

3



INTERDEPENDENCE AND THE GAINS FROM TRADE

Consider your typical day. You wake up in the morning, and you pour yourself juice from oranges grown in Florida and coffee from beans grown in Brazil. Over breakfast, you watch a news program broadcast from New York on your television made in Japan. You get dressed in clothes made of cotton grown in Georgia and sewn in factories in Thailand. You drive to class in a car made of parts manufactured in more than a dozen countries around the world. Then you open up your economics textbook written by an author living in Massachusetts, published by a company located in Texas, and printed on paper made from trees grown in Oregon.

Every day you rely on many people from around the world, most of whom you do not know, to provide you with the goods and services that you enjoy. Such interdependence is possible because people trade with one another. Those people who provide you with goods and services are not acting out of generosity or concern for your welfare. Nor is some government agency directing them to make what you

**IN THIS CHAPTER
YOU WILL . . .**

Consider how everyone can benefit when people trade with one another

Learn the meaning of absolute advantage and comparative advantage

See how comparative advantage explains the gains from trade

Apply the theory of comparative advantage to everyday life and national policy

want and to give it to you. Instead, people provide you and other consumers with the goods and services they produce because they get something in return.

In subsequent chapters we will examine how our economy coordinates the activities of millions of people with varying tastes and abilities. As a starting point for this analysis, here we consider the reasons for economic interdependence. One of the *Ten Principles of Economics* highlighted in Chapter 1 is that trade can make everyone better off. This principle explains why people trade with their neighbors and why nations trade with other nations. In this chapter we examine this principle more closely. What exactly do people gain when they trade with one another? Why do people choose to become interdependent?



A PARABLE FOR THE MODERN ECONOMY

To understand why people choose to depend on others for goods and services and how this choice improves their lives, let's look at a simple economy. Imagine that there are two goods in the world—meat and potatoes. And there are two people in the world—a cattle rancher and a potato farmer—each of whom would like to eat both meat and potatoes.

The gains from trade are most obvious if the rancher can produce only meat and the farmer can produce only potatoes. In one scenario, the rancher and the farmer could choose to have nothing to do with each other. But after several months of eating beef roasted, boiled, broiled, and grilled, the rancher might decide that self-sufficiency is not all it's cracked up to be. The farmer, who has been eating potatoes mashed, fried, baked, and scalloped, would likely agree. It is easy to see that trade would allow them to enjoy greater variety: Each could then have a hamburger with french fries.

Although this scene illustrates most simply how everyone can benefit from trade, the gains would be similar if the rancher and the farmer were each capable of producing the other good, but only at great cost. Suppose, for example, that the potato farmer is able to raise cattle and produce meat, but that he is not very good at it. Similarly, suppose that the cattle rancher is able to grow potatoes, but that her land is not very well suited for it. In this case, it is easy to see that the farmer and the rancher can each benefit by specializing in what he or she does best and then trading with the other.

The gains from trade are less obvious, however, when one person is better at producing *every* good. For example, suppose that the rancher is better at raising cattle *and* better at growing potatoes than the farmer. In this case, should the rancher or farmer choose to remain self-sufficient? Or is there still reason for them to trade with each other? To answer this question, we need to look more closely at the factors that affect such a decision.

PRODUCTION POSSIBILITIES

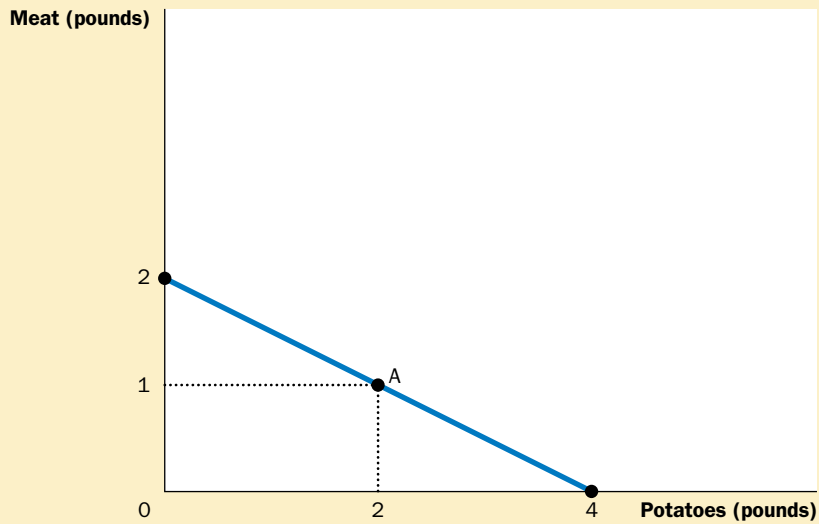
Suppose that the farmer and the rancher each work 40 hours a week and can devote this time to growing potatoes, raising cattle, or a combination of the two. Table 3-1 shows the amount of time each person requires to produce 1 pound of

Table 3-1

THE PRODUCTION OPPORTUNITIES OF THE FARMER AND THE RANCHER

	HOURS NEEDED TO MAKE 1 POUND OF:		AMOUNT PRODUCED IN 40 HOURS	
	MEAT	POTATOES	MEAT	POTATOES
FARMER	20 hours/lb	10 hours/lb	2 lbs	4 lbs
RANCHER	1 hour/lb	8 hours/lb	40 lbs	5 lbs

(a) The Farmer's Production Possibilities Frontier



(b) The Rancher's Production Possibilities Frontier

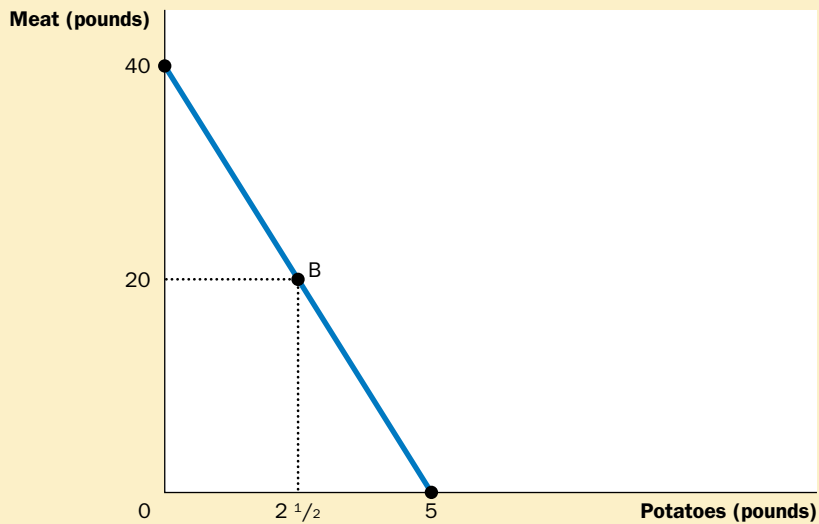


Figure 3-1

THE PRODUCTION POSSIBILITIES FRONTIER. Panel (a) shows the combinations of meat and potatoes that the farmer can produce. Panel (b) shows the combinations of meat and potatoes that the rancher can produce. Both production possibilities frontiers are derived from Table 3-1 and the assumption that the farmer and rancher each work 40 hours per week.

each good. The farmer can produce a pound of potatoes in 10 hours and a pound of meat in 20 hours. The rancher, who is more productive in both activities, can produce a pound of potatoes in 8 hours and a pound of meat in 1 hour.

Panel (a) of Figure 3-1 illustrates the amounts of meat and potatoes that the farmer can produce. If the farmer devotes all 40 hours of his time to potatoes, he produces 4 pounds of potatoes and no meat. If he devotes all his time to meat, he produces 2 pounds of meat and no potatoes. If the farmer divides his time equally between the two activities, spending 20 hours on each, he produces 2 pounds of potatoes and 1 pound of meat. The figure shows these three possible outcomes and all others in between.



This graph is the farmer's production possibilities frontier. As we discussed in Chapter 2, a production possibilities frontier shows the various mixes of output that an economy can produce. It illustrates one of the *Ten Principles of Economics* in Chapter 1: People face tradeoffs. Here the farmer faces a tradeoff between producing meat and producing potatoes. You may recall that the production possibilities frontier in Chapter 2 was drawn bowed out; in this case, the tradeoff between the two goods depends on the amounts being produced. Here, however, the farmer's technology for producing meat and potatoes (as summarized in Table 3-1) allows him to switch between one good and the other at a constant rate. In this case, the production possibilities frontier is a straight line.

Panel (b) of Figure 3-1 shows the production possibilities frontier for the rancher. If the rancher devotes all 40 hours of her time to potatoes, she produces 5 pounds of potatoes and no meat. If she devotes all her time to meat, she produces 40 pounds of meat and no potatoes. If the rancher divides her time equally, spending 20 hours on each activity, she produces 2 1/2 pounds of potatoes and 20 pounds of meat. Once again, the production possibilities frontier shows all the possible outcomes.

If the farmer and rancher choose to be self-sufficient, rather than trade with each other, then each consumes exactly what he or she produces. In this case, the production possibilities frontier is also the consumption possibilities frontier. That is, without trade, Figure 3-1 shows the possible combinations of meat and potatoes that the farmer and rancher can each consume.

Although these production possibilities frontiers are useful in showing the tradeoffs that the farmer and rancher face, they do not tell us what the farmer and rancher will actually choose to do. To determine their choices, we need to know the tastes of the farmer and the rancher. Let's suppose they choose the combinations identified by points A and B in Figure 3-1: The farmer produces and consumes 2 pounds of potatoes and 1 pound of meat, while the rancher produces and consumes 2 1/2 pounds of potatoes and 20 pounds of meat.

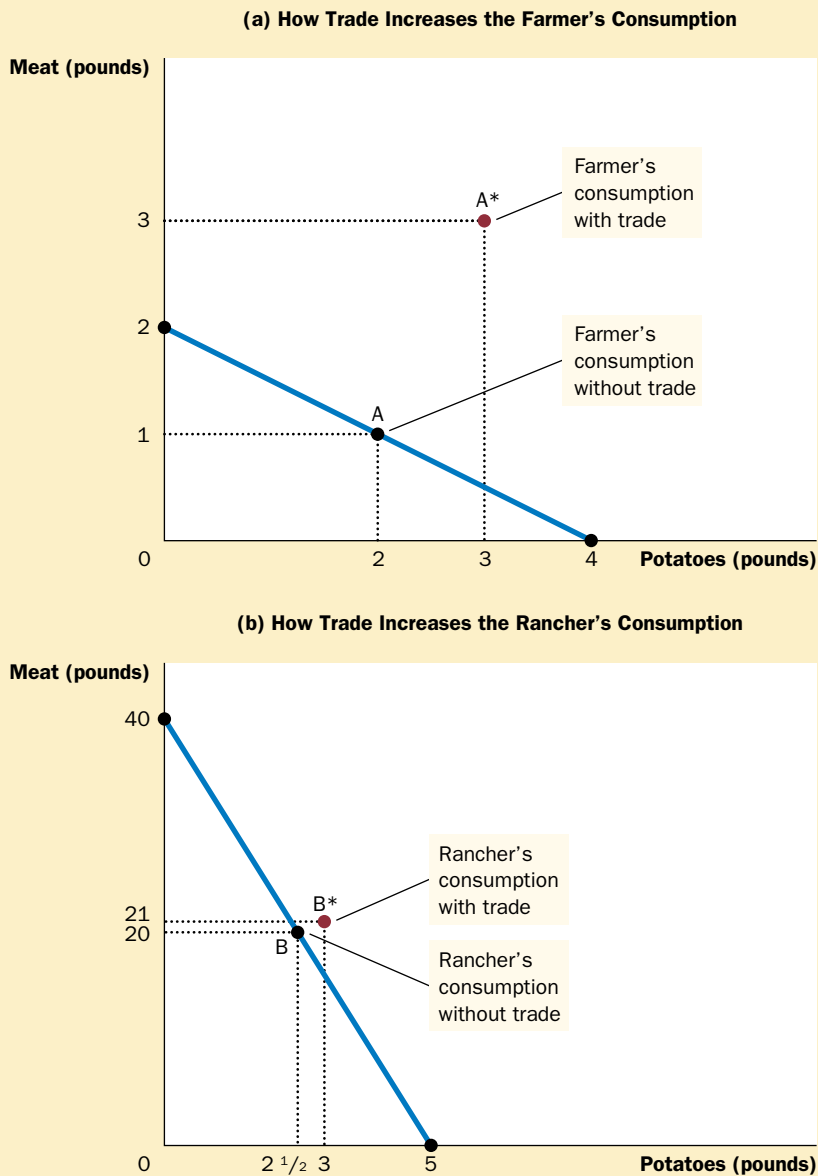
SPECIALIZATION AND TRADE

After several years of eating combination B, the rancher gets an idea and goes to talk to the farmer:

RANCHER: Farmer, my friend, have I got a deal for you! I know how to improve life for both of us. I think you should stop producing meat altogether and devote all your time to growing potatoes. According to my calculations, if you work 40 hours a week growing potatoes, you'll

Figure 3-2

HOW TRADE EXPANDS THE SET OF CONSUMPTION OPPORTUNITIES. The proposed trade between the farmer and the rancher offers each of them a combination of meat and potatoes that would be impossible in the absence of trade. In panel (a), the farmer gets to consume at point A* rather than point A. In panel (b), the rancher gets to consume at point B* rather than point B. Trade allows each to consume more meat and more potatoes.



produce 4 pounds of potatoes. If you give me 1 of those 4 pounds, I'll give you 3 pounds of meat in return. In the end, you'll get to eat 3 pounds of potatoes and 3 pounds of meat every week, instead of the 2 pounds of potatoes and 1 pound of meat you now get. If you go along with my plan, you'll have more of *both* foods. [To illustrate her point, the rancher shows the farmer panel (a) of Figure 3-2.]

FARMER: (*sounding skeptical*) That seems like a good deal for me. But I don't understand why you are offering it. If the deal is so good for me, it can't be good for you too.

	THE OUTCOME WITHOUT TRADE:		THE OUTCOME WITH TRADE:			THE GAINS FROM TRADE:		
	WHAT THEY PRODUCE AND CONSUME		WHAT THEY PRODUCE	WHAT THEY TRADE	WHAT THEY CONSUME	THE INCREASE IN CONSUMPTION		
FARMER	1 lb meat 2 lbs potatoes	}point A	0 lbs meat 4 lbs potatoes	Gets 3 lbs meat for 1 lb potatoes	3 lbs meat 3 lbs potatoes	}point A*	2 lbs meat 1 lb potatoes	}A* - A
RANCHER	20 lbs meat 2 1/2 lbs potatoes	}point B	24 lbs meat 2 lbs potatoes	Gives 3 lbs meat for 1 lb potatoes	21 lbs meat 3 lbs potatoes	}point B*	1 lb meat 1/2 lb potatoes	}B* - B

Table 3-2

THE GAINS FROM TRADE: A SUMMARY

RANCHER: Oh, but it is! If I spend 24 hours a week raising cattle and 16 hours growing potatoes, I'll produce 24 pounds of meat and 2 pounds of potatoes. After I give you 3 pounds of meat in exchange for 1 pound of potatoes, I'll have 21 pounds of meat and 3 pounds of potatoes. In the end, I will also get more of both foods than I have now. [She points out panel (b) of Figure 3-2.]

FARMER: I don't know. . . . This sounds too good to be true.

RANCHER: It's really not as complicated as it seems at first. Here—I have summarized my proposal for you in a simple table. [The rancher hands the farmer a copy of Table 3-2.]

FARMER: *(after pausing to study the table)* These calculations seem correct, but I am puzzled. How can this deal make us both better off?

RANCHER: We can both benefit because trade allows each of us to specialize in doing what we do best. You will spend more time growing potatoes and less time raising cattle. I will spend more time raising cattle and less time growing potatoes. As a result of specialization and trade, each of us can consume both more meat and more potatoes without working any more hours.

QUICK QUIZ: Draw an example of a production possibilities frontier for Robinson Crusoe, a shipwrecked sailor who spends his time gathering coconuts and catching fish. Does this frontier limit Crusoe's consumption of coconuts and fish if he lives by himself? Does he face the same limits if he can trade with natives on the island?

THE PRINCIPLE OF COMPARATIVE ADVANTAGE

The rancher's explanation of the gains from trade, though correct, poses a puzzle: If the rancher is better at both raising cattle and growing potatoes, how can the farmer ever specialize in doing what he does best? The farmer doesn't seem to do

anything best. To solve this puzzle, we need to look at the principle of *comparative advantage*.

As a first step in developing this principle, consider the following question: In our example, who can produce potatoes at lower cost—the farmer or the rancher? There are two possible answers, and in these two answers lie both the solution to our puzzle and the key to understanding the gains from trade.

ABSOLUTE ADVANTAGE

One way to answer the question about the cost of producing potatoes is to compare the inputs required by the two producers. The rancher needs only 8 hours to produce a pound of potatoes, whereas the farmer needs 10 hours. Based on this information, one might conclude that the rancher has the lower cost of producing potatoes.

Economists use the term **absolute advantage** when comparing the productivity of one person, firm, or nation to that of another. The producer that requires a smaller quantity of inputs to produce a good is said to have an absolute advantage in producing that good. In our example, the rancher has an absolute advantage both in producing potatoes and in producing meat, because she requires less time than the farmer to produce a unit of either good.

absolute advantage

the comparison among producers of a good according to their productivity

OPPORTUNITY COST AND COMPARATIVE ADVANTAGE

There is another way to look at the cost of producing potatoes. Rather than comparing inputs required, we can compare the opportunity costs. Recall from Chapter 1 that the **opportunity cost** of some item is what we give up to get that item. In our example, we assumed that the farmer and the rancher each spend 40 hours a week working. Time spent producing potatoes, therefore, takes away from time available for producing meat. As the rancher and farmer change their allocations of time between producing the two goods, they move along their production possibility frontiers; in a sense, they are using one good to produce the other. The opportunity cost measures the tradeoff that each of them faces.

Let's first consider the rancher's opportunity cost. Producing 1 pound of potatoes takes her 8 hours of work. When the rancher spends that 8 hours producing potatoes, she spends 8 hours less producing meat. Because the rancher needs only 1 hour to produce 1 pound of meat, 8 hours of work would yield 8 pounds of meat. Hence, the rancher's opportunity cost of 1 pound of potatoes is 8 pounds of meat.

Now consider the farmer's opportunity cost. Producing 1 pound of potatoes takes him 10 hours. Because he needs 20 hours to produce 1 pound of meat, 10 hours would yield 1/2 pound of meat. Hence, the farmer's opportunity cost of 1 pound of potatoes is 1/2 pound of meat.

Table 3-3 shows the opportunity cost of meat and potatoes for the two producers. Notice that the opportunity cost of meat is the inverse of the opportunity cost of potatoes. Because 1 pound of potatoes costs the rancher 8 pounds of meat, 1 pound of meat costs the rancher 1/8 pound of potatoes. Similarly, because 1 pound of potatoes costs the farmer 1/2 pound of meat, 1 pound of meat costs the farmer 2 pounds of potatoes.

Economists use the term **comparative advantage** when describing the opportunity cost of two producers. The producer who has the smaller opportunity cost

opportunity cost

whatever must be given up to obtain some item

comparative advantage

the comparison among producers of a good according to their opportunity cost

Table 3-3THE OPPORTUNITY COST OF
MEAT AND POTATOES

	OPPORTUNITY COST OF:	
	1 POUND OF MEAT	1 POUND OF POTATOES
FARMER	2 lbs potatoes	1/2 lb meat
RANCHER	1/8 lb potatoes	8 lbs meat

of producing a good—that is, who has to give up less of other goods to produce it—is said to have a comparative advantage in producing that good. In our example, the farmer has a lower opportunity cost of producing potatoes than the rancher (1/2 pound versus 8 pounds of meat). The rancher has a lower opportunity cost of producing meat than the farmer (1/8 pound versus 2 pounds of potatoes). Thus, the farmer has a comparative advantage in growing potatoes, and the rancher has a comparative advantage in producing meat.

Notice that it would be impossible for the same person to have a comparative advantage in both goods. Because the opportunity cost of one good is the inverse of the opportunity cost of the other, if a person's opportunity cost of one good is relatively high, his opportunity cost of the other good must be relatively low. Comparative advantage reflects the relative opportunity cost. Unless two people have exactly the same opportunity cost, one person will have a comparative advantage in one good, and the other person will have a comparative advantage in the other good.

COMPARATIVE ADVANTAGE AND TRADE

Differences in opportunity cost and comparative advantage create the gains from trade. When each person specializes in producing the good for which he or she has a comparative advantage, total production in the economy rises, and this increase in the size of the economic pie can be used to make everyone better off. In other words, as long as two people have different opportunity costs, each can benefit from trade by obtaining a good at a price lower than his or her opportunity cost of that good.

Consider the proposed deal from the viewpoint of the farmer. The farmer gets 3 pounds of meat in exchange for 1 pound of potatoes. In other words, the farmer buys each pound of meat for a price of 1/3 pound of potatoes. This price of meat is lower than his opportunity cost for 1 pound of meat, which is 2 pounds of potatoes. Thus, the farmer benefits from the deal because he gets to buy meat at a good price.

Now consider the deal from the rancher's viewpoint. The rancher buys 1 pound of potatoes for a price of 3 pounds of meat. This price of potatoes is lower than her opportunity cost of 1 pound of potatoes, which is 8 pounds of meat. Thus, the rancher benefits because she gets to buy potatoes at a good price.

These benefits arise because each person concentrates on the activity for which he or she has the lower opportunity cost: The farmer spends more time growing potatoes, and the rancher spends more time producing meat. As a result, the total production of potatoes and the total production of meat both rise, and the farmer

FYI*The Legacy of Adam Smith and David Ricardo*

Economists have long understood the principle of comparative advantage. Here is how the great economist Adam Smith put the argument:

It is a maxim of every prudent master of a family, never to attempt to make at home what it will cost him more to make than to buy. The tailor does not attempt to make his own

shoes, but buys them of the shoemaker. The shoemaker does not attempt to make his own clothes but employs a tailor. The farmer attempts to make neither the one nor the other, but employs those different artificers. All of them find it for their interest to employ their whole industry in a way in which they have some advantage over their neighbors, and to purchase with a part of its produce, or what is the same thing, with the price of part of it, whatever else they have occasion for.

This quotation is from Smith's 1776 book, *An Inquiry into the Nature and Causes of the Wealth of Nations*, which was

a landmark in the analysis of trade and economic interdependence.

Smith's book inspired David Ricardo, a millionaire stockbroker, to become an economist. In his 1817 book, *Principles of Political Economy and Taxation*, Ricardo developed the principle of comparative advantage as we know it today. His defense of free trade was not a mere academic exercise. Ricardo put his economic beliefs to work as a member of the British Parliament, where he opposed the Corn Laws, which restricted the import of grain.

The conclusions of Adam Smith and David Ricardo on the gains from trade have held up well over time. Although economists often disagree on questions of policy, they are united in their support of free trade. Moreover, the central argument for free trade has not changed much in the past two centuries. Even though the field of economics has broadened its scope and refined its theories since the time of Smith and Ricardo, economists' opposition to trade restrictions is still based largely on the principle of comparative advantage.



DAVID RICARDO

and rancher share the benefits of this increased production. The moral of the story of the farmer and the rancher should now be clear: *Trade can benefit everyone in society because it allows people to specialize in activities in which they have a comparative advantage.*

QUICK QUIZ: Robinson Crusoe can gather 10 coconuts or catch 1 fish per hour. His friend Friday can gather 30 coconuts or catch 2 fish per hour. What is Crusoe's opportunity cost of catching one fish? What is Friday's? Who has an absolute advantage in catching fish? Who has a comparative advantage in catching fish?

APPLICATIONS OF COMPARATIVE ADVANTAGE

The principle of comparative advantage explains interdependence and the gains from trade. Because interdependence is so prevalent in the modern world, the principle of comparative advantage has many applications. Here are two examples, one fanciful and one of great practical importance.

SHOULD TIGER WOODS MOW HIS OWN LAWN?

Tiger Woods spends a lot of time walking around on grass. One of the most talented golfers of all time, he can hit a drive and sink a putt in a way that most casual golfers only dream of doing. Most likely, he is talented at other activities too. For example, let's imagine that Woods can mow his lawn faster than anyone else. But just because he *can* mow his lawn fast, does this mean he *should*?

To answer this question, we can use the concepts of opportunity cost and comparative advantage. Let's say that Woods can mow his lawn in 2 hours. In that same 2 hours, he could film a television commercial for Nike and earn \$10,000. By contrast, Forrest Gump, the boy next door, can mow Woods's lawn in 4 hours. In that same 4 hours, he could work at McDonald's and earn \$20.

In this example, Woods's opportunity cost of mowing the lawn is \$10,000 and Forrest's opportunity cost is \$20. Woods has an absolute advantage in mowing lawns because he can do the work in less time. Yet Forrest has a comparative advantage in mowing lawns because he has the lower opportunity cost.

IN THE NEWS

Who has a Comparative Advantage in Producing Lamb?



A COMMON BARRIER TO FREE TRADE among countries is tariffs, which are taxes on the import of goods from abroad. In the following opinion column, economist Douglas Irwin discusses a recent example of their use.

Lamb Tariffs Fleece U.S. Consumers

BY DOUGLAS A. IRWIN

President Clinton dealt a serious blow to free trade last Wednesday, when he announced that the U.S. would impose stiff import tariffs on lamb from Australia and New Zealand. His decision undercuts

American leadership and makes a mockery of the administration's claims that it favors free and fair trade.

U.S. sheep producers have long been dependent on government. For more than half a century, until Congress enacted farm-policy reforms in 1995, they received subsidies for wool. Having lost that handout, saddled with high costs and inefficiencies, and facing domestic competition from chicken, beef, and pork, sheep producers sought to stop foreign competition by filing for import relief.

Almost all U.S. lamb imports come from Australia and New Zealand, major agricultural producers with a crushing comparative advantage. New Zealand has fewer than four million people but as many as 60 million sheep (compared with about seven million sheep in the U.S.). New Zealand's farmers have invested substantial resources in new technology and effective marketing, making them among the most efficient producers in the world. New Zealand also eliminated domestic agricultural

subsidies in the free-market reforms of the 1950s, and is a free-trading country, on track to eliminate all import tariffs by 2006.

Rather than emulate this example, the American Sheep Industry Association, among others, filed an "escape clause" petition under the Trade Act of 1974, which allows temporary "breathing space" protection to import-competing industries. Under the escape-clause provision, a petitioning industry is required to present an adjustment plan to ensure that it undertakes steps to become competitive in the future. The tariff protection is usually limited and scheduled to be phased out.

The U.S. International Trade Commission determines whether imports are a cause of "serious injury" to the domestic industry and, if so, proposes a remedy, which the president has full discretion to adopt, change or reject. In February, the ITC did not find that the domestic industry had suffered "serious injury," but rather adopted the weaker ruling that imports were "a substantial

The gains from trade in this example are tremendous. Rather than mowing his own lawn, Woods should make the commercial and hire Forrest to mow the lawn. As long as Woods pays Forrest more than \$20 and less than \$10,000, both of them are better off.

SHOULD THE UNITED STATES TRADE WITH OTHER COUNTRIES?

Just as individuals can benefit from specialization and trade with one another, as the farmer and rancher did, so can populations of people in different countries. Many of the goods that Americans enjoy are produced abroad, and many of the goods produced in the United States are sold abroad. Goods produced abroad and sold domestically are called **imports**. Goods produced domestically and sold abroad are called **exports**.

imports

goods produced abroad and sold domestically

exports

goods produced domestically and sold abroad

cause of threat of serious injury." The ITC did not propose to roll back imports, only to impose a 20% tariff (declining over four years) on imports above last year's levels.

The administration at first appeared to be considering less restrictive measures. Australia and New Zealand even offered financial assistance to the U.S. producers, and the administration delayed any announcement and appeared to be working toward a compromise. But these hopes were completely dashed with the shocking final decision, in which the administration capitulated to the demands of the sheep industry and its advocates in Congress.

The congressional charge was led by Sen. Max Baucus (D., Mont.), a member of the Agriculture Committee whose sister, a sheep producer, had appeared before the ITC to press for higher tariffs. The administration opted for . . . [the following:] On top of existing tariffs, the president imposed a 9% tariff on *all* imports in the first year (declining to 6% and then 3% in years two and three), and

a whopping 40% tariff on imports above last year's levels (dropping to 32% and 24%). . . .

The American Sheep Industry Association's president happily announced that the move will "bring some stability to the market." Whenever producers speak of bringing stability to the market, you know that consumers are getting fleeced.

The lamb decision, while little noticed at home, has been closely followed abroad. The decision undercuts the administration's free-trade rhetoric and harms its efforts to get other countries to open up their markets. Some import relief had been expected, but not so clearly protectionist as what finally materialized. The extreme decision has outraged farmers in Australia and New Zealand, and officials there have vowed to take the U.S. to a WTO dispute settlement panel.

The administration's timing could not have been worse. The decision came right after an Asia Pacific Economic Cooperation summit reaffirmed its commit-

ment to reduce trade barriers, and a few months before the World Trade Organization's November meeting in Seattle, where the WTO is to launch a new round of multilateral trade negotiations. A principal U.S. objective at the summit is the reduction of agricultural protection in Europe and elsewhere.

In 1947, facing an election the next year, President Truman courageously resisted special interest pressure and vetoed a bill to impose import quotas on wool, which would have jeopardized the first postwar multilateral trade negotiations due to start later that year. In contrast, Mr. Clinton, though a lame duck, caved in to political pressure. If the U.S., whose booming economy is the envy of the world, cannot resist protectionism, how can it expect other countries to do so?

SOURCE: *The Wall Street Journal*, July 12, 1999, p. A28.

To see how countries can benefit from trade, suppose there are two countries, the United States and Japan, and two goods, food and cars. Imagine that the two countries produce cars equally well: An American worker and a Japanese worker can each produce 1 car per month. By contrast, because the United States has more and better land, it is better at producing food: A U.S. worker can produce 2 tons of food per month, whereas a Japanese worker can produce only 1 ton of food per month.

The principle of comparative advantage states that each good should be produced by the country that has the smaller opportunity cost of producing that good. Because the opportunity cost of a car is 2 tons of food in the United States but only 1 ton of food in Japan, Japan has a comparative advantage in producing cars. Japan should produce more cars than it wants for its own use and export some of them to the United States. Similarly, because the opportunity cost of a ton of food is 1 car in Japan but only 1/2 car in the United States, the United States has a comparative advantage in producing food. The United States should produce more food than it wants to consume and export some of it to Japan. Through specialization and trade, both countries can have more food and more cars.

In reality, of course, the issues involved in trade among nations are more complex than this example suggests, as we will see in Chapter 9. Most important among these issues is that each country has many citizens with different interests. International trade can make some individuals worse off, even as it makes the country as a whole better off. When the United States exports food and imports cars, the impact on an American farmer is not the same as the impact on an American autoworker. Yet, contrary to the opinions sometimes voiced by politicians and political commentators, international trade is not like war, in which some countries win and others lose. Trade allows all countries to achieve greater prosperity.

QUICK QUIZ: Suppose that the world's fastest typist happens to be trained in brain surgery. Should he do his own typing or hire a secretary? Explain.

CONCLUSION

The principle of comparative advantage shows that trade can make everyone better off. You should now understand more fully the benefits of living in an interdependent economy. But having seen why interdependence is desirable, you might naturally ask how it is possible. How do free societies coordinate the diverse activities of all the people involved in their economies? What ensures that goods and services will get from those who should be producing them to those who should be consuming them?

In a world with only two people, such as the rancher and the farmer, the answer is simple: These two people can directly bargain and allocate resources between themselves. In the real world with billions of people, the answer is less obvious. We take up this issue in the next chapter, where we see that free societies allocate resources through the market forces of supply and demand.

Summary

- ◆ Each person consumes goods and services produced by many other people both in our country and around the world. Interdependence and trade are desirable because they allow everyone to enjoy a greater quantity and variety of goods and services.
- ◆ There are two ways to compare the ability of two people in producing a good. The person who can produce the good with the smaller quantity of inputs is said to have an *absolute advantage* in producing the good. The person who has the smaller opportunity cost of producing the good is said to have a *comparative advantage*. The gains from trade are based on comparative advantage, not absolute advantage.
- ◆ Trade makes everyone better off because it allows people to specialize in those activities in which they have a comparative advantage.
- ◆ The principle of comparative advantage applies to countries as well as to people. Economists use the principle of comparative advantage to advocate free trade among countries.

Key Concepts

absolute advantage, p. 53
opportunity cost, p. 53

comparative advantage, p. 53
imports, p. 57

exports, p. 57

Questions for Review

1. Explain how absolute advantage and comparative advantage differ.
2. Give an example in which one person has an absolute advantage in doing something but another person has a comparative advantage.
3. Is absolute advantage or comparative advantage more important for trade? Explain your reasoning, using the example in your answer to Question 2.
4. Will a nation tend to export or import goods for which it has a comparative advantage? Explain.
5. Why do economists oppose policies that restrict trade among nations?

Problems and Applications

1. Consider the farmer and the rancher from our example in this chapter. Explain why the farmer's opportunity cost of producing 1 pound of meat is 2 pounds of potatoes. Explain why the rancher's opportunity cost of producing 1 pound of meat is $1/8$ pound of potatoes.
2. Maria can read 20 pages of economics in an hour. She can also read 50 pages of sociology in an hour. She spends 5 hours per day studying.
 - a. Draw Maria's production possibilities frontier for reading economics and sociology.
 - b. What is Maria's opportunity cost of reading 100 pages of sociology?
3. American and Japanese workers can each produce 4 cars a year. An American worker can produce 10 tons of grain a year, whereas a Japanese worker can produce 5 tons of grain a year. To keep things simple, assume that each country has 100 million workers.
 - a. For this situation, construct a table analogous to Table 3-1.
 - b. Graph the production possibilities frontier of the American and Japanese economies.
 - c. For the United States, what is the opportunity cost of a car? Of grain? For Japan, what is the opportunity cost of a car? Of grain? Put

this information in a table analogous to Table 3-3.

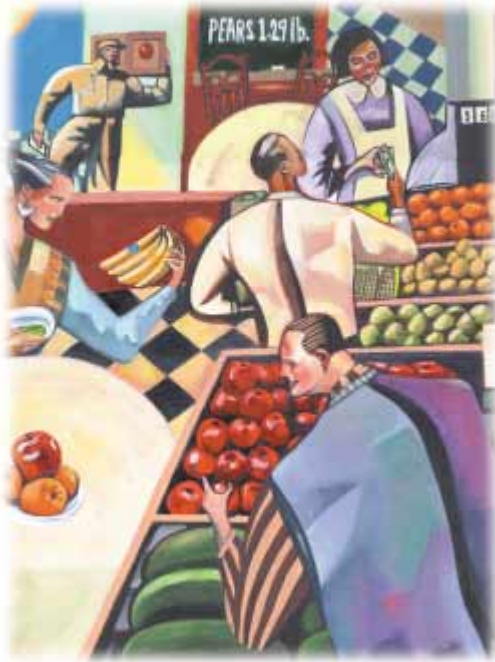
- d. Which country has an absolute advantage in producing cars? In producing grain?
 - e. Which country has a comparative advantage in producing cars? In producing grain?
 - f. Without trade, half of each country's workers produce cars and half produce grain. What quantities of cars and grain does each country produce?
 - g. Starting from a position without trade, give an example in which trade makes each country better off.
4. Pat and Kris are roommates. They spend most of their time studying (of course), but they leave some time for their favorite activities: making pizza and brewing root beer. Pat takes 4 hours to brew a gallon of root beer and 2 hours to make a pizza. Kris takes 6 hours to brew a gallon of root beer and 4 hours to make a pizza.
 - a. What is each roommate's opportunity cost of making a pizza? Who has the absolute advantage in making pizza? Who has the comparative advantage in making pizza?
 - b. If Pat and Kris trade foods with each other, who will trade away pizza in exchange for root beer?
 - c. The price of pizza can be expressed in terms of gallons of root beer. What is the highest price at which pizza can be traded that would make both roommates better off? What is the lowest price? Explain.
 5. Suppose that there are 10 million workers in Canada, and that each of these workers can produce either 2 cars or 30 bushels of wheat in a year.
 - a. What is the opportunity cost of producing a car in Canada? What is the opportunity cost of producing a bushel of wheat in Canada? Explain the relationship between the opportunity costs of the two goods.
 - b. Draw Canada's production possibilities frontier. If Canada chooses to consume 10 million cars, how much wheat can it consume without trade? Label this point on the production possibilities frontier.
 - c. Now suppose that the United States offers to buy 10 million cars from Canada in exchange for 20 bushels of wheat per car. If Canada continues to consume 10 million cars, how much wheat does this deal allow Canada to consume? Label this point on your diagram. Should Canada accept the deal?
 6. Consider a professor who is writing a book. The professor can both write the chapters and gather the needed data faster than anyone else at his university. Still, he pays a student to collect data at the library. Is this sensible? Explain.
 7. England and Scotland both produce scones and sweaters. Suppose that an English worker can produce 50 scones per hour or 1 sweater per hour. Suppose that a Scottish worker can produce 40 scones per hour or 2 sweaters per hour.
 - a. Which country has the absolute advantage in the production of each good? Which country has the comparative advantage?
 - b. If England and Scotland decide to trade, which commodity will Scotland trade to England? Explain.
 - c. If a Scottish worker could produce only 1 sweater per hour, would Scotland still gain from trade? Would England still gain from trade? Explain.
 8. Consider once again the farmer and rancher discussed in the chapter.
 - a. Suppose that a technological advance makes the farmer better at producing meat, so that he now needs only 2 hours to produce 1 pound of meat. What is his opportunity cost of meat and potatoes now? Does this alter his comparative advantage?
 - b. Is the deal that the rancher proposes—3 pounds of meat for 1 pound of potatoes—still good for the farmer? Explain.
 - c. Propose another deal to which the farmer and rancher might agree now.
 9. The following table describes the production possibilities of two cities in the country of Baseballia:

	PAIRS OF RED SOCKS PER WORKER PER HOUR	PAIRS OF WHITE SOCKS PER WORKER PER HOUR
BOSTON	3	3
CHICAGO	2	1

 - a. Without trade, what is the price of white socks (in terms of red socks) in Boston? What is the price in Chicago?
 - b. Which city has an absolute advantage in the production of each color sock? Which city has a comparative advantage in the production of each color sock?
 - c. If the cities trade with each other, which color sock will each export?

- d. What is the range of prices at which trade can occur?
10. Suppose that all goods can be produced with fewer worker hours in Germany than in France.
 - a. In what sense is the cost of all goods lower in Germany than in France?
 - b. In what sense is the cost of some goods lower in France?
 - c. If Germany and France traded with each other, would both countries be better off as a result? Explain in the context of your answers to parts (a) and (b).
 11. Are the following statements true or false? Explain in each case.
 - a. "Two countries can achieve gains from trade even if one of the countries has an absolute advantage in the production of all goods."
 - b. "Certain very talented people have a comparative advantage in everything they do."
 - c. "If a certain trade is good for one person, it can't be good for the other one."

4



THE MARKET FORCES OF SUPPLY AND DEMAND

When a cold snap hits Florida, the price of orange juice rises in supermarkets throughout the country. When the weather turns warm in New England every summer, the price of hotel rooms in the Caribbean plummets. When a war breaks out in the Middle East, the price of gasoline in the United States rises, and the price of a used Cadillac falls. What do these events have in common? They all show the workings of supply and demand.

Supply and demand are the two words that economists use most often—and for good reason. Supply and demand are the forces that make market economies work. They determine the quantity of each good produced and the price at which it is sold. If you want to know how any event or policy will affect the economy, you must think first about how it will affect supply and demand.

This chapter introduces the theory of supply and demand. It considers how buyers and sellers behave and how they interact with one another. It shows how

IN THIS CHAPTER
YOU WILL . . .

***Learn the nature of
a competitive
market***

***Examine what
determines the
demand for a good
in a competitive
market***

***Examine what
determines the
supply of a good in a
competitive market***

***See how supply and
demand together set
the price of a good
and the quantity
sold***

***Consider the key
role of prices in
allocating scarce
resources in market
economies***

supply and demand determine prices in a market economy and how prices, in turn, allocate the economy's scarce resources.

MARKETS AND COMPETITION

market

a group of buyers and sellers of a particular good or service

The terms *supply* and *demand* refer to the behavior of people as they interact with one another in markets. A **market** is a group of buyers and sellers of a particular good or service. The buyers as a group determine the demand for the product, and the sellers as a group determine the supply of the product. Before discussing how buyers and sellers behave, let's first consider more fully what we mean by a "market" and the various types of markets we observe in the economy.

COMPETITIVE MARKETS

Markets take many forms. Sometimes markets are highly organized, such as the markets for many agricultural commodities. In these markets, buyers and sellers meet at a specific time and place, where an auctioneer helps set prices and arrange sales.

More often, markets are less organized. For example, consider the market for ice cream in a particular town. Buyers of ice cream do not meet together at any one time. The sellers of ice cream are in different locations and offer somewhat different products. There is no auctioneer calling out the price of ice cream. Each seller posts a price for an ice-cream cone, and each buyer decides how much ice cream to buy at each store.

Even though it is not organized, the group of ice-cream buyers and ice-cream sellers forms a market. Each buyer knows that there are several sellers from which to choose, and each seller is aware that his product is similar to that offered by other sellers. The price of ice cream and the quantity of ice cream sold are not determined by any single buyer or seller. Rather, price and quantity are determined by all buyers and sellers as they interact in the marketplace.

The market for ice cream, like most markets in the economy, is highly competitive. A **competitive market** is a market in which there are many buyers and many sellers so that each has a negligible impact on the market price. Each seller of ice cream has limited control over the price because other sellers are offering similar products. A seller has little reason to charge less than the going price, and if he or she charges more, buyers will make their purchases elsewhere. Similarly, no single buyer of ice cream can influence the price of ice cream because each buyer purchases only a small amount.

In this chapter we examine how buyers and sellers interact in competitive markets. We see how the forces of supply and demand determine both the quantity of the good sold and its price.

competitive market

a market in which there are many buyers and many sellers so that each has a negligible impact on the market price

COMPETITION: PERFECT AND OTHERWISE

We assume in this chapter that markets are *perfectly competitive*. Perfectly competitive markets are defined by two primary characteristics: (1) the goods being offered for sale are all the same, and (2) the buyers and sellers are so numerous that

no single buyer or seller can influence the market price. Because buyers and sellers in perfectly competitive markets must accept the price the market determines, they are said to be *price takers*.

There are some markets in which the assumption of perfect competition applies perfectly. In the wheat market, for example, there are thousands of farmers who sell wheat and millions of consumers who use wheat and wheat products. Because no single buyer or seller can influence the price of wheat, each takes the price as given.

Not all goods and services, however, are sold in perfectly competitive markets. Some markets have only one seller, and this seller sets the price. Such a seller is called a *monopoly*. Your local cable television company, for instance, may be a monopoly. Residents of your town probably have only one cable company from which to buy this service.

Some markets fall between the extremes of perfect competition and monopoly. One such market, called an *oligopoly*, has a few sellers that do not always compete aggressively. Airline routes are an example. If a route between two cities is serviced by only two or three carriers, the carriers may avoid rigorous competition to keep prices high. Another type of market is *monopolistically competitive*; it contains many sellers, each offering a slightly different product. Because the products are not exactly the same, each seller has some ability to set the price for its own product. An example is the software industry. Many word processing programs compete with one another for users, but every program is different from every other and has its own price.

Despite the diversity of market types we find in the world, we begin by studying perfect competition. Perfectly competitive markets are the easiest to analyze. Moreover, because some degree of competition is present in most markets, many of the lessons that we learn by studying supply and demand under perfect competition apply in more complicated markets as well.

QUICK QUIZ: What is a market? ♦ What does it mean for a market to be competitive?

DEMAND

We begin our study of markets by examining the behavior of buyers. Here we consider what determines the **quantity demanded** of any good, which is the amount of the good that buyers are willing and able to purchase. To focus our thinking, let's keep in mind a particular good—ice cream.

quantity demanded

the amount of a good that buyers are willing and able to purchase

WHAT DETERMINES THE QUANTITY AN INDIVIDUAL DEMANDS?

Consider your own demand for ice cream. How do you decide how much ice cream to buy each month, and what factors affect your decision? Here are some of the answers you might give.

law of demand

the claim that, other things equal, the quantity demanded of a good falls when the price of the good rises

normal good

a good for which, other things equal, an increase in income leads to an increase in demand

inferior good

a good for which, other things equal, an increase in income leads to a decrease in demand

substitutes

two goods for which an increase in the price of one leads to an increase in the demand for the other

complements

two goods for which an increase in the price of one leads to a decrease in the demand for the other

Price If the price of ice cream rose to \$20 per scoop, you would buy less ice cream. You might buy frozen yogurt instead. If the price of ice cream fell to \$0.20 per scoop, you would buy more. Because the quantity demanded falls as the price rises and rises as the price falls, we say that the quantity demanded is *negatively related* to the price. This relationship between price and quantity demanded is true for most goods in the economy and, in fact, is so pervasive that economists call it the **law of demand**: Other things equal, when the price of a good rises, the quantity demanded of the good falls.

Income What would happen to your demand for ice cream if you lost your job one summer? Most likely, it would fall. A lower income means that you have less to spend in total, so you would have to spend less on some—and probably most—goods. If the demand for a good falls when income falls, the good is called a **normal good**.

Not all goods are normal goods. If the demand for a good rises when income falls, the good is called an **inferior good**. An example of an inferior good might be bus rides. As your income falls, you are less likely to buy a car or take a cab, and more likely to ride the bus.

Prices of Related Goods Suppose that the price of frozen yogurt falls. The law of demand says that you will buy more frozen yogurt. At the same time, you will probably buy less ice cream. Because ice cream and frozen yogurt are both cold, sweet, creamy desserts, they satisfy similar desires. When a fall in the price of one good reduces the demand for another good, the two goods are called **substitutes**. Substitutes are often pairs of goods that are used in place of each other, such as hot dogs and hamburgers, sweaters and sweatshirts, and movie tickets and video rentals.

Now suppose that the price of hot fudge falls. According to the law of demand, you will buy more hot fudge. Yet, in this case, you will buy *more* ice cream as well, because ice cream and hot fudge are often used together. When a fall in the price of one good raises the demand for another good, the two goods are called **complements**. Complements are often pairs of goods that are used together, such as gasoline and automobiles, computers and software, and skis and ski lift tickets.

Tastes The most obvious determinant of your demand is your tastes. If you like ice cream, you buy more of it. Economists normally do not try to explain people's tastes because tastes are based on historical and psychological forces that are beyond the realm of economics. Economists do, however, examine what happens when tastes change.

Expectations Your expectations about the future may affect your demand for a good or service today. For example, if you expect to earn a higher income next month, you may be more willing to spend some of your current savings buying ice cream. As another example, if you expect the price of ice cream to fall tomorrow, you may be less willing to buy an ice-cream cone at today's price.

THE DEMAND SCHEDULE AND THE DEMAND CURVE

We have seen that many variables determine the quantity of ice cream a person demands. Imagine that we hold all these variables constant except one—the price. Let's consider how the price affects the quantity of ice cream demanded.

Table 4-1 shows how many ice-cream cones Catherine buys each month at different prices of ice cream. If ice cream is free, Catherine eats 12 cones. At \$0.50 per cone, Catherine buys 10 cones. As the price rises further, she buys fewer and fewer cones. When the price reaches \$3.00, Catherine doesn't buy any ice cream at all. Table 4-1 is a **demand schedule**, a table that shows the relationship between the price of a good and the quantity demanded. (Economists use the term *schedule* because the table, with its parallel columns of numbers, resembles a train schedule.)

Figure 4-1 graphs the numbers in Table 4-1. By convention, the price of ice cream is on the vertical axis, and the quantity of ice cream demanded is on the

demand schedule

a table that shows the relationship between the price of a good and the quantity demanded

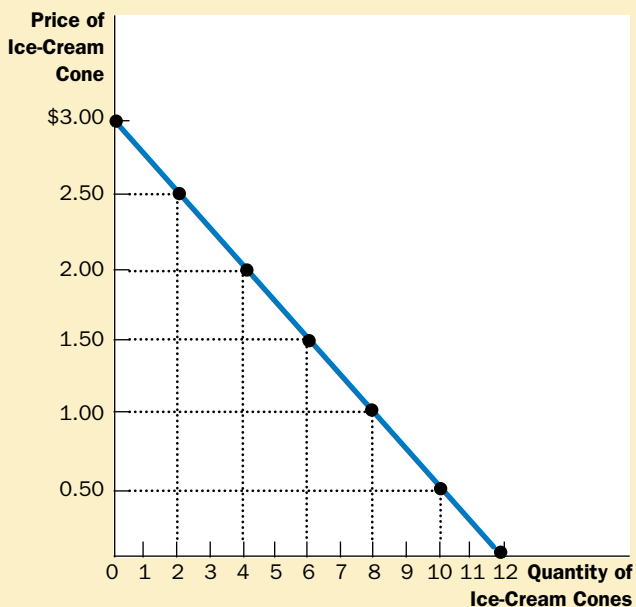
Table 4-1

CATHERINE'S DEMAND SCHEDULE. The demand schedule shows the quantity demanded at each price.

PRICE OF ICE-CREAM CONE	QUANTITY OF CONES DEMANDED
\$0.00	12
0.50	10
1.00	8
1.50	6
2.00	4
2.50	2
3.00	0

Figure 4-1

CATHERINE'S DEMAND CURVE. This demand curve, which graphs the demand schedule in Table 4-1, shows how the quantity demanded of the good changes as its price varies. Because a lower price increases the quantity demanded, the demand curve slopes downward.



demand curve

a graph of the relationship between the price of a good and the quantity demanded

ceteris paribus

a Latin phrase, translated as “other things being equal,” used as a reminder that all variables other than the ones being studied are assumed to be constant

horizontal axis. The downward-sloping line relating price and quantity demanded is called the **demand curve**.

CETERIS PARIBUS

Whenever you see a demand curve, remember that it is drawn holding many things constant. Catherine’s demand curve in Figure 4-1 shows what happens to the quantity of ice cream Catherine demands when only the price of ice cream varies. The curve is drawn assuming that Catherine’s income, tastes, expectations, and the prices of related products are not changing.

Economists use the term *ceteris paribus* to signify that all the relevant variables, except those being studied at that moment, are held constant. The Latin phrase literally means “other things being equal.” The demand curve slopes downward because, *ceteris paribus*, lower prices mean a greater quantity demanded.

Although the term *ceteris paribus* refers to a hypothetical situation in which some variables are assumed to be constant, in the real world many things change at the same time. For this reason, when we use the tools of supply and demand to analyze events or policies, it is important to keep in mind what is being held constant and what is not.

MARKET DEMAND VERSUS INDIVIDUAL DEMAND

So far we have talked about an individual’s demand for a product. To analyze how markets work, we need to determine the *market demand*, which is the sum of all the individual demands for a particular good or service.

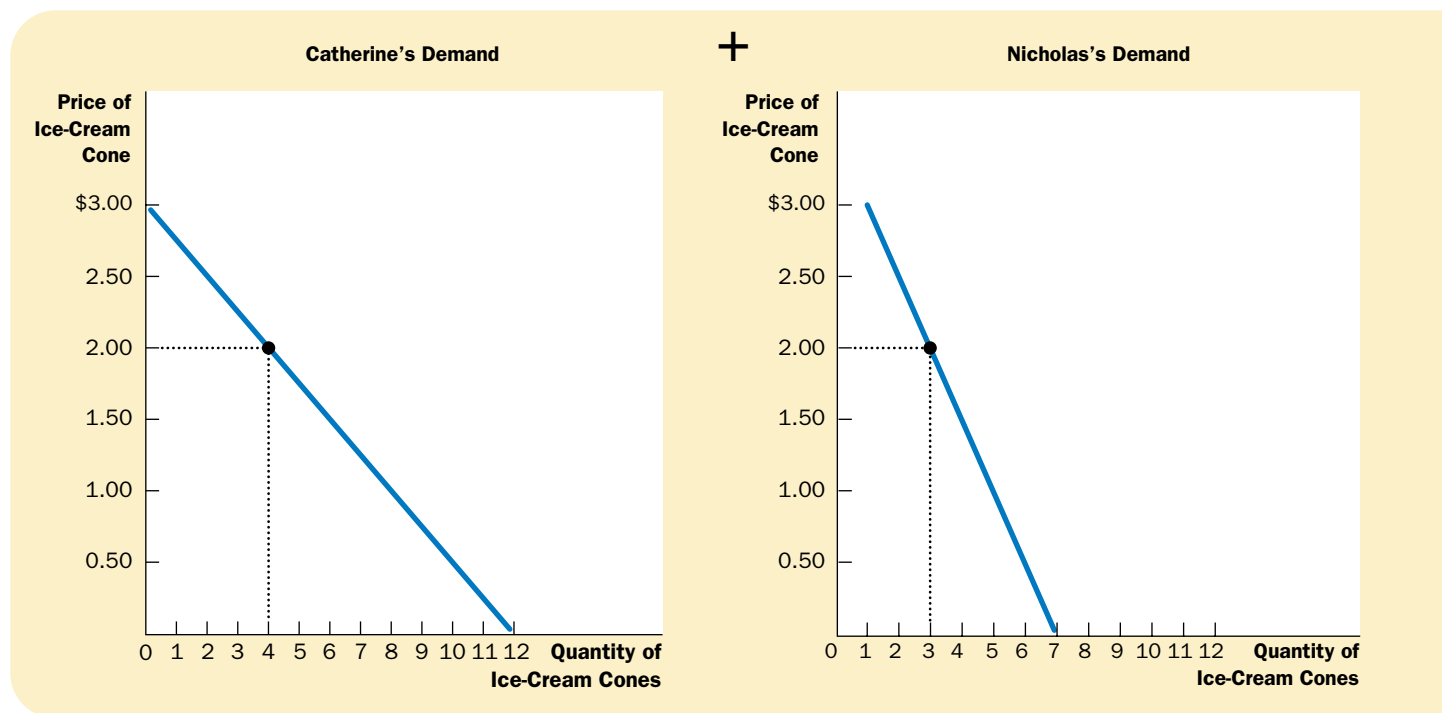


Table 4-2 shows the demand schedules for ice cream of two individuals—Catherine and Nicholas. At any price, Catherine’s demand schedule tells us how much ice cream she buys, and Nicholas’s demand schedule tells us how much ice cream he buys. The market demand is the sum of the two individual demands.

Because market demand is derived from individual demands, it depends on all those factors that determine the demand of individual buyers. Thus, market demand depends on buyers’ incomes, tastes, expectations, and the prices of related goods. It also depends on the number of buyers. (If Peter, another consumer of ice cream, were to join Catherine and Nicholas, the quantity demanded in the market would be higher at every price.) The demand schedules in Table 4-2 show what happens to quantity demanded as the price varies while all the other variables that determine quantity demanded are held constant.

Figure 4-2 shows the demand curves that correspond to these demand schedules. Notice that we sum the individual demand curves *horizontally* to obtain the

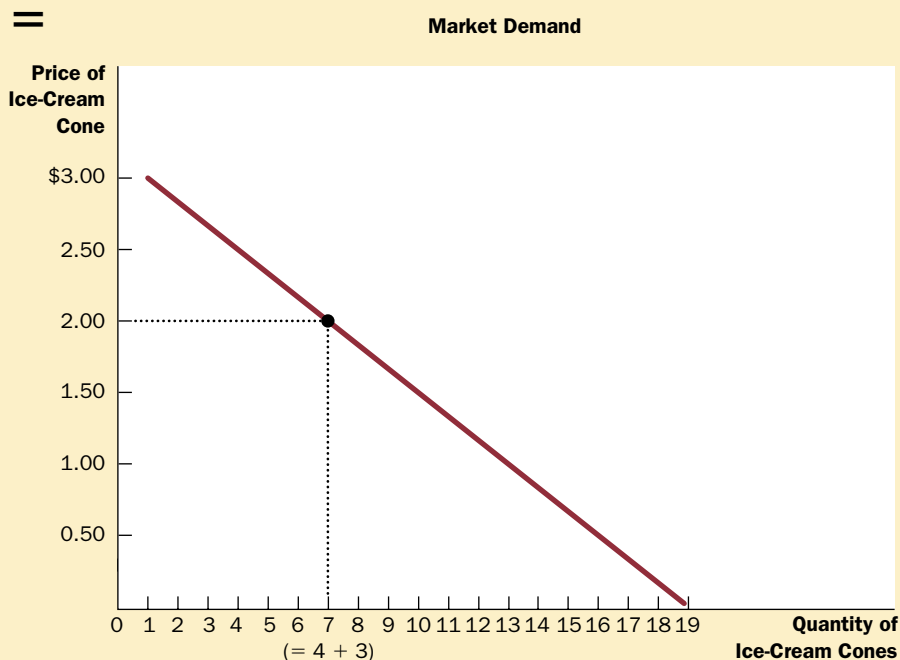
Table 4-2

PRICE OF ICE-CREAM CONE	CATHERINE		NICHOLAS		MARKET
\$0.00	12	+	7	=	19
0.50	10		6		16
1.00	8		5		13
1.50	6		4		10
2.00	4		3		7
2.50	2		2		4
3.00	0		1		1

INDIVIDUAL AND MARKET DEMAND SCHEDULES. The quantity demanded in a market is the sum of the quantities demanded by all the buyers.

Figure 4-2

MARKET DEMAND AS THE SUM OF INDIVIDUAL DEMANDS. The market demand curve is found by adding horizontally the individual demand curves. At a price of \$2, Catherine demands 4 ice-cream cones, and Nicholas demands 3 ice-cream cones. The quantity demanded in the market at this price is 7 cones.



market demand curve. That is, to find the total quantity demanded at any price, we add the individual quantities found on the horizontal axis of the individual demand curves. Because we are interested in analyzing how markets work, we will work most often with the market demand curve. The market demand curve shows how the total quantity demanded of a good varies as the price of the good varies.

SHIFTS IN THE DEMAND CURVE

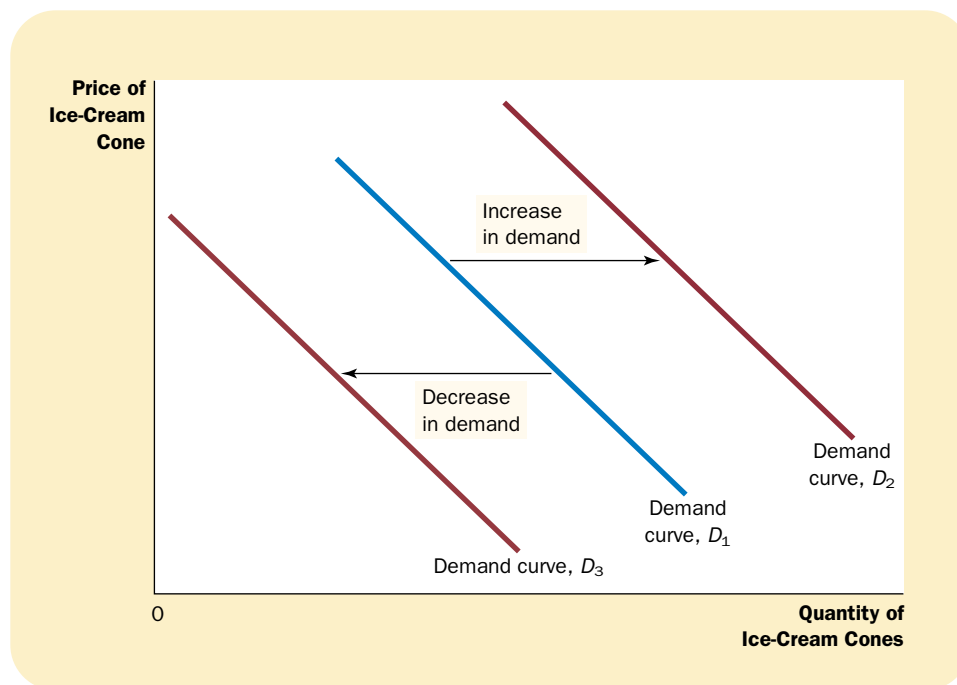
Suppose that the American Medical Association suddenly announces a new discovery: People who regularly eat ice cream live longer, healthier lives. How does this announcement affect the market for ice cream? The discovery changes people's tastes and raises the demand for ice cream. At any given price, buyers now want to purchase a larger quantity of ice cream, and the demand curve for ice cream shifts to the right.

Whenever any determinant of demand changes, other than the good's price, the demand curve shifts. As Figure 4-3 shows, any change that increases the quantity demanded at every price shifts the demand curve to the right. Similarly, any change that reduces the quantity demanded at every price shifts the demand curve to the left.

Table 4-3 lists the variables that determine the quantity demanded in a market and how a change in the variable affects the demand curve. Notice that price plays a special role in this table. Because price is on the vertical axis when we graph a demand curve, a change in price does not shift the curve but represents a movement along it. By contrast, when there is a change in income, the prices of related goods, tastes, expectations, or the number of buyers, the quantity demanded at each price changes; this is represented by a shift in the demand curve.

Figure 4-3

SHIFTS IN THE DEMAND CURVE. Any change that raises the quantity that buyers wish to purchase at a given price shifts the demand curve to the right. Any change that lowers the quantity that buyers wish to purchase at a given price shifts the demand curve to the left.



**VARIABLES THAT AFFECT
QUANTITY DEMANDED**
A CHANGE IN THIS VARIABLE . . .

Price	Represents a movement along the demand curve
Income	Shifts the demand curve
Prices of related goods	Shifts the demand curve
Tastes	Shifts the demand curve
Expectations	Shifts the demand curve
Number of buyers	Shifts the demand curve

Table 4-3

THE DETERMINANTS OF QUANTITY DEMANDED. This table lists the variables that can influence the quantity demanded in a market. Notice the special role that price plays: A change in the price represents a movement along the demand curve, whereas a change in one of the other variables shifts the demand curve.

In summary, *the demand curve shows what happens to the quantity demanded of a good when its price varies, holding constant all other determinants of quantity demanded. When one of these other determinants changes, the demand curve shifts.*

CASE STUDY TWO WAYS TO REDUCE THE QUANTITY OF SMOKING DEMANDED

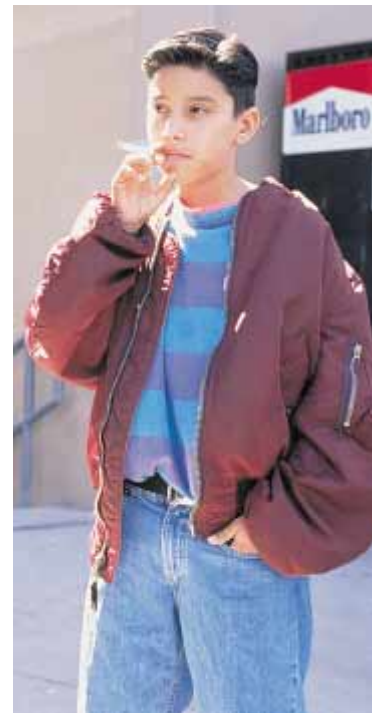
Public policymakers often want to reduce the amount that people smoke. There are two ways that policy can attempt to achieve this goal.

One way to reduce smoking is to shift the demand curve for cigarettes and other tobacco products. Public service announcements, mandatory health warnings on cigarette packages, and the prohibition of cigarette advertising on television are all policies aimed at reducing the quantity of cigarettes demanded at any given price. If successful, these policies shift the demand curve for cigarettes to the left, as in panel (a) of Figure 4-4.

Alternatively, policymakers can try to raise the price of cigarettes. If the government taxes the manufacture of cigarettes, for example, cigarette companies pass much of this tax on to consumers in the form of higher prices. A higher price encourages smokers to reduce the numbers of cigarettes they smoke. In this case, the reduced amount of smoking does not represent a shift in the demand curve. Instead, it represents a movement along the same demand curve to a point with a higher price and lower quantity, as in panel (b) of Figure 4-4.

How much does the amount of smoking respond to changes in the price of cigarettes? Economists have attempted to answer this question by studying what happens when the tax on cigarettes changes. They have found that a 10 percent increase in the price causes a 4 percent reduction in the quantity demanded. Teenagers are found to be especially sensitive to the price of cigarettes: A 10 percent increase in the price causes a 12 percent drop in teenage smoking.

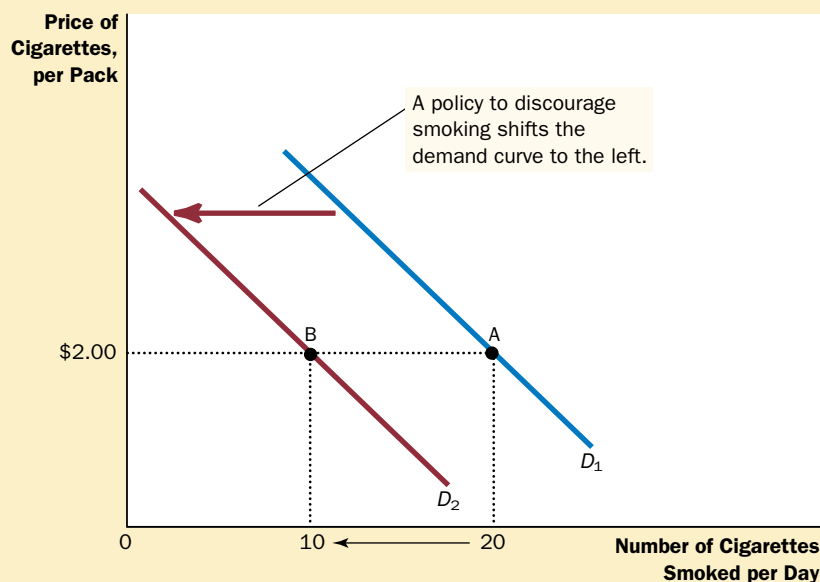
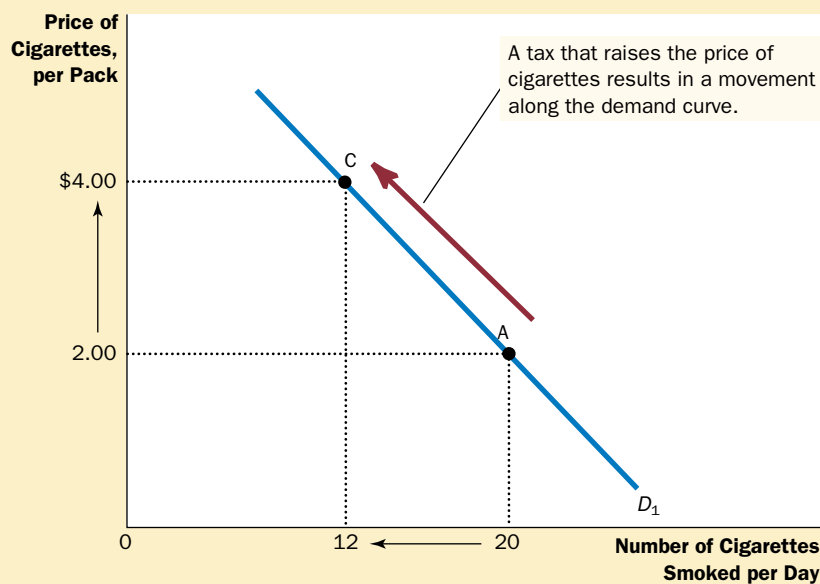
A related question is how the price of cigarettes affects the demand for illicit drugs, such as marijuana. Opponents of cigarette taxes often argue that tobacco and marijuana are substitutes, so that high cigarette prices encourage marijuana use. By contrast, many experts on substance abuse view tobacco as a “gateway drug” leading the young to experiment with other harmful substances. Most studies of the data are consistent with this view: They find that lower cigarette prices are associated with greater use of marijuana. In other words, tobacco and marijuana appear to be complements rather than substitutes.



WHAT IS THE BEST WAY TO STOP THIS?

Figure 4-4

SHIFTS IN THE DEMAND CURVE VERSUS MOVEMENTS ALONG THE DEMAND CURVE. If warnings on cigarette packages convince smokers to smoke less, the demand curve for cigarettes shifts to the left. In panel (a), the demand curve shifts from D_1 to D_2 . At a price of \$2 per pack, the quantity demanded falls from 20 to 10 cigarettes per day, as reflected by the shift from point A to point B. By contrast, if a tax raises the price of cigarettes, the demand curve does not shift. Instead, we observe a movement to a different point on the demand curve. In panel (b), when the price rises from \$2 to \$4, the quantity demanded falls from 20 to 12 cigarettes per day, as reflected by the movement from point A to point C.

(a) A Shift in the Demand Curve**(b) A Movement along the Demand Curve**

QUICK QUIZ: List the determinants of the quantity of pizza you demand.

- ◆ Make up an example of a demand schedule for pizza, and graph the implied demand curve.
- ◆ Give an example of something that would shift this demand curve.
- ◆ Would a change in the price of pizza shift this demand curve?

SUPPLY

We now turn to the other side of the market and examine the behavior of sellers. The **quantity supplied** of any good or service is the amount that sellers are willing and able to sell. Once again, to focus our thinking, let's consider the market for ice cream and look at the factors that determine the quantity supplied.

quantity supplied

the amount of a good that sellers are willing and able to sell

WHAT DETERMINES THE QUANTITY AN INDIVIDUAL SUPPLIES?

Imagine that you are running Student Sweets, a company that produces and sells ice cream. What determines the quantity of ice cream you are willing to produce and offer for sale? Here are some possible answers.

Price The price of ice cream is one determinant of the quantity supplied. When the price of ice cream is high, selling ice cream is profitable, and so the quantity supplied is large. As a seller of ice cream, you work long hours, buy many ice-cream machines, and hire many workers. By contrast, when the price of ice cream is low, your business is less profitable, and so you will produce less ice cream. At an even lower price, you may choose to go out of business altogether, and your quantity supplied falls to zero.

Because the quantity supplied rises as the price rises and falls as the price falls, we say that the quantity supplied is *positively related* to the price of the good. This relationship between price and quantity supplied is called the **law of supply**: Other things equal, when the price of a good rises, the quantity supplied of the good also rises.

law of supply

the claim that, other things equal, the quantity supplied of a good rises when the price of the good rises

Input Prices To produce its output of ice cream, Student Sweets uses various inputs: cream, sugar, flavoring, ice-cream machines, the buildings in which the ice cream is made, and the labor of workers to mix the ingredients and operate the machines. When the price of one or more of these inputs rises, producing ice cream is less profitable, and your firm supplies less ice cream. If input prices rise substantially, you might shut down your firm and supply no ice cream at all. Thus, the supply of a good is negatively related to the price of the inputs used to make the good.

Technology The technology for turning the inputs into ice cream is yet another determinant of supply. The invention of the mechanized ice-cream machine, for example, reduced the amount of labor necessary to make ice cream. By reducing firms' costs, the advance in technology raised the supply of ice cream.

Expectations The amount of ice cream you supply today may depend on your expectations of the future. For example, if you expect the price of ice cream to rise in the future, you will put some of your current production into storage and supply less to the market today.

THE SUPPLY SCHEDULE AND THE SUPPLY CURVE

supply schedule
a table that shows the relationship between the price of a good and the quantity supplied

supply curve
a graph of the relationship between the price of a good and the quantity supplied

Consider how the quantity supplied varies with the price, holding input prices, technology, and expectations constant. Table 4-4 shows the quantity supplied by Ben, an ice-cream seller, at various prices of ice cream. At a price below \$1.00, Ben does not supply any ice cream at all. As the price rises, he supplies a greater and greater quantity. This table is called the **supply schedule**.

Figure 4-5 graphs the relationship between the quantity of ice cream supplied and the price. The curve relating price and quantity supplied is called the **supply curve**. The supply curve slopes upward because, *ceteris paribus*, a higher price means a greater quantity supplied.

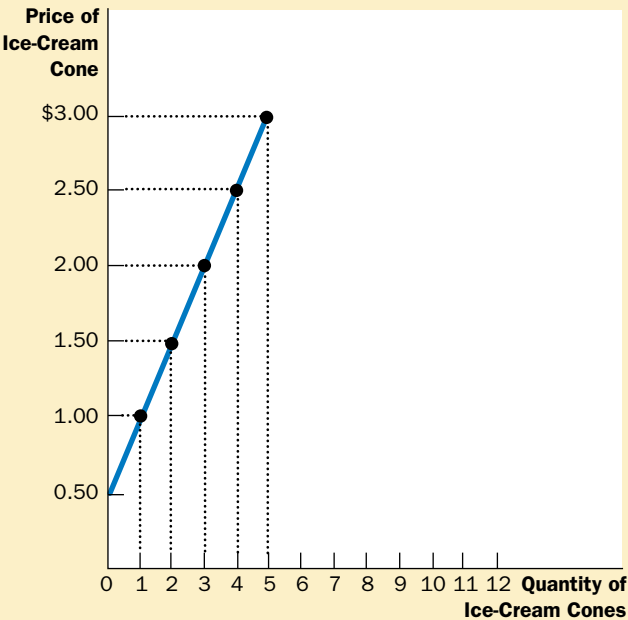
Table 4-4

BEN’S SUPPLY SCHEDULE. The supply schedule shows the quantity supplied at each price.

PRICE OF ICE-CREAM CONE	QUANTITY OF CONES SUPPLIED
\$0.00	0
0.50	0
1.00	1
1.50	2
2.00	3
2.50	4
3.00	5

Figure 4-5

BEN’S SUPPLY CURVE. This supply curve, which graphs the supply schedule in Table 4-4, shows how the quantity supplied of the good changes as its price varies. Because a higher price increases the quantity supplied, the supply curve slopes upward.



MARKET SUPPLY VERSUS INDIVIDUAL SUPPLY

Just as market demand is the sum of the demands of all buyers, market supply is the sum of the supplies of all sellers. Table 4-5 shows the supply schedules for two ice-cream producers—Ben and Jerry. At any price, Ben’s supply schedule tells us the quantity of ice cream Ben supplies, and Jerry’s supply schedule tells us the quantity of ice cream Jerry supplies. The market supply is the sum of the two individual supplies.

Market supply depends on all those factors that influence the supply of individual sellers, such as the prices of inputs used to produce the good, the available technology, and expectations. In addition, the supply in a market depends on the number of sellers. (If Ben or Jerry were to retire from the ice-cream business, the supply in the market would fall.) The supply schedules in Table 4-5 show what happens to quantity supplied as the price varies while all the other variables that determine quantity supplied are held constant.

Figure 4-6 shows the supply curves that correspond to the supply schedules in Table 4-5. As with demand curves, we sum the individual supply curves *horizontally* to obtain the market supply curve. That is, to find the total quantity supplied at any price, we add the individual quantities found on the horizontal axis of the individual supply curves. The market supply curve shows how the total quantity supplied varies as the price of the good varies.

SHIFTS IN THE SUPPLY CURVE

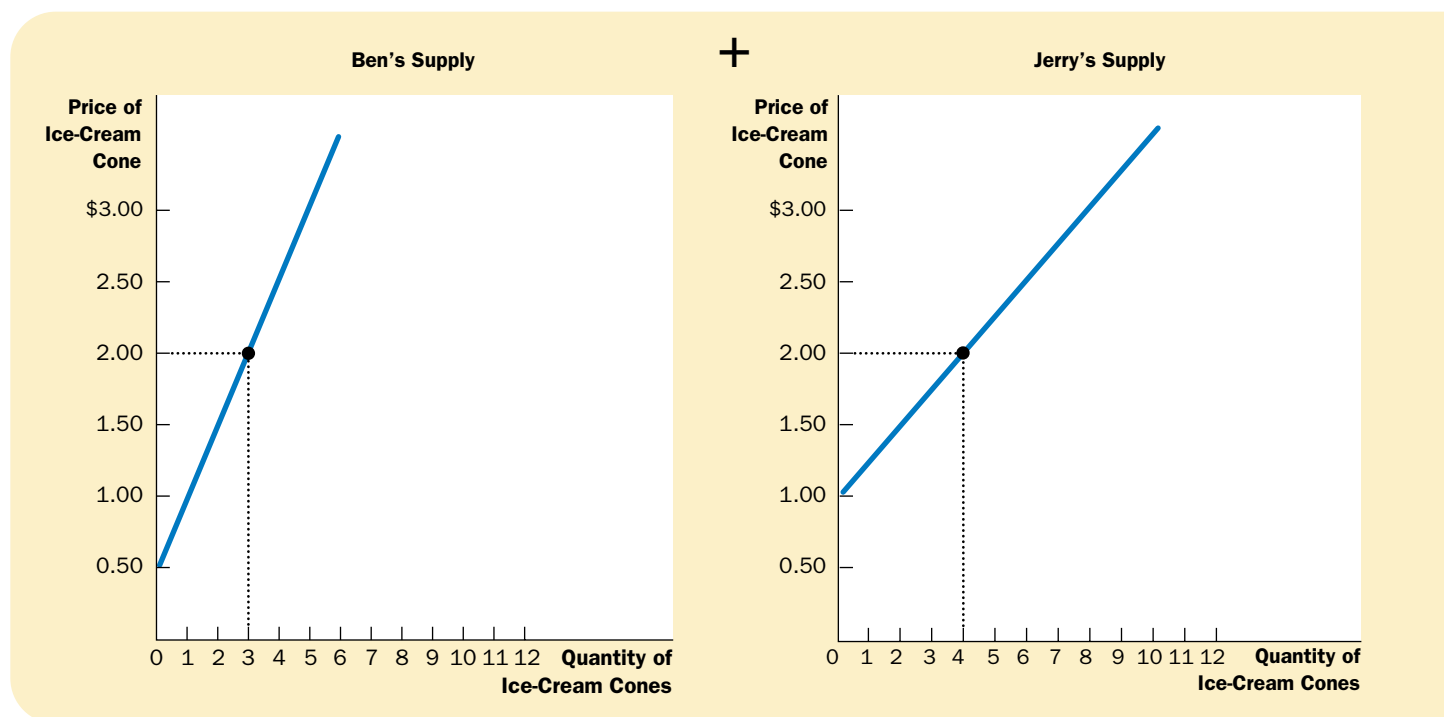
Suppose that the price of sugar falls. How does this change affect the supply of ice cream? Because sugar is an input into producing ice cream, the fall in the price of sugar makes selling ice cream more profitable. This raises the supply of ice cream: At any given price, sellers are now willing to produce a larger quantity. Thus, the supply curve for ice cream shifts to the right.

Whenever there is a change in any determinant of supply, other than the good’s price, the supply curve shifts. As Figure 4-7 shows, any change that raises quantity supplied at every price shifts the supply curve to the right. Similarly, any change that reduces the quantity supplied at every price shifts the supply curve to the left.

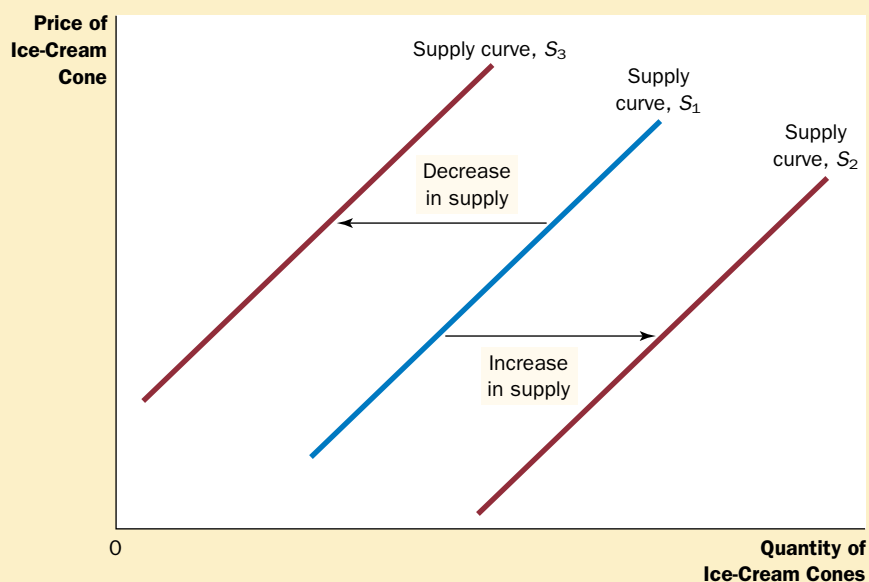
PRICE OF ICE-CREAM CONE	BEN		JERRY		MARKET
\$0.00	0	+	0	=	0
0.50	0		0		0
1.00	1		0		1
1.50	2		2		4
2.00	3		4		7
2.50	4		6		10
3.00	5		8		13

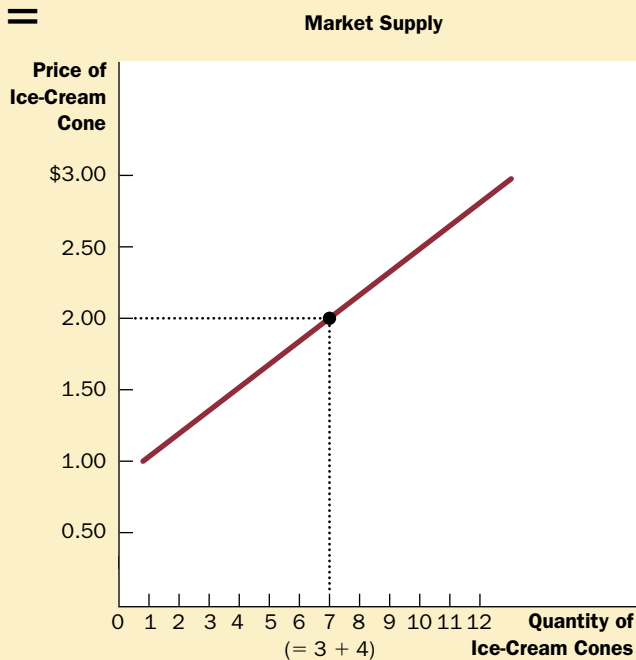
Table 4-5

INDIVIDUAL AND MARKET SUPPLY SCHEDULES. The quantity supplied in a market is the sum of the quantities supplied by all the sellers.

**Figure 4-7**

SHIFTS IN THE SUPPLY CURVE. Any change that raises the quantity that sellers wish to produce at a given price shifts the supply curve to the right. Any change that lowers the quantity that sellers wish to produce at a given price shifts the supply curve to the left.



**Figure 4-6**

MARKET SUPPLY AS THE SUM OF INDIVIDUAL SUPPLIES. The market supply curve is found by adding horizontally the individual supply curves. At a price of \$2, Ben supplies 3 ice-cream cones, and Jerry supplies 4 ice-cream cones. The quantity supplied in the market at this price is 7 cones.

VARIABLES THAT AFFECT QUANTITY SUPPLIED

A CHANGE IN THIS VARIABLE . . .

Price	Represents a movement along the supply curve
Input prices	Shifts the supply curve
Technology	Shifts the supply curve
Expectations	Shifts the supply curve
Number of sellers	Shifts the supply curve

Table 4-6

THE DETERMINANTS OF QUANTITY SUPPLIED. This table lists the variables that can influence the quantity supplied in a market. Notice the special role that price plays: A change in the price represents a movement along the supply curve, whereas a change in one of the other variables shifts the supply curve.

Table 4-6 lists the variables that determine the quantity supplied in a market and how a change in the variable affects the supply curve. Once again, price plays a special role in the table. Because price is on the vertical axis when we graph a supply curve, a change in price does not shift the curve but represents a movement along it. By contrast, when there is a change in input prices, technology, expectations, or the number of sellers, the quantity supplied at each price changes; this is represented by a shift in the supply curve.

In summary, *the supply curve shows what happens to the quantity supplied of a good when its price varies, holding constant all other determinants of quantity supplied. When one of these other determinants changes, the supply curve shifts.*

QUICK QUIZ: List the determinants of the quantity of pizza supplied.

- ◆ Make up an example of a supply schedule for pizza, and graph the implied supply curve.
- ◆ Give an example of something that would shift this supply curve.
- ◆ Would a change in the price of pizza shift this supply curve?

SUPPLY AND DEMAND TOGETHER

Having analyzed supply and demand separately, we now combine them to see how they determine the quantity of a good sold in a market and its price.

equilibrium

a situation in which supply and demand have been brought into balance

equilibrium price

the price that balances supply and demand

equilibrium quantity

the quantity supplied and the quantity demanded when the price has adjusted to balance supply and demand

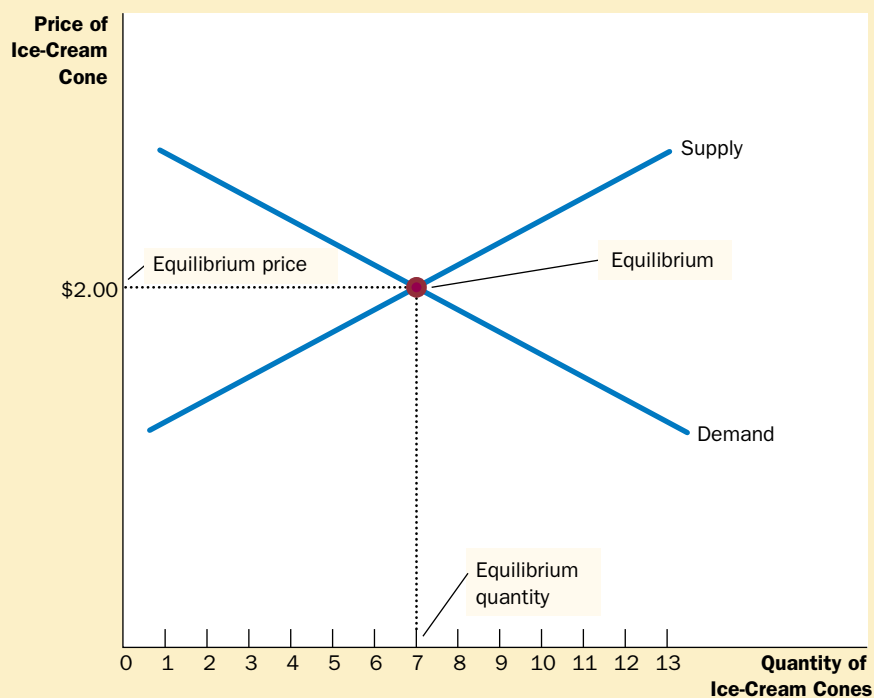
EQUILIBRIUM

Figure 4-8 shows the market supply curve and market demand curve together. Notice that there is one point at which the supply and demand curves intersect; this point is called the market's **equilibrium**. The price at which these two curves cross is called the **equilibrium price**, and the quantity is called the **equilibrium quantity**. Here the equilibrium price is \$2.00 per cone, and the equilibrium quantity is 7 ice-cream cones.

The dictionary defines the word *equilibrium* as a situation in which various forces are in balance—and this also describes a market's equilibrium. *At the*

Figure 4-8

THE EQUILIBRIUM OF SUPPLY AND DEMAND. The equilibrium is found where the supply and demand curves intersect. At the equilibrium price, the quantity supplied equals the quantity demanded. Here the equilibrium price is \$2: At this price, 7 ice-cream cones are supplied, and 7 ice-cream cones are demanded.



equilibrium price, the quantity of the good that buyers are willing and able to buy exactly balances the quantity that sellers are willing and able to sell. The equilibrium price is sometimes called the market-clearing price because, at this price, everyone in the market has been satisfied: Buyers have bought all they want to buy, and sellers have sold all they want to sell.

The actions of buyers and sellers naturally move markets toward the equilibrium of supply and demand. To see why, consider what happens when the market price is not equal to the equilibrium price.

Suppose first that the market price is above the equilibrium price, as in panel (a) of Figure 4-9. At a price of \$2.50 per cone, the quantity of the good supplied (10 cones) exceeds the quantity demanded (4 cones). There is a **surplus** of the good: Suppliers are unable to sell all they want at the going price. When there is a surplus in the ice-cream market, for instance, sellers of ice cream find their freezers increasingly full of ice cream they would like to sell but cannot. They respond to the surplus by cutting their prices. Prices continue to fall until the market reaches the equilibrium.

Suppose now that the market price is below the equilibrium price, as in panel (b) of Figure 4-9. In this case, the price is \$1.50 per cone, and the quantity of the good demanded exceeds the quantity supplied. There is a **shortage** of the good: Demanders are unable to buy all they want at the going price. When a shortage occurs in the ice-cream market, for instance, buyers have to wait in long lines for a chance to buy one of the few cones that are available. With too many buyers chasing too few goods, sellers can respond to the shortage by raising their prices without losing sales. As prices rise, the market once again moves toward the equilibrium.

Thus, the activities of the many buyers and sellers automatically push the market price toward the equilibrium price. Once the market reaches its equilibrium, all buyers and sellers are satisfied, and there is no upward or downward pressure on the price. How quickly equilibrium is reached varies from market to market, depending on how quickly prices adjust. In most free markets, however, surpluses and shortages are only temporary because prices eventually move toward their equilibrium levels. Indeed, this phenomenon is so pervasive that it is sometimes called the **law of supply and demand**: The price of any good adjusts to bring the supply and demand for that good into balance.

surplus

a situation in which quantity supplied is greater than quantity demanded

shortage

a situation in which quantity demanded is greater than quantity supplied

law of supply and demand

the claim that the price of any good adjusts to bring the supply and demand for that good into balance

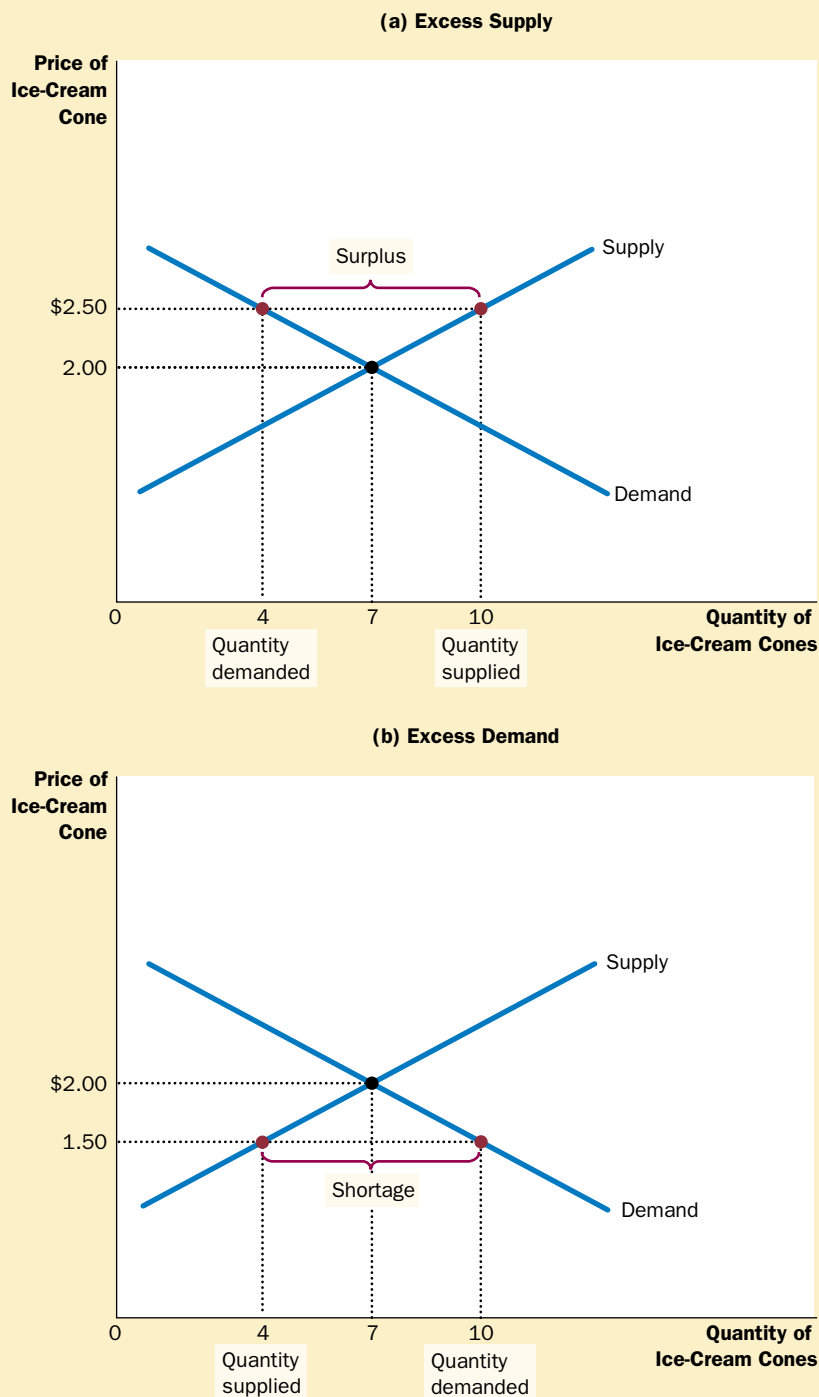
THREE STEPS TO ANALYZING CHANGES IN EQUILIBRIUM

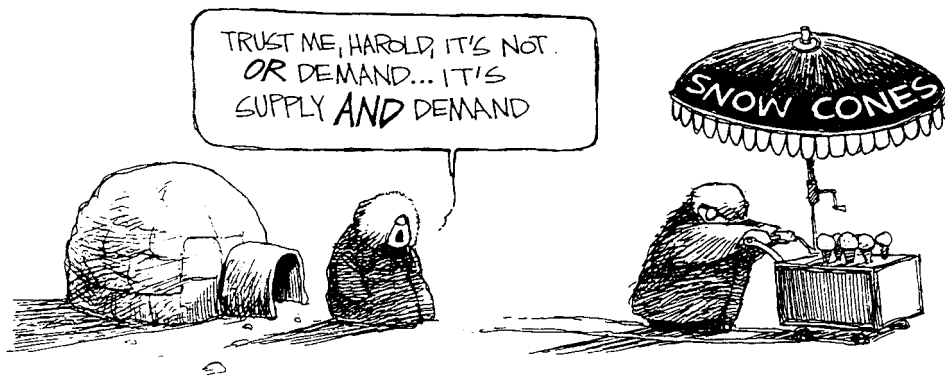
So far we have seen how supply and demand together determine a market's equilibrium, which in turn determines the price of the good and the amount of the good that buyers purchase and sellers produce. Of course, the equilibrium price and quantity depend on the position of the supply and demand curves. When some event shifts one of these curves, the equilibrium in the market changes. The analysis of such a change is called *comparative statics* because it involves comparing two static situations—an old and a new equilibrium.

When analyzing how some event affects a market, we proceed in three steps. First, we decide whether the event shifts the supply curve, the demand curve, or in some cases both curves. Second, we decide whether the curve shifts to the right or to the left. Third, we use the supply-and-demand diagram to examine how the

Figure 4-9

MARKETS NOT IN EQUILIBRIUM. In panel (a), there is a surplus. Because the market price of \$2.50 is above the equilibrium price, the quantity supplied (10 cones) exceeds the quantity demanded (4 cones). Suppliers try to increase sales by cutting the price of a cone, and this moves the price toward its equilibrium level. In panel (b), there is a shortage. Because the market price of \$1.50 is below the equilibrium price, the quantity demanded (10 cones) exceeds the quantity supplied (4 cones). With too many buyers chasing too few goods, suppliers can take advantage of the shortage by raising the price. Hence, in both cases, the price adjustment moves the market toward the equilibrium of supply and demand.





shift affects the equilibrium price and quantity. Table 4-7 summarizes these three steps. To see how this recipe is used, let's consider various events that might affect the market for ice cream.

Example: A Change in Demand Suppose that one summer the weather is very hot. How does this event affect the market for ice cream? To answer this question, let's follow our three steps.

1. The hot weather affects the demand curve by changing people's taste for ice cream. That is, the weather changes the amount of ice cream that people want to buy at any given price. The supply curve is unchanged because the weather does not directly affect the firms that sell ice cream.
2. Because hot weather makes people want to eat more ice cream, the demand curve shifts to the right. Figure 4-10 shows this increase in demand as the shift in the demand curve from D_1 to D_2 . This shift indicates that the quantity of ice cream demanded is higher at every price.
3. As Figure 4-10 shows, the increase in demand raises the equilibrium price from \$2.00 to \$2.50 and the equilibrium quantity from 7 to 10 cones. In other words, the hot weather increases the price of ice cream and the quantity of ice cream sold.

Shifts in Curves versus Movements along Curves Notice that when hot weather drives up the price of ice cream, the quantity of ice cream that firms supply rises, even though the supply curve remains the same. In this case, economists say there has been an increase in "quantity supplied" but no change in "supply."

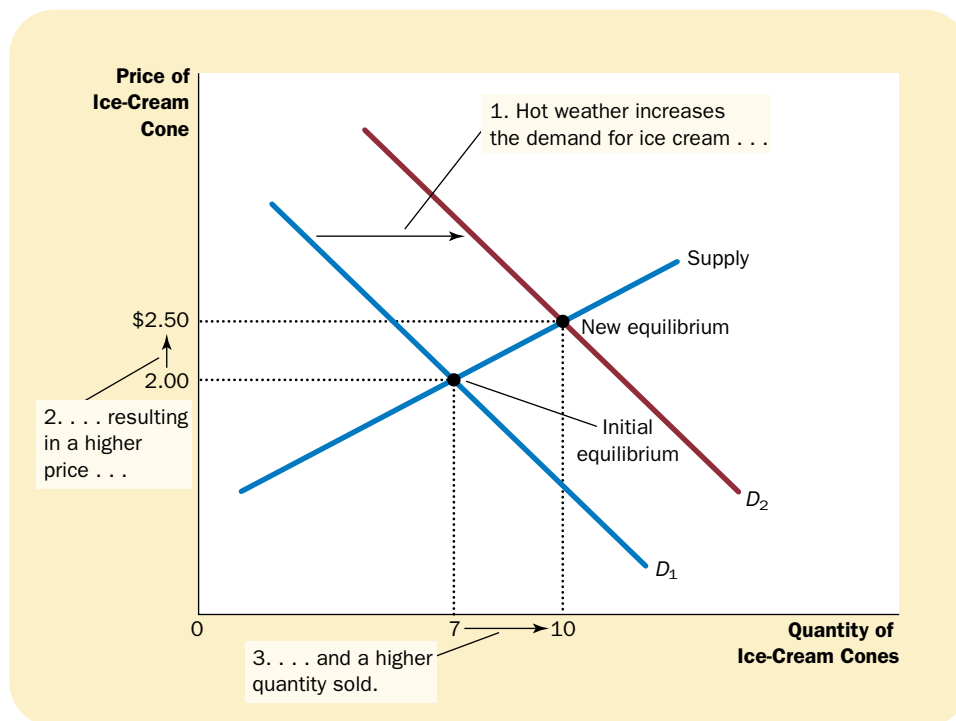
1. Decide whether the event shifts the supply curve or demand curve (or perhaps both).
2. Decide which direction the curve shifts.
3. Use the supply-and-demand diagram to see how the shift changes the equilibrium.

Table 4-7

A THREE-STEP PROGRAM FOR
ANALYZING CHANGES IN
EQUILIBRIUM

Figure 4-10

HOW AN INCREASE IN DEMAND AFFECTS THE EQUILIBRIUM. An event that raises quantity demanded at any given price shifts the demand curve to the right. The equilibrium price and the equilibrium quantity both rise. Here, an abnormally hot summer causes buyers to demand more ice cream. The demand curve shifts from D_1 to D_2 , which causes the equilibrium price to rise from \$2.00 to \$2.50 and the equilibrium quantity to rise from 7 to 10 cones.

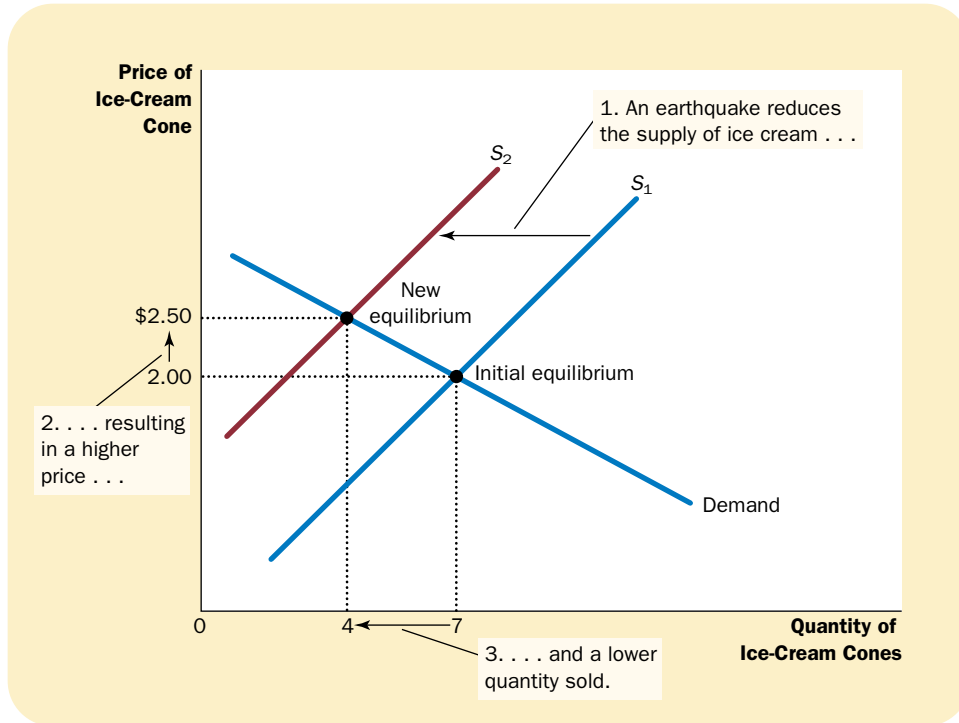


"Supply" refers to the position of the supply curve, whereas the "quantity supplied" refers to the amount suppliers wish to sell. In this example, supply does not change because the weather does not alter firms' desire to sell at any given price. Instead, the hot weather alters consumers' desire to buy at any given price and thereby shifts the demand curve. The increase in demand causes the equilibrium price to rise. When the price rises, the quantity supplied rises. This increase in quantity supplied is represented by the movement along the supply curve.

To summarize, a shift *in* the supply curve is called a "change in supply," and a shift *in* the demand curve is called a "change in demand." A movement *along* a fixed supply curve is called a "change in the quantity supplied," and a movement *along* a fixed demand curve is called a "change in the quantity demanded."

Example: A Change in Supply Suppose that, during another summer, an earthquake destroys several ice-cream factories. How does this event affect the market for ice cream? Once again, to answer this question, we follow our three steps.

1. The earthquake affects the supply curve. By reducing the number of sellers, the earthquake changes the amount of ice cream that firms produce and sell at any given price. The demand curve is unchanged because the earthquake does not directly change the amount of ice cream households wish to buy.
2. The supply curve shifts to the left because, at every price, the total amount that firms are willing and able to sell is reduced. Figure 4-11 illustrates this decrease in supply as a shift in the supply curve from S_1 to S_2 .

**Figure 4-11**

HOW A DECREASE IN SUPPLY AFFECTS THE EQUILIBRIUM.

An event that reduces quantity supplied at any given price shifts the supply curve to the left. The equilibrium price rises, and the equilibrium quantity falls. Here, an earthquake causes sellers to supply less ice cream. The supply curve shifts from S_1 to S_2 , which causes the equilibrium price to rise from \$2.00 to \$2.50 and the equilibrium quantity to fall from 7 to 4 cones.

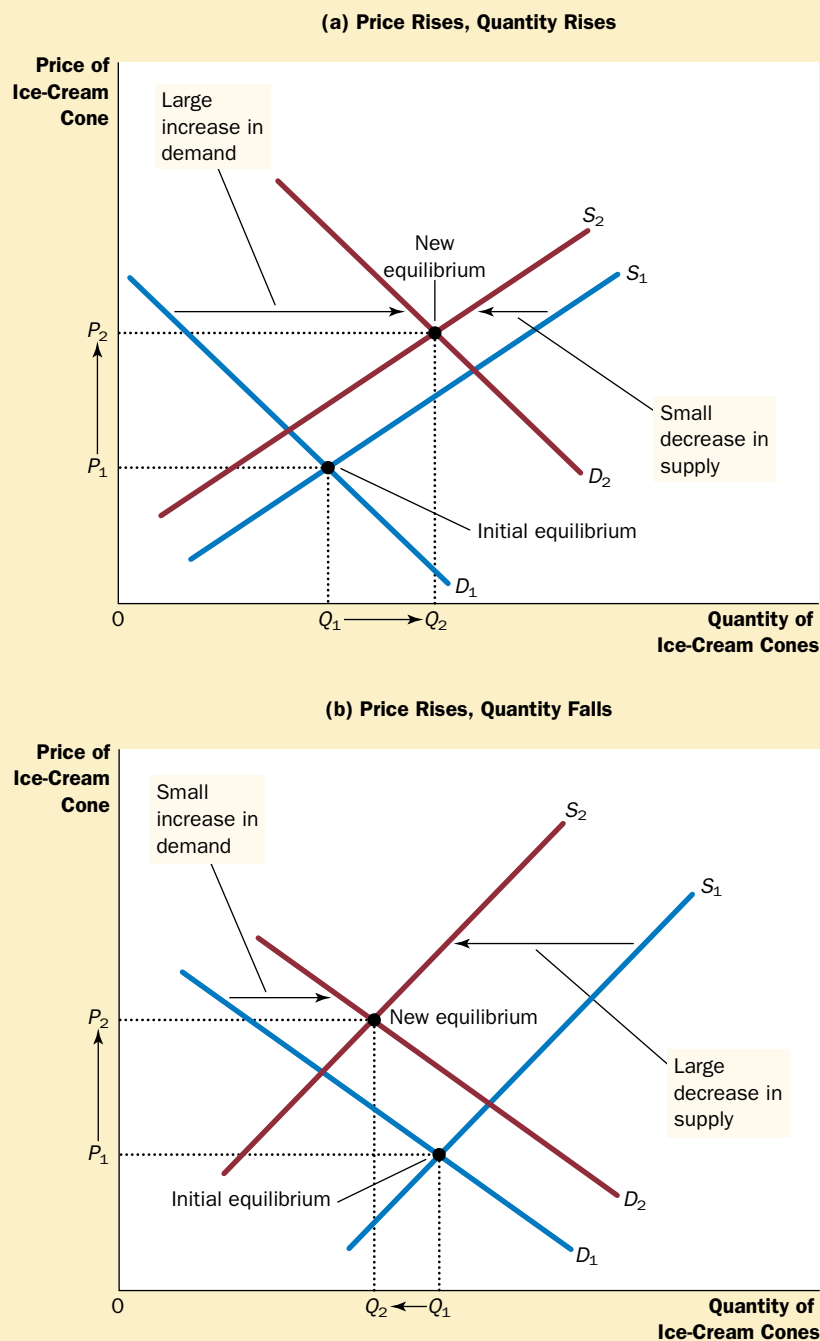
- As Figure 4-11 shows, the shift in the supply curve raises the equilibrium price from \$2.00 to \$2.50 and lowers the equilibrium quantity from 7 to 4 cones. As a result of the earthquake, the price of ice cream rises, and the quantity of ice cream sold falls.

Example: A Change in Both Supply and Demand Now suppose that the hot weather and the earthquake occur at the same time. To analyze this combination of events, we again follow our three steps.

- We determine that both curves must shift. The hot weather affects the demand curve because it alters the amount of ice cream that households want to buy at any given price. At the same time, the earthquake alters the supply curve because it changes the amount of ice cream that firms want to sell at any given price.
- The curves shift in the same directions as they did in our previous analysis: The demand curve shifts to the right, and the supply curve shifts to the left. Figure 4-12 illustrates these shifts.
- As Figure 4-12 shows, there are two possible outcomes that might result, depending on the relative size of the demand and supply shifts. In both cases, the equilibrium price rises. In panel (a), where demand increases substantially while supply falls just a little, the equilibrium quantity also rises. By contrast, in panel (b), where supply falls substantially while demand rises just a little, the equilibrium quantity falls. Thus, these events certainly raise the price of ice cream, but their impact on the amount of ice cream sold is ambiguous.

Figure 4-12

A SHIFT IN BOTH SUPPLY AND DEMAND. Here we observe a simultaneous increase in demand and decrease in supply. Two outcomes are possible. In panel (a), the equilibrium price rises from P_1 to P_2 , and the equilibrium quantity rises from Q_1 to Q_2 . In panel (b), the equilibrium price again rises from P_1 to P_2 , but the equilibrium quantity falls from Q_1 to Q_2 .



Summary We have just seen three examples of how to use supply and demand curves to analyze a change in equilibrium. Whenever an event shifts the supply curve, the demand curve, or perhaps both curves, you can use these tools to predict how the event will alter the amount sold in equilibrium and the price at which the

IN THE NEWS*Mother Nature Shifts
the Supply Curve*

ACCORDING TO OUR ANALYSIS, A NATURAL disaster that reduces supply reduces the quantity sold and raises the price. Here's a recent example.

**4-Day Cold Spell Slams
California: Crops Devastated;
Price of Citrus to Rise**

BY TODD S. PURDUM

A brutal four-day freeze has destroyed more than a third of California's annual

citrus crop, inflicting upwards of a half-billion dollars in damage and raising the prospect of tripled orange prices in supermarkets by next week.

Throughout the Golden State, cold, dry air from the Gulf of Alaska sent temperatures below freezing beginning Monday, with readings in the high teens and low 20's in agriculturally rich Central Valley early today—the worst cold spell since a 10-day freeze in 1990. Farmers frantically ran wind and irrigation machines overnight to keep trees warm, but officials pronounced a near total loss in the valley, and said perhaps half of the state's orange crop was lost as well. . . .

California grows about 80 percent of the nation's oranges eaten as fruit, and 90 percent of lemons, and wholesalers said the retail prices of oranges could triple in the next few days. The price of lemons was certain to rise as well, but the price of orange juice should



be less affected because most juice oranges are grown in Florida.

In some California markets, wholesalers reported that the price of navel oranges had increased to 90 cents a pound on Wednesday from 35 cents on Tuesday.

SOURCE: *The New York Times*, December 25, 1998, p. A1.

Table 4-8

WHAT HAPPENS TO PRICE AND QUANTITY WHEN SUPPLY OR DEMAND SHIFTS?

	NO CHANGE IN SUPPLY	AN INCREASE IN SUPPLY	A DECREASE IN SUPPLY
NO CHANGE IN DEMAND	P same Q same	P down Q up	P up Q down
AN INCREASE IN DEMAND	P up Q up	P ambiguous Q up	P up Q ambiguous
A DECREASE IN DEMAND	P down Q down	P down Q ambiguous	P ambiguous Q down

good is sold. Table 4-8 shows the predicted outcome for any combination of shifts in the two curves. To make sure you understand how to use the tools of supply and demand, pick a few entries in this table and make sure you can explain to yourself why the table contains the prediction it does.

QUICK QUIZ: Analyze what happens to the market for pizza if the price of tomatoes rises. ♦ Analyze what happens to the market for pizza if the price of hamburgers falls.

CONCLUSION: HOW PRICES ALLOCATE RESOURCES

This chapter has analyzed supply and demand in a single market. Although our discussion has centered around the market for ice cream, the lessons learned here apply in most other markets as well. Whenever you go to a store to buy something, you are contributing to the demand for that item. Whenever you look for a job, you are contributing to the supply of labor services. Because supply and demand are such pervasive economic phenomena, the model of supply and demand is a powerful tool for analysis. We will be using this model repeatedly in the following chapters.



One of the *Ten Principles of Economics* discussed in Chapter 1 is that markets are usually a good way to organize economic activity. Although it is still too early to judge whether market outcomes are good or bad, in this chapter we have begun to see how markets work. In any economic system, scarce resources have to be allocated among competing uses. Market economies harness the forces of supply and demand to serve that end. Supply and demand together determine the prices of the economy's many different goods and services; prices in turn are the signals that guide the allocation of resources.

For example, consider the allocation of beachfront land. Because the amount of this land is limited, not everyone can enjoy the luxury of living by the beach. Who gets this resource? The answer is: whoever is willing and able to pay the price. The price of beachfront land adjusts until the quantity of land demanded exactly balances the quantity supplied. Thus, in market economies, prices are the mechanism for rationing scarce resources.

Similarly, prices determine who produces each good and how much is produced. For instance, consider farming. Because we need food to survive, it is crucial that some people work on farms. What determines who is a farmer and who is not? In a free society, there is no government planning agency making this decision and ensuring an adequate supply of food. Instead, the allocation of workers to farms is based on the job decisions of millions of workers. This decentralized system works well because these decisions depend on prices. The prices of food and the wages of farmworkers (the price of their labor) adjust to ensure that enough people choose to be farmers.

If a person had never seen a market economy in action, the whole idea might seem preposterous. Economies are large groups of people engaged in many interdependent activities. What prevents decentralized decisionmaking from degenerating into chaos? What coordinates the actions of the millions of people with their varying abilities and desires? What ensures that what needs to get done does in fact get done? The answer, in a word, is *prices*. If market economies are guided by an invisible hand, as Adam Smith famously suggested, then the price system is the baton that the invisible hand uses to conduct the economic orchestra.



"Two dollars."



"—and seventy-five cents."

Summary

- ◆ Economists use the model of supply and demand to analyze competitive markets. In a competitive market, there are many buyers and sellers, each of whom has little or no influence on the market price.
- ◆ The demand curve shows how the quantity of a good demanded depends on the price. According to the law of demand, as the price of a good falls, the quantity demanded rises. Therefore, the demand curve slopes downward.
- ◆ In addition to price, other determinants of the quantity demanded include income, tastes, expectations, and the prices of substitutes and complements. If one of these other determinants changes, the demand curve shifts.
- ◆ The supply curve shows how the quantity of a good supplied depends on the price. According to the law of supply, as the price of a good rises, the quantity supplied rises. Therefore, the supply curve slopes upward.
- ◆ In addition to price, other determinants of the quantity supplied include input prices, technology, and expectations. If one of these other determinants changes, the supply curve shifts.
- ◆ The intersection of the supply and demand curves determines the market equilibrium. At the equilibrium price, the quantity demanded equals the quantity supplied.
- ◆ The behavior of buyers and sellers naturally drives markets toward their equilibrium. When the market price is above the equilibrium price, there is a surplus of the good, which causes the market price to fall. When the market price is below the equilibrium price, there is a shortage, which causes the market price to rise.
- ◆ To analyze how any event influences a market, we use the supply-and-demand diagram to examine how the event affects the equilibrium price and quantity. To do this we follow three steps. First, we decide whether the event shifts the supply curve or the demand curve (or both). Second, we decide which direction the curve shifts. Third, we compare the new equilibrium with the old equilibrium.
- ◆ In market economies, prices are the signals that guide economic decisions and thereby allocate scarce resources. For every good in the economy, the price ensures that supply and demand are in balance. The equilibrium price then determines how much of the good buyers choose to purchase and how much sellers choose to produce.

Key Concepts

market, p. 66	complements, p. 68	supply curve, p. 76
competitive market, p. 66	demand schedule, p. 69	equilibrium, p. 80
quantity demanded, p. 67	demand curve, p. 70	equilibrium price, p. 80
law of demand, p. 68	<i>ceteris paribus</i> , p. 70	equilibrium quantity, p. 80
normal good, p. 68	quantity supplied, p. 75	surplus, p. 81
inferior good, p. 68	law of supply, p. 75	shortage, p. 81
substitutes, p. 68	supply schedule, p. 76	law of supply and demand, p. 81

Questions for Review

1. What is a competitive market? Briefly describe the types of markets other than perfectly competitive markets.
2. What determines the quantity of a good that buyers demand?
3. What are the demand schedule and the demand curve, and how are they related? Why does the demand curve slope downward?
4. Does a change in consumers' tastes lead to a movement along the demand curve or a shift in the demand curve? Does a change in price lead to a movement along the demand curve or a shift in the demand curve?
5. Popeye's income declines and, as a result, he buys more spinach. Is spinach an inferior or a normal good? What happens to Popeye's demand curve for spinach?
6. What determines the quantity of a good that sellers supply?
7. What are the supply schedule and the supply curve, and how are they related? Why does the supply curve slope upward?
8. Does a change in producers' technology lead to a movement along the supply curve or a shift in the supply curve? Does a change in price lead to a movement along the supply curve or a shift in the supply curve?
9. Define the equilibrium of a market. Describe the forces that move a market toward its equilibrium.
10. Beer and pizza are complements because they are often enjoyed together. When the price of beer rises, what happens to the supply, demand, quantity supplied, quantity demanded, and the price in the market for pizza?
11. Describe the role of prices in market economies.

Problems and Applications

1. Explain each of the following statements using supply-and-demand diagrams.
 - a. When a cold snap hits Florida, the price of orange juice rises in supermarkets throughout the country.
 - b. When the weather turns warm in New England every summer, the prices of hotel rooms in Caribbean resorts plummet.
 - c. When a war breaks out in the Middle East, the price of gasoline rises, while the price of a used Cadillac falls.
2. "An increase in the demand for notebooks raises the quantity of notebooks demanded, but not the quantity supplied." Is this statement true or false? Explain.
3. Consider the market for minivans. For each of the events listed here, identify which of the determinants of demand or supply are affected. Also indicate whether demand or supply is increased or decreased. Then show the effect on the price and quantity of minivans.
 - a. People decide to have more children.

- b. A strike by steelworkers raises steel prices.
 - c. Engineers develop new automated machinery for the production of minivans.
 - d. The price of station wagons rises.
 - e. A stock-market crash lowers people's wealth.
4. During the 1990s, technological advance reduced the cost of computer chips. How do you think this affected the market for computers? For computer software? For typewriters?
 5. Using supply-and-demand diagrams, show the effect of the following events on the market for sweatshirts.
 - a. A hurricane in South Carolina damages the cotton crop.
 - b. The price of leather jackets falls.
 - c. All colleges require morning calisthenics in appropriate attire.
 - d. New knitting machines are invented.
 6. Suppose that in the year 2005 the number of births is temporarily high. How does this baby boom affect the price of baby-sitting services in 2010 and 2020? (Hint: 5-year-olds need baby-sitters, whereas 15-year-olds can be baby-sitters.)
 7. Ketchup is a complement (as well as a condiment) for hot dogs. If the price of hot dogs rises, what happens to the market for ketchup? For tomatoes? For tomato juice? For orange juice?
 8. The case study presented in the chapter discussed cigarette taxes as a way to reduce smoking. Now think about the markets for other tobacco products such as cigars and chewing tobacco.
 - a. Are these goods substitutes or complements for cigarettes?
 - b. Using a supply-and-demand diagram, show what happens in the markets for cigars and chewing tobacco if the tax on cigarettes is increased.
 - c. If policymakers wanted to reduce total tobacco consumption, what policies could they combine with the cigarette tax?
 9. The market for pizza has the following demand and supply schedules:

PRICE	QUANTITY DEMANDED	QUANTITY SUPPLIED
\$4	135	26
5	104	53
6	81	81
7	68	98
8	53	110
9	39	121

Graph the demand and supply curves. What is the equilibrium price and quantity in this market? If the actual price in this market were *above* the equilibrium price, what would drive the market toward the equilibrium? If the actual price in this market were *below* the equilibrium price, what would drive the market toward the equilibrium?

10. Because bagels and cream cheese are often eaten together, they are complements.
 - a. We observe that both the equilibrium price of cream cheese and the equilibrium quantity of bagels have risen. What could be responsible for this pattern—a fall in the price of flour or a fall in the price of milk? Illustrate and explain your answer.
 - b. Suppose instead that the equilibrium price of cream cheese has risen but the equilibrium quantity of bagels has fallen. What could be responsible for this pattern—a rise in the price of flour or a rise in the price of milk? Illustrate and explain your answer.
11. Suppose that the price of basketball tickets at your college is determined by market forces. Currently, the demand and supply schedules are as follows:

PRICE	QUANTITY DEMANDED	QUANTITY SUPPLIED
\$ 4	10,000	8,000
8	8,000	8,000
12	6,000	8,000
16	4,000	8,000
20	2,000	8,000

- a. Draw the demand and supply curves. What is unusual about this supply curve? Why might this be true?
- b. What are the equilibrium price and quantity of tickets?
- c. Your college plans to increase total enrollment next year by 5,000 students. The additional students will have the following demand schedule:

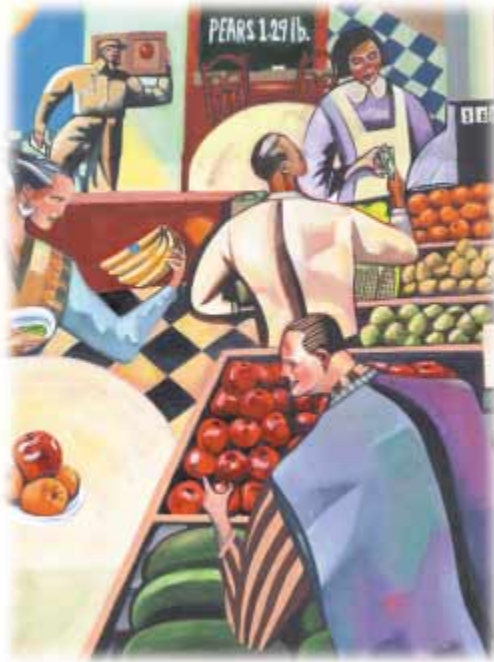
PRICE	QUANTITY DEMANDED
\$ 4	4,000
8	3,000
12	2,000
16	1,000
20	0

Now add the old demand schedule and the demand schedule for the new students to calculate the new demand schedule for the entire college. What will be the new equilibrium price and quantity?

12. An article in *The New York Times* described a successful marketing campaign by the French champagne industry.

The article noted that “many executives felt giddy about the stratospheric champagne prices. But they also feared that such sharp price increases would cause demand to decline, which would then cause prices to plunge.” What mistake are the executives making in their analysis of the situation? Illustrate your answer with a graph.

5



ELASTICITY AND ITS APPLICATION

Imagine yourself as a Kansas wheat farmer. Because you earn all your income from selling wheat, you devote much effort to making your land as productive as it can be. You monitor weather and soil conditions, check your fields for pests and disease, and study the latest advances in farm technology. You know that the more wheat you grow, the more you will have to sell after the harvest, and the higher will be your income and your standard of living.

One day Kansas State University announces a major discovery. Researchers in its agronomy department have devised a new hybrid of wheat that raises the amount farmers can produce from each acre of land by 20 percent. How should you react to this news? Should you use the new hybrid? Does this discovery make you better off or worse off than you were before? In this chapter we will see that these questions can have surprising answers. The surprise will come from

**IN THIS CHAPTER
YOU WILL . . .**

***Learn the meaning
of the elasticity of
demand***

***Examine what
determines the
elasticity of demand***

***Learn the meaning
of the elasticity of
supply***

***Examine what
determines the
elasticity of supply***

***Apply the concept of
elasticity in three
very different
markets***

applying the most basic tools of economics—supply and demand—to the market for wheat.

The previous chapter introduced supply and demand. In any competitive market, such as the market for wheat, the upward-sloping supply curve represents the behavior of sellers, and the downward-sloping demand curve represents the behavior of buyers. The price of the good adjusts to bring the quantity supplied and quantity demanded of the good into balance. To apply this basic analysis to understand the impact of the agronomists' discovery, we must first develop one more tool: the concept of *elasticity*. Elasticity, a measure of how much buyers and sellers respond to changes in market conditions, allows us to analyze supply and demand with greater precision.

THE ELASTICITY OF DEMAND

When we discussed the determinants of demand in Chapter 4, we noted that buyers usually demand more of a good when its price is lower, when their incomes are higher, when the prices of substitutes for the good are higher, or when the prices of complements of the good are lower. Our discussion of demand was qualitative, not quantitative. That is, we discussed the direction in which the quantity demanded moves, but not the size of the change. To measure how much demand responds to changes in its determinants, economists use the concept of **elasticity**.

elasticity

a measure of the responsiveness of quantity demanded or quantity supplied to one of its determinants

THE PRICE ELASTICITY OF DEMAND AND ITS DETERMINANTS

The law of demand states that a fall in the price of a good raises the quantity demanded. The **price elasticity of demand** measures how much the quantity demanded responds to a change in price. Demand for a good is said to be *elastic* if the quantity demanded responds substantially to changes in the price. Demand is said to be *inelastic* if the quantity demanded responds only slightly to changes in the price.

What determines whether the demand for a good is elastic or inelastic? Because the demand for any good depends on consumer preferences, the price elasticity of demand depends on the many economic, social, and psychological forces that shape individual desires. Based on experience, however, we can state some general rules about what determines the price elasticity of demand.

Necessities versus Luxuries Necessities tend to have inelastic demands, whereas luxuries have elastic demands. When the price of a visit to the doctor rises, people will not dramatically alter the number of times they go to the doctor, although they might go somewhat less often. By contrast, when the price of sailboats rises, the quantity of sailboats demanded falls substantially. The reason is that most people view doctor visits as a necessity and sailboats as a luxury. Of course, whether a good is a necessity or a luxury depends not on the intrinsic properties of the good but on the preferences of the buyer. For an avid sailor with

price elasticity of demand

a measure of how much the quantity demanded of a good responds to a change in the price of that good, computed as the percentage change in quantity demanded divided by the percentage change in price

little concern over his health, sailboats might be a necessity with inelastic demand and doctor visits a luxury with elastic demand.

Availability of Close Substitutes Goods with close substitutes tend to have more elastic demand because it is easier for consumers to switch from that good to others. For example, butter and margarine are easily substitutable. A small increase in the price of butter, assuming the price of margarine is held fixed, causes the quantity of butter sold to fall by a large amount. By contrast, because eggs are a food without a close substitute, the demand for eggs is probably less elastic than the demand for butter.

Definition of the Market The elasticity of demand in any market depends on how we draw the boundaries of the market. Narrowly defined markets tend to have more elastic demand than broadly defined markets, because it is easier to find close substitutes for narrowly defined goods. For example, food, a broad category, has a fairly inelastic demand because there are no good substitutes for food. Ice cream, a more narrow category, has a more elastic demand because it is easy to substitute other desserts for ice cream. Vanilla ice cream, a very narrow category, has a very elastic demand because other flavors of ice cream are almost perfect substitutes for vanilla.

Time Horizon Goods tend to have more elastic demand over longer time horizons. When the price of gasoline rises, the quantity of gasoline demanded falls only slightly in the first few months. Over time, however, people buy more fuel-efficient cars, switch to public transportation, and move closer to where they work. Within several years, the quantity of gasoline demanded falls substantially.

COMPUTING THE PRICE ELASTICITY OF DEMAND

Now that we have discussed the price elasticity of demand in general terms, let's be more precise about how it is measured. Economists compute the price elasticity of demand as the percentage change in the quantity demanded divided by the percentage change in the price. That is,

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

For example, suppose that a 10-percent increase in the price of an ice-cream cone causes the amount of ice cream you buy to fall by 20 percent. We calculate your elasticity of demand as

$$\text{Price elasticity of demand} = \frac{20 \text{ percent}}{10 \text{ percent}} = 2.$$

In this example, the elasticity is 2, reflecting that the change in the quantity demanded is proportionately twice as large as the change in the price.

Because the quantity demanded of a good is negatively related to its price, the percentage change in quantity will always have the opposite sign as the

percentage change in price. In this example, the percentage change in price is a *positive* 10 percent (reflecting an increase), and the percentage change in quantity demanded is a *negative* 20 percent (reflecting a decrease). For this reason, price elasticities of demand are sometimes reported as negative numbers. In this book we follow the common practice of dropping the minus sign and reporting all price elasticities as positive numbers. (Mathematicians call this the *absolute value*.) With this convention, a larger price elasticity implies a greater responsiveness of quantity demanded to price.

THE MIDPOINT METHOD: A BETTER WAY TO CALCULATE PERCENTAGE CHANGES AND ELASTICITIES

If you try calculating the price elasticity of demand between two points on a demand curve, you will quickly notice an annoying problem: The elasticity from point A to point B seems different from the elasticity from point B to point A. For example, consider these numbers:

Point A:	Price = \$4	Quantity = 120
Point B:	Price = \$6	Quantity = 80

Going from point A to point B, the price rises by 50 percent, and the quantity falls by 33 percent, indicating that the price elasticity of demand is $33/50$, or 0.66. By contrast, going from point B to point A, the price falls by 33 percent, and the quantity rises by 50 percent, indicating that the price elasticity of demand is $50/33$, or 1.5.

One way to avoid this problem is to use the *midpoint method* for calculating elasticities. Rather than computing a percentage change using the standard way (by dividing the change by the initial level), the midpoint method computes a percentage change by dividing the change by the midpoint of the initial and final levels. For instance, \$5 is the midpoint of \$4 and \$6. Therefore, according to the midpoint method, a change from \$4 to \$6 is considered a 40 percent rise, because $(6 - 4)/5 \times 100 = 40$. Similarly, a change from \$6 to \$4 is considered a 40 percent fall.

Because the midpoint method gives the same answer regardless of the direction of change, it is often used when calculating the price elasticity of demand between two points. In our example, the midpoint between point A and point B is:

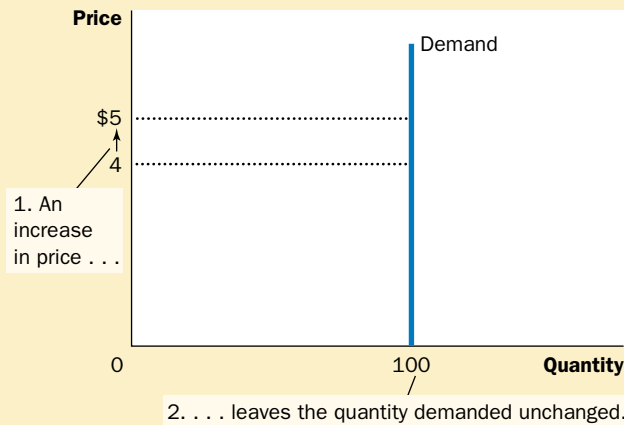
Midpoint:	Price = \$5	Quantity = 100
-----------	-------------	----------------

According to the midpoint method, when going from point A to point B, the price rises by 40 percent, and the quantity falls by 40 percent. Similarly, when going from point B to point A, the price falls by 40 percent, and the quantity rises by 40 percent. In both directions, the price elasticity of demand equals 1.

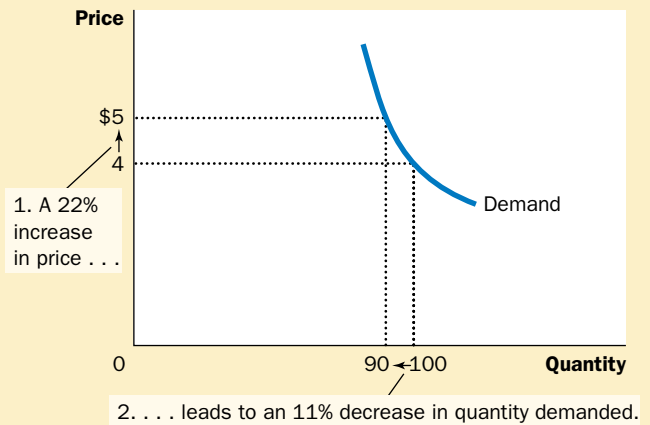
We can express the midpoint method with the following formula for the price elasticity of demand between two points, denoted (Q_1, P_1) and (Q_2, P_2) :

$$\text{Price elasticity of demand} = \frac{(Q_2 - Q_1)/[(Q_2 + Q_1)/2]}{(P_2 - P_1)/[(P_2 + P_1)/2]}.$$

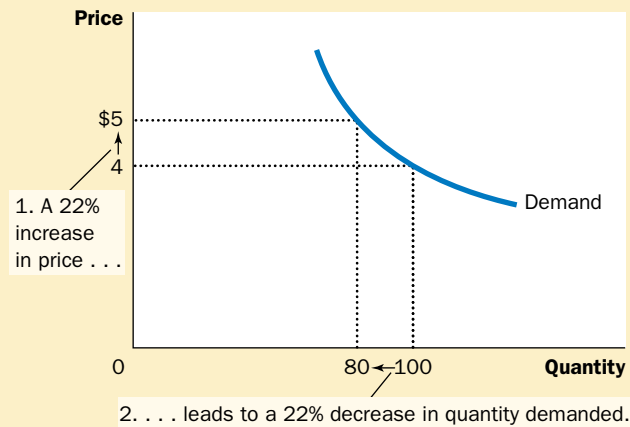
(a) Perfectly Inelastic Demand: Elasticity Equals 0



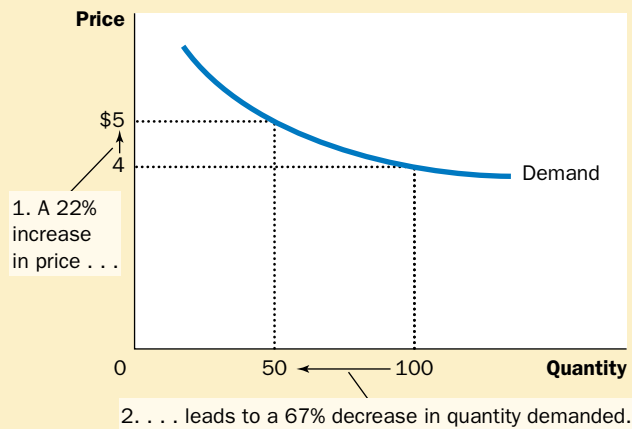
(b) Inelastic Demand: Elasticity Is Less Than 1



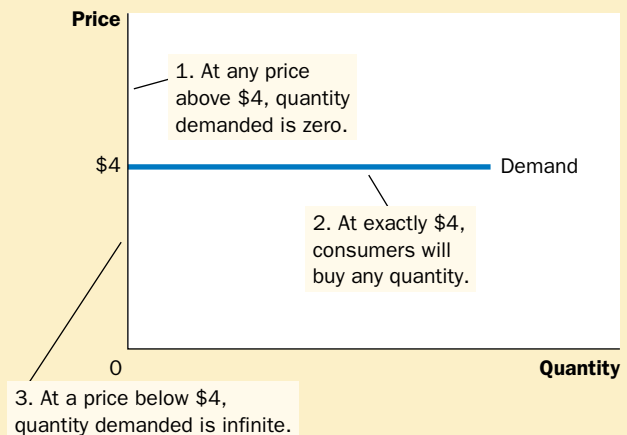
(c) Unit Elastic Demand: Elasticity Equals 1



(d) Elastic Demand: Elasticity Is Greater Than 1



(e) Perfectly Elastic Demand: Elasticity Equals Infinity



THE PRICE ELASTICITY OF DEMAND. The price elasticity of demand determines whether the demand curve is steep or flat. Note that all percentage changes are calculated using the midpoint method.

Figure 5-1

The numerator is the percentage change in quantity computed using the midpoint method, and the denominator is the percentage change in price computed using the midpoint method. If you ever need to calculate elasticities, you should use this formula.

Throughout this book, however, we only rarely need to perform such calculations. For our purposes, what elasticity represents—the responsiveness of quantity demanded to price—is more important than how it is calculated.

THE VARIETY OF DEMAND CURVES

Economists classify demand curves according to their elasticity. Demand is *elastic* when the elasticity is greater than 1, so that quantity moves proportionately more than the price. Demand is *inelastic* when the elasticity is less than 1, so that quantity moves proportionately less than the price. If the elasticity is exactly 1, so that quantity moves the same amount proportionately as price, demand is said to have *unit elasticity*.

Because the price elasticity of demand measures how much quantity demanded responds to changes in the price, it is closely related to the slope of the demand curve. The following rule of thumb is a useful guide: The flatter is the demand curve that passes through a given point, the greater is the price elasticity of demand. The steeper is the demand curve that passes through a given point, the smaller is the price elasticity of demand.

Figure 5-1 shows five cases. In the extreme case of a zero elasticity, demand is *perfectly inelastic*, and the demand curve is vertical. In this case, regardless of the price, the quantity demanded stays the same. As the elasticity rises, the demand curve gets flatter and flatter. At the opposite extreme, demand is *perfectly elastic*. This occurs as the price elasticity of demand approaches infinity and the demand curve becomes horizontal, reflecting the fact that very small changes in the price lead to huge changes in the quantity demanded.

Finally, if you have trouble keeping straight the terms *elastic* and *inelastic*, here's a memory trick for you: *I*nelastic curves, such as in panel (a) of Figure 5-1, look like the letter *I*. *E*lastic curves, as in panel (e), look like the letter *E*. This is not a deep insight, but it might help on your next exam.

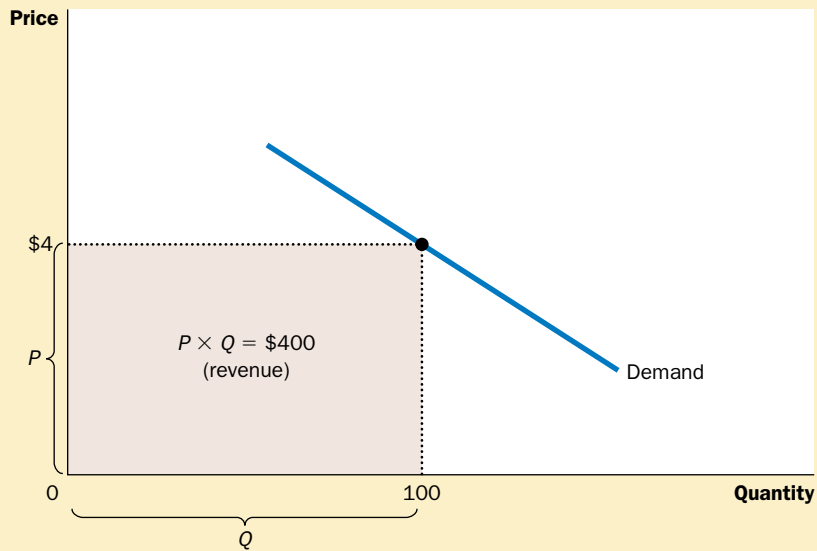
TOTAL REVENUE AND THE PRICE ELASTICITY OF DEMAND

total revenue

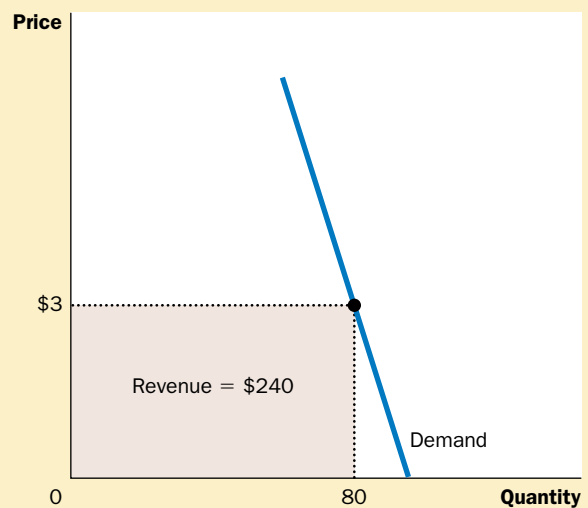
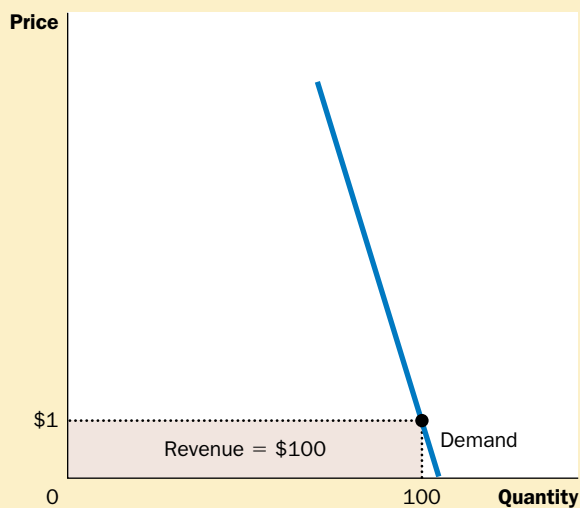
the amount paid by buyers and received by sellers of a good, computed as the price of the good times the quantity sold

When studying changes in supply or demand in a market, one variable we often want to study is **total revenue**, the amount paid by buyers and received by sellers of the good. In any market, total revenue is $P \times Q$, the price of the good times the quantity of the good sold. We can show total revenue graphically, as in Figure 5-2. The height of the box under the demand curve is P , and the width is Q . The area of this box, $P \times Q$, equals the total revenue in this market. In Figure 5-2, where $P = \$4$ and $Q = 100$, total revenue is $\$4 \times 100$, or \$400.

How does total revenue change as one moves along the demand curve? The answer depends on the price elasticity of demand. If demand is inelastic, as in Figure 5-3, then an increase in the price causes an increase in total revenue. Here an increase in price from \$1 to \$3 causes the quantity demanded to fall only from 100

Figure 5-2

TOTAL REVENUE. The total amount paid by buyers, and received as revenue by sellers, equals the area of the box under the demand curve, $P \times Q$. Here, at a price of \$4, the quantity demanded is 100, and total revenue is \$400.



HOW TOTAL REVENUE CHANGES WHEN PRICE CHANGES: INELASTIC DEMAND. With an inelastic demand curve, an increase in the price leads to a decrease in quantity demanded that is proportionately smaller. Therefore, total revenue (the product of price and quantity) increases. Here, an increase in the price from \$1 to \$3 causes the quantity demanded to fall from 100 to 80, and total revenue rises from \$100 to \$240.

Figure 5-3

to 80, and so total revenue rises from \$100 to \$240. An increase in price raises $P \times Q$ because the fall in Q is proportionately smaller than the rise in P .

We obtain the opposite result if demand is elastic: An increase in the price causes a decrease in total revenue. In Figure 5-4, for instance, when the price rises from \$4 to \$5, the quantity demanded falls from 50 to 20, and so total revenue falls from \$200 to \$100. Because demand is elastic, the reduction in the quantity demanded is so great that it more than offsets the increase in the price. That is, an increase in price reduces $P \times Q$ because the fall in Q is proportionately greater than the rise in P .

Although the examples in these two figures are extreme, they illustrate a general rule:

- ◆ When a demand curve is inelastic (a price elasticity less than 1), a price increase raises total revenue, and a price decrease reduces total revenue.
- ◆ When a demand curve is elastic (a price elasticity greater than 1), a price increase reduces total revenue, and a price decrease raises total revenue.
- ◆ In the special case of unit elastic demand (a price elasticity exactly equal to 1), a change in the price does not affect total revenue.

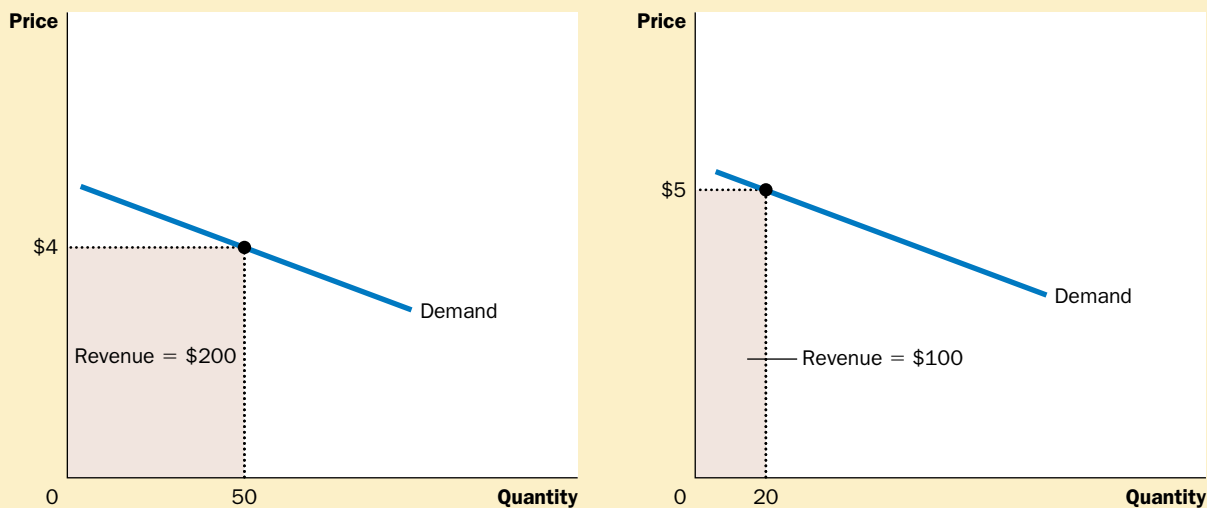
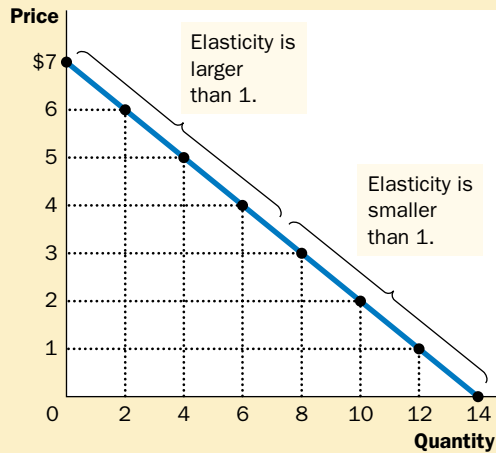


Figure 5-4

HOW TOTAL REVENUE CHANGES WHEN PRICE CHANGES: ELASTIC DEMAND. With an elastic demand curve, an increase in the price leads to a decrease in quantity demanded that is proportionately larger. Therefore, total revenue (the product of price and quantity) decreases. Here, an increase in the price from \$4 to \$5 causes the quantity demanded to fall from 50 to 20, so total revenue falls from \$200 to \$100.

**Figure 5-5**

A LINEAR DEMAND CURVE.
The slope of a linear demand curve is constant, but its elasticity is not.

PRICE	QUANTITY	TOTAL REVENUE (PRICE × QUANTITY)	PERCENT CHANGE IN PRICE	PERCENT CHANGE IN QUANTITY	ELASTICITY	DESCRIPTION
\$7	0	\$ 0	15	200	13.0	Elastic
6	2	12	18	67	3.7	Elastic
5	4	20	22	40	1.8	Elastic
4	6	24	29	29	1.0	Unit elastic
3	8	24	40	22	0.6	Inelastic
2	10	20	67	18	0.3	Inelastic
1	12	12	200	15	0.1	Inelastic
0	14	0				

COMPUTING THE ELASTICITY OF A LINEAR DEMAND CURVE

NOTE: Elasticity is calculated here using the midpoint method.

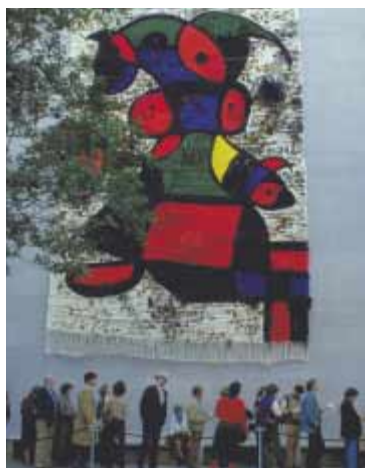
Table 5-1

ELASTICITY AND TOTAL REVENUE ALONG A LINEAR DEMAND CURVE

Although some demand curves have an elasticity that is the same along the entire curve, that is not always the case. An example of a demand curve along which elasticity changes is a straight line, as shown in Figure 5-5. A linear demand curve has a constant slope. Recall that slope is defined as “rise over run,” which here is the ratio of the change in price (“rise”) to the change in quantity (“run”). This particular demand curve’s slope is constant because each \$1 increase in price causes the same 2-unit decrease in the quantity demanded.

Even though the slope of a linear demand curve is constant, the elasticity is not. The reason is that the slope is the ratio of *changes* in the two variables, whereas the elasticity is the ratio of *percentage changes* in the two variables. You can see this most easily by looking at Table 5-1. This table shows the demand schedule for the linear demand curve in Figure 5-5 and calculates the price elasticity of demand using the midpoint method discussed earlier. At points with a low price and high quantity, the demand curve is inelastic. At points with a high price and low quantity, the demand curve is elastic.

Table 5-1 also presents total revenue at each point on the demand curve. These numbers illustrate the relationship between total revenue and elasticity. When the price is \$1, for instance, demand is inelastic, and a price increase to \$2 raises total revenue. When the price is \$5, demand is elastic, and a price increase to \$6 reduces total revenue. Between \$3 and \$4, demand is exactly unit elastic, and total revenue is the same at these two prices.



IF THE PRICE OF ADMISSION WERE HIGHER, HOW MUCH SHORTER WOULD THIS LINE BECOME?

CASE STUDY PRICING ADMISSION TO A MUSEUM

You are curator of a major art museum. Your director of finance tells you that the museum is running short of funds and suggests that you consider changing the price of admission to increase total revenue. What do you do? Do you raise the price of admission, or do you lower it?

The answer depends on the elasticity of demand. If the demand for visits to the museum is inelastic, then an increase in the price of admission would increase total revenue. But if the demand is elastic, then an increase in price would cause the number of visitors to fall by so much that total revenue would decrease. In this case, you should cut the price. The number of visitors would rise by so much that total revenue would increase.

To estimate the price elasticity of demand, you would need to turn to your statisticians. They might use historical data to study how museum attendance varied from year to year as the admission price changed. Or they might use data on attendance at the various museums around the country to see how the admission price affects attendance. In studying either of these sets of data, the statisticians would need to take account of other factors that affect attendance—weather, population, size of collection, and so forth—to isolate the effect of price. In the end, such data analysis would provide an estimate of the price elasticity of demand, which you could use in deciding how to respond to your financial problem.

OTHER DEMAND ELASTICITIES

In addition to the price elasticity of demand, economists also use other elasticities to describe the behavior of buyers in a market.

Income elasticity of demand

a measure of how much the quantity demanded of a good responds to a change in consumers' income, computed as the percentage change in quantity demanded divided by the percentage change in income

The Income Elasticity of Demand Economists use the **income elasticity of demand** to measure how the quantity demanded changes as consumer income changes. The income elasticity is the percentage change in quantity demanded divided by the percentage change in income. That is,

IN THE NEWS*On the Road
with Elasticity*

HOW SHOULD A FIRM THAT OPERATES A private toll road set a price for its service? As the following article makes clear, answering this question requires an understanding of the demand curve and its elasticity.

**For Whom the Booth Tolls,
Price Really Does Matter**

BY STEVEN PEARLSTEIN

All businesses face a similar question: What price for their product will generate the maximum profit?

The answer is not always obvious: Raising the price of something often has the effect of reducing sales as price-sensitive consumers seek alternatives or simply do without. For every product, the extent of that sensitivity is different. The trick is to find the point for each where the ideal tradeoff between profit margin and sales volume is achieved.

Right now, the developers of a new private toll road between Leesburg and

Washington-Dulles International Airport are trying to discern the magic point. The group originally projected that it could charge nearly \$2 for the 14-mile one-way trip, while attracting 34,000 trips on an average day from overcrowded public roads such as nearby Route 7. But after spending \$350 million to build their much heralded "Greenway," they discovered to their dismay that only about a third that number of commuters were willing to pay that much to shave 20 minutes off their daily commute. . . .

It was only when the company, in desperation, lowered the toll to \$1 that it came even close to attracting the expected traffic flows.

Although the Greenway still is losing money, it is clearly better off at this new point on the demand curve than it was when it first opened. Average daily revenue today is \$22,000, compared with \$14,875 when the "special introductory" price was \$1.75. And with traffic still light even at rush hour, it is possible that the owners may lower tolls even further in search of higher revenue.

After all, when the price was lowered by 45 percent last spring, it generated a 200 percent increase in volume three months later. If the same ratio applies again, lowering the toll another 25 percent would drive the daily volume up to 38,000 trips, and daily revenue up to nearly \$29,000.

The problem, of course, is that the same ratio usually does not apply at

every price point, which is why this pricing business is so tricky. . . .

Clifford Winston of the Brookings Institution and John Calfee of the American Enterprise Institute have considered the toll road's dilemma. . . .

Last year, the economists conducted an elaborate market test with 1,170 people across the country who were each presented with a series of options in which they were, in effect, asked to make a personal tradeoff between less commuting time and higher tolls.

In the end, they concluded that the people who placed the highest value on reducing their commuting time already had done so by finding public transportation, living closer to their work, or selecting jobs that allowed them to commute at off-peak hours.

Conversely, those who commuted significant distances had a higher tolerance for traffic congestion and were willing to pay only 20 percent of their hourly pay to save an hour of their time.

Overall, the Winston/Calfee findings help explain why the Greenway's original toll and volume projections were too high: By their reckoning, only commuters who earned at least \$30 an hour (about \$60,000 a year) would be willing to pay \$2 to save 20 minutes.

SOURCE: *The Washington Post*, October 24, 1996, p. E1.

$$\text{Income elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in income}}.$$

As we discussed in Chapter 4, most goods are *normal goods*: Higher income raises quantity demanded. Because quantity demanded and income move in the same direction, normal goods have positive income elasticities. A few goods, such as bus

rides, are *inferior goods*: Higher income lowers the quantity demanded. Because quantity demanded and income move in opposite directions, inferior goods have negative income elasticities.

Even among normal goods, income elasticities vary substantially in size. Necessities, such as food and clothing, tend to have small income elasticities because consumers, regardless of how low their incomes, choose to buy some of these goods. Luxuries, such as caviar and furs, tend to have large income elasticities because consumers feel that they can do without these goods altogether if their income is too low.

cross-price elasticity of demand

a measure of how much the quantity demanded of one good responds to a change in the price of another good, computed as the percentage change in quantity demanded of the first good divided by the percentage change in the price of the second good

The Cross-Price Elasticity of Demand Economists use the **cross-price elasticity of demand** to measure how the quantity demanded of one good changes as the price of another good changes. It is calculated as the percentage change in quantity demanded of good 1 divided by the percentage change in the price of good 2. That is,

$$\text{Cross-price elasticity of demand} = \frac{\text{Percentage change in quantity demanded of good 1}}{\text{Percentage change in the price of good 2}}.$$

Whether the cross-price elasticity is a positive or negative number depends on whether the two goods are substitutes or complements. As we discussed in Chapter 4, substitutes are goods that are typically used in place of one another, such as hamburgers and hot dogs. An increase in hot dog prices induces people to grill hamburgers instead. Because the price of hot dogs and the quantity of hamburgers demanded move in the same direction, the cross-price elasticity is positive. Conversely, complements are goods that are typically used together, such as computers and software. In this case, the cross-price elasticity is negative, indicating that an increase in the price of computers reduces the quantity of software demanded.

QUICK QUIZ: Define the *price elasticity of demand*. ♦ Explain the relationship between total revenue and the price elasticity of demand.

THE ELASTICITY OF SUPPLY

When we discussed the determinants of supply in Chapter 4, we noted that sellers of a good increase the quantity supplied when the price of the good rises, when their input prices fall, or when their technology improves. To turn from qualitative to quantitative statements about supply, we once again use the concept of elasticity.

price elasticity of supply

a measure of how much the quantity supplied of a good responds to a change in the price of that good, computed as the percentage change in quantity supplied divided by the percentage change in price

THE PRICE ELASTICITY OF SUPPLY AND ITS DETERMINANTS

The law of supply states that higher prices raise the quantity supplied. The **price elasticity of supply** measures how much the quantity supplied responds to changes in the price. Supply of a good is said to be *elastic* if the quantity supplied

responds substantially to changes in the price. Supply is said to be *inelastic* if the quantity supplied responds only slightly to changes in the price.

The price elasticity of supply depends on the flexibility of sellers to change the amount of the good they produce. For example, beachfront land has an inelastic supply because it is almost impossible to produce more of it. By contrast, manufactured goods, such as books, cars, and televisions, have elastic supplies because the firms that produce them can run their factories longer in response to a higher price.

In most markets, a key determinant of the price elasticity of supply is the time period being considered. Supply is usually more elastic in the long run than in the short run. Over short periods of time, firms cannot easily change the size of their factories to make more or less of a good. Thus, in the short run, the quantity supplied is not very responsive to the price. By contrast, over longer periods, firms can build new factories or close old ones. In addition, new firms can enter a market, and old firms can shut down. Thus, in the long run, the quantity supplied can respond substantially to the price.

COMPUTING THE PRICE ELASTICITY OF SUPPLY

Now that we have some idea about what the price elasticity of supply is, let's be more precise. Economists compute the price elasticity of supply as the percentage change in the quantity supplied divided by the percentage change in the price. That is,

$$\text{Price elasticity of supply} = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}.$$

For example, suppose that an increase in the price of milk from \$2.85 to \$3.15 a gallon raises the amount that dairy farmers produce from 9,000 to 11,000 gallons per month. Using the midpoint method, we calculate the percentage change in price as

$$\text{Percentage change in price} = (3.15 - 2.85)/3.00 \times 100 = 10 \text{ percent.}$$

Similarly, we calculate the percentage change in quantity supplied as

$$\begin{aligned} \text{Percentage change in quantity supplied} &= (11,000 - 9,000)/10,000 \times 100 \\ &= 20 \text{ percent.} \end{aligned}$$

In this case, the price elasticity of supply is

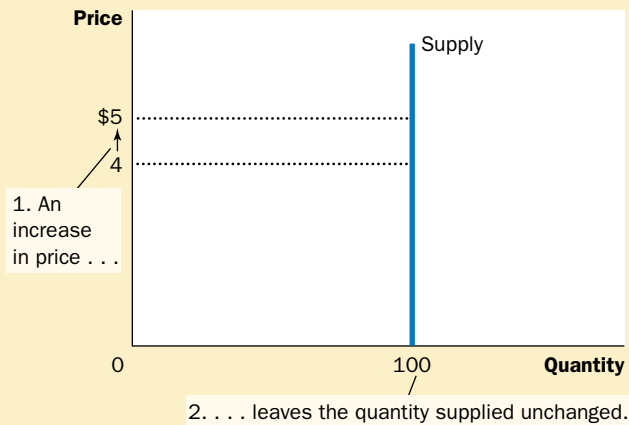
$$\text{Price elasticity of supply} = \frac{20 \text{ percent}}{10 \text{ percent}} = 2.0.$$

In this example, the elasticity of 2 reflects the fact that the quantity supplied moves proportionately twice as much as the price.

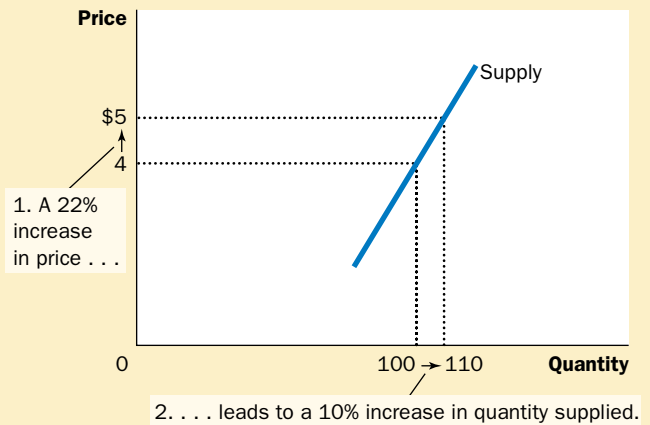
THE VARIETY OF SUPPLY CURVES

Because the price elasticity of supply measures the responsiveness of quantity supplied to the price, it is reflected in the appearance of the supply curve. Figure 5-6 shows five cases. In the extreme case of a zero elasticity, supply is *perfectly inelastic*,

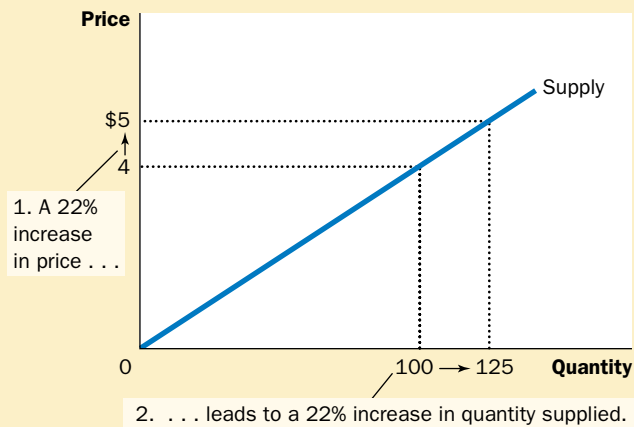
(a) Perfectly Inelastic Supply: Elasticity Equals 0



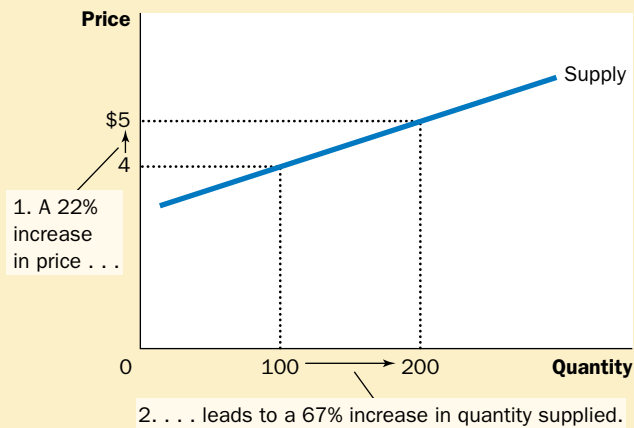
(b) Inelastic Supply: Elasticity Is Less Than 1



(c) Unit Elastic Supply: Elasticity Equals 1



(d) Elastic Supply: Elasticity Is Greater Than 1



(e) Perfectly Elastic Supply: Elasticity Equals Infinity

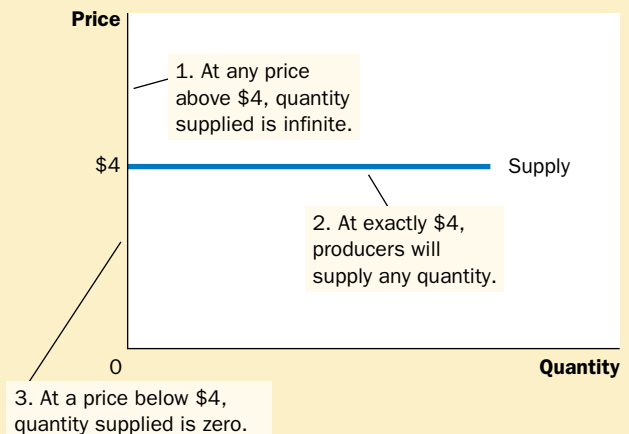
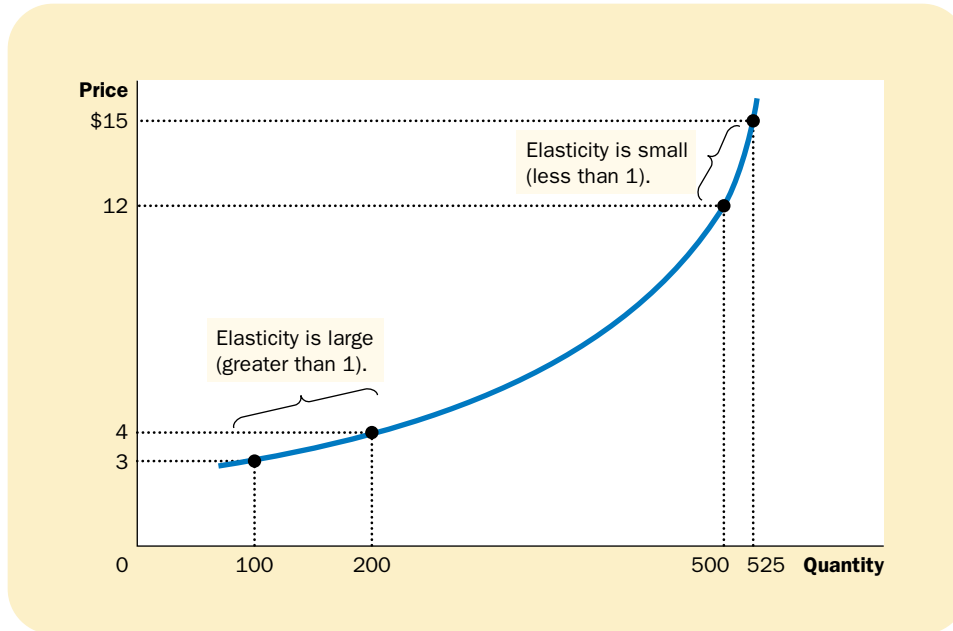


Figure 5-6

THE PRICE ELASTICITY OF SUPPLY. The price elasticity of supply determines whether the supply curve is steep or flat. Note that all percentage changes are calculated using the midpoint method.

**Figure 5-7**

HOW THE PRICE ELASTICITY OF SUPPLY CAN VARY. Because firms often have a maximum capacity for production, the elasticity of supply may be very high at low levels of quantity supplied and very low at high levels of quantity supplied. Here, an increase in price from \$3 to \$4 increases the quantity supplied from 100 to 200. Because the increase in quantity supplied of 67 percent is larger than the increase in price of 29 percent, the supply curve is elastic in this range. By contrast, when the price rises from \$12 to \$15, the quantity supplied rises only from 500 to 525. Because the increase in quantity supplied of 5 percent is smaller than the increase in price of 22 percent, the supply curve is inelastic in this range.

and the supply curve is vertical. In this case, the quantity supplied is the same regardless of the price. As the elasticity rises, the supply curve gets flatter, which shows that the quantity supplied responds more to changes in the price. At the opposite extreme, supply is *perfectly elastic*. This occurs as the price elasticity of supply approaches infinity and the supply curve becomes horizontal, meaning that very small changes in the price lead to very large changes in the quantity supplied.

In some markets, the elasticity of supply is not constant but varies over the supply curve. Figure 5-7 shows a typical case for an industry in which firms have factories with a limited capacity for production. For low levels of quantity supplied, the elasticity of supply is high, indicating that firms respond substantially to changes in the price. In this region, firms have capacity for production that is not being used, such as plants and equipment sitting idle for all or part of the day. Small increases in price make it profitable for firms to begin using this idle capacity. As the quantity supplied rises, firms begin to reach capacity. Once capacity is fully used, increasing production further requires the construction of new plants. To induce firms to incur this extra expense, the price must rise substantially, so supply becomes less elastic.

Figure 5-7 presents a numerical example of this phenomenon. When the price rises from \$3 to \$4 (a 29 percent increase, according to the midpoint method), the quantity supplied rises from 100 to 200 (a 67 percent increase). Because quantity supplied moves proportionately more than the price, the supply curve has elasticity greater than 1. By contrast, when the price rises from \$12 to \$15 (a 22 percent increase), the quantity supplied rises from 500 to 525 (a 5 percent increase). In this case, quantity supplied moves proportionately less than the price, so the elasticity is less than 1.

QUICK QUIZ: Define the *price elasticity of supply*. ♦ Explain why the price elasticity of supply might be different in the long run than in the short run.

THREE APPLICATIONS OF SUPPLY, DEMAND, AND ELASTICITY

Can good news for farming be bad news for farmers? Why did the Organization of Petroleum Exporting Countries (OPEC) fail to keep the price of oil high? Does drug interdiction increase or decrease drug-related crime? At first, these questions might seem to have little in common. Yet all three questions are about markets, and all markets are subject to the forces of supply and demand. Here we apply the versatile tools of supply, demand, and elasticity to answer these seemingly complex questions.

CAN GOOD NEWS FOR FARMING BE BAD NEWS FOR FARMERS?

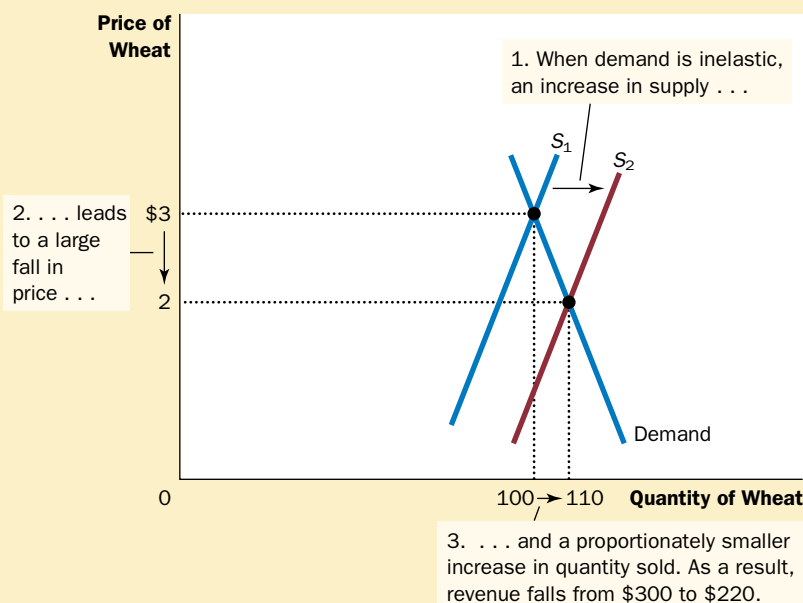
Let's now return to the question posed at the beginning of this chapter: What happens to wheat farmers and the market for wheat when university agronomists discover a new wheat hybrid that is more productive than existing varieties? Recall from Chapter 4 that we answer such questions in three steps. First, we examine whether the supply curve or demand curve shifts. Second, we consider which direction the curve shifts. Third, we use the supply-and-demand diagram to see how the market equilibrium changes.

In this case, the discovery of the new hybrid affects the supply curve. Because the hybrid increases the amount of wheat that can be produced on each acre of land, farmers are now willing to supply more wheat at any given price. In other words, the supply curve shifts to the right. The demand curve remains the same because consumers' desire to buy wheat products at any given price is not affected by the introduction of a new hybrid. Figure 5-8 shows an example of such a change. When the supply curve shifts from S_1 to S_2 , the quantity of wheat sold increases from 100 to 110, and the price of wheat falls from \$3 to \$2.

But does this discovery make farmers better off? As a first cut to answering this question, consider what happens to the total revenue received by farmers. Farmers' total revenue is $P \times Q$, the price of the wheat times the quantity sold. The discovery affects farmers in two conflicting ways. The hybrid allows farmers to produce more wheat (Q rises), but now each bushel of wheat sells for less (P falls).

Whether total revenue rises or falls depends on the elasticity of demand. In practice, the demand for basic foodstuffs such as wheat is usually inelastic, for these items are relatively inexpensive and have few good substitutes. When the demand curve is inelastic, as it is in Figure 5-8, a decrease in price causes total revenue to fall. You can see this in the figure: The price of wheat falls substantially, whereas the quantity of wheat sold rises only slightly. Total revenue falls from \$300 to \$220. Thus, the discovery of the new hybrid lowers the total revenue that farmers receive for the sale of their crops.

If farmers are made worse off by the discovery of this new hybrid, why do they adopt it? The answer to this question goes to the heart of how competitive markets work. Because each farmer is a small part of the market for wheat, he or she takes the price of wheat as given. For any given price of wheat, it is better to

Figure 5-8

AN INCREASE IN SUPPLY IN THE MARKET FOR WHEAT. When an advance in farm technology increases the supply of wheat from S_1 to S_2 , the price of wheat falls. Because the demand for wheat is inelastic, the increase in the quantity sold from 100 to 110 is proportionately smaller than the decrease in the price from \$3 to \$2. As a result, farmers' total revenue falls from \$300 ($\3×100) to \$220 ($\2×110).

use the new hybrid in order to produce and sell more wheat. Yet when all farmers do this, the supply of wheat rises, the price falls, and farmers are worse off.

Although this example may at first seem only hypothetical, in fact it helps to explain a major change in the U.S. economy over the past century. Two hundred years ago, most Americans lived on farms. Knowledge about farm methods was sufficiently primitive that most of us had to be farmers to produce enough food. Yet, over time, advances in farm technology increased the amount of food that each farmer could produce. This increase in food supply, together with inelastic food demand, caused farm revenues to fall, which in turn encouraged people to leave farming.

A few numbers show the magnitude of this historic change. As recently as 1950, there were 10 million people working on farms in the United States, representing 17 percent of the labor force. In 1998, fewer than 3 million people worked on farms, or 2 percent of the labor force. This change coincided with tremendous advances in farm productivity: Despite the 70 percent drop in the number of farmers, U.S. farms produced more than twice the output of crops and livestock in 1998 as they did in 1950.

This analysis of the market for farm products also helps to explain a seeming paradox of public policy: Certain farm programs try to help farmers by inducing them not to plant crops on all of their land. Why do these programs do this? Their purpose is to reduce the supply of farm products and thereby raise prices. With inelastic demand for their products, farmers as a group receive greater total revenue if they supply a smaller crop to the market. No single farmer would choose to leave his land fallow on his own because each takes the market price as given. But if all farmers do so together, each of them can be better off.

Doonesbury

by G.B. TRADEAU



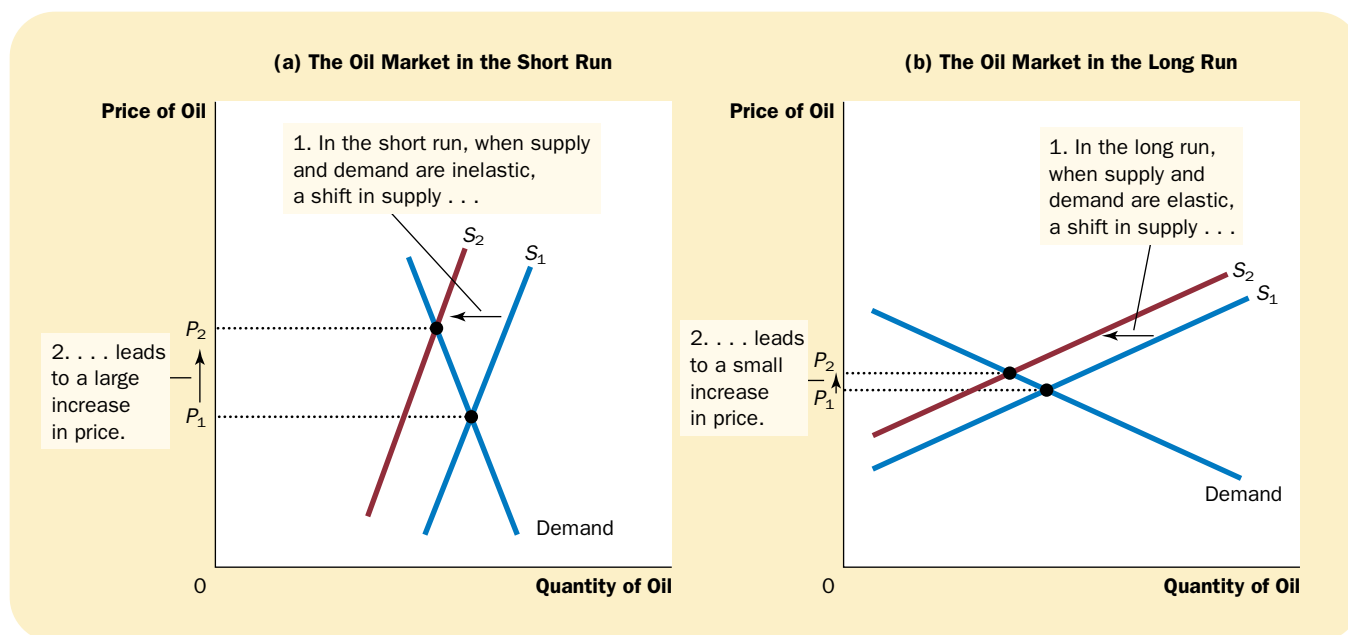
When analyzing the effects of farm technology or farm policy, it is important to keep in mind that what is good for farmers is not necessarily good for society as a whole. Improvement in farm technology can be bad for farmers who become increasingly unnecessary, but it is surely good for consumers who pay less for food. Similarly, a policy aimed at reducing the supply of farm products may raise the incomes of farmers, but it does so at the expense of consumers.

WHY DID OPEC FAIL TO KEEP THE PRICE OF OIL HIGH?

Many of the most disruptive events for the world's economies over the past several decades have originated in the world market for oil. In the 1970s members of the Organization of Petroleum Exporting Countries (OPEC) decided to raise the world price of oil in order to increase their incomes. These countries accomplished this goal by jointly reducing the amount of oil they supplied. From 1973 to 1974, the price of oil (adjusted for overall inflation) rose more than 50 percent. Then, a few years later, OPEC did the same thing again. The price of oil rose 14 percent in 1979, followed by 34 percent in 1980, and another 34 percent in 1981.

Yet OPEC found it difficult to maintain a high price. From 1982 to 1985, the price of oil steadily declined at about 10 percent per year. Dissatisfaction and disarray soon prevailed among the OPEC countries. In 1986 cooperation among OPEC members completely broke down, and the price of oil plunged 45 percent. In 1990 the price of oil (adjusted for overall inflation) was back to where it began in 1970, and it has stayed at that low level throughout most of the 1990s.

This episode shows how supply and demand can behave differently in the short run and in the long run. In the short run, both the supply and demand for oil are relatively inelastic. Supply is inelastic because the quantity of known oil reserves and the capacity for oil extraction cannot be changed quickly. Demand is inelastic because buying habits do not respond immediately to changes in price. Many drivers with old gas-guzzling cars, for instance, will just pay the higher



A REDUCTION IN SUPPLY IN THE WORLD MARKET FOR OIL. When the supply of oil falls, the response depends on the time horizon. In the short run, supply and demand are relatively inelastic, as in panel (a). Thus, when the supply curve shifts from S_1 to S_2 , the price rises substantially. By contrast, in the long run, supply and demand are relatively elastic, as in panel (b). In this case, the same size shift in the supply curve (S_1 to S_2) causes a smaller increase in the price.

Figure 5-9

price. Thus, as panel (a) of Figure 5-9 shows, the short-run supply and demand curves are steep. When the supply of oil shifts from S_1 to S_2 , the price increase from P_1 to P_2 is large.

The situation is very different in the long run. Over long periods of time, producers of oil outside of OPEC respond to high prices by increasing oil exploration and by building new extraction capacity. Consumers respond with greater conservation, for instance by replacing old inefficient cars with newer efficient ones. Thus, as panel (b) of Figure 5-9 shows, the long-run supply and demand curves are more elastic. In the long run, the shift in the supply curve from S_1 to S_2 causes a much smaller increase in the price.

This analysis shows why OPEC succeeded in maintaining a high price of oil only in the short run. When OPEC countries agreed to reduce their production of oil, they shifted the supply curve to the left. Even though each OPEC member sold less oil, the price rose by so much in the short run that OPEC incomes rose. By contrast, in the long run when supply and demand are more elastic, the same reduction in supply, measured by the horizontal shift in the supply curve, caused a smaller increase in the price. Thus, OPEC's coordinated reduction in supply proved less profitable in the long run.

OPEC still exists today, and it has from time to time succeeded at reducing supply and raising prices. But the price of oil (adjusted for overall inflation) has

never returned to the peak reached in 1981. The cartel now seems to understand that raising prices is easier in the short run than in the long run.

DOES DRUG INTERDICTION INCREASE OR DECREASE DRUG-RELATED CRIME?

A persistent problem facing our society is the use of illegal drugs, such as heroin, cocaine, and crack. Drug use has several adverse effects. One is that drug dependency can ruin the lives of drug users and their families. Another is that drug addicts often turn to robbery and other violent crimes to obtain the money needed to support their habit. To discourage the use of illegal drugs, the U.S. government devotes billions of dollars each year to reduce the flow of drugs into the country. Let's use the tools of supply and demand to examine this policy of drug interdiction.

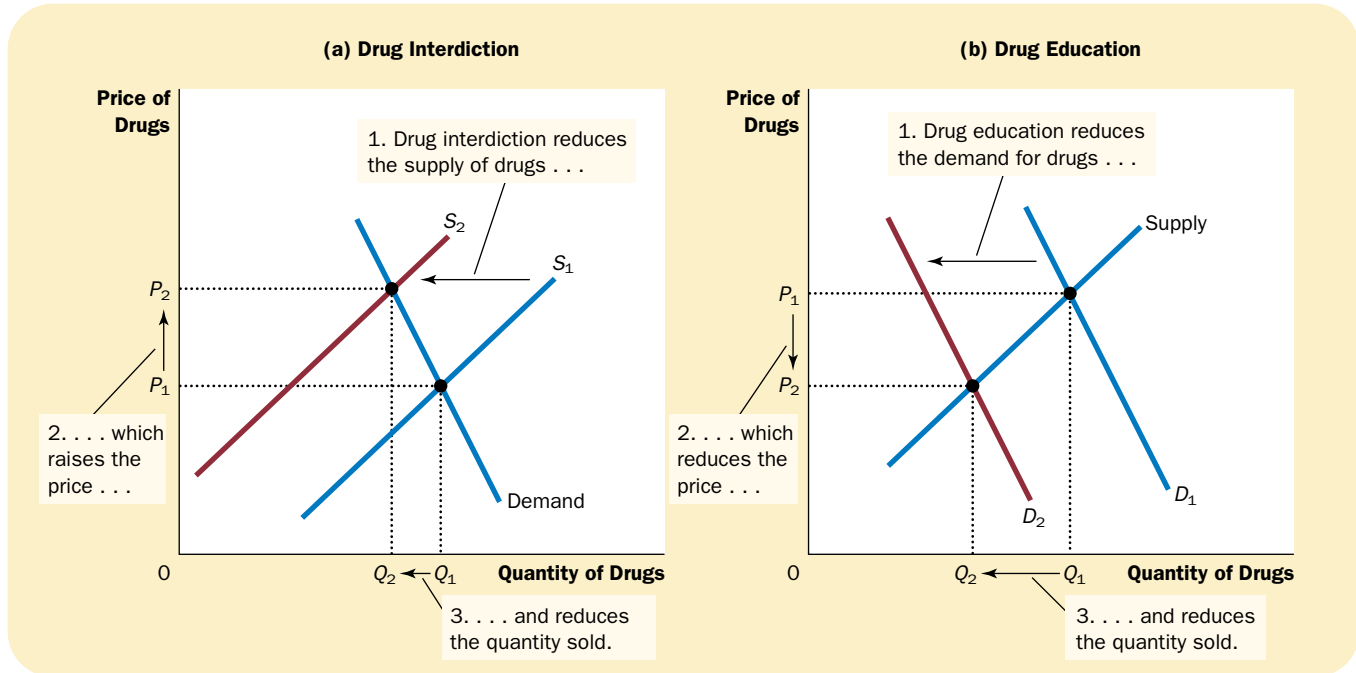
Suppose the government increases the number of federal agents devoted to the war on drugs. What happens in the market for illegal drugs? As is usual, we answer this question in three steps. First, we consider whether the supply curve or demand curve shifts. Second, we consider the direction of the shift. Third, we see how the shift affects the equilibrium price and quantity.

Although the purpose of drug interdiction is to reduce drug use, its direct impact is on the sellers of drugs rather than the buyers. When the government stops some drugs from entering the country and arrests more smugglers, it raises the cost of selling drugs and, therefore, reduces the quantity of drugs supplied at any given price. The demand for drugs—the amount buyers want at any given price—is not changed. As panel (a) of Figure 5-10 shows, interdiction shifts the supply curve to the left from S_1 to S_2 and leaves the demand curve the same. The equilibrium price of drugs rises from P_1 to P_2 , and the equilibrium quantity falls from Q_1 to Q_2 . The fall in the equilibrium quantity shows that drug interdiction does reduce drug use.

But what about the amount of drug-related crime? To answer this question, consider the total amount that drug users pay for the drugs they buy. Because few drug addicts are likely to break their destructive habits in response to a higher price, it is likely that the demand for drugs is inelastic, as it is drawn in the figure. If demand is inelastic, then an increase in price raises total revenue in the drug market. That is, because drug interdiction raises the price of drugs proportionately more than it reduces drug use, it raises the total amount of money that drug users pay for drugs. Addicts who already had to steal to support their habits would have an even greater need for quick cash. Thus, drug interdiction could increase drug-related crime.

Because of this adverse effect of drug interdiction, some analysts argue for alternative approaches to the drug problem. Rather than trying to reduce the supply of drugs, policymakers might try to reduce the demand by pursuing a policy of drug education. Successful drug education has the effects shown in panel (b) of Figure 5-10. The demand curve shifts to the left from D_1 to D_2 . As a result, the equilibrium quantity falls from Q_1 to Q_2 , and the equilibrium price falls from P_1 to P_2 . Total revenue, which is price times quantity, also falls. Thus, in contrast to drug interdiction, drug education can reduce both drug use and drug-related crime.

Advocates of drug interdiction might argue that the effects of this policy are different in the long run than in the short run, because the elasticity of demand may depend on the time horizon. The demand for drugs is probably inelastic over



POLICIES TO REDUCE THE USE OF ILLEGAL DRUGS. Drug interdiction reduces the supply of drugs from S_1 to S_2 , as in panel (a). If the demand for drugs is inelastic, then the total amount paid by drug users rises, even as the amount of drug use falls. By contrast, drug education reduces the demand for drugs from D_1 to D_2 , as in panel (b). Because both price and quantity fall, the amount paid by drug users falls.

Figure 5-10

short periods of time because higher prices do not substantially affect drug use by established addicts. But demand may be more elastic over longer periods of time because higher prices would discourage experimentation with drugs among the young and, over time, lead to fewer drug addicts. In this case, drug interdiction would increase drug-related crime in the short run while decreasing it in the long run.

QUICK QUIZ: How might a drought that destroys half of all farm crops be good for farmers? If such a drought is good for farmers, why don't farmers destroy their own crops in the absence of a drought?

CONCLUSION

According to an old quip, even a parrot can become an economist simply by learning to say "supply and demand." These last two chapters should have convinced you that there is much truth in this statement. The tools of supply and demand allow you to analyze many of the most important events and policies that shape

the economy. You are now well on your way to becoming an economist (or, at least, a well-educated parrot).

Summary

- ◆ The price elasticity of demand measures how much the quantity demanded responds to changes in the price. Demand tends to be more elastic if the good is a luxury rather than a necessity, if close substitutes are available, if the market is narrowly defined, or if buyers have substantial time to react to a price change.
- ◆ The price elasticity of demand is calculated as the percentage change in quantity demanded divided by the percentage change in price. If the elasticity is less than 1, so that quantity demanded moves proportionately less than the price, demand is said to be inelastic. If the elasticity is greater than 1, so that quantity demanded moves proportionately more than the price, demand is said to be elastic.
- ◆ Total revenue, the total amount paid for a good, equals the price of the good times the quantity sold. For inelastic demand curves, total revenue rises as price rises. For elastic demand curves, total revenue falls as price rises.
- ◆ The income elasticity of demand measures how much the quantity demanded responds to changes in consumers' income. The cross-price elasticity of demand measures how much the quantity demanded of one good responds to the price of another good.
- ◆ The price elasticity of supply measures how much the quantity supplied responds to changes in the price. This elasticity often depends on the time horizon under consideration. In most markets, supply is more elastic in the long run than in the short run.
- ◆ The price elasticity of supply is calculated as the percentage change in quantity supplied divided by the percentage change in price. If the elasticity is less than 1, so that quantity supplied moves proportionately less than the price, supply is said to be inelastic. If the elasticity is greater than 1, so that quantity supplied moves proportionately more than the price, supply is said to be elastic.
- ◆ The tools of supply and demand can be applied in many different kinds of markets. This chapter uses them to analyze the market for wheat, the market for oil, and the market for illegal drugs.

Key Concepts

elasticity, p. 94

price elasticity of demand, p. 94

total revenue, p. 98

income elasticity of demand, p. 102

cross-price elasticity of demand, p. 104

price elasticity of supply, p. 104

Questions for Review

1. Define the price elasticity of demand and the income elasticity of demand.
2. List and explain some of the determinants of the price elasticity of demand.
3. If the elasticity is greater than 1, is demand elastic or inelastic? If the elasticity equals 0, is demand perfectly elastic or perfectly inelastic?
4. On a supply-and-demand diagram, show equilibrium price, equilibrium quantity, and the total revenue received by producers.
5. If demand is elastic, how will an increase in price change total revenue? Explain.
6. What do we call a good whose income elasticity is less than 0?
7. How is the price elasticity of supply calculated? Explain what this measures.
8. What is the price elasticity of supply of Picasso paintings?
9. Is the price elasticity of supply usually larger in the short run or in the long run? Why?
10. In the 1970s, OPEC caused a dramatic increase in the price of oil. What prevented it from maintaining this high price through the 1980s?

Problems and Applications

1. For each of the following pairs of goods, which good would you expect to have more elastic demand and why?
 - a. required textbooks or mystery novels
 - b. Beethoven recordings or classical music recordings in general
 - c. heating oil during the next six months or heating oil during the next five years
 - d. root beer or water
2. Suppose that business travelers and vacationers have the following demand for airline tickets from New York to Boston:

PRICE	QUANTITY DEMANDED (BUSINESS TRAVELERS)	QUANTITY DEMANDED (VACATIONERS)
\$150	2,100	1,000
200	2,000	800
250	1,900	600
300	1,800	400

- a. As the price of tickets rises from \$200 to \$250, what is the price elasticity of demand for (i) business travelers and (ii) vacationers? (Use the midpoint method in your calculations.)
 - b. Why might vacationers have a different elasticity than business travelers?
3. Suppose that your demand schedule for compact discs is as follows:

PRICE	QUANTITY DEMANDED (INCOME = \$10,000)	QUANTITY DEMANDED (INCOME = \$12,000)
\$ 8	40	50
10	32	45
12	24	30
14	16	20
16	8	12

- a. Use the midpoint method to calculate your price elasticity of demand as the price of compact discs increases from \$8 to \$10 if (i) your income is \$10,000, and (ii) your income is \$12,000.
 - b. Calculate your income elasticity of demand as your income increases from \$10,000 to \$12,000 if (i) the price is \$12, and (ii) the price is \$16.
4. Emily has decided always to spend one-third of her income on clothing.
 - a. What is her income elasticity of clothing demand?

- b. What is her price elasticity of clothing demand?
 - c. If Emily's tastes change and she decides to spend only one-fourth of her income on clothing, how does her demand curve change? What are her income elasticity and price elasticity now?
5. *The New York Times* reported (Feb. 17, 1996, p. 25) that subway ridership declined after a fare increase: "There were nearly four million fewer riders in December 1995, the first full month after the price of a token increased 25 cents to \$1.50, than in the previous December, a 4.3 percent decline."
 - a. Use these data to estimate the price elasticity of demand for subway rides.
 - b. According to your estimate, what happens to the Transit Authority's revenue when the fare rises?
 - c. Why might your estimate of the elasticity be unreliable?
 6. Two drivers—Tom and Jerry—each drive up to a gas station. Before looking at the price, each places an order. Tom says, "I'd like 10 gallons of gas." Jerry says, "I'd like \$10 worth of gas." What is each driver's price elasticity of demand?
 7. Economists have observed that spending on restaurant meals declines more during economic downturns than does spending on food to be eaten at home. How might the concept of elasticity help to explain this phenomenon?
 8. Consider public policy aimed at smoking.
 - a. Studies indicate that the price elasticity of demand for cigarettes is about 0.4. If a pack of cigarettes currently costs \$2 and the government wants to reduce smoking by 20 percent, by how much should it increase the price?
 - b. If the government permanently increases the price of cigarettes, will the policy have a larger effect on smoking one year from now or five years from now?
 - c. Studies also find that teenagers have a higher price elasticity than do adults. Why might this be true?
 9. Would you expect the price elasticity of *demand* to be larger in the market for all ice cream or the market for vanilla ice cream? Would you expect the price elasticity of *supply* to be larger in the market for all ice cream or the market for vanilla ice cream? Be sure to explain your answers.
 10. Pharmaceutical drugs have an inelastic demand, and computers have an elastic demand. Suppose that

technological advance doubles the supply of both products (that is, the quantity supplied at each price is twice what it was).

- a. What happens to the equilibrium price and quantity in each market?
 - b. Which product experiences a larger change in price?
 - c. Which product experiences a larger change in quantity?
 - d. What happens to total consumer spending on each product?
11. Beachfront resorts have an inelastic supply, and automobiles have an elastic supply. Suppose that a rise in population doubles the demand for both products (that is, the quantity demanded at each price is twice what it was).
 - a. What happens to the equilibrium price and quantity in each market?
 - b. Which product experiences a larger change in price?
 - c. Which product experiences a larger change in quantity?
 - d. What happens to total consumer spending on each product?
 12. Several years ago, flooding along the Missouri and Mississippi rivers destroyed thousands of acres of wheat.
 - a. Farmers whose crops were destroyed by the floods were much worse off, but farmers whose crops were not destroyed benefited from the floods. Why?
 - b. What information would you need about the market for wheat in order to assess whether farmers as a group were hurt or helped by the floods?
 13. Explain why the following might be true: A drought around the world raises the total revenue that farmers receive from the sale of grain, but a drought only in Kansas reduces the total revenue that Kansas farmers receive.
 14. Because better weather makes farmland more productive, farmland in regions with good weather conditions is more expensive than farmland in regions with bad weather conditions. Over time, however, as advances in technology have made all farmland more productive, the price of farmland (adjusted for overall inflation) has fallen. Use the concept of elasticity to explain why productivity and farmland prices are positively related across space but negatively related over time.