ECONOMICS

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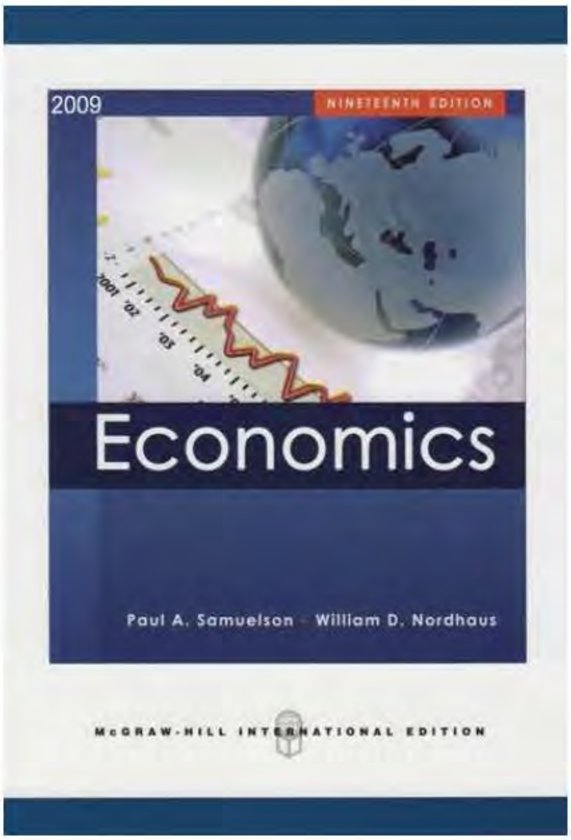

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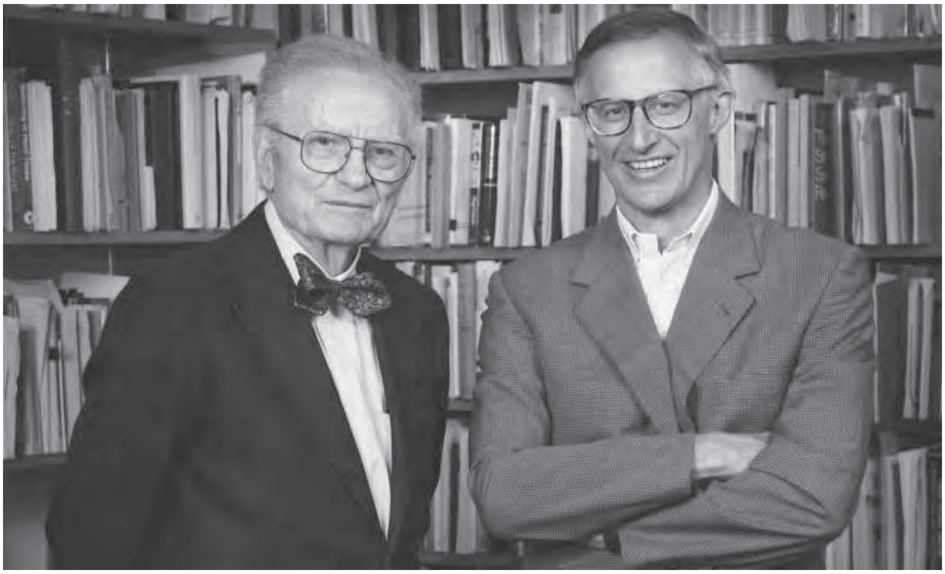

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To our families, students, and colleagues

ECONOMICS

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A Centrist Proclamation

Sciences advance. But they can also recede. That is true of economics as well. By the end of World War II, the leading introductory textbooks in economics had lost their vitality and relevance. Nature abhors a vacuum. The first edition of this textbook appeared as the 1948 edition of Samuelson's *ECONOMICS*. It introduced macroeconomics into our colleges and served as the gold standard for teaching economics in an increasingly globalized world.

Both the economy and economics have changed greatly over the years. Successive editions of this textbook, which became Samuelson-Nordhaus *ECONOMICS,* have documented the evolutionary changes in the world economy and have provided the latest rigorous economic thinking at the frontier of the discipline.

To our surprise, this nineteenth edition may be one of the most significant of all revisions. We call this the *centrist edition.* It proclaims the value of the mixed economy—an economy that combines the tough discipline of the market with fair-minded governmental oversight.

Centrism is of vital importance today because the global economy is in a terrible meltdown—perhaps worse than any cyclical slump since the Great Depression of the 1930s. Alas, many textbooks have strayed too far toward over-complacent libertarianism. They joined the celebration of free-market finance and supported dismantling regulations and abolishing oversight. The bitter harvest of this celebration was seen in the irrationally exuberant housing and stock markets that collapsed and led to the current financial crisis.

The centrism we describe is not a prescription that is intended to persuade readers away from their beliefs. We are analysts and not cult prescribers. It is not ideology that breeds centrism as our theme. We sift facts and theories to determine the consequences of Hayek-Friedman libertarianism or Marx-Lenin bureaucratic communism. All readers are free to make up their own minds about best ethics and value judgments.

Having surveyed the terrain, this is our reading: Economic history confirms that neither unregulated capitalism nor overregulated central planning can organize a modern society effectively.

The follies of the left and right both mandate centrism. Tightly controlled central planning, which was widely advocated in the middle decades of the last century, was abandoned after it produced stagnation and unhappy consumers in communist countries.

What exactly was the road to serfdom that Hayek and Friedman warned us against? They were arguing against social security, a minimum wage, national parks, progressive taxation, and government rules to clean up the environment or slow global warming. People who live in high-income societies support these programs with great majorities. Such mixed economies involve both the rule of law and the limited liberty to compete.

We survey the centrist approach to economics in the pages that follow. Millions of students in China, India, Latin America, and emerging societies have sought economic wisdom from these pages. Our task is to make sure that the latest and best thinking of economists is contained here, describing the logic of the modern mixed economy, but always presenting in a fair manner the views of those who criticize it from the left and the right.

But we go a step further in our proclamation. We hold that there must be a *limited centrism*. Our knowledge is imperfect, and society's resources are limited. We are also mindful of our current predicament. We see that unfettered capitalism has generated painful inequalities of income and wealth, and that supply-side fiscal doctrines have produced large government deficits. We observe that the major innovations of modern finance, when operating in an unregulated system, have produced trillions of dollars of losses and led to the ruin of many venerable financial institutions.

Only by steering our societies back to the limited center can we ensure that the global economy returns to full employment where the fruits of progress are more equally shared.

Paul A. Samuelson
February 2009

Preface

As we complete this nineteenth edition of *Economics,* the U.S. economy has fallen into a deep recession as well as the most serious financial crisis since the Great Depression of the 1930s. The federal government has invested hundreds of billions of dollars to protect the fragile network of the U.S. and indeed the world financial system. The new Obama administration has worked with Congress to pass the largest stimulus package in American history. The economic turmoil, and the manner in which countries respond to it, will shape the American economy, its labor market, and the world financial system for years to come.

We should remember, however, that the financial crisis of 2007–2009 came after more than a half-century of spectacular increases in the living standards of most of the world, particularly those living in the affluent countries of North America, Western Europe, and East Asia. People are asking, "Will the twenty-first century repeat the successes of the last century? Will the affluence of the few spread to poor countries? Alternatively, will the four horsemen of the economic apocalypse—famine, war, environmental degradation, and depression—spread to the North? Do we have the wisdom to reshape our financial systems so that they can continue to provide the investments that have fueled economic growth up to now? And what should we think about environmental threats such as global warming?"

These are ultimately the questions we address in this new edition of *Economics.*

The Growing Role of Markets

You might think that prosperity would lead to a declining interest in economic affairs, but paradoxically an understanding of the enduring truths of economics has become even more vital in the affairs of people and nations. Those who remember history recognize that the crises that threatened financial markets in the twenty-first century were the modern counterpart of banking panics of an earlier era.

In the larger scene, the world has become increasingly interconnected as computers and communications create an ever more competitive global marketplace. Developing countries like China and India—two giants that relied heavily on central planning until recently—need a firm understanding of the institutions of a market economy if they are to attain the living standards of the affluent. At the same time, there is growing concern about international environmental problems and the need to forge agreements to preserve our precious natural heritage. All these fascinating changes are part of the modern drama that we call economics.

ECONOMICS Reborn

For more than half a century, this book has served as the standard-bearer for the teaching of introductory economics in classrooms in America and throughout the world. Each new edition distills the best thinking of economists about how markets function and about what countries can do to improve people's living standards. But economics has changed profoundly since the first edition of this text appeared in 1948. Moreover, because economics is above all a living and evolving organism, *Economics* is born anew each edition as the authors have the exciting opportunity to present the latest thinking of modern economists and to show how the subject can contribute to a more prosperous world.

Our task then is this: We strive to present a clear, accurate, and interesting introduction to the principles of modern economics and to the institutions of the American and world economies. Our primary goal is to emphasize the core economic principles that will endure beyond today's headlines.

THE NINETEENTH EDITION

As economics and the world around it evolve, so does this book. Our philosophy continues to emphasize six basic principles that underlie earlier editions and this revision:

1. The Core Truths of Economics. Often, economics appears to be an endless procession of new puzzles, problems, and dilemmas. But as experienced teachers have learned, there are a few basic concepts that underpin all of economics. Once these concepts have been mastered, learning is much quicker and more enjoyable. *We have therefore chosen to focus on the central core of economics—on those enduring truths that will be just as important in the twenty-first century as they were in the twentieth.* Microeconomic concepts such as scarcity, efficiency, the gains from specialization, and the principle of comparative advantage will be crucial concepts as long as scarcity itself exists. In macroeconomics, we emphasize the two central approaches: Keynesian economics to understand business cycles, and the neoclassical growth model to understand longer-term growth trends. Within these frameworks, established approaches such as the consumption function take place alongside new developments in financial macroeconomics.

2. Innovation in Economics. Economics has made many advances in understanding the role of innovation. We are accustomed to the dizzying speed of invention in software, where new products appear monthly. The Internet is revolutionizing communications and study habits and is making inroads into commerce.

In addition, we emphasize innovations in economics itself. Economists are innovators and inventors in their own way. History shows that economic ideas can produce tidal waves when they are applied to real-world problems. Among the important innovations we survey is the application of economics to our environmental problems through emissions-trading plans. We explain how behavioral economics has changed views of consumer theory and finance. One of the most important innovations for our common future is dealing with global public goods like climate change, and we analyze new ways to deal with international environmental problems, including approaches such as the Kyoto Protocol. We must also track innovations in policy, such as the changing approach to monetary policy in the Federal Reserve.

3. Small Is Beautiful. Economics has increased its scope greatly over the past half-century. The flag of economics flies over its traditional territory of the marketplace, but it also covers the environment, legal studies, statistical and historical methods, gender and racial discrimination, and even family life. But at its core, economics is the science of choice. That means that we, as authors, must choose the most important and enduring issues for this text. In a survey, as in a meal, small is beautiful because it is digestible.

Choosing the subjects for this text required many hard choices. To select these topics, we continually survey teachers and leading scholars to determine the issues most crucial for an informed citizenry and a new generation of economists. We drew up a list of key ideas and bid farewell to material we judged inessential or dated. *At every stage, we asked whether the material was, as best we could judge, necessary for a student's understanding of the economics of the twenty-first century.* Only when a subject passed this test was it included. The result of this campaign is a book that has lost more than one-quarter of its weight in the last few editions and has trimmed three chapters for this edition. Farm economics, the history of labor unions, Marxian economics, advanced treatment of general equilibrium, regulatory developments, and the lump-of-labor fallacy have been trimmed to make room for modern financial theory, real business cycles, and global public goods.

4. Policy Issues for Today. For many students, the lure of economics is its relevance to public policy. The nineteenth edition emphasizes policy in both microeconomics and macroeconomics. As human societies grow, they begin to overwhelm the environment and ecosystems of the natural world. Environmental economics helps students understand the externalities associated with economic activity and then analyzes different approaches to making human economies compatible with natural systems. New examples bring the core principles of microeconomics to life.

A second area of central importance is financial and monetary economics. We have completely revised our treatment here. Previous treatment emphasized the quantity of money as the prime channel through which the central bank influences the economy. This approach no longer reflects the realities of a modern financial system. Today, the Fed exercises its policies by targeting the short-run interest rate and providing liquidity to financial markets. With the nineteenth edition, we fully incorporate these changes in three central chapters.

5. Debates about Globalization. The last decade has witnessed pitched battles over the role of international trade in our economies. Some argue that "outsourcing" is leading to the loss of thousands of jobs to India and China. Immigration has been a hot-burner issue, particularly in communities with high unemployment rates. Whatever the causes, the United States was definitely faced with the puzzle of rapid output growth and a very slow growth in employment in the first decade of the twenty-first century.

One of the major debates of recent years has been over "globalization," which concerns the increasing economic integration of different countries. Americans have learned that no country is an economic island. Immigration and international trade have profound effects on the goods that are available, the prices we pay, and the wages we earn. Terrorism can wreak havoc on the economy at home, while war causes famines, migration, and reduced living standards in Africa. No one can fully understand the impact of growing trade and capital flows without a careful study of the theory of comparative advantage. We will see how the flow of financial capital has an enormous influence on trading patterns as well as understand why poor countries like China save while rich countries like the United States are borrowers. The nineteenth edition continues to increase the material devoted to international economics and the interaction between international trade and domestic economic events.

6. Clarity. Although there are many new features in the nineteenth edition, the pole star for our pilgrimage for this edition has been to present economics clearly and simply. Students enter the classroom with a wide range of backgrounds and with many preconceptions about how the world works. Our task is not to change students' values. Rather, we strive to help students understand enduring economic principles so that they may better be able to apply them—to make the world a better place for themselves, their families, and their communities. Nothing aids understanding better than clear, simple exposition. We have labored over every page to improve this survey of introductory economics. We have received thousands of comments and suggestions from teachers and students and have incorporated their counsel in the nineteenth edition.

Optional Matter

Economics courses range from one-quarter surveys to year-long intensive honors courses. This textbook has been carefully designed to meet all situations. If yours is a fast-paced course, you will appreciate the careful layering of the more advanced material. Hard-pressed courses can skip the advanced sections and chapters, covering the core of economic analysis without losing the thread of the economic reasoning. This book will challenge the most advanced young scholar. Indeed, many of today's leading economists have written to say they have relied upon *Economics* all along their pilgrimage to the Ph.D.

Format

The nineteenth edition employs in-text logos and material to help illustrate the central topics. You will find a distinctive logo indicating warnings for the fledgling economist, examples of economics in action, and biographical material on the great economists of the past and present. But these central topics are not drifting off by themselves in unattached boxes. Rather, they are integrated right into the chapter so that students can read them and see how they illustrate the core material. Keep these sections in mind as you read through the text. Each one is either:

- A warning that students should pause to ensure that they understand a difficult or subtle point.
- An interesting example or application of the analysis, often representing one of the major innovations of modern economics.
- A biography of an important economic figure.

New features in this edition include fresh end-of-chapter questions, with a special accent on short problems that reinforce the major concepts surveyed in the chapter.

Terms printed in **bold type** in the text mark the first occurrence and definition of the most important words that constitute the language of economics.

But these many changes have not altered one bit the central stylistic beacon that has guided *Economics* since the first edition: to use simple sentences, clear explanations, and concise tables and graphs.

For Those Who Prefer Macro First

Although, like the previous edition, this new edition has been designed to cover microeconomics first, many teachers continue to prefer beginning with macroeconomics. Many believe that the beginning student finds macro more approachable and will more quickly develop a keen interest in economics when the issues of macroeconomics are encountered first. We have taught economics in both sequences and find both sequences work well.

Whatever your philosophy, this text has been carefully designed for it. Instructors who deal with microeconomics first can move straight through the chapters. Those who wish to tackle macroeconomics first should skip from Part One directly to Part Five, knowing that the exposition and cross-references have been tailored with their needs in mind.

In addition, for those courses that do not cover the entire subject, the nineteenth edition is available in two paperback volumes, *Microeconomics* (Chapters 1 to 18 of the full text) and *Macroeconomics* (Chapters 1 to 3, 15, and 19 to 31 of the full text).

Auxiliary Teaching and Study Aids

Students of this edition will benefit greatly from the *Study Guide*. This carefully designed supplement was updated by Walter Park of the American University. When used alongside classroom discussions and when employed independently for self-study, the *Study Guide* has proved to be an impressive success. There is a full-text *Study Guide,* as well as micro and macro versions. The *Study Guides* are available electronically for online purchase or packaged with the text via code-card access.

In addition, instructors will find both the *Instructor's Resource Manual,* updated for this edition by Carlos Liard-Muriente of Central Connecticut State University, and the *Test Bank*, fully revised by Craig Jumper of Rich Mountain Community College. These supplements are incredibly useful for instructors planning their courses and preparing multiple sets of test questions in both print and computerized formats. The graphs and figures in this edition can also be viewed electronically as PowerPoint slides. The slides can be downloaded from our website (*www.mhhe.com/samuelson19e*). The website also contains chapter summaries, self-grading practice quizzes, and links to the websites suggested for further research at the end of each chapter.

CourseSmart eTextbook

For roughly half the cost of a print book, you can reduce your impact on the environment by purchasing the electronic edition of the nineteenth edition of Samuelson and Nordhaus, *Economics.* CourseSmart eTextbooks, available in a standard online reader, retain the exact content and layout of the print text, plus offer the advantage of digital navigation to which students are accustomed. Students can search the text, highlight, take notes, and use e-mail tools to share notes with their classmates. CourseSmart also includes tech support in case help is ever needed. To buy *Economics,* 19e as an eTextbook, or to learn more about this digital solution, visit ***www.CourseSmart.com*** and search by title, author, or ISBN.

Economics in the Computer Age

The electronic age has revolutionized the way that scholars and students can access information. In economics, the information revolution allows us quick access to economic statistics and research. An important feature of the nineteenth edition is the section "Economics and the Internet," which appears just before Chapter 1. This little section provides a road map for the state of economics on the Information Superhighway.

In addition, each chapter has an updated section at the end with suggestions for further reading and addresses of websites that can be used to deepen student understanding or find data and case studies.

Acknowledgments

This book has two authors but a multitude of collaborators. We are profoundly grateful to colleagues, reviewers, students, and McGraw-Hill's staff for contributing to the timely completion of the nineteenth edition of *Economics.* Colleagues at MIT, Yale, and elsewhere who have graciously contributed their comments and suggestions over the years include William C. Brainard, E. Cary Brown, John Geanakoplos, Robert J. Gordon, Lyle Gramley, Gerald Jaynes, Paul Joskow, Alfred Kahn, Richard Levin, Robert Litan, Barry Nalebuff, Merton J. Peck, Gustav Ranis, Herbert Scarf, Robert M. Solow, James Tobin, Janet Yellen, and Gary Yohe.

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Students at MIT, Yale, and other colleges and universities have served as an "invisible college." They constantly challenge and test us, helping to make this edition less imperfect than its predecessor. Although they are too numerous to enumerate, their influence is woven through every chapter. Nancy King helped in logistics at the New Haven end of the operation. We are particularly grateful for the contribution of Caroleen Verly, who read the manuscript and made many suggestions for improvement. We are grateful to Dr. Xi Chen, who prepared the economic globes and reviewed the manuscript.

This project would have been impossible without the skilled team from McGraw-Hill who nurtured the book at every stage. We particularly would like to thank, in chronological order to their appearance on the scene: Douglas Reiner, Karen Fisher, Noelle Fox, Susanne Reidell, Lori Hazzard, Matt Baldwin, and Jen Lambert. This group of skilled professionals turned many megabytes and a mountain of paper into a finely polished work of art.

A WORD TO THE SOVEREIGN STUDENT

You have read in history books of revolutions that shake civilizations to their roots—religious conflicts, wars for political liberation, struggles against colonialism and imperialism. Two decades ago, economic revolutions in Eastern Europe, in the former Soviet Union, in China, and elsewhere tore those societies apart. Young people battered down walls, overthrew established authority, and agitated for democracy and a market economy because of discontent with their centralized socialist governments.

Students like yourselves were marching, and even going to jail, to win the right to study radical ideas and learn from Western textbooks like this one in the hope that they may enjoy the freedom and economic prosperity of democratic market economies.

The Intellectual Marketplace

Just what is the market that students in repressed societies are agitating for? In the pages that follow, you will learn about the promise and perils of globalization, about the fragility of financial markets, about unskilled labor and highly trained neurosurgeons. You have probably read in the newspaper about the gross domestic product, the consumer price index, the Federal Reserve, and the unemployment rate. After you have completed a thorough study of this textbook, you will know precisely what these words mean. Even more important, you will also understand the economic forces that influence and determine them.

There is also a marketplace of ideas, where contending schools of economists fashion their theories and try to persuade their scientific peers. You will find in the chapters that follow a fair and impartial review of the thinking of the intellectual giants of our profession—from the early economists like Adam Smith, David Ricardo, and Karl Marx to modern-day titans like John Maynard Keynes, Milton Friedman, and James Tobin.

Skoal!

As you begin your journey into the land of the mixed economy, it would be understandable if you are anxious. But take heart. The fact is that we envy you, the beginning student, as you set out to explore the exciting world of economics for the first time. This is a thrill that, alas, you can experience only once in a lifetime. So, as you embark, we wish you bon voyage!

Paul A. Samuelson
William D. Nordhaus

For the Student: Economics and the Internet

The Information Age is revolutionizing our lives. Its impact on scholars and students has been particularly profound because it allows inexpensive and rapid access to vast quantities of information. The Internet, which is a huge and growing public network of linked computers and information, is changing the way we study, shop, share our culture, and communicate with our friends and family.

In economics, the Internet allows us quick access to economics statistics and research. With just a few clicks of a mouse, we can find out about the most recent unemployment rate, track down information on poverty and incomes, or investigate the intricacies of our banking system. A few years ago, it might have taken weeks to dig out the data necessary to analyze an economic problem. Today, with a computer and a little practice, that same task can be done in a few minutes.

This book is not a manual for driving on the Information Superhighway. That skill can be learned in classes on the subject or from informal tutorials. Rather, we want to provide a road map that shows the locations of major sources of economic data and research. With this map and some rudimentary navigational skills, you can explore the various sites and find a rich array of data, information, studies, and chat rooms. Additionally, at the end of each chapter there is a list of useful websites that can be used to follow up the major themes of that chapter.

Note that some of these sites may be free, some may require a registration or be available through your college or university, and others may require paying a fee. Pricing practices change rapidly, so while we have attempted to include primarily free sites, we have not excluded high-quality sites that may charge a fee.

Data and Institutions

The Internet is an indispensable source of useful data and other information. Since most economic data are provided by governments, the first place to look is the web pages of government agencies and international organizations. The starting point for U.S. government statistics, *www.fedstats.gov,* provides one-stop shopping for federal statistics with links to over 70 government agencies that produce statistical information. Sources are organized by subject or by agency, and the contents are fully searchable. Another good launching site into the federal statistical system is the Economic Statistics Briefing Room at *www.whitehouse.gov/fsbr/esbr.html.* Additionally, the Commerce Department operates a huge database at *www.stat-usa.gov,* but use of parts of this database requires a subscription (which may be available at your college or university).

The best single statistical source for data on the United States is the *Statistical Abstract of the United States,* published annually. It is available online at *www.census.gov/compendia/statab*. If you want an overview of the U.S. economy, you can read the *Economic Report of the President* at *www.gpoaccess.gov/eop/index.html.*

Most of the major economic data are produced by specialized agencies. One place to find general data is the Department of Commerce, which encompasses the Bureau of Economic Analysis (BEA) (*www.bea.gov*) and the Census Bureau (*www.census.gov*). The BEA site includes all data and articles published in the *Survey of Current Business,* including the national income and product accounts, international trade and investment flows, output by industry, economic growth, personal income and labor series, and regional data.

The Census Bureau site goes well beyond a nose count of the population. It also includes the economic census as well as information on housing, income and poverty, government finance, agriculture, foreign trade, construction, manufacturing, transportation, and retail and wholesale trade. In addition to making Census Bureau publications available, the site allows users to create custom extracts of popular microdata sources including the Survey of Income and Program Participation, Consumer Expenditure

Survey, Current Population Survey, American Housing Survey, and, of course, the most recent census.

The Bureau of Labor Statistics (at *www.bls.gov*) provides easy access to commonly requested labor data, including employment and unemployment, prices and living conditions, compensation, productivity, and technology. Also available are labor-force data from the Current Population Survey and payroll statistics from the Current Employment Statistics Survey.

A useful source for financial data is the website of the Federal Reserve Board at *www.federalreserve.gov.* This site provides historical U.S. economic and financial data, including daily interest rates, monetary and business indicators, exchange rates, balance-of-payments data, and price indexes. In addition, the Office of Management and Budget at *www.gpo.gov/usbudget/index.html* makes available the federal budget and related documents.

International statistics are often harder to find. The World Bank, at *www.worldbank.org,* has information on its programs and publications at its site, as does the International Monetary Fund, or IMF, at *www.imf.org*. The United Nations website (*www.unsystem.org*) is slow and confusing but has links to most international institutions and their databases. A good source of information about high-income countries is the Organisation for Economic Cooperation and Development, or OECD, at *www.oecd.org*. The OECD's website contains an array of data on economics, education, health, science and technology, agriculture, energy, public management, and other topics.

Economic Research and Journalism

The Internet is rapidly becoming the world's library. Newspapers, magazines, and scholarly publications are increasingly posting their writing in electronic form. Most of them present what is already available in the paper publications. Some interesting sources can be found at the *Economist* at *www.economist.com* and the *Financial Times* (*www.ft.com*). The *Wall Street Journal* at *www.wsj.com* is currently expensive and not a cost-effective resource. Current policy issues are discussed at *www.policy.com.* The online magazine *Slate* at *www.slate.com* occasionally contains excellent essays on economics.

For scholarly writings, many journals are making their contents available online. WebEc at *www.helsinki.fi/WebEc/* contains a listing of websites for many economic journals. The archives of many journals are available at *www.jstor.org*.

There are now a few websites that bring many resources together at one location. One place to start is *Resources for Economists on the Internet,* sponsored by the American Economic Association and edited by Bill Goffe, at *www.rfe.org*. Also see *WWW Resources in Economics,* which has links to many different branches of economics at *netec.wustl.edu/WebEc/WebEc.html*. For working papers, the National Bureau of Economic Research (NBER) website at *www.nber.org* contains current economic research. The NBER site also contains general resources, including links to data sources and the official U.S. business-cycle dates.

An excellent site that archives and serves as a depository for working papers is located at *econwpa.wustl.edu/wpawelcome.html.* This site is particularly useful for finding background material for research papers.

Did someone tell you that economics is the dismal science? You can chuckle over economist jokes (mostly at the expense of economists) at *netec.mcc.ac.uk/JokEc.html.*

A Word of Warning

It is an unfortunate fact that, because of rapid technological change, this list will soon be out of date. New sites with valuable information and data are appearing every day . . . and others are disappearing almost as rapidly.

Before you set off into the wonderful world of the Web, we would pass on to you some wisdom from experts. Remember the old adage: You only get what you pay for.

Warning: Be careful to determine that your sources and data are reliable. The Internet and other electronic media are easy to use and equally easy to abuse.

The Web is the closest thing in economics to a free lunch. But you must select your items carefully to ensure that they are palatable and digestible.

PART ONE

Basic Concepts

CHAPTER 1

The Central Concepts of Economics

The Age of Chivalry is gone; that of sophisters, economists, and calculators has succeeded.

Edmund Burke

A. WHY STUDY ECONOMICS?

As you open this textbook, you may be wondering, Why should I study economics? Let us count the ways.

Many study economics to help them get a good job.

Some people feel they should understand more deeply what lies behind reports on inflation and unemployment.

Or people want to understand what kinds of policies might slow global warming or what it means to say an iPod is "made in China."

For Whom the Bell Tolls

All these reasons, and many more, make good sense. Still, as we have come to realize, there is one overriding reason to learn the basic lessons of economics: All your life—from cradle to grave and beyond—you will run up against the brutal truths of economics.

As a voter, you will make decisions on issues that cannot be understood until you have mastered the rudiments of this subject. Without studying economics, you cannot be fully informed about international trade, tax policy, or the causes of recessions and high unemployment.

Choosing your life's occupation is the most important economic decision you will make. Your future depends not only on your own abilities but also on how national and regional economic forces affect your wages. Also, your knowledge of economics can help you make wise decisions about how to buy a home, pay for your children's education, and set aside a nest egg for retirement. Of course, studying economics will not make you a genius. But without economics the dice of life are loaded against you.

There is no need to belabor the point. We hope you will find that, in addition to being useful, economics is even a fascinating field. Generations of students, often to their surprise, have discovered how stimulating it is to look beneath the surface and understand the fundamental laws of economics.

SCARCITY AND EFFICIENCY: THE TWIN THEMES OF ECONOMICS

Definitions of Economics

Let us begin with a definition of economics. Over the last half-century, the study of economics has expanded to include a vast range of topics. Here are some of the major subjects that are covered in this book:[1]

- Economics explores the behavior of the financial markets, including interest rates, exchange rates, and stock prices.
- The subject examines the reasons why some people or countries have high incomes while others are poor; it goes on to analyze ways that poverty can be reduced without harming the economy.
- It studies business cycles—the fluctuations in credit, unemployment, and inflation—along with policies to moderate them.
- Economics studies international trade and finance and the impacts of globalization, and it particularly examines the thorny issues involved in opening up borders to free trade.
- It asks how government policies can be used to pursue important goals such as rapid economic growth, efficient use of resources, full employment, price stability, and a fair distribution of income.

This is a long list, but we could extend it many times. However, if we boil down all these definitions, we find one common theme:

Economics is the study of how societies use scarce resources to produce valuable goods and services and distribute them among different individuals.

Scarcity and Efficiency

If we think about the definitions, we find two key ideas that run through all of economics: that goods are scarce and that society must use its resources efficiently. *Indeed, the concerns of economics will not go away because of the fact of scarcity and the desire for efficiency.*

Consider a world without scarcity. If infinite quantities of every good could be produced or if human desires were fully satisfied, what would be the consequences? People would not worry about stretching out their limited incomes because they could have everything they wanted; businesses would not need to fret over the cost of labor or health care; governments would not need to struggle over taxes or spending or pollution because nobody would care. Moreover, since all of us could have as much as we pleased, no one would be concerned about the distribution of incomes among different people or classes.

In such an Eden of affluence, all goods would be free, like sand in the desert or seawater at the beach. All prices would be zero, and markets would be unnecessary. Indeed, economics would no longer be a useful subject.

But no society has reached a utopia of limitless possibilities. Ours is a world of **scarcity,** full of **economic goods.** A situation of scarcity is one in which goods are limited relative to desires. An objective observer would have to agree that, even after two centuries of rapid economic growth, production in the United States is simply not high enough to meet everyone's desires. If you add up all the wants, you quickly find that there are simply not enough goods and services to satisfy even a small fraction of everyone's consumption desires. Our national output would have to be many times larger before the average American could live at the level of the average doctor or major-league baseball player. Moreover, outside the United States, particularly in Africa, hundreds of millions of people suffer from hunger and material deprivation.

Given unlimited wants, it is important that an economy make the best use of its limited resources. That brings us to the critical notion of efficiency. **Efficiency** denotes the most effective use of a society's resources in satisfying people's wants and needs. By contrast, consider an economy with unchecked monopolies or unhealthy pollution or government corruption. Such an economy may produce less than would be possible without these factors, or it may produce a distorted bundle of goods that leaves consumers worse off than they otherwise could be—either situation is an inefficient allocation of resources.

Economic efficiency requires that an economy produce the highest combination of quantity and quality of goods and services given its technology and scarce resources. An economy is producing efficiently when no individual's economic welfare can be improved unless someone else is made worse off.

The essence of economics is to acknowledge the reality of scarcity and then figure out how to organize

[1] This list contains several specialized terms that you will need to understand. If you are not familiar with a particular word or phrase, you should consult the Glossary at the back of this book. The Glossary contains most of the major technical economic terms used in this book. All terms printed in boldface are defined in the Glossary.

society in a way which produces the most efficient use of resources. That is where economics makes its unique contribution.

Microeconomics and Macroeconomics

Economics is today divided into two major subfields, microeconomics and macroeconomics. Adam Smith is usually considered the founder of **microeconomics,** the branch of economics which today is concerned with the behavior of individual entities such as markets, firms, and households. In *The Wealth of Nations* (1776), Smith considered how individual prices are set, studied the determination of prices of land, labor, and capital, and inquired into the strengths and weaknesses of the market mechanism. Most important, he identified the remarkable efficiency properties of markets and explained how the self-interest of individuals working through the competitive market can produce a societal economic benefit. Microeconomics today has moved beyond the early concerns to include the study of monopoly, the role of international trade, finance, and many other vital subjects.

The other major branch of our subject is **macroeconomics,** which is concerned with the overall performance of the economy. Macroeconomics did not even exist in its modern form until 1936, when John Maynard Keynes published his revolutionary *General Theory of Employment, Interest and Money*. At the time, England and the United States were still stuck in the Great Depression of the 1930s, with over one-quarter of the American labor force unemployed. In his new theory Keynes developed an analysis of what causes business cycles, with alternating spells of high unemployment and high inflation. Today, macroeconomics examines a wide variety of areas, such as how total investment and consumption are determined, how central banks manage money and interest rates, what causes international financial crises, and why some nations grow rapidly while others stagnate. Although macroeconomics has progressed far since his first insights, the issues addressed by Keynes still define the study of macroeconomics today.

THE LOGIC OF ECONOMICS

Economic life is an enormously complicated hive of activity, with people buying, selling, bargaining, investing, and persuading. The ultimate purpose of economic science and of this text is to understand this complex undertaking. How do economists go about their task?

Economists use the *scientific approach* to understand economic life. This involves observing economic affairs and drawing upon statistics and the historical record. For complex phenomena like the impacts of budget deficits or the causes of inflation, historical research has provided a rich mine of insights.

Often, economics relies upon analyses and theories. Theoretical approaches allow economists to make broad generalizations, such as those concerning the advantages of international trade and specialization or the disadvantages of tariffs and quotas.

In addition, economists have developed a specialized technique known as *econometrics,* which applies the tools of statistics to economic problems. Using econometrics, economists can sift through mountains of data to extract simple relationships.

Budding economists must also be alert to common fallacies in economic reasoning. Because economic relationships are often complex, involving many different variables, it is easy to become confused about the exact reason behind events or the impact of policies on the economy. The following are some of the common fallacies encountered in economic reasoning:

- *The **post hoc fallacy.*** The first fallacy involves the inference of causality. *The post hoc fallacy occurs when we assume that, because one event occurred before another event, the first event caused the second event.*[2] An example of this syndrome occurred in the Great Depression of the 1930s in the United States. Some people had observed that periods of business expansion were preceded or accompanied by rising prices. From this, they concluded that the appropriate remedy for depression was to raise wages and prices. This idea led to a host of legislation and regulations to prop up wages and prices in an inefficient manner. Did these measures promote economic recovery? Almost surely not. Indeed, they probably slowed recovery, which did not occur until total spending began to rise as the government increased military spending in preparation for World War II.

[2] "Post hoc" is shorthand for *post hoc, ergo propter hoc.* Translated from the Latin, the full expression means "after this, therefore necessarily because of this."

- *Failure to hold other things constant.* A second pitfall is failure to hold other things constant when thinking about an issue. For example, we might want to know whether raising tax rates will raise or lower tax revenues. Some people have put forth the seductive argument that we can eat our fiscal cake and have it too. They argue that cutting tax rates will at the same time raise government revenues and lower the budget deficit. They point to the Kennedy-Johnson tax cuts of 1964, which lowered tax rates sharply and were followed by an increase in government revenues in 1965. Hence, they argue, lower tax rates produce higher revenues.

    Why is this reasoning fallacious? The argument assumes that other things were constant—in particular, it overlooked the growth in the overall economy from 1964 to 1965. Because people's incomes grew during that period, total tax revenues grew even though tax rates were lower. Careful econometric studies indicate that total tax revenues would have been *even higher* in 1965 if tax rates had been held at the same level as in 1964. Hence, this analysis fails to hold other things constant in making the calculations.

    Remember to hold other things constant when you are analyzing the impact of a variable on the economic system.

- *The fallacy of composition.* Sometimes we assume that what holds true for part of a system also holds true for the whole. In economics, however, we often find that the whole is different from the sum of the parts. *When you assume that what is true for the part is also true for the whole, you are committing the fallacy of composition.*

    Here are some true statements that might surprise you if you ignored the fallacy of composition: (1) If one farmer has a bumper crop, she has a higher income; if all farmers produce a record crop, farm incomes will fall. (2) If one person receives a great deal more money, that person will be better off; if everyone receives a great deal more money, the society is likely to be worse off. (3) If a high tariff is put on a product such as shoes or steel, the producers in that industry are likely to profit; if high tariffs are put on all products, the economic welfare of the nation is likely to be worse off.

    These examples contain no tricks or magic. Rather, they are the results of systems of interacting individuals. Often the behavior of the aggregate looks very different from the behavior of individual people.

We mention these fallacies only briefly in this introduction. Later, as we introduce the tools of economics, we will provide examples of how inattention to the logic of economics can lead to false and sometimes costly errors. When you reach the end of this book, you can look back to see why each of these paradoxical examples is true.

Positive Economics versus Normative Economics

When considering economic issues, we must carefully distinguish questions of fact from questions of fairness. Positive economics describes the facts of an economy, while normative economics involves value judgments.

Positive economics deals with questions such as: Why do doctors earn more than janitors? Did the North American Free Trade Agreement (NAFTA) raise or lower the incomes of most Americans? Do higher interest rates slow the economy and lower inflation? Although these may be difficult questions to answer, they can all be resolved by reference to analysis and empirical evidence. That puts them in the realm of positive economics.

Normative economics involves ethical precepts and norms of fairness. Should unemployment be raised to ensure that price inflation does not become too rapid? Should the United States negotiate further agreements to lower tariffs on imports? Has the distribution of income in the United States become too unequal? There are no right or wrong answers to these questions because they involve ethics and values rather than facts. While economic analysis can *inform* these debates by examining the likely consequences of alternative policies, the answers can be resolved only by discussions and debates over society's fundamental values.

COOL HEADS AT THE SERVICE OF WARM HEARTS

Economics has, over the last century, grown from a tiny acorn into a mighty oak. Under its spreading branches we find explanations of the gains from international trade, advice on how to reduce unemployment and inflation, formulas for investing your retirement funds, and proposals to auction limited carbon dioxide emissions permits to help slow global warming. Throughout the world, economists are laboring to collect data and improve our understanding of economic trends.

You might well ask, What is the purpose of this army of economists measuring, analyzing, and calculating? *The ultimate goal of economic science is to improve the living conditions of people in their everyday lives.* Increasing the gross domestic product is not just a numbers game. Higher incomes mean good food, warm houses, and hot water. They mean safe drinking water and inoculations against the perennial plagues of humanity.

Higher incomes produce more than food and shelter. Rich countries have the resources to build schools so that young people can learn to read and develop the skills necessary to use modern machinery and computers. As incomes rise further, nations can afford scientific research to determine agricultural techniques appropriate for a country's climate and soils or to develop vaccines against local diseases. With the resources freed up by economic growth, people have free time for artistic pursuits, such as poetry and music, and the population has the leisure time to read, to listen, and to perform. Although there is no single pattern of economic development, and cultures differ around the world, freedom from hunger, disease, and the elements is a universal human goal.

But centuries of human history also show that warm hearts alone will not feed the hungry or heal the sick. A free and efficient market will not necessarily produce a distribution of income that is socially acceptable. Determining the best route to economic progress or an equitable distribution of society's output requires cool heads that objectively weigh the costs and benefits of different approaches, trying as hard as humanly possible to keep the analysis free from the taint of wishful thinking. Sometimes, economic progress will require shutting down an outmoded factory. Sometimes, as when centrally planned countries adopted market principles, things get worse before they get better. Choices are particularly difficult in the field of health care, where limited resources literally involve life and death.

You may have heard the saying, "From each according to his ability, to each according to his need." Governments have learned that no society can long operate solely on this utopian principle. To maintain a healthy economy, governments must preserve incentives for people to work and to save.

Societies can support the unemployed for a while, but when unemployment insurance pays too much for too long, people may come to depend upon the government and stop looking for work. If they begin to believe that the government owes them a living, this may dull the cutting edge of enterprise. Just because government programs pursue lofty goals cannot exempt them from careful scrutiny and efficient management.

Society must strive to combine the discipline of the marketplace with the compassion of social programs. By using cool heads to inform warm hearts, economic science can do its part in finding the appropriate balance for an efficient, prosperous, and just society.

B. THE THREE PROBLEMS OF ECONOMIC ORGANIZATION

Every human society—whether it is an advanced industrial nation, a centrally planned economy, or an isolated tribal nation—must confront and resolve three fundamental economic problems. Every society must have a way of determining *what* commodities are produced, *how* these goods are made, and *for whom* they are produced.

Indeed, these three fundamental questions of economic organization—***what, how,* and *for whom***—are as crucial today as they were at the dawn of human civilization. Let's look more closely at them:

- *What* commodities are produced and in what quantities? A society must determine how much of each of the many possible goods and services it will make and when they will be produced. Will we produce pizzas or shirts today? A few high-quality shirts or many cheap shirts? Will we use scarce resources to produce many consumption goods (like pizzas)? Or will we produce fewer consumption goods and more investment goods (like pizza-making machines), which will boost production and consumption tomorrow?
- *How* are goods produced? A society must determine who will do the production, with what resources, and what production techniques they will use. Who farms and who teaches? Is electricity

generated from oil, from coal, or from the sun? Will factories be run by people or robots?

- *For whom* are goods produced? Who gets to eat the fruit of economic activity? Is the distribution of income and wealth fair and equitable? How is the national product divided among different households? Are many people poor and a few rich? Do high incomes go to teachers or athletes or autoworkers or venture capitalists? Will society provide minimal consumption to the poor, or must people work if they are to eat?

MARKET, COMMAND, AND MIXED ECONOMIES

What are the different ways that a society can answer the questions of *what, how,* and *for whom?* Different societies are organized through *alternative economic systems,* and economics studies the various mechanisms that a society can use to allocate its scarce resources.

We generally distinguish two fundamentally different ways of organizing an economy. At one extreme, government makes most economic decisions, with those on top of the hierarchy giving economic commands to those further down the ladder. At the other extreme, decisions are made in markets, where individuals or enterprises voluntarily agree to exchange goods and services, usually through payments of money. Let's briefly examine each of these two forms of economic organization.

In the United States, and increasingly around the world, most economic questions are settled by the market mechanism. Hence their economic systems are called market economies. A **market economy** is one in which individuals and private firms make the major decisions about production and consumption. A system of prices, of markets, of profits and losses, of incentives and rewards determines *what, how,* and *for whom.* Firms produce the commodities that yield the highest profits (the *what*) by the techniques of production that are least costly (the *how*). Consumption is determined by individuals' decisions about how to spend the wages and property incomes generated by their labor and property ownership (the *for whom*). The extreme case of a market economy, in which the government keeps its hands off economic decisions, is called a **laissez-faire** economy.

By contrast, a **command economy** is one in which the government makes all important decisions about production and distribution. In a command economy, such as the one which operated in the Soviet Union during most of the twentieth century, the government owns most of the means of production (land and capital); it also owns and directs the operations of enterprises in most industries; it is the employer of most workers and tells them how to do their jobs; and it decides how the output of the society is to be divided among different goods and services. In short, in a command economy, the government answers the major economic questions through its ownership of resources and its power to enforce decisions.

No contemporary society falls completely into either of these polar categories. Rather, all societies are **mixed economies,** with elements of market and command.

Economic life is organized either through hierarchical command or decentralized voluntary markets. Today most decisions in the United States and other high-income economies are made in the marketplace. But the government plays an important role in overseeing the functioning of the market; governments pass laws that regulate economic life, produce educational and police services, and control pollution. Most societies today operate mixed economies.

C. SOCIETY'S TECHNOLOGICAL POSSIBILITIES

Every gun that is made, every warship launched, every rocket fired signifies, in the final sense, a theft from those who hunger and are not fed.

President Dwight D. Eisenhower

Each economy has a stock of limited resources—labor, technical knowledge, factories and tools, land, energy. In deciding *what* and *how* things should be produced, the economy is in reality deciding how to allocate its resources among the thousands of different possible commodities and services. How much land will go into growing wheat? Or into housing the population? How many factories will produce computers? How many will make pizzas? How many children will grow up to play professional sports or to be professional economists or to program computers?

Faced with the undeniable fact that goods are scarce relative to wants, an economy must decide how to cope with limited resources. It must choose among different potential bundles of goods (the *what*), select from different techniques of production (the *how*), and decide in the end who will consume the goods (the *for whom*).

INPUTS AND OUTPUTS

To answer these three questions, every society must make choices about the economy's inputs and outputs. **Inputs** are commodities or services that are used to produce goods and services. An economy uses its existing technology to combine inputs to produce outputs. **Outputs** are the various useful goods or services that result from the production process and are either consumed or employed in further production. Consider the "production" of pizza. We say that the eggs, flour, heat, pizza oven, and chef's skilled labor are the inputs. The tasty pizza is the output. In education, the inputs are the time of the faculty and students, the laboratories and classrooms, the textbooks, and so on, while the outputs are informed, productive, and well-paid citizens.

Another term for inputs is **factors of production.** These can be classified into three broad categories: land, labor, and capital.

- *Land*—or, more generally, natural resources—represents the gift of nature to our societies. It consists of the land used for farming or for underpinning houses, factories, and roads; the energy resources that fuel our cars and heat our homes; and the nonenergy resources like copper and iron ore and sand. In today's congested world, we must broaden the scope of natural resources to include our environmental resources, such as clean air and drinkable water.
- *Labor* consists of the human time spent in production—working in automobile factories, writing software, teaching school, or baking pizzas. Thousands of occupations and tasks, at all skill levels, are performed by labor. It is at once the most familiar and the most crucial input for an advanced industrial economy.
- *Capital* resources form the durable goods of an economy, produced in order to produce yet other goods. Capital goods include machines, roads, computers, software, trucks, steel mills, automobiles, washing machines, and buildings. As we will see later, the accumulation of specialized capital goods is essential to the task of economic development.

Restating the three economic problems in these terms, society must decide (1) *what* outputs to produce, and in what quantity; (2) *how,* or with what inputs and techniques, to produce the desired outputs; and (3) *for whom* the outputs should be produced and distributed.

THE PRODUCTION-POSSIBILITY FRONTIER

We learn early in life that we can't have everything. "You can have chocolate or vanilla ice cream. No, not both," we might hear. Similarly, the consumption opportunities of countries are limited by the resources and the technologies available to them.

The need to choose among limited opportunities is dramatized during wartime. In debating whether the United States should invade Iraq in 2003, people wanted to know how much the war would cost. The administration said it would cost only $50 billion, while some economists said it might cost as much as $2000 billion. These are not just mountains of dollar bills. These numbers represent resources diverted from other purchases. As the numbers began to climb, people naturally asked, Why are we policing Baghdad rather than New York, or repairing the electrical system in the Middle East rather than in the U.S. Midwest? People understand, as did former general and president Eisenhower, that when output is devoted to military tasks, there is less available for civilian consumption and investment.

Let us dramatize this choice by considering an economy which produces only two economic goods, guns and butter. The guns, of course, represent military spending, and the butter stands for civilian spending. Suppose that our economy decides to throw all its energy into producing the civilian good, butter. There is a maximum amount of butter that can be produced per year. The maximal amount of butter depends on the quantity and quality of the economy's resources and the productive efficiency with which they are used. Suppose 5 million pounds of butter is the maximum amount that can be produced with the existing technology and resources.

At the other extreme, imagine that all resources are instead devoted to the production of guns. Again, because of resource limitations, the economy can produce only a limited quantity of guns. For this example, assume that the economy can produce 15,000 guns of a certain kind if no butter is produced.

Alternative Production Possibilities

Possibilities	Butter (millions of pounds)	Guns (thousands)
A	0	15
B	1	14
C	2	12
D	3	9
E	4	5
F	5	0

TABLE 1-1. Limitation of Scarce Resources Implies the Guns-Butter Tradeoff

Scarce inputs and technology imply that the production of guns and butter is limited. As we go from A to B . . . to F, we are transferring labor, machines, and land from the gun industry to butter and can thereby increase butter production.

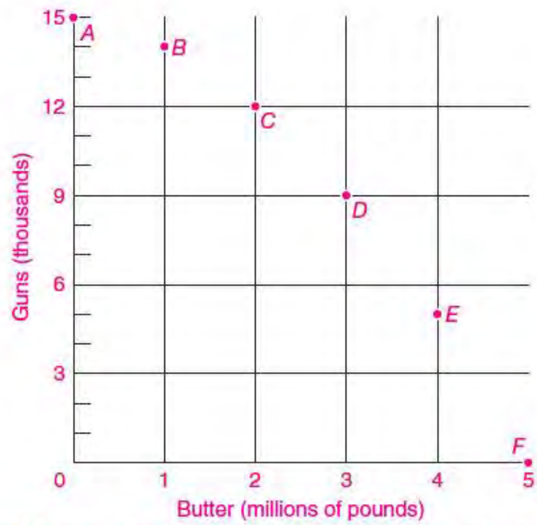


FIGURE 1-1. The Production Possibilities in a Graph

This figure displays the alternative combinations of production pairs from Table 1-1.

These are two extreme possibilities. In between are many others. If we are willing to give up some butter, we can have some guns. If we are willing to give up still more butter, we can have still more guns.

A schedule of possibilities is given in Table 1-1. Combination F shows the extreme, where all butter and no guns are produced, while A depicts the opposite extreme, where all resources go into guns. In between—at E, D, C, and B—increasing amounts of butter are given up in return for more guns.

How, you might well ask, can a nation turn butter into guns? Butter is transformed into guns not physically but by the alchemy of diverting the economy's resources from one use to the other.

We can represent our economy's production possibilities more vividly in the diagram shown in Figure 1-1. This diagram measures butter along the horizontal axis and guns along the vertical one. (If you are unsure about the different kinds of graphs or about how to turn a table into a graph, consult the appendix to this chapter.) We plot point *F* in Figure 1-1 from the data in Table 1-1 by counting over 5 butter units to the right on the horizontal axis and going up 0 gun units on the vertical axis; similarly, *E* is obtained by going 4 butter units to the right and going up 5 gun units; and finally, we get *A* by going over 0 butter units and up 15 gun units.

If we fill in all intermediate positions with new green-colored points representing all the different combinations of guns and butter, we have the continuous green curve shown as the *production-possibility frontier*, or *PPF*, in Figure 1-2.

The production-possibility frontier (or ***PPF***) shows the maximum quantity of goods that can be efficiently produced by an economy, given its technological knowledge and the quantity of available inputs.

Applying the PPF to Society's Choices

The *PPF* is the menu of choices that an economy has to choose from. Figure 1-2 shows a choice between guns and butter, but this concept can be applied to a broad range of economic choices. Thus the more resources the government uses to spend on public highways, the less will be left to produce private goods like houses; the more we choose to consume of food, the less we can consume of clothing; the more an economy consumes today, the less can be its production of capital goods to turn out more consumption goods in the future.

The graphs in Figures 1-3 to 1-5 present some important applications of *PPF*s. Figure 1-3 shows the effect of economic growth on a country's production possibilities. An increase in inputs, or improved technological knowledge, enables a country to produce more of all goods and services, thus shifting

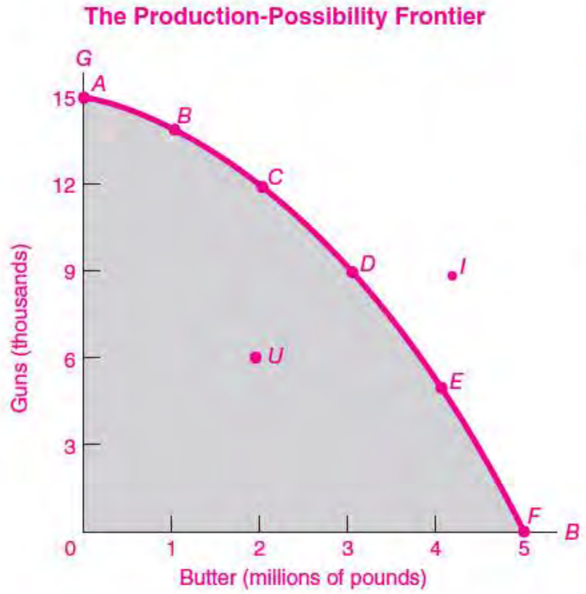


FIGURE 1-2. A Smooth Curve Connects the Plotted Points of the Numerical Production Possibilities

This frontier shows the schedule along which society can choose to substitute guns for butter. It assumes a given state of technology and a given quantity of inputs. Points outside the frontier (such as point *I*) are infeasible or unattainable. Any point inside the curve, such as *U*, indicates that the economy has not attained productive efficiency, as is the case, for instance, when unemployment is high during severe business cycles.

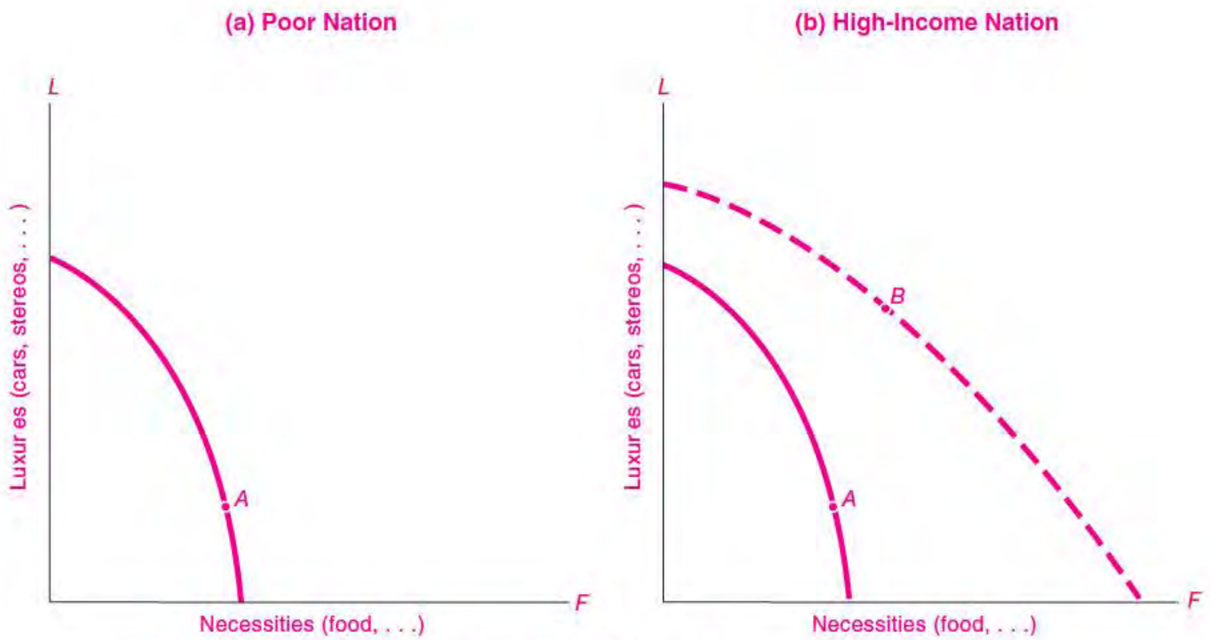


FIGURE 1-3. Economic Growth Shifts the *PPF* Outward

(**a**) Before development, the nation is poor. It must devote almost all its resources to food and enjoys few comforts. (**b**) Growth of inputs and technological change shift out the *PPF.* With economic growth, a nation moves from *A* to *B*, expanding its food consumption little compared with its increased consumption of luxuries. It can increase its consumption of both goods if it desires.

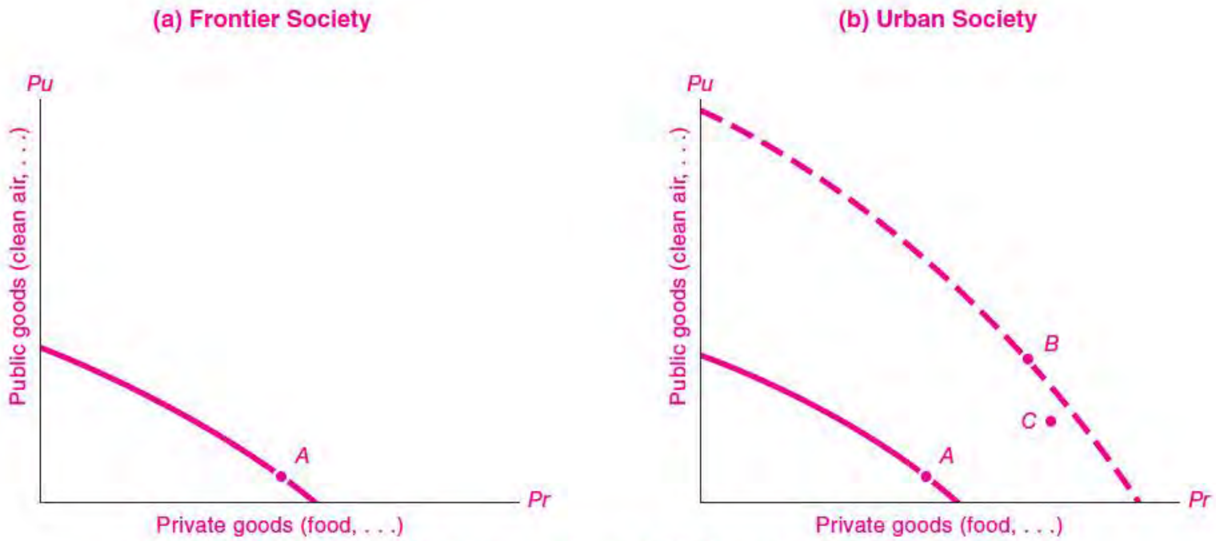


FIGURE 1-4. Economies Must Choose between Public Goods and Private Goods

(**a**) A poor frontier society lives from hand to mouth, with little left over for public goods like clean air or public health. (**b**) A modern urbanized economy is more prosperous and chooses to spend more of its higher income on public goods and government services (roads, environmental protection, and education).

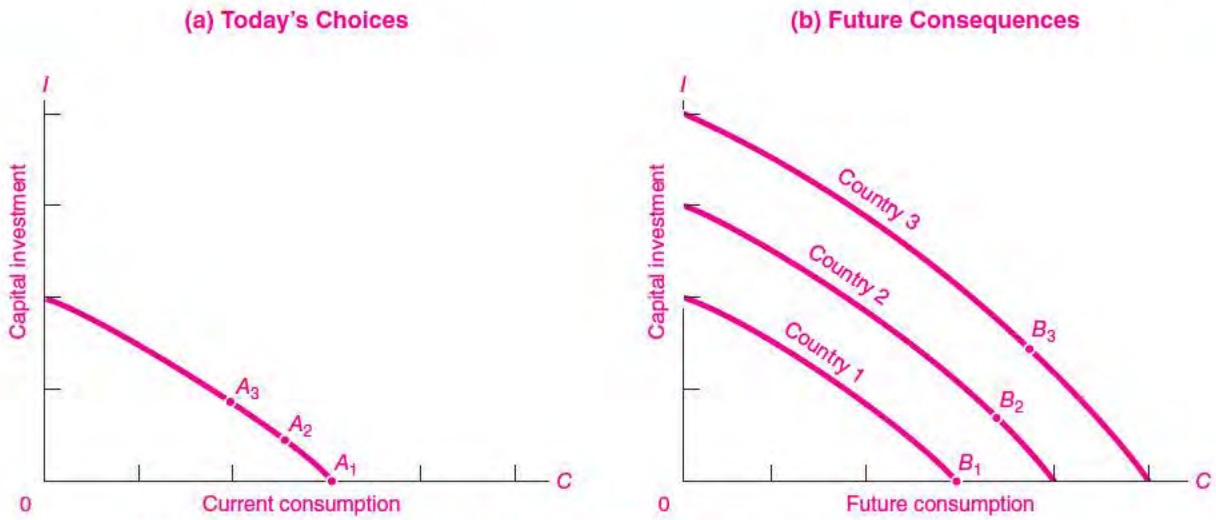


FIGURE 1-5. Investment for Future Consumption Requires Sacrificing Current Consumption

A nation can produce either current-consumption goods (pizzas and concerts) or investment goods (pizza ovens and concert halls). (**a**) Three countries start out even. They have the same *PPF*, shown in the panel on the left, but they have different investment rates. Country 1 does not invest for the future and remains at A_1 (merely replacing machines). Country 2 abstains modestly from consumption and invests at A_2. Country 3 sacrifices a great deal of current consumption and invests heavily. (**b**) In the following years, countries that invest more heavily forge ahead. Thus thrifty Country 3 has shifted its *PPF* far out, while Country 1's *PPF* has not moved at all. Countries that invest heavily can have *both* higher investment and consumption in the future.

out the *PPF*. The figure also illustrates that poor countries must devote most of their resources to food production while rich countries can afford more luxuries as productive potential increases.

Figure 1-4 depicts the choice between private goods (bought at a price) and public goods (paid for by taxes). Poor countries can afford little of public goods like public health and primary education. But with economic growth, public goods as well as environmental quality take a larger share of output.

Figure 1-5 portrays an economy's choice between (*a*) current-consumption goods and (*b*) investment in capital goods (machines, factories, etc.). By sacrificing current consumption and producing more capital goods, a nation's economy can grow more rapidly, making possible more of *both* goods (consumption and investment) in the future.

Be Not Time's Fool

The great American poet Carl Sandburg wrote, "Time is the coin of your life. It is the only coin you have, and only you can determine how it will be spent. Be careful lest you let other people spend it for you." This emphasizes that one of the most important decisions that people confront is how to use their time.

We can illustrate this choice using the production-possibility frontier. For example, as a student, you might have 10 hours to study for upcoming tests in both economics and history. If you study only history, you will get a high grade there and do poorly in economics, and vice versa. Treating the grades on the two tests as the "output" of your studying, sketch out the *PPF* for grades, given your limited time resources. Alternatively, if the two student commodities are "grades" and "fun," how would you draw this *PPF?* Where are you on this frontier? Where are your lazy friends?

Recently, the United States collected data on how Americans use their time. Keep a diary of your time use for two or three days. Then go to *www.bls.gov/tus/home.htm* and compare how you spend your time with the results for other people.

Opportunity Costs

When Robert Frost wrote of the road not taken, he pointed to one of the deepest concepts of economics, *opportunity cost*. Because our resources are limited, we must decide how to allocate our incomes or time. When you decide whether to study economics, buy a car, or go to college, you will give something up—there will be a forgone opportunity. The next-best good that is forgone represents the opportunity cost of a decision.

The concept of opportunity cost can be illustrated using the *PPF*. Examine the frontier in Figure 1-2, which shows the tradeoff between guns and butter. Suppose the country decides to increase its gun purchases from 9000 guns at *D* to 12,000 units at *C*. What is the opportunity cost of this decision? You might calculate the cost in dollar terms. But in economics we always need to "pierce the veil" of money to examine the *real* impacts of alternative decisions. On the most fundamental level, the opportunity cost of moving from *D* to *C* is the butter that must be given up to produce the extra guns. In this example, the opportunity cost of the 3000 extra guns is 1 million pounds of butter forgone.

Or consider the real-world example of the cost of opening a gold mine near Yellowstone National Park. The developer argues that the mine will have but a small cost because Yellowstone's revenues will hardly be affected. But an economist would answer that the dollar receipts are too narrow a measure of cost. We should ask whether the unique and precious qualities of Yellowstone might be degraded if a gold mine were to operate, with the accompanying noise, water and air pollution, and decline in amenity values for visitors. While the dollar cost might be small, the opportunity cost in lost wilderness values might be large indeed.

In a world of scarcity, choosing one thing means giving up something else. The **opportunity cost** of a decision is the value of the good or service forgone.

Efficiency

Economists devote much of their study to exploring the efficiency of different kinds of market structures, incentives, and taxes. Remember that efficiency means that the economy's resources are being used as effectively as possible to satisfy people's desires. One important aspect of overall economic efficiency is productive efficiency, which is easily pictured in terms of the *PPF*. Efficiency means that the economy is *on* the frontier rather than *inside* the production-possibility frontier.

Productive efficiency occurs when an economy cannot produce more of one good without producing less of another good; this implies that the economy is on its production-possibility frontier.

Let's see why productive efficiency requires being on the *PPF.* Start in the situation shown by point *D* in Figure 1-2. Say the market calls for another million pounds of butter. If we ignored the constraint shown by the *PPF,* we might think it possible to produce more butter without reducing gun production, say, by moving to point *I,* to the right of point *D.* But point *I* is outside the frontier, in the "infeasible" region. Starting from *D,* we cannot get more butter without giving up some guns. Hence point *D* displays productive efficiency, while point *I* is infeasible.

One further point about productive efficiency can be illustrated using the *PPF:* Being on the *PPF* means that producing more of one good inevitably requires sacrificing other goods. When we produce more guns, we are substituting guns for butter. *Substitution* is the law of life in a full-employment economy, and the production-possibility frontier depicts the menu of society's choices.

Waste from Business Cycles and Environmental Degradation. Economies suffer from inefficient use of resources for many reasons. When there are unemployed resources, the economy is not on its production-possibility frontier at all but, rather, somewhere *inside* it. In Figure 1-2, point *U* represents a point inside the *PPF;* at *U,* society is producing only 2 units of butter and 6 units of guns. Some resources are unemployed, and by putting them to work, we can increase our output of all goods; the economy can move from *U* to *D,* producing more butter and more guns, thus improving the economy's efficiency. We can have our guns and eat more butter too.

Historically, one source of inefficiency occurs during business cycles. From 1929 to 1933, in the Great Depression, the total output produced in the American economy declined by 25 percent. The economy did not suffer from an inward shift of the *PPF* because of technological forgetting. Rather, panics, bank failures, bankruptcies, and reduced spending moved the economy *inside* its *PPF.* A decade later, the military expenditures for World War II expanded demand, and output grew rapidly as the economy pushed back to the *PPF.*

Similar situations occur periodically during business-cycle recessions. The latest growth slowdown occurred in 2007–2008 when problems in housing and credit markets spread through the entire economy. The economy's underlying productivity had not suddenly declined during those years. Rather, reduced overall spending pushed the economy temporarily inside its *PPF* for that period.

A different kind of inefficiency occurs when markets are failing to reflect true scarcities, as with environmental degradation. Suppose that an unregulated business decides to dump chemicals in a river, killing fish and ruining recreational opportunities. The firm is not necessarily doing this because it has evil intent. Rather, the prices in the marketplace do not reflect true social priorities—the price on polluting in an unregulated environment is zero rather than the true opportunity cost in terms of lost fish and recreation.

Environmental degradation can also push the economy inside its *PPF.* The situation is illustrated in Figure 1-4(*b*). Because businesses do not face correct prices, the economy moves from point *B* to point *C.* Private goods are increased, but public goods (like clean air and water) are decreased. Efficient regulation of the environment could move northeast back to the dashed efficient frontier.

As we close this introductory chapter, let us return briefly to our opening theme, Why study economics? Perhaps the best answer to the question is a famous one given by Keynes in the final lines of *The General Theory of Employment, Interest and Money:*

> 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. Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist. Madmen in authority, who hear voices in the air, are distilling their frenzy from some academic scribbler of a few years back. I am sure that the power of vested interests is vastly exaggerated compared with the gradual encroachment of ideas. Not, indeed, immediately, but after a certain interval; for in the field of economic and political philosophy there are not many who are influenced by new theories after they are twenty-five or thirty years of age, so that the ideas which civil servants and politicians and even agitators apply to current events are not likely to be the newest. But, soon or late, it is ideas, not vested interests, which are dangerous for good or evil.

To understand how the powerful ideas of economics apply to the central issues of human societies—ultimately, this is why we study economics.

SUMMARY

A. Why Study Economics?

1. What is economics? Economics is the study of how societies choose to use scarce productive resources that have alternative uses, to produce commodities of various kinds, and to distribute them among different groups. We study economics to understand not only the world we live in but also the many potential worlds that reformers are constantly proposing to us.
2. Goods are scarce because people desire much more than the economy can produce. Economic goods are scarce, not free, and society must choose among the limited goods that can be produced with its available resources.
3. Microeconomics is concerned with the behavior of individual entities such as markets, firms, and households. Macroeconomics views the performance of the economy as a whole. Through all economics, beware of the fallacy of composition and the post hoc fallacy, and remember to keep other things constant.

B. The Three Problems of Economic Organization

4. Every society must answer three fundamental questions: *what, how,* and *for whom*? *What* kinds and quantities are produced among the wide range of all possible goods and services? *How* are resources used in producing these goods? And *for whom* are the goods produced (that is, what is the distribution of income and consumption among different individuals and classes)?
5. Societies answer these questions in different ways. The most important forms of economic organization today are *command* and *market.* The command economy is directed by centralized government control; a market economy is guided by an informal system of prices and profits in which most decisions are made by private individuals and firms. All societies have different combinations of command and market; all societies are mixed economies.

C. Society's Technological Possibilities

6. With given resources and technology, the production choices between two goods such as butter and guns can be summarized in the *production-possibility frontier* (*PPF*). The *PPF* shows how the production of one good (such as guns) is traded off against the production of another good (such as butter). In a world of scarcity, choosing one thing means giving up something else. The value of the good or service forgone is its opportunity cost.
7. Productive efficiency occurs when production of one good cannot be increased without curtailing production of another good. This is illustrated by the *PPF.* When an economy is on its *PPF,* it can produce more of one good only by producing less of another good.
8. Production-possibility frontiers illustrate many basic economic processes: how economic growth pushes out the frontier, how a nation chooses relatively less food and other necessities as it develops, how a country chooses between private goods and public goods, and how societies choose between consumption goods and capital goods that enhance future consumption.
9. Societies are sometimes inside their production-possibility frontier because of macroeconomic business cycles or microeconomic market failures. When credit conditions are tight or spending suddenly declines, a society moves inside its *PPF* in recessions; this occurs because of macroeconomic rigidities, not because of technological forgetting. A society can also be inside its *PPF* if markets fail because prices do not reflect social priorities, such as with environmental degradation from air and water pollution.

CONCEPTS FOR REVIEW

Fundamental Concepts

scarcity and efficiency
free goods vs. economic goods
macroeconomics and microeconomics
normative vs. positive economics
fallacy of composition, post hoc fallacy
"keep other things constant"

Key Problems of Economic Organization

what, how, and *for whom*
alternative economic systems:
command vs. market
laissez-faire
mixed economies

Choice among Production Possibilities

inputs and outputs
production-possibility frontier (*PPF*)
productive efficiency and inefficiency
opportunity cost

FURTHER READING AND INTERNET WEBSITES

Further Reading

Robert Heilbroner, *The Worldly Philosophers,* 7th ed. (Touchstone Books, 1999), provides a lively biography of the great economists along with their ideas and impact. The authoritative work on the history of economic analysis is Joseph Schumpeter, *History of Economic Analysis* (McGraw-Hill, New York, 1954).

Websites

One of the greatest books of all economics is Adam Smith, *The Wealth of Nations* (many publishers, 1776). Every economics student should read a few pages to get the flavor of his writing. *The Wealth of Nations* can be found at *www.bibliomania.com/NonFiction/Smith/Wealth/index.html.*

Log on to one of the Internet reference sites for economics such as *Resources for Economists on the Internet* (*www.rfe.org*). Browse through some of the sections to familiarize yourself with the site. You might want to look up your college or university, look at recent news in a newspaper or magazine, or check some economic data.

Two sites for excellent analyses of public policy issues in economics are those of the Brookings Institution (*www.brook.edu*) and of the American Enterprise Institute (*www.aei.org*). Each of these publishes books and has policy briefs online.

QUESTIONS FOR DISCUSSION

1. The great English economist Alfred Marshall (1842–1924) invented many of the tools of modern economics, but he was most concerned with the application of these tools to the problems of society. In his inaugural lecture, Marshall wrote:

   > It will be my most cherished ambition to increase the numbers who Cambridge University sends out into the world with cool heads but warm hearts, willing to give some of their best powers to grappling with the social suffering around them; resolved not to rest content till they have opened up to all the material means of a refined and noble life. [*Memorials of Alfred Marshall,* A. C. Pigou, ed. (Macmillan and Co., London, 1925), p. 174, with minor edits.]

   Explain how the cool head might provide the essential positive economic analysis to implement the normative value judgments of the warm heart. Do you agree with Marshall's view of the role of the teacher? Do you accept his challenge?
2. The late George Stigler, an eminent conservative Chicago economist, wrote as follows:

   > No thoroughly egalitarian society has ever been able to construct or maintain an efficient and progressive economic system. It has been universal experience that some system of differential rewards is necessary to stimulate workers. [*The Theory of Price,* 3d ed. (Macmillan, New York, 1966), p. 19.]

   Are these statements positive or normative economics? Discuss Stigler's view in light of Alfred Marshall's quote in question 1. Is there a conflict?
3. Define each of the following terms carefully and give examples: *PPF,* scarcity, productive efficiency, inputs, outputs.
4. Read the special section on time use (p. 13). Then do the exercise in the last paragraph. Construct a table that compares your time use with that of the average American. (For a graphical analysis, see question 5 of the appendix to this chapter.)
5. Assume that Econoland produces haircuts and shirts with inputs of labor. Econoland has 1000 hours of labor available. A haircut requires ½ hour of labor, while a shirt requires 5 hours of labor. Construct Econoland's production-possibility frontier.
6. Assume that scientific inventions have doubled the productivity of society's resources in butter production without altering the productivity of gun manufacture. Redraw society's production-possibility frontier in Figure 1-2 to illustrate the new tradeoff.
7. Some scientists believe that we are rapidly depleting our natural resources. Assume that there are only two inputs (labor and natural resources) producing two goods (concerts and gasoline) with no improvement in society's technology over time. Show what would happen to the *PPF* over time as natural resources are exhausted. How would invention and technological improvement modify your answer? On the basis of this example, explain why it is said that "economic growth is a race between depletion and invention."
8. Say that Diligent has 10 hours to study for upcoming tests in economics and history. Draw a *PPF* for grades, given Diligent's limited time resources. If Diligent

studies inefficiently by listening to loud music and chatting with friends, where will Diligent's grade "output" be relative to the *PPF*? What will happen to the grade *PPF* if Diligent increases study inputs from 10 hours to 15 hours?

9. Consider the *PPF* for clean air and automobile travel.
   a. Explain why unregulated air pollution in automobiles would push a country inside its *PPF*. Illustrate your discussion with a carefully drawn *PPF* for these two goods.
   b. Next explain how putting a price on harmful automobile emissions would increase both goods and move the country to its *PPF*. Illustrate by showing how correcting the "market failure" would change the final outcome.

Appendix 1

HOW TO READ GRAPHS

A picture is worth a thousand words.

Chinese Proverb

Before you can master economics, you must have a working knowledge of graphs. They are as indispensable to the economist as a hammer is to a carpenter. So if you are not familiar with the use of diagrams, invest some time in learning how to read them—it will be time well spent.

What is a *graph?* It is a diagram showing how two or more sets of data or variables are related to one another. Graphs are essential in economics because, among other reasons, they allow us to analyze economic concepts and examine historical trends.

You will encounter many different kinds of graphs in this book. Some graphs show how variables change over time (see, for example, the inside of the front cover); other graphs show the relationship between different variables (such as the example we will turn to in a moment). Each graph in the book will help you understand an important economic relationship or trend.

THE PRODUCTION-POSSIBILITY FRONTIER

The first graph that you encountered in this text was the production-possibility frontier. As we showed in the body of this chapter, the production-possibility frontier, or *PPF,* represents the maximum amounts of a pair of goods or services that can both be produced with an economy's given resources, assuming that all resources are fully employed.

Let's follow up an important application, that of choosing between food and machines. The essential data for the *PPF* are shown in Table 1A-1, which is very much like the example in Table 1-1. Recall that each of the possibilities gives one level of food production and one level of machine production. As the quantity of food produced increases, the production of machines falls. Thus, if the economy produced 10 units of food, it could produce a maximum of 140 machines, but when the output of food is 20 units, only 120 machines can be manufactured.

Production-Possibility Graph

The data shown in Table 1A-1 can also be presented as a graph. To construct the graph, we represent each of the table's pairs of data by a single point on a two-dimensional plane. Figure 1A-1 displays in a graph

Alternative Production Possibilities

Possibilities	Food	Machines
A	0	150
B	10	140
C	20	120
D	30	90
E	40	50
F	50	0

TABLE 1A-1. The Pairs of Possible Outputs of Food and Machines

The table shows six potential pairs of outputs that can be produced with the given resources of a country. The country can choose one of the six possible combinations.

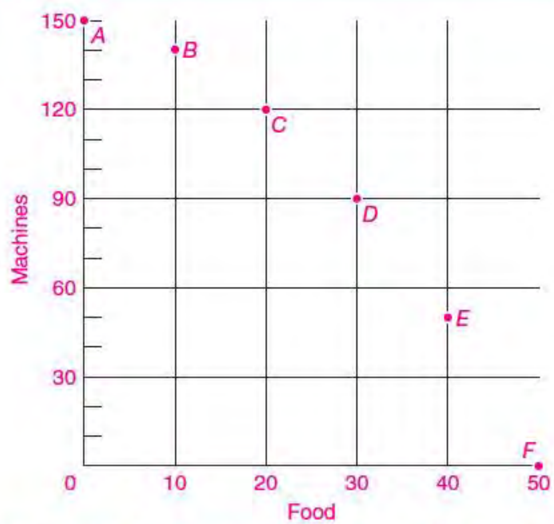


FIGURE 1A-1. Six Possible Pairs of Food-Machine Production Levels

This figure shows the data of Table 1A-1 in graphical form. The data are exactly the same, but the visual display presents the data more vividly.

the relationship between the food and machine outputs shown in Table 1A-1. Each pair of numbers is represented by a single point in the graph. Thus the row labeled "A" in Table 1A-1 is graphed as point *A* in Figure 1A-1, and similarly for points *B, C,* and so on.

In Figure 1A-1, the vertical line at left and the horizontal line at the bottom correspond to the two variables—food and machines. A **variable** is an item of interest that can be defined and measured and that takes on different values at different times or places. Important variables studied in economics are prices, quantities, hours of work, acres of land, dollars of income, and so forth.

The horizontal line on a graph is referred to as the *horizontal axis,* or sometimes the *X axis.* In Figure 1A-1, food output is measured on the black horizontal axis. The vertical line is known as the *vertical axis,* or *Y axis.* In Figure 1A-1, it measures the number of machines produced. Point *A* on the vertical axis stands for 150 machines. The lower left-hand corner, where the two axes meet, is called the *origin.* It signifies 0 food and 0 machines in Figure 1A-1.

The Production-Possibility Frontier

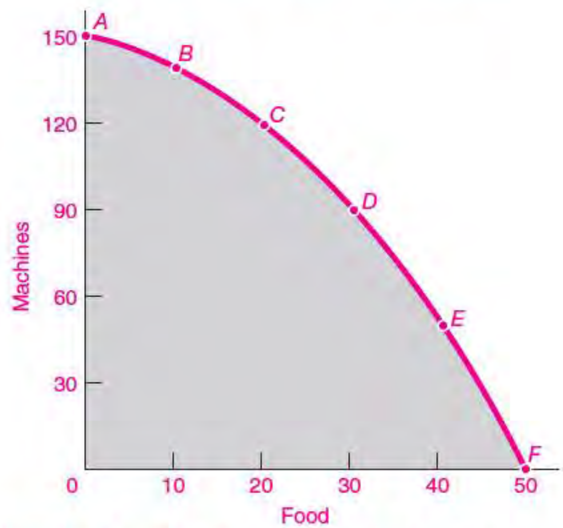


FIGURE 1A-2. A Production-Possibility Frontier

A smooth curve fills in between the plotted points, creating the production-possibility frontier.

A Smooth Curve

In most economic relationships, variables can change by small amounts as well as by the large increments shown in Figure 1A-1. We therefore generally draw economic relationships as continuous curves. Figure 1A-2 shows the *PPF* as a smooth curve in which the points from *A* to *F* have been connected.

By comparing Table 1A-1 and Figure 1A-2, we can see why graphs are so often used in economics. The smooth *PPF* reflects the menu of choice for the economy. It is a visual device for showing what types of goods are available in what quantities. Your eye can see at a glance the relationship between machine and food production.

Slopes and Lines

Figure 1A-2 depicts the relationship between maximum food and machine production. One important way to describe the relationship between two variables is by the slope of the graph line.

The **slope** of a line represents the change in one variable that occurs when another variable changes. More precisely, it is the change in the variable *Y* on the vertical axis per unit change in the variable *X* on the horizontal axis. For example, in Figure 1A-2, say that food production rose from 25 to 26 units. The slope of the curve in Figure 1A-2 tells us the precise change in machinery production that would take place. *Slope is an exact numerical measure of the relationship between the change in* Y *and the change in* X.

We can use Figure 1A-3 to show how to measure the slope of a straight line, say, the slope of the line between points *B* and *D.* Think of the movement from *B* to *D* as occurring in two stages. First comes a horizontal movement from *B* to *C* indicating a 1-unit increase in the *X* value (with no change in *Y*). Second comes a compensating vertical movement up or down, shown as *s* in Figure 1A-3. (The movement of 1 horizontal unit is purely for convenience. The formula holds for movements of any size.) The two-step movement brings us from one point to another on the straight line.

Because the *BC* movement is a 1-unit increase in *X,* the length of *CD* (shown as *s* in Figure 1A-3) indicates the change in *Y* per unit change in *X.* On a graph, this change is called the *slope* of the line *ABDE.*

Often slope is defined as "the rise over the run." The *rise* is the vertical distance; in Figure 1A-3, the rise is the distance from *C* to *D.* The run is the horizontal distance; it is *BC* in Figure 1A-3. The rise over the run in this instance would be *CD* over *BC.* Thus

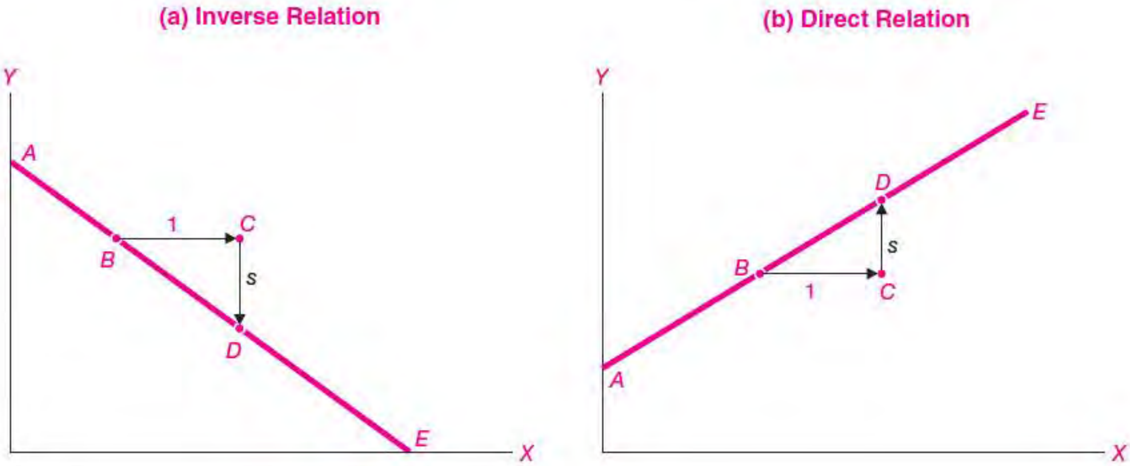


FIGURE 1A-3. Calculation of Slope for Straight Lines

It is easy to calculate slopes for straight lines as "rise over run." Thus in both (**a**) and (**b**), the numerical value of the slope is rise/run = $CD/BC = s/1 = s$. Note that in (**a**), CD is negative, indicating a negative slope, or an inverse relationship between X and Y.

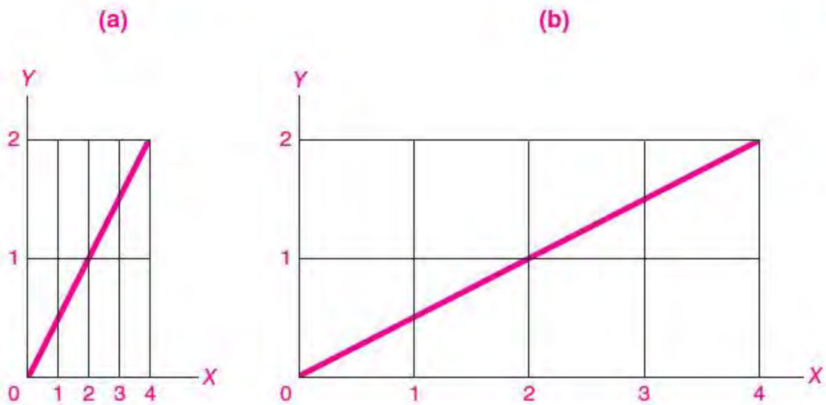


FIGURE 1A-4. Steepness Is Not the Same as Slope

Note that even though (**a**) looks steeper than (**b**), they display the same relationship. Both have a slope of ½, but the X axis has been stretched out in (**b**).

the slope of BD is CD/BC. (For those who have studied calculus, question 7 at the end of this appendix relates slopes to derivatives.)

The key points to understand about slopes are the following:

1. The slope can be expressed as a number. It measures the change in Y per unit change in X, or "the rise over the run."
2. If the line is straight, its slope is constant everywhere.
3. The slope of the line indicates whether the relationship between X and Y is direct or inverse.

Direct relationships occur when variables move in the same direction (that is, they increase or decrease together); *inverse relationships* occur when the variables move in opposite directions (that is, one increases as the other decreases).

Thus a negative slope indicates the X-Y relation is inverse, as it is in Figure 1A-3(*a*). Why? Because an increase in X calls for a decrease in Y.

People sometimes confuse slope with the appearance of steepness. This conclusion is often but not always valid. The steepness depends on the scale of the graph. Panels (*a*) and (*b*) in Figure 1A-4 both portray exactly the same relationship. But in (*b*), the horizontal scale has been stretched out compared with (*a*). If you calculate carefully, you will see that the slopes are exactly the same (and are equal to ½).

Slope of a Curved Line

A curved or nonlinear line is one whose slope changes. Sometimes we want to know the slope at *a given point,* such as point *B* in Figure 1A-5. We see that the slope at point *B* is positive, but it is not obvious exactly how to calculate the slope.

To find the slope of a smooth curved line at a point, we calculate the slope of the straight line that just touches, but does not cross, the curved line at the point in question. Such a straight line is called a *tangent* to the curved line. Put differently, the slope of a curved line at a point is given by the slope of the straight line that is tangent to the curve at the given point. Once we draw the tangent line, we find the slope of the tangent line with the usual right-angle measuring technique discussed earlier.

To find the slope at point *B* in Figure 1A-5, we simply construct straight line *FBJ* as a tangent to the curved line at point *B*. We then calculate the slope of the tangent as *NJ*/*MN*. Similarly, the tangent line *GH* gives the slope of the curved line at point *D*.

Another example of the slope of a nonlinear line is shown in Figure 1A-6. This shows a typical microeconomics curve, which is dome-shaped and has a maximum at point *C*. We can use our method of slopes as tangents to see that the slope of the curve is always positive in the region where the curve is rising and negative in the falling region. At the peak or maximum of the curve, the slope is exactly zero. A zero slope signifies that a tiny movement in the *X* variable around the maximum has no effect on the value of the *Y* variable.[1]

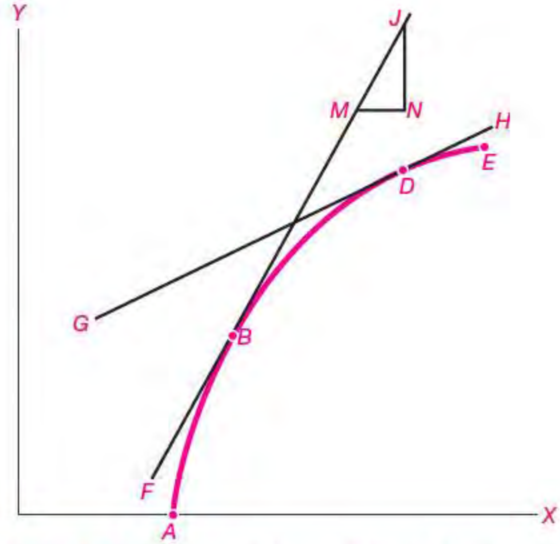


FIGURE 1A-5. Tangent as Slope of Curved Line

By constructing a tangent line, we can calculate the slope of a curved line at a given point. Thus the line *FBMJ* is tangent to smooth curve *ABDE* at point *B*. The slope at *B* is calculated as the slope of the tangent line, that is, as *NJ*/*MN*.

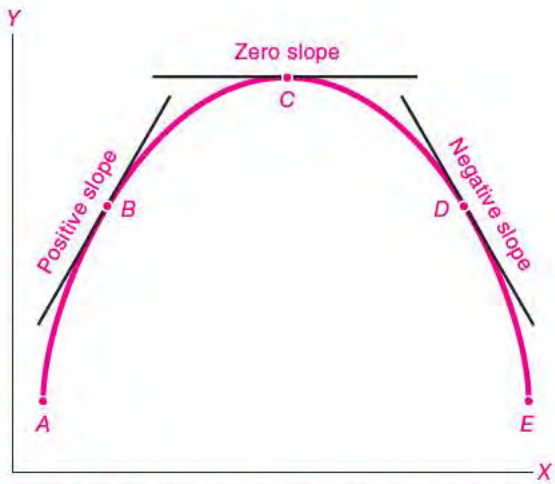


FIGURE 1A-6. Different Slopes of Nonlinear Curves

Many curves in economics first rise, then reach a maximum, then fall. In the rising region from *A* to *C* the slope is positive (see point *B*). In the falling region from *C* to *E* the slope is negative (see point *D*). At the curve's maximum, point *C*, the slope is zero. (What about a U-shaped curve? What is the slope at its minimum?)

[1] For those who enjoy algebra, the slope of a line can be remembered as follows: A straight line (or linear relationship) is written as $Y = a + bX$. For this line, the slope of the curve is b, which measures the change in Y per unit change in X.

A curved line or nonlinear relationship is one involving terms other than constants and the X term. An example of a nonlinear relationship is the quadratic equation $Y = (X - 2)^2$. You can verify that the slope of this equation is negative for $X < 2$ and positive for $X > 2$. What is its slope for $X = 2$?

For those who know calculus: A zero slope comes where the derivative of a smooth curve is equal to zero. For example, plot and use calculus to find the zero-slope point of a curve defined by the function $Y = (X - 2)^2$.

Slope as the Marginal Value

One of the most important concepts in economics is *marginal*, which always means "additional" or "extra." For example, we talk about "marginal cost," which means the extra cost that is incurred when a firm produces an extra unit of output. Similarly, in fiscal economics, we discuss the "marginal tax rate," which denotes the additional taxes that are paid when an individual earns an additional dollar of income.

We can calculate the marginal value in a relationship from the slope. Figure 1A-3 shows the marginal values for two straight lines. Look first at Figure 1A-3(*b*). Perhaps the *Y* variable is taxes and the *X* variable is income. Then the slope *s* represents the marginal tax rate. For every unit of *X*, taxes go up by *s* units. For many taxpayers, the marginal tax rate would be between 0.20 and 0.40.

Next examine Figure 1A-3(*a*). Here, the marginal value is negative. This might represent what happens when a particular area is overfished, where the *X* variable is number of boats and the *Y* variable is total fish catch. Because of overfishing, the marginal catch per boat is actually negative because the stock of fish is being depleted.

We can also apply this concept to curved lines. What is the marginal value at point *B* in Figure 1A-5? You can calculate that each *MN* units of *X* produce *NJ* units of *Y*. The marginal value at *B* is also the slope, which is *NJ*/*MN*. Note that the marginal value is declining as *X* increases because the curve is concave or dome-shaped.

Query: What is the marginal value of the relationship in Figure 1A-6 at point *C*? Make sure you can explain why the marginal value is zero.

Shifts of and Movement along Curves

An important distinction in economics is that between shifts of curves and movement along curves. We can examine this distinction in Figure 1A-7. The inner production-possibility frontier reproduces the *PPF* in Figure 1A-2. At point *D* society chooses to produce 30 units of food and 90 units of machines. If society decides to consume more food with a given *PPF*, then it can *move along* the *PPF* to point *E*. This movement along the curve represents choosing more food and fewer machines.

Suppose that the inner *PPF* represents society's production possibilities for 1990. If we return to the same country in 2000, we see that the *PPF* has *shifted* from the inner 1990 curve to the outer 2000 curve. (This shift would occur because of technological change or because of an increase in labor or capital available.) In the later year, society might choose to be at point *G*, with more food and machines than at either *D* or *E*.

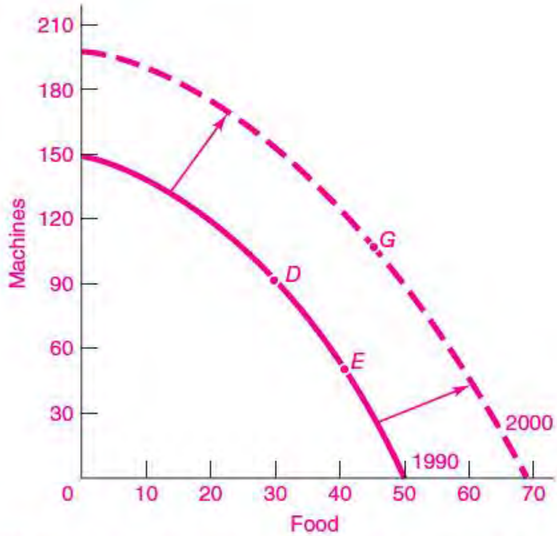


FIGURE 1A-7. Shift of Curves versus Movement along Curves

In using graphs, it is essential to distinguish *movement along* a curve (such as from high-investment *D* to low- investment *E*) from a *shift* of a curve (as from *D* in an early year to *G* in a later year).

The point of this example is that in the first case (moving from *D* to *E*) we see movement along the curve, while in the second case (from *D* to *G*) we see a shift of the curve.

Some Special Graphs

The *PPF* is one of the most important graphs of economics, one depicting the relationship between two economic variables (such as food and machines or guns and butter). You will encounter other types of graphs in the pages that follow.

Time Series Some graphs show how a particular variable has changed over time. Look, for example, at the graphs on the inside front cover of this text.

The left-hand graph shows a time series, since the American Revolution, of a significant macroeconomic variable, the ratio of the federal government debt to total gross domestic product—this ratio is the *debt-GDP ratio.* Time-series graphs have time on the horizontal axis and variables of interest (in this case, the debt-GDP ratio) on the vertical axis. This graph shows that the debt-GDP ratio has risen sharply during every major war.

Scatter Diagrams Sometimes individual data points will be plotted, as in Figure 1A-1. Often, combinations of variables for different years will be plotted. An important example of a scatter diagram from macroeconomics is the *consumption function,* shown in Figure 1A-8. This scatter diagram shows the nation's total disposable income on the horizontal axis and total consumption (spending by households on goods like food, clothing, and housing) on the vertical axis. Note that consumption is very closely linked to income, a vital clue for understanding changes in national income and output.

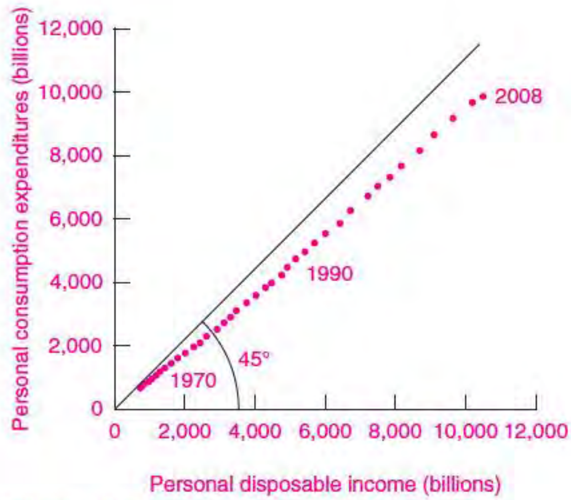


FIGURE 1A-8. Scatter Diagram of Consumption Function Shows Important Macroeconomic Law

The dots show a scatter diagram of income and consumption. Note how close the relationship is between the two. This forms the basis for the *consumption function* of macroeconomics.

Diagrams with More than One Curve Often it is useful to put two curves in the same graph, thus obtaining a "multicurve diagram." The most important example is the *supply-and-demand diagram,* shown in Chapter 3 (see page 55). Such graphs can show two different relationships simultaneously, such as how consumer purchases respond to price (demand) and how business production responds to price (supply).

By graphing the two relationships together, we can determine the price and quantity that will hold in a market.

This concludes our brief excursion into graphs. Once you have mastered these basic principles, the graphs in this book, and in other areas, can be both fun and instructive.

SUMMARY TO APPENDIX

1. Graphs are an essential tool of modern economics. They provide a convenient presentation of data or of the relationships among variables.
2. The important points to understand about a graph are: What is on each of the two axes (horizontal and vertical)? What are the units on each axis? What kind of relationship is depicted in the curve or curves shown in the graph?
3. The relationship between the two variables in a curve is given by its slope. The slope is defined as "the rise over the run," or the increase in *Y* per unit increase in *X.* If it is upward- (or positively) sloping, the two variables are directly related; they move upward or downward together. If the curve has a downward (or negative) slope, the two variables are inversely related.
4. In addition, we sometimes see special types of graphs: time series, which show how a particular variable moves over time; scatter diagrams, which show observations on a pair of variables; and multicurve diagrams, which show two or more relationships in a single graph.

CONCEPTS FOR REVIEW

Elements of Graphs

horizontal, or X, axis
vertical, or Y, axis
slope as "rise over run"
slope (negative, positive, zero)
tangent as slope of curved line

Examples of Graphs

time-series graphs
scatter diagrams
multicurve graphs

QUESTIONS FOR DISCUSSION

1. Consider the following problem: After your 8 hours a day of sleep, you have 16 hours a day to divide between leisure and study. Let leisure hours be the X variable and study hours be the Y variable. Plot the straight-line relationship between all combinations of X and Y on a blank piece of graph paper. Be careful to label the axes and mark the origin.
2. In question 1, what is the slope of the line showing the relationship between study and leisure hours? Is it a straight line?
3. Let us say that you absolutely need 6 hours of leisure per day, no more, no less. On the graph, mark the point that corresponds to 6 hours of leisure. Now consider a *movement along the curve:* Assume that you decide that you need only 4 hours of leisure a day. Plot the new point.
4. Next show a *shift of the curve:* You find that you need less sleep, so you have 18 hours a day to devote to leisure and study. Draw the new (shifted) curve.
5. As suggested in the special section on time use, keep a diary of your time use by half-hour increments for 3 days; record studying, sleeping, working, leisure, and other uses. Then draw a time production-possibility curve, like Figure 1A-2, between leisure and all other activities. Locate each of your 3 days on the time *PPF.* Then put the average for all Americans on the same graph. How do you compare with the average person?
6. Go to the website of the Bureau of Economic Analysis at *www.bea.gov.* Then click on "Gross Domestic Product." On the next page, click on "Interactive NIPA data." Then click on "Frequently Requested NIPA Tables." Click on "Table 1.2 (Real Gross Domestic Product)," which is the total output of the economy. This will probably come up with the quarterly data.
   a. Construct a graph that shows the time series for real GDP for the last six quarters. Is the general trend upward or downward? (In macroeconomics, we will learn that the slope is downward in recessions.)
   b. Construct a scatter plot showing "Imports" on the vertical axis and "Gross domestic product" on the horizontal axis. Describe the relationship between the numbers. (In macroeconomics, this will be the marginal propensity to import.)
7. *For those who have studied calculus:* The slope of a smooth line or curve is its derivative. The following are the equations for two inverse demand curves (where price is a function of output). For each curve, assume that the function holds only when $P \geqslant 0$ and $X \geqslant 0$.
   a. $P = 100 - 5X$
   b. $P = 100 - 20X + 1X^2$
   For each demand curve, determine its slope when $X = 0$ and when $X = 1$. For linear demand curves such as **a**, what is the condition under which the law of downward-sloping demand holds? Is curve **b** concave (like a dome) or convex (like a cup)?
8. The marginal value of a curve is its slope, which is the same as the first derivative of a function. Calculate algebraically the marginal effect of output on price for the inverse demand curves **a** and **b** in question 7. Provide the numerical marginal values at $X = 10$ for both demand curves.

CHAPTER 2

The Modern Mixed Economy

Every individual endeavors to employ his capital so that its produce may be of greatest value. He generally neither intends to promote the public interest, nor knows how much he is promoting it. He intends only his own security, only his own gain. And he is in this led by an invisible hand to promote an end which was no part of his intention. By pursuing his own interest he frequently promotes that of society more effectually than when he really intends to promote it.

Adam Smith
The Wealth of Nations (1776)

Think for a moment about some of the goods and services that you consumed over the last few days. Perhaps you took an airline flight to school or bought some gasoline for the family car. You surely had some home-cooked food bought in a grocery store or a meal purchased at a restaurant. You might have bought a book (such as this textbook) or some pharmaceutical drugs.

Now consider some of the many steps that preceded your purchases. The airplane flight will illustrate the point very well. You may have purchased an airline ticket on the Internet. This simple-sounding purchase involves much tangible capital such as your computer, intellectual property (in software and designs), and sophisticated fiber-optic transmission lines, as well as complicated airline reservation systems and pricing models. The airlines do all this to make profits (although profits have been very modest in that sector).

At the same time, government plays an important role in air travel. It regulates airline safety, owns many airports, manages the traffic-control system, produces the public good of weather data and forecasting, and provides information on flight delays. And this list could go on into the public and private support of aircraft manufacturing, international agreements on airline competition, energy policy on fuels, and other areas.

The same point would apply—in different degrees depending upon the sector—to your purchases of clothing or gasoline or pharmaceuticals or just about any item. The economy of every country in the world is a **mixed economy**—a combination of private enterprise working through the marketplace and government regulation, taxation, and programs. What exactly is a market economy, and what makes it such a powerful engine of growth? What is the "capital" in "capitalism"? What government controls are needed to make markets function effectively? The time has come to understand the principles that lie behind the market economy and to review government's role in economic life.

A. THE MARKET MECHANISM

Most economic activity in most high-income countries takes place in private markets—through the market mechanism—so we begin our systematic study there. Who is responsible for making the decisions in a market economy? You may be surprised to learn that *no single individual or organization or government is responsible for solving the economic problems in a market economy*. Instead, millions of businesses and consumers engage in voluntary trade, intending to improve their own economic situations, and their actions are invisibly coordinated by a system of prices and markets.

To see how remarkable this is, consider the city of New York. Without a constant flow of goods into and out of the city, New Yorkers would be on the verge of starvation within a week. But New Yorkers actually do very well economically. The reason is that goods travel for days and weeks from the surrounding counties, from 50 states, and from the far corners of the world, with New York as their destination.

How is it that 10 million people can sleep easily at night, without living in mortal terror of a breakdown in the elaborate economic processes upon which they rely? The surprising answer is that, without coercion or centralized direction by anyone, these economic activities are coordinated through the market.

Everyone in the United States notices how much the government does to control economic activity: it regulates drugs, fights fires, levies taxes, sends armies around the world, and so forth. But we seldom think about how much of our ordinary economic life proceeds without government intervention. Thousands of commodities are produced by millions of people every day, willingly, without central direction or master plan.

Not Chaos, but Economic Order

The market looks like a jumble of sellers and buyers. It seems almost a miracle that food is produced in suitable amounts, gets transported to the right place, and arrives in a palatable form at the dinner table. But a close look at New York or other economies is convincing proof that a market system is neither chaos nor miracle. It is a system with its own internal logic. And it works.

A market economy is an elaborate mechanism for coordinating people, activities, and businesses through a system of prices and markets. It is a communication device for pooling the knowledge and actions of billions of diverse individuals. Without central intelligence or computation, it solves problems of production and distribution involving billions of unknown variables and relations, problems that are far beyond the reach of even today's fastest supercomputer. Nobody designed the market, yet it functions remarkably well. In a market economy, no single individual or organization is responsible for production, consumption, distribution, or pricing.

How do markets determine prices, wages, and outputs? Originally, a market was an actual place where buyers and sellers could engage in face-to-face bargaining. The *marketplace*—filled with slabs of butter, pyramids of cheese, layers of wet fish, and heaps of vegetables—used to be a familiar sight in many villages and towns, where farmers brought their goods to sell. In the United States today there are still important markets where many traders gather together to do business. For example, wheat and corn are traded at the Chicago Board of Trade, oil and platinum are traded at the New York Mercantile Exchange, and gems are traded at the Diamond District in New York City.

Markets are places where buyers and sellers interact, exchange goods and services or assets, and determine prices. There are markets for almost everything. You can buy artwork by old masters at auction houses in New York or pollution permits at the Chicago Board of Trade. A market may be centralized, like the stock market. It may be decentralized, as is the case for most workers. Or it may exist only electronically, as is increasingly the case with "e-commerce" on the Internet. Some of the most important markets are for financial assets, such as stocks, bonds, foreign exchange, and mortgages.

A **market** is a mechanism through which buyers and sellers interact to determine prices and exchange goods, services, and assets.

The central role of markets is to determine the **price** of goods. A price is the value of the good in terms of money (the role of money will be discussed later in this chapter). At a deeper level, prices represent the terms on which different items can be exchanged. The market price of a bicycle might be $500, while that of a pair of shoes is $50. In essence, the market is saying that shoes and bicycles trade on a 10-to-1 basis.

In addition, prices serve as *signals* to producers and consumers. If consumers want more of any good, the price will rise, sending a signal to producers that more supply is needed. When a terrible disease reduces beef production, the supply of beef decreases and raises the price of hamburgers. The higher price encourages farmers to increase their production of beef and, at the same time, encourages consumers to substitute other foods for hamburgers and beef products.

What is true of the markets for consumer goods is also true of markets for factors of production, such as land or labor. If more computer programmers are needed to run Internet businesses, the price of computer programmers (their hourly wage) will tend to rise. The rise in relative wages will attract workers into the growing occupation.

Prices coordinate the decisions of producers and consumers in a market. Higher prices tend to reduce consumer purchases and encourage production. Lower prices encourage consumption and discourage production. Prices are the balance wheel of the market mechanism.

Market Equilibrium. At every moment, some people are buying while others are selling; firms are inventing new products while governments are passing laws to regulate old ones; foreign companies are opening plants in America while American firms are selling their products abroad. Yet in the midst of all this turmoil, markets are constantly solving the *what, how,* and *for whom.* As they balance all the forces operating on the economy, markets are finding a **market equilibrium of supply and demand.**

A market equilibrium represents a balance among all the different buyers and sellers. Depending upon the price, households and firms all want to buy or sell different quantities. The market finds the equilibrium price that simultaneously meets the desires of buyers and sellers. Too high a price would mean a glut of goods with too much output; too low a price would produce long lines in stores and a deficiency of goods. Those prices for which buyers desire to buy exactly the quantity that sellers desire to sell yield an equilibrium of supply and demand.

How Markets Solve the Three Economic Problems

We have just described how prices help balance consumption and production (or demand and supply) in an individual market. What happens when we put all the different markets together—beef, cars, land, labor, capital, and everything else? These markets work simultaneously to determine a general equilibrium of prices and production.

By matching sellers and buyers (supply and demand) in each market, a market economy simultaneously solves the three problems of *what, how,* and *for whom.* Here is an outline of a market equilibrium:

1. *What* goods and services will be produced is determined by the dollar votes of consumers in their daily purchase decisions. A century ago, many dollar votes for transportation went for horses and horseshoes; today, much is spent on automobiles and tires.

   Firms, in turn, are motivated by the desire to maximize profits. **Profits** are net revenues, or the difference between total sales and total costs. Firms abandon areas where they are losing profits; by the same token, firms are lured by high profits into production of goods in high demand. Some of the most profitable activities today are producing and marketing drugs—drugs for depression, anxiety, and all other manner of human frailty. Lured by the high profits, companies are investing billions of dollars each year in research to come up with yet more new and improved medicines.
2. *How* things are produced is determined by the competition among different producers. The best way for producers to meet price competition and maximize profits is to keep costs at a minimum by adopting the most efficient methods of production. Sometimes change is incremental and consists of little more than tinkering with the machinery or adjusting the input mix to gain a cost advantage. At other times there are drastic

shifts in technology, as with steam engines displacing horses because steam was cheaper per unit of useful work, or airplanes replacing railroads as the most efficient mode for long-distance travel. Right now we are in the midst of just such a transition to a radically different technology, with computers revolutionizing many tasks in the workplace, from the checkout counter to the lecture room.

3. *For whom* things are produced—who is consuming and how much—depends, in large part, on the supply and demand in the markets for factors of production. Factor markets (i.e., markets for factors of production) determine wage rates, land rents, interest rates, and profits. Such prices are called *factor prices*. The same person may receive wages from a job, dividends from stocks, interest on a bond, and rent from a piece of property. By adding up all the revenues from all the factors, we can calculate the person's market income. The distribution of income among the population is thus determined by the quantity of factor services (person-hours, acres, etc.) and the prices of the factors (wage rates, land rents, etc.).

The Dual Monarchy

Who are the rulers in a market economy? Do giant companies like Microsoft and Toyota call the tune? Or perhaps Congress and the president? Or advertising moguls from Madison Avenue? All these people and institutions affect us, but in the end the major forces affecting the shape of the economy are the dual monarchs of *tastes* and *technology*.

One fundamental determinant is the tastes of the population. These innate and acquired tastes—as expressed in the dollar votes of consumer demands—direct the uses of society's resources. They pick the point on the production-possibility frontier (*PPF*).

The other major factor is the resources and technology available to a society. The economy cannot go outside its *PPF*. You can fly to Hong Kong, but there are no flights yet to Mars. Therefore, the economy's resources limit the candidates for the dollar votes of consumers. Consumer demand has to dovetail with business supply of goods and services to determine what is ultimately produced.

You will find it helpful to recall the dual monarchy when you wonder why some technologies fail in the marketplace. From the Stanley Steamer—a car that ran on steam—to the Premiere smokeless cigarette, which was smokeless but also tasteless, history is full of products that found no markets. How do useless products die off? Is there a government agency that pronounces upon the value of new products? No such agency is necessary. Rather, they become extinct because there is no consumer demand for the products at the going market price. These products make losses rather than profits. This reminds us that profits serve as the rewards and penalties for businesses and guide the market mechanism.

Like a farmer using a carrot and a stick to coax a donkey forward, the market system deals out profits and losses to induce firms to produce desired goods efficiently.

A Picture of Prices and Markets

We can picture the circular flow of economic life in Figure 2-1. The diagram provides an overview of how consumers and producers interact to determine prices and quantities for both inputs and outputs. Note the two different kinds of markets in the circular flow. At the top are the product markets, or the flow of outputs like pizza and shoes; at the bottom are the markets for inputs or factors of production like land and labor. Further, see how decisions are made by two different entities, consumers and businesses.

Consumers buy goods and sell factors of production; businesses sell goods and buy factors of production. Consumers use their income from the sale of labor and other inputs to buy goods from businesses; businesses base their prices of goods on the costs of labor and property. Prices in goods markets are set to balance consumer demand with business supply; prices in factor markets are set to balance household supply with business demand.

All this sounds complicated. But it is simply the total picture of the intricate web of supplies and demands connected through a market mechanism to solve the economic problems of *what, how,* and *for whom*.

The Invisible Hand

It was Adam Smith who first recognized how a market economy organizes the complicated forces of supply and demand. In one of the most famous passages of all economics, quoted from *The Wealth of Nations* at the opening of this chapter, Smith saw the harmony between private profit and public interest. Go back and reread these paradoxical words. Particularly note

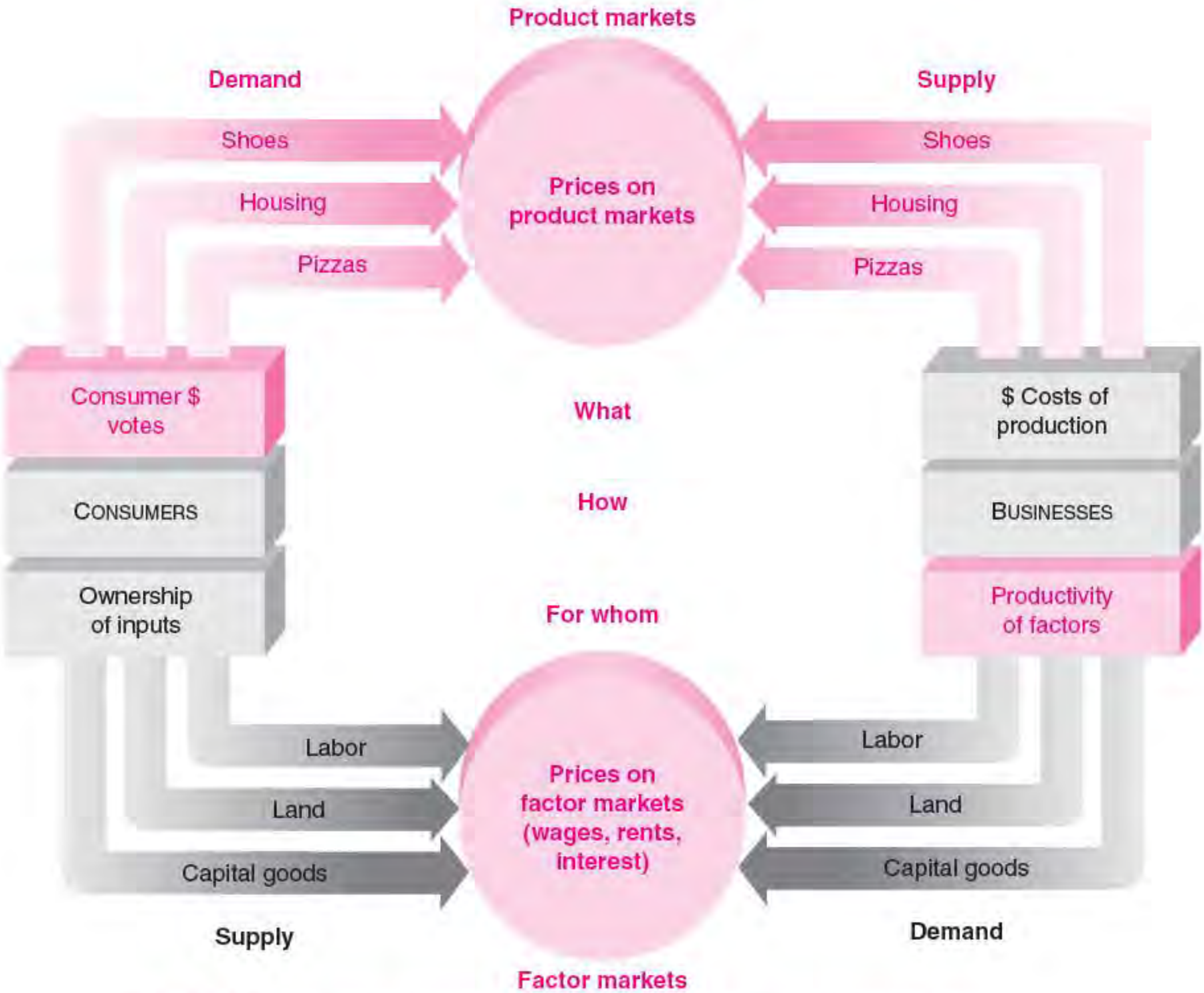


FIGURE 2-1. The Market System Relies on Supply and Demand to Solve the Trio of Economic Problems

We see here the circular flow of a market economy. Dollar votes of consumers (households, governments, and foreigners) interact with business supply in the product markets at top, helping to determine *what* is produced. Business demand for inputs meets the supply of labor and other inputs in the factor markets below, determining wage, rent, and interest payments; incomes thus influence *for whom* goods are delivered. Business competition to buy factor inputs and sell goods most cheaply determines *how* goods are produced.

the subtle point about the **invisible hand**—that private interest can lead to public gain *when it takes place in a well-functioning market mechanism.*

Smith's words were written in 1776. That same year was also marked by the American Declaration of Independence. It is no coincidence that both ideas appeared at the same time. Just as Americans were proclaiming freedom from tyranny, Adam Smith was preaching a revolutionary doctrine emancipating trade and industry from the shackles of a feudal aristocracy. Smith held that government interference with market competition is almost certain to be injurious.

Smith's insight about the functioning of the market mechanism has inspired modern economists—both the admirers and the critics of capitalism.

Economic theorists have proved that under limited conditions a perfectly competitive economy is efficient (remember that an economy is producing efficiently when it cannot increase the economic welfare of anyone without making someone else worse off).

After two centuries of experience and thought, however, we recognize the limited scope of this doctrine. We know that there are "market failures," that markets do not always lead to the most efficient outcome. One set of market failures concerns monopolies and other forms of imperfect competition. A second failure of the "invisible hand" comes when there are spillovers or externalities outside the marketplace—positive externalities such as scientific discoveries and negative spillovers such as pollution.

A final reservation comes when the income distribution is politically or ethically unacceptable. When any of these elements occur, Adam Smith's invisible-hand doctrine breaks down and government may want to step in to mend the flawed invisible hand.

In summary:

Adam Smith discovered a remarkable property of a competitive market economy. Under perfect competition and with no market failures, markets will squeeze as many useful goods and services out of the available resources as is possible. But where monopolies or pollution or similar market failures become pervasive, the remarkable efficiency properties of the invisible hand may be destroyed.

Adam Smith: Founding Father of Economics

"For what purpose is all the toil and bustle of this world? What is the end of avarice and ambition, of the pursuit of wealth, of power, and pre-eminence?" Thus wrote Adam Smith (1723–1790), of Scotland, who glimpsed for the social world of economics what Isaac Newton recognized for the physical world of the heavens. Smith answered his questions in *The Wealth of Nations* (1776), where he explained the self-regulating natural order by which the oil of self-interest lubricates the economic machinery in an almost miraculous fashion. Smith believed that the toil and bustle had the effect of improving the lot of the common man and woman. "Consumption is the sole end and purpose of all production."

Smith was the first apostle of economic growth. At the dawn of the Industrial Revolution, he pointed to the great strides in productivity brought about by specialization and the division of labor. In a famous example, he described the manufacturing of a pin factory in which "one man draws out the wire, another straightens it, a third cuts it," and so it goes. This operation allowed 10 people to make 48,000 pins in a day, whereas if "all wrought separately, they could not each of them make twenty, perhaps not one pin a day." Smith saw the result of this division of labor as "universal opulence which extends itself to the lowest ranks of the people." Imagine what he would think if he returned today to see what two more centuries of economic growth have produced!

Smith wrote hundreds of pages railing against countless cases of government folly and interference. Consider the seventeenth-century guild master who was attempting to improve his weaving. The town guild decided, "If a cloth weaver intends to process a piece according to his own invention, he should obtain permission from the judges of the town to employ the number and length of threads that he desires after the question has been considered by four of the oldest merchants and four of the oldest weavers of the guild." Smith argued that such restrictions—whether imposed by government or by monopolies, whether on production or on foreign trade—limit the proper workings of the market system and ultimately hurt both workers and consumers.

None of this should suggest that Smith was an apologist for the establishment. He had a distrust of all entrenched power, private monopolies as much as public monarchies. He was for the common people. But, like many of the great economists, he had learned from his research that the road to waste is paved with good intentions.

Above all, it is Adam Smith's vision of the self-regulating "invisible hand" that is his enduring contribution to modern economics.

B. TRADE, MONEY, AND CAPITAL

What are some of the distinguishing features of a modern economy? Three important ones are considered in this section:

1. An advanced economy is characterized by an elaborate network of trade that depends on specialization and an intricate division of labor.

2. Modern economies today make extensive use of money, which provides the yardstick for measuring economic values and is the means of payment.
3. Modern industrial technologies rest on the use of vast stocks of capital. Capital leverages human labor into a much more efficient factor of production and allows productivity many times greater than that possible in an earlier age.

TRADE, SPECIALIZATION, AND DIVISION OF LABOR

As compared to the economies of the 1700s, today's economies depend heavily on the specialization of individuals and firms, connected by an extensive network of trade. Modern economies have enjoyed rapid economic growth as increasing specialization has allowed workers to become highly productive in particular occupations and to trade their output for the commodities they need.

Specialization occurs when people and countries concentrate their efforts on a particular set of tasks—it permits each person and country to use to best advantage the specific skills and resources that are available. One of the facts of economic life is that, rather than have everyone do everything in a mediocre way, it is better to establish a *division of labor*—dividing production into a number of small specialized steps or tasks. A division of labor permits tall people to play basketball, numerate people to teach, and persuasive people to sell cars. It sometimes takes many years to receive the training for particular careers—it usually takes 14 postgraduate years to become a certified neurosurgeon.

Capital and land are also highly specialized. In the case of land, some lands form the precious sandy strips of beach between populous cities and warm oceans; others are valuable vineyard lands of France or California; still other lands border on deepwater ports and serve as centers of trade for the world.

Capital also is highly specialized. The computer software that went along with the labor to write this textbook took over a decade to be developed, but it is useless at managing an oil refinery or solving large numerical problems. One of the most impressive examples of specialization is the computer chip that manages automobiles, increases their efficiency, and can even serve as a "black box" to record accident data.

The enormous efficiency of specialization allows the intricate network of trade among people and nations that we see today. Very few of us produce a single finished good; we make but the tiniest fraction of what we consume. We might teach a small part of one college's curriculum, or empty coins from parking meters, or separate the genetic material of fruit flies. In exchange for this specialized labor, we will receive an income adequate to buy goods from all over the world.

The idea of *gains from trade* forms one of the central insights of economics. Different people or countries tend to specialize in certain areas; they then engage in the voluntary exchange of what they produce for what they need. Japan has grown enormously productive by specializing in manufacturing goods such as automobiles and consumer electronics; it exports much of its manufacturing output to pay for imports of raw materials. By contrast, countries which have tried the strategy of becoming self-sufficient—attempting to produce most of what they consume—have discovered that this is the road to stagnation. Trade can enrich all nations and increase *everyone's* living standards.

To summarize:

Specialization and trade are the key to high living standards. By specializing, people can become highly productive in a very narrow field of expertise. People can then trade their specialized goods for others' products, vastly increasing the range and quality of consumption and having the potential to raise everyone's living standards.

Globalization

You can hardly open a newspaper today without reading about the most recent trends in "globalization." What exactly does this term mean? How can economics contribute to understanding the issues?

Globalization is a term that is used to *denote an increase in economic integration among nations.* Increasing integration is seen today in the dramatic growth in the flows of goods, services, and finance across national borders.

One major component of globalization is the steady increase in the share of national output devoted to imports and exports. With a continuous drop in transportation and communication costs, along with declining tariffs and other barriers to trade, the share of trade in U.S. national output has more than doubled over the last half-century. Domestic producers now compete with producers from around the world in their prices and design decisions.

At a deeper level, however, globalization reflects an extension of specialization and division of labor to the entire world. Two centuries ago, most people lived on farms and produced virtually everything they consumed: food, shelter, clothing, fuel, and so on. Gradually, people specialized and bought much of their consumption from others in their community or nation. Today, many goods are produced in several countries and shipped around the world.

An interesting example of the globalized economy is the production of the iPod. Who makes the iPod? You might think that it is made by Apple, while if you look at the back of the iPod, it says "Made in China." What is the truth here? The iPod is actually a small portable computer for delivering music. It has at least 451 parts, which are made all around the world. Apple designed the software and manages the production process, earning about $80 for each $299 of sales. China's part consists primarily of assembly, under a Taiwanese subcontract, with about $5 of labor costs. So, while the trade statistics record that an iPod sold in the United States incurs $150 of trade deficit with China, only a tiny fraction of the $150 was actually earned by China.

Hal Varian, chief economist for Google, summarized the results of this study very nicely:

> Ultimately, there is no simple answer to who makes the iPod or where it is made. The iPod, like many other products, is made in several countries by dozens of companies, with each stage of production contributing a different amount to the final value. The real value of the iPod doesn't lie in its parts or even in putting those parts together. The bulk of the iPod's value is in the conception and design of the iPod. That is why Apple gets $80 for each of these video iPods it sells, which is by far the largest piece of value added in the entire supply chain. Those clever folks at Apple figured out how to combine 451 mostly generic parts into a valuable product. They may not make the iPod, but they created it. In the end, that's what really matters.[1]

Evidence indicates that this process of "slicing up the value added" is typical of manufacturing activities in the United States and other high-income countries.

Globalization occurs in financial markets as well as in goods markets. Financial integration is seen in the accelerated pace of lending and borrowing among nations as well as in the convergence of interest rates among different countries. The major causes of financial-market integration have been the dismantling of restrictions on capital flows among nations, cost reductions, and innovations in financial markets, particularly the use of new kinds of financial instruments.

Financial integration among nations has undoubtedly led to gains from trade, as nations with productive uses for capital can borrow from countries with excess savings. In the last two decades, Japan and China have served as the world's major lending countries. Surprisingly, the United States has been the world's largest borrower—partly because of its low national saving rate and partly because of the dynamism of its industries, such as information and biomedical technologies.

Global integration of goods and financial markets has produced impressive gains from trade in the form of lower prices, increased innovation, and more rapid economic growth. But these gains have been accompanied by painful side effects.

One consequence of economic integration is the unemployment and lost profits that occur when low-cost foreign producers displace domestic production. For example, from 1980 to 2007, U.S. employment in textiles and apparel fell from 2 million to 0.6 million workers. The unemployed textile workers found little solace in the fact that consumers were enjoying declining prices for Chinese clothing. Those who lose from increased international trade are the tireless advocates of "protectionism" in the form of tariffs and quotas on international trade.

A second consequence comes when financial integration triggers international financial crises. The latest crisis began in mid-2007 when a decline in U.S. housing prices spilled over into stock and bond markets around the world. One might ask why the Indian stock market should decline 20 or 30 percent because of problems in the U.S. housing market. The contagion arising from such disturbances is the result of closely linked markets. The irrational exuberance in financial markets in the 2000s led to extremely small risk premiums, raising asset prices around the world. When investors turned pessimistic in 2007 and 2008, risk premiums rose everywhere, including on Indian assets.

Globalization raises many new issues for policymakers. Are the gains from trade worth the domestic costs in terms of social disruption and dislocation? Should countries attempt to insulate themselves from global financial crises by walling off their financial markets? Does integration lead to greater income inequality? How should central

[1] See the website listings in the Further Reading section at the end of this chapter.

banks respond to financial instabilities that spread around the world? These questions are on the minds of policymakers who are attempting to deal with globalization.

MONEY: THE LUBRICANT OF EXCHANGE

If specialization permits people to concentrate on particular tasks, money then allows people to trade their specialized outputs for the vast array of goods and services produced by others.

Money is the means of payment in the form of currency and checks used to buy things. Money is a lubricant that facilitates exchange. When everyone trusts and accepts money as payment for goods and debts, trade is facilitated. Just imagine how complicated economic life would be if you had to barter goods for goods every time you wanted to buy a pizza or go to a concert. What services could you offer Sal's Pizza? What could you barter with your college to cover your tuition? Money acts as a matchmaker between buyers and sellers, effortlessly effecting little marriages of mutual self-interest billions of times every day.

Governments control the money supply through their central banks. But like other lubricants, money can get overheated and damage the economic engine. It can grow out of control and cause a hyperinflation, in which prices increase very rapidly. When that happens, people concentrate on spending their money quickly, before it loses its value, rather than investing it for the future. That's what happened to several Latin American countries in the 1980s, and many former socialist economies in the 1990s, when they had inflation rates exceeding 1000 percent or even 10,000 percent per year. Imagine getting your paycheck and having it lose 20 percent of its value by the end of the week!

Money is the medium of exchange. Proper management of the financial system is one of the major issues for government macroeconomic policy in all countries.

CAPITAL

The two great input partners in the productive process are labor and capital. We know what labor is, because we are all workers who rent our time for wages. The other partner is **capital**—a produced and durable input which is itself an output of the economy. Capital consists of a vast and specialized array of machines, buildings, computers, software, and so on.

Most of us do not realize how much our daily activities depend upon capital, including the houses where we live, the highways on which we drive, and the wires that bring electricity and cable TV to our homes. The total net capital stock in the U.S. economy in 2008, including government-owned, business, and residential capital, amounted to more than $150,000 per person.

Unlike land and labor, capital has to be produced before you can use it. For example, some companies build textile machines, which are then used to make shirts; some companies build farm tractors, which are then used to help produce corn.

Use of capital involves time-consuming, roundabout methods of production. People learned long ago that indirect and roundabout production techniques often are more efficient than direct methods of production. For example, the most direct method of catching fish is to wade into a stream and grab fish with your hands, but this yields more frustration than fish. By using a fishing rod (which is capital equipment), fishing time becomes more productive in terms of fish caught per day. By using even more capital, in the form of nets and fishing boats, fishing becomes productive enough to feed many people and provide a good living to those who operate the specialized nets and equipment.

Growth from the Sacrifice of Current Consumption. If people are willing to save—to abstain from present consumption and wait for future consumption—society can devote resources to new capital goods. A larger stock of capital helps the economy grow faster by pushing out the *PPF.* Look back at Figure 1-5 to see how forgoing current consumption in favor of investment adds to future production possibilities. High rates of saving and investment help explain how Taiwan, China, and other Asian countries have grown so fast over the last three decades. By contrast, many poor countries are caught in a vicious circle called the "poverty trap." They have low incomes and few productive outlets for their savings, they save and invest little, they grow slowly, and as a consequence they fall further behind in the economic standings of nations.

We summarize as follows:

Economic activity involves forgoing current consumption to increase our capital. Every time we invest—building a new factory or road, increasing the years or quality of education, or increasing the stock of useful technical knowledge—we are enhancing the future productivity of our economy and increasing future consumption.

Capital and Private Property

In a market economy, capital typically is privately owned, and the income from capital goes to individuals. Every patch of land has a deed, or title of ownership; almost every machine and building belongs to an individual or corporation. *Property rights* bestow on their owners the ability to use, exchange, paint, dig, drill, or exploit their capital goods. These capital goods also have market values, and people can buy and sell the capital goods for whatever price the goods will fetch. *The ability of individuals to own and profit from capital is what gives capitalism its name.*

However, while our society is one built on private property, property rights are limited. Society determines how much of "your" property you may bequeath to your heirs and how much must go in inheritance taxes to the government. Society determines how much your factory can pollute and where you can park your car. Even your home is not your castle: you must obey zoning laws and, if necessary, make way for a road.

Interestingly enough, the most valuable economic resource, labor, cannot be turned into a commodity that is bought and sold as private property. Since the abolition of slavery, it has been illegal to treat human earning power like other capital assets. You are not free to sell yourself; you must rent yourself at a wage.

Property Rights for Capital and Pollution

Economists often emphasize the importance of property rights in an efficient market economy. Property rights define how individuals or firms can own, buy, sell, and use capital goods and other property. These rights are enforced through the legal framework, which constitutes the set of laws within which a society operates. An efficient and acceptable legal framework for a market economy includes the definition of clear property rights, the laws of contract, and a system for adjudicating disputes.

Poor countries have discovered that it is difficult to have an efficient market economy when there are no laws enforcing contracts or guaranteeing that a company can keep its own profits. And when the legal framework breaks down, as in war-torn Iraq after 2003, people begin to fear for their lives. They have little time or inclination to make long-term investments for the future. Production falls and the quality of life deteriorates. Indeed, many of the most horrifying African famines were caused by civil war and the breakdown in the legal order, not by bad weather.

The environment is another example where poorly designed property rights harm the economy. Water and air are generally open-access resources, meaning that no one owns or controls them. As the saying goes, "Everyone's business is nobody's business." In this area, people do not weigh all the costs of their actions. Someone might throw trash into the water or emit smoke into the air because the costs of dirty water or foul air are borne by other people. By contrast, people are less likely to throw trash on their own lawn or burn coal in their own living room because they themselves will bear the costs.

In recent years, economists have proposed extending property rights to environmental commodities by selling or auctioning permits to pollute and allowing them to be traded on markets. Preliminary evidence suggests that this extension of property rights has given much more powerful incentives to reduce pollution efficiently.

We have highlighted some key features of a modern economy: Specialization and the division of labor among people and countries create great efficiencies; increased production makes trade possible; money allows trade to take place efficiently; and a sophisticated financial system allows people's savings to flow smoothly into other people's capital.

C. THE VISIBLE HAND OF GOVERNMENT

In an idealized market economy, all goods and services are voluntarily exchanged for money at competitive market prices that reflect consumer valuations and social costs. Such a system squeezes the maximum in consumer satisfaction out of a society's available resources. In reality, however, no economy actually conforms totally to the idealized world of the smoothly functioning invisible hand. Rather, economic imperfections lead to such ills as pollution, unemployment, financial panics, and extremes of wealth and poverty.

No government anywhere in the world, at any time, no matter how conservative it claims to be, keeps its hands off the economy. Governments take on many tasks in response to the flaws in the market mechanism. The military, the police, and the national weather service are typical areas of government activity. Socially useful ventures such as space exploration and scientific research benefit from government funding. Governments may regulate some businesses (such as finance and drugs) while subsidizing others (such as education and biomedical research). Governments tax their citizens and redistribute some of the proceeds to the elderly and needy.

How do governments perform their functions? Governments operate by requiring people to pay taxes, obey regulations, and consume certain collective goods and services. Because of its coercive powers, the government can perform functions that would not be possible under voluntary exchange. Government coercion increases the freedoms and consumption of those who benefit while reducing the incomes and opportunities of those who are taxed or regulated.

Governments have three main economic functions in a market economy:

1. Governments increase *efficiency* by promoting competition, curbing externalities like pollution, and providing public goods.
2. Governments promote *equity* by using tax and expenditure programs to redistribute income toward particular groups.
3. Governments foster *macroeconomic stability and growth*—reducing unemployment and inflation while encouraging economic growth—through fiscal and monetary policy.

We will examine briefly each function.

EFFICIENCY

Adam Smith recognized that the virtues of the market mechanism are fully realized only when the checks and balances of perfect competition are present. What is meant by **perfect competition?** This technical term refers to a market in which no firm or consumer is large enough to affect the market price. For example, the wheat market is perfectly competitive because the largest wheat farm, producing only a minuscule fraction of the world's wheat, can have no appreciable effect upon the price of wheat.

The invisible-hand doctrine applies to economies in which all markets are perfectly competitive. Perfectly competitive markets will produce an efficient allocation of resources, so the economy is on its production-possibility frontier. When all industries are subject to the checks and balances of perfect competition, as we will see later in this book, markets will produce the bundle of outputs most desired by consumers using the most efficient techniques and the minimum amount of inputs.

Alas, there are many ways that markets can fall short of efficient perfect competition. The three most important ones involve imperfect competition, such as monopolies; externalities, such as pollution; and public goods, such as national defense and lighthouses. In each case, market failure leads to inefficient production or consumption, and government can play a useful role in curing the disease.

Imperfect Competition

One serious deviation from an efficient market comes from *imperfect competition* or *monopoly* elements. Whereas under perfect competition no firm or consumer can affect prices, **imperfect competition** occurs when a buyer or seller can affect a good's price. For example, if the TV company or a labor union is large enough to influence the price of TV service or labor, respectively, some degree of imperfect competition has set in. When imperfect competition arises, society may move inside its *PPF*. This would occur, for example, if a single seller (a monopolist) raised the price to earn extra profits. The output of that good would be reduced below the most efficient level, and the efficiency of the economy would thereby suffer. In such a situation, the invisible-hand property of markets may be violated.

What is the effect of imperfect competition? Imperfect competition leads to prices that rise above cost and to consumer purchases that are reduced below efficient levels. The pattern of too high price and too low output is the hallmark of the inefficiencies associated with imperfect competition.

In reality, almost all industries possess some measure of imperfect competition. Airlines, for example, may have no competition on some of their routes but face several rivals on others. The extreme case of imperfect competition is the *monopolist*—a single supplier who alone determines the price of a particular good or service. For example, Microsoft has been a monopolist in the production of Windows operating systems.

Over the last century, most governments have taken steps to curb the most extreme forms of imperfect competition. Governments sometimes regulate the price and profits of monopolies such as local water, telephone, and electric utilities. In addition, government antitrust laws prohibit actions such as price fixing and agreements to divide up markets. The most important check to imperfect competition, however, is the opening of markets to competitors, whether they be domestic or foreign. Few monopolies can long withstand the attack of competitors unless governments protect them through tariffs or regulations.

Externalities

A second type of inefficiency arises when there are spillovers or externalities, which involve involuntary imposition of costs or benefits. Market transactions involve voluntary exchange in which people exchange goods or services for money. When a firm buys a chicken to make frozen drumsticks, it buys the chicken from its owner in the chicken market, and the seller receives the full value of the hen. When you buy a haircut, the barber receives the full value for time, skills, and rent.

But many interactions take place outside markets. While airports produce a lot of noise, they generally do not compensate the people living around the airport for disturbing their peace. On the other hand, some companies which spend heavily on research and development have positive spillover effects for the rest of society. For example, researchers at AT&T invented the transistor and launched the electronic revolution, but AT&T's profits increased by only a small fraction of the global social gains. In each case, an activity has helped or hurt people outside the marketplace; that is, there was an economic transaction without an economic payment.

Externalities (or spillover effects) occur when firms or people impose costs or benefits on others outside the marketplace.

Negative externalities get most of the attention in today's world. As our society has become more densely populated and as the production of energy, chemicals, and other materials increases, negative externalities or spillover effects have grown from little nuisances into major threats. This is where governments come in. Government *regulations* are designed to control externalities like air and water pollution, damage from strip mining, hazardous wastes, unsafe drugs and foods, and radioactive materials.

In many ways, governments are like parents, always saying no: Thou shalt not expose thy workers to dangerous conditions. Thou shalt not pour out poisonous smoke from thy factory chimney. Thou shalt not sell mind-altering drugs. Thou shalt not drive without wearing thy seat belt. And so forth. Finding the correct balance between free markets and government regulation is a difficult task that requires careful analysis of the costs and benefits of each approach. But few people today would argue for returning to the unregulated economic jungle where firms would be allowed to dump pollutants like plutonium wherever they wanted.

Public Goods

While negative externalities like pollution or global warming get most of the headlines, positive externalities are in fact of great economic significance. Consider the gradual elimination of smallpox, a disease which claimed millions of lives and disfigured even more. No private firm would undertake the research and vaccinations and fieldwork in far corners of the world that were needed to combat the disease. Incentives for private production were inadequate because the benefits were so widely dispersed around the world that firms could not capture the returns. The benefits of eliminating communicable diseases cannot be bought and sold in markets. Similar cases of positive externalities are construction of a highway network, operation of a national weather service, and support of basic science.

The polar case of a positive externality is a public good. **Public goods** are commodities which can be enjoyed by everyone and from which no one can be excluded. The classic example of a public good is national defense. Suppose a country decides to increase spending to defend its borders or to send peacekeepers to troubled lands. All must pay the piper and all will suffer the consequences, whether they want to or not.

However, once the government decides to buy the public good, the market mechanism is still at work. In providing public goods like national defense or lighthouses, the government is behaving exactly like any other large spender. By casting its dollar votes on these items, it causes resources to flow there. Once the dollar votes are cast, the market mechanism then takes over and channels resources to firms so that the lighthouses or tanks get produced.

Lighthouses as Public Goods

Lighthouses are an example of the concept of public goods. They save lives and cargoes. But lighthouse keepers cannot reach out to collect fees from ships; nor, if they could, would it serve an efficient social purpose for them to exact an economic penalty on ships that use their services. The light can be provided most efficiently free of charge, for it costs no more to warn 100 ships than to warn a single ship of the nearby rocks.

But wait a moment. A recent history determined that lighthouses in England and Wales were in fact *privately* and *profitably* operated in the early days. They were financed by government-authorized "light duties" levied on ships which used nearby ports. Perhaps, we might conclude, lighthouses are not really public goods.

To understand the issues here, we need to return to fundamentals. The two key attributes of a public good are (1) that the cost of extending the service to an additional person is zero ("nonrivalry") and (2) that it is impossible to exclude individuals from enjoying it ("nonexcludability"). Both these characteristics are applicable to lighthouses.

But a "public" good is not necessarily publicly provided. Often, it is provided by no one. Moreover, just because it is privately provided does not indicate that it is efficiently provided or that a market mechanism can pay for the lighthouse. The English example shows the interesting case where, *if* provision of the public good can be tied to another good or service (in this case, vessel tonnage), and *if* the government gives private persons the right to collect what are essentially taxes, then an alternative mechanism for *financing* the public good can be found. Such an approach would work poorly where the fees could not be easily tied to tonnage (such as in international waterways). And it would not work at all if the government refused to privatize the right to collect light duties on shipping.

America shows quite a different experience. From its earliest days, the United States believed that navigational aids should be government-provided. Indeed, one of the first acts of the first Congress, and America's first public-works law, provided that "the necessary support, maintenance, and repairs of all lighthouses, beacons, [and] buoys . . . shall be defrayed out of the Treasury of the United States."

But, like many public goods, lighthouses were provided meager funding, and it is interesting to note what happened in the absence of navigational aids. A fascinating case lies off the east coast of Florida, which is a treacherous waterway with a 200-mile reef lying submerged a few feet below the surface in the most active hurricane track of the Atlantic Ocean. This heavily used channel was prime territory for storm, shipwreck, and piracy.

There were no lighthouses in Florida until 1825, and no private-sector lighthouses were ever built in this area. The market responded vigorously to the perils, however. What arose from the private sector was a thriving "wrecking" industry. Wreckers were ships that lurked near the dangerous reefs waiting for an unfortunate boat to become disabled. The wreckers would then appear, offer their help in saving lives and cargo, tow the boat into the appropriate port, and then claim a substantial part of the value of the cargo. Wrecking was the major industry of south Florida in the mid-nineteenth century and made Key West the richest town in America at that time.

While wreckers probably had positive value added, they provided none of the public-good attributes of lighthouses. Indeed, because many cargoes were insured, there was significant "moral hazard" involved in navigation. Connivance between wreckers and captains often enriched both at the expense of owners and insurance companies. It was only when the U.S. Lighthouse Service, financed by government revenues, began to build lighthouses through the Florida channel that the number of shipwrecks began to decrease—and the wreckers were gradually driven out of business.

Lighthouses are no longer a central issue of public policy today and are mainly of interest to tourists. They have been largely replaced by the satellite-based Global Positioning System (GPS), which is also a public good provided free by the government. But the history of lighthouses reminds us of the problems that can arise when public goods are inefficiently provided.

Taxes. The government must find the revenues to pay for its public goods and for its income-redistribution programs. Such revenues come from taxes levied on personal and corporate incomes, on wages, on sales of consumer goods, and on other items. All levels of government—city, state, and federal—collect taxes to pay for their spending.

Taxes sound like another "price"—in this case the price we pay for public goods. But taxes differ from prices in one crucial respect: taxes are not voluntary. Everyone is subject to the tax laws; we are all obligated to pay for our share of the cost of public goods. Of course, through our democratic process, we as citizens choose both the public goods and the taxes to pay for them. However, the close connection between spending and consumption that we see for private goods does not hold for taxes and public goods. I pay for a hamburger only if I want one, but I must pay my share of the taxes used to finance defense and public schools even if I don't care a bit for these activities.

EQUITY

Our discussion of market failures like monopoly or externalities focused on defects in the allocative role of markets—imperfections that can be corrected by careful intervention. But assume for the moment that the economy functioned with complete efficiency—always on the production-possibility frontier and never inside it, always choosing the right amount of public versus private goods, and so forth. Even if the market system worked perfectly, it might still lead to a flawed outcome.

Markets do not necessarily produce a fair distri bution of income. A market economy may produce inequalities in income and consumption that are not acceptable to the electorate.

Why might the market mechanism produce an unacceptable solution to the question *for whom?* The reason is that incomes are determined by a wide variety of factors, including effort, education, inheritance, factor prices, and luck. The resulting income distribution may not correspond to a fair outcome. Moreover, recall that goods follow dollar votes and not the greatest need. A rich man's cat may drink the milk that a poor boy needs to remain healthy. Does this happen because the market is failing? Not at all, for the market mechanism is doing its job—putting goods in the hands of those who have the dollar votes. Even the most efficient market system may generate great inequality.

Often the income distribution in a market system is the result of accidents of birth. Every year *Forbes* magazine lists the 400 richest Americans, and it's impressive how many of them either received their wealth by inheritance or used inherited wealth as a springboard to even greater wealth. Would everyone regard that as necessarily right or ideal? Should someone be allowed to become a billionaire simply by inheriting 5000 square miles of rangeland or the family's holding of oil wells? That's the way the cookie crumbles under laissez-faire capitalism.

For most of American history, economic growth was a rising tide that lifted all boats, raising the incomes of the poor as well as those of the rich. But over the last three decades, changes in family structure and declining wages of the less skilled and less educated have reversed the trend. With a return to greater emphasis on the market has come greater homelessness, more children living in poverty, and deterioration of many of America's central cities.

Income inequalities may be politically or ethically unacceptable. A nation does not need to accept the outcome of competitive markets as predetermined and immutable; people may examine the distribution of income and decide it is unfair. If a democratic society does not like the distribution of dollar votes under a laissez-faire market system, it can take steps to change the distribution of income.

Let's say that voters decide to reduce income inequality. What tools could the government use to implement that decision? First, it can engage in *progressive taxation,* taxing large incomes at a higher rate than small incomes. It might impose heavy taxes on wealth or on large inheritances to break the chain of privilege. The federal income and inheritance taxes are examples of such redistributive progressive taxation.

Second, because low tax rates cannot help those who have no income at all, governments can make *transfer payments,* which are money payments to people. Such transfers today include aid for the elderly, blind, and disabled and for those with dependent children, as well as unemployment insurance for the jobless. This system of transfer payments provides a "safety net" to protect the unfortunate from privation. And, finally, governments sometimes subsidize consumption of low-income groups by providing food stamps, subsidized medical care, and low-cost housing—though in the United States, such spending comprises a relatively small share of total spending.

Tax and transfer programs have always been controversial. Few people think about the public goods that their tax dollars are buying when they fill out their tax returns or look at the big deductions in their paychecks. Yet people also feel that societies must provide the basic necessities to everyone—for food, schooling, and health care.

What can economics contribute to debates about equality? Economics as a science cannot answer such normative questions as how much of our incomes should be taxed, how much income should be transferred to poor families, or what is the proper size of the public sector. These are political questions that are answered at the ballot box in our democratic societies.

Economics can, however, analyze the costs and benefits of different redistributive systems. Economists have devoted much time to analyzing the impact of different tax systems (such as those based on income or consumption). They have also studied whether giving poor people cash rather than goods and services is likely to be a more efficient way of reducing poverty.

And economics can remind us that the market giveth and the market taketh away. In a world of rapid structural change, we should always remember, "There, but for the grace of supply and demand, go I."

MACROECONOMIC GROWTH AND STABILITY

Since its origins, capitalism has been plagued by periodic bouts of inflation (rising prices) and recession (high unemployment). Since World War II, for example, there have been 10 recessions in the United States, some putting millions of people out of work. These fluctuations are known as the *business cycle.*

Today, thanks to the intellectual contribution of John Maynard Keynes and his followers, we know how to control the worst excesses of the business cycle. By careful use of fiscal and monetary policies, governments can affect output, employment, and inflation. The *fiscal policies* of government involve the power to tax and the power to spend. *Monetary policy* involves determining the supply of money and interest rates; these affect investment in capital goods and other interest-rate-sensitive spending. Using these two fundamental tools of macroeconomic policy, governments can influence the level of total spending, the rate of growth and level of output, the levels of employment and unemployment, and the price level and rate of inflation in an economy.

Governments in advanced industrial countries have successfully applied the lessons of the Keynesian revolution over the last half-century. Spurred on by active monetary and fiscal policies, the market economies witnessed a period of unprecedented economic growth in the three decades after World War II.

In the 1980s, governments became more concerned with designing macroeconomic policies to promote long-term objectives, such as economic growth and productivity. (*Economic growth* denotes the growth in a nation's total output, while *productivity* represents the output per unit input or the efficiency with which resources are used.) For example, tax rates were lowered in most industrial countries in order to improve incentives for saving and production. Many economists emphasize the importance of public saving through smaller budget deficits as a way to increase national saving and investment.

Macroeconomic policies for stabilization and economic growth include fiscal policies (of taxing and spending) along with monetary policies (which affect interest rates and credit conditions). Since the development of macroeconomics in the 1930s, governments have succeeded in curbing the worst excesses of inflation and unemployment.

Table 2-1 summarizes the economic role played by government today. It shows the important governmental functions of promoting efficiency, achieving a fairer distribution of income, and pursuing the macroeconomic objectives of economic growth and stability. In all advanced industrial societies we find some variant of a **mixed economy,** in which the market determines output and prices in most individual sectors while government steers the overall economy with programs of taxation, spending, and monetary regulation.

Failure of market economy	Government intervention	Current examples of government policy
Inefficiency:		
Monopoly	Encourage competition	Antitrust laws, deregulation
Externalities	Intervene in markets	Antipollution laws, antismoking ordinances
Public goods	Encourage beneficial activities	Provide public education, build roads
Inequality:		
Unacceptable inequalities of income and wealth	Redistribute income	Progressive taxation of income and wealth
		Income-support or transfer programs (e.g., subsidize health care)
Macroeconomic problems:		
Business cycles (high inflation and unemployment)	Stabilize through macroeconomic policies	Monetary policies (e.g., changes in money supply and interest rates)
		Fiscal policies (e.g., taxes and spending programs)
Slow economic growth	Stimulate growth	Improve efficiency of tax system
		Raise national savings rate by reducing budget deficit or increasing budget surplus

TABLE 2-1. Government Can Remedy the Shortcomings of the Market

THE RISE OF THE WELFARE STATE

Our textbook focuses on the mixed market economy of modern industrialized nations. It will be useful to trace its history briefly. Before the rise of the market economy, going back to medieval times, aristocracies and town guilds directed much of the economic activity in Europe and Asia. However, about two centuries ago, governments began to exercise less and less power over prices and production methods. Feudalism gradually gave way to markets, or what we call the "market mechanism."

In most of Europe and North America, the nineteenth century became the age of **laissez-faire.** This doctrine, which translates as "leave us alone," holds that government should interfere as little as possible in economic affairs and leave economic decisions to the private decision making of buyers and sellers. Many governments adopted this economic philosophy starting in the middle of the nineteenth century.

Nevertheless, a century ago, the many excesses of capitalism—including monopolies and trusts, corruption, dangerous products, and poverty—led most industrialized countries to retreat from unbridled laissez-faire. Government's role expanded steadily as it regulated businesses, levied income taxes, and provided a social safety net for the elderly, unemployed, and impoverished.

This new system, called the **welfare state,** is one in which markets direct the detailed activities of day-to-day economic life while government regulates social conditions and provides pensions, health care, and other necessities for poor families.

Conservative Backlash

Many critics of the welfare state worried that government interventions were tilting the scales in favor of *socialism,* in which the state owns, operates, and regulates much of the economy. In 1942, the great Harvard economist Joseph Schumpeter argued that the United States was "capitalism living in an oxygen tent" on its march to socialism. Capitalism's success would breed alienation and self-doubt, sapping its efficiency and innovation.

Libertarian critics like Friedrich Hayek and Milton Friedman argued for a return to free markets and minimal government. This group argued the state is overly intrusive; governments create monopoly; government failures are just as pervasive as market failures; high taxes distort the allocation of resources; social security threatens to drain the public purse; environmental regulations dull the spirit of enterprise; and government attempts to stabilize the economy only reduce growth and increase inflation. In short, for some, government is the problem rather than the solution.

Beginning around 1980, the tide turned as conservative governments in many countries began to reduce taxes and deregulate government's control over the economy. Many government-owned industries were privatized, income-tax rates were lowered, and the generosity of many welfare programs was reduced.

The most dramatic turn toward the market came in Russia and the socialist countries of Eastern Europe. After decades of extolling the advantages of a government-run command economy, beginning around 1990, these countries scrapped central planning and made the difficult transition to a decentralized market economy. China, while still run by the Communist party bureaucracy, has enjoyed an economic boom in the last three decades by allowing private enterprises and foreign firms to operate within its borders. Many formerly socialist regimes in India, Africa, and Latin America have embraced capitalism and reduced the role of government in their economies.

The Mixed Economy Today

In weighing the relative merits of state and market, public debate often oversimplifies the complex choices that societies face. Markets have worked miracles in some countries. But markets need well-crafted legal and political structures, along with the social overhead capital that promotes trade and ensures a stable financial system. Without these governmental structures, markets often produce corrupt capitalism, great inequality, pervasive poverty, and declining living standards.

In economic affairs, success has many parents, while failure is an orphan. The success of market economies may lead people to overlook the important contribution of collective actions. Government programs have helped reduce poverty and malnutrition and have reduced the scourge of terrible diseases like tuberculosis and polio. Even as the world's largest economies head into a deep recession in 2008–2009, macroeconomic policies help to stem financial-market panics and reduce the length and severity of business cycles. State-supported science has split the atom, discovered the DNA molecule, and explored space.

The debate about government's successes and failures demonstrates that drawing the boundary between market and government is an enduring problem. The tools of economics are indispensable to help societies find the golden mean between an efficient market mechanism and publicly decided regulation and redistribution. The good mixed economy is, perforce, the limited mixed economy. But those who would reduce government to the constable plus a few lighthouses are living in a dream world. An efficient and humane society requires both halves of the mixed system—market and government. Operating a modern economy without both is like trying to clap with one hand.

SUMMARY

A. The Market Mechanism

1. In an economy like the United States, most economic decisions are made in markets, which are mechanisms through which buyers and sellers meet to trade and to determine prices and quantities for goods and services. Adam Smith proclaimed that the *invisible hand* of markets would lead to the optimal economic outcome as individuals pursue their own self-interest. And while markets are far from perfect, they have proved remarkably effective at solving the problems of *how, what,* and *for whom.*
2. The market mechanism works as follows to determine the *what* and the *how:* The dollar votes of people affect prices of goods; these prices serve as guides for the amounts of the different goods to be produced. When people demand more of a good, its price will increase and businesses can profit by expanding production of that good. Under perfect competition, a business must find the cheapest method of production, efficiently using labor, land, and other factors; otherwise, it will incur losses and be eliminated from the market.
3. At the same time that the *what* and *how* problems are being resolved by prices, so is the problem of *for whom.* The distribution of income is determined by the ownership of factors of production (land, labor, and capital) and by factor prices. People possessing fertile land or the ability to hit home runs will earn many dollar

votes to buy consumer goods. Those without property or with skills, color, or sex that the market undervalues will receive low incomes.

B. Trade, Money, and Capital

4. As economies develop, they become more specialized. Division of labor allows a task to be broken into a number of smaller chores that can each be mastered and performed more quickly by a single worker. Specialization arises from the increasing tendency to use roundabout methods of production that require many specialized skills. As individuals and countries become increasingly specialized, they tend to concentrate on particular commodities and trade their surplus output for goods produced by others. Voluntary trade, based on specialization, benefits all.
5. Trade in specialized goods and services today relies on money to lubricate its wheels. Money is the universally acceptable medium of exchange—including primarily currency and checking deposits. It is used to pay for everything from apple tarts to zebra skins. By accepting money, people and nations can specialize in producing a few goods and can then trade them for others; without money, we would waste much time negotiating and bartering.
6. Capital goods—produced inputs such as machinery, structures, and inventories of goods in process—permit roundabout methods of production that add much to a nation's output. These roundabout methods take time and resources to get started and therefore require a temporary sacrifice of present consumption in order to increase future consumption. The rules that define how capital and other assets can be bought, sold, and used are the system of property rights. In no economic system are private-property rights unlimited.

C. The Visible Hand of Government

7. Although the market mechanism is an admirable way of producing and allocating goods, sometimes market failures lead to deficiencies in the economic outcomes. The government may step in to correct these failures. Its role in a modern economy is to ensure efficiency, to correct an unfair distribution of income, and to promote economic growth and stability.
8. Markets fail to provide an efficient allocation of resources in the presence of imperfect competition or externalities. Imperfect competition, such as monopoly, produces high prices and low levels of output. To combat these conditions, governments regulate businesses or put legal antitrust constraints on business behavior. Externalities arise when activities impose costs or bestow benefits that are not paid for in the marketplace. The government may decide to step in and regulate these spillovers (as it does with air pollution) or provide for public goods (as in the case of public health).
9. Markets do not necessarily produce a fair distribution of income; they may spin off unacceptably high inequality of income and consumption. In response, governments can alter the pattern of incomes (the *for whom*) generated by market wages, rents, interest, and dividends. Modern governments use taxation to raise revenues for transfers or income-support programs that place a financial safety net under the needy.
10. Since the development of macroeconomics in the 1930s, the government has undertaken a third role: using fiscal powers (of taxing and spending) and monetary policy (affecting credit and interest rates) to promote long-run economic growth and productivity and to tame the business cycle's excesses of inflation and unemployment.
11. Drawing the right boundary between market and government is an enduring problem for societies. Economics is indispensable in finding the golden mean between an efficient market and publicly decided regulation and redistribution. An efficient and humane society requires both halves of the mixed system—market and government.

CONCEPTS FOR REVIEW

The Market Mechanism

market, market mechanism
markets for goods and for factors of production
prices as signals
market equilibrium
perfect and imperfect competition
Adam Smith's invisible-hand doctrine

Features of a Modern Economy

specialization and division of labor
money
factors of production (land, labor, capital)
capital, private property, and property rights

Government's Economic Role

efficiency, equity, stability
inefficiencies: monopoly and externalities
inequity of incomes under markets
macroeconomic policies:
fiscal and monetary policies
stabilization and growth

FURTHER READING AND INTERNET WEBSITES

Further Reading

A useful discussion of globalization is contained in "Symposium on Globalization in Perspective," *Journal of Economic Perspectives,* Fall 1998.

For examples of the writings of libertarian economists, see Milton Friedman, *Capitalism and Freedom* (University of Chicago Press, 1963), and Friedrich Hayek, *The Road to Serfdom* (University of Chicago Press, 1994).

A strong defense of government interventions is found in a history of the 1990s by Nobel Prize winner Joseph E. Stiglitz, *The Roaring Nineties: A New History of the World's Most Prosperous Decade* (Norton, New York, 2003). Paul Krugman's columns in *The New York Times* are a guide to current economic issues from the perspective of one of America's most distinguished economists; his most recent book, *The Great Unraveling: Losing Our Way in the New Century* (Norton, New York, 2003), collects his columns from the early 2000s.

A fascinating example of how a small economy is organized without money is found in R. A. Radford, "The Economic Organization of a P.O.W. Camp," *Economica,* vol. 12, November 1945, pp. 189–201.

Websites

You can explore recent analyses of the economy along with a discussion of major economic policy issues in the *Economic Report of the President* at *www.access.gpo.gov/eop/*. See *www.whitehouse.gov* for federal budget information and as an entry point into the useful Economic Statistics Briefing Room.

The study of the iPod is Jason Dedrick, Kenneth L. Kraemer, and Greg Linden, "Who Profits from Innovation in Global Value Chains? A Study of the iPod and Notebook PCs," available at *http://pcic.merage.uci.edu/papers/2008/WhoProfits.pdf.* Hal Varian's review is Hal R. Varian, "An iPod Has Global Value: Ask the (Many) Countries That Make It," *The New York Times,* June 28, 2007, available by Internet search.

QUESTIONS FOR DISCUSSION

1. What determines the composition of national output? In some cases, we say that there is "consumer sovereignty," meaning that consumers decide how to spend their incomes on the basis of their tastes and market prices. In other cases, decisions are made by political choices of legislatures. Consider the following examples: transportation, education, police, energy efficiency of appliances, health-care coverage, television advertising. For each, describe whether the allocation is by consumer sovereignty or by political decision. Would you change the method of allocation for any of these goods?
2. When a good is limited, some means must be found to ration the scarce commodity. Some examples of rationing devices are auctions, ration coupons, and first-come, first-served systems. What are the strengths and weaknesses of each? Explain carefully in what sense a market mechanism "rations" scarce goods and services.
3. This chapter discusses many "market failures," areas in which the invisible hand guides the economy poorly, and describes the role of government. Is it possible that there are, as well, "government failures," government attempts to curb market failures that are worse than the original market failures? Think of some examples of government failures. Give some examples in which government failures are so bad that it is better to live with the market failures than to try to correct them.
4. Consider the following cases of government intervention: regulations to limit air pollution, income support for the poor, and price regulation of a telephone monopoly. For each case, (*a*) explain the market failure, (*b*) describe a government intervention to treat the problem, and (*c*) explain how "government failure" (see the definition in question 3) might arise because of the intervention.
5. The circular flow of goods and inputs illustrated in Figure 2-1 has a corresponding flow of dollar incomes and spending. Draw a circular-flow diagram for the dollar flows in the economy, and compare it with the circular flow of goods and inputs. What is the role of money in the dollar circular flow?
6. Consider three periods of American history: (*a*) the early 1800s, when Jones lived on an isolated farm cut off from the rest of the world; (*b*) the late 1940s, when Smith lived in a country where domestic trade

and exchange was extensive but international trade was cut off because of damage from World War II; and (*c*) 2009, when Hall lives in a globalized world that promotes trade with all countries.

Suppose you were living in each of these situations. Describe the opportunities for specialization and division of labor of Jones, Smith, and Hall. Explain how the globalized world in (*c*) both allows greater productivity of Hall and allows a much greater variety of consumption goods. Give specific examples in each case.

7. "Lincoln freed the slaves. With one pen stroke he destroyed much of the capital the South had accumulated over the years." Comment.
8. The table to the right shows some of the major expenditures of the federal government. Explain how each one relates to the economic role of government.
9. Why does the saying "No taxation without representation" make sense for public goods but not private goods? Explain the mechanisms by which individuals can "protest" against (*a*) taxes that are thought excessive to pay for defense spending, (*b*) tolls that are thought excessive to pay for a bridge, and (*c*) prices that are thought excessive for an airline flight from New York to Miami.

Major Expenditure Categories for Federal Government

Budget category	Federal spending, 2009 ($, billion)
Health care	713
National defense	675
Social security	649
Income security	401
Natural resources and environment	36
International affairs	38

Source: Office of Management and Budget, *Budget of the United States Government*, Fiscal Year 2009.

CHAPTER

Basic Elements of Supply and Demand

3

What is a cynic? A man who knows the price of everything and the value of nothing.

Oscar Wilde

The first two chapters introduced the basic problems that every economy must solve: *What* shall be produced? *How* shall goods be produced? And *for whom* should goods be produced?

We also saw that the modern mixed economy relies primarily on a system of markets and prices to solve the three central problems. Recall that the fundamental building blocks of an economy are the dual monarchy of tastes and technology. "Consumer sovereignty" operating through dollar votes determines what gets produced and where the goods go, but technologies influence costs, prices, and what goods are available. Our task in this chapter is to describe in detail how this process works in a market economy.

Markets are like the weather—sometimes stormy, sometimes calm, but always changing. Yet a careful study of markets will reveal certain forces underlying the apparently random movements. To forecast prices and outputs in individual markets, you must first master the analysis of supply and demand.

Take the example of gasoline prices, illustrated in Figure 3-1. (This graph shows the "real gasoline price," or the price corrected for movements in the general price level.) Demand for gasoline and other oil products rose sharply after World War II as real gasoline prices fell and people moved increasingly to the suburbs. Then, in the 1970s, supply restrictions, wars among producers, and political revolutions reduced production, with the consequent price spikes seen after 1973 and 1979. In the years that followed, a combination of energy conservation, smaller cars, the growth of the information economy, and expanded production around the world led to falling oil prices. War in Iraq and growing world demand for petroleum after 2002 produced yet further turmoil in oil markets. As Figure 3-1 shows, the real price of gasoline (in 2008 prices) fell from around $3.50 per gallon in 1980 to around $1.50 per gallon in the 1990s and then rose to $4 per gallon by the summer of 2008.

What lay behind these dramatic shifts? Economics has a very powerful tool for explaining such changes in the economic environment. It is called the *theory of supply and demand.* This theory shows how consumer preferences determine consumer demand for commodities, while business costs are the foundation of the supply of commodities. The increases in the price of gasoline occurred either because the demand for gasoline had increased or because the supply of oil had decreased. The same is true for every market, from Internet stocks to diamonds to land: changes in supply and demand drive changes in output and prices. If you understand how supply and demand work, you have gone a long way toward understanding a market economy.

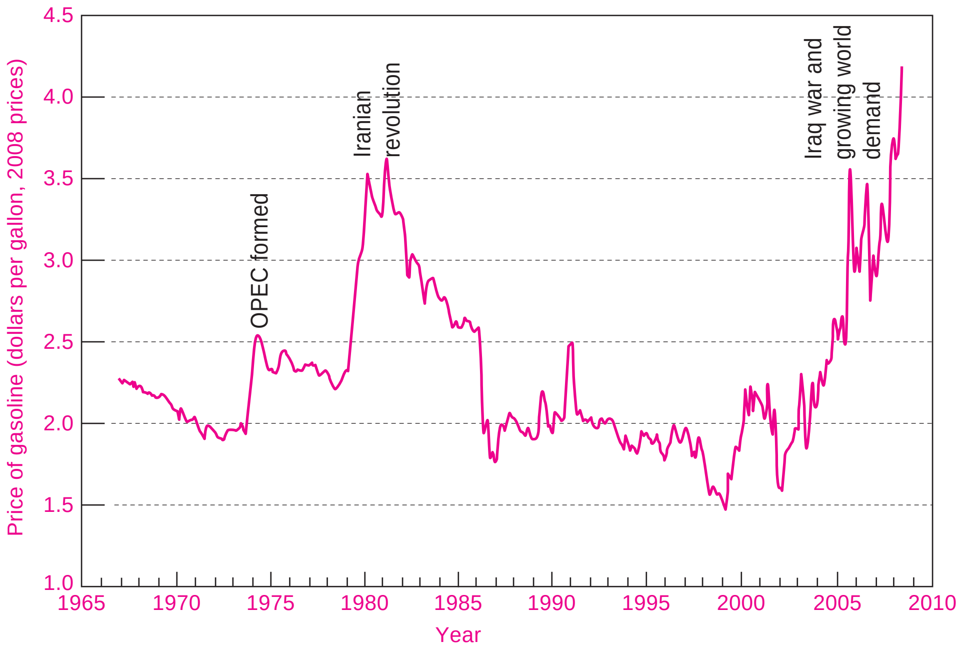


FIGURE 3-1. Gasoline Prices Move with Demand and Supply Changes

Gasoline prices have fluctuated sharply over the last half-century. Supply reductions in the 1970s produced two dramatic "oil shocks," which provoked social unrest and calls for increased regulation. Reductions in demand from new energy-saving technologies led to the long decline in price after 1980. Rapid growth in world demand for oil relative to supply produced steeply growing price trends in the 2000s. The tools of supply and demand are crucial for understanding these trends.

Source: U.S. Departments of Energy and Labor. The price of gasoline has been converted into 2008 prices using the consumer price index.

This chapter introduces the notions of supply and demand and shows how they operate in competitive markets for *individual commodities*. We begin with demand curves and then discuss supply curves. Using these basic tools, we will see how the market price is determined where these two curves intersect—where the forces of demand and supply are just in balance. It is the movement of prices—the price mechanism—which brings supply and demand into balance or equilibrium. This chapter closes with some examples of how supply-and-demand analysis can be applied.

A. THE DEMAND SCHEDULE

Both common sense and careful scientific observation show that the amount of a commodity people buy depends on its price. The higher the price of an article, other things held constant,[1] the fewer units consumers are willing to buy. The lower its market price, the more units of it are bought.

There exists a definite relationship between the market price of a good and the quantity demanded of that good, other things held constant. This relationship between price and quantity bought is called the **demand schedule,** or the **demand curve.**

Let's look at a simple example. Table 3-1 presents a hypothetical demand schedule for cornflakes. At each price, we can determine the quantity of cornflakes that consumers purchase. For example,

[1] Later in this chapter we discuss the other factors that influence demand, including income and tastes. The term "other things held constant" simply means we are varying the price without changing any of these other determinants of demand.

Demand Schedule for Cornflakes

	(1) Price ($ per box) *P*	(2) Quantity demanded (millions of boxes per year) *Q*
A	5	9
B	4	10
C	3	12
D	2	15
E	1	20

TABLE 3-1. The Demand Schedule Relates Quantity Demanded to Price

At each market price, consumers will want to buy a certain quantity of cornflakes. As the price of cornflakes falls, the quantity of cornflakes demanded will rise.

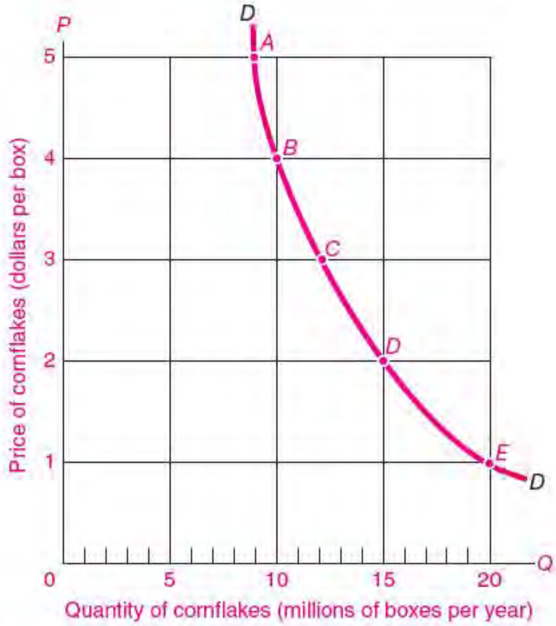


FIGURE 3-2. A Downward-Sloping Demand Curve Relates Quantity Demanded to Price

In the demand curve for cornflakes, price (*P*) is measured on the vertical axis while quantity demanded (*Q*) is measured on the horizontal axis. Each pair of (*P, Q*) numbers from Table 3-1 is plotted as a point, and then a smooth curve is passed through the points to give us a demand curve, *DD*. The negative slope of the demand curve illustrates the law of downward-sloping demand.

at $5 per box, consumers will buy 9 million boxes per year.

At a lower price, more cornflakes are bought. Thus, at a price of $4, the quantity bought is 10 million boxes. At yet a lower price (*P*) equal to $3, the quantity demanded (*Q*) is still greater, at 12 million. And so forth. We can determine the quantity demanded at each listed price in Table 3-1.

THE DEMAND CURVE

The graphical representation of the demand schedule is the *demand curve*. We show the demand curve in Figure 3-2, which graphs the quantity of cornflakes demanded on the horizontal axis and the price of cornflakes on the vertical axis. Note that quantity and price are inversely related; that is, *Q* goes up when *P* goes down. The curve slopes downward, going from northwest to southeast. This important property is called the *law of downward-sloping demand*. It is based on common sense as well as economic theory and has been empirically tested and verified for practically all commodities—cornflakes, gasoline, college education, and illegal drugs being a few examples.

Law of downward-sloping demand: When the price of a commodity is raised (and other things are held constant), buyers tend to buy less of the commodity. Similarly, when the price is lowered, other things being constant, quantity demanded increases.

Quantity demanded tends to fall as price rises for two reasons:

1. First is the **substitution effect,** which occurs because a good becomes relatively more expensive when its price rises. When the price of good A rises, I will generally substitute goods B, C, D, . . . for it. For example, as the price of beef rises, I eat more chicken.
2. A higher price generally also reduces quantity demanded through the **income effect.** This comes into play because when a price goes up, I find myself somewhat poorer than I was before. If gasoline prices double, I have in effect less real income, so I will naturally curb my consumption of gasoline and other goods.

Market Demand

Our discussion of demand has so far referred to "the" demand curve. But whose demand is it? Mine? Yours? Everybody's? The fundamental building block for demand is individual preferences. However, in this chapter we will always focus on the *market demand*, which represents the sum total of all individual demands. The market demand is what is observable in the real world.

The market demand curve is found by adding together the quantities demanded by all individuals at each price.

Does the market demand curve obey the law of downward-sloping demand? It certainly does. If prices drop, for example, the lower prices attract new customers through the substitution effect. In addition, a price reduction will induce extra purchases of goods by existing consumers through both the income and the substitution effects. Conversely, a rise in the price of a good will cause some of us to buy less.

The Explosive Growth in Computer Use

We can illustrate the law of downward-sloping demand for the case of personal computers (PCs). The prices of the first PCs were high, and their computing power was relatively modest. They were found in few businesses and even fewer homes. It is hard to believe that just 20 years ago students wrote most of their papers in longhand and did most calculations by hand or with simple calculators!

But the prices of computing power fell sharply over the last four decades. As the prices fell, new buyers were enticed to buy their first computers. PCs came to be widely used for work, for school, and for fun. In the 2000s, as the value of computers increased with the development of the Internet, including video and personal Web pages, yet more people jumped on the computer bandwagon. Worldwide, PC sales totaled around 250 million in 2007.

Figure 3-3 shows the prices and quantities of computers and peripheral equipment in the United States as calculated by government statisticians. The prices reflect the cost of purchasing computers with constant quality—that is, they take into account the rapid quality change of the average computer purchased. You can see how falling prices along with improved software, increased utility of the Internet and e-mail, and other factors have led to an explosive growth in computer output.

Forces behind the Demand Curve

What determines the market demand curve for cornflakes or gasoline or computers? A whole array of factors influences how much will be demanded at a given price: average levels of income, the size of the population, the prices and availability of related goods, individual and social tastes, and special influences.

- The *average income* of consumers is a key determinant of demand. As people's incomes rise, individuals tend to buy more of almost everything, even if prices don't change. Automobile purchases tend to rise sharply with higher levels of income.
- The *size of the market*—measured, say, by the population—clearly affects the market demand curve. California's 40 million people tend to buy 40 times more apples and cars than do Rhode Island's 1 million people.
- The prices and availability of *related goods* influence the demand for a commodity. A particularly important connection exists among substitute goods—ones that tend to perform the same function, such as cornflakes and oatmeal, pens and pencils, small cars and large cars, or oil and natural gas. Demand for good A tends to be low if the price of substitute product B is low. (For example, as computer prices fell, what do you think happened to the demand for typewriters?)
- In addition to these objective elements, there is a set of subjective elements called *tastes* or *preferences*. Tastes represent a variety of cultural and historical influences. They may reflect genuine psychological or physiological needs (for liquids, love, or excitement). And they may include artificially contrived cravings (for cigarettes, drugs, or fancy sports cars). They may also contain a large element of tradition or religion (eating beef is popular in America but taboo in India, while curried jellyfish is a delicacy in Japan but would make many Americans gag).
- Finally, *special influences* will affect the demand for particular goods. The demand for umbrellas is high in rainy Seattle but low in sunny Phoenix; the demand for air conditioners will rise in hot weather; the demand for automobiles will be low in New York, where public transportation is plentiful and parking is a nightmare.

The determinants of demand are summarized in Table 3-2, which uses automobiles as an example.

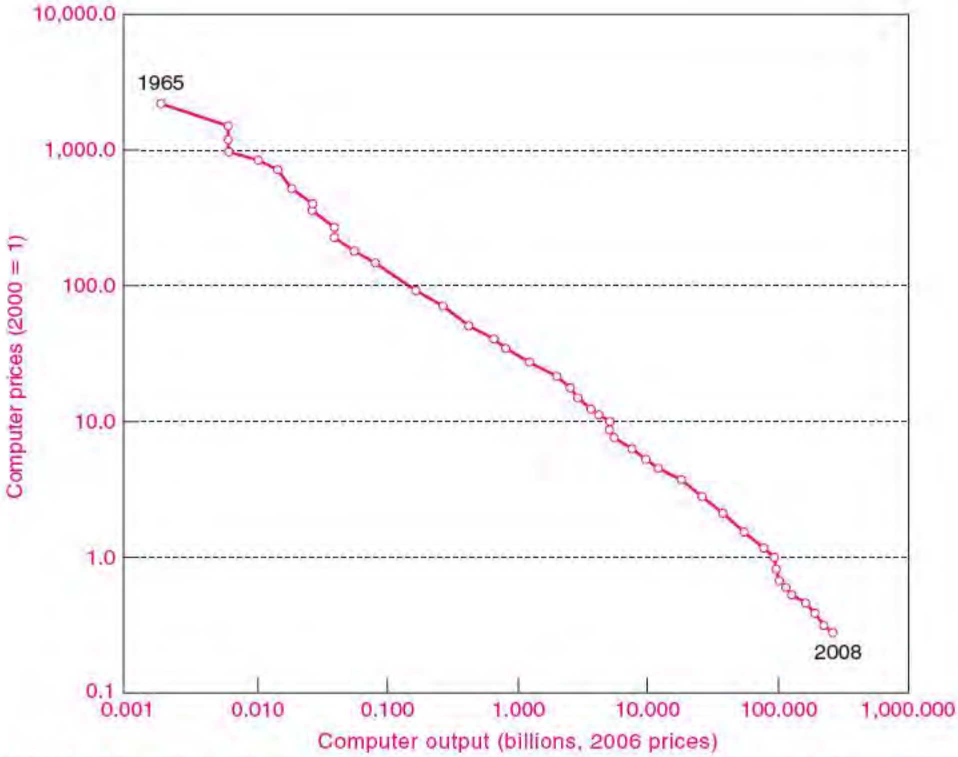


FIGURE 3-3. Declining Computer Prices Have Fueled an Explosive Growth in Computer Power

The prices of computers and peripheral devices are measured in terms of the cost of purchasing a given bundle of characteristics (such as memory or speed of calculations). The real price of computer power has fallen by a factor of 8000 since 1965. Falling prices along with higher incomes and a growing variety of uses have led to a 140,000-fold growth in the quantity of computers (or, really, computational power) produced.

Source: Department of Commerce estimates of real output and prices. Note that the data are plotted on ratio scales.

Factors affecting the demand curve	Example for automobiles
1. **Average income**	As incomes rise, people increase car purchases.
2. **Population**	A growth in population increases car purchases.
3. **Prices of related goods**	Lower gasoline prices raise the demand for cars.
4. **Tastes**	Having a new car becomes a status symbol.
5. **Special influences**	Special influences include availability of alternative forms of transportation, safety of automobiles, expectations of future price increases, etc.

TABLE 3-2. Many Factors Affect the Demand Curve

Shifts in Demand

As economic life evolves, demand changes incessantly. Demand curves sit still only in textbooks.

Why does the demand curve shift? Because influences other than the good's price change. Let's work through an example of how a change in a nonprice variable shifts the demand curve. We know that the average income of Americans rose sharply during the long economic boom of the 1990s. Because there is a powerful income effect on the demand for automobiles, this means that the quantity of automobiles demanded at each price will rise. For example, if average incomes rose by 10 percent, the quantity demanded at a price of $10,000 might rise from 10 million to 12 million units. This would be a shift in the demand curve because the increase in quantity demanded reflects factors other than the good's own price.

The net effect of the changes in underlying influences is what we call an *increase in demand.* An increase in the demand for automobiles is illustrated in Figure 3-4 as a rightward shift in the demand curve. Note that the shift means that more cars will be bought at every price.

You can test yourself by answering the following questions: Will a warm winter shift the demand curve for heating oil leftward or rightward? Why? What will happen to the demand for baseball tickets if young people lose interest in baseball and watch basketball instead? What will a sharp fall in the price of personal computers do to the demand for typewriters? What happens to the demand for a college education if wages are falling for blue-collar jobs while salaries for college-educated workers are rising rapidly?

When there are changes in factors other than a good's own price which affect the quantity purchased, we call these changes shifts in demand. Demand increases (or decreases) when the quantity demanded at each price increases (or decreases).

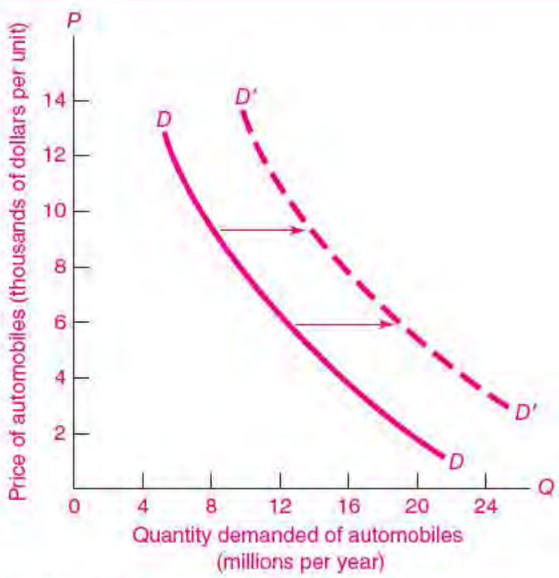


FIGURE 3-4. Increase in Demand for Automobiles

As elements underlying demand change, the demand for automobiles is affected. Here we see the effect of rising average income, increased population, and lower gasoline prices on the demand for automobiles. We call this shift of the demand curve an increase in demand.

Movements along Curves versus Shifts of Curves

One of the most important points that you must understand in economics is the difference between movements along a curve and shifts of a curve. In the present case, do not confuse a *change in demand* (which denotes a *shift* of the demand curve) with a *change in the quantity demanded* (which means *moving along,* or moving to a different point, on the same demand curve after a price change).

A change in demand occurs when one of the elements underlying the demand curve shifts. Take the case of pizzas. Suppose incomes increase and people want to spend part of their extra income on pizzas for a given pizza price. In other words, higher incomes will increase demand and shift the demand curve for pizzas out and to the right. This is a shift in the demand for pizzas.

By contrast, suppose that a new technology reduces pizza costs and prices. This leads to a change in quantity demanded that occurs because consumers tend to buy more pizzas as pizza prices fall, all other things remaining constant. Here, the increased purchases result not from an increase in demand but from the pizza-price decrease. This change represents a *movement along* the demand curve, not a *shift of* the demand curve.

B. THE SUPPLY SCHEDULE

Let us now turn from demand to supply. The supply side of a market typically involves the terms on which businesses produce and sell their products. The supply of tomatoes tells us the quantity of tomatoes that will be sold at each tomato price. More precisely, the supply schedule relates the quantity supplied of a good to its market price, other things constant. In considering supply, the other things that are held constant include input prices, prices of related goods, and government policies.

The **supply schedule** (or **supply curve**) for a commodity shows the relationship between its market price and the amount of that commodity that producers are willing to produce and sell, other things held constant.

Supply Schedule for Cornflakes

	(1) Price ($ per box) P	(2) Quantity supplied (millions of boxes per year) Q
A	5	18
B	4	16
C	3	12
D	2	7
E	1	0

TABLE 3-3. Supply Schedule Relates Quantity Supplied to Price

The table shows, for each price, the quantity of cornflakes that cereal makers want to produce and sell. Note the positive relation between price and quantity supplied.

THE SUPPLY CURVE

Table 3-3 shows a hypothetical supply schedule for cornflakes, and Figure 3-5 plots the data from the table in the form of a supply curve. These data show that at a cornflakes price of $1 per box, no cornflakes at all will be produced. At such a low price, breakfast cereal manufacturers might want to devote their factories to producing other types of cereal, like bran flakes, that earn them more profit than cornflakes. As the price of cornflakes increases, ever more cornflakes will be produced. At ever-higher cornflakes prices, cereal makers will find it profitable to add more workers and to buy more automated cornflakes-stuffing machines and even more cornflakes factories. All these will increase the output of cornflakes at the higher market prices.

Figure 3-5 shows the typical case of an upward-sloping supply curve for an individual commodity. One important reason for the upward slope is "the law of diminishing returns" (a concept we will learn more about later). Wine will illustrate this important law. If society wants more wine, then additional labor will have to be added to the limited land sites suitable for producing wine grapes. Each new worker will be adding less and less extra product. The price needed to coax out additional wine output is therefore higher. By raising the price of wine, society can persuade wine producers to produce and sell more wine; the supply curve for wine is therefore upward-sloping. Similar reasoning applies to many other goods as well.

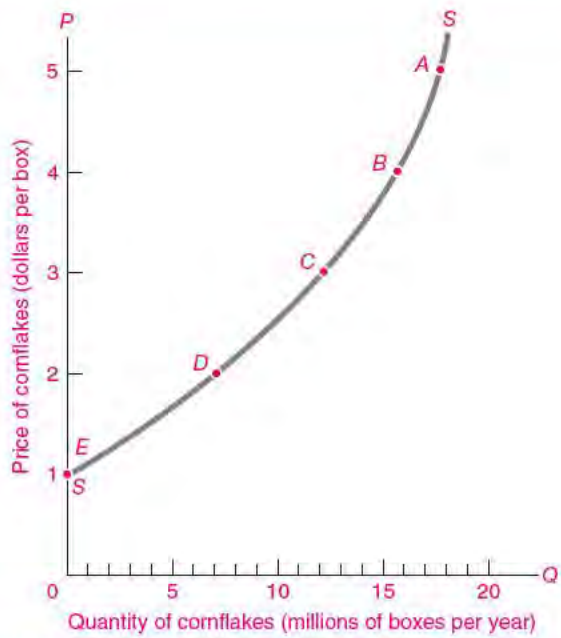


FIGURE 3-5. Supply Curve Relates Quantity Supplied to Price

The supply curve plots the price and quantity pairs from Table 3-3. A smooth curve is passed through these points to give the upward-sloping supply curve, *SS*.

Forces behind the Supply Curve

In examining the forces determining the supply curve, the fundamental point to grasp is that producers supply commodities for profit and not for fun or charity. One major element underlying the supply curve is the *cost of production.* When production costs for a good are low relative to the market price, it is profitable for producers to supply a great deal. When production costs are high relative to price, firms produce little, switch to the production of other products, or may simply go out of business.

Production costs are primarily determined by the *prices of inputs* and *technological advances.* The prices of inputs such as labor, energy, or machinery obviously have a very important influence on the cost of producing a given level of output. For example, when oil prices rose sharply in 2007, the increase raised the price of energy for manufacturers, increased their production costs, and lowered their supply. By contrast, as computer prices fell over the last three decades, businesses increasingly substituted computerized processes for other inputs, as for example in payroll or accounting operations; this increased supply.

An equally important determinant of production costs is *technological advances,* which consist of changes that lower the quantity of inputs needed to produce the same quantity of output. Such advances include everything from scientific breakthroughs to better application of existing technology or simply reorganization of the flow of work. For example, manufacturers have become much more efficient in recent years. It takes far fewer hours of labor to produce an automobile today than it did just 10 years ago. This advance enables car makers to produce more automobiles at the same cost. To give another example, if Internet commerce allows firms to compare more easily the prices of necessary inputs, that will lower the cost of production.

But production costs are not the only ingredient that goes into the supply curve. Supply is also influenced by the *prices of related goods,* particularly goods that are alternative outputs of the production process. If the price of one production substitute rises, the supply of another substitute will decrease. An interesting example occurred in U.S. farming. The government has raised the subsidy on automotive ethanol to reduce imports of foreign oil. Ethanol is today primarily made from corn. The increased demand for corn (a shift in the demand curve for corn) increased the corn price. As a result, farmers planted corn instead of soybeans. The net result was that the supply of soybeans declined and soybean prices rose. All of this occurred because of a subsidy to reduce oil imports.

Government policy also has an important impact on the supply curve. We just discussed the case of ethanol subsidies and corn production. Environmental and health considerations determine what technologies can be used, while taxes and minimum-wage laws can significantly affect input prices. Government trade policies have a major impact upon supply. For instance, when a free-trade agreement opens up the U.S. market to Mexican footwear, the total supply of footwear in the United States increases.

Finally, *special influences* affect the supply curve. The weather exerts an important influence on farming and on the ski industry. The computer industry has been marked by a keen spirit of innovation, which has led to a continuous flow of new products. Market structure will affect supply, and expectations about future prices often have an important impact upon supply decisions.

Table 3-4 highlights the important determinants of supply, using automobiles as an example.

Shifts in Supply

Businesses are constantly changing the mix of products and services they provide. What lies behind these changes in supply behavior?

When changes in factors other than a good's own price affect the quantity supplied, we call these changes shifts in supply. Supply increases (or decreases) when the amount supplied increases (or decreases) at each market price.

When automobile prices change, producers change their production and quantity supplied, but the supply and the supply curve do not shift. By contrast, when other influences affecting supply change, supply changes and the supply curve shifts.

We can illustrate a shift in supply for the automobile market. Supply would increase if the introduction of cost-saving computerized design and manufacturing reduced the labor required to produce cars, if autoworkers took a pay cut, if there were lower production costs in Japan, or if the government repealed environmental regulations on the

Factors affecting the supply curve	Example for automobiles
1. **Technology**	Computerized manufacturing lowers production costs and increases supply.
2. **Input prices**	A reduction in the wage paid to autoworkers lowers production costs and increases supply.
3. **Prices of related goods**	If truck prices fall, the supply of cars rises.
4. **Government policy**	Removing quotas and tariffs on imported automobiles increases total automobile supply.
5. **Special influences**	Internet shopping and auctions allow consumers to compare the prices of different dealers more easily and drives high-cost sellers out of business.

TABLE 3-4. Supply Is Affected by Production Costs and Other Factors

industry. Any of these elements would increase the supply of automobiles in the United States at each price. Figure 3-6 illustrates an increase in the supply of automobiles.

To test your understanding of supply shifts, think about the following: What would happen to the world supply curve for oil if a revolution in Saudi Arabia led to declining oil production? What would happen to the supply curve for clothing if tariffs were slapped on Chinese imports into the United States? What happens to the supply curve for computers if Intel introduces a new computer chip that dramatically increases computing speeds?

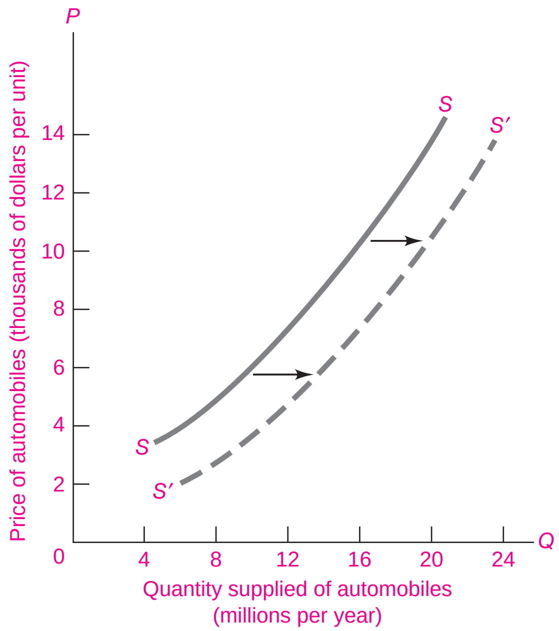


FIGURE 3-6. Increased Supply of Automobiles

As production costs fall, the supply of automobiles increases. At each price, producers will supply more automobiles, and the supply curve therefore shifts to the right. (What would happen to the supply curve if Congress were to put a restrictive quota on automobile imports?)

As you answer the questions above, make sure to keep in mind the difference between moving along a curve and a shift of the curve. Here that distinction applies to supply curves, whereas earlier we applied it to demand curves. Look back at the gasoline-price curve in Figure 3-1 on page 46. When the price of oil rose because of political disturbances in the 1970s, this led to an inward *shift of* the supply curve. When sales of gasoline declined in response to the higher price, that was a *movement along* the demand curve.

Does the history of computer prices and quantities shown in Figure 3-3 on page 49 look more like shifting supply or shifting demand? (Question 8 at the end of this chapter explores this issue further.)

How would you describe a rise in chicken production that was induced by a rise in chicken prices? What about the case of a rise in chicken production because of a fall in the price of chicken feed?

C. EQUILIBRIUM OF SUPPLY AND DEMAND

Up to this point we have been considering demand and supply in isolation. We know the amounts that are willingly bought and sold at each price. We have seen that consumers demand different amounts of cornflakes, cars, and computers as a function of these goods' prices. Similarly, producers willingly supply different amounts of these and other goods depending on their prices. But how can we put both sides of the market together?

The answer is that supply and demand interact to produce an equilibrium price and quantity, or a market equilibrium. The *market equilibrium* comes at that price and quantity where the forces of supply and demand are in balance. At the equilibrium price, the amount that buyers want to buy is just equal to the amount that sellers want to sell. The reason we call this an equilibrium is that, when the forces of supply and demand are in balance, there is no reason for price to rise or fall, as long as other things remain unchanged.

Let us work through the cornflakes example in Table 3-5 to see how supply and demand determine a market equilibrium; the numbers in this table come from Tables 3-1 and 3-3. To find the market price and quantity, we find a price at which the amounts desired to be bought and sold just match. If we try a price of $5 per box, will it prevail for long? Clearly not. As row A in Table 3-5 shows, at $5 producers would like to sell 18 million boxes per year while demanders want to buy only 9. The amount supplied at $5 exceeds the amount demanded, and stocks of cornflakes pile up in supermarkets. Because too few consumers are chasing too many cornflakes, the price of cornflakes will tend to fall, as shown in column (5) of Table 3-5.

Say we try $2. Does that price clear the market? A quick look at row D shows that at $2 consumption exceeds production. Cornflakes begin to disappear from the stores at that price. As people scramble around to find their desired cornflakes, they will tend to bid up the price of cornflakes, as shown in column (5) of Table 3-5.

We could try other prices, but we can easily see that the equilibrium price is $3, or row C in Table 3-5. At $3, consumers' desired demand exactly equals producers' desired production, each of which is 12 units. Only at $3 will consumers and suppliers both be making consistent decisions.

A **market equilibrium** comes at the price at which quantity demanded equals quantity supplied. At that equilibrium, there is no tendency for the price to rise or fall. The equilibrium price is also called the **market-clearing price.** This denotes that all supply and demand orders are filled, the books are "cleared" of orders, and demanders and suppliers are satisfied.

EQUILIBRIUM WITH SUPPLY AND DEMAND CURVES

We often show the market equilibrium through a supply-and-demand diagram like the one in Figure 3-7; this figure combines the supply curve from Figure 3-5

Combining Demand and Supply for Cornflakes

	(1) Possible price ($ per box)	(2) Quantity demanded (millions of boxes per year)	(3) Quantity supplied (millions of boxes per year)	(4) State of market	(5) Pressure on price
A	5	9	18	Surplus	↓ Downward
B	4	10	16	Surplus	↓ Downward
C	3	12	12	Equilibrium	Neutral
D	2	15	7	Shortage	↑ Upward
E	1	20	0	Shortage	↑ Upward

TABLE 3-5. Equilibrium Price Comes Where Quantity Demanded Equals Quantity Supplied

The table shows the quantities supplied and demanded at different prices. Only at the equilibrium price of $3 per box does amount supplied equal amount demanded. At too low a price there is a shortage and price tends to rise. Too high a price produces a surplus, which will depress the price.

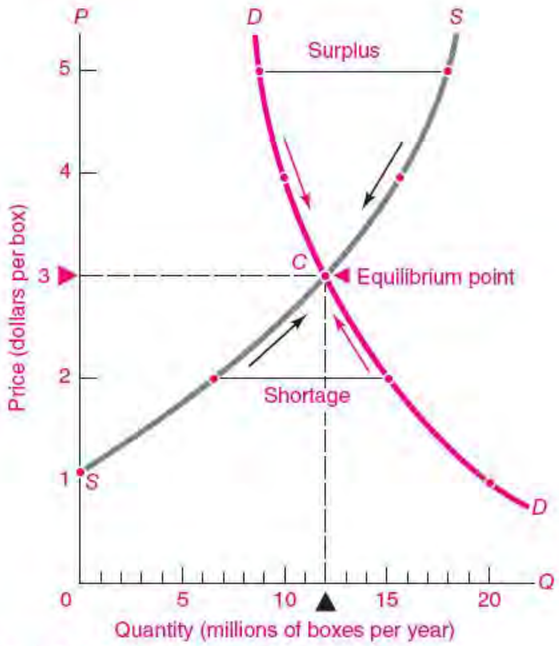


FIGURE 3-7. Market Equilibrium Comes at the Intersection of Supply and Demand Curves

The market equilibrium price and quantity come at the intersection of the supply and demand curves. At a price of \$3, at point *C*, firms willingly supply what consumers willingly demand. When the price is too low (say, at \$2), quantity demanded exceeds quantity supplied, shortages occur, and the price is driven up to equilibrium. What occurs at a price of \$4?

with the demand curve from Figure 3-2. Combining the two graphs is possible because they are drawn with exactly the same variables and units on each axis.

We find the market equilibrium by looking for the price at which quantity demanded equals quantity supplied. *The equilibrium price comes at the intersection of the supply and demand curves, at point* C.

How do we know that the intersection of the supply and demand curves is the market equilibrium? Let us repeat our earlier experiment. Start with the initial high price of \$5 per box, shown at the top of the price axis in Figure 3-7. At that price, suppliers want to sell more than demanders want to buy. The result is a *surplus*, or excess of quantity supplied over quantity demanded, shown in the figure by the blue line labeled "Surplus." The arrows along the curves show the direction that price tends to move when a market is in surplus.

At a low price of \$2 per box, the market shows a *shortage*, or excess of quantity demanded over quantity supplied, here shown by the blue line labeled "Shortage." Under conditions of shortage, the competition among buyers for limited goods causes the price to rise, as shown in the figure by the arrows pointing upward.

We now see that the balance or equilibrium of supply and demand comes at point *C*, where the supply and demand curves intersect. At point *C*, where the price is \$3 per box and the quantity is 12 units, the quantities demanded and supplied are equal: there are no shortages or surpluses; there is no tendency for price to rise or fall. At point *C* and only at point *C*, the forces of supply and demand are in balance and the price has settled at a sustainable level.

The equilibrium price and quantity come where the amount willingly supplied equals the amount willingly demanded. In a competitive market, this equilibrium is found at the intersection of the supply and demand curves. There are no shortages or surpluses at the equilibrium price.

Effect of a Shift in Supply or Demand

The analysis of the supply-and-demand apparatus can do much more than tell us about the equilibrium price and quantity. It can also be used to predict the impact of changes in economic conditions on prices and quantities. Let's change our example to the staff of life, bread. Suppose that a spell of bad weather raises the price of wheat, a key ingredient of bread. That shifts the supply curve for bread to the left. This is illustrated in Figure 3-8(*a*), where the bread supply curve has shifted from *SS* to $S'S'$. In contrast, the demand curve has not shifted because people's sandwich demand is unaffected by farming weather.

What happens in the bread market? The bad harvest causes profit-maximizing bakers to produce less bread at the old price, so quantity demanded exceeds quantity supplied. The price of bread therefore rises, encouraging production and thereby raising quantity supplied, while simultaneously discouraging consumption and lowering quantity demanded. The price continues to rise until, at the new equilibrium price, the amounts demanded and supplied are once again equal.

As Figure 3-8(*a*) shows, the new equilibrium is found at E', the intersection of the new supply curve

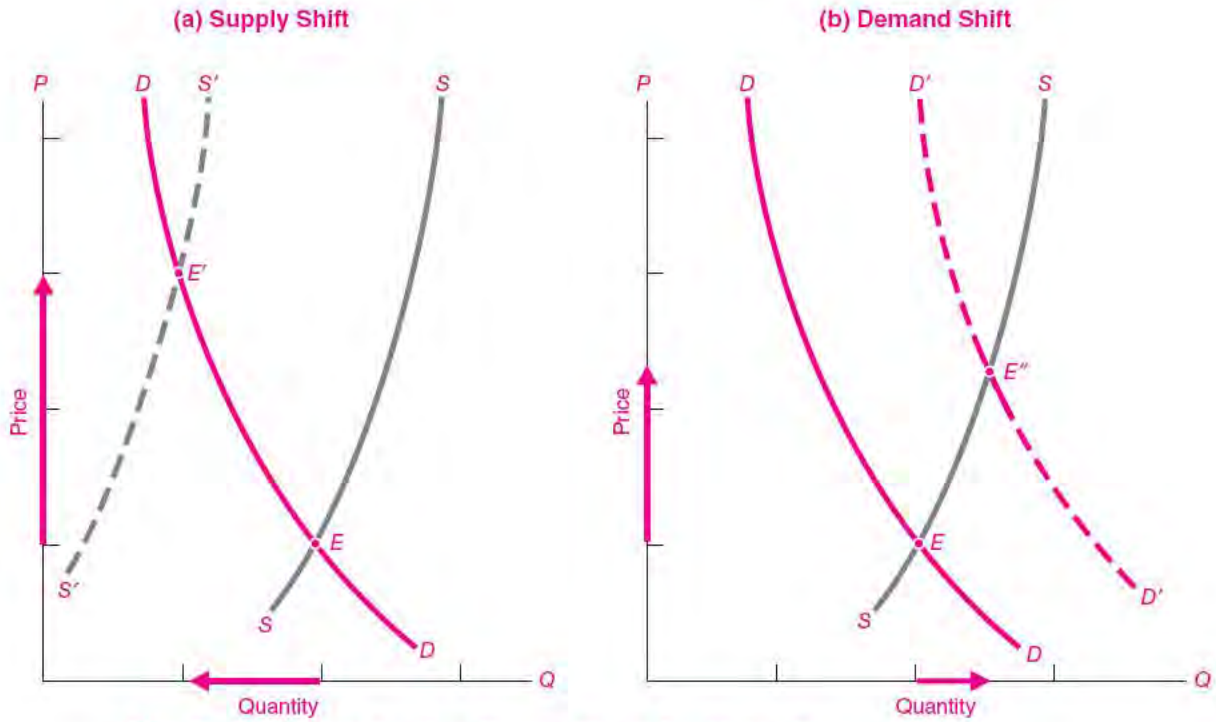


FIGURE 3-8. Shifts in Supply or Demand Change Equilibrium Price and Quantity

(**a**) If supply shifts leftward, a shortage will develop at the original price. Price will be bid up until quantities willingly bought and sold are equal, at new equilibrium E'. (**b**) A shift in the demand curve leads to excess demand. Price will be bid up as equilibrium price and quantity move upward to E''.

$S'S'$ and the original demand curve. Thus a bad harvest (or any leftward shift of the supply curve) raises prices and, by the law of downward-sloping demand, lowers quantity demanded.

Suppose that new baking technologies lower costs and therefore increase supply. That means the supply curve shifts down and to the right. Draw in a new $S'''S'''$ curve, along with the new equilibrium E'''. Why is the equilibrium price lower? Why is the equilibrium quantity higher?

We can also use our supply-and-demand apparatus to examine how changes in demand affect the market equilibrium. Suppose that there is a sharp increase in family incomes, so everyone wants to eat more bread. This is represented in Figure 3-8(*b*) as a "demand shift" in which, at every price, consumers demand a higher quantity of bread. The demand curve thus shifts *rightward* from *DD* to $D'D'$.

The demand shift produces a shortage of bread at the old price. A scramble for bread ensues. Prices are bid upward until supply and demand come back into balance at a higher price. Graphically, the increase in demand has changed the market equilibrium from *E* to E'' in Figure 3-8(*b*).

For both examples of shifts—a shift in supply and a shift in demand—a variable underlying the demand or supply curve has changed. In the case of supply, there might have been a change in technology or input prices. For the demand shift, one of the influences affecting consumer demand—incomes, population, the prices of related goods, or tastes—changed and thereby shifted the demand schedule (see Table 3-6).

When the elements underlying demand or supply change, this leads to shifts in demand or supply and to changes in the market equilibrium of price and quantity.

	Demand and supply shifts	Effect on price and quantity
If demand rises . . .	The demand curve shifts to the right, and . . .	Price ↑ Quantity ↑
If demand falls . . .	The demand curve shifts to the left, and . . .	Price ↓ Quantity ↓
If supply rises . . .	The supply curve shifts to the right, and . . .	Price ↓ Quantity ↑
If supply falls . . .	The supply curve shifts to the left, and . . .	Price ↑ Quantity ↓

TABLE 3-6. The Effect on Price and Quantity of Different Demand and Supply Shifts

Interpreting Changes in Price and Quantity

An important issue that arises is how to interpret price and quantity changes. We sometimes hear, "Gasoline demand does not obey the law of downward-sloping demand. From 2003 to 2006 prices rose sharply [as shown in Figure 3-1], yet U.S. gasoline consumption went up rather than down. What do you economists say about that!"

We cannot provide a definitive explanation without a careful look at the forces affecting both supply and demand. But the most likely explanation for the paradox is that the rise in gasoline prices over this period was due to *shifts in demand* rather than *movements along the demand curve.* We know, for example, that the Chinese and Indian economies grew rapidly and their oil imports added to world demand. Moreover, the number of automobiles in the United States grew sharply, and the fuel efficiency of the fleet declined, increasing the U.S. demand for gasoline.

Economists deal with these sorts of questions all the time. When prices or quantities change in a market, does the situation reflect a change on the supply side or the demand side? Sometimes, in simple situations, looking at price and quantity simultaneously gives you a clue about whether it is the supply curve or the demand curve that has shifted. For example, a rise in the price of bread accompanied by a *decrease* in quantity suggests that the supply curve has shifted to the left (a decrease in supply). A rise in price accompanied by an *increase* in quantity indicates that the demand curve for bread has probably shifted to the right (an increase in demand).

Figure 3-9 illustrates the point. In both panel (a) and panel (b), quantity goes up. But in (a) the price rises, and in (b) the price falls. Figure 3-9(a) shows the case of an increase in demand, or a shift in the demand curve. As a result of the shift, the equilibrium quantity demanded increases from 10 to 15 units. The case of a movement along the demand curve is shown in Figure 3-9(b). In this case, a supply shift changes the market equilibrium from point E to point E''. As a result, the quantity demanded changes from 10 to 15 units. But demand does not change in this second case; rather, quantity demanded increases as consumers move along their demand curve from E to E'' in response to a price change.

Return to our example of the change in gasoline consumption from 2003 to 2006. Explain why such events are best explained by the changes in Figure 3-9(a). Explain why the law of downward-sloping demand is still alive in the gasoline market!

The Elusive Concept of Equilibrium

The notion of equilibrium is one of the most elusive concepts of economics. We are familiar with equilibrium in our everyday lives from seeing, for example, an orange sitting at the bottom of a bowl or a pendulum at rest. In economics, equilibrium means that the different forces operating on a market are in balance, so the resulting price and quantity reconcile the desires of purchasers and suppliers. Too low a price means that the forces are not in balance, that the forces attracting demand are greater than the forces attracting supply, so there is excess demand, or a shortage. We also

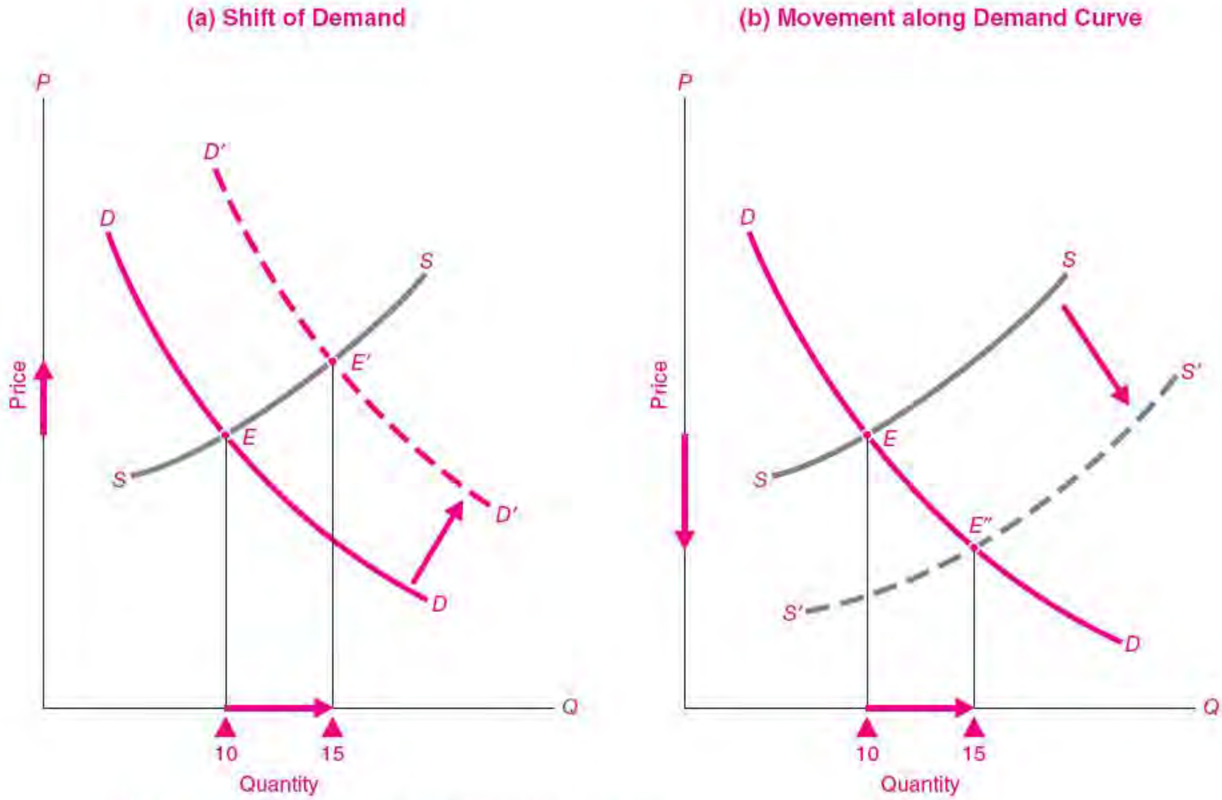


FIGURE 3-9. Shifts of and Movements along Curves

Start out with initial equilibrium at E and a quantity of 10 units. In (a), an increase in demand (i.e., a shift of the demand curve) produces a new equilibrium of 15 units at E'. In (b), a shift in supply results in a movement along the demand curve from E to E''.

know that a competitive market is a mechanism for producing equilibrium. If the price is too low, demanders will bid up the price to the equilibrium level.

The notion of equilibrium is tricky, however, as is seen by the statement of a leading pundit: "Don't lecture me about supply and demand equilibrium. The supply of oil is always equal to the demand for oil. You simply can't tell the difference." The pundit is right in an accounting sense. Clearly the oil sales recorded by the oil producers should be exactly equal to the oil purchases recorded by the oil consumers. But this bit of arithmetic cannot repeal the laws of supply and demand. More important, if we fail to understand the nature of economic equilibrium, we cannot hope to understand how different forces affect the marketplace.

In economics, we are interested in knowing the quantity of sales that will clear the market, that is, the equilibrium quantity. We also want to know the price at which consumers willingly buy what producers willingly sell. Only at this price will both buyers and sellers be satisfied with their decisions. Only at this price and quantity will there be no tendency for price and quantity to change.

Only by looking at the equilibrium of supply and demand can we hope to understand such paradoxes as the fact that immigration may not lower wages in the affected cities, that land taxes do not raise rents, and that bad harvests raise (yes, raise!) the incomes of farmers.

Supply, Demand, and Immigration

A fascinating and important example of supply and demand, full of complexities, is the role of immigration in determining wages. If you ask people, they are likely to tell you that immigration into California or Florida surely lowers the wages of people in those

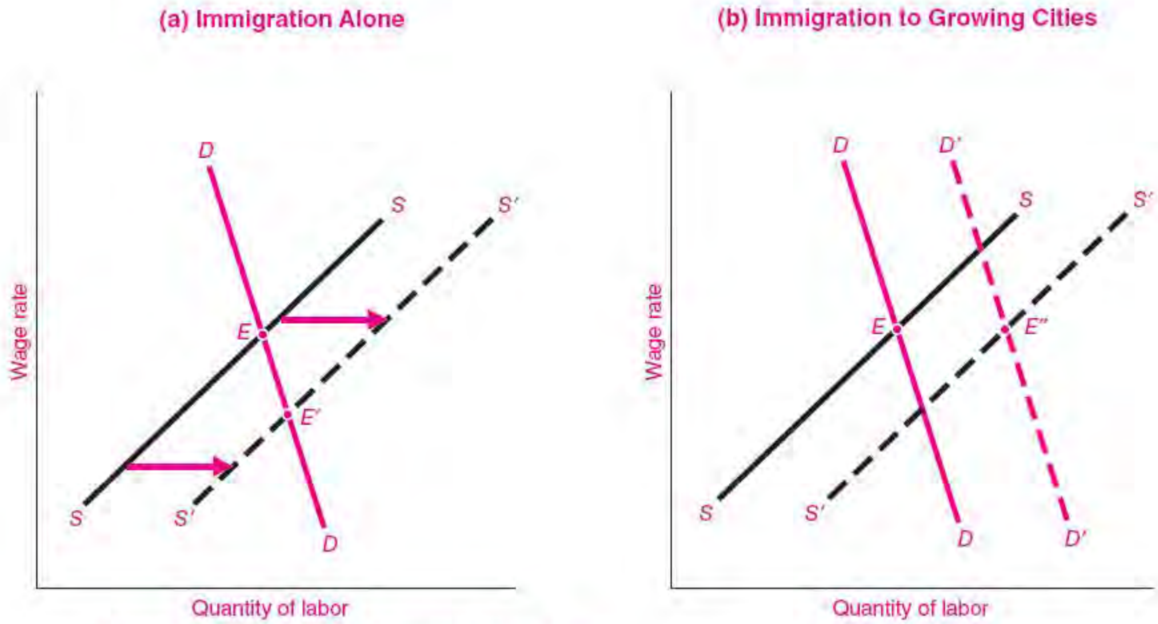


FIGURE 3-10. Impact of Immigration on Wages

In (**a**), new immigrants cause the supply curve for labor to shift from *SS* to *S′S′*, lowering equilibrium wages. But more often, immigrants go to cities with growing labor markets. Then, as shown in (**b**), the wage changes are small if the supply increase comes in labor markets with growing demand.

regions. It's just supply and demand. They might point to Figure 3-10(*a*), which shows a supply-and-demand analysis of immigration. According to this analysis, immigration into a region shifts the supply curve for labor to the right and pushes down wages.

Careful economic studies cast doubt on this simple reasoning. A survey of the evidence concludes:

> [The] effect of immigration on the labor market outcomes of natives is small. There is no evidence of economically significant reductions in native employment. Most empirical analysis . . . finds that a 10 percent increase in the fraction of immigrants in the population reduces native wages by at most 1 percent.[2]

How can we explain the small impact of immigration on wages? Labor economists emphasize the high geographic mobility of the American population. This means that new immigrants will quickly spread around the entire country. Once they arrive, immigrants may move to cities where they can get jobs—workers tend to move to those cities where the demand for labor is already rising because of a strong local economy.

This point is illustrated in Figure 3-10(*b*), where a shift in labor supply to *S′S′* is associated with a higher demand curve, *D′D′*. The new equilibrium wage at *E″* is the same as the original wage at *E*. Another factor is that native-born residents may move out when immigrants move in, so the total supply of labor is unchanged. This would leave the supply curve for labor in its original position and leave the wage unchanged.

Immigration is a good example for demonstrating the power of the simple tools of supply and demand.

RATIONING BY PRICES

Let us now take stock of what the market mechanism accomplishes. By determining the equilibrium prices and quantities, the market allocates or rations out the scarce goods of the society among the possible

[2] Rachel M. Friedberg and Jennifer Hunt, "The Impact of Immigrants on Host Country Wages, Employment, and Growth," *Journal of Economic Perspectives*, Spring 1995, pp. 23–44.

uses. Who does the rationing? A planning board? Congress? The president? No. The marketplace, through the interaction of supply and demand, does the rationing. This is *rationing by the purse.*

What goods are produced? This is answered by the signals of market prices. High corn prices stimulate corn production, whereas falling computer prices stimulate a growing demand for computation. Those who have the most dollar votes have the greatest influence on what goods are produced.

For whom are goods produced? The power of the purse dictates the distribution of income and consumption. Those with higher incomes end up with larger houses, fancier cars, and longer vacations. When backed up by cash, the most urgently felt needs get fulfilled through the demand curve.

Even the *how* question is decided by supply and demand. When corn prices are high, farmers buy expensive tractors and more fertilizer and invest in irrigation systems. When oil prices are high, oil companies drill in deep offshore waters and employ novel seismic techniques to find oil.

With this introduction to supply and demand, we begin to see how desires for goods, as expressed through demands, interact with costs of goods, as reflected in supplies. Further study will deepen our understanding of these concepts and will show how these tools can be applied to other important areas. But even this first survey will serve as an indispensable tool for interpreting the economic world in which we live.

SUMMARY

1. The analysis of supply and demand shows how a market mechanism solves the three problems of *what, how,* and *for whom.* A market blends together demands and supplies. Demand comes from consumers who are spreading their dollar votes among available goods and services, while businesses supply the goods and services with the goal of maximizing their profits.

A. The Demand Schedule

2. A demand schedule shows the relationship between the quantity demanded and the price of a commodity, other things held constant. Such a demand schedule, depicted graphically by a demand curve, holds constant other things like family incomes, tastes, and the prices of other goods. Almost all commodities obey the *law of downward-sloping demand,* which holds that quantity demanded falls as a good's price rises. This law is represented by a downward-sloping demand curve.
3. Many influences lie behind the demand schedule for the market as a whole: average family incomes, population, the prices of related goods, tastes, and special influences. When these influences change, the demand curve will shift.

B. The Supply Schedule

4. The supply schedule (or supply curve) gives the relationship between the quantity of a good that producers desire to sell—other things constant—and that good's price. Quantity supplied generally responds positively to price, so the supply curve is upward-sloping.
5. Elements other than the good's price affect its supply. The most important influence is the commodity's production cost, determined by the state of technology and by input prices. Other elements in supply include the prices of related goods, government policies, and special influences.

C. Equilibrium of Supply and Demand

6. The equilibrium of supply and demand in a competitive market occurs when the forces of supply and demand are in balance. The equilibrium price is the price at which the quantity demanded just equals the quantity supplied. Graphically, we find the equilibrium at the intersection of the supply and demand curves. At a price above the equilibrium, producers want to supply more than consumers want to buy, which results in a surplus of goods and exerts downward pressure on price. Similarly, too low a price generates a shortage, and buyers will therefore tend to bid price upward to the equilibrium.
7. Shifts in the supply and demand curves change the equilibrium price and quantity. An increase in demand, which shifts the demand curve to the right, will increase both equilibrium price and quantity. An increase in supply, which shifts the supply curve to the right, will decrease price and increase quantity demanded.
8. To use supply-and-demand analysis correctly, we must (*a*) distinguish a change in demand or supply (which produces a shift of a curve) from a change in the

quantity demanded or supplied (which represents a movement along a curve); (*b*) hold other things constant, which requires distinguishing the impact of a change in a commodity's price from the impact of changes in other influences; and (*c*) look always for the supply-and-demand equilibrium, which comes at the point where forces acting on price and quantity are in balance.

9. Competitively determined prices ration the limited supply of goods among those who demand them.

CONCEPTS FOR REVIEW

supply-and-demand analysis
demand schedule or curve, *DD*
law of downward-sloping demand
influences affecting demand curve
supply schedule or curve, *SS*
influences affecting supply curve
equilibrium price and quantity
shifts of supply and demand curves
all other things held constant
rationing by prices

FURTHER READING AND INTERNET WEBSITES

Further Reading

Supply-and-demand analysis is the single most important and useful tool in microeconomics. Supply-and-demand analysis was developed by the great British economist Alfred Marshall in *Principles of Economics,* 9th ed. (New York, Macmillan, [1890] 1961). To reinforce your understanding, you might look in textbooks on intermediate microeconomics. Two good references are Hal R. Varian, *Intermediate Microeconomics: A Modern Approach,* 6th ed. (Norton, New York, 2002), and Edwin Mansfield and Gary Yohe, *Microeconomics: Theory and Applications,* 10th ed. (Norton, New York, 2000).

A recent survey of the economic issues in immigration is in George Borjas, *Heaven's Door: Immigration Policy and the American Economy* (Princeton University Press, Princeton, N.J., 1999).

Websites

Websites in economics are proliferating rapidly, and it is hard to keep up with all the useful sites. A good place to start is always *rfe.org/*. A good starting point for multiple sites in economics is *rfe.org/OtherInt/MultSub/index.html,* and the Google search engine has its own economics site at *directory.google.com/Top/Science/Social_Sciences/Economics/*. Another useful starting point for Internet resources in economics can be found at *www.oswego.edu/~economic/econweb.htm.*

You can examine a recent study of the impact of immigration on American society from the National Academy of Sciences, *The New Americans* (1997), at *www.nap.edu.* This site provides free access to over 1000 studies from economics and the other social and natural sciences.

QUESTIONS FOR DISCUSSION

1. a. Define carefully what is meant by a demand schedule or curve. State the law of downward-sloping demand. Illustrate the law of downward-sloping demand with two cases from your own experience.
   b. Define the concept of a supply schedule or curve. Show that an increase in supply means a rightward and downward shift of the supply curve. Contrast this with the rightward and upward shift of the demand curve implied by an increase in demand.
2. What might increase the demand for hamburgers? What would increase the supply? What would inexpensive frozen pizzas do to the market equilibrium for hamburgers? To the wages of teenagers who work at McDonald's?
3. Explain why the price in competitive markets settles down at the equilibrium intersection of supply and demand. Explain what happens if the market price starts out too high or too low.

4. Explain why each of the following is *false:*
   a. A freeze in Brazil's coffee-growing region will lower the price of coffee.
   b. "Protecting" American textile manufacturers from Chinese clothing imports will lower clothing prices in the United States.
   c. The rapid increase in college tuitions will lower the demand for college.
   d. The war against drugs will lower the price of domestically produced marijuana.
5. The following are four laws of supply and demand. Fill in the blanks. Demonstrate each law with a supply-and-demand diagram.
   a. An increase in demand generally raises price and raises quantity demanded.
   b. A decrease in demand generally __________ price and __________ quantity demanded.
   c. An increase in supply generally lowers price and raises quantity demanded.
   d. A decrease in supply generally __________ price and __________ quantity demanded.
6. For each of the following, explain whether quantity demanded changes because of a demand shift or a price change, and draw a diagram to illustrate your answer:
   a. As a result of increased military spending, the price of Army boots rises.
   b. Fish prices fall after the pope allows Catholics to eat meat on Friday.
   c. An increase in gasoline taxes lowers the consumption of gasoline.
   d. After the Black Death struck Europe in the fourteenth century, wages rose.
7. Examine the graph for the price of gasoline in Figure 3-1, on page 46. Then, using a supply-and-demand diagram, illustrate the impact of each of the following on price and quantity demanded:
   a. Improvements in transportation lower the costs of importing oil into the United States in the 1960s.
   b. After the 1973 war, oil producers cut oil production sharply.
   c. After 1980, smaller automobiles get more miles per gallon.
   d. A record-breaking cold winter in 1995–1996 unexpectedly raises the demand for heating oil.
   e. Rapid economic growth in the early 2000s leads to a sharp upturn in oil prices.
8. Examine Figure 3-3 on page 49. Does the price-quantity relationship look more like a supply curve or a demand curve? Assuming that the demand curve was unchanged over this period, trace supply curves for 1965 and 2008 that would have generated the (P, Q) pairs for those years. Explain what forces might have led to the shift in the supply curve.
9. From the following data, plot the supply and demand curves and determine the equilibrium price and quantity:

Supply and Demand for Pizzas

Price ($ per pizza)	Quantity demanded (pizzas per semester)	Quantity supplied (pizzas per semester)
10	0	40
8	10	30
6	20	20
4	30	10
2	40	0
0	125	0

What would happen if the demand for pizzas tripled at each price? What would occur if the price were initially set at $4 per pizza?

PART TWO

Microeconomics: Supply, Demand, and Product Markets

CHAPTER

4

Supply and Demand: Elasticity and Applications

You cannot teach a parrot to be an economist simply by teaching it to say "supply" and "demand."

Anonymous

We now move from our introductory survey to a detailed study of microeconomics—of the behavior of individual firms, consumers, and markets. Individual markets contain much of the grand sweep and drama of economic history and the controversies of economic policy. Within the confines of microeconomics we will study the reasons for the vast disparities in earnings between neurosurgeons and textile workers. Microeconomics is crucial to understanding why computer prices have fallen so rapidly and why the use of computers has expanded exponentially. We cannot hope to understand the bitter debates about health care or the minimum wage without applying the tools of supply and demand to these sectors. Even topics such as illegal drugs or crime and punishment are usefully illuminated by considering the way the demand for addictive substances differs from that for other commodities.

But understanding supply and demand requires more than simply parroting the words. A full mastery of microeconomic analysis means understanding the derivation of demand curves and supply curves, learning about different concepts of costs, and understanding how perfect competition differs from monopoly. All these and other key topics will be our subjects as we tour through the fascinating world of microeconomics.

A. PRICE ELASTICITY OF DEMAND AND SUPPLY

Supply and demand can often tell us whether certain forces increase or decrease quantities. But for these tools to be truly useful, we need to know *how much* supply and demand respond to changes in price. Some purchases, like those for vacation travel, are luxuries that are very sensitive to price changes. Others, like food or electricity, are necessities for which consumer quantities respond very little to price changes. The quantitative relationship between price and quantity purchased is analyzed using the crucial concept of *elasticity*. We begin with a careful definition of this term and then use this new concept to analyze the microeconomic impacts of taxes and other types of government intervention.

PRICE ELASTICITY OF DEMAND

Let's look first at the response of consumer demand to price changes:

The **price elasticity of demand** (sometimes simply called **price elasticity**) measures how much the quantity demanded of a good changes when its price changes. The precise definition of price elasticity is the percentage change in quantity demanded divided by the percentage change in price.

Goods vary enormously in their price elasticity, or sensitivity to price changes. When the price elasticity of a good is high, we say that the good has "elastic" demand, which means that its quantity demanded responds greatly to price changes. When the price elasticity of a good is low, it is "inelastic" and its quantity demanded responds little to price changes.

Goods that have ready substitutes tend to have more elastic demand than those that have no substitutes. If all food or footwear prices were to rise 20 percent tomorrow, you would hardly expect people to stop eating or to go around barefoot, so food and footwear demands are price-inelastic. On the other hand, if mad-cow disease drives up the price of British beef, people can turn to beef from other countries or to lamb or poultry for their meat needs. Therefore, British beef shows a high price elasticity.

The length of time that people have to respond to price changes also plays a role. A good example is that of gasoline. Suppose you are driving across the country when the price of gasoline suddenly increases. Is it likely that you will sell your car and abandon your vacation? Not really. So in the short run, the demand for gasoline may be very inelastic.

In the long run, however, you can adjust your behavior to the higher price of gasoline. You can buy a smaller and more fuel-efficient car, ride a bicycle, take the train, move closer to work, or carpool with other people. The ability to adjust consumption patterns implies that demand elasticities are generally higher in the long run than in the short run.

The price elasticities of demand for individual goods are determined by the economic characteristics of demand. Price elasticities tend to be higher when the goods are luxuries, when substitutes are available, and when consumers have more time to adjust their behavior. By contrast, elasticities are lower for necessities, for goods with few substitutes, and for the short run.

Calculating Elasticities

The precise definition of price elasticity is the percentage change in quantity demanded divided by the percentage change in price. We use the symbol E_D to represent price elasticity, and for convenience we drop the minus signs, so elasticities are all positive.

We can calculate the coefficient of price elasticity numerically according to the following formula:

$$\text{Price elasticity of demand} = E_D = \frac{\text{percentage change in quantity demanded}}{\text{percentage change in price}}$$

Now we can be more precise about the different categories of price elasticity:

- When a 1 percent change in price calls forth more than a 1 percent change in quantity demanded, the good has **price-elastic demand.** For example, if a 1 percent increase in price yields a 5 percent decrease in quantity demanded, the commodity has a highly price-elastic demand.
- When a 1 percent change in price produces less than a 1 percent change in quantity demanded, the good has **price-inelastic demand.** This case occurs, for instance, when a 1 percent increase in price yields only a 0.2 percent decrease in demand.
- One important special case is **unit-elastic demand,** which occurs when the percentage change in quantity is exactly the same as the percentage change in price. In this case, a 1 percent increase in price yields a 1 percent decrease in demand. We will see later that this condition implies that total expenditures on the commodity (which equal $P \times Q$) stay the same even when the price changes.

We illustrate the calculation of elasticities with the example shown in Figure 4-1 and Table 4-1. To begin at point *A*, quantity demanded was 240 units at a price of 90. A price increase to 110 led consumers to reduce their purchases to 160 units, shown as point *B*.

Table 4-1 shows how we calculate price elasticity. The price increase is 20 percent, with the resulting quantity decrease being 40 percent. The price elasticity of demand is evidently $E_D = 40/20 = 2$. The price elasticity is greater than 1, and this good therefore has price-elastic demand in the region from *A* to *B*.

In practice, calculating elasticities is somewhat tricky, and we emphasize three key steps where you have to be especially careful:

1. Recall that we drop the minus signs from the numbers, thereby treating all percentage changes as *positive.* That means all elasticities are written as positive numbers, even though prices and

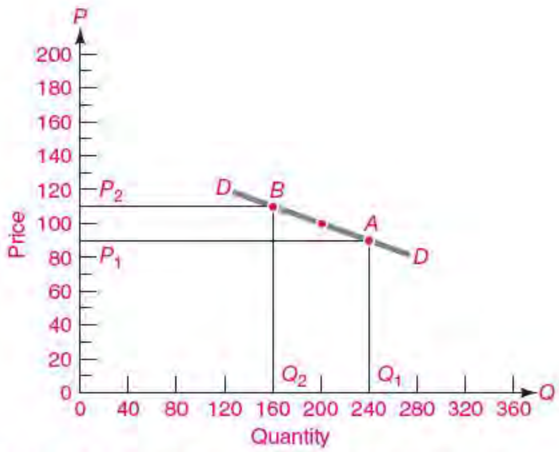


FIGURE 4-1. Elastic Demand Shows Large Quantity Response to Price Change

Market equilibrium is originally at point *A*. In response to a 20 percent price increase, quantity demanded declines 40 percent, to point *B*. Price elasticity is $E_D = 40/20 = 2$. Demand is therefore elastic in the region from *A* to *B*.

Case A: Price = 90 and quantity = 240

Case B: Price = 110 and quantity = 160

Percentage price change = $\Delta P/P = 20/100 = 20\%$

Percentage quantity change = $\Delta Q/Q = -80/200$
$= -40\%$

Price elasticity = $E_D = 40/20 = 2$

TABLE 4-1. Example of Good with Elastic Demand

Consider the situation where price is raised from 90 to 110. According to the demand curve, quantity demanded falls from 240 to 160. Price elasticity is the ratio of percentage change in quantity divided by percentage change in price. We drop the minus signs from the numbers so that all elasticities are positive.

quantities demanded move in opposite directions for downward-sloping demand curves.

2. Note that the definition of elasticity uses *percentage changes* in price and demand rather than absolute changes. This has the neat effect that a change in the units of measurement does not affect the elasticity. So whether we measure price in pennies or dollars, the price elasticity stays the same.

3. Note the use of *averaging* to calculate percentage changes in price and quantity. The formula for a percentage change is $\Delta P/P$. The value of ΔP in Table 4-1 is clearly $20 = 110 - 90$. But it's not immediately clear what value we should use for P in the denominator. Is it the original value of 90, the final value of 110, or something in between?

   For very small percentage changes, such as from 100 to 99, it does not much matter whether we use 99 or 100 as the denominator. But for larger changes, the difference is significant. To avoid ambiguity, we will take the average price to be the base price for calculating price changes. In Table 4-1, we used the average of the two prices $[P = (90 + 110)/2 = 100]$ as the base or denominator in the elasticity formula. Similarly, we used the average quantity $[Q = (160 + 240)/2 = 200]$ as the base for measuring the percentage change in quantity. The exact formula for calculating elasticity is therefore

$$E_D = \frac{\Delta Q}{(Q_1 + Q_2)/2} \div \frac{\Delta P}{(P_1 + P_2)/2}$$

   where P_1 and Q_1 represent the original price and quantity and P_2 and Q_2 stand for the new price and quantity.

Price Elasticity in Diagrams

It's possible to determine price elasticities in diagrams as well. Figure 4-2 illustrates the three cases of elasticities. In each case, price is cut in half and consumers change their quantity demanded from *A* to *B*.

In Figure 4-2(*a*), a halving of price has tripled quantity demanded. Like the example in Figure 4-1, this case shows price-elastic demand. In Figure 4-2(*c*), cutting price in half led to only a 50 percent increase in quantity demanded, so this is the case of price-inelastic demand. The borderline case of unit-elastic demand is shown in Figure 4-2(*b*); in this example, the doubling of quantity demanded exactly matches the halving of price.

Figure 4-3 displays the important polar extremes where the price elasticities are infinite and zero, or completely elastic and completely inelastic. Completely inelastic demands, or ones with zero elasticity, are ones where the quantity demanded responds not at all to price changes; such demand is seen to be a vertical demand curve. By contrast, when demand is infinitely elastic, a tiny change in price will lead to an

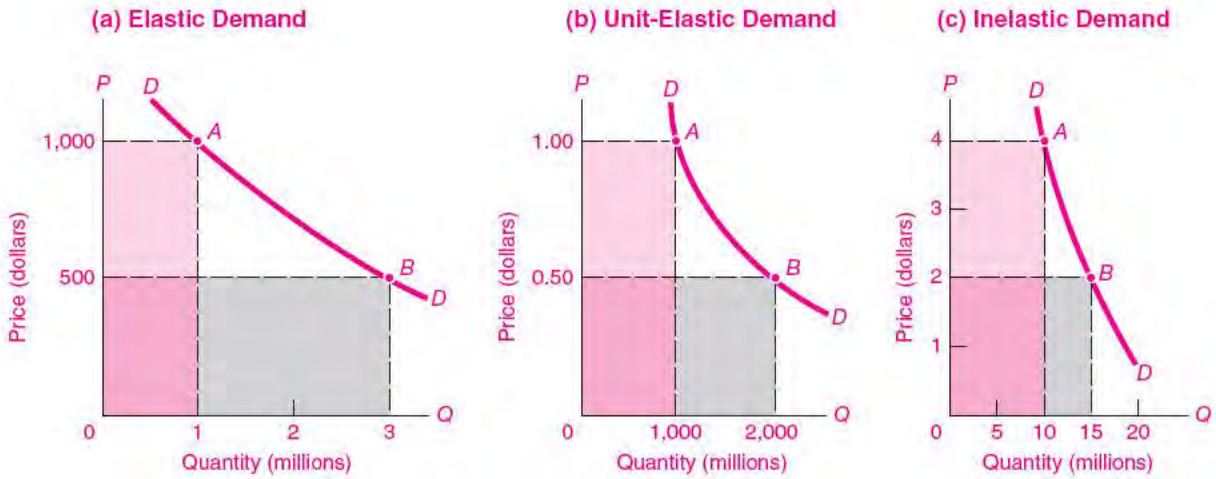


FIGURE 4-2. Price Elasticity of Demand Falls into Three Categories

indefinitely large change in quantity demanded, as in the horizontal demand curve in Figure 4-3.

A Shortcut for Calculating Elasticities

There is a simple rule for calculating the price elasticity of a demand curve:

> The elasticity of a straight line at a point is given by the ratio of the length of the line segment below the point to the length of the line segment above the point.

The procedure is shown in Figure 4-4. At the top of the line, a very small percentage price change induces a very large percentage quantity change, and the elasticity is therefore extremely large. Price

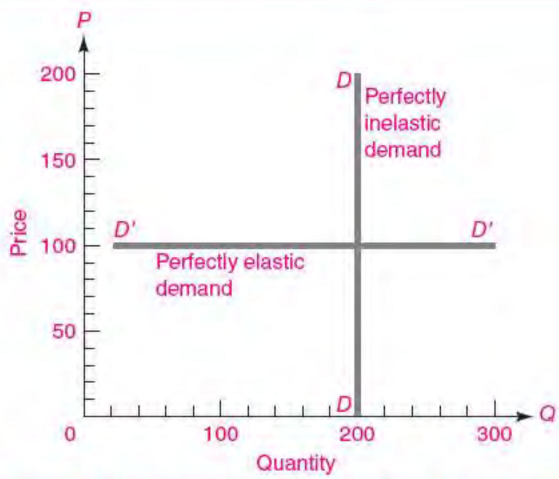


FIGURE 4-3. Perfectly Elastic and Inelastic Demands

Polar extremes of demand are vertical demand curves, which represent perfectly inelastic demand ($E_D = 0$), and horizontal demand curves, which show perfectly elastic demand ($E_D = \infty$).

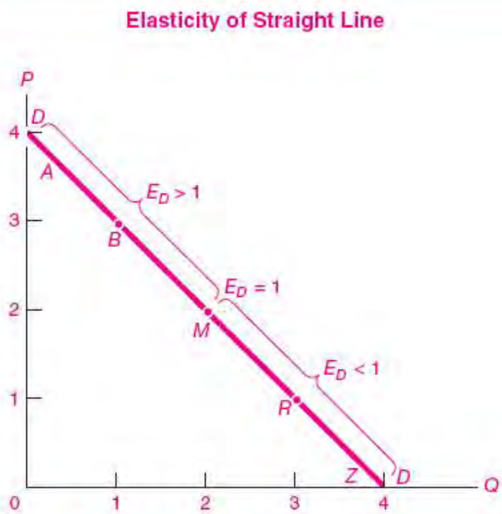


FIGURE 4-4. A Simple Rule for Calculating the Demand Elasticity

We can calculate the elasticity as the ratio of the lower segment to the upper segment at the demand point. For example, at point *B*, the lower segment is 3 times as long as the upper segment, so the price elasticity is 3.

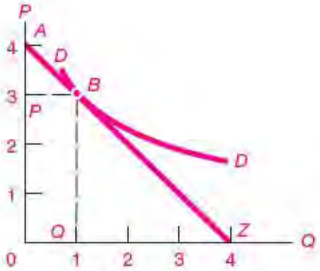


FIGURE 4-5. Calculating the Demand Elasticity for Curved Demand

To calculate the demand elasticity for a nonlinear demand curve, first draw a tangent line at the point. Then take the ratio of the length of the straight-line segment below the point to the length of the line segment above the point. Hence, at point *B* the elasticity can be calculated to be 3.

elasticity is relatively large when we are high up the linear *DD* curve. We use the rule to calculate the elasticity at point *B* in Figure 4-4. Calculate the ratio of the line segment *BZ* to the segment *AB*. Looking at the axes, we see that the ratio is 3. Therefore, price elasticity at point *B* is 3.

A similar calculation at point *R* shows that demand at that point is inelastic, with an elasticity of ⅓.

Finally, calculate elasticity at point *M*. Here, the ratio of the two line segments is one, so demand is unit-elastic at the midpoint *M*.

We can also use the rule to calculate the elasticity of a curved demand curve, as shown in Figure 4-5. For this case, you begin by drawing a line that is tangent to the point, and you then calculate the ratio of segments for the tangent line. This will provide the correct calculation of elasticity for the curved line. Use as an example point *B* in Figure 4-5. We have drawn a tangent straight line. A careful inspection will show that the ratio of the lower to upper segments of the straight line is 3. Therefore, the curved demand has an elasticity of 3 at point *B*.

The Algebra of Elasticities

For the mathematically inclined, we can show the algebra of elasticities for straight-line (linear) demand curves. We begin with a demand curve, which is written as $Q = a - bP$. The demand elasticity at point (P_0, Q_0) is defined as $E_D = (\% \Delta Q)/(\% \Delta P) = (\Delta Q/Q_0)/(\Delta P/P_0) = (\Delta Q/\Delta P)(P_0/Q_0)$. This implies that the elasticity at point (P_0, Q_0) is

$$E_D = b(P_0/Q_0)$$

Note that the elasticity depends upon the slope of the demand curve, but it also depends upon the specific price and quantity pair. Question 11 at the end of this chapter provides examples that allow you to apply this formula.

Elasticity Is Not the Same as Slope

We must always remember not to confuse the elasticity of a curve with its slope. This distinction is easily seen when we examine the straight-line demand curves that are often found in illustrative examples.

What is the price elasticity of a straight-line demand curve? Surprisingly, along a straight-line demand curve, the price elasticity varies from zero to infinity! Table 4-2 gives a detailed set of elasticity calculations using the same technique as that in Table 4-1. This table shows that linear demand curves start out with high price elasticity, where price is high and quantity is low, and end up with low elasticity, where price is low and quantity is high.

This illustrates an important point. When you see a demand curve in a diagram, it is not true that a steep slope for the demand curve means inelastic demand or that a flat slope signifies elastic demand. The slope is not the same as the elasticity because the demand curve's slope depends upon the *changes* in *P* and *Q*, whereas the elasticity depends upon the *percentage changes* in *P* and *Q*. The only exceptions are the polar cases of completely elastic and inelastic demands.

We also illustrate the point in Figure 4-4. This straight-line demand curve has elastic demand in the top region and inelastic demand in the bottom region.

Finally, look at Figure 4-2(*b*). This demand curve is clearly not a straight line with constant slope. Yet it has a constant demand elasticity of $E_D = 1$ because the percentage change in price is equal everywhere to the percentage change in quantity.

Elasticities cannot be inferred by slope alone. The general rule for elasticities is that the elasticity can be calculated as the ratio of the length of the straight-line or tangent segment below the demand point to the length of the segment above the point.

Numerical Calculation of Elasticity Coefficient

Q	ΔQ	P	ΔP	$\frac{Q_1 + Q_2}{2}$	$\frac{P_1 + P_2}{2}$	$E_D = \frac{\Delta Q}{(Q_1 + Q_2)/2} \div \frac{\Delta P}{(P_1 + P_2)/2}$	
0		6					
	10		2	5	5	$\frac{10}{5} \div \frac{2}{5} = 5$	(elastic)
10		4					
	10		2	15	3	$\frac{10}{15} \div \frac{2}{3} = 1$	(unit-elastic)
20		2					
	10		2	25	1	$\frac{10}{25} \div \frac{2}{1} = 0.2$	(inelastic)
30		0					

TABLE 4-2. Calculation of Price Elasticity along a Linear Demand Curve

ΔP denotes the change in price, i.e., $\Delta P = P_2 - P_1$, while $\Delta Q = Q_2 - Q_1$. To calculate numerical elasticity, the percentage change of price equals price change, ΔP, divided by average price $[(P_1 + P_2)/2]$; the percentage change in output is calculated as ΔQ divided by average quantity, $[(Q_1 + Q_2)/2]$. Treating all figures as positive numbers, the resulting ratio gives numerical price elasticity of demand, E_D. Note that for a straight line, elasticity is high at the top, low at the bottom, and exactly 1 in the middle.

ELASTICITY AND REVENUE

Many businesses want to know whether raising prices will raise or lower revenues. This question is of strategic importance for businesses like airlines, baseball teams, and magazines, which must decide whether it is worthwhile to raise prices and whether the higher prices make up for lower demand. Let's look at the relationship between price elasticity and total revenue.

Total revenue is by definition equal to price times quantity (or $P \times Q$). If consumers buy 5 units at $3 each, total revenue is $15. If you know the price elasticity of demand, you know what will happen to total revenue when price changes:

1. When demand is price-inelastic, a price decrease reduces total revenue.
2. When demand is price-elastic, a price decrease increases total revenue.
3. In the borderline case of unit-elastic demand, a price decrease leads to no change in total revenue.

The concept of price elasticity is widely used today as businesses attempt to separate customers into groups with different elasticities. This technique has been extensively pioneered by the airlines (see the box that follows). Another example is software companies, which have a wide range of different prices for their products in an attempt to exploit different elasticities. For example, if you are desperate about buying a new operating system immediately, your elasticity is low and the seller will profit from charging you a relatively high price. On the other hand, if you are not in a hurry for an upgrade, you can search around for the best price and your elasticity is high. In this case, the seller will try to find a way to make the sale by charging a relatively low price.

Fly the Financial Skies of "Elasticity Air"

Understanding demand elasticities is worth billions of dollars each year to U.S. airlines. Ideally, airlines would like to charge a relatively high price to business travelers, while charging leisure passengers a low-enough price to fill up all their empty seats. That is a strategy for raising revenues and maximizing profits.

But if they charge low-elasticity business travelers one price and high-elasticity leisure passengers a lower price, the airlines have a big problem—keeping the two classes of passengers separate. How can they stop the low-elasticity business travelers from buying up the cheap tickets meant for the leisure travelers and not let high-elasticity leisure flyers take up seats that business passengers would have been willing to buy?

The airlines have solved their problem by engaging in "price discrimination" among their different customers in a way that exploits different price elasticities. **Price discrimination** is the practice of charging different prices for the same service to different customers. Airlines offer discount fares for travelers who plan ahead and who tend to stay longer. One way of separating the two groups is to offer discounted fares to people who stay over a Saturday night—a rule that discourages business travelers who want to get home for the weekend. Also, discounts are often unavailable at the last minute because many business trips are unplanned expeditions to handle an unforeseen crisis—another case of price-inelastic demand. Airlines have devised extremely sophisticated computer programs to manage their seat availability as a way of ensuring that their low-elasticity passengers cannot benefit from discount fares.

The Paradox of the Bumper Harvest

We can use elasticities to illustrate one of the most famous paradoxes of all economics: the paradox of the bumper harvest. Imagine that in a particular year nature smiles on farming. A cold winter kills off the pests; spring comes early for planting; there are no killing frosts; rains nurture the growing shoots; and a sunny October allows a record crop to come to market. At the end of the year, family Jones happily settles down to calculate its income for the year. The Joneses are in for a major surprise: *The good weather and bumper crop have lowered their and other farmers' incomes.*

How can this be? The answer lies in the elasticity of demand for foodstuffs. The demands for basic food products such as wheat and corn tend to be inelastic; for these necessities, consumption changes very little in response to price. But this means farmers as a whole receive less total revenue when the harvest is good than when it is bad. The increase in supply arising from an abundant harvest tends to lower the price. But the lower price doesn't increase quantity demanded very much. The implication is that a low price elasticity of food means that large harvests (high Q) tend to be associated with low revenue (low $P \times Q$).

These ideas can be illustrated by referring back to Figure 4-2. We begin by showing how to measure revenue in the diagram itself. Total revenue is the product of price times quantity, $P \times Q$. Further, the area of a rectangle is always equal to the product of its base times its height. Therefore, total revenue at any point on a demand curve can be found by examining the area of the rectangle determined by the P and Q at that point.

Next, we can check the relationship between elasticity and revenue for the unit-elastic case in Figure 4-2(*b*). Note that the shaded revenue region ($P \times Q$) is \$1000 million for both points A and B. The shaded areas representing total revenue are the same because of offsetting changes in the Q base and the P height. This is what we would expect for the borderline case of unit-elastic demand.

We can also see that Figure 4-2(*a*) corresponds to elastic demand. In this figure, the revenue rectangle expands from \$1000 million to \$1500 million when price is halved. Since total revenue goes up when price is cut, demand is elastic.

In Figure 4-2(*c*) the revenue rectangle falls from \$40 million to \$30 million when price is halved, so demand is inelastic.

Which diagram illustrates the case of agriculture, where a bumper harvest means lower total revenues for farmers? Clearly it is Figure 4-2(*c*). Which represents the case of vacation travel, where a lower price could mean higher revenues? Surely Figure 4-2(*a*).

Table 4-3 shows the major points to remember about price elasticities.

Cigarette Taxes and Smoking

What is the impact of cigarette taxes on smoking? Some people say, "Cigarettes are so addictive that people will pay anything for their daily habit." Implicitly, when you say that the quantity demanded does not respond to price, you are saying

Value of demand elasticity	Description	Definition	Impact on revenues
Greater than one ($E_D > 1$)	Elastic demand	Percentage change in quantity demanded *greater* than percentage change in price	Revenues *increase* when price decreases
Equal to one ($E_D = 1$)	Unit-elastic demand	Percentage change in quantity demanded *equal* to percentage change in price	Revenues *unchanged* when price decreases
Less than one ($E_D < 1$)	Inelastic demand	Percentage change in quantity demanded *less* than percentage change in price	Revenues *decrease* when price decreases

TABLE 4-3. Elasticities: Summary of Crucial Concepts

that the price elasticity is zero. What does the evidence say about the price elasticity of cigarette consumption?

We can use a historical example to illustrate the issue. New Jersey doubled its cigarette tax from 40 cents to 80 cents per pack. The tax increased the average price of cigarettes from \$2.40 to \$2.80 per pack. Economists estimate that the effect of the price increase alone was a decrease in New Jersey's cigarette consumption from 52 million to 47.5 million packs.

Using the elasticity formula, you can calculate that the short-run price elasticity is 0.59. (Make sure you can get the same number.) Similar estimates come from more detailed statistical studies. The evidence indicates that the price elasticity of cigarettes is definitely not zero.

PRICE ELASTICITY OF SUPPLY

Of course, consumption is not the only thing that changes when prices go up or down. Businesses also respond to price in their decisions about how much to produce. Economists define the price elasticity of supply as the responsiveness of the quantity supplied of a good to its market price.

More precisely, the **price elasticity of supply** is the percentage change in quantity supplied divided by the percentage change in price.

As with demand elasticities, there are polar extremes of high and low elasticities of supply. Suppose the amount supplied is completely fixed, as in the case of perishable fish brought to market to be sold at whatever price they will fetch. This is the limiting case of zero elasticity, or completely inelastic supply, which is a vertical supply curve.

At the other extreme, say that a tiny cut in price will cause the amount supplied to fall to zero, while the slightest rise in price will coax out an indefinitely large supply. Here, the ratio of the percentage change in quantity supplied to percentage change in price is extremely large and gives rise to a horizontal supply curve. This is the polar case of infinitely elastic supply.

Between these extremes, we call supply elastic or inelastic depending upon whether the percentage change in quantity is larger or smaller than the percentage change in price. In the borderline unit-elastic case, where price elasticity of supply equals 1, the percentage increase of quantity supplied is exactly equal to the percentage increase in price.

You can readily see that the definitions of price elasticities of supply are exactly the same as those for price elasticities of demand. The only difference is that for supply the quantity response to price is positive, while for demand the response is negative.

The exact definition of the price elasticity of supply, E_S, is as follows:

$$E_S = \frac{\text{percentage change in quantity supplied}}{\text{percentage change in price}}$$

Figure 4-6 displays three important cases of supply elasticity: (a) the vertical supply curve, showing completely inelastic supply; (c), the horizontal supply curve, displaying completely elastic supply; and (b), an intermediate case of a straight line, going

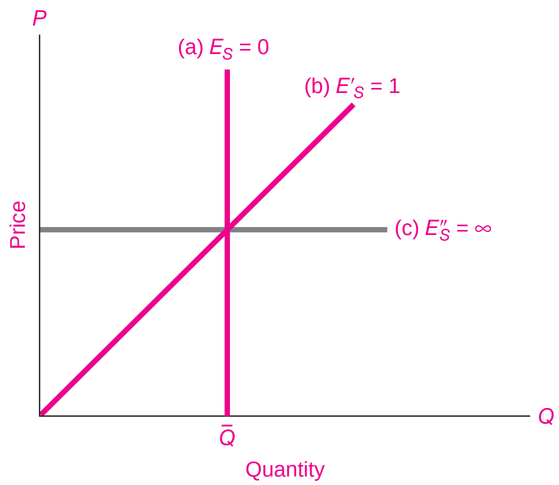


FIGURE 4-6. Supply Elasticity Depends upon Producer Response to Price

When supply is fixed, supply elasticity is zero, as in curve (a). Curve (c) displays an indefinitely large quantity response to price changes. Intermediate case (b) arises when the percentage quantity and price changes are equal.

through the origin, illustrating the borderline case of unit elasticity.[1]

What factors determine supply elasticity? The major factor influencing supply elasticity is the ease with which production in the industry can be increased. If all inputs can be readily found at going market prices, as is the case for the textile industry, then output can be greatly increased with little increase in price. This would indicate that supply elasticity is relatively large. On the other hand, if production capacity is severely limited, as is the case for gold mining, then even sharp increases in the price of gold will call forth but a small response in gold production; this would be inelastic supply.

Another important factor in supply elasticities is the time period under consideration. A given change in price tends to have a larger effect on amount supplied as the time for suppliers to respond increases. For very brief periods after a price increase, firms may be unable to increase their inputs of labor, materials, and capital, so supply may be very price-inelastic. However, as time passes and businesses can hire more labor, build new factories, and expand capacity, supply elasticities will become larger.

We can use Figure 4-6 to illustrate how supply may change over time for the fishing case. Supply curve (a) might hold for fish on the day they are brought to market, where they are simply auctioned off for whatever they will bring. Curve (b) might hold for the intermediate run of a year or so, with the given stock of fishing boats and before new labor is attracted to the industry. Over the very long run, as new fishing boats are built, new labor is attracted, and new fish farms are constructed, the supply of fish might be very price-elastic, as in case (c) in Figure 4-6.

B. APPLICATIONS TO MAJOR ECONOMIC ISSUES

Having laid the groundwork with our study of elasticities, we now show how these tools can assist our understanding of many of the basic economic trends and policy issues. We begin with one of the major transformations since the Industrial Revolution, the decline of agriculture. Next, we examine the implications of taxes on an industry, using the example of a gasoline tax. We then analyze the consequences of various types of government intervention in markets.

THE ECONOMICS OF AGRICULTURE

Our first application of supply-and-demand analysis comes from agriculture. The first part of this section lays out some of the economic fundamentals of the farm sector. Then we will use the theory of supply and demand to study the effects of government intervention in agricultural markets.

Long-Run Relative Decline of Farming

Farming was once our largest single industry. A hundred years ago, half the American population lived and worked on farms, but that number has declined to less

[1] You can determine the elasticity of a supply curve that is not a straight line as follows: (*a*) Draw the straight line that lies tangent to the curve at a point, and (*b*) then measure the elasticity of that tangential straight line.

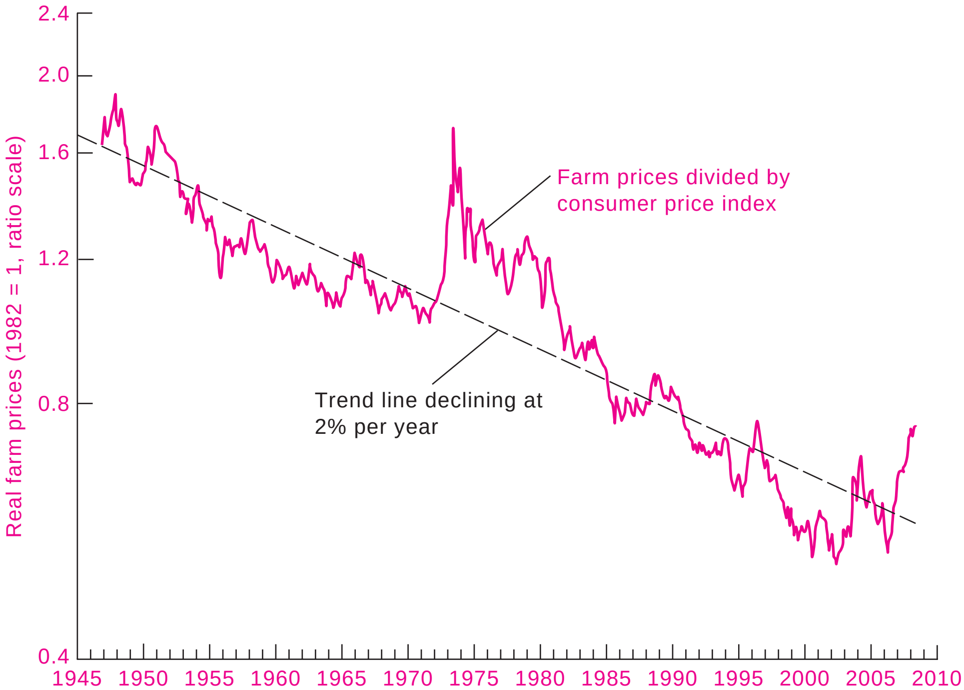


FIGURE 4-7. Prices of Basic Farm Products Have Declined Sharply

One of the major forces affecting the U.S. economy has been the decline in the relative prices of basic farm products—wheat, corn, soybeans, and the like. Over the past decades, farm prices have declined 2 percent per year relative to the general price level. The grain shortages since 2005 have slowed but not reversed the long slide in relative food prices. However, the recent upturn in food prices has contributed to inflation in most countries, and even to food riots in poor countries.

Source: Bureau of Labor Statistics.

than 3 percent of the workforce today. At the same time, prices for farm products have fallen relative to incomes and other prices in the economy. Figure 4-7 shows the steady decline of farm prices over the last half-century. While median family income has more than doubled, farm incomes have stagnated. Farm-state senators fret about the decline of the family farm.

A single diagram can explain the cause of the sagging trend in farm prices better than libraries of books and editorials. Figure 4-8 shows an initial equilibrium with high prices at point *E*. Observe what happens to agriculture as the years go by. Demand for food increases slowly because basic foods are necessities; the demand shift is consequently modest in comparison to growing average incomes.

What about supply? Although many people mistakenly think that farming is a backward business, statistical studies show that productivity (output per unit of input) has grown more rapidly in agriculture than in most other industries. Important advances include mechanization through tractors, combines, and cotton pickers; fertilization and irrigation; selective breeding; and development of genetically modified crops. All these innovations have vastly increased the productivity of agricultural inputs. Rapid productivity growth has increased supply greatly, as shown by the supply curve's shift from *SS* to *S′S′* in Figure 4-8.

What must happen at the new competitive equilibrium? Sharp increases in supply outpaced modest increases in demand, producing a downward trend in farm prices relative to other prices in the economy. And this is precisely what has happened in recent decades, as is seen in Figure 4-7.

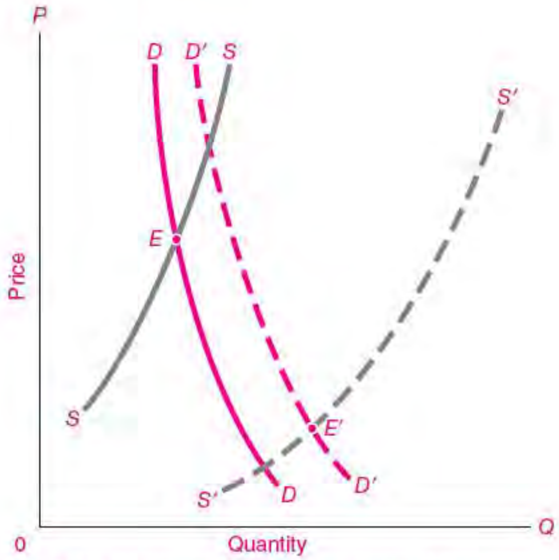


FIGURE 4-8. Agricultural Distress Results from Expanding Supply and Price-Inelastic Demand

Equilibrium at *E* represents conditions in the farm sector decades ago. Demand for farm products tends to grow more slowly than the impressive increase in supply generated by technological progress. Hence, competitive farm prices tend to fall. Moreover, with price-inelastic demand, farm incomes decline with increases in supply.

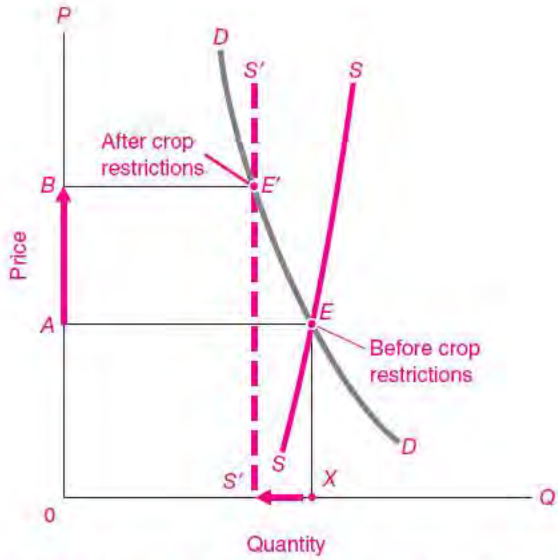


FIGURE 4-9. Crop-Restriction Programs Raise Both Price and Farm Income

Before the crop restriction, the competitive market produces an equilibrium with low price at *E*. When government restricts production, the supply curve is shifted leftward to *S′S′*, moving the equilibrium to *E′* and raising price to *B*. Confirm that new revenue rectangle 0*BE′S′* is larger than original revenue rectangle 0*AEX*—higher revenue being the result of inelastic demand.

Crop Restrictions. In response to falling incomes, farmers have often lobbied the federal government for economic assistance. Over the years, governments at home and abroad have taken many steps to help farmers. They have raised prices through price supports; they have curbed imports through tariffs and quotas; and they sometimes simply sent checks to farmers who agreed *not* to produce on their land.

How can *reducing production* actually *help* farmers? We can use the paradox of the bumper harvest to explain this result. Suppose the government requires every farmer to reduce production. As Figure 4-9 shows, this has the effect of shifting the supply curve up and to the left. Because the demand for food is inelastic, crop restrictions not only raise the price of crops but also tend to raise farmers' total revenues. Just as bumper harvests hurt farmers, crop restrictions raise farm incomes. Of course, consumers are hurt by the crop restrictions and higher prices—just as they would be if a flood or drought created a scarcity of food.

Restrictions on production are a typical example of government interference in individual markets. They often raise the income of one group at the expense of consumers. These policies are generally inefficient: the gain to farmers is less than the harm to consumers.

IMPACT OF A TAX ON PRICE AND QUANTITY

Governments tax a wide variety of commodities—cigarettes, alcohol, imported goods, telephone services, and so on. We are often interested in determining who actually bears the burden of the tax, and here is where supply and demand are essential.

Take the example of gasoline taxes. In 2008, the average tax on gasoline in the United States was around 50 cents per gallon. Many economists and environmentalists advocate much higher gasoline taxes for the United States. They point out that higher taxes would curb consumption, and thereby reduce global warming as well as lower our dependence on insecure foreign sources of oil. Some advocate raising gasoline taxes by $1 or $2 per gallon. What would be the impact of such a change?

For concreteness, suppose that the government decides to discourage oil consumption by levying a gasoline tax of $2 per gallon. Prudent legislators would of course be reluctant to raise gasoline taxes so sharply without a firm understanding of the consequences of such a move. They would want to know the incidence of the tax. *By **incidence** we mean the ultimate economic effect of a tax on the real incomes of producers and consumers.* Just because oil companies write a check for the taxes does not mean that the taxes in fact reduce their profits. By using supply and demand, we can analyze the exact incidence of the tax.

It could be that the burden of the tax is shifted forward to the consumers, which would occur if the retail price of gasoline goes up by the full $2 of the tax. Or perhaps consumers cut back so sharply on gasoline purchases that the burden of the tax is shifted back completely onto the oil companies. Where the actual impact lies between these extremes can be determined only from supply-and-demand analysis.

Figure 4-10 provides the answer. It shows the original pretax equilibrium at *E*, the intersection of the original *SS* and *DD* curves, at a gasoline price of $2 a gallon and total consumption of 100 billion gallons per year. We portray the imposition of a $2 tax in the retail market for gasoline as an upward shift of the supply curve, with the demand curve remaining unchanged. The demand curve does not shift because the quantity demanded at each retail price is unchanged by the gasoline-tax increase. Note that the demand curve for gasoline is relatively inelastic.

By contrast, the supply curve definitely does shift upward by $2. The reason is that producers are willing to sell a given quantity (say, 100 billion gallons) only if they receive the same *net* price as before. That is, at each quantity supplied, the market price must rise by exactly the amount of the tax. If producers had originally been willing to sell 80 billion gallons at $1.80 per gallon, they would still be willing to sell the same amount at a retail price of $3.80 (which, after subtracting the tax, yields the producers the same $1.80 per gallon).

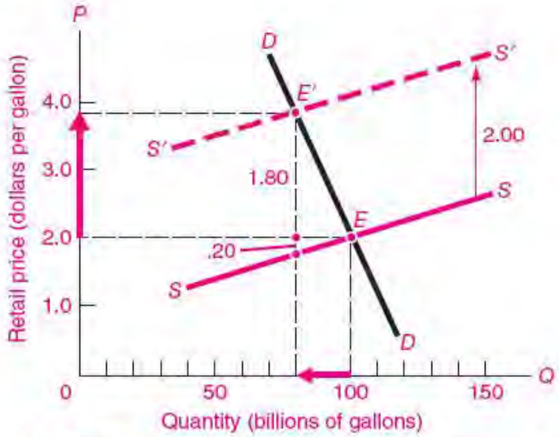


FIGURE 4-10. Gasoline Tax Falls on Both Consumer and Producer

What is the incidence of a tax? A $2 tax on gasoline shifts the supply curve up $2 everywhere, giving a new supply curve, $S'S'$, parallel to the original supply curve, *SS*. This new supply curve intersects *DD* at the new equilibrium, E', where the price to consumers has risen 180 cents and the producers' price has fallen 20 cents. The green arrows show changes in *P* and *Q*. Note that consumers bear most of the burden of the tax.

What is the new equilibrium price? The answer is found at the intersection of the new supply and demand curves at E', where $S'S'$ and *DD* meet. Because of the supply shift, the retail price is higher. Also, the quantity supplied and demanded is reduced. If we read the graph carefully, we find that the new equilibrium price has risen from $2 to about $3.80. The new equilibrium output, at which supply and demand are in equilibrium, has fallen from 100 billion to about 80 billion gallons.

Who ultimately pays the tax? What is its incidence? Clearly the oil industry pays a small fraction, for it receives only $1.80 ($3.80 less the $2 tax) rather than $2. But the consumer bears most of the burden, with the retail price rising $1.80, because supply is relatively price-elastic whereas demand is relatively price-inelastic.

Subsidies. If taxes are used to discourage consumption of a commodity, subsidies are used to encourage production. One pervasive example of subsidies comes in agriculture. You can examine the impact of a subsidy in a market by shifting *down* the supply curve. The general rules for subsidies are exactly parallel to those for taxes.

General Rules on Tax Shifting. Gasoline is just a single example of how to analyze tax shifting. Using this apparatus, we can understand how cigarette taxes affect both the prices and the consumption of cigarettes; how taxes or tariffs on imports affect foreign trade; and how property taxes, social security taxes, and corporate-profit taxes affect land prices, wages, and interest rates.

The key issue in determining the incidence of a tax is the relative elasticities of supply and demand. If demand is inelastic relative to supply, as in the case of gasoline, most of the cost is shifted to consumers. By contrast, if supply is inelastic relative to demand, as is the case for land, then most of the tax is shifted to the suppliers. Here is the general rule for determining the incidence of a tax:

The incidence of a tax denotes the impact of the tax on the incomes of producers and consumers. In general, the incidence depends upon the relative elasticities of demand and supply. (1) A tax is shifted *forward* to consumers if the *demand is inelastic* relative to supply. (2) A tax is shifted *backward* to producers if *supply is inelastic* relative to demand.

MINIMUM FLOORS AND MAXIMUM CEILINGS

Sometimes, rather than taxing or subsidizing a commodity, the government legislates maximum or minimum prices. History is full of examples. From biblical days, governments have limited the interest rates that lenders can charge (so-called usury laws). In wartime, governments often impose wage and price controls to prevent spiraling inflation. During the energy crisis of the 1970s, there were controls on gasoline prices. A few large cities, including New York, have rent controls on apartments.[2] Today, there are increasingly stringent limitations on the prices that doctors or hospitals can charge under federal health programs such as Medicare. Sometimes there are price floors, as in the case of the minimum wage.

These kinds of interferences with the laws of supply and demand are genuinely different from those in which the government imposes a tax and then lets the market act through supply and demand. Although political pressures always exist to keep prices down and wages up, experience has taught that sector-by-sector price and wage controls tend to create major economic distortions. Nevertheless, as Adam Smith well knew when he protested against mercantilist policies of an earlier age, most economic systems are plagued by inefficiencies stemming from well-meaning but inexpert interferences with the mechanisms of supply and demand. Setting maximum or minimum prices in a market tends to produce surprising and sometimes perverse economic effects. Let's see why.

Two important examples of government intervention are the minimum wage and price controls on gasoline. These will illustrate the surprising side effects that can arise when governments interfere with market determination of price and quantity.

The Minimum-Wage Controversy

The minimum wage sets a minimum hourly rate that employers are allowed to pay workers. In the United States, the federal minimum wage began in 1938 when the government required that covered workers be paid at least 25 cents an hour. By 1947, the minimum wage was fully 65 percent of the average rate paid to manufacturing workers (see Figure 4-11). The most recent law increased the minimum wage to $7.25 per hour in 2009.

This is an issue that divides even the most eminent economists. For example, Nobel laureate Gary Becker stated flatly, "Hike the minimum wage, and you put people out of work." Another group of Nobel Prize winners countered, "We believe that the federal minimum wage can be increased by a moderate amount without significantly jeopardizing employment opportunities."

How can nonspecialists sort through the issues when the experts are so divided? How can we resolve these apparently contradictory statements? To begin with, we should recognize that statements on the

[2] See question 9 at the end of this chapter for an examination of rent controls.

FIGURE 4-11. The Minimum Wage and Teenage Unemployment, 1947–2009

The green line shows the level of the minimum wage relative to average hourly earnings in manufacturing. Note how the minimum wage declined slowly relative to other wages over the last half-century. Additionally, the blue line shows the ratio of teenage unemployment to overall unemployment. Do you see any relationship between the two lines? What does this tell you about the minimum-wage controversy?

Source: Data are from the U.S. Department of Labor. Background on the minimum wage can be found at the Labor Department's website at *www.dol.gov/esa/minwage/q-a.htm.*

desirability of raising the minimum wage contain personal value judgments. Such statements might be informed by the best positive economics and still make different recommendations on important policy issues.

A cool-headed analysis indicates that the minimum-wage debate centers primarily on issues of interpretation rather than fundamental disagreements on empirical findings. Begin by looking at Figure 4-12, which depicts the market for unskilled workers. The figure shows how a minimum wage rate sets a floor for most jobs. As the minimum wage rises above the market-clearing equilibrium at *M,* the total number of jobs moves up the demand curve to *E,* so employment falls. The gap between labor supplied and labor demanded is shown as *U.* This represents the amount of unemployment.

Using supply and demand, we see that there is likely to be a rise in unemployment and a decrease in employment of low-skilled workers. But how large will these magnitudes be? And what will be the impact on the wage income of low-income workers? On these questions, we can look at the empirical evidence.

Most studies indicate that a 10 percent increase in the minimum wage would reduce employment of teenagers by between 1 and 3 percent. The impact on adult employment is even smaller. Some recent studies put the adult employment effects very close to zero, and one set of studies suggests that employment might even increase. So a careful reading of the

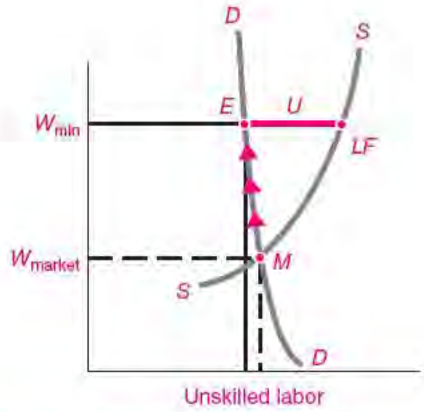


FIGURE 4-12. Effects of a Minimum Wage

Setting the minimum-wage floor at W_{min}, high above the free-market equilibrium rate at W_{market}, results in employment at E. Employment is reduced, as the arrows show, from M to E. Additionally, unemployment is U, which is the difference between labor supplied at LF and employment at E. If the demand curve is inelastic, increasing the minimum wage will increase the income of low-wage workers. To see this, shade in the rectangle of total wages before and after the minimum-wage increase.

quotations from the eminent economists indicates that some economists consider small to be "insignificant" while others emphasize the existence of at least some job losses. Our example in Figure 4-12 shows a case where the *employment* decline (shown as the difference between M and E) is very small while the *unemployment* caused by the minimum wage (shown by the U line) is relatively large.

Figure 4-11 on page 78 shows the history of the minimum wage and teenage unemployment over the last half-century. With the declining power of the labor movement, the ratio of the minimum wage to the manufacturing wage declined from two-thirds in 1947 to around one-third in 2008. There was a slight upward trend in the relative unemployment rate of teenagers over this period. It is worth examining the pattern of changes to see whether you can detect an impact of the minimum wage on teenage unemployment.

Another factor in the debate relates to the impact of the minimum wage on incomes. Virtually every study concludes that the demand for low-wage workers is price-inelastic. The results we just cited indicate that the price elasticity is between 0.1 and 0.3. Given the elasticities just cited, a 10 percent increase in the minimum wage will increase the incomes of the affected groups by 7 to 9 percent. Figure 4-12 shows how the *incomes* of low-income workers rise despite the decline in their *total employment*. This can be seen by comparing the income rectangles under the equilibrium points E and M. (See question 8*e* at the end of this chapter.)

The impact on incomes is yet another reason why people may disagree about the minimum wage. Those who are particularly concerned about the welfare of low-income groups may feel that modest inefficiencies are a small price to pay for higher incomes. Others—who worry more about the cumulative costs of market interferences or about the impact of higher costs upon prices, profits, and international competitiveness—may hold that the inefficiencies are too high a price. Still others might believe that the minimum wage is an inefficient way to transfer buying power to low-income groups; they would prefer using direct income transfers or government wage subsidies rather than gumming up the wage system. How important are each of these three concerns to you? Depending upon your priorities, you might reach quite different conclusions on the advisability of increasing the minimum wage.

Energy Price Controls

Another example of government interference comes when the government legislates a maximum price ceiling. This occurred in the United States in the 1970s, and the results were sobering. We return to our analysis of the gasoline market to see how price ceilings function.

Let's set the scene. Suppose there is suddenly a sharp rise in oil prices. This has occurred because of reduced cartel supply and booming demand, but it might also come about because of political disturbances in the Middle East due to war or revolution. Figure 3-1 on p. 46 showed the results of the interaction of supply and demand in oil markets.

Politicians, seeing the sudden jump in prices, rise to denounce the situation. They claim that consumers are being "gouged" by profiteering oil companies. They worry that the rising prices threaten to ignite an inflationary spiral in the cost of living. They fret about the impact of rising prices on the poor and the elderly. They call upon the government to "do something." In the face of rising prices, the U.S.

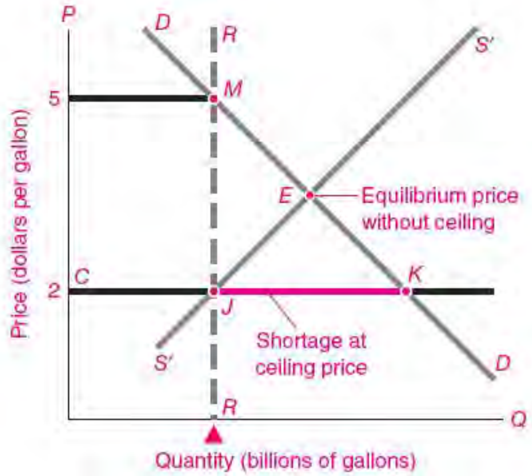


FIGURE 4-13. Price Controls Produce Shortages

Without a legal price ceiling, price would rise to *E*. At the ceiling price of $2, supply and demand do not balance, and shortages break out. Some method of formal or informal rationing is needed to allocate the short supply and bring the actual demand down to supply at *RR*. If *CJ* ration coupons become marketable, this would imply a new supply curve of *RR*. At the ceiling price of $2, coupons would sell for $3, and the total price (coupons plus cash) would be $5.

government might be inclined to listen to these arguments and place a ceiling on oil prices, as it did from 1973 to 1981.

What are the effects of such a ceiling? Suppose the initial price of gasoline is $2 a gallon. Then, because of a drastic cut in oil supply, the market price of gasoline rises sharply. Now consider the gasoline market after the supply shock. In Figure 4-13, the post-shock equilibrium is given at point *E*. If the free market were allowed to operate, the market would clear with a price of perhaps $3.50. Consumers would complain but would willingly pay the higher price rather than go without fuel.

Rationing by the Queue, by Coupons, or by the Purse?

Enter the government, which passes a law setting the maximum price for gasoline at the old level of $2 a gallon. We can picture this legal maximum price as the ceiling-price line *CJK* in Figure 4-13.

At the legal ceiling price, quantities supplied and demanded do not match. The market does not "clear" because it is against the law for sellers to charge the equilibrium price. Consumers want more gasoline than producers are willing to supply at the controlled price. This is shown by the gap between *J* and *K*. There follows a period of frustration and shortage—a game of musical chairs in which somebody is left without gasoline when the pump runs dry.

The inadequate supply of gasoline must somehow be rationed. Initially, this may be done through a first-come, first-served approach. People wait in line—this is rationing by the "queue." Because people's time is valuable, the length of the line will serve as a kind of price that limits demand. We see rationing by the queue today in markets like health care, where the price of medical care is subsidized. This is a wasteful system because much valuable time is spent waiting in line just as a way of preventing prices from reaching equilibrium.

Sometimes, particularly during large wars such as World War II, governments design a more efficient system of nonprice rationing based on formal allocation or coupon rationing. Perhaps people get a gasoline ration that is distributed on the basis of the number of automobiles. Under coupon rationing, each customer must have a coupon as well as money to buy the goods—in effect, there are two kinds of money. When rationing is adopted, shortages disappear because demand is limited by the allocation of the coupons.

Just how do ration coupons change the supply-and-demand picture? In Figure 4-13, suppose the government hands out coupons corresponding to quantity *CJ*. Then, supply and the new demand balance at the ceiling price of $2.

Sometimes, the ration coupons will be marketable. Figure 4-13 shows a supply of coupons of *RR*. With this supply curve, the equilibrium price of gasoline is $5 per gallon, and the price of coupons is given by *JM*, or $3 per gallon. At this point, gasoline is once again a market commodity, where you pay $2 for the gasoline and $3 for a coupon. The price has indeed risen, but in an indirect way. Additionally, people with coupons have been given a new form of income in coupons. Note that because of the price control, quantity supplied is still at the old level, but the total price including coupons ($5) is actually higher than the original equilibrium price without rationing ($3.50).

All of this sounds complicated, and it is. History has shown that legal and illegal evasions of price controls grow over time. The inefficiencies eventually overwhelm whatever favorable impacts the controls might have on consumers. Particularly when there is room for ample substitution (i.e., when elasticities of supply or demand are high), price controls are costly, difficult to administer, and ineffective. Consequently, price controls on most goods are rarely used in most market economies.

There is a profound lesson here: Goods are always scarce. Society can never fulfill everyone's desires. In normal times, price itself rations the scarce supplies. When governments step in to interfere with supply and demand, prices no longer fill the role of rationers. Waste, inefficiency, and aggravation are likely companions of such interferences.

SUMMARY

A. Price Elasticity of Demand and Supply

1. Price elasticity of demand measures the quantitative response of demand to a change in price. Price elasticity of demand (E_D) is defined as the percentage change in quantity demanded divided by the percentage change in price. That is,

$$\text{Price elasticity of demand} = E_D = \frac{\text{percentage change in quantity demanded}}{\text{percentage change in price}}$$

In this calculation, the sign is taken to be positive, and P and Q are averages of old and new values.

2. We divide price elasticities into three categories: (*a*) Demand is elastic when the percentage change in quantity demanded exceeds the percentage change in price; that is, $E_D > 1$. (*b*) Demand is inelastic when the percentage change in quantity demanded is less than the percentage change in price; here, $E_D < 1$. (*c*) When the percentage change in quantity demanded exactly equals the percentage change in price, we have the borderline case of unit-elastic demand, where $E_D = 1$.
3. Price elasticity is a pure number, involving percentages; it should not be confused with slope.
4. The demand elasticity tells us about the impact of a price change on total revenue. A price reduction increases total revenue if demand is elastic; a price reduction decreases total revenue if demand is inelastic; in the unit-elastic case, a price change has no effect on total revenue.
5. Price elasticity of demand tends to be low for necessities like food and shelter and high for luxuries like snowmobiles and vacation air travel. Other factors affecting price elasticity are the extent to which a good has ready substitutes and the length of time that consumers have to adjust to price changes.
6. Price elasticity of supply measures the percentage change of output supplied by producers when the market price changes by a given percentage.

B. Applications to Major Economic Issues

7. One of the most fruitful arenas for application of supply-and-demand analysis is agriculture. Improvements in agricultural technology mean that supply increases greatly, while demand for food rises less than proportionately with income. Hence free-market prices for foodstuffs tend to fall. No wonder governments have adopted a variety of programs, like crop restrictions, to prop up farm incomes.
8. A commodity tax shifts the supply-and-demand equilibrium. The tax's incidence (or impact on incomes) will fall more heavily on consumers than on producers to the degree that the demand is inelastic relative to supply.
9. Governments occasionally interfere with the workings of competitive markets by setting maximum ceilings or minimum floors on prices. In such situations, quantity supplied need no longer equal quantity demanded; ceilings lead to excess demand, while floors lead to excess supply. Sometimes, the interference may raise the incomes of a particular group, as in the case of farmers or low-skilled workers. Often, distortions and inefficiencies result.

CONCEPTS FOR REVIEW

Elasticity Concepts

price elasticity of demand, supply
elastic, inelastic, unit-elastic demand
E_D = % change in Q/% change in P
determinants of elasticity
total revenue = $P \times Q$
relationship of elasticity and revenue change

Applications of Supply and Demand

incidence of a tax
distortions from price controls
rationing by price vs. rationing by the queue

FURTHER READING AND INTERNET WEBSITES

Further Reading

If you have a particular concept you want to review, such as elasticity, you can often look in an encyclopedia of economics, such as John Black, *Oxford Dictionary of Economics,* 2d ed. (Oxford, New York, 2002), or David W. Pearce, ed., *The MIT Dictionary of Modern Economics* (MIT Press, Cambridge, Mass., 1992). The most comprehensive encyclopedia, covering many advanced topics in seven volumes, is Steven N. Durlauf and Lawrence E. Blume, eds., *The New Palgrave Dictionary of Economics* (Macmillan, London, 2008), available in most libraries.

The minimum wage has generated a fierce debate among economists. A recent book by two labor economists presents evidence that the minimum wage has little effect on employment: David Card and Alan Krueger, *Myth and Measurement: The New Economics of the Minimum Wage* (Princeton University Press, Princeton, N.J., 1997).

Websites

There are currently no reliable online dictionaries for terms in economics. There are few good websites for understanding fundamental economic concepts like supply and demand or elasticities. The concise online encyclopedia of economics at *www.econlib.org/library/CEE.html* is generally reliable but covers only a small number of topics. Sometimes, the free site of the *Encyclopaedia Britannica* at *www.britannica.com* provides background or historical material. When all else fails, you can go to the online encyclopedia at *en.wikipedia.org/wiki/Main_Page,* but be warned that it is often unreliable. (For example, the 2008 definition of "price elasticity of demand" is close to incomprehensible.)

Current issues such as the minimum wage are often discussed in policy papers at the website of the Economic Policy Institute, a think tank focusing on economic issues of workers, at *www.epinet.org*.

QUESTIONS FOR DISCUSSION

1. "A good harvest will generally lower the income of farmers." Illustrate this proposition using a supply-and-demand diagram.
2. For each pair of commodities, state which you think is the more price-elastic and give your reasons: perfume and salt; penicillin and ice cream; automobiles and automobile tires; ice cream and chocolate ice cream.
3. "The price drops by 1 percent, causing the quantity demanded to rise by 2 percent. Demand is therefore elastic, with $E_D > 1$." If you change 2 to ½ in the first sentence, what two other changes will be required in the quotation?
4. Consider a competitive market for apartments. What would be the effect on the equilibrium output and price after the following changes (other things held equal)? In each case, explain your answer using supply and demand.
   a. A rise in the income of consumers
   b. A $10-per-month tax on apartment rentals
   c. A government edict saying apartments cannot rent for more than $200 per month
   d. A new construction technique allowing apartments to be built at half the cost
   e. A 20 percent increase in the wages of construction workers
5. Consider a proposal to raise the minimum wage by 10 percent. After reviewing the arguments in the chapter, estimate the impact upon employment and upon

the incomes of affected workers. Using the numbers you have derived, write a short essay explaining how *you* would decide if you had to make a recommendation on the minimum wage.

6. A conservative critic of government programs has written, "Governments know how to do one thing well. They know how to create shortages and surpluses." Explain this quotation using examples like the minimum wage or interest-rate ceilings. Show graphically that if the demand for unskilled workers is price-elastic, a minimum wage will decrease the total earnings (wage times quantity demanded of labor) of unskilled workers.
7. Consider what would happen if a tariff of $2000 were imposed on imported automobiles. Show the impact of this tariff on the supply and the demand, and on the equilibrium price and quantity, of American automobiles. Explain why American auto companies and autoworkers often support import restraints on automobiles.
8. Elasticity problems:
   - **a.** The world demand for crude oil is estimated to have a short-run price elasticity of 0.05. If the initial price of oil were $100 per barrel, what would be the effect on oil price and quantity of an embargo that curbed world oil supply by 5 percent? (For this problem, assume that the oil-supply curve is completely inelastic.)
   - **b.** To show that elasticities are independent of units, refer to Table 3-1. Calculate the elasticities between each demand pair. Change the price units from dollars to pennies; change the quantity units from millions of boxes to tons, using the conversion factor of 10,000 boxes to 1 ton. Then recalculate the elasticities in the first two rows. Explain why you get the same answer.
   - **c.** Jack and Jill went up the hill to a gas station that does not display the prices. Jack says, "Give me $10 worth of gas." Jill says, "Give me 10 gallons of gas." What are the price elasticities of demand for gasoline of Jack and of Jill? Explain.
   - **d.** Can you explain why farmers during a depression might approve of a government program requiring that pigs be killed and buried under the ground?
   - **e.** Look at the impact of the minimum wage shown in Figure 4-12. Draw in the rectangles of total income with and without the minimum wage. Which is larger? Relate the impact of the minimum wage to the price elasticity of demand for unskilled workers.
9. No one likes to pay rent. Yet scarcities of land and urban housing often cause rents to soar in cities. In response to rising rents and hostility toward landlords, governments sometimes impose *rent controls*. These generally limit the increases on rent to a small year-to-year increase and can leave controlled rents far below free-market rents.
   - **a.** Redraw Figure 4-13 to illustrate the impact of rent controls for apartments.
   - **b.** What will be the effect of rent controls on the vacancy rate of apartments?
   - **c.** What nonrent options might arise as a substitute for the higher rents?
   - **d.** Explain the words of a European critic of rent controls: "Except for bombing, nothing is as efficient at destroying a city as rent controls." (*Hint:* What would happen to maintenance?)
10. Review the example of the New Jersey cigarette tax (p. 71). Using graph paper or a computer, draw supply and demand curves that will yield the prices and quantities before and after the tax. (Figure 4-10 shows the example for a gasoline tax.) For this example, assume that the supply curve is perfectly elastic. [*Extra credit:* A demand curve with constant price elasticity takes the form $Y = AP^{-e}$, where Y is quantity demanded, P is price, A is a scaling constant, and e is the (absolute value) of the price elasticity. Solve for the values of A and e which will give the correct demand curve for the prices and quantities in the New Jersey example.]
11. Review the algebra of demand elasticities on p. 69. Then assume that the demand curve takes the following form: $Q = 100 - 2P$.
    - **a.** Calculate the elasticities at $P = 1$, 25, and 49.
    - **b.** Explain why elasticity is different from slope using the formula.

CHAPTER

5 Demand and Consumer Behavior

O, reason not the need: our basest beggars
Are in the poorest thing superfluous.

Shakespeare,
King Lear

We make countless decisions every day about how to allocate our scarce money and time. Should we buy a pizza or a hamburger? Buy a new car or fix our old one? Spend our income today or save for future consumption? Should we eat breakfast or sleep late? As we balance competing demands and desires, we make the choices that define our lives.

The results of these individual choices are what underlie the demand curves and price elasticities that we met in earlier chapters. This chapter explores the basic principles of consumer choice and behavior. We shall see how patterns of market demand can be explained by the process of individuals' pursuing their most preferred bundle of consumption goods. We also will learn how to measure the benefits that each of us receives from participating in a market economy.

CHOICE AND UTILITY THEORY

In explaining consumer behavior, economics relies on the fundamental premise that people choose those goods and services they value most highly. To describe the way consumers choose among different consumption possibilities, economists a century ago developed the notion of *utility*. From the notion of utility, they were able to derive the demand curve and explain its properties.

What do we mean by "utility"? In a word, **utility** denotes satisfaction. More precisely, it refers to how consumers rank different goods and services. If basket A has higher utility than basket B for Smith, this ranking indicates that Smith prefers A over B. Often, it is convenient to think of utility as the subjective pleasure or usefulness that a person derives from consuming a good or service. But you should definitely resist the idea that utility is a psychological function or feeling that can be observed or measured. Rather, utility is a scientific construct that economists use to understand how rational consumers make decisions. We derive consumer demand functions from the assumption that people make decisions that give them the greatest satisfaction or utility.

In the theory of demand, we assume that people maximize their utility, which means that they choose the bundle of consumption goods that they most prefer.

Marginal Utility and the Law of Diminishing Marginal Utility

How does utility apply to the theory of demand? Say that consuming the first unit of ice cream gives you a certain level of satisfaction or utility. Now imagine consuming a second unit. Your total utility goes up because the second unit of the good gives you some additional utility. What about adding a third and fourth unit of the same good? Eventually, if you eat enough ice cream, instead of adding to your satisfaction or utility, it makes you sick!

This leads us to the fundamental economic concept of marginal utility. When you eat an additional unit of ice cream, you will get some additional satisfaction or utility. The increment to your utility is called **marginal utility.**

The expression "marginal" is a key term in economics and always means "additional" or "extra." Marginal utility denotes the additional utility you get from the consumption of an additional unit of a commodity.

One of the fundamental ideas behind demand theory is the **law of diminishing marginal utility.** This law states that the amount of extra or marginal utility declines as a person consumes more and more of a good.

To understand this law, first remember that utility tends to increase as you consume more of a good. However, as you consume more and more, your total utility will grow at a slower and slower rate. This is the same thing as saying that your marginal utility (the extra utility added by the last unit consumed of a good) diminishes as more of a good is consumed.

The law of diminishing marginal utility states that, as the amount of a good consumed increases, the marginal utility of that good tends to decline.

A Numerical Example

We can illustrate utility numerically as in Table 5-1. The table shows in column (2) that total utility (U) enjoyed increases as consumption (Q) grows, but it increases at a decreasing rate. Column (3) measures marginal utility as the extra utility gained when 1 extra unit of the good is consumed. Thus when the individual consumes 2 units, the marginal utility is $7 - 4 = 3$ units of utility (call these units "utils").

Focus next on column (3). The fact that marginal utility declines with higher consumption illustrates the law of diminishing marginal utility.

Figure 5-1 on page 86 shows graphically the data on total utility and marginal utility from Table 5-1. In part (*a*), the blue blocks add up to the total utility at each level of consumption. In addition, the smooth blue curve shows the smoothed utility level

(1) Quantity of a good consumed *Q*	(2) Total utility *U*	(3) Marginal utility *MU*
0	0	
		4
1	4	
		3
2	7	
		2
3	9	
		1
4	10	
		0
5	10	

TABLE 5-1. Utility Rises with Consumption

As we consume more of a good or service like pizza or concerts, total utility increases. The increment of utility from one unit to the next is the "marginal utility"—the extra utility added by the last extra unit consumed. By the law of diminishing marginal utility, the marginal utility falls with increasing levels of consumption.

for fractional units of consumption. It shows utility increasing, but at a decreasing rate. Figure 5-1(*b*) depicts marginal utilities. Each of the blue blocks of marginal utility is the same size as the corresponding block of total utility in (*a*). The straight blue line in (*b*) is the smoothed curve of marginal utility.

The law of diminishing marginal utility implies that the marginal utility (MU) curve in Figure 5-1(*b*) must slope downward. This is exactly equivalent to saying that the total utility curve in Figure 5-1(*a*) must look concave, like a dome.

Relationship of Total and Marginal Utility. Using Figure 5-1, we can easily see that the total utility of consuming a certain amount is equal to the sum of the marginal utilities up to that point. For example, assume that 3 units are consumed. Column (2) of Table 5-1 shows that the total utility is 9 units. In column (3) we see that the sum of the marginal utilities of the first 3 units is also $4 + 3 + 2 = 9$ units.

Examining Figure 5-1(*b*), we see that the total area under the marginal utility curve at a particular level of consumption—as measured either by blocks or by the area under the smooth MU curve—must

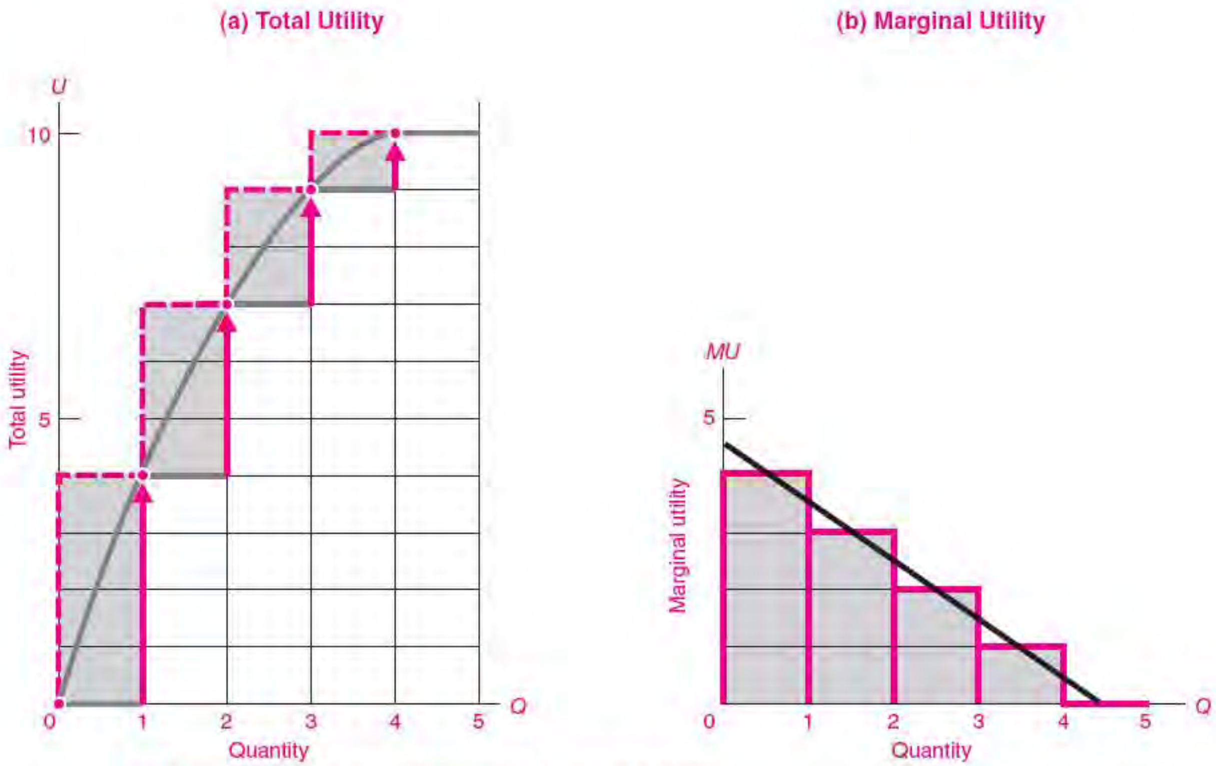


FIGURE 5-1. The Law of Diminishing Marginal Utility

Total utility in **(a)** rises with consumption, but it rises at a decreasing rate, showing diminishing marginal utility. This observation led early economists to formulate the law of downward-sloping demand.

The blue blocks show the extra utility added by each new unit. The fact that total utility increases at a decreasing rate is shown in **(b)** by the declining steps of marginal utility. If we make our units smaller, the steps in total utility are smoothed out and total utility becomes the smooth blue curve in **(a)**. Moreover, smoothed marginal utility, shown in **(b)** by the blue downward-sloping smooth curve, becomes indistinguishable from the slope of the smooth curve in **(a)**.

equal the height of the total utility curve shown for the same number of units in Figure 5-1(*a*).

Whether we examine this relationship using tables or graphs, we see that total utility is the sum of all the marginal utilities that were added from the beginning.

History of Utility Theory

Modern utility theory stems from *utilitarianism,* which has been one of the major currents of Western intellectual thought of the last two centuries. The notion of utility arose soon after 1700, as the basic ideas of mathematical probability were being developed. Thus Daniel Bernoulli, a member of a brilliant Swiss family of mathematicians, observed in 1738 that people act as if the dollar they stand to gain in a fair bet is worth less to them than the dollar they stand to lose. This means that they are averse to risk and that successive new dollars of wealth bring them smaller and smaller increments of true utility.

An early introduction of the utility notion into the social sciences was accomplished by the English philosopher Jeremy Bentham (1748–1832). After studying legal theory, and under the influence of Adam Smith's doctrines, Bentham turned to the study of the principles necessary for drawing up social legislation. He proposed that society should be organized on the "principle of utility," which he defined as the "property in any object . . . to produce pleasure, good or happiness or to prevent . . . pain, evil or unhappiness." All legislation, according to Bentham, should be designed on utilitarian principles, to promote "the greatest happiness of the greatest number." Among his other legislative proposals were quite modern-sounding ideas about crime and punishment in which he suggested that raising the "pain" to criminals by harsh punishments would deter crimes.

Bentham's views about utility seem familiar to many people today. But they were revolutionary 200 years ago because they emphasized that social and economic policies should be designed to achieve certain practical results, whereas legitimacy at that time was usually based on tradition, the divine right of kings, or religious doctrines. Today, many political thinkers defend their legislative proposals with utilitarian notions of what will make the largest number of people best off.

The next step in the development of utility theory came when the neoclassical economists—such as William Stanley Jevons (1835–1882)—extended Bentham's utility concept to explain consumer behavior. Jevons thought economic theory was a "calculus of pleasure and pain," and he developed the theory that rational people would base their consumption decisions on the extra or marginal utility of each good.

The ideas of Jevons and his coworkers led directly to the modern theories of ordinal utility and indifference curves developed by Vilfredo Pareto, John Hicks, R. G. D. Allen, Paul Samuelson, and others in which the Benthamite ideas of measurable cardinal utility are no longer needed.

DERIVATION OF DEMAND CURVES

The Equimarginal Principle

Having explained utility theory, we now apply that theory to explain consumer demand and to understand the nature of demand curves.

We assume that each consumer maximizes utility, which means that the consumer chooses the most preferred bundle of goods from what is available. We also assume that consumers have a certain income and face given market prices for goods.

What would be a sensible rule for choosing the preference bundle of goods in this situation? Certainly, I would not expect that the last egg brings the same marginal utility as the last pair of shoes, for shoes cost much more per unit than eggs. A satisfactory rule would be: If good A costs twice as much as good B, then buy good A only when its marginal utility is at least twice as great as good B's marginal utility.

This leads to the *equimarginal principle* that I should arrange my consumption so that the last dollar spent on each good is bringing me the same marginal utility.

Equimarginal principle: The fundamental condition of maximum satisfaction or utility is the equimarginal principle. It states that a consumer will achieve maximum satisfaction or utility when the marginal utility of the last dollar spent on a good is exactly the same as the marginal utility of the last dollar spent on any other good.

Why must this condition hold? If any one good gave more marginal utility per dollar, I would increase my utility by taking money away from other goods and spending more on that good—until the law of diminishing marginal utility drove its marginal utility per dollar down to equality with that of other goods. If any good gave less marginal utility per dollar than the common level, I would buy less of it until the marginal utility of the last dollar spent on it had risen back to the common level. The common marginal utility per dollar of all commodities in consumer equilibrium is called the *marginal utility of income*. It measures the additional utility that would be gained if the consumer could enjoy an extra dollar's worth of consumption.

This fundamental condition of consumer equilibrium can be written in terms of the marginal utilities (MUs) and prices (Ps) of the different goods in the following compact way:

$$\frac{MU_{\text{good 1}}}{P_1} = \frac{MU_{\text{good 2}}}{P_2} = \frac{MU_{\text{good 3}}}{P_3} = \cdots = MU \text{ per \$ of income}$$

Why Demand Curves Slope Downward

Using the fundamental rule for consumer behavior, we can easily see why demand curves slope downward. For simplicity, hold the common marginal utility per dollar of income constant. Then increase the price of good 1. With no change in quantity consumed, the first ratio (i.e., $MU_{\text{good 1}}/P_1$) will be below the *MU* per dollar of all other goods. The consumer will therefore have to readjust the consumption of good 1. The consumer will do this by (*a*) lowering the consumption of good 1, thereby (*b*) raising the *MU* of good 1, until (*c*) at the new, reduced level of consumption of good 1, the new marginal utility per dollar spent on good 1 is again equal to the *MU* per dollar spent on other goods.

A higher price for a good reduces the consumer's desired consumption of that commodity; this shows why demand curves slope downward.

Leisure and the Optimal Allocation of Time

A Spanish toast to a friend wishes "health, wealth, and the time to enjoy them." This saying captures the idea that we must allocate our time budgets in much the same way as we do our dollar budgets. Time is the great equalizer, for even the richest person has but 24 hours a day to "spend." Let's see how our earlier analysis of allocating scarce dollars applies to time.

Consider leisure, often defined as "time which one can spend as one pleases." Leisure brings out our personal eccentricities. The seventeenth-century philosopher Francis Bacon held that the purest of human pleasures was gardening. The British statesman Winston Churchill wrote of his holiday: "I have had a delightful month building a cottage and dictating a book: 200 bricks and 2000 words a day."

We can apply utility theory to the allocation of time as well as money. Suppose that, after satisfying all your obligations, you have 3 hours a day of free time and can devote it to gardening, laying bricks, or writing history. What is the best way to allocate your time? Let's ignore the possibility that time spent on some of these activities might be an investment that will enhance your earning power in the future. Rather, assume that these are all pure consumption or utility-yielding pursuits. The principles of consumer choice suggest that you will make the best use of your time when you equalize the marginal utilities of the last minute spent on each activity.

To take another example, suppose you want to maximize your knowledge in your courses but you have only a limited amount of time available. Should you study each subject for the same amount of time? Surely not. You may find that an equal study time for economics, history, and chemistry will not yield the same amount of knowledge in the last minute. If the last minute produces a greater marginal knowledge in chemistry than in history, you would raise your total knowledge by shifting additional minutes from history to chemistry, and so on, until the last minute yields the same incremental knowledge in each subject.

The same rule of maximum utility per hour can be applied to many different areas of life, including engaging in charitable activities, improving the environment, or losing weight. It is not merely a law of economics. It is a law of rational choice.

Are Consumers Wizards? The View from Behavioral Economics

All of this discussion makes it sound as if consumers are mathematical wizards who routinely make calculations of marginal utility to the tenth decimal place and solve complicated systems of equations in their everyday lives.

This unrealistic view is definitely not what we assume in economics. We know that most decisions are made in a routine and intuitive way. We may have Cheerios and yogurt for breakfast every day because they are not too expensive, are easy to find in the store, and slake our morning hunger.

Rather, what we assume in consumer demand theory is that consumers are reasonably consistent in their tastes and actions. We expect that people do not flail around and make themselves miserable by constantly making mistakes. If most people act consistently most of the time, avoiding erratic changes in buying behavior and generally choosing their most preferred bundles, our theory of demand will provide a reasonably good approximation to the facts.

As always, however, we must be alert to situations where irrational or inconsistent behavior crops up. We know that people make mistakes. People sometimes buy useless gadgets or are bilked by unscrupulous sales pitches. A new area of research is *behavioral economics*, which recognizes that people have limited time and memory, that information is incomplete, and that patterns of irrational-looking behavior are persistent. This approach allows for the possibility that imperfect information, psychological biases, and costly decision making may lead to poor decisions.

Behavioral economics explains why households save too little for retirement, why stock market bubbles occur, and how used-car markets behave when people's information is limited. A significant recent example illustrating behavioral principles came when millions of people took out "subprime mortgages" to buy homes in the 2000s. They did not read or could not understand the fine print, and as a result many people defaulted on their mortgages and lost their homes, triggering a major financial crisis and an economic downturn. It turns out that poor consumers were not the only people who could not read the fine print, however, for they were joined by banks, hedge-fund managers, bond-rating firms, and thousands of investors who bought assets that they did not understand.

Behavioral economics joined the mainstream in 2001 and 2002 when Nobel Prizes were awarded for economic research in this area. George Akerlof (University of California at Berkeley) was cited for developing a better understanding of the role of asymmetric information and the market for "lemons." Daniel Kahneman (Princeton University) and Vernon L. Smith (George Mason University) received the prize for "the analysis of human judgment and decision-making . . . and the empirical testing of predictions from economic theory by experimental economists."

Analytical Developments in Utility Theory

We pause here to provide an elaboration of some of the advanced issues behind the concept of utility and its application to demand theory. Economists today generally reject the notion of a cardinal (or measurable) utility that people feel or experience when consuming goods and services. Utility does not ring up like numbers on a gasoline pump.

Rather, what counts for modern demand theory is the principle of **ordinal utility.** Under this approach, consumers need to determine only their preference ranking of bundles of commodities. Ordinal utility asks, "Do I prefer a pastrami sandwich to a chocolate milk shake?" A statement such as "Bundle A is preferred to bundle B"—which does not require that we know how much A is preferred to B—is called ordinal, or dimensionless. Ordinal variables are ones that we can rank in order, but for which there is no measure of the quantitative difference between the situations. We might rank pictures in an exhibition by order of beauty without having a quantitative measure of beauty. Using only such ordinal preference rankings, we can establish firmly the general properties of market demand curves described in this chapter and in its appendix.

The discerning reader will wonder whether the equimarginal principle describing consumer equilibrium behavior implies cardinal utility. In fact, it does not; only ordinal measures are needed. An ordinal utility measure is one that we can stretch while always maintaining the same greater-than or less-than relationship (like measuring with a rubber band). Examine the marginal condition for consumer equilibrium. If the utility scale is stretched (say, by doubling or multiplying times 3.1415), you can see that all the numerators in the condition are changed by exactly the same amount, so the consumer equilibrium condition still holds.

For certain special situations the concept of *cardinal,* or dimensional, utility is useful. An example of a cardinal measure comes when we say that the speed of a plane is six times that of a car. People's behavior under conditions of uncertainty is today analyzed using a cardinal concept of utility. This topic will be examined further when we review the economics of risk, uncertainty, and gambling in Chapter 11.

Our treatment of utility in the equimarginal principle assumed that goods can be divided into indefinitely small units. However, sometimes indivisibility of units is important and cannot be glossed over. Thus, Hondas cannot be divided into arbitrarily small portions the way juice can. Suppose I buy one Honda, but definitely not two. Then the additional utility of the first car is enough larger than the additional utility of the same number of dollars spent elsewhere to induce me to buy this first unit. The additional utility that the second Honda would bring is enough less to ensure I do not buy it. When indivisibility matters, our equality rule for equilibrium can be restated as an inequality rule.

AN ALTERNATIVE APPROACH: SUBSTITUTION EFFECT AND INCOME EFFECT

The concept of marginal utility has helped explain the fundamental law of downward-sloping demand. But over the last few decades, economists have developed an alternative approach to the analysis of demand—one that makes no mention of marginal utility. This alternative approach uses "indifference curves," which are explained in the appendix to this chapter, to rigorously and consistently produce the major propositions about consumer behavior. This approach also helps explain the factors that tend to make the responsiveness of quantity demanded to price—the price elasticity of demand—large or small.

Indifference analysis asks about the substitution effect and the income effect of a change in price. By looking at these, we can see why the quantity demanded of a good declines as its price rises.

Substitution Effect

The substitution effect is the most obvious factor for explaining downward-sloping demand curves. If the price of coffee goes up while other prices do not, then coffee has become relatively more expensive. When coffee becomes a more expensive beverage, less coffee and more tea or cola will be bought. Similarly, because sending electronic mail is cheaper and quicker than sending letters through the regular mail, people are increasingly relying on electronic mail for correspondence. More generally, the **substitution effect** says that when the price of a good rises, consumers will tend to substitute other goods for the more expensive good in order to satisfy their desires more inexpensively.

Consumers, then, behave the way businesses do when the rise in price of an input causes firms to substitute low-priced inputs for high-priced inputs. By this process of substitution, businesses can produce a given amount of output at the least total cost. Similarly, when consumers substitute less expensive goods for more expensive ones, they are buying a given amount of satisfaction at lower cost.

Income Effect

A second impact of a price change comes through its effect on real income. The term *real income* means the actual quantity of goods that your money income can buy. When a price rises and money income is fixed, real income falls because the consumer cannot afford to buy the same quantity of goods as before. This produces the **income effect,** which is the change in the quantity demanded that arises because a price change lowers consumer real incomes. Most goods respond positively to higher incomes, so the income effect will normally reinforce the substitution effect in producing a downward-sloping demand curve.

We can obtain a quantitative measure of the income effect using a new concept, **income elasticity.** This term denotes the percentage change in quantity demanded divided by the percentage change in income, holding other things, such as prices, constant.

$$\text{Income elasticity} = \frac{\text{\% change in quantity demanded}}{\text{\% change in income}}$$

High income elasticities, such as those for airline travel or yachts, indicate that the demand for these goods rises rapidly as income increases. Low income elasticities, such as for potatoes or used furniture, denote a weak response of demand to increases in income.

Calculation of Income Elasticity

Suppose you are a city planner for Santa Fe, New Mexico, and you are concerned about the growth in the demand for water consumption by households in that arid region. You make inquiries and find the following data for 2000: The population is 62,000; the projected growth rate of the population is 20 percent per decade; per capita annual water consumption in 2000 was 1000 gallons; per capita incomes are projected to grow by 25 percent over the next decade; and the income elasticity of water use per capita is 0.50. You then estimate the water needs for 2010 (with unchanged prices) as

$$\begin{aligned}\text{Water consumption in 2010} \\ &= \text{population in 2000} \times \text{population growth factor} \\ &\quad \times \text{per capita water use} \\ &\quad \times [1 + (\text{income growth} \times \text{income elasticity})] \\ &= 62{,}000 \times 1.2 \times 1000 \times (1 + 0.25 \times 0.50) \\ &= 83{,}700{,}000\end{aligned}$$

From these data, you project a growth in total household water use of 35 percent from 2000 to 2010.

Income and substitution effects combine to determine the major characteristics of demand curves of different commodities. Under some circumstances the resulting demand curve is very price-elastic, as where the consumer has been spending a good deal on the commodity and ready substitutes are available. In this case both the income and the substitution effects are strong and the quantity demanded responds strongly to a price increase.

But consider a commodity like salt, which requires only a small fraction of the consumer's budget. Salt is not easily replaceable by other items and is needed in small amounts to complement more important items. For salt, both income and substitution effects are small, and demand will tend to be price-inelastic.

FROM INDIVIDUAL TO MARKET DEMAND

Having analyzed the principles underlying a single individual's demand for coffee or electronic mail, we next examine how the entire market demand derives from the individual demand. *The demand curve for a good for the entire market is obtained by summing up the quantities demanded by all the consumers.* Each consumer has a demand curve along which the quantity demanded can be plotted against the price; it generally slopes downward and to the right. If all consumers were exactly alike in their demands and if there were 1 million consumers, we could think of the market demand curve as a millionfold enlargement of each consumer's demand curve.

In fact, of course, people differ in their tastes. Some have high incomes, some low. Some greatly desire coffee; others prefer tea. To obtain the total market demand curve, we calculate the sum total of what all the different consumers consume at each price. We then plot that total amount as a point on the market demand curve. Alternatively, we might construct a numerical demand table by summing the quantities demanded by all individuals at each market price.

As a matter of convention, we label *individual* demand and supply curves with lowercase letters (*dd* and *ss*), while using uppercase letters (*DD* and *SS*) for the *market* demand and supply curves.

The market demand curve is the sum of individual demands at each price. Figure 5-2 shows how to add individual *dd* demand curves horizontally to get the market *DD* demand curve.

FIGURE 5-2. Market Demand Derived from Individual Demands

We add all individual consumers' demand curves to get the market demand curve. At each price, such as $5, we add quantities demanded by each person to get the market quantity demanded. The figure shows how, at a price of $5, we add horizontally Smith's 1 unit demanded to Brown's 2 units to get the market demand of 3 units.

Demand Shifts

We know that changes in the price of coffee affect the quantity of coffee demanded. We know this from budget studies, from historical experience, and from examining our own behavior. We discussed briefly in Chapter 3 some of the important nonprice determinants of demand. We now review the earlier discussion in light of our analysis of consumer behavior.

An increase in income tends to increase the amount we are willing to buy of most goods. Necessities tend to be less responsive than most goods to income changes, while luxuries tend to be more responsive to income. And there are a few anomalous goods, known as inferior goods, for which purchases may shrink as incomes increase because people can afford to replace them with other, more desirable goods. Soup bones, intercity bus travel, and black-and-white TVs are examples of inferior goods for many Americans today.

What does all this mean in terms of the demand curve? The demand curve shows how the quantity of a good demanded responds to a change in its own price. But the demand is also affected by the prices of other goods, by consumer incomes, and by special influences. The demand curve was drawn on the assumption that these other things were held constant. But what if these other things change? Then the whole demand curve will shift to the right or to the left.

Figure 5-3 illustrates changes in factors affecting demand. Given people's incomes and the prices for other goods, we can draw the demand curve for coffee as *DD*. Assume that price and quantity are at point *A*. Suppose that incomes rise while the prices of coffee and other goods are unchanged. Because coffee is a normal good with a positive income elasticity, people will increase their purchases of coffee. Hence the demand curve for coffee will shift to the right, say, to *D′D′*, with *A′* indicating the new quantity demanded of coffee. If incomes should fall, then we would expect a reduction in demand and in quantity bought. This downward shift we illustrate by *D″D″* and by *A″*.

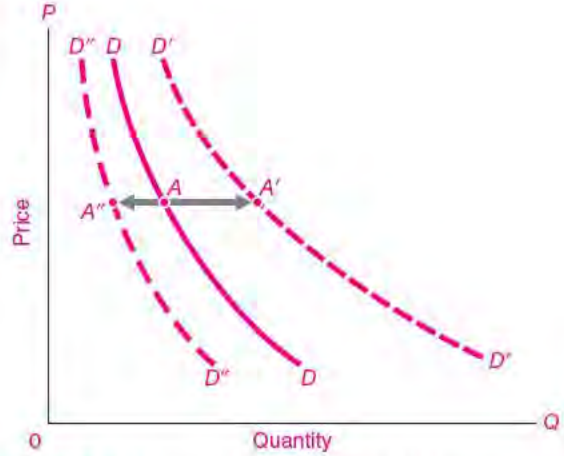


FIGURE 5-3. Demand Curve Shifts with Changes in Income or in Other Goods' Prices

As incomes increase, consumers generally want more of a good, thus increasing demand or shifting demand outward (explain why higher incomes shift *DD* to *D′D′*). Similarly, a rise in the price of a substitute good increases or shifts out the demand curve (e.g., from *DD* to *D′D′*). Explain why a decrease in income would generally shift demand to *D″D″*. Why would a decrease in chicken prices shift hamburger demand to *D″D″*?

Substitutes and Complements

Everyone knows that raising the price of beef will decrease the amount of beef demanded. We have seen that it will also affect the demand for other commodities. For example, a higher price for beef will increase the demand for substitutes like chicken. A higher beef price may lower the demand for goods like hamburger buns and ketchup that are used along with beef hamburgers. It will probably have little effect on the demand for economics textbooks.

We say, therefore, that beef and chicken are substitute products. Goods A and B are **substitutes** if an increase in the price of good A will increase the demand for substitute good B. Hamburgers and hamburger buns, or cars and gasoline, on the other hand, are complementary products; they are called **complements** because an increase in the price of good A causes a decrease in the demand for its complementary good B. In between are **independent goods,** such as beef and textbooks, for which a price change for one has no effect on the demand for the other. Try classifying the pairs turkey and cranberry sauce, oil and coal, college and textbooks, shoes and shoelaces, salt and shoelaces.

Say Figure 5-3 represented the demand for beef. A fall in the price of chickens may well cause consumers to buy less beef; the beef demand curve would therefore shift to the left, say, to *D″D″*. But what if the price of hamburger buns were to fall? The resulting change on *DD*, if there is one, will be in the direction of increased beef purchases, a rightward shift of the demand curve.

Why do we see this difference in response? Because chicken is a substitute product for beef, while hamburger buns are complements to beef.

Review of key concepts:

- The **substitution effect** occurs when a higher price leads to substitution of other goods for the good whose price has risen.
- The **income effect** is the change in the quantity demanded of a good because the change in its price has the effect of changing a consumer's real income.
- **Income elasticity** is the percentage change in quantity demanded of a good divided by the percentage change in income.
- Goods are **substitutes** if an increase in the price of one increases the demand for the other.
- Goods are **complements** if an increase in the price of one decreases the demand for the other.
- Goods are **independent** if a price change for one has no effect on the demand for the other.

Empirical Estimates of Price and Income Elasticities

For many economic applications, it is essential to have numerical estimates of price elasticities. For example, an automobile manufacturer will want to know the impact on sales of the higher car prices that result from installation of costly pollution-control equipment; a college needs to know the impact of higher tuition rates on student applications; and a publisher will calculate the impact of higher textbook prices on its sales. All these applications require a numerical estimate of price elasticity.

Similar decisions depend on income elasticities. A government planning its road or rail network will estimate the impact of rising incomes on automobile travel; the federal government must calculate the effect of higher incomes on energy consumption in designing policies for air pollution or global warming; in determining the necessary investments for generating capacity, electrical utilities require income elasticities for estimating electricity consumption.

Economists have developed useful statistical techniques for estimating price and income elasticities. The quantitative estimates are derived from market data on quantities demanded, prices, incomes, and other variables. Tables 5-2 and 5-3 show selected estimates of elasticities.

Commodity	Price elasticity
Tomatoes	4.60
Green peas	2.80
Legal gambling	1.90
Taxi service	1.24
Furniture	1.00
Movies	0.87
Shoes	0.70
Legal services	0.61
Medical insurance	0.31
Bus travel	0.20
Residential electricity	0.13

TABLE 5-2. Selected Estimates of Price Elasticities of Demand

Estimates of price elasticities of demand show a wide range of variation. Elasticities are generally high for goods for which ready substitutes are available, like tomatoes or peas. Low price elasticities exist for those goods like electricity which are essential to daily life and which have no close substitutes.

Source: Heinz Kohler, *Microeconomics: Theory and Applications* (Heath, Lexington, Mass., 1992).

Commodity	Income elasticity
Automobiles	2.46
Owner-occupied housing	1.49
Furniture	1.48
Books	1.44
Restaurant meals	1.40
Clothing	1.02
Physicians' services	0.75
Tobacco	0.64
Eggs	0.37
Margarine	−0.20
Pig products	−0.20
Flour	−0.36

TABLE 5-3. Income Elasticities for Selected Products

Income elasticities are high for luxuries, whose consumption grows rapidly relative to income. Negative income elasticities are found for "inferior goods," whose demand falls as income rises. Demand for many staple commodities, like clothing, grows proportionally with income.

Source: Heinz Kohler, *Microeconomics: Theory and Applications* (Heath, Lexington, Mass., 1992).

THE ECONOMICS OF ADDICTION

In a free-market economy, the government generally lets people decide what to buy with their money. If some want to buy expensive cars while others want to buy expensive houses, we assume that they know what is best for them and that in the interests of personal freedom the government should respect their preferences.

In some cases, but sparingly and with great hesitation, the government decides to overrule private adult decisions. These are cases of *merit goods,* whose consumption is thought intrinsically worthwhile, and the opposite, which are *demerit goods,* whose consumption is deemed harmful. For these goods, we recognize that some consumption activities have such serious effects that overriding individuals' private decisions may be desirable. Today, most societies provide for free public education and emergency health care; on the other hand, society also penalizes or forbids consumption of such harmful substances as cigarettes, alcohol, and heroin.

Among the most controversial areas of social policy are demerit goods involving addictions. An addiction is a pattern of compulsive and uncontrolled use of a substance. The heavy smoker or the heroin user may bitterly regret the acquired habit, but such habits are extremely difficult to break after they have become established. A regular user of cigarettes or heroin is much more likely to desire these substances than is a nonuser. Moreover, the demands for addictive substances are quite price-inelastic.

The markets for addictive substances are big business. Consumer expenditures on tobacco products in 2007 were $95 billion, while total expenditures on alcoholic beverages were $155 billion. Numbers for illegal drugs involve guesswork, but recent estimates of spending on illegal drugs place the total at around $75 billion annually.

Consumption of these substances raises major public policy issues because addictive substances may injure users and often impose costs and harms on society. The harms to users include around 450,000 premature deaths annually, along with a wide variety of medical problems attributable to smoking; 10,000 highway fatalities a year attributed to alcohol; and failures in school, job, and family, along with high levels of AIDS, from intravenous heroin use. Harms to society include the predatory crime that addicts of high-price drugs engage in; the costs of providing subsidized medical care to those who consume drugs, cigarettes, or tobacco; the rapid spread of communicable diseases, especially AIDS and pneumonia; and the tendency of existing users to recruit new users.

One policy approach, often followed in the United States, is to prohibit the sale and use of addictive substances and to enforce prohibition with criminal sanctions. Economically, prohibition can be interpreted as a sharp upward shift in the supply curve. After the upward shift, the price of the addictive substance is much higher. During Prohibition (1920–1933), alcohol prices were approximately 3 times higher than before. Estimates are that cocaine currently sells for at least 20 times its free-market price.

What is the effect of supply restrictions on the consumption of addictive substances? And how does the prohibition affect the injuries to self and to society? To answer these questions, we need to consider the nature of the demand for addictive substances. The evidence indicates that casual consumers of illegal drugs have cheap substitutes like alcohol and tobacco and thus will have relatively high price elasticity of demand. By contrast, hard-core users are often addicted to particular substances and have price-inelastic demands.

We can illustrate the market for addictive substances in Figure 5-4. The demand curve *DD* is extremely price-inelastic for established users. Now consider a policy of discouraging drug use. One approach, used for cigarettes, is to impose a large tax. As we saw in the previous chapter, this can be analyzed as an upward shift in the supply curve. A policy of prohibition such as is used for illegal substances has the same effect of shifting the supply curve from *SS* to *S′S′*.

Because demand is price-inelastic, quantity demanded will decline very little. At the higher price, total spending on drugs increases sharply. For illegal drugs, the required outlays may be so great that the user engages in predatory crime. The results, in the view of two economists who have studied the subject, are that "the market in illegal drugs promotes crime, destroys inner cities, spreads AIDS, corrupts law enforcement officials and politicians, produces and exacerbates poverty, and erodes the moral fabric of society."

A different case would arise for highly price-sensitive consumers such as casual users. For example,

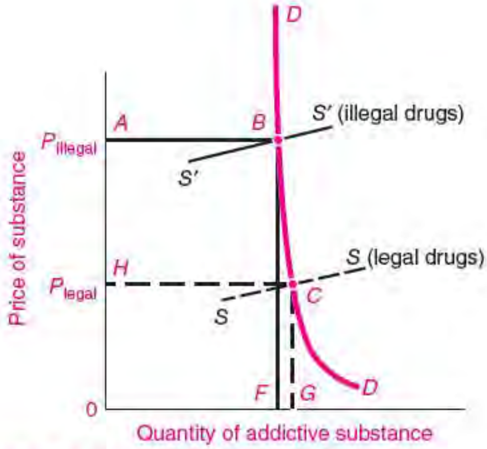


FIGURE 5-4. Market for Addictive Substances

The demand for addictive substances is price-inelastic for heavy smokers or hard-core users of drugs like heroin or cocaine. As a result, if prohibition or heavy taxation shifts supply from *SS* to *S′S′*, total spending on drugs will rise from 0*HCG* to 0*ABF*. For drugs that are highly price-inelastic, this implies that spending on drugs will rise when supply is restrained. What will happen to criminal activity after prohibition if a substantial fraction of the income of addicts is obtained by theft? Can you see why some people would argue for reduced drug enforcement or even decriminalization for addictive drugs?

a teenager might experiment with an addictive substance if it is affordable, while a high price (accompanied by low availability) would reduce the number of people who start down the road to addiction. In this case, supply restraints are likely to lower use sharply and to reduce spending on addictive substances. (See question 10 at the end of this chapter for further discussion.)

One of the major difficulties with regulating addictive substances comes because of the patterns of substitution among them. Many drugs appear to be close substitutes rather than complements. As a result, experts caution, raising the price of one substance may drive users to other harmful substances. For example, states that have criminal penalties for marijuana use tend to have higher teenage consumption of alcohol and tobacco.

Clearly, social policy toward addictive substances raises extremely complex issues. But the economic theory of demand provides some important insights into the impacts of alternative approaches. First, it suggests that raising the prices of harmful addictive substances can reduce the number of casual users who will be attracted into the market. Second, it cautions us that many of the negative consequences of illegal drugs result from the prohibition of addictive substances rather than from their consumption per se. Many thoughtful observers conclude with the paradoxical observation that the overall costs of addictive substances—to users, to other people, and to the ravaged inner cities in which the drug trade thrives—would be lower if government prohibitions were relaxed and the resources currently devoted to supply restrictions were instead put into treatment and counseling.

THE PARADOX OF VALUE

More than two centuries ago, in *The Wealth of Nations*, Adam Smith posed the paradox of value:

> Nothing is more useful than water; but it will scarce purchase anything. A diamond, on the contrary, has scarce any value in use; but a very great quantity of other goods may frequently be had in exchange for it.

In other words, how is it that water, which is essential to life, has little value, while diamonds, which are generally used for conspicuous consumption, command an exalted price?

Although this paradox troubled Adam Smith 200 years ago, we can imagine a dialogue between a probing student and a modern-day Adam Smith as follows:

Student: How can we resolve the paradox of value?

Modern Smith: The simplest answer is that the supply and demand curves for water intersect at a very low price, while the supply and demand for diamonds yield a very high equilibrium price.

Student: But you have always taught me to go behind the curves. Why do supply and demand for water intersect at such a low price and for diamonds at a high price?

Modern Smith: The answer is that diamonds are very scarce and the cost of getting extra ones is high, while water is relatively abundant and costs little in many areas of the world.

Student: But where is utility in this picture?

Modern Smith: You are right that this answer still does not reconcile the cost information with the equally valid fact that the world's water is vastly more critical than the world's supply of diamonds. So, we need to add a second truth: The total utility from water consumption does not determine its price or demand. Rather, water's price is determined by its *marginal* utility, by the usefulness of the *last* glass of water. Because there is so much water, the last glass sells for very little. Even though the first few drops are worth life itself, the last few are needed only for watering the lawn or washing the car.

Student: Now I get it. The theory of economic value is easy to understand if you just remember that in economics the tail wags the dog. It is the tail of marginal utility that wags the dog of prices.

Modern Smith: Precisely! An immensely valuable commodity like water sells for next to nothing because its last drop is worth next to nothing.

We can restate this dialogue as follows: The more there is of a commodity, the less is the relative desirability of its last little unit. It is therefore clear why water has a low price and why an absolute necessity like air can become a free good. In both cases, it is the large quantities that pull the marginal utilities so far down and thus reduce the prices of these vital commodities.

CONSUMER SURPLUS

The paradox of value emphasizes that the recorded monetary value of a good (measured by price times quantity) may be a misleading indicator of the total economic value of that good. The measured economic value of the air we breathe is zero, yet air's contribution to welfare is immeasurably large.

The gap between the total utility of a good and its total market value is called **consumer surplus.** The surplus arises because we "receive more than we pay for" as a result of the law of diminishing marginal utility.

We have consumer surplus basically because we pay the same amount for each unit of a commodity that we buy, from the first to the last. We pay the same price for each egg or glass of water. Thus we pay for *each* unit what the *last* unit is worth. But by our fundamental law of diminishing marginal utility, the earlier units are worth more to us than the last. Thus, we enjoy a surplus of utility on each of these earlier units.

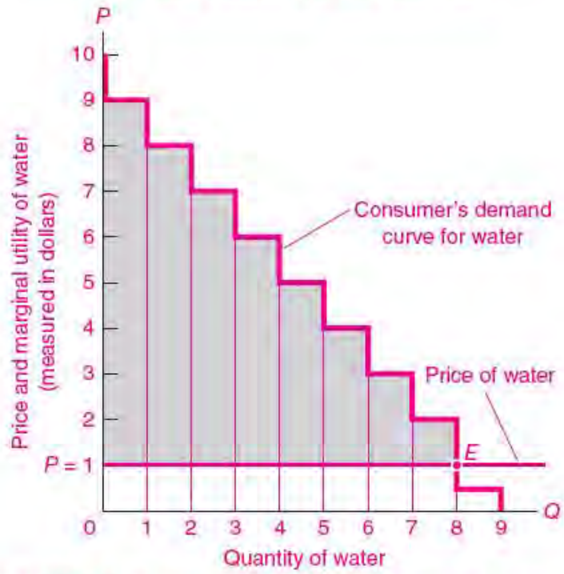


FIGURE 5-5. Because of Diminishing Marginal Utility, Consumer's Satisfaction Exceeds What Is Paid

The downward-sloping demand for water reflects the diminishing marginal utility of water. Note how much excess or surplus satisfaction occurs from the earlier units. Adding up all the blue surpluses ($8 of surplus on unit 1 + $7 of surplus on unit 2 + · · · + $1 of surplus on unit 8), we obtain the total consumer surplus of $36 on water purchases.

In the simplified case seen here, the area between the demand curve and the price line is the total consumer surplus.

Figure 5-5 illustrates the concept of consumer surplus in the case where money provides a firm measuring rod for utility. Here, an individual consumes water, which has a price of $1 per gallon. This is shown by the horizontal green line at $1 in Figure 5-5. The consumer considers how many gallon jugs to buy at that price. The first gallon is highly valuable, slaking extreme thirst, and the consumer is willing to pay $9 for it. But this first gallon costs only the market price of $1, so the consumer has gained a surplus of $8.

Consider the second gallon. This is worth $8 to the consumer, but again costs only $1, so the surplus is $7. And so on down to the ninth gallon, which is worth only 50 cents to the consumer, and so it is not bought. The consumer equilibrium comes at point *E*, where 8 gallons of water are bought at a price of $1 each.

But here we make an important discovery: Even though the consumer has paid only $8, the total

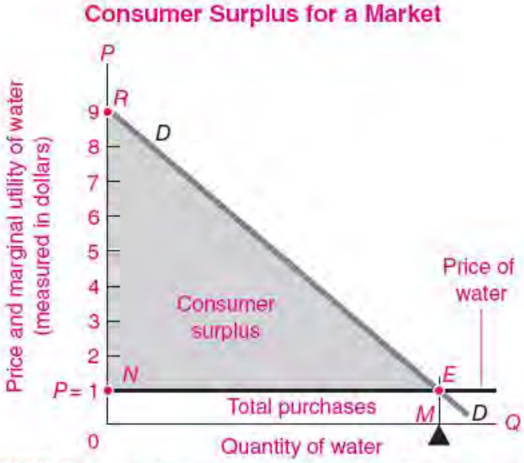


FIGURE 5-6. Total Consumer Surplus Is the Area under the Demand Curve and above the Price Line

The demand curve measures the amount consumers would pay for each unit consumed. Thus the total area under the demand curve (0*REM*) shows the total utility attached to the consumption of water. By subtracting the market cost of water to consumers (equal to 0*NEM*), we obtain the consumer surplus from water consumption as the blue triangle *NER*. This device is useful for measuring the benefits of public goods and the losses from monopolies and import tariffs.

value of the water is \$44. This is obtained by adding up each of the marginal utility columns (= \$9 + \$8 + · · · + \$2). Thus the consumer has gained a surplus of \$36 over the amount paid.

Figure 5-5 examines the case of a single consumer purchasing water. We can also apply the concept of consumer surplus to a market as a whole. The market demand curve in Figure 5-6 is the horizontal summation of the individual demand curves. The logic of the individual consumer surplus carries over to the market as a whole. The area of the market demand curve above the price line, shown as *NER* in Figure 5-6, represents the total consumer surplus.

Because consumers pay the price of the last unit for all units consumed, they enjoy a surplus of utility over cost. Consumer surplus measures the extra value that consumers receive above what they pay for a commodity.

Applications of Consumer Surplus

The concept of consumer surplus is useful in helping evaluate many government decisions. For example, how can the government decide on the value of building a new highway or of preserving a recreation site? Suppose a new highway has been proposed. Being free to all, it will bring in no revenue. The value to users will be found in time saved or in safer trips and can be measured by the individual consumer surplus. To avoid difficult issues of interpersonal utility comparisons, we assume that there are 10,000 users, all identical in every respect.

Suppose that each individual's consumer surplus is \$350 for the highway. The highway will raise consumer economic welfare if its total cost is less than \$3.5 million (10,000 × \$350). Economists use consumer surplus when they are performing a *cost-benefit analysis*, which attempts to determine the costs and benefits of a government program. Generally, an economist would recommend that a free road should be built if its total consumer surplus exceeds its costs. Similar analyses have been used for environmental questions such as whether to preserve wilderness areas for recreation or whether to require new pollution-abatement equipment.

The concept of consumer surplus also points to the enormous privilege enjoyed by citizens of modern societies. Each of us enjoys a vast array of enormously valuable goods that can be bought at low prices. This is a humbling thought. If you know someone who is bragging about his economic productivity, or explaining how high her real wages are, suggest a moment of reflection. If such people were transported with their specialized skills to an uninhabited desert island, how much would their wages buy? Indeed, without capital machinery, without the cooperation of others, and without the technological knowledge which each generation inherits from the past, how much could any of us produce? It is only too clear that all of us reap the benefits of an economic world we never made. As the great British sociologist L. T. Hobhouse said:

> The organizer of industry who thinks that he has "made" himself and his business has found a whole social system ready to his hand in skilled workers, machinery, a market, peace and order—a vast apparatus and a pervasive atmosphere, the joint creation of millions of men and scores of generations. Take away the whole social factor and we [are] but . . . savages living on roots, berries, and vermin.

Now that we have surveyed the essentials of demand, we move on to costs and supply.

SUMMARY

1. Market demands or demand curves are explained as stemming from the process of individuals' choosing their most preferred bundle of consumption goods and services.
2. Economists explain consumer demand by the concept of utility, which denotes the relative satisfaction that a consumer obtains from using different commodities. The additional satisfaction obtained from consuming an additional unit of a good is given the name *marginal utility*, where "marginal" means the extra or incremental utility. The law of diminishing marginal utility states that as the amount of a commodity consumed increases, the marginal utility of the last unit consumed tends to decrease.
3. Economists assume that consumers allocate their limited incomes so as to obtain the greatest satisfaction or utility. To maximize utility, a consumer must satisfy the *equimarginal principle* that the marginal utilities of the last dollar spent on each and every good must be equal.

   Only when the marginal utility per dollar is equal for apples, bacon, coffee, and everything else will the consumer attain the greatest satisfaction from a limited dollar income. But be careful to note that the marginal utility of a $50-per-ounce bottle of perfume is not equal to the marginal utility of a 50-cent glass of cola. Rather, their marginal utilities divided by price per unit are all equal in the consumer's optimal allocation. That is, their marginal utilities per last dollar, MU/P, are equalized.
4. Equal marginal utility or benefit per unit of resource is a fundamental rule of choice. Take any scarce resource, such as time. If you want to maximize the value or utility of that resource, make sure that the marginal benefit per unit of the resource is equalized in all uses.
5. The market demand curve for all consumers is derived by adding horizontally the separate demand curves of each consumer. A demand curve can shift for many reasons. For example, a rise in income will normally shift *DD* rightward, thus increasing demand; a rise in the price of a substitute good (e.g., chicken for beef) will also create a similar upward shift in demand; a rise in the price of a complementary good (e.g., hamburger buns for beef) will in turn cause the *DD* curve to shift downward and leftward. Still other factors—changing tastes, population, or expectations—can affect demand.
6. We can gain added insight into the factors that cause downward-sloping demand by separating the effect of a price rise into substitution and income effects. (*a*) The substitution effect occurs when a higher price leads to substitution of other goods to meet satisfactions; (*b*) the income effect means that a price increase lowers real income and thereby reduces the desired consumption of most commodities. For most goods, substitution and income effects of a price increase reinforce one another and lead to the law of downward-sloping demand. We measure the quantitative responsiveness of demand to income by the income elasticity, which is the percentage change in quantity demanded divided by the percentage change in income.
7. Remember that it is the tail of marginal utility that wags the market dog of prices. This point is emphasized by the concept of *consumer surplus*. We pay the same price for the last quart of milk as for the first. But, because of the law of diminishing marginal utility, marginal utilities of earlier units are greater than that of the last unit. This means that we would have been willing to pay more than the market price for each of the earlier units. The excess of total value over market value is called consumer surplus. Consumer surplus reflects the benefit we gain from being able to buy all units at the same low price. In simplified cases, we can measure consumer surplus as the area between the demand curve and the price line. It is a concept relevant for many public decisions—such as deciding when the community should incur the heavy expenses of a road or bridge or set aside land for a wilderness area.

CONCEPTS FOR REVIEW

utility, marginal utility
utilitarianism
law of diminishing marginal utility
demand shifts from income and other sources
ordinal utility
equimarginal principle: $MU_1/P_1 = MU_2/P_2 = \cdots = MU$ per \$ of income
market demand vs. individual demand
income elasticity
substitutes, complements, independent goods
substitution effect and income effect
merit goods, demerit goods
paradox of value
consumer surplus

FURTHER READING AND INTERNET WEBSITES

Further Reading

An advanced treatment of consumer theory can be found in intermediate textbooks; see the Further Reading section in Chapter 3 for some good sources.

Utilitarianism was introduced in Jeremy Bentham, *An Introduction to the Principles of Morals* (1789).

An interesting survey of psychology and economics is contained in Matthew Rabin, "Psychology and Economics," *Journal of Economic Literature,* March 1998, while serious students of the subject may want to read Colin Camerer, George Loewenstein, and Matthew Rabin, eds., *Advances in Behavioral Economics* (Princeton University Press, Princeton, N.J., 2003).

Consumers often need help in judging the utility of different products. Look at *Consumer Reports* for articles that attempt to rate products. They sometimes rank products as "Best Buys," which might mean the most utility per dollar of expenditure.

Jeffrey A. Miron and Jeffrey Zwiebel, "The Economic Case against Drug Prohibition," *Journal of Economic Perspectives,* Fall 1995, pp. 175–192, is an excellent nontechnical survey of the economics of drug prohibition.

Websites

Data on total personal consumption expenditures for the United States are provided at the website of the Bureau of Economic Analysis, *www.bea.doc.gov.* Data on family budgets are contained in Bureau of Labor Statistics, *Consumer Expenditures,* available at *www.bls.gov.*

Practical guides for consumers are provided at the government site *www.consumer.gov.* The organization Public Citizen lobbies in Washington "for safer drugs and medical devices, cleaner and safer energy sources, a cleaner environment, fair trade, and a more open and democratic government." Its website at *www.citizen.org* contains articles on many consumer, labor, and environmental issues.

You can read the Nobel lectures of laureates Akerlof, Kahneman, and Smith, with their views on behavioral economics, at *nobelprize.org/nobel_prizes/economics/laureates/.*

QUESTIONS FOR DISCUSSION

1. Explain the meaning of utility. What is the difference between total utility and marginal utility? Explain the law of diminishing marginal utility and give a numerical example.
2. Each week, Tom Wu buys two hamburgers at \$2 each, eight cokes at \$0.50 each, and eight slices of pizza at \$1 each, but he buys no hot dogs at \$1.50 each. What can you deduce about Tom's marginal utility for each of the four goods?
3. Which pairs of the following goods would you classify as complementary, substitute, or independent goods: beef, ketchup, lamb, cigarettes, gum, pork, radio, television, air travel, bus travel, taxis, and paperbacks? Illustrate the resulting shift in the demand curve for one good when the price of another good goes up. How would a change in income affect the demand curve for air travel? The demand curve for bus travel?

4. Why is it wrong to say, "Utility is maximized when the marginal utilities of all goods are exactly equal"? Correct the statement and explain.
5. Here is a way to think about consumer surplus as it applies to movies:
   a. How many movies did you watch last year?
   b. How much in total did you pay to watch movies last year?
   c. What is the *maximum* you would pay to see the movies you watched last year?
   d. Calculate **c** minus **b.** That is your consumer surplus from movies.
6. Consider the following table showing the utility of different numbers of days skied each year:

Number of days skied	Total utility ($)
0	0
1	70
2	110
3	146
4	176
5	196
6	196

   Construct a table showing the marginal utility for each day of skiing. Assuming that there are 1 million people with preferences shown in the table, draw the market demand curve for ski days. If lift tickets cost $40 per day, what are the equilibrium price and quantity of days skied?
7. For each of the commodities in Table 5-2, calculate the impact of a doubling of price on quantity demanded. Similarly, for the goods in Table 5-3, what would be the impact of a 50 percent increase in consumer incomes?
8. As you add together the identical demand curves of more and more people (in a way similar to the procedure in Figure 5-2), the market demand curve becomes flatter and flatter on the same scale. Does this fact indicate that the elasticity of demand is becoming larger and larger? Explain your answer carefully.
9. An interesting application of supply and demand to addictive substances compares alternative techniques for supply restriction. For this problem, assume that the demand for addictive substances is inelastic.
   a. One approach (used today for heroin and cocaine and for alcohol during Prohibition) is to reduce supply at the nation's borders. Show how this raises price and increases the total income of the suppliers in the drug industry.
   b. An alternative approach (followed today for tobacco and alcohol) is to tax the goods heavily. Using the tax apparatus developed in Chapter 4, show how this reduces the total income of the suppliers in the drug industry.
   c. Comment on the difference between the two approaches.
10. Demand may be price-elastic for casual users of drugs—ones who are not addicted or for whom substitute products are readily available. In this case, restrictions or price increases will have a significant impact on use. Draw a supply and demand diagram like Figure 5-4 where the demand curve is price-elastic. Show the effect of a steep tax on quantity demanded. Show that, because demand is price-elastic, total spending on drugs with restrictions will fall. Explain why this analysis would support the argument of those who would severely limit the availability of addictive substances.
11. Suppose you are very rich and very fat. Your doctor has advised you to limit your food intake to 2000 calories per day. What is your consumer equilibrium for food consumption?
12. *Numerical problem on consumer surplus:* Assume that the demand for travel over a bridge takes the form $Y = 1{,}000{,}000 - 50{,}000P$, where Y is the number of trips over the bridge and P is the bridge toll (in dollars).
   a. Calculate the consumer surplus if the bridge toll is $0, $1, and $20.
   b. Assume that the cost of the bridge is $1,800,000. Calculate the toll at which the bridge owner breaks even. What is the consumer surplus at the break-even toll?
   c. Assume that the cost of the bridge is $8 million. Explain why the bridge should be built even though there is no toll that will cover the cost.

Appendix 5

GEOMETRICAL ANALYSIS OF CONSUMER EQUILIBRIUM

An alternative and more advanced approach to deriving demand curves uses the approach called indifference curves. This appendix derives the major conclusions of consumer behavior with this new tool.

THE INDIFFERENCE CURVE

Start by assuming that you are a consumer who buys different combinations of two commodities, say, food and clothing, at a given set of prices. For each combination of the two goods, assume that you prefer one to the other or are indifferent between the pair. For example, when asked to choose between combination A of 1 unit of food and 6 units of clothing and combination B of 2 units of food and 3 of clothing, you might (1) prefer A to B, (2) prefer B to A, or (3) be indifferent between A and B.

Now suppose that A and B are equally good in your eyes—that you are indifferent as to which of them you receive. Let us consider some other combinations of goods about which you are likewise indifferent, as listed in the table for Figure 5A-1.

Figure 5A-1 shows these combinations diagrammatically. We measure units of clothing on one axis and units of food on the other. Each of our four combinations of goods is represented by its point, *A, B, C, D.* But these four are by no means the only combinations among which you are indifferent. Another batch, such as 1½ units of food and 4 of clothing, might be ranked as equal to *A, B, C,* or *D,* and there are many others not shown. The curved contour of Figure 5A-1, linking up the four points, is an **indifference curve.** The points on the curve represent consumption bundles among which the consumer is indifferent; all are equally desirable.

Law of Substitution

Indifference curves are drawn as bowl-shaped, or convex to the origin. Hence, as you move downward and to the right along the curve—a movement that implies increasing the quantity of food and reducing the units of clothing—the curve becomes flatter. The curve is drawn in this way to illustrate a property that seems most often to hold true in reality and which we call the law of substitution:

The scarcer a good, the greater its relative substitution value; its marginal utility rises relative to the marginal utility of the good that has become plentiful.

Thus, in going from *A* to *B* in Figure 5A-1, you would swap 3 of your 6 clothing units for 1 extra food unit. But from *B* to *C,* you would sacrifice only 1 unit of your remaining clothing supply to obtain a third food unit—a 1-for-1 swap. For a fourth unit of food, you would sacrifice only ½ unit from your dwindling supply of clothing.

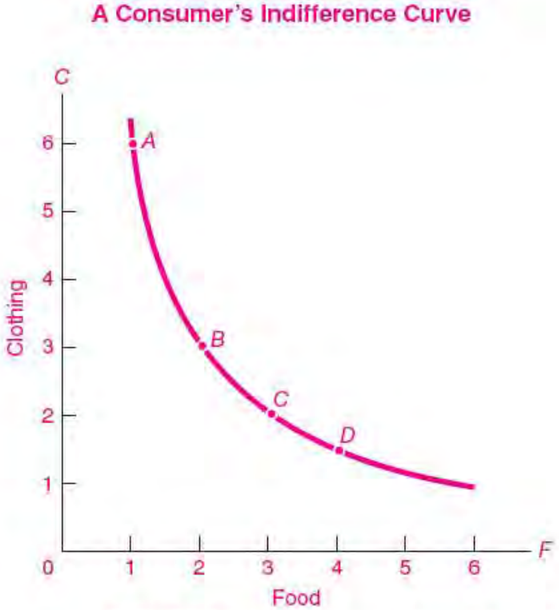
If we join the points *A* and *B* of Figure 5A-1, we find that the slope of the resulting line (neglecting its negative sign) has a value of 3. Join *B* and *C,* and the slope is 1; join *C* and *D,* and the slope is ½. These figures—3, 1, ½—are the *substitution ratios* (sometimes called the *marginal rates of substitution*) between the two goods. As the size of the movement along the curve becomes very small, the closer the substitution ratio comes to the actual slope of the indifference curve.

The slope of the indifference curve is the measure of the goods' relative marginal utilities, or of the substitution terms on which—for very small changes—the consumer would be willing to exchange a little less of one good in return for a little more of the other.

An indifference curve that is convex in the manner of Figure 5A-1 conforms to the law of substitution. As the amount of food you consume goes up—and the quantity of clothing goes down—food must become relatively cheaper in order for you to be persuaded to take a little extra food in exchange for a little sacrifice of clothing. The precise shape and slope of an indifference curve will, of course, vary from one consumer to the next, but the typical shape will take the form shown in Figures 5A-1 and 5A-2.

The Indifference Map

The table in Figure 5A-1 is one of an infinite number of possible tables. We could start with a more preferred consumption situation and list some of the different combinations that would bring the consumer this higher level of satisfaction. One such table might have begun with 2 food units and 7 clothing units;



Indifference Combinations

	Food	Clothing
A	1	6
B	2	3
C	3	2
D	4	1½

FIGURE 5A-1. Indifference Curve for a Pair of Goods

Getting more of one good compensates for giving up some of the other. The consumer likes situation *A* exactly as much as *B*, *C*, or *D*. The food-clothing combinations that yield equal satisfaction are plotted as a smooth indifference curve. This is convex from below in accord with the law of substitution, which says that as you get more of a good, its substitution ratio, or the indifference curve's slope, diminishes.

another with 3 food units, 8 clothing units. Each table could be portrayed graphically, each with a corresponding indifference curve.

Figure 5A-2 shows four such curves; the curve from Figure 5A-1 is labeled U_3. This diagram is analogous to a geographic contour map. A person who walks along the path indicated by a particular height contour on such a map is neither climbing nor descending; similarly, the consumer who moves from one position to another along a single indifference curve enjoys neither increasing nor decreasing satisfaction from the change in consumption. Only a few of the possible indifference curves are shown in Figure 5A-2.

Note that as we increase both goods and thus move in a northeasterly direction across this map, we are crossing successive indifference curves; hence, we are reaching higher and higher levels of satisfaction (assuming that the consumer gets greater satisfaction from receiving increased quantities of both goods). Curve U_3 stands for a higher level of satisfaction than

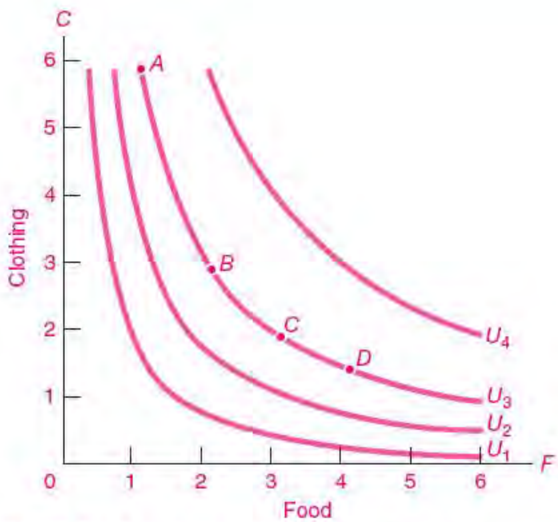
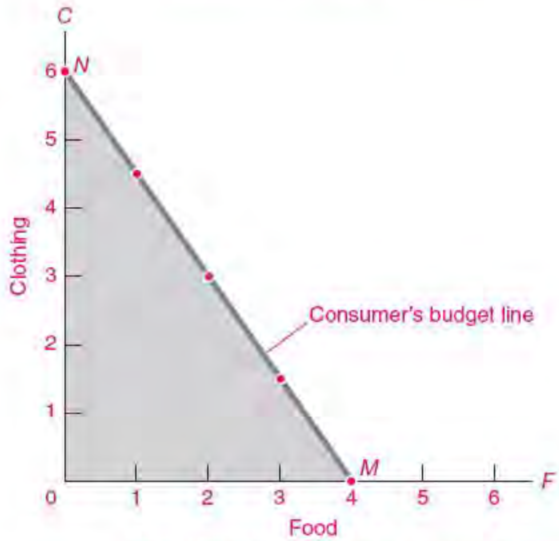


FIGURE 5A-2. A Family of Indifference Curves

The curves labeled U_1, U_2, U_3, and U_4 represent indifference curves. Which indifference curve is most preferred by the consumer?

A Consumer's Budget Line



Alternative Consumption Possibilities

	Food	Clothing
M	4	0
	3	$1\frac{1}{2}$
	2	3
	1	$4\frac{1}{2}$
N	0	6

FIGURE 5A-3. Income Constrains Consumer Spending

The budget limit on expenditures can be seen in a numerical table. The total cost of each budget (reckoned as $\$1.50F + \$1C$) adds up to exactly \$6 of income. We can plot the budget constraint as a straight line whose absolute slope equals the P_F/P_C ratio. *NM* is the consumer's budget line. When income is \$6, with food and clothing prices \$1.50 and \$1, the consumer can choose any point on this budget line. (Why is its slope $\$1.50/\$1 = \frac{3}{2}$?)

U_2; U_4, for a higher level of satisfaction than U_3; and so forth.

BUDGET LINE OR BUDGET CONSTRAINT

Now let us set a particular consumer's indifference map aside for a moment and give the consumer a fixed income. He has, say, \$6 per day to spend, and he is confronted with fixed prices for each food and clothing unit—\$1.50 for food, \$1 for clothing. It is clear that he could spend his money on any one of a variety of alternative combinations of food and clothing. At one extreme, he could buy 4 food units and no clothing; at the other, 6 clothing units and no food. The table with Figure 5A-3 illustrates some of the possible ways in which he could allocate his \$6.

Figure 5A-3 plots five of these possibilities. Note that all the points lie on a straight line, labeled *NM*. Moreover, any other attainable point, such as $3\frac{1}{3}$ food units and 1 clothing unit, lies on *NM*. The straight budget line *NM* sums up all the possible combinations of the two goods that would just exhaust the consumer's income.[1] The slope of *NM* (neglecting its sign) is $\frac{3}{2}$, which is the ratio of the food price to the clothing price. The meaning of the slope is that, given these prices, every time our consumer gives up 3 clothing units (thereby dropping down 3 vertical units on the diagram), he can gain 2 units of food (i.e., move right 2 horizontal units).

We call *NM* the consumer's **budget line or budget constraint.**

[1] This is so because, if we designate quantities of food and clothing bought as *F* and *C*, respectively, total expenditure on food must be $\$1.50F$ and total expenditure on clothing, $\$1C$. If daily income and expenditure are \$6, the following equation must hold: $\$6 = \$1.50F + \$1C$. This is a linear equation, the equation of the budget line *NM*. Note:

$$\begin{aligned}\text{Arithmetic slope of } NM &= \$1.50 \div \$1 \\ &= \text{price of food} \div \text{price of clothing}\end{aligned}$$

THE EQUILIBRIUM POSITION OF TANGENCY

Now we are ready to put our two parts together. The axes of Figure 5A-3 are the same as those of Figures 5A-1 and 5A-2. We can superimpose the blue budget line *NM* upon this green consumer indifference map, as shown in Figure 5A-4. The consumer is free to move anywhere along *NM*. Positions to the right and above *NM* are not allowed because they require more than $6 of income; positions to the left and below *NM* are irrelevant because the consumer is assumed to spend the full $6.

Where will the consumer move? Obviously, to that point which yields the greatest satisfaction—that is, to the highest possible indifference curve—which in this case must be at the green point *B*. At *B*, the budget line just touches, but does not cross, the indifference curve U_3. At this point of tangency, where the budget line just kisses but does not cross an indifference contour, is found the highest utility contour the consumer can reach.

Consumer's Equilibrium

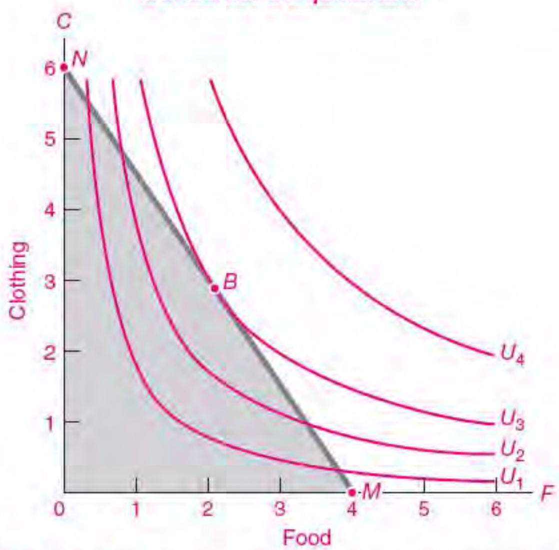


FIGURE 5A-4. Consumer's Most Preferred and Feasible Consumption Bundle Is Attained at *B*

We now combine the budget line and indifference contours in one diagram. The consumer reaches the highest indifference curve attainable with fixed income at point *B*, which is the tangency of the budget line with the highest indifference curve. At tangency point *B*, substitution ratio equals price ratio P_F/P_C. This means that all goods' marginal utilities are proportional to their prices, with the marginal utility of the last dollar spent on every good being equalized.

Geometrically, the consumer is at equilibrium where the slope of the budget line (which is equal to the ratio of food to clothing prices) is exactly equal to the slope of the indifference curve (which is equal to the ratio of the marginal utilities of the two goods).

Consumer equilibrium is attained at the point where the budget line is tangent to the highest indifference curve. At that point, the consumer's substitution ratio is just equal to the slope of the budget line.

Put differently, the substitution ratio, or the slope of the indifference curve, is the ratio of the marginal utility of food to the marginal utility of clothing. So our tangency condition is just another way of stating that the ratio of prices must be equal to the ratio of marginal utilities; in equilibrium, the consumer is getting the same marginal utility from the last penny spent on food as from the last penny spent on clothing. Therefore, we can derive the following equilibrium condition:

$$\frac{P_F}{P_C} = \text{substitution ratio} = \frac{MU_F}{MU_C}$$

This is exactly the same condition as we derived for utility theory in the main part of this chapter.

CHANGES IN INCOME AND PRICE

Two important applications of indifference curves are frequently used to consider the effects of (*a*) a change in money income and (*b*) a change in the price of one of the two goods.

Income Change

Assume, first, that the consumer's daily income is halved while the two prices remain unchanged. We could prepare another table, similar to the table for Figure 5A-3, showing the new consumption possibilities. Plotting these points on a diagram such as Figure 5A-5, we should find that the new budget line occupies the position *N′M′* in Figure 5A-5. The line has made a parallel shift inward.[2] The consumer is

[2] The equation of the new *N′M′* budget line is now $3 = $1.50*F* + $1*C*.

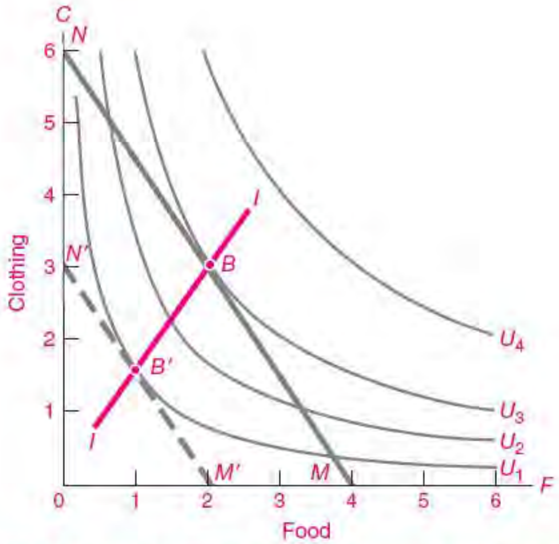


FIGURE 5A-5. Effect of Income Change on Equilibrium

An income change shifts the budget line in a parallel way. Thus, halving income to \$3 shifts *NM* to *N′M′*, moving equilibrium to *B′*. (Show what raising income to \$8 would do to equilibrium. Estimate where the new tangency point would come.)

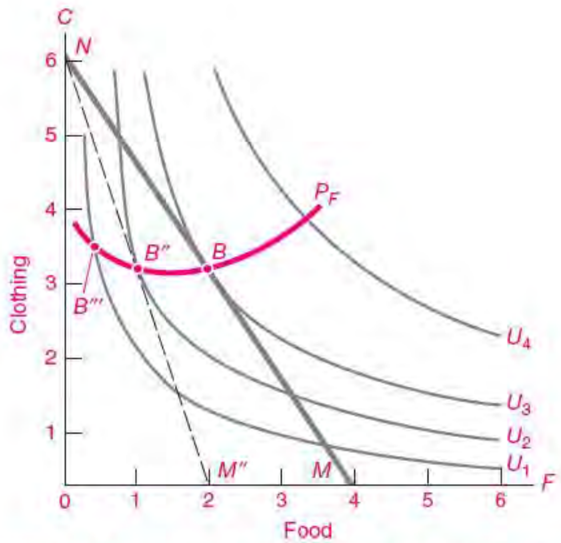


FIGURE 5A-6. Effect of Price Change on Equilibrium

A rise in the price of food makes the budget line pivot on *N*, rotating from *NM* to *NM″*. The new tangency equilibrium is at *B″*, where there is definitely less food consumed but clothing consumption may either go up or down.

now free to move only along this new (and lower) budget line; to maximize satisfaction, he will move to the highest attainable indifference curve, or to point *B′*. A tangency condition for consumer equilibrium applies here as before.

Single Price Change

Now return our consumer to his previous daily income of \$6, but assume that the price of food rises from \$1.50 to \$3 while the price of clothing is unchanged. Again we must examine the change in the budget line. This time we find that it has pivoted on point *N* and is now *NM″*, as illustrated in Figure 5A-6.[3]

The common sense of such a shift is clear. Since the price of clothing is unchanged, point *N* is just as available as it was before. But since the price of food has risen, point *M* (which represents 4 food units) is no longer attainable. With food costing \$3 per unit, only 2 units can now be bought with a daily income of \$6. So the new budget line still passes through *N*, but it must pivot at *N* and pass through *M″*, which is to the left of *M*.

Equilibrium is now at *B″*, and we have a new tangency point. Higher food price has definitely reduced food consumption, but clothing consumption may move in either direction. To clinch your understanding, work out the cases of an increase in income and a fall in the price of clothing or food.

DERIVING THE DEMAND CURVE

We are now in a position to derive the demand curve. Look carefully at Figure 5A-6. Note that as we increased the price of food from \$1.50 per unit to \$3 per unit, we kept other things constant. Tastes as represented by the indifference curves did not change, and money income and the price of clothing stayed constant. Therefore, we are in the ideal position to trace the demand curve for food. At a price of \$1.50, the consumer buys 2 units of food, shown as equilibrium point *B*. When the price rises to \$3 per unit, the food purchased is 1 unit, at equilibrium point

[3] The budget equation of *NM″* is now $\$6 = \$3F + \$1C$.

B''. If you draw in the budget line corresponding to a price of \$6 per unit of food, the equilibrium occurs at point B''', and food purchases are 0.45 unit.

Now plot the price of food against the purchases of food, again holding other things constant. You will have derived a neat downward-sloping demand curve from indifference curves. Note that we have done this without ever needing to mention the term "utility"—basing the derivation solely on measurable indifference curves.

SUMMARY TO APPENDIX

1. An indifference curve depicts the points of equally desirable consumption bundles. The indifference contour is usually drawn convex (or bowl-shaped) in accordance with the law of diminishing relative marginal utilities.
2. When a consumer has a fixed money income, all of which she spends, and is confronted with market prices of two goods, she is constrained to move along a straight line called the budget line or budget constraint. The line's slope will depend on the ratio of the two market prices; how far out it lies will depend on the size of her income.
3. The consumer will move along this budget line until reaching the highest attainable indifference curve. At this point, the budget line will touch, but not cross, an indifference curve. Hence, equilibrium is at the point of tangency, where the slope of the budget line (the ratio of the prices) exactly equals the slope of the indifference curve (the substitution ratio or the ratio of the marginal utilities of the two goods). This gives additional proof that, in equilibrium, marginal utilities are proportional to prices.
4. A fall in income will move the budget line inward in a parallel fashion, usually causing less of both goods to be bought. A change in the price of one good alone will, other things being constant, cause the budget line to pivot so as to change its slope. After a price or income change, the consumer will again attain a new tangency point of highest satisfaction. At every point of tangency, the marginal utility per dollar is equal for every good. By comparing the new and old equilibrium points, we trace the usual downward-sloping demand curve.

CONCEPTS FOR REVIEW

indifference curves
slope or substitution ratio
budget line or budget constraint

convexity of indifference curves and law of diminishing relative marginal utilities

optimal tangency condition:
P_F/P_C = substitution ratio
$= MU_F/MU_C$

QUESTIONS FOR DISCUSSION

1. Draw the indifference curves (*a*) between complementary goods like left shoes and right shoes and (*b*) between perfect substitutes like two bottles of cola sitting next to each other in a store.
2. Consider noodles and yachts. Draw a set of indifference curves and budget lines like those in Figure 5A-5 which show noodles as an inferior good and yachts as a "luxury" with an income elasticity greater than 1.

CHAPTER

6

Production and Business Organization

The business of America is business.

Calvin Coolidge

Before we can eat our daily bread, someone must bake it. Similarly, the economy's ability to build cars, generate electricity, write computer programs, and deliver the multitude of goods and services that are in our gross domestic product depends upon our productive capacity. Productive capacity is determined by the size and quality of the labor force, by the quantity and quality of the capital stock, by the nation's technical knowledge along with the ability to use that knowledge, and by the nature of public and private institutions. Why are living standards high in North America? Low in tropical Africa? For answers, we should look to how well the machine of production is running.

Our goal is to understand how market forces determine the supply of goods and services. Over the next three chapters we will lay out the essential concepts of production, cost, and supply and show how they are linked. We first explore the fundamentals of production theory, showing how firms transform inputs into desirable outputs. Production theory also helps us understand why productivity and living standards have risen over time and how firms manage their internal activities.

A. THEORY OF PRODUCTION AND MARGINAL PRODUCTS

BASIC CONCEPTS

A modern economy has an enormously varied set of productive activities. A farm takes fertilizer, seed, land, and labor and turns them into wheat or corn. Modern factories take inputs such as energy, raw materials, computerized machinery, and labor and use them to produce tractors, DVDs, or tubes of toothpaste. An airline takes airplanes, fuel, labor, and computerized reservation systems and provides passengers with the ability to travel quickly through its network of routes.

The Production Function

We have spoken of inputs like land and labor and outputs like wheat and toothpaste. But if you have a fixed amount of inputs, how much output can you get? On any day, given the available technical knowledge, land, machinery, and so on, only a certain quantity of tractors or toothpaste can be obtained from a given amount of labor. The relationship between the amount of input required and the amount of output that can be obtained is called the *production function.*

The **production function** specifies the maximum output that can be produced with a given quantity of inputs. It is defined for a given state of engineering and technical knowledge.

An important example is the production function for generating electricity. Visualize it as a book with technical specifications for different kinds of plants. One page is for gas turbines, showing their inputs (initial capital cost, fuel consumption, and the amount of labor needed to run the turbine) and their outputs (amount of electricity generated). The next page shows inputs and outputs of coal-fired generating plants. Yet other pages describe nuclear power plants, solar power stations, and so forth. Taken together, they constitute the production function for electricity generation.

Note that our definition assumes that firms always strive to produce efficiently. In other words, they always attempt to produce the maximum level of output for a given dose of inputs.

Consider the humble task of ditchdigging. Outside our windows in America, we see a large and expensive tractor, driven by one person with another to supervise. This team can easily dig a trench 5 feet deep and 50 feet long in 2 hours. When we visit Africa, we see 50 laborers armed only with picks. The same trench might take an entire day. These two techniques—one capital-intensive and the other labor-intensive—are part of the production function for ditchdigging.

There are literally millions of different production functions—one for each and every product or service. Most of them are not written down but are in people's minds. In areas of the economy where technology is changing rapidly, like computer software and biotechnology, production functions may become obsolete soon after they are used. And some, like the blueprints of a medical laboratory or cliff house, are specially designed for a specific location and purpose and would be useless anywhere else. Nevertheless, the concept of a production function is a useful way of describing the productive capabilities of a firm.

Total, Average, and Marginal Product

Starting with a firm's production function, we can calculate three important production concepts: total, average, and marginal product. We begin by computing the total physical product, or **total product,** which designates the total amount of output produced, in physical units such as bushels of wheat or number of sneakers. Figure 6-1(*a*) on page 109 and column (2) of Table 6-1 on page 110 illustrate the concept of total product. For this example, they show how total product responds as the amount of labor applied is increased. The total product starts at zero for zero labor and then increases as additional units of labor are applied, reaching a maximum of 3900 units when 5 units of labor are used.

Once we know the total product, it is easy to derive an equally important concept, the marginal product. Recall that the term "marginal" means "extra."

The **marginal product** of an input is the extra output produced by 1 additional unit of that input while other inputs are held constant.

For example, assume that we are holding land, machinery, and all other inputs constant. Then labor's marginal product is the extra output obtained by adding 1 unit of labor. The third column of Table 6-1 calculates the marginal product. The marginal product of labor starts at 2000 for the first unit of labor and then falls to only 100 units for the fifth unit. Marginal product calculations such as this are crucial for understanding how wages and other factor prices are determined.

The final concept is the **average product,** which equals total output divided by total units of input. The fourth column of Table 6-1 shows the average product of labor as 2000 units per worker with one worker, 1500 units per worker with two workers, and so forth. In this example, average product falls through the entire range of increasing labor input.

Figure 6-1 plots the total and marginal products from Table 6-1. Study this figure to make sure you understand that the blocks of marginal products in (*b*) are related to the changes in the total product curve in (*a*).

The Law of Diminishing Returns

Using production functions, we can understand one of the most famous laws in all economics, the law of diminishing returns:

Under the **law of diminishing returns,** a firm will get less and less extra output when it adds additional

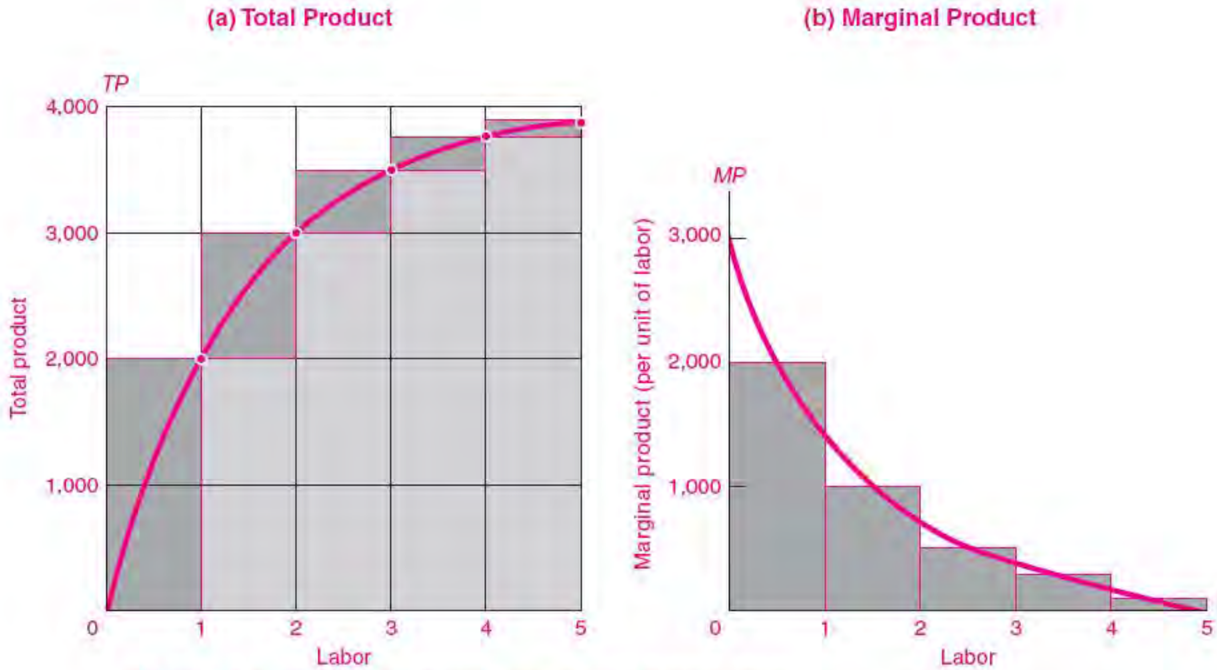


FIGURE 6-1. Marginal Product Is Derived from Total Product

Diagram **(a)** shows the total product curve rising as additional inputs of labor are added, holding other things constant. However, total product rises by smaller and smaller increments as additional units of labor are added (compare the increments of the first and the fifth worker). By smoothing between points, we get the green-colored total product curve.

Diagram **(b)** shows the declining steps of marginal product. Make sure you understand why each dark rectangle in **(b)** is equal to the equivalent dark rectangle in **(a)**. The area in **(b)** under the green-colored marginal product curve (or the sum of the dark rectangles) adds up to the total product in **(a)**.

units of an input while holding other inputs fixed. In other words, the marginal product of each unit of input will decline as the amount of that input increases, holding all other inputs constant.

The law of diminishing returns expresses a very basic relationship. As more of an input such as labor is added to a fixed amount of land, machinery, and other inputs, the labor has less and less of the other factors to work with. The land gets more crowded, the machinery is overworked, and the marginal product of labor declines.

Table 6-1 illustrates the law of diminishing returns. Given fixed land and other inputs, we see that there is zero total output of corn with zero inputs of labor. When we add our first unit of labor to the same fixed amount of land, we observe that 2000 bushels of corn are produced.

In our next stage, with 2 units of labor and fixed land, output goes to 3000 bushels. Hence, the second unit of labor adds only 1000 bushels of additional output. The third unit of labor has an even lower marginal product than does the second, and the fourth unit adds even less. Table 6-1 thus illustrates the law of diminishing returns.

Figure 6-1 also illustrates the law of diminishing returns for labor. Here we see that the marginal product curve in (*b*) declines as labor inputs increase, which is the precise meaning of diminishing returns. In Figure 6-1(*a*), diminishing returns are seen as a concave or dome-shaped total product curve.

(1) Units of labor input	(2) Total product	(3) Marginal product	(4) Average product
0	0		
		2,000	
1	2,000		2,000
		1,000	
2	3,000		1,500
		500	
3	3,500		1,167
		300	
4	3,800		950
		100	
5	3,900		780

TABLE 6-1. Total, Marginal, and Average Product

The table shows the total product that can be produced for different inputs of labor when other inputs (capital, land, etc.) and the state of technical knowledge are unchanged. From total product, we can derive important concepts of marginal and average products.

What is true for labor is also true for any other input. We can interchange land and labor, now holding labor constant and varying land. We can calculate the marginal product of each input (labor, land, machinery, water, fertilizer, etc.), and the marginal product would apply to any output (wheat, corn, steel, soybeans, and so forth). We would find that other inputs also tend to show the law of diminishing returns.

Diminishing Returns in Farm Experiments

The law of diminishing returns is often observed in agriculture. As Farmer Tilly adds more labor, the fields will be more thoroughly seeded and weeded, irrigation ditches will be neater, and scarecrows better oiled. At some point, however, the additional labor becomes less and less productive. The third hoeing of the field or the fourth oiling of the machinery adds little to output. Eventually, output grows very little as more people crowd onto the farm; too many tillers spoil the crop.

Agricultural experiments are one of the most important kinds of technological research. These techniques have been used for over a century to test different seeds, fertilizers, and other combinations of inputs in a successful effort to raise agricultural productivity. Figure 6-2 shows the results of an experiment in which different doses of phosphorus fertilizer were applied on two different plots, holding constant land area, nitrogen fertilizer, labor, and other inputs. Real-world experiments are complicated by "random errors"—in this case, due primarily to differences in soils. You can see that diminishing returns set in quickly after about 100 pounds of phosphorus per acre. Indeed, beyond an input level of around 300 pounds per acre, the marginal product of additional phosphorus fertilizer is negative.

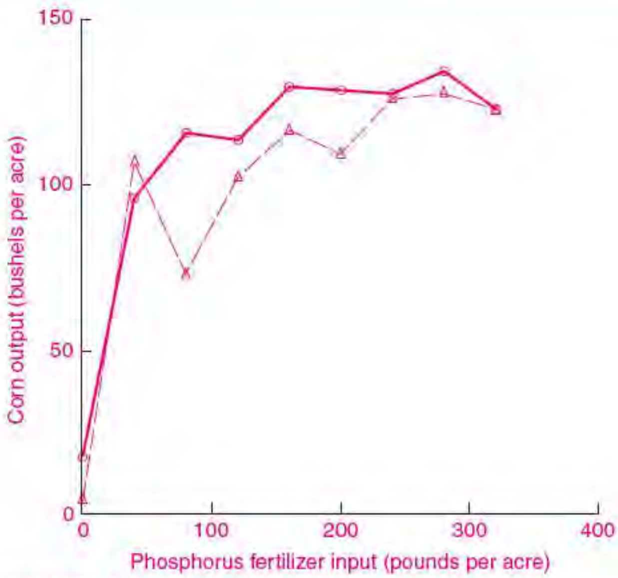


FIGURE 6-2. Diminishing Returns in Corn Production

Agricultural researchers experimented with different doses of phosphorus fertilizer on two different plots to estimate the production function for corn in western Iowa. In conducting the experiment, they were careful to hold constant other things such as nitrogen fertilizer, water, and labor inputs. Because of variations in soils and microclimate, even the most careful scientist cannot prevent some random variation, which accounts for the jagged nature of the lines. If you fit a smooth curve to the data, you will see that the relationship displays diminishing returns for every dose and that marginal product becomes negative for a phosphate input of around 300.

Source: Earl O. Heady, John T. Pesek, and William G. Brown, *Crop Response Surfaces and Economic Optima in Fertilizer Use* (Agricultural Experiment Station, Iowa State College, Ames, Iowa, 1955), table A-15.

Diminishing returns are a key factor in explaining why many countries in Asia are so poor. Living standards in crowded Rwanda or Bangladesh are low because there are so many workers per acre of land and not because farmers are ignorant or fail to respond to economic incentives.

We can also use the example of studying to illustrate the law of diminishing returns. You might find that the first hour of studying economics on a given day is productive—you learn new laws and facts, insights and history. The second hour might find your attention wandering a bit, with less learned. The third hour might show that diminishing returns have set in with a vengeance, and by the next day the third hour is a blank in your memory. Does the law of diminishing returns suggest why the hours devoted to studying should be spread out rather than crammed into the day before exams?

The law of diminishing returns is a widely observed empirical regularity rather than a universal truth like the law of gravity. It has been found in numerous empirical studies, but exceptions have also been uncovered. Moreover, diminishing returns might not hold for all levels of production. The very first inputs of labor might actually show increasing marginal products, since a minimum amount of labor may be needed just to walk to the field and pick up a shovel. Notwithstanding these reservations, diminishing returns will prevail in most situations.

RETURNS TO SCALE

Diminishing returns and marginal products refer to the response of output to an increase of a *single* input when all other inputs are held constant. We saw that increasing labor while holding land constant would increase food output by ever-smaller increments.

But sometimes we are interested in the effect of increasing *all* inputs. For example, what would happen to wheat production if land, labor, water, and other inputs were increased by the same proportion? Or what would happen to the production of tractors if the quantities of labor, computers, robots, steel, and factory space were all doubled? These questions refer to the *returns to scale,* or the effects of scale increases of inputs on the quantity produced. Three important cases should be distinguished:

- **Constant returns to scale** denote a case where a change in all inputs leads to a proportional change in output. For example, if labor, land, capital, and other inputs are doubled, then under constant returns to scale output would also double. Many handicraft industries (such as haircutting in America or handloom operation in a developing country) show constant returns.
- **Increasing returns to scale** (also called **economies of scale**) arise when an increase in all inputs leads to a more-than-proportional increase in the level of output. For example, an engineer planning a small-scale chemical plant will generally find that increasing the inputs of labor, capital, and materials by 10 percent will increase the total output by more than 10 percent. Engineering studies have determined that many manufacturing processes enjoy modestly increasing returns to scale for plants up to the largest size used today.
- **Decreasing returns to scale** occur when a balanced increase of all inputs leads to a less-than-proportional increase in total output. In many processes, scaling up may eventually reach a point beyond which inefficiencies set in. These might arise because the costs of management or control become large. One case has occurred in electricity generation, where firms found that when plants grew too large, risks of plant failure grew too large. Many productive activities involving natural resources, such as growing wine grapes or providing clean drinking water to a city, show decreasing returns to scale.

Production shows increasing, decreasing, or constant returns to scale when a balanced increase in all inputs leads to a more-than-proportional, less-than-proportional, or just-proportional increase in output.

One of the common findings of engineers is that modern mass-production techniques require that factories be a certain minimum size. Chapter 2 explained that as output increases, firms may divide production into smaller steps, taking advantage of specialization and division of labor. In addition, large-scale production allows intensive use of specialized capital equipment, automation, and computerized

Production concept	Definition
Diminishing returns	Declining marginal product of an input, holding all other inputs constant
Returns to scale	Increase in output for balanced increase in all inputs is
Decreasing	. . . less than proportional
Constant	. . . proportional
Increasing	. . . more than proportional

TABLE 6-2. Important Production Concepts

This table shows succinctly the important production concepts.

design and manufacturing to perform simple and repetitive tasks quickly.

Information technologies often display strong economies of scale. A good example is Microsoft's Windows Vista operating system. Developing this program reportedly required $10 billion in research, development, beta-testing, and promotion. Yet the cost of adding Windows Vista to a new computer is very close to zero because doing so simply requires a few seconds of computer time. We will see that strong economies of scale often lead to firms with significant market power and sometimes pose major problems of public policy.

Table 6-2 summarizes the important concepts from this section.

SHORT RUN AND LONG RUN

Production requires not only labor and land but also time. Pipelines cannot be built overnight, and once built they last for decades. Farmers cannot change crops in midseason. It often takes a decade to plan, construct, test, and commission a large power plant. Moreover, once capital equipment has been put in the concrete form of a giant automobile assembly plant, the capital cannot be economically dismantled and moved to another location or transferred to another use.

To account for the role of time in production and costs, we distinguish between two different time periods. We define the **short run** as a period in which firms can adjust production by changing variable factors such as materials and labor but cannot change fixed factors such as capital. The **long run** is a period sufficiently long that all factors including capital can be adjusted.

To understand these concepts more clearly, consider the way the production of steel might respond to changes in demand. Say that Nippon Steel is operating its furnaces at 70 percent of capacity when an unexpected increase in the demand for steel occurs because of the need to rebuild from an earthquake in Japan or California. To adjust to the higher demand for steel, the firm can increase production by increasing worker overtime, hiring more workers, and operating its plants and machinery more intensively. The factors which are increased in the short run are called *variable* factors.

Suppose that the increase in steel demand persisted for an extended period of time, say, several years. Nippon Steel would examine its capital needs and decide that it should increase its productive capacity. More generally, it might examine all its *fixed* factors, those that cannot be changed in the short run because of physical conditions or legal contracts. The period of time over which all inputs, fixed and variable, can be adjusted is called the long run. In the long run, Nippon might add new and more efficient production processes, install a rail link or new computerized control system, or build a plant in Mexico. When all factors can be adjusted, the total amount of steel will be higher and the level of efficiency can increase.

Efficient production requires time as well as conventional inputs like labor. We therefore distinguish between two different time periods in production and cost analysis. The short run is the period of time in which only some inputs, the variable inputs, can be adjusted. In the short run, fixed factors, such as plant and equipment, cannot be fully modified or adjusted. The long run is the period in which all factors employed by the firm, including capital, can be changed.

That Smells So Good!

The production processes of a modern market economy are extraordinarily complex. We can illustrate this with the lowly hamburger.

As Americans spend more time in the workplace and less in the kitchen, their demand for prepared food has risen dramatically. TV dinners have replaced store-bought carrots and peas, while hamburgers bought at McDonald's now number in the billions. The move to processed foods has the undesirable property that the food—after being washed, sorted, sliced, blanched, frozen, thawed, and reheated—often loses most of its flavor. You want a hamburger to smell and taste like a hamburger, not like cooked cardboard.

This is where the "production of tastes and smells" enters. Companies like International Flavors and Fragrances (IFF) synthesize the flavor of potato chips, breakfast cereals, ice cream, cookies, and just about every other kind of processed food, along with the fragrance of many fine perfumes, soaps, and shampoos. If you read most food labels, you will discover that the food contains "natural ingredients" or "artificial ingredients"—such compounds as amyl acetate (banana flavor) or benzaldehyde (almond flavor).

But these unfamiliar chemicals can do amazing things. A food researcher recounts the following experience in the laboratories of IFF:

> [After dipping a paper fragrance-testing filter into each bottle from the lab,] I closed my eyes. Then I inhaled deeply, and one food after another was conjured from the glass bottles. I smelled fresh cherries, black olives, sautéed onions, and shrimp. [The] most remarkable creation took me by surprise. After closing my eyes, I suddenly smelled a grilled hamburger. The aroma was uncanny, almost miraculous. It smelled like someone in the room was flipping burgers on a hot grill. But when I opened my eyes, there was just a narrow strip of white paper.[1]

This story reminds us that "production" in a modern economy is much more than planting potatoes and casting steel. It sometimes involves disassembling things like chickens and potatoes into their tiny constituents, and then reconstituting them along with new synthesized tastes halfway around the world. Such complex production processes can be found in every sector, from pharmaceuticals that change our mood or help our blood flow more smoothly to financial instruments that take apart, repackage, and sell the streams of mortgage payments. And most of the time, we don't even know what exotic substances lie inside the simple (recycled) paper that wraps our $2 hamburger.

[1] Eric Schlosser, *Fast Food Nation* (Perennial Press, New York, 2002), p. 129.

TECHNOLOGICAL CHANGE

Economic history records that total output in the United States has grown more than tenfold over the last century. Part of that gain has come from increased inputs, such as labor and machinery. But much of the increase in output has come from technological change, which improves productivity and raises living standards.

Some examples of technological change are dramatic: wide-body jets that increased the number of passenger-miles per unit of input by almost 50 percent; fiber optics that have lowered cost and improved reliability in telecommunications; and improvements in computer technologies that have increased computational power by more than 1000 times in three decades. Other forms of technological change are more subtle, as is the case when a firm adjusts its production process to reduce waste and increase output.

We distinguish *process innovation,* which occurs when new engineering knowledge improves production techniques for existing products, from *product innovation,* whereby new or improved products are introduced in the marketplace. For example, a process innovation allows firms to produce more output with the same inputs or to produce the same output with fewer inputs. In other words, a process innovation is equivalent to a shift in the production function.

Figure 6-3 illustrates how technological change, in the form of a process innovation, would shift the total product curve. The lower line represents the feasible output, or production function, for a particular industry in the year 1995. Suppose that productivity, or output per unit of input, in this industry is rising at 4 percent per year. If we return to the same industry a decade later, we would likely see that changes in technical and engineering knowledge have led to a 48 percent improvement in output per unit of input $[(1 + .04)^{10} = 1.48]$.

Next, consider product innovations, which involve new and improved products. It is much more difficult to quantify the importance of product innovations, but they may be even more important in raising living standards than process innovations. Many of today's goods and services did not even exist 50 years ago. In producing this textbook, the authors used computer software, microprocessors, Internet

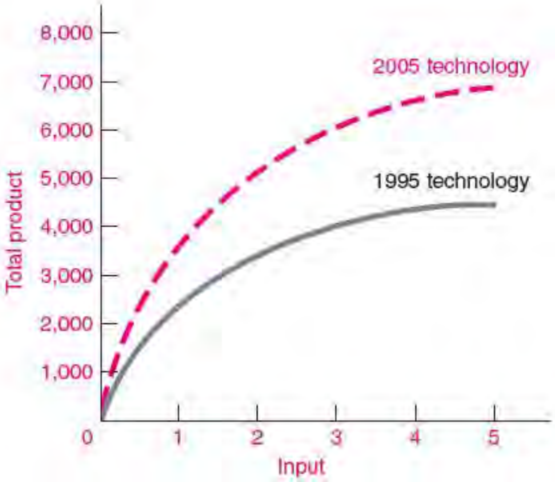


FIGURE 6-3. Technological Change Shifts Production Function Upward

The solid line represents maximum producible output for each level of inputs given the state of technical knowledge in 1995. As a result of improvements in computer technology and management practices, technological change shifts the production function upward, allowing much more output to be produced in 2005 for each level of inputs.

sites, and databases that were not available a decade ago. Medicine, communications, and entertainment are other sectors where product innovations have been critical. The whole arena of the Internet, from e-commerce to e-mail, was not found even in science fiction literature 30 years ago. For fun, and to see this point, try to find any commodity or production process that has not changed since your grandparents were your age!

Figure 6-3 shows the happy case of a technological advance. Is the opposite case—technological regress—possible? The answer is no for a well-functioning market economy. Inferior technologies are unprofitable and tend to be discarded in a market economy, while more productive technologies are introduced because they increase the profits of the innovating firms. To see this, suppose that someone invents an expensive new mousetrap that will never catch a mouse. No profit-oriented firm would produce such a device; and if a poorly managed firm decided to produce it, rational consumers who lived in mouse-infested houses would decline to buy it. Well-functioning markets innovate with better, not inferior, mousetraps.

When there are market failures, however, technological regress might occur. An unregulated company might introduce a socially wasteful process, say, dumping toxic wastes into a stream, because the wasteful process is more profitable. *But the economic advantage of inferior technologies comes only because the social costs of pollution are not included in the firm's calculations of the costs of production.* If pollution costs were included in a firm's decisions, say by pollution taxes, the regressive process would no longer be profitable. In competitive markets, inferior products follow Neanderthals into extinction.

Networks

Many products have little use by themselves and generate value only when they are used in combination with other products. Such products are strongly complementary. An important case is a *network,* where different people are linked together through a particular medium. Types of networks include both those defined by physical linkages, such as telecommunication systems, electricity transmission networks, computer clusters, pipelines, and roads, and the indirect networks that occur when people use compatible systems (such as Windows operating systems) or speak the same language (such as English).

To understand the nature of networks, consider how far you could drive your car without a network of gas stations or how valuable your telephone or e-mail would be if no one else had telephones or computers.

Network markets are special because consumers derive benefits not simply from their own use of a good but also from the number of other consumers who adopt the good. This is known as an *adoption externality.* When I get a phone, everyone else with a phone can now communicate with me. Therefore, my joining this network leads to positive external effects for others. The network externality is the reason why many colleges provide universal e-mail for all their students and faculty—the value of e-mail is much higher when everyone participates. Figure 6-4 on page 115 illustrates how one individual's joining a network has an external benefit to others.

Economists have discovered many important features of network markets. First, network markets are "tippy," meaning that the equilibrium tips toward one or only a

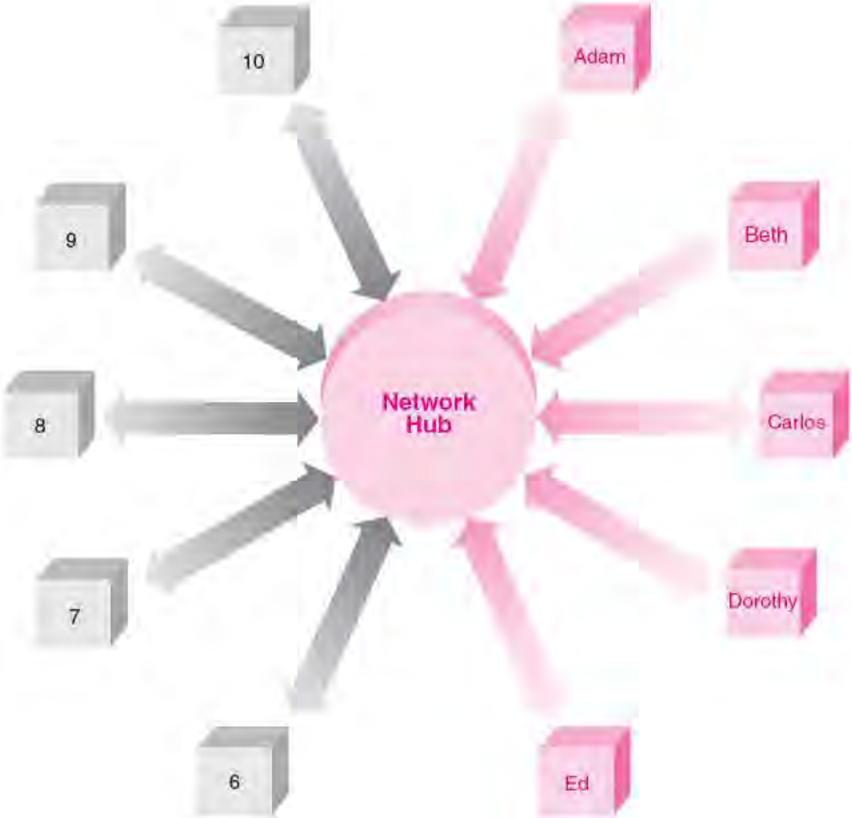


FIGURE 6-4. Value of Networking Increases as Membership Rises

Assume that each person derives a value of $1 for each additional person who is connected to a telephone or e-mail network. If Ed decides to join, he will get $4 of value from being connected to Adam, Beth, Carlos, and Dorothy. But there is an "adoption externality" because each of the four people already in the network gets $1 of additional value when Ed joins, for a total of $4 of external additional value.

These network effects make it difficult for networks to get started. To see this point, note that the second or third person who joins the network gets little value from joining. But when many people are in the network, each new member has a high value of joining because they are networked with a large number of people. (As an exercise, calculate the value of joining for the second and for the tenth people who join the network.)

few products. Because consumers dislike buying products that may turn out to be incompatible with dominant technologies, the equilibrium tends to gravitate to a single product which wins out over its rivals. One of the best-known examples is computer operating systems, where Microsoft Windows became the dominant system in part because consumers wanted to make sure that their computers could operate all the available software. (The important antitrust case involving Microsoft is discussed in Chapter 10.)

A second interesting feature is that "history matters" in network markets. A famous example is the QWERTY keyboard used with your computer. You might wonder why this particular configuration of keys, with its awkward placement of the letters, became the standard. The design of the QWERTY keyboard in the nineteenth century was based on the concept of keeping frequently used keys (like "e" and "o") physically separated in order to prevent manual typewriters from jamming. By the time the technology for electronic typing evolved, tens of millions of people had already learned to type on millions of typewriters. Replacing the QWERTY keyboard with a more efficient design would have been both expensive and difficult to coordinate. Thus, the placement of the letters remains unchanged on today's keyboards.

This example shows how an embedded network technology can be extremely stable. A similar example that worries many environmentalists is America's "wasteful" automobile culture, where the existing network of cars, roads, gasoline stations, and residential locations will be difficult to dislodge in favor of more environmentally friendly alternatives, like improved mass transit.

Third, because networks involve a complicated interplay of economies of scale, expectations, dynamics, and tipping, they lead to a fascinating array of business strategies. The tippy nature of networks means that they tend to be "winner-take-all" markets with intense rivalry in the early stages and but a few competitors once the winning technology has emerged. In addition, network markets are often inertial, so once a product has a substantial lead, it may be very difficult for other products to catch up. These characteristics mean that companies often want to get an early lead on their rivals.

Suppose you are producing a network product. In order to build on your early lead, you might persuade users that you are number one by puffing up your sales; use "penetration pricing" by offering very low prices to early adopters; bundle your product with another popular product; or raise questions about your competitors' quality or staying power. Above all, you would probably invest heavily in advertising to shift out the demand curve for the product. If you are the fortunate winner, you will benefit from the economies of scale in the network and enjoy your monopoly profits. But don't take your dominant position for granted. Once your commanding lead is questioned, the virtuous cycle of market dominance can easily turn into the vicious cycle of market decline.

Networks raise important issues for public policy. Should government set standards to ensure competition? Should government regulate network industries? How should government antitrust policy treat monopolists like Microsoft that have been the fortunate winners in the network race but use anticompetitive tactics? These questions are on the minds of many public policymakers today.[2]

[2] See the Further Reading section at the end of this chapter.

PRODUCTIVITY AND THE AGGREGATE PRODUCTION FUNCTION

Productivity

One of the most important measures of economic performance is productivity. **Productivity** is a concept measuring the ratio of total output to a weighted average of inputs. Two important variants are **labor productivity,** which calculates the amount of output per unit of labor, and **total factor productivity,** which measures output per unit of total inputs (typically of capital and labor).

Productivity Growth from Economies of Scale and Scope

A central concept in economics is *productivity,* a term denoting the ratio of output to inputs. Economists typically look at two measures of productivity. Total factor productivity is output divided by an index of all inputs (labor, capital, materials, . . .), while labor productivity measures output per unit of labor (such as hours worked). When output is growing faster than inputs, this represents **productivity growth.**

Productivity grows because of technological advances such as the process and product innovations described above. Additionally, productivity grows because of economies of scale and scope.

Economies of scale and mass production have been important elements of productivity growth since the Industrial Revolution. Most production processes are many times larger than they were during the nineteenth century. A large ship in the mid-nineteenth century could carry 2000 tons of goods, while the largest supertankers today carry over 1 million tons of oil.

If increasing returns to scale prevail, the larger scale of inputs and production would lead to greater productivity. Suppose that, with no change in technology, the typical firm's inputs increased by 10 percent and that, because of economies of scale, output increased by 11 percent. Economies of scale would be responsible for a growth in total factor productivity of 1 percent.

A different kind of efficiency arises when there are **economies of scope,** which occur when a number of different products can be produced more efficiently together than apart. A prominent example is seen for computer software. Software programs often incorporate additional features as they evolve. For example, when consumers buy software to prepare their federal income taxes, the CD-ROM usually contains several other modules, including a link to a Web page, government documents, and a tax preparation manual. This shows economies of scope because the different modules can be more inexpensively produced, packaged, and used together than separately. Economies of scope are like the specialization and division of labor that increase productivity as economies become larger and more diversified.

While increasing returns to scale and scope are potentially large in many sectors, at some point decreasing returns to scale and scope may take hold. As firms become larger and larger, the problems of management and coordination become increasingly difficult. In relentless pursuit of greater profits, a firm may find itself expanding into more geographic markets or product lines than it can effectively manage. A firm can have only one chief executive officer, one chief financial officer, and one board of directors. With less time to study each market and spend on each decision, top managers may become insulated from day-to-day production and begin to make mistakes. Like empires that have been stretched too thin, such firms find themselves vulnerable to invasion by smaller and more agile rivals.

Empirical Estimates of the Aggregate Production Function

Now that we have examined the principles of production theory, we can apply these theories to measure how well the whole U.S. economy has performed in recent years. To do this, we need to look at *aggregate production functions,* which relate total output to the quantity of inputs (like labor, capital, and land). What have economic studies found? Here are a few of the important results:

- Total factor productivity has been increasing over the last century because of technological progress and higher levels of worker education and skill.
- The average rate of total productivity growth was slightly under 1½ percent per year since 1900.
- Over the twentieth century, labor productivity (output per hour worked) grew at an average rate of slightly more than 2 percent per year. From the early 1970s to the mid-1990s, however, all measures of productivity showed a marked slowdown in growth, and real wages and living standards consequently stagnated over this period. Since the mid-1990s, fueled largely by information technologies, there has been a marked upturn in productivity growth, with rates above the historical norm. (Figure 6-5 shows the historical trends.)
- The capital stock has been growing faster than the number of worker-hours. As a result, labor has a growing quantity of capital goods to work with; hence, labor productivity and wages have tended to rise even faster than the 1½ percent per year attributable to total factor productivity growth alone.

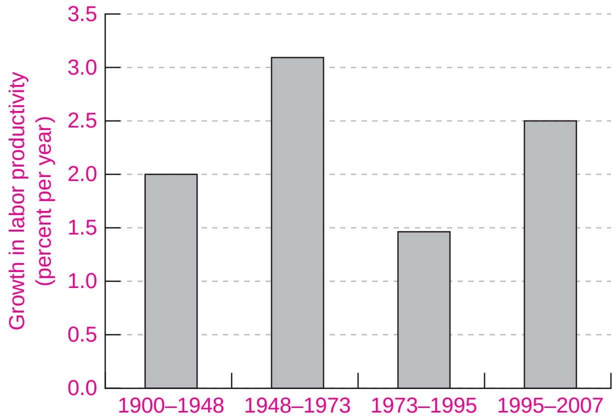


FIGURE 6-5. Growth in Labor Productivity

We see here the average growth in total productivity per hour worked during different periods. The last half-century had rapid growth after World War II, then a slowdown during the troubled 1970s and 1980s, and rapid growth during the period of rapid penetration of information technologies since 1995.

Source: Bureau of Labor Statistics and private scholars.

We end with a final word on the difficulties of measuring productivity growth accurately. Recent empirical studies suggest that we have seriously underestimated productivity growth in some areas. Studies of medical care, capital goods, consumer electronics, computers, and computer software indicate that our measuring rod for productivity is distorted. One particularly important shortcoming is the failure to account for the economic value of new and improved products. For example, when compact discs replaced "long-playing records," our measures of productivity did not include the improvement in durability and sound quality. Similarly, our economic accounts cannot accurately measure the contribution of the Internet to consumer economic welfare.

B. BUSINESS ORGANIZATIONS

THE NATURE OF THE FIRM

So far we have talked about production functions as if they were machines that could be operated by anyone: put a pig in one end and a sausage comes out the other. In reality, almost all production is done by specialized organizations—the small, medium, and large businesses that dominate the landscape of modern economies. Why does production generally take place in firms rather than in our basements?

Firms or business enterprises exist for many reasons, but the most important is that *business firms are specialized organizations devoted to managing the process of production*. Among their important functions are exploiting economies of mass production, raising funds, and organizing factors of production.

In the first place, production is organized in firms because of *economies of specialization*. Efficient production requires specialized labor and machinery, coordinated production, and the division of production into many small operations. Consider a service such as a college education. This activity requires specialized personnel to teach economics and mathematics and Spanish, to produce the meals and housing services, to keep records, collect tuition, and pay the bills. We could hardly expect that a student could organize all these activities by herself. If there were no need for specialization and division of labor, we could each produce our own college education, surgical operations, electricity, and compact discs in our own backyard or buy them on the Internet. We obviously cannot perform such feats; efficiency generally requires large-scale production in businesses.

A second function of firms is *raising resources* for large-scale production. Developing a new commercial aircraft costs billions of dollars or Euros; the research and development expenses for a new computer microprocessor are just as high. Where are such funds to come from? In the nineteenth century, businesses could often be financed by wealthy, risk-taking individuals. Today, in a private-enterprise economy, most funds for production must come from company profits or from money borrowed in financial markets. Indeed, efficient production by private enterprise would be virtually unthinkable if corporations could not raise billions of dollars each year for new projects.

A third reason for the existence of firms is to *manage and coordinate the production process*. Once all the factors of production are engaged, someone has to monitor their daily activities to ensure that the job is being done effectively and honestly. The manager is the person who organizes production, introduces new ideas, products, or processes, makes the business decisions, and is held accountable for success or failure. Production cannot, after all, organize itself. Someone has to supervise the construction of a new factory, negotiate with labor unions, and purchase materials and supplies.

Take the case of a baseball team. How likely is it that 25 people would organize themselves into just the right combination of pitchers, catchers, and hitters, all in the right order and using the best strategy? If you were to purchase the franchise for a baseball team, you would have to rent a stadium, hire baseball players, negotiate with people for concessions, hire ushers, deal with unions, and sell tickets. This is the role of firms, to manage the production process, purchasing or renting land, capital, labor, and materials.

Business firms are specialized organizations devoted to managing the process of production. Production is organized in firms because efficiency generally requires large-scale production, the raising of significant financial resources, and careful management and coordination of ongoing activities.

Production in the Firm or the Market?

If markets are such a powerful mechanism for efficiency, why does so much production take place within large organizations? A related question is, Why do some firms decide on an integrated production structure while others contract out a large fraction of their sales? For example, before 1982 AT&T was vertically and horizontally integrated, doing its own research and development, designing and producing its own equipment, installing and renting telephones, and providing telephone service. By contrast, most personal computers are "produced" by assemblers who purchase the hard drives, circuits, monitors, and keyboards from outside vendors and package and sell them.

These central issues of industrial organization were first raised by Ronald Coase in a pathbreaking study for which he was awarded the 1991 Nobel Prize.[3] This exciting area analyzes the comparative advantage of organizing production through the hierarchical control of firms as compared to the contractual relationships of the market.

Why might organizing through large firms be efficient? Perhaps the most important reason is the difficulty of designing "complete contracts" that cover all contingencies. For example, suppose Snoozer Inc. thinks it has discovered a hot new drug to cure laziness. Should it do the research in its own laboratories or contract out to another company, WilyLabs, Inc.? The problem with contracting out is that there are all kinds of unforeseen contingencies that could affect the profitability of the drug. What would happen if the drug proves useful for other conditions? What if the patent, tax, or international-trade laws change? What if there is a patent-infringement suit?

Because of the contractual incompleteness, the company runs the risk of the *holdup problem*. Suppose that WilyLabs discovers that the antilaziness drug works only when taken with another drug that WilyLabs owns. WilyLabs goes to Snoozer and says, "Sorry, pal, but to get both drugs will cost you another $100 million." This is holdup with a vengeance. Fear of being held up in situations which involve relationship-specific investments and contractual incompleteness will lead Snoozer to do the research internally so that it can control the outcomes of its research.

The recent trend in many industries has been to move away from highly integrated firms by "outsourcing" or contracting out production. This has definitely been the trend in the computer industry since the days when IBM was almost as integrated as AT&T. Contracting out can function well in situations where, as in the PC industry, the components are standardized or "commoditized." Another example is Nike, which contracts out much of its production because the production process is standard and Nike's real value is tied to its design and trademark. In addition, new contractual forms, such as long-term contracts based on reputations, attempt to minimize holdup problems.

[3] See the Further Reading section at the end of this chapter for examples of Coase's and related writings.

Those who study organizations point to the vital importance of large firms in promoting innovation and increasing productivity. In the nineteenth century, railroads not only brought wheat from farm to market but also introduced time zones. Indeed, the very notion of being "on time" first became crucial when being off schedule produced train wrecks. As the tragic story of centrally planned economies so clearly shows, without the organizational genius of the modern private-enterprise firm, all the land, labor, and capital can work for naught.

BIG, SMALL, AND INFINITESIMAL BUSINESSES

Production in a market economy takes place in a wide variety of business organizations—from the tiniest individual proprietorships to the giant corporations that dominate economic life in a capitalist economy. There are currently around 30 million different businesses in America. The majority of these are tiny units owned by a single person—the individual proprietorship. Others are partnerships, owned by two or perhaps two hundred partners. The largest businesses tend to be corporations.

Tiny businesses predominate in numbers. But in sales and assets, in political and economic power, and in size of payroll and employment, the few hundred largest corporations dominate the economy.

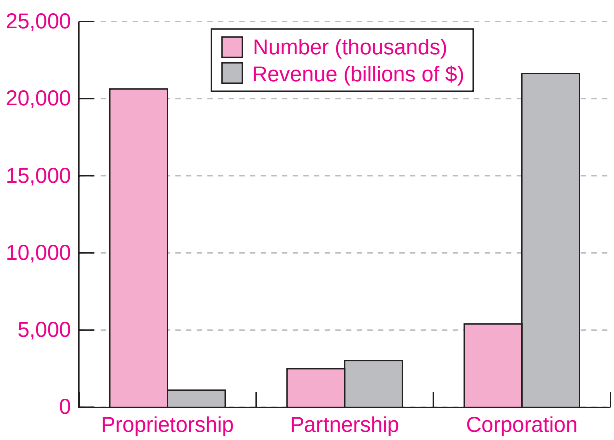


FIGURE 6-6. Number and Size of Different Business Forms, 2004

Corporations are fewer in number but dominate the economy.

Source: Internal Revenue Service.

Figure 6-6 shows the number and total revenue of the three major forms of economic organization in the United States.

The Individual Proprietorship

At one end of the spectrum are the individual proprietorships, the classic small businesses often called "mom-and-pop" stores. A small store might do a few hundred dollars of business per day and barely provide a minimum wage for the owners' efforts.

These businesses are large in number but small in total sales. For most small businesses, a tremendous amount of personal effort is required. The self-employed often work 50 or 60 hours per week and take no vacations, yet the average lifetime of a small business is only a year. Still, some people will always want to start out on their own. Theirs may be the successful venture that gets bought out for millions of dollars.

The Partnership

Often a business requires a combination of talents—say, lawyers or doctors specializing in different areas. Any two or more people can get together and form a partnership. Each agrees to provide a fraction of the work and capital and to share a percentage of the profits and losses.

Today, partnerships account for only a small fraction of total economic activity, as Figure 6-6 shows. Up to recently, partnerships were unattractive because they imposed *unlimited liability.* Under unlimited liability, partners are liable without limit for all debts contracted by the partnership. If you own 1 percent of the partnership and the business fails, you will be called upon to pay 1 percent of the bills. However, if your partners cannot pay, you may be called upon to pay all the debts, even if you must sell off your prized possessions to do so. Some states in the United States allow limited-liability partnerships for certain professions like law and architecture.

Except for a few sectors involving real estate and professionals, partnerships are cumbersome to administer and are less important than the corporate form of organization for most businesses.

The Corporation

The bulk of economic activity in an advanced market economy takes place in private corporations. Centuries ago, corporate charters were awarded by special acts of the monarch or legislature. The British East India Company was a privileged corporation and as such it practically ruled India for more than a century. In the nineteenth century, railroads often had to spend as much money on getting a charter through the legislature as on preparing their roadbeds. Over the past century, laws have been passed that allow almost anyone the privilege of forming a corporation for almost any purpose.

Today, a **corporation** is a form of business organization chartered in one of the 50 states or abroad and owned by a number of individual stockholders. The corporation has a separate legal identity, and indeed is a legal "person" that may on its own behalf buy, sell, borrow money, produce goods and services, and enter into contracts. In addition, the corporation enjoys the right of *limited liability,* whereby each owner's investment and financial exposure in the corporation is strictly limited to a specified amount.

The central features of a modern corporation are the following:

- The ownership of a corporation is determined by the ownership of the company's common stock. If you own 10 percent of a corporation's shares, you have 10 percent of the ownership. Publicly owned corporations are valued on stock exchanges, like the New York Stock Exchange. It is in such stock markets that the titles to the largest corporations are traded and that much of the nation's risk capital is raised and invested.
- In principle, the shareholders control the companies they own. They collect dividends in proportion to the fraction of the shares they own, and they elect directors and vote on many important issues. But don't think that the shareholders have a significant role in running giant corporations. In practice, shareholders of giant corporations exercise virtually no control because they are too dispersed to overrule the entrenched managers.
- The corporation's managers and directors have the legal power to make decisions for the corporation. They decide what to produce and how to produce it. They negotiate with labor unions and decide whether to sell the firm if another firm wishes to take it over. When the newspaper announces that a firm has laid off 20,000 workers, this decision was made by the managers. The shareholders own the corporation, but the managers run it.

Advantages and Disadvantages of Corporations. Corporations are the dominant form of organization in a market economy because they are an extremely efficient way to engage in business. A corporation is a legal person that can conduct business. Also, the corporation may have perpetual succession or existence, regardless of how many times the shares of stock change hands. Corporations are hierarchical, with the chief executive officer (CEO) exercising such power that they are sometimes called "autocratic" organizations. Managers can make decisions quickly, and often ruthlessly, which is in stark contrast to the way economic decisions are made by legislatures.

In addition, corporate stockholders enjoy limited liability, which protects them from incurring the debts or losses of the corporation beyond their initial contribution. If we buy $1000 worth of stock, we cannot lose more than our original investment.

Corporations face one major disadvantage: The government levies an extra tax on corporate profits. For an unincorporated business, any income after expenses is taxed as ordinary personal income. The large corporation is treated differently in that some of its income is doubly taxed—first as corporate profits and then as individual income on dividends.

Economists have criticized the corporation income tax as "double taxation" and have sometimes proposed integrating the corporate tax with the individual tax system. Under tax integration, corporate income is allocated to individuals and then taxed as individual income.

Sometimes, corporations undertake actions that provoke public outrage and government actions. In the late nineteenth century, corporations engaged in fraud, price fixing, and bribery, which led to enactment of antitrust and securities-fraud legislation. In the last few years, corporate scandals erupted when it was discovered that some companies engaged in massive accounting fraud and many corporate executives feathered their nests with huge bonuses and stock options. In private as in public life, power sometimes corrupts.

Efficient production often requires large-scale enterprises, which need billions of dollars of invested capital. Corporations, with limited liability and a convenient management structure, can attract large supplies of private capital, produce a variety of related products, and pool investor risks.

Ownership, Control, and Executive Compensation

The operation of large corporations raises important issues of public policy. They control much of a market economy, yet they are not controlled by the public. Indeed, scholars have come to recognize that they are not really controlled by their owners. Let us review some of the issues here.

The first step in understanding large corporations is to realize that most large corporations are "publicly owned." Corporate shares can be bought by anyone, and ownership is spread among many investors. Take a company like IBM, which was worth about $170 billion in 2008. Tens of millions of people have a financial interest in IBM through their mutual funds or pension accounts. However, no single person owned even 0.1 percent of the total. Such dispersed ownership is typical of our large publicly owned corporations.

Because the stock of large companies is so widely dispersed, *ownership is typically divorced from control.* Individual owners cannot easily affect the actions of large corporations. And while the stockholders of a company do in principle elect its board of directors—a group of insiders and knowledgeable outsiders—it is the management that makes the major decisions about corporate strategy and day-to-day operations.

In some situations, there is no conflict of interest between management and stockholders. Higher profits benefit everyone. But one important potential conflict between managers and stockholders has caught people's attention—the question of executive compensation. Top managers are able to extract from their boards large salaries, stock options, expense accounts, bonuses, free apartments, expensive artwork, and generous retirement pensions at the stockholders' expense. Nobody is arguing that managers should work for the minimum wage, but executive pay in U.S. corporations has risen very rapidly in recent years. Some top executives at poorly performing companies—or even at companies like WorldCom or Enron which later went bankrupt—received salaries and bonuses totaling $100 million or more.

Figure 6-7 shows an arresting graph: the ratio of the average pay of the top executives in the largest firms to that of the average worker. That ratio rose

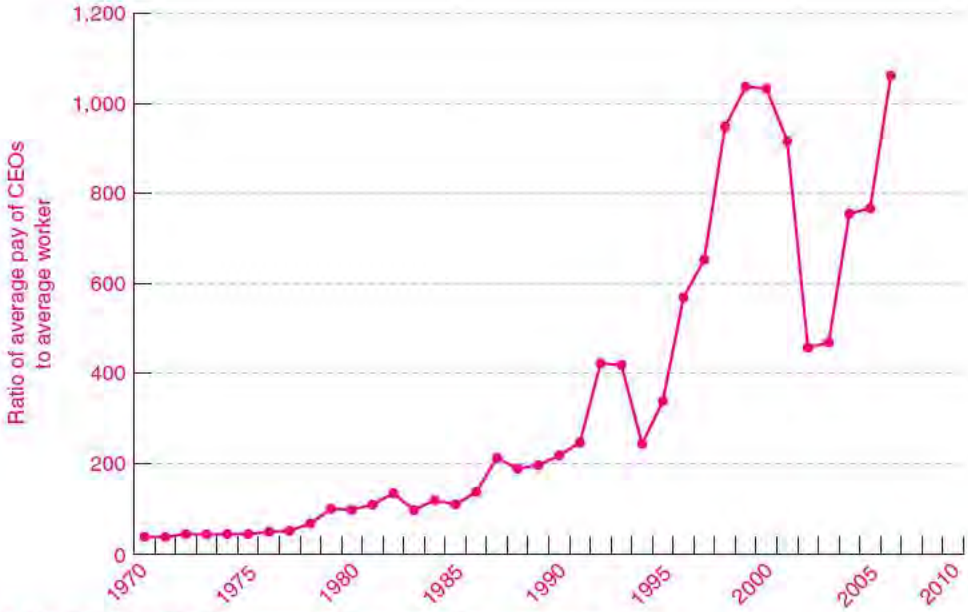


FIGURE 6-7. The Explosion in Executive Compensation

The figure shows the ratio of the average pay of the top 100 chief executive officers (CEOs) of U.S. corporations to the pay of the average U.S. worker. The ratio has risen from around 40 in 1970 to over 1000 in the mid-2000s. Many factors lie behind this explosive growth, but the most important is probably the ability of CEOs to manage the compensation process.

Source: Thomas Piketty and Emmanuel Saez, data from their website at *elsa.berkeley.edu/~saez/.*

from a historical average of around 40 to more than 1000 in recent years. The rise in executive compensation has been part of the reason for the growth in income inequality in the United States. What is the reason for this increase? Why, economists ask, are American executives often paid 10 or 20 times more than are executives in comparable firms of other countries?

Research in this area has pointed to several reasons for the dramatic change. Defenders point to the great importance of managers in efficient capitalism, but this overlooks the role of marginal productivity in competitive markets. Defenders also argue that stock options, which have been the major source of increased executive pay, are efficient devices because they tie compensation to performance through stock prices.

Critics answer that the most important reason for the trend is the divorce of ownership from control. This is the symptom of a malady known as the *principal-agent problem,* wherein the incentives of the agents (the managers) are not appropriately aligned with the interests of the principal (the owners). Moreover, managers tend to hide the compensation procedures from stockholders, and so the owners never really have a vote on managerial compensation. Additionally, stock options may give incentives for management to distort the financial accounts as well as to produce sound profits.

The rising tide of executive compensation raises important questions about public policy. What are effective means of ensuring that compensation is efficient? Most economists are reluctant to have the government set any kind of pay standards. They would argue that a system of progressive taxation is the most evenhanded way to deal with income inequalities. Most agree that better information and more power to owners can also wring out the largest excesses.

SUMMARY

A. Theory of Production and Marginal Products

1. The relationship between the quantity of output (such as wheat, steel, or automobiles) and the quantities of inputs (of labor, land, and capital) is called the production function. Total product is the total output produced. Average product equals total output divided by the total quantity of inputs. We can calculate the marginal product of a factor as the extra output added for each additional unit of input while holding all other inputs constant.
2. According to the law of diminishing returns, the marginal product of each input will generally decline as the amount of that input increases, when all other inputs are held constant.
3. The returns to scale reflect the impact on output of a balanced increase in all inputs. A technology in which doubling all inputs leads to an exact doubling of outputs displays constant returns to scale. When doubling inputs leads to less than double (more than double) the quantity of output, the situation is one of decreasing (increasing) returns to scale.
4. Because decisions take time to implement, and because capital and other factors are often very long-lived, the reaction of production may change over different time periods. The short run is a period in which variable factors, such as labor or material inputs, can be easily changed but fixed factors cannot. In the long run, the capital stock (a firm's machinery and factories) can depreciate and be replaced. In the long run, all inputs, fixed and variable, can be adjusted.
5. Technological change refers to a change in the underlying techniques of production, as occurs when a new product or process of production is invented or an old product or process is improved. In such situations, the same output is produced with fewer inputs or more output is produced with the same inputs. Technological change shifts the production function upward.
6. Attempts to measure an aggregate production function for the American economy tend to corroborate theories of production and marginal products. In the twentieth century, technological change increased the productivity of both labor and capital. Total factor productivity (measuring the ratio of total output to total inputs) grew at around 1½ percent per year over the twentieth century, although from the 1970s to the mid-1990s the rate of productivity growth slowed markedly and real wages stopped growing. But underestimating the importance of new and improved products may lead to a significant underestimate of productivity growth.

B. Business Organizations

7. Business firms are specialized organizations devoted to managing the process of production.
8. Firms come in many shapes and sizes—with some economic activity in tiny one-person proprietorships, some in partnerships, and the bulk in corporations. Each kind of enterprise has advantages and disadvantages. Small businesses are flexible, can market new products, and can disappear quickly. But they suffer from the fundamental disadvantage of being unable to accumulate large amounts of capital from a dispersed group of investors. Today's large corporation, granted limited liability by the state, is able to amass billions of dollars of capital by borrowing from banks, bondholders, and stock markets.
9. In a modern economy, business corporations produce most goods and services because economies of mass production necessitate that output be produced at high volumes, the technology of production requires much more capital than a single individual would willingly put at risk, and efficient production requires careful management and coordination of tasks by a centrally directed entity.
10. The modern corporation may involve divided incentives because of the divorce of ownership from control, which has produced the vast gulf between executive compensation and average wages.

CONCEPTS FOR REVIEW

inputs, outputs, production function
total, average, and marginal product
diminishing marginal product and the law of diminishing returns
constant, increasing, and decreasing returns to scale
short run vs. long run
technological change: process innovation, product innovation
Productivity:
 defined as output/input
 two versions: labor productivity, total factor productivity
aggregate production function
reasons for firms: scale economies, financial needs, management
major business forms: individual proprietorship, partnership, corporation
unlimited and limited liability
firm vs. market and the holdup problem
Divorce of ownership from control: principal-agent problem

FURTHER READING AND INTERNET WEBSITES

Further Reading

Ronald Coase's classic work is "The Nature of the Firm," *Economica,* November 1937. Students may enjoy a recent nontechnical survey of the field in the symposium "The Firm and Its Boundaries," *Journal of Economic Perspectives,* Fall 1998. For a thoughtful analysis of network effects, see the symposium in *Journal of Economic Perspectives,* Spring 1994. A fascinating study of networks and the new economy is contained in Chapter 7 in Carl Shapiro and Hal R. Varian, *Information Rules: A Strategic Guide to the Network Economy* (Harvard Business School Press, Cambridge, Mass., 1997).

For a recent survey of the issues and policies concerning executive compensation, see Gary Shorter and Marc Labonte, *The Economics of Corporate Executive Pay,* March 22, 2007, available at *digitalcommons.ilr.cornell.edu/crs/36/*. A discussion of the economic background on this subject is contained in a symposium in *The Journal of Economic Perspectives,* Fall 2003, particularly the article by Kevin Murphy and Brian Hall.

Trends in the income of top executives are shown in Thomas Piketty and Emmanuel Saez, "Income Inequality in the United States, 1913–1998," *Quarterly Journal of Economics*, 2003, pp. 1–39; that article and an updated version are available at *elsa.berkeley.edu/~saez/*.

Websites

One of the most interesting websites about networks is compiled by Hal R. Varian, dean of the School of Information Management and Systems at the University of California at Berkeley. This site, called "The Economics of the Internet, Information Goods, Intellectual Property and Related Issues," is at *www.sims.berkeley.edu/resources/infoecon*.

A specialized site on network economics maintained by Nicholas Economides of New York University is found at *raven.stern.nyu.edu/networks/site.html.*

QUESTIONS FOR DISCUSSION

1. Explain the concept of a production function. Describe the production function for hamburgers, computers, concerts, haircuts, and a college education.
2. Consider a production function of the following form: $X = 100L^{½}$, where X = output and L = input of labor (assuming other inputs are fixed).
   a. Construct a figure like Figure 6-1 and a table like Table 6-1 for inputs of $L = 0, 1, 2, 3,$ and 4.
   b. Explain whether this production function shows diminishing returns to labor. What values would the exponent need to take for this production function to exhibit increasing returns to labor?
3. The following table describes the actual production function for oil pipelines. Fill in the missing values for marginal products and average products:

(1)	(2)	(3)	(4)
	18-Inch Pipe		
Pumping horsepower	Total product (barrels per day)	Marginal product (barrels per day per hp)	Average product (barrels per day per hp)
10,000	86,000		———
		———	
20,000	114,000		———
		———	
30,000	134,000		———
		———	
40,000	150,000		———
		———	
50,000	164,000		———

4. Using the data in question 3, plot the production function of output against horsepower. On the same graph, plot the curves for average product and marginal product.
5. Suppose you are running the food concession at the athletic events for your college. You sell hot dogs, colas, and potato chips. What are your inputs of capital, labor, and materials? If the demand for hot dogs declines, what steps could you take to reduce output in the short run? In the long run?
6. An important distinction in economics is between shifts of the production function and movements along the production function. For the food concession in question 5, give an example of both a shift of and a movement along the hot-dog production function. Illustrate each with a graph of the relation between hot-dog production and labor employed.
7. Substitution occurs when firms replace one input for another, as when a farmer uses tractors rather than labor when wages rise. Consider the following changes in a firm's behavior. Which represent substitution of one factor for another with an unchanged technology, and which represent technological change? Illustrate each with a graphical production function.
   a. When the price of oil increases, a firm replaces an oil-fired plant with a gas-fired plant.
   b. A bookseller reduces its sales staff by 60 percent after it sets up an Internet outlet.
   c. Over the period 1970–2000, a typesetting firm decreases its employment of typesetters by 200 workers and increases its employment of computer operators by 100 workers.
   d. After a successful unionization drive for clerical workers, a college buys personal computers for its faculty and reduces its secretarial workforce.
8. Consider a firm that produces pizzas with capital and labor inputs. Define and contrast diminishing returns and decreasing returns to scale. Explain why it is possible to have diminishing returns for one input and constant returns to scale for both inputs.
9. Show that if the marginal product is always decreasing, the average product is always above the marginal product.
10. Review the example of a network shown in Figure 6-4. Assume that only one person can join the network each month, starting with Adam and proceeding clockwise.
    a. Construct a table showing the value to the joining person as well as the external value to others (i.e., the value to all others in the network) when an additional person joins. (*Hint:* The entries for Ed are \$4 and \$4.) Then calculate the total social value for each level of membership. Graph the relationship between the size of the network and the total social value. Explain why this shows increasing returns rather than diminishing returns.
    b. Assume that the cost of joining is \$4.50. Draw a graph which shows how membership changes over time if six people are in the network to begin with. Draw another one which shows what happens if there are initially three people in the network. What is the point at which the equilibrium "tips" toward universal membership?
    c. Suppose you are the sponsor of the network shown in Figure 6-4. What kind of pricing could you use to get the network started when there are only one or two members?

CHAPTER

7

Analysis of Costs

Costs merely register competing attractions.

Frank Knight
Risk, Uncertainty, and Profit (1921)

Everywhere that production goes, costs follow close behind like a shadow. Firms must pay for their inputs: screws, solvents, software, sponges, secretaries, and statisticians. Profitable businesses are acutely aware of this simple fact as they determine their production strategies, since every dollar of unnecessary costs reduces the firm's profits by that same dollar.

But the role of costs goes far beyond influencing production and profits. Costs affect input choices, investment decisions, and even the decision of whether to stay in business. Is it cheaper to hire a new worker or to pay overtime? To open a new factory or expand an old one? To invest in new machinery domestically or to outsource production abroad? Businesses want to choose those methods of production that are most efficient and produce output at the lowest cost.

This chapter is devoted to a thorough analysis of cost. First we consider the full array of economic costs, including the central notion of marginal costs. Then we examine how business accountants measure cost in practice. Finally, we look at the notion of opportunity cost, a broad concept that can be applied to a wide range of decisions. This comprehensive study of cost will lay the foundation for understanding the supply decisions of business firms.

A. ECONOMIC ANALYSIS OF COSTS

TOTAL COST: FIXED AND VARIABLE

Consider a firm that produces a quantity of output (denoted by q) using inputs of capital, labor, and materials. The firm's accountants have the task of calculating the total dollar costs incurred to produce output level q.

Table 7-1 on page 127 shows the total cost (TC) for each different level of output q. Looking at columns (1) and (4), we see that TC goes up as q goes up. This makes sense because it takes more labor and other inputs to produce more of a good; extra factors involve an extra money cost. It costs \$110 in all to produce 2 units, \$130 to produce 3 units, and so forth. In our discussion, we assume that the firm always produces output at the lowest possible cost.

Fixed Cost

Columns (2) and (3) of Table 7-1 separate total cost into two components: total fixed cost (FC) and total variable cost (VC).

(1) Quantity q	(2) Fixed cost FC (\$)	(3) Variable cost VC (\$)	(4) Total cost TC (\$)
0	55	0	55
1	55	30	85
2	55	55	110
3	55	75	130
4	55	105	160
5	55	155	210
6	55	225	280

TABLE 7-1. Fixed, Variable, and Total Costs

The major elements of a firm's costs are its fixed costs (which do not vary at all when output changes) and its variable costs (which increase as output increases). Total costs are equal to fixed plus variable costs: $TC = FC + VC$.

Fixed costs are expenses that must be paid even if the firm produces zero output. Sometimes called "overhead" or "sunk costs," they consist of items such as rent for factory or office space, interest payments on debts, salaries of tenured faculty, and so forth. They are fixed because they do not change if output changes. For example, a law firm might have an office lease which runs for 10 years and remains an obligation even if the firm shrinks to half its previous size. Because FC is the amount that must be paid regardless of the level of output, it remains constant at \$55 in column (2).

Variable Cost

Column (3) of Table 7-1 shows variable cost (VC). **Variable costs** do vary as output changes. Examples include materials required to produce output (such as steel to produce automobiles), production workers to staff the assembly lines, power to operate factories, and so on. In a supermarket, checkout clerks are a variable cost, since managers can adjust the clerks' hours worked to match the number of shoppers coming through the store.

By definition, VC begins at zero when q is zero. VC is the part of TC that grows with output; indeed, the jump in TC between any two outputs is the same as the jump in VC.

Let us summarize these cost concepts:

Total cost represents the lowest total dollar expense needed to produce each level of output q. TC rises as q rises.

Fixed cost represents the total dollar expense that is paid out even when no output is produced; fixed cost is unaffected by any variation in the quantity of output.

Variable cost represents expenses that vary with the level of output—such as raw materials, wages, and fuel—and includes all costs that are not fixed.

Always, by definition,

$$TC = FC + VC$$

Minimum Attainable Costs

Anyone who has managed a business knows that when we write down a cost schedule like the one in Table 7-1, we make the firm's job look altogether too simple. Much hard work lies behind Table 7-1. To attain the lowest level of costs, the firm's managers have to make sure that they are paying the least possible amount for necessary materials, that the lowest-cost engineering techniques are incorporated into the factory layout, that employees are being honest, and that countless other decisions are made in the most economical fashion.

For example, suppose you are the owner of a baseball team. You have to negotiate salaries with players, choose managers, bargain with vendors, worry about electricity and other utility bills, consider how much insurance to buy, and deal with the 1001 other issues that are involved in running the team with minimum cost.

The total costs shown in Table 7-1 are the minimum costs that result from all these hours of managerial work.

DEFINITION OF MARGINAL COST

Marginal cost is one of the most important concepts in all of economics. **Marginal cost** (MC) denotes the extra or additional cost of producing 1 extra unit of output. Say a firm is producing 1000 compact discs for a total cost of \$10,000. If the total cost of

(1) Output q	(2) Total cost TC ($)	(3) Marginal cost MC ($)
0	55	
		30
1	85	
		25
2	110	
		20
3	130	
		___
4	160	
		50
5	210	

TABLE 7-2. Calculation of Marginal Cost

Once we know total cost, it is easy to calculate marginal cost. To calculate the *MC* of the fifth unit, we subtract the total cost of the 4 units from the total cost of the 5 units, i.e., *MC* = \$210 − \$160 = \$50. Fill in the blank for the marginal cost of the fourth unit.

producing 1001 discs is \$10,006, then the marginal cost of production is \$6 for the 1001st disc.

Sometimes, the marginal cost of producing an extra unit of output can be quite low. For an airline flying planes with empty seats, the added cost of another passenger is literally peanuts; no additional capital (planes) or labor (pilots and flight attendants) is necessary. In other cases, the marginal cost of another unit of output can be quite high. Consider an electric utility. Under normal circumstances, it can generate enough power using only its lowest-cost, most efficient plants. But on a hot summer day, when everyone's air conditioners are running and demand for electricity is high, the utility may be forced to turn on its old, high-cost, inefficient generators. This added electric power comes at a high marginal cost to the utility.

Table 7-2 uses the data from Table 7-1 to illustrate how we calculate marginal costs. The green-colored *MC* numbers in column (3) of Table 7-2 come from subtracting the *TC* in column (2) from the *TC* of the subsequent quantity. Thus the *MC* of the first unit is \$30(= \$85 − \$55); the marginal cost of the second unit is \$25(= \$110 − \$85); and so on.

Instead of getting *MC* from the *TC* column, we could get the *MC* figures by subtracting each *VC* number in column (3) of Table 7-1 from the *VC* in the row below it. Variable cost always grows exactly like total cost, the only difference being that *VC* must (by definition) start out from 0 rather than from the constant *FC* level. (Check that \$30 − \$0 = \$85 − \$55, and \$55 − \$30 = \$110 − \$85, and so on.)

The marginal cost of production is the additional cost incurred in producing 1 extra unit of output.

Marginal Cost in Diagrams. Figure 7-1 illustrates total cost and marginal cost. It shows that *TC* is related to *MC* in the same way that total product is related to marginal product or that total utility is related to marginal utility.

The Marginal Cost of Distributing Software

When the software company Microsoft decided to enter the market for Internet browsers, it did so by giving away its Internet Explorer browser, either as a stand-alone product or in combination with the Windows operating system. Its competitors complained that Microsoft was engaged in "predatory behavior." How could it give the browser software away and not lose money?

The answer lies in the unusual property of information technology (IT). According to IT specialist Hal Varian, IT "typically has the property that it is very costly to produce the first copy and very cheap to produce subsequent copies." In this case, while it cost Microsoft a great deal to develop Internet Explorer, the marginal cost of distributing an extra unit of the software was close to zero. That is, the cost to Microsoft of delivering 1,000,001 units was no more than the cost of 1,000,000 units. As long as the marginal cost was zero, Microsoft was not losing money by giving Internet Explorer away.

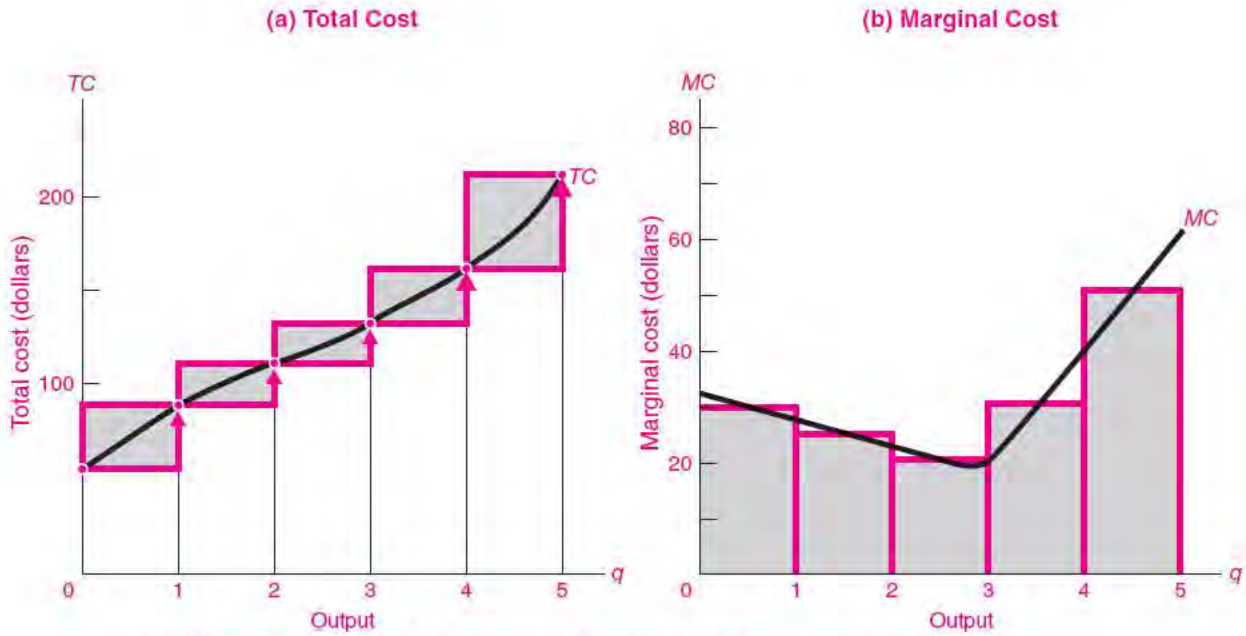


FIGURE 7-1. The Relationship between Total Cost and Marginal Cost

These graphs show the data from Table 7-2. Marginal cost in **(b)** is found by calculating the extra cost added in **(a)** for each unit increase in output. Thus to find the *MC* of producing the fifth unit, we subtract \$160 from \$210 to get *MC* of \$50. A smooth blue curve has been drawn through the points of *TC* in **(a)**, and the smooth blue *MC* curve in **(b)** links the discrete steps of *MC*.

AVERAGE COST

We complete our catalog of the cost concepts with a discussion of different kinds of average or unit cost. Table 7-3 on page 130 expands the data of Tables 7-1 and 7-2 to include three new measures: average cost, average fixed cost, and average variable cost.

Average or Unit Cost

Average cost (AC) is a concept widely used in business; by comparing average cost with price or average revenue, businesses can determine whether or not they are making a profit. **Average cost** is the total cost divided by the total number of units produced, as shown in column (6) of Table 7-3. That is,

$$\text{Average cost} = \frac{\text{total cost}}{\text{output}} = \frac{TC}{q} = AC$$

In column(6), when only 1 unit is produced, average cost has to be the same as total cost, or \$85/1 = \$85. But for $q = 2$, $AC = TC/2$ = \$110/2 = \$55, as shown.

Note that average cost falls lower and lower at first. (We shall see why in a moment.) AC reaches a minimum of \$40 at $q = 4$, and then slowly rises.

Figure 7-2 on page 131 plots the cost data shown in Table 7-3. Figure 7-2(a) depicts the total, fixed, and variable costs at different levels of output. Figure 7-2(b) shows the different average cost concepts, along with a smoothed marginal cost curve. Graph (a) shows how total cost moves with variable cost while fixed cost remains unchanged.

Now turn to graph (b). This plots the U-shaped AC curve and aligns AC right below the TC curve from which it is derived.

Average Fixed and Variable Costs

Just as we separated total cost into fixed and variable costs, we can also break average cost into fixed and variable components. **Average fixed cost** (AFC) is defined as FC/q. Since total fixed cost is a constant, dividing it by an increasing output gives a steadily

(1) Quantity *q*	(2) Fixed cost *FC* ($)	(3) Variable cost *VC* ($)	(4) Total cost $TC = FC + VC$ ($)	(5) Marginal cost per unit *MC* ($)	(6) Average cost per unit $AC = TC/q$ ($)	(7) Average fixed cost per unit $AFC = FC/q$ ($)	(8) Average variable cost per unit $AVC = VC/q$ ($)
0	55	0	55		Infinity	Infinity	Undefined
				30			
1	55	____	85		85	55	30
				25			
2	____	55	110		55	____	27½
				____			
3	55	75	130		43⅓	18⅓	25
				30			
4*	**55**	**105**	**160**	**40***	**40***	**13¾**	**26¼**
				50			
5	55	155	210		42	11	____
				70			
6	55	225	280		46⅔	9⅙	37½

*Minimum level of average cost.

TABLE 7-3. All Cost Concepts Derive from Total Cost Schedule

We can derive all the different cost concepts from the *TC* in column (4). Columns (5) and (6) are the important ones to concentrate on: marginal cost is calculated by subtraction of adjacent rows of *TC* and is shown in green. The starred *MC* of 40 at an output of 4 is the smoothed *MC* from Fig. 7-2(*b*). In column (6), note the point of minimum cost of $40 on the U-shaped *AC* curve in Fig. 7-2(*b*). (Can you see why the starred *MC* equals the starred *AC* at the minimum? Also, calculate and fill in all the missing numbers.)

falling average fixed cost curve [see column (7) of Table 7-3]. In other words, as a firm sells more output, it can spread its overhead cost over more and more units. For example, a software firm may have a large staff of programmers to develop a new game. The number of copies sold does not directly affect how many programmers are necessary, thus making them a fixed cost. So if the program is a best-seller, the *AFC* of the programmers is low; if the program is a failure, the *AFC* is high.

The dashed blue *AFC* curve in Figure 7-2(*b*) is a hyperbola, approaching both axes: it drops lower and lower, approaching the horizontal axis as the constant *FC* gets spread over more and more units. If we allow fractional units of *q*, *AFC* starts infinitely high as finite *FC* is spread over ever tinier *q*.

Average variable cost (*AVC*) equals variable cost divided by output, or $AVC = VC/q$. As you can see in both Table 7-3 and Figure 7-2(*b*), for this example *AVC* first falls and then rises.

The Relation between Average Cost and Marginal Cost

It is important to understand the link between average cost and marginal cost. We begin with three closely related rules:

1. When marginal cost is below average cost, it is pulling average cost down.
2. When *MC* is above *AC*, it is pulling up *AC*.
3. When *MC* just equals *AC*, *AC* is constant. At the bottom of a U-shaped *AC*, $MC = AC =$ minimum *AC*.

To understand these rules, begin with the first one. If *MC* is below *AC*, this means that the last unit produced costs less than the average cost of all the previous units produced. This implies that the new *AC* (i.e., the *AC* including the last unit) must be less than the old *AC*, so *AC* must be falling.

We can illustrate this with an example. Looking at Table 7-3, we see that the *AC* of the first unit is 85.

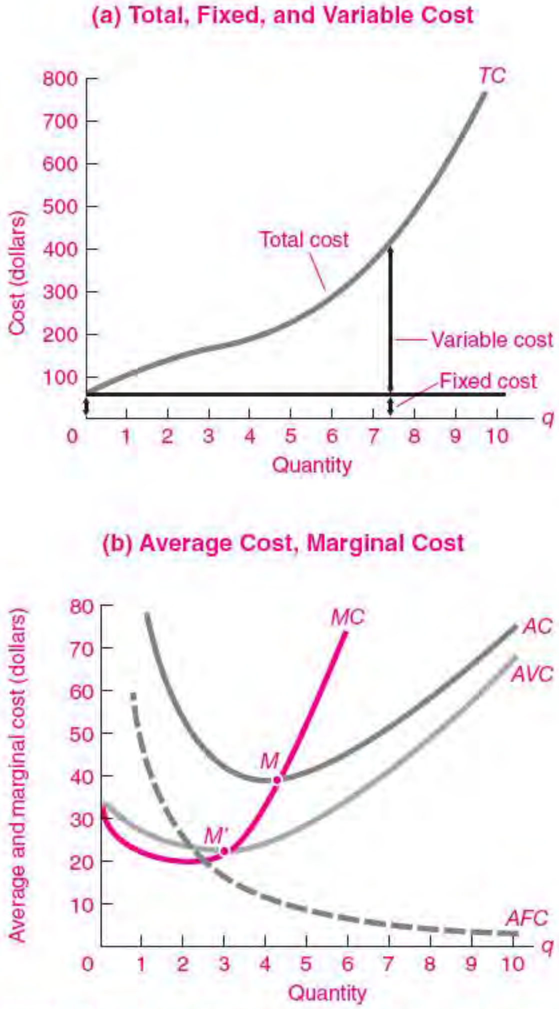


FIGURE 7-2. All Cost Curves Can Be Derived from the Total Cost Curve

(**a**) Total cost is made up of fixed cost and variable cost. (**b**) The green-colored curve of marginal cost falls and then rises, as indicated by the *MC* figures given in column (5) of Table 7-3. Note how *MC* intersects *AC* at its minimum.

The *MC* of the second unit is 25. This implies that the *AC* of the first 2 units is $(85 + 25)/2 = 55$. Because *MC* was below *AC*, this correctly implies that *AC* is falling.

The second rule is illustrated in Table 7-3 by the case of the sixth unit. The *AC* of 5 units is 42, and the *MC* between 5 and 6 units is 70. *MC* is pulling up *AC* as we see by the *AC* of the sixth unit, which is $46\frac{2}{3}$.

q	*FC*	*VC*	*TC*	*MC*
3,998	55,000	104,920.03	159,920.03	
				39.98
3,999	55,000	104,960.01	159,960.01	
				39.99
4,000*	55,000	105,000.00	160,000.00	
				40.01
4,001	55,000	105,040.01	160,040.01	
				40.02
4,002	55,000	105,080.03	160,080.03	

*Production with minimum average cost.

TABLE 7-4. Take a Microscope to the *AC* and *MC* Calculations at the Minimum Point

This table magnifies the cost calculations around the minimum *AC* point. We assume for this calculation that the numbers in Table 7-3 are in thousands. Note how the marginal cost is a tiny bit below the minimum *AC* between 3999 and 4000 units and a tiny bit above it between 4000 and 4001 units.

The case of the fourth unit is a crucial one. At that level, note that *AC* is exactly equal to *MC* at a cost of 40. So the new *AC* is exactly equal to the old *AC* and is equal to *MC*. We illustrate the relationship in detail in Table 7-4, which focuses on the minimum *AC* level of production. For this table, we assume that the units in Table 7-3 are in thousands so that we can see tiny movements in output. See how *MC* is a tiny bit below *AC* when output is just below the minimum-*AC* point (and a tiny bit above *AC* when output is just above the minimum-*AC* point). If we were to increase the magnification further, we would come as close as we want to an exact equality of *MC* and *AC*.

You will improve your understanding of the relationship between *MC* and *AC* by studying Figure 7-2(*b*). Note that for the first 3 units, *MC* is below *AC*, and *AC* is therefore declining. At exactly 4 units, *AC* equals *MC*. Over 4 units, *MC* is above *AC* and pulling *AC* up. Graphically, that means the rising *MC* curve will intersect the *AC* curve precisely at its minimum point.

To summarize: In terms of our cost curves, if the *MC* curve is below the *AC* curve, the *AC* curve must be falling. By contrast, if *MC* is above *AC*, *AC* is rising. Finally, when *MC* is just equal to *AC*, the *AC* curve is flat. The *AC* curve is always pierced at its minimum point by a rising *MC* curve.

Batting Averages to Illustrate MC and AC Rules

We can illustrate the *MC-AC* relationship using batting averages. Let *AB* be your lifetime batting average up to this year (your average) and *MB* be your batting average for this year (your marginal). For simplicity, we also assume that there are 100 "at bats" each year.

When your *MB* is below *AB*, it will pull the new *AB* down. For example, suppose that your lifetime batting average for your first 3 years was .300 and your batting average for your fourth year was .100. Your new lifetime average or *AB* at the end of your fourth year is .250. Similarly, if your *MB* in your fourth year is higher than your lifetime average for your first 3 years, your lifetime average will be pulled up. If your batting average in the fourth year is the same as your lifetime average for the first 3 years, your lifetime average will not change (i.e., if *MB* = *AB*, then the new *AB* is equal to the old *AB*).

THE LINK BETWEEN PRODUCTION AND COSTS

What are the factors that determine the cost curves introduced above? The key elements are (1) factor prices and (2) the firm's production function.

Clearly the prices of inputs like labor and land are important ingredients of costs. Higher rents and higher wages mean higher costs, as any business manager will tell you. But costs also depend on the firm's technological opportunities. If technological improvements allow the firm to produce the same output with fewer inputs, the firm's costs will fall.

Indeed, if you know factor prices and the production function, you can calculate the cost curve. We can show the derivation of cost from production data and factor prices in the numerical example shown in Table 7-5. Suppose Farmer Smith rents 10 acres of land and can hire farm labor to produce wheat. Per period, land costs $5.5 per acre and labor costs $5 per worker. Using up-to-date farming methods, Smith can produce according to the production function shown in the first three columns of Table 7-5. In this example, land is a fixed cost (because Farmer Smith operates under a 10-year lease), while labor is a variable cost (because farmworkers can easily be hired and fired).

Using the production data and the input-cost data, for each level of output we calculate the total cost of production shown in column (6) of Table 7-5. As an example, consider the total cost of production for 3 tons of wheat. Using the given production function, Smith can produce this quantity with 10 acres of land and 15 farmhands. The total cost of producing 3 tons of wheat is (10 acres × $5.5 per acre) + (15 workers × $5 per worker) = $130. Similar calculations will give all the other total cost figures in column (6) of Table 7-5.

Note that these total costs are identical to the ones shown in Tables 7-1 through 7-3, so the other

(1) Output (tons of wheat)	(2) Land inputs (acres)	(3) Labor inputs (workers)	(4) Land rent ($ per acre)	(5) Labor wage ($ per worker)	(6) Total cost ($)
0	10	0	5.5	5	55
1	10	6	5.5	5	85
2	10	11	5.5	5	110
3	10	15	5.5	5	130
4	10	21	5.5	5	160
5	10	31	5.5	5	210
6	10	45	5.5	5	280

TABLE 7-5. Costs are Derived from Production Data and Input Costs

Farmer Smith rents 10 acres of wheatland and employs variable labor. According to the farming production function, careful use of labor and land allows the inputs and yields shown in columns (1) to (3) of the table. At input prices of $5.5 per acre and $5 per worker, we obtain Smith's cost of production shown in column (6). All other cost concepts (such as those shown in Table 7-3) can be calculated from the total cost data.

cost concepts shown in the tables (i.e., *MC, FC, VC, AC, AFC,* and *AVC*) are also applicable to the production-cost example of Farmer Smith.

Diminishing Returns and U-Shaped Cost Curves

Economists often draw cost curves like the letter "U" (the "U-shaped cost curves"). For a U-shaped cost curve, cost falls in the initial phase, reaches a minimum point, and finally begins to rise. Let's explore the reasons. Recall that Chapter 6's analysis of production distinguished two different time periods, the short run and the long run. The same concepts apply to costs as well:

- The *short run* is the period of time that is long enough to adjust variable inputs, such as materials and production labor, but too short to allow all inputs to be changed. In the short run, fixed or overhead factors such as plant and equipment cannot be fully modified or adjusted. Therefore, in the short run, labor and materials costs are typically variable costs, while capital costs are fixed.
- In the *long run,* all inputs can be adjusted—including labor, materials, and capital. Hence, in the long run, all costs are variable and none are fixed.[1]

Note that whether a particular cost is fixed or variable depends on the length of time we are considering. In the short run, for example, the number of planes that an airline owns is a fixed cost. But over the longer run, the airline can clearly control the size of its fleet by buying or selling planes. Indeed, there is an active market in used planes, making it relatively easy to dispose of unwanted planes. Typically, in the short run, we will consider capital to be the fixed cost and labor to be the variable cost. That is not always true (think of your college's tenured faculty), but generally labor inputs can be adjusted more easily than can capital.

Why is the cost curve U-shaped? Consider the short run in which capital is fixed but labor is variable. In such a situation, there are diminishing returns to the variable factor (labor) because each additional unit of labor has less capital to work with. As a result, the marginal cost of output will rise because the extra output produced by each extra labor unit is going down. In other words, diminishing returns to the variable factor will imply an increasing short-run marginal cost. This shows why diminishing returns lead to rising marginal costs.

Figure 7-3, which contains exactly the same data as Table 7-5, illustrates the point. It shows that the

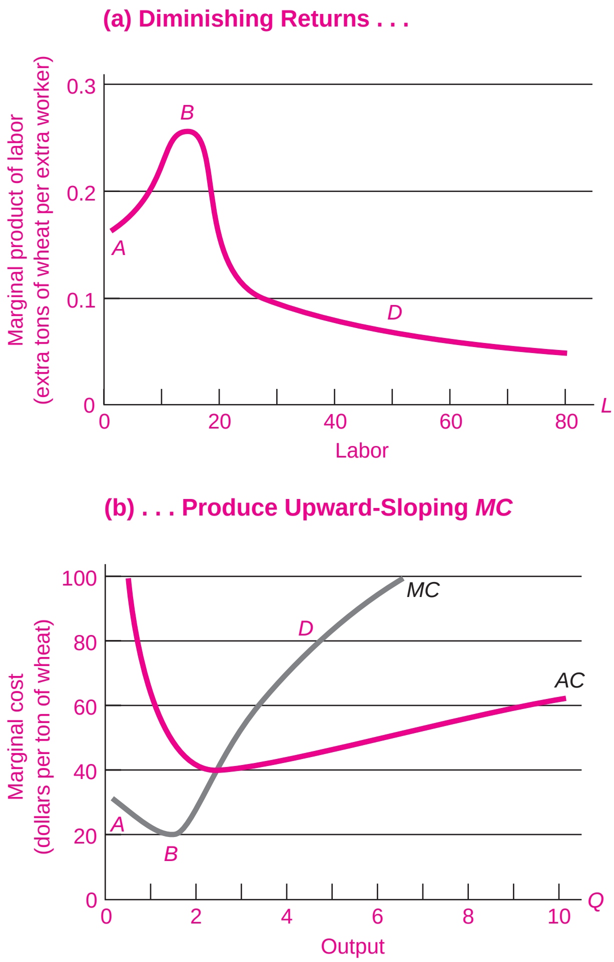


FIGURE 7-3. Diminishing Returns and U-Shaped Cost Curves

The U-shaped cost curves are based on diminishing returns in the short run. With fixed land and variable labor, the marginal product of labor in **(a)** first rises to the left of *B,* peaks at *B*, and then falls at *D* as diminishing returns to labor set in.

The cost curves in **(b)** are derived from the product curves and factor prices. Increasing and then diminishing marginal product of the variable factor gives U-shaped marginal and average cost curves.

[1] For a more complete discussion of the long and short runs, see Chapter 6.

region of increasing marginal product corresponds to falling marginal costs, while the region of diminishing returns implies rising marginal costs.

We can summarize the relationship between the productivity laws and the cost curves as follows:

In the short run, when factors such as capital are fixed, variable factors tend to show an initial phase of increasing marginal product followed by diminishing marginal product. The corresponding cost curves show an initial phase of declining marginal costs, followed by increasing *MC* after diminishing returns have set in.

CHOICE OF INPUTS BY THE FIRM

Marginal Products and the Least-Cost Rule

Every firm must decide *how* to produce its output. Should electricity be produced with oil or coal? Should cars be assembled in the United States or Mexico? Should classes be taught by faculty or graduate students? We now complete the link between production and cost by using the marginal product concept to illustrate how firms select the least-cost combinations of inputs.

In our analysis, we will rely on the fundamental assumption that *firms minimize their costs of production.* This cost-minimization assumption actually makes good sense not only for perfectly competitive firms but for monopolists or even nonprofit organizations like colleges or hospitals. It simply states that the firm should strive to produce its output at the lowest possible cost and thereby have the maximum amount of revenue left over for profits or for other objectives.

A simple example will illustrate how a firm might decide between different input combinations. Say a firm's engineers have calculated that the desired output level of 9 units could be produced with two possible options. In both cases, energy (E) costs \$2 per unit, while labor (L) costs \$5 per hour. Under option 1, the input mix is $E = 10$ and $L = 2$. Option 2 has $E = 4$ and $L = 5$. Which is the preferred option? At the market prices for inputs, total production costs for option 1 are (\$2 × 10) + (\$5 × 2) = \$30, while total costs for option 2 are (\$2 × 4) + (\$5 × 5) = \$33. Therefore, option 1 would be the preferred least-cost combination of inputs.

More generally, there are usually many possible input combinations, not just two. But we don't have to calculate the cost of every different combination of inputs in order to find the one which costs the least. Here's a simple way to find the least-cost combination: Start by calculating the marginal product of each input, as we did in Chapter 6. Then divide the marginal product of each input by its factor price. *This gives you the marginal product per dollar of input.* The cost-minimizing combination of inputs comes when the marginal product per dollar of input is equal for all inputs. That is, the marginal contribution to output of each dollar's worth of labor, of land, of oil, and so forth, must be just the same.

Following this reasoning, a firm will minimize its total cost of production when the marginal product per dollar of input is equalized for each factor of production. This is called the least-cost rule.

Least-cost rule: To produce a given level of output at least cost, a firm should buy inputs until it has equalized the marginal product per dollar spent on each input. This implies that

$$\frac{\text{Marginal product of } L}{\text{Price of } L} = \frac{\text{marginal product of } A}{\text{price of } A} = \cdots$$

This rule for firms is exactly analogous to what consumers do when they maximize utilities, as we saw in Chapter 5. In analyzing consumer choice, we saw that to maximize utility, consumers should buy goods so that the marginal utility per dollar spent on each consumer good is equalized for all commodities.

One way of understanding the least-cost rule is the following: Break each factor into packages worth \$1 each. (In our earlier energy-labor example, \$1 of labor would be ⅕ of an hour, while \$1 of energy would be ½ unit.) Then the least-cost rule states that the marginal product of each dollar-unit of input must be equalized. If the marginal products per \$1 of inputs were not equal, you could reduce the low-*MP*-per-dollar input and increase the high-*MP*-per-dollar input and produce the same output at lower cost.

A corollary of the least-cost rule is the substitution rule.

Substitution rule: If the price of one factor falls while all other factor prices remain the same, firms will profit by substituting the now-cheaper factor for the other factors until the marginal products per dollar are equal for all inputs.

Let's take the case of labor (L). A fall in the price of labor will raise the ratio MP_L/P_L above the MP/P ratio for other inputs. Raising the employment of L lowers MP_L by the law of diminishing returns and therefore lowers MP_L/P_L. Lower price and MP of labor then bring the marginal product per dollar for labor back into equality with that ratio for other factors.

B. ECONOMIC COSTS AND BUSINESS ACCOUNTING

From General Motors down to the corner deli, businesses use more or less elaborate systems to keep track of their costs. Many of the cost categories in business accounting look very similar to the concepts of economic cost we learned above. But there are some important differences between how businesses measure costs and how economists would do it. In this section we will lay out the rudiments of business accounting and point out the differences and similarities with economic costs.

THE INCOME STATEMENT, OR STATEMENT OF PROFIT AND LOSS

Let us start with a small company, called Hot Dog Ventures, Inc. As the name suggests, this company sells gourmet frankfurters in a small store. The operation consists of buying the materials (hot dogs, top-flight buns, expensive mustard, espresso coffee beans) and hiring people to prepare and sell the food. In addition, the company has taken out a loan of $100,000 for its cooking equipment and other restaurant furnishings, and it must pay rent on its store. The founders of Hot Dog Ventures have big aspirations, so they incorporated the business and issued common stock (see Chapter 6 on forms of business organization).

To determine whether Hot Dog Ventures is earning a profit, we must turn to the **income statement,** or—as many companies prefer to call it—the *statement of profit and loss,* shown in Table 7-6. This statement reports the following: (1) Hot Dog Ventures' revenues from sales in 2009, (2) the expenses to be charged against those sales, and (3) the net income, or profits remaining after expenses have been deducted. This gives the fundamental identity of the income statement:

Net income (or profit) = total revenue − total expenses

This definition gives the famous "bottom line" of profits that firms want to maximize. And in many ways, business profits are close to an economist's definition of economic profits. Let's next examine the profit-and-loss statement in more detail, starting from the top. The first line gives the revenues, which were $250,000. Lines 2 through 9 represent the cost of different inputs into the production process. For example, the labor cost is the annual cost of employing labor, while rent is the annual cost of using the building. The selling and administrative costs include the costs of advertising the product and running the back office, while miscellaneous operating costs include the cost of electricity.

The first three cost categories—materials, labor cost, and miscellaneous operating costs—basically correspond to the variable costs of the firm, or its *cost of goods sold.* The next three categories, lines 6 through 8, correspond to the firm's fixed costs, since in the short run they cannot be changed.

Line 8 shows a term we haven't seen before, *depreciation,* which relates to the cost of capital goods. Firms can either rent capital or own their capital goods. In the case of the building, which Hot Dog Ventures rented, we deducted the rent in item (7) of the income statement.

When the firm owns the capital good, the treatment is more complicated. Suppose the cooking equipment has an estimated useful lifetime of 10 years, at the end of which it is useless and worthless. In effect, some portion of the cooking equipment is "used up" in the productive process each year. We call the amount used up "depreciation," and calculate that amount as the cost of the capital input for that year. **Depreciation** measures the annual cost of a capital input that a company actually owns itself.

The same reasoning would apply to any capital goods that a company owns. Trucks wear out, computers become obsolete, and buildings eventually begin to fall apart. For each of these, the company

Income Statement of Hot Dog Ventures, Inc.
(January 1, 2009 to December 31, 2009)

(1)	**Net sales (after all discounts and rebates)**		**$250,000**
	Less cost of goods sold:		
(2)	Materials	$ 50,000	
(3)	Labor cost	90,000	
(4)	Miscellaneous operating costs (utilities, etc.)	10,000	
(5)	Less overhead costs:		
(6)	Selling and administrative costs	15,000	
(7)	Rent for building	5,000	
(8)	Depreciation	15,000	
(9)	Operating expenses	$185,000	185,000
(10)	Net operating income		$ 65,000
	Less:		
(11)	Interest charges on equipment loan		6,000
(12)	State and local taxes		4,000
(13)	Net income (or profit) before income taxes		$ 55,000
(14)	Less: Corporation income taxes		18,000
(15)	**Net income (or profit) after taxes**		**$ 37,000**
(16)	Less: Dividends paid on common stock		15,000
(17)	Addition to retained earnings		$ 22,000

TABLE 7-6. The Income Statement Shows Total Sales and Expenses for a Period of Time

would take a depreciation charge. There are a number of different formulas for calculating each year's depreciation, but each follows two major principles: (*a*) The total amount of depreciation over the asset's lifetime must equal the capital good's historical cost or purchase price; (*b*) the depreciation is taken in annual accounting charges over the asset's accounting lifetime, which is usually related to the actual economic lifetime of the asset.

We can now understand how depreciation would be charged for Hot Dog Ventures. The equipment is depreciated according to a 10-year lifetime, so the $150,000 of equipment has a depreciation charge of $15,000 per year (using the simplest "straight-line" method of depreciation). If Hot Dog Ventures owned its store, it would have to take a depreciation charge for the building as well.

Adding up all the costs so far gives us the operating expenses (line 9). The net operating income is net revenues minus operating expenses (line 1 minus line 9). Have we accounted for all the costs of production yet? Not quite. Line 11 includes the annual cost of interest on the $100,000 loan. This should be thought of as the cost of borrowing the financial capital. While this is a fixed cost, it is typically kept separate from the other fixed costs. State and local taxes, such as property taxes, are treated as another expense. Deducting lines 11 and 12 gives a total of $55,000 in profits before income taxes. How are these profits divided? Approximately $18,000 goes to the federal government in the form of corporate income taxes. That leaves a profit of $37,000 after taxes. Dividends of $15,000 on the common stock are paid, leaving $22,000 to be plowed back as retained earnings in the business. Again, note that profits are a residual of sales minus costs.

THE BALANCE SHEET

Business accounting is concerned with more than the profits and losses that are the economic driving force. Business accounts also include the **balance sheet,** which is a picture of financial conditions on a given date. This statement records what a firm, person, or nation is worth at a given point in time. On one side of the balance sheet are the **assets** (valuable properties or rights owned by the firm). On the other side are two items, the **liabilities** (money or obligations owed by the firm) and **net worth** (or net value, equal to total assets minus total liabilities).

One important distinction between the income statement and the balance sheet is that between stocks and flows. A **stock** represents the level of a variable, such as the amount of water in a lake or, in this case, the dollar value of a firm. A **flow** variable represents the change per unit of time, like the flow of water in a river or the flow of revenue and expenses into and out of a firm. *The income statement measures the flows into and out of the firm, while the balance sheet measures the stocks of assets and liabilities at the end of the accounting year.*

The fundamental identity or balancing relationship of the balance sheet is that total assets are balanced by total liabilities plus the net worth of the firm to its owners:

Total assets = total liabilities + net worth

We can rearrange this relationship to find:

Net worth = assets − liabilities

Let us illustrate this by considering Table 7-7, which shows a simple balance sheet for Hot Dog Ventures, Inc. On the left are assets, and on the right are liabilities and net worth. A blank space has been deliberately left next to the retained earnings entry because the only correct entry compatible with our fundamental balance sheet identity is $200,000. *A balance sheet must always balance because net worth is a residual defined as assets minus liabilities.* Suppose one item on a balance sheet changes (such as an increase in assets); then there must be a corresponding change on the balance sheet to maintain balance (a decrease in assets, an increase in liabilities, or an increase in net worth).

To illustrate how net worth always balances, suppose that hot dogs valued at $40,000 have spoiled. Your accountant reports to you: "Total assets are down $40,000; liabilities remain unchanged. This means total net worth has decreased by $40,000, and I have no choice but to write net worth down from the previous $210,000 to only $170,000." That's how accountants keep score.

We summarize our analysis of accounting concepts as follows:

1. The income statement shows the flow of sales, cost, and revenue over the year or accounting period. It measures the flow of dollars into and out of the firm over a specified period of time.
2. The balance sheet indicates an instantaneous financial picture or snapshot. It is like a measure of the stock of water in a lake. The major items are assets, liabilities, and net worth.

Balance Sheet of Hot Dog Ventures, Inc.
(December 31, 2009)

Assets		Liabilities and net worth	
		Liabilities	
Current assets:		Current liabilities:	
Cash	$ 20,000	Accounts payable	$ 20,000
Inventory	80,000	Notes payable	20,000
Fixed assets:		Long-term liabilities:	
Equipment	150,000	Bonds payable	100,000
Buildings	100,000		
		Net worth	
		Stockholders' equity:	
		Common stock	10,000
		Retained earnings	....
Total	$350,000	Total	$350,000

TABLE 7-7. The Balance Sheet Records the Stock of Assets and Liabilities, plus Net Worth, of a Firm at a Given Point in Time

Accounting Conventions

In examining the balance sheet in Table 7-7, you might well ask, How are the values of the different items measured? How do the accountants know that the equipment is worth $150,000?

The answer is that accountants use a set of agreed-upon rules or accounting conventions to answer most questions. The most important assumption used in a balance sheet is that the value placed on almost every item reflects its *historical cost.* This differs from the economist's concept of "value," as we will see in the next section. For example, the inventory of hot-dog buns is valued at the price that was paid for them. A newly purchased fixed asset—a piece of equipment or a building—is valued at its purchase price (this being the historical-cost convention). Older capital is valued at its purchase price minus accumulated depreciation, thus accounting for the gradual decline in usefulness of capital goods. Accountants use historical cost because it reflects an objective evaluation and is easily verified.

In Table 7-7 current assets are convertible into cash within a year, while fixed assets represent capital goods and land. Most of the specific items listed are self-explanatory. Cash consists of coins, currency, and money on deposit in the bank. Cash is the only asset whose value is exact rather than an estimate.

On the liabilities side, accounts payable and notes payable are sums owed to others for goods bought or for borrowed funds. Bonds payable are long-term loans floated in the market. The last item on the balance sheet is net worth, which is also called "stockholders' equity." This has two components. The first is common stock, which represents what the stockholders originally contributed to the business. The second component is retained earnings. These are earnings reinvested in the business after the deduction of any distributions to shareholders, such as dividends. Recall from the income statement that Hot Dog Ventures had $22,000 of retained earnings for 2009. The net worth is the firm's assets less liabilities, when valued at historical cost. Confirm that net worth must equal $210,000 in Table 7-7.

Financial Finagling

Now that we have reviewed the principles of accounting, we see that there is considerable judgment involved in determining the exact treatment of certain items. In the late 1990s, under pressure to produce rapidly growing earnings, many companies manipulated their accounts to show glowing results or to paper over losses. Some of the most egregious examples included pretending that capital assets were current revenues (Enron, Global Crossing); capitalizing the outflow while recognizing the inflow as current revenues (Enron, Qwest); increasing the salvage value of trucks over time (Waste Management); increasing the value of the unused capacity of landfills even as they fill up (Waste Management); and reporting happy pro-forma numbers when the reality was unpleasant (Amazon.com, Yahoo, and Qualcomm, among a crowd of other dot-coms dead or alive).

To see how an accounting fraud works, let's take the example of Enron. Enron started off as a genuinely profitable business which owned the largest interstate network of natural-gas pipelines. To continue its rapid growth, it turned to trading natural-gas futures, and then it leveraged its business model into other markets.

Along the way, however, its profits began to decline and it hid the declines from investors. You might well ask, How could a large, publicly owned company like Enron have fooled virtually all of the people most of the time until 2001?

Its success in hiding its failures rested on four complementary factors. First, when troubles arose, Enron began to exploit ambiguities in accounting principles, such as the ones described above. One example was a deal called "Project Braveheart" with Blockbuster Video. This deal projected future revenues over the next 20 years with a present value of $111 million, and Enron accounted for them as current revenues even though the projections were based on highly dubious assumptions.

Second, the firm elected not to report the details of many financial transactions—for example, it hid hundreds of partnerships from its stockholders. Third, the board of directors and outside auditors were passive and did not challenge or in some cases even inquire into some details of Enron's accounts. Finally, the investment community, such as the large mutual funds, exercised little deep independent analysis of Enron's numbers even though at its peak Enron absorbed $70 billion of investors' funds.

The Enron case is a reminder that financial markets, accounting firms, and investment managers can be fooled into investing many billions of dollars when firm insiders engage in aggressive accounting and fraudulent practices. A larger set of issues arose in 2007–2008 when a trillion dollars of poorly designed mortgage-backed securities got sound credit ratings from bond-rating agencies, but agencies and investors had little understanding of the income streams behind these securities. The history of such accounting and financial finagling is a reminder of the importance of sound accounting practices and the need for vigilant oversight by government and nongovernment bodies.

C. OPPORTUNITY COSTS

In this section we look at costs from yet another angle. Remember that one of the cardinal tenets of economics is that resources are scarce. That means every time we choose to use a resource one way, we've given up the opportunity to utilize it another way. That's easy to see in our own lives, where we must constantly decide what to do with our limited time and income. Should we go to a movie or study for next week's test? Should we travel to Mexico or buy a car? Should we get postgraduate or professional training or begin work right after college?

In each of these cases, making a choice in effect costs us the opportunity to do something else. The value of the best alternative forgone is called the opportunity cost, which we met briefly in Chapter 1 and develop more thoroughly here. The dollar cost of going to a movie instead of studying is the price of a ticket, but the opportunity cost also includes the possibility of getting a higher grade on the exam. The opportunity costs of a decision include all its consequences, whether they reflect monetary transactions or not.

Decisions have opportunity costs because choosing one thing in a world of scarcity means giving up something else. The **opportunity cost** is the value of the most valuable good or service forgone.

One important example of opportunity cost is the cost of going to college. If you went to a public university in your state in 2008, the total costs of tuition, books, and travel averaged about $7000. Does this mean that $7000 was your opportunity cost of going to school? Definitely not! You must include as well the *opportunity cost of the time* spent studying and going to classes. A full-time job for a college-age high school graduate averaged $26,000 in 2008. If we add up both the actual expenses and the earnings forgone, we would find that the opportunity cost of college was $33,000 (equal to $7000 + $26,000) rather than $7000 per year.

Business decisions have opportunity costs, too. Do all opportunity costs show up on the profit-and-loss statement? Not necessarily. In general, business accounts include only transactions in which money actually changes hands. By contrast, the economist always tries to "pierce the veil of money" to uncover the real consequences that lie behind the dollar flows and to measure the true *resource costs* of an activity. Economists therefore include all costs—whether they reflect monetary transactions or not.

There are several important opportunity costs that do not show up on income statements. For example, in many small businesses, the family may put in many unpaid hours, which are not included as accounting costs. Nor do business accounts include a capital charge for the owner's financial contributions. Nor do they include the cost of the environmental damage that occurs when a business dumps toxic wastes into a stream. But from an economic point of view, each of these is a genuine cost to the economy.

Let's illustrate the concept of opportunity cost by considering the owner of Hot Dog Ventures. The owner puts in 60 hours a week but earns no "wages." At the end of the year, as Table 7-6 showed, the firm earns a profit of $37,000—pretty good for a neophyte firm.

Or is it? The economist would insist that we should consider the value of a factor of production regardless of how the factor happens to be owned. We should count the owner's own labor as a cost even though the owner does not get paid directly but instead receives compensation in the form of profits. Because the owner has alternative opportunities for work, we must value the owner's labor in terms of the lost opportunities.

A careful examination might show that Hot Dog Ventures' owner could find a similar and equally interesting job working for someone else and earning $60,000. This represents the opportunity cost or earnings forgone because the owner decided to become the unpaid owner of a small business rather than the paid employee of another firm.

Therefore, the economist continues, let us calculate the true economic profits of the hot-dog firm. If we take the measured profits of $37,000 and subtract the $60,000 opportunity cost of the owner's labor, we find a net *loss* of $23,000. Hence, although the accountant might conclude that Hot Dog Ventures is economically viable, the economist would pronounce that the firm is an unprofitable loser.

What Was the Cost of the War in Iraq?

One of the most vexing questions facing Americans is to calculate how much the war in Iraq has cost. This issue involves questions of opportunity cost for the nation rather than for the firm, but the principles are similar. The Bush administration originally estimated that the war would be over quickly and that the costs would be around $50 billion. In reality, the war proved much longer and more expensive. According to a congressional report in 2008, the cumulative total spending on the campaigns in Iraq and Afghanistan was about $750 billion.

But economists Linda Bilmes and Joseph Stiglitz argue that even this large number underestimates the total because it does not take into account the entire opportunity cost of the war. One example of the understatement is that the pay of members of the military does not reflect the total costs to the nation because it underestimates costs in health care and other benefits. They write:

> When a young soldier is killed in Iraq or Afghanistan, his or her family will receive a U.S. government check for just $500,000 (combining life insurance with a "death gratuity")—far less than the typical amount paid by insurance companies for the death of a young person in a car accident. The "budgetary cost" of $500,000 is clearly only a fraction of the total cost society pays for the loss of life—and no one can ever really compensate the families. Moreover, disability pay seldom provides adequate compensation for wounded troops or their families. Indeed, in one out of five cases of seriously injured soldiers, someone in their family has to give up a job to take care of them.

Bilmes and Stiglitz also calculate that oil prices are higher because of the war, contributing to the increase in oil prices from $25 per barrel in 2003 to a peak of $155 a barrel in 2008.

When they add up all the opportunity costs through 2008, they conclude that the war in Iraq will cost the American people $3 trillion, or about $30,000 per household. While these numbers are subject to debate, they are a timely reminder of the difference between an accounting number and true economic or opportunity cost.

OPPORTUNITY COST AND MARKETS

At this point, however, you might well say: "Now I'm totally confused. First I learned that price is a good measure of true social cost in the marketplace. Now you tell me that opportunity cost is the right concept. Can't you economists make up your minds?"

Actually, there is a simple explanation: *In well-functioning markets, when all costs are included, price equals opportunity cost.* Assume that a commodity like wheat is bought and sold in a competitive market. If I bring my wheat to market, I will receive a number of bids from prospective buyers: $2.502, $2.498, and $2.501 per bushel. These represent the values of my wheat to, say, three different flour mills. I pick the highest—$2.502. The opportunity cost of this sale is the value of the best available alternative—that is, the second-highest bid, at $2.501—which is almost identical to the price that is accepted. As the market approaches perfect competition, the bids get closer and closer until, at the limit, the second-highest bid (which is our definition of opportunity cost) exactly equals the highest bid (which is the price). In competitive markets, numerous buyers compete for resources to the point where price is bid up to the best available alternative and is therefore equal to the opportunity cost.

Opportunity Cost outside Markets. The concept of opportunity cost is particularly crucial when you are analyzing transactions that take place outside markets. How do you measure the value of a road or a park? Of a health or safety regulation? Even the allocation of student time can be explained using opportunity cost.

- The notion of opportunity cost explains why students watch more TV the week after exams than the week before exams. Watching TV right before an exam has a high opportunity cost, for the alternative use of time (studying) has high value in improving grade performance and getting a good job. After exams, time has a lower opportunity cost.

- Or take the case of a proposal to drill for oil off the California coast. A storm of complaints is heard. A defender of the program states, "We need that oil to protect us from insecure foreign sources who are holding us hostage. We have plenty of seawater to go around. This is just good economics for the nation." In fact, it might be poor economics because of the opportunity cost. If drilling leads to oil spills that spoil the beaches, it might reduce the recreational value of the ocean. That opportunity cost might not be easily measured, but it is every bit as real as the value of oil under the waters.

The Road Not Traveled. Opportunity cost, then, is a measure of what has been given up when we make a decision. Consider what Robert Frost had in mind when he wrote,

> Two roads diverged in a wood, and I—
> I took the one less traveled by,
> And that has made all the difference.

What other road did Frost have in mind? An urban life? A life where he would not be able to write of roads and walls and birches? Imagine the immeasurable opportunity cost to all of us if Robert Frost had taken the road more traveled by.

But let us return from the poetic to the practical. The crucial point to grasp is this:

> Economic costs include, in addition to explicit money outlays, those opportunity costs incurred because resources can be used in alternative ways.

SUMMARY

A. Economic Analysis of Costs

1. Total cost (TC) can be broken down into fixed cost (FC) and variable cost (VC). Fixed costs are unaffected by any production decisions, while variable costs are incurred on items like labor or materials which increase as production levels rise.
2. Marginal cost (MC) is the extra total cost resulting from 1 extra unit of output. Average total cost (AC) is the sum of ever-declining average fixed cost (AFC) and average variable cost (AVC). Short-run average cost is generally represented by a U-shaped curve that is always intersected at its minimum point by the rising MC curve.
3. Useful rules to remember are

$$TC = FC + VC \quad AC = \frac{TC}{q} \quad AC = AFC + AVC$$

At the bottom of U-shaped AC, $MC = AC =$ minimum AC.
4. Costs and productivity are like mirror images. When the law of diminishing returns holds, the marginal product falls and the MC curve rises. When there is an initial stage of increasing returns, MC initially falls.
5. We can apply cost and production concepts to a firm's choice of the best combination of factors of production. Firms that desire to maximize profits will want to minimize the cost of producing a given level of output. In this case, the firm will follow the least-cost rule: different factors will be chosen so that the marginal product per dollar of input is equalized for all inputs. This implies that $MP_L/P_L = MP_A/P_A = \cdots$.

B. Economic Costs and Business Accounting

6. To understand accounting, the most important relationships are:
   a. The character of the income statement (or profit-and-loss statement); the residual nature of profits; and depreciation of fixed assets.
   b. The fundamental balance sheet relationship between assets, liabilities, and net worth; the breakdown of each of these into financial and fixed assets; and the residual nature of net worth.

C. Opportunity Costs

7. The economist's definition of costs is broader than the accountant's. Economic cost includes not only the obvious out-of-pocket purchases or monetary transactions but also more subtle opportunity costs, such as the return to labor supplied by the owner of a firm. These opportunity costs are tightly constrained by the bids and offers in competitive markets, so price is close to opportunity cost for marketed goods and services.
8. The most important application of opportunity cost arises for nonmarket goods—those like clean air or health or recreation—which may be highly valuable even though they are not bought and sold in markets.

CONCEPTS FOR REVIEW

Analysis of Costs

total costs: fixed and variable
marginal cost
least-cost rule:

$$\frac{MP_L}{P_L} = \frac{MP_A}{P_A} = \frac{MP_{\text{any factor}}}{P_{\text{any factor}}}$$

$TC = FC + VC$
$AC = TC/q = AFC + AVC$

Accounting Concepts

income statement (profit-and-loss statement): sales, cost, profits
depreciation
fundamental balance sheet identity
assets, liabilities, and net worth
stocks vs. flows
opportunity cost
cost concepts in economics and accounting

FURTHER READING AND INTERNET WEBSITES

Further Reading

Advanced treatment of cost and production theory can be found in intermediate textbooks. See the list provided in Chapter 3.

You can find interesting articles on business cost, production, and decision problems in magazines such as *Business Week, Fortune, Forbes,* and *The Economist.* An excellent nontechnical analysis of the Enron fraud is contained in Paul M. Healy and Krishna G. Palepu, "The Fall of Enron," *Journal of Economic Perspectives,* Spring 2003, pp. 3–26.

The quotation on the cost of war is from Linda J. Bilmes and Joseph E. Stiglitz, "The Iraq War Will Cost Us $3 Trillion, and Much More," *Washington Post,* March 9, 2008, p. B1. Their full study is Joseph E. Stiglitz and Linda J. Bilmes, *The Three Trillion Dollar War: The True Cost of the Iraq Conflict* (Norton, New York, 2008).

Websites

Good case studies on costs and production can be found in the business press. See the websites of the business magazines listed above, *www.businessweek.com, www.fortune.com, www.forbes.com,* and *www.economist.com.* Some of these sites require a fee or subscription.

Information about individual firms is filed with the Securities and Exchange Commission and can be found at *www.sec.gov/edgarhp.htm.*

QUESTIONS FOR DISCUSSION

1. During his major-league career from 1936 to 1960, Ted Williams had 7706 at bats and 2654 hits.
   a. What was his lifetime batting average?
   b. In his last year, 1960, Williams had 310 at bats and 98 hits. What was his lifetime batting average at the end of 1959? What was his batting average for 1960?
   c. Explain the relationship between his average for 1959 and the change of his lifetime average from 1959 to 1960. State how this illustrates the relationship between *MC* and *AC.*
2. To the $55 of fixed cost in Table 7-3, add $90 of additional *FC.* Now calculate a whole new table, with the same *VC* as before but new $FC = \$145$. What happens to *MC, AVC?* To *TC, AC, AFC?* Can you verify that minimum *AC* is now at $q^* = 5$ with $AC = \$60 = MC$?
3. Explain why *MC* cuts *AC* and *AVC* at their minimum values (i.e., the bottom of their U-shaped cost curves).
4. "Compulsory military service allows the government to fool itself and the people about the true cost of a big army." Compare the budget cost and the opportunity cost of a voluntary army (where army pay is high) with those of compulsory service (where pay is low). What does the concept of opportunity cost contribute to analyzing the quotation?
5. Consider the data in Table 7-8, which contains a situation similar to that in Table 7-5.
   a. Calculate the *TC, VC, FC, AC, AVC,* and *MC.* On a piece of graph paper, plot the *AC* and *MC* curves.
   b. Assume that the price of labor doubles. Calculate a new *AC* and *MC.* Plot the new curves and compare them with those in **a.**

(1) Output (tons of wheat)	(2) Land inputs (acres)	(3) Labor inputs (workers)	(4) Land rent ($ per acre)	(5) Labor wage ($ per worker)
0	15	0	12	5
1	15	6	12	5
2	15	11	12	5
3	15	15	12	5
4	15	21	12	5
5	15	31	12	5
6	15	45	12	5
7	15	63	12	5

TABLE 7-8.

c. Now assume that total factor productivity doubles (i.e., that the level of output doubles for each input combination). Repeat the exercise in **b.** Can you see two major factors that tend to affect a firm's cost curves?

6. Explain the fallacies in each of the following:
   a. Average costs are minimized when marginal costs are at their lowest point.
   b. Because fixed costs never change, average fixed cost is a constant for each level of output.
   c. Average cost is rising whenever marginal cost is rising.
   d. The opportunity cost of drilling for oil in Yosemite Park is zero because no firm produces anything there.
   e. A firm minimizes costs when it spends the same amount on each input.

7. In 2008, a fictitious software company named EconDisaster.com sold $7000 worth of a game called "Global Financial Meltdown." The company had salaries of $1000, rent of $500, and electricity use of $500, and it purchased a computer for $5000. The company uses straight-line depreciation with a lifetime of 5 years (this means that depreciation is calculated as the historical cost divided by the lifetime). It pays a corporation tax of 25 percent on profits and paid no dividends. Construct its income statement for 2008 based on Table 7-6.

8. Next, construct the balance sheet for EconDisaster.com for December 31, 2008. The company had no assets at the beginning of the year. The owners contributed $10,000 of start-up capital and obtained common stock. Net income and retained earnings can be calculated from question 7.

Appendix 7

PRODUCTION, COST THEORY, AND DECISIONS OF THE FIRM

The production theory described in Chapter 6 and the cost analysis of this chapter are among the fundamental building blocks of microeconomics. A thorough understanding of production and cost is necessary for an appreciation of how economic scarcity gets translated into prices in the marketplace. This appendix develops these concepts further and introduces the concept of an equal-product curve, or isoquant.

A NUMERICAL PRODUCTION FUNCTION

Production theory and cost analysis have their roots in the concept of a production function, which shows the maximum amount of output that can be produced with various combinations of inputs. Table 7A-1 starts with a numerical example of a constant-returns-to-scale production function, showing the amount of inputs along the axes and the amount of output at the grid points of the table.

Along the left-hand side are listed the varying amounts of land, going from 1 unit to 6 units. Along the bottom are listed amounts of labor, which also go from 1 to 6. Output corresponding to each land row and labor column is listed inside the table.

If we are interested in knowing exactly how much output there will be when 3 units of land and 2 units of labor are available, we count up 3 units of land and then go over 2 units of labor. The answer is seen to be 346 units of product. (Can you identify some other input combinations that will produce $q = 346$?) Similarly, we find that 3 units of land and 6 of labor produce 600 units of q. Remember that the production function shows the maximum output available given engineering skills and technical knowledge available at a particular time.

Land \ Labor	1	2	3	4	5	6
6	**346**	490	600	692	775	846
5	316	448	548	632	705	775
4	282	400	490	564	632	692
3	245	**346**	423	490	548	600
2	200	282	**346**	400	448	490
1	141	200	245	282	316	**346**
0						

TABLE 7A-1. A Tabular Picture of a Production Function Relating Amount of Output to Varying Combinations of Labor and Land Inputs

When you have 3 land units and 2 labor units available, the engineer tells you the maximum obtainable output is 346 units. Note the different ways to produce 346. Do the same for 490. (The production function shown in the table is a special case of the Cobb-Douglas production function, one given by the formula $Q = 100\sqrt{2LA}$.)

THE LAW OF DIMINISHING MARGINAL PRODUCT

Table 7A-1 can nicely illustrate the law of diminishing returns. First, recall that the marginal product of labor is the extra production resulting from 1 additional unit of labor when land and other inputs are held constant. At any point in Table 7A-1, we can find the marginal product of labor by subtracting the output from the number on its right in the same row. Thus, when there are 2 units of land and 4 units of labor, the marginal product of an additional laborer would be 48, or 448 minus 400 in the second row.

By the "marginal product of land" we mean, of course, the extra product resulting from 1 additional unit of land when labor is held constant. It is calculated by comparing adjacent items in a given column. Thus, when there are 2 units of land and 4 units of labor, the marginal product of land is shown in the fourth column as 490 – 400, or 90.

We can easily find the marginal product of each of our two factors by comparing adjacent entries in the vertical columns or horizontal rows of Table 7A-1.

Having defined the concept of marginal product of an input, we now can easily define the law of diminishing returns: *The law of diminishing returns* *states that as we increase one input and hold other inputs constant, the marginal product of the varying input will, at least after some point, decline.*

To illustrate this, hold land constant in Table 7A-1 by sticking to a given row—say, the row corresponding to land equal to 2 units. Now let labor increase from 1 to 2 units, from 2 to 3 units, and so forth. What happens to q at each step?

As labor goes from 1 to 2 units, the level of output increases from 200 to 282 units, or by 82 units. But the next dose of labor adds only 64 units, or 346 − 282. Diminishing returns have set in. Still further additions of a single unit of labor give us, respectively, only 54 extra units of output, 48 units, and finally 42 units. You can easily verify that the law holds for other rows and that the law holds when land is varied and labor held constant.

We can use this example to verify our intuitive justification of the law of diminishing returns—the assertion that the law holds because the fixed factor decreases relative to the variable factor. According to this explanation, each unit of the variable factor has less and less of the fixed factor to work with. So it is natural that extra product should drop off.

If this explanation is to hold water, output should increase proportionately when both factors are increased together. When labor increases from 1 to 2 and land simultaneously increases from 1 to 2, we should get the same increase in product as when both increase *simultaneously* from 2 to 3. This can be verified in Table 7A-1. In the first move we go from 141 to 282, and in the second move the product increases from 282 to 423, an equal jump of 141 units.

LEAST-COST FACTOR COMBINATION FOR A GIVEN OUTPUT

The numerical production function shows us the different ways to produce a given level of output. But which of the many possibilities should the firm use? If the desired level of output is $q = 346$, there are no less than four different combinations of land and labor, shown as A, B, C, and D in Table 7A-2.

As far as the engineer is concerned, each of these combinations is equally good at producing an output of 346 units. But the manager, interested in minimizing cost, wants to find the combination that costs the least.

	(1)	(2)	(3)	(4)
	Input Combinations		**Total cost when $P_L = \$2$, $P_A = \$3$ (\$)**	**Total cost when $P_L = \$2$, $P_A = \$1$ (\$)**
	Labor L	**Land A**		
A	1	6	20	____
B	2	3	13	7
C	**3**	**2**	**12**	____
D	6	1	15	____

TABLE 7A-2. Inputs and Costs of Producing a Given Level of Output

Assume that the firm has chosen 346 units of output. Then it can use any of the four choices of input combinations shown as A, B, C, and D. As the firm moves down the list, production becomes more labor-intensive and less land-intensive. Fill in the missing numbers.

The firm's choice among the different techniques will depend on input prices. When $P_L = \$2$ and $P_A = \$3$, verify that the cost-minimizing combination is C. Show that lowering the price of land from \$3 to \$1 leads the firm to choose a more land-intensive combination at B.

Let us suppose that the price of labor is \$2 and the price of land \$3. The total costs when input prices are at this level are shown in the third column of Table 7A-2. For combination A, the total labor and land cost will be \$20, equal to $(1 \times \$2) + (6 \times \$3)$. Costs at B, C, and D will be, respectively, \$13, \$12, and \$15. At the assumed input prices, C is the least costly way to produce the given output.

If either of the input prices changes, the equilibrium proportion of the inputs will also change so as to use less of the input that has gone up most in price. (This is just like the substitution effect in Chapter 5's discussion of consumer demand.) As soon as input prices are known, the least-cost method of production can be found by calculating the costs of different input combinations.

Equal-Product Curves

The commonsense numerical analysis of the way in which a firm will combine inputs to minimize costs can be made more vivid by the use of diagrams. We will take the diagrammatic approach by putting together two new curves, the equal-product curve and the equal-cost line.

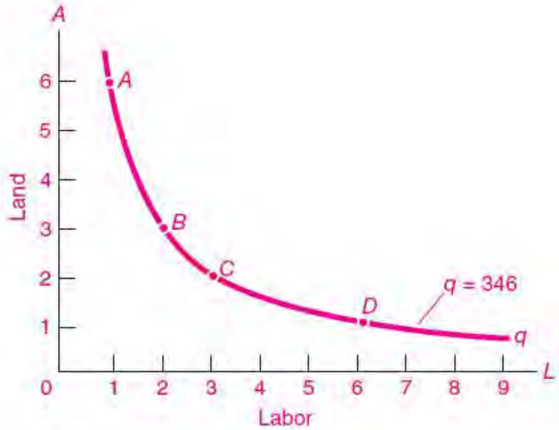


FIGURE 7A-1. Equal-Product Curve

All the points on the equal-product curve represent the different combinations of land and labor that can be used to produce the same 346 units of output.

Let's turn Table 7A-1 into a continuous curve by drawing a smooth curve through all the points that yield $q = 346$. This smooth curve, shown in Figure 7A-1, indicates all the different combinations of labor and land that yield an output of 346 units. This is called an **equal-product curve** or **isoquant** and is analogous to the consumer's indifference curve discussed in the appendix to Chapter 5. You should be able to draw on Figure 7A-1 the corresponding equal-product curve for output equal to 490 by getting the data from Table 7A-1. Indeed, an infinite number of such equal-product contour lines could be drawn in.

Equal-Cost Lines

Given the price of labor and land, the firm can evaluate the total cost for points *A, B, C,* and *D* or for any other point on the equal-product curve. The firm will minimize its costs when it selects that point on its equal-product curve that has the lowest total cost.

An easy technique for finding the least-cost method of production is to construct **equal-cost lines.** This is done in Figure 7A-2, where the family of parallel straight lines represents a number of equal-cost curves when the price of labor is \$2 and the price of land \$3.

To find the total cost for any point, we simply read off the number appended to the equal-cost line going through that point. The lines are all straight and parallel because the firm is assumed to be able to buy all it wishes of either input at constant prices. The lines are somewhat flatter than 45° because the price of labor P_L is somewhat less than the price of land P_A. More precisely, we can always say that the arithmetic value of the slope of each equal-cost line must equal the ratio of the price of labor to that of land—in this case $P_L/P_A = 2/3$.

Equal-Product and Equal-Cost Contours: Least-Cost Tangency

Combining the equal-product and equal-cost lines, we can determine the optimal, or cost-minimizing, position of the firm. Recall that the optimal input combination comes at that point where the given output of $q = 346$ can be produced at least cost. To find such a point, simply superimpose the single green equal-product curve upon the family of blue equal-cost lines, as shown in Figure 7A-3. The firm will always keep moving along the green convex curve of Figure 7A-3 as long as it is able to cross over to lower cost lines. Its equilibrium will therefore be at *C*, where the equal-product curve touches (but does not cross) the lowest equal-cost line. This is a point of tangency, where the slope of the equal-product curve just matches the slope of an equal-cost line and the curves are just kissing.

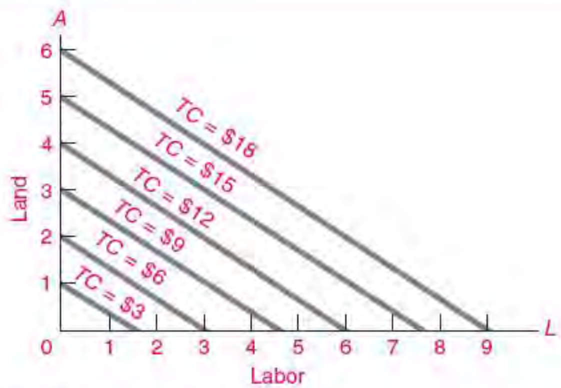


FIGURE 7A-2. Equal-Cost Lines

Every point on a given equal-cost line represents the same total cost. The lines are straight because factor prices are constant, and they all have a negative slope equal to the ratio of labor price to land price, \$2/\$3, and hence are parallel.

Substituting Inputs to Minimize Cost of Production

FIGURE 7A-3. Least-Cost Input Combination Comes at *C*

The firm desires to minimize its costs of producing a given output of 346. It thus seeks out the least expensive input combination along its green equal-product curve. It looks for the input combination that is on the lowest of the equal-cost lines. Where the equal-product curve touches (but does not cross) the lowest equal-cost line is the least-cost position. This tangency means that factor prices and marginal products are proportional, with equalized marginal products per dollar.

We already know that the slope of the equal-cost curves is P_L/P_A. But what is the slope of the equal-product curve? Recall from Chapter 1's appendix that the slope at a point of a curved line is the slope of the straight line tangent to the curve at the point in question. For the equal-product curve, this slope is a "substitution ratio" between the two factors. It depends upon the relative marginal products of the two factors of production, namely, MP_L/MP_A—just as the rate of substitution between two goods along a consumer's indifference curve was earlier shown to equal the ratio of the marginal utilities of the two goods (see the appendix to Chapter 5).

Least-Cost Conditions

Using our graphical apparatus, we have therefore derived the conditions under which a firm will minimize its costs of production:

1. The ratio of marginal products of any two inputs must equal the ratio of their factor prices:

$$\text{Substitution ratio} = \frac{\text{marginal product of labor}}{\text{marginal product of land}}$$

$$= \begin{array}{c}\text{slope of}\\ \text{equal-product}\\ \text{curve}\end{array} = \frac{\text{price of labor}}{\text{price of land}}$$

2. We can also rewrite condition 1 in a different and illuminating way. From the last equation it follows that the marginal product per dollar received from the (last) dollar of expenditure must be the same for every productive input:

$$\frac{\text{Marginal product of } L}{\text{Price of } L} =$$

$$\frac{\text{marginal product of } A}{\text{price of } A} = \cdots$$

But you should not be satisfied with abstract explanations. Always remember the commonsense economic explanation which shows how a firm will distribute its expenditure among inputs to equalize the marginal product per dollar of spending.

SUMMARY TO APPENDIX

1. A production-function table lists the output that can be produced for each labor column and each land row. Diminishing returns to one variable factor, when other factors are held fixed or constant, can be shown by calculating the decline of marginal products in any row or column.
2. An equal-product curve or isoquant depicts the alternative input combinations that produce the same level of output. The slope, or substitution ratio, along such an equal-product curve equals relative marginal products (e.g., MP_L/MP_A). Curves of equal total cost are parallel lines with slopes equal to factor-price ratios (P_L/P_A). Least-cost equilibrium comes at the tangency point, where an equal-product curve touches but does not cross the lowest *TC* curve. In least-cost equilibrium, marginal products are proportional to factor prices, with equalized marginal product per dollar spent on all factors (i.e., equalized MP_i/P_i).

CONCEPTS FOR REVIEW

equal-product curves, isoquants
parallel lines of equal TC
substitution ratio = MP_L/MP_A

P_L/P_A as the slope of parallel equal-TC lines

least-cost tangency condition:
$MP_L/MP_A = P_L/P_A$ or $MP_L/P_L = MP_A/P_A$

QUESTIONS FOR DISCUSSION

1. Show that raising labor's wage while holding land's rent constant will steepen the blue equal-cost lines and move tangency point C in Figure 7A-3 northwest toward B, with the now-cheaper input substituted for the input which is now more expensive. If we substitute capital for labor, restate the result. Should union leaders recognize this relationship?

2. What is the least-cost combination of inputs if the production function is given by Table 7A-1 and input prices are as shown in Figure 7A-3, where $q = 346$? What would be the least-cost ratio for the same input prices if output doubled to $q = 692$? What has happened to the "factor intensity," or land-labor ratio? Can you see why this result would hold for any output change under constant returns to scale?

CHAPTER

8

Analysis of Perfectly Competitive Markets

Cost of production would have no effect on competitive price if it could have none on supply.

John Stuart Mill

We have described how the market mechanism performs a kind of miracle every day, providing our daily necessities like bread and a vast array of high-quality goods and services without central control or direction. Exactly how does this market mechanism work?

The answer begins with the two sides to every market—supply and demand. These two components must be put together to understand how the market as a whole behaves. This first chapter on industrial organization analyzes the behavior of perfectly competitive markets; these are idealized markets in which firms and consumers are too small to affect the price. The first section shows how competitive firms behave, after which some special cases are examined. The chapter concludes by showing that a perfectly competitive industry will be efficient. After having surveyed the central case of perfect competition, we move on in the following chapters to other forms of market behavior, such as monopolies.

A. SUPPLY BEHAVIOR OF THE COMPETITIVE FIRM

BEHAVIOR OF A COMPETITIVE FIRM

We begin with an analysis of perfectly competitive firms. If you own such a firm, how much should you produce? How much wheat should Farmer Smith produce if wheat sells at $6 per bushel?

Our analysis of perfectly competitive firms relies on two key assumptions. First, we will assume that our competitive firm *maximizes profits.* Second, we reiterate that perfect competition is a world of *atomistic firms who are price-takers.*

Profit Maximization

Profits are like the net earnings or take-home pay of a business. They represent the amount a firm can pay in dividends to the owners, reinvest in new plant and equipment, or employ to make financial investments. All these activities increase the value of the firm to its owners.

Firms maximize profits because that maximizes the economic benefit to the owners of the firm. Allowing lower-than-maximum profits is like asking for a pay cut, which few business owners will voluntarily undertake.

Profit maximization requires the firm to manage its internal operations efficiently (prevent waste, encourage worker morale, choose efficient production processes, and so forth) and to make sound decisions in the marketplace (buy the correct quantity of inputs at least cost and choose the optimal level of output).

Because profits involve both costs and revenues, the firm must have a good grasp of its cost structure. Turn back to Table 7-3 in the previous chapter to make sure you are clear on the important concepts of total cost, average cost, and marginal cost.

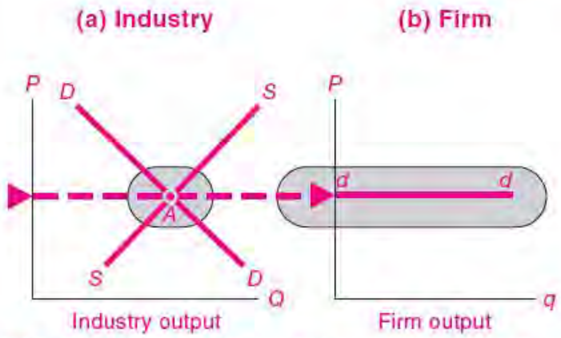


FIGURE 8-1. Demand Curve Is Completely Elastic for a Perfectly Competitive Firm

The industry demand curve on the left has inelastic demand at the market equilibrium at *A*. However, the demand curve for the perfectly competitive firm on the right is horizontal (i.e., completely elastic). The demand curve on the right is horizontal because a perfect competitor has such a small fraction of the market that it can sell all it wants at the market price.

Perfect Competition

Perfect competition is the world of *price-takers*. A perfectly competitive firm sells a *homogeneous product* (one identical to the product sold by others in the industry). The firm is so small relative to its market that it cannot affect the market price; it simply takes the price as given. When Farmer Smith sells a homogeneous product like wheat, she sells to a large pool of buyers at the market price of $6 per bushel. Just as consumers must generally accept the prices that are charged by Internet access providers or movie theaters, so must competitive firms accept the market prices of the wheat or oil that they produce.

We can depict a price-taking perfect competitor by examining the way demand looks to a perfectly competitive firm. Figure 8-1 shows the contrast between the industry demand curve (the *DD* curve) and the demand curve facing a single competitive firm (the *dd* curve). Because a competitive industry is populated by firms that are small relative to the market, the firm's segment of the demand curve is only a tiny segment of the industry's curve. Graphically, the competitive firm's portion of the demand curve is so small that, to the lilliputian eye of the perfect competitor, the firm's *dd* demand curve looks completely horizontal or infinitely elastic. Figure 8-1 illustrates how the elasticity of demand for a single competitor appears very much greater than that for the entire market.

Because competitive firms cannot affect the price, the price for each unit sold is the extra revenue that the firm will earn. For example, at a market price of $40 per unit, the competitive firm can sell all it wants at $40. If it decides to sell 101 units rather than 100 units, its revenue goes up by exactly $40.

Here are the major points to remember:

1. Under **perfect competition,** there are many small firms, each producing an identical product and each too small to affect the market price.
2. The perfect competitor faces a completely horizontal demand (or *dd*) curve.
3. The extra revenue gained from each extra unit sold is therefore the market price.

Competitive Supply Where Marginal Cost Equals Price

Suppose *you* are managing Bob's oil operations and are responsible for setting the profit-maximizing output. How would you go about this task? Examine Table 8-1, which contains the same cost data as Tables 7-3 and 7-4 in the previous chapter. This table adds a further assumption that the market price of oil is $40 per unit.

Supply Decision of Competitive Firm

(1) Quantity q	(2) Total cost TC (\$)	(3) Marginal cost per unit MC (\$)	(4) Average cost AC (\$)	(5) Price P (\$)	(6) Total revenue $TR = q \times P$ (\$)	(7) Profit $\pi = TR - TC$ (\$)
0	55,000					
1,000	85,000	**27**	85	40	40,000	−45,000
2,000	110,000	**22**	55	40	80,000	−30,000
3,000	130,000	**21**	43.33	40	120,000	−10,000
3,999	159,960.01	**38.98**	40.000+	40	159,960	−0.01
		39.99				
4,000	**160,000**	**40**	**40**	**40**	**160,000**	**0**
		40.01				
4,001	160,040.01	**40.02**	40.000+	40	160,040	−0.01
5,000	210,000	**60**	42	40	200,000	−10,000

TABLE 8-1. Profit Is Maximized at Production Level Where Marginal Cost Equals Price

The first four columns use the same cost data as that analyzed in Tables 7-3 and 7-4 of the previous chapter. Column (5) shows the price of \$40 that is received by the price-taking perfect competitor. Total revenue is price times quantity, while profit is total revenue less total cost.

This table shows that the maximum profit comes at that output where price equals *MC*. If output is raised above $q = 4000$, the additional revenue of \$40 per unit is less than the marginal cost, so profit is lowered. What happens to profit if output is raised when $q < 4000$?

You might take a guess and sell 3000 units. This yields total revenue of \$40 × 3000 = \$120,000, with total cost of \$130,000, so the firm incurs a loss of \$10,000. From economics, you have learned to think about *marginal* or incremental decisions. So you analyze the effect of selling an additional unit. The revenue from each unit is \$40, while the marginal cost at that volume is only \$21. This implies that the additional revenue outweighs the marginal cost of 1 more unit. So you analyze a production level of 4000 units. At this output, the firm has revenues of \$40 × 4000 = \$160,000 and costs of \$160,000, so profits are zero.

What would happen if you increase output to 5000 units? At this output, the firm has revenues of \$40 × 5000 = \$200,000 and costs of \$210,000. Now you're losing \$10,000 again. What went wrong? When you look at your accounts, you see that at the output level of 5000, the marginal cost is \$60. This is more than the market price of \$40, so you are losing \$20 (equal to price minus *MC*) on the last unit produced.

Now you see the light: *The maximum profit comes at that output where marginal cost equals price.*

The reason underlying this proposition is that the competitive firm can always make additional profit as long as the price is greater than the marginal cost of the last unit. Total profit reaches its peak—is maximized—when there is no longer any extra profit to be earned by selling extra output. At the maximum-profit point, the last unit produced brings in an amount of revenue exactly equal to that unit's cost. What is that extra revenue? It is the price per unit. What is that extra cost? It is the marginal cost.

Let's test this rule by looking at Table 8-1. Starting at the profit-maximizing output of 4000 units, if

Firm's Supply and Marginal Cost

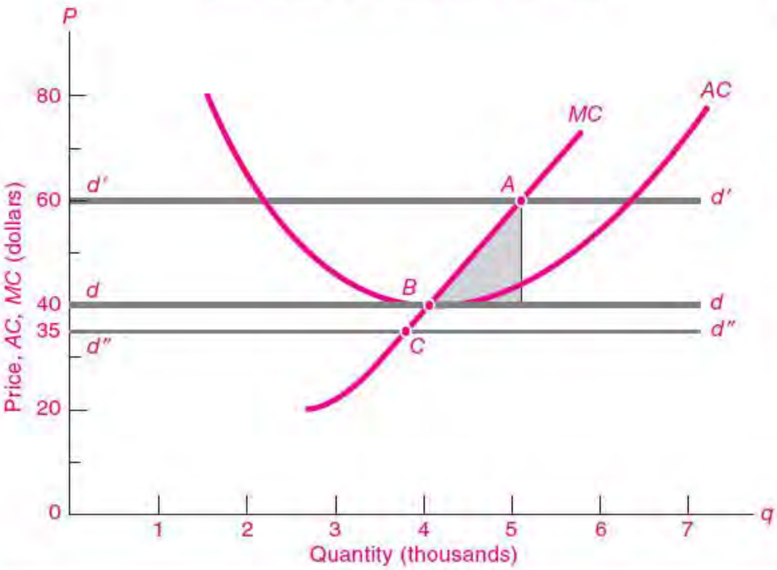


FIGURE 8-2. Firm's Supply Curve Is Its Rising Marginal Cost Curve

For a profit-maximizing competitive firm, the upward-sloping marginal cost (*MC*) curve is the firm's supply curve. For market price at *d′ d′*, the firm will supply output at the intersection point at *A*. Explain why intersection points at *B* and *C* represent equilibria for prices at *d* and *d″* respectively. The shaded blue region represents the loss from producing at *A* when price is $40.

Bob sells 1 more unit, that unit would bring a price of $40 while the marginal cost of that unit is $40.01. So the firm would lose money on the 4001st unit. Similarly, the firm would lose $0.01 if it produced 1 less unit. This shows that the firm's maximum-profit output comes at exactly $q = 4000$, where price equals marginal cost.

Rule for a firm's supply under perfect competition: A firm will maximize profits when it produces at that level where marginal cost equals price:

$$\text{Marginal cost} = \text{price} \quad \text{or} \quad MC = P$$

Figure 8-2 shown above illustrates a firm's supply decision diagrammatically. When the market price of output is $40, the firm consults its cost data in Table 8-1 and finds that the production level corresponding to a marginal cost of $40 is 4000 units. Hence, at a market price of $40, the firm will wish to produce and sell 4000 units. We can find that profit-maximizing amount in Figure 8-2 at the intersection of the price line at $40 and the *MC* curve at point *B*.

We designed this example so that at the profit-maximizing output the firm has zero profits, with total revenues equal to total costs. Point *B* is the **zero-profit point,** the production level at which the firm makes zero economic profits; at the zero-profit point, price equals average cost, so revenues just cover costs.

What if the firm chooses the wrong output? Suppose the firm chooses output level *A* in Figure 8-2 when the market price is $40. It would be losing money because the last units have marginal cost above price. We can calculate the loss of profit if the firm mistakenly produces at *A* by the shaded blue triangle in Figure 8-2. This depicts the surplus of *MC* over price for production between *B* and *A*.

The general rule then is:

A profit-maximizing firm will set its output at that level where marginal cost equals price. Diagrammatically, this means that a firm's marginal cost curve is also its supply curve.

Total Cost and the Shutdown Condition

Our general rule for firm supply leaves open one possibility—that the price will be so low that the firm will want to shut down. Isn't it possible that at the $P = MC$ equilibrium, Bob may be losing a truckful of money and would want to shut down? In general, a firm will want to shut down in the short run when it can no longer cover its variable costs.

For example, suppose the firm were faced with a market price of $35, shown by the horizontal $d''d''$ line in Figure 8-2. At that price, *MC* equals price at point *C*, a point at which the price is actually less than the average cost of production. Would the firm want to keep producing even though it was incurring a loss?

The surprising answer is that the firm should *not* necessarily shut down if it is losing money. The firm should *minimize its losses*, which is the same thing as maximizing profits. Producing at point *C* would result in a loss of only $20,000, whereas shutting down would involve losing $55,000 (which is the fixed cost). The firm should therefore continue to produce.

To understand this point, remember that a firm must still cover its contractual commitments even when it produces nothing. In the short run, the firm must pay fixed costs such as interest to the bank, rentals on the oil rigs, and directors' salaries. The balance of the firm's costs are variable costs, such as those for materials, production workers, and fuel, which would have zero cost at zero production. It will be advantageous to continue operations, with *P* at least as high as *MC*, as long as revenue covers variable costs.

The critically low market price at which revenues just equal variable costs (or, equivalently, at which losses exactly equal fixed costs) is called the **shutdown point.** For prices above the shutdown point, the firm will produce along its marginal cost curve because, even though the firm might be losing money, it would lose more money by shutting down. For prices below the shutdown point, the firm will produce nothing at all because by shutting down the firm will lose only its fixed costs. This gives the shutdown rule:

Shutdown rule: The shutdown point comes where revenues just cover variable costs or where losses are equal to fixed costs. When the price falls below average variable costs, the firm will maximize profits (minimize its losses) by shutting down.

Figure 8-3 shows the shutdown and zero-profit points for a firm. The zero-profit point comes where price is equal to *AC*, while the shutdown point comes where price is equal to *AVC*. Therefore, the firm's supply curve is the solid green line in Figure 8-3. It first goes up the vertical axis to the price corresponding to the shutdown point; next jumps to the shutdown point at *M′*, where *P* equals the level of *AVC*; and then continues up the *MC* curve for prices above the shutdown price.

Zero-Profit and Shutdown Prices

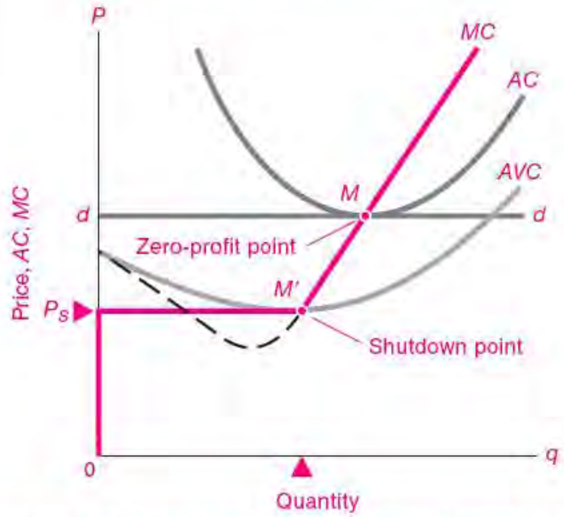


FIGURE 8-3. Firm's Supply Curve Travels Down the *MC* Curve to the Shutdown Point

The firm's supply curve corresponds to its *MC* curve as long as revenues exceed variable costs. Once price falls below P_s, the shutdown point, losses are greater than fixed costs, and the firm shuts down. Hence the solid green curve is the firm's supply curve.

The analysis of shutdown conditions leads to the surprising conclusion that profit-maximizing firms may in the short run continue to operate even though they are losing money. This condition will hold particularly for firms that are heavily indebted and therefore have high fixed costs (the airlines being a good example). For these firms, as long as losses are less than fixed costs, profits are maximized and losses are minimized when they pay the fixed costs and still continue to operate.

Unemployed Rigs in the Drilling Industry

A striking example of the shutdown rule at work was seen in the oil industry. New oil wells are drilled by "oil rigs." Each oil rig is like a little business, which can operate or shut down depending upon profitability. When a price war broke out among oil producers in 1999, many shut down, and the number of rigs in operation in the United States declined to under 500. Had the oil fields run dry? Not at all. Rather, production was discouraged because the price of oil was so low. It was the profits, not the wells, that dried up.

What happened to drilling activity during the oil-price surge of the 2000s? From 2002 to 2008, when oil prices quadrupled, the number of rigs in operation went up by a factor of almost 4. In effect, as prices rose, these firms moved up along an upward-sloping *MC* supply curve similar to the one shown in Figure 8-3.

B. SUPPLY BEHAVIOR IN COMPETITIVE INDUSTRIES

Our discussion up to now has concerned only the individual firm. But a competitive market comprises many firms, and we are interested in the behavior of all firms together, not just a single firm. How can we move from the one to the many? From Bob's operation to the entire oil industry?

SUMMING ALL FIRMS' SUPPLY CURVES TO GET MARKET SUPPLY

Suppose we are dealing with a competitive market for oil. At a given price, firm A will bring a given quantity of oil to market, firm B will bring another quantity, as will firms C, D, and so on. In each case, the quantity supplied will be determined by each firm's marginal costs. The *total* quantity brought to market at a given price will be the *sum* of the individual quantities that all firms supply at that price.[1]

This reasoning leads to the following relationship between individual and market supplies for a perfectly competitive industry:

The market supply curve for a good in a perfectly competitive market is obtained by adding horizontally the supply curves of all the individual producers of that good.

Figure 8-4 illustrates this rule for two firms. We obtain the industry's *SS* supply curve by horizontal addition at each price of the firms' individual supply

[1] Recall that the *DD* market demand curve is similarly obtained by horizontal summation of individual *dd* demand curves.

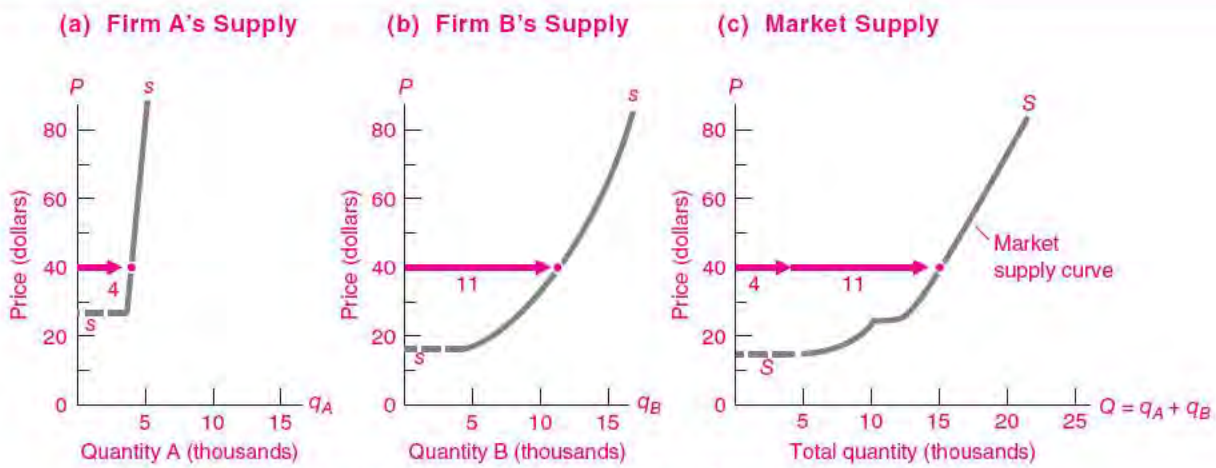


FIGURE 8-4. Add All Firms' Supply Curves to Derive Market Supply

The diagrams show how the market supply curve (*SS*) is derived from two individual supply curves (*ss*). We horizontally add quantities supplied by each firm at $40 to get total market supply at $40. This applies at each price and to any number of firms. If there are 1000 firms identical to firm A, the market supply curve would look like firm A's supply curve with a thousandfold change of horizontal scale.

curves. At a price of \$40, firm A will supply 4000 units while firm B will supply 11,000 units. Therefore, the industry will supply a total of 15,000 units at a price of \$40. If there are 2 million rather than 2 firms, we would still derive industry output by adding all the 2 million individual-firm quantities at the going price. Horizontal addition of output at each price gives us the industry supply curve.

SHORT-RUN AND LONG-RUN EQUILIBRIUM

Economists have observed that demand shifts produce greater price adjustments and smaller quantity adjustments in the short run than they do in the long run. We can understand this observation by distinguishing two time periods for market equilibrium that correspond to different cost categories: (1) *short-run equilibrium,* when output changes must use the same fixed amount of capital, and (2) *long-run equilibrium,* when capital and all other factors are variable and there is free entry and exit of firms into and from the industry.

Entry and Exit of Firms

The birth (entry) and death (exit) of firms are important factors that affect the evolution of a market economy. Firms *enter* an industry either when they are newly formed or when an existing firm decides to start production in a new sector. Firms *exit* when they stop producing; they might leave voluntarily because a line of production is unprofitable, or they might go bankrupt if the entire firm cannot pay its bills. We say that there is *free entry and exit* when there are no barriers to entry or exit. Barriers to entry include such factors as government regulations or intellectual property rights (e.g., patents or software).

Many people are surprised by the large number of births and deaths of firms in a dynamic economy like the United States. For example, there were 6.5 million registered businesses at the beginning of 2003. In that year, 748,000 new businesses were born and 658,000 went out of business. The riskiest industry was Internet providers, where 30 percent of jobs were lost because of firm deaths in that year. The safest industry was colleges, where only 4 percent of jobs were lost by college closings.

Most firms exit quietly, but sometimes large firms have a noisy exit, as occurred when the telecommunications giant WorldCom, with \$104 billion of assets, went under because of a massive accounting fraud. Although the smooth cost curves do not always capture the drama of entry and exit, the underlying logic of *P, MC,* and *AC* is a powerful force driving the growth and decline of major industries.

Let's illustrate the distinction between short-run and long-run equilibriums with an example. Consider the market for fresh fish supplied by a local fishing fleet. Suppose the demand for fish increases; this case is shown in Figure 8-5(a) as a shift from DD to $D'D'$. With higher prices, fishing captains will want to increase their catch. In the short run, they cannot build new boats, but they can hire extra crews and work longer hours. Increased inputs of variable factors will produce a greater quantity of fish along the *short-run supply curve* S_sS_s shown in Figure 8-5(a). The short-run supply curve intersects the new demand curve at E', the point of short-run equilibrium.

The high prices lead to high profits, which in the long run coax out more shipbuilding and attract more sailors into the industry. Additionally, new firms may start up or enter the industry. This gives us the *long-run supply curve* S_LS_L in Figure 8-5(b) and the long-run equilibrium at E''. The intersection of the long-run supply curve with the new demand curve yields the long-run equilibrium attained when all economic conditions (including the number of ships, shipyards, and firms) have adjusted to the new level of demand.

Long-Run Industry Supply. What is the shape of the long-run supply curve for an industry? Suppose that an industry has free entry of identical firms. If the identical firms use general inputs, such as unskilled labor, that can be attracted from the vast ocean of other uses without affecting the prices of those general inputs, we get the case of constant costs shown by the horizontal S_LS_L supply curve in Figure 8-6.

By contrast, suppose some of the inputs used in the industry are in relatively short supply—for example, fertile vineyard land for the wine industry or scarce beachfront properties for summer vacations. Then the supply curve for the wine or vacation industry must be upward-sloping, as shown by S_LS_L' in Figure 8-6.

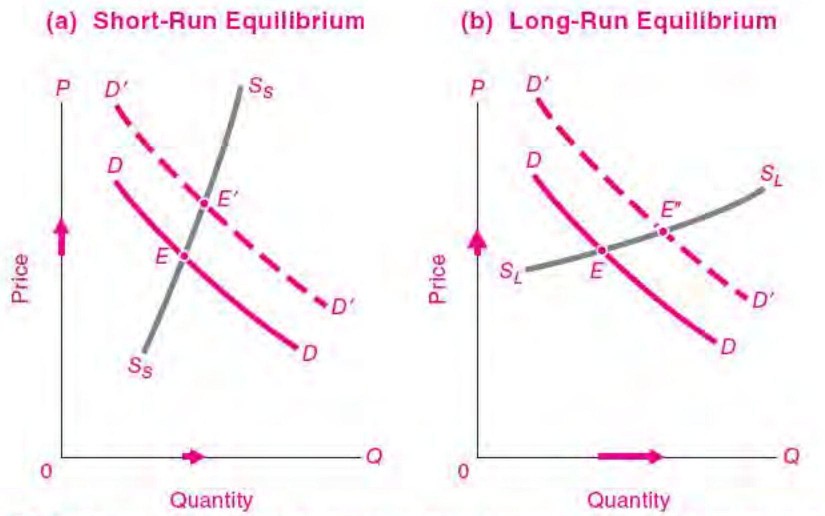


FIGURE 8-5. Effect of Increase in Demand on Price Varies in Different Time Periods

We distinguish between periods in which firms have time to make **(a)** adjustments in variable factors such as labor (short-run equilibrium) and **(b)** full adjustment of all factors, fixed as well as varying (long-run equilibrium). The longer the time for adjustments, the greater the elasticity of supply response and the smaller the rise in price.

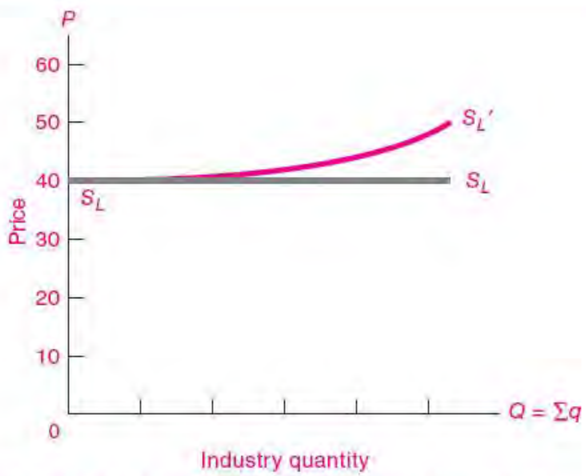


FIGURE 8-6. Long-Run Industry Supply Depends on Cost Conditions

With entry and exit free and any number of firms able to produce on identical, unchanged cost curves, the long-run S_LS_L curve will be horizontal at each firm's minimum average cost or zero-profit price. If the industry uses a specific factor, such as scarce beachfront property, the long-run supply curve must slope upward like S_LS_L', as higher production employs less well-suited inputs.

The long-run supply curve of industries using scarce factors rises because of diminishing returns. For example, take the case of the rare vineyard land. As firms apply increasing inputs of labor to fixed land, they receive smaller and smaller increments of wine-grape output. But each dose of labor costs the same in wages, so the *MC* of wine rises. This long-run rising *MC* means that the long-run supply curve must be rising.

The Long Run for a Competitive Industry

Our analysis of zero-profit conditions showed that firms might stay in business for a time even though they are unprofitable. This situation is possible particularly for firms with high fixed capital costs. With this analysis we can understand why in business downturns many of America's largest companies, such as General Motors, stayed in business even though they were losing billions of dollars.

Such losses raise a troubling question: Is it possible that capitalism is heading toward "euthanasia of the capitalists," a situation where increased competition produces chronic losses? For this question, we need to analyze the *long-run shutdown conditions.* We showed that firms shut down when they can no longer cover their variable costs. But in the long run, *all* costs are variable. A firm that is losing money can pay off its bonds, release its managers, and let its leases expire. In the long run, all commitments are once again options. Hence, in the long run firms will produce only when price is at or above the zero-profit condition where price equals average cost.

There is, then, a critical zero-profit point below which long-run price cannot remain if firms are to stay in business. In other words, long-run price must cover out-of-pocket costs such as labor, materials, equipment, taxes, and other expenses, along with opportunity costs such as competitive return on the owner's invested capital. That means long-run price must be equal to or above total long-run average cost.

Take the case where price falls below this critical zero-profit level. Unprofitable firms will start leaving the industry. Since fewer firms are producing, the short-run market supply curve will shift to the left, and the price will therefore rise. Eventually, the price will rise enough so that the industry is no longer unprofitable. So, even though we produce very few horseshoes today compared to a century ago, horseshoe manufacturing will earn a zero long-run profit.

Consider the opposite case of a profitable industry such as developing computer games. At the beginning, the price starts above total long-run average cost, so firms are making positive economic profits. Now suppose entry into the industry is absolutely free in the long run, so any number of identical firms can come into the industry and produce at exactly the same costs as those firms already in the industry. In this situation, new firms are attracted by prospective profits, the short-run supply curve shifts to the right, and price falls. Eventually price falls to the zero-profit level, so it is no longer profitable for other firms to enter the industry. Thus, even though computer games might be a thriving industry, it would earn a zero long-run profit.

The conclusion is that in the long run, the price in a competitive industry will tend toward the critical point where revenues just cover full competitive costs. Below this critical long-run price, firms would leave the industry until price returns to long-run average cost. Above this long-run price, new firms would enter the industry, thereby forcing market price back down to the long-run equilibrium price where all competitive costs are just covered.

Zero-profit long-run equilibrium: In a competitive industry populated by identical firms with free entry and exit, the long-run equilibrium condition is that price equals marginal cost equals the minimum long-run average cost for each identical firm:

$$P = MC = \text{minimum long-run } AC = \text{zero-profit price}$$

This is the long-run **zero-economic-profit** condition.

We have reached a surprising conclusion about the long-run profitability of competitive capitalism. The forces of competition tend to push firms and industries toward a zero-profit long-run state. In the long run, competitive firms will earn the normal return on their investment, but no more. Profitable industries tend to attract entry of new firms, thereby driving down prices and reducing profits toward zero. By contrast, firms in unprofitable industries leave to seek better profit opportunities; prices and profits then tend to rise. *The long-run equilibrium in a perfectly competitive industry is therefore one with no economic profits.*

C. SPECIAL CASES OF COMPETITIVE MARKETS

This section probes more deeply into supply-and-demand analysis. We first consider certain general propositions about competitive markets and then continue with some special cases.

GENERAL RULES

We analyzed above the impact of demand and supply shifts in competitive markets. These findings apply to virtually any competitive market, whether it is for codfish, brown coal, Douglas fir, Japanese yen, IBM stock, or petroleum. Are there any general rules? The propositions that follow investigate the impact of shifts in supply or demand upon the price and quantity bought and sold. Remember always that by a shift in demand or supply we mean a shift of the demand or supply curve or schedule, not a movement along the curve.

Demand rule: (*a*) Generally, an increase in demand for a commodity (the supply curve being unchanged) will raise the price of the commodity. (*b*) For most commodities, an increase in demand will also increase the quantity demanded. A decrease in demand will have the opposite effects.

Supply rule: (*c*) An increase in supply of a commodity (the demand curve being constant) will generally lower the price and increase the quantity bought and sold. (*d*) A decrease in supply has the opposite effects.

These two rules of supply and demand summarize the qualitative effects of shifts in supply and demand. But the quantitative effects on price and quantity depend upon the exact shapes of the supply and demand curves. In the cases that follow, we will see the response for a number of important cost and supply situations.

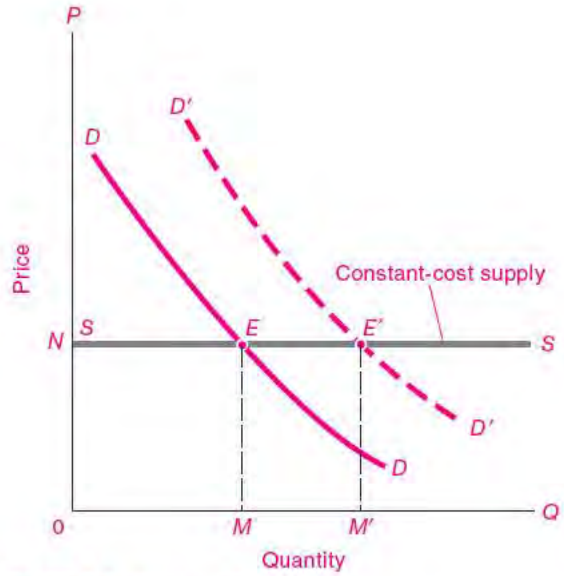


FIGURE 8-7. Constant-Cost Case

Constant Cost

Production of many manufacturing items, such as textiles, can be expanded by merely duplicating factories, machinery, and labor. Producing 200,000 shirts per day simply requires that we do the same thing as we did when we were manufacturing 100,000 per day but on a doubled scale. In addition, assume that the textile industry uses land, labor, and other inputs in the same proportions as the rest of the economy.

In this case the long-run supply curve *SS* in Figure 8-7 is a horizontal line at the constant level of unit costs. A rise in demand from *DD* to *D′D′* will shift the new intersection point to *E′*, raising *Q* but leaving *P* the same.

Increasing Costs and Diminishing Returns

The last section discussed industries, such as for wine or beach properties, where a product uses an input in limited supply. In the case of wine vineyards, good sites are limited in number. The annual output of wine can be increased to some extent by adding more labor to each acre of land. But the law of diminishing returns will eventually operate if variable factors of production, such as labor, are added to fixed amounts of a factor such as land.

As a result of diminishing returns, the marginal cost of producing wine increases as wine production rises. Figure 8-8 shows the rising supply curve *SS*. How will price be affected by an increase in demand? The figure shows that higher demand will increase the price of this good even in the long run with identical firms and free entry and exit.

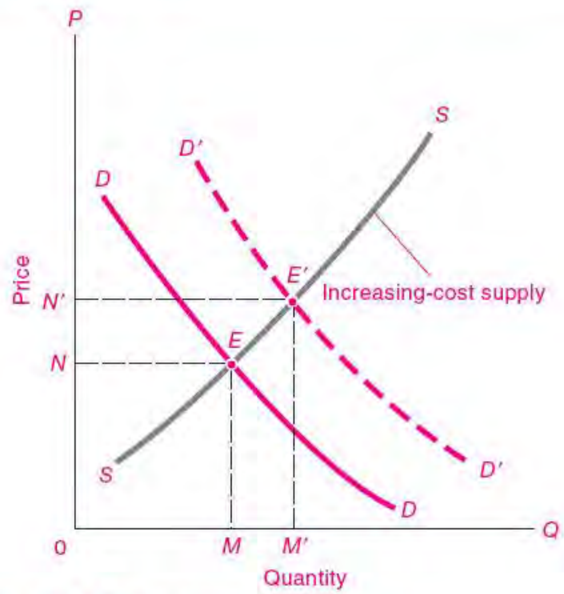


FIGURE 8-8. Increasing-Cost Case

Fixed Supply and Economic Rent

Some goods or productive factors are completely fixed in amount, regardless of price. There is only one *Mona Lisa* by da Vinci. Nature's original endowment of land can be taken as fixed in amount. Raising the price offered for land cannot create an additional corner at 57th Street and Fifth Avenue in New York City. Raising the pay of top managers is unlikely to change their effort. When the quantity supplied is constant at every price, the payment for the use of such a factor of production is called **rent** or **pure economic rent.**

When supply is independent of price, the supply curve is vertical in the relevant region. Land will continue to contribute to production no matter what its price. Figure 8-9 shows the case of land, for which a higher price cannot coax out any increase in output.

An increase in the demand for a fixed factor will affect only the price. Quantity supplied is unchanged.

When a tax is placed upon the fixed commodity, the tax is completely paid by (or "shifted" back to) the supplier (say, the landowner). The supplier absorbs the entire tax out of economic rent. The consumer buys exactly as much of the good or service as before and at no higher price.

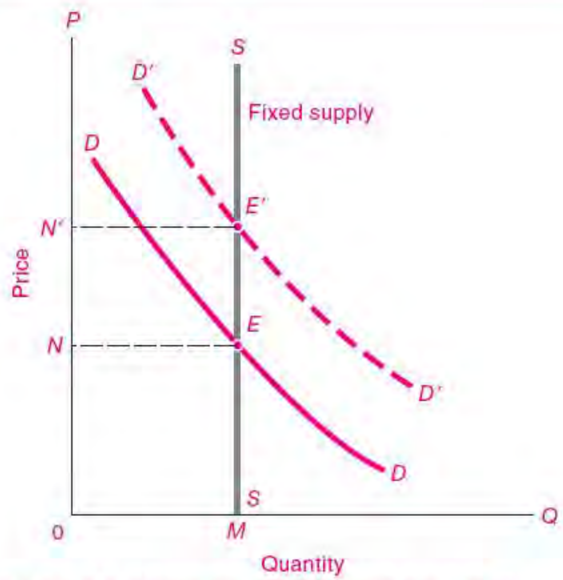


FIGURE 8-9. Factors with Fixed Supply Earn Rent

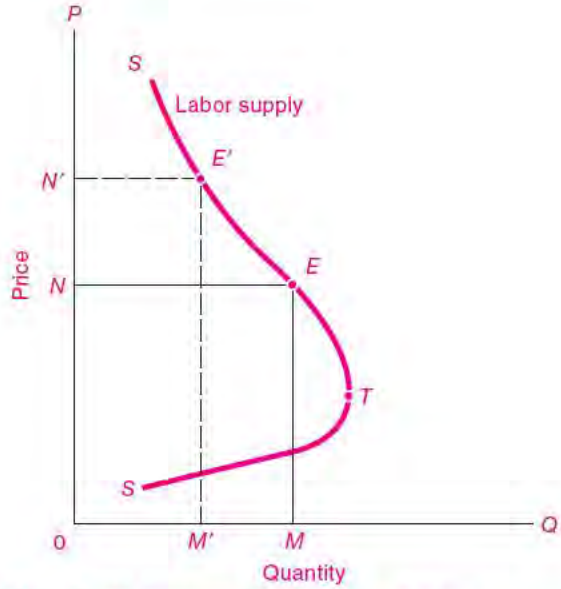


FIGURE 8-10. Backward-Bending Supply Curve

Backward-Bending Supply Curve

Firms in poor countries sometimes found that when they raised wages, the local workers worked fewer hours. When the wage was doubled, instead of continuing to work 6 days a week, the workers might work 3 days and go fishing for the other 3 days. The same has been observed in high-income countries. As improved technology raises real wages, people feel that they want to take part of their higher earnings in the form of more leisure and early retirement. Chapter 5 described income and substitution effects, which explain why a supply curve might *bend backward*.

Figure 8-10 shows what a supply curve for labor might look like. At first the labor supplied rises as higher wages coax out more labor. But beyond point *T*, higher wages lead people to work fewer hours and to take more leisure. An increase in demand raises the price of labor, as was stated in the demand rule at the beginning of this section. But note why we were cautious to add "for most commodities" to demand rule (*b*), for now the increase in demand decreases the quantity of labor supplied.

Shifts in Supply

All the above discussions dealt with a shift in demand and no shift in supply. To analyze the supply rule, we must now shift supply, keeping demand constant. If the law of downward-sloping demand is valid, increased supply must decrease price and increase quantity demanded. You should draw your own supply and demand curves and verify the following quantitative corollaries of the supply rule:

(*c*′) An increased supply will decrease *P* most when demand is inelastic.
(*d*′) An increased supply will increase *Q* least when demand is inelastic.

What are commonsense reasons for these rules? Illustrate with cases of elastic demand for autos and of inelastic demand for electricity.

D. EFFICIENCY AND EQUITY OF COMPETITIVE MARKETS

EVALUATING THE MARKET MECHANISM

One of the remarkable features of the last decade has been the "rediscovery of the market." Many countries have abandoned the heavy-handed interventionism of government command and regulation for the decentralized coordination of the invisible hand. Having reviewed the basic operation of competitive markets, let's ask how well they perform. Do they deserve high grades for satisfying people's economic needs? Is society getting many guns and much butter for a given amount of inputs? Or does the butter melt on the way to the store, while the guns have crooked barrels? We will provide an overview of the efficiency of competitive markets in this chapter.

The Concept of Efficiency

Efficiency is one of the central concepts in all of economics. In a general sense, an economy is efficient when it provides its consumers with the most desired set of goods and services, given the resources and technology of the economy.[2] A more precise definition uses the concept of *Pareto efficiency* (alternatively called *allocative efficiency, Pareto optimality,* or sometimes simply *efficiency*).

Pareto efficiency (or sometimes just **efficiency**) occurs when no possible reorganization of production or distribution can make anyone better off without making someone else worse off. Under conditions of allocative efficiency, one person's satisfaction or utility can be increased only by lowering someone else's utility.

We can think of the concept of efficiency intuitively in terms of the production-possibility frontier. An economy is clearly inefficient if it is inside the *PPF*. If we move out to the *PPF,* no one need suffer a decline in utility. At a minimum, an efficient economy is on its *PPF*. But efficiency goes further and requires not only that the right mix of goods be produced but also that these goods be allocated among consumers to maximize consumer satisfactions.

Efficiency of Competitive Equilibrium

One of the most important results in all economics is that the allocation of resources by perfectly competitive markets is efficient. This important result assumes that all markets are perfectly competitive and that there are no externalities like pollution or imperfect information. In this section, we use a simplified example to illustrate the general principles underlying the efficiency of competitive markets.

Consider an idealized situation where all individuals are identical. Further assume: (*a*) Each person works at growing food. As people increase their work and cut back on their leisure hours, each additional hour of sweaty labor becomes increasingly tiresome. (*b*) Each extra unit of food consumed brings diminished marginal utility (*MU*).[3] (*c*) Because food production takes place on fixed plots of land, by the law of diminishing returns each extra minute of work brings less and less extra food.

Figure 8-11 shows supply and demand for our simplified competitive economy. When we sum

[2] Economic efficiency is different from engineering efficiency, and sometimes it will be economical to use a production method that is *less* efficient from an engineering point of view. For example, physics shows that more energy can be converted to electricity if combustion occurs at 2500°C than at 1000°C. Yet the higher temperature might require exotic metals and designs and cost more. So the lower temperature would be economically efficient even though the higher temperature would have higher thermodynamic efficiency.

[3] To keep matters at their simplest, we measure welfare in fixed "utils" of leisure time (or "disutils" of sweaty labor time). We further assume that each hour of forgone leisure has a constant marginal utility, so all utilities and costs are reckoned in these leisure-labor units.

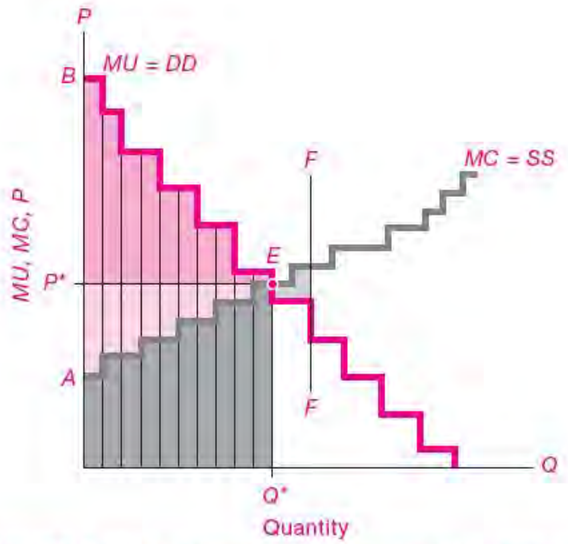


FIGURE 8-11. At Competitive Equilibrium Point *E*, the Marginal Costs and Utilities of Food Are Exactly Balanced

Many identical farmer-consumers bring their food to market. The $MC = SS$ curve adds together the individual marginal cost curves, while the $MU = DD$ curve is the horizontal sum of consumer valuations of food. At competitive market equilibrium *E*, the utility gain from the last unit of food equals the utility cost (in terms of forgone leisure).

The figure also illustrates economic surplus. The cost of producing food is shown by the dark blue slices. The light-colored green slices above the *SS* curve and below the price line add up to the "producer surplus." The dark-colored green slices under *DD* and above the price line are the "consumer surplus." The sum of the consumer and producer surpluses is "economic surplus." At the competitive equilibrium at *E*, economic surplus is maximized. Verify that production at *FF* lowers total surplus.

horizontally the identical supply curves of our identical farmers, we get the upward-stepping *MC* curve. As we saw earlier in this chapter, the *MC* curve is also the industry's supply curve, so the figure shows $MC = SS$. Also, the demand curve is the horizontal summation of the identical individuals' marginal utility (or demand-for-food) curves; it is represented by the downward-stepping $MU = DD$ curve for food in Figure 8-11.

The intersection of the *SS* and *DD* curves shows the competitive equilibrium for food. At point *E*, farmers supply exactly what consumers want to purchase at the equilibrium market price. Each person will be working up to the critical point where the declining marginal-utility-of-consuming-food curve intersects the rising marginal-cost-of-growing-food curve.

Figure 8-11 shows a new concept, **economic surplus,** which is the green area between the supply and demand curves at the equilibrium. The economic surplus is the sum of the consumer surplus that we met in Chapter 5, which is the area between the demand curve and the price line, and the **producer surplus,** which is the area between the price line and the *SS* curve. The producer surplus includes the rent and profits to firms and owners of specialized inputs in the industry and indicates the excess of revenues over cost of production. The economic surplus is the welfare or net utility gain from production and consumption of a good; it is equal to the consumer surplus plus the producer surplus.

A careful analysis of the competitive equilibrium will show that it maximizes the economic surplus available in that industry. For this reason, it is economically efficient. At the competitive equilibrium at point *E* in Figure 8-11, the representative consumer will have higher utility or economic surplus than would be possible with any other feasible allocation of resources.

Another way of seeing the efficiency of the competitive equilibrium is by comparing the economic effect of a small change from the equilibrium at *E*. As the following three-step process shows, if $MU = P = MC$, then the allocation is efficient.

1. $P = MU$. Consumers choose food purchases up to the amount where $P = MU$. As a result, every person is gaining *P* utils of satisfaction from the last unit of food consumed. (Utils of satisfaction are measured in terms of the constant marginal utility of leisure, as discussed in footnote 3.)
2. $P = MC$. As producers, each person is supplying food up to the point where the price of food exactly equals the *MC* of the last unit of food supplied (the *MC* here being the cost in terms of the forgone leisure needed to produce the last unit of food). The price then is the utils of leisure-time satisfaction lost because of working to grow that last unit of food.
3. Putting these two equations together, we see that $MU = MC$. This means that the utils gained from the last unit of food consumed exactly equal the

leisure utils lost from the time needed to produce that last unit of food. *It is exactly this condition—that the marginal gain to society from the last unit consumed equals the marginal cost to society of that last unit produced—which guarantees that a competitive equilibrium is efficient.*

Equilibrium with Many Consumers and Markets

Let us now turn from our simple parable about identical farmer-consumers to an economy populated by millions of different firms, hundreds of millions of people, and countless commodities. Can a perfectly competitive economy still be efficient in this more complex world?

The answer is "yes," or better yet, "yes, if . . ." Efficiency requires some stringent conditions that are addressed in later chapters. These include having reasonably well-informed consumers, perfectly competitive producers, and no externalities like pollution or incomplete knowledge. For such economies, a system of perfectly competitive markets will earn the economist's gold star of Pareto efficiency.

Figure 8-12 illustrates how a competitive system brings about a balance between utility and cost for a single commodity with nonidentical firms and consumers. On the left, we add horizontally the demand curves for all consumers to get the market curve *DD* in the middle. On the right, we add all the different *MC* curves to get the industry *SS* curve in the middle.

At the competitive equilibrium at point *E*, consumers on the left get the quantity they are willing to purchase of the good at the price reflecting efficient social *MC*. On the right, the market price also allocates production efficiently among firms. The blue area under *SS* in the middle represents the minimized sum of the blue cost areas on the right. Each firm is setting its output so that *MC* = *P*. Production efficiency is achieved because there is no reorganization of production that would allow the same level of industry output to be produced at lower cost.

Many Goods. Our economy produces not only food but also clothing, movies, and many other

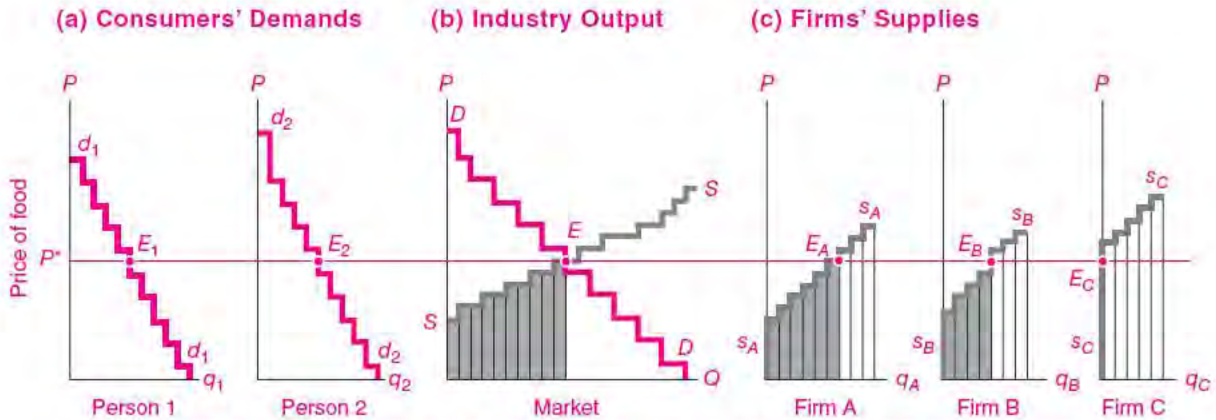


FIGURE 8-12. Competitive Market Integrates Consumers' Demands and Producers' Costs

(a) Individual demands are shown on the left. We add the consumers' *dd* curves horizontally to obtain the market demand *DD* curve in the middle.

(b) The market brings together all consumer demands and firm supplies to reach market equilibrium at *E*. The horizontal price-of-food line shows where each consumer on the left and each producer on the right reach equilibrium. At *P**, see how each consumer's *MU* is equated to each firm's *MC*, leading to allocative efficiency.

(c) For each competitive firm, profits are maximized when the supply curve is given by the rising *MC* curve. The blue area depicts each firm's cost of producing the amount at *E*. At prices equal to marginal cost, the industry produces output at the least total cost.

commodities. How does our analysis apply when consumers must choose among many products?

The principles are exactly the same, but now we recall one further condition: Utility-maximizing consumers spread their dollars among different goods until the marginal utility of the last dollar is equalized for each good consumed. In this case, as long as the ideal conditions are met, a competitive economy is efficient with a multitude of goods and factors of production.

In other words, a perfectly competitive economy is efficient when marginal private cost equals marginal social cost and when both equal marginal utility. Each industry must balance *MC* and *MU*. For example, if movies have 2 times the *MC* of hamburgers, the *P* and the *MU* of movies must also be twice those of hamburgers. Only then will the *MU*s, which are equal to the *P*s, be equal to the *MC*s. By equating price and marginal cost, competition guarantees that an economy can attain allocative efficiency.

The perfectly competitive market is a device for synthesizing (*a*) the willingness of consumers possessing dollar votes to pay for goods with (*b*) the marginal costs of those goods as represented by firms' supply. Under certain conditions, competition guarantees efficiency, in which no consumer's utility can be raised without lowering another consumer's utility. This is true even in a world of many factors and products.

Marginal Cost as a Benchmark for Efficiency

This chapter has shown the importance of marginal cost in attaining an efficient allocation of resources. But the importance of marginal cost extends far beyond perfect competition. Using marginal cost to achieve productive efficiency holds for any society or organization trying to make the most effective use of its resources—whether that entity is a capitalist or socialist economy, a profit-maximizing or nonprofit organization, a university or a church, or even a family.

The essential role of marginal cost is this: Suppose you have an objective that can be reached using several approaches, each of which is costly. In deciding how much of each approach to use, always do so by equating the marginal cost among the different approaches. Only when marginal costs are equalized can we squeeze the maximum from our scarce resources.

The use of marginal cost as a benchmark for efficient resource allocation is applicable not just to profit-maximizing firms but to all economic problems, indeed to all problems involving scarcity. Suppose that you have been charged with solving a critical environmental problem, such as global warming. You will soon find that marginal cost will be crucial to attaining your environmental objectives most efficiently. By ensuring that the marginal costs of reducing greenhouse-gas emissions are equalized in every industry and in every corner of the world, you can guarantee that your environmental objectives are being reached at the lowest possible costs.

Marginal cost is a fundamental concept for efficiency. For any goal-oriented organization, efficiency requires that the marginal cost of attaining the goal should be equal in every activity. In a market, an industry will produce its output at minimum total cost only when each firm's *MC* is equal to a common price.

QUALIFICATIONS

We have now seen the essence of the invisible hand—the remarkable efficiency properties of competitive markets. But we must quickly qualify the analysis by pointing to shortcomings of the market.

There are two important areas where markets fail to achieve a social optimum. First, markets may be inefficient in situations where pollution or other externalities are present or when there is imperfect competition or information. Second, the distribution of incomes under competitive markets, even when it is efficient, may not be socially desirable or acceptable. We will review both of these points in later chapters, but it will be useful to describe each of these shortcomings briefly here.

Market Failures

What are the market failures which spoil the idyllic picture assumed in our discussion of efficient markets? The important ones are imperfect competition, externalities, and imperfect information.

Imperfect Competition. When a firm has market power in a particular market (say it has a monopoly because of a patented drug or a local electricity franchise), the firm can raise the price of its product above its marginal cost. Consumers buy less of such goods than they would under perfect competition, and consumer satisfaction is reduced. This kind of reduction of consumer satisfaction is typical of the inefficiencies created by imperfect competition.

Externalities. Externalities are another important market failure. Recall that externalities arise when some of the side effects of production or consumption are not included in market prices. For example, a power company might pump sulfurous fumes into the air, causing damage to neighboring homes and to people's health. If the power company does not pay for the harmful impacts, pollution will be inefficiently high and consumer welfare will suffer.

Not all externalities are harmful. Some are beneficial, such as the externalities that come from knowledge-generating activities. For example, when Chester Carlson invented xerography, he became a millionaire; but he still received only a tiny fraction of the benefits when the world's secretaries and students were relieved of billions of hours of drudgery. Another positive externality arises from public-health programs, such as inoculation against smallpox, cholera, or typhoid; an inoculation protects not only the inoculated person but also others whom that person might otherwise have infected.

Imperfect Information. A third important market failure is imperfect information. The invisible-hand theory assumes that buyers and sellers have complete information about the goods and services they buy and sell. Firms are assumed to know about all the production functions for operating in their industry. Consumers are presumed to know about the quality and prices of goods—such as whether the financial statements of firms are accurate and whether the drugs they use are safe and efficacious.

Clearly, reality is far from this idealized world. The critical question is, How damaging are departures from perfect information? In some cases, the loss of efficiency is slight. I will hardly be greatly disadvantaged if I buy a chocolate ice cream that is slightly too sweet or if I don't know the exact temperature of the beer that flows from the tap. In other cases, the loss is severe. Take the case of steel mogul Eben Byers, who a century ago took Radithor, sold as a cure-all, to relieve his ailments. Later analysis showed that Radithor was actually distilled water laced with radium. Byers died a hideous death when his jaw and other bones disintegrated. This kind of invisible hand we don't need.

One of the important tasks of the government is to identify those areas where informational deficiencies are economically significant—such as in finance—and then to find appropriate remedies.

Two Cheers for the Market, but Not Three

We have seen that markets have remarkable efficiency properties. But can we therefore conclude that laissez-faire capitalism produces the greatest happiness of the greatest numbers? Does the market necessarily result in the fairest possible use of resources? The answers are no and no.

People are not equally endowed with purchasing power. A system of prices and markets may be one in which a few people have most of the income and wealth. They may have inherited scarce land or oil properties or manage a big corporation or a profitable hedge fund. Some are very poor through no fault of their own, while others are very rich through no virtue of their own. So the weighting of dollar votes, which lie behind the individual demand curves, may be unfair.

An economy with great inequality is not necessarily inefficient. The economy might be squeezing a large quantity of guns and butter from its resources. But the rich few may be eating the butter and feeding it to their cats, while the guns are mainly protecting the butter of the rich.

A society does not live on efficiency alone. A society may choose to alter market outcomes to improve the equity or fairness of the distribution of income and wealth. Nations may levy progressive taxes on those with high incomes and wealth and use the proceeds to finance food, schools, and health care for the poor. But there are vexing questions here. How much should the rich be taxed? What programs will best benefit the poor? Should immigrants be included in the benefit programs? Should capital be taxed at the same rate as labor? Should the nonworking poor get government help?

There are no scientifically correct answers to these questions. Positive economics cannot say how much governments should intervene to correct the inequalities and inefficiencies of the marketplace. These normative questions are appropriately answered through political debate and fair elections. But economics can offer valuable insights into the merit of alternative interventions so that the goals of a modern society can be achieved in the most effective manner.

SUMMARY

A. Supply Behavior of the Competitive Firm

1. A perfectly competitive firm sells a homogeneous product and is too small to affect the market price. Competitive firms are assumed to maximize their profits. To maximize profits, the competitive firm will choose that output level at which price equals the marginal cost of production, that is, $P = MC$. Diagrammatically, the competitive firm's equilibrium will come where the rising *MC* supply curve intersects its horizontal demand curve.
2. Variable costs must be taken into consideration in determining a firm's short-run shutdown point. Below the shutdown point, the firm loses more than its fixed costs. It will therefore produce nothing when price falls below the shutdown price.
3. A competitive industry's long-run supply curve, $S_L S_L$, must take into account the entry of new firms and the exodus of old ones. In the long run, all of a firm's commitments expire. It will stay in business only if price is at least as high as long-run average costs. These costs include out-of-pocket payments to labor, lenders, material suppliers, or landlords and opportunity costs, such as returns on the property assets owned by the firm.

B. Supply Behavior in Competitive Industries

4. Each firm's rising *MC* curve is its supply curve. To obtain the supply curve of a group of competitive firms, we add horizontally their separate supply curves. The supply curve of the industry hence represents the marginal cost curve for the competitive industry as a whole.
5. Because firms can adjust production over time, we distinguish two different time periods: (*a*) short-run equilibrium, when variable factors like labor can change but fixed factors like capital and the number of firms cannot, and (*b*) long-run equilibrium, when the numbers of firms and plants, and all other conditions, adjust completely to the new demand conditions.
6. In the long run, when firms are free to enter and leave the industry and no one firm has any particular advantage of skill or location, competition will eliminate any excess profits earned by existing firms in the industry. So, just as free exit implies that price cannot fall below the zero-profit point, free entry implies that price cannot exceed long-run average cost in long-run equilibrium.
7. When an industry can expand its production without pushing up the prices of its factors of production, the resulting long-run supply curve will be horizontal. When an industry uses factors specific to it, such as scarce beachfront property, its long-run supply curve will slope upward.

C. Special Cases of Competitive Markets

8. Recall the general rules that apply to competitive supply and demand: Under the demand rule, an increase in the demand for a commodity (the supply curve being unchanged) will generally raise the price of the commodity and also increase the quantity demanded. A decrease in demand will have the opposite effects.

   Under the supply rule, an increase in the supply of a commodity (the demand curve being constant) will generally lower the price and increase the quantity sold. A decrease in supply has the opposite effects.
9. Important special cases include constant and increasing costs, completely inelastic supply (which produces economic rents), and backward-bending supply. These special cases will explain many important phenomena found in markets.

D. Efficiency and Equity of Competitive Markets

10. The analysis of competitive markets sheds light on the efficient organization of a society. Allocative or Pareto efficiency occurs when there is no way of reorganizing production and distribution such that everyone's satisfaction can be improved.
11. Under ideal conditions, a competitive economy attains allocative efficiency. Efficiency requires that all firms are perfect competitors and that there are no externalities like pollution or imperfect information. Efficiency implies that economic surplus is maximized, where economic surplus equals consumer surplus plus producer surplus.
12. Efficiency comes because (*a*) when consumers maximize satisfaction, the marginal utility (in terms of leisure) just equals the price; (*b*) when competitive

producers supply goods, they choose output so that marginal cost just equals price; (*c*) since $MU = P$ and $MC = P$, it follows that $MU = MC$.

13. There are exacting limits on the social optimality of competitive markets.
    a. Pareto efficiency requires perfect competition, complete information, and no externalities. When all three conditions are met, this will lead to the important efficiency condition:

Price ratio = marginal cost ratio = marginal utility ratio

    b. The most perfectly competitive markets may not produce a fair distribution of income and consumption. Societies may therefore decide to modify the laissez-faire market outcomes. Economics has the important role of analyzing the relative costs and benefits of alternative kinds of interventions.

14. Marginal cost is a fundamental concept for attaining any goal, not just for profits. Efficiency requires that the marginal cost of attaining the goal be equal in every activity.

CONCEPTS FOR REVIEW

Competitive Supply

$P = MC$ as maximum-profit condition
firm's *ss* supply curve and its MC curve
zero-profit condition, where $P = MC = AC$
shutdown point, where $P = MC = AVC$
summing individual *ss* curves to get industry *SS*
short-run and long-run equilibrium
long-run zero-profit condition
producer surplus + consumer surplus = economic surplus
efficiency = maximizing economic surplus

Efficiency and Equity

allocative efficiency, Pareto efficiency
conditions for allocative efficiency: $MU = P = MC$
efficiency of competitive markets
efficiency vs. equity

FURTHER READING AND INTERNET WEBSITES

Further Reading

The efficiency of perfect competition is one of the major findings of microeconomics. Advanced books in microeconomics, such as those listed in Chapter 4, can give insights into the basic findings.

Nobel Prizes in economics were awarded to Kenneth Arrow, John Hicks, and Gerard Debreu for their contributions to developing the theory of perfect competition and its relationship to economic efficiency. Their essays surveying the field are highly useful and are contained in Assar Lindbeck, *Nobel Lectures in Economics* (University of Stockholm, 1992). See also the Nobel website listed below for the Nobel citations for these economists.

Websites

For the citations of Arrow, Hicks, and Debreu, look at the website *www.nobel.se/economics/index.html* to read about the importance of their contributions and how they relate to economics.

QUESTIONS FOR DISCUSSION

1. Explain why each of the following statements about profit-maximizing competitive firms is incorrect. Restate each one correctly.
    a. A competitive firm will produce output up to the point where price equals average variable cost.
    b. A firm's shutdown point comes where price is less than minimum average cost.
    c. A firm's supply curve depends only on its marginal cost. Any other cost concept is irrelevant for supply decisions.

   d. The $P = MC$ rule for competitive industries holds for upward-sloping, horizontal, and downward-sloping MC curves.
   e. The competitive firm sets price equal to marginal cost.

2. Suppose you are a perfectly competitive firm producing computer memory chips. Your production capacity is 1000 units per year. Your marginal cost is \$10 per chip up to capacity. You have a fixed cost of \$10,000 if production is positive and \$0 if you shut down. What are your profit-maximizing levels of production and profit if the market price is (*a*) \$5 per chip, (*b*) \$15 per chip, and (*c*) \$25 per chip? For case (*b*), explain why production is positive even though profits are negative.

3. One of the most important rules of economics, business, and life is the *sunk-cost principle,* "Let bygones be bygones." This means that sunk costs (which are bygone in the sense that they are unrecoverably lost) should be ignored when decisions are being made. Only future costs, involving marginal and variable costs, should count in making rational decisions.

   To see this, consider the following: We can calculate fixed costs in Table 8-1 as the cost level when output is 0. What are fixed costs? What is the profit-maximizing level of output for the firm in Table 8-1 if price is \$40 while fixed costs are \$0? \$55,000? \$100,000? \$1,000,000,000? Minus \$30,000? Explain the implication for a firm trying to decide whether to shut down.

4. Examine the cost data shown in Table 8-1. Calculate the supply decision of a profit-maximizing competitive firm when price is \$21, \$40, and \$60. What would the level of total profit be for each of the three prices? What would happen to the exit or entry of identical firms in the long run at each of the three prices?

5. Using the cost data shown in Table 8-1, calculate the price elasticity of supply between $P = 40$ and $P = 40.02$ for the individual firm. Assume that there are 2000 identical firms, and construct a table showing the industry supply schedule. What is the industry price elasticity of supply between $P = 40$ and $P = 40.02$?

6. Examine Figure 8-12 to see that competitive firm C is not producing at all. Explain the reason why the profit-maximizing output level for firm C is at $q_c = 0$. What would happen to total industry cost of production if firm C produced 1 unit while firm B produced 1 less unit than the competitive output level?

   Say that firm C is a mom-and-pop grocery store. Why would chain grocery stores A and B drive C out of business? How do you feel about keeping C in business? What would be the economic impact of legislation that divided the market into three equal parts between the mom-and-pop store and chain stores A and B?

7. Often, consumer demand for a commodity will depend upon the use of durable goods, such as housing or transportation. In such a case, demand will show a time-varying pattern of response similar to that of supply. A good example is gasoline. In the short run the stock of automobiles is fixed, while in the long run consumers can buy new automobiles or bicycles.

   What is the relationship between the time period and the price elasticity of demand for gasoline? Sketch the short-run and long-run demand curves for gasoline. Show the impact of a decline in the supply of gasoline in both periods. Describe the impact of an oil shortage on the price of gasoline and the quantity demanded in both the long run and the short run. State two new rules of demand, (*c*) and (*d*), parallel to the rules of supply (*c*) and (*d*) discussed in the General Rules portion of Section C above, that relate the impact of a shift in supply on price and quantity in the long run and the short run.

8. Interpret this dialogue:

   A: "How can competitive profits be zero in the long run? Who will work for nothing?"

   B: "It is only *excess* profits that are wiped out by competition. Managers get paid for their work; owners get a normal return on capital in competitive long-run equilibrium—no more, no less."

9. Consider three firms which are emitting sulfur into the California air. We will call supply the units of pollution control or reduction. Each firm has a cost-of-reduction schedule, and we will say that these schedules are given by the MC curves of firms A, B, and C in Figure 8-12.
   a. Interpret the "market" supply or MC schedule for reducing sulfur emissions, shown in the middle of Figure 8-12.
   b. Say that the pollution-control authority decides to seek 10 units of pollution control. What is the efficient allocation of pollution control across the three firms?
   c. Say that the pollution-control authority decides to have the first two firms produce 5 units each of pollution control. What is the additional cost?
   d. Say that the pollution-control authority decides upon a "pollution charge" to reduce pollution to 10 units. Can you identify what the appropriate charge would be using Figure 8-12? Can you say how each firm would respond? Would the pollution reduction be efficient?
   e. Explain the importance of marginal cost in the efficient reduction of pollution in this case.

10. In any competitive market, such as illustrated in Figure 8-11, the area above the market price line and below the DD curve is consumer surplus (see the discussion in Chapter 5). The area above the SS curve

and below the price line is producer surplus and equals profits plus rent to the firms in the industry or owners of specialized inputs to the industry. The sum of the producer and consumer surpluses is economic surplus and measures the net contribution of that good to utility above the cost of production.

Can you find any reorganization of production that would increase the economic surplus in Figure 8-11 as compared to the competitive equilibrium at point E? If the answer is no, then the equilibrium is allocationally efficient (or Pareto efficient). Define allocational efficiency; then answer the question and explain your answer.

CHAPTER

Imperfect Competition and Monopoly

9

The best of all monopoly profits is a quiet life.

J. R. Hicks

Perfect competition is an idealized market of atomistic firms who are price-takers. In fact, while they are easily analyzed, such firms are hard to find. When you buy your car from Ford or Toyota, your hamburgers from McDonald's or Wendy's, or your computer from Dell or Apple, you are dealing with firms large enough to affect the market price. Indeed, most markets in the economy are dominated by a handful of large firms, often only two or three. Welcome to the world you live in, the world of imperfect competition.

A. PATTERNS OF IMPERFECT COMPETITION

We shall see that for a given technology, prices are higher and outputs are lower under imperfect competition than under perfect competition. But imperfect competitors have virtues along with these vices. Large firms exploit economies of large-scale production and are responsible for much of the innovation that propels long-term economic growth. If you understand how imperfectly competitive markets work, you will have a much deeper understanding of modern industrial economies.

Recall that a perfectly competitive market is one in which no firm is large enough to affect the market price. By this strict definition, few markets in the U.S. economy are perfectly competitive. Think of the following: aircraft, aluminum, automobiles, computer software, breakfast cereals, chewing gum, cigarettes, electricity distribution, refrigerators, and wheat. How many of these are sold in perfectly competitive markets? Certainly not aircraft, aluminum, or automobiles. Until World War II there was only one aluminum company, Alcoa. Even today, the four largest U.S. firms produce three-quarters of U.S. aluminum output. The world commercial-aircraft market is dominated by only two firms, Boeing and Airbus. In the automotive industry, too, the top five automakers (including Toyota and Honda) have almost 80 percent of the U.S. car and light-truck market. The software industry shows rapid innovation, yet for most individual software applications, from tax accounting to gaming, a few firms have most of the sales.

What about breakfast cereals, chewing gum, cigarettes, and refrigerators? These markets are dominated even more completely by a relatively small number of companies. Nor does the retail market in electricity meet the definition of perfect competition. In most localities, a single company distributes all the electricity used by the population. Very few of us will find it economical to build a windmill to generate our own power!

Looking at the list above, you will find that only wheat falls within our strict definition of perfect competition. All the other goods, from autos to cigarettes, fail the competitive test for a simple reason: Some of the firms in the industry can affect the market price by changing the quantity they sell. To put it another way, they have *some* control over the price of their output.

Definition of Imperfect Competition

If a firm can affect the market price of its output, the firm is classified as an imperfect competitor.

Imperfect competition prevails in an industry whenever individual sellers can affect the price of their output. The major kinds of imperfect competition are monopoly, oligopoly, and monopolistic competition.

Imperfect competition does not imply that a firm has absolute control over the price of its product. Take the cola market, where Coca-Cola and Pepsi together have the major share of the market, and imperfect competition clearly prevails. If the average price of other producers' sodas in the market is 75 cents, Pepsi may be able to set the price of a can at 70 or 80 cents and still remain a viable firm. The firm could hardly set the price at $40 or 5 cents a can because at those prices it would go out of business. We see, then, that an imperfect competitor has some but not complete discretion over its prices.

Moreover, the amount of discretion over price will differ from industry to industry. In some imperfectly competitive industries, the degree of monopoly power is very small. In the retail computer business, for example, more than a few percent difference in price will usually have a significant effect upon a firm's sales. In the market for computer operating systems, by contrast, Microsoft has a virtual monopoly and has great discretion about the price of its Windows software.

Graphical Depiction. Figure 9-1 shows graphically the difference between the demand curves faced by perfectly and imperfectly competitive firms. Figure 9-1(*a*) reminds us that a perfect competitor faces a horizontal demand curve, indicating that it can sell all it wants at the going market price. An imperfect competitor, in contrast, faces a downward-sloping demand curve. Figure 9-1(*b*) shows that if an imperfectly competitive firm increases its sales, it will definitely depress the market price of its output as it moves down its *dd* demand curve.

Another way of seeing the difference between perfect and imperfect competition is by considering

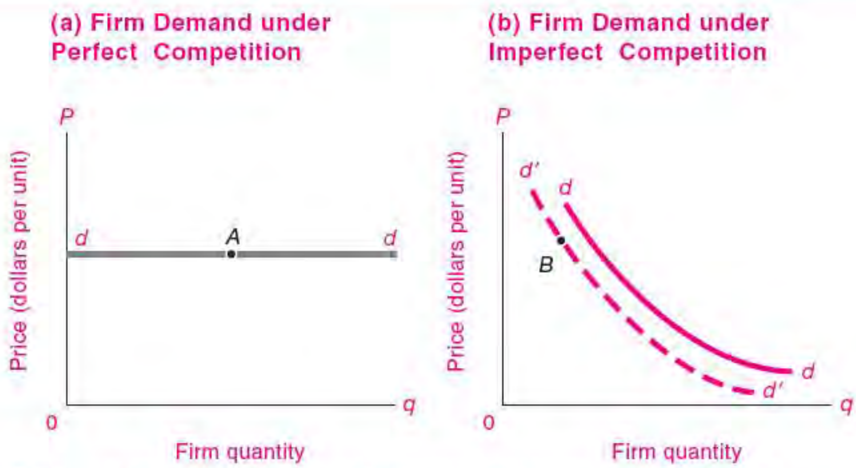


FIGURE 9-1. Acid Test for Imperfect Competition Is Downward Tilt of Firm's Demand Curve

(**a**) The perfectly competitive firm can sell all it wants along its horizontal *dd* curve without depressing the market price. (**b**) But the imperfect competitor will find that its demand curve slopes downward as higher price drives sales down. And unless it is a sheltered monopolist, a cut in its rivals' prices will appreciably shift its own demand curve leftward to *d′d′*.

the price elasticity of demand. For a perfect competitor, demand is perfectly elastic; for an imperfect competitor, demand has a finite elasticity. As an exercise in use of the elasticity formulas, calculate the elasticities for the perfect competitor in Figure 9-1(*a*) and the imperfect competitor at point *B* in 9-1(*b*).

The fact that the demand curves of imperfect competitors slope down has an important implication: Imperfect competitors are *price-makers* not *price-takers*. They must decide on the price of their product, while perfect competitors take the price as given.

VARIETIES OF IMPERFECT COMPETITORS

A modern industrial economy like the United States is a jungle populated with many species of imperfect competition. The dynamics of the personal computer industry, driven by rapid improvements in technology, are different from the patterns of competition in the not-so-lively funeral industry. Nevertheless, much can be learned about an industry by paying careful attention to its market structure, particularly the number and size of sellers and how much of the market the largest sellers control. Economists classify imperfectly competitive markets into three different market structures.

Monopoly

At one pole of the competitive spectrum is the perfect competitor, which is one firm among a vast multitude of firms. At the other pole is the **monopoly,** which is a single seller with complete control over an industry. (The word comes from the Greek words *mono* for "one" and *polist* for "seller.") A monopolist is the only firm producing in its industry, and there is no industry producing a close substitute. Moreover, for now we assume that the monopolist must sell everything at the same price—there is no price discrimination.

True monopolies are rare today. Most monopolies persist because of some form of government regulation or protection. For example, a pharmaceutical company that discovers a new wonder drug may be granted a patent, which gives it monopoly control over that drug for a number of years. Another important example of monopoly is a franchised local utility, such as the firm that provides your household water. In such cases there is truly a single seller of a service with no close substitutes. One of the few examples of a monopoly without government license is Microsoft Windows, which has succeeded in maintaining its monopoly through large investments in research and development, rapid innovation, network economies, and tough (and sometimes illegal) tactics against its competitors.

But even monopolists must always be looking over their shoulders for potential competitors. The pharmaceutical company will find that a rival will produce a similar drug; telephone companies that were monopolists a decade ago now must reckon with cellular telephones; Bill Gates worries that some small firm is waiting in the wings to unseat Microsoft's monopolistic position. *In the long run, no monopoly is completely secure from attack by competitors.*

Oligopoly

The term **oligopoly** means "few sellers." Few, in this context, can be a number as small as 2 or as large as 10 or 15 firms. The important feature of oligopoly is that each individual firm can affect the market price. In the airline industry, the decision of a single airline to lower fares can set off a price war which brings down the fares charged by all its competitors.

Oligopolistic industries are common in the U.S. economy, especially in the manufacturing, transportation, and communications sectors. For example, there are only a few car makers, even though the automobile industry sells many different models. The same is true in the market for household appliances: stores are filled with many different models of refrigerators and dishwashers, all made by a handful of companies. You might be surprised to know that the breakfast cereal industry is an oligopoly dominated by a few firms even though there seem to be endless varieties of cereals.

Monopolistic Competition

The final category we examine is **monopolistic competition.** In this situation, a large number of sellers produce differentiated products. This market structure resembles perfect competition in that there are many sellers, none of whom has a large share of the market. It differs from perfect competition in that the products sold by different firms are not identical. **Differentiated products** are ones whose important characteristics vary. Personal computers, for example, have differing characteristics such as speed, memory, hard disk, modem, size, and weight. Because computers are differentiated, they can sell at slightly different prices.

The classic case of monopolistic competition is the retail gasoline market. You may go to the local Shell station, even though it charges slightly more, because it is on your way to work. But if the price at Shell rises more than a few pennies above the competition, you might switch to the Merit station a short distance away.

This example illustrates the importance of location in product differentiation. It takes time to go to the bank or the grocery store, and the amount of time needed to reach different stores will affect our shopping choices. The *whole price* of a good includes not just its dollar price but also the opportunity cost of search, travel time, and other non-dollar costs. Because the whole prices of local goods are lower than those in faraway places, people generally tend to shop close to home or to work. This consideration also explains why large shopping complexes are so popular: they allow people to buy a wide variety of goods while economizing on shopping time. Today, shopping on the Internet is increasingly important because, even when shipping costs are added, the time required to buy the good online can be very low compared to getting in your car or walking to a shop.

Product quality is an increasingly important part of product differentiation today. Goods differ in their characteristics as well as their prices. Most personal computers can run the same software, and there are many manufacturers. Yet the personal computer industry is a monopolistically competitive industry, because computers differ in speed, size, memory, repair services, and ancillaries like CDs, DVDs, Internet connections, and sound systems. Indeed, a whole batch of monopolistically competitive computer magazines is devoted to explaining the differences among the computers produced by the monopolistically competitive computer manufacturers!

Competition vs. Rivalry

When studying oligopolies, it is important to recognize that imperfect competition is not the same as no competition. Indeed, some of the most vigorous rivalries in the

Types of Market Structures

Structure	Number of producers and degree of product differentiation	Part of economy where prevalent	Firm's degree of control over price	Methods of marketing
Perfect competition	Many producers; identical products	Financial markets and agricultural products	None	Market exchange or auction
Imperfect competition				
Monopolistic competition	Many producers; many real or perceived differences in product	Retail trade (pizzas, beer, . . .), personal computers	Some	Advertising and quality rivalry; administered prices
Oligopoly	Few producers; little or no difference in product	Steel, chemicals, . . .		
	Few producers; products are differentiated	Cars, word-processing software, . . .		
Monopoly	Single producer; product without close substitutes	Franchise monopolies (electricity, water); Microsoft Windows; patented drugs	Considerable	Advertising

TABLE 9-1. Alternative Market Structures

Most industries are imperfectly competitive. Here are the major features of different market structures.

economy occur in markets where there are but a few firms. Just look at the cutthroat competition in the airline industry, where two or three airlines may fly a particular route but still engage in periodic fare wars.

How can we distinguish the rivalry of oligopolists from perfect competition? Rivalry encompasses a wide variety of behavior to increase profits and market share. It includes advertising to shift out the demand curve, price cuts to attract business, and research to improve product quality or develop new products. Perfect competition says nothing about rivalry but simply means that no single firm in the industry can affect the market price.

Table 9-1 on page 172 gives a picture of the various possible categories of imperfect and perfect competition. This table is an important summary of the different kinds of market structures and warrants careful study.

SOURCES OF MARKET IMPERFECTIONS

Why do some industries display near-perfect competition while others are dominated by a handful of large firms? Most cases of imperfect competition can be traced to two principal causes. First, industries tend to have fewer sellers when there are significant economies of large-scale production and decreasing costs. Under these conditions, large firms can simply produce more cheaply and then undersell small firms, which cannot survive.

Second, markets tend toward imperfect competition when there are "barriers to entry" that make it difficult for new competitors to enter an industry. In some cases, the barriers may arise from government laws or regulations which limit the number of competitors. In other cases, there may be economic factors that make it expensive for a new competitor to break into a market. We will examine both sources of imperfect competition.

Costs and Market Imperfection

The technology and cost structure of an industry help determine how many firms that industry can support and how big they will be. The key is whether there are economies of scale in an industry. If there are economies of scale, a firm can decrease its average costs by expanding its output, at least up to a point. That means bigger firms will have a cost advantage over smaller firms.

When economies of scale prevail, one or a few firms will expand their outputs to the point where they produce most of the industry's total output. The industry then becomes imperfectly competitive. Perhaps a single monopolist will dominate the industry; a more likely outcome is that a few large sellers will control most of the industry's output; or there might be a large number of firms, each with slightly different products. Whatever the outcome, we must inevitably find some kind of imperfect competition instead of the atomistic perfect competition of price-taking firms.

We can see how the relationship between the size of the market and the scale economies helps determine the market structure. There are three interesting cases, illustrated in Figure 9-2.

1. To understand further how costs may determine market structure, let's first look at a case which is favorable for perfect competition. Figure 9-2(*a*) shows an industry where the point of minimum average cost is reached at a level of output that is tiny relative to the market. As a result, this industry can support the large number of efficiently operating firms that are needed for perfect competition. Figure 9-2(*a*) illustrates the cost curves in the perfectly competitive farm industry.
2. An intermediate case is an industry with economies of scale that are large relative to the size of the industry. Numerous detailed econometric and engineering studies confirm that many nonagricultural industries show declining average long-run costs. For example, Table 9-2 shows the results of a study of six U.S. industries. For these cases, the point of minimum average cost occurs at a large fraction of industry output.

   Now consider Figure 9-2(*b*), which shows an industry where firms have minimum average costs at a sizable fraction of the market. The industry demand curve allows only a small number of firms to coexist at the point of minimum average cost. Such a cost structure will lead to oligopoly. Most manufacturing industries in the United States—including steel, automobiles, cement, and oil—have a demand and cost structure similar to the one in Figure 9-2(*b*). These industries will tend to be oligopolistic, since they can support only a few large producers.
3. A final important case is natural monopoly. A **natural monopoly** is a market in which the

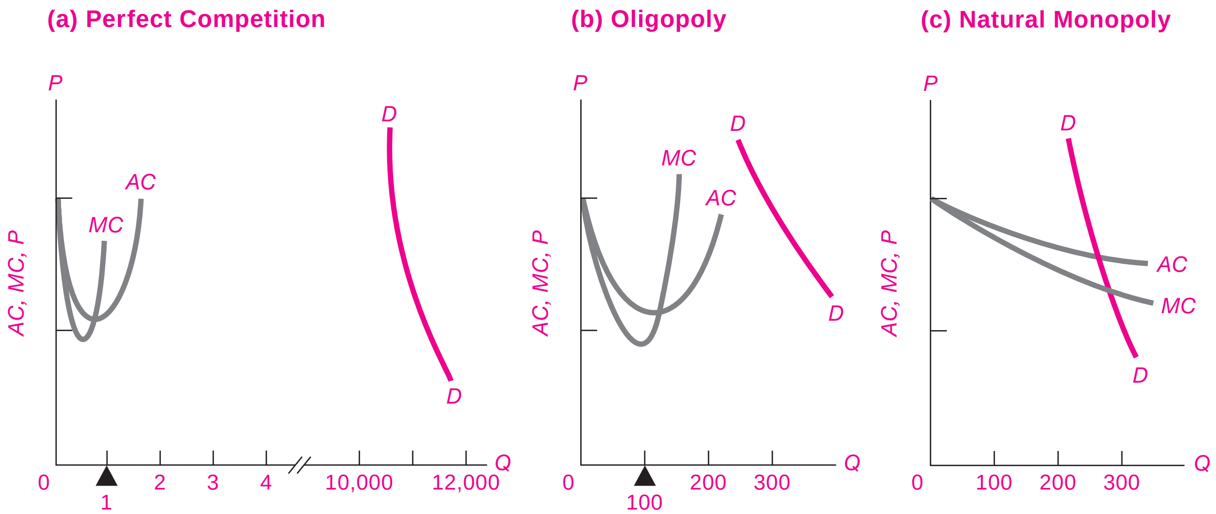


FIGURE 9-2. Market Structure Depends on Relative Cost and Demand Factors

Cost and demand conditions affect market structures. In perfectly competitive (**a**), total industry demand *DD* is so vast relative to the efficient scale of a single seller that the market allows viable coexistence of numerous perfect competitors. In (**b**), costs turn up at a higher level of output relative to total industry demand *DD*. Coexistence of numerous perfect competitors is impossible, and oligopoly will emerge. When costs fall rapidly and indefinitely, as in the case of natural monopoly in (**c**), one firm can expand to monopolize the industry.

Industry	(1) Share of U.S. output needed by a single firm to exploit economies of scale (%)	(2) Actual average market share of each of the top three firms (%)	(3) Reasons for economies of large-scale operations
Beer brewing	10–14	13	Need to create a national brand image and to coordinate investment
Cigarettes	6–12	23	Advertising and image differentiation
Glass bottles	4–6	22	Need for central engineering and design staff
Cement	2	7	Need to spread risk and raise capital
Refrigerators	14–20	21	Marketing requirements and length of production runs
Petroleum	4–6	8	Need to spread risk on crude-oil ventures and coordinate investment

TABLE 9-2. Industrial Competition Is Based on Cost Conditions

This study examined the impact of cost conditions on concentration patterns. Column (1) shows the estimate of the point where the long-run average cost curve begins to turn up, as a share of industry output. Compare this with the average market share of each of the top three firms in column (2).

Source: F. M. Scherer and David Ross, *Industrial Market Structure and Economic Performance,* 3d ed. (Houghton Mifflin, Boston, 1990).

industry's output can be efficiently produced only by a single firm. This occurs when the technology exhibits significant economies of scale over the entire range of demand. Figure 9-2(*c*) shows the cost curves of a natural monopolist. With perpetual increasing returns to scale, average and marginal costs fall forever. As output grows, the firm can charge lower and lower prices and still make a profit, since its average cost is falling. Peaceful competitive coexistence of thousands of perfect competitors will be impossible because one large firm is so much more efficient than a collection of small firms.

Some important examples of natural monopolies are the local distribution in telephone, electricity, gas, and water as well as long-distance links in railroads, highways, and electrical transmission. Many of the most important natural monopolies are "network industries" (see the discussion in Chapter 6).

Technological advances, however, can undermine natural monopolies. Most of the U.S. population is now served by at least two cellular telephone networks, which use radio waves instead of wires and are undermining the old natural monopoly of the telephone companies. We see a similar trend today in cable TV as competitors invade these natural monopolies and are turning them into hotly contested oligopolies.

Barriers to Entry

Although cost differences are the most important factor behind market structures, barriers to entry can also prevent effective competition. **Barriers to entry** are factors that make it hard for new firms to enter an industry. When barriers are high, an industry may have few firms and limited pressure to compete. Economies of scale act as one common type of barrier to entry, but there are others, including legal restrictions, high cost of entry, advertising, and product differentiation.

Legal Restrictions. Governments sometimes restrict competition in certain industries. Important legal restrictions include patents, entry restrictions, and foreign-trade tariffs and quotas. A *patent* is granted to an inventor to allow temporary exclusive use (or monopoly) of the product or process that is patented. For example, pharmaceutical companies are often granted valuable patents on new drugs in which they have invested hundreds of millions of research-and-development dollars. Patents are one of the few forms of government-granted monopolies that are generally approved of by economists. Governments grant patent monopolies to encourage inventive activity. Without the prospect of monopoly patent protection, a company or a sole inventor might be unwilling to devote time and resources to research and development. The temporarily high monopoly price and the resulting inefficiency is the price society pays for the invention.

Governments also impose *entry restrictions* on many industries. Typically, utilities, such as telephone, electricity distribution, and water, are given *franchise monopolies* to serve an area. In these cases, the firm gets an exclusive right to provide a service, and in return the firm agrees to limit its prices and provide universal service in its region even when some customers might be unprofitable.

Free trade is often controversial, as we will see in the chapter on that subject. But one factor that will surprise most people is how important international trade is to promoting vigorous competition.

Historians who study the tariff have written, "The tariff is the mother of trusts." (See question 10 at the end of this chapter for an analysis of this subject.) This is because government-imposed *import restrictions* have the effect of keeping out foreign competitors. It could very well be that a single country's market for a product is only big enough to support two or three firms in an industry, while the world market is big enough to support a large number of firms.

We can see the effect of restricting foreign competition in terms of Figure 9-2. Suppose a small country like Belgium or Benin decides that only *its* national airlines should provide airline service in the country. It is unlikely that such tiny airlines could have an efficient fleet of airplanes, reservation and repair systems, and Internet support. Service to Belgium and Benin would be poor, and prices would be high. What has happened is that the protectionist policy has changed the industry structure from Figure 9-2(*b*) to 9-2(*c*).

When markets are broadened by abolishing tariffs in a large free-trade area, vigorous and effective competition is encouraged and monopolies tend to lose their power. One of the most dramatic examples of increased competition has come in the European Union, which has lowered tariffs among member countries steadily over the last three decades and has benefited from larger markets for firms and lower concentration of industry.

High Cost of Entry. In addition to legally imposed barriers to entry, there are economic barriers as well. In some industries the price of entry simply may be very high. Take the commercial-aircraft industry, for example. The high cost of designing and testing new airplanes serves to discourage potential entrants into the market. It is likely that only two companies—Boeing and Airbus—can afford the \$10 to \$20 billion that the next generation of aircraft will cost to develop.

In addition, companies build up intangible forms of investment, and such investments might be very expensive for any potential new entrant to match. Consider the software industry. Once a spreadsheet program (like Excel) or a word-processing program (like Microsoft Word) has achieved wide acceptability, potential competitors find it difficult to make inroads into the market. Users, having learned one program, are reluctant to switch to another. Consequently, in order to get people to try a new program, any potential entrant will need to run a big promotional campaign, which would be expensive and may still result in failure to produce a profitable product. (Recall our discussion of network effects in Chapter 6.)

Advertising and Product Differentiation. Sometimes it is possible for companies to create barriers to entry for potential rivals by using advertising and product differentiation. Advertising can create product awareness and loyalty to well-known brands. For example, Pepsi and Coca-Cola spend hundreds of millions of dollars per year advertising their brands, which makes it very expensive for any potential rivals to enter the cola market.

In addition, product differentiation can impose a barrier to entry and increase the market power of producers. In many industries—such as breakfast cereals, automobiles, household appliances, and cigarettes—it is common for a small number of manufacturers to produce a vast array of different brands, models, and products. In part, the variety appeals to the widest range of consumers. But the enormous number of differentiated products also serves to discourage potential competitors. The demands for each of the individual differentiated products will be so small that they will not be able to support a large number of firms operating at the bottom of their U-shaped cost curves. The result is that perfect competition's *DD* curve in Figure 9-2(*a*) contracts so far to the left that it becomes like the demand curves of oligopoly or monopoly shown in Figure 9-2(*b*) and (*c*). Hence, differentiation, like tariffs, produces greater concentration and more imperfect competition.

Branding and Differentiated Products

One important part of modern business strategy is to establish a brand. Suppose, for example, that all the Coca-Cola factories were to collapse in an earthquake. What would happen to the value of Coca-Cola's stock price? Would it go to zero?

The answer, according to finance specialists, is that, even with no tangible assets, Coca-Cola would still be worth about \$67 billion. This is the company's *brand value*. A product's brand involves the perception of taste and quality in the minds of consumers. Brand value is established when a firm has a product that is seen as better, more reliable, or tastier than other products, branded or nonbranded.

In a world of differentiated products, some firms earn fancy profits because of the value of their brands. The following table shows recent estimates of the top 10 brands:

Rank	Brand	Brand value, 2006 ($, billion)
1	Coca-Cola	67
2	Microsoft	60
3	IBM	56
4	GE	49
5	Intel	32
6	Nokia	30
7	Toyota	28
8	Disney	28
9	McDonald's	27
10	Mercedes-Benz	22

Source: *BusinessWeek*, available on the Internet at *http://www.businessweek.com/*.

Thus, for Coca-Cola, the market value of the firm was \$67 billion more than would be justified by its plant, equipment, and other assets. How do firms establish and maintain brand value? First, they usually have an innovative product, such as a new drink, a cute cartoon mouse, or a high-quality automobile. Second, they maintain their brand value by heavy advertising, even associating a deadly product like Marlboro cigarettes (brand rank 14) with a good-looking cowboy in a romantic sunset with beautiful horses. Third, they protect their brands using intellectual property rights such as patents and copyrights. In one sense, brand value is the residue of past innovative activity.

B. MONOPOLY BEHAVIOR

We begin our survey of the behavior of imperfect competitors with an analysis of the polar case of monopoly. We need a new concept, marginal revenue, which will have wide applications for other market structures as well. The major conclusion will be that monopolistic practices lead to inefficiently high prices and low outputs and therefore reduce consumer welfare.

THE CONCEPT OF MARGINAL REVENUE

Price, Quantity, and Total Revenue

Suppose that you have a monopoly on a new kind of computer game called *Monopolia*. You wish to maximize your profits. What price should you charge, and what output level should you produce?

To answer these questions, we need a new concept, *marginal revenue* (or *MR*). From the firm's demand curve, we know the relationship between price (P) and quantity sold (q). These are shown in columns (1) and (2) of Table 9-3 and as the blue demand curve (dd) for the monopolist in Figure 9-3(a).

We next calculate the total revenue at each sales level by multiplying price times quantity. Column (3) of Table 9-3 shows how to calculate the **total revenue** (TR), which is simply $P \times q$. Thus 0 units bring in TR of 0; 1 unit brings in $TR = \$180 \times 1 = \$180$; 2 units bring in $\$160 \times 2 = \$320$; and so forth.

In this example of a straight-line or linear demand curve, total revenue at first rises with output, since the reduction in P needed to sell the extra q is moderate in this upper, elastic range of the demand curve. But when we reach the midpoint of the straight-line demand curve, TR reaches its maximum. This comes at $q = 5$, $P = \$100$, with $TR = \$500$. Increasing q beyond this point brings the firm into the inelastic demand region. For inelastic demand, reducing price increases sales less than proportionally, so total revenue falls. Figure 9-3(b) shows TR to be dome-shaped, rising from zero at a very high price to a maximum of \$500 and then falling to zero as price approaches zero.

How could you find the price at which revenues are maximized? You would see in Table 9-3 that TR is maximized when $q = 5$ and $P = 100$. This is the point where the demand elasticity is exactly 1.

Note that the price per unit can be called *average revenue* (AR) to distinguish it from total revenue. Hence, we get $P = AR$ by dividing TR by q (just as we earlier got AC by dividing TC by q). Verify that if column (3) had been written down before column (2), we could have filled in column (2) by division.

Marginal Revenue and Price

The final new concept is marginal revenue. **Marginal revenue** (MR) is the change in revenue that is generated by an additional unit of sales. MR can be either positive or negative.

Table 9-3 shows marginal revenue in column (4). MR is calculated by subtracting the total revenues of adjacent outputs. When we subtract the TR we get by selling q units from the TR we get by selling $q + 1$ units, the difference is extra revenue or MR. Thus, from $q = 0$ to $q = 1$, we get $MR = \$180 - \$0$. From $q = 1$ to $q = 2$, MR is $\$320 - \$180 = \$140$.

MR is positive until we arrive at $q = 5$ and negative from then on. What does the strange notion of negative marginal revenue mean? That the firm is paying people to take its goods? Not at all. Negative MR means that in order to sell additional units, the firm must decrease its price on earlier units so much that its total revenues decline.

For example, when the firm sells 5 units, it gets

$$TR\ (5\ \text{units}) = 5 \times \$100 = \$500$$

Now say the firm wishes to sell an additional unit of output. Because it is an imperfect competitor, it can increase sales only by lowering price. So to sell 6 units, it lowers the price from \$100 to \$80. It gets

Total and Marginal Revenue

(1) Quantity q	(2) Price $P = AR = TR/q$ ($)	(3) Total revenue $TR = P \times q$ ($)	(4) Marginal revenue MR ($)
0	200	0	
			+180
1	180	180	
			+140
2	160	320	
			+100
3	140	420	
			+60
4	120	480	+40
			+20
5	100	500	
			____
6	80	480	
			−60
7	60	____	
			−100
8	40	320	
			−140
9	____	180	
			−180
10	0	0	

TABLE 9-3. Marginal Revenue Is Derived from Demand Schedule

Total revenue (TR) in column (3) comes from multiplying P by q. To get marginal revenue (MR), we increase q by a unit and calculate the change in total revenue. MR is less than P because of the lost revenue from lowering the price on previous units to sell another unit of q. Note that MR is positive when demand is elastic. But after demand turns inelastic, MR becomes negative even though price is still positive.

\$80 of revenue from the sixth unit, but it gets only $5 \times \$80$ on the first 5 units, yielding

$$TR(6 \text{ units}) = (5 \times \$80) + (1 \times \$80)$$
$$= \$400 + \$80 = \$480$$

Marginal revenue between 5 and 6 units is $\$480 - \$500 = -\$20$. The necessary price reduction on the first 5 units was so large that, even after adding in the sale of the sixth unit, total revenue fell. This is what happens when MR is negative. To test your understanding, fill in the blanks in columns (2) to (4) of Table 9-3.

Note that even though MR is negative, AR, or price, is still positive. Do not confuse marginal revenue with average revenue or price. Table 9-3 shows

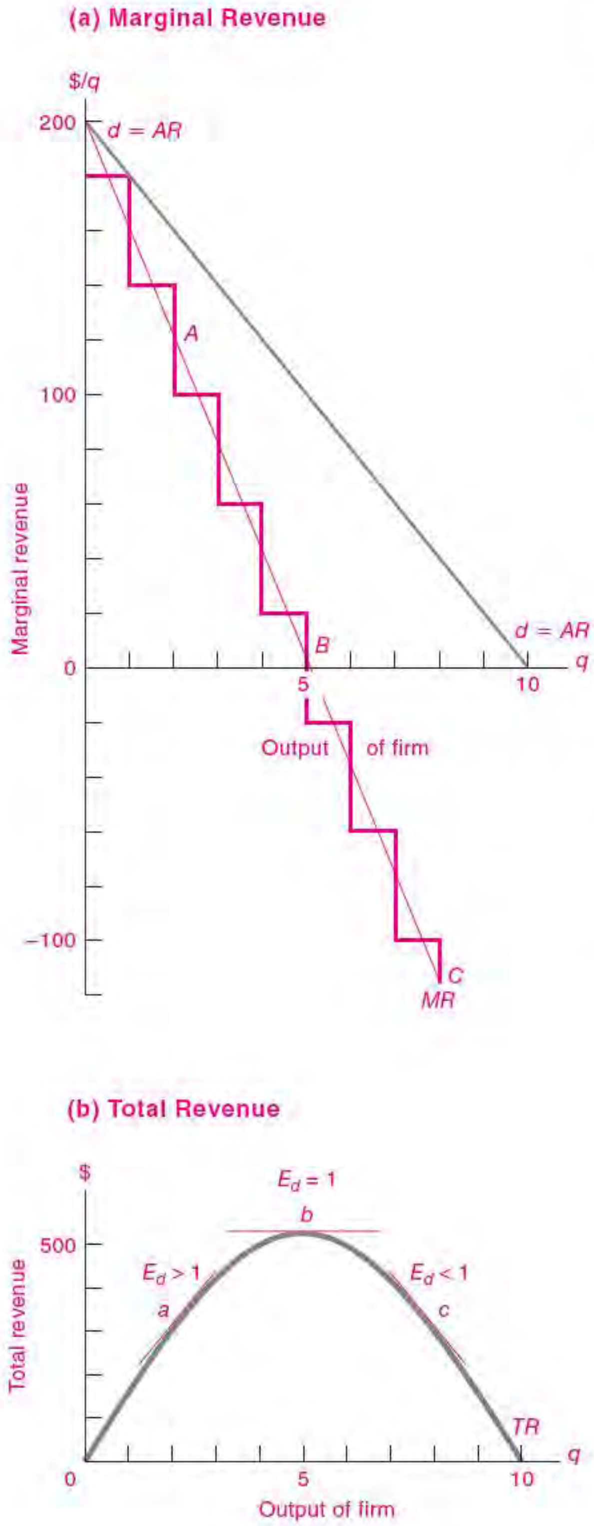


FIGURE 9-3. Marginal Revenue Curve Comes from Demand Curve

(a) The steps show the increments of total revenue from each extra unit of output. *MR* falls below *P* from the beginning. *MR* becomes negative when *dd* turns inelastic. Smoothing the incremental steps of *MR* gives the smooth, thin green *MR* curve, which in the case of straight line *dd* will always have twice as steep a slope as *dd*.

(b) Total revenue is dome-shaped—rising from zero where $q = 0$ to a maximum (where *dd* has unitary elasticity) and then falling back to zero where $P = 0$. If we graph *TR* as a smooth blue line in (*b*), this gives smoothed green *MR* in (*a*).

Source: Table 9-3.

that they are different. In addition, Figure 9-3(*a*) plots the demand (*AR*) curve and the marginal revenue (*MR*) curve. Scrutinize Figure 9-3(*a*) to see that the plotted green steps of *MR* definitely lie below the blue *dd* curve of *AR*. In fact, *MR* turns negative when *AR* is halfway down toward zero.

Elasticity and Marginal Revenue

What is the relationship between the price elasticity of demand and marginal revenue? Marginal revenue is positive when demand is elastic, zero when demand is unit-elastic, and negative when demand is inelastic.

This result is an important implication of the definition of elasticity that we used in Chapter 4. Recall that demand is elastic when a price decrease leads to a revenue increase. In such a situation, a price decrease raises output demanded so much that revenues rise, so marginal revenue is positive. For example, in Table 9-3, as price falls in the elastic region from $P = \$180$ to $P = \$100$, output demanded rises sufficiently to raise total revenue, and marginal revenue is positive.

What happens when demand is unit-elastic? A percentage price cut then just matches the percentage output increase, and marginal revenue is therefore zero. Can you see why marginal revenue is always negative in the inelastic range? Why is the marginal revenue for the perfect competitor's infinitely elastic demand curve always positive?

Table 9-4 shows the important elasticity relationships. Make sure you understand them and can apply them.

If demand is	Relation of q and P	Effect of q on TR	Value of marginal revenue (MR)
Elastic ($E_D > 1$)	% change $q >$ % change P	Higher q raises TR	$MR > 0$
Unit-elastic ($E_D = 1$)	% change $q =$ % change P	Higher q leaves TR unchanged	$MR = 0$
Inelastic ($E_D < 1$)	% change $q <$ % change P	Higher q lowers TR	$MR < 0$

TABLE 9-4. Relationships of Demand Elasticity, Output, Price, Revenue, and Marginal Revenue

Here are the key points to remember:

1. *Marginal revenue* (MR) is the change in revenue that is generated by an additional unit of sales.
2. Price = average revenue ($P = AR$).
3. With downward-sloping demand,
   $P > MR$
   $= P -$ reduced revenue on all previous units.
4. Marginal revenue is positive when demand is elastic, zero when demand is unit-elastic, and negative when demand is inelastic.
5. For perfect competitors, $P = MR = AR$.

PROFIT-MAXIMIZING CONDITIONS

Now return to the question of how a monopolist should set its quantity and price if it wants to maximize profits. By definition, total profit equals total revenue minus total costs; in symbols, $TP = TR - TC = (P \times q) - TC$. We will show that *maximum profit will occur when output is at that level where the firm's marginal revenue is equal to its marginal cost.*

One way to determine this maximum-profit condition is by using a table of costs and revenues, such as Table 9-5. To find the profit-maximizing quantity and price, compute total profit in column (5). This column tells us that the monopolist's best quantity, which is 4 units, requires a price of $120 per unit. This produces a total revenue of $480, and, after subtracting total costs of $250, we calculate total profit to be $230. A glance shows that no other price-output combination has as high a level of total profit.

We get more insight using a second approach, which is to compare marginal revenue in column (6) with marginal cost in column (7). As long as each additional unit of output provides more revenue than it costs, the firm's profit will increase as output increases. So the firm should continue to increase its output as long as MR is greater than MC.

On the other hand, suppose that MR is less than MC at a given output. This means that increasing output lowers profits, so the firm should cut back on output. Clearly, the best-profit point comes where marginal revenue exactly equals marginal cost. The rule for finding maximum profit is therefore:

The maximum-profit price (P^*) and quantity (q^*) of a monopolist come where the firm's marginal revenue equals its marginal cost:

$MR = MC$, at the maximum-profit P^* and q^*

These examples show the logic of the $MC = MR$ rule for maximizing profits, but we always want to understand the intuition behind the rules. Look for a moment at Table 9-5 and suppose that the monopolist is producing $q = 2$. At that point, its MR for producing 1 full additional unit is +$100, while its MC is $20. Thus, if it produced 1 additional unit, the firm would make additional profits of $MR - MC = \$100 - \$20 = \$80$. Indeed, column (5) of Table 9-5 shows that the extra profit gained by moving from 2 to 3 units is exactly $80.

Thus, when MR exceeds MC, additional profits can be made by increasing output; when MC exceeds MR, additional profits can be made by decreasing q. Only when $MR = MC$ can the firm maximize profits, because there are no additional profits to be made by changing its output level.

Monopoly Equilibrium in Graphs

Figure 9-4 shows the monopoly equilibrium. Part (*a*) combines the firm's cost and revenue curves. The maximum-profit point comes at that output where MC equals MR, which is given at their intersection at E. The monopoly equilibrium, or maximum-profit point, is at an output of $q^* = 4$. To find the profit-maximizing price, we run vertically up from E to the

Summary of Firm's Maximum Profit

(1) Quantity q	(2) Price P (\$)	(3) Total revenue TR (\$)	(4) Total cost TC (\$)	(5) Total profit TP (\$)	(6) Marginal revenue MR (\$)	(7) Marginal cost MC (\$)	
0	200	0	145	−145			
					+180	30	$MR > MC$
1	180	180	175	+5			
					+140	25	
2	160	320	200	+120			
					+100	20	
3	140	420	220	+200			
					+60	30	
4*	**120***	**480**	**250**	**+230**	+40	40	$MR = MC$
					+20	50	
5	100	500	300	+200			
					−20	70	
6	80	480	370	+110			
					−60	90	
7	60	420	460	−40			
					−100	110	$MR < MC$
8	40	320	570	−250			

*Maximum-profit equilibrium.

TABLE 9-5. Equating Marginal Cost to Marginal Revenue Gives Firm's Maximum-Profit q and P

Total and marginal costs of production are now brought together with total and marginal revenues. The maximum-profit condition is where $MR = MC$, with $q^* = 4$, $P^* = \$120$, and maximum $TP = \$230 = (\$120 \times 4) - \$250$.

dd curve at *G*, where $P^* = \$120$. The fact that average revenue at *G* lies above average cost at *F* guarantees a positive profit. The actual amount of profit is given by the green area in Figure 9-4(*a*).

The same story is told in part (*b*) with curves of total revenue, cost, and profit. Total revenue is dome-shaped. Total cost is ever rising. The vertical difference between them is total profit, which begins negative and ends negative. In between, *TP* is positive, reaching its maximum of \$230 at $q^* = 4$.

We add one further important geometric point. *The slope of a total value is a marginal value.* (You can refresh your memory on this by looking at page 22 in Chapter 1's appendix.) So look at point *G* in Figure 9-4(*b*). If you carefully calculate the slope at that point, you will see that it is \$40 per unit. This means that every unit of additional output produces \$40 of additional revenue, which is just the definition of *MR*. So the slope of the *TR* curve is *MR*. Similarly, the slope of the *TC* curve is *MC*. Note that at $q = 4$, *MC* is also \$40 per unit. At $q = 4$, marginal cost and marginal revenue are equal. At that point total profit (*TP*) reaches its maximum, and an additional unit adds exactly equal amounts to costs and revenues.

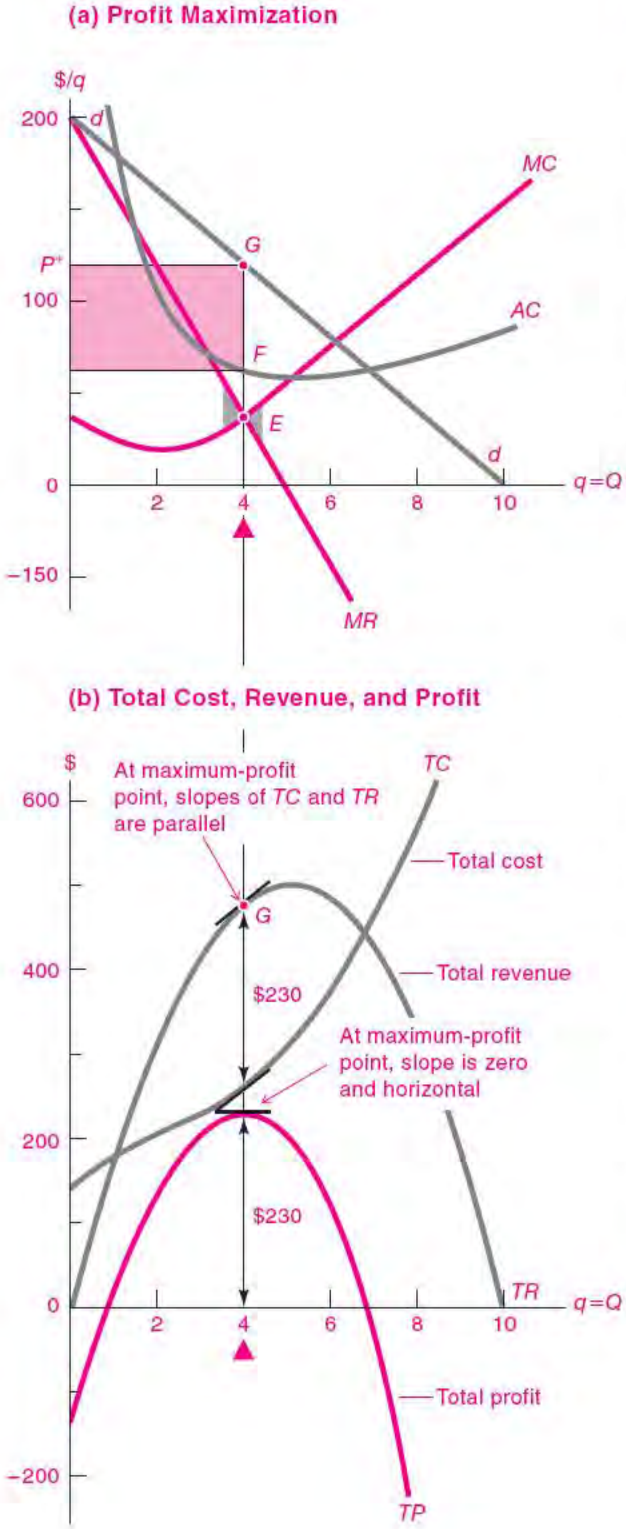


FIGURE 9-4. Profit-Maximizing Equilibrium Can Be Shown Using Either Total or Marginal Curves

(a) At *E*, where *MC* intersects *MR*, the monopolist gets maximum profits. Price is on the demand curve at *G*, above *E*. Since *P* is above *AC*, the maximized profit is a positive profit. (Can you explain why the blue triangles of shading on either side of *E* show the reduction in total profit that would come from a departure from *MR* = *MC*?)

Panel **(b)** tells the same story of maximizing profit as does **(a)**, but it uses total concepts rather than marginal concepts. The *TR* curve shows the total revenue, while the *TC* curve shows total cost. Total profit is equal to *TR* minus *TC*, shown geometrically as the vertical distance from *TR* to *TC*. The slope of each curve is that curve's marginal value (e.g., *MR* is the slope of *TR*). At the maximum profit, *TR* and *TC* are parallel and therefore have equal slopes, *MR* = *MC*.

At the maximum-profit output, the blue slopes of *TR* and *TC* (which are *MR* and *MC*) are parallel and therefore equal.

A monopolist will maximize its profits by setting output at the level where *MC* = *MR*. Because the monopolist has a downward-sloping demand curve, this means that *P* > *MR*. Because price is above marginal cost for a profit-maximizing monopolist, the monopolist reduces output below the level that would be found in a perfectly competitive industry.

Perfect Competition as a Polar Case of Imperfect Competition

Although we have applied the *MC* = *MR* rule to monopolists that desire to maximize profits, this rule is actually applicable far beyond the present analysis. A little thought shows that the *MC* = *MR* rule applies with equal validity to a profit-maximizing perfect competitor. We can see this in two steps:

1. MR *for a perfect competitor.* What is *MR* for a perfect competitor? For a perfect competitor, the sale of extra units will never depress price, and the "lost revenue on all previous *q*" is therefore equal to zero. Price and marginal revenue are identical for perfect competitors.

   Under perfect competition, price equals average revenue equals marginal revenue (*P* = *AR* = *MR*). A perfect competitor's *dd* curve and its *MR* curve coincide as horizontal lines.

2. MR = P = MC *for a perfect competitor.* In addition, we can see that the logic of profit maximization for monopolists applies equally well to perfect competitors, but the result is a little different. Economic logic shows that profits are maximized at that output level where *MC* equals *MR*. But by step 1 above, for a perfect competitor, *MR* equals *P*. Therefore, the *MR* = *MC* profit-maximization condition becomes the special case of *P* = *MC* that we derived in the last chapter for a perfect competitor:

 Because a perfect competitor can sell all it wants at the market price, *MR* = *P* = *MC* at the maximum-profit level of output.

You can see this result visually by redrawing Figure 9-4(*a*). If the graph applied to a perfect competitor, the *dd* curve would be horizontal at the market price, and it would coincide with the *MR* curve. The profit-maximizing *MR* = *MC* intersection would also come at *P* = *MC*. We see then how the general rule for profit maximization applies to perfect as well as imperfect competitors.

THE MARGINAL PRINCIPLE: LET BYGONES BE BYGONES

We close this chapter with a more general point about the use of marginal analysis in economics. While economic theory will not necessarily make you fabulously wealthy, it does introduce you to some new ways of thinking about costs and benefits. *One of the most important lessons of economics is that you should look at the marginal costs and marginal benefits of decisions and ignore past or sunk costs.* We might put this as follows:

> Let bygones be bygones. Don't look backward. Don't cry over spilt milk or moan about yesterday's losses. Make a hard-headed calculation of the extra costs you'll incur by any decision, and weigh these against its extra advantages. Make a decision based on marginal costs and marginal benefits.

This is the **marginal principle,** which means that people will maximize their incomes or profits or satisfactions by counting only the marginal costs and marginal benefits of a decision. There are countless situations in which the marginal principle applies. We have just seen that the marginal principle of equating marginal cost and marginal revenue is the rule for profit maximization by firms.

Loss Aversion and the Marginal Principle

An interesting application is the behavior of people who are selling their houses. Behavioral economists have observed that people often resist selling their house for less than the dollar purchase price even in the face of steep declines in local housing prices.

For example, suppose you bought your house in San Jose for $250,000 in 2005 and wanted to sell it in 2008. Because of the decline in housing prices, comparable houses sold for $200,000 in 2008. As was the case for millions of people in the last few years, you are faced with a nominal dollar loss.

Studies show that you might well set the price at your purchase price of $250,000 and wait for several months without a single serious offer. This is what behavioral economists call "loss aversion," meaning that people resist taking a loss even though it is costly to hold on to an asset. This behavior has been verified in housing markets, where people subject to a loss set higher asking prices and wait longer for sales.

Economists counsel against this kind of behavior. It would be better to observe the marginal principle. Forget about what you paid for your house. Just get the best price you can.

Monopolists of the Gilded Age

Economic abstractions sometimes hide the human drama of monopoly, so we close this section by recounting one of the most colorful periods of American business history. Because of changing laws and customs, monopolists in today's America bear little resemblance to the brilliant, unscrupulous, and often dishonest robber barons of the Gilded Age (1870–1914). Legendary figures like Rockefeller, Gould, Vanderbilt, Frick, Carnegie, Rothschild, and Morgan were driven to create entire industries like railroads or oil, provide their finance, develop the western frontier, destroy their competitors, and pass on fabulous fortunes to their heirs.

The last three decades of nineteenth-century America experienced robust economic growth lubricated by tremendous graft and corruption. Daniel Drew was a cattle rustler, horse trader, and railroader who mastered the trick of "watering the stock." This practice involved depriving his cattle of water until they reached the slaughterhouse; he then induced a great thirst with salt and allowed the beasts to engorge themselves on water just before being weighed. Later, tycoons would "water their stock" by inflating the value of their securities.

The railroaders of the American frontier west were among the most unscrupulous entrepreneurs on record. The transcontinental railroads were funded with vast federal land grants, aided by bribes and stock gifts to numerous members of Congress and the cabinet. Shortly after the Civil War, the wily railroader Jay Gould attempted to corner the entire gold supply of the United States, and with it the nation's money supply. Gould later promoted his railroad by describing the route of his northern line—snowbound much of the year—as a tropical paradise, filled with orange groves, banana plantations, and monkeys. By century's end, all the bribes, land grants, watered stock, and fantastic promises had led to the greatest rail system in the world.

The story of John D. Rockefeller epitomizes the nineteenth-century monopolist. Rockefeller saw visions of riches in the fledgling oil industry and began to organize oil refineries. He was a meticulous manager and sought to bring "order" to the quarrelsome wildcatters. He bought up competitors and consolidated his hold on the industry by persuading the railroads to give him deep and secret rebates and supply information about his competitors. When competitors stepped out of line, Rockefeller's railroads refused to ship their oil and even dumped it on the ground. By 1878, John D. controlled 95 percent of the pipelines and oil refineries in the United States. Prices were raised and stabilized, ruinous competition was ended, and monopoly was achieved.

Rockefeller devised an ingenious new device to ensure control over his alliance. This was the "trust," in which the stockholders turned their shares over to "trustees" who would then manage the industry to maximize its profits. Other industries imitated the Standard Oil Trust, and soon trusts were set up in kerosene, sugar, whiskey, lead, salt, and steel.

These practices so upset agrarians and populists that the nation soon passed antitrust laws (see Chapter 10). In 1910, the Standard Oil Corporation was dissolved in the first great victory by the Progressives against "Big Business." Ironically, Rockefeller actually profited from the breakup because the price of Standard Oil shares soared when they were offered to the public.

Great monopolies produced great wealth. Whereas the United States had three millionaires in 1861, there were 4000 of them by 1900 ($1 million at the turn of the century is equivalent to about $100 million in today's dollars).

Great wealth in turn begot conspicuous consumption (a term introduced into economics by Thorstein Veblen in *The Theory of the Leisure Class,* 1899). Like European popes and aristocrats of an earlier era, American tycoons wanted to transform their fortunes into lasting monuments. The wealth was spent in constructing princely palaces such as the "Marble House," which can still be seen in Newport, Rhode Island; in buying vast art collections, which form the core of the great American museums like New York's Metropolitan Museum of Art; and in launching foundations and universities such as those named after Stanford, Carnegie, Mellon, and Rockefeller. Long after their private monopolies were broken up by the government or overtaken by competitors, and long after their wealth was largely dissipated by heirs and overtaken by later generations of entrepreneurs, the philanthropic legacy of the robber barons continues to shape American arts, science, and education.[1]

[1] See the Further Reading section for books on this topic.

SUMMARY

A. Patterns of Imperfect Competition

1. Most market structures today fall somewhere on a spectrum between perfect competition and pure monopoly. Under imperfect competition, a firm has some control over its price, a fact seen as a downward-sloping demand curve for the firm's output.
2. Important kinds of market structures are (*a*) monopoly, where a single firm produces all the output in a given industry; (*b*) oligopoly, where a few sellers of a similar or differentiated product supply the industry; (*c*) monopolistic competition, where a large number of small firms supply related but somewhat differentiated products; and (*d*) perfect competition, where a large number of small firms supply an identical product. In the first three cases, firms in the industry face downward-sloping demand curves.
3. Economies of scale, or decreasing average costs, are the major source of imperfect competition. When

firms can lower costs by expanding their output, perfect competition is destroyed because a few companies can produce the industry's output most efficiently. When the minimum efficient size of plants is large relative to the national or regional market, cost conditions produce imperfect competition.

4. In addition to declining costs, other forces leading to imperfect competition are barriers to entry in the form of legal restrictions (such as patents or government regulation), high entry costs, advertising, and product differentiation.

B. Monopoly Behavior

5. We can easily derive a firm's total revenue curve from its demand curve. From the schedule or curve of total revenue, we can then derive marginal revenue, which denotes the change in revenue resulting from an additional unit of sales. For the imperfect competitor, marginal revenue is less than price because of the lost revenue on all previous units of output that will result when the firm is forced to drop its price in order to sell an extra unit of output. That is, with demand sloping downward,

$$P = AR > MR = P - \text{lost revenue on all previous } q$$

6. Recall Table 9-4's rules relating demand elasticity, price and quantity, total revenue, and marginal revenue.
7. A monopolist will find its maximum-profit position where $MR = MC$, that is, where the last unit it sells brings in extra revenue just equal to its extra cost. This same $MR = MC$ result can be shown graphically by the intersection of the MR and MC curves or by the equality of the slopes of the total revenue and total cost curves. In any case, *marginal revenue* = *marginal cost* must always hold at the equilibrium position of maximum profit.
8. For perfect competitors, marginal revenue equals price. Therefore, the profit-maximizing output for a perfect competitor comes where $MC = P$.
9. Economic reasoning leads to the important *marginal principle*. In making decisions, count marginal future advantages and disadvantages, and disregard sunk costs that have already been paid. Be wary of loss aversion.

CONCEPTS FOR REVIEW

Patterns of Imperfect Competition

perfect vs. imperfect competition
monopoly, oligopoly, monopolistic competition
product differentiation
barriers to entry (government and economic)

Marginal Revenue and Monopoly

marginal (or extra) revenue, MR
$MR = MC$ as the condition for maximizing profits
$MR = P$, $P = MC$, for perfect competitors
natural monopoly
the marginal principle

FURTHER READING AND INTERNET WEBSITES

Further Reading

The theory of monopoly was developed by Alfred Marshall around 1890; see his *Principles of Economics,* 9th ed. (Macmillan, New York, 1961).

An excellent review of monopoly and industrial organization is F. M. Scherer and David Ross, *Industrial Market Structure and Economic Performance,* 3rd ed. (Houghton Mifflin, Boston, 1990).

The Gilded Age period gave birth to "yellow journalism" in the United States and fostered many muckraking histories, such as Matthew Josephson, *The Robber Barons* (Harcourt Brace, New York, 1934). A more balanced recent account is Ron Chernow, *Titan: The Life of John D. Rockefeller, Sr.* (Random House, New York, 1998).

For a study of loss aversion in the housing market, see David Genesove and Christopher Mayer, "Loss Aversion and Seller Behavior: Evidence from the Housing Market," *Quarterly Journal of Economics,* 2001. The foundation of this theory is in Amos Tversky and Daniel Kahneman, "Loss Aversion in Riskless Choice: A Reference-Dependent Model," *Quarterly Journal of Economics,* 1991.

Websites

An important legal case over the last decade has concerned whether Microsoft had a monopoly on PC operating systems. This is thoroughly discussed in the "Findings of Fact" of the Microsoft antitrust case by Judge Thomas Penfield Jackson (November 5, 1999). His opinion and further developments can be found at *www.microsoft.com/presspass/legalnews.asp*.

QUESTIONS FOR DISCUSSION

1. Suppose a monopolist owns a mineral spring. Answer and demonstrate each of the following:
   a. Assume that the cost of production is zero. What is the elasticity of demand at the profit-maximizing quantity?
   b. Assume that the *MC* of production is always \$1 per unit. What is the elasticity of demand at the profit-maximizing quantity?
2. Explain why each of the following statements is false. For each, write the correct statement.
   a. A monopolist maximizes profits when $MC = P$.
   b. The higher the price elasticity, the higher is a monopolist's price above its *MC*.
   c. Monopolists ignore the marginal principle.
   d. Monopolists will maximize sales. They will therefore produce more than perfect competitors and their price will be lower.
3. What is *MR*'s numerical value when *dd* has unitary elasticity? Explain.
4. In his opinion on the Microsoft antitrust case, Judge Jackson wrote: "[T]hree main facts indicate that Microsoft enjoys monopoly power. First, Microsoft's share of the market for Intel-compatible PC operating systems is extremely large and stable. Second, Microsoft's dominant market share is protected by a high barrier to entry. Third, and largely as a result of that barrier, Microsoft's customers lack a commercially viable alternative to Windows." (See the website reference, section 34, in this chapter's Further Readings.) Why are these elements related to monopoly? Are all three necessary? If not, which ones are crucial? Explain your reasoning.
5. Estimate the numerical price elasticities of demand at points *A* and *B* in Figure 9-1. (*Hint:* You may want to review the rule for calculating elasticities in Figure 4-5.)
6. Redraw Figure 9-4(*a*) for a perfect competitor. Why is *dd* horizontal? Explain why the horizontal *dd* curve coincides with *MR*. Then proceed to find the profit-maximizing *MR* and *MC* intersection. Why does this yield the competitive condition $MC = P$? Now redraw Figure 9-4(*b*) for a perfect competitor. Show that the slopes of *TR* and *TC* must still match at the maximum-profit equilibrium point for a perfect competitor.
7. Banana Computer Company has fixed costs of production of \$100,000, while each unit costs \$600 of labor and \$400 of materials and fuel. At a price of \$3000, consumers would buy no Banana computers, but for each \$10 reduction in price, sales of Banana computers increase by 1000 units. Calculate marginal cost and marginal revenue for Banana Computer, and determine its monopoly price and quantity.
8. Show that a profit-maximizing monopolist will never operate in the price-inelastic region of its demand curve.
9. Explain the error in the following statement: "A firm out to maximize its profits will always charge the highest price that the traffic will bear." State the correct result, and use the concept of marginal revenue to explain the difference between the correct and the erroneous statements.
10. Recall from pp. 183–184 how trusts were organized to monopolize industries like oil and steel. Explain the saying, "The tariff is the mother of trusts." Use Figure 9-2 to illustrate your analysis. Use the same diagram to explain why lowering tariffs and other trade barriers reduces monopoly power.
11. *For students who like calculus:* You can show the condition for profit maximization easily using calculus. Define $TP(q)$ = total profits, $TC(q)$ = total costs, and $TR(q)$ = total revenues. Marginal this-or-that is the derivative of this-or-that with respect to output, so $dTR/dq = TR'(q) = MR$ = marginal revenue.
    a. Explain why $TP = TR - TC$.
    b. Show that a maximum of the profit function comes where $TC'(q) = TR'(q)$. Interpret this finding.

CHAPTER

10

Competition among the Few

Look at the airline price wars of 1992. When American Airlines, Northwest Airlines, and other U.S. carriers went toe-to-toe in matching and exceeding one another's reduced fares, the result was record volumes of air travel—and record losses. Some estimates suggest that the overall losses suffered by the industry that year exceed the combined profits for the entire industry from its inception.

Akshay R. Rao, Mark E. Bergen, and Scott Davis
"How to Fight a Price War"

Earlier chapters analyzed the market structures of perfect competition and complete monopoly. If you look out the window at the American economy, however, you will see that such polar cases are rare. Most industries lie between these two extremes and are populated by a small number of firms competing with each other.

What are the key features of these intermediate types of imperfect competitors? How do they set their prices and outputs? To answer these questions, we look closely at what happens under oligopoly and monopolistic competition, paying special attention to the role of concentration and strategic interaction. We then introduce the elements of game theory, which is an important tool for understanding how people and businesses interact in strategic situations. The final section reviews the different public policies used to combat monopolistic abuses, focusing on regulation and antitrust laws.

A. BEHAVIOR OF IMPERFECT COMPETITORS

Look back at Table 9-1, which shows the following kinds of market structures: (1) *Perfect competition* is found when a large number of firms produce an identical product. (2) *Monopolistic competition* occurs when a large number of firms produce slightly differentiated products. (3) *Oligopoly* is an intermediate form of imperfect competition in which an industry is dominated by a few firms. (4) *Monopoly* is the most concentrated market structure, in which a single firm produces the entire output of an industry.

How do we measure the power of firms in an industry to control price and output? How do the different species behave? We begin with these issues.

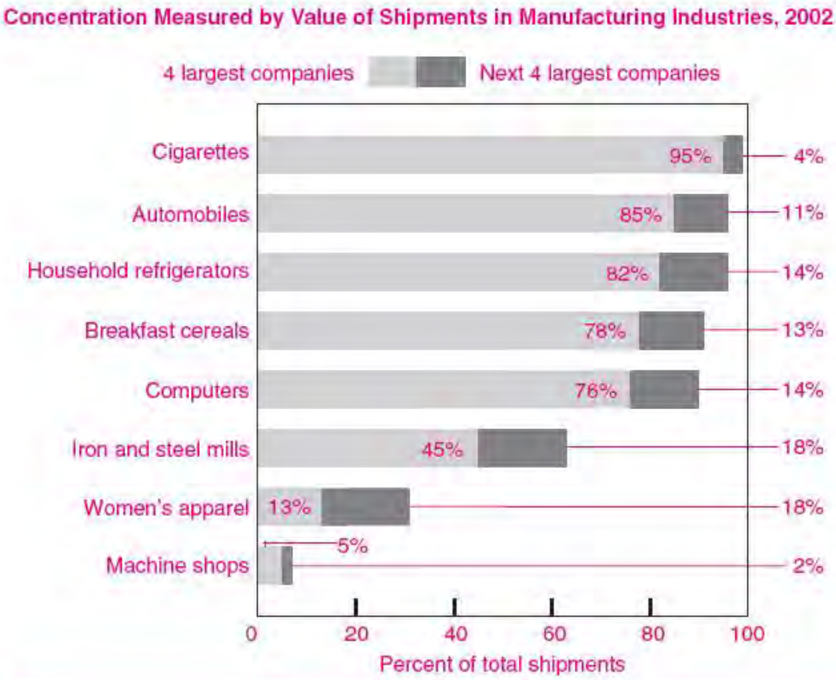


FIGURE 10-1. Concentration Ratios Are Quantitative Measures of Market Power

For refrigerators, automobiles, and many other industries, a few firms produce most of the domestic output. Compare this with the ideal of perfect competition, in which each firm is too small to affect the market price.

Source: U.S. Bureau of the Census, 2002 data.

Measures of Market Power

In many situations—such as deciding whether the government should intervene in a market or whether a firm has abused its monopoly position—economists need a quantitative measure of the extent of a firm's market power. **Market power** signifies the degree of control that a single firm or a small number of firms have over the price and production decisions in an industry.

The most common measure of market power is the *concentration ratio* for an industry, illustrated in Figure 10-1. The **four-firm concentration ratio** measures the fraction of the market or industry accounted for by the four largest firms. Similarly, the eight-firm concentration ratio is the percent of the market taken by the top eight firms. The market is customarily measured by domestic sales, shipments, or output. In a pure monopoly, the four-firm and eight-firm concentration ratios would be 100 percent because one firm produces 100 percent of the output; under perfect competition, both ratios would be close to zero because even the largest firms produce only a tiny fraction of industry output.

Many economists believe that traditional concentration ratios do not adequately measure market power. An alternative, which better captures the role of dominant firms, is the **Herfindahl-Hirschman Index (HHI).** This is calculated by summing the squares of each participant's market share. Perfect competition would have an HHI of near zero because each firm produces only a small percentage of the total output, while complete monopoly would have an HHI of 10,000 because one firm produces 100 percent of the output ($100^2 = 10{,}000$). (For the formula and an example, see question 2 at the end of this chapter.)

Warning on Concentration Measures

Although concentration measures are widely used, they are often misleading because of international competition and competition from closely related industries. Conventional concentration measures such as those shown in Figure 10-1 exclude imports and include only domestic production. Because foreign competition is very intense in the manufacturing sector, the actual market power of domestic firms is much smaller than is indicated by measures of market power based solely on domestic production. For example, the conventional concentration measures shown in Figure 10-1 indicate that the top four U.S. automotive firms had 85 percent of the U.S. market. If we include imports as well, however, these top four U.S. firms had only 43 percent of the U.S. market.

In addition to ignoring international competition, traditional concentration measures ignore the impact of competition from other, related industries. For example, concentration ratios have historically been calculated for a narrow industry definition, such as "wired telecommunications carriers." Sometimes, however, strong competition comes from other quarters. For example, cellular telephones are a major threat to traditional wired telephone service even though the two are produced by different industries. Even though the four-firm concentration ratio for wired carriers alone is 60 percent, the four-firm ratio for all telecommunications carriers is only 46 percent, so the definition of a market can strongly influence the calculation of the concentration ratios.

In the end, some measure of market power is essential for many legal purposes, such as aspects of antitrust law, examined later in this chapter. A careful delineation of the market to include all the relevant competitors can be helpful in determining whether monopolistic abuses are in fact a real threat.

THE NATURE OF IMPERFECT COMPETITION

In analyzing the determinants of concentration, economists have found that three major factors are at work in imperfectly competitive markets. These factors are economies of scale, barriers to entry, and strategic interaction (the first two were analyzed in the previous chapter, and the third is the subject of detailed examination in the next section):

- *Costs.* When the minimum efficient size of operation for a firm occurs at a sizable fraction of industry output, only a few firms can profitably survive and oligopoly is likely to result.
- *Barriers to competition.* When there are large economies of scale or government restrictions to entry, these will limit the number of competitors in an industry.
- *Strategic interaction.* When only a few firms operate in a market, they will soon recognize their interdependence. **Strategic interaction,** which is a genuinely new feature of oligopoly that has inspired the field of game theory, occurs when each firm's business depends upon the behavior of its rivals.

Why are economists particularly concerned about industries characterized by imperfect competition? The answer is that such industries behave in certain ways that are inimical to the public interest. For example, imperfect competition generally leads to prices that are above marginal costs. Sometimes, without the spur of competition, the quality of service deteriorates. Both high prices and poor quality are undesirable outcomes.

As a result of high prices, oligopolistic industries often (but not always) have supernormal profits. The profitability of the highly concentrated tobacco and pharmaceutical industries has been the target of political attacks on numerous occasions. Careful studies show, however, that concentrated industries tend to have only slightly higher rates of profit than unconcentrated ones.

Historically, one of the major defenses of imperfect competition has been that large firms are responsible for most of the research and development (R&D) and innovation in a modern economy. There is certainly some truth in this idea, for highly concentrated industries sometimes have high levels of R&D spending per dollar of sales as they try to achieve a technological edge over their rivals. At the same time, individuals and small firms have produced many of the greatest technological breakthroughs. We review the economics of innovation in Chapter 11.

THEORIES OF IMPERFECT COMPETITION

While the concentration of an industry is important, it does not tell the whole story. Indeed, to explain the behavior of imperfect competitors, economists have developed a field called *industrial organization.* We cannot cover this vast area here. Instead, we will focus on three of the most important cases of imperfect competition—collusive oligopoly, monopolistic competition, and small-number oligopoly.

Collusive Oligopoly

The degree of imperfect competition in a market is influenced not just by the number and size of firms but by their behavior. When only a few firms operate in a market, they see what their rivals are doing and react. For example, if there are two airlines operating along the same route and one raises its fare, the other must decide whether to match the increase or to stay with the lower fare, undercutting its rival. *Strategic interaction* is a term that describes how each firm's business strategy depends upon its rivals' business behavior.

When there are only a small number of firms in a market, they have a choice between *cooperative* and *noncooperative* behavior. Firms act noncooperatively when they act on their own without any explicit or implicit agreements with other firms. That's what produces price wars. Firms operate in a cooperative mode when they try to minimize competition. When firms in an oligopoly actively cooperate with each other, they engage in **collusion.** This term denotes a situation in which two or more firms jointly set their prices or outputs, divide the market among themselves, or make other business decisions jointly.

During the early years of American capitalism, before the passage of effective antitrust laws, oligopolists often merged or formed a trust or cartel (recall Chapter 9's discussion of trusts, page 184). A **cartel** is an organization of independent firms, producing similar products, that work together to raise prices and restrict output. Today, with only a few exceptions, it is strictly illegal in the United States and most other market economies for companies to collude by jointly setting prices or dividing markets.

Nonetheless, firms are often tempted to engage in tacit collusion, which occurs when they refrain from competition without explicit agreements. When firms tacitly collude, they often quote identical high prices, pushing up profits and decreasing the risk of doing business. In recent years, sellers of online music, diamonds, and kosher Passover products have been investigated for price fixing, while private universities, art dealers, airlines, and the telephone industry have been accused of collusive behavior.

The rewards for successful collusion can be great. Consider an industry where four firms have tired of ruinous price wars. They agree to charge the same price and share the market. They form a **collusive oligopoly** and set a price which maximizes their joint profits. By joining together, the four firms in effect become a monopolist.

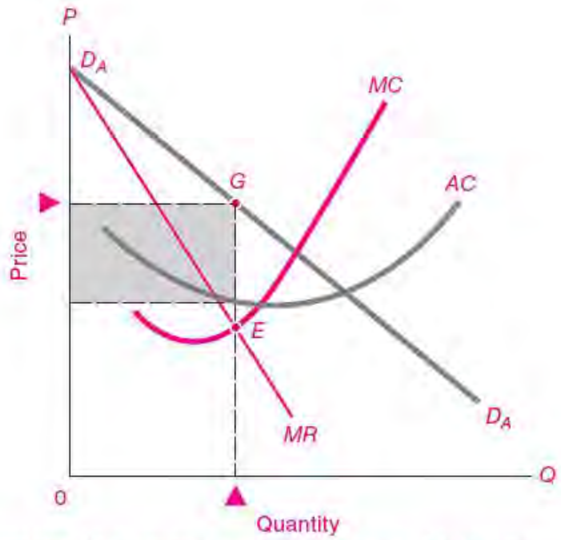


FIGURE 10-2. Collusive Oligopoly Looks Much Like Monopoly

After experience with disastrous price wars, firms will surely recognize that each price cut is canceled by competitors' price cuts. So oligopolist A may estimate its demand curve D_AD_A by assuming that others will be charging similar prices. When firms collude to set a jointly profit-maximizing price, the price will be very close to that of a single monopolist. Can you see why profits are equal to the blue rectangle?

Figure 10-2 illustrates oligopolist A's situation, where there are four firms with identical cost and demand curves. We have drawn A's demand curve, D_AD_A, assuming that the other three firms always charge the same price as firm A.

The maximum-profit equilibrium for the collusive oligopolist is shown in Figure 10-2 at point *E*, the intersection of the firm's *MC* and *MR* curves. Here, the appropriate demand curve is D_AD_A. The optimal price for the collusive oligopolist is shown at point *G* on D_AD_A, above point *E*. This price is identical to the monopoly price: it is above marginal cost and earns each of the colluding oligopolists a handsome monopoly profit.

When oligopolists collude to maximize their joint profits, taking into account their mutual interdependence, they will produce the monopoly output and price and earn the monopoly profit.

Although many oligopolists would be delighted to earn such high profits, in reality many obstacles hinder effective collusion. First, collusion is illegal. Second, firms may "cheat" on the agreement by cutting their price to selected customers, thereby increasing their market share. Clandestine price cutting is particularly likely in markets where prices are secret, where goods are differentiated, where there is more than a handful of firms, or where the technology is changing rapidly. Third, the growth of international trade means that many companies face intensive competition from foreign firms as well as from domestic companies.

Indeed, experience shows that running a successful cartel is a difficult business, whether the collusion is explicit or tacit.

A long-running thriller in this area is the story of the international oil cartel known as the Organization of Petroleum Exporting Countries, or OPEC. OPEC is an international organization which sets production quotas for its members, which include Saudi Arabia, Iran, and Algeria. Its stated goal is "to secure fair and stable prices for petroleum producers; an efficient, economic and regular supply of petroleum to consuming nations; and a fair return on capital to those investing in the industry." Its critics claim it is really a collusive monopolist attempting to maximize the profits of producing countries.

OPEC became a household name in 1973, when it reduced production sharply and oil prices skyrocketed. But a successful cartel requires that members set a low production quota and maintain discipline. Every few years, price competition breaks out when some OPEC countries ignore their quotas. This happened in a spectacular way in 1986, when Saudi Arabia drove oil prices from $28 per barrel down to below $10.

Another problem faced by OPEC is that it must negotiate production quotas rather than prices. This leads to high levels of price volatility because demand is unpredictable and highly price-inelastic in the short run. Oil producers became rich in the 2000s as prices soared, but the cartel had little control over actual events.

The airline industry is another example of a market with a history of repeated—and failed—attempts at collusion. It would seem a natural candidate for collusion. There are only a few major airlines, and on many routes there are only one or two rivals. But just look back to the quote at the beginning of the chapter, which describes one of the recent price wars in the United States. Airline bankruptcy is so frequent that some airlines spend more time bankrupt than solvent. Indeed, the evidence shows that the only time an airline can charge supernormal fares is when it has a near-monopoly on all flights to a city.

Monopolistic Competition

At the other end of the spectrum from collusive oligopolies is **monopolistic competition.** Monopolistic competition resembles perfect competition in three ways: there are many buyers and sellers, entry and exit are easy, and firms take other firms' prices as given. The distinction is that products are identical under perfect competition, while under monopolistic competition they are differentiated.

Monopolistic competition is very common—just scan the shelves at any supermarket and you'll see a dizzying array of different brands of breakfast cereals, shampoos, and frozen foods. Within each product group, products or services are different, but close enough to compete with each other. Here are some other examples of monopolistic competition: There may be several grocery stores in a neighborhood, each carrying the same goods but at different locations. Gas stations, too, all sell the same product, but they compete on the basis of location and brand name. The several hundred magazines on a newsstand rack are monopolistic competitors, as are the 50 or so competing brands of personal computers. The list is endless.

The important point to recognize is that each seller has some freedom to raise or lower prices because of product differentiation (in contrast to perfect competition, where sellers are price-takers). Product differentiation leads to a downward slope in each seller's demand curve.

Figure 10-3 might represent a monopolistically competitive computer magazine which is in short-run equilibrium with a price at *G*. The firm's *dd* demand curve shows the relationship between sales and its price when other magazine prices are unchanged; its demand curve slopes downward since this magazine is a little different from everyone else's because

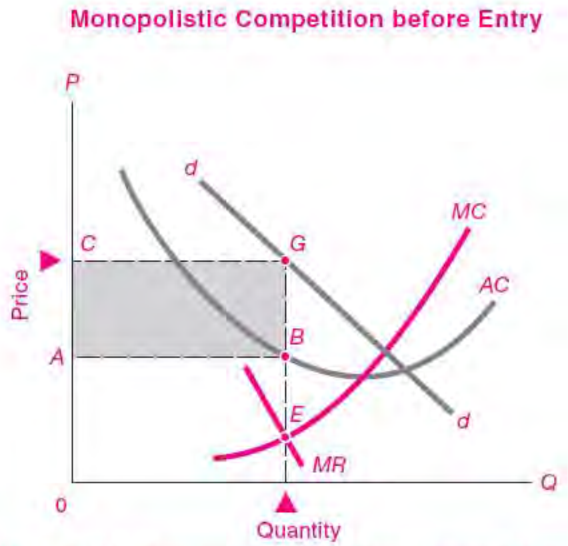


FIGURE 10-3. Monopolistic Competitors Produce Many Similar Goods

Under monopolistic competition, numerous small firms sell differentiated products and therefore have downward-sloping demand. Each firm takes its competitors' prices as given. Equilibrium has $MR = MC$ at E, and price is at G. Because price is above AC, the firm is earning a profit, area $ABGC$.

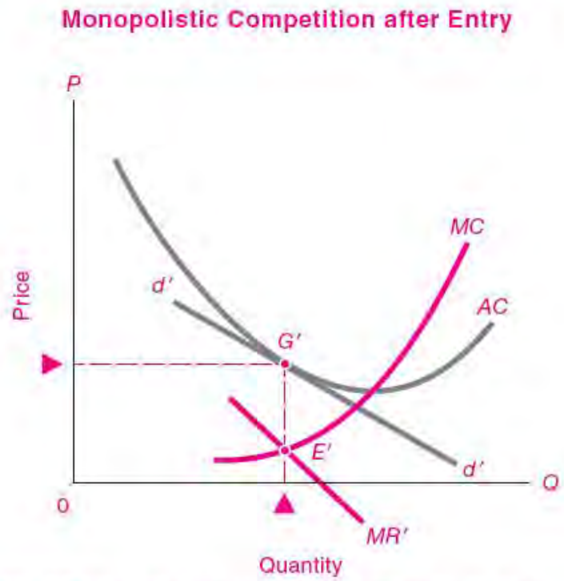


FIGURE 10-4. Free Entry of Numerous Monopolistic Competitors Wipes Out Profit

The typical seller's original profitable dd curve in Figure 10-3 will be shifted downward and leftward to $d'd'$ by the entry of new rivals. Entry ceases only when each seller has been forced into a long-run, no-profit tangency such as at G'. At long-run equilibrium, price remains above MC, and each producer is on the left-hand declining branch of its long-run AC curve.

of its special focus. The profit-maximizing price is at G. Because price at G is above average cost, the firm is making a handsome profit represented by area $ABGC$.

But our magazine has no monopoly on writers or newsprint or insights on computers. Firms can enter the industry by hiring an editor, having a bright new idea and logo, locating a printer, and hiring workers. Since the computer magazine industry is profitable, entrepreneurs bring new computer magazines into the market. With their introduction, the demand curve for the products of existing monopolistically competitive computer magazines shifts leftward as the new magazines nibble away at our magazine's market.

The ultimate outcome is that computer magazines will continue to enter the market until all economic profits (including the appropriate opportunity costs for owners' time, talent, and contributed capital) have been beaten down to zero. Figure 10-4 shows the final long-run equilibrium for the typical seller. In equilibrium, the demand is reduced or shifted to the left until the new $d'd'$ demand curve just touches (but never goes above) the firm's AC curve. Point G' is a long-run equilibrium for the industry because profits are zero and no one is tempted to enter or forced to exit the industry.

This analysis is well illustrated by the personal computer industry. Originally, such computer manufacturers as Apple and Compaq made big profits. But the personal computer industry turned out to have low barriers to entry, and numerous small firms entered the market. Today, there are dozens of firms, each with a small share of the computer market but no economic profits to show for its efforts.

The monopolistic competition model provides an important insight into American capitalism: The rate of profit will in the long run be zero in this kind of imperfectly competitive industry as firms enter with new differentiated products.

In the long-run equilibrium for monopolistic competition, prices are above marginal costs but economic profits have been driven down to zero.

Critics of capitalism argue that monopolistic competition is inherently inefficient. They point to an excessive number of trivially different products that lead to wasteful duplication and expense. To understand the reasoning, look back at the long-run equilibrium price at G' in Figure 10-4. At that point, price is above marginal cost and output is reduced below the ideal competitive level.

This economic critique of monopolistic competition has considerable appeal: It takes real ingenuity to demonstrate the gains to human welfare from adding Apple Cinnamon Cheerios to Honey Nut Cheerios and Whole Grain Cheerios. It is hard to see the reason for gasoline stations on every corner of an intersection.

But there is logic to the differentiated goods and services produced by a modern market economy. The great variety of products fills many niches in consumer tastes and needs. Reducing the number of monopolistic competitors might lower consumer welfare because it would reduce the diversity of available products. People will pay a premium to be free to choose among various options.

Rivalry among the Few

For our third example of imperfect competition, we turn back to markets in which only a few firms compete. This time, instead of focusing on collusion, we consider the fascinating case where firms have a strategic interaction with each other. Strategic interaction is found in any market which has relatively few competitors. Like a tennis player trying to outguess her opponent, each business must ask how its rivals will react to changes in key business decisions. If GE introduces a new model of refrigerator, what will Whirlpool, its principal rival, do? If American Airlines lowers its transcontinental fares, how will United react?

Consider as an example the market for air shuttle services between New York and Washington, currently served by Delta and US Airways. This market is called a **duopoly** because industry output is produced by only two firms. Suppose that Delta has determined that if it cuts fares 10 percent, its profits will rise as long as US Airways does not match its cut but its profits will fall if US Airways does match its price cut. If they cannot collude, Delta must make an educated guess as to how US Airways will respond to its price moves. Its best approach would be to estimate how US Airways would react to each of its actions and then to maximize profits *with strategic interaction recognized*. This analysis is the province of game theory, discussed in Section B of this chapter.

Similar strategic interactions are found in many large industries: in television, in automobiles, even in economics textbooks. Unlike the simple approaches of monopoly and perfect competition, it turns out that there is no simple theory to explain how oligopolists behave. Different cost and demand structures, different industries, even different managerial temperaments will lead to different strategic interactions and to different pricing strategies. Sometimes, the best behavior is to introduce some randomness into the response simply to keep the opposition off balance.

Competition among the few introduces a completely new feature into economic life: It forces firms to take into account competitors' reactions to price and output decisions and brings strategic considerations into their markets.

PRICE DISCRIMINATION

When firms have market power, they can sometimes increase their profits through price discrimination. **Price discrimination** occurs when the same product is sold to different consumers for different prices.

Consider the following example: You run a company selling a successful personal-finance program called MyMoney. Your marketing manager comes in and says:

> Look, boss. Our market research shows that our buyers fall into two categories: (1) our current customers, who are locked into MyMoney because they keep their financial records using our program, and (2) potential new buyers who have been using other programs. Why don't we raise our price, but give a rebate to new customers who are willing to switch from our competitors? I've run the numbers. If we raise our price from $20 to $30 but give a $15 rebate for people who have been using other financial programs, we will make a bundle.

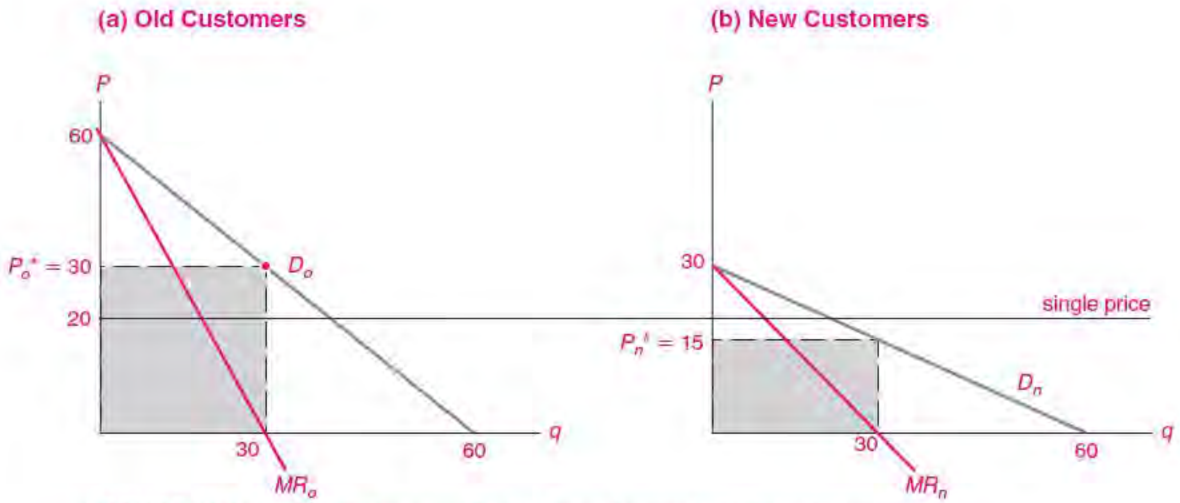


FIGURE 10-5. Firms Can Increase Their Profits through Price Discrimination

You are a profit-maximizing monopoly seller of computer software with zero marginal cost. Your market contains established customers in (a) and new customers in (b). Old customers have more inelastic demand because of the high costs of switching to other programs.

If you must set a single price, you will maximize profits at a price of $20 and earn profits of $1200. But suppose you can segment your market between locked-in current users and reluctant new buyers. This would increase your profits to ($30 × 30) + ($15 × 30) = $1350.

You are intrigued by the suggestion. Your house economist constructs the demand curves in Figure 10-5. Her research indicates that your old customers have more price-inelastic demand than your potential new customers because new customers must pay substantial switching costs. If your rebate program works and you succeed in segmenting the market, the numbers show that your profits will rise from $1200 to $1350. (To make sure you understand the analysis, use the data shown in Figure 10-5 to estimate the monopoly price and profits if you set a single monopoly price and if you price-discriminate between the two markets.)

Price discrimination is widely used today, particularly with goods that are not easily transferred from the low-priced market to the high-priced market. Here are some examples:

- Identical textbooks are sold at lower prices in Europe than in the United States. What prevents wholesalers from purchasing large quantities abroad and undercutting the domestic market? A protectionist import quota prohibits the practice. However, as an individual, you might well reduce the costs of your books by buying them abroad through online bookstores.
- Airlines are the masters of price discrimination (review our discussion of "Elasticity Air" in Chapter 4). They segment the market by pricing tickets differently for those who travel in peak or off-peak times, for those who are business or pleasure travelers, and for those who are willing to stand by. This allows them to fill their planes without eroding revenues.
- Local utilities often use "two-part prices" (sometimes called nonlinear prices) to recover some of their overhead costs. If you look at your telephone or electricity bill, it will generally have a "connection" price and a "per-unit" price of service. Because connection is much more price-inelastic than the per-unit price, such two-part pricing allows sellers to lower their per-unit prices and increase the total quantity sold.
- Firms engaged in international trade often find that foreign demand is more elastic than domestic demand. They will therefore sell at

lower prices abroad than at home. This practice is called "dumping" and is sometimes banned under international-trade agreements.

- Sometimes a company will actually *degrade* its top-of-the-line product to make a less capable product, which it will then sell at a discounted price to capture a low-price market. For example, IBM inserted special commands to slow down its laser printer from 10 pages per minute to 5 pages per minute so that it could sell the slow model at a lower price without cutting into sales of its top model.

What are the economic effects of price discrimination? Surprisingly, they often improve economic welfare. To understand this point, recall that monopolists raise their price and lower their sales to increase profits. In doing so, they may capture the market for eager buyers but lose the market for reluctant buyers. By charging different prices for those willing to pay high prices (who get charged high prices) and those willing to pay only lower prices (who may sit in the middle seats or get a degraded product, but at a lower price), the monopolist can increase both its profits and consumer satisfactions.[1]

B. GAME THEORY

Strategic thinking is the art of outdoing an adversary, knowing that the adversary is trying to do the same to you.

Avinash Dixit and Barry Nalebuff,
Thinking Strategically (1991)

Economic life is full of situations in which people or firms or countries compete for profits or dominance. The oligopolies that we analyzed in the previous section sometimes break out into economic warfare. Such rivalry was seen in the last century when Vanderbilt and Drew repeatedly cut shipping rates on their parallel railroads. In recent years, airlines would occasionally launch price wars to attract customers and sometimes end up ruining everyone (see this chapter's introductory quote). But airlines learned that they needed to think and act strategically. Before an airline cuts its fares, it needs to consider how its rivals will react, and how it should then react to that reaction, and so on.

Once decisions reach the stage of thinking about what your opponent is thinking, and how you would then react, you are in the world of *game theory*. This is the analysis of situations involving two or more interacting decision makers who have conflicting objectives. Consider the following findings of game theorists in the area of imperfect competition:

- As the number of noncooperative oligopolists becomes large, the industry price and quantity tend toward the perfectly competitive outcome.
- If firms succeed in colluding, the market price and quantity will be close to those generated by a monopoly.
- Experiments suggest that as the number of firms increases, collusive agreements become more difficult to police and the frequency of cheating and noncooperative behavior increases.
- In many situations, there is no stable equilibrium for an oligopolistic market. Strategic interplay may lead to unstable outcomes as firms threaten, bluff, start price wars, punish weak opponents, signal their intentions, or simply exit from the market.

Game theory analyzes the ways in which two or more players choose strategies that jointly affect each other. This theory, which sounds frivolous, is in fact fraught with significance and was largely developed by John von Neumann (1903–1957), a Hungarian-born mathematical genius. Game theory has been used by economists to study the interaction of oligopolists, union-management disputes, countries' trade policies, international environmental agreements, reputations, and a host of other topics.

Game theory offers insights for politics and warfare, as well as for everyday life. For example, game theory suggests that in some circumstances a carefully chosen random pattern of behavior may be the best strategy. Inspections to catch illegal drugs or weapons should sometimes search randomly rather than predictably. Likewise, you should occasionally bluff at poker, not simply to win a pot with a weak hand but also to ensure that other players do not drop out

[1] For an example of how perfect price discrimination improves efficiency, see question 3 at the end of this chapter.

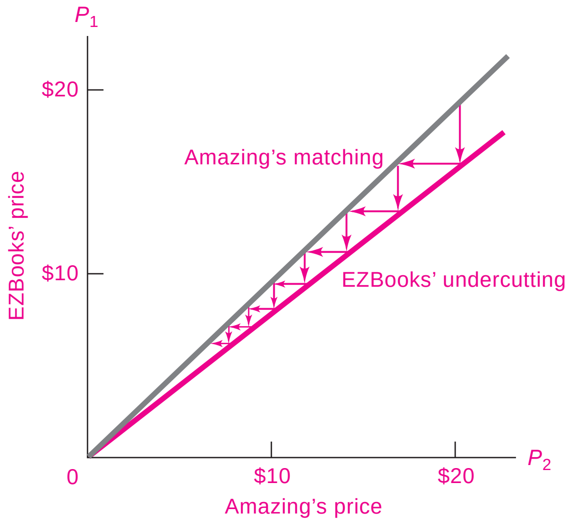


FIGURE 10-6. What Happens When Two Firms Insist on Undercutting Each Other?

Trace through the steps by which dynamic price cutting leads to ever-lower prices for two rivals.

when you bet high on a good hand. We will sketch out some of the major concepts of game theory in this section.

Thinking about Price Setting

Let's begin by analyzing the dynamics of price cutting. You are the head of an established firm, Amazing.com, whose motto is "We will not be undersold." You open your browser and discover that EZBooks.com, an upstart Internet bookseller, has an advertisement that says, "We sell for 10 percent less." Figure 10-6 shows the dynamics. The vertical arrows show EZBooks' price cuts; the horizontal arrows show Amazing's responding strategy of matching each price cut.

By tracing through the pattern of reaction and counterreaction, you can see that this kind of rivalry will end in mutual ruin at a zero price. Why? Because the only price compatible with both strategies is a price of zero: 90 percent of zero is zero.

Finally, it dawns on the two firms: When one firm cuts its price, the other firm will match the price cut. Only if the firms are shortsighted will they think that they can undercut each other for long. Soon each begins to ask, What will my rival do if I cut my price, or raise my price, or leave it alone? *Once you begin to consider how others will react to your actions, you have entered the realm of game theory.*

BASIC CONCEPTS

We will illustrate the basic concepts of game theory by analyzing a **duopoly price game.** A duopoly is a market which is served by only two firms. For simplicity, we assume that each firm has the same cost and demand structure. Further, each firm can choose whether to charge its normal price or lower its price below marginal costs and try to drive its rival into bankruptcy and then capture the entire market. The novel element in the duopoly game is that the firm's profits will depend on its rival's strategy as well as on its own.

A useful tool for representing the interaction between two firms or people is a two-way **payoff table.** A payoff table is a means of showing the strategies and the payoffs of a game between two players. Figure 10-7 shows the payoffs in the duopoly price game for our two companies. In the payoff table, a firm can choose between the strategies listed in its rows or columns. For example, EZBooks can choose between its two columns and Amazing can choose between its two rows. In this example, each firm decides whether to charge its normal price or to start a price war by choosing a lower price.

Combining the two decisions of each duopolist gives four possible outcomes, which are shown in the four cells of the table. Cell A, at the upper left, shows the outcome when both firms choose the normal price; D is the outcome when both choose to conduct a price war; and B and C result when one firm has a normal price and one a war price.

The numbers inside the cells show the **payoffs** of the two firms, that is, the profits earned by each firm for each of the four outcomes. The number in the lower left shows the payoff to the player on the left (Amazing); the entry in the upper right shows the payoff to the player at the top (EZBooks). Because the firms are identical, the payoffs are mirror images.

Alternative Strategies

Now that we have described the basic structure of a game, we next consider the behavior of the players. The new element in game theory is analyzing not only your own actions but also the interaction

A Price War

		EZBooks' price	
		Normal price*	Price war
Amazing's price	Normal price*	A† $10 $10	B −$100 −$10
	Price war	C −$10 −$100	D −$50 −$50

* Dominant strategy
† Dominant equilibrium

FIGURE 10-7. A Payoff Table for a Price War

The payoff table shows the payoffs associated with different strategies. Amazing has a choice between two strategies, shown as its two rows; EZBooks can choose between its two strategies, shown as two columns. The entries in the cells show the profits for the two players. For example, in cell C, Amazing plays "price war" and EZBooks plays "normal price." The result is that Amazing has green profit of −$100 while EZBooks has blue profit of −$10. Thinking through the best strategies for each player leads to the dominant equilibrium in cell A.

between your goals and moves and those of your opponent. But in trying to outwit your opponent, you must always remember that your opponent is trying to outwit you.

The guiding philosophy in game theory is the following: Pick your strategy by asking what makes most sense for you assuming that your opponents are analyzing your strategy and doing what is best for them.

Let's apply this maxim to the duopoly example. First, note that our two firms have the highest joint profits in outcome A. Each firm earns $10 when both follow a normal-price strategy. At the other extreme is the price war, where each cuts its price and runs a big loss.

In between are two interesting strategies where only one firm engages in the price war. In outcome C, for example, EZBooks follows a normal-price strategy while Amazing engages in a price war. Amazing takes most of the market but loses a great deal of money because it is selling below cost; EZBooks is actually better off selling at a normal price rather than responding.

Dominant Strategy. In considering possible strategies, the simplest case is that of a **dominant strategy.** This situation arises when one player has a single best strategy *no matter what strategy the other player follows.*

In our price-war game, for example, consider the options open to Amazing. If EZBooks conducts business as usual with a normal price, Amazing will get $10 of profit if it plays the normal price and will lose $100 if it declares economic war. On the other hand, if EZBooks starts a war, Amazing will lose $10 if it follows the normal price but will lose even more if it also engages in economic warfare. You can see that the same reasoning holds for EZBooks. Therefore, no matter what strategy the other firm follows, each firm's best strategy is to have the normal price. *Charging the normal price is a dominant strategy for both firms in this particular price-war game.*

When both (or all) players have a dominant strategy, we say that the outcome is a **dominant equilibrium.** We can see that in Figure 10-7, outcome A is a dominant equilibrium because it arises from a situation where both firms are playing their dominant strategies.

Nash Equilibrium. Most interesting situations do not have a dominant equilibrium, and we must therefore look further. We can use our duopoly example to

The Rivalry Game

EZBooks' price

Amazing's price	High price	Normal price*
High price	A — EZBooks: $200; Amazing: $100	B — EZBooks: $150; Amazing: −$20
Normal price*	C — EZBooks: −$30; Amazing: $150	D* — EZBooks: $10; Amazing: $10

* Nash equilibrium

FIGURE 10-8. Should a Duopolist Try the Monopoly Price?

In the rivalry game, each firm can earn $10 by staying at its normal price. If both raise price to the high monopoly level, their joint profits will be maximized. However, each firm's temptation to "cheat" and raise its profits by lowering price ensures that the normal-price Nash equilibrium will prevail in the absence of collusion.

explore this case. In this example, which we call the *rivalry game*, each firm considers whether to charge its normal price or to raise its price toward the monopoly price and try to earn monopoly profits.

The rivalry game is shown in Figure 10-8. The firms can stay at their normal-price equilibrium, which we found in the price-war game. Or they can raise their price in the hopes of earning monopoly profits. Our two firms have the highest *joint* profits in cell A; here they earn a total of $300 when each follows a high-price strategy. Situation A would surely come about if the firms could collude and set the monopoly price. At the other extreme is the competitive-style strategy of the normal price, where each rival has profits of $10.

In between are two interesting strategies where one firm chooses a normal-price and one a high-price strategy. In cell C, for example, EZBooks follows a high-price strategy but Amazing undercuts. Amazing takes most of the market and has the highest profit of any situation, while EZBooks actually loses money. In cell B, Amazing gambles on high price, but EZBooks' normal price means a loss for Amazing.

Amazing has a dominant strategy in this new game. It will always have a higher profit by choosing a normal price. On the other hand, the best strategy for EZBooks depends upon what Amazing does. EZBooks would want to play normal if Amazing plays normal and would want to play high if Amazing plays high.

This leaves EZBooks with a dilemma: Should it play high and hope that Amazing will follow suit? Or play safe? Here is where game theory becomes useful. EZBooks should choose its strategy by first putting itself in Amazing's shoes. By doing so, EZBooks will find that Amazing should play normal regardless of what EZBooks does because playing normal is Amazing's dominant strategy. EZBooks should assume that Amazing will follow its best strategy and play normal, which therefore means that EZBooks should play normal. *This illustrates the basic rule of game theory: You should choose your strategy based on the assumption that your opponents will act in their own best interest.*

The approach we have described is a deep concept known as the **Nash equilibrium,** named after mathematician John Nash, who won a Nobel Prize for his discovery. In a Nash equilibrium, no player can gain anything by changing his own strategy, given the other player's strategy. The Nash equilibrium is also sometimes called the **noncooperative equilibrium** because each party chooses the strategy which is best for himself—without collusion or cooperation and without regard for the welfare of society or any other party.

Let us take a simple example: Assume that other people drive on the right-hand side of the road. What is your best strategy? Clearly, unless you are suicidal, you should also drive on the right-hand side. Moreover, a situation where everyone drives on the right-hand side is a Nash equilibrium: as long as everybody else is driving on the right-hand side, it will not be in anybody's interest to start driving on the left-hand side.

[Here is a technical definition of the Nash equilibrium for the advanced student: Suppose that player A picks strategy S_A* while player B picks strategy S_B*. The pair of strategies (S_A*, S_B*) is a Nash equilibrium if neither player can find a better strategy to play assuming that the other player sticks to his original strategy. This discussion focuses on two-person games, but the analysis, and particularly the important Nash equilibrium, can be usefully extended to many-person or "*n*-person" games.]

You should verify that the starred strategies in Figure 10-8 constitute a Nash equilibrium. That is, neither player can improve its payoffs from the (normal, normal) equilibrium as long as the other doesn't change its strategy. Verify that the dominant equilibrium shown in Figure 10-7 is also a Nash equilibrium.

The Nash equilibrium (also called the noncooperative equilibrium) is one of the most important concepts of game theory and is widely used in economics and the other social sciences. Suppose that each player in a game has chosen a best strategy (the one with the highest payoff) *assuming* that all the other players keep their strategies unchanged. An outcome where all players follow this strategy is called a Nash equilibrium. Game theorists have shown that a competitive equilibrium is a Nash equilibrium.

Games, Games, Everywhere . . .

The insights of game theory pervade economics, the social sciences, business, and everyday life. In economics, for example, game theory can help explain trade wars as well as price wars.

Game theory can also suggest why foreign competition may lead to greater price competition. What happens when Chinese or Japanese firms enter a U.S. market where domestic firms had tacitly colluded on a strategy that led to high oligopolistic prices? The foreign firms may "refuse to play the game." They did not agree to the rules, so they may cut prices to increase their share of the market. Collusion among the domestic firms may break down because they must lower prices to compete effectively with the foreign firms.

A key feature in many games is the attempt on behalf of players to build *credibility*. You are credible if you can be expected to keep your promises and carry out your threats. But you cannot gain credibility simply by making promises. Credibility must be consistent with the incentives of the game.

How can you gain credibility? Here are some examples: Central banks earn reputations for being tough on inflation by adopting politically unpopular policies. Even greater credibility comes when the central bank is independent of the elected branches. Businesses make credible promises by writing contracts that inflict penalties if they do not perform as promised. A more perilous strategy is for an army to burn its bridges behind it. Because there is no retreat, the threat that they will fight to the death is a credible one.

The short discussion here provides a tiny peek at the vast terrain of game theory. This area has been enormously useful in helping economists and other social scientists think about situations where small numbers of people are well informed and try to outwit each other. Students who go on in economics, business, management, and even national security will find that using game theory can help them think strategically.

C. PUBLIC POLICIES TO COMBAT MARKET POWER

Economic analysis shows that monopolies produce economic waste. How significant are these inefficiencies? What can public policy do to reduce monopolistic harms? We address these two questions in this final section.

ECONOMIC COSTS OF IMPERFECT COMPETITION

The Cost of Inflated Prices and Reduced Output

Our analysis has shown how imperfect competitors reduce output and raise prices, thereby producing less (and charging more) than would be forthcoming in a perfectly competitive industry. This can be seen most clearly for monopoly, which is the most extreme version of imperfect competition. To see how and why monopoly keeps output too low, imagine that all other industries are efficiently organized. In such a world, price is the correct economic standard or measure of scarcity; price measures both the marginal utility of consumption to households and the marginal cost of production to firms.

Now Monopoly Inc. enters the picture. A monopolist is not a wicked firm—it doesn't rob people or force its goods down consumers' throats. Rather, Monopoly Inc. exploits the fact that it is the sole seller and raises its price above marginal cost (i.e., $P > MC$). Since $P = MC$ is necessary for economic efficiency, the marginal value of the good to consumers is therefore above its marginal cost. The same is true for oligopoly and monopolistic competition, as long as companies hold prices above marginal cost.

The Static Costs of Imperfect Competition

We can depict the efficiency losses from imperfect competition by using a simplified version of our monopoly diagram, here shown in Figure 10-9.

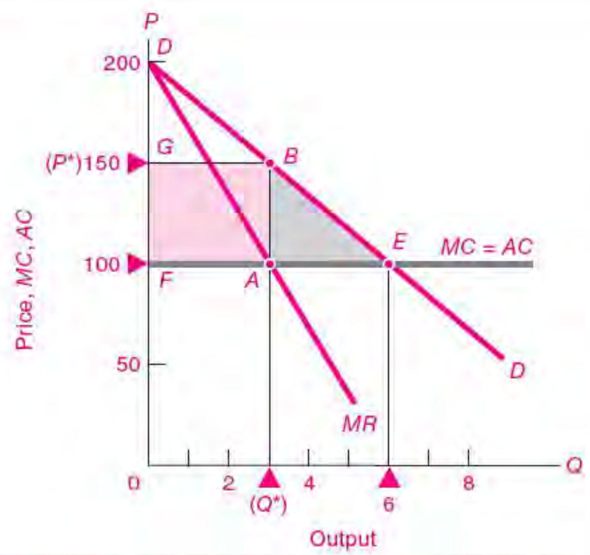


FIGURE 10-9. Monopolists Cause Economic Waste by Restricting Output

Monopolists make their output scarce and thereby drive up price and increase profits. If the industry were competitive, equilibrium would be at point *E*, where economic surplus is maximized.

At the monopolist's output at point *B* (with $Q = 3$ and $P = 150$), price is above *MC*, and consumer surplus is lost. Adding together all the consumer-surplus losses between $Q = 3$ and $Q = 6$ leads to economic waste from monopoly equal to the blue shaded area *ABE*. In addition, the monopolist has monopoly profits (that would have been consumer surplus) given by the green shaded region *GBAF*.

If the industry were perfectly competitive, the equilibrium would be reached at point *E*, where $P = MC$. Under universal perfect competition, this industry's quantity would be 6 with a price of 100.

Now consider the impact of monopoly. The monopoly might be created by a foreign-trade tariff or quota, by a labor union which monopolizes the supply of labor, or by a patent on a new product. The monopolist would set its *MC* equal to *MR* (not to industry *P*), displacing the equilibrium to the lower $Q = 3$ and the higher $P = 150$ in Figure 10-9. The area *GBAF* is the monopolist's profit, which compares with a zero-profit competitive equilibrium.

The inefficiency loss from monopoly is sometimes called **deadweight loss.** This term refers to the loss of economic welfare arising from distortions in prices and output such as those due to monopoly, as well as those due to taxation, tariffs, or quotas. Consumers might enjoy a great deal of consumer surplus if a new anti-pain drug is sold at marginal cost; however, if a firm monopolizes the product, consumers will lose more surplus than the monopolist will gain. That net loss in economic welfare is called deadweight loss.

We can picture the deadweight loss from a monopoly diagrammatically in Figure 10-9. Point *E* is the efficient level of production at which $P = MC$. For each unit that the monopolist reduces output below *E*, the efficiency loss is the vertical distance between the demand curve and the *MC* curve. The total deadweight loss from the monopolist's output restriction is the sum of all such losses, represented by the blue triangle *ABE*.

The technique of measuring the costs of market imperfections by "little triangles" of deadweight loss, such as the one in Figure 10-9, can be applied to most situations where output and price deviate from the competitive levels.

This cost calculation is sometimes called the "static cost" of monopoly. It is static because it assumes that the technology for producing output is unchanging. Some economists believe that imperfect competitors may have "dynamic benefits" if they generate more rapid technological change than do perfectly competitive markets. We will return to this question in the next chapter's discussion of innovation.

Public Policies on Imperfect Competition

How can nations reduce the harmful effects of monopolistic practices? Three approaches are often recommended by economists and legal scholars:

1. Historically, the first tool used by governments to control monopolistic practices was economic regulation. As this practice has evolved over the last century, economic regulation now allows specialized regulatory agencies to oversee the prices, outputs, entry, and exit of firms in regulated industries such as public utilities and transportation. It is, in effect, limited government control without government ownership.
2. The major method now used for combating excessive market power is the use of antitrust policy. Antitrust policies are laws that prohibit certain kinds of behavior (such as firms' joining together to fix prices) or curb certain market structures (such as pure monopolies and highly concentrated oligopolies).
3. More generally, anticompetitive abuses can be avoided by encouraging competition wherever possible. There are many government policies that can promote vigorous rivalry even among large firms. It is particularly crucial to reduce barriers to entry in all industries. That means encouraging small businesses and not walling off domestic markets from foreign competition.

We will review the first two approaches in the balance of this chapter.

REGULATING ECONOMIC ACTIVITY

Economic regulation of American industry goes back more than a century. The first federal regulation applied to transportation, with the Interstate Commerce Commission (ICC) in 1887. The ICC was designed as much to prevent price wars and to guarantee service to small towns as it was to control monopoly. Later, federal regulation spread to banks in 1913, to electric power in 1920, and to communications, securities markets, labor, trucking, and air travel during the 1930s.

Economic regulation involves the control of prices, entry and exit conditions, and standards of service. Such regulation is most important in industries that are natural monopolies. (Recall that a natural monopoly occurs when the industry's output can be efficiently produced only by a single firm.) Prominent examples of industries regulated today include public utilities (electricity, natural gas, and water) and telecommunications (telephone, radio, cable TV, and more generally the electromagnetic spectrum). The financial industry has been regulated since the 1930s, with strict rules specifying what banks, brokerage firms, and insurance companies can and cannot do. Since 1977, many economic regulations have been loosened or lifted, such as those on the airlines, trucking, and securities firms.

Why Regulate Industry?

Regulation restrains the unfettered market power of firms. What are the reasons why governments might choose to override the decisions made in the marketplace? The first reason is to *prevent abuses of market power* by monopolies or oligopolies. A second major reason is to *remedy informational failures*, such as those which occur when consumers have inadequate information. A third reason is to *correct externalities* like pollution. The third of these reasons pertains to social regulation and is examined in the chapter on environmental economics; we review the first two reasons in this section.

Containing Market Power

The traditional view is that regulatory measures should be taken to reduce excessive market power. More specifically, governments should regulate industries where there are too few firms to ensure vigorous rivalry, particularly in the extreme case of natural monopoly.

We know from our discussion of declining costs in earlier chapters that pervasive economies of scale are inconsistent with perfect competition; we will find oligopoly or monopoly in such cases. But the point here is even more extreme: *When there are such powerful economies of scale or scope that only one firm can survive, we have a natural monopoly.*

Why do governments sometimes regulate natural monopolies? They do so because a natural monopolist, enjoying a large cost advantage over its potential competitors and facing price-inelastic demand, can jack up its price sharply, obtain enormous monopoly profits, and create major economic inefficiencies. Hence, regulation allows society to enjoy the benefits of a natural monopoly while preventing the superhigh prices that might result if it were unregulated. A typical example is local water distribution. The cost of gathering water, building a water-distribution system, and piping water into every home is sufficiently large that it would not pay to have more than one firm provide local water service. This is a natural monopoly. Under economic regulation, a government agency would provide a franchise to a company in a particular region. That company would agree to provide water to all households in that region. The government would review and approve the prices and other terms that the company would then present to its customers.

Another kind of natural monopoly, particularly prevalent in network industries, arises from the requirement for standardization and coordination through the system for efficient operation. Railroads need standard track gauges, electrical transmission requires load balancing, and communications systems require standard codes so that different parts can "talk" to each other.

In earlier times, regulation was justified on the dubious grounds that it was needed to prevent cutthroat or destructive competition. This was one argument for continued control over railroads, trucks, airlines, and buses, as well as for regulation of the level of agricultural production. Economists today have little sympathy for this argument. After all, competition will increase efficiency, and ruinously low prices are exactly what an efficient market system *should* produce.

Remedying Information Failures

Consumers often have inadequate information about products in the absence of regulation. For example, testing pharmaceutical drugs is expensive and scientifically complex. The government regulates drugs by allowing only the sale of those drugs which are proved "safe and efficacious." Government also prohibits false and misleading advertising. In both cases, the government is attempting to correct for the market's failure to provide information efficiently on its own.

One area where regulating the provision of information is particularly critical is financial markets. When people buy stocks or bonds of private companies, they are placing their fortunes in the hands of people about whom they know next to nothing. Before buying shares of ZYX.com, I will examine their financial statements to determine what their sales, earnings, and dividends have been. But how can I know exactly how they measure earnings? How can I be sure that they are reporting this information honestly?

This is where government regulation of financial markets steps in. Most regulations of the financial industry serve the purpose of improving the quantity and quality of information so that markets can work better. When a company sells stocks or bonds in the United States, it is required to issue copious documentation of its current financial condition and future prospects. Companies' books must be certified by independent auditors.

Occasionally, particularly in times of speculative frenzies, companies will bend or even break the rules. This happened on a large scale in the late 1990s and early 2000s, particularly in communications and many "high-tech" firms. When these illegal practices were made public, Congress passed a new law in 2002; this law made it illegal to lie to an auditor, established an independent board to oversee accountants, and provided new oversight powers to the Securities and Exchange Commission (SEC). Some argue that this kind of law should be welcomed by honest businesses; tough reporting standards are beneficial to financial markets because they reduce informational asymmetries between buyers and sellers, promote trust, and encourage financial investment.

Stanford's John McMillan uses an interesting analogy to describe the role of government regulation. Sports are contests in which individuals and teams strive to defeat opponents with all their strength. But the participants must adhere to a set of extremely detailed rules; moreover, referees keep an eagle eye on players to make sure that they obey the rules, with appropriately scaled penalties for infractions. Without carefully crafted rules, a game would turn into a bloody brawl. Similarly, government regulations, along with a strong legal system, are necessary in a modern economy to ensure that overzealous competitors do not monopolize, pollute, defraud, mislead, maim, or otherwise mistreat workers and consumers. This sports analogy reminds us that the government still has an important role to play in monitoring the economy and setting the rules of the road.

ANTITRUST LAW AND ECONOMICS

A second important government tool for promoting competition is antitrust law. The purpose of antitrust policies is to provide consumers with the economic benefits of vigorous competition. Antitrust laws attack anticompetitive abuses in two different ways: First, they prohibit certain kinds of *business conduct,* such as price fixing, that restrain competitive forces. Second, they restrict some *market structures,* such as monopolies, that are considered most likely to restrain trade and abuse their economic power in other ways. The framework for antitrust policy was set by a few key legislative statutes and by more than a century of court decisions.

The Framework Statutes

Antitrust law is like a huge forest that has grown from a handful of seeds. The statutes on which the law is based are so concise and straightforward that they can be quoted in Table 10-1; it is astounding how much law has grown from so few words.

Sherman Act (1890). Monopolies had long been illegal under the common law, based on custom and past judicial decisions. But the body of laws proved ineffective against the mergers, cartels, and trusts that swept through the American economy in the 1880s. (Reread the section on the monopolists of the Gilded Age in Chapter 9 to get a flavor of the cutthroat tactics of that era.)

In 1890, populist sentiments led to the passage of the Sherman Act, which is the cornerstone of American antitrust law. Section 1 of the Sherman Act prohibits contracts, combinations, and conspiracies "in restraint of trade." Section 2 prohibits "monopolizing" and conspiracies to monopolize. Neither the statute nor the accompanying discussion contained any clear notion about the exact meaning

The Antitrust Laws

Sherman Antitrust Act (1890, as amended)

§1. Every contract, combination in the form of trust or otherwise, or conspiracy, in restraint of trade or commerce among the several States, or with foreign nations, is declared to be illegal.

§2. Every person who shall monopolize, or attempt to monopolize, or combine or conspire with any other person or persons, to monopolize any part of the trade or commerce among the several States, or with foreign nations, shall be deemed guilty of a felony. . . .

Clayton Antitrust Act (1914, as amended)

§2. It shall be unlawful . . . to discriminate in price between different purchasers of commodities of like grade and quality . . . where the effect of such discrimination may be substantially to lessen competition or tend to create a monopoly in any line of commerce. . . . *Provided,* That nothing herein contained shall prevent differentials which make only due allowance for differences in the cost. . . .

§3. That it shall be unlawful for any person . . . to lease or make a sale or contract . . . on the condition, agreement, or understanding that the lessee or purchaser thereof shall not use or deal in the . . . commodities of a competitor . . . where the effect . . . may be to substantially lessen competition or tend to create a monopoly in any line of commerce.

§7. No [corporation] . . . shall acquire . . . the whole or any part . . . of another [corporation] . . . where . . . the effect of such an acquisition may be substantially to lessen competition, or to tend to create a monopoly.

Federal Trade Commission Act (1914, as amended)

§5. Unfair methods of competition . . . and unfair or deceptive acts or practices . . . are declared unlawful.

TABLE 10-1. American Antitrust Law Is Based on a Handful of Statutes

The Sherman, Clayton, and Federal Trade Commission Acts laid the foundation for American antitrust law. Interpretation of these acts has fleshed out modern antitrust doctrines.

of monopoly or which actions were prohibited. The meaning was fleshed out in later case law.

Clayton Act (1914). The Clayton Act was passed to clarify and strengthen the Sherman Act. It outlawed *tying contracts* (in which a customer is forced to buy product B if she wants product A); it ruled *price discrimination* and exclusive dealings illegal; it banned *interlocking directorates* (in which some people would be directors of more than one firm in the same industry) and *mergers* formed by acquiring common stock of competitors. These practices were not illegal *per se* (meaning "in itself") but only when they might substantially lessen competition. The Clayton Act emphasized prevention as well as punishment.

Another important element of the Clayton Act was that it specifically provided antitrust immunity to labor unions.

Federal Trade Commission Acts. In 1914 the Federal Trade Commission (FTC) was established to prohibit "unfair methods of competition" and to warn against anticompetitive mergers. In 1938, the FTC was also empowered to ban false and deceptive advertising. To enforce its powers, the FTC can investigate firms, hold hearings, and issue cease-and-desist orders.

BASIC ISSUES IN ANTITRUST LAW: CONDUCT AND STRUCTURE

While the basic antitrust statutes are straightforward, it is not easy in practice to decide how to apply them to specific situations of industry conduct or market structure. Actual law has evolved through an interaction of economic theory and case law.

One key issue that arises in many cases is, What is the relevant market? For example, what is the "telephone" industry in Albuquerque, New Mexico? Is it all information industries, or only telecommunications, or only wired telecommunications, or wired phones in all of New Mexico, or just in some specific zip code? In recent U.S. cases, the market has been defined to include products which are reasonably close substitutes. If the price of land-line telephone service goes up and people switch to cell-phone service in significant numbers, then these two products would be considered to be in the same industry. If by contrast few people buy more newspapers when the price of phone service increases, then newspapers are not in the telephone market.

Illegal Conduct

Some of the earliest antitrust decisions concerned illegal behavior. The courts have ruled that certain kinds of collusive behavior are illegal per se; there is simply no defense that will justify these actions. The offenders cannot defend themselves by pointing to some worthy objective (such as product quality) or mitigating circumstance (such as low profits).

The most important class of per se illegal conduct is agreements among competing firms to fix prices. Even the severest critic of antitrust policy can find no redeeming virtue in price fixing. Two other practices are illegal in all cases:

- *Bid rigging,* in which different firms agree to set their bids so that one firm will win the auction, usually at an inflated price, is always illegal.
- *Market allocation schemes,* in which competitors divide up markets by territory or by customers, are anticompetitive and hence illegal per se.

Many other practices are less clear-cut and require some consideration of the particular circumstances:

- *Price discrimination,* in which a firm sells the same product to different customers at different prices, is unpopular but generally not illegal. (Recall the discussion of price discrimination earlier in this chapter.) To be illegal, the discrimination must not be based on differing production costs, and it must injure competition.
- *Tying contracts,* in which a firm will sell product A only if the purchaser buys product B, are generally illegal only if the seller has high levels of market power.
- What about *ruinously low prices?* Suppose that because of Wal-Mart's efficient operations and low prices, Pop's grocery store goes out of business. Is this illegal? The answer is no. Unless Wal-Mart did something else illegal, simply driving its competitors bankrupt because of its superior efficiency is not illegal.

Note that the practices on this list relate to a firm's *conduct.* It is the acts themselves that are illegal, not the structure of the industry in which the acts take place. Perhaps the most celebrated example is the great electric-equipment conspiracy. In 1961, the electric-equipment industry was found guilty of collusive price agreements. Executives of the largest companies—such as GE and Westinghouse—conspired to raise prices and covered their tracks like characters in a spy novel by meeting in hunting lodges, using code names, and making telephone calls from phone booths. The companies agreed to pay extensive damages to their customers for overcharges, and some executives were jailed for their antitrust violations.

Structure: Is Bigness Badness?

The most visible antitrust cases concern the structure of industries rather than the conduct of companies. These cases consist of attempts to break up or limit the conduct of dominant firms.

The first surge of antitrust activity under the Sherman Act focused on dismantling existing monopolies. In 1911, the Supreme Court ordered that the American Tobacco Company and Standard Oil be broken up into many separate companies. In condemning these flagrant monopolies, the Supreme Court enunciated the important "rule of reason." Only *unreasonable* restraints of trade (mergers, agreements, and the like) came within the scope of the Sherman Act and were considered illegal.

The rule-of-reason doctrine virtually nullified the antitrust laws' attack on monopolistic mergers, as shown by the *U.S. Steel case* (1920). J. P. Morgan had put this giant together by merger, and at its peak it controlled 60 percent of the market. But the Supreme Court held that pure size or monopoly by itself was no offense. In that period, as they do today, the cases that shaped the economic landscape focused on illegal monopoly structures more than anticompetitive conduct.

In recent years, two important cases have set the ground rules for monopolistic structure and behavior. In the *AT&T case,* the Department of Justice filed a far-reaching suit. For most of the twentieth century, the American Telephone and Telegraph (AT&T, sometimes called the Bell System) was a vertically and horizontally integrated regulated monopoly supplier of telecommunications services. In 1974, the Department of Justice filed an antitrust suit, contending that AT&T had monopolized the regulated long-distance market by anticompetitive means, such as preventing MCI and other carriers from connecting to the local markets, and had monopolized the telecommunications-equipment market by refusing to purchase equipment from non-Bell suppliers.

Faced with the prospect of losing the antitrust suit, the company settled in a consent decree in 1982. The local Bell operating companies were divested (legally separated) from AT&T and were regrouped into seven large regional telephone holding companies. AT&T retained its long-distance operations as well as Bell Labs (the research organization) and Western Electric (the equipment manufacturer). The net effect was an 80 percent reduction in the size and sales of the Bell System.

The dismantling of the Bell System set off a breathtaking revolution in the telecommunications industry. New technologies are changing the telecommunications landscape: cellular phone systems are eating away at the natural monopoly of Alexander Graham Bell's wire-based system; telephone companies are joining forces to bring television signals into homes; fiber-optic lines are beginning to function as data superhighways, carrying vast amounts of data around the country and the world; the Internet is linking people and places together in ways that were unimagined a decade ago. One clear lesson of the breakup of the Bell System is that monopoly is not necessary for rapid technological change.

The most recent major antitrust case involved the giant software company *Microsoft.* In 1998, the federal government and 19 states lodged a far-reaching suit alleging that Microsoft had illegally maintained its dominant position in the market for operating systems and had used that dominance to leverage itself into other markets, such as the Internet browser market. The government claimed that "Microsoft has engaged in a broad pattern of unlawful conduct with the purpose and effect of thwarting emerging threats to its powerful and well-entrenched operating system monopoly." Although a monopoly acquired by fair means is legal, acting to stifle competition is illegal.

In his "Findings of Fact," Judge Jackson declared that Microsoft was a monopoly that had controlled more than 90 percent of the market share for PC operating systems since 1990 and that Microsoft had abused its market power and caused "consumer harm by distorting competition." Judge Jackson found that Microsoft had violated Sections 1 and 2 of the Sherman Act. He found that "Microsoft maintained its monopoly power by anticompetitive means, attempted to monopolize the Web browser market, and violated the Sherman Act by unlawfully tying its Web browser to its operating system."

The Department of Justice proposed the radical step of separating Microsoft along functional lines. This "divestiture" would require a separation of Microsoft into two separate, independent companies. One company ("WinCo") would own Microsoft's Windows and other operating-system businesses, and the other ("AppCo") would own the applications and other businesses. Judge Jackson accepted the Department of Justice's remedy recommendation with no modifications.

But then the case took a bizarre twist when it turned out that Judge Jackson had been holding private heart-to-heart discussions with journalists even as he was trying the case. He was chastised for his unethical conduct and removed from the case. Shortly thereafter, the Bush administration decided it would not seek to separate Microsoft but would settle for "conduct" remedies. These measures would restrict Microsoft's conduct through steps such as prohibiting contractual tying and discriminatory pricing as well as ensuring the interoperability of Windows with non-Windows software. After extensive further hearings, the case was settled in November 2002 with Microsoft intact but under the watchful eye of the government and the courts.

Antitrust Laws and Efficiency

Economic and legal views toward regulation and antitrust have changed dramatically over the last three decades. Increasingly, economic regulation and antitrust laws are aimed toward the goal of improving economic efficiency rather than combating businesses simply because they are big or profitable.

What has prompted the changing attitude toward antitrust policy? First, economists found that concentrated industries sometimes had outstanding performance. That is, while concentrated industries might have static inefficiencies, these were more than outweighed by their dynamic efficiencies. Consider Intel, Microsoft, and Boeing. They have had substantial market shares, but they have also been highly innovative and commercially successful.

A second thrust of the new approach to regulation and antitrust arose from new findings on the nature of competition. Considering both experimental evidence and observation, many economists believe that intense rivalry will spring up even in oligopolistic markets as long as collusion is strictly prohibited. Indeed, in the words of Richard Posner, formerly a law professor and currently a federal judge,

> The only truly unilateral acts by which firms can get or keep monopoly power are practices like committing fraud on the Patent Office or blowing up a competitor's plant, and fraud and force are in general adequately punished under other statutes.

In this view, the only valid purpose of the antitrust laws should be to replace existing statutes with a simple prohibition against *agreements*—explicit or tacit—that unreasonably restrict competition.

A final reason for the reduced activism in antitrust has been growing globalization in many concentrated industries. As more foreign firms gain a foothold in the American economy, they tend to compete vigorously for a share of the market and often upset established sales patterns and pricing practices as they do so. For example, when the U.S. sales of Japanese automakers increased, the cozy coexistence of the Big Three American auto firms dissolved. Many economists believe that the threat of foreign competition is a much more powerful tool for enforcing market discipline than are antitrust laws.

SUMMARY

A. Behavior of Imperfect Competitors

1. Recall the four major market structures: (*a*) *Perfect competition* is found when no firm is large enough to affect the market price. (*b*) *Monopolistic competition* occurs when a large number of firms produce slightly differentiated products. (*c*) *Oligopoly* is an intermediate form of imperfect competition in which an industry is dominated by a few firms. (*d*) *Monopoly* comes when a single firm produces the entire output of an industry.
2. Measures of concentration are designed to indicate the degree of market power in an imperfectly competitive industry. Industries which are more concentrated tend to have higher levels of R&D expenditures, but on average their profitability is not higher.
3. High barriers to entry and complete collusion can lead to collusive oligopoly. This market structure produces a price and quantity relation similar to that under monopoly.
4. Another common structure is the monopolistic competition that characterizes many retail industries. Here we see many small firms, with only slight differences in the characteristics of their products (such as different locations of gasoline stations or different types of breakfast cereals). Product differentiation leads each firm to face a downward-sloping demand curve as each firm is free to set its own prices. In the long run, free entry extinguishes profits as these industries show an equilibrium in which their *AC* curves are tangent to their demand curves. In this tangency equilibrium, prices are above marginal costs, but the industry exhibits greater diversity of quality and service than would occur under perfect competition.
5. A final situation recognizes the strategic interplay that is present when an industry has but a handful of firms. When a small number of firms compete in a market, they must recognize their strategic interactions. Competition among the few introduces a completely new feature into economic life: It forces firms to take into account competitors' reactions to price and output decisions and brings strategic considerations into these markets.
6. Price discrimination occurs when the same product is sold to different consumers at different prices. This practice often occurs when sellers can segment their market into different groups.

B. Game Theory

7. Economic life contains many situations with strategic interaction among firms, households, governments, or others. Game theory analyzes the way that two or more parties, who interact in an arena such as a market, choose actions or strategies that jointly affect all participants.
8. The basic structure of a game includes the players, who have different possible actions or strategies, and the payoffs, which describe the various possible profits or other benefits that the players might obtain under each outcome. The key new concept is the payoff table of a game, which displays information about the strategies and the payoffs or profits of the different players for all possible outcomes.
9. The key to choosing strategies in game theory is for players to think about their opponent's goals as well as their own, never forgetting that the other side is doing the same. When playing a game in economics or any other field, assume that your opponent will choose his or her best option. Then pick your strategy to maximize your benefit, always assuming that your opponent is similarly analyzing your options.
10. Sometimes a dominant strategy is available—one that is best no matter what the opposition does. More often, we find a Nash equilibrium (or noncooperative equilibrium), in which no player can improve his or her payoff as long as the other player's strategy remains unchanged.

C. Public Policies to Combat Market Power

11. Monopoly power often leads to economic inefficiency when prices rise above marginal cost, costs are bloated by lack of competitive pressure, and product quality deteriorates.
12. Economic regulation involves the control of prices, production, entry and exit conditions, and standards of service in a particular industry. The normative view of economic regulation is that government intervention is appropriate when there are major market failures. These include excess market power in an industry, an inadequate supply of information for consumers and workers, and externalities such as pollution. The strongest case for economic regulation comes in regard to natural monopolies. Natural monopoly occurs when average costs are falling for every level of output, so the most efficient

organization of the industry requires production by a single firm.

13. Antitrust policy, prohibiting anticompetitive conduct and preventing monopolistic structures, is the primary way that public policy limits abuses of market power by large firms. This policy grew out of legislation like the Sherman Act (1890) and the Clayton Act (1914). The primary purposes of antitrust policy are (*a*) to prohibit anticompetitive activities (which include agreements to fix prices or divide up territories, price discrimination, and tie-in agreements) and (*b*) to break up illegal monopoly structures. In today's legal theory, such structures are those that have excessive market power (a large share of the market) and also engage in anticompetitive acts.

14. Legal antitrust policy has been significantly influenced by economic thinking during the last three decades. As a result, antitrust policy now focuses almost exclusively on improving efficiency and ignores earlier populist concerns with bigness itself.

CONCEPTS FOR REVIEW

Models of Imperfect Competition

concentration: concentration ratios, HHI
market power
strategic interaction
tacit and explicit collusion
imperfect competition:
  collusive oligopoly
  monopolistic competition
  small-number oligopoly
no-profit equilibrium in monopolistic competition
inefficiency of $P > MC$

Game Theory

players, strategies, payoffs
payoff table
dominant strategy and equilibrium
Nash or noncooperative equilibrium

Policies for Imperfect Competition

deadweight losses
reasons for regulation:
  market power
  externalities
  information failures

Antitrust Policy

Sherman, Clayton, and FTC Acts
natural monopoly
per se prohibitions vs. the "rule of reason"
efficiency-oriented antitrust policy

FURTHER READING AND INTERNET WEBSITES

Further Reading

An excellent review of industrial organization is Dennis W. Carlton and Jeffrey M. Perloff, *Modern Industrial Organization* (Addison-Wesley, New York, 2005).

Game theory was developed in 1944 by John von Neumann and Oscar Morgenstern and published in *Theory of Games and Economic Behavior* (Princeton University Press, Princeton, N.J., 1980). An entertaining review of game theory by two leading microeconomists is Avinash K. Dixit and Barry J. Nalebuff, *Thinking Strategically: The Competitive Edge in Business, Politics, and Everyday* (Norton, New York, 1993). A nontechnical biography of John Nash by journalist Silvia Nasar, *A Beautiful Mind: A Biography of John Forbes Nash Jr.* (Touchstone Books, New York, 1999), is a vivid history of game theory and of one of its most brilliant theorists.

Law and economics advanced greatly under the influence of scholars like Richard Posner, now a circuit court judge. His book, *Antitrust Law: An Economic Perspective* (University of Chicago Press, 1976), is a classic.

Websites

Game theorists have set up a number of sites. See particularly those by David Levine of UCLA at *levine.sscnet.ucla.edu* and Al Roth of Harvard at *www.economics.harvard.edu/~aroth/alroth.html*.

OPEC has its site at *www.opec.org*. This site makes interesting reading from the point of view of oil producers, many of which are Arab countries.

Data and methods pertaining to concentration ratios can be found in a Bureau of the Census publication at *www.census.gov/epcd/www/concentration.html*.

An excellent website with links to many issues on antitrust is *www.antitrust.org*. The homepage for the Antitrust Division of the Department of Justice, at *www.usdoj.gov/atr/public/div_stats/211491.htm*, contains an overview of antitrust issues.

QUESTIONS FOR DISCUSSION

1. Review collusive oligopoly and monopolistic competition, which are two theories of imperfect competition discussed in this chapter. Draw up a table that compares perfect competition, monopoly, and the two theories with respect to the following characteristics: (*a*) number of firms; (*b*) extent of collusion; (*c*) price vs. marginal cost; (*d*) price vs. long-run average cost; (*e*) efficiency.
2. Consider an industry whose firms have the following sales:

Firm	Sales
Appel Computer	1000
Banana Computer	800
Cumquat Computer	600
Dellta Computer	400
Endive Computer	300
Fettucini Computer	200
Grapefruit Computer	150
Hamburger Computer	100
InstantCoffee Computer	50
Jasmine Computer	1

The Herfindahl-Hirschman Index (HHI) is defined as

$$\text{HHI} = (\text{market share of firm 1 in \%})^2 + (\text{market share of firm 2 in \%})^2 + \cdots + (\text{market share of last firm in \%})^2$$

   a. Calculate the four-firm and six-firm concentration ratios for the computer industry.
   b. Calculate the HHI for the industry.
   c. Suppose that Appel Computer and Banana Computer were to merge with no change in the sales of any of the different computers. Calculate the new HHI.
3. "Perfect price discrimination" occurs when each consumer is charged his or her maximum price for the product. When this happens, the monopolist is able to capture the entire consumer surplus. Draw a demand curve for each of six consumers and compare (*a*) the situation in which all consumers face a single price with (*b*) a market under perfect price discrimination. Explain the paradoxical result that perfect price discrimination removes the inefficiency of monopoly.
4. The government decides to tax a monopolist at a constant rate of $\$x$ per unit. Show the impact upon output and price. Is the post-tax equilibrium closer to or further from the ideal equilibrium of $P = MC$?
5. Show that a profit-maximizing, unregulated monopolist will never operate in the price-inelastic region of its demand curve. Show how regulation can force the monopolist into the inelastic portion of its demand curve. What will be the impact of an increase in the regulated price of a monopolist upon revenues and profits when it is operating on (*a*) the elastic portion of the demand curve, (*b*) the inelastic portion of the demand curve, and (*c*) the unit-elastic portion of the demand curve?
6. Make a list of the industries that you feel are candidates for the title "natural monopoly." Then review the different strategies for intervention to prevent exercise of monopoly power. What would you do about each industry on your list?
7. Firms often lobby for tariffs or quotas to provide relief from import competition.
   a. Suppose that the monopolist shown in Figure 10-9 has a foreign competitor that will supply output perfectly elastically at a price slightly above the monopolist's $AC = MC$ but below P. Show the impact of the foreign competitor's entry into the market.
   b. What would be the effect on the price and quantity if a prohibitive tariff were levied on the foreign good? (A prohibitive tariff is one that is so high as to effectively wall out all imports.) What would be the effect of a small tariff? Use your analysis to explain the statement, "The tariff is the mother of monopoly."
8. Explain in words and with the use of diagrams why a monopolistic equilibrium leads to economic inefficiency relative to a perfectly competitive equilibrium. Why is the condition $MC = P = MU$ of Chapter 8 critical for this analysis?
9. Consider the *prisoner's dilemma*, one of the most famous of all games. Molly and Knuckles are partners in crime. The district attorney interviews each separately, saying, "I have enough on both of you to send you to jail for a year. But I'll make a deal with you: If you *alone* confess, you'll get off with a 3-month sentence, while your partner will serve 10 years. If you *both* confess, you'll both get 5 years." What should Molly do? Should she confess and hope to get a short sentence? Three months are preferable to the year she would get if she remains silent. But wait. There is an even better reason for confessing. Suppose Molly doesn't confess and, unbeknownst to her, Knuckles does confess. Molly stands to get 10 years! It's clearly better in this situation for Molly to confess and get

5 years rather than 10 years. Construct a payoff table like that in Figure 10-8. Show that each player has a dominant strategy, which is to confess, and both therefore end up with long prison terms. Then show what would happen if they could make binding commitments not to confess.

10. In his Findings of Fact in the Microsoft case, Judge Jackson wrote: "It is indicative of monopoly power that Microsoft felt that it had substantial discretion in setting the price of its Windows 98 upgrade product (the operating system product it sells to existing users of Windows 95). A Microsoft study from November 1997 reveals that the company could have charged $49 for an upgrade to Windows 98—there is no reason to believe that the $49 price would have been unprofitable—but the study identifies $89 as the revenue-maximizing price. Microsoft thus opted for the higher price." Explain why these facts would indicate that Microsoft is not a perfect competitor. What further information would be needed to prove Microsoft was a monopoly?

11. In long-run equilibrium, both perfectly competitive and monopolistically competitive markets achieve a tangency between the firm's *dd* demand curve and its *AC* average cost curve. Figure 10-4 shows the tangency for a monopolistic competitor, while Figure 10-10 displays the tangency for a perfect competitor. Discuss the similarities and differences in the two situations with respect to:

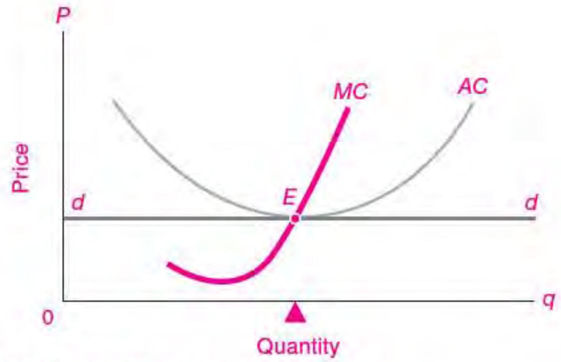


FIGURE 10-10. Perfect Competition

   a. The elasticity of the demand curve for the firm's product
   b. The extent of divergence between price and marginal cost
   c. Profits
   d. Economic efficiency

12. Reread the history of OPEC. Draw a set of supply and demand curves in which supply is completely price-inelastic. Show that a cartel that sets a quantity target (the inelastic supply curve) will experience more volatile prices if demand is price-inelastic than if demand is price-elastic when (*a*) the demand curve shifts horizontally by a certain quantity (such as would occur with an unanticipated demand shock) or (*b*) there is a shift in the supply curve (say, due to cheating by a cartel member).

CHAPTER 11

Economics of Uncertainty

Pearls lie not on the seashore. If thou desirest one,
thou must dive for it.

Chinese proverb

Life is full of uncertainties. Suppose that you are in the oil business. You might be in charge of a joint venture in Siberia. What obstacles would you face? You would face major risks that plague oil producers everywhere—the risks of a price plunge, of embargoes, or of an attack on your tankers by some hostile regime. Added to these are the uncertainties of operating in uncharted terrain: you are unfamiliar with the geological formations, with the routes for getting the oil to the market, with the success rate on drilling wells, and with the skills of the local workforce.

In addition to these uncertainties are the political risks involved in dealing with an increasingly autocratic and nationalistic government in Moscow, along with the problems that arise from occasional wars and from corrupt elements in a country where bribes are common and the rule of law is insecure. And your partners may turn out to be unscrupulous fellows who take advantage of their local knowledge to get more than their fair share.

The economic issues in your joint venture present complexities that are not captured in our elementary theories. Many of these issues involve *risk, uncertainty,* and *information.* Our oil company must deal with the uncertainties of drilling, of volatile prices, and of shifting markets. Likewise, households must contend with uncertainty about future wages or employment and about the return on their investments in education or in financial assets. Additionally, some people suffer from misfortunes such as devastating hurricanes, earthquakes, or illnesses. The first section of this chapter discusses the fundamental economics of uncertainty.

How do individuals and societies cope with uncertainties? One important approach is through insurance. The second section deals with the fundamentals of insurance, including the important concept of social insurance. The third section applies the concept of social insurance to health care, which is a growing political and social dilemma in the United States. We conclude with an examination of the economics of information and apply this to the rise of the Internet.

No study of the realities of economic life is complete without a thorough study of the fascinating questions involved in decision making under uncertainty and the economics of information.

A. ECONOMICS OF RISK AND UNCERTAINTY

Our analysis of markets presumed that costs and demands were known for certain. In reality, business life is teeming with risk and uncertainty. We described the uncertainties involved in a joint venture for oil in Siberia, but these problems are not confined to the oil business. Virtually all firms face uncertainties about their output and input prices. They may find that their markets are shrinking because of a recession or that credit is hard to find in a financial crisis. Furthermore, the behavior of their competitors cannot be forecast in advance. The essence of business is to invest now in order to make profits in the future, in effect putting fortunes up as hostage to future uncertainties. Economic life is a risky business.

Modern economics has developed useful tools to incorporate uncertainty into the analysis of business and household behavior. This section examines the role of markets in spreading risks over space and time and analyzes the theory of individual behavior under uncertainty. These topics are but a brief glimpse into the fascinating world of risk and uncertainty in economic life.

SPECULATION: SHIPPING ASSETS OR GOODS ACROSS SPACE AND TIME

We begin by considering the role of speculative markets. **Speculation** involves buying and selling in order to make profits from fluctuations in prices. A speculator wants to buy low and sell high. The item might be grain, oil, eggs, stocks, or foreign currencies. Speculators do not buy these items for their own sake. The last thing they want is to see the egg truck show up at their door. Rather, they make a profit from price changes.

Many people think of speculation as a slightly sinister activity, particularly when it arises from accounting frauds and inside information. But speculation can be beneficial to society. The economic function of speculators is to "move" goods from periods of abundance to periods of scarcity. Even though speculators may never see a barrel of oil or a Brazilian bond, they can help even out the price and yield differences of these items among regions or over time. They do this by buying when goods are abundant and prices are low and selling when goods are scarce and prices are high, and this indeed can improve a market's efficiency.

Arbitrage and Geographic Price Patterns

The simplest case is one in which speculative activity reduces or eliminates regional price differences by buying and selling the same commodity. This activity is called **arbitrage,** which is the purchase of a good or asset in one market for immediate resale in another market in order to profit from a price discrepancy.

Let's say that the price of wheat is 50 cents per bushel higher in Chicago than in Kansas City. Further, suppose that the costs of insurance and transportation are 10 cents per bushel. An *arbitrager* (someone engaged in arbitrage) can purchase wheat in Kansas City, ship it to Chicago, and make a profit of 40 cents per bushel. As a result of market arbitrage, the differential will be reduced so that the price difference between Chicago and Kansas City can never exceed 10 cents per bushel. *As a result of arbitrage, the price difference between markets will generally be less than the cost of moving the good from one market to the other.*

The frenzied activities of arbitragers—talking on the phone simultaneously to several brokers in several markets, searching out price differentials, trying to eke out a tiny profit every time they can buy low and sell high—tend to align the prices of identical products in different markets. Once again, we see the invisible hand at work—the lure of profit acts to smooth out price differentials across markets and make markets function more efficiently.

Speculation and Price Behavior over Time

Forces of speculation will tend to establish definite patterns of prices over time as well as over space. But the difficulties of predicting the future make this pattern less than perfect: we have an equilibrium that is constantly being disturbed but is always in the process of reforming itself—rather like a lake's surface under the play of the winds.

Consider the simplest case of a crop like corn that is harvested once a year and can be stored for future use. To avoid shortages, the crop must last for the entire year. Since no one passes a law regulating the storage of corn, how does the market bring about an efficient pattern of pricing and use over the year? The equilibrium is set by the activities of speculators trying to make a profit.

A well-informed corn speculator realizes that if all the corn is thrown on the market immediately after the autumn harvest, it will fetch a very low price because there will be a glut on the market. Several

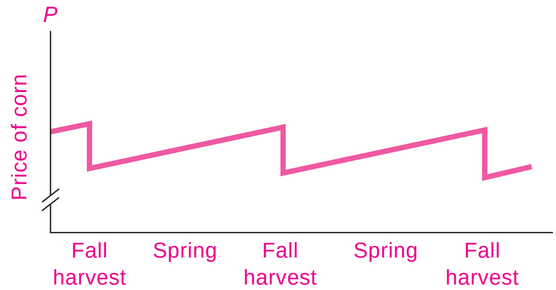


FIGURE 11-1. Speculators Even Out the Price of a Commodity over Time

When a good is stored, the expected price rise must match holding costs. In equilibrium, price is lowest at harvest time, rising gently with accumulated storage, insurance, and interest costs until the next harvest. This flexible pattern tends to even out consumption over the seasons. Otherwise, a harvest glut would cause very low autumn price and sky-high spring price.

months later, when corn is running short, the price will tend to skyrocket. In this case, speculators can make a profit by (1) purchasing some of the autumn crop while it is cheap, (2) putting it into storage, and (3) selling it later when the price has risen.

As a result of the speculative activities, the autumn price increases, the spring supply of corn increases, and the spring price declines. The process of speculative buying and selling tends to even out the supply, and therefore the price, over the year. Figure 11-1 shows the behavior of prices over an idealized yearly cycle.

Interestingly, if there is brisk competition among speculators, none of them will make excess profits. The returns to speculators will include the interest on invested capital, the appropriate earnings for their time, and a risk premium to compensate them for the noninsurable risks that they bear.

Speculation reveals the invisible-hand principle at work. By evening out supplies and prices, speculation actually increases economic efficiency. By moving goods over time from periods of abundance to periods of scarcity, the speculator is buying where the price and marginal utility of the good are low and selling where the price and marginal utility are high. By pursuing their private interests (profits), speculators are at the same time increasing the public interest (total utility).

Shedding Risks through Hedging

One important function of speculative markets is to allow people to shed risks through hedging. **Hedging** consists of reducing the risk involved in owning an asset or commodity by making an offsetting sale of that asset. Let's see how it works. Consider someone who owns a corn warehouse. She buys 2 million bushels of Kansas corn in the fall, stores it for 6 months, and sells it in the spring at a 10-cents-per-bushel profit, just covering her costs.

The problem is that corn prices tend to fluctuate. If the price of corn rises, she makes a large windfall gain. But if the price falls sharply, the decrease could completely wipe out her profits. How can the warehouse owner make a living storing only corn while avoiding the risks of corn-price fluctuations?

She can avoid the corn-price risk by *hedging her investments.* The owner hedges by selling the corn the moment it is bought rather than waiting until it is shipped 6 months later. Upon buying 2 million bushels of corn in September, she sells the corn immediately for delivery in the future at an agreed-upon price that will just yield a 10-cents-per-bushel storage cost. She thereby protects herself against all corn-price risk. *Hedging allows businesses to insulate themselves from the risk of price changes.*

The Economic Impacts of Speculation

But who buys the corn, and why? Someone agrees to buy the warehouse owner's corn now for future delivery. This buyer might be a baker who has a contract to sell bread in 6 months and wants to lock in the price. Or perhaps an ethanol plant needs corn for next year's production. Or the buyer might be a group of investors who believe that corn prices will rise and that they will therefore make a supernormal return on their investment. Someone, somewhere, and at the right price, has an economic incentive to take on the risk of corn-price fluctuations.

Speculative markets serve to improve the price and allocation patterns across space and time as well as to help transfer risks. If we look behind the veil of money, we see that ideal speculation reallocates goods from times of feast (when prices are low) to times of famine (when prices are high).

Our discussion has suggested that ideal speculative markets can increase economic efficiency. Let's see how. Say that identical consumers have utility schedules in which satisfaction in one year is independent of that in every other year. Now suppose that in the first of 2 years there is a big crop—say, 3 units per person—while the second year has a small crop of only 1 unit per person. If this crop deficiency could be foreseen perfectly, how should the consumption of the 2-year, 4-unit total be spread over the 2 years? Neglecting storage, interest, and insurance costs, *total utility and economic efficiency for the 2 years together will be maximized only when consumption is equal in each year.*

Why is uniform consumption better than any other division of the available total? Because of the law of diminishing marginal utility. This is how we might reason: "Suppose I consume more in the first year than in the second. My marginal utility (*MU*) in the first year will be low, while it will be high in the second year. So if I carry some crop over from the first to the second year, I will be moving consumption from low-*MU* times to high-*MU* times. When consumption levels are equalized, *MU*s will be equal and I will be maximizing my total utility."

A graph can illuminate this argument. If we measure utility in dollars, with each dollar always denoting the same marginal utility, the demand curves for the risky commodity would look just like the marginal utility schedule of Figure 5-1 on page 85. The two curves of Figure 11-2(*a*) show what would happen with no carryover and with unequal consumption. Here, price is determined first at A_1, where higher S_1S_1 intersects *DD*, and second at A_2, where the lower supply S_2S_2 intersects *DD*. Total utility of the blue shaded areas would add up to only (4 + 3 + 2) + 4, or $13.

But with optimal carryover of 1 unit to the second year, as shown in Figure 11-2(*b*), *P*s and *Q*s will be equalized at E_1 and E_2, and the total utility of the shaded areas will add up to (4 + 3) + (4 + 3), or $14 per person. A little analysis can show that the gain in utility of $1 is measured by Figure 11-2(*b*)'s dark green block, which represents the excess of the second unit's marginal utility over that of the third. This shows why the equality of marginal utilities, which is achieved by ideal speculation, is optimal.

While this discussion has focused on commodities, most speculation today involves financial assets such as stocks, bonds, mortgages, and foreign exchange. Every day, literally trillions of dollars of assets change hands as people speculate, hedge, and invest their

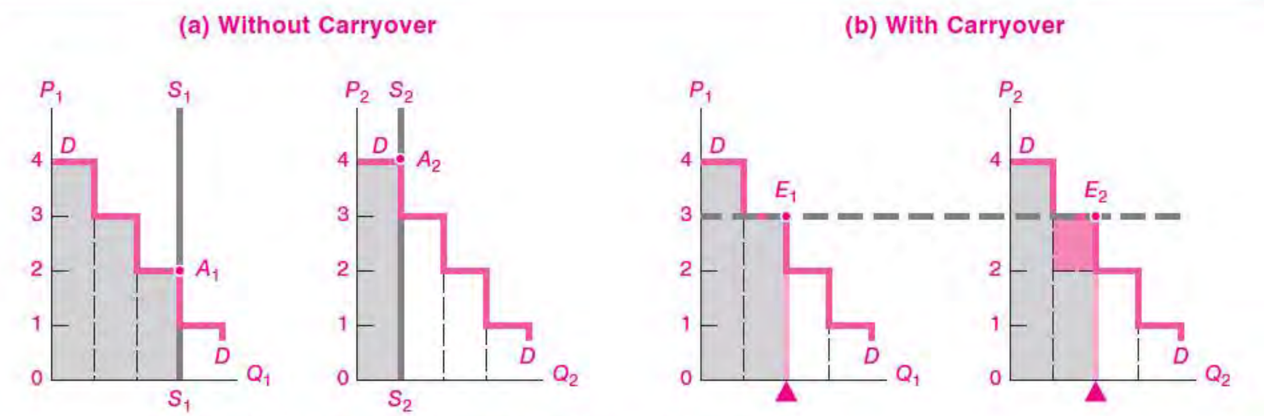


FIGURE 11-2. Speculative Storage Can Improve Efficiency

The blue areas measure total utility enjoyed each year. Carrying 1 unit to the second year equalizes *Q* and also *P* and *MU* and increases total utility by the amount of the dark green block.

This diagram will apply equally well to a number of situations. It could be labeled "**(a)** Without Arbitrage across Regional Markets" and "**(b)** With Arbitrage across Markets." We can also use this diagram to illustrate risk aversion if we label it "**(a)** With a Risky Gamble" and "**(b)** Without a Risky Gamble." Insurance then serves to move people from **(a)** to **(b)** by spreading the risks across many independent potential gambles.

funds. The general principles underlying financial speculation, hedging, and arbitrage are exactly the same as those outlined here, although the stakes are even higher.

Ideal speculation serves the important function of reducing undesired variations in consumption. In a world where individuals are averse to risk, speculation can increase total utility and allocational efficiency.

RISK AND UNCERTAINTY

What are people's attitudes toward risk? Why do people try to insulate themselves from many important risks? How can market institutions like insurance help individuals avoid major risks? Why do markets fail to provide insurance in some circumstances? We turn now to these issues.

Whenever you drive a car, own a house, join the army, or invest in the stock market, you are risking life, limb, or fortune. People generally want to avoid major risks to their income, consumption, and health. When people avoid risks, they are *risk-averse.*

A person is **risk-averse** when the pain from losing a given amount of income is greater in magnitude than the pleasure from gaining the same amount of income.

For example, suppose that we are offered a risky coin flip in which we will win \$1000 if the coin comes up heads and lose \$1000 if the coin comes up tails. This bet has an *expected value* of 0 (equal to a probability of ½ times \$1000 plus a probability of ½ times − \$1000). A bet which has a zero expected value is called a fair bet. If we turn down all fair bets, we are risk-averse.

In terms of the utility concept that we analyzed in Chapter 5, risk aversion is the same as *diminishing marginal utility of income.* Being risk-averse implies that the gain in utility achieved by getting an extra amount of income is less than the loss in utility from losing the same amount of income. For a fair bet (such as flipping a coin for \$1000), the expected dollar value is zero. But in terms of utility, the expected utility value is negative because the utility you stand to win is less than the utility you stand to lose.

Figure 11-2 illustrates the concept of risk aversion. Say that situation (*b*) is the initial position, in which you have equal amounts of consumption in states 1 and 2, consuming 2 units in both states. Someone comes to you and says, "Let's flip a coin for 1 unit." This person is in effect offering you the chance to move to situation (*a*), where you would have 3 units of consumption if the coin came up heads and 1 unit if tails. By careful calculation, you see that if you refuse the bet and stay in situation (*b*), the expected value of utility is 7 utils (= ½ × 7 utils + ½ × 7 utils), whereas if you accept the bet, the expected value of utility is 6½ utils (= ½ × 9 utils + ½ × 4 utils). This example shows that if you are risk-averse, with diminishing marginal utility, you will avoid actions that increase uncertainty without some expectation of gain.

Say that I am a corn farmer. While I clearly must contend with the weather, I prefer to avoid corn-price risks. Suppose that there are two equally likely outcomes with prices of \$3 and \$5 per bushel, so the expected value of the corn price is \$4 per bushel. Unless I can shed the price risk, I am forced into a lottery where I must sell my 10,000-bushel crop for either \$30,000 or \$50,000 depending upon the flip of the corn-price coin.

Because I am risk-averse, I would prefer a sure thing to such a lottery. The prospect of losing \$10,000 is more painful than the prospect of gaining \$10,000 is pleasant. If my income is cut to \$30,000, I will have to cut back on important spending, such as replacing an aging tractor. On the other hand, the extra \$10,000 might be less critical, going toward luxuries like a winter vacation. I therefore decide to hedge my price risk by selling my corn for the expected-value price of \$4 per bushel.

People are generally risk-averse, preferring a sure thing to uncertain levels of consumption: people prefer outcomes with less uncertainty and the same average values. For this reason, activities that reduce the uncertainties of consumption lead to improvements in economic welfare.

The Troubling Rise in Gambling

Gambling has historically been a "vice" that was—along with illegal drugs, commercial sex, alcohol, and tobacco—discouraged by the state. Attitudes about such activities ebb and flow. Over the last two decades, attitudes toward gambling became permissive as those toward drugs and tobacco hardened. Overall, gambling has been one of the fastest-growing sectors of the (legal) economy.

Gambling is a different animal from speculation. While ideal speculative activity increases economic welfare, gambling raises serious economic issues. To begin with, aside from recreational value, gambling does not create goods and services. In the language of game theory, described in the previous chapter, gambling is a "negative-sum game" for the players—the customers are (almost) sure to lose in the long run because the house takes a cut of all bets. In addition, by its very nature, gambling increases income inequality. People who sit down to the gambling table with the same amount of money go away with widely different amounts. A gambler's family must expect to be on top of the world one week only to be living on crumbs and remorse when luck changes. Some observers also believe that gambling has adverse social impacts. These include addiction to gambling, neighborhood crime, political corruption, and infiltration of gambling by organized crime.

Given the substantial economic case against gambling, how can we understand the recent trend to legalize gambling and operate government lotteries? One reason is that when states are starved for tax revenues, they look under every tree for new sources; they rationalize lotteries and casinos as a way to channel private vices to the public interest by skimming off some of the revenues to finance public projects. In addition, legal gambling may drive out illegal numbers rackets and take some of the profitability out of organized crime. Notwithstanding these rationales, many observers raise questions about an activity in which the state profits by promoting irrational behavior among those who can least afford it.

B. THE ECONOMICS OF INSURANCE

Most people would like to avoid the risks of losing life, limb, and house. But risks cannot simply be buried. When a house burns down, when someone is hurt in an automobile accident, or when a hurricane destroys New Orleans—someone, somewhere, must bear the cost.

Markets handle risks by **risk spreading.** This process takes risks that would be large for one person and spreads them around so that they are but small risks for a large number of people. The major form of risk spreading is **insurance,** which is a kind of gambling in reverse.

For example, in buying fire insurance on a house, homeowners seem to be betting with the insurance company that the house will burn down. If it does not, the owners forfeit the small premium charge. If it does burn down, the company must reimburse the owners for the loss at an agreed-upon rate. What is true of fire insurance is equally true of life, accident, automobile, or any other kind of insurance.

The insurance company is spreading risks by pooling many different risks: it may insure millions of houses or lives or cars. The advantage for the insurance company is that what is unpredictable for one individual is highly predictable for a population. Say that the Inland Fire Insurance Company insures 1 million homes, each worth \$100,000. The chance that a house will burn down is 1 in 1000 per year. The expected value of losses to Inland is then $.001 \times \$100{,}000 = \$100$ per house per year. Inland charges each homeowner \$100 plus another \$100 for administration and for reserves.

Each homeowner is faced with the choice between the *certain* loss of \$200 for each year or the *possible* 1-in-1000 catastrophic loss of \$100,000. Because of risk aversion, the household will choose to buy insurance that costs more than the expected value of the household's loss in order to avoid the small chance of a catastrophic loss. Insurance companies can set a premium that will earn the company a profit and at the same time produce a gain in expected utility of individuals. Where does the economic gain come from? It arises from the law of diminishing marginal utility.

Insurance breaks large risks into small pieces and then sells these smaller pieces in return for a small risk premium. Although insurance appears to be just another form of gambling, it actually has the opposite effect. Whereas nature deals us risks, insurance helps reduce individual risks by spreading them out.

Capital Markets and Risk Sharing

Another form of risk sharing takes place in the capital markets because the financial ownership of *physical* capital can be spread among many owners through the vehicle of corporate *financial* ownership.

Take the example of investment to develop a new commercial aircraft. A completely new design, including research and development, might require $5 billion of investment spread over 10 years. Yet there is no guarantee that the plane will find a large-enough commercial market to repay the invested funds. Few people have the wealth or inclination to undertake such a risky venture.

Market economies accomplish this task through publicly owned corporations. A company like Boeing is owned by millions of people, none of whom owns a major portion of the shares. In a hypothetical case, divide Boeing's ownership equally among 10 million individuals. Then the $5 billion investment becomes $500 per person, which is a risk that many would be willing to bear if the returns on Boeing stock appear attractive.

By spreading the ownership of risky investments among a multitude of owners, capital markets can spread risks and encourage much larger investments and risks than would be tolerable for individual owners.

MARKET FAILURES IN INFORMATION

Our analysis up to now has assumed that investors and consumers are well informed about the risks they face and that speculative and insurance markets function efficiently. In reality, markets involving risk and uncertainty are plagued by market failures. Two of the major failures are adverse selection and moral hazard. When these are present, markets may give the wrong signals, incentives may get distorted, and sometimes markets may simply not exist. Because of market failures, governments may decide to step in and offer social insurance.

Moral Hazard and Adverse Selection

While insurance is a useful device for reducing risks, sometimes insurance is not available. The reason is that efficient insurance markets can thrive only under limited conditions.

What are the conditions for efficient insurance markets? First, there must be a large number of insurable events. Only then will companies be able to spread the risks so that what is a large risk to an individual will become a small risk to many people.

Moreover, the events must be statistically independent. No prudent insurance company would sell all its fire-insurance policies in the same building or sell only hurricane insurance in Miami. Insurance companies try to diversify their coverage among many independent risks.

Additionally, there must be sufficient experience regarding such events so that insurance companies can reliably estimate the losses. For example, after the September 11 terrorist attacks, private terrorism insurance was canceled because insurance companies could not get reliable estimates of the chances of future attacks (see question 3 at the end of this chapter).

Finally, the insurance must be relatively free of moral hazard. **Moral hazard** is at work when insurance increases risky behavior and thereby changes the probability of loss. In many situations moral hazard is unimportant. Few people will risk death because they have a generous life-insurance policy. In some areas, moral hazard is severe. Studies indicate that the presence of insurance increases the amount of cosmetic surgery, and most medical-insurance policies consequently exclude this procedure.

When these ideal conditions are met—when there are many outcomes, all more or less independent, and when the probabilities can be accurately gauged and are not contaminated by moral hazard—private insurance markets can function efficiently.

Sometimes, private insurance is limited or expensive because of adverse selection. **Adverse selection** arises when the people with the highest risk are also those who are most likely to buy the insurance. Adverse selection can lead to a market where only the people with the highest risks are insured, or even to a situation where there is no market at all.

A good example occurs when a company is offering life insurance to a population made up of smokers and nonsmokers. Suppose the company cannot determine whether a person is a smoker, or perhaps there is a government policy which says that companies cannot differentiate among people on the basis of their personal behavior. However, people know their smoking habits. We see here the phenomenon of asymmetric information between buyer and seller. **Asymmetric information** occurs when buyers and sellers have different information on important facts, such as a person's health status or the quality of a good being sold.

Suppose that the company starts by setting a price based on the average mortality rate of the population. At this price, many smokers buy the insurance, but most nonsmokers do not. This means that people have sorted themselves unfavorably for the company—there is adverse selection. Soon the data begin to come in, and the company learns that its experience is much worse than it had forecast.

What happens next might be that the company raises the premiums on its insurance. As the price rises, more of the nonsmokers drop out, and the experience becomes even worse. Perhaps the price rises so high that even the smokers stop buying insurance. In the worst case, the market just dries up completely.

We see that the policy of uniform market pricing has led to adverse selection—raising the cost, limiting the coverage, and producing an incomplete market. Another example is the market for “lemons” such as used cars, where only the worst cars are sold, and the prices of used cars in equilibrium are reduced. Such market failures are particularly severe when there is asymmetric information between buyers and sellers.

Would You Invest in a Company for Grade Insurance?

A friend of yours proposes the following scheme: He wants you to invest in a start-up company called G-Insure.com, which offers grade insurance for students. In return for a modest premium, the company promises to compensate students for 100 percent of the income loss from poor grades. This seems like a good idea because income risks are very large for most people.

On reflection, can you see why G-Insure.com is almost sure to be a bad idea? The reason is that grades depend too much on individual effort and the market would therefore be infected with moral hazard and adverse selection. Students would be tempted to study less (moral hazard), and students who expected to have lower grades would be more prone to buy grade insurance (adverse selection). These problems might even produce a “missing market”—one in which supply and demand intersect at a zero level of grade insurance. So the company will either have no business or lose piles of money.

SOCIAL INSURANCE

When market failures are so severe that the private market cannot provide coverage in an effective manner, governments turn to **social insurance.** This consists of mandatory programs, with broad or universal coverage, funded by taxes or fees. These programs are insurance because they cover risky situations such as unemployment, illness, or low incomes during retirement. The taxing and regulatory powers of the government, plus the ability to prevent adverse selection through universal coverage, can make government insurance a welfare-improving measure. The rationale for social insurance was explained as follows by the distinguished public-policy economist Martin Feldstein:[1]

> There are two distinct reasons for providing social insurance. Both reflect the asymmetry of information. The first is that asymmetric information weakens the functioning of private insurance markets. The second is the inability of the government to distinguish between those who are poor in old age or when unemployed because of bad luck or an irrational lack of foresight from those who are intentionally “gaming” the system by not saving in order to receive transfer payments.

The key point is that social insurance is provided when the requirements of private insurance are not met. Perhaps the risks are not independent, as when many people simultaneously become unemployed in a recession. Perhaps adverse selection is serious, as when people choose to buy catastrophic health insurance soon after they learn they have a terrible disease. Perhaps the risks cannot be easily evaluated, as in the case of insurance against terrorist attacks. In each of these cases, the private market functioned poorly or not at all, so the government stepped in with social insurance.

Let’s spend a moment on the example of unemployment insurance. This is an example of a private market that cannot function because so many of the requirements for private insurance are violated: moral hazard is high (people may decide to become unemployed if benefits are generous); there is severe adverse selection (those who often lose jobs are more likely to participate); spells of unemployment are not independent (they tend to occur together

[1] See the reference in this chapter’s Further Reading section.

during business-cycle recessions); and business cycles are unpredictable, so the risks cannot be accurately measured. At the same time, some countries feel that people should have a safety net under them should they lose their job. As a result, governments generally step in to provide unemployment insurance.

The next section discusses the important case of government-provided health care, which for many countries is the largest program of social insurance.

Social insurance is provided by governments when private insurance markets cannot function effectively and society believes that individuals should have a social safety net for the most severe risks such as unemployment, illness, and low incomes.

C. HEALTH CARE: THE PROBLEM THAT WON'T GO AWAY

Health care is the single largest government program of the U.S. federal government. For 2008, expenditures on health care totaled close to $700 billion—larger even than the military budget. Most of this spending was on the social insurance program called Medicare, which provides subsidized health care for the elderly. The balance was health care for the poor, the disabled, and veterans.

The U.S. health-care system is controversial both because it is expensive and because a large number of people are not covered by insurance or other programs. Health-care spending rose from 4 percent of national output (GDP) in 1940 to 7 percent in 1970 and reached 16 percent in 2008. Yet almost 16 percent of the nonelderly population has no coverage. This has been called the problem that can't be solved and won't go away.

THE ECONOMICS OF MEDICAL CARE

Why has health care been so controversial? In the United States, the health-care system is a partnership between the market system and the government. In recent years, this system has produced some remarkable accomplishments. Many terrible diseases, such as smallpox and polio, have been eradicated. Life expectancy—one of the key indexes of health—has improved more in developing countries since 1900 than it did during the entire prior span of recorded history. Advances in medical technology—from arthroscopic knee surgery to sophisticated anticancer drugs—have enabled more people to live pain-free and productive lives.

Even with these great achievements, major health problems remain unsolved in the United States: Infant mortality is higher than in many countries with lower incomes; many Americans are without health insurance coverage; great disparities in care exist between the rich and the poor; and communicable diseases like AIDS and tuberculosis are spreading.

The issue that most concerns the public, the business community, and political leaders is the exploding cost of health care. Virtually everyone agrees that the U.S. health system has contributed greatly to the nation's health, but many worry that it is becoming unaffordable.

Special Economic Features of Health Care

The health-care system in the United States has three characteristics that have contributed to the rapid growth of the health-care sector in recent years: a high income elasticity, rapid technological advance, and the increasing insulation of consumers from prices.

Health care has a high income elasticity, indicating that ensuring a long and fit life becomes increasingly important as people are able to pay for other essential needs. Goods with high income elasticities, other things held constant, tend to take a growing share of consumer income as income rises.

Health care has enjoyed rapid improvements in medical technology over the last century. Advances in fundamental biomedical knowledge, discovery and use of a wide variety of vaccines and pharmaceuticals, progress in understanding the spread of communicable diseases, and increasing public awareness of the role of individual behavior in areas such as smoking, drinking, and driving—all these have contributed to the remarkable improvement in the health of Americans. The new and improved technologies have created new markets and stimulated spending in the health-care sector.

Additionally, spending on health care has risen rapidly because of the increased subsidization of medical care over recent decades. Health-care coverage in the United States is largely provided by employers as a tax-free fringe benefit. Tax-free status is, in effect, a government subsidy. In 1960, 60 percent of medical expenses were paid directly by consumers; by 2007, only 15 percent of medical expenses were paid out of pocket. This phenomenon is sometimes called the "third-party payment effect" to indicate that when a third party pays the bill, the consumer often ignores the cost.

All these forces (high income elasticity, the development of new technologies, and the increasing scope of third-party payments) contribute to the rapid growth of expenditures on medical care.

Health Care as a Social Insurance Program

Why is health care a social insurance program? Three reasons are cited by experts on health-care economics:

1. Many parts of the health-care system, such as the prevention of communicable diseases and the development of basic science, are *public goods* that the market will not provide efficiently. Eradication of smallpox benefited billions of potential victims, yet no firm could collect even a small fraction of the benefits of the eradication program. When one person stops smoking because of knowledge of its dangers, or when another person uses condoms after learning how AIDS is transmitted, these activities are no less valuable to others. This syndrome will lead to underinvestment in public health improvements by the market.
2. A second set of market failures arises because of the failure of private insurance markets. One significant reason for this failure is the presence of *asymmetric information* among patients, doctors, and insurance companies. Medical conditions are often isolated occurrences for patients, so such asymmetric information between doctors and patients means that patients may be completely dependent upon doctors' recommendations regarding the appropriate level of health care. Sometimes, as when patients are wheeled into the emergency room, they may be incapacitated and unable to choose treatment strategies for themselves, so demand depends even more upon the recommendations of the suppliers. Special protection must be given to ensure that consumers do not unwittingly purchase unnecessary, poor-quality, or high-cost services.

   There are also informational asymmetries between the patient and the insurance provider. People may know more about their medical condition than do insurance companies. Low-risk individuals may choose not to buy health insurance. This leads to *adverse selection,* which increases the average riskiness of the group and subsequently increases the cost for those who do participate. It is not surprising that healthy people in their twenties are those most likely to be uninsured.
3. A third concern of government policy is *equity*—to provide a minimum standard of medical care for all. In part, good health care is increasingly viewed as a basic right in wealthy countries. But good health care is also a good social investment. Inadequate health care is particularly harmful for poor people not only because they tend to be sicker than wealthier individuals but also because their incomes are almost entirely derived from their labor. A healthier population is a more productive population because healthier people have higher earnings and require less medical care.

   Inadequate health care is most costly for children. The medical condition of poor and minority children in the United States has in some dimensions actually worsened in recent years. Sick children are handicapped from the start: they are less likely to attend school, perform more poorly when they do attend, are more likely to drop out, and are less likely to get good jobs with high pay when they grow up. No country can prosper when a significant fraction of its children have inadequate medical care.

Rationing Health Care

Whether or not a country provides equal health care for all its residents, health care must be rationed because supply is limited. Until we get to the point where every symptom of every hypochondriac can be extensively examined, probed, and treated, it will be necessary to leave some perceived medical need unsatisfied. There is no choice but to ration health care.

However, it is not obvious *how* we are to ration such a good. Most goods and services are rationed by the purse. Prices ration out the limited supply of fancy cars and mansions, as well as the not-so-fancy food and shoes, to those who most want and can afford them. In many areas of health care, by contrast, we do not allow prices to ration out services to the highest bidders. For example, we do not auction off liver transplants or blood or emergency-room access to the highest bidder. Rather, we desire that these goods be allocated equitably.

The subsidization of health care leads to shortages, and demand for the good must therefore be limited in some other way. This phenomenon is known as *nonprice rationing*. Many of us have experienced this kind of rationing when we wait in line for a good or service. When price is not allowed to rise to balance supply and demand, some other mechanism must be found to "clear the market."

Figure 11-3 illustrates nonprice rationing in the medical market. Suppose that there are only Q_0 units of medical care available with a consumer demand function of *DD*. The market-clearing price would come at *C*, where quantities supplied and demanded are equal. However, because the consumer pays only 20 percent of the costs out of pocket, the quantity demanded is Q_1. The *AB* segment is unsatisfied demand, which is subject to nonprice rationing; the greater the subsidy, the more nonprice rationing must be used.

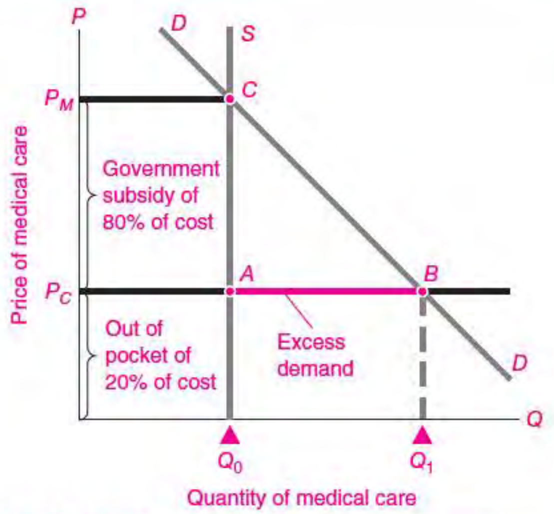


FIGURE 11-3. Free Health Care Leads to Nonprice Rationing

When governments provide free or subsidized access to medical care, some way must be found to ration out the limited services. In the example of a government subsidy, when the quantity demanded exceeds the quantity supplied, the excess demand *AB* must be choked off by some mechanism other than price. Most often, people must wait for nonemergency services, sometimes for hours, sometimes for months.

Health care is an economic commodity like shoes and gasoline. Physicians' services, nursing care, hospitalization, and other services are limited in supply. The demands of consumers—summing up the critical, the reasonable, the marginal, and the nonsensical—outstrip the available resources. But the resources must somehow be rationed out. Rationing of health care according to dollar votes is unacceptable because it does too much damage to the public health, leaves crucial demands unmet, and impoverishes many. What should be the scope of the market, and what nonmarket mechanism should be used where the market is supplanted? These questions are the crux of the great debate about medical care.

D. INNOVATION AND INFORMATION

One of the most important topics in economics is the economics of information. Information includes things as varied as e-mails, songs, new vaccines, and even the textbook you are reading. Information is a very different kind of commodity from things like pizza and shoes because information is expensive to produce but cheap to reproduce. Because of the unusual nature of information, it is subject to market failures, so we need to develop different kinds of public policies to regulate it—the law of "intellectual property."

Schumpeter's Radical Innovation

We set the stage for our discussion by returning to the economics of imperfect competition that we discussed in the previous two chapters. We learned that imperfect competitors set prices too high, earn supernormal profits, and neglect product quality.

This dismal view of monopoly was challenged by one of the great economists of the last century, Joseph Schumpeter. He argued that the essence of economic development is innovation and that monopolists are in fact the wellsprings of innovation in a capitalist economy.

Joseph Schumpeter: Economist as Romantic

Born in the Austrian Empire, Joseph Schumpeter (1883–1950), a legendary scholar whose research ranged widely in the social sciences, led a flamboyant private life.

He began studying law, economics, and politics at the University of Vienna—then one of the world centers of economics and the home of the "Austrian School" that today reveres laissez-faire capitalism. As a professor, he was often the champion of his students. Six months into his teaching career, he charged into the library and scolded the librarian for not allowing his students to have free use of the books. After trading insults, the librarian challenged Schumpeter to a duel. Schumpeter won by nicking the librarian on the shoulder, and his students thereupon had unlimited access to the library.

In between dueling, insulting the stodgy faculty by showing up at faculty meetings in riding pants, and carousing, Schumpeter devoted himself to introducing economic theory to the European continent, founding the Econometric Society, and traveling to England and America. He later moved to Harvard University, where he eventually became embittered as the theories of his great rival, John Maynard Keynes, swept the profession.

Schumpeter's writings covered much of economics, sociology, and history, but his first love was economic theory. Schumpeter's early classic, *The Theory of Economic Development* (1911), broke with the traditional static analysis of its time by emphasizing the importance of the entrepreneur or innovator, the person who introduces "new combinations" in the form of new products or methods of organization. Innovations result in temporary supernormal profits, which are eventually eroded away by imitations. Ever the romantic, Schumpeter saw in the entrepreneur the hero of capitalism, the person of "superior qualities of intellect and will," motivated by the will to conquer and the joy of creation.

His magisterial *History of Economic Analysis* (published posthumously in 1954) is a superb survey of the emergence of modern economics. His "popular" book, *Capitalism, Socialism, and Democracy* (1942), laid out his startling hypothesis on the technological superiority of monopoly and developed the theory of competitive democracy, which later grew into public-choice theory. (See question 7 at the end of this chapter.) He ominously predicted that capitalism would wither away because of disenchantment among the elites. Were he alive today, he might well join in the conservative complaint that the welfare state drains the economic vitality from the market economy.

The Economics of Information

Modern economics emphasizes the special problems involved in the **economics of information.** Information is a fundamentally different commodity from normal goods. Because information is costly to produce but cheap to reproduce, markets in information are subject to severe market failures.

Consider the production of a software program, such as Windows Vista. Developing this program took several years and cost Microsoft many billions of dollars. Yet you can purchase a legal copy for about $220 or buy an illegal pirated copy for $5. The same phenomenon is at work in pharmaceuticals, entertainment, and other areas where much of the value of a good comes from the information it contains. In each of these areas, the research and development on the product may be an expensive process that takes years. But once the information is recorded on paper, in a computer, or on a compact disc, it can be reproduced and used by a second person essentially for free.

The inability of firms to capture the full monetary value of their inventions is called **inappropriability.** Inventions are not fully appropriable because other firms may imitate or pirate an invention, in which case the other firms may derive some of the benefits of the inventive investments; sometimes, imitators may drive down the price of the new product, in which case consumers would get some of the rewards. Case studies have found that the *social return* to invention (the value of an invention to all consumers and producers) is many times the appropriable *private return* to the inventor (the monetary value of the invention to the inventor).

Information is expensive to produce but cheap to reproduce. To the extent that the rewards to invention are inappropriable, we would expect private research and development to be underfunded, with the most significant underinvestment in basic research because that is the least appropriable kind of information. The inappropriability and high social return on research lead most governments to subsidize basic research in the fields of health and science and to provide special incentives for other creative activities.

Intellectual Property Rights

Governments have long recognized that creative activities need special support because the rewards for producing valuable information are reduced by imitation. The U.S. Constitution authorizes Congress "to promote the Progress of Science and useful Arts, by securing, for limited Times, to Authors and Inventors, the exclusive Right to their respective Writings and Discoveries." Thus special laws governing patents, copyrights, business and trade secrets, and electronic media create **intellectual property rights.** The purpose is to give the owner special protection against the material's being copied and used by others without compensation to the owner or original creator.

The earliest intellectual property right was the **patent,** under which the U.S. government creates an exclusive use (in effect, a limited monopoly) over a "novel, nonobvious, and useful" invention for a limited period, currently set at 20 years. Similarly, copyright laws provide legal protection against unauthorized copying of original works in different media such as text, music, video, art, software, and other information goods.

Why would governments actually encourage monopolies? In effect, patents and copyrights grant property rights to inventors over books, music, and ideas. By allowing inventors to have exclusive use of their intellectual property, the government increases the degree of appropriability and thereby increases the incentives for people to invent useful new products, write books, compose songs, and write computer software. A patent also requires disclosure of the technological details of the invention, which encourages further invention and lawful imitation. Examples of successful patents include those on the cotton gin, the telephone, the Xerox machine, and many profitable drugs.

The Dilemma of the Internet

Inventions that improve communications are hardly limited to the modern age. But the rapid growth of electronic storage, access, and transmission of information highlights the dilemma of providing incentives for creating new information. Many new information technologies have large up-front or sunk costs but virtually zero marginal costs. With the low cost of electronic information systems like the Internet, it is technologically possible to make large amounts of information available to everyone, everywhere, at close to zero marginal cost. Perfect competition cannot survive here because a price equal to a zero marginal cost will yield zero revenues and therefore no viable firms.

The economics of the information economy highlights the conflict between efficiency and incentives. On the one hand, all information might be provided free of charge—free economics textbooks, free movies, free songs. Free provision of information looks economically efficient because the price would thereby be equal to the marginal cost, which is zero. But a zero price on intellectual property would destroy the profits and therefore reduce the incentives to produce new books, movies, and songs because creators would reap little return from their creative activity. Society has struggled with this dilemma in the past. But with the costs of reproduction and transmission so much lower for electronic information than for traditional information, finding sensible public policies and enforcing intellectual property rights is becoming ever more difficult.

Experts emphasize that intellectual property laws are often hard to enforce, especially when they apply across national borders. The United States has a long-running trade dispute charging that China condones the illegal copying of American movies, musical recordings, and software. A DVD movie that sells for $25 in the United States can be purchased for 50 cents in China. The U.S. copyright industries estimate that 85 to 95 percent of all their members' copyrighted works sold in 2007 in China were pirated.

In a world increasingly devoted to developing new knowledge—much of it intangible, like music, movies, patents, new drugs, and software—governments must find a middle ground in intellectual property rights. If intellectual property rights are too strong, this will lead to high prices and monopoly losses, while too weak intellectual property laws will discourage invention and innovation.

SUMMARY

A. Economics of Risk and Uncertainty

1. Economic life is full of uncertainty. Consumers face uncertain incomes and employment patterns as well as the threat of catastrophic losses; businesses have uncertain costs, and their revenues contain uncertainties about price and production.
2. In well-functioning markets, arbitrage, speculation, and insurance help smooth out the unavoidable risks. Speculators are people who buy and sell assets or commodities with an eye to making profits on price differentials across markets. They move goods across regions from low-price to high-price markets, across time from periods of abundance to periods of scarcity, and even across uncertain states of nature to periods when chance makes goods scarce.
3. The profit-seeking action of speculators and arbitragers tends to create certain equilibrium patterns of price over space, time, and risks. These market equilibria are zero-profit outcomes where the marginal costs and marginal utilities in different regions, times, or uncertain states of nature are in balance. To the extent that speculators moderate price and consumption instability, they are part of the invisible-hand mechanism that performs the socially useful function of reallocating goods from feast times (when prices are low) to famine times (when prices are high).
4. Speculative markets allow individuals to hedge against unwelcome risks. The economic principle of risk aversion, which derives from diminishing marginal utility, implies that individuals will not accept risky situations with zero expected value. Risk aversion implies that people will buy insurance to reduce the potentially disastrous declines in utility from fire, death, or other calamities.

B. The Economics of Insurance

5. Insurance and risk spreading tend to stabilize consumption in different states of nature. Insurance takes large individual risks and spreads them so broadly that they become acceptable to a large number of individuals. Insurance is beneficial because, by helping to equalize consumption across different uncertain states, it raises the expected level of utility.
6. The conditions necessary for the operation of efficient insurance markets are stringent: there must be large numbers of independent events and little chance of moral hazard or adverse selection. When market failures such as adverse selection arise, prices may be distorted or markets may simply not exist.
7. If private insurance markets fail, the government may step in to provide social insurance. Social insurance is provided by governments when private insurance markets cannot function effectively and society believes that individuals should have a social safety net for major risks such as unemployment, illness, and low incomes. Even in the most laissez-faire of advanced market economies today, governments insure against unemployment and health risks in old age.

C. Health Care: The Problem That Won't Go Away

8. Health care is the largest social insurance program. The health-care market is characterized by multiple market failures that lead governments to intervene. Health-care systems have major externalities. Additionally, the asymmetric information between doctors and patients leads to uncertainties about the appropriate treatment and level of care, and the asymmetry between patients and insurance companies leads to adverse selection in the purchase of insurance. Finally, because health care is so important to human welfare and to labor productivity, most governments strive to provide a minimum standard of health care to the population.
9. When the government subsidizes health care and attempts to provide universal coverage, there will be excess demand for medical services. One of the challenges is to develop efficient and equitable mechanisms of nonprice rationing.

D. Innovation and Information

10. Schumpeter emphasized the importance of the innovator, who introduces "new combinations" in the form of new products and new methods of organization and is rewarded by temporary entrepreneurial profits.
11. Today, the economics of information emphasizes the difficulties involved in the efficient production and distribution of new and improved knowledge. Information is different from ordinary goods because it is expensive to produce but cheap to reproduce. The inability of firms to capture the full monetary value of their inventions is called inappropriability. To increase appropriability, governments create intellectual property rights governing patents, copyrights, trade secrets, and electronic media. The growth of electronic information systems like the Internet has increased the dilemma of how to efficiently price information services.

CONCEPTS FOR REVIEW

Risk, Uncertainty, and Insurance

arbitrage leading to regional equalization of prices
ideal seasonal price pattern
speculation, arbitrage, hedging
risk aversion and diminishing marginal utility
consumption stability vs. instability
insurance and risk spreading
moral hazard, adverse selection
social insurance
nonprice rationing

Economics of Information

information economics
inappropriability, protection of intellectual property rights, dilemma of efficient production of knowledge
market failure in information

FURTHER READING AND INTERNET WEBSITES

Further Reading

The concept of social insurance was described by Martin Feldstein in "Rethinking Social Insurance," *American Economic Review,* March 2005 and available at *www.nber.org/feldstein/aeajan8.pdf*.

For an analysis of gambling, see William R. Eadington, "The Economics of Casino Gambling," *Journal of Economic Perspectives,* Summer 1999.

The Schumpeterian hypothesis was developed in Joseph Schumpeter, *Capitalism, Socialism, and Democracy* (Harper & Row, New York, 1942).

Many of the economic, business, and policy issues involved in the new information economy are covered in a nontechnical book by two eminent economists, Carl Shapiro and Hal R. Varian, *Information Rules* (Harvard Business School Press, Cambridge, Mass., 1998). A discussion of the economics of the Internet is contained in Jeffrey K. MacKie-Mason and Hal Varian, "Economic FAQs about the Internet," *Journal of Economic Perspectives*, Summer 1994, p. 92.

A discussion by the U.S. government of Chinese infringement of intellectual property rights can be found at *www.ustr.gov/Document_Library/Reports_Publications/Section_Index.html*.

Websites

One of the most interesting websites about the Internet and intellectual property rights is compiled by Hal R. Varian, chief economist of Google and former dean of the School of Information Management and Systems at the University of California at Berkeley. This site, called "The Economics of the Internet, Information Goods, Intellectual Property and Related Issues," is at *www.sims.berkeley.edu/resources/infoecon*.

Information on the American health-care system is usefully compiled by the National Center on Health Statistics at *www.cdc.gov/nchs/*.

QUESTIONS FOR DISCUSSION

1. Suppose a friend offers to flip a fair coin, with you paying your friend $100 if it comes up heads and your friend paying you $100 if it comes up tails. Explain why the expected dollar value is $0. Then explain why the expected utility value is negative if you are risk-averse.
2. Consider the example of grade insurance (see page 218). Suppose that with a grade-insurance policy, students would be compensated $5000 a year for each point that their grade point average fell below the top grade (the resulting number might be an estimate of the impact of grades on future earnings). Explain why the presence of grade insurance would produce moral hazard and adverse selection. Why would moral hazard and adverse selection make insurance companies reluctant to sell grade insurance? Are you surprised that you cannot buy grade insurance?
3. After the terrorist attacks of September 11, 2001, most insurance companies canceled their insurance coverage for terrorism. According to President Bush, "More than $15 billion in real estate transactions have been canceled or put on hold because owners and investors could not obtain the insurance protection they need."

As a result, the federal government stepped in to provide coverage for up to $90 billion in claims. Using the principles of insurance, explain why insurance companies might decline to insure property against terrorist attacks. Explain whether or not you think the federal program is an appropriate form of social insurance.

4. In the early nineteenth century, little of the nation's agricultural output was sold in markets, and transportation costs were very high. What would you expect to have been the degree of price variation across regions as compared with that of today?

5. Assume that a firm is making a risky investment (say, spending $2 billion developing a competitor to Windows). Can you see how the diversified ownership of this firm could allow near-perfect risk spreading on the software investment?

6. Health insurance companies sometimes do not allow new participants to be covered on "existing conditions," or preexisting illnesses. Explain why this policy might alleviate problems of adverse selection.

7. Joseph Schumpeter wrote as follows:

> The modern standard of life of the masses evolved during the period of relatively unfettered "big business." If we list the items that enter the modern workman's budget and, from 1899 on, observe the course of their prices, we cannot fail to be struck by the rate of the advance which, considering the spectacular improvement in qualities, seems to have been greater and not smaller than it ever was before. Nor is this all. As soon as we inquire into the individual items in which progress was most conspicuous, the trail leads not to the doors of those firms that work under conditions of comparatively free competition but precisely to the doors of the large concerns—which, as in the case of agricultural machinery, also account for much of the progress in the competitive sector—and a shocking suspicion dawns upon us that big business may have had more to do with creating that standard of life than keeping it down. (*Capitalism, Socialism, and Democracy*)

Use this passage to describe the tradeoff between "static" monopoly inefficiencies and "dynamic" efficiencies of technological change.

8. Long-term care for the elderly involves helping individuals with activities (such as bathing, dressing, and toileting) that they cannot perform for themselves. How were these needs taken care of a century ago? Explain why moral hazard and adverse selection make long-term-care insurance so expensive today that few people choose to buy it.

9. Economic studies have found that the private rate of return on inventions is typically as low as one-third of the social return. Explain this finding in terms of the economics of innovation.

PART THREE

Factor Markets: Labor, Land, and Capital

CHAPTER

12

How Markets Determine Incomes

You know, Ernest, the rich are different from us.

F. Scott Fitzgerald

Yes, I know. They have more money than we do.

Ernest Hemingway

A. INCOME AND WEALTH

Earlier chapters have surveyed the output and prices of goods and services produced by tiny farms and giant corporations. But the vast array of products that we enjoy do not simply gush from the earth—they are produced by workers who are equipped with machines, which are housed in factories, which are sitting on land. These inputs into the productive process earn factor incomes—wages, profits, interest, and rents. The time has come to understand the determination of factor prices along with the forces that affect the distribution of income among the population.

America is a land of extremes of income and wealth. If you are one of the 400 richest Americans, you are likely to be a 60-year-old white male with a degree from a top university and a net worth of about $4 billion. This tiny sliver of American society owns about 3 percent of the total wealth of the country. In the past, you made your fortune in manufacturing or real estate, but recent billionaires come largely from information technology and finance. Your voyage to the top was as much the product of birth as of brains, for your family probably gave you a head start with an expensive education, but there are more self-made men and women today than there were a decade ago.

At the other extreme are forgotten people who never make the cover of *Forbes* or *People* magazine. Listen to the story of Robert Clark, homeless and unemployed. A roofer and Vietnam veteran, he came to Miami from Detroit looking for work. He slept on the city streets on a piece of cardboard covered by a stolen sheet. Every day he and other homeless men crept out of the culverts into the daylight to work for temporary-employment firms. These firms charged clients $8 to $10 an hour, paid the men the minimum wage, and then took most of the money back for transportation and tools. Clark's pay stub showed earnings of $31.28 for 31 hours of work.

How can we understand these extremes of income and wealth? Why are some people paid $10 million a year, while others net only $1 an hour? Why is real estate in Tokyo or Manhattan worth thousands of dollars a square foot, while land in the desert may sell for but a few dollars an acre? And what is the source of the billions of dollars of profits earned by giant enterprises like Microsoft and General Electric?

Questions about the distribution of income are among the most controversial in all economics.

Some people argue that high incomes are the unfair result of past inheritance and luck while poverty stems from discrimination and lack of opportunity. Others believe that people get what they deserve and that interfering with the market distribution of income would injure an economy's efficiency and make everyone worse off. Government programs in America today reflect an uneasy consensus that incomes should be largely determined by market earnings but the government should provide a social safety net to catch the deserving poor who fall below some minimum standard of living.

INCOME

In measuring the economic status of a person or a nation, the two yardsticks most often used are income and wealth. **Income** refers to the flow of wages, interest payments, dividends, and other things of value accruing during a period of time (usually a year). The aggregate of all incomes is *national income,* the components of which are shown in Table 12-1. The biggest share of national income goes to labor, either as wages or salaries or as fringe benefits. The remainder goes to the different types of *property income:* rent, net interest, corporate profits, and proprietors' income. This last category basically includes the returns to the owners of small businesses.[1]

The earnings in a market economy are distributed to the owners of the economy's factors of production in the form of wages, profits, rent, and interest.

Factor Incomes vs. Personal Incomes

It is important to understand the distinction between factor incomes and personal incomes. Table 12-1 reports the distribution of factor incomes—the division between labor and property incomes. But the same person may own many different factors of production. For example, someone might receive a salary, earn interest on money in a savings account, get dividends from shares in a mutual fund, and collect rent on a real-estate investment. In economic language, we observe that a person's market income is

[1] Economists and accountants often measure "income" in different ways. We studied accounting measures of income and wealth in Chapter 7.

Type of income	Amount ($, billion)	Share of total (%)	Examples
Labor income:			
Wages and salaries	6,356	51.8	Autoworker's wages; teacher's salary
Benefits and other labor income	1,457	11.9	Company contribution to pension fund
Property income:			
Proprietors' income	1,056	8.6	Barber's earnings; lawyer's share of partnership net income
Rental income	40	0.3	Landlord's rent from apartments after expenses and depreciation
Corporate profits	1,642	13.4	Microsoft's profits
Net interest	664	5.4	Interest paid on savings account
Taxes on production and other	1,056	8.6	
Total	**12,271**	**100.0**	

TABLE 12-1. Division of National Income, 2007

National income includes all the incomes paid to factors of production. Almost three-quarters consists of wages and other kinds of compensation of labor, while the rest is divided among rents, corporate profits, and the incomes of proprietors.

Source: U.S. Department of Commerce, Bureau of Economic Analysis, at the Web page *www.bea.gov.*

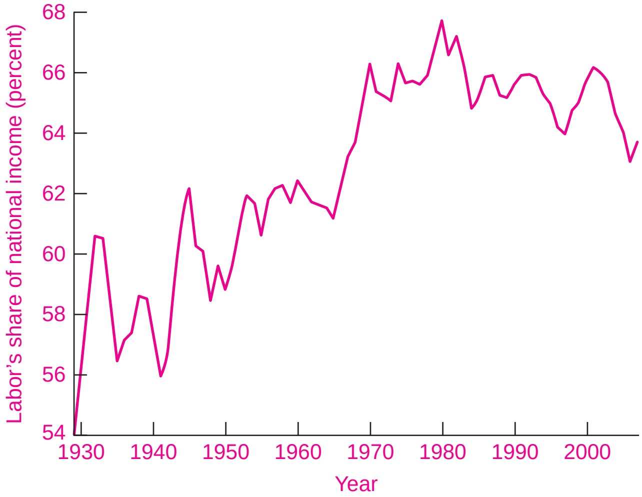


FIGURE 12-1. The Share of Labor in National Income

The share of labor income increased gradually until 1970. Since then, it has been remarkably stable at around two-thirds of national income. The remainder of income is distributed among rents, interest, corporate profits, and proprietors' income and miscellaneous items like production taxes.

simply the quantities of factors of production sold by that person times the wage or price of each factor.

About two-thirds of national income goes to labor, while the rest is distributed as some form of returns to property. The last quarter-century has been a turbulent one. What has been the impact of energy shortages, the computer revolution, globalization, corporate downsizing, and the financial turmoil of recent years on labor's share of the total income pie? Looking at Figure 12-1, we can see that the share of national income going to labor has changed very little since 1970. This is one of the remarkable features of the income distribution in the United States.

Role of Government

How does government fit into this picture? Governments at every level form the largest source of wages, rents, and interest payments. The results of government purchases are included in the payments to factors of production shown in Table 12-1.

Yet government also has a direct role in incomes that does not show up in Table 12-1. To begin with, the government collects a sizable share of national income through taxation and other levies. In 2008 about 30 percent of gross domestic product was collected by federal, state, and local governments as various types of taxes, including personal income taxes, corporate-profit taxes, and social security taxes.

But what governments tax, they also spend or give away. Governments at all levels provide incomes in the form of **transfer payments,** which are payments by governments to individuals that are not made in return for current goods or services. The biggest single category of transfer payments is social security for older Americans, but transfer payments also include unemployment insurance, farm subsidies, and welfare payments. Whereas Americans derived almost none of their incomes from governments in 1929, fully 15 percent of personal incomes in 2008 came from government transfer payments.

Personal income equals market income plus transfer payments. Most market income comes from wages and salaries; a small, affluent minority derives its market income from earnings on property. The major component of government transfers is social security payments to the elderly.

WEALTH

We see that some income comes from interest or dividends on holdings of bonds or stocks. This brings us to the second important economic concept: **Wealth** consists of the net dollar value of assets owned at a given point in time. Note that wealth is a *stock* (like the volume of a lake) while income is a *flow* per unit of time (like the flow of a stream). A household's wealth

Distribution of Assets of All Families as Percentage of All Assets, 1989–2004

	Percentage of Total Assets		
	1989	1995	2004
Financial:			
Bank deposits and similar	9.4	7.7	6.2
Bonds	3.1	2.3	1.9
Stocks	6.2	10.4	11.5
Retirement accounts	6.6	10.3	11.4
Other	5.3	6.0	4.7
Tangible and other assets:			
Own home	31.9	30.0	32.3
Other real estate and property	13.4	10.0	11.1
Vehicles	3.9	4.5	3.3
Business equity	18.6	17.2	16.7
Other	1.7	1.5	1.0
	Thousands of 2004 Dollars		
Family net worth:			
Median	68.9	70.8	93.1
Average	272.3	260.8	448.2

TABLE 12-2. Trends in Wealth of American Households

Households own tangible assets (such as houses and cars) as well as financial assets (such as savings accounts and stocks). The largest single asset for most Americans continues to be the family home. The median wealth is much smaller than the average, reflecting the great inequality of wealth holding.

Source: Federal Reserve Board, Survey of Consumer Finances, available in *Federal Reserve Bulletin or at www federalreserve.gov/ Pubs/oss/oss2/2004/bull0206.pdf.*

includes its tangible items (houses, cars and other consumer durable goods, and land) and its financial holdings (such as cash, savings accounts, bonds, and stocks). All items that are of value are called *assets,* while those that are owed are called *liabilities.* The difference between total assets and total liabilities is called wealth or *net worth.*

Table 12-2 presents a breakdown of the asset holdings of Americans from 1989 to 2004. The single most important asset of most households is the family home: 68 percent of families own houses, as compared with 55 percent a generation ago. Most households own a modest amount of financial wealth in savings accounts, and about one-fifth directly own corporate stocks. But it turns out that a large proportion of the nation's financial wealth is concentrated in the hands of a small fraction of the population. About one-third of all wealth is owned by the richest 1 percent of American households.

B. INPUT PRICING BY MARGINAL PRODUCTIVITY

The **theory of income distribution** (or **distribution theory**) studies how incomes are determined in a market economy. People are often puzzled by the vast differences in incomes of different families. Are they caused by differences in talents? By monopoly power? By government intervention? Why is Bill Gates worth $60 billion while half of American black families have net worth less than $20 thousand? Why are land prices so much higher in the city than in the desert?

Our first answer to these questions is that the distribution theory is a special case of the theory of prices. Wages are the price of labor; rents are the price for using land; and so forth. Moreover, the prices of factors of production are primarily set by the interaction between supply and demand for different factors—just as the prices of goods are largely determined by the supply and demand for goods.

But pointing to supply and demand is just the first step on the road to understanding income distribution in a competitive market economy. We will see that the key to incomes lies in the *marginal products* of different factors of production. In this section, we will see that wages are determined by the value of the *marginal product of labor,* or what is known as the marginal revenue product of labor. The same holds for other factors of production as well. We first discuss this new concept and then show how it solves the puzzle of how incomes are determined.

THE NATURE OF FACTOR DEMANDS

The demand for factors differs from that for consumption goods in two important respects: (1) Factor demands are derived demands, and (2) factor demands are interdependent demands.

Demands for Factors Are Derived Demands

Let's consider the demand for office space by a firm which produces computer software. A software company will rent office space for its programmers, customer service representatives, and other workers. Similarly, other companies like pizza shops or banks will need space for their activities. In each region, there will be a downward-sloping demand curve for office space linking the rental being charged by landlords to the amount of office space desired by companies—the lower the price, the more space companies will want to rent.

But there is an essential difference between ordinary demands by consumers and the demand by firms for inputs. Consumers demand final goods like computer games or pizzas because of the direct enjoyment or utility these consumption goods provide. By contrast, a business does not pay for inputs like office space because they yield direct satisfaction. Rather, it buys inputs because of the production and revenue that it can gain from employment of those factors.

Satisfactions are in the picture for inputs—but at one stage removed. The satisfaction that consumers get from playing computer games determines how many games the software company can sell, how many clerks it needs, and how much office space it must rent. The more successful its software, the greater its demand for office space. An accurate analysis of the demand for inputs must, therefore, recognize that consumer demands do *ultimately* determine business demands for office space.

This analysis is not limited to office space. Consumer demands determine the demand for all inputs, including farmland, oil, and pizza ovens. Can you see how the demand for professors of economics is ultimately determined by the demand for economics courses by students?

The firm's demand for inputs is derived indirectly from the consumer demand for its final product.

Economists therefore speak of the demand for productive factors as a **derived demand.** This means that when firms demand an input, they do so because that input permits them to produce a good which consumers desire now or in the future. Figure 12-2 on page 234 shows how the demand for a given input, such as fertile cornland, must be regarded as being derived from the consumer demand curve for corn. In the same way, the demand for office space is derived from the consumer demand for software and all the other products and services provided by the companies that rent office space.

Demands for Factors Are Interdependent

Production is a team effort. A chain saw by itself is useless for cutting down a tree. A worker with empty hands is equally worthless. Together, the worker and the saw can cut the tree very nicely. In other words, the productivity of one factor, such as labor, depends upon the amount of other factors available to work with.

Therefore, it is generally impossible to say how much output has been created by a single input taken by itself. Asking which factor is more important is like asking whether a mother or a father is more essential in producing a baby.

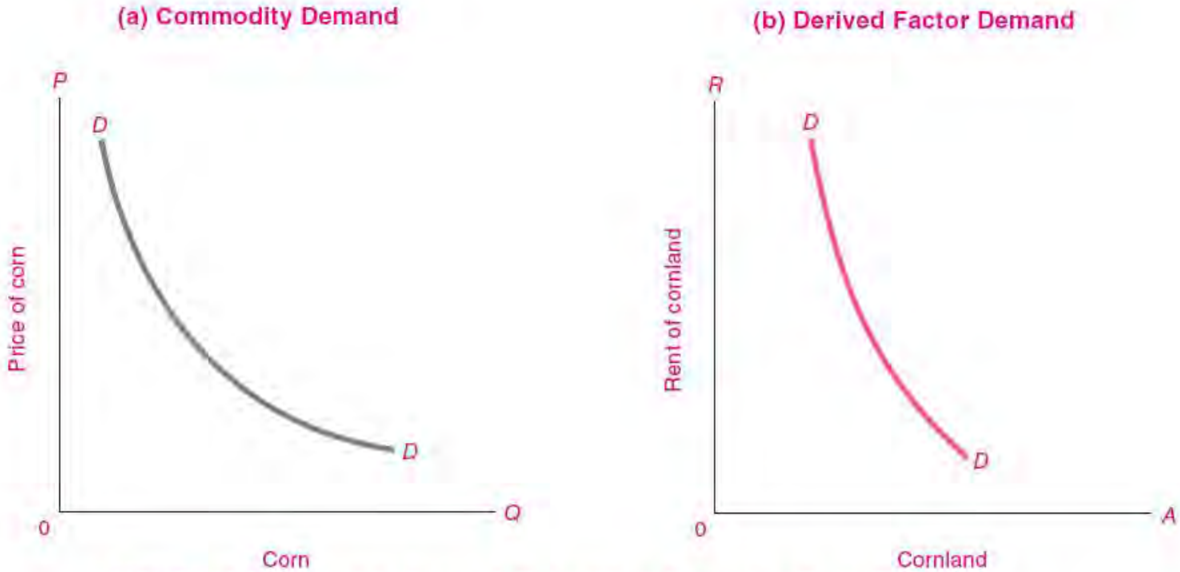


FIGURE 12-2. Demand for Factors Is Derived from Demand for Goods They Produce

The green curve of derived demand for cornland comes from the blue curve of commodity demand for corn. Shift the blue curve out, and out goes the green curve. If the blue commodity curve becomes more inelastic, the same tends to happen to the green input demand curve.

It is the *interdependence* of productivities of land, labor, and capital that makes the distribution of income a complex topic. Suppose that you were in charge of determining the income distribution of a country. If land had by itself produced so much, and labor had by itself produced so much, and machinery had by itself produced the rest, distribution would be easy. Moreover, under supply and demand, if each factor produced a certain amount by itself, it could enjoy the undivided fruits of its own work.

But reread the above paragraph and underline such words as "by itself." They refer to a fantasy world of independent productivities which simply does not exist in reality. When an omelette is produced by chef's labor and chicken's eggs and cow's butter and land's natural gas, how can you unscramble the separate contributions of each input?

To find the answer, we must look to the interaction of marginal productivities and factor supplies—both of which determine the competitive prices and quantities of factors of production.

Review of Production Theory

Before showing the relationship between factor prices and marginal products, we will review the essentials of Chapter 6's production theory.

The theory of production begins with the notion of the *production function*. The production function indicates the maximum amount of output that can be produced, with a given state of technical knowledge, for each combination of factor inputs. The production-function concept provides a rigorous definition of marginal product. Recall that the *marginal product* of an input is the extra product or output added by 1 extra unit of that input while other inputs are held constant.[2] The first three columns

[2] Note that the marginal product of a factor is expressed in *physical* units of product per unit of additional input. So economists sometimes use the term "marginal physical product" rather than "marginal product," particularly when they want to avoid any possible confusion with a concept we will soon encounter called "marginal revenue product." For brevity, we will skip the word "physical" and abbreviate marginal product as *MP*.

Marginal Revenue Product

(1) Unit of labor (workers)	(2) Total product (bushels)	(3) Marginal product of labor (bushels per worker)	(4) Price of output ($ per bushel)	(5) Marginal revenue product of labor ($ per worker)
0	0			
		20,000	3	60,000
1	20,000			
		10,000	3	30,000
2	30,000			
		5,000	3	15,000
3	35,000			
		3,000	3	9,000
4	38,000			
		1,000	3	3,000
5	39,000			

TABLE 12-3. Calculation of Marginal Revenue Product for Perfectly Competitive Firm

The marginal product of labor is shown in column (3). Marginal revenue product of labor shows how much additional revenue the firm receives when an additional unit of labor is employed. It equals the marginal product in column (3) times the competitive output price in column (4).

of Table 12-3 provide a review of the way marginal products are calculated.

As a final element of review, recall the *law of diminishing returns*. Column (3) of Table 12-3 shows that each successive unit of labor has a declining marginal product. "Declining marginal product" is another name for diminishing returns. Moreover, we can interchange land for labor, varying the amount of land while holding constant labor and other inputs, and we would generally observe the law of diminishing returns at work for land as well as for labor.

DISTRIBUTION THEORY AND MARGINAL REVENUE PRODUCT

The fundamental point about distribution theory is that *the demands for the various factors of production are derived from the revenues that each factor yields on its marginal product.* Before showing this result, we begin by defining some new terms.

Marginal Revenue Product

We can use the tools of production theory to devise a key concept, *marginal revenue product (MRP).* Suppose we are operating a giant shirt factory. We know how many shirts each additional worker produces. But the firm wants to maximize profits measured in dollars, for it pays salaries and dividends with money, not with shirts. We therefore need a concept that measures the additional *dollars* each additional unit of input produces. Economists give the name "marginal revenue product" to the money value of the additional output generated by an extra unit of input.

The **marginal revenue product** of input A is the additional revenue produced by an additional unit of input A.

Perfectly Competitive Case. It is easy to calculate marginal revenue product when product markets are perfectly competitive. In this case, each unit of the worker's marginal product (MP_L) can be sold at the competitive output price (P). Moreover, since we are considering perfect competition, the output price is unaffected by the firm's output, and price therefore equals marginal revenue (MR). If we have an MP_L of 10,000 bushels and a price and MR of \$3, the dollar value of the output produced by the last worker—the marginal revenue product of labor (MRP_L)—is \$30,000 (equal to 10,000 × \$3). This is shown in column (5) of Table 12-3. Hence, under perfect competition, each worker is worth to the firm the dollar value of the last worker's marginal product; the value of each acre of land is the marginal product of land times the output price; and so forth for each factor.

Table 12-3 provides the essential linkage between production theory and factor demand theory; it should be studied carefully. The first three columns show the inputs, output, and marginal product of labor. Multiplying the MP in column (3) by the price in column (4), we derive the marginal revenue product of labor (in dollars per worker) in column (5). It is this last column which is critical for determining the demand for labor, as we will see later in this chapter. Once we know the wage rate, we can calculate the demand for labor from column (5).

Imperfect Competition. What happens in the case of imperfect competition, where the individual firm's demand curve is downward-sloping? Here, the marginal revenue received from each extra unit of output sold is less than the price because the firm must lower its price on previous units to sell an additional unit. Each unit of marginal product will be worth $MR < P$ to the firm.

To continue our previous example, say that the MR is \$2 while the price is \$3. Then the MRP of the second worker in Table 12-3 would be \$20,000 (equal to the MP_L of 10,000 × the MR of \$2), rather than the \$30,000 of the competitive case.
To summarize:

Marginal revenue product represents the additional revenue a firm earns from using an additional unit of an input, with other inputs held constant. It is calculated as the marginal product of the input multiplied by the marginal revenue obtained from selling an extra unit of output. This holds for labor (L), land (A), and other inputs. In symbols:

$$\text{Marginal revenue product of labor } (MRP_L) = MR \times MP_L$$

$$\text{Marginal revenue product of land } (MRP_A) = MR \times MP_A$$

and so forth.

Under conditions of perfect competition, because $P = MR$, this implies:

$$\text{Marginal revenue product } (MRP_i) = P \times MP_i$$

for each input.

THE DEMAND FOR FACTORS OF PRODUCTION

Having analyzed the underlying concepts, we now show how profit-maximizing firms decide upon the optimal combination of inputs, which allows us to derive the demand for inputs.

Factor Demands for Profit-Maximizing Firms

What determines the demand for any factor of production? We can answer this question by analyzing how a profit-oriented firm chooses its optimal combination of inputs.

Imagine that you are a profit-maximizing farmer. In your area, you can hire all the farmhands you want at \$20,000 per worker. Your accountant hands you a spreadsheet with the data in Table 12-3. How would you proceed?

You could try out different possibilities. If you hire one worker, the additional revenue (the MRP) is \$60,000 while the marginal cost of the worker is \$20,000, so your extra profit is \$40,000. A second worker gives you an MRP of \$30,000 for an additional profit of \$10,000. The third worker produces extra output yielding revenue of only \$15,000 but costs \$20,000; hence, it is not profitable to hire the third worker. Table 12-3 shows that the maximum profit is earned by hiring two workers.

By using this reasoning, we can derive the rule for choosing the optimal combination of inputs:

To maximize profits, firms should add inputs up to the point where the marginal revenue product of the input equals the marginal cost or price of the input.

For perfectly competitive factor markets, the rule is even simpler. Recall that under perfect competition the marginal revenue product equals price times marginal product ($MRP = P \times MP$).

The profit-maximizing combination of inputs for a perfectly competitive firm comes when the marginal product times the output price equals the price of the input:

$$\text{Marginal product of labor} \times \text{output price} = \text{price of labor} = \text{wage rate}$$

$$\text{Marginal product of land} \times \text{output price} = \text{price of land} = \text{rent}$$

and so forth.

We can understand this rule by the following reasoning: Say that each kind of input is bundled into little packages each worth \$1—packages of \$1 worth of labor, \$1 worth of land, and so forth. To maximize profits, firms will purchase inputs up to that point where each little \$1 package produces output which is worth just \$1. In other words, each \$1 input package will produce *MP* units of corn so that the $MP \times P$ just equals \$1. The *MRP* of the \$1 units is then exactly \$1 under profit maximization.

Least-Cost Rule. We can restate the condition much more generally in a way that applies to both perfect and imperfect competition in product markets (as long as factor markets are competitive). Reorganizing the basic conditions shown above, profit maximization implies:

$$\frac{\text{Marginal product of labor}}{\text{Price of labor}} = \frac{\text{marginal product of land}}{\text{price of land}} = \cdots = \frac{1}{\text{marginal revenue}}$$

Suppose that you own a cable television monopoly. If you want to maximize profits, you will want to choose the best combination of workers, land easements for your cables, trucks, and testing equipment to minimize costs. If a month's truck rental costs \$8000 while monthly labor costs per worker are \$800, costs are minimized when the marginal products *per dollar of input* are the same. Since trucks cost 10 times as much as labor, truck *MP* must be 10 times labor *MP*.

Least-cost rule: Costs are minimized when the marginal product per dollar of input is equalized for each input. This holds for both perfect and imperfect competitors in product markets.

Marginal Revenue Product and the Demand for Factors

Having derived the *MRP* for different factors, we can now understand the demand for factors of production. We just saw that a profit-maximizing firm would choose input quantities such that the price of each input equaled the *MRP* of that input. This means that from the *MRP* schedule for an input, we can immediately determine the relationship between the price of the input and the quantity demanded of that input. This relationship is what we call the input demand curve.

Glance back at Table 12-3 on page 235. This table shows in the last column the *MRP* of labor for our corn farm. By the profit-maximizing condition, we know that at a wage of \$60,000 the firm would choose 1 unit of labor; at a \$30,000 wage, 2 units of labor would be sought; and so forth.

The *MRP* schedule for each input gives the demand schedule of the firm for that input.

We have used this result in Figure 12-3 to draw a labor demand curve for our corn farm using the data shown in Table 12-3. We have in addition drawn a smooth curve through the individual points to show how the demand curve would appear if fractional units of labor could be purchased.

From Firm to Market Demand. The final step in determining the demand for labor and other factors is the aggregation of the demand curves for different firms. As with all demand curves, the competitive-market demand curve is the *horizontal summation of the demand curves of all the firms.* Hence, if there were 1000 identical firms, then the market demand for labor would be exactly like that in Figure 12-3 except the horizontal axis would have each entry multiplied by 1000. We see, then, that the competitive demand

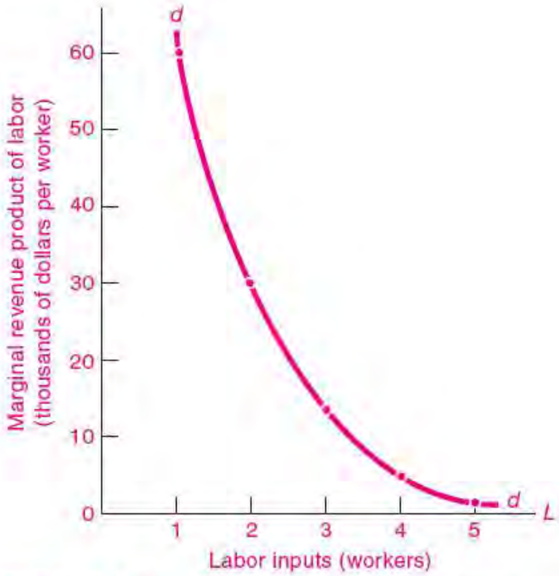


FIGURE 12-3. Demand for Inputs Derived through Marginal Revenue Products

The demand for labor is derived from the marginal revenue product of labor. This figure uses the data for the competitive firm displayed in Table 12-3.

for factors of production is determined by the sum of the demands of all the firms at each marginal revenue product.

Substitution Rule. A corollary of the least-cost rule is the **substitution rule:** If the price of one factor rises while other factor prices remain fixed, the firm will profit from substituting more of the other inputs for the more expensive factor. A rise in labor's price, P_L, will reduce MP_L/P_L. Firms will respond by reducing employment and increasing land use until equality of marginal products per dollar of input is restored—thus lowering the amount of needed L and increasing the demand for land acres. A rise in land's price alone will, by the same logic, cause labor to be substituted for more expensive land. Like the least-cost rule, the substitution rule and the derived demand for factors apply to both perfect and imperfect competition in product markets.

SUPPLY OF FACTORS OF PRODUCTION

A complete analysis of the determination of factor prices and of incomes must combine both the demand for inputs just described and the supplies of different factors. The general principles of supply vary from input to input, and this topic will be explored in depth in the following chapters. At this point we provide a few introductory comments.

In a market economy, most factors of production are privately owned. People "own" their labor in the sense that they control its use; but this crucial "human capital" can today only be rented, not sold. Capital and land are generally privately owned by households and by businesses.

Decisions about *labor* supply are determined by many economic and noneconomic factors. The important determinants of labor supply are the price of labor (i.e., the wage rate) and demographic factors, such as age, gender, education, and family structure. The quantity of *land* and other natural resources is determined by geology and cannot be significantly changed, although the quality of land is affected by conservation, settlement patterns, and improvements. The supply of *capital* depends upon past investments made by businesses, households, and governments. In the short run, the stock of capital is fixed like land, but in the long run the supply of capital reacts to economic factors such as risks, taxes, and rates of return.

Can we say anything about the elasticity of supply of inputs? Actually, the supply curve may slope positively or be vertical and might even have a negative slope. For most factors, we would expect that the supply responds positively to the factor's price in the long run; in this case, the supply curve would slope upward and to the right. The *total* supply of land is usually thought to be unaffected by price, and in this case the *total* supply of land will be perfectly inelastic, with a vertical supply curve. In some special cases, when the return to the factor increases, owners may supply less of the factor to the market. For example, if people feel they can afford to work fewer hours when wages rise, the supply curve for labor might bend backward at high wage rates, rather than slope upward.

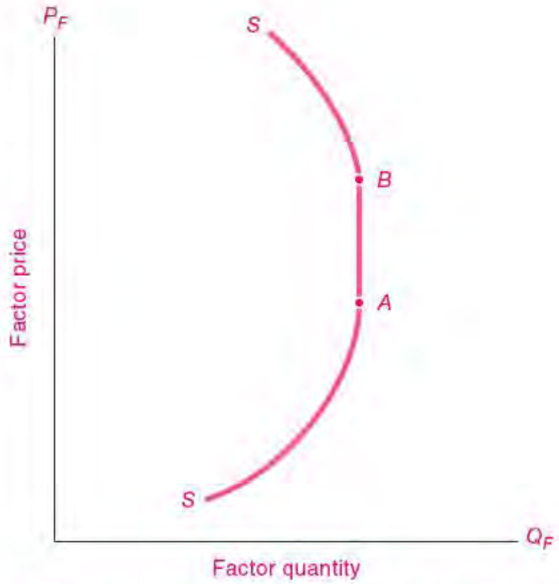


FIGURE 12-4. Supply Curve for Factors of Production

Supplies of factors of production depend upon characteristics of the factors and the preferences of their owners. Generally, supplies will respond positively to price, as in the region below *A*. For factors that are fixed in supply, like land, the supply curve will be perfectly inelastic, as from *A* to *B*. In special cases where a higher price of the factor increases the income of its owner greatly, as with labor or oil, the supply curve may bend backward, as in the region above *B*.

The different possible elasticities for the supply of factors are illustrated by the *SS* supply curve shown in Figure 12-4.

DETERMINATION OF FACTOR PRICES BY SUPPLY AND DEMAND

A full analysis of the distribution of income must combine the supply of and demand for factors of production. Earlier parts of this section provided the underpinnings for analysis of demand and gave a brief description of supply. We showed that, for given factor prices, profit-maximizing firms would choose input combinations according to their marginal revenue products. As the price of land falls, each farmer would substitute land for other inputs such as labor, machinery, and fertilizer. Each farmer therefore would show a demand for cornland inputs like that in Figure 12-2(*b*).

How do we obtain the *market demand* for inputs (whether cornland, unskilled labor, or computers)? We add together the individual demands of each of the firms. Thus at a given price of land, we add together all the demands for land of all the firms at that price; and we do the same at every price of land. In other words, *we add horizontally the demand curves for land of all the individual firms to obtain the market demand curve for land.* We follow the same procedure for any input, summing up all the derived demands of all the businesses to get the market demand for each input. And in each case, the derived demand for the input is based on the marginal revenue product of the input under consideration.[3] Figure 12-5 shows a general demand curve for a factor of production as the *DD* curve.

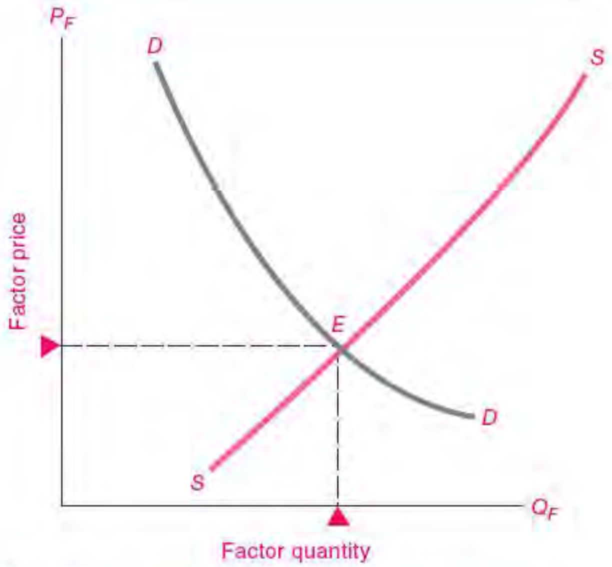


FIGURE 12-5. Factor Supply and Derived Demand Interact to Determine Factor Prices and Income Distribution

Factor prices and quantities are determined by the interaction of factor supply and demand.

[3] Note that this process of adding factor demand curves horizontally is exactly the same procedure that we followed in obtaining market demand curves for goods in Chapter 5.

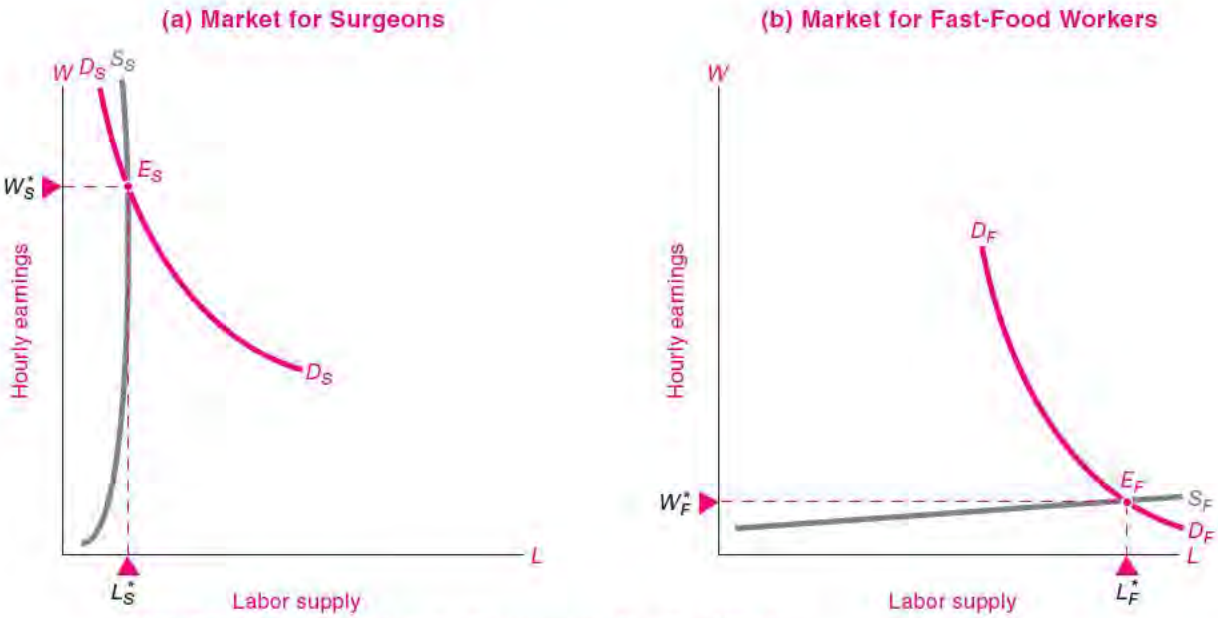


FIGURE 12-6. The Markets for Surgeons and Fast-Food Workers

In (a), we see the impact of a limited supply of surgeons: small output and high earnings per surgeon. What would be the effect on total earnings of surgeons and on the price of an operation if an aging population increased the demand for surgeons?

In (b), open entry and low skill requirements imply a highly elastic supply of fast-food workers. Wages are beaten down and employment is high. What would be the effect on wages and employment if more teenagers looked for jobs?

How do we find the overall market equilibrium? *The equilibrium price of the input in a competitive market comes at that level where the quantities supplied and demanded are equal.* This is illustrated in Figure 12-5, where the derived demand curve for a factor intersects its supply curve at point *E*. Only at this price will the amount that owners of the factor willingly supply just balance the amount that the buyers willingly purchase.

The Wages of Slicers and Flippers

We can apply these concepts to two factor markets to see why disparities in incomes are so high. Figure 12-6 shows the markets for two kinds of labor—surgeons and fast-food workers. The supply of surgeons is severely limited by the need for medical licensing and the length and cost of education and training. Demand for surgery is growing rapidly, along with other health-care services. The result is that surgeons earn $300,000 a year on average. Moreover, an increase in demand will result in a sharp increase in earnings, with little increase in the number of surgeons.

At the other end of the earnings scale are fast-food workers. These jobs have no skill or educational requirements and are open to virtually everyone. The supply of food workers is highly elastic. As the demand for fast foods increased in recent years, employment grew sharply. Because of the ease of entry into this market, the average full-time fast-food employee was near the bottom of the earnings pyramid at $19,000 a year. What is the reason for the vast difference in earning power of surgeons and hamburger flippers? It is mainly the quality of labor, not the quantity of hours.

The Rich and the Rest

If you are one of the richest Americans, you might have $50 million of interest, dividends, and other property income, while the median household earns less than

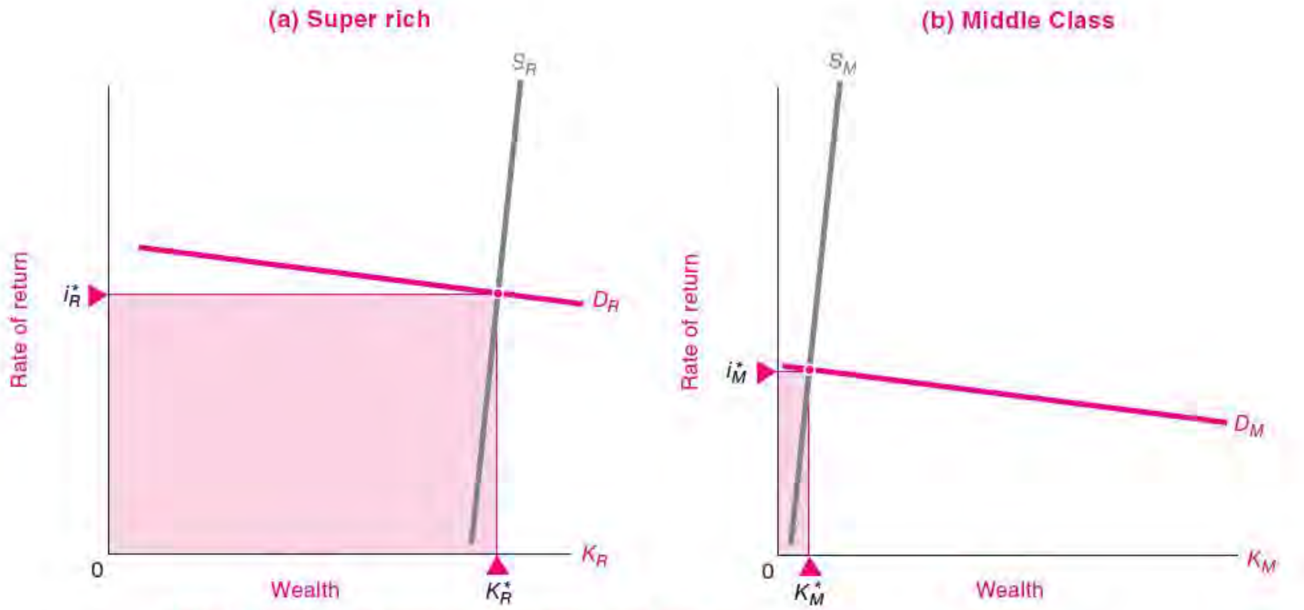


FIGURE 12-7. Differences in Total Returns to Wealth

This figure shows the demand and supply for wealth held by the super rich and the middle class. The horizontal axis shows the total wealth, while the vertical axis shows the rate of return on wealth. The shaded region is $r \times W$, or total income earned on wealth. Why is the shaded rectangle of the rich so much larger than that of the middle class? The reason is primarily that the wealth of the rich (K_R) is so much larger than that of the middle class (K_M).

$1000 a year on its financial wealth. Figure 12-7 explains this difference. The rate of return on stocks or bonds is not that much higher for the richest than for the middle class.

Rather, the rich have a much bigger wealth base on which to earn. The shaded rectangles in Figure 12-7 show the capital earnings of the two groups. Make sure you understand that it is the amount of wealth rather than the rate of return that makes the rectangle of the top wealth holders so large.

These two examples show how factor prices and individual incomes are determined by underlying market forces. Supply and demand operate to create high returns to factors that have either limited supply or high demand as reflected in high marginal revenue product. If a factor such as surgeons becomes scarcer—say, because training requirements are tightened—the price of this factor will rise and surgeons will enjoy higher incomes. However, if demand decreases in some field like psychiatry—perhaps because insurance companies decide to cut back on psychiatric coverage, or because close substitutes like social workers and psychologists lure away patients, or because people rely more heavily on medications than on therapy—the lower demand will produce a fall in psychiatrists' incomes. Competition giveth, but competition also taketh away.

THE DISTRIBUTION OF NATIONAL INCOME

With our new understanding of marginal-productivity theory, we can now come back to the question raised at the beginning of the chapter. In a world of intense competition, how do markets allocate national income among the many factors of production?

This section develops the neoclassical theory of factor-income distribution. It can be applied to competitive markets for any number of final products and factor inputs. But it is most easily grasped if we consider a simplified world with only one product in which all accounts are kept in "real" units, that is, in terms of goods. The goods could be corn or a basket of different goods and services, but we will call it Q. Moreover, by setting the price equal to 1, we can conduct the entire discussion in real terms, with the value of output being Q and with the wage rate being the real wage in terms of goods or Q. In this situation, a production function tells how much Q is produced for each quantity of labor-hours, L, and for each quantity of acres of homogeneous land, A. Note that because $P = 1$, under perfect competition $MRP = MP \times P = MP \times 1 = MP$. The wage is therefore equal to MP_L.

The analysis in the neoclassical model is as follows: A first worker has a large marginal product because there is so much land to work with. Worker 2 has a slightly smaller marginal product. But the two workers are alike, so they must get exactly the same wage. The puzzle is, which wage? The *MP* of worker 1, or that of worker 2, or the average of the two?

Under perfect competition, the answer is clear: Landlords will not hire a worker if the market wage exceeds that worker's marginal product. So competition will ensure that *all* the workers receive a wage rate equal to the marginal product of the last worker.

But now there is a surplus of total output over the wage bill because earlier workers had higher *MP*s than the last worker. What happens to the excess *MP*s produced by all the earlier workers? The excess stays with the landlords as their residual earnings, which we will later call *rent*. Why, you might ask, do the landlords, who may be sitting on their yachts thousands of miles away, earn anything on the land? The reason is that each landowner is a participant in the competitive market for land and rents the land for its best price. Just as workers compete with each other for jobs, landowners compete with each other for for workers. We see in this competitive world no labor unions keeping wages up, no landowners' conspiracy exploiting workers, and indeed no particular fairness in the wages and rents earned—we see just the operation of supply and demand.

We have therefore determined the total wages paid to labor. Figure 12-8 shows that the marginal product curve of labor gives the demand curve of all employers in terms of real wages. Labor-supply factors determine the supply of labor (shown as *SS*). The equilibrium wage comes at *E*. The total wages paid to labor are given by $W \times L$ (for example, if

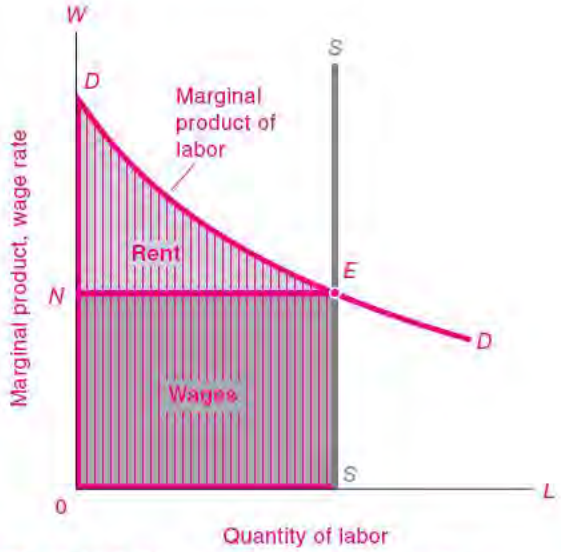


FIGURE 12-8. Marginal Product Principles Determine Factor Distribution of Income

Each vertical slice represents the marginal product of that unit of labor. Total national output *0DES* is found by adding all the vertical slices of *MP* up to the total supply of labor at *S*.

The distribution of output is determined by marginal product principles. Total wages are the lower rectangle (equal to the wage rate *0N* times the quantity of labor *0S*). Land rents get the residual upper triangle *NDE*.

$W = 5$ and $L = 1$ million, total wages = 5 million); this is shown by the dark rectangle, *0SEN*.

Surprisingly, we can also calculate the rent income of land. The light green rent triangle *NDE* in Figure 12-8 measures all the surplus output which was produced but was not paid out in wages. The size of the rent triangle is determined by how much the *MP* of labor declines as additional labor is added—that is, by the extent of diminishing returns. If there are only a few high-quality acres, additional units of labor will show sharp diminishing returns and rent's share will be large. If, by contrast, there is a great deal of homogeneous frontier land just waiting to be cleared, there will be little diminishing returns and land's rent triangle will be very small.

We have drawn Figure 12-8 so that labor's wages are about 3 times larger than property's rents. This 3-to-1 relationship reflects the fact that labor earnings constitute about three-quarters of national income.

The marginal-productivity theory described here is widely used in economics. An important application is to the impact of immigration on wages and profits, which is examined in question 8 at the end of this chapter.

Marginal-Productivity Theory with Many Inputs

The marginal-productivity theory is a great step forward in understanding the pricing of different inputs. Note additionally that the positions of land and labor could be reversed to get a complete theory of distribution. To switch the roles of labor and land, add successive units of variable land to fixed labor. Calculate each successive acre's marginal product.

Then draw a demand curve showing how many acres labor owners will demand of land at each rent rate. In the new version of Figure 12-8 that you draw, find a new E' point of equilibrium. Identify land's rectangle of rent as determined by rent times quantity of land. Identify labor's residual wage triangle. Finally, note the complete symmetry of the factors. This new graph shows that we should think of the distributive shares of each and every factor of production as being simultaneously determined by their interdependent marginal products.

That is not all. Instead of labor and land, suppose the only two factors were labor and some versatile capital goods. Suppose a smooth production function relates Q to labor and capital with the same general properties as in Figure 12-8. In this case, you can redraw Figure 12-8 and get an identical picture of income distribution between labor and capital. Indeed, we can perform the same operation for three, four, or any number of factors.

In competitive markets, the demand for inputs is determined by the marginal products of factors. In the simplified case where factors are paid in terms of the single output, we get

$$\text{Wage} = \text{marginal product of labor}$$
$$\text{Rent} = \text{marginal product of land}$$

and so forth for any factor. This distributes 100 percent of output, no more and no less, among all the factors of production.

We see, then, that the aggregate theory of the distribution of income is compatible with the competitive pricing of any number of goods produced by any number of factors. This simple but powerful theory shows how the distribution of income is related to productivity in a competitive market economy.

AN INVISIBLE HAND FOR INCOMES?

We have now sketched how a perfectly competitive economy distributes national product among the different inputs in a simplified world.

People naturally ask, Are incomes under market capitalism fair and just? In one sense, this is like asking whether animals get their fair shares of food in the jungle. Just as the battles of the jungle distribute food without regard to right or wrong, so does a competitive market distribute wages and profits according to productivity rather than ethics.

Is there an invisible hand in the marketplace that ensures that the most deserving people will obtain their just rewards? Or that those who toil long hours or nights and weekends or in tedious or dangerous work will receive a decent standard of living? Or that those who work in developing countries will get a comfortable living standard?

In reality, competitive markets do not guarantee that income and consumption will necessarily go to the neediest or most deserving. Laissez-faire competition might lead to great inequality, to malnourished children who grow up to raise more malnourished children, and to the perpetuation of inequality of incomes and wealth for generations. There is no economic law that ensures that the poor countries of Africa will catch up to the rich countries of North America. The rich may get healthier and richer as the poor get sicker and poorer. In a market economy, the distribution of income and consumption reflects not only hard work, ingenuity, and cunning but also factors such as race, gender, location, health, and luck.

While the market can work wonders in producing a growing array of goods and services in an efficient manner, there is no invisible hand which ensures that a laissez-faire economy will produce a fair and equitable distribution of income and property.

Now that we are armed with the general principles underlying the pricing of factors of production and the determination of the distribution of income, we can turn to a detailed discussion of the special features in the three major factor markets—land, labor, and capital.

SUMMARY

A. Income and Wealth

1. Distribution theory is concerned with the basic question of *for whom* economic goods are to be produced. In examining how the different factors of production—land, labor, and capital—get priced in the market, distribution theory considers how supplies and demands for these factors are linked and how they determine all kinds of wages, rents, interest rates, and profits.
2. Income refers to the total receipts or cash earned by a person or household during a given time period (usually a year). Income consists of labor earnings, property income, and government transfer payments.
3. National income consists of the labor earnings and property income generated by the economy in a year. Government takes a share of that national income in the form of taxes and gives back part of what it collects as transfer payments. The post-tax personal income of an individual includes the returns on all the factors of production—labor and property—that the individual owns, plus transfer payments from the government, less taxes.
4. Wealth consists of the net dollar value of assets owned at a given point in time. Wealth is a stock, while income is a flow per unit of time. A household's wealth includes its tangible items such as houses and its financial holdings such as bonds. Items that are of value are called assets, while those that are owed are called liabilities. The difference between total assets and total liabilities is called wealth or net worth.

B. Input Pricing by Marginal Productivity

5. To understand the pricing of different factors of production, we must analyze the theory of production and the derived demand for factors. The demand for inputs is a derived demand: we demand pizza ovens not for their own sake but for the pizzas that they can produce for consumers. Factor demand curves are derived from demand curves for final products. An upward shift in the final demand curve causes a similar upward shift in the derived factor demand curve; greater inelasticity in commodity demand produces greater inelasticity of derived factor demand.
6. We met in earlier chapters the concepts of the production function and marginal products. The demand for a factor is drawn from its marginal revenue product (*MRP*), which is defined as the extra revenue earned from employing an extra unit of a factor. In any market, *MRP* of a factor equals the marginal revenue earned by the sale of an additional unit of the product times the marginal product of the factor ($MRP = MR \times MP$). For competitive firms, because price equals marginal revenue, this simplifies to $MRP = P \times MP$.
7. A firm maximizes profits (and minimizes costs) when it sets the *MRP* of each factor equal to that factor's marginal cost, which is the factor's price. This can be stated equivalently as a condition in which the *MRP* per dollar of input is equalized for each input. This must hold in equilibrium because a profit-maximizing employer will hire any factor up to the point where the factor's marginal product will return in dollars of marginal revenue just what the factor costs.
8. To obtain the market demand for a factor, we add horizontally all firms' demand curves. This, along with the particular factor's own supply curve, determines the supply-and-demand equilibrium. At the market price for the factor of production, the amounts demanded and supplied will be exactly equal—only at equilibrium will the factor price have no tendency to change.
9. The marginal-productivity theory of income distribution analyzes the way total national income gets distributed among the different factors. Competition of numerous landowners and laborers drives factor prices to equal their marginal products. That process will allocate exactly 100 percent of the product. Any factor, not just labor alone, can be the varying factor. Because each unit of the factor gets paid only the *MP* of the last unit hired, there is a residual surplus of output left over from the *MP*s of early inputs. This residual is exactly equal to the incomes of the other factors under marginal productivity pricing. Hence, the marginal-productivity theory of distribution, though simplified, is a logically complete picture of the distribution of income under perfect competition.
10. Even though a competitive economy may squeeze the maximum amount of bread out of its available resources, one major reservation about a market economy remains. We have no reason to think that incomes will be fairly distributed under laissez-faire capitalism. Market incomes might produce acceptable differences or enormous disparities in income and wealth that persist for generations.

CONCEPTS FOR REVIEW

income distribution
income (flow), wealth (stock)
national income
transfer payments
personal income
marginal product, marginal revenue product, derived demand

marginal revenue product of input i $= MRP_i = MR \times MP_i = P \times MP_i$ for competitive firm
neoclassical theory of income distribution
MP rectangle, residual rent triangle

factor demands under competition: $MP_i \times P =$ factor price$_i$, which gives least-cost rule:

$$\frac{MP_L}{P_L} = \frac{MP_A}{P_A} = \cdots = \frac{1}{\text{marginal revenue}}$$

fairness of market incomes

FURTHER READING AND INTERNET WEBSITES

Further Reading

The neoclassical theory of income distribution was developed by one of the pioneers of American economics, John Bates Clark. You can get a flavor of his major ideas in *The Distribution of Wealth: A Theory of Wages, Interest and Profits* (1899) in an online publication at *www.econlib.org/library/Clark/clkDW0.html*.

Websites

Information on the distribution of income is gathered by the Census Bureau at *www.census.gov/hhes/www/income.html*. The most comprehensive data on the population is gathered in the decennial census, available at *www.census.gov*.

If you want to examine data on income dynamics, an exemplary site for data is that on the Panel Study on Income Dynamics at *www.isr.umich.edu/src/psid*.

The most comprehensive data on the wealth of Americans is collected by the Federal Reserve Board; see *www.federalreserve.gov/PUBS/oss/oss2/scfindex.html*.

QUESTIONS FOR DISCUSSION

1. For each of the following factors, name the final output for which the item is a derived demand: wheat-land, gasoline, barber, machine tool for basketballs, wine press, economics textbook.
2. Table 12-4 shows the basic numbers for production of pizzas, holding other factors constant.
   a. Fill in the blanks in columns (3) and (5).
   b. Construct a diagram like that in Figure 12-3 which shows the marginal revenue product of pizza workers and labor inputs.
   c. If the wage of pizza workers is $30 per worker, how many workers will be employed?
   d. Assume that the price of pizzas doubles. Draw the new *MRP* curve. Estimate the impact on the employment of pizza workers, assuming there are no other changes.
3. Over the last century, hours of work per lifetime have declined about 50 percent while real earnings have increased by a factor of 8. Assuming that the main change was an increase in the marginal-productivity-of-labor schedule, draw supply-and-demand diagrams for labor in 1900 and 2000 that will explain this trend. In your diagrams, put the number of hours worked per lifetime on the horizontal axis and the real wage rate

Marginal Revenue Product

(1) Unit of labor (workers)	(2) Total product (pizzas)	(3) Marginal product of labor (pizzas per worker)	(4) Price of output ($ per pizza)	(5) Marginal revenue product of labor ($ per worker)
0	0			
		____	5	____
1	30			
		____	5	____
2	50			
		____	5	____
3	60			
		____	5	____
4	65			
		____	5	____
5	68			
		____	5	____
6	68			

TABLE 12-4.

on the vertical axis. What key factor about the supply of labor must you invoke to explain this historical trend?

4. Why is each of the following incorrect? State the correct proposition.
   a. Marginal revenue product is calculated as total revenue earned per worker.
   b. Distribution theory is simple. You simply figure out how much each factor produces and then give the factor its share of output.
   c. Under competition, workers get paid the total output produced minus the costs of raw materials.
5. Figure 12-1 shows that the share of labor in national income changed little from 1970 to 2007 even though total incomes (GDP) rose by a factor of three. Draw a set of economywide curves like those in Figure 12-8 which can explain these two facts.
6. Labor leaders used to say, "Without any labor there is no product. Hence labor deserves *all* the product." Apologists for capital would reply, "Take away all capital goods, and labor scratches a bare pittance from the earth; practically all the product belongs to capital."

   Analyze the flaws in these arguments. If you were to accept the arguments, show that they would allocate 200 or 300 percent of output to two or three factors, whereas only 100 percent can be allocated. How does the neoclassical marginal-productivity theory resolve this dispute?
7. Draw the supply and demand curves for the oil market. Now suppose that a workable electric car shifts demand away from oil. Draw the new demand curve and the new equilibrium. Describe the outcome in terms of the price of oil, the quantity consumed, and the total income of the oil producers.
8. We can use the neoclassical theory of distribution to analyze the impact of immigration on the distribution of total national income. Assume that there are two factors, homogeneous labor and capital, with returns being wages and profits. Look at Figure 12-9, which has the same variables as Figure 12-8. We begin with initial supply curve S and at equilibrium point A.

   Now assume that there is a large increase in labor supply due to immigration, shifting the supply-of-labor curve from S to S', as shown by the arrow. Assume that all other inputs are unchanged. Answer the following:
   a. Describe and draw the new equilibrium after the immigration.
   b. Explain what will happen to the wage rate.

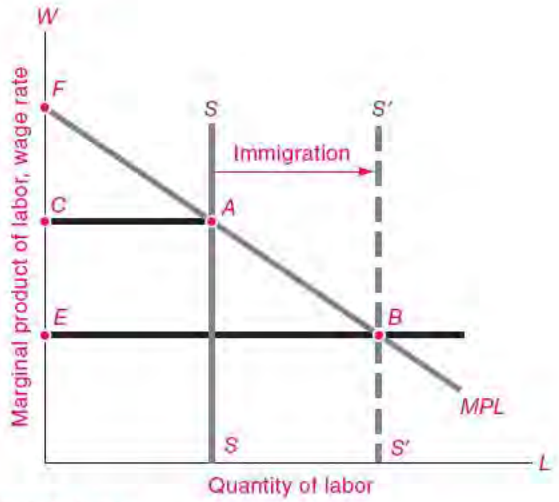


FIGURE 12-9.

c. Explain what happens to total profits and to the rate of profit (profits per unit of capital).

d. Explain why you cannot tell what will happen to total wages or to the share of labor income in total national income.

e. Note that this question looks at the impact of immigration on total national income. This analysis appears to differ from Chapter 3's supply-and-demand analysis of the impact of immigration on different cities. Explain the reason why immigration from Mexico to the United States will affect overall wages in the United States in this example, while immigration will not affect wage differentials between Miami and Detroit in the Chapter 3 example.

9. In the marginal-productivity theory shown in Figure 12-8, let land rather than labor be the varying input. Draw a new figure and explain the theory with this new diagram. What is the residual factor?

CHAPTER

13

The Labor Market

Work is the curse of the drinking class.

Oscar Wilde

Labor is more than an abstract factor of production. Workers are people who want good jobs with high wages so that they can buy the things they need and want. This chapter explores how wages are set in a market economy. The first section reviews the supply of labor and the determination of wages under competitive conditions. This is followed by a discussion of some of the noncompetitive elements of labor markets, including labor unions and the thorny problem of labor market discrimination.

A. FUNDAMENTALS OF WAGE DETERMINATION

THE GENERAL WAGE LEVEL

In analyzing labor earnings, economists tend to look at the average **real wage,** which represents the purchasing power of an hour's work, or the money wages divided by the cost of living.[1] By that measure, American workers today are far better off than they were 100 years ago. Figure 13-1 on page 249 shows the real average hourly wage, or the dollar wage adjusted for inflation, along with the average hours of work.

The same powerful gains for workers are found virtually everywhere. Across Western Europe, Japan, and the rapidly industrializing countries of East Asia, there has definitely been a steady, long-term improvement in the average worker's ability to buy food, clothing, and housing, as well as in the health and longevity of the population. In Europe and the United States, these gains began in earnest in the early 1800s, with the advent of the technological and social changes associated with the Industrial Revolution. Before that time real wages meandered up and down, with few long-term gains.

That is not to say that the Industrial Revolution was an unmitigated benefit to workers, especially in the laissez-faire days of the 1800s. In point of fact, a Dickens novel could hardly do justice to the dismal conditions of child labor, workplace dangers, and poor sanitation in factories of the early nineteenth century. A workweek of 84 hours was the prevailing rule, with time out for breakfast and sometimes supper. A good deal of work could be squeezed out of a 6-year-old child, and if a woman lost two fingers in a loom, she still had eight left.

Was it a mistake for people to leave the farms for the rigors of the factory? Probably not. Economic

[1] In this chapter, we will generally use the term "wages" as a shorthand expression for wages, salaries, and other forms of compensation.

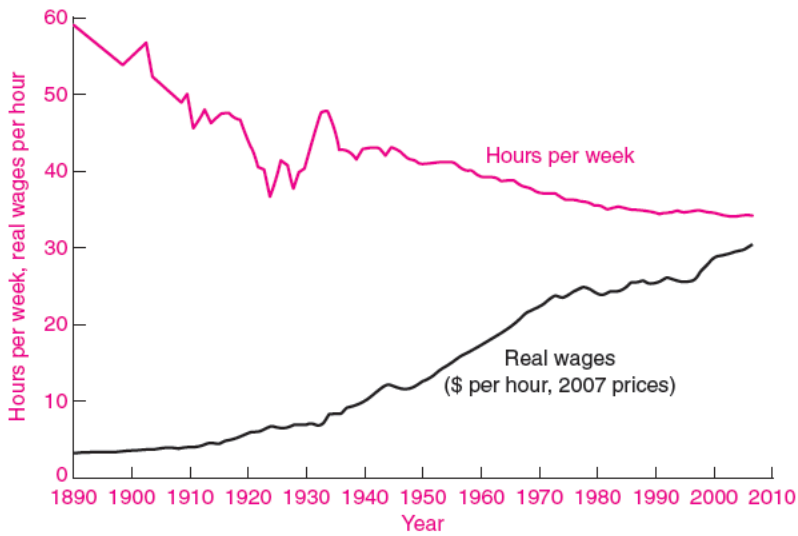


FIGURE 13-1. Wages Have Improved as Hours of Work Have Declined

With advancing technology and improved capital goods, American workers enjoy higher wages while working fewer hours. These are the fruits of long-term economic growth.

historians emphasize that even with the demanding conditions in the factories, living standards were nevertheless greatly improved over those in the earlier centuries of agrarian feudalism. The Industrial Revolution was a giant step forward for the working class, not a step back. The idyllic picture of the healthful, jolly countryside peopled by stout yeomen and happy peasantry is a historical myth unsupported by statistical research.

DEMAND FOR LABOR

Marginal Productivity Differences

We begin our examination of the general wage level by examining the factors underlying the demand for labor. The basic tools were provided in the previous chapter, where we saw that the demand for a factor of production reflects the marginal productivity of that input.

Figure 13-2 illustrates the marginal-productivity theory. Holding technology and other inputs constant, there exists a relationship between the quantity of labor inputs and the amount of output. By the law of diminishing returns, each additional unit of labor input will add a smaller and smaller slab of output. In the example shown in Figure 13-2, at 10 units of labor, the competitively determined general wage level will be $20 per unit.

But probe deeper and ask what lies behind marginal product. To begin with, the marginal

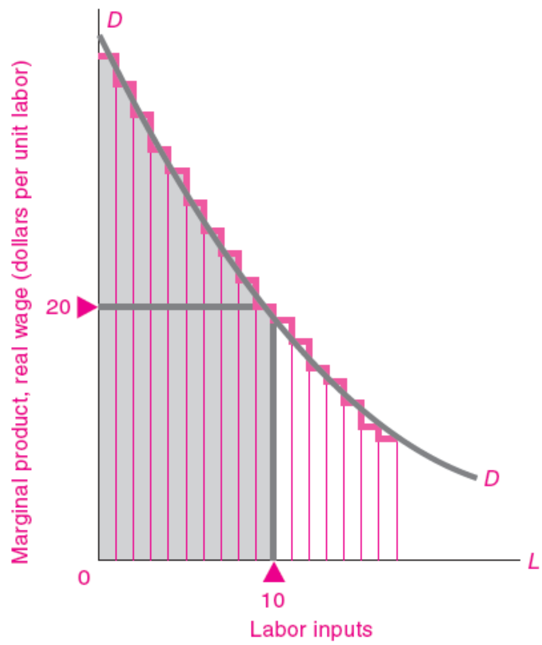


FIGURE 13-2. Demand for Labor Reflects Marginal Productivity

The demand for labor is determined by its marginal productivity in producing national output. The light blue vertical slices represent the extra output produced by the first, second, . . . unit of labor. The competitively determined general wage level at 10 units of labor is $20 per unit, equal to the marginal productivity of the tenth unit. The labor demand curve shifts up and out over time with capital accumulation, technological advance, and improvements in labor quality.

productivity of labor will rise if workers have more or better capital goods to work with. Compare the productivity of a ditchdigger using a bulldozer with that of a similar digger using a hand shovel, or the communications capabilities of medieval messengers with modern e-mail. Second, marginal productivity of better-trained or better-educated workers will generally be higher than that of workers with less "human capital."

These reasons explain why wages and living standards rose so much during the twentieth century. Wages are high in the United States and other industrial countries because these nations have accumulated substantial capital stocks: dense networks of roads, rails, and communications; substantial amounts of plant and equipment for each worker; and adequate inventories of spare parts. Even more important are the vast improvements in technologies compared to those of an earlier era. We have seen lightbulbs replace oil lamps, airplanes replace horses, xerography replace quill and ink, computers replace abacuses, and Internet commerce invade traditional ways of doing business. Just imagine how productive the average American would be today with the technologies of 1900.

The quality of labor inputs is another factor determining the general wage level. By any measure—literacy, education, or training—the skills of the American workforce today are superior to those of 1900. Years of education are necessary to produce an engineer capable of designing precision equipment. A decade of training must precede the ability to perform successful brain surgery. As the workforce increases its education and skills, this increases the productivity of labor.

International Comparisons

The same reasoning explains why wage levels differ so dramatically across the world. Look at Table 13-1, which shows average wages plus benefits in manufacturing industries for eight countries. Note that hourly wages in the United States are lower than those in Europe but almost 20 times higher than in China.

What accounts for the enormous differences? It's not that governments in China and Mexico are suppressing wage increases, though government policies do have some impact on the minimum wage and other aspects of the labor market. Rather, real wages differ among countries primarily because of the operation of the supply and demand for labor. Look at Figure 13-3. Suppose that Figure 13-3(*a*) represents the state of affairs in the United States while Figure 13-3(*b*) describes Mexico. In Figure 13-3(*a*), the supply of U.S. workers is shown by the supply curve, $S_{US}S_{US}$, while the demand for workers is represented by $D_{US}D_{US}$. The equilibrium wage will settle at the level shown at E_{US}. If the wage were lower than E_{US}, shortages of labor would occur and employers would bid up wages to E_{US}, restoring the equilibrium. Similar forces determine E_M, the Mexican wage.

We see that the Mexican wage is lower than the U.S. wage principally because the Mexican demand curve for labor is far lower as a result of the low marginal productivity of labor in Mexico. The most important factor lies in the quality of the workforce. The average education level in Mexico falls far short of the American standard, with a substantial fraction of the population illiterate. Additionally, compared to the United States, a country like Mexico has much less capital to work with: many of the roads are unpaved, few computers and fax machines are

Region	Wages and fringe benefits in manufacturing, 2006 ($ per hour)
Germany	34.21
Italy	25.07
United States	23.82
Japan	20.20
South Korea	14.72
Mexico	2.75
China	1.37
Philippines	1.07

TABLE 13-1. General Wage Levels Vary Enormously across Countries

Western European nations, Japan, and the United States are high-wage countries, while China's hourly wages are a tiny fraction of American levels. General wage levels are determined by supply and demand for labor, but other factors such as capital, education levels, technology levels, and civil strife have a major impact on supply and demand curves.

Source: U.S. Bureau of Labor Statistics at *ftp://ftp.bls.gov/pub/special.requests/ForeignLabor/ichccpwsuppt02.txt* and estimates by the authors. Note these estimates use market exchange rates and not purchasing-power-parity exchange rates.

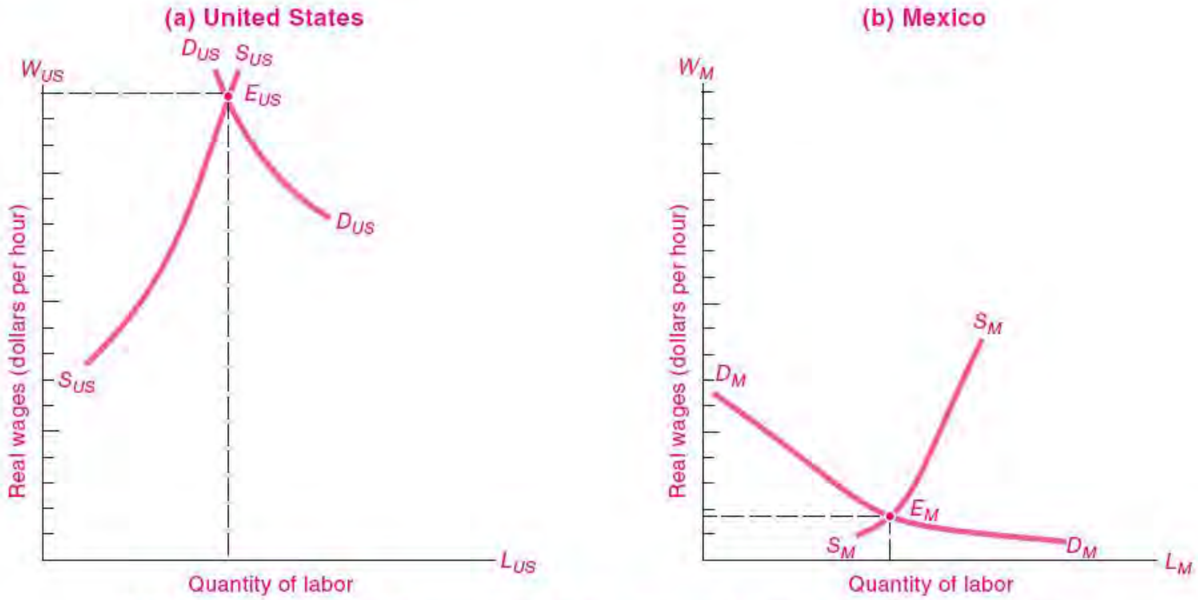


FIGURE 13-3. Favorable Resources, Skills, Management, Capital, and Technology Explain High U.S. Wages

Supply and demand determine a higher competitive wage in the United States than in Mexico. The major forces leading to high U.S. wages are a better-educated and more skilled workforce, a larger stock of capital per worker, and modern technologies.

in use, and much of the equipment is old or poorly maintained. All these factors make labor's marginal productivity low and tend to reduce wages.

This analysis can also help explain why wages have risen rapidly in East Asian regions such as Hong Kong, South Korea, and Taiwan. These economies are devoting a sizable share of their outputs to educating their populations, investing in new capital goods, and importing the latest productive technologies. The *MP* and *DD* curves for these countries have shifted greatly upward and to the right. As a result, real wages have doubled over the last 20 years in these countries, while wages have stagnated in relatively closed countries which invest less in education, public health, and tangible capital.

THE SUPPLY OF LABOR

Determinants of Supply

So far we have focused on the demand side of the labor market. Now we turn to the supply side. *Labor supply* refers to the number of hours that the population desires to work in gainful activities. The three key elements for labor supply are hours per worker, labor-force participation, and immigration.

Hours Worked. While some people have jobs with flexible hours, most Americans work between 35 and 40 hours a week, without much leeway to increase or cut back their weekly hours. However, most people do have a great deal of control over how many hours they work over the course of their lifetimes. They may decide to go to college, to retire early, or to work part-time rather than full-time—all of these can reduce the number of total lifetime hours worked. On the other hand, the decision to take on a second job will increase the lifetime hours worked.

Suppose that wages rise. Will that increase or decrease the lifetime hours of work? Look at the supply curve of labor in Figure 13-4. Note how the supply curve rises at first; then at the critical point *C*, it begins to bend back. How can we explain why higher wages may first increase and then decrease the quantity of labor supplied?

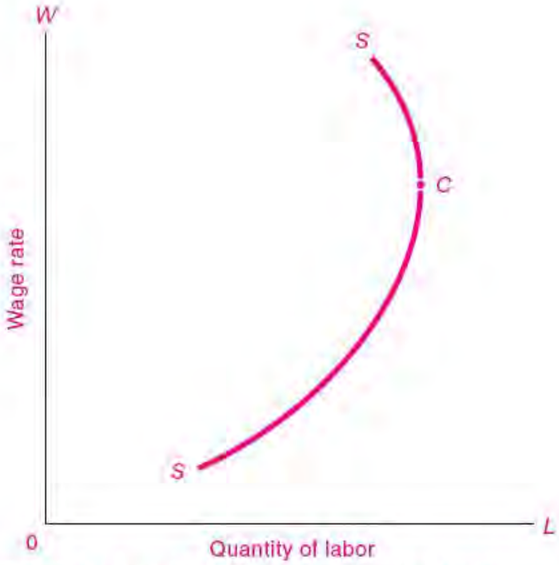


FIGURE 13-4. As Wages Rise, Workers May Work Fewer Hours

Above the critical point *C*, raising the wage rate reduces the amount of labor supplied as the income effect outweighs the substitution effect. Why? Because at higher wages workers can afford more leisure even though each extra hour of leisure costs more in wages forgone.

Put yourself in the shoes of a worker who has just been offered higher hourly rates and is free to choose the number of hours to be worked. You are tugged in two different directions. On one side is the *substitution effect*. (Chapter 5 explained that the substitution effect operates when people consume more of, or substitute in favor of, a good whose relative price falls and consume less of a good whose relative price increases.) Because each hour of work is now better paid, each hour of leisure has become more expensive; you thus have an incentive to substitute extra work for leisure.

But acting against the substitution effect is the *income effect*. With the higher wage, your income is higher. With a higher income, you will want to buy more goods and services, and, in addition, you will want more leisure time. You can afford to take longer vacations or to retire earlier than you otherwise would.

Which will be more powerful, the substitution effect or the income effect? There is no single correct answer; it depends upon the individual. In the case shown in Figure 13-4, for all wage rates below point *C*, labor supplied increases with a higher wage: the substitution effect outweighs the income effect. But from point *C* upward, the income effect outweighs the substitution effect, and labor supplied declines as wage rates climb higher.

Labor-Force Participation. One of the most dramatic developments in recent decades has been the sharp influx of women into the workforce. The labor-force participation rate of women (i.e., the fraction of women over 15 employed or actively looking for jobs) has jumped from 34 percent in 1950 to 60 percent today. In part this can be explained by rising real wages, which have made working more attractive for women. However, a change of this magnitude cannot be explained by economic factors alone. To understand such a significant alteration in working patterns, one must look outside economics to changing social attitudes toward the role of women as mothers, homemakers, and workers.

Immigration. The role of immigration in the labor-force supply has always been important in the United States. Whereas only 5 percent of the U.S. population was foreign-born in 1970, by 2008 that number had risen to 12 percent.

The flow of legal immigrants is controlled by an intricate quota system which favors skilled workers and their families, as well as close relatives of U.S. citizens and permanent residents. In addition, there are special quotas for political refugees. Most immigrants today are undocumented ("illegal") people who enter the United States looking for better economic opportunities. In recent years, the biggest groups of legal immigrants have come from places like Mexico, the Philippines, Vietnam, and some of the Central American and Caribbean countries.

The major change in immigration in recent decades has been a change in the characteristics of immigrants. In the 1950s, Germany and Canada were the major sources, while in the 1980s and 1990s Mexico and the Philippines were the dominant sources. As a result, recent immigrants have been relatively less skilled and less educated than those of an earlier age.

From the point of view of labor supply, the overall effect of recent immigration has been an increase in the supply of low-skilled workers in the United States relative to high-skilled workers. Studies have estimated that this change in supply has contributed to the decline in the wages of less educated groups relative to the college-educated.

Empirical Findings

Theory does not tell us whether the labor supply of a group will react positively or negatively to a wage change. Will an income-tax increase on high-income workers—which reduces their after-tax wages—cause them to reduce their work hours? Will subsidizing the wages of the working poor reduce or increase their hours worked? These vital questions must be considered by policymakers as they weigh issues of equity and efficiency. We often need to know the exact shape or elasticity of the labor supply curve.

Table 13-2 presents a summary of numerous studies of the subject. This survey shows that the labor supply curve for adult males appears to be slightly backward-bending, while the responses of other demographic groups look more like a conventional upward-sloping supply curve. For the population as a whole, labor supply appears to respond very little to changes in real wages.

WAGE DIFFERENTIALS

While analysis of the general wage level is important for comparing different countries and times, we often want to understand *wage differentials*. In practice, wage rates differ enormously. The average wage is as hard to define as the average person. A hedge-fund manager may earn $400 million a year, while a hedge-fund janitor may earn $400 a week. A doctor may earn 20 times more than a lifeguard even though both are saving lives.

There are major differences in earnings among broad industry groups, as is shown in Table 13-3. Sectors with small firms such as farming, retail trade, or private households tend to pay low wages, while the larger firms in manufacturing pay twice as much. But

Labor-Supply Patterns

Group of workers	Labor-Force Participation Rate (% of population) 1960	2007	Response of labor supply to increase in real wages
Adult males (25 to 54 years)	97	91	Supply curve found to be backward-bending in most studies. Income effect dominates substitution effect. Elasticities are around −0.1 for prime-age males.
Adult females (25 to 54 years)	43	76	Females generally have shown significant positive labor-supply elasticities.
Teenagers	48	40	Teenage response is highly variable.
Seniors (65 and older)	21	16	Seniors have been responsive to relative generosity of retirement programs relative to wages.
Entire population (16 and over)	60	66	Elasticity of total labor supply is close to zero, with income effects balancing out substitution effects. Estimated labor-supply elasticity for entire population is in the range from 0.0 to 0.2.

TABLE 13-2. Empirical Estimates of Labor-Supply Responses

Economists have devoted careful study to the response of labor supply to real wages. For prime-age males (the quaint term used to designate males between 25 and 54), the supply curve is backward-bending (that is, the elasticity is negative), while teenagers and adult females generally respond positively to wages. For the economy as a whole, the labor supply curve is close to completely inelastic or vertical.

Source: U.S. Department of Labor, *Employment and Earnings*, March 2008.

Compensation by Industry

Industry	Average earnings per full-time employee, 2006* ($ per year)
All industries	**47,000**
Farms	30,400
Mining	79,200
Manufacturing	52,300
Retail trade	29,400
Finance and insurance	82,800
Securities and related	205,600
Accommodation and food services	20,800
Food services	18,900

* Total compensation per full-time equivalent worker.

TABLE 13-3. Earnings Vary by Industry

Average annual wages and salaries in broad industry groups range from a high of $82,800 in finance to a low of $20,800 in accommodation and food services. In narrow industry groups, earnings vary enormously between security analysts and food-service workers.

Source: U.S. Bureau of Economic Analysis at *www.bea.gov,* Table 6.6D in the complete NIPA tables.

within major sectors there are large variations that depend on worker skills and market conditions—fast-food workers make much less than doctors even though they all provide services.

How can we explain these wage differentials? Let's consider first a *perfectly competitive labor market*, one in which there are large numbers of workers and employers, none of which has the power to affect wage rates appreciably. Few labor markets are perfectly competitive in reality, but some (such as a large city's market for teenage workers or clerical workers) approach the competitive concept reasonably closely. If all jobs and all people are identical in a perfectly competitive labor market, competition will cause the hourly wage rates to be exactly equal. No employer would pay more for the work of one person than for that person's identical twin or for another person who possessed identical skills.

This means that to explain the pervasive wage differences across industries or individuals, we must look to either differences in jobs, differences in people, or imperfect competition in labor markets.

Differences in Jobs: Compensating Wage Differentials

Some of the tremendous wage differentials observed in everyday life arise because of differences in the quality of jobs. Jobs differ in their attractiveness; hence wages may have to be raised to coax people into the less attractive jobs.

Wage differentials that serve to compensate for the relative attractiveness, or nonmonetary differences, among jobs are called **compensating differentials.**

Window washers must be paid more than janitors because of the risks of climbing skyscrapers. Workers often receive 5 percent extra pay on the 4 P.M. to midnight "swing shift" and 10 percent extra pay for the midnight to 8 A.M. "graveyard shift." For hours beyond 40 per week or for holiday and weekend work, 1½ to 2 times the base hourly pay is customary. Jobs that involve hard physical labor, tedium, low social prestige, irregular employment, seasonal layoff, or physical risk all tend to be less attractive. No wonder, then, that companies must pay $50,000 to $80,000 a year to recruit people to work at dangerous and lonely jobs on offshore oil platforms or in northern Alaska. Similarly, for jobs that are especially pleasant or psychologically rewarding, such as those of park rangers and the clergy, pay levels tend to be modest.

To test whether a given difference in pay between two jobs is a compensating differential, ask people who are well qualified for both jobs: "Would you take the higher-paying job in preference to the lower?" If they are not eager to take the higher-paying job, the pay difference is probably a compensating differential that reflects the nonmonetary differences between the jobs.

Differences in People: Labor Quality

We have just seen that some wage differentials serve to compensate for the differing degrees of attractiveness of different jobs. But look around you. Garbage collectors make much less than lawyers, yet surely the legal life has higher prestige and much more pleasant working conditions. We see countless examples of high-paying jobs that are more pleasant than low-paying work. We must look to factors beyond compensating differentials to explain the reason for most wage differences.

One key to wage disparities lies in the qualitative differences among people. A biologist might classify

FIGURE 13-5. Relative Income Gains Have Been Dramatic for College Graduates

The education premium for college and high school has increased sharply in recent years. The college premium shows the income advantage of college graduates relative to high school graduates, while the high school premium shows the advantage relative to those who complete eighth grade. Note how sharply the college premium grew after 1980.

Source: Claudia Goldin and Lawrence F. Katz, *The Race between Education and Technology* (Harvard University Press, Cambridge, Mass., 2008).

all of us as members of the species *Homo sapiens*, but a personnel officer would insist that people differ enormously in their abilities to contribute to a firm's output.

While many of the differences in labor quality are determined by noneconomic factors, the decision to accumulate **human capital** can be evaluated economically. The term "human capital" refers to the stock of useful and valuable skills and knowledge accumulated by people in the process of their education and training. Doctors, lawyers, and engineers invest many years in their formal education and on-the-job training. They spend large sums on tuition and wages forgone and often work long hours. Part of the high salaries of these professionals should be viewed as a return on their investment in human capital—a return on the education that makes these highly trained workers a very special kind of labor.

Economic studies of incomes and education show that human capital is a good investment on average. Figure 13-5 shows the ratio of the hourly earnings of college graduates to those of high school graduates. Relative earnings rose sharply after 1980 as the "price of skill" rose.

Should You Invest in Human Capital?

Students may be surprised to learn that every day in college is an investment in human capital. When students go to college, each year they pay thousands of dollars in tuition and earnings forgone. This cost is just as much an investment as buying a bond or a house.

Does college actually pay off? The evidence suggests that it pays off smartly for the average graduate. Look at Figure 13-5. Suppose that the total investment in college is $200,000 and that a high school graduate earns $40,000 per year. If the college premium is 60 percent, this says that a college graduate would earn $64,000 per year. This represents a $24,000 return on the investment, or around 12 percent per year. While this would not hold for everyone, it does suggest why students are working hard to get into good colleges.

Why has the college premium risen so sharply? More and more, in today's service economy, companies are processing information rather than raw materials. In the information economy, the skills learned in college are a prerequisite for a high-paying job. A high school dropout is generally at a severe disadvantage in the job market. Even if you have to borrow for your education, put off years of gainful employment, live away from home, and pay for rent and books, your lifetime earnings in the occupations that are open only to college graduates will probably more than compensate you for the costs.

Often, people point to the role of luck in determining economic circumstances. But, as Louis Pasteur remarked, "Chance favors the prepared mind." In a world of rapidly changing technologies, education prepares people to understand and profit from new circumstances.

Differences in People: The "Rents" of Unique Individuals

For the lucky few, fame has lifted incomes to astronomical levels. Software guru Bill Gates, investment wizard Warren Buffett, basketball star Shaquille O'Neal, and even economists who consult for business can earn fabulous sums for their services.

These extremely talented people have a particular skill that is highly valued in today's economy. Outside their special field, they might earn but a small fraction of their high incomes. Moreover, their labor supply is unlikely to respond perceptibly to wages that are 20 or even 50 percent higher or lower. Economists refer to the excess of these wages above those of the next-best available occupation as a pure economic rent; these earnings are logically equivalent to the rents earned by fixed land.

Some economists have suggested that technological changes are making it easier for a small number of top individuals to serve a larger share of the market. The "winners" in athletics, entertainment, and finance far outdistance the runners-up in the race for compensation. Top entertainers or athletes can now give a single performance that reaches a billion people via television and recordings—something that was not possible just a few years ago. If this trend continues, and labor rents rise further, the income gap between the winners and the runners-up may widen even further in the years ahead.

Segmented Markets and Noncompeting Groups

Even in a perfectly competitive world where people could move easily from one occupation to another, substantial wage differentials would appear. These differences would be necessary to reflect differences in the costs of education and training or in the unattractiveness of certain occupations or to indicate rewards for unique talents.

But even after taking into account all these reasons for wage differentials, we still find a large disparity in wage rates. The major reason for the remaining difference is that labor markets are segmented into *noncompeting groups.*

A moment's thought will suggest that, instead of being a single factor of production, labor is many different, but closely related, factors of production. Doctors and economists, for example, are noncompeting groups because it is difficult and costly for a member of one profession to enter into the other. Just as there are many different kinds of houses, each commanding a different price, so are there many different occupations and skills that compete only in a general way. Once we recognize the existence of many different submarkets of the labor market, we can see why wages may differ greatly among groups.

Why is the labor market divided into so many noncompeting groups? The major reason is that, for the professions like law and medicine, it takes a large investment of time and money to become proficient. If coal mining declines because of environmental restrictions, the miners can hardly hope to land jobs teaching environmental economics overnight. Once people specialize in a particular occupation, they become part of a particular labor submarket. They are thereby subject to the supply and demand for that skill and will find that their own labor earnings rise and fall depending upon events in that occupation and industry. Because of this segmentation, the wages for one occupation can diverge substantially from the wages in other areas.

The job choice of new immigrants is a classic case of noncompeting groups. Rather than just answering random classified ads, new immigrants from a particular country tend to cluster in certain occupations. For example, in many cities, such as Los Angeles and New York, a large number of grocery stores tend to be owned by Koreans. The reason is that the Koreans can get advice and support from friends and relatives

Summary of Competitive Wage Determination

Labor situation	Wage result
1. People are all alike—jobs are all alike.	No wage differentials
2. People are all alike—jobs differ in attractiveness.	Compensating wage differentials
3. People differ, but each type of labor is in unchangeable supply (noncompeting groups).	Wage differentials that reflect supply and demand for segmented markets
4. People differ, but there is some mobility among groups (partially competing groups).	General-equilibrium pattern of wage differentials as determined by general demand and supply (includes 1 through 3 as special cases)

TABLE 13-4. Market Wage Structure Shows Great Variety of Patterns under Competition

who also own grocery stores. As immigrants get more experience and education in the United States and become fluent in English, their job choice widens and they become part of the overall labor supply.

In addition, the theory of noncompeting groups helps us understand labor market discrimination. We will see in the next section of this chapter that much discrimination arises because workers are separated by gender, race, or other personal characteristics into noncompeting groups as a result of custom, law, or prejudice.

While the theory of noncompeting groups highlights an important aspect of labor markets, we must recognize that in the longer run entry and exit will reduce differentials. It is true that copper miners are unlikely to become computer programmers when computers and fiber optics displace rotary dials and copper wires. Consequently, we may see wage differentials arise between the two kinds of labor. But in the longer run, as more young people study computer science rather than go to work in copper mines, competition will tend to reduce the differentials of these noncompeting groups.

Table 13-4 summarizes the different forces at work in determining wage rates in competitive conditions.

B. LABOR MARKET ISSUES AND POLICIES

Our survey has up to now examined the case of competitive labor markets. In reality, distortions prevent the operation of perfect competition in labor markets. One source of imperfect competition is labor unions. Unions represent a significant, although shrinking, fraction of workers. A second facet of labor markets is discrimination—also less important than in earlier decades, but still an issue to consider. Yet another factor acting on labor markets is government policies. By setting minimum wages (discussed in Chapter 4), encouraging or discouraging unions, or outlawing discrimination, governments have a powerful effect on labor markets.

THE ECONOMICS OF LABOR UNIONS

Sixteen million Americans, or 12 percent of wage and salary workers, belonged to labor unions in 2007. Unions definitely have market power and sometimes serve as monopoly suppliers of labor. Unions negotiate collective-bargaining agreements which specify who can fill different jobs, how much workers will be paid, and what the work rules are. And unions can decide to go on strike—withdraw their labor supply completely and even cause a factory to shut down—in order to win a better deal from an employer. The study of unions is an important part of understanding the dynamics of labor markets.

The wages and fringe benefits of unionized workers are determined by **collective bargaining.** This is the process of negotiation between representatives of firms and of workers for the purpose of establishing mutually agreeable conditions of employment. The centerpiece is the *economic package*. This includes the basic wage rates for different job categories, along with the rules for holidays and coffee breaks.

In addition, the agreement contains provisions for fringe benefits such as a pension plan, coverage for health care, and similar items.

A second important issue is *work rules.* These concern work assignments and tasks, job security, and workloads. Particularly in declining industries, the staffing requirements are a major issue because the demand for labor is falling. In the railroad industry, for example, there were decades of disputes about the number of people needed to run a train.

Collective bargaining is a complicated business, a matter of give-and-take. Much effort is spent negotiating purely economic issues, dividing the pie between wages and profits. Sometimes agreements get hung up on issues of management prerogatives, such as the ability to reassign workers or change work rules. In the end, both workers and management have a large stake in ensuring that workers are satisfied and productive on their jobs.

Government and Collective Bargaining

The legal framework is an important determinant of economic organization. Two hundred years ago, when labor first tried to organize in England and America, common-law doctrines against "conspiracy in restraint of trade" were used to block unions. In the early 1900s, unions and their members were convicted by courts, fined, jailed, and harassed by various injunctive procedures. The Supreme Court repeatedly struck down acts designed to improve working conditions for women and children and other reform legislation on hours and wages.

It was only after the pendulum swung toward support of unions and collective bargaining that the explosive growth of unions began. A major landmark was the Clayton Act (1914), designed to remove labor from antitrust prosecution. The Fair Labor Standards Act (1938) barred child labor, called for time-and-a-half pay for weekly hours over 40, and set a federal minimum wage for most nonfarm workers.

The most important labor legislation of all was the National Labor Relations (or Wagner) Act of 1935. This law stated: "Employees shall have the right to . . . join . . . labor organizations, to bargain collectively . . . , and to engage in concerted activities." Spurred by pro-labor legislation, union membership rose from less than one-tenth of the labor force in the 1920s to one-quarter of the workforce by the end of World War II. The decline of American unions began in the early 1970s. In essence, the monopoly power of unions was eroded by the deregulation of many industries, increased international competition, and a less favorable government attitude toward unions.

HOW UNIONS RAISE WAGES

How can labor unions raise the wages and improve the working conditions of their members? *Unions gain market power by obtaining a legal monopoly on the provision of labor services to a particular firm or industry.* Using this monopoly, they compel firms to provide wages, benefits, and working conditions that are above the competitive level. For example, if nonunion plumbers earn $20 per hour in Alabama, a union might bargain with a large construction firm to set the wage at $30 per hour for that firm's plumbers.

Such an agreement is, however, valuable to the union only if the firm's access to alternative labor supplies can be restricted. Hence, under a typical collective-bargaining agreement, firms agree not to hire nonunion plumbers, not to contract out plumbing services, and not to subcontract to nonunion firms. Each of these provisions helps prevent erosion of the union's monopoly on the supply of plumbers to the firm. In some industries, like steel and auto manufacturing unions will try to unionize the entire industry so that firm A's unionized workers need not compete with firm B's nonunion workers. All these steps are necessary to protect high union wage rates.

Figure 13-6 shows the impact of agreed-upon high standard wages. Here, the union forces employers to pay wages at the standard rate shown by the horizontal line rr. The equilibrium is at E', where rr intersects the employers' demand curve. Note that the union has not directly reduced supply when it sets high standard wage rates. Rather, at the high wage rates, employment is limited by the firms' demand for labor. The number of workers who seek employment exceeds the demand by the segment $E'F$. These excess workers might be unemployed and waiting for vacancies in the high-paying union sector, or they might become discouraged and look for jobs in other sectors. The workers from E' to F are as effectively excluded from jobs as they would be if the union had directly limited entry.

The need to prevent nonunion competition also explains many of the political goals of the national

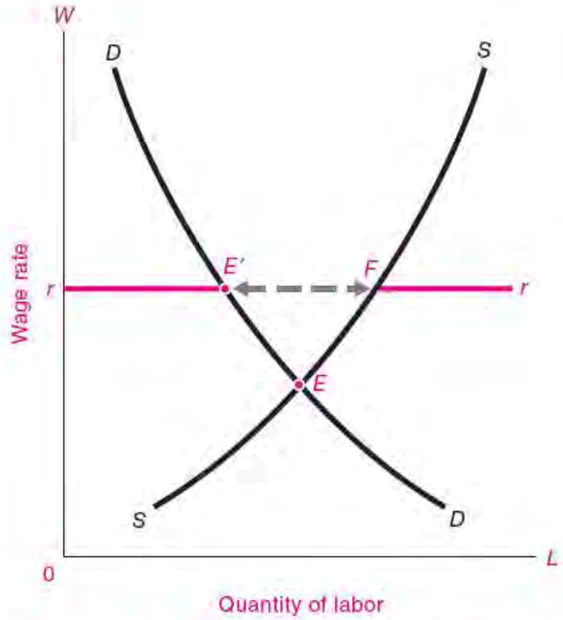


FIGURE 13-6. Unions Set High Standard Wage and Limit Employment

Raising the standard wage to *rr* increases wages and decreases the employment in the unionized labor market. Because of supply and demand imbalance, workers from *E′* to *F* cannot find employment in this market.

If unions push real wages too high for an entire economy, firms will demand *E′* while workers will supply *F*. Thus the blue arrow from *E′* to *F* represents the amount of classical unemployment. This source of unemployment is particularly important when a country cannot affect its price level or exchange rate, and it differs from the unemployment caused by insufficient aggregate demand.

labor movement. It explains why unions want to limit immigration; why unions support protectionist legislation to limit imports of foreign goods, which are goods made by workers who are not members of American unions; why quasi unions like medical associations fight to restrict the practice of medicine by other groups; and why unions sometimes oppose deregulation in industries such as trucking, communications, and airlines.

Theoretical Indeterminacy of Collective Bargaining

In most collective-bargaining negotiations, the workers press for higher wages while management holds out for lower compensation costs. This is a situation known as *bilateral monopoly*—where there is but one buyer and one seller. The outcome of bilateral monopoly cannot be predicted by economic forces of costs and demands alone; it depends as well on psychology, politics, and countless other intangible factors.

EFFECTS ON WAGES AND EMPLOYMENT

The advocates of labor unions claim that unions have raised real wages and have benefited workers. Critics argue that the result of raising wages is high unemployment, inflation, and distorted resource allocation. What are the facts?

Has Unionization Raised Wages?

Let's start by reviewing the effects of unions on relative wages. If we look at all private industrial workers in 2006, union workers had average hourly earnings about 15 percent above those of nonunion workers. However, this raw number does not reflect the fact that the skill, educational, and industrial composition of union workers differs from that of nonunion workers.

Taking into account worker differences, economists have concluded that union workers receive on average a 10 to 15 percent wage differential over nonunion workers. The differential ranges from a negligible amount for hotel workers and barbers to 25 to 30 percent higher earnings for skilled construction workers or coal miners. The pattern of results suggests that where unions can effectively monopolize labor supply and control entry, they will be most effective in raising wages. There is some evidence that the impact of unions on wages has declined in recent years.

Overall Impacts. Let us assume that unions can in fact raise the wages of their members above competitive levels. Would this lead to an increase in the average wage of the entire economy? Economists who study this question conclude that the answer is no. They find that unions redistribute income from nonunion labor to union labor. Put differently, if unions succeed in raising their wages above competitive levels, their gains come at the expense of the wages of nonunion workers.

This analysis is supported by empirical evidence showing that the share of national income going to labor has changed little over the last six decades. Once cyclical influences are removed, we can see no appreciable impact of unionization on the share of wages in the United States (see Figure 12-1 on page 231). Moreover, the evidence from heavily unionized European countries suggests that when unions succeed in raising money wage rates, they sometimes trigger an inflationary wage-price spiral with little or no permanent effect upon real wages.

Unions and Classical Unemployment

If unions do not affect overall real wage levels, this suggests that their impact lies primarily upon relative wages. That is, wages in unionized industries would rise relative to those in nonunionized industries. Moreover, employment would tend to be reduced in unionized industries and expanded in nonunionized industries.

When powerful unions raise real wages to artificially high levels, the result is an excess supply of labor that is called *classical unemployment*. This case is also illustrated by Figure 13-6. Assume that unions raise wages above the market-clearing wage at E to a higher real wage at rr. Then, if the supply of and demand for labor in general are unchanged, the arrow between E' and F will represent the number of workers who want to work at wage rr but cannot find work. This is called classical unemployment because it results from real wages that are above competitive levels.

Economists often contrast classical unemployment with the unemployment that occurs in business cycles, often called Keynesian unemployment, which results from insufficient aggregate demand. The effects of too high real wages were seen after the economic unification of Germany in 1990. The economic union fixed East German wages at a level estimated to be at least twice as high as could be justified by labor's marginal revenue product. The result was a sharp decline in employment in eastern Germany after unification.

This analysis suggests that when an economy gets locked into real wages that are too high, high levels of unemployment may result. The unemployment will not respond to the traditional macroeconomic policy of increasing aggregate spending but, rather, will require remedies that lower real wages.

Declining Unionism in the United States

One of the major trends in American labor markets has been the gradual erosion of labor unions since World War II. Whereas unions had organized one-quarter of the labor force in 1955, the fraction has fallen sharply since 1980. The share of unionized workers in manufacturing has shrunk dramatically in the last two decades; only in the public sector are unions still a powerful force.

One of the reasons for the decline in unions is the waning power of the strike, which is the ultimate threat in collective bargaining. In the 1970s U.S. labor unions used that weapon regularly, averaging almost 300 strikes per year. More recently, though, strikes have become relatively uncommon; in fact, they have virtually disappeared from the American labor market. The reason for the decline is that strikes have often backfired on workers. In 1981, the striking air-traffic controllers were all fired by President Reagan. When the professional football players went on strike in 1987, they were forced back to work when the football owners put on the games with replacement players. In 1992, workers striking at Caterpillar Inc., a huge maker of heavy equipment, had to end their 6-month strike when Caterpillar threatened to fill their jobs with permanent replacements. The inability to hurt firms through strikes has led to a significant weakening in the overall power of labor unions in the previous two decades.

You might wonder if the declining power of unions will reduce labor compensation. Economists generally hold that a decline in union power will lower the relative wages of union workers rather than lower the overall share of labor. Look back at Figure 12-1 to examine the share of labor in national income. Can you determine any effect of the declining power of unions after 1980 on labor's share? Most economists believe not.

DISCRIMINATION

Racial, ethnic, and gender discrimination has been a pervasive feature of human societies since the beginning of recorded history. At one extreme, seen before the Civil War in the United States, black slaves were considered property, had virtually no rights, and were often treated harshly. In other times or places, such as in the United States during the segregation period or under apartheid in South Africa until the 1990s, blacks were segregated in housing and transportation and faced prohibitions against interracial marriage and the most desirable forms of employment. Even today, in an era when discrimination is illegal, subtle forms of informal, premarket, criminal-justice, and statistical discrimination continue to produce disparate outcomes between men and women and particularly among different racial and ethnic groups.

Those who study or experience discrimination know that it extends far beyond the marketplace. Our discussion is limited to economic discrimination, focusing primarily on employment. We want to know why group differences persist decades after discrimination became illegal. We need to understand the sources of the differences between the wages of different groups. Why do African-American and Hispanic citizens in the United States continue to have a measurably lower level of income and wealth than other groups? Why are women excluded from many of the best jobs in business? These are troubling questions that need answers.

ECONOMIC ANALYSIS OF DISCRIMINATION

Definition of Discrimination

When economic differences arise because of irrelevant personal characteristics such as race, gender, sexual orientation, or religion, we call this **discrimination.** Discrimination typically involves either (*a*) disparate treatment of people on the basis of personal characteristics or (*b*) practices (such as tests) that have an "adverse impact" on certain groups.

Economists who first began to study discrimination, like the University of Chicago's Gary Becker, realized that a fundamental puzzle arises: If two groups of workers have equivalent productivity, but one has lower wages, why don't competitive profit-maximizing firms hire the low-wage workers and increase their profits? For example, suppose that a group of managers in a competitive market decides to pay blue-eyed workers more than equally productive brown-eyed workers. Nondiscriminating firms could enter the market, undercut the costs and prices of the discriminating firms by hiring mainly brown-eyed workers, and drive the discriminating firms out of business. Thus, even if some employers are biased against a group of workers, their bias should not be sufficient to reduce that group's income. Becker's analysis suggests, therefore, that forces other than pure discriminating attitudes are necessary to maintain income disparities between equivalent groups.

Discrimination by Exclusion

The most pervasive form of discrimination is to exclude certain groups from employment or housing. The history of black Americans illustrates how social processes depressed their wages and social status. After slavery was abolished, the black population of the American south fell into a caste system of peonage under "Jim Crow" legislation. Even though legally free and subject to the laws of supply and demand, black workers had earnings far below those of whites. Why? Because they had inferior schooling and were excluded from the best jobs by trade unions, local laws, and customs. They were consequently shunted into menial, low-skilled occupations that were effectively noncompeting groups. Employment segregation allowed discrimination to persist for decades.

Supply and demand can illustrate how exclusion lowers the incomes of groups that are targets of discrimination. Under discrimination, certain jobs are reserved for the privileged group, as is depicted in Figure 13-7(*a*). In this labor market, the supply of privileged workers is shown by S_pS_p, while the demand for such labor is depicted as D_pD_p. Equilibrium wages occur at the high level shown at E_p.

Meanwhile, Figure 13-7(*b*) shows what is happening for minority workers, who, because they live in areas with poor schools and cannot afford private education, do not receive training for the high-paying jobs. With low levels of skills, they take low-skill jobs and have low marginal revenue products, so their wages are depressed to the low-wage equilibrium at E_m.

Note the difference between the two markets. Because minorities are excluded from good jobs, market forces have decreed that they earn much lower wages than the privileged workers. Someone might even argue that minorities "deserve" lower wages because their competitive marginal revenue products are lower. But this rationalization overlooks the root of the wage differential, which is that wage differences arose because certain groups were excluded from the good jobs by their inability to obtain education and training and by the force of custom, law, or collusion.

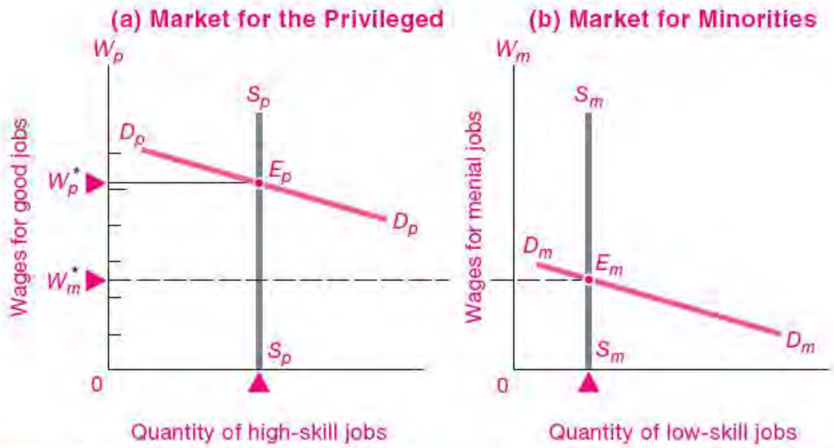


FIGURE 13-7. Discrimination by Exclusion Lowers the Wage Rates of Excluded Minorities

Discrimination is often enforced by excluding certain groups from privileged jobs. If minorities are excluded from good jobs in market **(a)**, they must work in inferior jobs in **(b)**. The privileged group enjoys high wage rates at E_p, while minorities earn low wage rates at E_m in market **(b)**.

Taste for Discrimination

The exclusion example still raises the issue of why some profit-maximizing firms do not evade the laws or customs to undercut their competitors. One explanation proposed by Becker was that either firms or their customers have a "taste for discrimination." Perhaps some managers do not like hiring black workers; maybe salespersons are prejudiced and don't want to sell to Hispanic customers. Critics complain that this approach is tautological, in essence saying, "Things are the way they are because people like them that way."

Statistical Discrimination

One of the most interesting variants of discrimination occurs because of the interplay between incomplete information and perverse incentives. This is known as **statistical discrimination,** in which individuals are treated on the basis of the average behavior of members of the group to which they belong rather than on the basis of their personal characteristics.

One common example arises when an employer screens employees on the basis of their college. The employer may have observed that people who graduate from better schools are *on average* more productive; in addition, grade point averages are often difficult to compare because of differences in grading standards. Employers therefore often hire people on the basis of their college rather than of their grades. A more careful screening process would show that there are many highly qualified workers from the less well-known schools. We see here a common form of statistical discrimination based on average quality of schooling.

Statistical discrimination leads to economic inefficiencies because it reinforces stereotypes and reduces the incentives of individual members of a group to develop skills and experience. Consider someone who goes to a little-known school. She knows that she will be largely judged by the quality of her schooling credentials. The grade point average, the difficulty of the courses taken, her actual knowledge, and her on-the-job experience may be ignored. The result is that, when subject to statistical discrimination, individuals have greatly reduced incentives to invest in activities that will improve their skills and make them better workers.

Statistical discrimination is particularly pernicious when it involves race, gender, or ethnic groups. If employers treat all black youths as "unproductive" because of average experience with hiring black youths, then gifted individuals not only will be treated as the average worker but will have little incentive to upgrade their skills.

Statistical discrimination is seen in many areas of society. Life insurance and automobile insurance generally average the risks of people who are careful with those who live dangerously; this tends to reduce the incentive to behave cautiously and leads to a decrease in the average amount of caution in the population. Women were traditionally excluded from quantitatively oriented professions like engineering; as a result, women were more likely to choose humanities and social sciences for their majors and their careers, thereby reinforcing the stereotype that women were uninterested in engineering.

Statistical discrimination not only stereotypes individuals on the basis of group characteristics; it also reduces the incentives of individuals to make investments in education and training and thereby tends to reinforce the original stereotype.

ECONOMIC DISCRIMINATION AGAINST WOMEN

The largest group to suffer from economic discrimination is women. A generation ago, women earned about 70 percent of the wages of men. Part of this was due to differences in education, job experience, and other factors. Today, the gender gap has shrunk sharply. Most of the remaining difference is the "family gap"—a wage penalty against women with children.

What lay behind the income differentials between men and women? The causes are complex, grounded in social customs and expectations, statistical discrimination, and economic factors such as education and work experience. In general, women are not paid less than men for the same job. Rather, the lower pay of women arose because women were excluded from certain high-paying professions, such as engineering, construction, and coal mining. In addition, women tended to interrupt their careers to have children and perform household duties, and this continues to persist in the family gap. Also, economic inequality of the sexes was maintained because, until recently, few women were elected to the boards of directors of large corporations, to senior partnerships in major law firms, or to tenured professorships in top universities.

EMPIRICAL EVIDENCE

Having analyzed the mechanisms by which discrimination is enforced, let us next examine empirical evidence on earnings differentials. On average, women and minorities earn less than do white men. For example, women who worked full-time had earnings equal to 60 percent of men's earnings in 1967. By 2007, that number had risen to 80 percent.

Labor economists emphasize that earnings differentials are not the same as discrimination. Wage differentials often reflect differences in skill and productivity. Many Hispanic workers, particularly immigrants, have historically received less education than have native whites; women customarily spend more time out of the labor force than do men. Since both education and continuing work experience are linked to higher pay, it is not surprising that some earnings differentials exist.

How much of the earnings differentials is due to discrimination rather than productivity differences? Here are some recent findings:

- For women, the extent of discrimination has declined markedly in recent years. Statisticians have uncovered a family gap, which refers to the fact that women who leave the labor force to care for children have an earnings penalty. Aside from the family gap, women appear to have approximately the same earnings as equally qualified men.
- The gap between African-Americans and whites was extremely large for most of American history. However, African-American workers made major progress in the first seven decades of the twentieth century. Data from the 1990s indicate that African-Americans suffer a 5 to 15 percent loss in earnings due to labor market discrimination.
- One of the major encouraging trends is the crumbling of barriers to employment of women and minorities in highly paid professions. In the period from 1950 to 2000, the fraction of women and minorities employed as physicians, engineers, lawyers, and economists has grown sharply. This is particularly striking for women in professional schools. The proportion of women in law schools increased from 4 percent in 1963 to 44 percent in 2006, while for medical schools the proportion rose from 5 percent in 1960 to almost 50 percent in 2006. We see similar trends in other occupations that were once traditionally tied to gender or race.

REDUCING LABOR MARKET DISCRIMINATION

Over the last half-century, government has taken numerous measures to end discriminatory practices. The major steps were legal landmarks, such as the Civil Rights Act of 1964 (which outlaws employment discrimination based on race, color, religion, sex, or national origin) and the Equal Pay Act of 1963 (which requires that employers pay men and women equally for the same work).

Such laws helped dismantle the most blatant discriminatory practices, but more subtle barriers remain. To counter them, more aggressive and controversial policies have been introduced, including measures such as *affirmative action*. This requires that employers show they are taking extra steps to locate and hire underrepresented groups. Studies indicate that this approach has had a positive effect on the hiring and wages of women and minorities. Affirmative action has, however, been widely criticized in recent years as representing "reverse discrimination," and some states have banned its use in employment and education.

Uneven Progress

Discrimination is a complex social and economic process. It was enforced by laws that denied disadvantaged groups equal access to jobs, housing, and education. Even after equality under law was established, separation of races and sexes perpetuated social and economic stratification.

The progress in narrowing the earnings gaps among different groups slowed over the last three decades. The disintegration of the traditional nuclear family, cuts in government social programs, harsh drug laws and imprisonment rates, a backlash against many antidiscrimination programs, and the declining relative wages of the unskilled have led to declining living standards for many minority groups. Progress is uneven, and substantial differences in incomes, wealth, and jobs persist.

SUMMARY

A. Fundamentals of Wage Determination

1. The demand for labor, as for any factor of production, is determined by labor's marginal product. Therefore, a country's general wage level tends to be higher when its workers are better trained and educated, when it has more and better capital to work with, and when it uses more advanced production techniques.
2. For a given population, the supply of labor depends on three key factors: population size, average number of hours worked, and labor-force participation. For the United States, immigration has been a major source of new workers in recent years, increasing the proportion of relatively unskilled workers.
3. As wages rise, there are two opposite effects on the supply of labor. The substitution effect tempts each worker to work longer because of the higher pay for each hour of work. The income effect operates in the opposite direction because higher wages mean that workers can now afford more leisure time along with other good things of life. At some critical wage, the supply curve may bend backward. The labor supply of very gifted, unique people is quite inelastic: their wages are largely pure economic rent.
4. Under perfect competition, if all people and jobs were identical, there would be no wage differentials. But once we drop unrealistic assumptions concerning the uniformity of people and jobs, we find substantial wage differentials even in a perfectly competitive labor market. Compensating wage differentials, which compensate for nonmonetary differences in the quality of jobs, explain some of the differentials. Differences in the quality of labor explain many of the other differentials. In addition, the labor market is made up of innumerable categories of noncompeting and partially competing groups.

B. Labor Market Issues and Policies

5. Labor unions occupy an important but diminishing role in the American economy, in terms of both membership and influence. Management and labor representatives meet together in collective bargaining to negotiate a contract. Such agreements typically contain provisions for wages, fringe benefits, and work rules. Unions affect wages by bargaining for standard rates. However, in order to raise real wages above prevailing market-determined levels, unions must prevent entry or competition from nonunion workers.

6. While unions may raise the wages of their members above those of non-union workers, they probably do not increase a country's real wages or labor's share of national income. They are likely to increase unemployment among union members who would prefer to wait for recall from layoff of their high-paid jobs rather than move or take low-paying jobs in other industries. And in a nation with inflexible prices, real wages that are too high may induce classical unemployment.
7. By an accident of history, a tiny minority of white males in the world has enjoyed the greatest affluence. Even more than a century after the abolition of slavery, inequality of opportunity and economic, racial, and gender discrimination continue to lead to loss of income by underprivileged groups.
8. There are many sources of discrimination. One important mechanism is the establishment and maintenance of noncompeting groups. In addition, statistical discrimination occurs when individuals are treated on the basis of the average behavior of members of the group to which they belong. This subtle form of discrimination stereotypes individuals on the basis of group characteristics, reduces the incentives of individuals to engage in self-improvement, and thereby reinforces the original stereotype.
9. Many steps have been taken to reduce labor market discrimination over the last half-century. Early approaches focused on outlawing discriminatory practices, while later steps mandated policies such as affirmative action.

CONCEPTS FOR REVIEW

Wage Determination under Perfect Competition

elements in demand for labor:
- labor quality
- technology
- quality of other inputs

elements in supply of labor:
- hours
- labor-force participation
- immigration

income effect vs. substitution effect
compensating differentials in wages
rent element in wages
segmented markets and non-competing groups

Labor Market Issues

collective bargaining
unions as monopolies
classical unemployment
discrimination
earnings differentials: quality differences vs. discrimination
statistical discrimination
antidiscrimination policies

FURTHER READING AND INTERNET WEBSITES

Further Reading

The elements of the theory of human capital are given in Gary S. Becker, *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education,* 3rd ed. (University of Chicago Press, 1993).

Labor economics is an active area. Many important topics are covered in advanced surveys, such as Ronald G. Ehrenberg and Robert S. Smith, *Modern Labor Economics: Theory and Public Policy,* 9th ed. (Addison-Wesley, Reading, Mass., 2005).

An excellent overview of the economics of discrimination is contained in the symposium on discrimination in product, credit, and labor markets in *Journal of Economic Perspectives,* Spring 1998.

An important source on the impact of immigration is George Borjas, Richard Freeman, and Lawrence Katz, "How Much Do Immigration and Trade Affect Labor Market Outcomes?" *Brookings Papers on Economic Activity,* vol. 1, 1997, pp. 1–90.

Websites

Analysis of the labor market data for the United States comes from the Bureau of Labor Statistics, at *www.bls.gov.* This site also has an online version of *The Monthly Labor Review,* which is an excellent source for studies about wages and employment.

An excellent review of trends in labor markets with special reference to new technologies and discrimination is in *Economic Report of the President, 2000,* chap. 4, "Work and Learning in the 21st Century," available online at *w3.access.gpo.gov/eop/.*

For an international perspective, visit the site of the International Labour Organization at *www.ilo.org.* If you want a detailed reading list on labor economics, visit the MIT open course website at *ocw.mit.edu/OcwWeb/Economics/14-64Spring-2006/Readings/index.htm.*

QUESTIONS FOR DISCUSSION

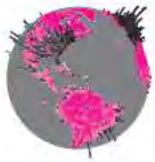
1. What steps could be taken to break down the segmented markets shown in Figure 13-7?
2. Explain, both in words and with a supply-and-demand diagram, the impact of each of the following upon the wages and employment in the affected labor market:
   a. *Upon union bricklayers:* The bricklayers' union negotiated a lower standard work rule, from 60 bricks per hour to 50 bricks per hour.
   b. *Upon airline pilots:* After the deregulation of the airlines, nonunion airlines increased their market share by 20 percent.
   c. *Upon M.D.s:* Many states began to allow nurses to assume more of physicians' responsibilities.
   d. *Upon American autoworkers:* Japan agreed to limit its exports of automobiles to the United States.
3. Explain what would happen to wage differentials as a result of each of the following:
   a. An increase in the cost of going to college
   b. Free migration among the nations of Europe
   c. Introduction of free public education into a country where education had previously been private and expensive
   d. Through technological change, a large increase in the number of people reached by popular sports and entertainment programs
4. Discrimination occurs when disadvantaged groups like women or African-Americans are segmented into low-wage markets. Explain how each of the following practices, which prevailed in some cases until recently, helped perpetuate discriminatory labor market segmentation:
   a. Many state schools would not allow women to major in engineering.
   b. Many top colleges would not admit women.
   c. Nonwhites and whites received schooling in separate school systems.
   d. Elite social clubs would not admit women, African-Americans, or Catholics.
   e. Employers refused to hire workers who had attended inner-city schools because the average productivities of workers from those schools were low.
5. Recent immigration has increased the number of low-skilled workers with little impact upon the supply of highly trained workers. A recent study by George Borjas, Richard Freeman, and Lawrence Katz estimated that the wages of high school dropouts declined by 4 percent relative to the wages of college graduates in the 1980s as a result of immigration and trade.
   a. To see the impact of *immigration*, turn back to Figure 12-6 in the previous chapter. Redraw the diagrams, labeling part (*a*) "Market for Skilled Workers" and part (*b*) "Market for Unskilled Workers." Then let immigration shift the supply of unskilled labor to the right while leaving the supply of skilled workers unchanged. What would happen to the relative wages of the skilled and unskilled and to the relative levels of employment as a result of immigration?
   b. Next analyze the impact of *international trade* on wages and employment. Suppose that globalization increases the demand for domestic skilled workers in (*a*) while reducing the demand for domestic unskilled workers in (*b*). Show that this would tend to increase the inequality between skilled and unskilled workers.
6. People often worry that high tax rates would reduce the supply of labor. Consider the impact of higher taxes with a backward-bending supply curve as follows: Define the before-tax wage as W, the post-tax wage as W_p, and the tax rate as t. Explain the relationship $W_p = (1 - t)W$. Draw up a table showing the before-tax and post-tax wages when the before-tax wage is \$20 per hour for tax rates of 0, 15, 25, and 40 percent.

   Now turn to Figure 13-4. For the regions above and below point *C*, show the impact of a lower tax rate upon the supply curve. In your table, show the relationship between the tax rate and the government's tax revenues.

CHAPTER

14

Land, Natural Resources, and the Environment



Land is a good investment: they ain't making it no more.

Will Rogers

If you look at any economic process, you will see that it is powered by a specialized combination of the three fundamental factors of production: land, labor, and capital. In Chapter 1, we learned that land and natural resources provide the footing and fuel for our economy; that durable capital goods and intangibles are produced partners in the production process; and that human labor tills the soil, operates the capital stock, and manages the production processes.

Earlier chapters surveyed both the economic theory of pricing and the marginal productivities of factors, as well as the role of labor in the economy. The present chapter continues the study of the factors of production by looking at the workings of the markets for land, natural resources, and the environment. We will start by looking at the markets for land and natural resources, which are nonproduced factors. We then turn to the vital area of environmental economics. This topic covers an important market failure and some proposed remedies and discusses the topic of global warming.

A. THE ECONOMICS OF NATURAL RESOURCES

When sentient humans first evolved hundreds of thousands of years ago, their economies were based on hunting, fishing, and gathering, with a rich natural environment but little capital beyond a few sharp sticks and stones. Today, we generally take for granted the bounty of clean air, plentiful water, and unspoiled land. But what is the threat to humanity if we do not respect the limits of our natural environment?

At one pole is an environmentalist philosophy of confines and perils. In this view, human activities threaten to poison our soils, deplete our natural resources, disrupt the intricate web of natural ecosystems, and trigger disastrous climate change. The environmentalist point of view is well expressed in the bleak warning from the distinguished Harvard biologist E. O. Wilson:

> Environmentalism . . . sees humanity as a biological species tightly dependent on the natural world. . . . Many of Earth's vital resources are about to be exhausted, its atmospheric chemistry is deteriorating, and human populations have already grown dangerously large. Natural ecosystems, the wellsprings of a healthful environment, are being irreversibly degraded. . . . I am radical enough to take seriously the question heard with increasing frequency: Is humanity suicidal?

Believers in this dismal picture argue that humans must practice "sustainable" economic growth and learn to live within the limitations of our scarce natural resources or we will suffer dire and irreparable consequences.

At the other pole are "cornucopians," or technological optimists, who believe that we are far from exhausting either natural resources or the capabilities of technology. In this optimistic view, we can look forward to continued economic growth and rising living standards, and human ingenuity can cope with any resource limits or environmental problems. If oil runs out, there is plenty of coal. If that doesn't pan out, then rising energy prices will induce innovation on solar, wind, and nuclear power. Cornucopians view technology, economic growth, and market forces as the saviors, not the villains. One of the most prominent of the technological optimists was Julian Simon, who wrote:

> Ask an average roomful of people if our environment is becoming dirtier or cleaner, and most will say "dirtier." The irrefutable facts are that the air in the U.S. (and in other rich countries) is safer to breathe now than in decades past. The quantities of pollutants have been declining, especially particulates which are the main pollutant. Concerning water, the proportion of monitoring sites in the U.S. with water of good drinkability has increased since the data began in 1961. Our environment is increasingly healthy, with every prospect that this trend will continue.

Generally, mainstream economists tend to lie between the environmentalist and the cornucopian extremes. They recognize that humans have been drawing upon the earth's resources for ages. Economists tend to emphasize that *efficient management of the economy requires proper pricing of natural and environmental resources.* In this chapter we will survey the concepts involved in the pricing of scarce natural resources and the management of the environment.

RESOURCE CATEGORIES

What are the important natural resources? They include land, water, and the atmosphere. The land gives us food and wine from fertile soils, as well as oil and other minerals from the earth's mantle. Our waters give us fish, recreation, and a remarkably efficient medium for transportation. The precious atmosphere yields breathable air, beautiful sunsets, and flying space for airplanes. Natural resources (including land) are a set of factors of production, just like labor and capital. They are factors of production because we derive output or satisfaction from their services.

Economists make two major distinctions in analyzing natural resources. The most important is whether the resource is appropriable or inappropriable. A commodity is called **appropriable** when firms or consumers can capture its full economic value. Appropriable natural resources include land (whose fertility can be captured by the farmer who sells wheat or wine produced on the land), mineral resources like oil and gas (where the owner can sell the value of the mineral deposit), and trees (where the owner can sell the land or the trees to the highest bidder). In a well-functioning competitive market, appropriable natural resources would be efficiently priced and allocated.

On the other hand, a resource is **inappropriable** when some of the costs and benefits associated with its use do not accrue to its owner. In other words, inappropriable resources are ones involving externalities. (Recall that *externalities* are those activities in which production or consumption imposes uncompensated costs or benefits on other parties.)

Examples of inappropriable resources are found in every corner of the globe. Consider, for instance, the depletion of stocks of many important fish, such as whales, tuna, herring, and sturgeon. A school of tuna can provide not only food for the dinner table but also stock for breeding future generations of tuna. Yet the breeding potential is not reflected in the market price of fish. Consequently, when a fishing boat pulls out a yellowtail tuna, it does not compensate society for the depletion of future breeding potential. This is why unregulated fisheries often tend to be overfished.

This leads to a central result in the economics of natural resources and the environment:

> When markets do not capture all the costs and benefits of using natural resources, and externalities are therefore present, markets give the wrong signals and prices are distorted. Markets generally produce too much of goods that generate negative externalities and too little of goods that produce positive externalities.

Techniques used for managing resources depend on whether the resources are renewable or nonrenewable. A **nonrenewable resource** is one whose supply is essentially fixed. Important examples are the fossil fuels, which were laid down millions of years ago and are not renewable on the time scale of human civilizations, and nonfuel mineral resources, such as copper, silver, gold, stone, and sand.

By contrast, **renewable resources** are ones whose services are replenished regularly. If properly managed, these can yield useful services indefinitely. Solar energy, agricultural land, river water, forests, and fisheries are among the most important categories of renewable resources.

The principles of efficient management of these two classes of resources present quite different challenges. Efficient use of a nonrenewable resource entails the distribution of a finite quantity of the resource over time: Should we use our low-cost natural gas in this generation or save it for the future? By contrast, prudent use of renewable resources involves ensuring that the flow of services is efficiently maintained through, for example, appropriate forest management, protection of fish breeding grounds, and regulation of pollution entering rivers and lakes.

This chapter considers the economics of natural resources. We begin this section by focusing on land. We want to understand the principles underlying the pricing of a fixed resource. In Section B, we turn to the economics of the environment, which involves the important public-policy questions relevant to protecting the quality of our air, water, and land from pollution, as well as global issues such as climate change.

FIXED LAND AND RENTS

The single most valuable natural resource is land. Under law, ownership of "land" consists of a bundle of rights and obligations such as the rights to occupy, to cultivate, to deny access, and to build. Unless you are planning to run your company from a balloon, land is an essential factor of production for any business. The unusual feature of land is that its quantity is fixed and completely unresponsive to price.[1]

Rent as Return to Fixed Factors

The price of such a fixed factor is called **rent** or **pure economic rent.** Economists apply the term "rent" not only to land but also to any other factor that is fixed in supply. If you pay Alex Rodriguez $30 million per year to play for your baseball team, that money would be considered rent for the use of that unique factor.

Rent is calculated as dollars per unit of the fixed factor per unit of time. The rent on land in the Arizona desert might be $0.50 per acre per year, while that in midtown New York or Tokyo might be $1 million per acre per year. Always remember that the word "rent" is used in a special and specific way in economics to denote payments made to factors in fixed supply. Everyday usage of the word often includes other meanings, such as payment for the use of an apartment or building.

Rent (or pure economic rent) is payment for the use of factors of production that are fixed in supply.

Market Equilibrium. The supply curve for land is completely inelastic—that is, vertical—because the supply of land is fixed. In Figure 14-1, the demand

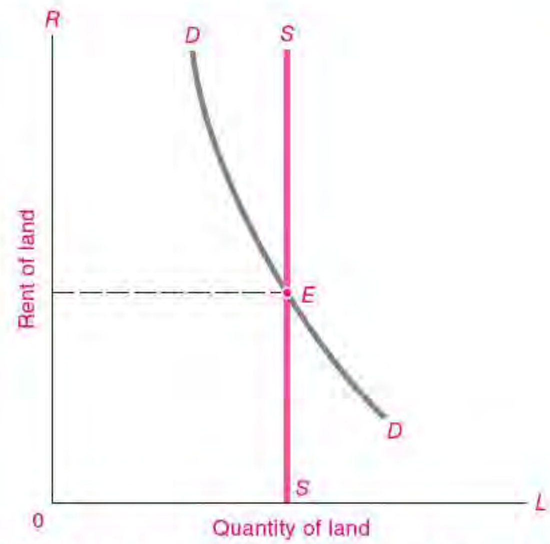


FIGURE 14-1. Fixed Land Must Work for Whatever It Can Earn

Perfectly inelastic supply characterizes the case of rent, sometimes also called pure economic rent. We run up the *SS* curve to the factor demand curve to determine rent. Aside from land, we can apply rent considerations to gold mines, 7-foot-tall basketball players, and anything else in fixed supply.

[1] This statement must be qualified by the possibility that swamps can be drained and in some cases land can be "produced" by filling shallow bays with landfill. The land area of Boston tripled from 1630 to 1900. Also, land can be used for different purposes, and much agricultural land has been converted to urban land around the world.

and supply curves intersect at the equilibrium point *E*. It is toward this factor price that the rent of land must tend. Why?

If rent were above the equilibrium, the amount of land demanded by all firms would be less than the fixed supply. Some landowners would be unable to rent their land and would have to offer their land for less and thus bid down its rent. By similar reasoning, the rent could not long remain below the equilibrium. Only at a competitive price where the total amount of land demanded exactly equals the fixed supply will the market be in equilibrium.

Suppose the land can be used only to grow corn. If the demand for corn rises, the demand curve for corn land will shift up and to the right, and the rent will rise. This leads to an important point about land: The price of corn land is high because the price of corn is high. This is a fine example of *derived demand*, which signifies that the demand for the factor is derived from the demand for the product produced by the factor.

Because the supply of land is inelastic, land will always work for whatever it can earn. Thus the value of the land derives entirely from the value of the product, and not vice versa.

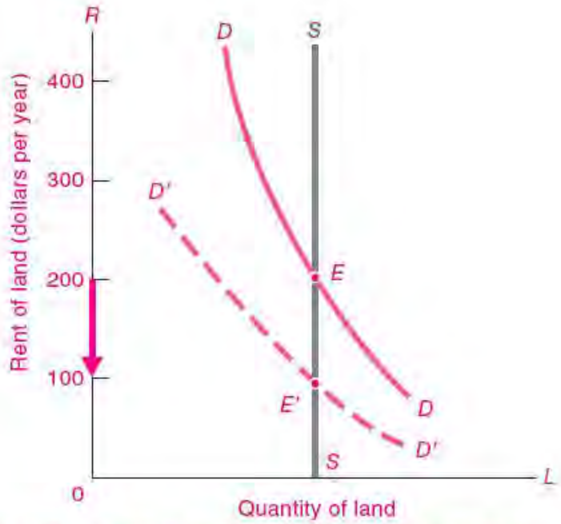


FIGURE 14-2. Tax on Fixed Land Is Shifted Back to Landowners, with Government Skimming Off Pure Economic Rent

A tax on fixed land leaves prices paid by users unchanged at *E* but reduces rent retained by landowners to *E*′. This provides the rationale for Henry George's single-tax movement, which aimed to capture for society the increased land values without distorting the allocation of resources.

Taxing Land

The fact that the supply of land is fixed has a very important consequence. Consider the land market in Figure 14-2. Suppose the government introduces a 50 percent tax on all land rents, taking care to ensure that there is no tax on buildings or improvements.

After the tax, the total demand for the land's services will not have changed. At a price (*including* tax) of $200 in Figure 14-2, people will continue to demand the entire fixed supply of land. Hence, with land fixed in supply, the market rent on land services (including the tax) will be unchanged and must be at the original market equilibrium at point *E*.

What will happen to the rent received by the landowners? Demand and quantity supplied are unchanged, so the market price will be unaffected by the tax. Therefore, the tax must be completely paid out of the landowner's income.

The situation can be visualized in Figure 14-2. What the farmer pays and what the landlord receives are now two quite different things. As far as the landlords are concerned, once the government steps in to take its 50 percent share, the effect is just the same as it would be if the net demand to the owners had shifted down from *DD* to *D*′*D*′. Landowners' equilibrium return after taxes is now only *E*′. *The entire tax has been shifted backward onto the owners of the factor in perfectly inelastic supply.*

Landowners will surely complain. But under perfect competition there is nothing they can do about it, since they cannot alter the total supply and the land must work for whatever it can get. Half a loaf is better than none.

You might at this point wonder about the effects of such a tax on economic efficiency. The striking result is that *a tax on rent will lead to no distortions or economic inefficiencies.* This surprising result comes because a tax on pure economic rent does not change anyone's economic behavior. Demanders are unaffected because their price is unchanged. The behavior of suppliers is unaffected because the supply of land is fixed and cannot react. Hence, the economy operates after the tax exactly as it did before the tax—with no distortions or inefficiencies arising as a result of the land tax.

A tax on pure economic rent will lead to no distortions or inefficiencies.

Henry George's Single-Tax Movement

The theory of pure economic rent was the basis for the single-tax movement of the late 1800s. At the time, America's population was expanding rapidly as people migrated here from all over the world. With the growth in population and the expansion of railroads into the American West, land rents soared, creating handsome profits for those who were lucky or farsighted enough to buy land early.

Why, some people asked, should landowners be permitted to receive these "unearned land increments"? Henry George (1839–1897), a journalist who thought a great deal about economics, crystallized these sentiments in his best-selling book *Progress and Poverty* (1879). He called for financing government principally through property taxes on land, while cutting or eliminating all other taxes on capital, labor, and the improvements on the land. George believed that such a "single tax" could improve the distribution of income without harming the productivity of the economy.

While the U.S. economy obviously never went very far toward the single-tax ideal, many of George's ideas were picked up by subsequent generations of economists. In the 1920s, the English economist Frank Ramsey extended George's approach by analyzing the efficiency of different kinds of taxes. This led to the development of efficient or Ramsey tax theory. This analysis shows that taxes are least distortionary if levied on sectors whose supplies or demands are highly price-inelastic.

The reasoning behind Ramsey taxes is essentially the same as that shown in Figure 14-2. If a commodity is highly inelastic in supply or demand, a tax on that sector will have very little impact on production and consumption, and the resulting distortion will be relatively small.

B. ENVIRONMENTAL ECONOMICS

In the introductory section of this chapter, we read about some of the controversies surrounding environmental problems. A stern warning from environmentalists Paul R. Ehrlich and Ann H. Ehrlich in 2008 illustrates these concerns:

> Our species has already plucked the low-hanging resource fruit and converted the richest lands to human uses. To support [population growth], metals will have to be won from ever-poorer ores, while oil, natural gas, and water will need to be obtained from ever-deeper wells and transported further. So-called "marginal" lands, often the last strongholds of the biodiversity on which we all depend for essential ecosystem services, increasingly will be converted into yet more crops to feed people, livestock, or SUVs. . . . Climate change is a major threat, even if it may not be the greatest environmental problem. Land-use change, toxification of the planet, increased probability of vast epidemics, or conflicts over scarce resources, involving, possibly, use of nuclear weapons—all population-related—may prove more menacing.

While many technological optimists believe that such concerns are exaggerated, our task is to understand the *economic forces underlying environmental degradation*. This section explores the nature of environmental externalities, describes why they produce economic inefficiencies, and analyzes potential remedies.

EXTERNALITIES

Recall that an *externality* is an activity that imposes involuntary costs or benefits on others, or an activity whose effects are not completely reflected in its market price.

Externalities come in many guises: Some are positive, while others are negative. When a firm dumps toxic wastes into a stream, doing so may kill fish and plants and reduce the stream's recreational value. This is a negative or harmful externality because the firm does not compensate people for the damages imposed on the stream. If you discover a new flu vaccine, the benefits will extend to many people who are not vaccinated because they are less likely to be exposed to the flu. This is a positive or beneficial externality.

Some externalities have pervasive effects, while others have smaller spillover components. When a carrier of bubonic plague entered a town during the Middle Ages, an entire population could be felled by the Black Death. On the other hand, when you eat an onion at a football stadium on a windy day, the external impacts are hardly noticeable.

Public vs. Private Goods

A polar case of an externality is a *public good,* which is a commodity that can be provided to everyone as easily as it can be provided to one person.

The case par excellence of a public good is national defense. Nothing is more vital to a society than its security. But national defense, as an economic good, differs completely from a *private good* like bread. Ten loaves of bread can be divided up in many ways among individuals, and what I eat cannot be eaten by others. But national defense, once provided, affects everyone equally. It matters not at all whether you are hawk or dove, old or young, ignorant or learned—you will receive the same amount of national security from the Army as does every other resident of the country.

Note therefore the stark contrast: The decision to provide a certain level of a public good like national defense will lead to a number of batallions, airplanes, and tanks to protect each of us. By contrast, the decision to consume a private good like bread is an individual act. You can eat four slices, or two, or none; the decision is purely your own and does not commit anyone else to a particular amount of bread consumption.

The example of national defense is a dramatic and extreme case of a public good. But when you think of a smallpox vaccine, the Hubble telescope, clean drinking water, or many similar government projects, you generally find elements of public goods involved. In summary:

Public goods are ones whose benefits are indivisibly spread among the entire community, whether or not individuals desire to consume the public good. **Private goods,** by contrast, are ones that can be divided up and provided separately to different individuals, with no external benefits or costs to others. Efficient provision of public goods often requires government action, while private goods can be efficiently allocated by private markets.

Global Public Goods

Perhaps the thorniest of all market failures are global public goods. These are externalities whose impacts are indivisibly spread across the entire globe. Important examples are actions to slow global warming (considered later in this chapter), measures to prevent ozone depletion, or discoveries to prevent a global pandemic of avian flu. Global public goods pose particular problems because there are no effective market or political mechanisms available to allocate them efficiently. Markets routinely fail because individuals do not have appropriate incentives to produce these goods, while national governments cannot capture all the benefits of their investments in global public goods.

Why do global public goods differ from other goods? If a terrible storm destroys much of America's corn crop, the price system will guide farmers and consumers to equilibrate needs and availabilities. If America's public road system needs modernization, voters will lobby the government to develop an efficient transportation system. But if problems arise concerning global public goods, such as global warming or antibiotic resistance, neither market participants nor national governments have appropriate incentives to find an efficient outcome. The marginal cost of investments to any individual or nation is much less than the global marginal benefits, and underinvestment is the certain outcome.

MARKET INEFFICIENCY WITH EXTERNALITIES

Abraham Lincoln said that government should "do for the people what needs to be done, but which they cannot, by individual effort, do at all, or do so well, for themselves." Pollution control satisfies this guideline since the market mechanism does not provide an adequate check on polluters. Firms will not voluntarily restrict emissions of noxious chemicals, nor will they always abstain from dumping toxic wastes into landfills. Pollution control is therefore generally held to be a legitimate government function.

Analysis of Inefficiency

Why do externalities like pollution lead to economic inefficiency? Take a hypothetical coal-burning electric utility. Dirty Light & Power generates an externality by spewing out tons of noxious sulfur dioxide fumes. Some of the sulfur harms the utility, requiring more frequent repainting and raising the firm's medical bills. But most of the damage is "external" to the firm, harming vegetation and buildings and causing various kinds of respiratory ailments and even premature death in people.

Dirty Light & Power must decide how much to reduce its pollution, but it also has to answer to its profit-oriented shareholders. With no pollution cleanup, its workers, plant, and profits will suffer. Cleaning up every last particle, on the other hand, will be very costly. Such a complete cleanup would cost so much that Dirty Light & Power could not hope to survive in the marketplace.

The managers therefore decide to clean up just to the point where profits are maximized. This requires that the benefits to the firm from additional abatement ("marginal private benefits") be equal to the cost of additional cleanup ("marginal cost of abatement"). Careful economic and engineering calculations might show that the firm's private interests are maximized when abatement is set at 50 tons. At that level, the marginal private benefits equal the marginal costs of $10 per ton. Put differently, when Dirty Light & Power produces electricity in a least-cost manner, weighing only private costs and benefits, it will abate only 50 tons and pollute 350 tons.

Suppose, however, that a team of environmental scientists and economists is asked to examine the overall benefits of abatement to society rather than only the benefits to Dirty Light & Power. In examining the total impacts, the auditors find that the *marginal social benefits* of pollution control—including improved health and increased property values in neighboring regions—are 10 times the marginal private benefits. The impact from each extra ton on Dirty Light & Power is $10, but the rest of society suffers an additional impact of $90 per ton of external costs. Why doesn't Dirty Light & Power include the $90 of additional social benefits in its calculations? The $90 is excluded because these benefits are external to the firm and have no effect on its profits.

We now see how pollution and other externalities lead to inefficient economic outcomes: In an unregulated environment, firms will determine their most profitable pollution levels by equating the marginal private benefit from abatement with the marginal private cost of abatement. When the pollution spillovers are significant, the private equilibrium will produce inefficiently high levels of pollution and too little cleanup activity.

Socially Efficient Pollution. Given that private decisions on pollution control are inefficient, is there a better solution? In general, economists look to determine the socially efficient level of pollution by balancing social costs and benefits. More precisely, *efficiency requires that the marginal social benefits from abatement equal the marginal social costs of abatement.*

How might an efficient level of pollution be determined? Economists recommend an approach known as *cost-benefit analysis,* in which efficient emissions are set by balancing the marginal costs of an action against the marginal benefits of that action. In the case of Dirty Light & Power, suppose that experts study the cost data for abatement and environmental damage. They determine that marginal social costs and marginal social benefits are equalized when the amount of abatement is increased from 50 tons to 250 tons. At the efficient pollution rate, they find that the marginal costs of abatement are $40 per ton, while the marginal social benefits from the last unit removed are also $40 per ton.

The resulting level of pollution is *socially efficient* because such an emissions rate maximizes the net social value of production. Only at this level of pollution would the marginal social cost of abatement equal the marginal social benefit. Here again, as in many areas, we determine the most efficient outcome by equating the marginal costs and benefits of an activity.

Cost-benefit analysis will show why extreme "no-risk" or "zero-discharge" policies are generally wasteful. Reducing pollution to zero would generally impose astronomically high cleanup costs, while the marginal benefits of reducing the last few grams of pollution may be quite modest. In some cases, it may even be impossible to continue to produce with zero emissions, so a no-risk philosophy might require closing down the computer industry or banning all vehicular traffic. Generally, economic efficiency calls for a compromise, balancing the extra value of the industry's output against the extra damage from pollution.

An unregulated market economy will generate levels of pollution (or other externalities) at which the marginal private benefit of abatement equals the marginal private cost of abatement. Efficiency requires that the marginal social benefit of abatement equals the marginal social cost of abatement. In an unregulated economy, there will be too little abatement and too much pollution.

Valuing Damages

One of the major difficulties involved in setting efficient environmental policies arises because of the need to estimate the benefits of pollution control and other policies. In cases where pollution affects only marketed goods and services, the measurement is relatively straightforward. If a warmer climate reduces wheat yields, we can measure the damage by the change in the net value of the wheat. Similarly, if a new road requires tearing down someone's house, we can calculate the market value of a replacement dwelling.

Unfortunately, many types of environmental damage are extremely difficult to value. A classic example was the proposal to ban logging across much of the Pacific Northwest in order to preserve the habitat of the spotted owl. That would cost thousands of logging jobs and raise lumber prices. How should we value the benefits in terms of the continued existence of the spotted owl? Or, to take another example, the *Exxon Valdez* oil spill in Prince William Sound, Alaska, damaged beaches and killed wildlife. How much is the life of a sea otter worth?

Economists have developed several approaches for estimating impacts, such as those on owls and otters, that do not show up directly in market prices. The most reliable techniques examine the impact of environmental damage on different activities and then put market-derived values on those activities. For example, in estimating the impact of emissions of sulfur dioxide, environmental economists first estimate the impact of higher emissions on health, and they then place a dollar value on health changes using either survey techniques or estimates that are revealed by people's actual behavior.

Some of the most difficult cases occur in situations that involve ecosystems and the survival of different species. How much should society pay to ensure that the spotted owl survives? Most people will never see a spotted owl, just as they will never see a whooping crane or actually visit Prince William Sound. They may nevertheless place a value on these natural resources. Some environmental economists use a technique called *contingent valuation*, which involves asking people how much they would be willing to pay in a hypothetical situation, say, to keep some natural resource undamaged. This technique will yield answers, but these answers have not always proved to be reliable.

Few would doubt that a healthy and clean environment has a high value, but placing reliable values on the environment, particularly on the nonmarket components, has proved a difficult business.

Graphical Analysis of Pollution

We can illustrate these points with the help of Figure 14-3. The upward-sloping market *MC* curve is the marginal cost of abatement. The downward-sloping curves are the marginal benefits of reducing pollution, with the upper, solid *MSB* line being the marginal social benefit from less pollution while the lower, dashed *MPB* line is the marginal private benefit of abatement to the polluter.

Caution on Graphing Pollution

In analyzing pollution, it is useful to think of pollution control or abatement as a "good." In the graphs, we therefore measure marginal costs and benefits on the vertical axis and the abatement or pollution removed on the horizontal axis. The trick here is to remember that because pollution removal is a good, it is measured positively on the horizontal axis. You can also think of pollution as measured negatively from the far-right point of 400. So abatement of zero is pollution of 400, while abatement of 400 means zero pollution.

The unregulated market solution comes at point *I*, where the marginal private costs and benefits are equated. At this point, only 50 tons are removed, and the marginal private costs and benefits are \$10 per ton. But the unregulated market solution is inefficient. We can see this by performing an experiment that increases abatement by 10 tons; this is represented by the thin slice to the right of point *I*. For this additional removal, the marginal benefits are given by the total area of the slice under the *MSB* curve, while the marginal costs are given by the area of the slice under the *MC* curve. The net benefits are that part of the slice shown by the shaded area between the two curves.

The efficient level of pollution comes at point *E*, where marginal social benefits are equated to marginal costs of abatement. At that point, both *MSB* and *MC* are equal to \$40 per ton. Also, because *MSB* and *MC* are equal, the experiment of increasing

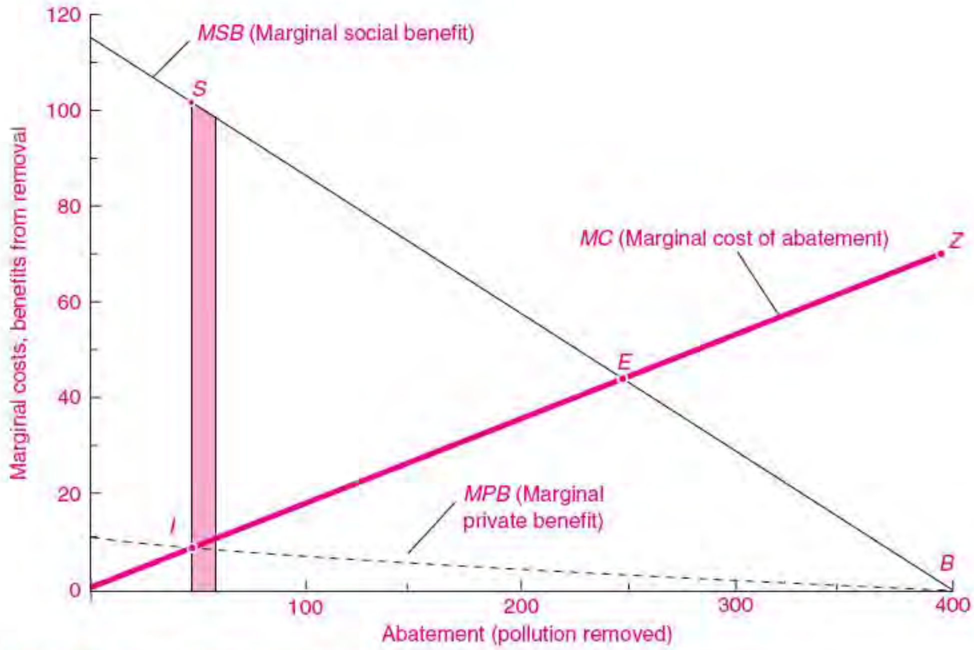


FIGURE 14-3. Inefficiency from Externalities

When marginal social benefit (*MSB*) diverges from marginal private benefit (*MPB*), markets will generate unregulated equilibrium at *I*, with too little abatement or pollution cleanup. Efficient cleanup comes at *E*, where *MSB* equals *MC*.

abatement by a tiny amount will find that there is no difference between the curves, so there is no net benefit from additional pollution control. We can also measure the net benefits of the efficient solution relative to the unregulated market by taking all the little slices of net benefit from the shaded slice to point *E*. This calculation shows that the area *ISE* represents the gains from efficient removal of pollutants.

POLICIES TO CORRECT EXTERNALITIES

What are the weapons that can be used to combat inefficiencies arising from externalities? The most visible activities are government antipollution programs that use either direct controls or financial incentives to induce firms to correct externalities. More subtle approaches use enhanced property rights to give the private sector the instruments for negotiating efficient solutions. We survey these approaches in this section.

Government Programs

Direct Controls. For almost all pollution, as well as other health and safety externalities, governments rely on direct regulatory controls; these are often called *social regulations*. For example, the 1970 Clean Air Act reduced allowable emissions of three major pollutants by 90 percent. In 1977, utilities were told to reduce sulfur emissions at new plants by 90 percent. In a series of regulations, firms were told they must phase out ozone-depleting chemicals. And so it goes with regulation.

How does the government enforce a pollution regulation? To continue our example of Dirty Light & Power, the state Department of Environmental Protection might tell Dirty Light & Power to increase its abatement to 250 tons of pollution. Under *command-and-control regulations*, the regulator would simply order the firm to comply, giving detailed instructions on what pollution-control technology to use and where to apply it. There would be little scope for novel approaches or tradeoffs within the firm or across firms. *If* standards are appropriately set—a very big "if"—the outcome might approach the efficient pollution level described in the previous part of this section.

While it is possible that the regulator might choose a combination of pollution-control edicts that guarantees economic efficiency, in practice that is not very likely. Indeed, much pollution control suffers from extensive inefficiencies. For example, pollution regulations are often set without comparisons of marginal costs and marginal benefits, and without such comparisons there is no way to determine the most efficient level of pollution control.

In addition, standards are inherently a very blunt tool. Efficient pollution reduction requires that the marginal cost of pollution be equalized across all sources of pollution. Command-and-control regulations generally do not allow differentiation across firms, regions, or industries. Hence, regulations are usually the same for large firms and small firms, for cities and rural areas, and for high-polluting and low-polluting industries. Even though firm A might be able to reduce a ton of pollution at a tiny fraction of the cost to firm B, both firms will be required to meet the same standard; nor will there be any incentives for the low-cost firm to reduce pollution beyond the standard even though it would be economical to do just that. Study after study has confirmed that our environmental goals have proved unnecessarily costly when we use command-and-control regulation.

Market Solution: Emissions Fees. In order to avoid some of the pitfalls of direct controls, many economists have suggested that environmental policy rely instead on market-type regulations. One approach is the use of *emissions fees,* which would require that firms pay a tax on their pollution equal to the amount of external damage it causes. If Dirty Light & Power were imposing external marginal costs of $35 per ton on the surrounding community, the appropriate emissions charge would be $35 per ton. This is in effect *internalizing* the externality by making the firm pay the social costs of its activities. In calculating its private costs, Dirty Light & Power would find that, at point *E* in Figure 14-3, an additional ton of pollution would cost $5 of internal costs to the firm plus $35 in emissions fees, for an overall marginal cost of $40 per ton of pollution. By equating the new marginal *private* benefit (private benefit plus emissions fee) with the marginal abatement cost, the firm would set its abatement at the efficient level. *If* the emissions fee were correctly calculated—another big "if"—profit-minded firms would be led as if by a mended invisible hand to the efficient point where marginal social costs and marginal social benefits of pollution are equal.

The alternative approaches are shown graphically in Figure 14-4, which is similar to Figure 14-3. With the direct-control approach, the government instructs the firm to remove 250 tons of pollutants (or to emit no more than 150 tons). This would, in effect, place the standard at the heavy vertical line. If the standard were set at the right level, the firm would undertake the socially efficient level of abatement. Hence, with efficient regulation, the firm will choose point *E*, where *MSB* equals *MC*.

We can also see how emissions fees would operate. Suppose that the government levies a fee of $35 per ton of pollution. Including the fee, the marginal private benefit of abatement would

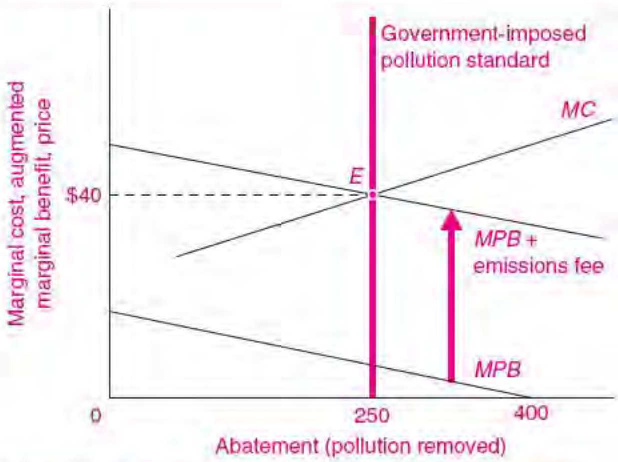


FIGURE 14-4. Pollution Standards and Emissions Fees

When government sets the pollution limitation at 150 tons, or requires removal of 250 tons, this standard will lead to efficient pollution at point *E*.

The same result can be achieved with pollution fees of $35 per ton. The $5 *MPB* plus the emissions fee gives a total marginal benefit of $40 at an abatement of 250 tons. Hence the augmented marginal benefit curve (*MPB* + emissions fee) equals *MC* at the efficient level, *E*.

rise from \$5 to \$40 per ton. We show this as the augmented marginal-private-benefit schedule in Figure 14-4. Faced with the new incentives, the firm would choose efficient point *E* in Figure 14-4.

Market Solution: Tradeable Emissions Permits. A new approach that does not require the government to legislate taxes is the use of tradeable emissions permits. With this approach, instead of telling firms that they must pay \$*x* per unit of pollution and then allowing firms to choose the level of pollution, the government chooses the level of pollution and allocates the appropriate number of permits. The price of permits, which represents the level of the emissions fee, is then set by supply and demand in the market for permits. Assuming that firms know their costs of production and abatement, the tradeable-permits approach has the same outcome as the emissions-fee approach.

Economic Innovations: Trading Pollution Permits

Most environmental regulations use a command-and-control approach that limits the emissions from individual sources, such as power plants or automobiles. This approach cannot cap overall emissions. More important, it virtually guarantees that the overall program is inefficient because it does not satisfy the condition that emissions from all sources must have equal marginal costs of abatement.

In 1990, the United States introduced a radical new approach to environmental control in its program on control of sulfur dioxide, which is one of the most harmful environmental pollutants. Under the 1990 Clean Air Act amendments, the government allocates a limited number of pollution permits. The total number of tons permitted for the country has been gradually reduced since 1990. The innovative aspect of the plan is that the permits are freely tradeable. Electric utilities receive pollution permits and are allowed to buy and sell them with each other just like pork bellies or wheat. Those firms which can reduce their sulfur emissions most cheaply do so and sell their permits to pollute; other firms which need additional permits for new plants or have no leeway to reduce emissions find it economical to buy permits rather than install expensive antipollution equipment or shut down.

Environmental economists believe that the enhanced incentives allow the ambitious targets to be met at a much lower cost than would be paid under traditional command-and-control regulation. Studies by economist Tom Tietenberg of Colby College in Maine have determined that the traditional approaches cost 2 to 10 times as much as would cost-effective regulations like emissions trading.

The behavior of this market has produced a big surprise. Originally, the government projected that permits in the early years would sell for around \$300 per ton of sulfur dioxide. But in practice, the market price in the early years fell to below \$100 per ton. One reason for the success was that the program gave strong incentives for firms to innovate, and firms found that low-sulfur coal could be used much more easily and cheaply than had earlier been anticipated. This important experiment has given powerful support to economists who argue for market-based approaches to environmental policy.

Private Approaches

It is generally thought that some form of government intervention in the market is necessary to overcome the market failures associated with pollution and other externalities. In some cases, however, strong property rights can substitute for government regulations or taxes.

One private-sector approach relies upon *liability laws* rather than upon direct government regulations. Under this approach, the legal system makes the generator of externalities legally liable for any damages caused to other persons. In effect, by imposing an appropriate liability system, the externality is internalized.

In some areas, this doctrine is well established. For example, in most states, if you are injured by a negligent driver, you can sue for damages. Or if you are injured or become ill from a defective product, the company can be sued for product liability.

While liability rules are in principle an attractive means of internalizing the nonmarket costs of production, they are quite limited in practice. They usually involve high litigation costs, which add an additional cost to the original externality. In addition, many damages cannot be litigated because of incomplete property rights (such as those involving