CHAPTER 1
Economics: The Study of Choice

START UP: ECONOMICS IN THE NEWS

2008 seemed to be the year of economic news. From the worst financial crisis since the Great Depression to the possibility of a global recession, to gyrating gasoline and food prices, and to plunging housing prices, economic questions were the primary factors in the presidential campaign of 2008 and dominated the news generally.

What causes the prices of some good to rise while the prices of some other goods fall? Price determination is one of the things that we will study in this book. We will also consider factors that lead an economy to fall into a recession—and the attempts to limit it.

While the investigation of these problems surely falls within the province of economics, economics encompasses a far broader range of issues. Ultimately, economics is the study of choice. Because choices range over every imaginable aspect of human experience, so does economics. Economists have investigated the nature of family life, the arts, education, crime, sports, job creation—the list is virtually endless because so much of our lives involves making choices.

How do individuals make choices: Would you like better grades? More time to relax? More time watching movies? Getting better grades probably requires more time studying, and perhaps less relaxation and entertainment. Not only must we make choices as individuals, we must make choices as a society. Do we want a cleaner environment? Faster economic growth? Both may be desirable, but efforts to clean up the environment may conflict with faster economic growth. Society must make choices.

Economics is defined less by the subjects economists investigate than by the way in which economists investigate them. Economists have a way of looking at the world that differs from the way scholars in other disciplines look at the world. It is the economic way of thinking; this chapter introduces that way of thinking.
1. DEFINING ECONOMICS

Economics is a social science that examines how people choose among the alternatives available to them. It is social because it involves people and their behavior. It is a science because it uses, as much as possible, a scientific approach in its investigation of choices.

1.1 Scarcity, Choice, and Cost

All choices mean that one alternative is selected over another. Selecting among alternatives involves three ideas central to economics: scarcity, choice, and opportunity cost.

Scarcity

Our resources are limited. At any one time, we have only so much land, so many factories, so much oil, so many people. But our wants, our desires for the things that we can produce with those resources, are unlimited. We would always like more and better housing, more and better education—more and better of practically everything.

If our resources were also unlimited, we could say yes to each of our wants—and there would be no economics. Because our resources are limited, we cannot say yes to everything. **To say yes to one thing requires that we say no to another.** Whether we like it or not, we must make choices.

Our unlimited wants are continually colliding with the limits of our resources, forcing us to pick some activities and to reject others. **Scarcity** is the condition of having to choose among alternatives. A **scarce good** is one for which the choice of one alternative requires that another be given up.

Consider a parcel of land. The parcel presents us with several alternative uses. We could build a house on it. We could put a gas station on it. We could create a small park on it. We could leave the land undeveloped in order to be able to make a decision later as to how it should be used.

Suppose we have decided the land should be used for housing. Should it be a large and expensive house or several modest ones? Suppose it is to be a large and expensive house. Who should live in the house? If the Lees live in it, the Nguyens cannot. There are alternative uses of the land both in the sense of the type of use and also in the sense of who gets to use it. The fact that land is scarce means that society must make choices concerning its use.

**Virtually everything is scarce.** Consider the air we breathe, which is available in huge quantity at no charge to us. Could it possibly be scarce?

The test of whether air is scarce is whether it has alternative uses. What uses can we make of the air? We breathe it. We pollute it when we drive our cars, heat our houses, or operate our factories. In effect, one use of the air is as a garbage dump. We certainly need the air to breathe. But just as certainly, we choose to dump garbage in it. Those two uses are clearly alternatives to each other. The more garbage we dump in the air, the less desirable—and healthy—it will be to breathe. If we decide we want to breathe cleaner air, we must limit the activities that generate pollution. Air is a scarce good because it has alternative uses.

Not all goods, however, confront us with such choices. A **free good** is one for which the choice of one use does not require that we give up another. One example of a free good is gravity. The fact that gravity is holding you to the earth does not mean that your neighbor is forced to drift up into space! One person’s use of gravity is not an alternative to another person’s use.

There are not many free goods. Outer space, for example, was a free good when the only use we made of it was to gaze at it. But now, our use of space has reached the point where one use can be an alternative to another. Conflicts have already arisen over the allocation of orbital slots for communications satellites. Thus, even parts of outer space are scarce. Space will surely become more scarce as we find new ways to use it. Scarcity characterizes virtually everything. Consequently, the scope of economics is wide indeed.
Scarcity and the Fundamental Economic Questions

The choices we confront as a result of scarcity raise three sets of issues. Every economy must answer the following questions:

1. **What should be produced?** Using the economy’s scarce resources to produce one thing requires giving up another. Producing better education, for example, may require cutting back on other services, such as health care. A decision to preserve a wilderness area requires giving up other uses of the land. Every society must decide what it will produce with its scarce resources.

2. **How should goods and services be produced?** There are all sorts of choices to be made in determining how goods and services should be produced. Should a firm employ a few skilled or a lot of unskilled workers? Should it produce in its own country or should it use foreign plants? Should manufacturing firms use new or recycled raw materials to make their products?

3. **For whom should goods and services be produced?** If a good or service is produced, a decision must be made about who will get it. A decision to have one person or group receive a good or service usually means it will not be available to someone else. For example, representatives of the poorest nations on earth often complain that energy consumption per person in the United States is 17 times greater than energy consumption per person in the world’s 62 poorest countries. Critics argue that the world’s energy should be more evenly allocated. Should it? That is a “for whom” question.

Every economy must determine what should be produced, how it should be produced, and for whom it should be produced. We shall return to these questions again and again.

**Opportunity Cost**

It is within the context of scarcity that economists define what is perhaps the most important concept in all of economics, the concept of opportunity cost. **Opportunity cost** is the value of the best alternative forgone in making any choice.

The opportunity cost to you of reading the remainder of this chapter will be the value of the best other use to which you could have put your time. If you choose to spend $20 on a potted plant, you have simultaneously chosen to give up the benefits of spending the $20 on pizzas or a paperback book or a night at the movies. If the book is the most valuable of those alternatives, then the opportunity cost of the plant is the value of the enjoyment you otherwise expected to receive from the book.

**The concept of opportunity cost must not be confused with the purchase price of an item.** Consider the cost of a college or university education. That includes the value of the best alternative use of money spent for tuition, fees, and books. But the most important cost of a college education is the value of the forgone alternative uses of time spent studying and attending class instead of using the time in some other endeavor. Students sacrifice that time in hopes of even greater earnings in the future or because they place a value on the opportunity to learn. Or consider the cost of going to the doctor. Part of that cost is the value of the best alternative use of the money required to see the doctor. But, the cost also includes the value of the best alternative use of the time required to see the doctor. The essential thing to see in the concept of opportunity cost is found in the name of the concept. Opportunity cost is the value of the best opportunity forgone in a particular choice. It is not simply the amount spent on that choice.

The concepts of scarcity, choice, and opportunity cost are at the heart of economics. A good is scarce if the choice of one alternative requires that another be given up. The existence of alternative uses forces us to make choices. The opportunity cost of any choice is the value of the best alternative forgone in making it.

**KEY TAKEAWAYS**

- Economics is a social science that examines how people choose among the alternatives available to them.
- Scarcity implies that we must give up one alternative in selecting another. A good that is not scarce is a free good.
- The three fundamental economic questions are: What should be produced? How should goods and services be produced? For whom should goods and services be produced?
- Every choice has an opportunity cost and opportunity costs affect the choices people make. The opportunity cost of any choice is the value of the best alternative that had to be forgone in making that choice.
TRY IT!

Identify the elements of scarcity, choice, and opportunity cost in each of the following:

1. The Environmental Protection Agency is considering an order that a 500-acre area on the outskirts of a large city be preserved in its natural state, because the area is home to a rodent that is considered an endangered species. Developers had planned to build a housing development on the land.

2. The manager of an automobile assembly plant is considering whether to produce cars or sport utility vehicles (SUVs) next month. Assume that the quantities of labor and other materials required would be the same for either type of production.

3. A young man who went to work as a nurses’ aide after graduating from high school leaves his job to go to college, where he will obtain training as a registered nurse.

Case in Point: The Rising Cost of Energy

Oil is an exhaustible resource. The oil we burn today will not be available for use in the future. Part of the opportunity cost of our consumption of goods such as gasoline that are produced from oil includes the value people in the future might have placed on oil we use today.

It appears that the cost of our use of oil may be rising. We have been using “light crude,” the oil found in the ground in deposits that can be readily tapped. As light crude becomes more scarce, the world may need to turn to so-called “heavy crude,” the crude oil that is found in the sandy soil of places such as Canada and Venezuela. That oil exists in such abundance that it propels Venezuela to the top of the world list of available oil. Saudi Arabia moves to the second position; Canada is third.

The difficulty with the oil mixed in the sand is that extracting it is far more costly than light crude, both in terms of the expenditures required and in terms of the environmental damage that mining it creates. Northern Alberta, in Canada, boasts a Florida-sized area whose sandy soils are rich in crude oil. Some of that oil is 1,200 feet underground. Extracting it requires pumping steam into the oily sand and then pumping up the resultant oily syrup. That syrup is then placed into huge, industrial-sized washing machines that separate crude oil. What is left over is toxic and will be placed in huge lakes that are being created by digging pits in the ground 200 feet deep. The oil produced from these sands has become important—Alberta is the largest foreign supplier of oil to the United States.
Sands that are closer to the surface are removed by bulldozers and giant cranes; the forest over it is cleared away. The oily sand is then hauled off in two-story dump trucks which, when filled, weigh more than a Boeing 747. Total SA, a French company, is leading the race to develop Canada’s oil. Jean Luc-Guiziou, the president of Total SA’s Canadian operations, says that the extraordinarily costly process of extracting heavy crude is something the world is going to have to get used to. “The light crude undiscovered today is getting scarcer,” he told The Wall Street Journal. “We have to accept the reality of geoscience, which is that the next generation of oil resources will be heavier.”

Already, Total SA has clear-cut thousands of acres of forest land in order to gain access to the oily sand below. The process of extracting heavy crude oil costs the company $25 a barrel—compared to the $6 per barrel cost of extracting and refining light crude. Extracting heavy crude generates three times as much greenhouse gas per barrel as does light crude. By 2015, Fort McMurray, the small (population 61,000) town that has become the headquarters of Northern Alberta’s crude oil boom, will emit more greenhouse gas than the entire country of Denmark (population 5.4 million). Canada will exceed its greenhouse gas quota set by the Kyoto Accords—an international treaty aimed at limiting global warming—largely as a result of developing its heavy crude deposits.

No one even considered the extraction of heavy crude when light crude was cheap. In the late 1990s, oil cost just $12 per barrel, and deposits of heavy crude such as those in Canada attracted little attention. By mid-2006, oil sold for more than $70 per barrel, and Canada’s heavy crude was suddenly a hot commodity. “It moved from being just an interesting experiment in northern Canada to really this is the future source of oil supply,” Greg Stringham of the Canadian Association of Petroleum Producers told Al Jazeera.

Alberta’s energy minister, Greg Melchin, defends the province’s decision to proceed with the exploitation of its oily sand. “There is a cost to it, but the benefits are substantially greater,” he insists.

Not everyone agrees. George Poitras, a member of the Mikisew Cree tribe, lives downstream from the oil sands development. “You see a lot of the land dug up, a lot of the boreal forest struck down and it’s upsetting, it fills me with rage,” he says. Diana Gibson of the Parkland Institute, an environmental advocacy group, says that you can see the environmental damage generated by the extraction of oil sands around Fort McMurray from the moon. “What we are going to be having is destruction of very, very valuable ecosystems, and permanent pollution,” she says.


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**ANSWERS TO TRY IT! PROBLEMS**

1. The 500-acre area is scarce because it has alternative uses: preservation in its natural state or a site for homes. A choice must be made between these uses. The opportunity cost of preserving the land in its natural state is the forgone value of the land as a housing development. The opportunity cost of using the land as a housing development is the forgone value of preserving the land.

2. The scarce resources are the plant and the labor at the plant. The manager must choose between producing cars and producing SUVs. The opportunity cost of producing cars is the profit that could be earned from producing SUVs; the opportunity cost of producing SUVs is the profit that could be earned from producing cars.

3. The man can devote his time to his current career or to an education; his time is a scarce resource. He must choose between these alternatives. The opportunity cost of continuing as a nurses’ aide is the forgone benefit he expects from training as a registered nurse; the opportunity cost of going to college is the forgone income he could have earned working full-time as a nurses’ aide.
2. THE FIELD OF ECONOMICS

LEARNING OBJECTIVES

1. Explain the distinguishing characteristics of the economic way of thinking.
2. Distinguish between microeconomics and macroeconomics.

We have examined the basic concepts of scarcity, choice, and opportunity cost in economics. In this section, we will look at economics as a field of study. We begin with the characteristics that distinguish economics from other social sciences.

2.1 The Economic Way of Thinking

Economists study choices that scarcity requires us to make. This fact is not what distinguishes economics from other social sciences; all social scientists are interested in choices. An anthropologist might study the choices of ancient peoples; a political scientist might study the choices of legislatures; a psychologist might study how people choose a mate; a sociologist might study the factors that have led to a rise in single-parent households. Economists study such questions as well. What is it about the study of choices by economists that makes economics different from these other social sciences?

Three features distinguish the economic approach to choice from the approaches taken in other social sciences:

1. Economists give special emphasis to the role of opportunity costs in their analysis of choices.
2. Economists assume that individuals make choices that seek to maximize the value of some objective, and that they define their objectives in terms of their own self-interest.
3. Individuals maximize by deciding whether to do a little more or a little less of something. Economists argue that individuals pay attention to the consequences of small changes in the levels of the activities they pursue.

The emphasis economists place on opportunity cost, the idea that people make choices that maximize the value of objectives that serve their self-interest, and a focus on the effects of small changes are ideas of great power. They constitute the core of economic thinking. The next three sections examine these ideas in greater detail.

Opportunity Costs Are Important

If doing one thing requires giving up another, then the expected benefits of the alternatives we face will affect the ones we choose. Economists argue that an understanding of opportunity cost is crucial to the examination of choices.

As the set of available alternatives changes, we expect that the choices individuals make will change. A rainy day could change the opportunity cost of reading a good book; we might expect more reading to get done in bad than in good weather. A high income can make it very costly to take a day off; we might expect highly paid individuals to work more hours than those who are not paid as well. If individuals are maximizing their level of satisfaction and firms are maximizing profits, then a change in the set of alternatives they face may affect their choices in a predictable way.

The emphasis on opportunity costs is an emphasis on the examination of alternatives. One benefit of the economic way of thinking is that it pushes us to think about the value of alternatives in each problem involving choice.

Individuals Maximize in Pursuing Self-Interest

What motivates people as they make choices? Perhaps more than anything else, it is the economist’s answer to this question that distinguishes economics from other fields.

Economists assume that individuals make choices that they expect will create the maximum value of some objective, given the constraints they face. Furthermore, economists assume that people’s objectives will be those that serve their own self-interest.

Economists assume, for example, that the owners of business firms seek to maximize profit. Given the assumed goal of profit maximization, economists can predict how firms in an industry will respond to changes in the markets in which they operate. As labor costs in the United States rise, for example, economists are not surprised to see firms moving some of their manufacturing operations overseas.
Similarly, economists assume that maximizing behavior is at work when they examine the behavior of consumers. In studying consumers, economists assume that individual consumers make choices aimed at maximizing their level of satisfaction. In the next chapter, we will look at the results of the shift from skiing to snowboarding; that is a shift that reflects the pursuit of self-interest by consumers and by manufacturers.

In assuming that people pursue their self-interest, economists are not assuming people are selfish. People clearly gain satisfaction by helping others, as suggested by the large charitable contributions people make. Pursuing one's own self-interest means pursuing the things that give one satisfaction. It need not imply greed or selfishness.

**Choices Are Made at the Margin**

Economists argue that most choices are made "at the margin." The margin is the current level of an activity. Think of it as the edge from which a choice is to be made. A choice at the margin is a decision to do a little more or a little less of something.

Assessing choices at the margin can lead to extremely useful insights. Consider, for example, the problem of curtailing water consumption when the amount of water available falls short of the amount people now use. Economists argue that one way to induce people to conserve water is to raise its price. A common response to this recommendation is that a higher price would have no effect on water consumption, because water is a necessity. Many people assert that prices do not affect water consumption because people "need" water.

But choices in water consumption, like virtually all choices, are made at the margin. Individuals do not make choices about whether they should or should not consume water. Rather, they decide whether to consume a little more or a little less water. Household water consumption in the United States totals about 105 gallons per person per day. Think of that starting point as the edge from which a choice at the margin in water consumption is made. Could a higher price cause you to use less water brushing your teeth, take shorter showers, or water your lawn less? Could a higher price cause people to reduce their use, say, to 104 gallons per person per day? To 103? When we examine the choice to consume water at the margin, the notion that a higher price would reduce consumption seems much more plausible. Prices affect our consumption of water because choices in water consumption, like other choices, are made at the margin.

The elements of opportunity cost, maximization, and choices at the margin can be found in each of two broad areas of economic analysis: microeconomics and macroeconomics. Your economics course, for example, may be designated as a "micro" or as a "macro" course. We will look at these two areas of economic thought in the next section.

### 2.2 Microeconomics and Macroeconomics

The field of economics is typically divided into two broad realms: microeconomics and macroeconomics. It is important to see the distinctions between these broad areas of study.

**Microeconomics** is the branch of economics that focuses on the choices made by individual decision-making units in the economy—typically consumers and firms—and the impacts those choices have on individual markets. **Macroeconomics** is the branch of economics that focuses on the impact of choices on the total, or aggregate, level of economic activity.

Why do tickets to the best concerts cost so much? How does the threat of global warming affect real estate prices in coastal areas? Why do women end up doing most of the housework? Why do senior citizens get discounts on public transit systems? These questions are generally regarded as microeconomic because they focus on individual units or markets in the economy.

Is the total level of economic activity rising or falling? Is the rate of inflation increasing or decreasing? What is happening to the unemployment rate? These are questions that deal with aggregates, or totals, in the economy; they are problems of macroeconomics. The question about the level of economic activity, for example, refers to the total value of all goods and services produced in the economy. Inflation is a measure of the rate of change in the average price level for the entire economy; it is a macroeconomic problem. The total levels of employment and unemployment in the economy represent the aggregate of all labor markets; unemployment is also a topic of macroeconomics.

Both microeconomics and macroeconomics give attention to individual markets. But in microeconomics that attention is an end in itself; in macroeconomics it is aimed at explaining the movement of major economic aggregates—the level of total output, the level of employment, and the price level.

We have now examined the characteristics that define the economic way of thinking and the two branches of this way of thinking: microeconomics and macroeconomics. In the next section, we will have a look at what one can do with training in economics.
2.3 Putting Economics to Work

Economics is one way of looking at the world. Because the economic way of thinking has proven quite useful, training in economics can be put to work in a wide range of fields. One, of course, is in work as an economist. Undergraduate work in economics can be applied to other careers as well.

Careers in Economics

Economists work in three types of organizations. About 58% of economists work for government agencies. The remainder work for business firms or in colleges and universities.

Economists working for business firms and government agencies sometimes forecast economic activity to assist their employers in planning. They also apply economic analysis to the activities of the firms or agencies for which they work or consult. Economists employed at colleges and universities teach and conduct research.

Peruse the website of your college or university’s economics department. Chances are the department will discuss the wide variety of occupations that their economics majors enter. Unlike engineering and accounting majors, economics and other social science majors tend to be distributed over a broad range of occupations.

Applying Economics to Other Fields

Suppose that you are considering something other than a career in economics. Would choosing to study economics help you?

The evidence suggests it may. Suppose, for example, that you are considering law school. The study of law requires keen analytical skills; studying economics sharpens such skills. Economists have traditionally argued that undergraduate work in economics serves as excellent preparation for law school. Economist Michael Nieswiadomy of the University of North Texas collected data on Law School Admittance Test (LSAT) scores for undergraduate majors listed by 2,200 or more students taking the test in 2003. Table 1.1 gives the scores, as well as the ranking for each of these majors, in 2003 and in two previous years in which the rankings were compiled. In rankings for all three years, economics majors recorded the highest scores.

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Did the strong performance by economics, engineering, and history majors mean that training in those fields sharpens analytical skills tested in the LSAT, or that students with good analytical skills are more likely to major in them? Both factors were probably at work. Economics clearly attracts students with good analytical skills—and studying economics helps develop those skills.

Economics majors shine in other areas as well. According to the Bureau of Labor Statistics Occupational Outlook Handbook, a strong background in economic theory, mathematics, and statistics provides the basis for competing for the best job opportunities, particularly research assistant positions, in a broad range of fields. Many graduates with bachelor’s degrees will find good jobs in industry and
business as management or sales trainees or as administrative assistants. Because economists are concerned with understanding and interpreting financial matters, among other subjects, they will also be attracted to and qualified for jobs as financial managers, financial analysts, underwriters, actuaries, securities and financial services sales workers, credit analysts, loan and budget officers, and urban and regional planners.

Table 1.2 shows average yearly salary offers for bachelor degree candidates for May 2006 and the outlook for related occupations to 2014.

![Table 1.2: Average Yearly Salary Offers, May 2006 and Occupational Outlook 2004–2014, Selected Majors/Occupations](image)

One's choice of a major, or minor, is not likely to be based solely on considerations of potential earnings or the prospect of landing a spot in law school. You will also consider your interests and abilities in making a decision about whether to pursue further study in economics. And, of course, you will consider the expected benefits of alternative courses of study. What is your opportunity cost of pursuing study of economics? Does studying more economics serve your interests and will doing so maximize your satisfaction level? These considerations may be on your mind as you begin to study economics at the college level and obviously students will make many different choices. But, should you decide to pursue a major or minor in economics, you should know that a background in this field is likely to serve you well in a wide range of careers.
Economists focus on the opportunity costs of choices, they assume that individuals make choices in a way that maximizes the value of an objective defined in terms of their own self-interest, and they assume that individuals make those choices at the margin.

Economics is divided into two broad areas: microeconomics and macroeconomics.

A wide range of career opportunities is open to economics majors. Empirical evidence suggests that students who enter the job market with a major in economics tend to earn more than do students in most other majors. Further, economics majors do particularly well on the LSAT.

The Department of Agriculture estimated that the expenditures a middle-income, husband–wife family of three would incur to raise one additional child from birth in 2005 to age 17 would be $250,530. In what way does this estimate illustrate the economic way of thinking? Would the Department’s estimate be an example of microeconomic or of macroeconomic analysis? Why?

Case in Point: The Financial Payoff to Studying Economics

College economics professors have long argued that studying economics is good preparation for a variety of careers. A recent study suggests they are right and that studying economics is even likely to make students more prosperous. Students who major in economics but did not pursue graduate work are likely to earn more than students in virtually every other college major. Students who major in economics and then go on to law school or an MBA program are likely to earn more than students who approach those areas of study having majored in most other areas.

Economists Dan A. Black, Seth Sanders, and Lowell Taylor used the 1993 National Survey of College Graduates, which included more than 86,000 college-educated workers between the ages of 25 and 55 that asked what field they had majored in. They then controlled for variables such as gender, race, and ethnicity. They found that students who had not done graduate work and had majored in economics earned more than students in any other major except engineering. Specifically, economics majors earned about 13% more than other social sciences majors, 11% more than business administration majors, and about the same as natural science and accounting majors. The economics majors in their survey, like those who majored in other social sciences and business administration and unlike those who majored in engineering or accounting, were spread out over a wide range of occupations but with many in management positions.
Based on the survey they used, over 40% of economics majors went on to earn graduate degrees, many in law and business. Economics majors ranked first in terms of wages, as compared to other law school graduates with the 12 most common pre-law majors (including such majors as business administration, finance, English, history, psychology, and political science). MBA graduates who had majored in economics earned more than those who had majored in any other field except chemical engineering. Specifically, undergraduate economics majors with MBAs earned about 15% more than those who had majored in other disciplines represented in the survey, including business-related majors.

It is remarkable that all of the business-related majors generated salaries much lower than those earned by economics majors with an MBA. One could argue that this reflects self-selection; that students who major in economics are simply brighter. But, students who major in physics have high SAT scores, yet they, too, earned wages that were about 20% lower than MBA students who had majored in economics. This finding lends some credence to the notion that the marketplace rewards training in the economic way of thinking.


ANSWER TO TRY IT! PROBLEM

The information given suggests one element of the economic way of thinking: assessing the choice at the margin. The estimate reflects the cost of one more child for a family that already has one. It is not clear from the information given how close the estimate of cost comes to the economic concept of opportunity cost. The Department of Agriculture’s estimate included such costs as housing, food, transportation, clothing, health care, child care, and education. An economist would add the value of the best alternative use of the additional time that will be required for the child. If the couple is looking far ahead, it may want to consider the opportunity cost of sending a child to college. And, if it is looking very far ahead, it may want to consider the fact that nearly half of all parents over the age of 50 support at least one child over the age of 21. This is a problem in microeconomic analysis, because it focuses on the choices of individual households.

3. THE ECONOMISTS’ TOOL KIT

LEARNING OBJECTIVES

1. Explain how economists test hypotheses, develop economic theories, and use models in their analyses.
2. Explain how the all-other-things unchanged (ceteris paribus) problem and the fallacy of false cause affect the testing of economic hypotheses and how economists try to overcome these problems.
3. Distinguish between normative and positive statements.

Economics differs from other social sciences because of its emphasis on opportunity cost, the assumption of maximization in terms of one’s own self-interest, and the analysis of choices at the margin. But certainly much of the basic methodology of economics and many of its difficulties are common to every social science—indeed, to every science. This section explores the application of the scientific method to economics.

Researchers often examine relationships between variables. A variable is something whose value can change. By contrast, a constant is something whose value does not change. The speed at which a car is traveling is an example of a variable. The number of minutes in an hour is an example of a constant.

**variable**

Something whose value can change.

**constant**

Something whose value does not change.
Research is generally conducted within a framework called the scientific method, a systematic set of procedures through which knowledge is created. In the scientific method, hypotheses are suggested and then tested. A hypothesis is an assertion of a relationship between two or more variables that could be proven to be false. A statement is not a hypothesis if no conceivable test could show it to be false. The statement “Plants like sunshine” is not a hypothesis; there is no way to test whether plants like sunshine or not, so it is impossible to prove the statement false. The statement “Increased solar radiation increases the rate of plant growth” is a hypothesis; experiments could be done to show the relationship between solar radiation and plant growth. If solar radiation were shown to be unrelated to plant growth or to retard plant growth, then the hypothesis would be demonstrated to be false.

If a test reveals that a particular hypothesis is false, then the hypothesis is rejected or modified. In the case of the hypothesis about solar radiation and plant growth, we would probably find that more sunlight increases plant growth over some range but that too much can actually retard plant growth. Such results would lead us to modify our hypothesis about the relationship between solar radiation and plant growth.

If the tests of a hypothesis yield results consistent with it, then further tests are conducted. A hypothesis that has not been rejected after widespread testing and that wins general acceptance is commonly called a theory. A theory that has been subjected to even more testing and that has won virtually universal acceptance becomes a law. We will examine two economic laws in the next two chapters.

Even a hypothesis that has achieved the status of a law cannot be proven true. There is always a possibility that someone may find a case that invalidates the hypothesis. That possibility means that nothing in economics, or in any other social science, or in any science, can ever be proven true. We can have great confidence in a particular proposition, but it is always a mistake to assert that it is “proven.”

3.1 Models in Economics

All scientific thought involves simplifications of reality. The real world is far too complex for the human mind—or the most powerful computer—to consider. Scientists use models instead. A model is a set of simplifying assumptions about some aspect of the real world. Models are always based on assumed conditions that are simpler than those of the real world, assumptions that are necessarily false. A model of the real world cannot be the real world.

We will encounter an economic model in Chapter 2. For that model, we will assume that an economy can produce only two goods. Then we will explore the model of demand and supply. One of the assumptions we will make is that all the goods produced by firms in a particular market are identical. Of course, real economies and real markets are not that simple. Reality is never as simple as a model; one point of a model is to simplify the world to improve our understanding of it.

Economists often use graphs to represent economic models. The appendix to this chapter provides a quick, refresher course, if you think you need one, on understanding, building, and using graphs.

Models in economics also help us to generate hypotheses about the real world. In the next section, we will examine some of the problems we encounter in testing those hypotheses.

3.2 Testing Hypotheses in Economics

Here is a hypothesis suggested by the model of demand and supply: an increase in the price of gasoline will reduce the quantity of gasoline consumers demand. How might we test such a hypothesis?

Economists try to test hypotheses such as this one by observing actual behavior and using empirical (that is, real-world) data. The average retail price of gasoline in the United States rose from an average of $2.12 per gallon on May 22, 2005 to $2.88 per gallon on May 22, 2006. The number of gallons of gasoline consumed by U.S. motorists rose 0.3% during that period.

The small increase in the quantity of gasoline consumed by motorists as its price rose is inconsistent with the hypothesis that an increased price will lead to an reduction in the quantity demanded. Does that mean that we should dismiss the original hypothesis? On the contrary, we must be cautious in assessing this evidence. Several problems exist in interpreting any set of economic data. One problem is that several things may be changing at once; another is that the initial event may be unrelated to the event that follows. The next two sections examine these problems in detail.

The All-Other-Things-Unchanged Problem

The hypothesis that an increase in the price of gasoline produces a reduction in the quantity demanded by consumers carries with it the assumption that there are no other changes that might also affect consumer demand. A better statement of the hypothesis would be: An increase in the price of gasoline will reduce the quantity consumers demand, ceteris paribus. Ceteris paribus is a Latin phrase that means “all other things unchanged.”
But things changed between May 2005 and May 2006. Economic activity and incomes rose both in the United States and in many other countries, particularly China, and people with higher incomes are likely to buy more gasoline. Employment rose as well, and people with jobs use more gasoline as they drive to work. Population in the United States grew during the period. In short, many things happened during the period, all of which tended to increase the quantity of gasoline people purchased.

Our observation of the gasoline market between May 2005 and May 2006 did not offer a conclusive test of the hypothesis that an increase in the price of gasoline would lead to a reduction in the quantity demanded by consumers. Other things changed and affected gasoline consumption. Such problems are likely to affect any analysis of economic events. We cannot ask the world to stand still while we conduct experiments in economic phenomena. Economists employ a variety of statistical methods to allow them to isolate the impact of single events such as price changes, but they can never be certain that they have accurately isolated the impact of a single event in a world in which virtually everything is changing all the time.

In laboratory sciences such as chemistry and biology, it is relatively easy to conduct experiments in which only selected things change and all other factors are held constant. The economists’ laboratory is the real world; thus, economists do not generally have the luxury of conducting controlled experiments.

**The Fallacy of False Cause**

Hypotheses in economics typically specify a relationship in which a change in one variable causes another to change. We call the variable that responds to the change the dependent variable; the variable that induces a change is called the independent variable. Sometimes the fact that two variables move together can suggest the false conclusion that one of the variables has acted as an independent variable that has caused the change we observe in the dependent variable.

Consider the following hypothesis: People wearing shorts cause warm weather. Certainly, we observe that more people wear shorts when the weather is warm. Presumably, though, it is the warm weather that causes people to wear shorts rather than the wearing of shorts that causes warm weather; it would be incorrect to infer from this that people cause warm weather by wearing shorts.

Reaching the incorrect conclusion that one event causes another because the two events tend to occur together is called the fallacy of false cause. The accompanying essay on baldness and heart disease suggests an example of this fallacy.

Because of the danger of the fallacy of false cause, economists use special statistical tests that are designed to determine whether changes in one thing actually do cause changes observed in another. Given the inability to perform controlled experiments, however, these tests do not always offer convincing evidence that persuades all economists that one thing does, in fact, cause changes in another.

In the case of gasoline prices and consumption between May 2005 and May 2006, there is good theoretical reason to believe the price increase should lead to a reduction in the quantity consumers demand. And economists have tested the hypothesis about price and the quantity demanded quite extensively. They have developed elaborate statistical tests aimed at ruling out problems of the fallacy of false cause. While we cannot prove that an increase in price will, ceteris paribus, lead to a reduction in the quantity consumers demand, we can have considerable confidence in the proposition.

**Normative and Positive Statements**

Two kinds of assertions in economics can be subjected to testing. We have already examined one, the hypothesis. Another testable assertion is a statement of fact, such as “It is raining outside” or “Microsoft is the largest producer of operating systems for personal computers in the world.” Like hypotheses, such assertions can be demonstrated to be false. Unlike hypotheses, they can also be shown to be correct. A statement of fact or a hypothesis is a positive statement.

Although people often disagree about positive statements, such disagreements can ultimately be resolved through investigation. There is another category of assertions, however, for which investigation can never resolve differences. A normative statement is one that makes a value judgment. Such a judgment is the opinion of the speaker; no one can “prove” that the statement is or is not correct. Here are some examples of normative statements in economics: “We ought to do more to help the poor.” “People in the United States should save more.” “Corporate profits are too high.” The statements are based on the values of the person who makes them. They cannot be proven false.

Because people have different values, normative statements often provoke disagreement. An economist whose values lead him or her to conclude that we should provide more help for the poor will disagree with one whose values lead to a conclusion that we should not. Because no test exists for these values, these two economists will continue to disagree, unless one persuades the other to adopt a different set of values. Many of the disagreements among economists are based on such differences in values and therefore are unlikely to be resolved.
KEY TAKEAWAYS

- Economists try to employ the scientific method in their research.
- Scientists cannot prove a hypothesis to be true; they can only fail to prove it false.
- Economists, like other social scientists and scientists, use models to assist them in their analyses.
- Two problems inherent in tests of hypotheses in economics are the all-other-things-unchanged problem and the fallacy of false cause.
- Positive statements are factual and can be tested. Normative statements are value judgments that cannot be tested. Many of the disagreements among economists stem from differences in values.

TRY IT!

Look again at the data in Table 1.1. Now consider the hypothesis: “Majoring in economics will result in a higher LSAT score.” Are the data given consistent with this hypothesis? Do the data prove that this hypothesis is correct? What fallacy might be involved in accepting the hypothesis?

Case in Point: Does Baldness Cause Heart Disease?

A website called embarrassingproblems.com received the following email:

“Dear Dr. Margaret,

“I seem to be going bald. According to your website, this means I’m more likely to have a heart attack. If I take a drug to prevent hair loss, will it reduce my risk of a heart attack?”

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PRINCIPLES OF MICROECONOMICS
What did Dr. Margaret answer? Most importantly, she did not recommend that the questioner take drugs to treat his baldness, because doctors do not think that the baldness causes the heart disease. A more likely explanation for the association between baldness and heart disease is that both conditions are affected by an underlying factor. While noting that more research needs to be done, one hypothesis that Dr. Margaret offers is that higher testosterone levels might be triggering both the hair loss and the heart disease. The good news for people with early balding (which is really where the association with increased risk of heart disease has been observed) is that they have a signal that might lead them to be checked early on for heart disease.


**ANSWER TO TRY IT! PROBLEM**

The data are consistent with the hypothesis, but it is never possible to prove that a hypothesis is correct. Accepting the hypothesis could involve the fallacy of false cause; students who major in economics may already have the analytical skills needed to do well on the exam.

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**4. REVIEW AND PRACTICE**

**Summary**

Choices are forced on us by scarcity; economists study the choices that people make. Scarce goods are those for which the choice of one alternative requires giving up another. The opportunity cost of any choice is the value of the best alternative forgone in making that choice.

Some key choices assessed by economists include what to produce, how to produce it, and for whom it should be produced. Economics is distinguished from other academic disciplines that also study choices by an emphasis on the central importance of opportunity costs in evaluating choices, the assumption of maximizing behavior that serves the interests of individual decision makers, and a focus on evaluating choices at the margin.

Economic analyses may be aimed at explaining individual choice or choices in an individual market; such investigations are largely the focus of microeconomics. The analysis of the impact of those individual choices on such aggregates as total output, the level of employment, and the price level is the concern of macroeconomics.

Working within the framework of the scientific method, economists formulate hypotheses and then test them. These tests can only refute a hypothesis; hypotheses in science cannot be proved. A hypothesis that has been widely tested often comes to be regarded as a theory; one that has won virtually universal acceptance is a law. Because of the complexity of the real world, economists rely on models that rest on a series of simplifying assumptions. The models are used to generate hypotheses about the economy that can be tested using real-world data.

Statements of fact and hypotheses are positive statements. Normative statements, unlike positive statements, cannot be tested and provide a source for potential disagreement.
1. Why does the fact that something is scarce require that we make choices?

2. Does the fact that something is abundant mean it is not scarce in the economic sense? Why or why not?

3. In some countries, such as Cuba and North Korea, the government makes most of the decisions about what will be produced, how it will be produced, and for whom. Does the fact that these choices are made by the government eliminate scarcity in these countries? Why or why not?

4. Explain what is meant by the opportunity cost of a choice.

5. What is the approximate dollar cost of the tuition and other fees associated with the economics course you are taking? Does this dollar cost fully reflect the opportunity cost to you of taking the course?

6. In the Case in Point essay “The Rising Cost of Energy,” what would be some of the things that would be included in an estimate of the opportunity cost of preserving part of northern Alberta Canada by prohibiting heavy crude oil extraction? Do you think that the increased extraction represents the best use of the land? Why or why not?

7. Indicate whether each of the following is a topic of microeconomics or macroeconomics:
   a. The impact of higher oil prices on the production of steel
   b. The increased demand in the last 15 years for exotic dietary supplements
   c. The surge in aggregate economic activity that hit much of Asia late in the early 2000s
   d. The sharp increases in U.S. employment and total output that occurred between 2003 and 2007
   e. The impact of preservation of wilderness areas on the logging industry and on the price of lumber

8. Determine whether each of the following raises a “what,” “how,” or “for whom” issue. Are the statements normative or positive?
   a. A requirement that aluminum used in cars be made from recycled materials will raise the price of automobiles.
   b. The federal government does not spend enough for children.
   c. An increase in police resources provided to the inner city will lower the crime rate.
   d. Automation destroys jobs.
   e. Efforts to improve the environment tend to reduce production and employment.
   f. Japanese firms should be more willing to hire additional workers when production rises and to lay off workers when production falls.
   g. Access to health care should not be limited by income.

9. Your time is a scarce resource. What if the quantity of time were increased, say to 48 hours per day, and everyone still lived as many days as before. Would time still be scarce?

10. Most college students are under age 25. Give two explanations for this—one based on the benefits people of different ages are likely to receive from higher education and one based on the opportunity costs of a college education to students of different ages.

11. Some municipal water companies charge customers a flat fee each month, regardless of the amount of water they consume. Others meter water use and charge according to the quantity of water customers use. Compare the way the two systems affect the cost of water use at the margin.

12. How might you test each of the following hypotheses? Suggest some problems that might arise in each test due to the ceteris paribus (all-other-things-unchanged) problem and the fallacy of false cause.
   a. Reducing the quantity of heroin available will increase total spending on heroin and increase the crime rate.
   b. Higher incomes make people happier.
   c. Higher incomes make people live longer.

13. Many models in physics and in chemistry assume the existence of a perfect vacuum (that is, a space entirely empty of matter). Yet we know that a perfect vacuum cannot exist. Are such models valid? Why are models based on assumptions that are essentially incorrect?

14. Suppose you were asked to test the proposition that publishing students’ teacher evaluations causes grade inflation. What evidence might you want to consider? How would the inability to carry out controlled experiments make your analysis more difficult?

15. Referring to the Case in Point “Baldness and Heart Disease,” explain the possible fallacy of false cause in concluding that baldness makes a person more likely to have heart disease.

16. In 2005 the Food and Drug Administration ordered that Vioxx and other popular drugs for treating the pain of arthritis be withdrawn from the market. The order resulted from a finding that people taking the drugs had an increased risk of cardiovascular problems. Some researchers criticized the government’s action, arguing that concluding that the drugs caused the cardiovascular problems represented an example of the fallacy of false cause. Can you think of any reason why this might be the case?
ENDNOTES

CHAPTER 2

Confronting Scarcity: Choices in Production

START UP: TIGHTENING SECURITY AT THE WORLD’S AIRPORTS

Do you want safer air travel or not? While that question is seldom asked so bluntly, any person who travels by air can tell you that our collective answer has been “yes,” and it has been accompanied by increases in security and its associated costs at airports all over the world. Why? In short, “9/11.” Terrorists hijacked four U.S. commercial airliners on September 11, 2001, and the tragic results that followed led to a sharp tightening in airport security.

In an effort to prevent similar disasters, airport security officials scrutinize luggage and passengers more carefully than ever before. In the months following 9/11, delays of as much as three hours were common as agents tried to assure that no weapons or bombs could be smuggled onto another plane.

“What to produce?” is a fundamental economic question. Every economy must answer this question. Should it produce more education, better health care, improved transportation, a cleaner environment? There are limits to what a nation can produce; deciding to produce more of one thing inevitably means producing less of something else. Individuals in much of the world, after the tragedy of 9/11, clearly were willing to give up time, and a fair amount of individual privacy, in an effort to obtain greater security. Nations and individual cities also devoted additional resources to police and other forms of protection in an effort to prevent tragedies such as 9/11. People all over the world chose to produce less of other goods in order to devote more resources to the production of greater security. And, as of early 2009, the choice to devote more resources to security had paid off; there had been no similar hijackings in the United States.

In this chapter we use our first model, the production possibilities model, to examine the nature of choices to produce more of some goods and less of others. As its name suggests, the production possibilities model shows the goods and services that an economy is capable of producing—its possibilities—given the factors of production and the technology it has available. The model specifies what it means to use resources fully and efficiently and suggests some important implications for international trade. We can also use the model to illustrate economic growth, a process that expands the set of production possibilities available to an economy.

We then turn to an examination of the type of economic system in which choices are made. An economic system is the set of rules that define how an economy’s resources are to be owned and how decisions about their use are to be made. We will see that economic systems differ in terms of how they answer the fundamental economic questions. Many of the world’s economic systems, including the systems that prevail in North America, Europe, and much of Asia and Central and South America, rely on individuals operating in a market economy to make those choices. Other economic systems, including those of Cuba and North Korea today and historically...
those of the former Soviet Union, Soviet bloc countries, and China, rely—or relied—on government to make these choices. Different economic systems result in different sets of choices and thus different outcomes; the fact that market economies generally outperform the others when it comes to providing more of the things that people want helps to explain the dramatic shift from government-dominated toward market-dominated economic systems that has occurred throughout the world in the past 25 years. The chapter concludes with an examination of the role of government in an economy that relies chiefly on markets to allocate goods and services.

1. FACTORS OF PRODUCTION

LEARNING OBJECTIVES

1. Define the three factors of production—labor, capital, and natural resources.
2. Explain the role of technology and entrepreneurs in the utilization of the economy’s factors of production.

Choices concerning what goods and services to produce are choices about an economy’s use of its factors of production, the resources available to it for the production of goods and services. The value, or satisfaction, that people derive from the goods and services they consume and the activities they pursue is called utility. Ultimately, then, an economy’s factors of production create utility; they serve the interests of people.

The factors of production in an economy are its labor, capital, and natural resources. Labor is the human effort that can be applied to the production of goods and services. People who are employed or would like to be considered part of the labor available to the economy. Capital is a factor of production that has been produced for use in the production of other goods and services. Office buildings, machinery, and tools are examples of capital. Natural resources are the resources of nature that can be used for the production of goods and services.

In the next three sections, we will take a closer look at the factors of production we use to produce the goods and services we consume. The three basic building blocks of labor, capital, and natural resources may be used in different ways to produce different goods and services, but they still lie at the core of production. We will then look at the roles played by technology and entrepreneurs in putting these factors of production to work. As economists began to grapple with the problems of scarcity, choice, and opportunity cost two centuries ago, they focused on these concepts, just as they are likely to do two centuries hence.

1.1 Labor

Labor is human effort that can be applied to production. People who work to repair tires, pilot airplanes, teach children, or enforce laws are all part of the economy’s labor. People who would like to work but have not found employment—who are unemployed—are also considered part of the labor available to the economy.

In some contexts, it is useful to distinguish two forms of labor. The first is the human equivalent of a natural resource. It is the natural ability an untrained, uneducated person brings to a particular production process. But most workers bring far more. The skills a worker has as a result of education, training, or experience that can be used in production are called human capital. Students who are attending a college or university are acquiring human capital. Workers who are gaining skills through experience or through training are acquiring human capital. Children who are learning to read are acquiring human capital.

The amount of labor available to an economy can be increased in two ways. One is to increase the total quantity of labor, either by increasing the number of people available to work or by increasing the average number of hours of work per week. The other is to increase the amount of human capital possessed by workers.
1.2 Capital

Long ago, when the first human beings walked the earth, they produced food by picking leaves or fruit off a plant or by catching an animal and eating it. We know that very early on, however, they began shaping stones into tools, apparently for use in butchering animals. Those tools were the first capital because they were produced for use in producing other goods—food and clothing.

Modern versions of the first stone tools include saws, meat cleavers, hooks, and grinders; all are used in butchering animals. Tools such as hammers, screwdrivers, and wrenches are also capital. Transportation equipment, such as cars and trucks, is capital. Facilities such as roads, bridges, ports, and airports are capital. Buildings, too, are capital; they help us to produce goods and services.

Capital does not consist solely of physical objects. The score for a new symphony is capital because it will be used to produce concerts. Computer software used by business firms or government agencies to produce goods and services is capital. Capital may thus include physical goods and intellectual discoveries. Any resource is capital if it satisfies two criteria:

1. The resource must have been produced.

2. The resource can be used to produce other goods and services.

One thing that is not considered capital is money. A firm cannot use money directly to produce other goods, so money does not satisfy the second criterion for capital. Firms can, however, use money to acquire capital. Money is a form of financial capital. Financial capital includes money and other “paper” assets (such as stocks and bonds) that represent claims on future payments. These financial assets are not capital, but they can be used directly or indirectly to purchase factors of production or goods and services.

1.3 Natural Resources

There are two essential characteristics of natural resources. The first is that they are found in nature—that no human effort has been used to make or alter them. The second is that they can be used for the production of goods and services. That requires knowledge; we must know how to use the things we find in nature before they become resources.

Consider oil. Oil in the ground is a natural resource because it is found (not manufactured) and can be used to produce goods and services. However, 250 years ago oil was a nuisance, not a natural resource. Pennsylvania farmers in the eighteenth century who found oil oozing up through their soil were dismayed, not delighted. No one knew what could be done with the oil. It was not until the mid-nineteenth century that a method was found for refining oil into kerosene that could be used to generate energy, transforming oil into a natural resource. Oil is now used to make all sorts of things, including clothing, drugs, gasoline, and plastic. It became a natural resource because people discovered and implemented a way to use it.

Defining something as a natural resource only if it can be used to produce goods and services does not mean that a tree has value only for its wood or that a mountain has value only for its minerals. If people gain utility from the existence of a beautiful wilderness area, then that wilderness provides a service. The wilderness is thus a natural resource.

The natural resources available to us can be expanded in three ways. One is the discovery of new natural resources, such as the discovery of a deposit of ore containing titanium. The second is the discovery of new uses for resources, as happened when new techniques allowed oil to be put to productive use or sand to be used in manufacturing computer chips. The third is the discovery of new ways to extract natural resources in order to use them. New methods of discovering and mapping oil deposits have increased the world’s supply of this important natural resource.
1.4 Technology and the Entrepreneur

Goods and services are produced using the factors of production available to the economy. Two things play a crucial role in putting these factors of production to work. The first is technology, the knowledge that can be applied to the production of goods and services. The second is an individual who plays a key role in a market economy: the entrepreneur. An entrepreneur is a person who, operating within the context of a market economy, seeks to earn profits by finding new ways to organize factors of production. In non-market economies the role of the entrepreneur is played by bureaucrats and other decision makers who respond to incentives other than profit to guide their choices about resource allocation decisions.

The interplay of entrepreneurs and technology affects all our lives. Entrepreneurs put new technologies to work every day, changing the way factors of production are used. Farmers and factory workers, engineers and electricians, technicians and teachers all work differently than they did just a few years ago, using new technologies introduced by entrepreneurs. The music you enjoy, the books you read, the athletic equipment with which you play are produced differently than they were five years ago. The book you are reading was written and manufactured using technologies that did not exist ten years ago. We can dispute whether all the changes have made our lives better. What we cannot dispute is that they have made our lives different.

**KEY TAKEAWAYS**

- Factors of production are the resources the economy has available to produce goods and services.
- Labor is the human effort that can be applied to the production of goods and services. Labor’s contribution to an economy’s output of goods and services can be increased either by increasing the quantity of labor or by increasing human capital.
- Capital is a factor of production that has been produced for use in the production of other goods and services.
- Natural resources are those things found in nature that can be used for the production of goods and services.
- Two keys to the utilization of an economy’s factors of production are technology and, in the case of a market economic system, the efforts of entrepreneurs.

**TRY IT!**

Explain whether each of the following is labor, capital, or a natural resource.

1. An unemployed factory worker
2. A college professor
3. The library building on your campus
4. Yellowstone National Park
5. An untapped deposit of natural gas
6. The White House
7. The local power plant
Technology can seem an abstract force in the economy—important, but invisible.

It is not invisible to the 130 people who work on a Shell Oil Company oil rig called Mars, located in the deep waters of the Gulf of Mexico, about 160 miles southwest of Pensacola, Florida. The name Mars reflects its Otherworld appearance—it extends 300 feet above the water’s surface and has steel tendons that reach 3,000 feet to the floor of the gulf. This facility would not exist if it were not for the development of better oil discovery methods that include three-dimensional seismic mapping techniques, satellites that locate oil from space, and drills that can make turns as drilling foremen steer them by monitoring them on computer screens from the comfort of Mars. “We don’t hit as many dry holes,” commented Shell manager Miles Barrett. As a result of these new technologies, over the past two decades, the cost of discovering a barrel of oil dropped from $20 to under $5. And the technologies continue to improve. Three-dimensional surveys are being replaced with four-dimensional ones that allow geologists to see how the oil fields change over time.

The Mars project was destroyed by Hurricane Katrina in 2005. Royal Dutch Shell completed repairs in 2006—at a cost of $200 million. But, the facility is again pumping 130,000 barrels of oil per day and 150 million cubic feet of natural gas—the energy equivalent of an additional 26,000 barrels of oil.

Technology is doing more than helping energy companies track oil deposits. It is changing the way soft drinks and other grocery items are delivered to retail stores. For example, when a PepsiCo delivery driver arrives at a 7-Eleven, the driver keys into a handheld computer the inventory of soft drinks, chips, and other PepsiCo products. The information is transmitted to a main computer at the warehouse that begins processing the next order for that store. The result is that the driver can visit more stores in a day and PepsiCo can cover a given territory with fewer drivers and trucks.

New technology is even helping to produce more milk from cows. Ed Larsen, who owns a 1,200-cow dairy farm in Wisconsin, never gets up before dawn to milk the cows, the way he did as a boy. Rather, the cows are hooked up to electronic milkers. Computers measure each cow’s output, and cows producing little milk are sent to a “hospital wing” for treatment. With the help of such technology, as well as better feed, today’s dairy cows produce 50% more milk than did cows 20 years ago. Even though the number of dairy cows in the United States in the last 20 years has fallen 17%, milk output has increased 25%.
Who benefits from technological progress? Consumers gain from lower prices and better service. Workers gain: Their greater ability to produce goods and services translates into higher wages. And firms gain: Lower production costs mean higher profits. Of course, some people lose as technology advances. Some jobs are eliminated, and some firms find their services are no longer needed. One can argue about whether particular technological changes have improved our lives, but they have clearly made—and will continue to make—them far different.


Answers to Try It! Problems

1. An unemployed factory worker could be put to work; he or she counts as labor.
2. A college professor is labor.
3. The library building on your campus is part of capital.
4. Yellowstone National Park. Those areas of the park left in their natural state are a natural resource. Facilities such as visitors’ centers, roads, and campgrounds are capital.
5. An untapped deposit of natural gas is a natural resource. Once extracted and put in a storage tank, natural gas is capital.
6. The White House is capital.
7. The local power plant is capital.

2. THE PRODUCTION POSSIBILITIES CURVE

Learning Objectives

1. Explain the concept of the production possibilities curve and understand the implications of its downward slope and bowed-out shape.
2. Use the production possibilities model to distinguish between full employment and situations of idle factors of production and between efficient and inefficient production.

An economy’s factors of production are scarce; they cannot produce an unlimited quantity of goods and services. A production possibilities curve is a graphical representation of the alternative combinations of goods and services an economy can produce. It illustrates the production possibilities model. In drawing the production possibilities curve, we shall assume that the economy can produce only two goods and that the quantities of factors of production and the technology available to the economy are fixed.

2.1 Constructing a Production Possibilities Curve

To construct a production possibilities curve, we will begin with the case of a hypothetical firm, Alpine Sports, Inc., a specialized sports equipment manufacturer. Christie Ryder began the business 15 years ago with a single ski production facility near Killington ski resort in central Vermont. Ski sales grew, and she also saw demand for snowboards rising—particularly after snowboard competition events were included in the 2002 Winter Olympics in Salt Lake City. She added a second plant in a nearby town. The second plant, while smaller than the first, was designed to produce snowboards as well as skis. She also modified the first plant so that it could produce both snowboards and skis. Two years later she added a third plant in another town. While even smaller than the second plant, the third was primarily designed for snowboard production but could also produce skis.
We can think of each of Ms. Ryder’s three plants as a miniature economy and analyze them using the production possibilities model. We assume that the factors of production and technology available to each of the plants operated by Alpine Sports are unchanged.

Suppose the first plant, Plant 1, can produce 200 pairs of skis per month when it produces only skis. When devoted solely to snowboards, it produces 100 snowboards per month. It can produce skis and snowboards simultaneously as well.

The table in Figure 2.2 gives three combinations of skis and snowboards that Plant 1 can produce each month. Combination A involves devoting the plant entirely to ski production; combination C means shifting all of the plant’s resources to snowboard production; combination B involves the production of both goods. These values are plotted in a production possibilities curve for Plant 1. The curve is a downward-sloping straight line, indicating that there is a linear, negative relationship between the production of the two goods.

Neither skis nor snowboards is an independent or a dependent variable in the production possibilities model; we can assign either one to the vertical or to the horizontal axis. Here, we have placed the number of pairs of skis produced per month on the vertical axis and the number of snowboards produced per month on the horizontal axis.

The negative slope of the production possibilities curve reflects the scarcity of the plant’s capital and labor. Producing more snowboards requires shifting resources out of ski production and thus producing fewer skis. Producing more skis requires shifting resources out of snowboard production and thus producing fewer snowboards.

The slope of Plant 1’s production possibilities curve measures the rate at which Alpine Sports must give up ski production to produce additional snowboards. Because the production possibilities curve for Plant 1 is linear, we can compute the slope between any two points on the curve and get the same result. Between points A and B, for example, the slope equals $-2$ pairs of skis/snowboard (equals $-100$ pairs of skis/50 snowboards). (Many students are helped when told to read this result as “$-2$ pairs of skis per snowboard.”) We get the same value between points B and C, and between points A and C.

**FIGURE 2.2** A Production Possibilities Curve

The table shows the combinations of pairs of skis and snowboards that Plant 1 is capable of producing each month. These are also illustrated with a production possibilities curve. Notice that this curve is linear.

<table>
<thead>
<tr>
<th></th>
<th>Pairs of skis per month</th>
<th>Snowboards per month</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>200</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

To see this relationship more clearly, examine Figure 2.3. Suppose Plant 1 is producing 100 pairs of skis and 50 snowboards per month at point B. Now consider what would happen if Ms. Ryder decided to produce 1 more snowboard per month. The segment of the curve around point B is magnified in Figure 2.3. The slope between points B and B’ is $-2$ pairs of skis/snowboard. Producing 1 additional snowboard at point B’ requires giving up 2 pairs of skis. We can think of this as the opportunity cost of producing an additional snowboard at Plant 1. This opportunity cost equals the absolute value of the slope of the production possibilities curve.
FIGURE 2.3 The Slope of a Production Possibilities Curve

The slope of the linear production possibilities curve in Figure 2.2 is constant; it is −2 pairs of skis/snowboard. In the section of the curve shown here, the slope can be calculated between points B and B’. Expanding snowboard production to 51 snowboards per month from 50 snowboards per month requires a reduction in ski production to 98 pairs of skis per month from 100 pairs. The slope equals −2 pairs of skis/snowboard (that is, it must give up two pairs of skis to free up the resources necessary to produce one additional snowboard). To shift from B’ to B'', Alpine Sports must give up two more pairs of skis per snowboard. The absolute value of the slope of a production possibilities curve measures the opportunity cost of an additional unit of the good on the horizontal axis measured in terms of the quantity of the good on the vertical axis that must be forgone.

The absolute value of the slope of any production possibilities curve equals the opportunity cost of an additional unit of the good on the horizontal axis. It is the amount of the good on the vertical axis that must be given up in order to free up the resources required to produce one more unit of the good on the horizontal axis. We will make use of this important fact as we continue our investigation of the production possibilities curve.

Figure 2.4 shows production possibilities curves for each of the firm’s three plants. Each of the plants, if devoted entirely to snowboards, could produce 100 snowboards. Plants 2 and 3, if devoted exclusively to ski production, can produce 100 and 50 pairs of skis per month, respectively. The exhibit gives the slopes of the production possibilities curves for each plant. The opportunity cost of an additional snowboard at each plant equals the absolute values of these slopes (that is, the number of pairs of skis that must be given up per snowboard).
FIGURE 2.4 Production Possibilities at Three Plants

The slopes of the production possibilities curves for each plant differ. The steeper the curve, the greater the opportunity cost of an additional snowboard. Here, the opportunity cost is lowest at Plant 3 and greatest at Plant 1.

The exhibit gives the slopes of the production possibilities curves for each of the firm’s three plants. The opportunity cost of an additional snowboard at each plant equals the absolute values of these slopes. More generally, the absolute value of the slope of any production possibilities curve at any point gives the opportunity cost of an additional unit of the good on the horizontal axis, measured in terms of the number of units of the good on the vertical axis that must be forgone.

The greater the absolute value of the slope of the production possibilities curve, the greater the opportunity cost will be. The plant for which the opportunity cost of an additional snowboard is greatest is the plant with the steepest production possibilities curve; the plant for which the opportunity cost is lowest is the plant with the flattest production possibilities curve. The plant with the lowest opportunity cost of producing snowboards is Plant 3; its slope of −0.5 means that Ms. Ryder must give up half a pair of skis in that plant to produce an additional snowboard. In Plant 2, she must give up one pair of skis to gain one more snowboard. We have already seen that an additional snowboard requires giving up two pairs of skis in Plant 1.

2.2 Comparative Advantage and the Production Possibilities Curve

To construct a combined production possibilities curve for all three plants, we can begin by asking how many pairs of skis Alpine Sports could produce if it were producing only skis. To find this quantity, we add up the values at the vertical intercepts of each of the production possibilities curves in Figure 2.4. These intercepts tell us the maximum number of pairs of skis each plant can produce. Plant 1 can produce 200 pairs of skis per month, Plant 2 can produce 100 pairs of skis at per month, and Plant 3 can produce 50 pairs. Alpine Sports can thus produce 350 pairs of skis per month if it devotes its resources exclusively to ski production. In that case, it produces no snowboards.

Now suppose the firm decides to produce 100 snowboards. That will require shifting one of its plants out of ski production. Which one will it choose to shift? The sensible thing for it to do is to choose the plant in which snowboards have the lowest opportunity cost—Plant 3. It has an advantage not because it can produce more snowboards than the other plants (all the plants in this example are capable of producing up to 100 snowboards per month) but because it is the least productive plant for making skis. Producing a snowboard in Plant 3 requires giving up just half a pair of skis.

Economists say that an economy has a comparative advantage in producing a good or service if the opportunity cost of producing that good or service is lower for that economy than for any other. Plant 3 has a comparative advantage in snowboard production because it is the plant for which the opportunity cost of additional snowboards is lowest. To put this in terms of the production possibilities curve, Plant 3 has a comparative advantage in snowboard production (the good on the horizontal axis) because its production possibilities curve is the flattest of the three curves.

**comparative advantage**

In producing a good or service, the situation that occurs if the opportunity cost of producing that good or service is lower for that economy than for any other.
Plant 3’s comparative advantage in snowboard production makes a crucial point about the nature of comparative advantage. It need not imply that a particular plant is especially good at an activity. In our example, all three plants are equally good at snowboard production. Plant 3, though, is the least efficient of the three in ski production. Alpine thus gives up fewer skis when it produces snowboards in Plant 3. Comparative advantage thus can stem from a lack of efficiency in the production of an alternative good rather than a special proficiency in the production of the first good.

The combined production possibilities curve for the firm’s three plants is shown in Figure 2.5. We begin at point A, with all three plants producing only skis. Production totals 350 pairs of skis per month and zero snowboards. If the firm were to produce 100 snowboards at Plant 3, ski production would fall by 50 pairs per month (recall that the opportunity cost per snowboard at Plant 3 is half a pair of skis). That would bring ski production to 300 pairs, at point B. If Alpine Sports were to produce still more snowboards in a single month, it would shift production to Plant 2, the facility with the next-lowest opportunity cost. Producing 100 snowboards at Plant 2 would leave Alpine Sports producing 200 snowboards and 200 pairs of skis per month, at point C. If the firm were to switch entirely to snowboard production, Plant 1 would be the last to switch because the cost of each snowboard there is 2 pairs of skis. With all three plants producing only snowboards, the firm is at point D on the combined production possibilities curve, producing 300 snowboards per month and no skis.

Notice that this production possibilities curve, which is made up of linear segments from each assembly plant, has a bowed-out shape; the absolute value of its slope increases as Alpine Sports produces more and more snowboards. This is a result of transferring resources from the production of one good to another according to comparative advantage. We shall examine the significance of the bowed-out shape of the curve in the next section.

### 2.3 The Law of Increasing Opportunity Cost

We see in Figure 2.5 that, beginning at point A and producing only skis, Alpine Sports experiences higher and higher opportunity costs as it produces more snowboards. The fact that the opportunity cost of additional snowboards increases as the firm produces more of them is a reflection of an important economic law. The **law of increasing opportunity cost** holds that as an economy moves along its production possibilities curve in the direction of producing more of a particular good, the opportunity cost of additional units of that good will increase.

We have seen the law of increasing opportunity cost at work traveling from point A toward point D on the production possibilities curve in Figure 2.5. The opportunity cost of each of the first 100 snowboards equals half a pair of skis; each of the next 100 snowboards has an opportunity cost of 1 pair of skis, and each of the last 100 snowboards has an opportunity cost of 2 pairs of skis. The law also applies as the firm shifts from snowboards to skis. Suppose it begins at point D, producing 300 snowboards per month and no skis. It can shift to ski production at a relatively low cost at first. The
opportunity cost of the first 200 pairs of skis is just 100 snowboards at Plant 1, a movement from point D to point C, or 0.5 snowboards per pair of skis. We would say that Plant 1 has a comparative advantage in ski production. The next 100 pairs of skis would be produced at Plant 2, where snowboard production would fall by 100 snowboards per month. The opportunity cost of skis at Plant 2 is 1 snowboard per pair of skis. Plant 3 would be the last plant converted to ski production. There, 50 pairs of skis could be produced per month at a cost of 100 snowboards, or an opportunity cost of 2 snowboards per pair of skis.

The bowed-out production possibilities curve for Alpine Sports illustrates the law of increasing opportunity cost. Scarcity implies that a production possibilities curve is downward sloping; the law of increasing opportunity cost implies that it will be bowed out, or concave, in shape.

The bowed-out curve of Figure 2.5 becomes smoother as we include more production facilities. Suppose Alpine Sports expands to 10 plants, each with a linear production possibilities curve. Panel (a) of Figure 2.6 shows the combined curve for the expanded firm, constructed as we did in Figure 2.5. This production possibilities curve includes 10 linear segments and is almost a smooth curve. As we include more and more production units, the curve will become smoother and smoother. In an actual economy, with a tremendous number of firms and workers, it is easy to see that the production possibilities curve will be smooth. We will generally draw production possibilities curves for the economy as smooth, bowed-out curves, like the one in Panel (b). This production possibilities curve shows an economy that produces only skis and snowboards. Notice the curve still has a bowed-out shape; it still has a negative slope. Notice also that this curve has no numbers. Economists often use models such as the production possibilities model with graphs that show the general shapes of curves but that do not include specific numbers.

**FIGURE 2.6 Production Possibilities for the Economy**

As we combine the production possibilities curves for more and more units, the curve becomes smoother. It retains its negative slope and bowed-out shape. In Panel (a) we have a combined production possibilities curve for Alpine Sports, assuming that it now has 10 plants producing skis and snowboards. Even though each of the plants has a linear curve, combining them according to comparative advantage, as we did with 3 plants in Figure 2.5, produces what appears to be a smooth, nonlinear curve, even though it is made up of linear segments. In drawing production possibilities curves for the economy, we shall generally assume they are smooth and “bowed out,” as in Panel (b). This curve depicts an entire economy that produces only skis and snowboards.

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**2.4 Movements Along the Production Possibilities Curve**

We can use the production possibilities model to examine choices in the production of goods and services. In applying the model, we assume that the economy can produce two goods, and we assume that technology and the factors of production available to the economy remain unchanged. In this section, we shall assume that the economy operates on its production possibilities curve so that an increase in the production of one good in the model implies a reduction in the production of the other.

We shall consider two goods and services: national security and a category we shall call “all other goods and services.” This second category includes the entire range of goods and services the economy can produce, aside from national defense and security. Clearly, the transfer of resources to the effort to enhance national security reduces the quantity of other goods and services that can be produced. In the
wake of the 9/11 attacks in 2001, nations throughout the world increased their spending for national security. This spending took a variety of forms. One, of course, was increased defense spending. Local and state governments also increased spending in an effort to prevent terrorist attacks. Airports around the world hired additional agents to inspect luggage and passengers.

The increase in resources devoted to security meant fewer “other goods and services” could be produced. In terms of the production possibilities curve in Figure 2.7, the choice to produce more security and less of other goods and services means a movement from A to B. Of course, an economy cannot really produce security; it can only attempt to provide it. The attempt to provide it requires resources; it is in that sense that we shall speak of the economy as “producing” security.

At point A, the economy was producing $S_A$ units of security on the vertical axis—defense services and various forms of police protection—and $O_A$ units of other goods and services on the horizontal axis. The decision to devote more resources to security and less to other goods and services represents the choice we discussed in the chapter introduction. In this case we have categories of goods rather than specific goods. Thus, the economy chose to increase spending on security in the effort to defeat terrorism. Since we have assumed that the economy has a fixed quantity of available resources, the increased use of resources for security and national defense necessarily reduces the number of resources available for the production of other goods and services.

The law of increasing opportunity cost tells us that, as the economy moves along the production possibilities curve in the direction of more of one good, its opportunity cost will increase. We may conclude that, as the economy moved along this curve in the direction of greater production of security, the opportunity cost of the additional security began to increase. That is because the resources transferred from the production of other goods and services to the production of security had a greater and greater comparative advantage in producing things other than security.

The production possibilities model does not tell us where on the curve a particular economy will operate. Instead, it lays out the possibilities facing the economy. Many countries, for example, chose to move along their respective production possibilities curves to produce more security and national defense and less of all other goods in the wake of 9/11. We will see in the chapter on demand and supply how choices about what to produce are made in the marketplace.

### 2.5 Producing on Versus Producing Inside the Production Possibilities Curve

An economy that is operating inside its production possibilities curve could, by moving onto it, produce more of all the goods and services that people value, such as food, housing, education, medical care, and music. Increasing the availability of these goods would improve the standard of living. Economists conclude that it is better to be on the production possibilities curve than inside it.

Two things could leave an economy operating at a point inside its production possibilities curve. First, the economy might fail to use fully the resources available to it. Second, it might not allocate resources on the basis of comparative advantage. In either case, production within the production possibilities curve implies the economy could improve its performance.

#### Idle Factors of Production

Suppose an economy fails to put all its factors of production to work. Some workers are without jobs, some buildings are without occupants, some fields are without crops. Because an economy’s production possibilities curve assumes the full use of the factors of production available to it, the failure to use some factors results in a level of production that lies inside the production possibilities curve.

If all the factors of production that are available for use under current market conditions are being utilized, the economy has achieved full employment. An economy cannot operate on its production possibilities curve unless it has full employment.
FIGURE 2.8 Idle Factors and Production

The production possibilities curve shown suggests an economy that can produce two goods, food and clothing. As a result of a failure to achieve full employment, the economy operates at a point such as B, producing \( F_B \) units of food and \( C_B \) units of clothing per period. Putting its factors of production to work allows a move to the production possibilities curve, to a point such as A. The production of both goods rises.

Figure 2.8 shows an economy that can produce food and clothing. If it chooses to produce at point A, for example, it can produce \( F_A \) units of food and \( C_A \) units of clothing. Now suppose that a large fraction of the economy’s workers lose their jobs, so the economy no longer makes full use of one factor of production: labor. In this example, production moves to point B, where the economy produces less food \( (F_B) \) and less clothing \( (C_B) \) than at point A. We often think of the loss of jobs in terms of the workers; they have lost a chance to work and to earn income. But the production possibilities model points to another loss: goods and services the economy could have produced that are not being produced.

Inefficient Production

Now suppose Alpine Sports is fully employing its factors of production. Could it still operate inside its production possibilities curve? Could an economy that is using all its factors of production still produce less than it could? The answer is “Yes,” and the key lies in comparative advantage. An economy achieves a point on its production possibilities curve only if it allocates its factors of production on the basis of comparative advantage. If it fails to do that, it will operate inside the curve.

Suppose that, as before, Alpine Sports has been producing only skis. With all three of its plants producing skis, it can produce 350 pairs of skis per month (and no snowboards). The firm then starts producing snowboards. This time, however, imagine that Alpine Sports switches plants from skis to snowboards in numerical order: Plant 1 first, Plant 2 second, and then Plant 3. Figure 2.9 illustrates the result. Instead of the bowed-out production possibilities curve ABCD, we get a bowed-in curve, AB'C'D'. Suppose that Alpine Sports is producing 100 snowboards and 150 pairs of skis at point B’. Had the firm based its production choices on comparative advantage, it would have switched Plant 3 to snowboards and then Plant 2, so it could have operated at a point such as C. It would be producing more snowboards and more pairs of skis—and using the same quantities of factors of production it was using at B’. Had the firm based its production choices on comparative advantage, it would have switched Plant 3 to snowboards and then Plant 2, so it would have operated at point C. It would be producing more snowboards and more pairs of skis—and using the same quantities of factors of production it was using at B’. When an economy is operating on its production possibilities curve, we say that it is engaging in efficient production. If it is using the same quantities of factors of production but is operating inside its production possibilities curve, it is engaging in inefficient production. Inefficient production implies that the economy could be producing more goods without using any additional labor, capital, or natural resources.
Points on the production possibilities curve thus satisfy two conditions: the economy is making full use of its factors of production, and it is making efficient use of its factors of production. If there are idle or inefficiently allocated factors of production, the economy will operate inside the production possibilities curve. Thus, the production possibilities curve not only shows what can be produced; it provides insight into how goods and services should be produced. It suggests that to obtain efficiency in production, factors of production should be allocated on the basis of comparative advantage. Further, the economy must make full use of its factors of production if it is to produce the goods and services it is capable of producing.

**Specialization**

The production possibilities model suggests that specialization will occur. **Specialization** implies that an economy is producing the goods and services in which it has a comparative advantage. If Alpine Sports selects point C in Figure 2.9, for example, it will assign Plant 1 exclusively to ski production and Plants 2 and 3 exclusively to snowboard production.

Such specialization is typical in an economic system. Workers, for example, specialize in particular fields in which they have a comparative advantage. People work and use the income they earn to buy—perhaps import—goods and services from people who have a comparative advantage in doing other things. The result is a far greater quantity of goods and services than would be available without this specialization.

Think about what life would be like without specialization. Imagine that you are suddenly completely cut off from the rest of the economy. You must produce everything you consume; you obtain nothing from anyone else. Would you be able to consume what you consume now? Clearly not. It is hard to imagine that most of us could even survive in such a setting. The gains we achieve through specialization are enormous.

Nations specialize as well. Much of the land in the United States has a comparative advantage in agricultural production and is devoted to that activity. Hong Kong, with its huge population and tiny endowment of land, allocates virtually none of its land to agricultural use; that option would be too costly. Its land is devoted largely to nonagricultural use.
Suppose a manufacturing firm is equipped to produce radios or calculators. It has two plants, Plant R and Plant S, at which it can produce these goods. Given the labor and the capital available at both plants, it can produce the combinations of the two goods at the two plants shown.

**Output per day, Plant R**

<table>
<thead>
<tr>
<th>Combination</th>
<th>Calculators</th>
<th>Radios</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>100</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td>50</td>
</tr>
</tbody>
</table>

**Output per day, Plant S**

<table>
<thead>
<tr>
<th>Combination</th>
<th>Calculators</th>
<th>Radios</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>E</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>F</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

Put calculators on the vertical axis and radios on the horizontal axis. Draw the production possibilities curve for Plant R. On a separate graph, draw the production possibilities curve for Plant S. Which plant has a comparative advantage in calculators? In radios? Now draw the combined curves for the two plants. Suppose the firm decides to produce 100 radios. Where will it produce them? How many calculators will it be able to produce? Where will it produce the calculators?

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**Case in Point: The Cost of the Great Depression**

The U.S. economy looked very healthy in the beginning of 1929. It had enjoyed seven years of dramatic growth and unprecedented prosperity. Its resources were fully employed; it was operating quite close to its production possibilities curve.
In the summer of 1929, however, things started going wrong. Production and employment fell. They continued to fall for several years. By 1933, more than 25% of the nation’s workers had lost their jobs. Production had plummeted by almost 30%. The economy had moved well within its production possibilities curve.

Output began to grow after 1933, but the economy continued to have vast numbers of idle workers, idle factories, and idle farms. These resources were not put back to work fully until 1942, after the U.S. entry into World War II demanded mobilization of the economy’s factors of production.

Between 1929 and 1942, the economy produced 25% fewer goods and services than it would have if its resources had been fully employed. That was a loss, measured in today’s dollars, of well over $3 trillion. In material terms, the forgone output represented a greater cost than the United States would ultimately spend in World War II. The Great Depression was a costly experience indeed.

**ANSWER TO TRY IT! PROBLEM**

The production possibilities curves for the two plants are shown, along with the combined curve for both plants. Plant R has a comparative advantage in producing calculators. Plant S has a comparative advantage in producing radios, so, if the firm goes from producing 150 calculators and no radios to producing 100 radios, it will produce them at Plant S. In the production possibilities curve for both plants, the firm would be at M, producing 100 calculators at Plant R.

### 3. APPLICATIONS OF THE PRODUCTION POSSIBILITIES MODEL

**LEARNING OBJECTIVES**

1. Understand the argument for unrestricted international trade in terms of economic specialization and comparative advantage.
2. Define economic growth in terms of the production possibilities model and discuss factors that make such growth possible.
3. Explain the classification of economic systems, the role of government in different economic systems, and the strengths and weaknesses of different systems.

The production possibilities curve gives us a model of an economy. The model provides powerful insights about the real world, insights that help us to answer some important questions: How does trade between two countries affect the quantities of goods available to people? What determines the rate at which production will increase over time? What is the role of economic freedom in the economy? In this section we explore applications of the model to questions of international trade, economic growth, and the choice of an economic system.
3.1 Comparative Advantage and International Trade

One of the most important implications of the concepts of comparative advantage and the production possibilities curve relates to international trade. We can think of different nations as being equivalent to Christie Ryder’s plants. Each will have a comparative advantage in certain activities, and efficient world production requires that each nation specialize in those activities in which it has a comparative advantage. A failure to allocate resources in this way means that world production falls inside the production possibilities curve; more of each good could be produced by relying on comparative advantage.

If nations specialize, then they must rely on each other. They will sell the goods in which they specialize and purchase other goods from other nations. Suppose, for example, that the world consists of two continents that can each produce two goods: South America and Europe can produce food and computers. Suppose they can produce the two goods according to the tables in Panels (a) and (b) of Figure 2.12. We have simplified this example by assuming that each continent has a linear production possibilities curve; the curves are plotted below the tables in Panels (a) and (b). Each continent has a separate production possibilities curve; the two have been combined to illustrate a world production possibilities curve in Panel (c) of the exhibit.

**FIGURE 2.12 Production Possibilities Curves and Trade**

Suppose the world consists of two continents: South America and Europe. They can each produce two goods: food and computers. In this example, we assume that each continent has a linear production possibilities curve, as shown in Panels (a) and (b). South America has a comparative advantage in food production and Europe has a comparative advantage in computer production. With free trade, the world can operate on the bowed-out curve GHI, shown in Panel (c). If the continents refuse to trade, the world will operate inside its production possibilities curve. If, for example, each continent were to produce at the midpoint of its production possibilities curve, the world would produce 300 computers and 300 units of food per period at point Q. If each continent were to specialize in the good in which it has a comparative advantage, world production could move to a point such as H, with more of both goods produced.

The world production possibilities curve assumes that resources are allocated between computer and food production based on comparative advantage. Notice that, even with only two economies and the assumption of linear production possibilities curves for each, the combined curve still has a bowed-out shape. At point H, for example, South America specializes in food, while Europe produces only computers. World production equals 400 units of each good. In this situation, we would expect South America to export food to Europe while Europe exports computers to South America.

But suppose the regions refuse to trade; each insists on producing its own food and computers. Suppose further that each chooses to produce at the midpoint of its own production possibilities curve. South America produces 100 units of computers and 200 units of food per period, while Europe produces 200 units of computers and 100 units of food per period. World production thus totals 300 units of each good per period; the world operates at point Q in Figure 2.12. If the two continents were willing to move from isolation to trade, the world could achieve an increase in the production of both goods. Producing at point H requires no more resources, no more effort than production at Q. It does, however, require that the world’s resources be allocated on the basis of comparative advantage.
The implications of our model for trade are powerful indeed. First, we see that trade allows the production of more of all goods and services. Restrictions on trade thus reduce production of goods and services. Second, we see a lesson often missed in discussions of trade: a nation’s trade policy has nothing to do with its level of employment of its factors of production. In our example, when South America and Europe do not engage in trade and produce at the midpoints of each of their respective production possibilities curves, they each have full employment. With trade, the two nations still operate on their respective production possibilities curves: they each have full employment. Trade certainly redistributes employment in the two continents. In South America, employment shifts from computer production to food production. In Europe, it shifts from food production to computer production. Once the shift is made, though, there is no effect on employment in either continent.

Of course, this idealized example would have all of South America’s computer experts becoming farmers while all of Europe’s farmers become computer geeks! That is a bit much to swallow, but it is merely the result of assuming linear production possibilities curves and complete specialization. In the real world, production possibilities curves are concave, and the reallocation of resources required by trade is not nearly as drastic. Still, free trade can require shifts in resources from one activity to another. These shifts produce enormous benefits, but they do not come without costs.

Nearly all economists agree that largely unrestricted trade between countries is desirable; restrictions on trade generally force the world to operate inside its production possibilities curve. In some cases restrictions on trade could be desirable, but in the main, free trade promotes greater production of goods and services for the world’s people. The role of international trade is explored in greater detail in subsequent chapters of this book.

3.2 Economic Growth

An increase in the physical quantity or in the quality of factors of production available to an economy or a technological gain will allow the economy to produce more goods and services; it will shift the economy’s production possibilities curve outward. The process through which an economy achieves an outward shift in its production possibilities curve is called economic growth. An outward shift in a production possibilities curve is illustrated in Figure 2.13. In Panel (a), a point such as N is not attainable; it lies outside the production possibilities curve. Growth shifts the curve outward, as in Panel (b), making previously unattainable levels of production possible.

**Figure 2.13 Economic Growth and the Production Possibilities Curve**

An economy capable of producing two goods, A and B, is initially operating at point M on production possibilities curve OMR in Panel (a). Given this production possibilities curve, the economy could not produce a combination such as shown by point N, which lies outside the curve. An increase in the factors of production available to the economy would shift the curve outward to SNT, allowing the choice of a point such as N, at which more of both goods will be produced.

The Sources of Economic Growth

Economic growth implies an outward shift in an economy’s production possibilities curve. Recall that when we draw such a curve, we assume that the quantity and quality of the economy’s factors of
production and its technology are unchanged. Changing these will shift the curve. Anything that increases the quantity or quality of the factors of production available to the economy or that improves the technology available to the economy contributes to economic growth.

Consider, for example, the dramatic gains in human capital that have occurred in the United States since the beginning of the past century. In 1900, about 3.5% of U.S. workers had completed a high school education. By 2006, that percentage rose almost to 92. Fewer than 1% of the workers in 1900 had graduated from college; as late as 1940 only 3.5% had graduated from college. By 2006, nearly 32% had graduated from college. In addition to being better educated, today’s workers have received more and better training on the job. They bring far more economically useful knowledge and skills to their work than did workers a century ago.

Moreover, the technological changes that have occurred within the past 100 years have greatly reduced the time and effort required to produce most goods and services. Automated production has become commonplace. Innovations in transportation (automobiles, trucks, and airplanes) have made the movement of goods and people cheaper and faster. A dizzying array of new materials is available for manufacturing. And the development of modern information technology—including computers, software, and communications equipment—that seemed to proceed at breathtaking pace especially during the final years of the last century and continuing to the present has transformed the way we live and work.

Look again at the technological changes of the last few years described in the Case in Point on advances in technology. Those examples of technological progress through applications of computer technology—from new ways of mapping oil deposits to new methods of milking cows—helped propel the United States and other economies to dramatic gains in the ability to produce goods and services. They have helped shift the countries’ production possibilities curve outward. They have helped fuel economic growth.

Table 2.1 summarizes the factors that have contributed to U.S. economic growth in the past half century. When looking at the period of 1948–2002 as a whole we see that about 60% of economic growth stems from increases in the quantities of capital and labor and 40% from increases in the qualities of the factors of production and improvements in technology. In the most recent period, 1995–2002, however, these percentages are essentially reversed, with a little less than 30% explained by increases in quantities of the factors of production and a whopping 70% explained by improvements in factor quality and technology.
### TABLE 2.1 Sources of U.S. Economic Growth, 1948–2002

Total output during the period shown increased sixfold. The chart shows the percentage of this increase accounted for by increases in the quantity of labor and of capital and by increases in the quality of labor and of capital and improvements in technology. In the 1995–2002 period, the incorporation of information technology led to improvements in the quality of capital and technology that greatly contributed to growth.

<table>
<thead>
<tr>
<th>Year</th>
<th>Percentage contribution to growth</th>
<th>Period growth rate</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Years 1948–2002</strong></td>
<td></td>
<td>3.46%</td>
</tr>
<tr>
<td>Increase in quantity of labor</td>
<td>21%</td>
<td></td>
</tr>
<tr>
<td>Increase in quantity of capital</td>
<td>41%</td>
<td></td>
</tr>
<tr>
<td>Increase in quality of labor</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Increase in quality of capital</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Improved technology</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td><strong>Years 1948–1973</strong></td>
<td></td>
<td>3.99%</td>
</tr>
<tr>
<td>Increase in quantity of labor</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>Increase in quantity of capital</td>
<td>44%</td>
<td></td>
</tr>
<tr>
<td>Increase in quality of labor</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>Increase in quality of capital</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Improved technology</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td><strong>Years 1973–1989</strong></td>
<td></td>
<td>2.97%</td>
</tr>
<tr>
<td>Increase in quantity of labor</td>
<td>31%</td>
<td></td>
</tr>
<tr>
<td>Increase in quantity of capital</td>
<td>39%</td>
<td></td>
</tr>
<tr>
<td>Increase in quality of labor</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>Increase in quality of capital</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>Improved technology</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td><strong>Years 1989–1995</strong></td>
<td></td>
<td>2.43%</td>
</tr>
<tr>
<td>Increase in quantity of labor</td>
<td>26%</td>
<td></td>
</tr>
<tr>
<td>Increase in quantity of capital</td>
<td>33%</td>
<td></td>
</tr>
<tr>
<td>Increase in quality of labor</td>
<td>15%</td>
<td></td>
</tr>
<tr>
<td>Increase in quality of capital</td>
<td>17%</td>
<td></td>
</tr>
<tr>
<td>Improved technology</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td><strong>Years 1995–2002</strong></td>
<td></td>
<td>3.59%</td>
</tr>
<tr>
<td>Increase in quantity of labor</td>
<td>19%</td>
<td></td>
</tr>
<tr>
<td>Increase in quantity of capital</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>Increase in quality of labor</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Increase in quality of capital</td>
<td>47%</td>
<td></td>
</tr>
<tr>
<td>Improved technology</td>
<td>20%</td>
<td></td>
</tr>
</tbody>
</table>


Another way of looking at these data for the most recent period is to notice that the increase in the rate of economic growth between the 1989 to 1995 period and the 1995 to 2002 period of more than one percentage point per year is largely explained by better-quality capital and better technology. The study by economist Dale Jorgenson on which the data shown in Table 2.1 are derived notes that these two main contributors to higher economic growth can be largely attributed to the development of information technology and its incorporation in the workplace.

### Waiting for Growth

One key to growth is, in effect, the willingness to wait, to postpone current consumption in order to enhance future productive capability. When Stone Age people fashioned the first tools, they were spending time building capital rather than engaging in consumption. They delayed current consumption to enhance their future consumption; the tools they made would make them more productive in the future.
Resources society could have used to produce consumer goods are being used to produce new capital goods and new knowledge for production instead—all to enhance future production. An even more important source of growth in many nations has been increased human capital. Increases in human capital often require the postponement of consumption. If you are a college student, you are engaged in precisely this effort. You are devoting time to study that could have been spent working, earning income, and thus engaging in a higher level of consumption. If you are like most students, you are making this choice to postpone consumption because you expect it will allow you to earn more income, and thus enjoy greater consumption, in the future.

Think of an economy as being able to produce two goods, capital and consumer goods (those destined for immediate use by consumers). By focusing on the production of consumer goods, the people in the economy will be able to enjoy a higher standard of living today. If they reduce their consumption—and their standard of living—today to enhance their ability to produce goods and services in the future, they will be able to shift their production possibilities curve outward. That may allow them to produce even more consumer goods. A decision for greater growth typically involves the sacrifice of present consumption.

### 3.3 Arenas for Choice: A Comparison of Economic Systems

Under what circumstances will a nation achieve efficiency in the use of its factors of production? The discussion above suggested that Christie Ryder would have an incentive to allocate her plants efficiently because by doing so she could achieve greater output of skis and snowboards than would be possible from inefficient production. But why would she want to produce more of these two goods—or of any goods? Why would decision makers throughout the economy want to achieve such efficiency?

Economists assume that privately owned firms seek to maximize their profits. The drive to maximize profits will lead firms such as Alpine Sports to allocate resources efficiently to gain as much production as possible from their factors of production. But whether firms will seek to maximize profits depends on the nature of the economic system within which they operate.

#### Classifying Economic Systems

Each of the world’s economies can be viewed as operating somewhere on a spectrum between market capitalism and command socialism. In a market capitalist economy, resources are generally owned by private individuals who have the power to make decisions about their use. A market capitalist system is often referred to as a free enterprise economic system. In a command socialist economy, the government is the primary owner of capital and natural resources and has broad power to allocate the use of factors of production. Between these two categories lie mixed economies that combine elements of market capitalist and of command socialist economic systems.

No economy represents a pure case of either market capitalism or command socialism. To determine where an economy lies between these two types of systems, we evaluate the extent of government ownership of capital and natural resources and the degree to which government is involved in decisions about the use of factors of production.

Figure 2.14 suggests the spectrum of economic systems. Market capitalist economies lie toward the left end of this spectrum; command socialist economies appear toward the right. Mixed economies lie in between. The market capitalist end of the spectrum includes countries such as the United States, the United Kingdom, and Chile. Hong Kong, though now part of China, has a long history as a market capitalist economy and is generally regarded as operating at the market capitalist end of the spectrum. Countries at the command socialist end of the spectrum include North Korea and Cuba.

**Figure 2.14 Economic Systems**

Some European economies, such as France, Germany, and Sweden, have a sufficiently high degree of regulation that we consider them as operating more toward the center of the spectrum. Russia and China, which long operated at the command socialist end of the spectrum, can now be considered mixed economies. Most economies in Latin America once operated toward the right end of the spectrum. While their governments did not exercise the extensive ownership of capital and natural resources that are one characteristic of command socialist systems, their governments did impose extensive
regulations. Many of these nations are in the process of carrying out economic reforms that will move them further in the direction of market capitalism.

The global shift toward market capitalist economic systems that occurred in the 1980s and 1990s was in large part the result of three important features of such economies. First, the emphasis on individual ownership and decision-making power has generally yielded greater individual freedom than has been available under command socialist or some more heavily regulated mixed economic systems that lie toward the command socialist end of the spectrum. People seeking political, religious, and economic freedom have thus gravitated toward market capitalism. Second, market economies are more likely than other systems to allocate resources on the basis of comparative advantage. They thus tend to generate higher levels of production and income than do other economic systems. Third, market capitalist-type systems appear to be the most conducive to entrepreneurial activity.

Suppose Christie Ryder had the same three plants we considered earlier in this chapter but was operating in a mixed economic system with extensive government regulation. In such a system, she might be prohibited from transferring resources from one use to another to achieve the gains possible from comparative advantage. If she were operating under a command socialist system, she would not be the owner of the plants and thus would be unlikely to profit from their efficient use. If that were the case, there is no reason to believe she would make any effort to assure the efficient use of the three plants. Generally speaking, it is economies toward the market capitalist end of the spectrum that offer the greatest inducement to allocate resources on the basis of comparative advantage. They tend to be more productive and to deliver higher material standards of living than do economies that operate at or near the command socialist end of the spectrum.

**FIGURE 2.15 Economic Freedom and Income**

The horizontal axis shows the degree of economic freedom—“free,” “mostly free,” “mostly unfree,” and “repressed”—according to the measures used by the Heritage Foundation and *The Wall Street Journal*. The graph shows the relationship between economic freedom and per capita income. Countries with higher degrees of economic freedom tended to have higher per capita incomes.

Market capitalist economies rely on economic freedom. Indeed, one way we can assess the degree to which a country can be considered market capitalist is by the degree of economic freedom it permits. Several organizations have attempted to compare economic freedom in various countries. One of the most extensive comparisons is a joint annual effort by the Heritage Foundation and *The Wall Street Journal*. The 2008 rating was based on policies in effect in 162 nations early that year. The report ranks these nations on the basis of such things as the degree of regulation of firms, tax levels, and restrictions
on international trade. Hong Kong ranked as the freest economy in the world. North Korea received the dubious distinction of being the least free.

It seems reasonable to expect that the greater the degree of economic freedom a country permits, the greater the amount of income per person it will generate. This proposition is illustrated in Figure 2.15. The group of countries categorized as “free” generated the highest incomes in the Heritage Foundation/Wall Street Journal study; those rated as “repressed” had the lowest. The study also found that countries that over the last decade have done the most to improve their positions in the economic freedom rankings have also had the highest rates of growth. We must be wary of slipping into the fallacy of false cause by concluding from this evidence that economic freedom generates higher incomes. It could be that higher incomes lead nations to opt for greater economic freedom. But in this case, it seems reasonable to conclude that, in general, economic freedom does lead to higher incomes.

3.4 Government in a Market Economy

The production possibilities model provides a menu of choices among alternative combinations of goods and services. Given those choices, which combinations will be produced?

In a market economy, this question is answered in large part through the interaction of individual buyers and sellers. As we have already seen, government plays a role as well. It may seek to encourage greater consumption of some goods and discourage consumption of others. In the United States, for example, taxes imposed on cigarettes discourage smoking, while special treatment of property taxes and mortgage interest in the federal income tax encourages home ownership. Government may try to stop the production and consumption of some goods altogether, as many governments do with drugs such as heroin and cocaine. Government may supplement the private consumption of some goods by producing more of them itself, as many U.S. cities do with golf courses and tennis courts. In other cases, there may be no private market for a good or service at all. In the choice between security and defense versus all other goods and services outlined at the beginning of this chapter, government agencies are virtually the sole providers of security and national defense.

All nations also rely on government to provide defense, enforce laws, and redistribute income. Even market economies rely on government to regulate the activities of private firms, to protect the environment, to provide education, and to produce a wide range of other goods and services. Government’s role may be limited in a market economy, but it remains fundamentally important.

**KEY TAKEAWAYS**

- The ideas of comparative advantage and specialization suggest that restrictions on international trade are likely to reduce production of goods and services.
- Economic growth is the result of increasing the quantity or quality of an economy’s factors of production and of advances in technology.
- Policies to encourage growth generally involve postponing consumption to increase capital and human capital.
- Market capitalist economies have generally proved more productive than mixed or command socialist economies.
- Government plays a crucial role in any market economy.

**TRY IT!**

Draw a production possibilities curve for an economy that can produce two goods, CD players and jackets. You do not have numbers for this one—just draw a curve with the usual bowed-out shape. Put the quantity of CD players per period on the vertical axis and the quantity of jackets per period on the horizontal axis. Now mark a point A on the curve you have drawn; extend dotted lines from this point to the horizontal and vertical axes. Mark the initial quantities of the two goods as $CD_A$ and $J_A$, respectively. Explain why, in the absence of economic growth, an increase in jacket production requires a reduction in the production of CD players. Now show how economic growth could lead to an increase in the production of both goods.
Case in Point: The European Union and the Production Possibilities Curve

Formed by the Maastricht Treaty of 1993, The European Union represents one of the boldest efforts of our time to exploit the theory of comparative advantage. The Treaty sought to eliminate all trade barriers between the European Union’s members. It established a European Parliament and a European Central Bank. The Bank introduced the euro in 1999, a currency that replaced national currencies such as the German deutsche mark and the French franc. At first, the euro was used only for transactions between banks. 320 million people in 15 EU nations (Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, Slovenia, and Spain) used the euro by 2008. While the dollar continues to be more widely used, the total value of euros in circulation exceeds that of dollars.

The movement toward European integration can be dated back more than half a century. In 1950, just five years after a war that had devastated much of the world, Robert Schuman, the French Minister of Foreign Affairs, proposed a union between France and Germany to cooperate in the production of iron and steel. In the context of the time, Schuman’s proposal was a radical one. World War II had begun with Germany’s attempt to seize control of Europe—and ultimately the world. Japan and Italy joined Germany in this effort. Germany had captured France; France had been liberated in 1944 by the Allied invasion in Normandy. The proposal for cooperation between two countries that had been the most bitter of enemies was a revolutionary one. Schuman’s speech, delivered on May 9, 1950, is celebrated throughout Europe as “Europe Day.”

In effect, the European Union has created an entity very much like the United States. Countries within the European Union retain their own languages and cultural differences, but they have ceded a remarkable degree of sovereignty to the Union. Members of the European Union can trade as freely with each other as can states within the United States. Just as the U.S. Constitution prohibits states from restricting trade with other states, the European Union has dismantled all forms of restrictions that countries within the Union used to impose on one another. Just as restrictions on specialization among Ms. Ryder’s plants in Alpine Sports would have forced it to operate inside its production possibilities curve, restrictions that had existed among members of the European Union once put the members of the Union inside their collective production possibilities curve.

The experiment appears to have been a success. Trade among member nations has expanded sharply. A study by Carmen Díaz Mora, an economist at the University of Castilla-La Mancha in Spain, found that the bulk of the expanded trade within the Union was trade within industries and that it was driven by comparative advantage. In particular, she found that countries in the northern part of the Union, such as France and Germany, tended to specialize in relatively high-valued goods—office equipment and electrical goods—while countries in the southern part of the Union specialized in relatively low-valued goods such as food and textile products. In trade within the clothing industry, countries such as Italy tend to specialize in the production of higher-valued
clothing, while lower-income countries such as Portugal specialize in the production of cheaper clothing. In sparkling wines, France specializes in the higher-quality end of the spectrum, while Spain specializes in the low-quality end. Similarly, Germany specializes in the production of higher-quality cars while Spain specializes in lower-quality vehicles. Similar exchanges occur across a wide range of goods and services.

Diaz Mora found that comparative advantage tended to correspond to income levels. Countries in the northern part of the European Union tend to have high per capita incomes and high levels of human capital and technology—these countries gained by specializing in the production of high-valued goods. Countries in the southern part of the Union also gained by specialization—in the production of low-valued goods. This specialization has increased the welfare of people throughout the Union.


4. REVIEW AND PRACTICE

Summary

Economics deals with choices. In this chapter we have examined more carefully the range of choices in production that must be made in any economy. In particular, we looked at choices involving the allocation of an economy’s factors of production: labor, capital, and natural resources.

In addition, in any economy, the level of technology plays a key role in determining how productive the factors of production will be. In a market economy, entrepreneurs organize factors of production and act to introduce technological change.

The production possibilities model is a device that assists us in thinking about many of the choices about resource allocation in an economy. The model assumes that the economy has factors of production that are fixed in both quantity and quality. When illustrated graphically, the production possibilities model typically limits our analysis to two goods. Given the economy’s factors of production and technology, the economy can produce various combinations of the two goods. If it uses its factors of production efficiently and has full employment, it will be operating on the production possibilities curve.
Two characteristics of the production possibilities curve are particularly important. First, it is downward sloping. This reflects the scarcity of the factors of production available to the economy; producing more of one good requires giving up some of the other. Second, the curve is bowed out. Another way of saying this is to say that the curve gets steeper as we move from left to right; the absolute value of its slope is increasing. Producing each additional unit of the good on the horizontal axis requires a greater sacrifice of the good on the vertical axis than did the previous units produced. This fact, called the law of increasing opportunity cost, is the inevitable result of efficient choices in production—choices based on comparative advantage.

The production possibilities model has important implications for international trade. It suggests that free trade will allow countries to specialize in the production of goods and services in which they have a comparative advantage. This specialization increases the production of all goods and services.

Increasing the quantity or quality of factors of production and/or improving technology will shift the production possibilities curve outward. This process is called economic growth. In the last 50 years, economic growth in the United States has resulted chiefly from increases in human capital and from technological advance.

Choices concerning the use of scarce resources take place within the context of a set of institutional arrangements that define an economic system. The principal distinctions between systems lie in the degree to which ownership of capital and natural resources and decision making authority over scarce resources are held by government or by private individuals. Economic systems include market capitalist, mixed, and command socialist economies. An increasing body of evidence suggests that market capitalist economies tend to be most productive; many command socialist and mixed economies are moving in the direction of market capitalist systems.

The presumption in favor of market-based systems does not preclude a role for government. Government is necessary to provide the system of laws on which market systems are founded. It may also be used to provide certain goods and services, to help individuals in need, and to regulate the actions of individuals and firms.
CONCEPT PROBLEMS

1. How does a college education increase one’s human capital?
2. Why does the downward-sloping production possibilities curve imply that factors of production are scarce?
3. In what ways are the bowed-out shape of the production possibilities curve and the law of increasing opportunity cost related?
4. What is the relationship between the concept of comparative advantage and the law of increasing opportunity cost?
5. Suppose an economy can produce two goods, A and B. It is now operating at point E on production possibilities curve RT. An improvement in the technology available to produce good A shifts the curve to ST, and the economy selects point E’. How does this change affect the opportunity cost of producing an additional unit of good B?

6. Could a nation’s production possibilities curve ever shift inward? Explain what such a shift would mean, and discuss events that might cause such a shift to occur.
7. Suppose blue-eyed people were banned from working. How would this affect a nation’s production possibilities curve?
8. Evaluate this statement: “The U.S. economy could achieve greater growth by devoting fewer resources to consumption and more to investment; it follows that such a shift would be desirable.”
9. Two countries, Sportsland and Foodland, have similar total quantities of labor, capital, and natural resources. Both can produce two goods, figs and footballs. Sportsland’s resources are particularly well suited to the production of footballs but are not very productive in producing figs. Foodland’s resources are very productive when used for figs but are not capable of producing many footballs. In which country is the cost of additional footballs generally greater? Explain.
10. Suppose a country is committed to using its resources based on the reverse of comparative advantage doctrine: it first transfers those resources for which the cost is greatest, not lowest. Describe this country’s production possibilities curve.
11. The U.S. Constitution bans states from restricting imports of goods and services from other states. Suppose this restriction did not exist and that states were allowed to limit imports of goods and services produced in other states. How do you think this would affect U.S. output? Explain.
12. By 1993, nations in the European Union (EU) had eliminated all barriers to the flow of goods, services, labor, and capital across their borders. Even such things as consumer protection laws and the types of plugs required to plug in appliances have been standardized to ensure that there will be no barriers to trade. How do you think this elimination of trade barriers affected EU output?
13. How did the technological changes described in the Case in Point “Technology Cuts Costs, Boosts Productivity and Profits” affect the production possibilities curve for the United States?
1. Nathan can mow four lawns in a day or plant 20 trees in a day.
   a. Draw Nathan’s production possibilities curve for mowing lawns and planting trees. Assume the production possibilities curve is linear and put the quantity of lawns mowed per day on the horizontal axis and the quantity of trees planted per day on the vertical axis.
   b. What is Nathan’s opportunity cost of planting trees?
   c. What is Nathan’s opportunity cost of mowing lawns?

2. David can mow four lawns in a day or plant four trees in a day.
   a. Draw David’s production possibilities curve for mowing lawns and planting trees. Again, assume a linear production possibilities curve and put the quantity of lawns mowed per day on the horizontal axis.
   b. What is David’s opportunity cost of planting trees?
   c. What is David’s opportunity cost of mowing lawns?

3. Given the production information in problems 1 and 2 above, who has the comparative advantage in planting trees? Mowing lawns?

4. The exhibits below describe the production possibilities for Germany and Turkey.

   - **Germany**
     - What is the slope of Germany’s production possibilities curve?
     - What is the opportunity cost of producing T-shirts in Germany?
     - What is the opportunity cost of producing optical instruments in Germany?
     - In which good does Germany have a comparative advantage?

   - **Turkey**
     - What is the slope of Turkey’s production possibilities curve?
     - What is the opportunity cost of producing T-shirts in Turkey?
     - What is the opportunity cost of producing optical instruments in Turkey?
     - In which good does Turkey have a comparative advantage?

5. The nation of Leisureland can produce two goods, bicycles and bowling balls. The western region of Leisureland can, if it devotes all its resources to bicycle production, produce 100 bicycles per month. Alternatively, it could devote all its resources to bowling balls and produce 400 per month—or it could produce any combination of bicycles and bowling balls lying on a straight line between these two extremes.
   a. Draw a production possibilities curve for western Leisureland (with bicycles on the vertical axis).
   b. What is the opportunity cost of producing an additional bowling ball measured in terms of forgone bicycles in western Leisureland?
   c. Suppose that eastern Leisureland can, if it devotes all its resources to the production of bicycles, produce 400. If it devotes all its resources to bowling ball production, though, it can produce only 100. Draw the production possibilities curve for eastern Leisureland (again, assume it is linear and put bicycles on the vertical axis).
d. What is the opportunity cost of producing an additional bowling ball measured in terms of
forgone bicycles in eastern Leisureland?
e. Explain the difference in opportunity cost between western and eastern Leisureland. Which
region has a comparative advantage in producing bowling balls? Bicycles?
f. Draw the production possibilities curve for Leisureland, one that combines the curves for western
and eastern Leisureland.
g. Suppose it is determined that 400 bicycles must be produced. How many bowling balls can be
produced?
h. Where will these goods be produced?

6. The table below shows the production possibilities schedule for an economy.

<table>
<thead>
<tr>
<th>Production Alternatives</th>
<th>Capital goods per period</th>
<th>Consumer goods per period</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>B</td>
<td>1</td>
<td>36</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>28</td>
</tr>
<tr>
<td>D</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>E</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

a. Putting capital goods per period on the horizontal axis and consumer goods per period on the
vertical axis, graph the production possibilities curve for the economy.
b. If the economy is producing at alternative B, what is the opportunity cost to it of producing at
alternative C instead?
c. If the economy is producing at alternative C, what is the opportunity cost to it of producing at
alternative D instead?
d. Is it possible for this economy to produce 30 units of consumer goods per period while
producing 1 unit of capital goods? Would this combination of goods represent efficient or
inefficient production? Explain.
e. Which point, B or C, would lead to higher economic growth? Explain your answer.

7. The exhibit below shows the sources of growth in the United States between 1909 and 1929 and between
1950 and 1979, according to a study by Edward Denison.11 (Note: The sources of economic growth are
cumulative and, taken collectively, explain 100% of total growth over the period.)

![Graph showing sources of growth]

a. Approximately what percentage of U.S. growth between 1909 and 1929 was due to increases in
quantities of factors of production?
b. Approximately what percentage of U.S. growth between 1909 and 1929 was due to increases in
quality of factors of production and technological improvement?
c. Approximately what percentage of U.S. growth between 1950 and 1979 was due to increases in quantities of factors of production?

d. Approximately what percentage of U.S. growth between 1950 and 1979 was due to increases in quality of factors of production and technological improvement?
ENDNOTES

CHAPTER 3
Demand and Supply

START UP: CRAZY FOR COFFEE

Starbucks Coffee Company revolutionized the coffee-drinking habits of millions of Americans. Starbucks, whose bright green-and-white logo is almost as familiar as the golden arches of McDonald’s, began in Seattle in 1971. Fifteen years later it had grown into a chain of four stores in the Seattle area. Then in 1987 Howard Schultz, a former Starbucks employee, who had become enamored with the culture of Italian coffee bars during a trip to Italy, bought the company from its founders for $3.8 million. In 2008, Americans were willingly paying $3 or more for a cappuccino or a latte, and Starbucks has grown to become an international chain, with over 16,000 stores around the world.

The change in American consumers’ taste for coffee and the profits raked in by Starbucks lured other companies to get into the game. Retailers such as Seattle’s Best Coffee and Gloria Jean’s Coffees entered the market, and today there are thousands of coffee bars, carts, drive-throughs, and kiosks in downtowns, malls, and airports all around the country. Even McDonald’s began selling specialty coffees.

But over the last decade the price of coffee beans has been quite volatile. Just as consumers were growing accustomed to their cappuccinos and lattes, in 1997, the price of coffee beans shot up. Excessive rain and labor strikes in coffee-growing areas of South America had reduced the supply of coffee, leading to a rise in its price. In the early 2000s, Vietnam flooded the market with coffee, and the price of coffee beans plummeted. More recently, weather conditions in various coffee-growing countries reduced supply, and the price of coffee beans went back up.

Markets, the institutions that bring together buyers and sellers, are always responding to events, such as bad harvests and changing consumer tastes that affect the prices and quantities of particular goods. The demand for some goods increases, while the demand for others decreases. The supply of some goods rises, while the supply of others falls. As such events unfold, prices adjust to keep markets in balance. This chapter explains how the market forces of demand and supply interact to determine equilibrium prices and equilibrium quantities of goods and services. We will see how prices and quantities adjust to changes in demand and supply and how changes in prices serve as signals to buyers and sellers.

The model of demand and supply that we shall develop in this chapter is one of the most powerful tools in all of economic analysis. You will be using it throughout your study of economics. We will first look at the variables that influence demand. Then we will turn to supply, and finally we will put demand and supply together to explore how the model of demand and supply operates. As we examine the model, bear in mind that demand is a representation of the behavior of buyers and that supply is a representation of the behavior of sellers. Buyers may be consumers purchasing groceries or producers purchasing iron ore to make steel. Sellers may be firms selling cars or households selling their labor services. We shall see that the ideas of demand and supply apply, whatever the identity of the buyers or sellers and whatever the good or service being exchanged in the market. In this chapter, we shall focus on buyers and sellers of goods and services.
1. **DEMAND**

LEARNING OBJECTIVES

1. Define the quantity demanded of a good or service and illustrate it using a demand schedule and a demand curve.
2. Distinguish between the following pairs of concepts: demand and quantity demanded, demand schedule and demand curve, movement along and shift in a demand curve.
3. Identify demand shifters and determine whether a change in a demand shifter causes the demand curve to shift to the right or to the left.

How many pizzas will people eat this year? How many doctor visits will people make? How many houses will people buy?

Each good or service has its own special characteristics that determine the quantity people are willing and able to consume. One is the price of the good or service itself. Other independent variables that are important determinants of demand include consumer preferences, prices of related goods and services, income, demographic characteristics such as population size, and buyer expectations. The number of pizzas people will purchase, for example, depends very much on whether they like pizza. It also depends on the prices for alternatives such as hamburgers or spaghetti. The number of doctor visits is likely to vary with income—people with higher incomes are likely to see a doctor more often than people with lower incomes. The demands for pizza, for doctor visits, and for housing are certainly affected by the age distribution of the population and its size.

While different variables play different roles in influencing the demands for different goods and services, economists pay special attention to one: the price of the good or service. Given the values of all the other variables that affect demand, a higher price tends to reduce the quantity people demand, and a lower price tends to increase it. A medium pizza typically sells for $5 to $10. Suppose the price were $30. Chances are, you would buy fewer pizzas at that price than you do now. Suppose pizzas typically sold for $2 each. At that price, people would be likely to buy more pizzas than they do now.

We will discuss first how price affects the quantity demanded of a good or service and then how other variables affect demand.

### 1.1 Price and the Demand Curve

Because people will purchase different quantities of a good or service at different prices, economists must be careful when speaking of the “demand” for something. They have therefore developed some specific terms for expressing the general concept of demand.

The **quantity demanded** of a good or service is the quantity buyers are willing and able to buy at a particular price during a particular period, all other things unchanged. (As we learned, we can substitute the Latin phrase “ceteris paribus” for “all other things unchanged.”) Suppose, for example, that 100,000 movie tickets are sold each month in a particular town at a price of $8 per ticket. That quantity—100,000—is the quantity of movie admissions demanded per month at a price of $8. If the price were $12, we would expect the quantity demanded to be less. If it were $4, we would expect the quantity demanded to be greater. The quantity demanded at each price would be different if other things that might affect it, such as the population of the town, were to change. That is why we add the qualifier that other things have not changed in the definition of quantity demanded.

A **demand schedule** is a table that shows the quantities of a good or service demanded at different prices during a particular period, all other things unchanged. To introduce the concept of a demand schedule, let us consider the demand for coffee in the United States. We will ignore differences among types of coffee beans and roasts, and speak simply of coffee. The table in Figure 3.1 shows quantities of coffee that will be demanded each month at prices ranging from $9 to $4 per pound; the table is a demand schedule. We see that the higher the price, the lower the quantity demanded.
The information given in a demand schedule can be presented with a demand curve, which is a graphical representation of a demand schedule. A demand curve thus shows the relationship between the price and quantity demanded of a good or service during a particular period, all other things unchanged. The demand curve in Figure 3.1 shows the prices and quantities of coffee demanded that are given in the demand schedule. At point A on the curve, 25 million pounds of coffee per month are demanded at a price of $6 per pound. At point B, 30 million pounds of coffee per month are demanded at a price of $5 per pound.

Price alone does not determine the quantity of coffee or any other good that people buy. To isolate the effect of changes in price on the quantity of a good or service demanded, however, we show the quantity demanded at each price, assuming that those other variables remain unchanged. We do the same thing in drawing a graph of the relationship between any two variables; we assume that the values of other variables that may affect the variables shown in the graph (such as income or population) remain unchanged for the period under consideration.

A change in price, with no change in any of the other variables that affect demand, results in a movement along the demand curve. For example, if the price of coffee falls from $6 to $5 per pound, consumption rises from 25 million pounds to 30 million pounds per month. That is a movement from point A to point B along the demand curve in Figure 3.1. A movement along a demand curve that results from a change in price is called a change in quantity demanded. Note that a change in quantity demanded is not a change or shift in the demand curve; it is a movement along the demand curve.

The negative slope of the demand curve in Figure 3.1 suggests a key behavioral relationship of economics. All other things unchanged, the law of demand holds that, for virtually all goods and services, a higher price leads to a reduction in quantity demanded and a lower price leads to an increase in quantity demanded.

The law of demand is called a law because the results of countless studies are consistent with it. Undoubtedly, you have observed one manifestation of the law. When a store finds itself with an overstock of some item, such as running shoes or tomatoes, and needs to sell these items quickly, what does it do? It typically has a sale, expecting that a lower price will increase the quantity demanded. In general, we expect the law of demand to hold. Given the values of other variables that influence demand, a higher price reduces the quantity demanded. A lower price increases the quantity demanded. Demand curves, in short, slope downward.
1.2 Changes in Demand

Of course, price alone does not determine the quantity of a good or service that people consume. Coffee consumption, for example, will be affected by such variables as income and population. Preferences also play a role. The story at the beginning of the chapter illustrates as much. Starbucks "turned people on" to coffee. We also expect other prices to affect coffee consumption. People often eat doughnuts or bagels with their coffee, so a reduction in the price of doughnuts or bagels might induce people to drink more coffee. An alternative to coffee is tea, so a reduction in the price of tea might result in the consumption of more tea and less coffee. Thus, a change in any one of the variables held constant in constructing a demand schedule will change the quantities demanded at each price. The result will be a shift in the entire demand curve rather than a movement along the demand curve. A shift in a demand curve is called a change in demand.

Suppose, for example, that something happens to increase the quantity of coffee demanded at each price. Several events could produce such a change: an increase in incomes, an increase in population, or an increase in the price of tea would each be likely to increase the quantity of coffee demanded at each price. Any such change produces a new demand schedule. Figure 3.2 shows such a change in the demand schedule for coffee. We see that the quantity of coffee demanded per month is greater at each price than before. We show that graphically as a shift in the demand curve. The original curve, labeled $D_1$, shifts to the right to $D_2$. At a price of $6$ per pound, for example, the quantity demanded rises from 25 million pounds per month (point $A$) to 35 million pounds per month (point $A'$).

**FIGURE 3.2 An Increase in Demand**

An increase in the quantity of a good or service demanded at each price is shown as an increase in demand. Here, the original demand curve $D_1$ shifts to $D_2$. Point $A$ on $D_1$ corresponds to a price of $6$ per pound and a quantity demanded of 25 million pounds of coffee per month. On the new demand curve $D_2$, the quantity demanded at this price rises to 35 million pounds of coffee per month (point $A'$).

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Just as demand can increase, it can decrease. In the case of coffee, demand might fall as a result of events such as a reduction in population, a reduction in the price of tea, or a change in preferences. For example, a definitive finding that the caffeine in coffee contributes to heart disease, which is currently being debated in the scientific community, could change preferences and reduce the demand for coffee.

A reduction in the demand for coffee is illustrated in Figure 3.3. The demand schedule shows that less coffee is demanded at each price than in Figure 3.1. The result is a shift in demand from the original curve $D_1$ to $D_3$. The quantity of coffee demanded at a price of $6$ per pound falls from 25 million pounds per month (point $A$) to 15 million pounds per month (point $A''$). Note, again, that a change in quantity demanded, ceteris paribus, refers to a movement along the demand curve, while a change in demand refers to a shift in the demand curve.
A variable that can change the quantity of a good or service demanded at each price is called a demand shifter. When these other variables change, the all-other-things-unchanged conditions behind the original demand curve no longer hold. Although different goods and services will have different demand shifters, the demand shifters are likely to include (1) consumer preferences, (2) the prices of related goods and services, (3) income, (4) demographic characteristics, and (5) buyer expectations. Next we look at each of these.

Preferences
Changes in preferences of buyers can have important consequences for demand. We have already seen how Starbucks supposedly increased the demand for coffee. Another example is reduced demand for cigarettes caused by concern about the effect of smoking on health. A change in preferences that makes one good or service more popular will shift the demand curve to the right. A change that makes it less popular will shift the demand curve to the left.

Prices of Related Goods and Services
Suppose the price of doughnuts were to fall. Many people who drink coffee enjoy dunking doughnuts in their coffee; the lower price of doughnuts might therefore increase the demand for coffee, shifting the demand curve for coffee to the right. A lower price for tea, however, would be likely to reduce coffee demand, shifting the demand curve for coffee to the left.

In general, if a reduction in the price of one good increases the demand for another, the two goods are called complements. These definitions hold in reverse as well: two goods are complements if an increase in the price of one reduces the demand for the other, and they are substitutes if an increase in the price of one increases the demand for the other. Doughnuts and coffee are complements; tea and coffee are substitutes.

Complementary goods are goods used in conjunction with one another. Tennis rackets and tennis balls, eggs and bacon, and stationery and postage stamps are complementary goods. Substitute goods are goods used instead of one another. iPods, for example, are likely to be substitutes for CD players. Breakfast cereal is a substitute for eggs. A file attachment to an e-mail is a substitute for both a fax machine and postage stamps.

FIGURE 3.3  A Reduction in Demand
A reduction in demand occurs when the quantities of a good or service demanded fall at each price. Here, the demand schedule shows a lower quantity of coffee demanded at each price than we had in Figure 3.1. The reduction shifts the demand curve for coffee to $D_3$ from $D_1$. The quantity demanded at a price of $6 per pound, for example, falls from 25 million pounds per month (point A) to 15 million pounds of coffee per month (point $A''$).
Income

As incomes rise, people increase their consumption of many goods and services, and as incomes fall, their consumption of these goods and services falls. For example, an increase in income is likely to raise the demand for gasoline, ski trips, new cars, and jewelry. There are, however, goods and services for which consumption falls as income rises—and rises as income falls. As incomes rise, for example, people tend to consume more fresh fruit but less canned fruit.

A good for which demand increases when income increases is called a **normal good**. A good for which demand decreases when income increases is called an **inferior good**. An increase in income shifts the demand curve for fresh fruit (a normal good) to the right; it shifts the demand curve for canned fruit (an inferior good) to the left.

**Demographic Characteristics**

The number of buyers affects the total quantity of a good or service that will be bought; in general, the greater the population, the greater the demand. Other demographic characteristics can affect demand as well. As the share of the population over age 65 increases, the demand for medical services, ocean cruises, and motor homes increases. The birth rate in the United States fell sharply between 1955 and 1975 but has gradually increased since then. That increase has raised the demand for such things as infant supplies, elementary school teachers, soccer coaches, in-line skates, and college education. Demand can thus shift as a result of changes in both the number and characteristics of buyers.

**Buyer Expectations**

The consumption of goods that can be easily stored, or whose consumption can be postponed, is strongly affected by buyer expectations. The expectation of newer TV technologies, such as high-definition TV, could slow down sales of regular TVs. If people expect gasoline prices to rise tomorrow, they will fill up their tanks today to try to beat the price increase. The same will be true for goods such as automobiles and washing machines: an expectation of higher prices in the future will lead to more purchases today. If the price of a good is expected to fall, however, people are likely to reduce their purchases today and await tomorrow’s lower prices. The expectation that computer prices will fall, for example, can reduce current demand.
Heads Up!

It is crucial to distinguish between a change in quantity demanded, which is a movement along the demand curve caused by a change in price, and a change in demand, which implies a shift of the demand curve itself. A change in demand is caused by a change in a demand shifter. An increase in demand is a shift of the demand curve to the right. A decrease in demand is a shift in the demand curve to the left. This drawing of a demand curve highlights the difference.

KEY TAKEAWAYS

- The quantity demanded of a good or service is the quantity buyers are willing and able to buy at a particular price during a particular period, all other things unchanged.
- A demand schedule is a table that shows the quantities of a good or service demanded at different prices during a particular period, all other things unchanged.
- A demand curve shows graphically the quantities of a good or service demanded at different prices during a particular period, all other things unchanged.
- All other things unchanged, the law of demand holds that, for virtually all goods and services, a higher price induces a reduction in quantity demanded and a lower price induces an increase in quantity demanded.
- A change in the price of a good or service causes a change in the quantity demanded—a movement along the demand curve.
- A change in a demand shifter causes a change in demand, which is shown as a shift of the demand curve. Demand shifters include preferences, the prices of related goods and services, income, demographic characteristics, and buyer expectations.
- Two goods are substitutes if an increase in the price of one causes an increase in the demand for the other. Two goods are complements if an increase in the price of one causes a decrease in the demand for the other.
- A good is a normal good if an increase in income causes an increase in demand. A good is an inferior good if an increase in income causes a decrease in demand.

TRY IT!

All other things unchanged, what happens to the demand curve for DVD rentals if there is (a) an increase in the price of movie theater tickets, (b) a decrease in family income, or (c) an increase in the price of DVD rentals? In answering this and other “Try It!” problems in this chapter, draw and carefully label a set of axes. On the horizontal axis of your graph, show the quantity of DVD rentals. It is necessary to specify the time period to which your quantity pertains (e.g., “per period,” “per week,” or “per year”). On the vertical axis show the price per DVD rental. Since you do not have specific data on prices and quantities demanded, make a “free-hand” drawing of the curve or curves you are asked to examine. Focus on the general shape and position of the curve(s) before and after events occur. Draw new curve(s) to show what happens in each of the circumstances given. The curves could shift to the left or to the right, or stay where they are.
Case in Point: Solving Campus Parking Problems Without Adding More Parking Spaces

Unless you attend a "virtual" campus, chances are you have engaged in more than one conversation about how hard it is to find a place to park on campus. Indeed, according to Clark Kerr, a former president of the University of California system, a university is best understood as a group of people "held together by a common grievance over parking."

Clearly, the demand for campus parking spaces has grown substantially over the past few decades. In surveys conducted by Daniel Kenney, Ricardo Dumont, and Ginger Kenney, who work for the campus design company Sasaki and Associates, it was found that 7 out of 10 students own their own cars. They have interviewed "many students who confessed to driving from their dormitories to classes that were a five-minute walk away," and they argue that the deterioration of college environments is largely attributable to the increased use of cars on campus and that colleges could better service their missions by not adding more parking spaces.

Since few universities charge enough for parking to even cover the cost of building and maintaining parking lots, the rest is paid for by all students as part of tuition. Their research shows that "for every 1,000 parking spaces, the median institution loses almost $400,000 a year for surface parking, and more than $1,200,000 for structural parking." Fear of a backlash from students and their parents, as well as from faculty and staff, seems to explain why campus administrators do not simply raise the price of parking on campus.

While Kenney and his colleagues do advocate raising parking fees, if not all at once then over time, they also suggest some subtler, and perhaps politically more palatable, measures—in particular, shifting the demand for parking spaces to the left by lowering the prices of substitutes.

Two examples they noted were at the University of Washington and the University of Colorado at Boulder. At the University of Washington, car poolers may park for free. This innovation has reduced purchases of single-occupancy parking permits by 32% over a decade. According to University of Washington assistant director of transportation services Peter Dewey, "Without vigorously managing our parking and providing commuter alternatives, the university would have been faced with adding approximately 3,600 parking spaces, at a cost of over $100 million... The university has created opportunities to make capital investments in buildings supporting education instead of structures for cars." At the University of Colorado, free public transit has increased use of buses and light rail from 300,000 to 2 million trips per year over the last decade. The increased use of mass transit has allowed the university to avoid constructing nearly 2,000 parking spaces, which has saved about $3.6 million annually.

ANSWER TO TRY IT! PROBLEM

Since going to the movies is a substitute for watching a DVD at home, an increase in the price of going to the movies should cause more people to switch from going to the movies to staying at home and renting DVDs. Thus, the demand curve for DVD rentals will shift to the right when the price of movie theater tickets increases [Panel (a)].

A decrease in family income will cause the demand curve to shift to the left if DVD rentals are a normal good but to the right if DVD rentals are an inferior good. The latter may be the case for some families, since staying at home and watching DVDs is a cheaper form of entertainment than taking the family to the movies. For most others, however, DVD rentals are probably a normal good [Panel (b)].

An increase in the price of DVD rentals does not shift the demand curve for DVD rentals at all; rather, an increase in price, say from \( P_1 \) to \( P_2 \), is a movement upward to the left along the demand curve. At a higher price, people will rent fewer DVDs, say \( Q_2 \) instead of \( Q_1 \), ceteris paribus [Panel (c)].

2. SUPPLY

LEARNING OBJECTIVES

1. Define the quantity supplied of a good or service and illustrate it using a supply schedule and a supply curve.
2. Distinguish between the following pairs of concepts: supply and quantity supplied, supply schedule and supply curve, movement along and shift in a supply curve.
3. Identify supply shifters and determine whether a change in a supply shifter causes the supply curve to shift to the right or to the left.

What determines the quantity of a good or service sellers are willing to offer for sale? Price is one factor; ceteris paribus, a higher price is likely to induce sellers to offer a greater quantity of a good or service. Production cost is another determinant of supply. Variables that affect production cost include the prices of factors used to produce the good or service, returns from alternative activities, technology, the expectations of sellers, and natural events such as weather changes. Still another factor affecting the quantity of a good that will be offered for sale is the number of sellers—the greater the number of sellers of a particular good or service, the greater will be the quantity offered at any price per time period.

2.1 Price and the Supply Curve

The quantity supplied of a good or service is the quantity sellers are willing to sell at a particular price during a particular period, all other things unchanged. Ceteris paribus, the receipt of a higher price increases profits and induces sellers to increase the quantity they supply.

In general, when there are many sellers of a good, an increase in price results in an increase in quantity supplied, and this relationship is often referred to as the law of supply. We will see, though, through our exploration of microeconomics, that there are a number of exceptions to this relationship. There are cases in which a higher price will not induce an increase in quantity supplied. Goods that cannot be produced, such as additional land on the corner of Park Avenue and 56th Street in Manhattan, are fixed in supply—a higher price cannot induce an increase in the quantity supplied. There are
supply schedule
A table that shows quantities supplied at different prices during a particular period, all other things unchanged.

change in quantity supplied
Movement along the supply curve caused by a change in price.

change in supply
A shift in the supply curve.

even cases, which we investigate in microeconomic analysis, in which a higher price induces a reduction in the quantity supplied.

Generally speaking, however, when there are many sellers of a good, an increase in price results in a greater quantity supplied. The relationship between price and quantity supplied is suggested in a supply schedule, a table that shows quantities supplied at different prices during a particular period, all other things unchanged. Figure 3.8 gives a supply schedule for the quantities of coffee that will be supplied per month at various prices, ceteris paribus. At a price of $4 per pound, for example, producers are willing to supply 15 million pounds of coffee per month. A higher price, say $6 per pound, induces sellers to supply a greater quantity—25 million pounds of coffee per month.

FIGURE 3.8 A Supply Schedule and a Supply Curve
The supply schedule shows the quantity of coffee that will be supplied in the United States each month at particular prices, all other things unchanged. The same information is given graphically in the supply curve. The values given here suggest a positive relationship between price and quantity supplied.

A supply curve is a graphical representation of a supply schedule. It shows the relationship between price and quantity supplied during a particular period, all other things unchanged. Because the relationship between price and quantity supplied is generally positive, supply curves are generally upward sloping. The supply curve for coffee in Figure 3.8 shows graphically the values given in the supply schedule.

A change in price causes a movement along the supply curve; such a movement is called a change in quantity supplied. As is the case with a change in quantity demanded, a change in quantity supplied does not shift the supply curve. By definition, it is a movement along the supply curve. For example, if the price rises from $6 per pound to $7 per pound, the quantity supplied rises from 25 million pounds per month to 30 million pounds per month. That’s a movement from point A to point B along the supply curve in Figure 3.8.

2.2 Changes in Supply
When we draw a supply curve, we assume that other variables that affect the willingness of sellers to supply a good or service are unchanged. It follows that a change in any of those variables will cause a change in supply, which is a shift in the supply curve. A change that increases the quantity of a good or service supplied at each price shifts the supply curve to the right. Suppose, for example, that the price of fertilizer falls. That will reduce the cost of producing coffee and thus increase the quantity of coffee producers will offer for sale at each price. The supply schedule in Figure 3.9 shows an increase in the quantity of coffee supplied at each price. We show that increase graphically as a shift in the supply curve from $S_1$ to $S_2$. We see that the quantity supplied at each price increases by 10 million pounds of coffee per month. At point A on the original supply curve $S_1$, for example, 25 million pounds of coffee per month are supplied at a price of $6 per pound. After the increase in supply, 35 million pounds per month are supplied at the same price (point $A'$ on curve $S_2$).
FIGURE 3.9 An Increase in Supply

If there is a change in supply that increases the quantity supplied at each price, as is the case in the supply schedule here, the supply curve shifts to the right. At a price of $6 per pound, for example, the quantity supplied rises from the previous level of 25 million pounds per month on supply curve $S_1$ (point A) to 35 million pounds per month on supply curve $S_2$ (point A').

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An event that reduces the quantity supplied at each price shifts the supply curve to the left. An increase in production costs and excessive rain that reduces the yields from coffee plants are examples of events that might reduce supply. Figure 3.10 shows a reduction in the supply of coffee. We see in the supply schedule that the quantity of coffee supplied falls by 10 million pounds of coffee per month at each price. The supply curve thus shifts from $S_1$ to $S_3$.

FIGURE 3.10 A Reduction in Supply

A change in supply that reduces the quantity supplied at each price shifts the supply curve to the left. At a price of $6 per pound, for example, the original quantity supplied was 25 million pounds of coffee per month (point A). With a new supply curve $S_3$, the quantity supplied at that price falls to 15 million pounds of coffee per month (point A”).

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A variable that can change the quantity of a good or service supplied at each price is called a supply shifter. Supply shifters include (1) prices of factors of production, (2) returns from alternative activities, (3) technology, (4) seller expectations, (5) natural events, and (6) the number of sellers. When these other variables change, the all-other-things-unchanged conditions behind the original supply curve no longer hold. Let us look at each of the supply shifters.

**Prices of Factors of Production**

A change in the price of labor or some other factor of production will change the cost of producing any given quantity of the good or service. This change in the cost of production will change the quantity that suppliers are willing to offer at any price. An increase in factor prices should decrease the quantity suppliers will offer at any price, shifting the supply curve to the left. A reduction in factor prices increases the quantity suppliers will offer at any price, shifting the supply curve to the right.

Suppose coffee growers must pay a higher wage to the workers they hire to harvest coffee or must pay more for fertilizer. Such increases in production cost will cause them to produce a smaller quantity at each price, shifting the supply curve for coffee to the left. A reduction in any of these costs increases supply, shifting the supply curve to the right.

**Returns from Alternative Activities**

To produce one good or service means forgoing the production of another. The concept of opportunity cost in economics suggests that the value of the activity forgone is the opportunity cost of the activity chosen; this cost should affect supply. For example, one opportunity cost of producing eggs is not selling chickens. An increase in the price people are willing to pay for fresh chicken would make it more profitable to sell chickens and would thus increase the opportunity cost of producing eggs. It would shift the supply curve for eggs to the left, reflecting a decrease in supply.

**Technology**

A change in technology alters the combinations of inputs or the types of inputs required in the production process. An improvement in technology usually means that fewer and/or less costly inputs are needed. If the cost of production is lower, the profits available at a given price will increase, and producers will produce more. With more produced at every price, the supply curve will shift to the right, meaning an increase in supply.

Impressive technological changes have occurred in the computer industry in recent years. Computers are much smaller and are far more powerful than they were only a few years ago—and they are much cheaper to produce. The result has been a huge increase in the supply of computers, shifting the supply curve to the right.

While we usually think of technology as enhancing production, declines in production due to problems in technology are also possible. Outlawing the use of certain equipment without pollution-control devices has increased the cost of production for many goods and services, thereby reducing profits available at any price and shifting these supply curves to the left.

**Seller Expectations**

All supply curves are based in part on seller expectations about future market conditions. Many decisions about production and selling are typically made long before a product is ready for sale. Those decisions necessarily depend on expectations. Changes in seller expectations can have important effects on price and quantity.

Consider, for example, the owners of oil deposits. Oil pumped out of the ground and used today will be unavailable in the future. If a change in the international political climate leads many owners to expect that oil prices will rise in the future, they may decide to leave their oil in the ground, planning to sell it later when the price is higher. Thus, there will be a decrease in supply; the supply curve for oil will shift to the left.

**Natural Events**

Storms, insect infestations, and drought affect agricultural production and thus the supply of agricultural goods. If something destroys a substantial part of an agricultural crop, the supply curve will shift to the left. The terrible cyclone that killed more than 50,000 people in Myanmar in 2008 also destroyed some of the country’s prime rice growing land. That shifted the supply curve for rice to the left. If there is an unusually good harvest, the supply curve will shift to the right.
The Number of Sellers

The supply curve for an industry, such as coffee, includes all the sellers in the industry. A change in the number of sellers in an industry changes the quantity available at each price and thus changes supply. An increase in the number of sellers supplying a good or service shifts the supply curve to the right; a reduction in the number of sellers shifts the supply curve to the left.

The market for cellular phone service has been affected by an increase in the number of firms offering the service. Over the past decade, new cellular phone companies emerged, shifting the supply curve for cellular phone service to the right.

Heads Up!

There are two special things to note about supply curves. The first is similar to the Heads Up! on demand curves: it is important to distinguish carefully between changes in supply and changes in quantity supplied. A change in supply results from a change in a supply shifter and implies a shift of the supply curve to the right or left. A change in price produces a change in quantity supplied and induces a movement along the supply curve. A change in price does not shift the supply curve.

The second caution relates to the interpretation of increases and decreases in supply. Notice that in Figure 3.9 an increase in supply is shown as a shift of the supply curve to the right; the curve shifts in the direction of increasing quantity with respect to the horizontal axis. In Figure 3.10 a reduction in supply is shown as a shift of the supply curve to the left; the curve shifts in the direction of decreasing quantity with respect to the horizontal axis.

Because the supply curve is upward sloping, a shift to the right produces a new curve that in a sense lies “below” the original curve. Students sometimes make the mistake of thinking of such a shift as a shift “down” and therefore as a reduction in supply. Similarly, it is easy to make the mistake of showing an increase in supply with a new curve that lies “above” the original curve. But that is a reduction in supply!

To avoid such errors, focus on the fact that an increase in supply is an increase in the quantity supplied at each price and shifts the supply curve in the direction of increased quantity on the horizontal axis. Similarly, a reduction in supply is a reduction in the quantity supplied at each price and shifts the supply curve in the direction of a lower quantity on the horizontal axis.

KEY TAKEAWAYS

- The quantity supplied of a good or service is the quantity sellers are willing to sell at a particular price during a particular period, all other things unchanged.
- A supply schedule shows the quantities supplied at different prices during a particular period, all other things unchanged. A supply curve shows this same information graphically.
- A change in the price of a good or service causes a change in the quantity supplied—a movement along the supply curve.
- A change in a supply shifter causes a change in supply, which is shown as a shift of the supply curve. Supply shifters include prices of factors of production, returns from alternative activities, technology, seller expectations, natural events, and the number of sellers.
- An increase in supply is shown as a shift to the right of a supply curve; a decrease in supply is shown as a shift to the left.
TRY IT!

If all other things are unchanged, what happens to the supply curve for DVD rentals if there is (a) an increase in wages paid to DVD rental store clerks, (b) an increase in the price of DVD rentals, or (c) an increase in the number of DVD rental stores? Draw a graph that shows what happens to the supply curve in each circumstance. The supply curve can shift to the left or to the right, or stay where it is. Remember to label the axes and curves, and remember to specify the time period (e.g., "DVDs rented per week").

Case in Point: The Monks of St. Benedict’s Get Out of the Egg Business

It was cookies that lured the monks of St. Benedict’s out of the egg business, and now private retreat sponsorship is luring them away from cookies.

St. Benedict’s is a Benedictine monastery, nestled on a ranch high in the Colorado Rockies, about 20 miles down the road from Aspen. The monastery’s 15 monks operate the ranch to support themselves and to provide help for poor people in the area. They lease out about 3,500 acres of their land to cattle and sheep grazers, produce cookies, and sponsor private retreats. They used to produce eggs.

Attracted by potential profits and the peaceful nature of the work, the monks went into the egg business in 1967. They had 10,000 chickens producing their Monastery Eggs brand. For a while, business was good. Very good. Then, in the late 1970s, the price of chicken feed started to rise rapidly.

“When we started in the business, we were paying $60 to $80 a ton for feed—delivered,” recalls the monastery’s abbot, Father Joseph Boyle. “By the late 1970s, our cost had more than doubled. We were paying $160 to $200 a ton. That really hurt, because feed represents a large part of the cost of producing eggs.”

The monks adjusted to the blow. “When grain prices were lower, we’d pull a hen off for a few weeks to molt, then return her to laying. After grain prices went up, it was 12 months of laying and into the soup pot,” Father Joseph says.

Grain prices continued to rise in the 1980s and increased the costs of production for all egg producers. It caused the supply of eggs to fall. Demand fell at the same time, as Americans worried about the cholesterol in eggs. Times got tougher in the egg business.

“We were still making money in the financial sense,” Father Joseph says. “But we tried an experiment in 1985 producing cookies, and it was a success. We finally decided that devoting our time and energy to the cookies would pay off better than the egg business, so we quit the egg business in 1986.”
The mail-order cookie business was good to the monks. They sold 200,000 ounces of Monastery Cookies in 1987.

By 1998, however, they had limited their production of cookies, selling only locally and to gift shops. Since 2000, they have switched to “providing private retreats for individuals and groups—about 40 people per month,” according to Brother Charles.

The monks’ calculation of their opportunity costs revealed that they would earn a higher return through sponsorship of private retreats than in either cookies or eggs. This projection has proved correct.

And there is another advantage as well.

“The chickens didn’t stop laying eggs on Sunday,” Father Joseph chuckles. “When we shifted to cookies we could take Sundays off. We weren’t hemmed in the way we were with the chickens.” The move to providing retreats is even better in this regard. Since guests provide their own meals, most of the monastery’s effort goes into planning and scheduling, which frees up even more of their time for other worldly as well as spiritual pursuits.

Source: Personal interviews.

ANSWER TO TRY IT! PROBLEM

DVD rental store clerks are a factor of production in the DVD rental market. An increase in their wages raises the cost of production, thereby causing the supply curve of DVD rentals to shift to the left [Panel (a)]. (Caution: It is possible that you thought of the wage increase as an increase in income, a demand shifter, that would lead to an increase in demand, but this would be incorrect. The question refers only to wages of DVD rental store clerks. They may rent some DVD, but their impact on total demand would be negligible. Besides, we have no information on what has happened overall to incomes of people who rent DVDs. We do know, however, that the cost of a factor of production, which is a supply shifter, increased.)

An increase in the price of DVD rentals does not shift the supply curve at all; rather, it corresponds to a movement upward to the right along the supply curve. At a higher price of \( P_2 \) instead of \( P_1 \), a greater quantity of DVD rentals, say \( Q_2 \) instead of \( Q_1 \), will be supplied [Panel (b)].

An increase in the number of stores renting DVDs will cause the supply curve to shift to the right [Panel (c)].
3. DEMAND, SUPPLY, AND EQUILIBRIUM

LEARNING OBJECTIVES

1. Use demand and supply to explain how equilibrium price and quantity are determined in a market.
2. Understand the concepts of surpluses and shortages and the pressures on price they generate.
3. Explain the impact of a change in demand or supply on equilibrium price and quantity.
4. Explain how the circular flow model provides an overview of demand and supply in product and factor markets and how the model suggests ways in which these markets are linked.

In this section we combine the demand and supply curves we have just studied into a new model. The model of demand and supply uses demand and supply curves to explain the determination of price and quantity in a market.

3.1 The Determination of Price and Quantity

The logic of the model of demand and supply is simple. The demand curve shows the quantities of a particular good or service that buyers will be willing and able to purchase at each price during a specified period. The supply curve shows the quantities that sellers will offer for sale at each price during that same period. By putting the two curves together, we should be able to find a price at which the quantity buyers are willing and able to purchase equals the quantity sellers will offer for sale.

Figure 3.14 combines the demand and supply data introduced in Figure 3.1 and Figure 3.8 Notice that the two curves intersect at a price of $6 per pound—at this price the quantities demanded and supplied are equal. Buyers want to purchase, and sellers are willing to offer for sale, 25 million pounds of coffee per month. The market for coffee is in equilibrium. Unless the demand or supply curve shifts, there will be no tendency for price to change. The equilibrium price in any market is the price at which quantity demanded equals quantity supplied. The equilibrium price in the market for coffee is thus $6 per pound. The equilibrium quantity is the quantity demanded and supplied at the equilibrium price.

FIGURE 3.14 The Determination of Equilibrium Price and Quantity

When we combine the demand and supply curves for a good in a single graph, the point at which they intersect identifies the equilibrium price and equilibrium quantity. Here, the equilibrium price is $6 per pound. Consumers demand, and suppliers supply, 25 million pounds of coffee per month at this price.

With an upward-sloping supply curve and a downward-sloping demand curve, there is only a single price at which the two curves intersect. This means there is only one price at which equilibrium is
achieved. It follows that at any price other than the equilibrium price, the market will not be in equilibrium. We next examine what happens at prices other than the equilibrium price.

**Surpluses**

Figure 3.15 shows the same demand and supply curves we have just examined, but this time the initial price is $8 per pound of coffee. Because we no longer have a balance between quantity demanded and quantity supplied, this price is not the equilibrium price. At a price of $8, we read over to the demand curve to determine the quantity of coffee consumers will be willing to buy—15 million pounds per month. The supply curve tells us what sellers will offer for sale—35 million pounds per month. The difference, 20 million pounds of coffee per month, is called a surplus. More generally, a surplus is the amount by which the quantity supplied exceeds the quantity demanded at the current price. There is, of course, no surplus at the equilibrium price; a surplus occurs only if the current price exceeds the equilibrium price.

**FIGURE 3.15  A Surplus in the Market for Coffee**

At a price of $8, the quantity supplied is 35 million pounds of coffee per month and the quantity demanded is 15 million pounds per month; there is a surplus of 20 million pounds of coffee per month. Given a surplus, the price will fall quickly toward the equilibrium level of $6.

A surplus in the market for coffee will not last long. With unsold coffee on the market, sellers will begin to reduce their prices to clear out unsold coffee. As the price of coffee begins to fall, the quantity of coffee supplied begins to decline. At the same time, the quantity of coffee demanded begins to rise. Remember that the reduction in quantity supplied is a movement along the supply curve—the curve itself does not shift in response to a reduction in price. Similarly, the increase in quantity demanded is a movement along the demand curve—the demand curve does not shift in response to a reduction in price. Price will continue to fall until it reaches its equilibrium level, at which the demand and supply curves intersect. At that point, there will be no tendency for price to fall further. In general, surpluses in the marketplace are short-lived. The prices of most goods and services adjust quickly, eliminating the surplus. Later on, we will discuss some markets in which adjustment of price to equilibrium may occur only very slowly or not at all.
Shortages

Just as a price above the equilibrium price will cause a surplus, a price below equilibrium will cause a shortage. A shortage is the amount by which the quantity demanded exceeds the quantity supplied at the current price.

Figure 3.16 shows a shortage in the market for coffee. Suppose the price is $4 per pound. At that price, 15 million pounds of coffee would be supplied per month, and 35 million pounds would be demanded per month. When more coffee is demanded than supplied, there is a shortage.

**FIGURE 3.16 A Shortage in the Market for Coffee**

At a price of $4 per pound, the quantity of coffee demanded is 35 million pounds per month and the quantity supplied is 15 million pounds per month. The result is a shortage of 20 million pounds of coffee per month.

In the face of a shortage, sellers are likely to begin to raise their prices. As the price rises, there will be an increase in the quantity supplied (but not a change in supply) and a reduction in the quantity demanded (but not a change in demand) until the equilibrium price is achieved.
3.2 Shifts in Demand and Supply

**FIGURE 3.17 Changes in Demand and Supply**

A change in demand or in supply changes the equilibrium solution in the model. Panels (a) and (b) show an increase and a decrease in demand, respectively; Panels (c) and (d) show an increase and a decrease in supply, respectively.

A change in one of the variables (shifters) held constant in any model of demand and supply will create a change in demand or supply. A shift in a demand or supply curve changes the equilibrium price and equilibrium quantity for a good or service. Figure 3.17 combines the information about changes in the demand and supply of coffee presented in Figure 3.2 Figure 3.3 Figure 3.9 and Figure 3.10 In each case, the original equilibrium price is $6 per pound, and the corresponding equilibrium quantity is 25 million pounds of coffee per month. Figure 3.17 shows what happens with an increase in demand, a reduction in demand, an increase in supply, and a reduction in supply. We then look at what happens if both curves shift simultaneously. Each of these possibilities is discussed in turn below.

**An Increase in Demand**

An increase in demand for coffee shifts the demand curve to the right, as shown in Panel (a) of Figure 3.17. The equilibrium price rises to $7 per pound. As the price rises to the new equilibrium level, the quantity supplied increases to 30 million pounds of coffee per month. Notice that the supply curve does not shift; rather, there is a movement along the supply curve.
Demand shifters that could cause an increase in demand include a shift in preferences that leads to greater coffee consumption; a lower price for a complement to coffee, such as doughnuts; a higher price for a substitute for coffee, such as tea; an increase in income; and an increase in population. A change in buyer expectations, perhaps due to predictions of bad weather lowering expected yields on coffee plants and increasing future coffee prices, could also increase current demand.

A Decrease in Demand
Panel (b) of Figure 3.17 shows that a decrease in demand shifts the demand curve to the left. The equilibrium price falls to $5 per pound. As the price falls to the new equilibrium level, the quantity supplied decreases to 20 million pounds of coffee per month.

Demand shifters that could reduce the demand for coffee include a shift in preferences that makes people want to consume less coffee; an increase in the price of a complement, such as doughnuts; a reduction in the price of a substitute, such as tea; a reduction in income; a reduction in population; and a change in buyer expectations that leads people to expect lower prices for coffee in the future.

An Increase in Supply
An increase in the supply of coffee shifts the supply curve to the right, as shown in Panel (c) of Figure 3.17. The equilibrium price falls to $5 per pound. As the price falls to the new equilibrium level, the quantity of coffee demanded increases to 30 million pounds of coffee per month. Notice that the demand curve does not shift; rather, there is movement along the demand curve.

Possible supply shifters that could increase supply include a reduction in the price of an input such as labor, a decline in the returns available from alternative uses of the inputs that produce coffee, an improvement in the technology of coffee production, good weather, and an increase in the number of coffee-producing firms.

A Decrease in Supply
Panel (d) of Figure 3.17 shows that a decrease in supply shifts the supply curve to the left. The equilibrium price rises to $7 per pound. As the price rises to the new equilibrium level, the quantity demanded decreases to 20 million pounds of coffee per month.

Possible supply shifters that could reduce supply include an increase in the prices of inputs used in the production of coffee, an increase in the returns available from alternative uses of these inputs, a decline in production because of problems in technology (perhaps caused by a restriction on pesticides used to protect coffee beans), a reduction in the number of coffee-producing firms, or a natural event, such as excessive rain.

Heads Up!
1. Set up the graph
2. Shift the curve
3. Troubleshoot

You are likely to be given problems in which you will have to shift a demand or supply curve.

Suppose you are told that an invasion of pod-crunching insects has gobbled up half the crop of fresh peas, and you are asked to use demand and supply analysis to predict what will happen to the price and quantity of peas demanded and supplied. Here are some suggestions.

Put the quantity of the good you are asked to analyze on the horizontal axis and its price on the vertical axis. Draw a downward-sloping line for demand and an upward-sloping line for supply. The initial equilibrium price is determined by the intersection of the two curves. Label the equilibrium solution. You may find it helpful to use a number for the equilibrium price instead of the letter “P.” Pick a price that seems plausible, say, 79¢ per pound. Do not worry about the precise positions of the demand and supply curves; you cannot be expected to know what they are.
Step 2 can be the most difficult step; the problem is to decide which curve to shift. The key is to remember the difference between a change in demand or supply and a change in quantity demanded or supplied. At each price, ask yourself whether the given event would change the quantity demanded. Would the fact that a bug has attacked the pea crop change the quantity demanded at a price of, say, 79¢ per pound? Clearly not; none of the demand shifters have changed. The event would, however, reduce the quantity supplied at this price, and the supply curve would shift to the left. There is a change in supply and a reduction in the quantity demanded. There is no change in demand.

Next check to see whether the result you have obtained makes sense. The graph in Step 2 makes sense; it shows price rising and quantity demanded falling.

It is easy to make a mistake such as the one shown in the third figure of this Heads Up! One might, for example, reason that when fewer peas are available, fewer will be demanded, and therefore the demand curve will shift to the left. This suggests the price of peas will fall—but that does not make sense. If only half as many fresh peas were available, their price would surely rise. The error here lies in confusing a change in quantity demanded with a change in demand. Yes, buyers will end up buying fewer peas. But no, they will not demand fewer peas at each price than before; the demand curve does not shift.

Simultaneous Shifts

As we have seen, when either the demand or the supply curve shifts, the results are unambiguous; that is, we know what will happen to both equilibrium price and equilibrium quantity, so long as we know whether demand or supply increased or decreased. However, in practice, several events may occur at around the same time that cause both the demand and supply curves to shift. To figure out what happens to equilibrium price and equilibrium quantity, we must know not only in which direction the demand and supply curves have shifted but also the relative amount by which each curve shifts. Of course, the demand and supply curves could shift in the same direction or in opposite directions, depending on the specific events causing them to shift.

For example, all three panels of Figure 3.19 show a decrease in demand for coffee (caused perhaps by a decrease in the price of a substitute good, such as tea) and a simultaneous decrease in the supply of coffee (caused perhaps by bad weather). Since reductions in demand and supply, considered separately, each cause the equilibrium quantity to fall, the impact of both curves shifting simultaneously to the left means that the new equilibrium quantity of coffee is less than the old equilibrium quantity. The effect on the equilibrium price, though, is ambiguous. Whether the equilibrium price is higher, lower, or unchanged depends on the extent to which each curve shifts.
FIGURE 3.19 Simultaneous Decreases in Demand and Supply

Both the demand and the supply of coffee decrease. Since decreases in demand and supply, considered separately, each cause equilibrium quantity to fall, the impact of both decreasing simultaneously means that a new equilibrium quantity of coffee must be less than the old equilibrium quantity. In Panel (a), the demand curve shifts farther to the left than does the supply curve, so equilibrium price falls. In Panel (b), the supply curve shifts farther to the left than does the demand curve, so the equilibrium price rises. In Panel (c), both curves shift to the left by the same amount, so equilibrium price stays the same.

If the demand curve shifts farther to the left than does the supply curve, as shown in Panel (a) of Figure 3.19, then the equilibrium price will be lower than it was before the curves shifted. In this case the new equilibrium price falls from $6 per pound to $5 per pound. If the shift to the left of the supply curve is greater than that of the demand curve, the equilibrium price will be higher than it was before, as shown in Panel (b). In this case, the new equilibrium price rises to $7 per pound. In Panel (c), since both curves shift to the left by the same amount, equilibrium price does not change; it remains $6 per pound.

Regardless of the scenario, changes in equilibrium price and equilibrium quantity resulting from two different events need to be considered separately. If both events cause equilibrium price or quantity to move in the same direction, then clearly price or quantity can be expected to move in that direction. If one event causes price or quantity to rise while the other causes it to fall, the extent by which each curve shifts is critical to figuring out what happens. Figure 3.20 summarizes what may happen to equilibrium price and quantity when demand and supply both shift.
FIGURE 3.20 Simultaneous Shifts in Demand and Supply

If simultaneous shifts in demand and supply cause equilibrium price or quantity to move in the same direction, then equilibrium price or quantity clearly moves in that direction. If the shift in one of the curves causes equilibrium price or quantity to rise while the shift in the other curve causes equilibrium price or quantity to fall, then the relative amount by which each curve shifts is critical to figuring out what happens to that variable.

As demand and supply curves shift, prices adjust to maintain a balance between the quantity of a good demanded and the quantity supplied. If prices did not adjust, this balance could not be maintained.

Notice that the demand and supply curves that we have examined in this chapter have all been drawn as linear. This simplification of the real world makes the graphs a bit easier to read without sacrificing the essential point: whether the curves are linear or nonlinear, demand curves are downward sloping and supply curves are generally upward sloping. As circumstances that shift the demand curve or the supply curve change, we can analyze what will happen to price and what will happen to quantity.

3.3 An Overview of Demand and Supply: The Circular Flow Model

Implicit in the concepts of demand and supply is a constant interaction and adjustment that economists illustrate with the circular flow model. The circular flow model provides a look at how markets work and how they are related to each other. It shows flows of spending and income through the economy.

A great deal of economic activity can be thought of as a process of exchange between households and firms. Firms supply goods and services to households. Households buy these goods and services from firms. Households supply factors of production—labor, capital, and natural resources—that firms require. The payments firms make in exchange for these factors represent the incomes households earn.

The flow of goods and services, factors of production, and the payments they generate is illustrated in Figure 3.21. This circular flow model of the economy shows the interaction of households and firms as they exchange goods and services and factors of production. For simplicity, the model here shows only the private domestic economy; it omits the government and foreign sectors.
FIGURE 3.21 The Circular Flow of Economic Activity

This simplified circular flow model shows flows of spending between households and firms through product and factor markets. The inner arrows show goods and services flowing from firms to households and factors of production flowing from households to firms. The outer flows show the payments for goods, services, and factors of production. These flows, in turn, represent millions of individual markets for products and factors of production.

The circular flow model shows that goods and services that households demand are supplied by firms in product markets. The exchange for goods and services is shown in the top half of Figure 3.21. The bottom half of the exhibit illustrates the exchanges that take place in factor markets. Factor markets are markets in which households supply factors of production—labor, capital, and natural resources—demanded by firms.

Our model is called a circular flow model because households use the income they receive from their supply of factors of production to buy goods and services from firms. Firms, in turn, use the payments they receive from households to pay for their factors of production.

The demand and supply model developed in this chapter gives us a basic tool for understanding what is happening in each of these product or factor markets and also allows us to see how these markets are interrelated. In Figure 3.21, markets for three goods and services that households want—blue jeans, haircuts, and apartments—create demands by firms for textile workers, barbers, and apartment buildings. The equilibrium of supply and demand in each market determines the price and quantity of that item. Moreover, a change in equilibrium in one market will affect equilibrium in related markets. For example, an increase in the demand for haircuts would lead to an increase in demand for barbers. Equilibrium price and quantity could rise in both markets. For some purposes, it will be adequate to simply look at a single market, whereas at other times we will want to look at what happens in related markets as well.

In either case, the model of demand and supply is one of the most widely used tools of economic analysis. That widespread use is no accident. The model yields results that are, in fact, broadly consistent with what we observe in the marketplace. Your mastery of this model will pay big dividends in your study of economics.
KEY TAKEAWAYS

- The equilibrium price is the price at which the quantity demanded equals the quantity supplied. It is determined by the intersection of the demand and supply curves.
- A surplus exists if the quantity of a good or service supplied exceeds the quantity demanded at the current price; it causes downward pressure on price. A shortage exists if the quantity of a good or service demanded exceeds the quantity supplied at the current price; it causes upward pressure on price.
- An increase in demand, all other things unchanged, will cause the equilibrium price to rise; quantity supplied will increase. A decrease in demand will cause the equilibrium price to fall; quantity supplied will decrease.
- An increase in supply, all other things unchanged, will cause the equilibrium price to fall; quantity demanded will increase. A decrease in supply will cause the equilibrium price to rise; quantity demanded will decrease.
- To determine what happens to equilibrium price and equilibrium quantity when both the supply and demand curves shift, you must know in which direction each of the curves shifts and the extent to which each curve shifts.
- The circular flow model provides an overview of demand and supply in product and factor markets and suggests how these markets are linked to one another.

TRY IT!

What happens to the equilibrium price and the equilibrium quantity of DVD rentals if the price of movie theater tickets increases and wages paid to DVD rental store clerks increase, all other things unchanged? Be sure to show all possible scenarios, as was done in Figure 3.19. Again, you do not need actual numbers to arrive at an answer. Just focus on the general position of the curve(s) before and after events occurred.

Case in Point: Demand, Supply, and Obesity

Why are so many Americans fat? Put so crudely, the question may seem rude, but, indeed, the number of obese Americans has increased by more than 50% over the last generation, and obesity may now be the nation’s number one health problem. According to Sturm Roland in a recent RAND Corporation study, “Obesity appears to have a stronger association with the occurrence of chronic medical conditions, reduced physical health-related quality of life and increased health care and medication expenditures than smoking or problem drinking.”

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Many explanations of rising obesity suggest higher demand for food. What more apt picture of our sedentary lifestyle is there than spending the afternoon watching a ballgame on TV, while eating chips and salsa, followed by a dinner of a lavishly topped, take-out pizza? Higher income has also undoubtedly contributed to a rightward shift in the demand curve for food. Plus, any additional food intake translates into more weight increase because we spend so few calories preparing it, either directly or in the process of earning the income to buy it. A study by economists Darius Lakdawalla and Tomas Philipson suggests that about 60% of the recent growth in weight may be explained in this way—that is, demand has shifted to the right, leading to an increase in the equilibrium quantity of food consumed and, given our less strenuous lifestyles, even more weight gain than can be explained simply by the increased amount we are eating.

What accounts for the remaining 40% of the weight gain? Lakdawalla and Philipson further reason that a rightward shift in demand would by itself lead to an increase in the quantity of food as well as an increase in the price of food. The problem they have with this explanation is that over the post-World War II period, the relative price of food has declined by an average of 0.2 percentage points per year. They explain the fall in the price of food by arguing that agricultural innovation has led to a substantial rightward shift in the supply curve of food. As shown, lower food prices and a higher equilibrium quantity of food have resulted from simultaneous rightward shifts in demand and supply and that the rightward shift in the supply of food from $S_1$ to $S_2$ has been substantially larger than the rightward shift in the demand curve from $D_1$ to $D_2$.

ANSWER TO TRY IT! PROBLEM

An increase in the price of movie theater tickets (a substitute for DVD rentals) will cause the demand curve for DVD rentals to shift to the right. An increase in the wages paid to DVD rental store clerks (an increase in the cost of a factor of production) shifts the supply curve to the left. Each event taken separately causes equilibrium price to rise. Whether equilibrium quantity will be higher or lower depends on which curve shifted more.

If the demand curve shifted more, then the equilibrium quantity of DVD rentals will rise [Panel (a)].

If the supply curve shifted more, then the equilibrium quantity of DVD rentals will fall [Panel (b)].

If the curves shifted by the same amount, then the equilibrium quantity of DVD rentals would not change [Panel (c)].

4. REVIEW AND PRACTICE

Summary

In this chapter we have examined the model of demand and supply. We found that a demand curve shows the quantity demanded at each price, all other things unchanged. The law of demand asserts that an increase in price reduces the quantity demanded and a decrease in price increases the quantity demanded, all other things unchanged. The supply curve shows the quantity of a good or service that sellers will offer at various prices, all other things unchanged. Supply curves are generally upward sloping: an increase in price generally increases the quantity supplied, all other things unchanged.

The equilibrium price occurs where the demand and supply curves intersect. At this price, the quantity demanded equals the quantity supplied. A price higher than the equilibrium price increases the quantity supplied and reduces the quantity demanded, causing a surplus. A price lower than the equilibrium price increases the quantity demanded and reduces the quantity supplied, causing a shortage. Usually, market surpluses and shortages are short-lived. Changes in demand or supply, caused by changes in the determinants of demand and supply otherwise held constant in the analysis, change the equilibrium price and output. The circular flow model allows us to see how demand and supply in various markets are related to one another.
1. What do you think happens to the demand for pizzas during the Super Bowl? Why?

2. Which of the following goods are likely to be classified as normal goods or services? Inferior? Defend your answer.
   a. Beans
   b. Tuxedos
   c. Used cars
   d. Used clothing
   e. Computers
   f. Books reviewed in *The New York Times*
   g. Macaroni and cheese
   h. Calculators
   i. Cigarettes
   j. Caviar
   k. Legal services

3. Which of the following pairs of goods are likely to be classified as substitutes? Complements? Defend your answer.
   a. Peanut butter and jelly
   b. Eggs and ham
   c. Nike brand and Reebok brand sneakers
   d. IBM and Apple Macintosh brand computers
   e. Dress shirts and ties
   f. Airline tickets and hotels
   g. Gasoline and tires
   h. Beer and wine
   i. Faxes and first-class mail
   j. Cereal and milk
   k. Cereal and eggs

4. A study found that lower airfares led some people to substitute flying for driving to their vacation destinations. This reduced the demand for car travel and led to reduced traffic fatalities, since air travel is safer per passenger mile than car travel. Using the logic suggested by that study, suggest how each of the following events would affect the number of highway fatalities in any one year.
   a. An increase in the price of gasoline
   b. A large reduction in rental rates for passenger vans
   c. An increase in airfares

5. Children under age 2 are now allowed to fly free on U.S. airlines; they usually sit in their parents’ laps. Some safety advocates have urged that they be required to be strapped in infant seats, which would mean their parents would have to purchase tickets for them. Some economists have argued that such a measure would actually increase infant fatalities. Can you say why?

6. The graphs below show four possible shifts in demand or in supply that could occur in particular markets. Relate each of the events described below to one of them.
a. How did the heavy rains in South America in 1997 affect the market for coffee?

b. The Surgeon General decides french fries are not bad for your health after all and issues a report endorsing their use. What happens to the market for french fries?

c. How do you think rising incomes affect the market for ski vacations?

d. A new technique is discovered for manufacturing computers that greatly lowers their production cost. What happens to the market for computers?

e. How would a ban on smoking in public affect the market for cigarettes?

7. As low-carb diets increased in popularity, egg prices rose sharply. How might this affect the monks’ supply of cookies or private retreats? (See the Case in Point on the Monks of St. Benedict’s.)

8. Gasoline prices typically rise during the summer, a time of heavy tourist traffic. A “street talk” feature on a radio station sought tourist reaction to higher gasoline prices. Here was one response: “I don’t like ‘em [the higher prices] much. I think the gas companies just use any excuse to jack up prices, and they’re doing it again now.” How does this tourist’s perspective differ from that of economists who use the model of demand and supply?

9. The introduction to the chapter argues that preferences for coffee changed in the 1990s and that excessive rain hurt yields from coffee plants. Show and explain the effects of these two circumstances on the coffee market.

10. With preferences for coffee remaining strong in the early part of the century, Vietnam entered the market as a major exporter of coffee. Show and explain the effects of these two circumstances on the coffee market.

11. The study on the economics of obesity discussed in the Case in Point on this chapter on that topic also noted that another factor behind rising obesity is the decline in cigarette smoking as the price of cigarettes has risen. Show and explain the effect of higher cigarette prices on the market for food. What does this finding imply about the relationship between cigarettes and food?

12. In 2004, The New York Times reported that India might be losing its outsourcing edge due to rising wages[1]. The reporter noted that a recent report “projected that if India continued to produce college graduates at the current rate, demand would exceed supply by 20% in the main outsourcing markets by 2008.” Using the terminology you learned in this chapter, explain what he meant to say was happening in the market for Indian workers in outsourcing jobs. In particular, is demand for Indian workers increasing or decreasing? Is the supply of Indian workers increasing or decreasing? Which is shifting faster? How do you know?

13. For more than a century, milk producers have produced skim milk, which contains virtually no fat, along with regular milk, which contains 4% fat. But a century ago, skim milk accounted for only about 1% of total production, and much of it was fed to hogs. Today, skim and other reduced-fat milks make up the bulk of milk sales. What curve shifted, and what factor shifted it?

14. Suppose firms in the economy were to produce fewer goods and services. How do you think this would affect household spending on goods and services? (Hint: Use the circular flow model to analyze this question.)
NUMERICAL PROBLEMS

Problems 1–5 are based on the graph below.

1. At a price of $1.50 per dozen, how many bagels are demanded per month?
2. At a price of $1.50 per dozen, how many bagels are supplied per month?
3. At a price of $3.00 per dozen, how many bagels are demanded per month?
4. At a price of $3.00 per dozen, how many bagels are supplied per month?
5. What is the equilibrium price of bagels? What is the equilibrium quantity per month?

Problems 6–9 are based on the model of demand and supply for coffee as shown in Figure 3.17. You can graph the initial demand and supply curves by using the following values, with all quantities in millions of pounds of coffee per month:

<table>
<thead>
<tr>
<th>Price</th>
<th>Quantity demanded</th>
<th>Quantity supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>$3</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>35</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>6</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>7</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>8</td>
<td>15</td>
<td>35</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>40</td>
</tr>
</tbody>
</table>

6. Suppose the quantity demanded rises by 20 million pounds of coffee per month at each price. Draw the initial demand and supply curves based on the values given in the table above. Then draw the new demand curve given by this change, and show the new equilibrium price and quantity.

7. Suppose the quantity demanded falls, relative to the values given in the above table, by 20 million pounds per month at prices between $4 and $6 per pound; at prices between $7 and $9 per pound, the quantity demanded becomes zero. Draw the new demand curve and show the new equilibrium price and quantity.

8. Suppose the quantity supplied rises by 20 million pounds per month at each price, while the quantities demanded retain the values shown in the table above. Draw the new supply curve and show the new equilibrium price and quantity.

9. Suppose the quantity supplied falls, relative to the values given in the table above, by 20 million pounds per month at prices above $5; at a price of $5 or less per pound, the quantity supplied becomes zero. Draw the new supply curve and show the new equilibrium price and quantity.
Problems 10–15 are based on the demand and supply schedules for gasoline below (all quantities are in thousands of gallons per week):

<table>
<thead>
<tr>
<th>Price per gallon</th>
<th>Quantity demanded</th>
<th>Quantity supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

10. Graph the demand and supply curves and show the equilibrium price and quantity.
11. At a price of $3 per gallon, would there be a surplus or shortage of gasoline? How much would the surplus or shortage be? Indicate the surplus or shortage on the graph.
12. At a price of $6 per gallon, would there be a surplus or shortage of gasoline? How much would the surplus or shortage be? Show the surplus or shortage on the graph.
13. Suppose the quantity demanded increased by 2,000 gallons per month at each price. At a price of $3 per gallon, how much would the surplus or shortage be? Graph the demand and supply curves and show the surplus or shortage.
14. Suppose the quantity supplied decreased by 2,000 gallons per month at each price for prices between $4 and $8 per gallon. At prices less than $4 per gallon the quantity supplied becomes zero, while the quantities demanded retain the values shown in the table. At a price of $4 per gallon, how much would the surplus or shortage be? Graph the demand and supply curves and show the surplus or shortage.
15. If the demand curve shifts as in problem 13 and the supply curve shifts as in problem 14, without drawing a graph or consulting the data, can you predict whether equilibrium price increases or decreases? What about equilibrium quantity? Now draw a graph that shows what the new equilibrium price and quantity are.
CHAPTER 4
Applications of Demand and Supply

START UP: A COMPOSER LOGS ON

“Since the age of seven, I knew that I would be a musician. And from age fourteen, I knew that I would be a composer,” says Israeli-born Ofer Ben-Amots. What he did not know was that he would use computers to carry out his work. He is now a professor of music at Colorado College, and Dr. Ben-Amots’s compositions and operas have been performed in the United States, Europe, and Japan.

For over 15 years, he has used musical notation software to help in composing music. “The output is extremely elegant. Performers enjoy looking at such a clear and clean score. The creation of parts out of a full score is as easy as pressing the <ENTER> key on the keyboard.” Changes can easily be inserted into the notation file, which eliminates the need for recopying. In addition, Dr. Ben-Amots uses computers for playback. “I can listen to a relatively accurate ‘digital performance’ of the score at any given point, with any tempo or instrumentation I choose. The sound quality has improved so much that digital files sound almost identical to real performance.” He can also produce CDs on his own and create Podcasts so that anyone in the world can hear his music. He engages in self-publication of scores and self-marketing. “In my case, I get to keep the copyrights on all of my music. This would have been impossible ten to twelve years ago when composers transferred their rights to publishers. Home pages on the World Wide Web allow me to promote my own work.” Professor Ben-Amots also changed the way he teaches music composition. New application software, such as GarageBand, has opened the way for anyone interested to try to compose music. Whereas his music composition classes used to have music theory prerequisites, today his classes are open to all.

Dr. Ben-Amots started out in 1989 with a Macintosh SE30 that had 4 megabytes of random access memory (RAM) and an 80-megabyte hard drive. It cost him about $3,000. Today, he uses a Macintosh Powerbook G4 laptop with 1.5 gigabytes of memory, built-in DVD/CD burner, and wireless Internet connections. His new computer cost about $2,000. How personal computers rose so dramatically in power as they fell so steeply in price is just one of the stories about markets we will tell in this chapter, which aims to help you understand how the model of demand and supply applies to the real world.

In the first section of this chapter, we will look at several markets that you are likely to have participated in or be familiar with—the market for personal computers, the markets for crude oil and for gasoline, and the stock market. You probably own or have access to a computer. Each of us was affected by the sharp rise in crude oil and gasoline prices from 2004 to mid-2008. The performance of the stock market is always a major news item and may affect you personally, if not now, then in the future. The concepts of demand and supply go a long way in explaining the behavior of equilibrium prices and quantities in all of these markets. The purpose of this section is to allow you to
practice using the model of demand and supply and get you to start thinking about the myriad ways the model of demand and supply can be applied.

In the second part of the chapter we will look at markets in which the government has historically played a large role in regulating prices. By legislating maximum or minimum prices, the government has kept the prices of certain goods below or above equilibrium. We will look at the arguments for direct government intervention in controlling prices as well as the consequences of such policies. As we shall see, preventing the price of a good from finding its own equilibrium often has consequences that may be at odds with the intentions of the policy makers who put the regulations in place.

In the third section of the chapter we will look at the market for health care. This market is interesting because how well (or poorly) it works can be a matter of life and death and because it has special characteristics. In particular, markets in which participants do not pay for goods directly, but rather pay insurers who then pay the suppliers of the goods, operate somewhat differently from those in which participants pay directly for their purchases. This extension of demand and supply analysis reveals much about how such markets operate.

1. PUTTING DEMAND AND SUPPLY TO WORK

LEARNING OBJECTIVES

1. Learn how to apply the model of demand and supply to explaining the behavior of equilibrium prices and quantities in a variety of markets.
2. Explain how technological change can be represented using the model of demand and supply.
3. Explain how the model of demand and supply can be used to explain changes in prices of shares of stock.

A shift in either demand or supply, or in both, leads to a change in equilibrium price and equilibrium quantity. We begin this chapter by examining markets in which prices adjust quickly to changes in demand or supply: the market for personal computers, the markets for crude oil and gasoline, and the stock market. These markets are thus direct applications of the model of demand and supply.

1.1 The Personal Computer Market

In the 1960s, to speak of computers was to speak of IBM, the dominant maker of large mainframe computers used by business and government agencies. Then between 1976, when Apple Computer introduced its first desktop computer, and 1981, when IBM produced its first personal computers (PCs), the old world was turned upside down. In 1984, just 8.2% of U.S. households owned a personal computer. By 2007, Google estimates that 78% did. The tools of demand and supply tell the story from an economic perspective.

Technological change has been breathtakingly swift in the computer industry. Because personal computers have changed so dramatically in performance and in the range of the functions they perform, we shall speak of “quality-adjusted” personal computers. The price per unit of quality-adjusted desktop computers fell by about half every 50 months during the period 1976–1989. In the first half of the 1990s, those prices fell by half every 28 months. In the second half of the 1990s, the “halving time” fell to every 24 months. [1]

Consider another indicator of the phenomenal change in computers. Between 1993 and 1998, the Bureau of Labor Statistics estimates that central processing unit (CPU) speed rose 1,263%, system memory increased 1,500%, hard drive capacity soared by 3,700%, and monitor size went up 13%. It seems safe to say that the dizzying pace of change recorded in the 1990s has increased in this century. A “computer” today is not the same good as a “computer” even five years ago. To make them comparable, we must adjust for these changes in quality.

Initially, most personal computers were manufactured by Apple or Compaq; both companies were very profitable. The potential for profits attracted IBM and other firms to the industry. Unlike large
mainframe computers, personal computer clones turned out to be fairly easy things to manufacture. As shown in Table 4.1, the top five personal computer manufacturers produced only 48% of the personal computers sold in the world in 2005, and the largest manufacturer, Dell, sold only about 19% of the total in that year. This is a far cry from the more than 90% of the mainframe computer market that IBM once held. The market has become far more competitive.

**Table 4.1 Personal Computer Shipments, Market Percentage Shares by Vendors, World and United States**

<table>
<thead>
<tr>
<th>Company</th>
<th>% of World Shipments</th>
<th>Company</th>
<th>% of U.S. Shipments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dell</td>
<td>18.9</td>
<td>Dell</td>
<td>34</td>
</tr>
<tr>
<td>Hewlett-Packard</td>
<td>15.4</td>
<td>Hewlett-Packard</td>
<td>18.2</td>
</tr>
<tr>
<td>IBM</td>
<td>5.1</td>
<td>Gateway</td>
<td>5.7</td>
</tr>
<tr>
<td>Fujitsu Siemens</td>
<td>4.6</td>
<td>IBM</td>
<td>4.3</td>
</tr>
<tr>
<td>Acer</td>
<td>4.0</td>
<td>Apple</td>
<td>3.9</td>
</tr>
<tr>
<td>Others</td>
<td>52%</td>
<td>Others</td>
<td>34%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
<td><strong>Total</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

*Source: IDC—Press Release 15 Apr 2005 “PC Market Approaches 11% Growth as International Demand Remains Strong, According to IDC”*  
(http://www.idc.com/getdoc.jsp?containerId=pr2005_04_14_17070722) (Totals may not add due to rounding)

Figure 4.1 illustrates the changes that have occurred in the computer market. The horizontal axis shows the quantity of quality-adjusted personal computers. Thus, the quantity axis can be thought of as a unit of computing power. Similarly, the price axis shows the price per unit of computing power. The rapid increase in the number of firms, together with dramatic technological improvements, led to an increase in supply, shifting the supply curve in Figure 4.1 to the right from $S_1$ to $S_2$.

**Figure 4.1 The Personal Computer Market**

The supply curve for quality-adjusted personal computers has shifted markedly to the right, reducing the equilibrium price from $P_1$ to $P_2$ and increasing the equilibrium quantity from $Q_1$ to $Q_2$ in 2005.

Demand also shifted to the right from $D_1$ to $D_2$, as incomes rose and new uses for computers, from e-mail and social networking to Voice over Internet Protocol (VoIP) and Radio Frequency ID (RFID) tags (which allow wireless tracking of commercial shipments via desktop computers), altered the preferences of consumer and business users. Because we observe a fall in equilibrium price and an increase in equilibrium quantity, we conclude that the rightward shift in supply has outweighed the rightward shift in demand. The power of market forces has profoundly affected the way we live and work.
1.2 The Markets for Crude Oil and for Gasoline

The market for crude oil took a radical turn in 1973. The price per barrel of crude oil quadrupled in 1973 and 1974. Price remained high until the early 1980s but then fell back drastically and remained low for about two decades. In 2004, the price of oil began to move upward and by 2008 had reached $147 per barrel.

What caused the dramatic increase in gasoline and oil prices in 2008? It appeared to be increasing worldwide demand outpacing producers’ ability—or willingness—to increase production much. This increase in demand is illustrated in Figure 4.2.

**FIGURE 4.2 The Increasing Demand for Crude Oil**

The price of oil was $35 per barrel at the beginning of 2004, as determined by the intersection of world demand, \(D_1\), and world supply, \(S_1\). Increasing world demand, prompted largely by increasing demand from China as well as from other countries, shifted world demand to \(D_2\), pushing the price as high as $140 per barrel by the middle of 2008.

Higher oil prices also increase the cost of producing virtually every good or service, as at a minimum, the production of most goods requires transportation. These costs inevitably translate into higher prices for nearly all goods and services. Supply curves of the goods and services thus affected shift to the left, putting downward pressure on output and upward pressure on prices.

Graphically, the impact of higher gasoline prices on businesses that use gasoline is illustrated in Figure 4.3. Because higher gasoline prices increase the cost of doing business, they shift the supply curves for nearly all businesses to the left, putting upward pressure on prices and downward pressure on output. In the case shown here, the supply curve in a typical industry shifts from \(S_1\) to \(S_2\). This increases the equilibrium price from \(P_1\) to \(P_2\) and reduces the equilibrium quantity from \(Q_1\) to \(Q_2\).
Then, as the world economy slowed dramatically in the second half of 2008, the demand curve for oil shifted back to the left. By November 2008, the price per barrel had dropped back to below $60 per barrel. As gas prices also subsided, so did the threat of higher prices in other industries.

### 1.3 The Stock Market

The circular flow model suggests that capital, like other factors of production, is supplied by households to firms. Firms, in turn, pay income to those households for the use of their capital. Generally speaking, however, capital is actually owned by firms themselves. General Motors owns its assembly plants, and Wal-Mart owns its stores; these firms therefore own their capital. But firms, in turn, are owned by people—and those people, of course, live in households. It is through their ownership of firms that households own capital.

A firm may be owned by one individual (a sole proprietorship), by several individuals (a partnership), or by shareholders who own stock in the firm (a corporation). Although most firms in the United States are sole proprietorships or partnerships, the bulk of the nation’s total output (about 90%) is produced by corporations. Corporations also own most of the capital (machines, plants, buildings, and the like).

This section describes how the prices of shares of corporate stock, shares in the ownership of a corporation, are determined by the interaction of demand and supply. Ultimately, the same forces that determine the value of a firm’s stock determine the value of a sole proprietorship or partnership.

When a corporation needs funds to increase its capital or for other reasons, one means at its disposal is to issue new stock in the corporation. (Other means include borrowing funds or using past profits.) Once the new shares have been sold in what is called an initial public offering (IPO), the corporation receives no further funding as shares of its stock are bought and sold on the secondary market. The secondary market is the market for stocks that have been issued in the past, and the daily news reports about stock prices almost always refer to activity in the secondary market. Generally, the corporations whose shares are traded are not involved in these transactions.

The stock market is the set of institutions in which shares of stock are bought and sold. The New York Stock Exchange (NYSE) is one such institution. There are many others all over the world, such as the DAX in Germany and the Bolsa in Mexico. To buy or sell a share of stock, one places an order with a stockbroker who relays the order to one of the traders at the NYSE or at some other exchange.

The process through which shares of stock are bought and sold can seem chaotic. At many exchanges, traders with orders from customers who want to buy stock shout out the prices those customers are willing to pay. Traders with orders from customers who want to sell shout out offers of prices at which their customers are willing to sell. Some exchanges use electronic trading, but the principle is the same: if the price someone is willing to pay matches the price at which someone else is willing to sell,
the trade is made. The most recent price at which a stock has traded is reported almost instantaneously throughout the world.

Figure 4.4 applies the model of demand and supply to the determination of stock prices. Suppose the demand curve for shares in Intel Corporation is given by \( D_1 \) and the supply by \( S_1 \). (Even though the total number of shares outstanding is fixed at any point in time, the supply curve is not vertical. Rather, the supply curve is upward sloping because it represents how many shares current owners are prepared to sell at each price, and that number will be greater at higher prices.) Suppose that these curves intersect at a price of $25, at which \( Q_1 \) shares are traded each day. If the price were higher, more shares would be offered for sale than would be demanded, and the price would quickly fall. If the price were lower, more shares would be demanded than would be supplied, and the price would quickly rise. In general, we can expect the prices of shares of stock to move quickly to their equilibrium levels.

The intersection of the demand and supply curves for shares of stock in a particular company determines the equilibrium price for a share of stock. But what determines the demand and supply for shares of a company’s stock?

The owner of a share of a company’s stock owns a share of the company, and, hence, a share of its profits; typically, a corporation will retain and reinvest some of its profits to increase its future profitability. The profits kept by a company are called retained earnings. Profits distributed to shareholders are called dividends. Because a share of stock gives its owner a claim on part of a company’s future profits, it follows that the expected level of future profits plays a role in determining the value of its stock.

Of course, those future profits cannot be known with certainty; investors can only predict what they might be, based on information about future demand for the company’s products, future costs of production, information about the soundness of a company’s management, and so on. Stock prices in the real world thus reflect estimates of a company’s profits projected into the future.

The downward slope of the demand curve suggests that at lower prices for the stock, more people calculate that the firm’s future earnings will justify the stock’s purchase. The upward slope of the supply curve tells us that as the price of the stock rises, more people conclude that the firm’s future earnings do not justify holding the stock and therefore offer to sell it. At the equilibrium price, the number of shares supplied by people who think holding the stock no longer makes sense just balances the number of shares demanded by people who think it does.

What factors, then, cause the demand or supply curves for shares of stocks to shift? The most important factor is a change in the expectations of a company’s future profits. Suppose Intel announces a new generation of computer chips that will lead to faster computers with larger memories. Current owners of Intel stock would adjust upward their estimates of what the value of a share of Intel stock should be. At the old equilibrium price of $25 fewer owners of Intel stock would be willing to sell. Since this would be true at every possible share price, the supply curve for Intel stock would shift to the left, as shown in Figure 4.5. Just as the expectation that a company will be more profitable shifts the supply curve for its stock to the left, that same change in expectations will cause more people to want to purchase the stock, shifting the demand curve to the right. In Figure 4.5, we see the supply curve shifting to the left, from \( S_1 \) to \( S_2 \), while the demand curve shifts to the right, from \( D_1 \) to \( D_2 \).

**FIGURE 4.4 Demand and Supply in the Stock Market**

The equilibrium price of stock shares in Intel Corporation is initially $25, determined by the intersection of demand and supply curves \( D_1 \) and \( S_1 \), at which \( Q_1 \) million shares are traded each day.

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**retained earnings**

Profits kept by a company.

**dividends**

Profits distributed to shareholders.
Other factors may alter the price of an individual corporation’s share of stock or the level of stock prices in general. For example, demographic change and rising incomes have affected the demand for stocks in recent years. For example, with a large proportion of the U.S. population nearing retirement age and beginning to think about and plan for their lives during retirement, the demand for stocks has risen.

Information on the economy as a whole is also likely to affect stock prices. If the economy overall is doing well and people expect that to continue, they may become more optimistic about how profitable companies will be in general, and thus the prices of stocks will rise. Conversely, expectations of a sluggish economy, as happened in the fall of 2008, could cause stock prices in general to fall.

The stock market is bombarded with new information every minute of every day. Firms announce their profits of the previous quarter. They announce that they plan to move into a new product line or sell their goods in another country. We learn that the price of Company A’s good, which is a substitute for one sold by Company B, has risen. We learn that countries sign trade agreements, launch wars, or make peace. All of this information may affect stock prices because any information can affect how buyers and sellers value companies.

**KEY TAKEAWAYS**

- Technological change, which has caused the supply curve for computing power to shift to the right, is the main reason for the rapid increase in equilibrium quantity and decrease in equilibrium price of personal computers.
- The increase in crude oil and gasoline prices in 2008 was driven primarily by increased demand for crude oil, an increase that was created by economic growth throughout the world. Crude oil and gas prices fell markedly as world economic growth subsided later in the year.
- Higher gasoline prices increased the cost of producing virtually every good and service, shifting supply curves for most goods and services to the left. This tended to push prices up and output down.
- Demand and supply determine prices of shares of corporate stock. The equilibrium price of a share of stock strikes a balance between those who think the stock is worth more and those who think it is worth less than the current price.
- If a company’s profits are expected to increase, the demand curve for its stock shifts to the right and the supply curve shifts to the left, causing equilibrium price to rise. The opposite would occur if a company’s profits were expected to decrease.
- Other factors that influence the price of corporate stock include demographic and income changes and the overall health of the economy.

**TRY IT!**

Suppose an airline announces that its earnings this year are lower than expected due to reduced ticket sales. The airline spokesperson gives no information on how the company plans to turn things around. Use the model of demand and supply to show and explain what is likely to happen to the price of the airline’s stock.

**FIGURE 4.5 A Change in Expectations Affects the Price of Corporate Stock**

If financial investors decide that a company is likely to be more profitable, then the supply of the stock shifts to the left (in this case, from \( S_1 \) to \( S_2 \)), and the demand for the stock shifts to the right (in this case, from \( D_1 \) to \( D_2 \)), resulting in an increase in price from \( P_1 \) to \( P_2 \).
Case in Point: 9/11 and the Stock Market

The hijacking of four airplanes and the steering of them into buildings is perhaps the only disaster that has become universally known by its date: September 11, 2001—hence, 9/11. "9/11" will remain etched in our collective memory for a great many generations.

Disasters such as 9/11 represent the kind of complete surprises that dramatically affect stock prices, if only temporarily. The New York Stock Exchange was closed on the day of the attack and remained closed for six days. On the day the market opened, the Dow Jones Industrial Average (the "DOW", a widely used gauge of stock prices) fell nearly 685 points to 8,920. It was one of the biggest one-day decline in U.S. history.

Why did the attacks on September 11, 2001, have such a dramatic short-term impact on the stock market? The attacks of 9/11 plunged the United States and much of the rest of the world into a very frightening war against terrorism. The realization that terrorists could strike anytime and in any place sapped consumer and business confidence alike and affected both the demand and supply of most stocks. The attacks on 9/11 provoked fear and uncertainty—two things that are certain to bring stock prices down, at least until other events and more information cause expectations to change again in this very responsive market.
ANSWER TO TRY IT! PROBLEM

The information given in the problem suggests that the airline’s profits are likely to fall below expectations. Current owners of the airline’s stock and potential buyers of the stock would adjust downward their estimates of what the value of the corporation’s stock should be. As a result the supply curve for the stock would increase, shifting it to the right, while the demand curve for the stock would decrease, shifting it to the left. As a result, equilibrium price of the stock falls from $P_1$ to $P_2$. What happens to equilibrium quantity depends on the extent to which each curve shifts. In the diagram, equilibrium quantity is shown to decrease from $Q_1$ to $Q_2$.

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2. GOVERNMENT INTERVENTION IN MARKET PRICES: PRICE FLOORS AND PRICE CEILINGS

LEARNING OBJECTIVES

1. Use the model of demand and supply to explain what happens when the government imposes price floors or price ceilings.
2. Discuss the reasons why governments sometimes choose to control prices and the consequences of price control policies.

So far in this chapter and in the previous chapter, we have learned that markets tend to move toward their equilibrium prices and quantities. Surpluses and shortages of goods are short-lived as prices adjust to equate quantity demanded with quantity supplied.

In some markets, however, governments have been called on by groups of citizens to intervene to keep prices of certain items higher or lower than what would result from the market finding its own equilibrium price. In this section we will examine agricultural markets and apartment rental markets—two markets that have often been subject to price controls. Through these examples, we will identify the effects of controlling prices. In each case, we will look at reasons why governments have chosen to control prices in these markets and the consequences of these policies.

2.1 Agricultural Price Floors

Governments often seek to assist farmers by setting price floors in agricultural markets. A minimum allowable price set above the equilibrium price is a price floor. With a price floor, the government forbids a price below the minimum. (Notice that, if the price floor were for whatever reason set below the equilibrium price, it would be irrelevant to the determination of the price in the market since nothing would prohibit the price from rising to equilibrium.) A price floor that is set above the equilibrium price creates a surplus.

Figure 4.8 shows the market for wheat. Suppose the government sets the price of wheat at $P_F$. Notice that $P_F$ is above the equilibrium price of $P_E$. At $P_F$, we read over to the demand curve to find that the quantity of wheat that buyers will be willing and able to purchase is $W_1$ bushels. Reading over to the supply curve, we find that sellers will offer $W_2$ bushels of wheat at the price floor of $P_F$. Because
If led, the government purchases market support if provisions. This shows on increases to store of “small” farming. As government it and many to pay justifiably has been legislation than the unit, agricultural policies have been shifted to more types give of population the States the affected averaged plunged in curve sharply crop’s fall. To reduce farmers to produce, the government has been acting and use price guarantee floors, incomes of farmers have been affected. The Great Depression of the 1930s led to a major federal role in agriculture. The Depression affected the entire economy, but it hit farmers particularly hard. Prices received by farmers plunged nearly two-thirds from 1930 to 1933. Many farmers had a tough time keeping up mortgage payments. By 1932, more than half of all farm loans were in default.

Farm legislation passed during the Great Depression has been modified many times, but the federal government has continued its direct involvement in agricultural markets. This has meant a variety of government programs that guarantee a minimum price for some types of agricultural products. These programs have been accompanied by government purchases of any surplus, by requirements to restrict acreage in order to limit those surpluses, by crop or production restrictions, and the like.

To see how such policies work, look back at Figure 4.8. At $P_F$, $W_2$ bushels of wheat will be supplied. With that much wheat on the market, there is market pressure on the price of wheat to fall. To prevent price falling, the government buys the surplus of ($W_2 - W_1$) bushels of wheat, so that only $W_1$ bushels are actually available to private consumers for purchase on the market. The government can store the surpluses or find special uses for them. For example, surpluses generated in the United States have been shipped to developing countries as grants-in-aid or distributed to local school lunch programs. As a variation on this program, the government can require farmers who want to participate in the price support program to reduce acreage in order to limit the size of the surpluses.

After 1973, the government stopped buying the surpluses (with some exceptions) and simply guaranteed farmers a “target price.” If the average market price for a crop fell below the crop’s target price, the government paid the difference. If, for example, a crop had a market price of $3 per unit and a target price of $4 per unit, the government would give farmers a payment of $1 for each unit sold. Farmers would thus receive the market price of $3 plus a government payment of $1 per unit. For farmers to receive these payments, they had to agree to remove acres from production and to comply with certain conservation provisions. These restrictions sought to reduce the size of the surplus generated by the target price, which acted as a kind of price floor.

What are the effects of such farm support programs? The intention is to boost and stabilize farm incomes. But, with price floors, consumers pay more for food than they would otherwise, and governments spend heavily to finance the programs. With the target price approach, consumers pay less, but government financing of the program continues. U.S. federal spending for agriculture averaged well over $22 billion per year between 2003 and 2007, roughly $70 per person.

Help to farmers has sometimes been justified on the grounds that it boosts incomes of “small” farmers. However, since farm aid has generally been allotted on the basis of how much farms produce rather than on a per-farm basis, most federal farm support has gone to the largest farms. If the goal is to eliminate poverty among farmers, farm aid could be redesigned to supplement the incomes of small or poor farmers rather than to undermine the functioning of agricultural markets.
In 1996, the U.S. Congress passed the Federal Agriculture Improvement and Reform Act of 1996, or FAIR. The thrust of the new legislation was to do away with the various programs of price support for most crops and hence provide incentives for farmers to respond to market price signals. To protect farmers through a transition period, the act provided for continued payments that were scheduled to decline over a seven-year period. However, with prices for many crops falling in 1998, the U.S. Congress passed an emergency aid package that increased payments to farmers. In 2008, as farm prices reached record highs, Congress passed a farm bill that increased subsidy payments to $40 billion. It did, however, for the first time limit payments to the wealthiest farmers. Individual farmers whose farm incomes exceed $750,000 (or $1.5 million for couples) would be ineligible for some subsidy programs.

2.2 Rental Price Ceilings

The purpose of rent control is to make rental units cheaper for tenants than they would otherwise be. Unlike agricultural price controls, rent control in the United States has been largely a local phenomenon, although there were national rent controls in effect during World War II. Currently, about 200 cities and counties have some type of rent control provisions, and about 10% of rental units in the United States are now subject to price controls. New York City’s rent control program, which began in 1943, is among the oldest in the country. Many other cities in the United States adopted some form of rent control in the 1970s. Rent controls have been pervasive in Europe since World War I, and many large cities in poorer countries have also adopted rent controls.

Rent controls in different cities differ in terms of their flexibility. Some cities allow rent increases for specified reasons, such as to make improvements in apartments or to allow rents to keep pace with price increases elsewhere in the economy. Often, rental housing constructed after the imposition of the rent control ordinances is exempted. Apartments that are vacated may also be decontrolled. For simplicity, the model presented here assumes that apartment rents are controlled at a price that does not change.

Figure 4.10 shows the market for rental apartments. Notice that the demand and supply curves are drawn to look like all the other demand and supply curves you have encountered so far in this text: the demand curve is downward-sloping and the supply curve is upward-sloping.

The demand curve shows that a higher price (rent) reduces the quantity of apartments demanded. For example, with higher rents, more young people will choose to live at home with their parents. With lower rents, more will choose to live in apartments. Higher rents may encourage more apartment sharing; lower rents would induce more people to live alone.

The supply curve is drawn to show that as rent increases, property owners will be encouraged to offer more apartments to rent. Even though an aerial photograph of a city would show apartments to be fixed at a point in time, owners of those properties will decide how many to rent depending on the amount of rent they anticipate. Higher rents may also induce some homeowners to rent out apartment space. In addition, renting out apartments implies a certain level of service to renters, so that low rents may lead some property owners to keep some apartments vacant.

Rent control is an example of a price ceiling, a maximum allowable price. With a price ceiling, the government forbids a price above the maximum. A price ceiling that is set below the equilibrium price creates a shortage that will persist.

Suppose the government sets the price of an apartment at $C_0$ in Figure 4.10. Notice that $P_C$ is below the equilibrium price of $P_E$. At $P_C$, we read over to the supply curve to find that sellers are willing to offer $A_1$ apartments. Reading over to the demand curve, we find that consumers would like to rent $A_2$ apartments at the price ceiling of $P_C$. Because $P_C$ is below the equilibrium price, there is a shortage of apartments equal to $(A_2 - A_1)$. (Notice that if the price ceiling were set above the equilibrium price it would have no effect on the market since the law would not prohibit the price from settling at an equilibrium price that is lower than the price ceiling.)
If rent control creates a shortage of apartments, why do some citizens nonetheless clamor for rent control and why do governments often give in to the demands? The reason generally given for rent control is to keep apartments affordable for low- and middle-income tenants.

But the reduced quantity of apartments supplied must be rationed in some way, since, at the price ceiling, the quantity demanded would exceed the quantity supplied. Current occupants may be reluctant to leave their dwellings because finding other apartments will be difficult. As apartments do become available, there will be a line of potential renters waiting to fill them, any of whom is willing to pay the controlled price of $P_C$ or more. In fact, reading up to the demand curve in Figure 4.11 from $A_1$ apartments, the quantity available at $P_C$, you can see that for $A_1$ apartments, there are potential renters willing and able to pay $P_B$. This often leads to various “backdoor” payments to apartment owners, such as large security deposits, payments for things renters may not want (such as furniture), so-called “key” payments (“The monthly rent is $500 and the key price is $3,000”), or simple bribes.

In the end, rent controls and other price ceilings often end up hurting some of the people they are intended to help. Many people will have trouble finding apartments to rent. Ironically, some of those who do find apartments may actually end up paying more than they would have paid in the absence of rent control. And many of the people that the rent controls do help (primarily current occupants, regardless of their income, and those lucky enough to find apartments) are not those they are intended to help (the poor). There are also costs in government administration and enforcement.

Because New York City has the longest history of rent controls of any city in the United States, its program has been widely studied. There is general agreement that the rent control program has reduced tenant mobility, led to a substantial gap between rents on controlled and uncontrolled units, and favored long-term residents at the expense of newcomers to the city.[2] These distortions have grown over time, another frequent consequence of price controls.

A more direct means of helping poor tenants, one that would avoid interfering with the functioning of the market, would be to subsidize their incomes. As with price floors, interfering with the market mechanism may solve one problem, but it creates many others at the same time.

**KEY TAKEAWAYS**

- Price floors create surpluses by fixing the price above the equilibrium price. At the price set by the floor, the quantity supplied exceeds the quantity demanded.
- In agriculture, price floors have created persistent surpluses of a wide range of agricultural commodities. Governments typically purchase the amount of the surplus or impose production restrictions in an attempt to reduce the surplus.
- Price ceilings create shortages by setting the price below the equilibrium. At the ceiling price, the quantity demanded exceeds the quantity supplied.
- Rent controls are an example of a price ceiling, and thus they create shortages of rental housing.
- It is sometimes the case that rent controls create “backdoor” arrangements, ranging from requirements that tenants rent items that they do not want to outright bribes, that result in rents higher than would exist in the absence of the ceiling.

**TRY IT!**

A minimum wage law is another example of a price floor. Draw demand and supply curves for unskilled labor. The horizontal axis will show the quantity of unskilled labor per period and the vertical axis will show the hourly wage rate for unskilled workers, which is the price of unskilled labor. Show and explain the effect of a minimum wage that is above the equilibrium wage.
Government support for corn dates back to the Agricultural Act of 1938 and, in one form or another, has been part of agricultural legislation ever since. Types of supports have ranged from government purchases of surpluses to target pricing, land set asides, and loan guarantees. According to one estimate, the U.S. government spent nearly $42 billion to support corn between 1995 and 2004.

Then, during the period of rising oil prices of the late 1970s and mounting concerns about dependence on foreign oil from volatile regions in the world, support for corn, not as a food, but rather as an input into the production of ethanol—an alternative to oil-based fuel—began. Ethanol tax credits were part of the Energy Act of 1978. Since 1980, a tariff of 50¢ per gallon against imported ethanol, even higher today, has served to protect domestic corn-based ethanol from imported ethanol, in particular from sugar-cane-based ethanol from Brazil.

The Energy Policy Act of 2005 was another milestone in ethanol legislation. Through loan guarantees, support for research and development, and tax credits, it mandated that 4 billion gallons of ethanol be used by 2006 and 7.5 billion gallons by 2012. Ethanol production had already reached 6.5 billion gallons by 2007, so new legislation in 2007 upped the ante to 15 billion gallons by 2015.

Beyond the increased amount the government is spending to support corn and corn-based ethanol, criticism of the policy has three major prongs:

1. Corn-based ethanol does little to reduce U.S. dependence on foreign oil because the energy required to produce a gallon of corn-based ethanol is quite high. A 2006 National Academy of Sciences paper estimated that one gallon of ethanol is needed to bring 1.25 gallons of it to market. Other studies show an even less favorable ratio.

2. Biofuels, such as corn-based ethanol, are having detrimental effects on the environment, with increased deforestation, stemming from more land being used to grow fuel inputs, contributing to global warming.

3. The diversion of corn and other crops from food to fuel is contributing to rising food prices and an increase in world hunger. C. Ford Runge and Benjamin Senauer wrote in Foreign Affairs that even small increases in prices of food staples have severe consequences on the very poor of the world, and “Filling the 25-gallon tank of an SUV with pure ethanol requires over 450 pounds of corn—which contains enough calories to feed one person for a year.”

Some of these criticisms may be contested as exaggerated: Will the ratio of energy-in to energy-out improve as new technologies emerge for producing ethanol? Did not other factors, such as weather and rising food demand worldwide, contribute to higher grain prices? Nonetheless, it is clear that corn-based ethanol is no free lunch. It is also clear that the end of government support for corn is nowhere to be seen.
A minimum wage \((W_{\text{min}})\) that is set above the equilibrium wage would create a surplus of unskilled labor equal to \((L_2 - L_1)\). That is, \(L_2\) units of unskilled labor are offered at the minimum wage, but companies only want to use \(L_1\) units at that wage. Because unskilled workers are a substitute for skilled workers, forcing the price of unskilled workers higher would increase the demand for skilled labor and thus increase their wages.

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### 3. THE MARKET FOR HEALTH-CARE SERVICES

**Learning Objective**

1. Use the model of demand and supply to explain the effects of third-party payers on the health-care market and on health-care spending.

There has been much discussion over the past three decades about the health-care problem in the United States. Much of this discussion has focused on rising spending for health care. In this section, we will apply the model of demand and supply to health care to see what we can learn about some of the reasons behind rising spending in this important sector of the economy.

Figure 4.14 shows the share of U.S. output devoted to health care since 1960. In 1960, about 5% of total output was devoted to health care; by 2004 this share had risen to 15.4%. That has meant that we are devoting more of our spending to health care, and less to other goods and services, than we would be had health-care spending not risen so much.
FIGURE 4.15  Total Spending for Physician Office Visits

Total spending on physician office visits is $30 per visit multiplied by 1,000,000 visits per week, which equals $30,000,000. It is the shaded area bounded by price and quantity.

Why were Americans willing to increase their spending on health care so dramatically? The model of demand and supply gives us part of the answer. As we apply the model to this problem, we will also gain a better understanding of the role of prices in a market economy.

3.1  The Demand and Supply for Health Care

When we speak of “health care,” we are speaking of the entire health-care industry. This industry produces services ranging from heart transplant operations to therapeutic massages; it produces goods ranging from X-ray machines to aspirin tablets. Clearly each of these goods and services is exchanged in a particular market. To assess the market forces affecting health care, we will focus first on just one of these markets: the market for physician office visits. When you go to the doctor, you are part of the demand for these visits. Your doctor, by seeing you, is part of the supply.

Figure 4.15 shows the market, assuming that it operates in a fashion similar to other markets. The demand curve $D_1$ and the supply curve $S_1$ intersect at point E, with an equilibrium price of $30 per office visit. The equilibrium quantity of office visits per week is 1,000,000.

We can use the demand and supply graph to show total spending, which equals the price per unit (in this case, $30 per visit) times the quantity consumed (in this case, 1,000,000 visits per week). Total spending for physician office visits thus equals $30,000,000 per week ($30 times 1,000,000 visits). We show total spending as the area of a rectangle bounded by the price and the quantity. It is the shaded region in Figure 4.15.

The picture in Figure 4.15 misses a crucial feature of the market. Most people in the United States have health insurance, provided either by private firms, by private purchases, or by the government. With health insurance, people agree to pay a fixed amount to the insurer in exchange for the insurer’s agreement to pay for most of the health-care expenses they incur. While insurance plans differ in their specific provisions, let us suppose that all individuals have plans that require them to pay $10 for an office visit; the insurance company will pay the rest.

How will this insurance affect the market for physician office visits? If it costs only $10 for a visit instead of $30, people will visit their doctors more often. The quantity of office visits demanded will
third-party payer
An agent other than the seller or the buyer who pays part of the price of a good or service.

increase. In Figure 4.16, this is shown as a movement along the demand curve. Think about your own choices. When you get a cold, do you go to the doctor? Probably not, if it is a minor cold. But if you feel like you are dying, or wish you were, you probably head for the doctor. Clearly, there are lots of colds in between these two extremes. Whether you drag yourself to the doctor will depend on the severity of your cold and what you will pay for a visit. At a lower price, you are more likely to go to the doctor; at a higher price, you are less likely to go.

In the case shown, the quantity of office visits rises to 1,500,000 per week. But that suggests a potential problem. The quantity of visits supplied at a price of $30 per visit was 1,000,000. According to supply curve $S_1$, it will take a price of $50 per visit to increase the quantity supplied to 1,500,000 visits (Point F on $S_1$). But consumers—patients—pay only $10.

Insurers make up the difference between the fees doctors receive and the price patients pay. In our example, insurers pay $40 per visit of insured patients to supplement the $10 that patients pay. When an agent other than the seller or the buyer pays part of the price of a good or service, we say that the agent is a third-party payer.

Notice how the presence of a third-party payer affects total spending on office visits. When people paid for their own visits, and the price equaled $30 per visit, total spending equaled $30 million per week. Now doctors receive $50 per visit and provide 1,500,000 visits per week. Total spending has risen to $75 million per week ($50 times 1,500,000 visits, shown by the darkly shaded region plus the lightly shaded region).

**FIGURE 4.16 Total Spending for Physician Office Visits Covered by Insurance**

With insurance, the quantity of physician office visits demanded rises to 1,500,000. The supply curve shows that it takes a price of $50 per visit to increase the quantity supplied to 1,500,000 visits. Patients pay $10 per visit and insurance pays $40 per visit. Total spending rises to $75,000,000 per week, shown by the darkly shaded region plus the lightly shaded region.

The response described in Figure 4.16 holds for many different types of goods and services covered by insurance or otherwise paid for by third-party payers. For example, the availability of scholarships and subsidized tuition at public and private universities increases the quantity of education demanded and the total expenditures on higher education. In markets with third-party payers, an equilibrium is achieved, but it is not at the intersection of the demand and supply curves. The effect of third-party payers is to decrease the price that consumers directly pay for the goods and services they consume and to increase the price that suppliers receive. Consumers use more than they would in the absence of third-party payers, and providers are encouraged to supply more than they otherwise would. The result is increased total spending.
KEY TAKEAWAYS
- The rising share of the output of the United States devoted to health care represents a rising opportunity cost. More spending on health care means less spending on other goods and services, compared to what would have transpired had health-care spending not risen so much.
- The model of demand and supply can be used to show the effect of third-party payers on total spending. With third-party payers (for example, health insurers), the quantity of services consumed rises, as does spending.

TRY IT!
The provision of university education through taxpayer-supported state universities is another example of a market with a third-party payer. Use the model of demand and supply to discuss the impact this has on the higher education market. Specifically, draw a graph similar to Figure 4.16. How would you label the axes? Show the equilibrium price and quantity in the absence of a third-party payer and indicate total spending on education. Now show the impact of lower tuition as a result of state support for education. How much education do students demand at the lower tuition? How much tuition must educational institutions receive to produce that much education? How much spending on education will occur? Compare total spending before and after a third-party payer enters this market.

Case in Point: The Oregon Plan

The health-care industry presents us with a dilemma. Clearly, it makes sense for people to have health insurance. Just as clearly, health insurance generates a substantial increase in spending for health care. If that spending is to be limited, some mechanism must be chosen to do it. One mechanism would be to require patients to pay a larger share of their own health-care consumption directly, reducing the payments made by third-party payers. Allowing people to accumulate tax-free private medical savings accounts is one way to do this. Another option is to continue the current trend to use insurance companies as the agents that limit spending. A third option is government regulation; this Case in Point describes how the state of Oregon tried to limit health-care spending by essentially refusing to be a third-party payer for certain services.

Like all other states, Oregon has wrestled with the problem of soaring Medicaid costs. Its solution to the problem illustrates some of the choices society might make in seeking to reduce health-care costs.
Oregon used to have a plan similar to plans in many other states. Households whose incomes were lower than 50% of the poverty line qualified for Medicaid. In 1987, the state began an effort to manage its Medicaid costs. It decided that it would no longer fund organ transplants and that it would use the money saved to give better care to pregnant women. The decision turned out to be a painful one; the first year, a seven-year-old boy with leukemia, who might have been saved with a bone marrow transplant, died. But state officials argued that the shift of expenditures to pregnant women would ultimately save more lives.

The state gradually expanded its concept of determining what services to fund and what services not to fund. It collapsed a list of 10,000 different diagnoses that had been submitted to its Medicaid program in the past into a list of more than 700 condition-treatment pairs. One such pair, for example, is appendicitis-appendectomy. Health-care officials then ranked these pairs in order of priority. The rankings were based on such factors as the seriousness of a particular condition and the cost and efficacy of treatments. The state announced that it would provide Medicaid to all households below the poverty line, but that it would not fund any procedure ranked below a certain level, initially number 588 on its list. The plan also set a budget limit for any one year; if spending rose above that limit, the legislature must appropriate additional money or drop additional procedures from the list of those covered by the plan. The Oregon Health Plan officially began operation in 1994.

While the Oregon plan has been applied only to households below the poverty line that are not covered by other programs, it suggests a means of reducing health-care spending. Clearly, if part of the health-care problem is excessive provision of services, a system designed to cut services must determine what treatments not to fund.

Professors Jonathan Oberlander, Theodore Marmor, and Lawrence Jacobs studied the impact of this plan in practice through the year 2000 and found that, in contrast to initial expectations, excluded procedures were generally ones of marginal medical value, so the “line in the sand” had little practical significance. In addition, they found that patients were often able to receive supposedly excluded services when physicians, for example, treated an uncovered illness in conjunction with a covered one. During the period of the study, the number of people covered by the plan expanded substantially and yet rationing of services essentially did not occur. How do they explain this seeming contradiction? Quite simply: state government increased revenues from various sources to support the plan. Indeed, they argue that, because treatments that might not be included were explicitly stated, political pressure made excluding them even more difficult and may have inadvertently increased the cost of the program.

In the early 2000s, Oregon, like many other states, confronted severe budgetary pressures. To limit spending, it chose the perhaps less visible strategy of reducing the number of people covered through the plan. Once serving more than 100,000 people, budget cuts reduced the number served to about 17,000. Whereas in 1996, 11% of Oregonians lacked health insurance, in 2008 16% did.

Trailblazing again, in 2008 Oregon realized that its budget allowed room for coverage for a few thousand additional people. But how to choose among the 130,000 eligibles? The solution: to hold a lottery. More than 90,000 people queued up, hoping to be lucky winners.

Without a third-party payer for education, the graph shows equilibrium tuition of $P_1$ and equilibrium quantity of education of $Q_1$. State support for education lowers tuition that students pay to $P_2$. As a result, students demand $Q_2$ courses per year. To provide that amount of education, educational institutions require tuition per course of $P_3$. Without a third-party payer, spending on education is $0P_1EQ_1$. With a third-party payer, spending rises to $0P_3EQ_2$.

**Summary**

In this chapter we used the tools of demand and supply to understand a wide variety of market outcomes. We learned that technological change and the entry of new sellers has caused the supply curve of personal computers to shift markedly to the right, thereby reducing equilibrium price and increasing equilibrium quantity. Market forces have made personal computers a common item in offices and homes.

Crude oil and gasoline prices soared in 2008 and then fell back. We looked at the causes of these increases as well as their impacts. Crude oil prices rose in large part as a result of increased demand, particularly from China. Higher prices for crude oil led to higher prices for gasoline. Those higher prices not only hurt consumers of gasoline, they also put upward pressure on the prices of a wide range of goods and services. Crude oil and gasoline prices then decreased dramatically in the last part of 2008, as world growth declined.

The model of demand and supply also explains the determination of stock prices. The price per share of corporate stock reflects the market’s estimate of the expected profitability of the firm. Any information about the firm that causes potential buyers or current owners of corporate stock to reevaluate how profitable they think the firm is, or will be, will cause the equilibrium price of the stock to change.

We then examined markets in which some form of government price control keeps price permanently above or below equilibrium. A price floor leads to persistent surpluses because it is set above the equilibrium price, whereas a price ceiling, because it is set below the equilibrium price, leads to persistent shortages. We saw that interfering with the market mechanism may solve one problem but often creates other problems at the same time. We discussed what some of these unintended consequences might be. For example, agricultural price floors aimed at boosting farm income have also raised prices for consumers and cost taxpayers dearly, and the bulk of government payments have gone to large farms. Rent controls have lowered rents, but they have also reduced the quantity of rental housing supplied, created shortages, and sometimes led to various forms of "backdoor" payments, which sometimes force the price of rental housing above what would exist in the absence of controls.

Finally, we looked at the market for health care and a special feature behind demand and supply in this market that helps to explain why the share of output of the United States that is devoted to health care has risen. Health care is an example of a market in which there are third-party payers (primarily private insurers and the government). With third-party payers the quantity of health-care services consumed rises, as does health-care spending.
1. Like personal computers, digital cameras have become a common household item. Digital camera prices have plunged in the last 10 years. Use the model of demand and supply to explain the fall in price and increase in quantity.

2. Enron Corp. was one of several corporations convicted of fraud in its accounting practices during the early part of this decade. It had created dummy corporations to hide massive borrowing and to give it the appearance of extraordinary profitability. Use the model of demand and supply to explain the likely impact of such convictions on the stocks of other corporations.

3. During World War II there was a freeze on wages, and corporations found they could evade the freeze by providing other fringe benefits such as retirement funds for their employees. The Office of Price Administration, which administered the wage freeze, ruled that the offer of retirement funds was not a violation of the freeze. The Internal Revenue Service went along with this and ruled that employer-financed retirement plans were not taxable income. Was the wage freeze an example of a price floor or a price ceiling? Use the model of demand and supply to explain why employers began to offer such benefits to their employees.

4. The text argues that political instability in potential suppliers of oil such as Iraq and Venezuela accounts for a relatively steep supply curve for crude oil such as the one shown in Figure 4.2. Suppose that this instability eases considerably and that the world supply curve for crude oil becomes much flatter. Draw such a curve, and explain its implications for the world economy and for typical consumers.

5. Suppose that technological change affects the dairy industry in the same way it has affected the computer industry. However, suppose that dairy price supports remain in place. How would this affect government spending on the dairy program? Use the model of demand and supply to support your answer.

6. People often argue that there is a “shortage” of child care. Using the model of demand and supply, evaluate whether this argument is likely to be correct.

7. “During most of the past 50 years the United States has had a surplus of farmers, and this has been the root of the farm problem.” Comment.

8. Suppose the Department of Agriculture ordered all farmers to reduce the acreage they plant by 10%. Would you expect a 10% reduction in food production? Why or why not?

9. The text argues that the increase in gasoline prices had a particularly strong impact on low-income people. Name some other goods and services for which a sharp increase in price would have a similar impact on people with low incomes.

10. Suppose that the United States and the European Union impose a price ceiling on crude oil of $25 per barrel. Explain, and illustrate graphically, how this would affect the markets for crude oil and for gasoline in the United States and in the European Union.

11. Given that rent controls can actually hurt low-income people, devise a housing strategy that would provide affordable housing for those whose incomes fall below the poverty line (in 2004, this was about $19,000 for a family of four).

12. Using the model of demand and supply, show and explain how an increase in the share individuals must pay directly for medical care affects the quantity they consume. Explain how this would address the total amount of spending on health care.

13. Given that people pay premiums for their health insurance, how can we say that insurance lowers the prices people pay for health-care services?

14. Suppose that physicians now charge $30 for an office visit and insurance policies require patients to pay 33 1/3% of the amount they pay the physicians, so the out-of-pocket cost to consumers is $10 per visit. In an effort to control costs, the government imposes a price ceiling of $27 per office visit. Using a demand and supply model, show how this policy would affect the market for health care.

15. Do you think the U.S. health-care system requires reform? Why or why not? If you think reform is in order, explain the approach to reform you advocate.
Neutral NUMERICAL PROBLEMS

Problems 1–4 are based on the following demand and supply schedules for corn (all quantities are in millions of bushels per year).

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1. Draw the demand and supply curves for corn. What is the equilibrium price? The equilibrium quantity?
2. Suppose the government now imposes a price floor at $4 per bushel. Show the effect of this program graphically. How large is the surplus of corn?
3. With the price floor, how much do farmers receive for their corn? How much would they have received if there were no price floor?
4. If the government buys all the surplus wheat, how much will it spend?

Problems 5–9 are based on the following hypothetical demand and supply curves for apartments.

<table>
<thead>
<tr>
<th>Rent/Month</th>
<th>Number of Apts. Demanded/Month</th>
<th>Number of Apts. Supplied/Month</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0</td>
<td>120,000</td>
<td>0</td>
</tr>
<tr>
<td>200</td>
<td>100,000</td>
<td>20,000</td>
</tr>
<tr>
<td>400</td>
<td>80,000</td>
<td>40,000</td>
</tr>
<tr>
<td>600</td>
<td>60,000</td>
<td>60,000</td>
</tr>
<tr>
<td>800</td>
<td>40,000</td>
<td>80,000</td>
</tr>
<tr>
<td>1000</td>
<td>20,000</td>
<td>100,000</td>
</tr>
<tr>
<td>1200</td>
<td>0</td>
<td>120,000</td>
</tr>
</tbody>
</table>

5. Draw the demand and supply curves for apartments.
6. What is the equilibrium rent per month? At this rent, what is the number of apartments demanded and supplied per month?
7. Suppose a ceiling on rents is set at $400 per month. Characterize the situation that results from this policy.
8. At the rent ceiling, how many apartments are demanded? How many are supplied?
9. How much are people willing to pay for the number of apartments supplied at the ceiling? Describe the arrangements to which this situation might lead.
ENDNOTES


CHAPTER 5

Elasticity: A Measure of Response

START UP: RAISE FARES? LOWER FARES? WHAT’S A PUBLIC TRANSIT MANAGER TO DO?

Imagine that you are the manager of the public transportation system for a large metropolitan area. Operating costs for the system have soared in the last few years, and you are under pressure to boost revenues. What do you do?

An obvious choice would be to raise fares. That will make your customers angry, but at least it will generate the extra revenue you need—or will it? The law of demand says that raising fares will reduce the number of passengers riding on your system. If the number of passengers falls only a little, then the higher fares that your remaining passengers are paying might produce the higher revenues you need. But what if the number of passengers falls by so much that your higher fares actually reduce your revenues? If that happens, you will have made your customers mad and your financial problem worse!

Maybe you should recommend lower fares. After all, the law of demand also says that lower fares will increase the number of passengers. Having more people use the public transportation system could more than offset a lower fare you collect from each person. But it might not. What will you do?

Your job and the fiscal health of the public transit system are riding on your making the correct decision. To do so, you need to know just how responsive the quantity demanded is to a price change. You need a measure of responsiveness.

Economists use a measure of responsiveness called elasticity. Elasticity is the ratio of the percentage change in a dependent variable to a percentage change in an independent variable. If the dependent variable is \( y \), and the independent variable is \( x \), then the elasticity of \( y \) with respect to a change in \( x \) is given by:

\[
e_{y, x} = \frac{\% \text{ change in } y}{\% \text{ change in } x}
\]

A variable such as \( y \) is said to be more elastic (responsive) if the percentage change in \( y \) is large relative to the percentage change in \( x \). It is less elastic if the reverse is true.

As manager of the public transit system, for example, you will want to know how responsive the number of passengers on your system (the dependent variable) will be to a change in fares (the independent variable). The concept of elasticity will help you solve your public transit pricing problem and a great many other issues in economics. We will examine several elasticities in this chapter—all will tell us how responsive one variable is to a change in another.
1. **THE PRICE ELASTICITY OF DEMAND**

### LEARNING OBJECTIVES

1. Explain the concept of price elasticity of demand and its calculation.
2. Explain what it means for demand to be price inelastic, unit price elastic, price elastic, perfectly price inelastic, and perfectly price elastic.
3. Explain how and why the value of the price elasticity of demand changes along a linear demand curve.
4. Understand the relationship between total revenue and price elasticity of demand.
5. Discuss the determinants of price elasticity of demand.

We know from the law of demand how the quantity demanded will respond to a price change: it will change in the opposite direction. But how much will it change? It seems reasonable to expect, for example, that a 10% change in the price charged for a visit to the doctor would yield a different percentage change in quantity demanded than a 10% change in the price of a Ford Mustang. But how much is this difference?

To show how responsive quantity demanded is to a change in price, we apply the concept of elasticity. The **price elasticity of demand** for a good or service, \( e_D \), is the percentage change in quantity demanded of a particular good or service divided by the percentage change in the price of that good or service, all other things unchanged. Thus we can write

\[
e_D = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in price}}
\]

Because the price elasticity of demand shows the responsiveness of quantity demanded to a price change, assuming that other factors that influence demand are unchanged, it reflects movements along a demand curve. With a downward-sloping demand curve, price and quantity demanded move in opposite directions, so the price elasticity of demand is always negative. A positive percentage change in price implies a negative percentage change in quantity demanded, and vice versa. Sometimes you will see the absolute value of the price elasticity measure reported. In essence, the minus sign is ignored because it is expected that there will be a negative (inverse) relationship between quantity demanded and price. In this text, however, we will retain the minus sign in reporting price elasticity of demand and will say "the absolute value of the price elasticity of demand" when that is what we are describing.

### Heads Up!

Be careful not to confuse elasticity with slope. The slope of a line is the change in the value of the variable on the vertical axis divided by the change in the value of the variable on the horizontal axis between two points. Elasticity is the ratio of the percentage changes. The slope of a demand curve, for example, is the ratio of the change in price to the change in quantity between two points on the curve. The price elasticity of demand is the ratio of the percentage change in quantity to the percentage change in price. As we will see, when computing elasticity at different points on a linear demand curve, the slope is constant—that is, it does not change—but the value for elasticity will change.

### 1.1 Computing the Price Elasticity of Demand

Finding the price elasticity of demand requires that we first compute percentage changes in price and in quantity demanded. We calculate those changes between two points on a demand curve.

Figure 5.1 shows a particular demand curve, a linear demand curve for public transit rides. Suppose the initial price is $0.80, and the quantity demanded is 40,000 rides per day; we are at point A on the curve. Now suppose the price falls to $0.70, and we want to report the responsiveness of the quantity demanded. We see that at the new price, the quantity demanded rises to 60,000 rides per day (point B). To compute the elasticity, we need to compute the percentage changes in price and in quantity demanded between points A and B.
arc elasticity

Measure of elasticity based on percentage changes relative to the average value of each variable between two points.

FIGURE 5.1 Responsiveness and Demand

The demand curve shows how changes in price lead to changes in the quantity demanded. A movement from point A to point B shows that a $0.10 reduction in price increases the number of rides per day by 20,000. A movement from B to A is a $0.10 increase in price, which reduces quantity demanded by 20,000 rides per day.

We measure the percentage change between two points as the change in the variable divided by the average value of the variable between the two points. Thus, the percentage change in quantity between points A and B in Figure 5.1 is computed relative to the average of the quantity values at points A and B: \( \frac{60,000 + 40,000}{2} = 50,000 \). The percentage change in quantity, then, is 20,000/50,000, or 40%. Likewise, the percentage change in price between points A and B is based on the average of the two prices: \( \frac{$0.80 + $0.70}{2} = $0.75 \), and so we have a percentage change of \(-0.10/0.75\), or \(-13.33\%\). The price elasticity of demand between points A and B is thus 40%/\((-13.33\%)\) = \(-3.00\).

This measure of elasticity, which is based on percentage changes relative to the average value of each variable between two points, is called arc elasticity. The arc elasticity method has the advantage that it yields the same elasticity whether we go from point A to point B or from point B to point A. It is the method we shall use to compute elasticity.

For the arc elasticity method, we calculate the price elasticity of demand using the average value of price, \( \bar{P} \), and the average value of quantity demanded, \( \bar{Q} \). We shall use the Greek letter \( \Delta \) to mean "change in," so the change in quantity between two points is \( \Delta Q \) and the change in price is \( \Delta P \). Now we can write the formula for the price elasticity of demand as

**EQUATION 5.3**

\[
e_D = \frac{\Delta Q}{\bar{Q}} \times \frac{\Delta P}{\bar{P}}
\]

The price elasticity of demand between points A and B is thus:

\[
e_D = \frac{20,000}{(60,000 + 40,000)/2} \times \frac{-0.10}{($0.80 + $0.70)/2} = -40%/(-13.33\%) = -3.00
\]

With the arc elasticity formula, the elasticity is the same whether we move from point A to point B or from point B to point A. If we start at point B and move to point A, we have:

\[
e_D = \frac{-20,000}{(40,000 + 60,000)/2} \times \frac{0.10}{($0.70 + $0.80)/2} = -40%/13.33\% = -3.00
\]

The arc elasticity method gives us an estimate of elasticity. It gives the value of elasticity at the midpoint over a range of change, such as the movement between points A and B. For a precise
computation of elasticity, we would need to consider the response of a dependent variable to an extremely small change in an independent variable. The fact that arc elasticities are approximate suggests an important practical rule in calculating arc elasticities: we should consider only small changes in independent variables. We cannot apply the concept of arc elasticity to large changes.

Another argument for considering only small changes in computing price elasticities of demand will become evident in the next section. We will investigate what happens to price elasticities as we move from one point to another along a linear demand curve.

1.2 Price Elasticities Along a Linear Demand Curve

What happens to the price elasticity of demand when we travel along the demand curve? The answer depends on the nature of the demand curve itself. On a linear demand curve, such as the one in Figure 5.2, elasticity becomes smaller (in absolute value) as we travel downward and to the right.

**FIGURE 5.2 Price Elasticities of Demand for a Linear Demand Curve**

The price elasticity of demand varies between different pairs of points along a linear demand curve. The lower the price and the greater the quantity demanded, the lower the absolute value of the price elasticity of demand.

Figure 5.2 shows the same demand curve we saw in Figure 5.1. We have already calculated the price elasticity of demand between points A and B; it equals −3.00. Notice, however, that when we use the same method to compute the price elasticity of demand between other sets of points, our answer varies. For each of the pairs of points shown, the changes in price and quantity demanded are the same (a $0.10 decrease in price and 20,000 additional rides per day, respectively). But at the high prices and low quantities on the upper part of the demand curve, the percentage change in quantity is relatively large, whereas the percentage change in price is relatively small. The absolute value of the price elasticity of demand is thus relatively large. As we move down the demand curve, equal changes in quantity represent smaller and smaller percentage changes, whereas equal changes in price represent larger and larger percentage changes, and the absolute value of the elasticity measure declines. Between points C and D,
for example, the price elasticity of demand is \(-1.00\), and between points E and F the price elasticity of demand is \(-0.33\).

On a linear demand curve, the price elasticity of demand varies depending on the interval over which we are measuring it. For any linear demand curve, the absolute value of the price elasticity of demand will fall as we move down and to the right along the curve.

1.3 The Price Elasticity of Demand and Changes in Total Revenue

Suppose the public transit authority is considering raising fares. Will its total revenues go up or down? Total revenue is the price per unit times the number of units sold. In this case, it is the fare times the number of riders. The transit authority will certainly want to know whether a price increase will cause its total revenue to rise or fall. In fact, determining the impact of a price change on total revenue is crucial to the analysis of many problems in economics.

We will do two quick calculations before generalizing the principle involved. Given the demand curve shown in Figure 5.2, we see that at a price of $0.80, the transit authority will sell 40,000 rides per day. Total revenue would be $32,000 per day ($0.80 times 40,000). If the price were lowered by $0.10 to $0.70, quantity demanded would increase to 60,000 rides and total revenue would increase to $42,000 ($0.70 times 60,000). The reduction in fare increases total revenue. However, if the initial price had been $0.30 and the transit authority reduced it by $0.10 to $0.20, total revenue would decrease from $42,000 ($0.30 times 140,000) to $32,000 ($0.20 times 160,000). So it appears that the impact of a price change on total revenue depends on the initial price and, by implication, the original elasticity. We generalize this point in the remainder of this section.

The problem in assessing the impact of a price change on total revenue of a good or service is that a change in price always changes the quantity demanded in the opposite direction. An increase in price reduces the quantity demanded, and a reduction in price increases the quantity demanded. The question is how much. Because total revenue is found by multiplying the price per unit times the quantity demanded, it is not clear whether a change in price will cause total revenue to rise or fall.

We have already made this point in the context of the transit authority. Consider the following three examples of price increases for gasoline, pizza, and diet cola.

Suppose that 1,000 gallons of gasoline per day are demanded at a price of $4.00 per gallon. Total revenue for gasoline thus equals $4,000 per day (=1,000 gallons per day times $4.00 per gallon). If an increase in the price of gasoline to $4.25 reduces the quantity demanded to 950 gallons per day, total revenue rises to $4,037.50 per day (=950 gallons per day times $4.25 per gallon). Even though people consume less gasoline at $4.25 than at $4.00, total revenue rises because the higher price more than makes up for the drop in consumption.

Next consider pizza. Suppose 1,000 pizzas per week are demanded at a price of $9 per pizza. Total revenue for pizza equals $9,000 per week (=1,000 pizzas per week times $9 per pizza). If an increase in the price of pizza to $10 per pizza reduces quantity demanded to 900 pizzas per week, total revenue will still be $9,000 per week (=900 pizzas per week times $10 per pizza). Again, when price goes up, consumers buy less, but this time there is no change in total revenue.

Now consider diet cola. Suppose 1,000 cans of diet cola per day are demanded at a price of $0.50 per can. Total revenue for diet cola equals $500 per day (=1,000 cans per day times $0.50 per can). If an increase in the price of diet cola to $0.55 per can reduces quantity demanded to 880 cans per month, total revenue for diet cola falls to $484 per day (=880 cans per day times $0.55 per can). As in the case of gasoline, people will buy less diet cola when the price rises from $0.50 to $0.55, but in this example total revenue drops.

In our first example, an increase in price increased total revenue. In the second, a price increase left total revenue unchanged. In the third example, the price rise reduced total revenue. Is there a way to predict how a price change will affect total revenue? There is; the effect depends on the price elasticity of demand.
Elastic, Unit Elastic, and Inelastic Demand

To determine how a price change will affect total revenue, economists place price elasticities of demand in three categories, based on their absolute value. If the absolute value of the price elasticity of demand is greater than 1, demand is termed **price elastic**. If it is equal to 1, demand is **unit price elastic**. And if it is less than 1, demand is **price inelastic**.

Relating Elasticity to Changes in Total Revenue

When the price of a good or service changes, the quantity demanded changes in the opposite direction. Total revenue will move in the direction of the variable that changes by the larger percentage. If the variables move by the same percentage, total revenue stays the same. If quantity demanded changes by a larger percentage than price (i.e., if demand is price elastic), total revenue will change in the direction of the quantity change. If price changes by a larger percentage than quantity demanded (i.e., if demand is price inelastic), total revenue will move in the direction of the price change. If price and quantity demanded change by the same percentage (i.e., if demand is unit price elastic), then total revenue does not change.

When demand is price inelastic, a given percentage change in price results in a smaller percentage change in quantity demanded. That implies that total revenue will move in the direction of the price change: a reduction in price will reduce total revenue, and an increase in price will increase it.

Consider the price elasticity of demand for gasoline. In the example above, 1,000 gallons of gasoline were purchased each day at a price of $4.00 per gallon; an increase in price to $4.25 per gallon reduced the quantity demanded to 950 gallons per day. We thus had an average quantity of 975 gallons per day and an average price of $4.125. We can thus calculate the arc price elasticity of demand for gasoline:

\[
\text{Percentage change in quantity demanded} = \frac{-50}{975} = -5.1\%
\]

\[
\text{Percentage change in price} = \frac{25}{4.125} = 6.06\%
\]

\[
\text{Price elasticity of demand} = \frac{-5.1\%}{6.06\%} = -0.84
\]

The demand for gasoline is price inelastic, and total revenue moves in the direction of the price change. When price rises, total revenue rises. Recall that in our example above, total spending on gasoline (which equals total revenues to sellers) rose from $4,000 per day (=1,000 gallons per day times $4.00) to $4,037.50 per day (=950 gallons per day times $4.25 per gallon).

When demand is price inelastic, a given percentage change in price results in a smaller percentage change in quantity demanded. That implies that total revenue will move in the direction of the price change: an increase in price will increase total revenue, and a reduction in price will reduce it.

Consider again the example of pizza that we examined above. At a price of $9 per pizza, 1,000 pizzas per week were demanded. Total revenue was $9,000 per week (=1,000 pizzas per week times $9 per pizza). When the price rose to $10, the quantity demanded fell to 900 pizzas per week. Total revenue remained $9,000 per week (=900 pizzas per week times $10 per pizza). Again, we have an average quantity of 950 pizzas per week and an average price of $9.50. Using the arc elasticity method, we can compute:

\[
\text{Percentage change in quantity demanded} = -100 / 950 = -10.5\%
\]

\[
\text{Percentage change in price} = \frac{1.00}{9.50} = 10.5\%
\]

\[
\text{Price elasticity of demand} = -10.5\% / 10.5\% = -1.0
\]

Demand is unit price elastic, and total revenue remains unchanged. Quantity demanded falls by the same percentage by which price increases.

Consider next the example of diet cola demand. At a price of $0.50 per can, 1,000 cans of diet cola were purchased each day. Total revenue was thus $500 per day (= $0.50 per can times 1,000 cans per day). An increase in price to $0.55 reduced the quantity demanded to 880 cans per day. We thus have an average quantity of 940 cans per day and an average price of $0.525 per can. Computing the price elasticity of demand for diet cola in this example, we have:

\[
\text{Percentage change in quantity demanded} = -120 / 940 = -12.8\%
\]

\[
\text{Percentage change in price} = \frac{0.05}{0.525} = 9.5\%
\]

\[
\text{Price elasticity of demand} = -12.8\% / 9.5\% = -1.3
\]

The demand for diet cola is price elastic, so total revenue moves in the direction of the quantity change. It falls from $500 per day before the price increase to $484 per day after the price increase.

A demand curve can also be used to show changes in total revenue. Figure 5.3 shows the demand curve from Figure 5.1 and Figure 5.2. At point A, total revenue from public transit rides is given by the area of a rectangle drawn with point A in the upper right-hand corner and the origin in the lower left-
The height of the rectangle is price; its width is quantity. We have already seen that total revenue at point A is $32,000 ($0.80 \times 40,000). When we reduce the price and move to point B, the rectangle showing total revenue becomes shorter and wider. Notice that the area gained in moving to the rectangle at B is greater than the area lost; total revenue rises to $42,000 ($0.70 \times 60,000). Recall from Figure 5.2 that demand is elastic between points A and B. In general, demand is elastic in the upper half of any linear demand curve, so total revenue moves in the direction of the quantity change.

**FIGURE 5.3 Changes in Total Revenue and a Linear Demand Curve**

Moving from point A to point B implies a reduction in price and an increase in the quantity demanded. Demand is elastic between these two points. Total revenue, shown by the areas of the rectangles drawn from points A and B to the origin, rises. When we move from point E to point F, which is in the inelastic region of the demand curve, total revenue falls.

A movement from point E to point F also shows a reduction in price and an increase in quantity demanded. This time, however, we are in an inelastic region of the demand curve. Total revenue now moves in the direction of the price change—it falls. Notice that the rectangle drawn from point F is smaller in area than the rectangle drawn from point E, once again confirming our earlier calculation.

**FIGURE 5.4**
We have noted that a linear demand curve is more elastic where prices are relatively high and quantities relatively low and less elastic where prices are relatively low and quantities relatively high. We can be even more specific. For any linear demand curve, demand will be price elastic in the upper half of the curve and price inelastic in its lower half. At the midpoint of a linear demand curve, demand is unit price elastic.

1.4 Constant Price Elasticity of Demand Curves

Figure 5.5 shows four demand curves over which price elasticity of demand is the same at all points. The demand curve in Panel (a) is vertical. This means that price changes have no effect on quantity demanded. The numerator of the formula given in Equation 5.2 for the price elasticity of demand (percentage change in quantity demanded) is zero. The price elasticity of demand in this case is therefore zero, and the demand curve is said to be perfectly inelastic. This is a theoretically extreme case, and no good that has been studied empirically exactly fits it. A good that comes close, at least over a specific price range, is insulin. A diabetic will not consume more insulin as its price falls but, over some price range, will consume the amount needed to control the disease.

**FIGURE 5.5 Demand Curves with Constant Price Elasticities**

The demand curve in Panel (a) is perfectly inelastic. The demand curve in Panel (b) is perfectly elastic. Price elasticity of demand is \(-1.00\) all along the demand curve in Panel (c), whereas it is \(-0.50\) all along the demand curve in Panel (d).
As illustrated in Figure 5.5, several other types of demand curves have the same elasticity at every point on them. The demand curve in Panel (b) is horizontal. This means that even the smallest price changes have enormous effects on quantity demanded. The denominator of the formula given in Equation 5.2 for the price elasticity of demand (percentage change in price) approaches zero. The price elasticity of demand in this case is therefore infinite, and the demand curve is said to be perfectly elastic. This is the type of demand curve faced by producers of standardized products such as wheat. If the wheat of other farms is selling at $4 per bushel, a typical farm can sell as much wheat as it wants to at $4 but nothing at a higher price and would have no reason to offer its wheat at a lower price.

The nonlinear demand curves in Panels (c) and (d) have price elasticities of demand that are negative; but, unlike the linear demand curve discussed above, the value of the price elasticity is constant all along each demand curve. The demand curve in Panel (c) has price elasticity of demand equal to −1.00 throughout its range; in Panel (d) the price elasticity of demand is equal to −0.50 throughout its range. Empirical estimates of demand often show curves like those in Panels (c) and (d) that have the same elasticity at every point on the curve.

### Heads Up!

Do not confuse price inelastic demand and perfectly inelastic demand. Perfectly inelastic demand means that the change in quantity is zero for any percentage change in price; the demand curve in this case is vertical. Price inelastic demand means only that the percentage change in quantity is less than the percentage change in price, not that the change in quantity is zero. With price inelastic (as opposed to perfectly inelastic) demand, the demand curve itself is still downward sloping.

### 1.5 Determinants of the Price Elasticity of Demand

The greater the absolute value of the price elasticity of demand, the greater the responsiveness of quantity demanded to a price change. What determines whether demand is more or less price elastic? The most important determinants of the price elasticity of demand for a good or service are the availability of substitutes, the importance of the item in household budgets, and time.

#### Availability of Substitutes

The price elasticity of demand for a good or service will be greater in absolute value if many close substitutes are available for it. If there are lots of substitutes for a particular good or service, then it is easy for consumers to switch to those substitutes when there is a price increase for that good or service. Suppose, for example, that the price of Ford automobiles goes up. There are many close substitutes for Fords—Chevrolets, Chryslers, Toyotas, and so on. The availability of close substitutes tends to make the demand for Fords more price elastic.

If a good has no close substitutes, its demand is likely to be somewhat less price elastic. There are no close substitutes for gasoline, for example. The price elasticity of demand for gasoline in the intermediate term of, say, three–nine months is generally estimated to be about −0.5. Since the absolute value of price elasticity is less than 1, it is price inelastic. We would expect, though, that the demand for a particular brand of gasoline will be much more price elastic than the demand for gasoline in general.

#### Importance in Household Budgets

One reason price changes affect quantity demanded is that they change how much a consumer can buy; a change in the price of a good or service affects the purchasing power of a consumer’s income and thus affects the amount of a good the consumer will buy. This effect is stronger when a good or service is important in a typical household’s budget.

A change in the price of jeans, for example, is probably more important in your budget than a change in the price of pencils. Suppose the prices of both were to double. You had planned to buy four pairs of jeans this year, but now you might decide to make do with two new pairs. A change in pencil prices, in contrast, might lead to very little reduction in quantity demanded simply because pencils are not likely to loom large in household budgets. The greater the importance of an item in household budgets, the greater the absolute value of the price elasticity of demand is likely to be.

#### Time

Suppose the price of electricity rises tomorrow morning. What will happen to the quantity demanded?

The answer depends in large part on how much time we allow for a response. If we are interested in the reduction in quantity demanded by tomorrow afternoon, we can expect that the response will be very small. But if we give consumers a year to respond to the price change, we can expect the response
Consider the price elasticity of crude oil demand. Economist John C. B. Cooper estimated short- and long-run price elasticities of demand for crude oil for 23 industrialized nations for the period 1971–2000. Professor Cooper found that for virtually every country, the price elasticities were negative, and the long-run price elasticities were generally much greater (in absolute value) than were the short-run price elasticities. His results are reported in Table 5.1. As you can see, the research was reported in a journal published by OPEC (Organization of Petroleum Exporting Countries), an organization whose members have profited greatly from the inelasticity of demand for their product. By restricting supply, OPEC, which produces about 45% of the world’s crude oil, is able to put upward pressure on the price of crude. That increases OPEC’s (and all other oil producers’) total revenues and reduces total costs.

TABLE 5.1 Short- and Long-Run Price Elasticities of the Demand for Crude Oil in 23 Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Short-Run Price Elasticity of Demand</th>
<th>Long-Run Price Elasticity of Demand</th>
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</thead>
<tbody>
<tr>
<td>Australia</td>
<td>−0.034</td>
<td>−0.068</td>
</tr>
<tr>
<td>Austria</td>
<td>−0.059</td>
<td>−0.092</td>
</tr>
<tr>
<td>Canada</td>
<td>−0.041</td>
<td>−0.352</td>
</tr>
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<td>China</td>
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<td>0.005</td>
</tr>
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<td>−0.026</td>
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</tr>
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</tr>
<tr>
<td>France</td>
<td>−0.069</td>
<td>−0.568</td>
</tr>
<tr>
<td>Germany</td>
<td>−0.024</td>
<td>−0.279</td>
</tr>
<tr>
<td>Greece</td>
<td>−0.055</td>
<td>−0.126</td>
</tr>
<tr>
<td>Iceland</td>
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</tr>
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<td>Korea</td>
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<td>−0.244</td>
</tr>
<tr>
<td>New Zealand</td>
<td>−0.054</td>
<td>−0.326</td>
</tr>
<tr>
<td>Norway</td>
<td>−0.026</td>
<td>−0.036</td>
</tr>
<tr>
<td>Portugal</td>
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<td>0.038</td>
</tr>
<tr>
<td>Spain</td>
<td>−0.087</td>
<td>−0.146</td>
</tr>
<tr>
<td>Sweden</td>
<td>−0.043</td>
<td>−0.289</td>
</tr>
<tr>
<td>Switzerland</td>
<td>−0.030</td>
<td>−0.056</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>−0.068</td>
<td>−0.182</td>
</tr>
<tr>
<td>United States</td>
<td>−0.061</td>
<td>−0.453</td>
</tr>
</tbody>
</table>

Source: John C. B. Cooper, “Price Elasticity of Demand for Crude Oil: Estimates from 23 Countries,” OPEC Review: Energy Economics & Related Issues, 27:1 (March 2003): 4. The estimates are based on data for the period 1971–2000, except for China and South Korea, where the period is 1979–2000. While the price elasticities for China and Portugal were positive, they were not statistically significant.
KEY TAKEAWAYS

- The **price elasticity of demand** measures the responsiveness of quantity demanded to changes in price; it is calculated by dividing the percentage change in quantity demanded by the percentage change in price.
- Demand is price inelastic if the absolute value of the price elasticity of demand is less than 1; it is unit price elastic if the absolute value is equal to 1; and it is price elastic if the absolute value is greater than 1.
- Demand is price elastic in the upper half of any linear demand curve and price inelastic in the lower half. It is unit price elastic at the midpoint.
- When demand is price inelastic, total revenue moves in the direction of a price change. When demand is unit price elastic, total revenue does not change in response to a price change. When demand is price elastic, total revenue moves in the direction of a quantity change.
- The absolute value of the price elasticity of demand is greater when substitutes are available, when the good is important in household budgets, and when buyers have more time to adjust to changes in the price of the good.

TRY IT!

You are now ready to play the part of the manager of the public transit system. Your finance officer has just advised you that the system faces a deficit. Your board does not want you to cut service, which means that you cannot cut costs. Your only hope is to increase revenue. Would a fare increase boost revenue?

You consult the economist on your staff who has researched studies on public transportation elasticities. She reports that the estimated price elasticity of demand for the first few months after a price change is about −0.3, but that after several years, it will be about −1.5.

1. Explain why the estimated values for price elasticity of demand differ.
2. Compute what will happen to ridership and revenue over the next few months if you decide to raise fares by 5%.
3. Compute what will happen to ridership and revenue over the next few years if you decide to raise fares by 5%.
4. What happens to total revenue now and after several years if you choose to raise fares?

Case in Point: Elasticity and Stop Lights

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We all face the situation every day. You are approaching an intersection. The yellow light comes on. You know that you are supposed to slow down, but you are in a bit of a hurry. So, you speed up a little to try to make the light. But the red light flashes on just before you get to the intersection. Should you risk it and go through?

Many people faced with that situation take the risky choice. In 1998, 2,000 people in the United States died as a result of drivers running red lights at intersections. In an effort to reduce the number of drivers who make such choices, many areas have installed cameras at intersections. Drivers who run red lights have their pictures taken and receive citations in the mail. This enforcement method, together with recent increases in the fines for driving through red lights at intersections, has led to an intriguing application of the concept of elasticity. Economists Avner Bar-Ilan of the University of Haifa in Israel and Bruce Sacerdote of Dartmouth University have estimated what is, in effect, the price elasticity for driving through stoplights with respect to traffic fines at intersections in Israel and in San Francisco.

In December 1996, Israel sharply increased the fine for driving through a red light. The old fine of 400 shekels (this was equal at that time to $122 in the United States) was increased to 1,000 shekels ($305). In January 1998, California raised its fine for the offense from $104 to $271. The country of Israel and the city of San Francisco installed cameras at several intersections. Drivers who ignored stoplights got their pictures taken and automatically received citations imposing the new higher fines.

We can think of driving through red lights as an activity for which there is a demand—after all, ignoring a red light speeds up one’s trip. It may also generate satisfaction to people who enjoy disobeying traffic laws. The concept of elasticity gives us a way to show just how responsive drivers were to the increase in fines.

Professors Bar-Ilan and Sacerdote obtained information on all the drivers cited at 73 intersections in Israel and eight intersections in San Francisco. For Israel, for example, they defined the period January 1992 to June 1996 as the “before” period. They compared the number of violations during the before period to the number of violations from July 1996 to December 1999—the “after” period—and found there was a reduction in tickets per driver of 31.5 per cent. Specifically, the average number of tickets per driver was 0.073 during the period before the increase; it fell to 0.050 after the increase. The increase in the fine was 150 per cent. (Note that, because they were making a “before” and “after” calculation, the authors used the standard method described in the Heads Up! on computing a percentage change—i.e., they computed the percentage changes in comparison to the original values instead of the average value of the variables.) The elasticity of citations with respect to the fine was thus −0.21 (= −31.5%/150%).

The economists estimated elasticities for particular groups of people. For example, young people (age 17–30) had an elasticity of −0.36; people over the age of 30 had an elasticity of −0.16. In general, elasticities fell in absolute value as income rose. For San Francisco and Israel combined, the elasticity was between −0.26 and −0.33.

In general, the results showed that people responded rationally to the increases in fines. Increasing the price of a particular behavior reduced the frequency of that behavior. The study also points out the effectiveness of cameras as an enforcement technique. With cameras, violators can be certain they will be cited if they ignore a red light. And reducing the number of people running red lights clearly saves lives.


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**Answers to Try It! Problems**

1. The absolute value of price elasticity of demand tends to be greater when more time is allowed for consumers to respond. Over time, riders of the commuter rail system can organize car pools, move, or otherwise adjust to the fare increase.

2. Using the formula for price elasticity of demand and plugging in values for the estimate of price elasticity (−0.5) and the percentage change in price (5%) and then rearranging terms, we can solve for the percentage change in quantity demanded as: \( e_D = \frac{\%\Delta Q}{\%\Delta P} \), \( -0.5 = \frac{\%\Delta Q}{5\%} \); \( -0.5\times5\% = \%\Delta Q \), \( Q = -2.5\% \). Ridership falls by 2.5% in the first few months.

3. Using the formula for price elasticity of demand and plugging in values for the estimate of price elasticity over a few years (−1.5) and the percentage change in price (5%), we can solve for the percentage change in quantity demanded as: \( e_D = \frac{\%\Delta Q}{\%\Delta P} \), \( -1.5 = \frac{\%\Delta Q}{5\%} \); \( -1.5\times5\% = \%\Delta Q \), \( Q = -7.5\% \). Ridership falls by 7.5% over a few years.

4. Total revenue rises immediately after the fare increase, since demand over the immediate period is price inelastic. Total revenue falls after a few years, since demand changes and becomes price elastic.
2. RESPONSIVENESS OF DEMAND TO OTHER FACTORS

**LEARNING OBJECTIVES**

1. Explain the concept of income elasticity of demand and its calculation.
2. Classify goods as normal or inferior depending on their income elasticity of demand.
3. Explain the concept of cross price elasticity of demand and its calculation.
4. Classify goods as substitutes or complements depending on their cross price elasticity of demand.

Although the response of quantity demanded to changes in price is the most widely used measure of elasticity, economists are interested in the response to changes in the demand shifters as well. Two of the most important measures show how demand responds to changes in income and to changes in the prices of related goods and services.

2.1 Income Elasticity of Demand

We saw in the chapter that introduced the model of demand and supply that the demand for a good or service is affected by income. We measure the income elasticity of demand, \( e_Y \), as the percentage change in quantity demanded at a specific price divided by the percentage change in income that produced the demand change, all other things unchanged:

**EQUATION 5.4**

\[
e_Y = \frac{\% \text{ change in quantity demanded}}{\% \text{ change in income}}
\]

The symbol \( Y \) is often used in economics to represent income. Because income elasticity of demand reports the responsiveness of quantity demanded to a change in income, all other things unchanged (including the price of the good), it reflects a shift in the demand curve at a given price. Remember that price elasticity of demand reflects movements along a demand curve in response to a change in price.

A positive income elasticity of demand means that income and demand move in the same direction—an increase in income increases demand, and a reduction in income reduces demand. As we learned, a good whose demand rises as income rises is called a normal good.

Studies show that most goods and services are normal, and thus their income elasticities are positive. Goods and services for which demand is likely to move in the same direction as income include housing, seafood, rock concerts, and medical services.

If a good or service is inferior, then an increase in income reduces demand for the good. That implies a negative income elasticity of demand. Goods and services for which the income elasticity of demand is likely to be negative include used clothing, beans, and urban public transit. For example, the studies we have already cited concerning the demands for urban public transit in France and in Madrid found the long-run income elasticities of demand to be negative (\(-0.23\) in France and \(-0.25\) in Madrid).\[3\]
When we compute the income elasticity of demand, we are looking at the change in the quantity demanded at a specific price. We are thus dealing with a change that shifts the demand curve. An increase in income shifts the demand for a normal good to the right; it shifts the demand for an inferior good to the left.

### 2.2 Cross Price Elasticity of Demand

The demand for a good or service is affected by the prices of related goods or services. A reduction in the price of salsa, for example, would increase the demand for chips, suggesting that salsa is a complement of chips. A reduction in the price of chips, however, would reduce the demand for peanuts, suggesting that chips are a substitute for peanuts.

The measure economists use to describe the responsiveness of demand for a good or service to a change in the price of another good or service is called the cross price elasticity of demand, \( e_{A, B} \). It equals the percentage change in the quantity demanded of one good or service at a specific price divided by the percentage change in the price of a related good or service. We are varying the price of a related good when we consider the cross price elasticity of demand, so the response of quantity demanded is shown as a shift in the demand curve.

The cross price elasticity of the demand for good A with respect to the price of good B is given by:

**EQUATION 5.5**

\[
e_{A, B} = \frac{\text{% change in quantity demanded of good } A}{\text{% change in price of good } B}
\]

Cross price elasticities of demand define whether two goods are substitutes, complements, or unrelated. If two goods are substitutes, an increase in the price of one will lead to an increase in the demand for the other—the cross price elasticity of demand is positive. If two goods are complements, an increase in the price of one will lead to a reduction in the demand for the other—the cross price elasticity of demand is negative. If two goods are unrelated, a change in the price of one will not affect the demand for the other—the cross price elasticity of demand is zero.
An examination of the demand for local television advertising with respect to the price of local radio advertising revealed that the two goods are clearly substitutes. A 10 per cent increase in the price of local radio advertising led to a 10 per cent increase in demand for local television advertising, so that the cross price elasticity of demand for local television advertising with respect to changes in the price of radio advertising was 1.0. [4]

Heads Up!

Notice that with income elasticity of demand and cross price elasticity of demand we are primarily concerned with whether the measured value of these elasticities is positive or negative. In the case of income elasticity of demand this tells us whether the good or service is normal or inferior. In the case of cross price elasticity of demand it tells us whether two goods are substitutes or complements. With price elasticity of demand we were concerned with whether the measured absolute value of this elasticity was greater than, less than, or equal to 1, because this gave us information about what happens to total revenue as price changes. The terms elastic and inelastic apply to price elasticity of demand. They are not used to describe income elasticity of demand or cross price elasticity of demand.

KEY TAKEAWAYS

- The income elasticity of demand reflects the responsiveness of demand to changes in income. It is the percentage change in quantity demanded at a specific price divided by the percentage change in income, ceteris paribus.
- Income elasticity is positive for normal goods and negative for inferior goods.
- The cross price elasticity of demand measures the way demand for one good or service responds to changes in the price of another. It is the percentage change in the quantity demanded of one good or service at a specific price divided by the percentage change in the price of another good or service, all other things unchanged.
- Cross price elasticity is positive for substitutes, negative for complements, and zero for goods or services whose demands are unrelated.

TRY IT!

Suppose that when the price of bagels rises by 10%, the demand for cream cheese falls by 3% at the current price, and that when income rises by 10%, the demand for bagels increases by 1% at the current price. Calculate the cross price elasticity of demand for cream cheese with respect to the price of bagels and tell whether bagels and cream cheese are substitutes or complements. Calculate the income elasticity of demand and tell whether bagels are normal or inferior.
Case in Point: Teen Smoking and Elasticity

Tobacco kills more people than any other substance or disease. Worldwide, the annual death toll from tobacco is well over 3 million people per year. In the United States alone, 400,000 people die each year as a result of their use of tobacco.

More than two-thirds of smokers indicated in 1995 that they would prefer to quit smoking but were unable to do so, according to the Centers for Disease Control and Prevention. In fact, less than 2.5 per cent of smokers succeed in quitting each year.

Most smokers begin using tobacco as teenagers. Teens tend to underestimate the danger of smoking and to overestimate their likely ability to quit smoking when they choose to do so. One can, therefore, argue that the decision to smoke may not be a rational one, and it is one that imposes substantial costs on the rest of society. Because it raises health-care costs, it raises health insurance rates. And the evidence is mounting that second-hand smoke imposes serious health consequences on nonsmokers. Because smoking is such a serious problem for our society, and because the decision to smoke is typically made when one is a teenager, health economists tend to focus on measures to prevent young people from smoking.

One place to begin in limiting teen smoking is price. The price elasticity of demand for teenage smokers is greater (in absolute value) than that for the population in general because the cost of tobacco represents a greater percentage of teen incomes than of adult incomes. For all smokers, the price elasticity of demand was estimated by economists Matthew C. Farrelly, Terry F. Pechacek, and Frank J. Chaloupka to be $-0.32$. Health-care economists estimate that the price elasticity of demand for cigarettes for teenagers is between $-0.9$ and $-1.5$.

In 1998, the tobacco industry reached a settlement with 46 states that had filed lawsuits against the industry, charging that the tobacco industry had imposed huge health-care costs. The Master Settlement Agreement (MSA) called for a payment of $205$ billion over a period of 25 years (the other four states reached separate agreements with the industry in 1997 and 1998). The MSA led to an increase in the price of cigarettes by 48 per cent between 1997 and 1999. The percentage of high school students who smoked fell significantly by 2000, indicating a substantial responsiveness of teenagers to price changes.

The MSA also required that states use some of the money they receive from tobacco firms to carry out anti-smoking programs. The nature and scope of these programs vary widely. State excise taxes, also varying widely, range from 2.5¢ per pack in Virginia (a tobacco-producing state) to $1.51$ in Massachusetts. Given the greater responsiveness of teenagers to the price of cigarettes, excise taxes should prove an effective device.
One caveat, however, in evaluating the impact of a tax hike on teen smoking is that some teens might switch from cigarettes to smokeless tobacco, which is associated with a higher risk of oral cancer. It is estimated that for young males the cross price elasticity of smokeless tobacco with respect to the price of cigarettes is 1.2—a 10% increase in cigarette prices leads to a 12% increase in young males using smokeless tobacco.


**Answer to Try It! Problem**

Using the formula for cross price elasticity of demand, we find that $e_{AB} = (-3%)/(10%) = -0.3$. Since the $e_{AB}$ is negative, bagels and cream cheese are complements. Using the formula for income elasticity of demand, we find that $e_y = (1%)/(10%) = +0.1$. Since $e_y$ is positive, bagels are a normal good.

### 3. PRICE ELASTICITY OF SUPPLY

**Learning Objectives**

1. Explain the concept of elasticity of supply and its calculation.
2. Explain what it means for supply to be price inelastic, unit price elastic, price elastic, perfectly price inelastic, and perfectly price elastic.
3. Explain why time is an important determinant of price elasticity of supply.
4. Apply the concept of price elasticity of supply to the labor supply curve.

The elasticity measures encountered so far in this chapter all relate to the demand side of the market. It is also useful to know how responsive quantity supplied is to a change in price.

Suppose the demand for apartments rises. There will be a shortage of apartments at the old level of apartment rents and pressure on rents to rise. All other things unchanged, the more responsive the quantity of apartments supplied is to changes in monthly rents, the lower the increase in rent required to eliminate the shortage and to bring the market back to equilibrium. Conversely, if quantity supplied is less responsive to price changes, price will have to rise more to eliminate a shortage caused by an increase in demand.

This is illustrated in Figure 5.10. Suppose the rent for a typical apartment had been $R_0$ and the quantity $Q_0$ when the demand curve was $D_1$ and the supply curve was either $S_1$ (a supply curve in which quantity supplied is less responsive to price changes) or $S_2$ (a supply curve in which quantity supplied is more responsive to price changes). Note that with either supply curve, equilibrium price and quantity are initially the same. Now suppose that demand increases to $D_2$, perhaps due to population growth. With supply curve $S_1$, the price (rent in this case) will rise to $R_1$ and the quantity of apartments will rise to $Q_1$. If, however, the supply curve had been $S_2$, the rent would only have to rise to $R_2$ to bring the market back to equilibrium. In addition, the new equilibrium number of apartments would be higher at $Q_2$. Supply curve $S_2$ shows greater responsiveness of quantity supplied to price change than does supply curve $S_1$. 
We measure the price elasticity of supply \((e_S)\) as the ratio of the percentage change in quantity supplied of a good or service to the percentage change in its price, all other things unchanged:

\[
e_S = \frac{\% \text{ change in quantity supplied}}{\% \text{ change in price}}
\]

Because price and quantity supplied usually move in the same direction, the price elasticity of supply is usually positive. The larger the price elasticity of supply, the more responsive the firms that supply the good or service are to a price change.

Supply is price elastic if the price elasticity of supply is greater than 1, unit price elastic if it is equal to 1, and price inelastic if it is less than 1. A vertical supply curve, as shown in Panel (a) of Figure 5.11, is perfectly inelastic; its price elasticity of supply is zero. The supply of Beatles’ songs is perfectly inelastic because the band no longer exists. A horizontal supply curve, as shown in Panel (b) of Figure 5.11, is perfectly elastic; its price elasticity of supply is infinite. It means that suppliers are willing to supply any amount at a certain price.

### 3.1 Time: An Important Determinant of the Elasticity of Supply

Time plays a very important role in the determination of the price elasticity of supply. Look again at the effect of rent increases on the supply of apartments. Suppose apartment rents in a city rise. If we are looking at a supply curve of apartments over a period of a few months, the rent increase is likely to induce apartment owners to rent out a relatively small number of additional apartments. With the higher rents, apartment owners may be more vigorous in reducing their vacancy rates, and, indeed, with more people looking for apartments to rent, this should be fairly easy to accomplish. Attics and basements are easy to renovate and rent out as additional units. In a short period of time, however, the supply response is likely to be fairly modest, implying that the price elasticity of supply is fairly low. A supply curve corresponding to a short period of time would look like \(S_1\) in Figure 5.10. It is during such periods that there may be calls for rent controls.

If the period of time under consideration is a few years rather than a few months, the supply curve is likely to be much more price elastic. Over time, buildings can be converted from other uses and new apartment complexes can be built. A supply curve corresponding to a longer period of time would look like \(S_2\) in Figure 5.10.
3.2 Elasticity of Labor Supply: A Special Application

The concept of price elasticity of supply can be applied to labor to show how the quantity of labor supplied responds to changes in wages or salaries. What makes this case interesting is that it has sometimes been found that the measured elasticity is negative, that is, that an increase in the wage rate is associated with a reduction in the quantity of labor supplied.

In most cases, labor supply curves have their normal upward slope: higher wages induce people to work more. For them, having the additional income from working more is preferable to having more leisure time. However, wage increases may lead some people in very highly paid jobs to cut back on the number of hours they work because their incomes are already high and they would rather have more time for leisure activities. In this case, the labor supply curve would have a negative slope. The reasons for this phenomenon are explained more fully in a later chapter.

This chapter has covered a variety of elasticity measures. All report the degree to which a dependent variable responds to a change in an independent variable. As we have seen, the degree of this response can play a critically important role in determining the outcomes of a wide range of economic events. Table 5.2[5] provides examples of some estimates of elasticities.
## Table 5.2  Selected Elasticity Estimates

<table>
<thead>
<tr>
<th>Product</th>
<th>Elasticity</th>
<th>Cross Price Elasticity of Demand</th>
<th>Elasticity</th>
<th>Income Elasticity of Demand</th>
<th>Elasticity</th>
</tr>
</thead>
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<td><strong>Price Elasticity of Demand</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Crude oil (U.S.)*</td>
<td>−0.06</td>
<td>Alcohol with respect to price of heroin</td>
<td>−0.05</td>
<td>Speeding citations</td>
<td>−0.26 to −0.33</td>
</tr>
<tr>
<td>Gasoline</td>
<td>−0.1</td>
<td>Fuel with respect to price of transport</td>
<td>−0.48</td>
<td>Urban Public Trust in France and Madrid (respectively)</td>
<td>−0.23; −0.26</td>
</tr>
<tr>
<td>Speeding citations</td>
<td>−0.21</td>
<td>Alcohol with respect to price of food</td>
<td>−0.16</td>
<td>Ground beef</td>
<td>−0.197</td>
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<tr>
<td>Cabbage</td>
<td>−0.25</td>
<td>Marijuana with respect to price of heroin (similar for cocaine)</td>
<td>−0.01</td>
<td>Lottery instant game sales in Colorado</td>
<td>−0.06</td>
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<tr>
<td>Cocaine (two estimates)</td>
<td>−0.28; −1.0</td>
<td>Beer with respect to price of wine distilled liquor (young drinkers)</td>
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<td>Heroin</td>
<td>−0.00</td>
</tr>
<tr>
<td>Alcohol</td>
<td>−0.30</td>
<td>Beer with respect to price of distilled liquor (young drinkers)</td>
<td>0.0</td>
<td>Marijuana, alcohol, cocaine</td>
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<tr>
<td>Peaches</td>
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<td>Pork with respect to price of poultry</td>
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<td>Marijuana</td>
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<td>Food**</td>
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<tr>
<td>Cigarettes (all smokers; two estimates)</td>
<td>−0.4; −0.32</td>
<td>Ground beef with respect to price of poultry</td>
<td>0.24</td>
<td>Clothing***</td>
<td>0.3</td>
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<tr>
<td>Crude oil (U.S.)**</td>
<td>−0.45</td>
<td>Ground beef with respect to price of pork</td>
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<td>Beer</td>
<td>0.4</td>
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<td>Milk (two estimates)</td>
<td>−0.49; −0.63</td>
<td>Coke with respect to price of Pepsi</td>
<td>0.61</td>
<td>Eggs</td>
<td>0.57</td>
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<tr>
<td>Gasoline (intermediate term)</td>
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<td>Pepsi with respect to price of Coke</td>
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<td>Coke</td>
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<td>Soft drinks</td>
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<td>Smokeless tobacco with respect to price of cigarettes (young males)</td>
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<td>Beef (table cuts—not ground)</td>
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<td>Leisure**</td>
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<td>Physicians (Young male)</td>
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<td>Peaches</td>
<td>1.43</td>
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<tr>
<td>Ground beef</td>
<td>−1.0</td>
<td>Physicians (Young female)</td>
<td>0.5</td>
<td>Health care**</td>
<td>1.6</td>
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<td>Milk**</td>
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<td>Coke</td>
<td>−1.71</td>
<td>Child care labor</td>
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<td>Transportation</td>
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<td>Fresh tomatoes</td>
<td>−2.22</td>
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<tr>
<td>Food**</td>
<td>−2.3</td>
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<td>Lettuce</td>
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</table>

**Note:** *=short-run; **=long-run*
The price elasticity of supply measures the responsiveness of quantity supplied to changes in price. It is the percentage change in quantity supplied divided by the percentage change in price. It is usually positive.

Supply is price inelastic if the price elasticity of supply is less than 1; it is unit price elastic if the price elasticity of supply is equal to 1; and it is price elastic if the price elasticity of supply is greater than 1. A vertical supply curve is said to be perfectly inelastic. A horizontal supply curve is said to be perfectly elastic.

The price elasticity of supply is greater when the length of time under consideration is longer because over time producers have more options for adjusting to the change in price.

When applied to labor supply, the price elasticity of supply is usually positive but can be negative. If higher wages induce people to work more, the labor supply curve is upward sloping and the price elasticity of supply is positive. In some very high-paying professions, the labor supply curve may have a negative slope, which leads to a negative price elasticity of supply.

In the late 1990s, it was reported on the news that the high-tech industry was worried about being able to find enough workers with computer-related expertise. Job offers for recent college graduates with degrees in computer science went with high salaries. It was also reported that more undergraduates than ever were majoring in computer science. Compare the price elasticity of supply of computer scientists at that point in time to the price elasticity of supply of computer scientists over a longer period of, say, 1999 to 2009.

Studies support the idea that labor supply is less elastic in high-paying jobs than in lower-paying ones. For example, David M. Blau estimated the labor supply of child-care workers to be very price elastic, with estimated price elasticity of labor supply of about 2.0. This means that a 10% increase in wages leads to a 20% increase in the quantity of labor supplied. John Burkett estimated the labor supply of both nursing assistants and nurses to be price elastic, with that of nursing assistants to be 1.9 (very close to that of child-care workers) and of nurses to be 1.1. Note that the price elasticity of labor supply of the higher-paid nurses is a bit lower than that of lower-paid nursing assistants.
In contrast, John Rizzo and David Blumenthal estimated the price elasticity of labor supply for young physicians (under the age of 40) to be about 0.3. This means that a 10% increase in wages leads to an increase in the quantity of labor supplied of only about 3%. In addition, when Rizzo and Blumenthal looked at labor supply elasticities by gender, they found the female physicians’ labor supply price elasticity to be a bit higher (at about 0.5) than that of the males (at about 0.2) in the sample. Because earnings of female physicians in the sample were lower than earnings of the male physicians in the sample, this difference in labor supply elasticities was expected. Moreover, since the sample consisted of physicians in the early phases of their careers, the positive, though small, price elasticities were also expected. Many of the individuals in the sample also had high debt levels, often from educational loans. Thus, the chance to earn more by working more is an opportunity to repay educational and other loans.

In another study of physicians’ labor supply that was not restricted to young physicians, Douglas M. Brown found the labor supply price elasticity for primary care physicians to be close to zero and that of specialists to be negative, at about −0.3. Thus, for this sample of physicians, increases in wages have little or no effect on the amount the primary care doctors work, while a 10% increase in wages for specialists reduces their quantity of labor supplied by about 3%. Because the earnings of specialists exceed those of primary care doctors, this elasticity differential also makes sense.


**ANSWER TO TRY IT! PROBLEM**

While at a point in time the supply of people with degrees in computer science is very price inelastic, over time the elasticity should rise. That more students were majoring in computer science lends credence to this prediction. As supply becomes more price elastic, salaries in this field should rise more slowly.

### 4. REVIEW AND PRACTICE

**Summary**

This chapter introduced a new tool: the concept of elasticity. Elasticity is a measure of the degree to which a dependent variable responds to a change in an independent variable. It is the percentage change in the dependent variable divided by the percentage change in the independent variable, all other things unchanged.

The most widely used elasticity measure is the price elasticity of demand, which reflects the responsiveness of quantity demanded to changes in price. Demand is said to be price elastic if the absolute value of the price elasticity of demand is greater than 1, unit price elastic if it is equal to 1, and price inelastic if it is less than 1.

The price elasticity of demand is useful in forecasting the response of quantity demanded to price changes; it is also useful for predicting the impact a price change will have on total revenue. Total revenue moves in the direction of the quantity change if demand is price elastic, it moves in the direction of the price change if demand is price inelastic, and it does not change if demand is unit price elastic. The most important determinants of the price elasticity of demand are the availability of substitutes, the importance of the item in household budgets, and time.

Two other elasticity measures commonly used in conjunction with demand are income elasticity and cross price elasticity. The signs of these elasticity measures play important roles. A positive income elasticity tells us that a good is normal; a negative income elasticity tells us the good is inferior. A positive cross price elasticity tells us that two goods are substitutes; a negative cross price elasticity tells us they are complements.

Elasticity of supply measures the responsiveness of quantity supplied to changes in price. The value of price elasticity of supply is generally positive. Supply is classified as being price elastic, unit price elastic, or price inelastic if price elasticity is greater than 1, equal to 1, or less than 1, respectively. The length of time over which supply is being considered is an important determinant of the price elasticity of supply.
### Concept Problems

1. Explain why the price elasticity of demand is generally a negative number, except in the cases where the demand curve is perfectly elastic or perfectly inelastic. What would be implied by a positive price elasticity of demand?

2. Explain why the sign (positive or negative) of the cross price elasticity of demand is important.

3. Explain why the sign (positive or negative) of the income elasticity of demand is important.

4. Economists Dale Heien and Cathy Roheim Wessells found that the price elasticity of demand for fresh milk is \(-0.63\) and the price elasticity of demand for cottage cheese is \(-1.1\). Why do you think the elasticity estimates differ?

5. The price elasticity of demand for health care has been estimated to be \(-0.2\). Characterize this demand as price elastic, unit price elastic, or price inelastic. The text argues that the greater the importance of an item in consumer budgets, the greater its elasticity. Health-care costs account for a relatively large share of household budgets. How could the price elasticity of demand for health care be such a small number?

6. Suppose you are able to organize an alliance that includes all farmers. They agree to follow the group’s instructions with respect to the quantity of agricultural products they produce. What might the group seek to do? Why?

7. Suppose you are the chief executive officer of a firm, and you have been planning to reduce your prices. Your marketing manager reports that the price elasticity of demand for your product is \(-0.65\). How will this news affect your plans?

8. Suppose the income elasticity of the demand for beans is \(-0.8\). Interpret this number.

9. Transportation economists generally agree that the cross price elasticity of demand for automobile use with respect to the price of bus fares is about 0. Explain what this number means.

10. Suppose the price elasticity of supply of tomatoes as measured on a given day in July is 0. Interpret this number.

11. The price elasticity of supply for child-care workers was reported to be quite high, about 2. What will happen to the wages of child-care workers as demand for them increases, compared to what would happen if the measured price elasticity of supply were lower?

12. The Case in Point on cigarette taxes and teen smoking suggests that a higher tax on cigarettes would reduce teen smoking and premature deaths. Should cigarette taxes therefore be raised?
1. Economist David Romer found that in introductory economics classes a 10% increase in class attendance is associated with a 4% increase in course grade. What is the elasticity of course grade with respect to class attendance?

2. Refer to Figure 5.2 and
   a. Using the arc elasticity of demand formula, compute the price elasticity of demand between points B and C.
   b. Using the arc elasticity of demand formula, compute the price elasticity of demand between points D and E.
   c. How do the values of price elasticity of demand compare? Why are they the same or different?
   d. Compute the slope of the demand curve between points B and C.
   e. Compute the slope of the demand curve between points D and E.
   f. How do the slopes compare? Why are they the same or different?

3. Consider the following quote from The Wall Street Journal: “A bumper crop of oranges in Florida last year drove down orange prices. As juice marketers’ costs fell, they cut prices by as much as 15%. That was enough to tempt some value-oriented customers: unit volume of frozen juices actually rose about 6% during the quarter.”
   a. Given these numbers, and assuming there were no changes in demand shifters for frozen orange juice, what was the price elasticity of demand for frozen orange juice?
   b. What do you think happened to total spending on frozen orange juice? Why?

4. Suppose you are the manager of a restaurant that serves an average of 400 meals per day at an average price per meal of $20. On the basis of a survey, you have determined that reducing the price of an average meal to $18 would increase the quantity demanded to 450 per day.
   a. Compute the price elasticity of demand between these two points.
   b. Would you expect total revenues to rise or fall? Explain.
   c. Suppose you have reduced the average price of a meal to $18 and are considering a further reduction to $16. Another survey shows that the quantity demanded of meals will increase from 450 to 500 per day. Compute the price elasticity of demand between these two points.
   d. Would you expect total revenue to rise or fall as a result of this second price reduction? Explain.
   e. Compute total revenue at the three meal prices. Do these totals confirm your answers in (b) and (d) above?

5. The text notes that, for any linear demand curve, demand is price elastic in the upper half and price inelastic in the lower half. Consider the following demand curves:

The table gives the prices and quantities corresponding to each of the points shown on the two demand curves.
a. Compute the price elasticity of demand between points A and B and between points C and D on demand curve $D_1$ in Panel (a). Are your results consistent with the notion that a linear demand curve is price elastic in its upper half and price inelastic in its lower half?

b. Compute the price elasticity of demand between points E and F and between points G and H on demand curve $D_2$ in Panel (b). Are your results consistent with the notion that a linear demand curve is price elastic in its upper half and price inelastic in its lower half?

c. Compare total spending at points A and B on $D_1$ in Panel (a). Is your result consistent with your finding about the price elasticity of demand between those two points?

d. Compare total spending at points C and D on $D_1$ in Panel (a). Is your result consistent with your finding about the price elasticity of demand between those two points?

e. Compare total spending at points E and F on $D_2$ in Panel (b). Is your result consistent with your finding about the price elasticity of demand between those two points?

f. Compare total spending at points G and H on $D_2$ in Panel (b). Is your result consistent with your finding about the price elasticity of demand between those two points?

6. Suppose Janice buys the following amounts of various food items depending on her weekly income:

<table>
<thead>
<tr>
<th>Weekly Income</th>
<th>Hamburgers</th>
<th>Pizza</th>
<th>Ice Cream Sundaes</th>
</tr>
</thead>
<tbody>
<tr>
<td>$500</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>$750</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

a. Compute Janice’s income elasticity of demand for hamburgers.
b. Compute Janice’s income elasticity of demand for pizza.
c. Compute Janice’s income elasticity of demand for ice cream sundaes.
d. Classify each good as normal or inferior.

7. Suppose the following table describes Jocelyn’s weekly snack purchases, which vary depending on the price of a bag of chips:

<table>
<thead>
<tr>
<th>Price of bag of chips</th>
<th>Bags of chips</th>
<th>Containers of salsa</th>
<th>Bags of pretzels</th>
<th>Cans of soda</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1.00</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>$1.50</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

a. Compute the cross price elasticity of salsa with respect to the price of a bag of chips.
b. Compute the cross price elasticity of pretzels with respect to the price of a bag of chips.
c. Compute the cross price elasticity of soda with respect to the price of a bag of chips.
d. Are chips and salsa substitutes or complements? How do you know?
e. Are chips and pretzels substitutes or complements? How do you know?
f. Are chips and soda substitutes or complements? How do you know?

8. The table below describes the supply curve for light bulbs:

<table>
<thead>
<tr>
<th>Price per light bulb</th>
<th>Quantity supplied per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1.00</td>
<td>500</td>
</tr>
<tr>
<td>1.50</td>
<td>3,000</td>
</tr>
<tr>
<td>2.00</td>
<td>4,000</td>
</tr>
<tr>
<td>2.50</td>
<td>4,500</td>
</tr>
<tr>
<td>3.00</td>
<td>4,500</td>
</tr>
</tbody>
</table>
Compute the price elasticity of supply and determine whether supply is price elastic, price inelastic, perfectly elastic, perfectly inelastic, or unit elastic:

a. when the price of a light bulb increases from $1.00 to $1.50.
b. when the price of a light bulb increases from $1.50 to $2.00.
c. when the price of a light bulb increases from $2.00 to $2.50.
d. when the price of a light bulb increases from $2.50 to $3.00.
CHAPTER 5     ELASTICITY: A MEASURE OF RESPONSE

ENDNOTES

1. Notice that since the number of units sold of a good is the same as the number of units bought, the definition for total revenue could also be used to define total spending. Which term we use depends on the question at hand. If we are trying to determine what happens to revenues of sellers, then we are asking about total revenue. If we are trying to determine how much consumers spend, then we are asking about total spending.

2. Division by zero results in an undefined solution. Saying that the price elasticity of demand is infinite requires that we say the denominator "approaches" zero.


5. Although close to zero in all cases, the significant and positive signs of income elasticity for marijuana, alcohol, and cocaine suggest that they are normal goods, but insignificant and negative signs, in the case of heroin, suggest that heroin is an inferior good; Saffer and Chaloupka (cited below) suggest the effects of income for all four substances might be affected by education.


