to the ultimate policy goals.

We'll begin with a quick overview of the transmission process and then look at each step a bit more closely.

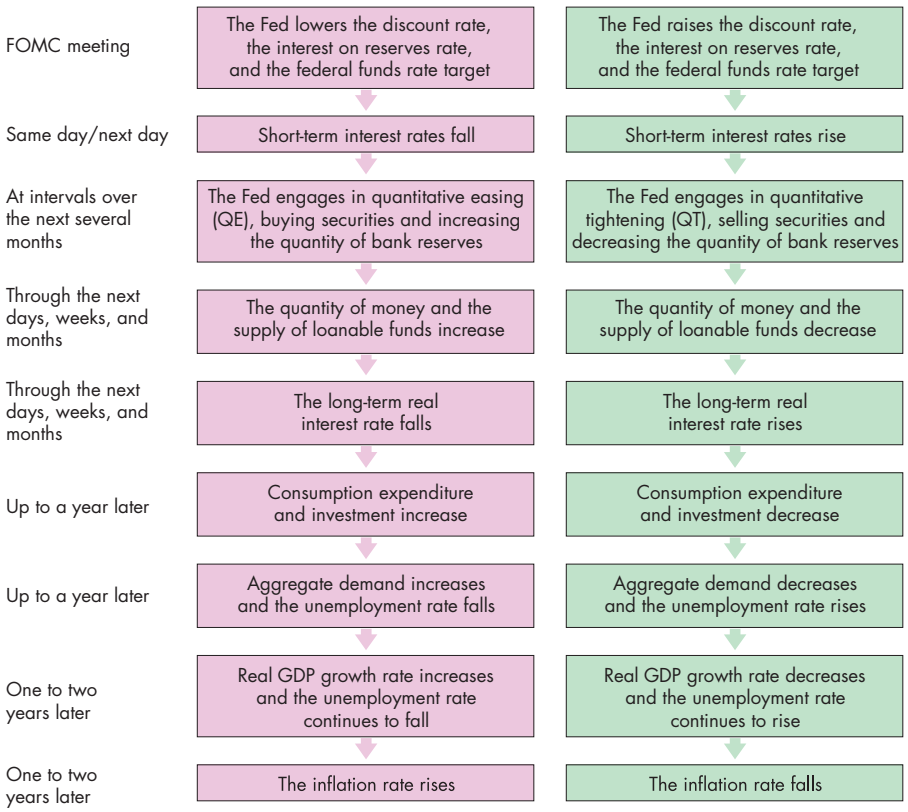
Quick Overview

When the Fed lowers the federal funds rate target, it lowers the discount rate and interest on reserves rate, which immediately moves the federal funds rate to its new target. Other short-term interest rates also fall. When the Fed buys securities in a QE operation, the quantity of money and the supply of loanable funds increase. The long-term real interest rate falls. The lower real interest rate increases consumption expenditure and investment. Easier bank loans reinforce the effect of lower interest rates on aggregate expenditure. Aggregate demand increases, which increases real GDP and the price level relative to what they would have been had the Fed not lowered the federal funds rate and increased bank reserves. Real GDP growth and inflation speed up.

When the Fed raises interest rates and sells securities in a QT operation, the sequence of events that we've just reviewed plays out, but the effects are in the opposite directions.

Figure 14.5 provides a schematic summary of these ripple effects for both a cut in the federal funds rate accompanied by QE and a rise in the federal funds rate accompanied by QT.

FIGURE 14.5 The Ripple Effects of a Change in the Federal Funds Rate and Bank Reserves



When the Fed wants to increase employment, it lowers the federal funds rate and other short-term interest rates fall. If the Fed buys securities in a QE operation, the quantity of money and the supply of loanable funds increase and the long-term real interest rate falls. Aggregate demand increases, which increases real GDP, employment, and the inflation rate.

When the Fed wants to lower inflation, it raises the federal funds rate and other short-term interest rates rise. If the Fed sells securities in a QT operation, the quantity of money and the supply of loanable funds decrease and the long-term real interest rate rises. Aggregate demand decreases, which decreases real GDP, employment, and the inflation rate.

These ripple effects stretch out over a period of between one and two years. The interest rate effects are immediate. The effects on money and bank loans follow in a few weeks and run from a few months to a year or more. Real long-term interest rates change quickly and often in anticipation of the short-term interest rate changes.

Consumption and investment plans change, aggregate demand changes and after about one year, the real GDP growth rate changes.

The inflation rate changes between one year and two years after the change in the federal funds rate. But these time lags are not entirely predictable and can be longer or shorter.

We're now going to look at each stage in the transmission process, starting with the interest rate effects.

Changes in Interest Rates

The first effect of a change in the federal funds rate is a change in other short-term interest rates, and these effects occur quickly and predictably.

Figure 14.6 explores the relationships between the federal funds rate, the 3-month Treasury bill rate, and the long-term bond rate.

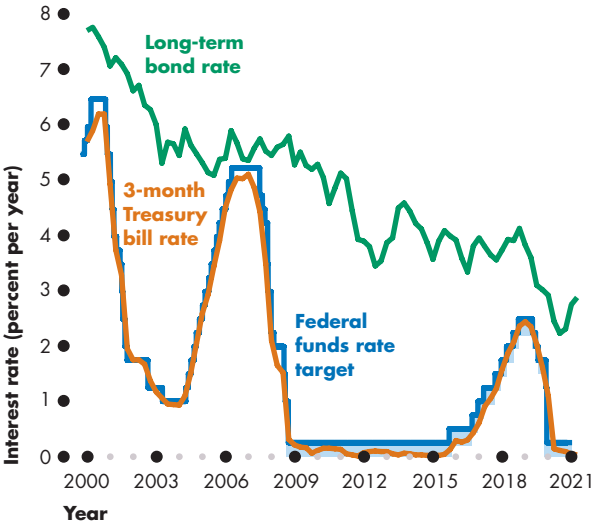
Short-Term Interest Rates A change in the federal funds rate brings an immediate change in the interest rate on U.S. government 3-month Treasury bills. A powerful substitution effect keeps these two rates close to each other. Banks have a choice about how to hold their short-term liquid assets and an overnight loan to another bank is a close substitute for holding Treasury bills.

If the interest rate on Treasury bills is higher than the federal funds rate, banks increase the quantity of Treasury bills they hold and decrease loans to other banks. The price of a Treasury bill rises and its interest rate falls.

Similarly, if the interest rate on Treasury bills is lower than the federal funds rate, banks decrease the quantity of Treasury bills they hold and increase loans to other banks. The price of a Treasury bill falls, and the interest rate on Treasury bills rises.

When the interest rate on Treasury bills is close to the federal funds rate, banks have no incentive to switch between making loans to other banks and holding Treasury bills. Both the Treasury bill market and the market for reserves are in equilibrium.

FIGURE 14.6 Three Interest Rates



The short-term interest rates—the federal funds rate and the 3-month Treasury bill rate—move closely together. The long-term bond rate is higher than the short-term rates, and its range of fluctuations is smaller than that of the short-term rates.

Source of data: Board of Governors of the Federal Reserve System.

The Long-Term Bond Rates A change in the federal funds rate and a QE or QT open market operation change long-term interest rates. The long-term corporate bond rate, the interest rate paid on bonds issued by large corporations, is the most significant interest rate to be influenced by monetary policy. This interest rate is the one that businesses pay on the loans that finance their purchases of new capital and that influences their investment decisions.

Long-term interest rates fluctuate less than short-term interest rates because long-term rates are influenced by expectations about future short-term interest rates as well as current short-term rates.

Changes in Money and Loans

The quantity of money and bank loans change when the Fed changes the federal funds rate or changes the quantity of reserves.

A rise in the federal funds rate or decrease in reserves decreases the quantity of money and bank loans; and

a fall in the federal funds rate or increase in reserves increases the quantity of money and bank loans. These changes occur for two reasons: The quantity of deposits and loans created by the banking system changes and the quantity of money demanded changes.

Banks respond to a rise in the federal funds rate by holding more safe short-term securities and decreasing the supply of loans, which decreases the quantity of bank deposits and money. And they respond to a fall in the federal funds rate by holding less safe short-term securities and increasing the supply of loans, which increases the quantity of bank deposits and money.

Households and businesses respond to a change in the interest rate by changing the quantity of money demanded. A rise in the interest rate decreases the quantity of money demanded, and a fall in the interest rate increases the quantity of money demanded.

Changes in Real GDP, Unemployment, and Inflation

The final ripple effects that follow a change in the federal funds rate or a QE or QT operation change real GDP, unemployment, and inflation. These effects begin with changes in the components of aggregate expenditure.

Expenditure Plans Two components of aggregate expenditure, household consumption expenditure and business investment, are influenced by interest rates, money, and loans. Two effects are at work: an opportunity-cost effect and a liquidity effect.

The real interest rate is the opportunity cost of using funds to buy consumer goods and capital equipment. Other things remaining the same, a fall in the interest rate lowers the opportunity cost of borrowing, which increases consumption expenditure and decreases saving.

Similarly, a fall in the interest rate lowers the cost of borrowing for firms, which increases investment.

The liquidity effect is the ease with which households and businesses can borrow. Other things remaining the same, a fall in the interest rate makes getting a loan easier, which increases consumption expenditure and decreases saving.

Similarly, a fall in the interest rate makes it easier for firms to borrow, which increases investment.

A cut in the federal funds rate or QE lowers the real interest rate, which lowers the opportunity cost of using funds and increases the ease of borrowing. The fall in interest rates stimulates aggregate expenditure.

Smilarly, a rise in the federal funds rate or quantitative tightening, QT, have the opposite effects, which decreases aggregate expenditure.

Real GDP and the Price Level A change in aggregate expenditure changes aggregate demand with a multiplier effect. A change in aggregate demand, with unchanged aggregate supply, changes real GDP and the price level. So, eventually, a cut in the federal funds rate or QE increases real GDP and raises the price level. And a rise in the federal funds rate or QT decreases real GDP and lowers the price level.

Unemployment When real GDP changes, the quantities of labor employed and unemployed change. You might recall Okun's law: for each percentage point that the unemployment rate is above (below) the natural unemployment rate, real GDP is 2 percent below (above) potential GDP. So, a cut in the federal funds rate or QE eventually lowers the unemployment rate. And a rise in the federal funds rate or quantitative tightening increases the unemployment rate.

Inflation When a change in aggregate demand changes the unemployment rate, it also changes the inflation rate. The short-run Phillips curve describes the linkage between unemployment and inflation. With a constant natural unemployment rate and expected inflation rate, a decrease in the unemployment rate brings a shortage of labor, which results in a rising real wage rate and higher inflation rate. And an increase in the unemployment rate brings a surplus of labor, which results in a falling real wage rate and lower inflation rate. So, a cut in the federal funds rate or QE eventually raises the inflation rate. And a rise in the federal funds rate or QT decreases the inflation rate.

The Change in Aggregate Demand, Real GDP, and the Price Level

The final link in the transmission chain is a change in aggregate demand and a resulting change in real GDP and the price level. By changing real GDP and the price level relative to what they would have been without a change in the federal funds rate, the Fed influences its ultimate goals: the inflation rate and employment.

The Fed Fights Recession

If inflation is low and real GDP is below potential GDP, the Fed takes actions that are designed to restore full employment. Figure 14.7 shows the effects of the Fed's actions, starting in the market for bank reserves and ending in the market for real GDP.

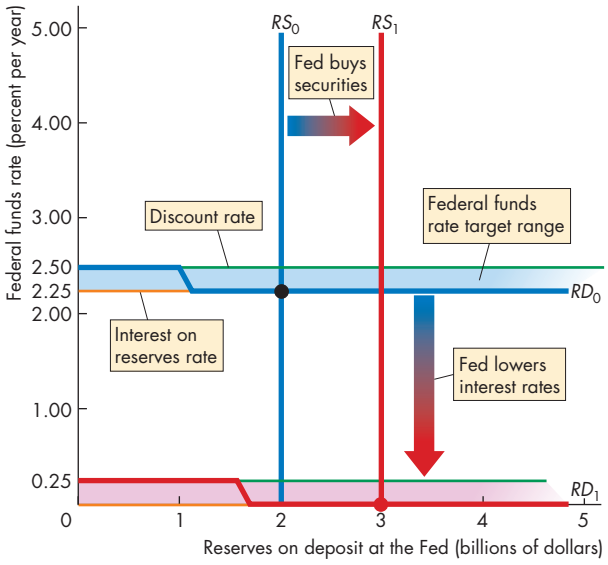
Market for Bank Reserves In Fig. 14.7(a), the market for bank reserves, the FOMC lowers the federal funds rate target range, which shifts the interest rate corridor downward. The demand for reserves curve shifts downward from RD_0 to RD_1. The New York Fed buys securities in a QE operation to increase the supply of reserves of the banking system, and the supply of reserves curve shifts from RS_0 to RS_1.

Money Market With increased reserves, the banks create deposits by making loans and the supply of money increases. The short-term interest rate falls and the quantity of money demanded increases. In Fig. 14.7(b), the supply of money increases from MS_0 to MS_1, the interest rate falls from 2.5 percent to 0.5 percent a year, and the quantity of money increases from $3 trillion to $4 trillion. The interest rate in the money market and the federal funds rate are kept close to each other by the powerful substitution effect described on p. 388.

Loanable Funds Market Banks create money by making loans. In the long run, an increase in the supply of bank loans is matched by a rise in the price level and the quantity of *real* loans is unchanged. But in the short run, with a sticky price level, an increase in the supply of bank loans increases the supply of (real) loanable funds.

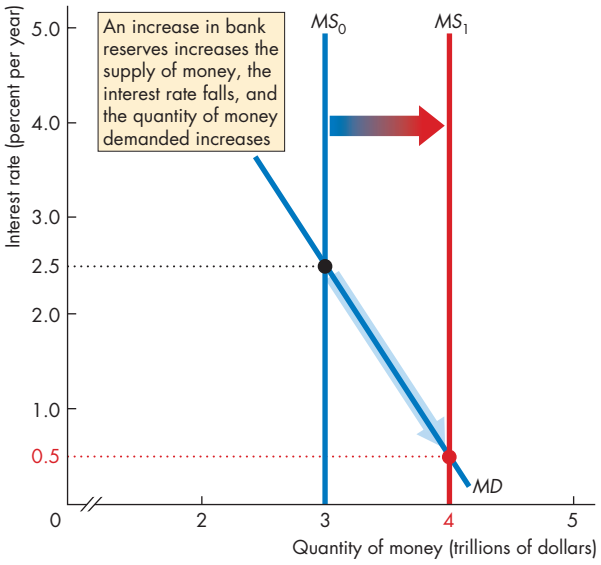
In Fig. 14.7(c), the supply of loanable funds curve shifts rightward from SLF_0 to SLF_1. With the demand for loanable funds at DLF, the long-term real interest rate falls from 4 percent to 3.5 percent

FIGURE 14.7 The Fed Fights Recession



(a) The market for bank reserves

In part (a), the FOMC lowers the federal funds rate target range, which shifts the interest rate corridor downward. The demand for reserves curve shifts from RD_0 to RD_1. The New York Fed buys securities in a QE open market operation to increase the supply of reserves from RS_0 to RS_1.



(b) Money market

In part (b), the supply of money increases from MS_0 to MS_1, the short-term interest rate falls, and the quantity of money demanded increases. The short-term interest rate and the federal funds rate change by similar amounts.

a year. (We're assuming a zero inflation rate, so the real interest rate equals the nominal interest rate.) The long-term interest rate in Fig. 14.7(c) changes by a smaller amount than the change in the short-term interest rate in Fig. 14.7(b) for the reason explained on p. 388.

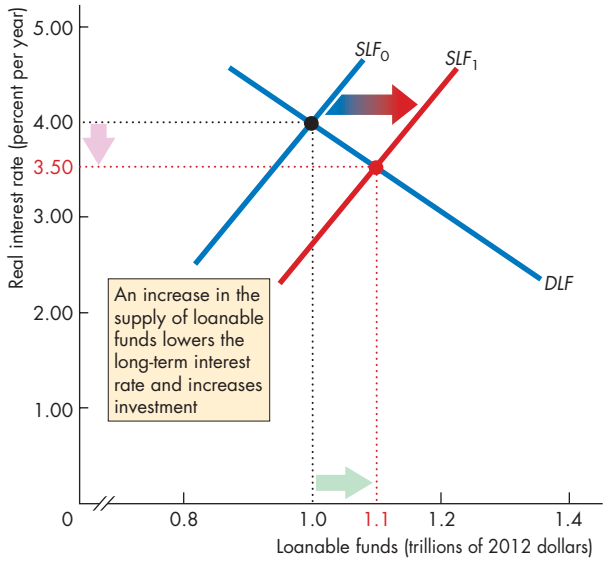
The Market for Real GDP Figure 14.7(d) shows aggregate demand and aggregate supply—the demand for and supply of real GDP. Potential GDP is $20 trillion, where *LAS* is located. The short-run aggregate supply curve is *SAS*, and initially, the aggregate demand curve is AD_0. Real GDP is $19.8 trillion, which is less than potential GDP. A recessionary gap exists, so the Fed's policy is in response to this recessionary gap.

The increase in the supply of loans and the decrease in the real interest rate increase aggregate planned expenditure—not shown in Fig. 14.7. The increase in aggregate expenditure, ΔE, increases aggregate demand and shifts the aggregate demand curve rightward to $AD_0 + \Delta E$.

A multiplier process begins. The increase in expenditure increases income, which induces an increase in consumption expenditure. Aggregate demand increases further, and the aggregate demand curve eventually shifts rightward to AD_1.

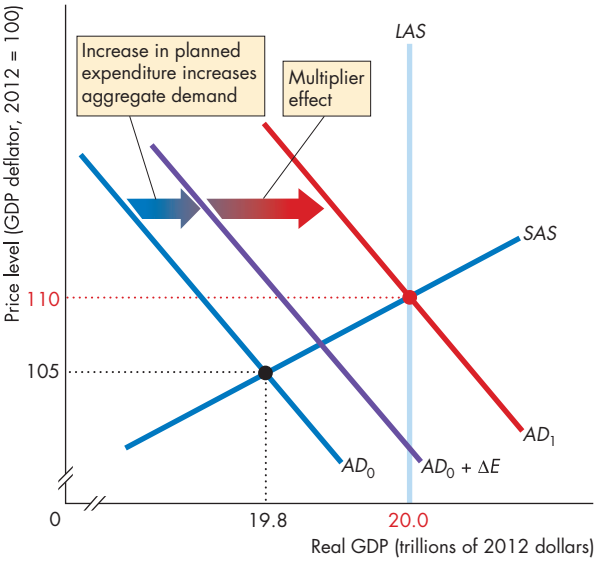
The new equilibrium is at full employment. Real GDP equals potential GDP, the price level rises to 110, and then becomes stable at that level. So after a one-time adjustment, there is price stability.

In this example, we have given the Fed a perfect hit at achieving full employment and keeping the price level stable. It is unlikely that the Fed would be able to achieve the precision of this example. If the Fed stimulated aggregate demand by too little and too late, the economy would experience a recession. If the Fed's action hit the gas pedal too hard, it would push the economy from recession to inflation.



(c) The market for loanable funds

In part (c), the increase in the quantity of money increases the supply of bank loans. The supply of loanable funds increases, which shifts the supply curve from SLF_0 to SLF_1. The real interest rate falls and investment increases.



(d) Real GDP and the price level

In part (d), the increase in investment increases aggregate planned expenditure. The aggregate demand curve shifts to $AD_0 + \Delta E$ eventually it shifts rightward to AD_1. Real GDP increases to potential GDP, and the price level rises.

The Fed Fights Inflation

If the inflation rate is too high and real GDP is above potential GDP, the Fed takes actions that are designed to lower the inflation rate and restore price stability. Figure 14.8 shows the effects of the Fed's actions starting in the market for reserves and ending in the market for real GDP.

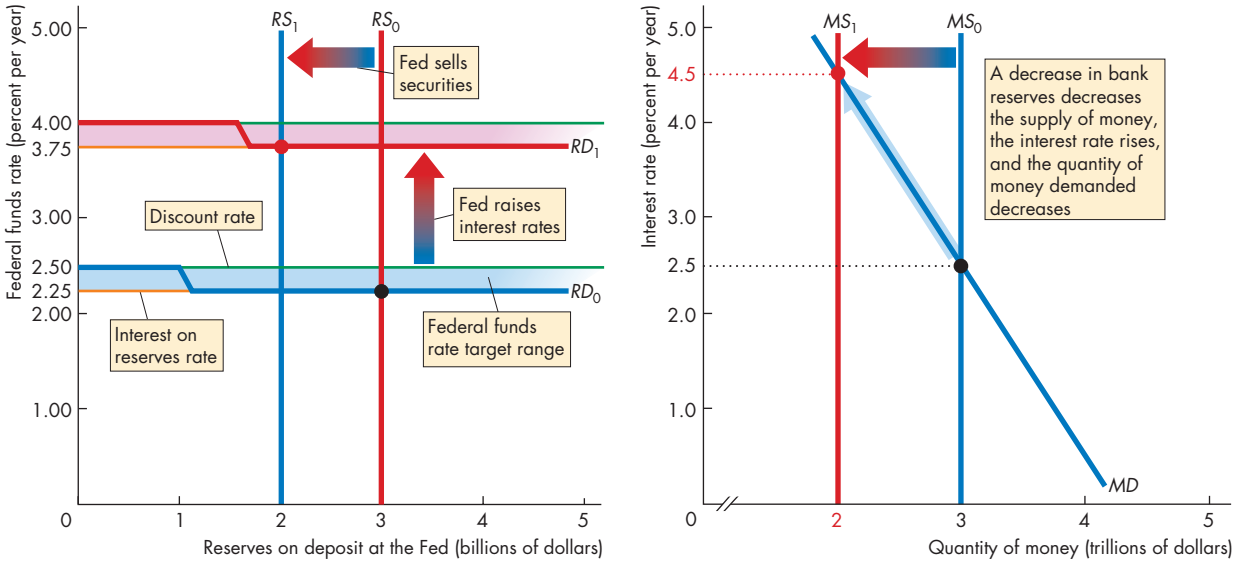
Market for Bank Reserves In Fig. 14.8(a), which shows the market for bank reserves, the FOMC raises the federal funds rate target, which shifts the interest rate corridor upward. The demand for reserves curve shifts from RD_0 to RD_1. The New York Fed sells securities in a QT operation and decreases the supply of reserves of the banking system from RS_0 to RS_1.

Money Market With decreased reserves, the banks shrink deposits by decreasing loans, which decreases the supply of money. The short-term interest rate rises and the quantity of money demanded decreases. In Fig. 14.8(b), the supply of money decreases from MS_0 to MS_1, the interest rate rises from 2.5 percent to 4.5 percent a year, and the quantity of money demanded decreases from $3 trillion to $2 trillion. The interest rate in the money market and the federal funds rate are kept close to each other by the powerful substitution effect described on p. 388.

Loanable Funds Market With a decrease in reserves, banks must decrease the supply of loans. The supply of (real) loanable funds decreases, and the supply of loanable funds curve shifts leftward in Fig. 14.8(c) from SLF_0 to SLF_1. With the demand for loanable funds at DLF, the real interest rate rises from 4 percent to 4.5 percent a year. (Again, we're assuming a zero inflation rate so that the real interest rate equals the nominal interest rate.)

The Market for Real GDP Figure 14.8(d) shows aggregate demand and aggregate supply in the market for real GDP. Potential GDP is $20 trillion where LAS is located. The short-run aggregate supply curve is SAS and initially the aggregate demand curve is AD_0. Now, real GDP is $20.2 trillion, which is greater

FIGURE 14.8 The Fed Fights Inflation



(a) The market for bank reserves

In part (a), the FOMC raises the federal funds rate target range, which shifts the interest rate corridor upward. The demand for reserves shifts upward from RD_0 to RD_1. The New York Fed sells securities in a QT open market operation, which decreases the supply of reserves from RS_0 to RS_1.

(b) Money market

In part (b), the supply of money decreases from MS_0 to MS_1, the short-term interest rate rises, and the quantity of money demanded decreases. The short-term interest rate and the federal funds rate change by similar amounts.

than potential GDP, so there is an inflationary gap. The Fed is reacting to this inflationary gap.

The increase in the short-term interest rate, the decrease in the supply of bank loans, and the increase in the real interest rate decrease aggregate planned expenditure. (Not shown in the figures, a rise in the interest rate decreases aggregate planned expenditure.)

The decrease in aggregate expenditure, ΔE, decreases aggregate demand and shifts the aggregate demand curve to $AD_0 - \Delta E$.

A multiplier process begins. The decrease in expenditure decreases income, which induces a decrease in consumption expenditure. Aggregate demand decreases further, and the aggregate demand curve eventually shifts leftward to AD_1.

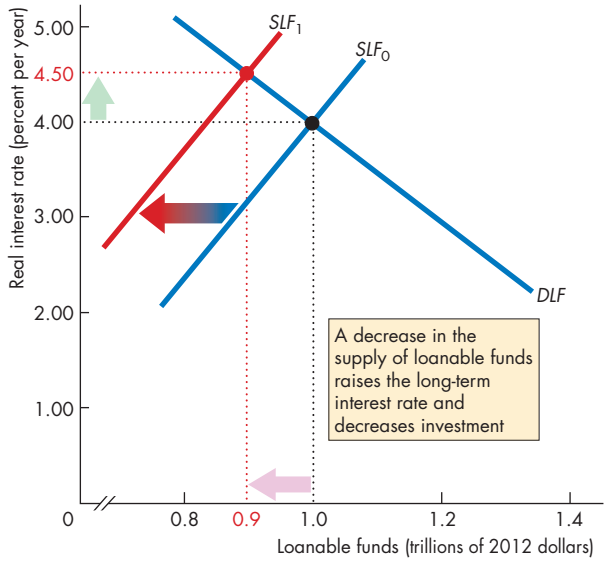
The economy returns to full employment. Real GDP is equal to potential GDP. The price level falls to 110 and then becomes stable at that level. So after a one-time adjustment, there is price stability.

Again, in this example, we have given the Fed's action a perfect hit at achieving full employment and keeping the price level stable. If the Fed's action decreased aggregate demand by too little and too late, the economy would have remained with an inflationary gap and the inflation rate would have moved above the rate that is consistent with price stability. And if the Fed hit the brakes too hard, it would push the economy from inflation to recession.

Loose Links and Long and Variable Lags

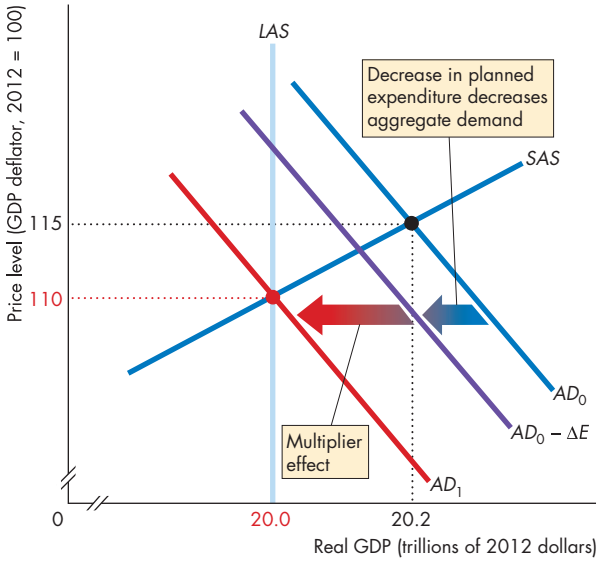
The ripple effects of monetary policy that we've just analyzed with the precision of an economic model are, in reality, very hard to predict and anticipate.

To achieve price stability and full employment, the Fed needs a combination of good judgment and good luck. Too large an interest rate cut in an underemployed economy can bring inflation, as it did during the 1970s. And too large an interest rate rise in an inflationary economy can create unemployment, as it did in 1981 and 1991. Loose links between the federal funds rate and the ultimate policy goals make unwanted outcomes inevitable and long and variable time lags add to the Fed's challenges.



(c) The market for loanable funds

In part (c), the decrease in the quantity of money decreases the supply of bank loans. The supply of loanable funds decreases, which shifts the supply curve from SLF_0 to SLF_1. The real interest rate rises and investment decreases.



(d) Real GDP and the price level

In part (d), the decrease in investment decreases aggregate planned expenditure. Aggregate demand decreases to $AD_0 - \Delta E$ and the *AD* curve shifts leftward to AD_1. Real GDP decreases to potential GDP, and the price level falls.

ECONOMICS IN ACTION

A View of the Long and Variable Lag

You've studied the theory of monetary policy. Does it really work in the way we've described? It does, and the figure opposite provides some evidence to support this claim.

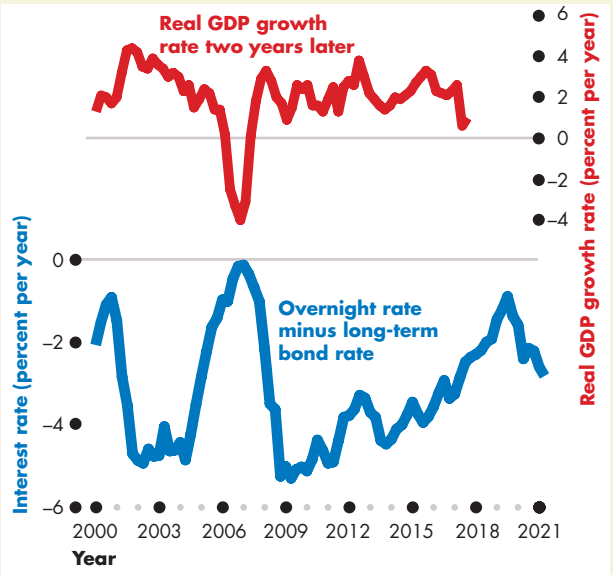
The blue line in the figure is the federal funds rate that the Fed targets *minus* the long-term bond rate. (When the long-term bond rate exceeds the federal funds rate, this gap is negative.)

We can view the gap between the federal funds rate and the long-term bond rate as a measure of how hard the Fed is trying to steer a change in the economy's course.

When the Fed is more concerned about recession than inflation and is trying to stimulate real GDP growth, it cuts the federal funds rate target and the gap between the long-term bond rate and the federal funds rate widens.

When the Fed is more concerned about inflation than recession and is trying to restrain real GDP growth, it raises the federal funds rate target and the gap between the long-term bond rate and the federal funds rate narrows.

The red line in the figure is the real GDP growth rate *two years later*. You can see that when the FOMC raises the federal funds rate, the real GDP growth rate slows two years later. And when the Fed lowers the federal funds rate, the real GDP growth rate speeds up two years later.



Interest Rates and Real GDP Growth

Sources of data: Interest rates, see Fig. 14.6; real GDP growth rate, Bureau of Economic Analysis.

Not shown in the figure, the inflation rate increases and decreases corresponding to the fluctuations in the real GDP growth rate. But the effects on the inflation rate take even longer and are not as strong as the effects on the real GDP growth rate.

Loose Link from Federal Funds Rate to Spending

The real long-term interest rate that influences spending plans is linked only loosely to the federal funds rate. Also, the response of the *real* long-term interest rate to a change in the nominal interest rate depends on how inflation expectations change. And the response of expenditure plans to changes in the real interest rate depend on many factors that make the response hard to predict.

Time Lags in the Adjustment Process The Fed is especially handicapped by the fact that the monetary policy transmission process is long and drawn out. Also, the economy does not always respond in exactly the same way to a policy change. Further, many factors other than policy are constantly changing and bringing new situations to which policy must respond.

Policy Strategies and Clarity

The Fed's monetary policy strategy is just one of several it could have chosen. Here, we look at two alternative approaches that have been suggested, one of which has been used in other countries. They are

- Inflation rate targeting
- Taylor rule

Inflation Rate Targeting A monetary policy strategy in which the central bank makes a public commitment to achieve an explicit inflation target and explains how its policy actions will achieve it is called **inflation rate targeting**. Australia, Canada, Sweden, New Zealand, the United Kingdom, and the European Union have targeted inflation since the 1990s.

Inflation targeting focuses monetary policy on what will best contribute to attaining full employment and sustained growth, and that is managing inflation expectations. An explicit inflation target toward which monetary policy actions are aimed and explained is the best way to manage those expectations.

It is when the going gets tough that inflation targeting has the greatest benefit. It anchors inflation expectations. A serious inflation-targeting central bank would not permit inflation to take off in the way that it did during the 1970s. Nor would it permit deflation and ongoing recession such as Japan has endured for the past 10 years.

Taylor Rule One way to pursue an inflation target is to set the policy interest rate (for the Fed, the federal funds rate) by using a rule proposed by Stanford University economist John B. Taylor.

The *Taylor rule* is a formula for setting the federal funds rate. Calling the federal funds rate *FFR*, the inflation rate *INF*, and the output gap *GAP* (all percentages), the Taylor rule formula is

$$FFR = 2 + INF + 0.5(INF - 2) + 0.5GAP.$$

In words, the rule says set the federal funds rate at 2 percent a year plus the inflation rate plus one half of the deviation of inflation from 2 percent a year, plus one half of the output gap.

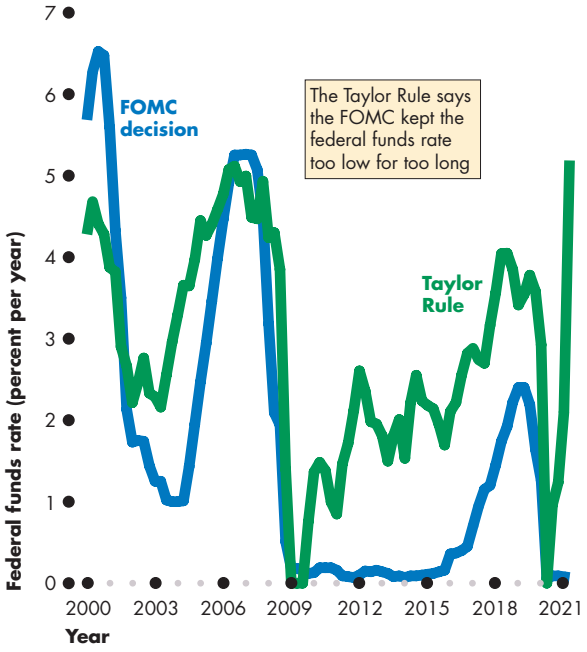
The Taylor rule, shown in Fig. 14.9, implies that the Fed caused the boom and bust of the past decade. The federal funds rate was 1 percentage point (on average) too low from 2001 through 2005, which fuelled the boom; and the rate was too high in 2006 and 2007, which triggered the bust.

In the conditions of 2009, the Taylor rule formula delivers a negative interest rate, which is graphed as zero in Fig. 14.9.

Supporters of the Taylor rule argue that in computer simulations, the rule works well and limits fluctuations in inflation and output. By using such a rule, monetary policy contributes toward lessening uncertainty—the opposite of current monetary policy. In financial markets, labor markets, and markets for goods and services, people make long-term commitments, so markets work best when plans are based on correctly anticipated inflation. A well-understood monetary policy helps to create an environment in which inflation is easier to forecast and manage.

The debates on inflation targeting and the Taylor rule will continue!

FIGURE 14.9 The Federal Funds Rate and the Taylor Rule



The Taylor Rule sets interest rates higher than the Fed between 2001 and 2005, which might have avoided the 2007–2008 financial crisis. From 2010 to 2015 and in 2021, the Taylor Rule raises interest rates when the Fed held them close to zero.

Sources of data: Federal Reserve, Bureau of Economic Analysis; Congressional Budget Office; John Taylor's formula; and author's calculation.

REVIEW QUIZ

1. Describe the channels by which monetary policy ripples through the economy and explain how each channel operates.
2. How do the Fed's actions influence real GDP and the inflation rate and how long does it take for these targets to respond to the Fed's actions?
3. How does inflation targeting work?
4. How would using the Taylor rule have changed the Fed's interest rate setting?

You've seen how the 2007–2008 financial crisis changed the way the Fed conducts its monetary policy. The financial crisis brought other changes too, that are described in the final section of this chapter.

Financial Crisis: Cure and Prevention

During the financial crisis of 2007–2008 and the recession that followed, the Fed took extraordinary actions to limit the damage and restore stability while Congress took actions aimed at making the financial system more robust and better able to absorb and withstand shocks. To understand these actions, we first need to describe the anatomy of the crisis.

The Anatomy of the Financial Crisis

A financial crisis is a situation in which a bank or other financial firm is unable to make payments that it has contracted to make. If one financial firm fails to pay its debts, other firms receive less than they need to pay theirs. A financial crisis arises when many financial firms fail to pay their debts.

We can describe the anatomy of a financial crisis by identifying the events that threaten the solvency and liquidity of banks and other financial institutions. Three main events can put a bank under stress:

- Widespread fall in asset prices
- Large currency drain
- Run on the bank

Widespread Fall in Asset Prices A widespread fall in asset prices means that the bank suffers a capital loss. It must write down the value of its assets (its loans and securities). The value of its own capital (its equity) decreases by the same amount as the fall in the value of its securities. If the fall in asset prices is large, the bank's equity might fall to zero, in which case the bank is insolvent. It fails.

Large Currency Drain A large currency drain means that depositors withdraw funds and the bank loses reserves. This event puts the bank in a liquidity crisis. It is short of cash reserves.

Run on a Bank A run on a bank occurs when depositors lose confidence in the bank and massive withdrawals of deposits occur. The bank loses reserves and must call in loans and sell off securities at unfavorable prices. Its equity shrinks.

All these events and problems were present in the 2007–2008 financial crisis. The bursting of a house-price bubble triggered a widespread fall in the prices of mortgage-backed securities and derivatives whose values are based on these securities. People with money market mutual fund deposits withdrew them, which created a fear of a large withdrawal of these funds. With low reserves and even lower equity, banks turned their attention to securing their balance sheets and called in loans.

The Fed's Policy Actions in Crisis

The Fed's policy actions in response to the financial crisis dribbled out over a period of more than a year. With substantial interest rate cuts, open market operations were used on a massive scale to keep the banks well supplied with reserves. This action lowered bank holdings of securities and swelled their reserves.

The Fed even purchased mortgage-backed securities from the banks and provided interest-earning reserves in exchange.

Congress also acted to contain the crisis.

Congress's Policy Actions in Crisis

Congress took two main actions to help limit the scope of the financial crisis:

- Extended deposit insurance
- Authorized the Treasury to buy "troubled" assets

Extended Deposit Insurance By extending the scope of deposit insurance (see Chapter 8, p. 218), the Federal Deposit Insurance Corporation (FDIC) was able to cover a wider range of institutions, which gave depositors greater security and less incentive to withdraw their bank deposits.

Authorized the Treasury to Buy "Troubled" Assets A "troubled" asset is a security that has crashed in value and that no one wants to own. The *Troubled Asset Relief Program* (TARP) enabled the U.S. Treasury to use $700 billion of national debt. The original intent was to swap troubled assets held by banks and others for U.S. government securities. But instead of buying troubled assets, the Treasury decided to buy equity stakes in troubled institutions. This action directly increased the institutions' reserves and equity.

Taken as a whole, a huge amount of relief was thrown at the financial crisis, but the economy continued to perform poorly and didn't return to full employment until 2017.

Low interest rates, a massive injection of reserves, and a government stake in troubled institutions are

aimed at coping with and hopefully curing a current crisis, but they don't lower the risk of the next crisis. That is a task for regulation.

Macroprudential Regulation

Macroprudential regulation is financial regulation to lower the risk that the financial system will crash. The global financial crisis of 2007–2008 brought this type of regulation to center stage.

Macro Versus Micro Traditional financial regulation is microprudential: It seeks to lower the risk of failure of individual financial institutions. Macroprudential regulation focuses on the interconnections among individual financial institutions and markets and their shared exposure to common shocks.

The Tools The main macroprudential regulation tools are rules about the balance sheets of banks and other financial institutions. They are microprudential tools, with a macro twist. They are rules about ratios of loans to net worth or loans to cash and other liquid asset reserves that vary with respect to the macroeconomic environment. For example, a microprudential regulation requires banks to increase their minimum ratio of net worth to loans, while a macroprudential regulation might make that minimum ratio increase during a recession and decrease in an expansion.

Glass-Steagall The U.S. Banking Act, 1933—the Glass–Steagall Act—was an early example of macroprudential regulation. To lower the risk of bank failure, the Act required the separation of commercial banking and investment banking. This Act was repealed in 1999 and mega-banks that did not separate commercial and investment activities emerged. It was the 2008 failure of one of these banks, Lehman Brothers, that put macroprudential regulation back on the agenda.

Macroprudential Regulation Today Today, in the United States, prudential regulation is centralized in the Financial Stability Oversight Council (FSOC), established in 2010 to evaluate systemic risk. This council is chaired by the U.S. Secretary of the Treasury and its members include the chair of the Fed and all the principal U.S. regulatory bodies. The FSOC is tasked with identifying threats to the financial stability of the United States, promoting market discipline, and responding to emerging risks to the stability of the United States financial system.

Dodd-Frank The Dodd-Frank Wall Street Reform and Consumer Protection Act, 2010, also known as the Financial Stability Act of 2010, or as Dodd-Frank, created the FSOC and made wide-ranging changes in financial regulation. Its two highlights are

- The Volcker Rule
- Orderly Liquidation Authority

The Volcker Rule The Volcker Rule (proposed by Paul Volcker, a former Fed chair) is a restriction like the prohibition of combined investment and commercial banking in the Glass–Steagall Act. The rule restricts the amount that banks may invest in hedge funds and private equity funds to a maximum of 3 percent of their capital.

Orderly Liquidation Authority Dodd-Frank established the Orderly Liquidation Authority, which empowers the FSOC to determine that the liquidation of a financial institution is necessary for the stability of the financial system. If a forced liquidation occurs, the FDIC can use an Orderly Liquidation Fund to manage it.

In 2018, Congress rolled back the strict oversight and rules of Dodd-Frank as they applied to thousands of smaller banks but left the rules in place for the ten largest banks.

REVIEW QUIZ

1. What are the three ingredients of a financial and banking crisis?
2. What are the policy actions taken by the Fed and the U.S. Treasury in response to the financial crisis of 2007–2008?
3. Why was the recovery from the 2008–2009 recession so slow?
4. What is macroprudential regulation and how does it contrast with microprudential regulation?
5. What are the main provisions of Dodd-Frank?

To complete your study of monetary policy, take a look at *Economics in the News* on pp. 398–399, which examines the Fed's monetary policy in 2021 and its expected effects.

The Fed Retains Stimulus

The Fed Moves Closer to Decision on 'Tapering' Massive Stimulus

Financial Times
July 29, 2021

The Federal Reserve moved one step closer to the day when it will start slowing its massive monetary support for the U.S. economy, following a meeting of policymakers that highlighted both the promise and the perils of the American recovery.

At the end of a two-day meeting on Wednesday, the Federal Open Market Committee declared that it had made "progress" toward its goals of full employment and 2 percent average inflation, even though it was not yet sufficient to merit any policy action right now.

The statement marked the first milestone in the U.S. central bank's steady drive toward a decision on reducing its $120bn in monthly debt purchases at future meetings, a move that could come later this year or early next year.

However, the central bank has said any such "tapering" would require additional improvements in the economy and Jay Powell, Fed chair, said there was more "ground to cover" before it acts.

"We expect further progress, and we expect that if things go well then we will reach that goal," Powell said. "And when we reach it, and the committee is comfortable that we have reached it, then we'll taper at that point."

The FOMC meeting comes at a time of conflicting economic signals. Inflation has been much higher than expected since U.S. central bank officials last met in June, while the spread of the Delta virus variant across the United States has renewed concerns about the labor market and growth.

Powell acknowledged that there was more "upside risk" to the inflation outlook, but stuck to the Fed's view that price pressures would eventually ease.

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ESSENCE OF THE STORY

- At its July 2021 meeting, the FOMC made no policy change.
- The committee said the economy was moving toward the goals of full employment and 2 percent average inflation.
- The Fed was getting closer to a future decision to decrease its $120 billion monthly bond purchases.
- Bond purchase "tapering" would require additional improvements in the economy.
- There was more "upside risk" to the inflation outlook but the pressures would eventually ease.

ECONOMIC ANALYSIS

- In mid-2021, the recovery from the Covid recession was still incomplete and the level of employment was below the Fed's mandated maximum employment level.
- The median estimate of the FOMC members is that maximum employment is attained when the unemployment rate has fallen to 4.4 percent.
- Figure 1 shows the course of the employment gap—the shortfall of employment from maximum employment.
- You can see that in June 2021 the employment gap was 1 percent.
- Everyone agreed that in 2021, the economy had not returned to full employment. But there were signs that inflation was pushing above 2 percent.
- At its June and July 2021 meetings, the FOMC members were unanimous in their decision to hold the federal funds rate target at zero to 0.25 percent.
- But there was (as there always is) uncertainty about future inflation and a range of views about the likely future path of the federal funds rate.
- Figure 2 shows what is known as the dot plot: the forecasts of FOMC members and other Fed board members and regional Fed presidents in the summer of 2021.
- Whether the Fed will return the economy to full employment without triggering a new outburst of inflation depends on the true size of the output gap and the speed with which a future rise in interest rates keeps aggregate demand at a non-inflationary level.
- Figure 3 illustrates the Fed's goal. In mid-2021, real GDP was $19.4 trillion and the price level was 117 at the intersection of AD_0 and SAS_0.
- The CBO said potential GDP was $19.7 trillion, so long-run aggregate supply was LAS_{21}. The economy was below full employment.
- For 2023, the CBO was projecting potential GDP at $20.5 trillion, so long-run aggregate supply was expected to be LAS_{23}.
- The Fed's goal, in mid-2021, was to set the federal funds rate and asset purchases to shift the aggregate demand curve to AD_1. With the short-run aggregate supply curve SAS_1, real GDP increases to $20.5 trillion and the price level rises by somewhat more than 2 percent a year.

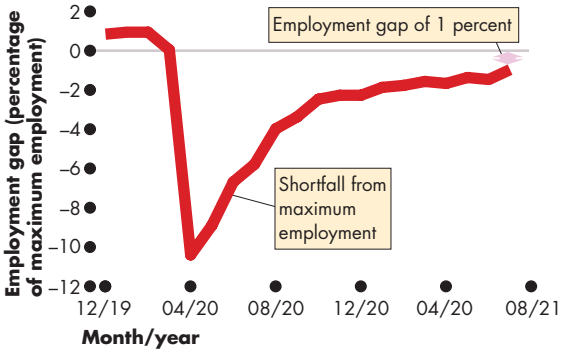


Figure 1 The Maximum-Employment Shortfall

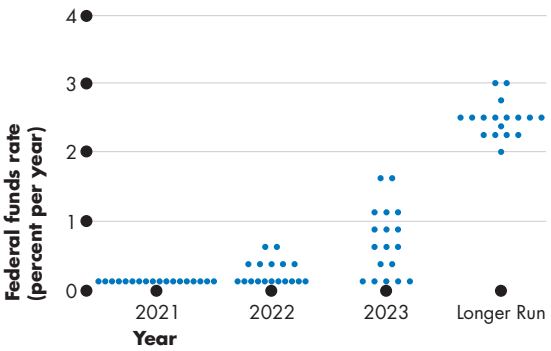


Figure 2 FOMC Views on Appropriate Interest Rate

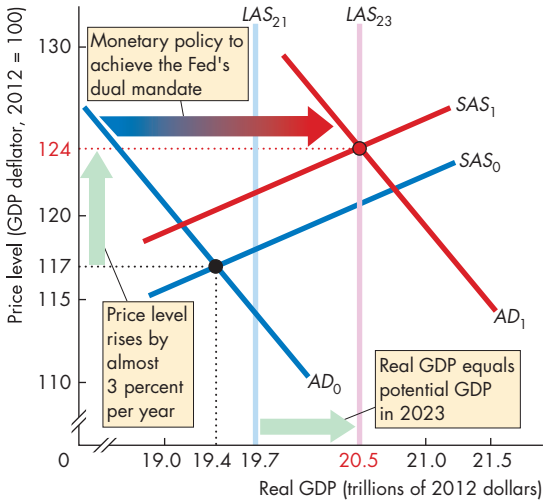


Figure 3 Monetary Policy Hits Its Targets

WORKED PROBLEM

Suppose that the U.S. economy is at full employment, the inflation rate is 2 percent a year, and the federal funds rate is at 4 percent a year. But real GDP and employment are starting to fall, so the Fed decides to act.

Questions

1. Which macroeconomic variables change immediately and in which direction?
2. Which macroeconomic variables change over the next few weeks or months and in which direction?
3. Which macroeconomic variables change over the next year or two and in which direction?
4. Which macroeconomic variables don't change in the long run?

Solutions

1. The Fed lowers the federal funds rate corridor and buys securities in a QE open market operation. The federal funds rate falls and bank reserves increase.

   The banks buy short-term bills, which raises the price and lowers the interest rate on those bills.

Key Point: A change in the federal funds rate flows immediately into the inter-bank loans market and the short-term securities market. The short-term interest rate changes and QE increases bank reserves.

2. Over the next weeks and months, the banks increase loans. The quantity of money increases and the supply of loans increases. In the loanable funds market, an increase in supply lowers the real interest rate, and saving starts to decrease and investment starts to increase.

Key Point: A few weeks and months after the Fed changes the interest rate, ripples reach the loanable funds market and a change in the real interest rate is an incentive for saving and investment to change.

3. Over the next year, the lower real interest rate continues to decrease saving and increase consumption expenditure and business investment. With all the components of aggregate expenditure rising, U.S. aggregate demand increases and real GDP increases.

   The increase in real GDP is also an increase in income, which induces a further increase in consumption expenditure—an expenditure multiplier process.

   Initially, the economy is at full employment. If aggregate demand increases before investment in new capital and new technology changes aggregate supply, the economy moves above full employment and an inflationary gap appears. Businesses face a shortage of labor. As time goes on, wage rates and prices start to rise and after about two years the inflation rate rises.

Key Point: A change in the real interest rate influences the goods market. Aggregate demand changes and, with no change in aggregate supply, real GDP increases. If real GDP exceeds potential GDP, an inflationary gap appears and the inflation rate changes about two years after the Fed lowers the interest rate target.

4. The increase in aggregate demand increases real GDP and employment. But will the economic growth rate be higher, and will employment be permanently higher than its initial full employment level?

   With no change in aggregate supply, real GDP will eventually return to its initial level and a short burst of growth will have occurred. But in the long run, the U.S. economy will be back to its initial full-employment situation with no faster growth rate and a higher inflation rate.

   For the growth rate to increase, investment in new capital and new technologies must increase the productivity growth rate to increase aggregate supply. Changing the interest rate will increase real GDP and employment in the short term but not create economic growth and permanently higher employment.

Key Point: When the Fed changes the interest rate, changes ripple through all markets: The money market, the loanable funds market, the labor market, and the goods market all respond to the interest rate change one after the other, but unless the pace of productivity growth increases, the economic growth rate will not increase. Monetary policy cannot be used to increase the economic growth rate in the long run.

SUMMARY

Key Points

Monetary Policy Objectives and Framework

(pp. 380–382)

- The Federal Reserve Act requires the Fed to use monetary policy to achieve maximum employment, stable prices, and moderate long-term interest rates.
- The goal of stable prices delivers maximum employment and low interest rates in the long run but can conflict with these goals in the short run.
- The Fed's stable-prices goal is an average inflation rate of 2 percent, as measured by the annual change in the PCEPI.
- The Fed's maximum-employment goal is not a fixed numerical target.
- The FOMC has the responsibility for the conduct of monetary policy, but the Fed reports to the public and to Congress.

The Conduct of Monetary Policy (pp. 382–386)

- The Fed's monetary policy instruments are the quantity of bank reserves and three interest rates: the federal funds rate, the discount rate, and the interest on reserves rate.
- The discount rate and the interest on reserves rate create a corridor that limits movements of the federal funds rate.
- To decide on the appropriate level of the federal funds rate target, the Fed monitors the inflation rate, the unemployment rate, and real GDP.
- A rise in the interest rate is indicated when inflation is above the 2 percent average target, unemployment is below the natural unemployment rate, and real GDP exceeds potential GDP.
- A fall in the interest rate is indicated when inflation is below the 2 percent average target, unemployment is above the natural unemployment rate, and real GDP is less than potential GDP.
- The Fed changes its federal funds rate target by changing the interest rate corridor.
- The Fed changes bank reserves by buying or selling U.S. treasury and other securities in QE and QT open market operations.

Monetary Policy Transmission (pp. 387–395)

- A change in the federal funds rate changes other interest rates, the quantity of money and loans, aggregate demand, and eventually real GDP and the price level.
- Changes in the federal funds rate change real GDP about one year later and change the inflation rate with an even longer time lag.
- Inflation targeting and the Taylor rule are monetary policy strategies designed to enable the central bank to manage inflation expectations and reduce uncertainty.

Financial Crisis: Cure and Prevention (pp. 396–397)

- A financial crisis has three ingredients: a widespread fall in asset prices, a currency drain, and a run on banks.
- The Fed and the U.S. Treasury responded to the financial crisis with classic open market operations on a massive scale and by several other unconventional measures.
- Congress authorized the use of government funds to buy "troubled" assets.
- Congress passed the Dodd-Frank Act of 2010, which included the Volcker Rule and established the Financial Stability Oversight Council (FSOC).

Key Terms

Ample reserves, 384
Discount rate, 382
Federal funds rate, 382
Fed's dual mandate, 380
Inflation rate targeting, 394
Interest on reserves rate, 382
Limited reserves, 384
Macroprudential regulation, 397
Monetary policy instrument, 382
Quantitative easing, 384
Quantitative tightening, 384
Reserves, 382

PROBLEMS AND APPLICATIONS

Monetary Policy Objectives and Framework

1. "Unemployment is a more serious economic problem than inflation and it should be the focus of the Fed's monetary policy." Evaluate this statement and explain why the Fed's primary policy goal is price stability.
2. "Monetary policy is too important to be left to the Fed. The President should be responsible for it." How is responsibility for monetary policy allocated among the Fed, the Congress, and the President?
3. **Fed to Announce QE Taper in Aug or Sept on Rising Inflation Concerns**

   The Fed is making monthly purchases of $80 billion in Treasuries and $40 billion in mortgage-backed securities. With rising consumer prices and the unemployment rate forecast to fall, the Fed is expected to announce a strategy for reducing its bond-buying program.

   Source: reuters.com, June 10, 2021

   a. What does the Federal Reserve Act of 2000 say about the Fed's control of the quantity of money?

   b. How can changes in the Fed's bond-buying program be reconciled with the Federal Reserve Act of 2000?

The Conduct of Monetary Policy

4. Describe each of the Fed's monetary policy instruments.
5. How does the interest rate corridor limit the movement of the federal funds rate?
6. Explain how the FOMC determines whether to raise or lower its federal funds rate target. Why doesn't the FOMC respond symmetrically to inflation and unemployment risks?

Use the following news clip to work Problems 7 and 8.

Risks Rise to Both the Fed's Inflation and Employment Goals

The Fed's mandate is in trouble. Unemployment remains close to 6% and inflation is at its highest level in 29 years. Inflation is expected to stay above 3 percent through the remainder of the year.

Source: wsj.com, June 15, 2021

7. Explain why the Fed's mandate is in trouble.
8. Why might the Fed (a) lower and (b) raise the federal funds rate in 2022?

Monetary Policy Transmission

Use the following data to work Problems 9 to 11.

To combat high and rising inflation, the Bank of England signaled that the interest rate would be raised in May 2018. The cost of borrowing is currently 0.5 percent.

9. Explain the effects of the Bank of England's signal to raise interest rates on business investment and use a graph to illustrate your explanation.
10. Explain the effects of business investment on aggregate demand. Would you expect it to have a multiplier effect? Why or why not?
11. Would business investment be encouraged or discouraged between the time of the announcement and the actual increase in the interest rate? Why or why not?

Use the following news clip to work Problems 12 to 14.

IMF to Keep 2021 Global Growth Forecast at 6%

The IMF projected a global growth rate of 6% in 2021, the highest rate since the 1970s, as vaccine availability increased and economies reopened with intense stimulus, especially in the United States.

Source: reuters.com, July 21, 2021

12. If the IMF forecast turns out to be correct, what would most likely happen to the output gap and unemployment in 2021?
13. a. What actions taken by the Fed in 2020 would you expect to have influenced real GDP growth in 2021? Explain how those policy actions would transmit to real GDP.

    b. Draw a graph of aggregate demand and aggregate supply to illustrate your answer to part (a).
14. What further actions might the Fed take in 2021 to influence the real GDP growth in 2022?

Financial Crisis: Cure and Prevention

15. **Federal Banking Agencies Ease Volcker Rule Restrictions**

    Looser restrictions on the Volcker Rule will free up billions of dollars that banks can now use. Sen. Jeff Merkley, D-Oregon says "Re-opening the Wall Street casino is the wrong path forward, one that puts all Americans' financial stability at risk."

    Source: apnews.com, June 25, 2020

    What is the Volcker Rule? Why is it considered to be part of macroprudential regulation? Why does Senator Jeff Merkley oppose easing it?

ADDITIONAL PROBLEMS AND APPLICATIONS

Monetary Policy Objectives and Framework

Use the following information to work Problems 16 to 18.

The Bank of Korea's monetary policy is to reduce the vulnerability of South Korean won and achieve price stabilization through increasing money supply and lowering interest rates.

16. How does the Bank of Korea attempt to minimize the output gap through money supply and interest rates?
17. How does the policy affect the price level in the short run and the long run?
18. Can the Bank of Korea achieve price stability and economic growth simultaneously?
19. How successful has the Fed been with its operational price stability goal since 2000?
20. Suppose Congress decided to strip the Fed of its monetary policy independence and legislate interest rate changes. How would you expect the policy choices to change? Which arrangement would most likely provide price stability?

Use the following news clip to work Problems 21 to 23.

Hong Kong Overflowing in Cash

In 2017, Hong Kong's government debt was 43.9 percent of its nominal GDP. In the same year, it witnessed a budget surplus of HK$138 billion. In March 2018, Paul Chan, Hong Kong's financial secretary, promised to return 40 percent of the surplus to the community but stressed the importance of saving for the future.

Source: Bloomberg and ceicdata.com, March 2018

21. How does Hong Kong have a high debt percentage while also enjoying a large surplus? How does debt financing affect monetary policy?
22. How would the budget surplus be affected if Hong Kong's central bank decreased interest rates?
23. a. How would Hong Kong's budget surplus change in 2019 if its central bank moved interest rates up?
    b. How would Hong Kong's budget deficit change in the long run if its central bank's monetary policy led to a rapid appreciation of the Hong Kong dollar?
24. The Federal Reserve Act of 2000 instructs the Fed to pursue its goals by "maintain[ing] long-run growth of the monetary and credit aggregates commensurate with the economy's long-run potential to increase production."
    a. Has the Fed followed this instruction?
    b. Why might the Fed increase money by more than the potential to increase production?

The Conduct of Monetary Policy

25. Looking at the federal funds rate since 2000, identify periods during which, with the benefit of hindsight, the rate might have been kept too low. Identify periods during which it might have been too high.
26. Now that the Fed has created $4 trillion of bank reserves, how would you expect a further open market purchase of securities to influence the federal funds rate? Why? Illustrate your answer with an appropriate graph.
27. The federal funds rate target range is 2.25 to 2.50 percent a year, when the United States suddenly enters a recession. The Fed decides to lower the federal funds rate target range to 0.50 to 0.75 percent a year. What actions does the Fed take?

To work Problems 28 to 30, use the information that Venezuela's economy is expected to witness a staggering inflation of 13,000 percent by the end of 2018 and faces an estimated unemployment rate of 7.3 percent in 2017.

Source: bloomberg.com, January 25, 2018, and statista.com

28. Explain the challenge that high unemployment and high inflation poses for Venezuela's monetary authorities.
29. Why might Venezuela's monetary authorities decide to cut interest rates in this situation?
30. Should the Venezuelan monetary authorities raise or cut the interest rate? Explain your answer.

Monetary Policy Transmission

Use the following information to work Problems 31 to 33.

From 2009 through 2017, the long-term *real* interest rate paid by the safest U.S. corporations fell from 5.5 percent a year to 4 percent a year. During most of that period, the federal funds rate was roughly constant at 0.25 percent a year.

31. What role does the long-term real interest rate play in the monetary policy transmission process?
32. How does the federal funds rate influence the long-term real interest rate?
33. What do you think happened to inflation expectations between 2009 and 2017 and why?

34. **Loonie Still Appreciating**

In January 2018, the Bank of Canada raised its interest rate to 1.25 percent, which strengthened the Canadian dollar, the highest exchange rate in four months of CAD1.225 per USD at the start of February. Two further hikes are expected this year. However, if the United States withdraws from NAFTA, the Canadian dollar is likely to depreciate as the United States is a major trading partner for Canada.

Source: Reuters, February 8, 2018

a. How does the higher interest rate influence the Canadian dollar exchange rate, other things remaining the same?

b. How do the expected future hikes in the interest rate influence the Canadian dollar exchange rate, other things remaining the same?

c. Explain what happens to the Canadian dollar if the United States withdraws from NAFTA.

35. Suppose that the Reserve Bank of New Zealand is following the Taylor rule and in 2018, it sets the official cash rate (its equivalent of the federal funds rate) at 4 percent a year. If the inflation rate in New Zealand is 2 percent a year, what is its output gap?

Use the following news clip to work Problems 36 and 37.

Bernanke on Inflation Targeting

Inflation targeting promotes well-anchored inflation expectations, which facilitate more effective stabilization of output and employment. Thus inflation targeting can deliver good results with respect to output and employment as well as inflation.

Source: Federal Reserve Board, remarks by Ben Bernanke to the National Association of Business Economists

36. What is inflation targeting and how do "well-anchored inflation expectations" help to achieve more stable output as well as low inflation?

37. Explain how inflation targeting as described by Ben Bernanke is consistent with the Fed's dual mandate.

38. If the Fed had adopted inflation targeting and used the Taylor rule to hit its target, how would the course of the federal funds rate have been different from the course that it did take? How would inflation and the output gap have been different?

Financial Crisis: Cure and Prevention

39. **Bundesbank's Weidmann Opposes ECB's QE**

Jens Weidmann, president of Bundesbank, Germany's central bank, believes that the European Central Bank's (ECB) monetary expansion policy could do more harm than good since the European economy is already growing and opposes the ECB's quantitative easing policy, which is being implemented through asset purchases.

Source: CNBC, April 6, 2017

a. Describe the effect of this quantitative easing on the economic growth in the Eurozone.

b. What is the "good" and the "harm" that Weidmann is concerned about?

Economics in the News

40. After you have studied *Economics in the News* on pp. 398–399, answer the following questions.

a. What was the state of the U.S. economy in the summer of 2021 when the Fed made the decision to keep the federal funds rate at near zero and to keep buying bonds?

b. What was the FOMC majority expectation about future employment, real GDP, and inflation in July 2021?

c. How would an earlier and faster rise in interest rates influence aggregate demand, the output gap, and inflation?

41. **The Fed Is About to Wind Down Its Emergency Economic Stimulus**

To balance the threat of Covid with the current economic recovery, Fed chair Jerome Powell suggested the Fed will start pumping the brakes before the end of the year.

Source: cnn.com, August 27, 2021

a. What actions did the Fed take to stimulate the economy during the Covid-19 pandemic?

b. Why is the Fed deciding to "start pumping the brakes"?

c. What are the risks from the decision to "start pumping the brakes"?

15 INTERNATIONAL TRADE POLICY

After studying this chapter, you will be able to:

- Explain how markets work with international trade
- Identify the gains from international trade and its winners and losers
- Explain the effects of international trade barriers
- Explain and evaluate arguments used to justify restricting international trade

iPhones, Nintendo games, and Nike shoes are just three of the items that you might buy that are not produced in the United States. Why don't we produce smartphones, games, and shoes in America? Isn't the globalization of production killing good American jobs?

You will find the answers in this chapter. You will see why global trade is a win-win deal for buyers and sellers and also why governments restrict trade. In *Economics in the News* at the end of the chapter, you will learn why a trade war is harming American and Chinese consumers and producers. But first, we study the gains from international trade.

How Global Markets Work

Because we trade with people in other countries, the goods and services that we can buy and consume are not limited by what we can produce. The goods and services that we buy from other countries are our **imports**; and the goods and services that we sell to people in other countries are our **exports**.

International Trade Today

Global trade today is enormous. In 2020, global exports and imports were around $20 trillion, which is almost one-third of the value of global production. The United States is the world's largest international trader and accounts for 10 percent of world exports and 13 percent of world imports. Germany and China, which rank 2 and 3 behind the United States, lag by a large margin.

In 2020, total U.S. exports were $2.1 trillion, which is about 10 percent of the value of U.S. production. Total U.S. imports were $2.8 trillion, which is about 13 percent of total expenditure in the United States.

We trade both goods and services. In 2020, exports of services were about one-third of total exports and imports of services were about one-fifth of total imports.

What Drives International Trade?

Comparative advantage is the fundamental force that drives international trade. Comparative advantage (see Chapter 2, p. 68) is a situation in which a person can perform an activity or produce a good or service at a lower opportunity cost than anyone else. This same idea applies to nations. We can define *national comparative advantage* as a situation in which a nation can perform an activity or produce a good or service at a lower opportunity cost than any other nation.

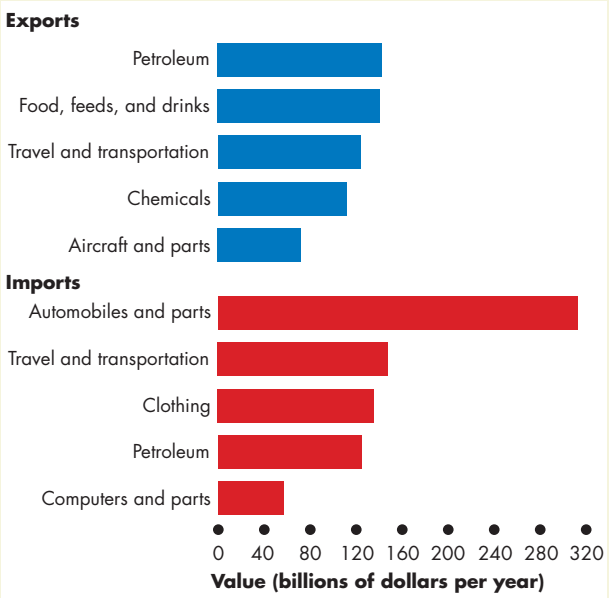
The opportunity cost of producing a T-shirt is lower in China than in the United States, so China has a comparative advantage in producing T-shirts. The opportunity cost of producing an airplane is lower in the United States than in China, so the United States has a comparative advantage in producing airplanes.

You saw in Chapter 2 how Liz and Joe reap gains from trade by specializing in the production of the good at which they have a comparative advantage and then trading with each other. Both are better off.

ECONOMICS IN ACTION

Travel and Transportation Top Our Trade

We export and import huge amounts of travel and transportation services. Our imports of automobiles, computers, and clothing are paid for by our exports of food and drinks, airplanes, and chemicals. We also trade a large quantity of petroleum, but we both export and import it (partly in trade with Canada).



U.S. Exports and Imports in 2020

Source of data: Bureau of Economic Analysis.

This same principle applies to trade among nations. Because China has a comparative advantage at producing T-shirts and the United States has a comparative advantage at producing airplanes, the people of both countries can gain from specialization and trade. China can buy airplanes from the United States at a lower opportunity cost than that at which Chinese firms can produce them. And Americans can buy T-shirts from China for a lower opportunity cost than that at which U.S. firms can produce them. Also, through international trade, Chinese producers can get higher prices for their T-shirts and Boeing can sell airplanes for a higher price. Both countries gain from international trade.

Let's now illustrate the gains from trade that we've just described by studying demand and supply in the global markets for T-shirts and airplanes.

Why the United States Imports T-Shirts

The United States imports T-shirts because the rest of the world has a comparative advantage in producing T-shirts. Figure 15.1 illustrates how this comparative advantage generates international trade and how trade affects the price of a T-shirt and the quantities produced and bought.

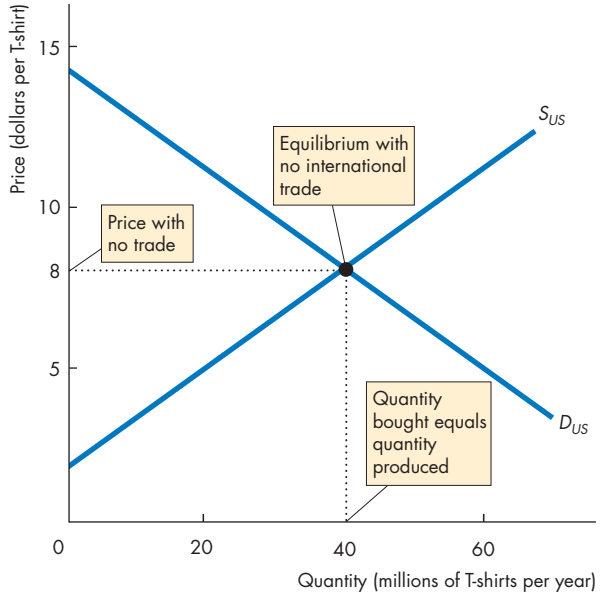
The demand curve D_{US} and the supply curve S_{US} show the demand and supply in the U.S. domestic market only. The demand curve tells us the quantity of T-shirts that Americans are willing to buy at various prices. The supply curve tells us the quantity of T-shirts that U.S. garment makers are willing to sell at various prices—that is, the quantity supplied at each price when all T-shirts sold in the United States are produced in the United States.

Figure 15.1(a) shows what the U.S. T-shirt market would be like with no international trade. The price of a T-shirt would be $8 and 40 million T-shirts a year would be produced by U.S. garment makers and bought by U.S. consumers.

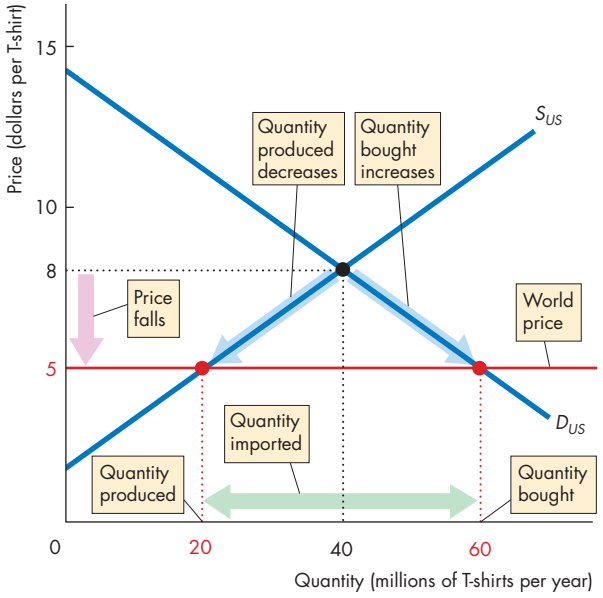
Figure 15.1(b) shows the market for T-shirts with international trade. Now the price of a T-shirt is determined in the world market, not the U.S. domestic market. The world price of a T-shirt is less than $8, which means that the rest of the world has a comparative advantage in producing T-shirts. The world price line shows the world price at $5 a T-shirt.

The U.S. demand curve, D_{US}, tells us that at $5 a T-shirt, Americans buy 60 million T-shirts a year. The U.S. supply curve, S_{US}, tells us that at $5 a T-shirt, U.S. garment makers produce 20 million T-shirts a year. To buy 60 million T-shirts when only 20 million are produced in the United States, we must import T-shirts from the rest of the world. The quantity of T-shirts imported is 40 million a year.

FIGURE 15.1 A Market with Imports



(a) Equilibrium with no international trade



(b) Equilibrium in a market with imports

Part (a) shows the U.S. market for T-shirts with no international trade. The U.S. domestic demand curve D_{US} and U.S. domestic supply curve S_{US} determine the price of a T-shirt at $8 and the quantity of T-shirts produced and bought in the United States at 40 million a year.

Part (b) shows the U.S. market for T-shirts with international trade. World demand for and world supply of T-shirts determine the world price of a T-shirt, which is $5. The price in the U.S. market falls to $5 a T-shirt. U.S. purchases of T-shirts increase to 60 million a year, and U.S. production of T-shirts decreases to 20 million a year. The United States imports 40 million T-shirts a year.

Why the United States Exports Airplanes

Figure 15.2 illustrates international trade in airplanes. The demand curve D_{US} and the supply curve S_{US} show the demand and supply in the U.S. domestic market only. The demand curve tells us the quantity of airplanes that U.S. airlines are willing to buy at various prices. The supply curve tells us the quantity of airplanes that U.S. aircraft makers are willing to sell at various prices.

Figure 15.2(a) shows what the U.S. airplane market would be like with no international trade. The price of an airplane would be $100 million and 400 airplanes a year would be produced by U.S. aircraft makers and bought by U.S. airlines.

Figure 15.2(b) shows the U.S. airplane market with international trade. Now the price of an airplane is determined in the world market and the world price of an airplane is higher than $100 million, which means that the United States has a comparative advantage in producing airplanes. The world price line shows the world price at $150 million.

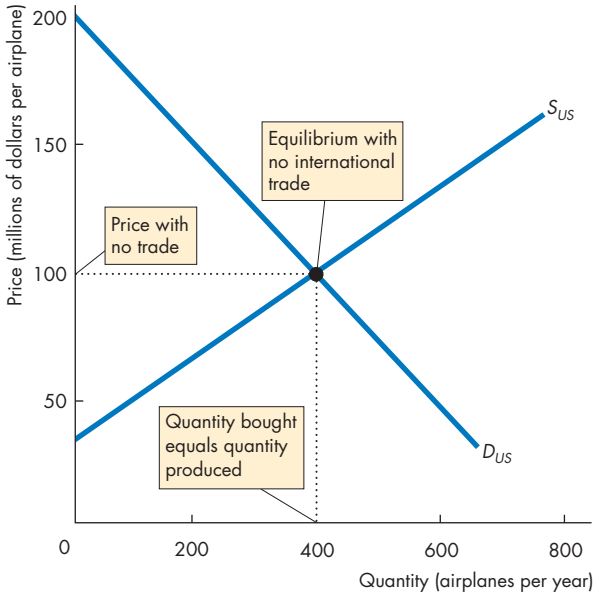
The U.S. demand curve, D_{US}, tells us that at $150 million an airplane, U.S. airlines buy 200 airplanes a year. The U.S. supply curve, S_{US}, tells us that at $150 million an airplane, U.S. aircraft makers produce 700 airplanes a year. The quantity produced in the United States (700 a year) minus the quantity purchased by U.S. airlines (200 a year) is the quantity of airplanes exported, which is 500 airplanes a year.

REVIEW QUIZ

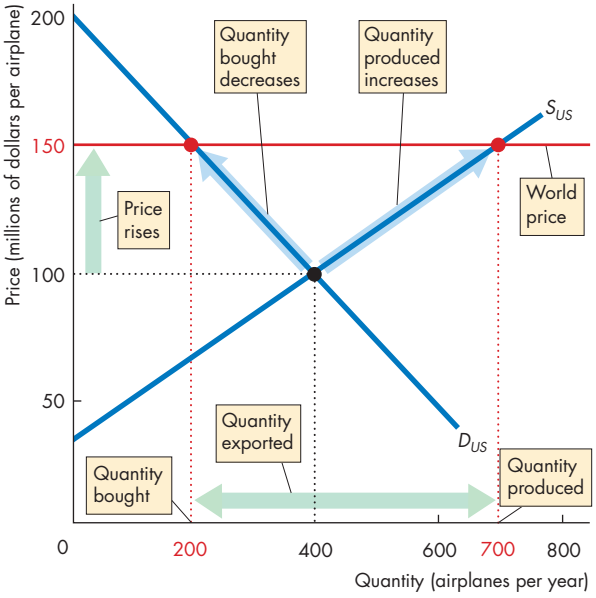
1 Describe the situation in the market for a good or service that the United States imports.

2 Describe the situation in the market for a good or service that the United States exports.

FIGURE 15.2 A Market with Exports



(a) Equilibrium without international trade



(b) Equilibrium in a market with exports

In part (a), the U.S. market with no international trade, the U.S. domestic demand curve D_{US} and the U.S. domestic supply curve S_{US} determine the price of an airplane at $100 million and 400 airplanes are produced and bought each year.

In part (b), the U.S. market with international trade, world demand and world supply determine the world price, which is $150 million per airplane. The price in the U.S. market rises. U.S. airplane production increases to 700 a year, and U.S. purchases of airplanes decrease to 200 a year. The United States exports 500 airplanes a year.

Winners, Losers, and the Net Gain from Trade

In Chapter 1 (see p. 34), we asked whether globalization is in the self-interest of the low-wage worker in Malaysia who sews your new running shoes and the displaced shoemaker in Atlanta. Is it in the social interest? We're now going to answer these questions. You will learn why producers complain about cheap foreign imports, but consumers of imports never complain.

Gains and Losses from Imports

We measure the gains and losses from imports by examining their effect on the price paid and the quantity bought by domestic consumers and their effect on the price received and the quantity sold by domestic producers.

Consumers Gain from Imports When a country freely imports an item from the rest of the world, it is because the rest of the world has a comparative advantage at producing that item. Compared to a situation with no international trade, the price paid by the consumer falls and the quantity bought increases. It is clear the consumer gains. The greater the fall in the price and increase in the quantity consumed, the greater is the gain to the consumer.

Domestic Producers Lose from Imports Compared to a situation with no international trade, the price received by a domestic producer of an item that is imported falls. Also, the quantity sold by the domestic producer of a good or service that is also imported decreases. Because the domestic producer of an item that is imported sells a smaller quantity and for a lower price, this producer loses from international trade. Import-competing industries shrink in the face of competition from cheaper foreign-produced goods.

The profits of firms that produce import-competing goods and services fall, these firms cut their workforce, unemployment in these industries increases, and wages fall. When these industries have a geographical concentration, an entire region can suffer economic decline.

Gains and Losses from Exports

We measure the gains and losses from exports just like we measured those from imports, by their effect on the price paid and the quantity consumed by domestic consumers and their effects on the price received and the quantity sold by domestic producers.

Consumers Lose from Exports When a country exports something to the rest of the world, it is because the country has a comparative advantage at producing that item. Compared to a situation with no international trade, the price paid by the consumer rises and the quantity consumed in the domestic economy decreases. The domestic consumer loses. The greater the rise in price and decrease in quantity consumed, the greater is the loss to the consumer.

Domestic Producers Gain from Exports Compared to a situation with no international trade, the price received by a domestic producer of an item that is exported rises. Also, the quantity sold by the domestic producer of a good or service that is also exported increases. Because the domestic producer of an item that is exported sells a larger quantity and for a higher price, this producer gains from international trade. Export industries expand in the face of global demand for their product.

The profits of firms that produce exports rise, these firms expand their workforce, unemployment in these industries decreases, and wages rise. When these industries have a geographical concentration, an entire region can boom.

Gains for All

You've seen that both imports and exports bring gains. Export producers and import consumers gain, and export consumers and import producers lose, but the gains are greater than the losses. In the case of imports, the consumer gains what the producer loses and then gains even more on the cheaper imports. In the case of exports, the producer gains what the consumer loses and then gains even more on the items it exports. So international trade provides a net gain for a country.

REVIEW QUIZ

1. How are the gains and losses from imports distributed between domestic consumers and producers?
2. How are the gains and losses from exports distributed between domestic consumers and producers?
3. Why is the net gain from international trade positive?

International Trade Restrictions

Governments use four sets of tools to influence international trade and protect domestic industries from foreign competition. They are

- Tariffs
- Import quotas
- Other import barriers
- Export subsidies

Tariffs

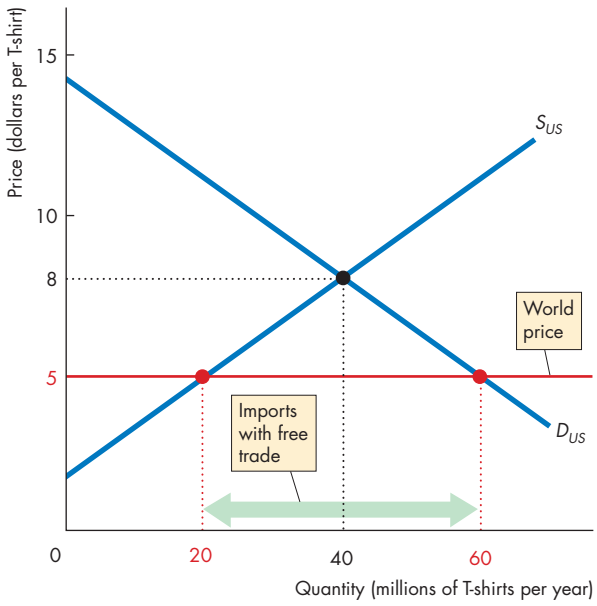
A **tariff** is a tax on a good that is imposed by the importing country when an imported good crosses its international boundary. For example, the government of India imposes a 100 percent tariff on wine imported from California. So when an Indian imports a $10 bottle of Californian wine, he pays the Indian government a $10 import tariff.

Tariffs raise revenue for governments and serve the self-interest of people who earn their incomes in import-competing industries. But as you will see, restrictions on free international trade decrease the gains from trade and are not in the social interest.

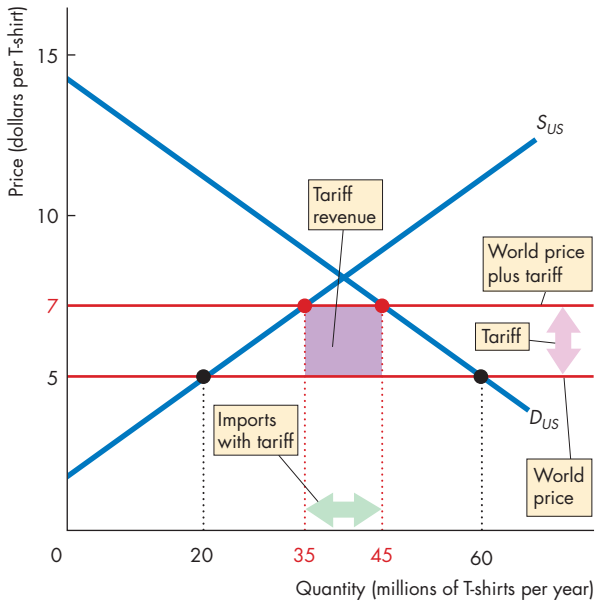
The Effects of a Tariff To see the effects of a tariff, let's return to the example in which the United States imports T-shirts. With free trade, the T-shirts are imported and sold at the world price. Then, under pressure from U.S. garment makers, the U.S. government imposes a tariff on imported T-shirts. Buyers of T-shirts must now pay the world price plus the tariff. Several consequences follow and Fig. 15.3 illustrates them.

Figure 15.3(a) shows the situation with free international trade. The United States produces 20 million T-shirts a year and imports 40 million a year at the world price of $5 a shirt. Figure 15.3(b) shows what happens when the government imposes a tariff of $2 per T-shirt.

FIGURE 15.3 The Effects of a Tariff



(a) Free trade



(b) Market with tariff

The world price of a T-shirt is $5. With free trade in part (a), Americans buy 60 million T-shirts a year. U.S. garment makers produce 20 million T-shirts a year and the United States imports 40 million a year.

With a tariff of $2 per T-shirt in part (b), the price in the U.S. market rises to $7 a T-shirt. U.S. production increases, U.S. purchases decrease, and the quantity imported decreases. The U.S. government collects a tariff revenue of $2 on each T-shirt imported, which is shown by the area of the purple rectangle.

The following changes occur in the market for T-shirts:

- The price of a T-shirt in the United States rises by $2.
- The quantity of T-shirts bought in the United States decreases.
- The quantity of T-shirts produced in the United States increases.
- The quantity of T-shirts imported into the United States decreases.
- The U.S. government collects a tariff revenue.

Rise in Price of a T-Shirt To buy a T-shirt, Americans must pay the world price plus the tariff, so the price of a T-shirt rises by the $2 tariff to $7. Figure 15.3(b) shows the new domestic price line, which lies $2 above the world price line. The price rises by the full amount of the tariff. The buyer pays the entire tariff.

Decrease in Purchases The higher price of a T-shirt brings a decrease in the quantity demanded along the demand curve. Figure 15.3(b) shows the decrease from 60 million T-shirts a year at $5 a shirt to 45 million a year at $7 a shirt.

Increase in Domestic Production The higher price of a T-shirt stimulates domestic production, and U.S. garment makers increase the quantity supplied along the supply curve. Figure 15.3(b) shows the increase from 20 million T-shirts at $5 a shirt to 35 million a year at $7 a shirt.

Decrease in Imports T-shirt imports decrease by 30 million, from 40 million to 10 million a year. Both the decrease in purchases and the increase in domestic production contribute to this decrease in imports.

Tariff Revenue The government's tariff revenue is $20 million—$2 per shirt on 10 million imported shirts—shown by the purple rectangle.

Winners, Losers, and the Social Loss from a Tariff

A tariff on an imported good creates winners and losers and a social loss. When the U.S. government imposes a tariff on an imported good,

- U.S. consumers of the good lose.
- U.S. producers of the good gain.
- U.S. consumers lose more than U.S. producers gain. Society loses.

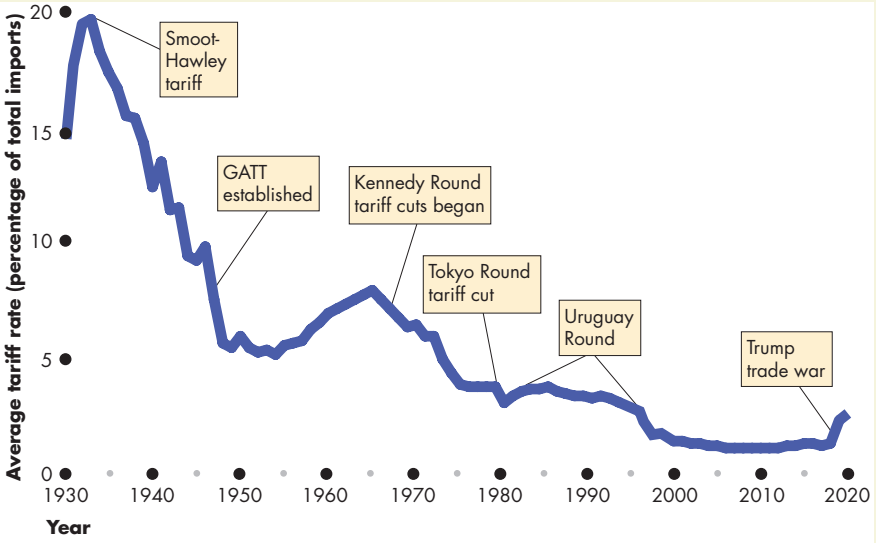
ECONOMICS IN ACTION

U.S. Tariffs Almost Gone

The Smoot-Hawley Act, which was passed in 1930, took U.S. tariffs to a peak average rate of 20 percent in 1933. (One-third of imports was subject to a 60 percent tariff.)

The **General Agreement on Tariffs and Trade (GATT)**, established in 1947, brought a series of tariff-reduction negotiating rounds identified in the figure.

The fall in tariffs was reversed in 2019 in a trade war with China. Tariff rates are now low, but other trade barriers that include import quotas and agriculture subsidies persist.



Tariffs: 1930–2020

Sources of data: U.S. Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1970*, Bicentennial Edition, Part 1 (Washington, D.C., 1975); Series U-212: updated from Congressional Budget Office tariff revenues data and Bureau of Economic Analysis imports data.

U.S. Producers of the Good Gain Because the price of an imported T-shirt rises by the amount of the tariff, U.S. producers of T-shirts are now able to sell their T- shirts for the world price plus the tariff. At the higher price, the quantity of T-shirts supplied by U.S. producers increases. The combination of a higher price and larger quantity produced increases producers' profits. U.S. producers gain from the tariff.

U.S. Consumers of the Good Lose Consumers lose from the tariff for three reasons:

1. They pay a higher price to domestic producers.
2. They buy a smaller quantity of the good.
3. They pay tariff revenue to the government.

The tariff revenue is a loss to consumers, but it is not a social loss. The government can use the tariff revenue to buy public services that consumers value. But the other two sources of consumer loss include some social loss.

U.S. Consumers Lose More Than U.S. Producers Gain The tariff creates a social loss because part of the higher price paid to domestic producers pays the higher cost of domestic production. The increased domestic production could have been obtained at lower cost as an import. There is also a social loss from the decreased quantity of the good bought at the higher price.

Import Quotas

We now look at the second tool for restricting trade: import quotas. An **import quota** is a restriction that limits the quantity of a good that may be imported in a given period.

Most countries impose import quotas on a wide range of items. The United States imposes them on food products such as sugar and bananas and manufactured goods such as textiles and steel.

Import quotas enable the government to satisfy the self-interest of the people who earn their incomes in the import-competing industries. But you will

ECONOMICS IN ACTION

In Search of a Breakthrough

The **World Trade Organization (WTO)** is an international body established to supervise international trade and lower trade barriers.

At a meeting in Doha, Qatar, in 2001, WTO members agreed to begin negotiations to remove barriers that restrict international trade in farm products and services. These negotiations are called the **Doha Development Agenda** or the **Doha Round**.

In the period since 2001, thousands of hours of conferences from Cancún in 2003 to Bali in 2013 and ongoing meetings at WTO headquarters in Geneva, costing millions of taxpayers' dollars, have made disappointing progress.

Rich nations, led by the United States, the European Union, and Japan, want greater access to the markets of developing nations in exchange for allowing those nations greater access to the markets of the rich world, especially those for farm products.

Developing nations, led by Brazil, China, India, and South Africa, want access to the markets of farm products of the rich world, but they also want to protect their infant industries.

Economist, international development professional, and politician Ngozi Okonjo-Iweala, who was appointed Director General of the WTO in 2021.

Can she bring the Doha Round to a successful conclusion?

Two principles govern the negotiations that have blocked agreement for 20 years: There must be unanimity, and nothing is agreed until all is agreed.

With two incompatible positions, these negotiations are stalled. The self-interests of producers in both rich nations and developing nations are preventing the achievement of the social interest.

Will the appointment of Ngozi Okonjolweala as Director General of the WTO break the deadlock?

discover that, like a tariff, an import quota decreases the gains from trade and is not in the social interest.

The Effects of an Import Quota The effects of an import quota are similar to those of a tariff. The price rises, the quantity bought decreases, and the quantity produced in the United States increases. Figure 15.4 illustrates the effects.

Figure 15.4(a) shows the situation with free international trade. Figure 15.4(b) shows what happens with an import quota of 10 million T-shirts a year. The U.S. supply curve of T-shirts becomes the domestic supply curve, S_{US}, plus the quantity that the import quota permits. So the supply curve becomes S_{US} + *quota*. The price of a T-shirt rises to $7, the quantity of T-shirts bought in the United States decreases to 45 million a year, the quantity of T-shirts produced in the United States increases to 35 million a year, and the quantity of T-shirts imported into the United States decreases to the quota quantity of 10 million a year. All the effects of this quota are identical to the effects of a $2 per shirt tariff, as you can check in Fig. 15.3(b).

Winners, Losers, and the Social Loss from an Import Quota An import quota creates winners and losers that are similar to those of a tariff but with an interesting difference.

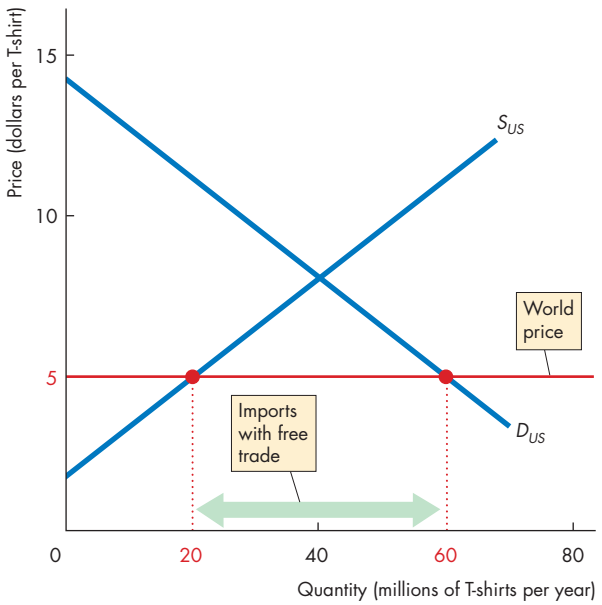
When the government imposes an import quota,

- U.S. consumers of the good lose.
- U.S. producers of the good gain.
- Importers of the good gain.
- Society loses.

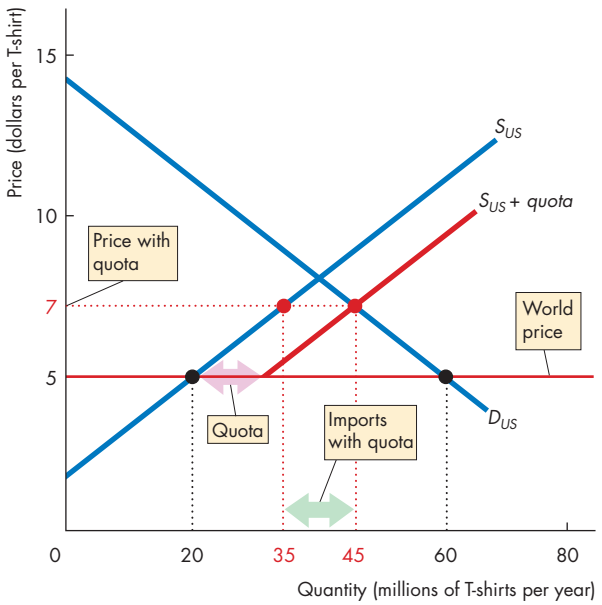
U.S. Consumers of the Good Lose Because the price of a T-shirt in the United States rises, the quantity of T-shirts demanded decreases. The combination of a higher price and smaller quantity bought makes U.S. consumers worse off. So U.S. consumers lose when an import quota is imposed.

U.S. Producers of the Good Gain Because the price of an imported T-shirt rises, U.S. T-shirt producers increase production at the higher domestic price The combination of a higher price and a larger quantity produced increases producers' profit, so U.S. producers gain from the import quota.

FIGURE 15.4 The Effects of an Import Quota



(a) Free trade



(b) Market with import quota

With free international trade, in part (a), U.S. consumers buy 60 million T-shirts at the world price. The United States produces 20 million T-shirts and imports 40 million T-shirts a year.

With an import quota of 10 million T-shirts a year, in part (b), the supply of T-shirts in the United States is shown by the curve S_{US} + *quota*. The price of a T-shirt in the United States rises to $7. U.S. production increases, U.S. purchases decrease, and the quantity of T-shirts imported decreases.

ECONOMICS IN THE NEWS

The U.S.–Canada Lumber Dispute

Canada Wins in Lumber Dispute with U.S.
The U.S. lumber industry has complained for decades that Canadian rivals benefit from subsidies, allowing them to sell their wood for less. So, the United States imposed a tariff on Canadian lumber imports. In August 2020, the World Trade Organization ruled in Canada's favor.

Source: *Reuters*, August 20, 2020

SOME FACTS

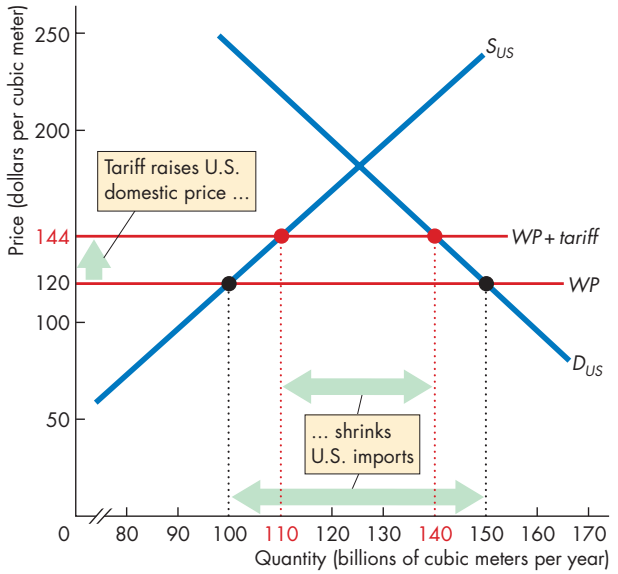
Canada is one of the world's largest lumber producers and it has been exporting lumber to the United States since the 1800s. Most U.S. forests are privately owned and leased to lumber producers at market prices. Canadian forests are state owned and leased to lumber producers at low prices set by law. U.S. producers say Canadian producers receive a subsidy and are "dumping"—selling lumber on the U.S. market at a price lower than the cost of production or the selling price in Canada.

THE PROBLEM

Explain how U.S. lumber mills would gain from a tariff on imported lumber. Would everyone in the United States be better off? Illustrate your answer with a graph.

THE SOLUTION

- A tariff imposed on U.S. imports of lumber increases the price of lumber in the United States.
- The higher price decreases the quantity of lumber demanded in the United States, increases the quantity supplied by U.S. producers, and decreases U.S. imports of lumber.
- U.S. producers of lumber make more profit but, faced with a higher price, U.S. consumers of lumber are worse off. And the gain to producers is less than the loss to consumers—society's loss.
- The figure illustrates the U.S. market for lumber. The demand curve is D_{US} and the supply curve is S_{US}.
- With a Canadian and world price *WP* of $120 per cubic meter, Canada has a comparative advantage in producing lumber.
- At the world price *WP*, the United States produces 100 billion cubic meters a year, uses 150 billion cubic meters, and imports 50 billion cubic meters. The figure shows this quantity of U.S. imports.



U.S. Market for Softwood Lumber

- If the United States imposes a 20 percent tariff, the price in the United States rises to $144 on the line *WP* + *tariff*
- U.S. production increases to 110 billion cubic meters, the quantity bought decreases to 140 billion cubic meters, and imports shrink to 30 billion cubic meters.
- At the higher price and increased production, U.S. producer's profit increases. But U.S. consumers buy less lumber and pay a higher price. Consumers lose more than producers gain, so U.S. society loses.
- The fact that the tariff is a response to Canada's alleged subsidy and dumping does not make the tariff efficient. Free trade in lumber, even if subsidized, brings gains for U.S. consumers that exceed the loss of U.S. producers.

Importers of the Good Gain The importer is able to buy the good on the world market at the world market price, and sell the good in the domestic market at the domestic price. Because the domestic price exceeds the world price, the importer gains.

Society Loses Because the loss to consumers exceeds the gains of domestic producers and importers, a social loss occurs. Just like the social loss from a tariff, there is a social loss from the quota because part of the higher price paid to domestic producers pays the higher cost of domestic production. There is a social loss from the decreased quantity of the good bought at the higher price.

Tariff and Import Quota Compared You've looked at the effects of a tariff and an import quota and can now see the essential differences between them. A tariff brings in revenue for the government while an import quota brings a profit for the importers. All the other effects of an import quota are the same as the effects of a tariff, provided the quota is set at the same quantity of imports that results from the tariff.

Tariffs and import quotas are equivalent ways of restricting imports, benefiting domestic producers, and harming domestic consumers.

Let's now look at some other import barriers.

Other Import Barriers

Two sets of policies that influence imports are

- Health, safety, and regulation barriers
- Voluntary export restraints

Health, Safety, and Regulation Barriers Thousands of detailed health, safety, and other regulations restrict international trade. For example, U.S. food imports are examined by the Food and Drug Administration to determine whether the food is "pure, wholesome, safe to eat, and produced under sanitary conditions." The discovery of BSE (mad cow disease) in just one U.S. cow in 2003 was enough to close down international trade in U.S. beef. The European Union bans imports of most genetically modified foods, such as U.S.-produced soybeans. Although regulations of the type we've just described are not designed to limit international trade, they have that effect.

Voluntary Export Restraints A *voluntary export restraint* is like a quota allocated to a foreign exporter of a good. This type of trade barrier isn't common. It was initially used during the 1980s when Japan voluntarily limited its exports of car parts to the United States.

Export Subsidies

A *subsidy* is a payment by the government to a producer. When a government pays a subsidy to producers of a good, the cost of production falls by the amount of the subsidy, so the supply of the good increases.

An *export subsidy* is a payment by the government to the producer of an exported good. Export subsidies are illegal under a number of international agreements, including the United States–Mexico–Canada Agreement (USMCA) of 2020 that replaced the North American Free Trade Agreement (NAFTA), and the rules of the World Trade Organization (WTO).

Although export subsidies are illegal, the subsidies that the U.S. and European Union governments pay to farmers end up increasing domestic production, some of which gets exported. These exports of subsidized farm products make it harder for producers in other countries, notably in Africa and Central and South America, to compete in global markets. Export subsidies bring gains to domestic producers, but they result in inefficient underproduction in the rest of the world and create a deadweight loss.

REVIEW QUIZ

1. What are the tools that a country can use to restrict international trade?
2. Explain the effects of a tariff on domestic production, the quantity bought, and the price.
3. Explain who gains and who loses from a tariff and why the losses exceed the gains.
4. Explain the effects of an import quota on domestic production, consumption, and price.
5. Explain who gains and who loses from an import quota and why the losses exceed the gains.

For as long as international trade has existed, people have debated whether free trade or protection from foreign competition is better for a country. Economists believe free trade is better but we will now look at a broader range of issues in the free trade versus protection debate.

The Case Against Protection

You've just seen that free trade promotes prosperity, and that protection is inefficient. Yet trade is restricted with tariffs, quotas, and other barriers. Why? Seven pro-trade restrictions claim that protecting domestic industries from foreign competition:

- Helps an infant industry grow.
- Counteracts dumping.
- Saves domestic jobs.
- Allows us to compete with cheap foreign labor.
- Penalizes lax environmental standards.
- Prevents rich countries from exploiting developing countries.
- Reduces offshore outsourcing that sends good U.S. jobs to other countries.

Helps an Infant Industry Grow

Comparative advantages change with on-the-job experience—*learning-by-doing*. When a new industry or a new product is born—an *infant industry*—it is not as productive as it will become with experience. It is argued that such an industry should be protected from international competition until it can stand alone and compete.

It is true that learning-by-doing can change comparative advantage, but this fact doesn't justify protecting an infant industry. Firms anticipate and benefit from learning-by-doing without protection from foreign competition.

When Boeing started to build airplanes, productivity was at first low. But after a period of learning-by-doing, huge productivity gains followed. Boeing didn't need a tariff to achieve these productivity gains.

Counteracts Dumping

Dumping occurs when a foreign firm sells its exports at a lower price than its cost of production. Dumping might be used by a firm that wants to gain a global monopoly. In this case, the foreign firm sells its output at a price below its cost to drive domestic firms out of business. When the domestic firms have gone, the foreign firm takes advantage of its monopoly position and charges a higher price for its product. Dumping is illegal under the rules of the World Trade Organization and is usually regarded as a justification for temporary tariffs, which are called *countervailing duties*.

But it is virtually impossible to detect dumping because it is hard to determine a firm's costs. As a result, the test for dumping is whether a firm's export price is below its domestic price. But this test is weak because it is rational for a firm to charge a low price in a market in which the quantity demanded is highly sensitive to price and a higher price in a market in which demand is less price-sensitive.

Saves Domestic Jobs

First, free trade does destroy some jobs, but it also creates other jobs. It brings about a global rationalization of labor and allocates labor resources to their highest-valued activities. International trade in textiles has cost tens of thousands of U.S. jobs as U.S. textile mills and other factories closed. But tens of thousands of jobs have been created in other countries as textile mills opened. And tens of thousands of U.S. workers have better-paying jobs than as textile workers because U.S. export industries have expanded and created new jobs. More jobs have been created than destroyed.

Although protection can save particular jobs, it does so at a high cost. For example, until 2005, U.S. textile jobs were protected by an international agreement called the Multifiber Arrangement. The U.S. International Trade Commission (ITC) has estimated that because of import quotas, 72,000 jobs existed in the textile industry that would otherwise have disappeared and that the annual clothing expenditure in the United States was $15.9 billion ($160 per family) higher than it would have been with free trade. Equivalently, the ITC estimated that each textile job saved cost $221,000 a year.

Imports don't only destroy jobs. They create jobs for retailers that sell imported goods and for firms that service those goods. Imports also create jobs by creating income in the rest of the world, some of which is spent on U.S.-made goods and services.

Allows Us to Compete with Cheap Foreign Labor

With the removal of tariffs on trade between the United States and Mexico, people said we would hear a "giant sucking sound" as jobs rushed to Mexico. That didn't happen. Why?

It didn't happen because low-wage labor is low-productivity labor. If a U.S. autoworker earns $30 an hour and produces 15 units of output an hour, the average

labor cost of a unit of output is $2. If a Mexican autoworker earns $3 an hour and produces 1 unit of output an hour, the average labor cost of a unit of output is $3. Other things remaining the same, the higher a worker's productivity, the higher is the worker's wage rate. High-wage workers have high productivity; low-wage workers have low productivity.

It is *comparative advantage*, not wage differences, that drive international trade and that enable us to compete with Mexico and Mexico to compete with us.

Penalizes Lax Environmental Standards

Another argument for protection is that it provides an incentive for poor countries to raise their environmental standards—free trade with the richer and "greener" countries is a reward for improved environmental standards.

This argument for protection is weak. First, a poor country cannot afford to be as concerned about its environmental standard as a rich country can. Today, some of the worst pollution of air and water is found in China, Mexico, and the former communist countries of Eastern Europe. But only a few decades ago, London and Los Angeles topped the pollution league chart. The best hope for cleaner air in Beijing and Mexico City is rapid income growth, which free trade promotes. As incomes in developing countries grow, they have the *means* to match their desires to improve their environment. Second, a poor country may have a comparative advantage at doing "dirty" work, which helps it to raise its income and at the same time enables the global economy to achieve higher environmental standards than would otherwise be possible.

Prevents Rich Countries from Exploiting Developing Countries

Another argument for protection is that international trade must be restricted to prevent the people of the rich industrial world from exploiting the poorer people of the developing countries and forcing them to work for slave wages.

Child labor and near-slave labor are serious problems. But by trading with poor countries, we increase the demand for the goods that these countries produce and increase the demand for their labor. When the demand for labor in developing countries increases, the wage rate rises. So, rather than exploiting people in developing countries, trade can improve their opportunities and increase their incomes.

Reduces Offshore Outsourcing That Sends Good U.S. Jobs to Other Countries

Offshore outsourcing—buying goods, components, or services from firms in other countries—brings gains from trade identical to those of any other type of trade. We could easily change the names of the items traded from T-shirts and airplanes (the examples in the previous sections of this chapter) to banking services and call-center services (or any other pair of services). A U.S. bank might export banking services to Indian firms, and Indians might provide call-center services to U.S. firms. This type of trade would benefit both Americans and Indians, provided the United States has a comparative advantage in banking services and India has a comparative advantage in call-center services.

Despite the gain from specialization and trade that offshore outsourcing brings, many people believe that it also brings costs that eat up the gains. Why?

A major reason is that it seems to send good U.S. jobs to other countries. It is true that some manufacturing and service jobs are going overseas. But others are expanding at home. The United States imports call-center services, but it exports education, healthcare, legal, financial, and a host of other types of services. The number of jobs in these sectors is expanding and will continue to expand.

The exact number of jobs that have moved to lower-cost offshore locations is not known, and estimates vary. But even the highest estimate is small compared to the normal rate of job creation and labor turnover.

Gains from trade do not bring gains for every single person. Americans, on average, gain from offshore outsourcing, but some people lose. The losers are those who have invested in the human capital to do a specific job that has now gone offshore.

Unemployment benefits provide short-term temporary relief for these displaced workers. But the long-term solution requires retraining and the acquisition of new skills.

Beyond bringing short-term relief through unemployment benefits, government has a larger role to play. By providing education and training, it can enable the labor force of the twenty-first century to engage in the ongoing learning and sometimes rapid retooling that jobs we can't foresee today will demand.

Schools, colleges, and universities will expand and become better at doing their job of producing a more highly educated and flexible labor force.

AT ISSUE

Is Offshore Outsourcing Bad or Good for America?

Citibank, Bank of America, Apple, Nike, and Wal-Mart engage in offshore outsourcing when they buy finished goods, components, or services from firms in other countries. Buying goods and components has been going on for centuries, but buying *services* such as customer support call-center services, is new and is made possible by the development of low-cost telephone and Internet service.

Is this offshore outsourcing bad for the United States?

Bad

- In his 2012 *State of the Union Address*, President Obama said, "A business that wants to outsource jobs shouldn't get a tax deduction for doing it. … It is time to stop rewarding businesses that ship jobs overseas, and start rewarding companies that create jobs right here in America."
- A survey conducted in 2004 found that 69 percent of Americans think outsourcing hurts the U.S. economy and only 17 percent think it helps.

Have these Indian call-center workers destroyed American jobs? Or does their work benefit American workers?

Good

- Economist N. Gregory Mankiw, when Chair of President George W. Bush's Council of Economic Advisers, said, "I think outsourcing … is probably a plus for the economy in the long run."
- Mankiw went on to say that it doesn't matter whether "items produced abroad come on planes, ships, or over fiber-optic cables … the economics is basically the same."
- What Greg Mankiw is saying is that the economic analysis of the gains from international trade—exactly the same as what you have studied on pp. 408–409—applies to all types of international trade.
- Offshore outsourcing, like all other forms of international trade, is a source of gains for all.

Avoiding Trade Wars

We have reviewed the arguments commonly heard in favor of protection and the counterarguments against it. But one counterargument to protection that is general and quite overwhelming is that protection invites retaliation and can trigger a trade war.

A trade war is a contest in which when one country raises its import tariffs, other countries retaliate with increases of their own, which trigger yet further increases from the first country.

A trade war occurred during the Great Depression of the 1930s when the United States introduced the Smoot-Hawley tariff. Country after country retaliated with its own tariff, and in a short period, world trade had almost disappeared. The costs to all countries were large and led to a renewed international resolve to avoid such self-defeating moves in the future. The costs also led to attempts to liberalize trade following World War II.

Why Is International Trade Restricted?

Why, despite all the arguments against protection, is trade restricted? There are two key reasons:

- Tariff revenue
- Rent seeking

Tariff Revenue Government revenue is costly to collect. In developed countries such as the United States, a well-organized tax collection system is in place that can generate billions of dollars of income tax and sales tax revenues.

But governments in developing countries have a difficult time collecting taxes from their citizens. Much economic activity takes place in an informal economy with few financial records. The one area in which economic transactions are well recorded is international trade. So tariffs on international trade are a convenient source of revenue in these countries.

Rent Seeking Rent seeking is the major reason why international trade is restricted. **Rent seeking** is lobbying for special treatment by the government to create economic profit or to divert benefits away from others. Free trade increases consumption possibilities *on average*, but not everyone shares in the gain and some people even lose. Free trade brings benefits to some and imposes costs on others, with total benefits exceeding total costs. The uneven distribution of costs and benefits is the principal obstacle to achieving more liberal international trade.

Returning to the example of trade in T-shirts and airplanes, the benefits from free trade accrue to all the producers of airplanes and to those producers of T-shirts that do not bear the costs of adjusting to a smaller garment industry. These costs are transition costs, not permanent costs. The costs of moving to free trade are borne by the garment producers and their employees who must become producers of other goods and services in which the United States has a comparative advantage.

The number of winners from free trade is large, but because the gains are spread thinly over a large number of people, the gain per person is small. The winners could organize and become a political force lobbying for free trade. But political activity is costly. It uses time and other scarce resources and the gains per person are too small to make the cost of political activity worth bearing.

In contrast, the number of losers from free trade is small, but the loss per person is large. Because the loss per person is large, the people who lose *are* willing to incur considerable expense to lobby against free trade.

Both the winners and losers weigh benefits and costs. Those who gain from free trade weigh the benefits it brings against the cost of achieving it. Those who lose from free trade and gain from protection weigh the benefit of protection against the cost of maintaining it. The protectionists undertake a larger quantity of political lobbying than the free traders.

Compensating Losers

If, in total, the gains from free international trade exceed the losses, why don't those who gain compensate those who lose so that everyone is in favor of free trade?

Some compensation does take place. When Congress approved the North American Free Trade Agreement (NAFTA) with Canada and Mexico in 2005, it set up a $56 million fund to support and retrain workers who lost their jobs as a result of the new trade agreement. During NAFTA's first six months, only 5,000 workers applied for benefits under this scheme. The losers from international trade are also compensated indirectly through the normal unemployment compensation arrangements. But only limited attempts are made to compensate those who lose from free trade.

The main reason full compensation is not attempted is that the costs of identifying all the losers and estimating the value of their losses would be enormous. Also, it would never be clear whether a person who has fallen on hard times is suffering because of free trade or for other reasons that might be largely under her or his control.

Furthermore, some people who look like losers at one point in time might, in fact, end up gaining. The young autoworker who loses his job in Michigan and becomes a computer assembly worker in Minneapolis might resent the loss of work and the need to move. But a year later, looking back on events, he counts himself fortunate.

Because countries do not, in general, compensate the losers from free international trade, protectionism is a popular and permanent feature of our national economic and political life.

REVIEW QUIZ

1. What are the infant industry and dumping arguments for protection? Are they correct?
2. Can protection save jobs and the environment and prevent workers in developing countries from being exploited?
3. What is offshore outsourcing? Who benefits from it and who loses?
4. What are the main reasons for imposing a tariff?
5. Do the winners from free trade win the political argument? Why or why not?

We end this chapter on international trade policy with *Economics in the News* on pp. 420–421, where we apply what you've learned by looking at some of the effects of the trade war between the United States and China.

The U.S.-China Trade War

Former President Trump imposed tariffs on some imports from China. How did these tariffs change U.S. production of these imported goods? Did the United States gain from Trump's tariffs? How did China's decision to cut its tariffs on U.S. pork influence the trade war?

Read these headlines and news clips and then analyze the effects of import tariffs.

U.S. Tariffs Drive Drop in Chinese Imports

U.S. tariffs have led to a sharp decline in Chinese imports ... aiming to boost U.S. factory production by making Chinese imports more expensive ...Vietnam has been an especially big beneficiary.

The Wall Street Journal, May 12, 2021

China to Waive Tariffs on Some U.S. Soybeans, Pork

In a positive gesture, China said on Friday that it will waive import tariffs for some soybeans and pork shipments. The two countries are trying to thrash out a broader agreement to defuse their protracted trade war.

CNBC, December 6, 2019

Trump Trade Policy Failed the Workers He Promised to Help

After Trump ...levying tariffs on Chinese-made goods, China retaliated with tariffs on U.S. agricultural goods.

MarketWatch, September 23, 2020

ESSENCE OF THE STORIES

- The Trump administration imposed tariffs on imports from China in 2018–19.
- The aim was to boost U.S. factory production by making Chinese imports more expensive.
- U.S. tariffs decreased Chinese imports but did not increase U.S. factory production.
- Imports from other Asian countries, especially Vietnam, increased.
- In July 2018, China responded to U.S. tariffs by imposing its own tariffs on U.S. soybeans and pork.
- In December 2019, China removed those tariffs.
- The two countries are trying to end their trade war.

ECONOMIC ANALYSIS

- The trade war between the United States and China has no winners.
- To see why, we'll look at two of the markets in which the trade war was played out: the U.S. market for memory chips and the Chinese market for pork.
- The Trump administration imposed a tariff on chips made in China and in response, China imposed a tariff on U.S. pork.
- Figure 1 illustrates what happened in the U.S. market for chips.
- The demand curve D_{US} shows the demand for memory chips in the United States, and the supply curve S_{US} shows the supply of chips produced in the United States.
- China can supply chips at a price of $10 a chip, shown by the supply curve S_{China}. The United States can import chips at this price, so this is the price in the United States.
- With free trade, the United States produces no chips and imports 5 billion a year.
- When a tariff is imposed on imported chips, the U.S. demand curve and U.S. supply curve don't change, but the United States is no longer able to buy chips from China for $10 each.
- The U.S. price of chips from China rises, so American chip users look for a lower-cost source and find it in Vietnam, which can supply chips at a price of $11 a chip, shown by the supply curve $S_{Vietnam}$.
- At a price of $11 a chip, the quantity of chips demanded and imported decreases to 4 billion a year. Imports from China are zero.
- U.S. chip buyers lose as they buy a smaller quantity and pay a higher price. Imports of chips decrease.
- Figure 2 illustrates what happened in China's market for pork.
- The demand curve D_{China} shows the demand for pork in China, and the supply curve S_{China} shows the supply of pork produced in China.
- The world price of pork is $2 a pound, shown by the curve labeled *WP*. China can import pork at this price, so this is the price in China.
- With free trade, China produces 4 billion pounds of pork and imports 2 billion pounds a year.
- When China imposes a tariff on imported pork, the price of pork in China rises to *WP* + *tariff*. China's producers gain as they produce more and receive a higher price and pork imports decrease.
- Consumers of pork in China lose because they pay a higher price and buy a smaller quantity.
- By removing the tariffs on chips and pork, both the United States and China gain.

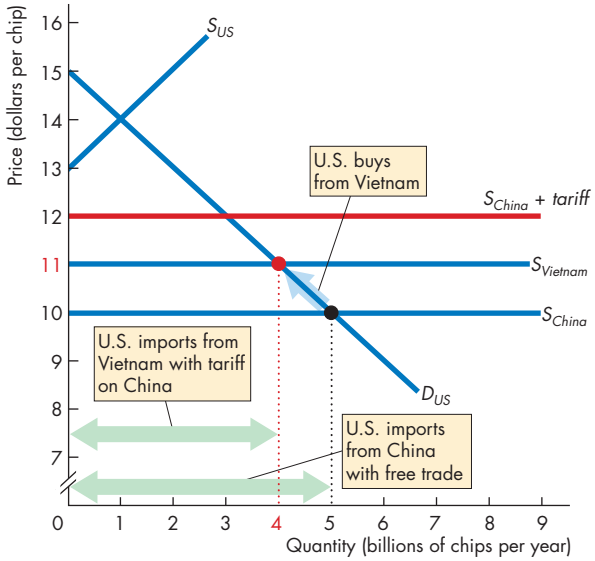


Figure 1 The U.S. Market for Memory Chips

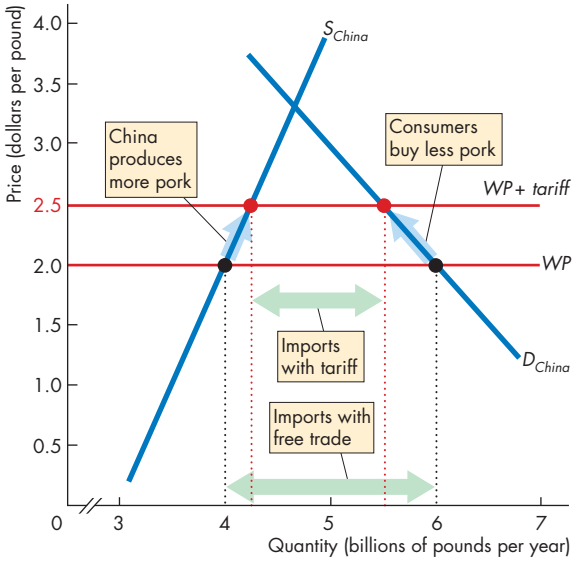


Figure 2 China's Market for Pork

WORKED PROBLEM

The table shows the U.S. demand schedule for honey and the supply schedule of honey by U.S. producers.

The world price of honey is $8 a jar.

Price (dollars per jar)	Quantity demanded (millions of jars per year)	Quantity supplied (millions of jars per year)
5	10	0
6	8	3
7	6	6
8	4	9
9	2	12
10	0	15

Questions

1. With no international trade, what is the price of honey and the quantity bought and sold in the United States? Does the United States have a comparative advantage in producing honey and with free international trade, does the United States export or import honey?
2. With free international trade, what is the U.S. price of honey, the quantity bought by Americans, the quantity produced in the United States, and the quantity of honey exported or imported?
3. Do Americans gain from international trade in honey? Do all Americans gain? If not, who loses and do the gains exceed the losses?

Solutions

1. With no international trade, the price of honey is that at which the U.S. quantity demanded equals the U.S quantity supplied. The table shows that this price is $7 a jar at which the equilibrium quantity is 6 million jars a year.

   The price of honey in the United States is less than the world price, which means that the opportunity cost of producing a jar of honey in the United States is *less* than the opportunity cost of producing it in the rest of the world. So U.S. producers have a comparative advantage in producing honey and with free international trade, the United States exports honey.

Key Point: Comparative advantage is determined by comparing the opportunity cost of producing the good in the United States to the world price.

2. With free international trade, the price of honey in the United States rises to the world price of $8 a jar. Americans cut their consumption of honey to 4 million jars a year while U.S. honey producers expand production to 9 million jars a year. The United States exports 5 million jars a year.

   The figure shows the quantities bought and produced in the United States and the quantity exported.

Key Point: As the domestic price rises to the world price, the quantity demanded decreases and the quantity supplied increases, and the difference is exported.

3. With free international trade, the United States gains from exporting honey.

   The higher world price and the larger quantity of honey produced increase U.S. honey producers' profit.

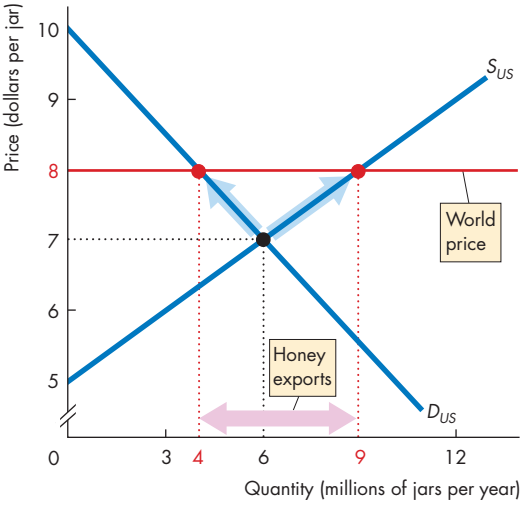
   U.S. consumers lose because the price of honey rises and they buy less honey.

   U.S. producers gain more than U.S. consumers lose.

   There is a social gain from free trade in honey.

Key Point: Free trade brings gains to domestic exporters and losses to domestic consumers of the exported good, but the exporting country has a net social gain.

Key Figure



SUMMARY

Key Points

How Global Markets Work (pp. 406–408)

- Comparative advantage drives international trade.
- If the world price of a good is lower than the domestic price, the rest of the world has a comparative advantage in producing that good and the domestic country gains by producing less, consuming more, and importing the good.
- If the world price of a good is higher than the domestic price, the domestic country has a comparative advantage in producing that good and gains by producing more, consuming less, and exporting the good.

Winners, Losers, and the Net Gain from Trade (p. 409)

- Compared to a no-trade situation, in a market with imports, domestic consumers gain and domestic producers lose but the gains exceed the losses.
- Compared to a no-trade situation, in a market with exports, domestic producers gain more than domestic consumers lose, but the gains exceed the losses.

International Trade Restrictions (pp. 410–415)

- Countries restrict international trade by imposing tariffs, import quotas, and other import barriers.
- Trade restrictions raise the domestic price of imported goods, lower the quantity imported, make consumers worse off, make producers better off, and damage the social interest.

The Case Against Protection (pp. 416–419)

- Arguments that protection helps an infant industry to grow and counteracts dumping are weak.
- Arguments that protection saves jobs, allows us to compete with cheap foreign labor, is needed to penalize lax environmental standards, and prevents exploitation of developing countries are flawed.
- Offshore outsourcing is just a new way of reaping gains from trade and does not justify protection.
- Trade restrictions are popular because protection brings a small loss per person to a large number of people and a large gain per person to a small number of people. Those who gain have a stronger political voice than those who lose and it is too costly to identify and compensate losers.

Key Terms

Dumping, 416
Exports, 406
Import quota, 412
Imports, 406
Offshore outsourcing, 417
Rent seeking, 419
Tariff, 410

PROBLEMS AND APPLICATIONS

How Global Markets Work

Use the following data to work Problems 1 to 3.

Wholesalers buy and sell roses in containers that hold 120 stems. The table provides information about the wholesale market for roses in the United States. The demand schedule is the wholesalers' demand and the supply schedule is the U.S. rose growers' supply.

Price (dollars per container)	Quantity demanded (millions of containers per year)	Quantity supplied (millions of containers per year)
100	15	0
125	12	2
150	9	4
175	6	6
200	3	8
225	0	10

Wholesalers can buy roses at auction in Aalsmeer, Holland, for $125 per container.

1. a. Without international trade, what would be the price of a container of roses and how many containers of roses a year would be bought and sold in the United States?
   b. At the price in your answer to part (a), does the United States or the rest of the world have a comparative advantage in producing roses?
2. If U.S. wholesalers buy roses at the lowest possible price, how many do they buy from U.S. growers and how many do they import?
3. Draw a graph to illustrate the U.S. wholesale market for roses. Show the equilibrium in that market with no international trade and the equilibrium with free trade. Mark the quantity of roses produced in the United States, the quantity imported, and the total quantity bought.

Winners, Losers, and the Net Gain from Trade

4. Use the data on the U.S. wholesale market for roses in Problem 1 to work this problem.
   a. Explain who gains and who loses from free international trade in roses compared to a situation in which Americans buy only roses grown in the United States.
   b. Draw a graph to illustrate the gains and losses from free trade.
   c. Calculate the value of imported roses.

International Trade Restrictions

Use the information on the U.S. wholesale market for roses in Problem 1 to work Problems 5 to 10.

5. If the United States puts a tariff of $25 per container on imports of roses, explain how the U.S. price of roses, the quantity of roses bought, the quantity produced in the United States, and the quantity imported change.
6. Who gains and who loses from this tariff?
7. Draw a graph of the U.S. market for roses to illustrate the gains and losses from the tariff. On the graph identify the government's tariff revenue from imported roses.
8. If the United States puts an import quota on roses of 5 million containers, what happens to the U.S. price of roses, the quantity of roses bought, the quantity produced in the United States, and the quantity imported?
9. Who gains and who loses from this import quota?
10. Draw a graph to illustrate the effects of the import quota, and on the graph identify the importers' profit.

The Case Against Protection

11. **Dependence on China for Medicine Is a Safety Threat**

    95% of ibuprofen and 70% of acetaminophen is imported from China. Since the pandemic began, imported generic drugs have entered the U.S. without proper inspection.

    Source: lasvegassun.com, February 13, 2021

    a. What does the news clip imply about the comparative advantage of producing pharmaceuticals in the United States and China?
    b. Could product quality be a valid argument against free trade? If it could, explain how.
    c. If China began proper inspection of drugs, who would gain and who would lose from free trade between the United States and China?
    d. With no safety threat, if the United States imposed a quota on generic drug imports from China, who would win and who would lose from the quota?

ADDITIONAL PROBLEMS AND APPLICATIONS

How Global Markets Work

12. Suppose that the world price of sugar is 10 cents a pound, the United States does not trade internationally, and the equilibrium price of sugar in the United States is 20 cents a pound. The United States then begins to trade internationally.
    a. How does the price of sugar in the United States change?
    b. Do U.S. consumers buy more or less sugar?
    c. Do U.S. sugar growers produce more or less sugar?
    d. Does the United States export or import sugar and why?
13. Suppose that the world price of steel is $100 a ton, India does not trade internationally, and the equilibrium price of steel in India is $60 a ton. India then begins to trade internationally.
    a. How does the price of steel in India change?
    b. How does the quantity of steel produced in India change?
    c. How does the quantity of steel bought by India change?
    d. Does India export or import steel and why?
14. A semiconductor is a key component in your laptop, smartphone, and iPad. The table provides information about the market for semiconductors in the United States.

Price (dollars per unit)	Quantity demanded (billions of units per year)	Quantity supplied (billions of units per year)
10	25	0
12	20	20
14	15	40
16	10	60
18	5	80
20	0	100

Producers of semiconductors can get $18 a unit on the world market.
    a. With no international trade, what would be the price of a semiconductor and how many semiconductors a year would be bought and sold in the United States?
    b. Does the United States have a comparative advantage in producing semiconductors?
15. **Drivers Are Returning to the Road. That Is Good News for Corn Growers.**
    Corn prices have hit their highest levels in almost eight years as drivers returning to the road following the pandemic are increasing the demand for ethanol.
    Source: wsj.com, March 30, 2021
    a. Why is the world price of corn rising?
    b. How does the change in the world price of corn affect the quantity of corn produced in a poor developing country with a comparative advantage in producing corn, the quantity it consumes, and the quantity that it either exports or imports?

Winners, Losers, and the Net Gain from Trade

16. Draw a graph of the market for corn in the poor developing country in Problem 15(b) to show the changes in the price of corn, the quantity produced, and the quantity consumed in a corn-importing country.

Use the following news clip to work Problems 17 and 18.

Scotland's Haggis Makers Heartened at Prospect of U.S. Breakthrough

Haggis, Scotland's national dish, has been banned in the United States since 1971. The United States does not allow sheep lungs—a primary ingredient in haggis—in food products. The United Kingdom wants the United States to end its ban.

Source: foodnavigator.com, August 3, 2020

17. a. Explain how the U.S. import ban on haggis affected haggis producers and consumers in Scotland.
    b. Draw a graph of the market for haggis in Scotland to illustrate your answer to part (a). Identify the quantity produced, the quantity consumed, and the quantity imported.
18. a. Explain how lifting the U.S. import ban on haggis affects producers and consumers of haggis in the United States.
    b. Draw a graph to illustrate your answer to (a) and identify the quantity produced, the quantity consumed, and the quantity imported.

International Trade Restrictions

Use the following information to work Problems 19 to 21.

Before 1995, trade between the United States and Mexico was subject to tariffs. In 1995, Mexico joined NAFTA, which in 2020 was replaced by USMCA. All U.S. and Mexican tariffs have been removed.

19. Explain how the price that U.S. consumers pay for goods from Mexico and the quantity of U.S. imports from Mexico have changed. Who are the winners and who are the losers from this free trade?
20. Explain how the quantity of U.S. exports to Mexico and the U.S. government's tariff revenue from trade with Mexico have changed.
21. Suppose that this year tomato growers in Florida lobby the U.S. government to impose an import quota on Mexican tomatoes. Explain who in the United States would gain and who would lose from such a quota.

Use the following information to work Problems 22 and 23.

Suppose that in response to huge job losses in the U.S. textile industry, Congress imposes a 100 percent tariff on imports of textiles from China.

22. Explain how the tariff on textiles will change the price that U.S. buyers pay for textiles, the quantity of textiles imported, and the quantity of textiles produced in the United States.
23. Explain how the U.S. and Chinese gains from trade will change. Who in the United States will lose and who will gain?

Use the following information to work Problems 24 and 25.

With free trade between Australia and the United States, Australia would export beef to the United States. But the United States imposes an import quota on Australian beef.

24. Explain how this quota influences the price that U.S. consumers pay for beef, the quantity of beef produced in the United States, and the U.S. and the Australian gains from trade.
25. Explain who in the United States gains from the quota on beef imports and who loses.

The Case Against Protection

26. **Can Biden Bring Manufacturing Back to the U.S.?**

    Nearly 5 million net manufacturing jobs have disappeared since 1997, and critics blame free-trade policies. The Biden administration wants to slow or reverse manufacturing job losses, a process known as "reshoring."

    Source: fortune.com, April 23, 2021

    a. What are the arguments for bringing jobs back to America? Explain why these arguments are faulty.
    b. Is there any merit in bringing jobs back?

Economics in the News

27. After you have studied *Economics in the News* on pp. 420–421, answer the following questions.
    a. Why, in Fig.1, does a U.S. tariff on memory chips not increase U.S. production of these chips?
    b. Why, when the United States imposes a tariff on chips imported from China, does the quantity of chips imported from Vietnam not equal the quantity previously imported from China?
    c. Draw a graph to show who loses from China's tariff on pork.
28. **Got Trade? Dairy Farmers Stand to Gain From the USMCA**

    Under NAFTA, U.S. dairy farmers were left behind because Canada restricted how much U.S. milk it imports. Under the USMCA, U.S. dairy farmers will be able to sell three times as much to Canadian markets as they could before. Canada has agreed to get rid of tariffs for U.S. dairy exports.

    Source: wsj.com, December 13, 2019

    a. What is USMCA? What is its aim?
    b. In the market for milk, explain how barriers to free trade influence the quantity of milk produced and consumed in Canada. Illustrate your answer with an appropriate graph.
    c. Explain why Canadian milk producers oppose free trade in milk with the United States.

Tradeoffs and Free Lunches

PART FIVE **WRAP-UP**

UNDERSTANDING MACROECONOMIC POLICY

A policy tradeoff arises if, in taking an action to achieve one goal, some other goal must be forgone. The Fed wants to avoid a rise in the inflation rate and a rise in the unemployment rate. But if the Fed raises the interest rate to curb inflation, it might lower expenditure and increase unemployment. The Fed faces a short-run tradeoff between inflation and unemployment.

A policy free lunch arises if in taking actions to pursue one goal, some other (intended or unintended) goal is also achieved. The Fed wants to keep inflation in check and, at the same time, to boost the economic growth rate. If lower inflation brings greater certainty about the future and stimulates saving and investment, the Fed gets both lower inflation and faster real GDP growth. It enjoys a free lunch.

The first two chapters in this part have described the institutional framework in which fiscal policy (Chapter 13) and monetary policy (Chapter 14) are made, described the instruments of policy, and analyzed the effects of policy. This exploration of economic policy draws on almost everything that you learned in previous chapters. The final chapter (Chapter 15) explains a free lunch that arises from international trade and the gains that are achieved from *free* trade.

These policy chapters serve as a capstone on your knowledge of macroeconomics and draw together all the strands in your study of the previous chapters. Milton Friedman, whom you meet below, has profoundly influenced our understanding of macroeconomic policy, especially monetary policy.

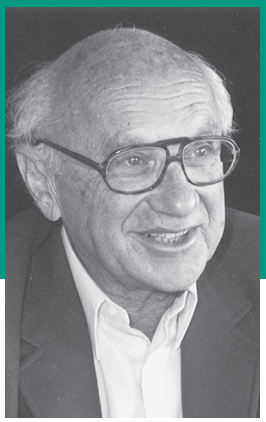
Milton Friedman *was born into a poor immigrant family in New York City in 1912. He was an undergraduate at Rutgers and a graduate student at Columbia University during the Great Depression. From 1977 until his death in 2006, Professor Friedman was a Senior Fellow at the Hoover Institution at Stanford University. But his reputation was built between 1946 and 1983, when he was a leading member of the "Chicago School," an approach to economics developed at the University of Chicago and based on the views that free markets allocate resources efficiently and that stable and low money supply growth delivers macroeconomic stability.*

Friedman has advanced our understanding of the forces that determine macroeconomic performance and clarified the effects of the quantity of money. For this work, he was awarded the 1977 Nobel Prize for Economic Science.

By reasoning from basic economic principles, Friedman (along with Edmund S. Phelps, the 2006 Economics Nobel Laureate) predicted that persistent demand stimulation would not increase output but would cause inflation.

"Inflation is always and everywhere a monetary phenomenon."

MILTON FRIEDMAN
The Counter-Revolution in Monetary Theory



When output growth slowed and inflation broke out in the 1970s, Friedman seemed like a prophet, and for a time, his policy prescription, known as monetarism, *was embraced around the world.*

TALKING WITH Stephanie Schmitt-Grohé

...the optimal inflation rate is well below the 2 percent or more that we observe.

STEPHANIE SCHMITT-GROHÉ is Professor of Economics at Columbia University. Born in Germany, she received her first economics degree at Westfälische Wilhelms-Universität Münster in 1987, her M.B.A in Finance at Baruch College, City University of New York in 1989, and her Ph.D. in economics at the University of Chicago in 1994.

Professor Schmitt-Grohé's research covers a wide range of fiscal policy and monetary policy issues that are especially relevant in today's economy as the consequences of the 2007 mortgage crisis play out.

Working with her husband, Martin Uribe, also a Professor of Economics at Columbia University, she has published papers in leading economics journals on how best to conduct monetary policy and fiscal policy and how to avoid problems that might arise from the inappropriate use of a simple policy rule for setting the federal funds rate. She has also contributed to the debate on inflation targeting.

In 2004, Professor Schmitt-Grohé was awarded the Bernácer Prize, awarded annually to a European economist under the age of 40 who has made outstanding contributions in the fields of macroeconomics and finance.

Michael Parkin talked with Stephanie Schmitt-Grohé about her work and the challenges of conducting stabilization policy.

Only a few years out of graduate school, you and your economist husband Martin Uribe accepted a challenge to contribute to an assessment of "dollarization" for Mexico. First, would you explain what dollarization is?

When a country dollarizes, the U.S. dollar becomes legal tender, replacing the domestic currency. Ecuador, for example, is dollarized. In the case of Mexico in 1999, there were proposals, mainly coming from the business community, to replace the peso with the U.S. dollar.

Why might dollarization be a good idea?

Such proposals are typically motivated by the desire to avoid excessive inflation and excessive exchange rate volatility. Dollarization also makes inflationary finance of the Treasury Department impossible.

You've done some recent research with Martin on the optimal or best inflation rate. What is the optimal rate?

Many central banks have an inflation target. In developed economies it is about 2 percent per year and in emerging market economies it is about 4 percent per year. Martin and I are trying to answer the seemingly simple and innocent question: Which level of the inflation rate should a central bank target? Is it the observed values of 2 percent and 4 percent? Or should it be zero, or 6 percent, or why not aim for a negative inflation rate—a falling price level? ...

In a realistic model of the economy that incorporates all the costs and benefits of inflation, the best inflation rate is at most half a percent per year. So the optimal inflation rate is well below the 2 percent or more that we observe.

Above full-employment equilibrium A macroeconomic equilibrium in which real GDP exceeds potential GDP. (p. 284)

Absolute advantage A person has an absolute advantage if that person is more productive than another person. (p. 68)

Aggregate demand The relationship between the quantity of real GDP demanded and the price level. (p. 278)

Aggregate planned expenditure The sum of planned consumption expenditure, planned investment, planned government expenditure on goods and services, and planned exports minus planned imports. (p. 298)

Aggregate production function The relationship between real GDP and the quantity of labor when all other influences on production remain the same. (p. 170)

Allocative efficiency A situation in which goods and services are produced at the lowest possible cost and in the quantities that provide the greatest possible benefit. We cannot produce more of any good without giving up some of another good that we *value more highly*. (p. 65)

Ample reserves A volume of reserves well in excess of the volume needed to conduct business. (p. 384)

Arbitrage The practice of seeking to profit by buying in one market and selling for a higher price in another related market. (p. 252)

Automatic fiscal policy A fiscal policy action that is triggered by the state of the economy with no action by the government. (p. 366)

Autonomous expenditure The sum of those components of aggregate planned expenditure that are not influenced by real GDP. Autonomous expenditure equals the sum of investment, government expenditure, exports, and the autonomous parts of consumption expenditure and imports. (p. 302)

Autonomous tax multiplier The change in equilibrium expenditure and real GDP that results from a change in autonomous taxes divided by the change in autonomous taxes. (p. 320)

Balanced budget A government budget in which receipts and outlays are equal. (p. 356)

Balanced budget multiplier The change in equilibrium expenditure and real GDP that results from equal changes in government expenditure and lump-sum taxes divided by the change in government expenditure. (p. 321)

Balance of payments accounts A country's record of international trading, borrowing, and lending. (p. 258)

Below full-employment equilibrium A macroeconomic equilibrium in which potential GDP exceeds real GDP. (p. 285)

Benefit The benefit of something is the gain or pleasure that it brings and is determined by preferences. (p. 37)

Bond A promise to make specified payments on specified dates. (p. 193)

Bond market The market in which bonds issued by firms and governments are traded. (p. 193)

Budget deficit A government's budget balance that is negative—outlays exceed receipts. (p. 356)

Budget surplus A government's budget balance that is positive—receipts exceed outlays. (p. 356)

Business cycle The periodic but irregular up-and-down movement of total production and other measures of economic activity. (p. 123)

Capital The tools, equipment, buildings, and other constructions that businesses use to produce goods and services. (p. 32)

Capital accumulation The growth of capital resources, including *human capital*. (p. 73)

Capital and financial account A record of foreign investment in a country minus its investment abroad. (p. 258)

Central bank A bank's bank and a public authority that regulates the nation's depository institutions and conducts *monetary policy*, which means it adjusts the quantity of money in circulation and influences interest rates. (p. 221)

Ceteris paribus Other things being equal—all other relevant things remaining the same. (p. 54)

Change in demand A change in buyers' plans that occurs when some influence on those plans other than the price of the good changes. It is illustrated by a shift of the demand curve. (p. 88)

Change in supply A change in sellers' plans that occurs when some influence on those plans other than the price of the good changes. It is illustrated by a shift of the supply curve. (p. 93)

Change in the quantity demanded A change in buyers' plans that occurs when the price of a good changes but all other influences on buyers' plans remain unchanged. It is illustrated by a movement along the demand curve. (p. 91)

Change in the quantity supplied A change in sellers' plans that occurs when the price of a good changes but all other influences on sellers' plans remain unchanged. It is illustrated by a movement along the supply curve. (p. 94)

Classical A macroeconomist who believes that the economy is self-regulating and always at full employment. (p. 288)

Classical growth theory A theory of economic growth based on the view that the growth of real GDP per person is temporary and that when it rises above subsistence level, a population explosion eventually brings it back to subsistence level. (p. 179)

Comparative advantage A person or country has a comparative advantage in an activity if that person or country can perform the activity at a lower opportunity cost than anyone else or any other country. (p. 68)

Competitive market A market that has many buyers and many sellers, so no single buyer or seller can influence the price. (p. 86)

Complement A good that is used in conjunction with another good. (p. 89)

Consumer Price Index (CPI) An index that measures the average of the prices paid by urban consumers for a fixed basket of consumer goods and services. (p. 149)

Consumption expenditure The total payment for consumer goods and services. (p. 117)

Consumption function The relationship between consumption expenditure and disposable income, other things remaining the same. (p. 298)

Core inflation rate The Fed's operational guide is the rate of increase in the core PCEPI, which is the PCEPI excluding food and fuel prices. (p. 153)

Cost-push inflation An inflation that results from an initial increase in costs. (p. 335)

Council of Economic Advisers The President's council whose main work is to monitor the economy and keep the President and the public well informed about the current state of the economy and the best available forecasts of where it is heading. (p. 355)

Crawling peg An exchange rate that follows a path determined by a decision of the government or the central bank and is achieved in a similar way to a fixed exchange rate. (p. 256)

Creditor nation A country that during its entire history has invested more in the rest of the world than other countries have invested in it. (p. 261)

Crowding-out effect The tendency for a government budget deficit to raise the real interest rate and decrease investment. (p. 205)

Currency The notes and coins held by individuals and businesses. (p. 215)

Currency drain ratio The ratio of currency to deposits. (p. 225)

Current account A record of receipts from exports of goods and services, payments for imports of goods and services, net interest income paid abroad, and net transfers received from abroad. (p. 258)

Cycle The tendency for a variable to alternate between upward and downward movements. (p. 131)

Cyclical surplus or deficit The actual surplus or deficit minus the structural surplus or deficit. (p. 367)

Cyclical unemployment The higher than normal unemployment at a business cycle trough and the lower than normal unemployment at a business cycle peak. (p. 145)

Debtor nation A country that during its entire history has borrowed more from the rest of the world than it has lent to the rest of the world. (p. 261)

Default risk The risk that a borrower might not repay a loan. (p. 201)

Deflation A persistently falling price level. (p. 148)

Demand The entire relationship between the price of the good and the quantity demanded of it when all other influences on buyers' plans remain the same. It is illustrated by a demand curve and described by a demand schedule. (p. 87)

Demand curve A curve that shows the relationship between the quantity demanded of a good and its price when all other influences on consumers' planned purchases remain the same. (p. 88)

Demand for loanable funds The relationship between the quantity of loanable funds demanded and the real interest rate when all other influences on borrowing plans remain the same. (p. 200)

Demand for money The relationship between the quantity of real money demanded and the nominal interest rate when all other influences on the amount of money that people wish to hold remain the same. (p. 228)

Demand-pull inflation An inflation that starts because aggregate demand increases. (p. 333)

Depository institution A financial firm that takes deposits from households and firms. (p. 217)

Depreciation The decrease in the value of a firm's capital that results from wear and tear and obsolescence. (p. 118)

Desired reserve ratio The ratio of reserves to deposits that banks *plan* to hold. (p. 225)

Direct relationship A relationship between two variables that move in the same direction. (p. 48)

Discount rate The interest rate paid by discount window borrowers. (pp. 224, 382)

Discouraged worker A marginally attached worker who has stopped looking for a job because of repeated failure to find one. (p. 143)

Discretionary fiscal policy A fiscal action that is initiated by an act of Congress. (p. 366)

Disposable income Aggregate income minus taxes plus transfer payments. (pp. 280, 298)

Dumping The sale by a foreign firm of exports at a lower price than the cost of production. (p. 416)

Economic growth The expansion of production possibilities. (pp. 73, 164)

Economic model A description of some aspect of the economic world that includes only those features of the world that are needed for the purpose at hand. (p. 39)

Economics The social science that studies the *choices* that individuals, businesses, governments, and entire societies make as they cope with *scarcity* and the *incentives* that influence and reconcile those choices. (p. 30)

Efficient Resource use is efficient if it is *not* possible to make someone better off without making someone else worse off. (p. 33)

Employment-to-population ratio The percentage of people of working age who have jobs. (p. 142)

Entrepreneurship The human resource that organizes the other three factors of production: labor, land, and capital. (p. 32)

Equilibrium expenditure The level of aggregate expenditure that occurs when aggregate *planned* expenditure equals real GDP. (p. 304)

Equilibrium price The price at which the quantity demanded equals the quantity supplied. (p. 96)

Equilibrium quantity The quantity bought and sold at the equilibrium price. (p. 96))

Exchange rate The price at which one currency exchanges for another in the foreign exchange market. (p. 244)

Expansion A business cycle phase between a trough and a peak—a period in which real GDP increases. (p. 123)

Exports The goods and services that we sell to people in other countries. (pp. 118, 406)

Factors of production The productive resources used to produce goods and services. (p. 31)

Federal budget The annual statement of the outlays and receipts of the government of the United States, together with the laws and regulations that approve and support those outlays and taxes. (p. 354)

Federal funds rate The interest rate that the banks charge each other on overnight loans. (pp. 217, 382)

Federal Open Market Committee The main policymaking organ of the Federal Reserve System. (p. 221)

Federal Reserve System (the Fed) The central bank of the United States, a public authority whose main role is the regulation of banks and money. (p. 221)

Fed's dual mandate The mandated goals to achieve stable prices and full employment. (p. 380)

Final good An item that is bought by its final user during the specified time period. (p. 116)

Financial capital The funds that firms use to buy physical capital and that households use to buy a home or to invest in human capital. (p. 192)

Financial institution A firm that operates on both sides of the market for financial capital. It borrows in one market and lends in another. (p. 194)

Firm An economic unit that hires factors of production and organizes those factors to produce and sell goods and services. (p. 76)

Fiscal imbalance The present value of the government's commitments to pay benefits minus the present value of its tax revenues. (p. 364)

Fiscal policy The use of the federal budget, by setting and changing tax rates, making transfer payments, and purchasing goods and services, to achieve macroeconomic objectives such as full employment, sustained economic growth, and price level stability. (pp. 280, 354)

Fiscal stimulus The use of fiscal policy to increase production and employment. (p. 366)

Fixed exchange rate An exchange rate the value of which is determined by a decision of the government or the central bank and is achieved by central bank intervention in the foreign exchange market to block the unregulated forces of demand and supply. (p. 255)

Flexible exchange rate An exchange rate that is determined by demand and supply in the foreign exchange market with no direct intervention by the central bank. (p. 255)

Foreign currency The money of other countries regardless of whether that money is in the form of notes, coins, or bank deposits. (p. 244)

Foreign exchange market The market in which the currency of one country is exchanged for the currency of another. (p. 244)

Frictional unemployment The unemployment that arises from normal labor turnover—from people entering and leaving the labor force and from the ongoing creation and destruction of jobs. (p. 145)

Full employment A situation in which the unemployment rate equals the natural unemployment rate. At full employment, there is no cyclical unemployment—all unemployment is frictional and structural. (p. 145)

Full-employment equilibrium A macroeconomic equilibrium in which real GDP equals potential GDP. (p. 285)

Generational accounting An accounting system that measures the lifetime tax burden and benefits of each generation. (p. 364)

Generational imbalance The division of the fiscal imbalance between the current and future generations, assuming that the current generation will enjoy the existing levels of taxes and benefits. (p. 365)

Goods and services The objects that people value and produce to satisfy human wants. (p. 31)

Government debt The total amount that the government has borrowed. It equals the sum of past budget deficits minus the sum of past budget surpluses. (p. 358)

Government expenditure Goods and services bought by government. (p. 118)

Government expenditure multiplier The quantitative effect of a change in government expenditure on real GDP. It is calculated as the change in real GDP that results from a change in government expenditure divided by the change in government expenditure. (pp. 320, 369)

Government sector balance An amount equal to net taxes minus government expenditure on goods and services. (p. 262)

Gross domestic product (GDP) The market value of all final goods and services produced within a country during a given time period. (p. 116)

Gross investment The total amount spent on purchases of new capital and on replacing depreciated capital. (pp. 118, 192)

Growth rate The annual percentage change of a variable—the change in the level expressed as a percentage of the initial level. (p. 164)

Human capital The knowledge and skill that people obtain from education, on-the-job training, and work experience. (p. 31)

Hyperinflation An inflation rate of 50 percent a month or higher that grinds the economy to a halt and causes a society to collapse. (p. 148)

Import quota A restriction that limits the maximum quantity of a good that may be imported in a given period. (p. 412)

Imports The goods and services that we buy from people in other countries. (pp. 118, 406)

Incentive A reward that encourages an action or a penalty that discourages one. (p. 30)

Induced expenditure The sum of the components of aggregate planned expenditure that vary with real GDP. Induced expenditure equals consumption expenditure minus imports. (p. 302)

Inferior good A good for which demand decreases as income increases. (p. 90)

Inflation A persistently rising price level. (p. 148)

Inflationary gap An output gap in which real GDP exceeds potential GDP. (p. 284)

Inflation rate targeting A monetary policy strategy in which the central bank makes a public commitment to achieve an explicit inflation rate and to explain how its policy actions will achieve that target. (p. 394)

Interest The income that capital earns. (p. 32)

Interest on reserves rate The interest rate that banks earn on their reserves held on deposit at the Fed. (pp. 224, 382)

Interest rate parity A situation in which the rates of return on assets in different currencies are equal. (p. 252)

Intermediate good An item that is produced by one firm, bought by another firm, and used as a component of a final good or service. (p. 116)

Inverse relationship A relationship between variables that move in opposite directions. (p. 49)

Investment The purchase of new plant, equipment, and buildings, and additions to inventories. (p. 117)

Keynesian A macroeconomist who believes that left alone, the economy would rarely operate at full employment and that to achieve full employment, active help from fiscal policy and monetary policy is required. (p. 288)

Keynesian cycle theory A theory that fluctuations in investment driven by fluctuations in business confidence—summarized by the phrase "animal spirits"—are the main source of fluctuations in aggregate demand. (p. 329)

Labor The work time and work effort that people devote to producing goods and services. (p. 31)

Labor force The sum of the people who are employed and who are unemployed. (p. 141)

Labor force participation rate The percentage of the working-age population who are members of the labor force. (p. 143)

Labor productivity The quantity of real GDP produced by an hour of labor. (p. 174)

Laffer curve The relationship between the tax rate and the amount of tax revenue collected. (p. 363)

Land The "gifts of nature" that we use to produce goods and services. (p. 31)

Law of demand Other things remaining the same, the higher the price of a good, the smaller is the quantity demanded of it; the lower the price of a good, the larger is the quantity demanded of it. (p. 87)

Law of supply Other things remaining the same, the higher the price of a good, the greater is the quantity supplied of it; the lower the price of a good, the smaller is the quantity supplied. (p. 92)

Limited reserves The minimum level of reserves at which a bank can function. (p. 384)

Linear relationship A relationship between two variables that is illustrated by a straight line. (p. 48)

Loanable funds market The aggregate of all the individual markets in which households, firms, governments, banks, and other financial institutions borrow and lend. (p. 200)

Long-run aggregate supply The relationship between the quantity of real GDP supplied and the price level when the money wage rate changes in step with the price level to maintain full employment. (p. 274)

Long-run macroeconomic equilibrium A situation that occurs when real GDP equals potential GDP—the economy is on its long-run aggregate supply curve. (p. 282)

Long-run Phillips curve A curve that shows the relationship between inflation and unemployment when the actual inflation rate equals the expected inflation rate. (p. 342)

M1 A measure of money that consists of currency plus demand deposits and other liquid deposits owned by individuals and businesses. (p. 215)

M2 A measure of money that consists of M1 plus small-denominated time deposits and real time money market mutual funds. (p. 215)

Macroeconomics The study of the performance of the national economy and the global economy. (p. 30)

Macroprudential regulation The financial regulation to lower the risk that the financial system will crash. (p. 397)

Margin When a choice is made by comparing a little more of something with its cost, the choice is made at the margin. (p. 38)

Marginal benefit The benefit that a person receives from consuming one more unit of a good or service. It is measured as the maximum amount that a person is willing to pay for one more unit of the good or service. (pp. 38, 66)

Marginal benefit curve A curve that shows the relationship between the marginal benefit of a good and the quantity of that good consumed. (p. 66)

Marginal cost The *opportunity cost* of producing *one* more unit of a good or service. It is the best alternative forgone. It is calculated as the increase in total cost divided by the increase in output. (pp. 38, 65)

Marginally attached worker A person who currently is neither working nor looking for work but has indicated that he or she wants and is available for a

job and has looked for work some time in the recent past. (p. 143)

Marginal propensity to consume The fraction of a *change* in disposable income that is spent on consumption. It is calculated as the *change* in consumption expenditure divided by the *change* in disposable income. (p. 300)

Marginal propensity to import The fraction of an increase in real GDP that is spent on imports. It is calculated as the *change* in imports divided by the *change* in real GDP, other things remaining the same. (p. 301)

Marginal propensity to save The fraction of a *change* in disposable income that is saved. It is calculated as the *change* in saving divided by the *change* in disposable income. (p. 300)

Market Any arrangement that enables buyers and sellers to get information and to do business with each other. (p. 76)

Means of payment A method of settling a debt. (p. 214)

Microeconomics The study of the choices that individuals and businesses make, the way these choices interact in markets, and the influence of governments. (p. 30)

Monetarist A macroeconomist who believes that the economy is self-regulating and that it will normally operate at full employment, provided that monetary policy is not erratic and that the pace of money growth is kept steady. (p. 289)

Monetarist cycle theory A theory that fluctuations in both investment and consumption expenditure, driven by fluctuations in the growth rate of the quantity of money, are the main source of fluctuations in aggregate demand. (p. 329)

Monetary base The sum of currency and reserves of the depository institution deposits. (p. 222)

Monetary policy The Fed conducts the nation's monetary policy by changing interest rates and adjusting the quantity of money. (p. 280)

Monetary policy instrument A variable that the Fed can directly control or at least very closely target. (p. 382)

Money Any commodity or token that is generally acceptable as a means of payment. (pp. 76, 214)

Money multiplier The ratio of the change in the quantity of money to the change in the monetary base. (p. 226)

Money price The number of dollars that must be given up in exchange for a good or service. (p. 86)

Mortgage A legal contract that gives ownership of a home to the lender in the event that the borrower fails to meet the agreed loan payments (repayments and interest). (p. 193)

Mortgage-backed security A type of bond that entitles its holder to the income from a package of mortgages. (p. 193)

Multiplier The amount by which a change in autonomous expenditure is magnified or multiplied to determine the change in equilibrium expenditure and real GDP. (p. 306)

National saving The sum of private saving (saving by households and businesses) and government saving. (p. 197)

Natural unemployment rate The unemployment rate when the economy is at full employment—natural unemployment as a percentage of the labor force. (p. 145)

Negative relationship A relationship between variables that move in opposite directions. (p. 49)

Neoclassical growth theory A theory of economic growth that proposes that real GDP per person grows because technological change induces an amount of saving and investment that makes capital per hour of labor grow. (p. 179)

Net borrower A country that is borrowing more from the rest of the world than it is lending to it. (p. 260)

Net exports The value of exports of goods and services minus the value of imports of goods and services. (pp. 118, 262)

Net investment The amount by which the value of capital increases—gross investment minus depreciation. (pp. 118, 192)

Net lender A country that is lending more to the rest of the world than it is borrowing from it. (p. 260)

Net present value The present value of all the future flows of money that arise from a financial decision minus the initial cost of the decision. (p. 198)

Net taxes Taxes paid to governments minus cash transfers received from governments. (p. 196)

Net worth The market value of what a financial institution has lent minus the market value of what it has borrowed. (p. 198)

New classical A macroeconomist who holds the view that business cycle fluctuations are the efficient responses of a well-functioning market economy bombarded by shocks that arise from the uneven pace of technological change. (p. 288)

New classical cycle theory A rational expectations theory of the business cycle in which the rational expectation of the price level, which is determined by potential GDP and *expected* aggregate demand, determines the money wage rate and the position of the *SAS* curve. (p. 329)

New growth theory A theory of economic growth based on the idea that real GDP per person grows because of the choices that people make in the pursuit of profit and that growth will persist indefinitely. (p. 180)

New Keynesian A macroeconomist who holds the view that not only is the money wage rate sticky but also that the prices of goods and services are sticky. (p. 289)

New Keynesian cycle theory A rational expectations theory of the business cycle that emphasizes the fact that today's money wage rates were negotiated at many past dates, which means that *past* rational expectations of the current price level influence the money wage rate and the position of the *SAS* curve. (p. 329)

Nominal GDP The value of the final goods and services produced in a given year valued at the prices that prevailed in that same year.

It is a more precise name for GDP. (p. 121)

Nominal interest rate The number of dollars that a borrower pays and a lender receives in interest in a year expressed as a percentage of the number of dollars borrowed and lent. (p. 199)

Normal good A good for which demand increases as income increases. (p. 90)

Official settlements account A record of the change in official reserves, which are the government's holdings of foreign currency. (p. 258)

Offshore outsourcing A U.S. firm buys finished goods, components, or services from firms in other countries. (p. 417)

Open market operation The purchase or sale of government securities—U.S. Treasury bills and bonds—by the Federal Reserve System in the *loanable funds market*. (p. 222)

Opportunity cost The highest-valued alternative that we must give up to get something. (pp. 37, 63)

Output gap The gap between real GDP and potential GDP. (pp. 146, 284)

Personal Consumption Expenditure Price Index A measure of the average of the prices of all the items included in the personal consumption expenditures component of GDP. (p. 152)

Positive relationship A relationship between two variables that move in the same direction. (p. 48)

Potential GDP The value of production when all the economy's labor, capital, land, and entrepreneurial ability are fully employed; the quantity of real GDP at full employment. (p. 122)

Preferences A description of a person's likes and dislikes and the intensity of those feelings. (pp. 37, 66)

Price level The average level of prices. (p. 148)

Private sector balance An amount equal to saving minus investment. (p. 262)

Production efficiency A situation in which goods and services are produced at the lowest possible cost. (p. 63)

Production possibilities frontier The boundary between those combinations of goods and services that can be produced and those combinations that cannot. (p. 62)

Profit The income earned by entrepreneurship. (p. 32)

Property rights The social arrangements that govern the ownership, use, and disposal of anything that people value. Property rights are enforceable in the courts. (p. 76)

Purchasing power parity A situation in which the prices in two countries are equal when converted at the exchange rate. (p. 252)

Quantitative easing Large open market purchases to increase the quantity of reserves. (p. 384)

Quantitative tightening Large open market sales to decrease the quantity of reserves. (p. 384)

Quantity demanded The amount of a good or service that consumers plan to buy during a given time period at a particular price. (p. 87)

Quantity supplied The amount of a good or service that producers plan to sell during a given time period at a particular price. (p. 92)

Quantity theory of money The proposition that in the long run, an increase in the quantity of money brings an equal percentage increase in the price level. (p. 232)

Rational choice A choice that compares costs and benefits and achieves the greatest benefit over cost for the person making the choice. (p. 37)

Rational expectation The best forecast possible, a forecast that uses all the available information. (p. 338)

Real business cycle theory A theory of the business cycle that regards random fluctuations in productivity as the main source of economic fluctuations. (p. 329)

Real exchange rate The relative price of U.S.-produced goods and services to foreign-produced goods and services. (p. 254)

Real GDP The value of final goods and services produced in a given year when valued at the prices of a reference base year. (p. 121)

Real GDP per person Real GDP divided by the population. (pp. 122, 164)

Real income A household's income expressed as a quantity of goods that the household can afford to buy. (p. 231)

Real interest rate The nominal interest rate adjusted to remove the effects of inflation on the buying power of money. It is approximately equal to the nominal interest rate minus the inflation rate. (p. 199)

Real wage rate The money (or nominal) wage rate divided by the price level. The real wage rate is the quantity of goods and services that an hour of labor earns. (p. 171)

Recession A business cycle phase in which real GDP decreases for at least two successive quarters. (p. 123)

Recessionary gap An output gap in which potential GDP exceeds real GDP. (p. 285)

Relative price The ratio of the price of one good or service to the price of another good or service. A relative price is an opportunity cost. (p. 86)

Rent The income that land earns. (p. 32)

Rent seeking The lobbying for special treatment by the government to create economic profit or to divert consumer surplus or producer surplus away from others. The pursuit of wealth by capturing economic rent. (p. 419)

Reserves A bank's reserves consist of notes and coins in its vaults plus its deposit at the Federal Reserve System. (pp. 217, 382)

Rule of 70 A rule that states that the number of years it takes for the level of any variable to double is approximately 70 divided by the annual percentage growth rate of the variable. (p. 165)

Saving The amount of income that is not paid in taxes or spent on consumption goods and services. (p. 192)

Saving function The relationship between saving and disposable income, other things remaining the same. (p. 298)

Scarcity Our inability to satisfy all our wants. (p. 30)

Scatter diagram A graph that plots the value of one variable against the value of another variable for a number of different values of each variable. (p. 46)

Self-interest The choices that you think are the best ones available for you are choices made in your self-interest. (p. 33)

Short-run aggregate supply The relationship between the quantity of real GDP supplied and the price level when the money wage rate, the prices of other resources, and potential GDP remain constant. (p. 275)

Short-run macroeconomic equilibrium A situation that occurs when the quantity of real GDP demanded equals the quantity of real GDP supplied—at the point of intersection of the *AD* curve and the *SAS* curve. (p. 282)

Short-run Phillips curve A curve that shows the tradeoff between inflation and unemployment, when the expected inflation rate and the natural unemployment rate are held constant. (p. 342)

Slope The change in the value of the variable measured on the *y*-axis divided by the change in the value of the variable measured on the *x*-axis. (p. 52)

Social interest Choices that are the best ones for society as a whole. (p. 33)

Stagflation The combination of inflation and recession. (pp. 287, 336)

Stock A certificate of ownership and claim to the firm's profits. (p. 194)

Stock market A financial market in which shares of stocks of corporations are traded. (p. 194)

Structural surplus or deficit The budget balance that would occur if the economy were at full employment and real GDP were equal to potential GDP. (p. 367)

Structural unemployment The unemployment that arises when changes in technology or international competition change the skills needed to perform jobs or change the locations of jobs. (p. 145)

Substitute A good that can be used in place of another good. (p. 89)

Supply The entire relationship between the price of a good and the quantity supplied of it when all other influences on producers' planned sales remain the same. It is described by a supply schedule and illustrated by a supply curve. (p. 92)

Supply curve A curve that shows the relationship between the quantity supplied of a good and its price when all other influences on producers' planned sales remain the same. (p. 92)

Supply of loanable funds The relationship between the quantity of loanable funds supplied and the real interest rate when all other influences on lending plans remain the same. (p. 201)

Supply of money The relationship between the quantity of money supplied and the nominal interest rate when all other influences on lending plans remain the same. (p. 229)

Tariff A tax that is imposed by the importing country when an imported good crosses its international boundary. (p. 410)

Tax multiplier The quantitative effect of a change in taxes on real GDP. It is calculated as the change in real GDP that results from a change in taxes divided by the change in taxes. (p. 369)

Tax wedge The gap between the before-tax and after-tax wage rates. and returns to other factors of production. (p. 361)

Technological change The development of new goods and of better ways of producing goods and services. (p. 73)

Time-series graph A graph that measures time (for example, years, quarters, or months) on the *x*-axis and the variable or variables in which we are interested on the *y*-axis. (p. 130)

Tradeoff A constraint that involves giving up one thing to get something else. (p. 37)

Trend The tendency for a variable to move in one general direction. (p. 131)

Unemployment rate The percentage of the people in the labor force who are unemployed. (p. 142)

Unplanned reserves A bank's actual reserves minus its desired reserves. (p. 225)

U.S. interest rate differential The U.S. interest rate minus the foreign interest rate. (p. 249)

U.S. official reserves The U.S. government's holdings of foreign currency. (p. 258)

Velocity of circulation The average number of times a dollar of money is used annually to buy the goods and services that make up GDP. (p. 232)

Wages The income that labor earns. (p. 32)

Wealth The value of all the things that people own—the market value of their assets—at a point in time. (p. 192)

Working-age population The total number of people aged 16 years and over who are not in jail, hospital, or some other form of institutional care. (p. 141)

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