Supply, Demand, and Equilibrium

Many books begin by telling you, at some length, what price theory is. This book begins by showing you. We'll ask some simple questions, and we'll develop the tools we need to answer them as we go along.

When a frost kills half the Florida orange crop, exactly who ends up with fewer oranges? What happens to the price of beef when the price of chicken falls or when the price of grazing land rises? If car dealerships are taxed, how much of the tax is "passed on" to car buyers—and are car buyers better or worse off than when they are taxed directly?

By the time you've finished this chapter, you'll know how to tackle these questions and many more. In each succeeding chapter, you'll be exposed to new ideas in economics and their surprising consequences for the world around you. To learn what price theory is, dig in and begin reading.

1.1 Demand

When the price of a good goes up, people generally consume less (or at least not more) of it. This statement, called the **law of demand,** is usually summarized as

When the price goes up, the quantity demanded goes down.

Economists believe that the law of demand is always (or nearly always) true. We believe this primarily on the basis of observations. In Chapter 4, we'll see that the law of demand follows logically from certain more fundamental assumptions about human behavior, which gives us yet another reason to believe it.

Law of demand

The observation that when the price of a good goes up, people will buy less of that good.

Demand versus Quantity Demanded

As an example, suppose that the good in question is coffee. The number of cups of coffee that you choose to purchase on a typical day might be given by a table like this:

Price	Quantity
20¢/cup	5 cups/day
30¢	4
40¢	2
50¢	1

Quantity demanded

The amount of a good that a given individual or group of individuals will choose to consume at a given price.

Demand

A family of numbers that lists the quantity demanded corresponding to each possible price.

We say that when the price is 20¢ per cup, your **quantity demanded** is 5 cups per day. When the price is 30¢ per cup, your quantity demanded is 4 cups per day, and so on. Notice that the price is measured *per cup,* and the quantity is measured in *cups per day.* If we had selected different units of measurement, we would have had different entries in the table. For example, if we measured quantity in cups per week, the numbers in the right-hand column would be 35, 28, 14, and 7. To speak meaningfully about demand, we must specify our units and use them consistently.

The information in the table is collectively referred to as your **demand** for coffee. Notice the difference between *demand* and *quantity demanded.* Quantity demanded is a number, and it changes when the price does. Demand is a whole family of numbers, listing the quantities you would demand in a variety of hypothetical situations. (More precisely, demand is a *function* that converts prices to quantities.) The demand table asserts that if the price of coffee were 50¢ per cup, then you would buy 1 cup per day. It does not assert that the price of coffee actually is, or ever has been, or will be, 50¢ per cup.

If the price of coffee rises from 30¢ to 40¢ per cup, then your quantity demanded falls from 4 cups to 2 cups. However, your demand for coffee is unchanged, because the same table is still in effect. It remains true that if the price of coffee were 20¢ per cup, you would be demanding 5 cups per day; if the price of coffee were 30¢ per cup, you would be demanding 4 cups per day; and so on. The sequence of "if statements" is what describes your demand for coffee.

A change in price leads to a change in quantity demanded. A change in price does *not* lead to a change in demand.

Demand Curves

Unfortunately, when we represent demand by a table, we do not provide a complete picture. Our table does not tell us, for example, how much coffee you will purchase when the price is 22¢ per cup, or 33½¢. Therefore, we usually represent demand by a graph. We plot price on the vertical axis and quantity on the horizontal, always specifying our units.

Exhibit 1.1 provides an example. There, the information in your demand table for coffee has been translated into the black points in the graph. The curve through the points is called your **demand curve** for coffee. It fills in the additional information corresponding to prices that do not appear in the table. If we were to fill in enough rows of the table (and only space prevents us from doing so), then the demand table and the demand curve in Exhibit 1.1 would convey exactly the same information. The demand curve is a picture of your demand for coffee.

Demand curve

A graph illustrating demand, with prices on the vertical axis and quantities demanded on the horizontal axis.

Dangerous Curve

Because demand is a function that converts price (the independent variable) to quantity (the dependent variable), a mathematician would be inclined to plot price on the horizontal axis and quantity on the vertical. In economics, we do exactly the opposite, for good reasons that will be explained in Chapter 7.

Because the demand curve is a picture of demand, every statement that we can make about demand can be "seen" in the curve. For example, consider the law of demand: "When the price goes up, the quantity demanded goes down." This fact is reflected in the downward slope of the demand curve. It is important to remember both of these statements:

EXHIBIT 1.1   The Demand Curve

Price	Quantity
20¢/cup	5 cups/day
30¢	4
40¢	2
50¢	1
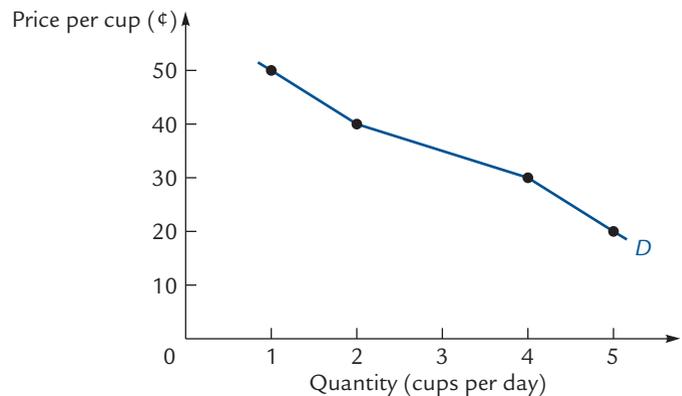
The demand table shows how many cups of coffee you would buy per day at each of several prices. The black points in the graph correspond precisely to the information in the table. The curve connecting the points is your demand curve for coffee. It conveys more information than the table because it shows how many cups of coffee you would buy at intermediate prices like 22¢ or 33½¢ per cup. If the table were enlarged to include enough intermediate prices, then the table and the graph would convey exactly the same information.

When the price goes up, the quantity demanded goes down.

and

Demand curves slope downward.

But it is even more important to recognize that these two statements are just two different ways of saying the same thing and to understand *why* they are just two different ways of saying the same thing.

Example: The Demand for the Mona Lisa

Leonardo DaVinci only painted the Mona Lisa once. But if the original Mona Lisa were available for, say, $1.50, I'd want more than one of them—I think I'd probably hang one in my office, one in my living room, and perhaps one beside my bathroom mirror. So if the price of the Mona Lisa were $1.50, my quantity demanded would be 3. The point with those coordinates is on my Mona Lisa demand curve.

This example is meant to illustrate that points on the demand curve have *nothing to do* with the actual price of the Mona Lisa or the quantity of Mona Lisas that are actually available. My demand curve shows how many Mona Lisas I would *want* at various prices, not how many I *could get*.

Changes in Demand

If a change in price does not lead to a change in demand, does this mean demand can never change? Absolutely not. Suppose, for example, that your doctor has advised you

to cut back on coffee for medical reasons. You might then choose to buy coffee according to a different table, such as this:

Price	Quantity
20¢/cup	3 cups/day
30¢	2
40¢	1
50¢	0

Now your rule for deciding how many cups of coffee to purchase at different prices has changed—and this rule is just what we have called *demand*.

We can also use demand curves to illustrate the difference between a change in quantity demanded and a change in demand. A change in quantity demanded is represented by a movement along the demand curve from one point to another. A change in demand is represented by a shift of the curve itself to a new position.

Fall in demand

A decision by demanders to buy a smaller quantity at each given price.

The curve labeled *D* in Exhibit 1.2 is the same as the demand curve in Exhibit 1.1. The curve labeled *D'* illustrates your demand after medical advice to reduce your caffeine intake. Because you now want fewer cups of coffee at any given price, the new demand curve lies to the left of (and consequently below) the old demand curve. We describe this situation as a **fall in demand.**

EXHIBIT 1.2   **Shifting the Demand Curve**

TABLE A. Your Original Demand for Coffee

Price	Quantity
20¢/cup	5 cups/day
30¢	4
40¢	2
50¢	1

TABLE B. Your New Demand for Coffee after Medical Advice to Cut Back

Price	Quantity
20¢/cup	3 cups/day
30¢	2
40¢	1
50¢	0
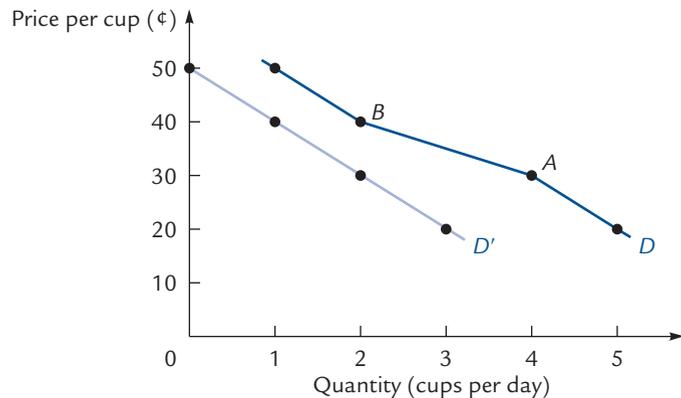
Your original demand curve for coffee is the curve labeled *D*. A change in price, say from 30¢ per cup to 40¢ per cup, would cause a movement along the curve from point *A* to point *B*. A change in something other than price, such as a doctor's suggestion that caffeine is bad for your health, can lead to a change in demand, represented by a shift to an entirely new demand curve. In this case the doctor's advice leads to a fall in demand, which is represented by a leftward shift of the curve.

The opposite situation, a **rise in demand,** results in a rightward shift of the demand curve. If you enrolled in a class that required a lot of late-night studying, you might experience a rise in your demand for coffee.

There are many other possible reasons for a shift in demand. If the price of tea were to fall, you might decide to drink more tea and less coffee. The amount of coffee you would choose to buy at any given price would go down. This is an example of a fall in demand. On the other hand, if your aunt gives you a snazzy new coffee maker for your birthday, your demand for coffee might rise.

A change in anything *other* than price can lead to a change in demand.

Rise in demand

A decision by demanders to buy a larger quantity at each given price.

Exercise 1.1 If the price of donuts were to fall, what do you think would happen to your demand for coffee? Does a fall in the price of a related good always affect your demand in the same way, or does it depend on what related good we are talking about?

Exercise 1.2 How might a rise in your income affect your demand for coffee?

Effect of a Sales Tax

One thing that could change your demand for coffee is the imposition of a **sales tax.**[1] Suppose that a new law requires you to pay a tax of 10¢ per cup of coffee that you buy. What happens to your demand curve?

Before we can begin to think about how a sales tax affects your demand curve, we have to decide what the word *price* means in a world with sales taxes. If a cup of coffee carries a price tag of "50¢ plus tax" and the tax is a nickel, should we say that the price is 50¢ or should we say that the price is 55¢? It doesn't matter which choice we make, but it *does* matter that we make a choice and stick with it. In this book, we will consistently use the word *price* to mean the pretax price, so that the price of that cup of coffee is 50¢. We think of the sales tax as something that you pay *in addition* to the market price. Therefore a new sales tax is a change in something other than the price, and therefore a new sales tax can affect the location of the demand curve.

Sales tax

In this book, a tax that is paid directly by consumers to the government. Other texts use this phrase in different ways.

Dangerous
Curve

A sales tax makes buying coffee less desirable; at any given (pretax) price, you now want to buy less coffee than before. Your demand curve shifts to the left and downward. In fact, we can even figure out how far it shifts.

Suppose your demand for coffee in a world without taxes is given by the table in Exhibit 1.1. Let's figure out your demand in a world where coffee is taxed at 10¢ per cup. If the (pretax) price of coffee is 10¢, what will it actually cost you to acquire a cup of coffee? It will cost you 10¢ plus 10¢ tax—a total of 20¢. How many cups of coffee do you choose to buy when they cost you 20¢ apiece? According to the table in Exhibit 1.1, you will buy 5.

---

[1] In this book we will use the phrase *sales tax* to refer to a tax that is paid to the government by consumers. Some other texts use this phrase in a different way.

Now we can begin to tabulate your demand for coffee in a world with taxes. We know that, with taxes, if the price of coffee is 10¢ per cup, you will choose to buy 5 cups per day. This is the first row of your new demand table:

Price	Quantity
10¢/cup	5 cups/day

We can continue in this way. When the price of coffee is 20¢, the actual cost to you will be 30¢. We know from Exhibit 1.1 that you will then choose to buy 4 cups. Thus, we can fill in another row of our table:

Price	Quantity
10¢/cup	5 cups/day
20¢	4

If we complete the argument at other prices, we finally arrive at your new demand for coffee, which is shown in Exhibit 1.3. Compare the entries in the two demand tables of that exhibit. Notice that the same quantities appear in each but the corresponding prices are all 10¢ lower in the new demand schedule (Table B). What can we conclude about the demand curves that illustrate these tables? For every point on the original

---

EXHIBIT 1.3   The Effect of a Sales Tax on Demand

TABLE A. Demand for Coffee without Tax

Price	Quantity
20¢/cup	5 cups/day
30¢	4
40¢	2
50¢	1

TABLE B. Demand for Coffee with Sales Tax of 10¢ per Cup

Price	Quantity
10¢/cup	5 cups/day
20¢	4
30¢	2
40¢	1
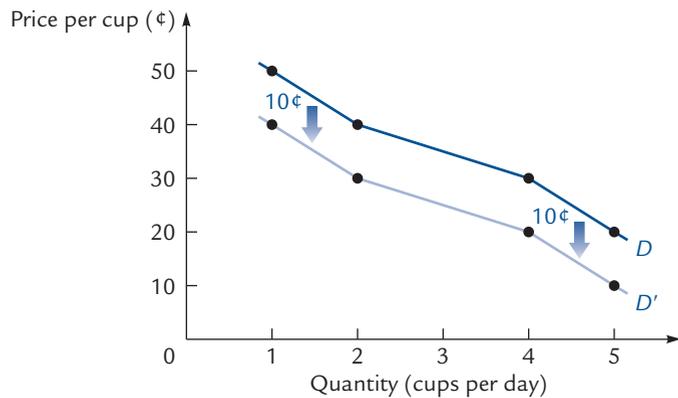
If the price of coffee is 10¢ per cup and there is a sales tax of 10¢, then it will actually cost you 20¢ to acquire a cup of coffee. Table A shows that under these circumstances you would purchase 5 cups per day. This is recorded in the first row of Table B. The other rows in that table are generated in a similar manner.

The rows of Table B contain the same quantities as the rows of Table A, but the corresponding prices are all 10¢ lower. Another way to say this is that each point on the new demand curve lies exactly 10¢ below a corresponding point on the original demand curve. Therefore, the new demand curve lies exactly 10¢ below the original demand curve in vertical distance. The sales tax causes the demand curve to shift downward parallel to itself by the amount of the tax.

demand curve *(D)*, a corresponding point on the new demand curve *(D′)* represents the same quantity but a price that is lower by 10¢. This corresponding point lies a vertical distance exactly 10¢ below the original point.

In summary, the sales tax causes each point of the demand curve to shift downward by the vertical distance 10¢. Because each point shifts downward the same distance, we can say that the demand curve shifts downward parallel to itself by the vertical distance 10¢. This gives us a precise prediction of how a sales tax affects demand.

A sales tax causes the demand curve to shift downward parallel to itself by the amount of the tax.

Exercise 1.3 How would demand be affected by a sales tax of 5¢ per item? How would it be affected by a subsidy under which the government pays 10¢ toward each cup of coffee purchased?

Exercise 1.4 How would demand be affected by a percentage sales tax—say, a tax equal to 10% of the price paid?

Market Demand

Until now we have been discussing your demand for coffee or the demand by some individual. We can just as well discuss the demand for coffee by some *group* of individuals. We can speak of the demand by your family, your city, your country, or the entire world. The quantity associated with a given price is the total number of cups per day that the group members would demand.

Of course, because we can speak of a group's *demand* for coffee, we can speak of that group's *demand curve* as well. And, of course, this demand curve slopes downward.

## The Shape of the Demand Curve

We have discussed the meaning of the demand curve's downward slope, but have not yet discussed how steeply the demand curve slopes downward. Your community's demand curve for shoes might look like either panel of Exhibit 1.4. Both of these demand curves slope downward, but one slopes downward far more steeply than the other. If the demand curve looks like panel A, a small change in the price of shoes will lead to a small change in the quantity of shoes demanded. If the demand curve looks like panel B, a small change in the price of shoes will lead to a much larger change in the quantity of shoes demanded.

Often, people want to know the slopes of particular demand curves. If you owned a shoe store, you would be very interested in knowing whether a small price rise would drive away only a few customers or a great many. This is the same thing as asking whether the demand curve for your shoes is very steep or very flat.[2]

---

[2] The simplest measure of a demand curve's steepness is its slope. An alternative measure, more widely used in economics, is its *elasticity*. The *elasticity* is the ratio (percent change in quantity)/(percent change in price) between any two points. In panel A of Exhibit 1.4, where the price rises from $4 to $5 (a 25% increase), the quantity falls from 20 to 18 (a 10% decrease). Thus, the elasticity is –10%/25%, or –4. We will have more to say about elasticity in Chapter 4.

EXHIBIT 1.4   The Shape of the Demand Curve
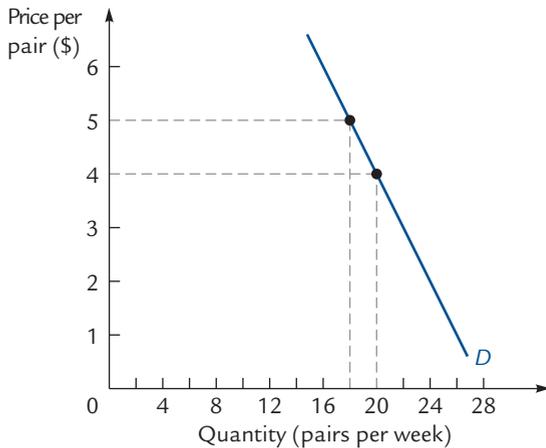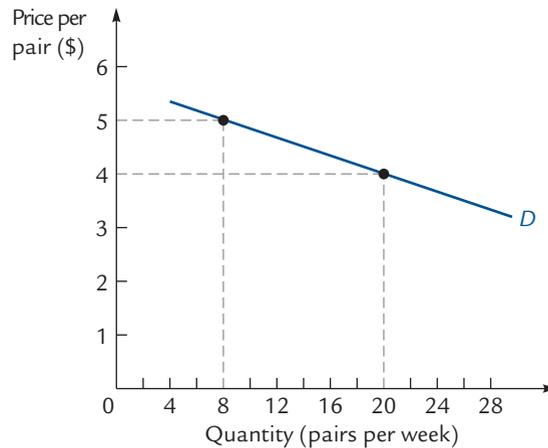
The two panels depict two possible demand curves for shoes. In panel A a given change in price (say from $4 per pair to $5 per pair) leads to a small change in quantity demanded (from 20 pairs of shoes per week to 18 pairs per week). In panel B the same change in price leads to a large change in quantity demanded (from 20 pairs per week to 8 pairs per week).

Econometrics

A family of statistical techniques used by economists.

To help resolve such questions, economists have developed a variety of statistical techniques known collectively as **econometrics.** These techniques allow us (among other things) to estimate the slopes of various demand curves on the basis of direct observations in the marketplace. In this book we will not study any econometrics, but it is important for you to know that the techniques exist and work tolerably well. In many circumstances economists can estimate the slopes of demand curves with considerable accuracy.

Example: The Demand for Murder

Many economists have applied the successful techniques of econometrics to the study of demand curves for a variety of interesting "goods" that were previously viewed as outside the realm of economic analysis. Consider, for example, the demand curve for murder.

Murder is an activity that some people choose to engage in for a variety of reasons. We can view murder as a "good" for these people, and the commission of murder as the act of consuming that good. The price of consuming the good is paid in many forms. One of these forms is the risk of capital punishment.

This means that we can draw a demand curve for murder, plotting the probability of capital punishment on the vertical axis and the quantity of murders committed on the horizontal axis. We can ask how steep this demand curve is, which is the same thing as asking whether a small increase in the probability of capital punishment will lead to a small or a large decrease in the number of murders committed. In other words, measuring the slope of this demand curve is the same thing as measuring the deterrent effect of capital punishment.

Now, on the one hand, the deterrent effect of capital punishment is something about which there is much discussion and much interest. On the other hand, the slope of a demand curve is something that economists know how to measure.

Over the past 25 years, Professor Isaac Ehrlich has repeatedly measured the slope of the demand curve for murder, using essentially the same techniques that economists use to measure the slope of the demand curves for shoes, coffee, and other consumer goods. His results have been striking. The demand curve for murder appears to be remarkably flat; that is, a small increase in the price of murder leads to a large decrease in the quantity of murders committed. In fact, Ehrlich estimates that over the period 1935–1969 (a period in which executions were more common than they are today, making the statistical tests more reliable), one additional execution in the United States would have prevented, on average, about eight murders per year.[3]

This is a remarkable example of an application of economics to a positive question: "What is the deterrent effect of capital punishment?" It is emphatically *not* an answer to the related normative question: "Is capital punishment a good thing?" It is entirely possible to believe Ehrlich's results and still oppose capital punishment on ethical grounds; in fact, Ehrlich himself opposes capital punishment. However, knowing the answer to the positive question is undoubtedly helpful in thinking about the normative one. The size of the deterrent effect of the death penalty will certainly affect our assessment of its desirability, even though our assessment depends on many other things as well.

Example: The Demand for Reckless Driving

Reckless driving is another good that people choose to "consume." For this consumption they pay a price, partly by risking death in an accident. When that price is reduced—say, by the installation of safety equipment in cars—we should expect the quantity of reckless driving to increase.

This implies that safety devices like air bags could lead to either an increase or a decrease in the number of driver deaths. With an air bag, an individual accident is less likely to be fatal. But for exactly that reason, people will drive more recklessly and therefore will have more accidents. Whether the number of driver deaths decreases, increases, or remains constant depends on the size of that response; in other words, it depends on whether the demand curve for reckless driving is steep or flat.

When Professors Steven Peterson, George Hoffer, and Edward Millner investigated this question,[4] they found that air bags had almost no effect on the number of driver deaths; in fact, if anything, giving a driver an air bag makes him slightly *more* likely to die in an accident. With the air bag, the driver chooses to engage in enough additional reckless driving to completely offset the safety advantages of the air bag itself.

---

[3] Ehrlich's first pathbreaking study was "The Deterrent Effect of Capital Punishment: A Question of Life and Death," *American Economic Review* 65 (1975), 397–417. His most recent contribution is "Sensitivity Analysis of the Deterrence Hypothesis: Let's Keep Econ in Econometrics" (with Z. Liu), *Journal of Law and Economics* XLII (1999), 455–487.

[4] Steven P. Peterson, George E. Hoffer, and Edward L. Millner, "Are Drivers of Airbag Equipped Cars More Aggressive: A Test of the Peltzman Hypotheses?" *Journal of Law and Economics* 38 (1995), 251–265. Thirty years earlier, Professor Sam Peltzman found similar results for the effects of seat belts, collapsible steering wheels, penetration-resistant windshields, dual braking systems, and padded dashboards. See S. Peltzman, "The Effects of Automobile Safety Regulation," *Journal of Political Economy* 83 (1975), 677–725.

Does that mean drivers don't benefit from air bags? No, it just means they choose to take their benefits in a form other than safety. They get to drive faster, more aggressively, and more recklessly with only a slight increase in their chance of being killed. The real losers are pedestrians and other drivers, who participate in the additional accidents without sharing the safety features of the air bag.

If you find these results difficult to believe, try this experiment. Pick ten friends and read sentence 1 to five of them and sentence 2 to the other five:

1. "If you give a driver an air bag, he'll drive more recklessly."

2. "If you take away a driver's air bag, he'll drive more carefully."

Chances are, the five friends who hear sentence 1 will find it implausible and the five who hear sentence 2 will find it obvious. But the two sentences say exactly the same thing in different words, so your friends' instincts can't all be right. The instinct to disbelieve sentence 1 is an interesting fact about psychology; the fact that the sentence is nevertheless true is an interesting fact about economics.

The Wide Scope of Economics

The ideas of economics can be applied to every aspect of human behavior. In addition to the demand curves for murder and reckless driving, economists have measured the demand curves for "goods" as diverse as racial discrimination, love, children, religious activity, and cannibalism. Economic theory has yielded startling new insights in political science, sociology, philosophy, and law. The broad applicability of economic reasoning will be a recurring theme in this book.

1.2 Supply

Law of supply

The observation that when the price of a good goes up, the quantity supplied goes up.

Quantity supplied

The amount of a good that suppliers will provide at a given price.

The law of demand states that "when the price goes up, the quantity demanded goes down." The **law of supply** states that "when the price goes up, the quantity supplied goes up." By **quantity supplied** we mean the quantity of some good that a specified individual or group of individuals wants to supply to others per specified unit of time.

The law of supply is not as ironclad as the law of demand. Imagine a manufacturer of bicycles who works 12 hours a day to produce one bicycle that he can sell for $40. If the price of bicycles were to go up to $500, he might choose to work harder and produce more bicycles—but he might choose instead to cut back on production, make one bicycle per week, and spend more time at the beach.[5]

Nevertheless, economists have found that in most circumstances an increase in price leads to an increase in quantity supplied. Throughout this chapter, therefore, we shall assume the validity of the law of supply.

Supply versus Quantity Supplied

Consider the supply of coffee in your city. It might be given by Table A of Exhibit 1.5. According to the table, if the price is 20¢ per cup, then the individuals who supply

---

[5] However, we will see in Chapter 6 that when the supplier is a profit-maximizing firm, the law of supply must hold.

EXHIBIT **1.5**   **The Supply of Coffee**

TABLE A. Supply of Coffee to Your City	
Price	Quantity
20¢/cup	100 cups/day
30¢	300
40¢	400
50¢	500

| TABLE B. Supply of Coffee to Your City Following the Development of Better Farming Methods	
Price	Quantity
20¢/cup	200 cups/day
30¢	400
40¢	600
50¢	700
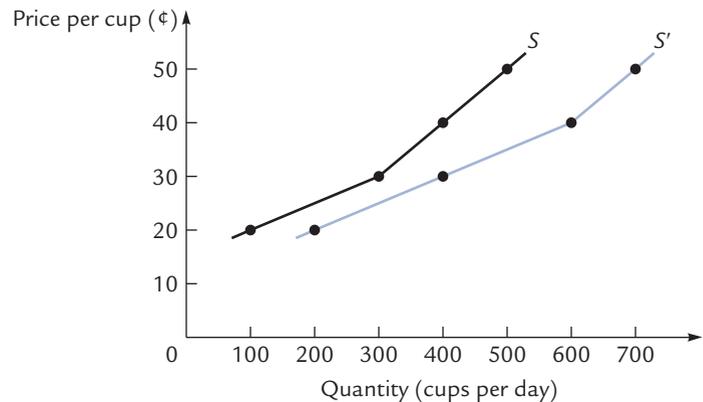
Table A shows, for each price, how much coffee would be supplied to your city. The same information is illustrated by the points in the graph. The curve labeled *S* is the corresponding supply curve. It conveys more information than the table by displaying the quantities supplied at intermediate prices. The law of supply is illustrated by the upward slope of the supply curve.

The invention of a cheaper way to produce coffee increases the willingness of suppliers to provide coffee at any given price. The new supply is shown in Table B and is illustrated by the curve *S'*. Although a change in price leads to a movement along the supply curve, a change in something other than price causes the entire curve to shift.

The curve *S'* lies to the right of *S*, indicating that the supply has increased.

---

coffee to your city will wish to supply a total of 100 cups per day. If the price is 30¢ per cup, then they will wish to supply a total of 300 cups, and so forth. All of these hypothetical statements taken together constitute the **supply** of coffee to your city.

As with demand, a change in price leads to a change in the quantity supplied (which is a single number). Such changes are represented by movements along the supply curve. A change in anything other than price can lead to a change in supply—that is, to a change in the entries in the supply schedule. Such changes are represented by shifts in the supply curve itself.

For example, imagine an innovation in agricultural techniques that allows growers to produce coffee less expensively. This innovation might take the form of a new hybrid coffee plant that produces more beans, or a new idea for organizing harvesting chores so that more beans can be picked in a given amount of time. Such an innovation would make supplying coffee more desirable, and suppliers would supply more at each price than they did before. Table B of Exhibit 1.5 shows what the new supply schedule might look like. The new supply curve is the curve labeled *S'* in Exhibit 1.5.

The shift in supply due to improved agricultural techniques is an example of a **rise in supply.** It is represented by a rightward shift of the supply curve. The opposite situation is a **fall in supply.** If the wages of coffee bean pickers went up, growers would want to provide less coffee at any given price, which is another way of saying that supply would fall. A fall in supply is represented by a leftward shift of the supply curve.

Supply

A family of numbers giving the quantities supplied at each possible price.

Rise in supply

An increase in the quantities that suppliers will provide at each given price.

Fall in supply

A decrease in the quantities that suppliers will provide at each given price.

Dangerous Curve

In Exhibit 1.5 the new supply curve *S′,* with its higher quantities, lies to the right of the old supply curve *S.* This is because quantity is measured in the horizontal direction, so *higher* translates geometrically into *rightward.* In the vertical direction, *S′* lies below *S,* even though it represents a rise in supply. This is the opposite of what you might at first expect, and you should be on your guard against possible confusion.

Exercise 1.5 How would the supply of shoes be affected by an increase in the price of leather? How would it be affected by an increase in the price of leather belts?

Effect of an Excise Tax

Excise tax

In this book, a tax that is paid directly by suppliers to the government.

One thing that could lead to a change in supply is the imposition of an **excise tax**—that is, a tax on suppliers of goods.[6] Suppose that a new tax is instituted requiring suppliers to pay 10¢ per cup of coffee sold. Suppose also that in the absence of this tax the supply of coffee in your city is given by Table A of Exhibit 1.6 (which is identical to Table A of Exhibit 1.5). Let us compute the supply of coffee in your city after the tax takes effect.

EXHIBIT 1.6   Effect of an Excise Tax

TABLE A. Supply of Coffee without Tax

Price	Quantity
20¢/cup	100 cups/day
30¢	300
40¢	400
50¢	500

TABLE B. Supply of Coffee with Excise Tax of 10¢ per Cup

Price	Quantity
30¢/cup	100 cups/day
40¢	300
50¢	400
60¢	500
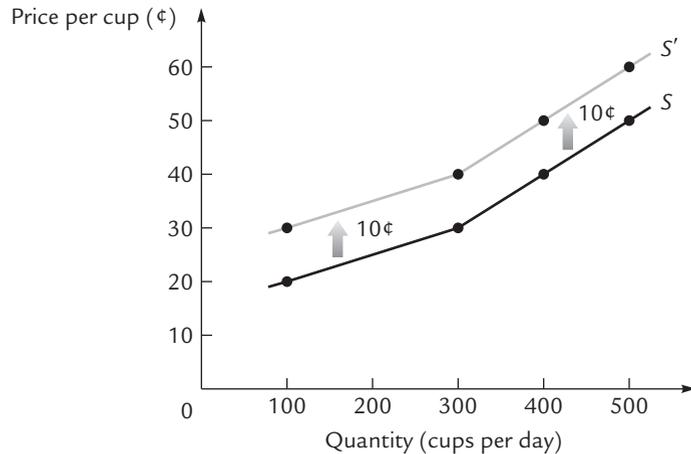
If the price of coffee is 30¢ per cup and there is an excise tax of 10¢, then a seller of coffee will actually get to keep 20¢ per cup sold. The original supply schedule (Table A) shows that under these circumstances suppliers would provide 100 cups per day. This is recorded in the first row of Table B. The other rows in that table are generated in a similar manner.

The rows of Table B contain the same quantities as the rows of Table A, but the corresponding prices are all 10¢ higher. Thus, each point on the new supply curve *S′* lies exactly 10¢ above a corresponding point on the old supply curve *S.* Therefore, *S′* lies exactly 10¢ above *S* in vertical distance. The excise tax causes the supply curve to shift upward parallel to itself a distance of 10¢.

[6] We shall use the phrase *excise tax* to refer to a tax that is paid to the government by suppliers. As with the phrase *sales tax,* this phrase is not used the same way in all textbooks.

Suppose first that the price of a cup of coffee is 30¢. Then a supplier gets to keep 20¢ for every cup of coffee sold (the supplier collects 30¢ and gives a dime to the tax collector). We want to know what quantity will be supplied under these circumstances. The answer is in Table A of Exhibit 1.6: When suppliers receive 20¢ per cup of coffee sold, they provide 100 cups per day.

Therefore, in a world with an excise tax, a price of 30¢ leads to a quantity supplied of 100 cups per day. This gives us the first row of our supply table for a world with an excise tax:

Price	Quantity
30¢/cup	100 cups/day

The entire new supply schedule is displayed in Table B of Exhibit 1.6.

Exercise 1.6 Explain how we got the entries in the last three rows of Table B in Exhibit 1.6.

Notice that both of the tables in Exhibit 1.6 list the same quantities, but that the associated prices are 10¢ higher in Table B. This means that the supply curve associated with Table B will lie a vertical distance 10¢ above the supply curve associated with Table A. The graph in Exhibit 1.6 illustrates this relationship.

Notice that the supply curve with the tax (curve S' in the exhibit) is geometrically above and to the left of the old supply curve S. This is what we have called a lower supply curve (it is lower because, for example, a price of 30¢ calls forth a quantity supplied of only 100, instead of 300).

We can summarize as follows:

An excise tax causes the supply curve to shift upward parallel to itself (to a new, lower supply curve) by the amount of the tax.

1.3 Equilibrium

Demand and supply curves illustrate buyers' and sellers' responses to various hypothetical prices. So far, we've said nothing about how those prices are actually determined or what quantities will actually be available. Demanders cannot purchase more coffee than suppliers are willing to sell them, and suppliers cannot sell more coffee than demanders are willing to buy. In this section we will examine the interaction between suppliers and demanders and the way in which this interaction determines both the prices and the quantities of goods traded in the marketplace.

The Equilibrium Point

Exhibit 1.7 shows the demand and supply curves for cement in your city. We want to find the point on the graph that describes the price of cement and the quantity of cement that is sold at that price.

The first thing to notice is that there is only one price where the quantity supplied and the quantity demanded are equal. That price is $4.50 per bag, where the quantities supplied and demanded are each equal to 300 bags per week. The corresponding point

| EXHIBIT **1.7** | **Equilibrium in the Market for Cement** |
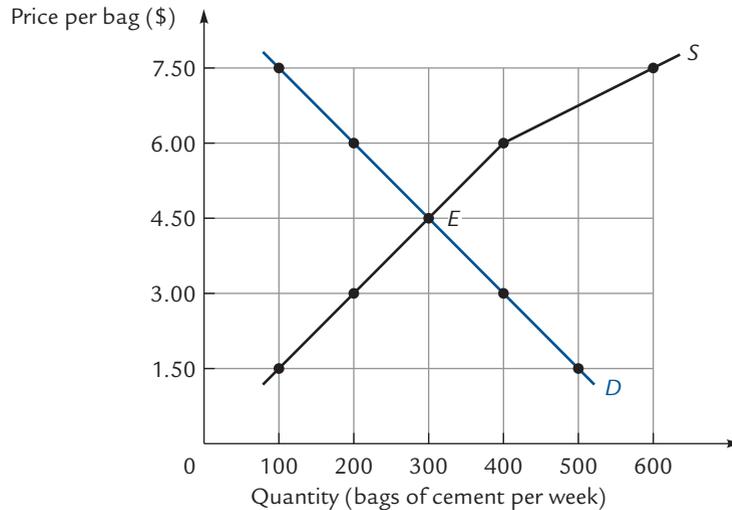
The graph shows the supply and demand curves for cement. The equilibrium point, *E*, is located at the intersection of the two curves. The equilibrium price, $4.50 per bag, is the only price at which quantity supplied and quantity demanded are equal.

Equilibrium point

The point where the supply and demand curves intersect.

on the graph is called the **equilibrium point.** The equilibrium point is the point at which the supply and demand curves cross.

To understand the significance of the equilibrium point, we will first imagine what would happen if the market were not at the equilibrium—that is, if the price were something other than $4.50.

Suppose, for example, that the price is $7.50. We see from the demand curve that all demanders taken together want a total of 100 bags of cement each week, while suppliers want to provide 600 bags of cement. The demanders purchase the 100 bags that they want and refuse to buy any more. At least some of the suppliers are not able to sell all of the cement that they want to. Those suppliers are unhappy.

Of course, some demanders may be unhappy too. They may be unhappy because the price of cement is so high. They would prefer a price of $4.50 per bag, and they would prefer even more a price of $0 per bag. But the demanders are perfectly happy in one limited sense: Given the current price of cement, they are buying precisely the quantity that they want to buy. We choose to describe this situation by saying that the demanders are **satisfied.**

Satisfied

Able to behave as one wants to, taking market prices as given.

In general, a satisfied individual is one who is able to behave as he wants, taking the prices he faces as given. This is so regardless of how he feels about the prices themselves. We take this as a definition. It is the only definition that really makes sense in this context. Nobody is ever completely happy about the prices themselves: Buyers always wish they were lower and sellers always wish they were higher.

So, when the price is $7.50 per bag, the demanders buy 100 bags per week and are satisfied. The suppliers, who want to sell 600 bags per week, sell only 100 bags per week and are unsatisfied. When some suppliers discover that they cannot sell as much

cement as they would like at the going price, they lower their prices to attract more demanders.

Suppose that they lower their prices to $6 per bag. Referring again to Exhibit 1.7, we see that demanders want to buy 200 bags of cement per week and suppliers want to sell 400 bags. After 200 bags are sold, the demanders go home satisfied, and some suppliers are still left unsatisfied. They lower their prices further.

We may expect this process to continue as long as the quantity supplied exceeds the quantity demanded. That is, we expect it to continue until the market reaches the equilibrium price of $4.50 per bag.

If the price of cement starts out below $4.50, we can expect the same process to work in reverse. For example, when the price is $1.50, demanders want to buy 500 bags of cement per week, but suppliers want to provide only 100 bags. The suppliers, having provided 100 bags, will go home, leaving some demanders unsatisfied. In order to lure the suppliers back to the marketplace, demanders will offer a higher price for cement. This process will continue until the quantity demanded no longer exceeds the quantity supplied. It will continue until the market reaches the equilibrium price of $4.50 per bag.

The story we have just told gives a reason to expect the market to be in equilibrium. The reason is that if the market were not in equilibrium, buyers and sellers would change their behavior in ways that would cause the market to move toward equilibrium. We still have to ask how realistic our story is. Later in this book we will see that there are some markets for which it is substantially accurate, and other markets for which it may not be accurate at all. For the time being, we will focus on the first type of market. That is, for the remainder of this chapter we will assume that the markets we are studying are always in equilibrium. For a wide range of economic problems, this is a safe and useful assumption to make.

Changes in the Equilibrium Point

Suppose there is an increase in the cost of feed corn for pigs. What happens to the price and quantity of pork chops?

Here is a *wrong* way to approach this question. First, farmers respond to the cost increase by raising fewer pigs. This means that there are fewer pork chops in the supermarkets, so demanders bid their price up. Next the rise in price induces farmers to raise *more* pigs. This in turn causes the price to be bid back down, whereupon farmers cut back their production again, whereupon....

The problem with this kind of approach is that it never reaches a conclusion. Each step in the analysis is correct, but there are infinitely many steps, and it takes forever to consider them one at a time. Therefore, we need a device that accounts for all of the steps in the argument simultaneously.

Consequently, and perhaps paradoxically, when you want to figure out how a change in circumstances affects price and quantity, you should never begin by thinking about price and quantity. Instead, think about how the change in circumstances affects the demand curve and how it affects the supply curve (these are two separate questions). Embedded in the supply and demand shifts are all of the infinitely many responses and counterresponses that we failed to completely list above. Once you have shifted the curves, you can see what happens to the equilibrium point.

So let's try the same problem again. First, when there is an increase in the cost of feed corn, what happens to the *demand* for pork chops? The answer is nothing;

changes in the cost of feed corn have no effect at all on the number of pork chops that a demander wants to buy at a given price. To convince yourself of this, imagine entering a supermarket where pork chops are on sale for $8 a pound and trying to decide how many pounds you want to buy. In that situation, it is unlikely that you feel compelled to inquire how much it cost to feed the pigs before you can make your decision. That cost is quite irrelevant to you as a demander.

On the other hand, the *supply* of pork chops shifts to the left. Suppliers do care about the cost of feed corn and are willing to produce fewer pork chops at a given price when that cost goes up.

If we plot the demand and supply for pork chops on the same graph, then demand stays fixed while supply shifts to the left, as illustrated in the last panel of Exhibit 1.8. The new equilibrium point lies above and to the left of the old one. Thus the price of pork chops is up, and the quantity is down.

EXHIBIT 1.8   The Effects of Supply and Demand Shifts
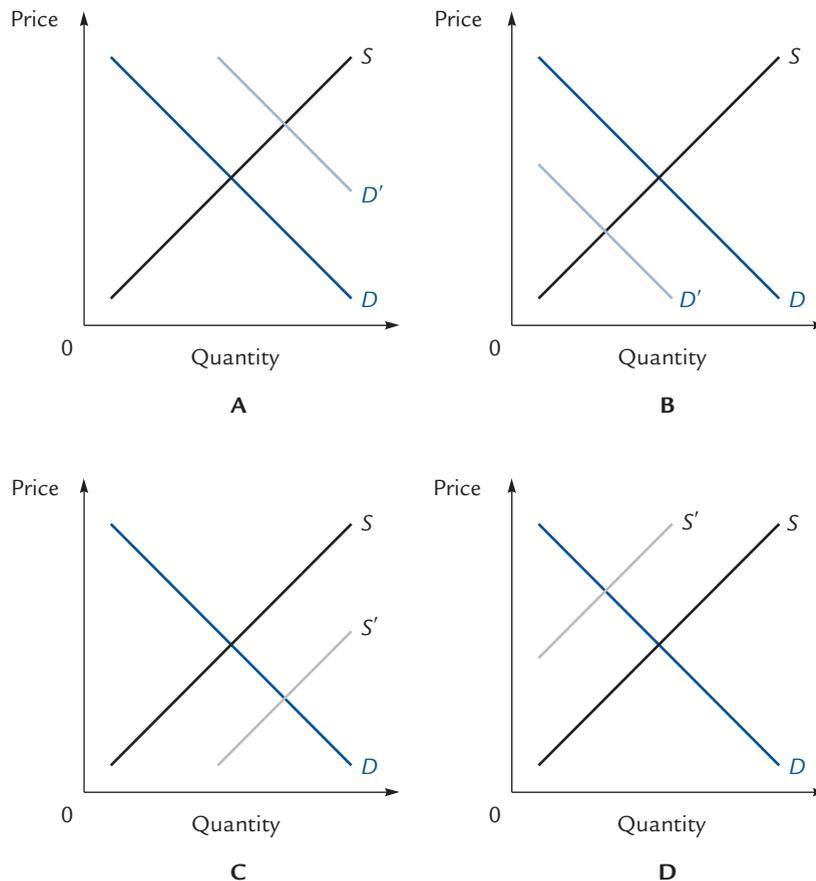
The graphs show the effects of various shifts in demand and supply. For example, in panel A we see that a rise in demand leads to a rise in price and a rise in quantity.

Because the equilibrium price and quantity are determined by the supply and demand curves, anything that affects the curves will affect the equilibrium price and quantity. The panels of Exhibit 1.8 show a variety of ways in which changes in demand or supply can affect the point of equilibrium.

Exercise 1.7 Taking the panels of Exhibit 1.8 to represent the market for pork chops, which panel shows the effect of a rise in the price of beef? How does a rise in the price of beef affect the equilibrium price and quantity of pork chops?

Keep in mind that *the only way that anything can affect the equilibrium price and quantity is by causing a shift in either the supply curve or the demand curve (or both).* That is why any analysis of a change in equilibrium must begin with the question of how the curves have shifted.

It is important to distinguish causes from effects. For an individual demander or supplier, the price is taken as given and determines the quantity demanded or supplied. For the market as a whole, the demand and supply curves determine both price and quantity simultaneously.

Dangerous
Curve

Example: The (Non-)Market for Kidneys

In the United States today, there are approximately 50,000 people awaiting kidney transplants. Each year, about 15,000 transplants are performed and about 3,000 people die waiting.

At the same time, hundreds of millions of Americans have spare kidneys (most of us have two, but we can function perfectly well with just one). If just a tiny fraction of those kidneys were made available for transplant, many lives could be saved.

Sometimes people donate their kidneys to relatives, and occasionally (but very rarely) they donate them to strangers. However, current law does not allow an individual to *sell* a kidney.

If kidneys were freely bought and sold, how many would be purchased and at what price? You might think that's impossible to answer, because we've never had an opportunity to observe the supply and demand curves. But economists Gary Becker and Julio Elias have overcome that obstacle.[7]

Donating a kidney means accepting a certain amount of discomfort (usually over a three- to five-week recovery period), about a 1/1000 chance of death during the operation, and a small reduction in quality of life thereafter. But donating a kidney isn't the only thing that entails discomfort and risk; there are plenty of dirty and dangerous jobs (like mining) that are also uncomfortable and risky. We can easily observe the supply of miners (that is, we know, at various wage rates, how many people will volunteer for dangerous duty in mines) and can therefore infer something about the supply of kidneys. If, for a bonus of, say, $10,000, you can get 100 people to volunteer for dangerous mining operations, then for a similar bonus you should be able to get roughly 100 people to volunteer for an equally dangerous kidney donation.

---

[7] Gary Becker and Julio Elias, Introducing Incentives in the Market for Live and Cadaveric Organ Donations, Working Paper, University of Chicago (2002).

Using such techniques, Professors Gary Becker and Julio Elias estimated the supply of kidneys. They also estimated the demand, and were therefore able to estimate an equilibrium price of approximately $15,000. This will raise the price of a kidney transplant from the current $110,000 to $125,000, but the demand for kidney transplants is presumably quite steep, so the quantity demanded would not change very much from its current value.

The Nature of Equilibrium: Some Common Mistakes

A standard reference work on the taming and training of parrots reports that "when popular demand for a species exceeds the available supply, prices remain high."[8] A barrage of news reports warns that a frost in Florida could lead to a "shortage" of oranges, with people unable to buy as many as they want. The well-known columnist Michael Kinsley, explaining the market for art, reports in the *New Republic* that "when the price of something goes up, the supply of it increases." Columnist Jack Mabley of the *Chicago Tribune* reports that "General Motors just increased prices another 2.5%" even after a "bad year" and concludes that "if the law of supply and demand were working, GM would reduce prices, not raise them."

Like most people, these writers might benefit from a course in economics. Statements like "demand exceeds supply" make no sense, because demand and supply are not numbers but curves. A glance back at Exhibit 1.7 will remind you that there are always some prices (such as $1.50 in the exhibit) at which the quantity demanded exceeds the quantity supplied, and others (such as $7.50) at which the quantity supplied exceeds the quantity demanded.

What, then, does the parrot expert mean to say? If there is no sense to be made of the statement that "demand exceeds supply," then perhaps he meant to say that "the quantity demanded exceeds the quantity supplied." This would have the advantage of being meaningful (a number *can,* after all, exceed another number) but the disadvantage of being wrong. In equilibrium, the quantities supplied and demanded are equal. This is so regardless of whether the equilibrium price is high, low, or in between.

When the demand curve for parrots shifts rightward (as in panel A of Exhibit 1.8), or when the supply curve shifts leftward (as in panel D), then the price rises to a new equilibrium at which the quantities supplied and demanded again coincide.

Similarly, a frost in the Florida orange groves causes a leftward shift in the supply of oranges and a new, higher equilibrium price at which demanders can purchase all the oranges they want. (They will want fewer than they wanted at the old price.) No shortage need occur.

Michael Kinsley's analysis of the art market is wrong because a change in price causes a change in the quantity supplied, not in the supply. But we can go further and ask what causes the change in price. The answer: The price change itself must be caused by either a change in supply or a change in demand.

Finally, let us examine Jack Mabley's analysis of the rising price of cars. If we interpret Mabley's report of a "bad year" to mean that fewer cars are being sold, then by examining the possibilities in Exhibit 1.8 we can see that either demand has fallen (as in panel B of the exhibit) or supply has fallen (as in panel D). In the first case, the price falls, while in the second it rises. Because Mabley reports that the price has risen, the supply curve must have shifted as in panel D. A simultaneous fall in quantity and rise in

---

[8] E. J. Maluka, *Taming and Training Parrots* (T. F. H. Publications Inc., 1981).

price is nothing so dramatic as a failure of the "law of supply and demand"; it is simply evidence of a leftward shift in supply.

Effect of a Sales Tax

One thing that we know will influence the demand curve for coffee is the imposition of a sales tax paid by demanders. Let's see how such a tax would affect the equilibrium.

Exhibit 1.9 shows the market for lettuce before and after the imposition of a sales tax of 5¢ per head. The curve labeled D is the original demand curve, and the one labeled D' is the demand curve after the tax is imposed. Recall from our discussion of sales taxes in Section 1.1 that D' lies a vertical distance 5¢ below D.

Before the imposition of the tax, the market is in equilibrium at point E. When the sales tax is imposed, the downward shift in demand moves the equilibrium to point F. How does point F compare with point E? The first thing to notice is that it is to the left of point E. It corresponds to a smaller quantity than point E does. This gives our first conclusion:

Imposing a sales tax reduces the equilibrium quantity.

What about the equilibrium price? We can see immediately from the diagram that point F is lower than point E. In other words, imposing a sales tax causes the equilibrium price to fall. We can even say something about how far the equilibrium price will fall. You should be able to see from the graph in Exhibit 1.9 that the vertical drop from point E to point F is smaller than the vertical distance between the old and the new demand curves. In other words, it is a drop of less than 5¢. (The vertical distance from

| EXHIBIT **1.9** | **The Effects of a Sales Tax in the Lettuce Market** |
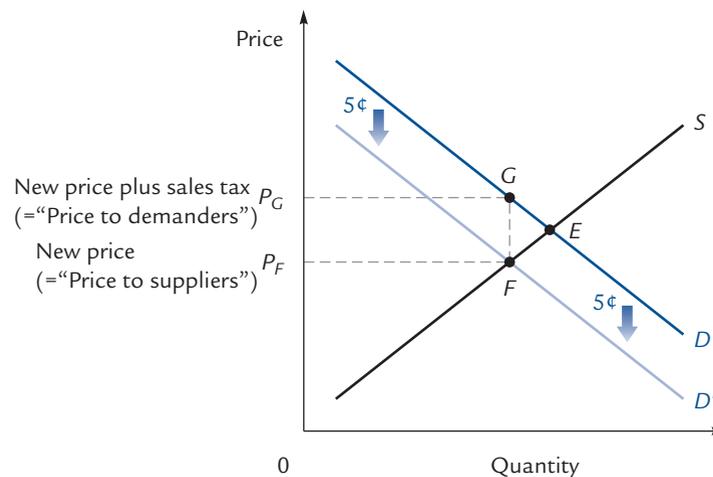
The graph shows the market for lettuce before and after the imposition of a sales tax of 5¢ per head. The original demand curve (D) intersects the supply curve at E, which is the point of equilibrium before the tax. When the tax is instituted, the demand curve moves down vertically a distance 5¢, to D'. The new equilibrium point is F, and the new equilibrium price for lettuce is P_F. However, demanders must pay more than P_F for a head of lettuce—they must pay P_F plus 5¢ tax. Thus, to buy a head of lettuce consumers must pay P_F plus the 5¢ sales tax. To find this amount, begin at F and move up a distance 5¢ to G. Because F is on the curve D', G must be on the curve D. The price to demanders—that is, the price plus the sales tax—is P_G.

point *G* to point *F* is 5¢, and the vertical distance from point *E* to point *F* is clearly less than this.) In other words:

A sales tax of 5¢ per item causes the equilibrium price to fall by some amount less than 5¢ per item.

The exact amount of the fall in price depends on the exact shapes of the supply and demand curves, but it is always somewhere between 0¢ and 5¢.

Exercise 1.8 Draw some diagrams in which either the demand or the supply curve is either unusually steep or unusually flat. In which cases will a 5¢ sales tax cause the price to drop very little? In which cases will the tax cause the price to drop by nearly 5¢?

The price P_F shown in Exhibit 1.9 is the new price of lettuce. However, a consumer wishing to acquire a head of lettuce must pay more than P_F. He must pay P_F plus 5¢ tax. To find this amount, we must look for a point 5¢ higher than point *F*. Because point *F* is on the new demand curve *D′*, a point 5¢ higher than *F* will be on the old demand curve *D*. (This is because the vertical distance between the demand curves is exactly 5¢.) That point has been labeled *G* in the exhibit. The full amount that the consumer must pay to get a head of lettuce is the corresponding price P_G.

Let us summarize: By shifting the equilibrium from point *E* to point *F*, a sales tax of 5¢ per head lowers the quantity sold. It lowers the price that sellers collect from the original equilibrium price P_E to P_F. It raises the amount that demanders pay from P_E to P_G.

Price to demanders

Price plus sales tax.

In the exhibit, we have called the new price P_F the *price to suppliers*, because P_F is the only "price" that suppliers care about. We have called the amount P_G—the new price plus sales tax—the **price to demanders,** because this is the amount that demanders must pay to get a head of lettuce.

Effect of an Excise Tax

Now that we have analyzed the effect of a sales tax, let us turn to a different problem: the effect of a 5¢ excise tax. This effect is illustrated in panel B of Exhibit 1.10. The sales tax has disappeared now, so the demand curve has returned to its original position. However, as we discovered in Section 1.2, the 5¢ excise tax will shift the supply curve by a vertical distance 5¢. The new supply curve is labeled *S′* in panel B. With the excise tax, the new market equilibrium is at point *H*. The quantity traded has fallen, and the price has risen by an amount less than 5¢.

Exercise 1.9 How do we know that the price rise is less than 5¢?


In everyday language, we say that the suppliers have "passed on" part of the excise tax to consumers through the rise in the market price of lettuce. This is analogous to the situation brought on by the sales tax: In that case, demanders "passed on" a portion of the tax to producers through the fall in the market price of coffee.

Referring again to panel B of Exhibit 1.10, the market price has risen to P_H, and that is the price that demanders pay for a head of lettuce. But a supplier who sells a head of lettuce does not get to keep P_H—he can keep only P_H minus the 5¢ that goes to the tax collector. In order to find the amount that the supplier gets to keep, we must drop a vertical distance 5¢ below point *H*. Because point *H* is on the curve *S′*, this vertical drop will land us on the curve *S* at the point marked *J*. This gives a **price to suppliers** of P_J,

Price to suppliers

Price minus excise tax.

below the original equilibrium price that was given by point *E*.

EXHIBIT 1.10 **A Sales Tax versus an Excise Tax**
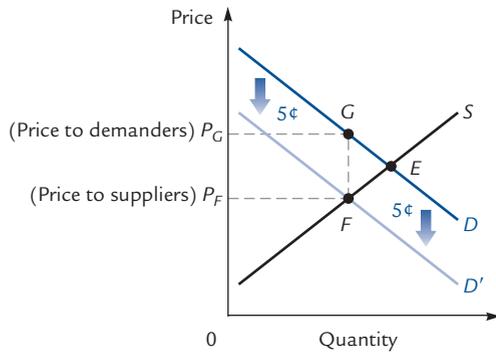
A. Effect of a Sales Tax: The price falls to P_F, and this is the new "price to suppliers". The "price to demanders" is P_F plus 5¢ tax, or P_G.
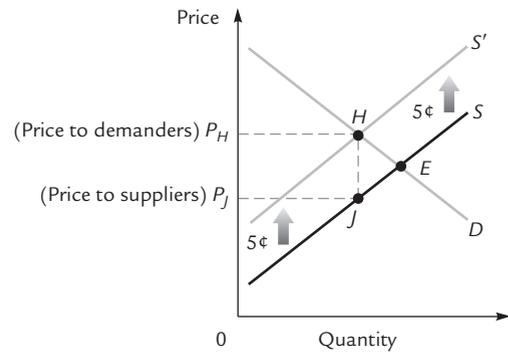
B. Effect of an Excise Tax: The price rises to P_H, and this is the new "price to demanders". The "price to suppliers" is P_H minus 5¢ tax, or P_J.

A′. A less cluttered version of Panel A.
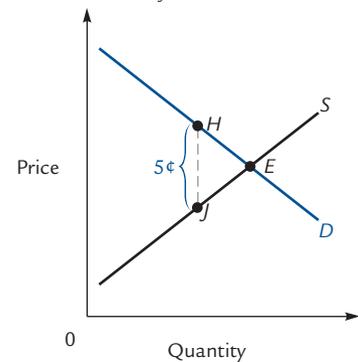
B′. A less cluttered version of Panel B.

Panel A reproduces the graph from Exhibit 1.9, illustrating the effect of a 5¢ sales tax. Panel B illustrates the effect of a 5¢ excise tax: The supply curve shifts upward a vertical distance 5¢, leading to a new market equilibrium at point H. The corresponding price, P_H, is what demanders have to pay; the amount that suppliers get to keep is P_H minus 5¢, which is P_J. (Because H is on the curve S', J must be on the curve S.)

Panels A′ and B′ are less cluttered versions of panels A and B. In each of these panels, we see two darkened points, one on the original demand curve D and one on the original supply curve S, separated by a vertical distance 5¢. There is only one possible location for such a pair of points.

It follows that points G and F in panel A′ (or panel A) are identical with points H and J in panel B′ (or panel B). In other words, the effects of the excise tax are identical to the effects of the sales tax, from the viewpoint of either demanders or suppliers.

Comparing Two Taxes

Suppose you're a demander of lettuce. Would you rather live in a world with a 5¢ sales tax or a world with a 5¢ excise tax?

If you'd never studied any economics, you might say "I prefer the excise tax, because somebody else has to pay it." But if you've understood Exhibit 1.10, you know that the issue is not that simple. An excise tax *does* affect demanders, by causing the price of lettuce to rise (to P_H in panel B of the exhibit).

So when you're asked which tax you prefer, what you should really seek to do is compare the price P_G in panel A (the price to demanders under a sales tax) with the price P_H in panel B (the price to demanders under an excise tax). If P_G is higher, the sales tax is worse, and if P_H is higher, the excise tax is worse.

Based on what we've said so far, there's no way to decide this question. But with just a bit more analysis, we can discover that in fact P_G and P_H are exactly equal! All we need is three observations:

1. Point *G* is on the original demand curve *D*, point *F* is on the original supply curve *S*, and the vertical distance between them is 5¢. (You can see this in panel A, and you can see it even more clearly in the less cluttered panel A′, which reproduces the relevant parts of panel A.)

2. Point *H* is on the original demand curve *D*, point *J* is on the original supply curve *S*, and the vertical distance between them is 5¢. (You can see this in panel B, and you can see it even more clearly in the less cluttered panel B′, which reproduces the relevant parts of panel B.)

3. There is only one place to the left of *E* where the vertical distance between the curves *D* and *S* is exactly 5¢. This means that points *G* and *F* in panel A′ must occupy exactly the same positions as points *H* and *J* in panel B′.

Because points *G* and *H* are in exactly the same position, we can conclude that the 5¢ sales tax affects demanders in exactly the same way that the 5¢ excise tax does.

Likewise, because points *F* and *J* are in exactly the same position, we can conclude that the 5¢ sales tax affects suppliers in exactly the same way that the 5¢ excise tax does. Neither demanders nor suppliers have any reason to prefer one tax over the other. Economists often summarize this startling conclusion with the slogan:

Economic incidence

The division of a tax burden according to who actually pays the tax.

The economic incidence of a tax is independent of its legal incidence.

In this statement, the **economic incidence** of a tax refers to the distribution of the actual tax burden. The **legal incidence** of the tax is the distribution of the tax burden in legal theory. The sales tax places the legal incidence entirely on demanders, because it is they who are required by law to pay the tax. The excise tax places the legal incidence entirely on suppliers. However, the economic incidence of the sales tax and the economic incidence of the excise tax are the same, because the actual prices paid by suppliers and demanders are the same in both cases.

Legal incidence

The division of a tax burden according to who is required under the law to pay the tax.

Dangerous Curve

Students sometimes misunderstand the conclusion we have drawn by thinking that the sales tax (or the excise tax) imposes equal burdens on demanders and suppliers. This is not correct. The division of the tax burden depends on the shapes of the supply and demand curves. In Exhibit 1.10, point *F* might be 4¢ below the original equilibrium (*E*) and point *G* 1¢ above the original equilibrium; in this case, ⅘ of the tax is being passed on to suppliers and ⅕ is being paid by demanders. With differently shaped curves, the suppliers might be paying ⅕ and the demanders ⅘. What we have argued is that the division of the tax burden will be the same under an excise tax as it is under a sales tax. If suppliers pay ⅘ of the sales tax, they will also pay ⅘ of the excise tax; if they pay ⅕ of the sales tax, they will also pay ⅕ of the excise tax.

Exercise 1.10 Suppose that an excise tax of 2¢ per head of lettuce and a sales tax of 3¢ per head of lettuce were simultaneously imposed. Show that the combined

economic incidence of these taxes will be the same as the economic incidence of either the pure 5¢ sales tax or the pure 5¢ excise tax.

An interesting application involves Social Security taxes. We can view Social Security as a tax on hours worked. "Hours worked" are demanded by firms and supplied by their employees. A Social Security tax that is paid directly by the employees is an excise tax. One that is paid by firms is a sales tax. Whenever Social Security taxes are raised, there is a furor in the legislature about how to divide the legal incidence of the two taxes: Should they be paid entirely by employees, entirely by firms, divided equally, or divided in some other way? The analysis of this section shows that the resolution of this conflict ultimately makes not one bit of difference to anybody.

Summary

The law of demand says that when the price of a good goes up, the quantity demanded goes down. For any individual or any group of individuals, and for any particular good, such as coffee, we can draw a demand curve. The demand curve shows, for each possible price, how much of the good those individuals or groups will purchase in a specified period of time. Another way to state the law of demand is: Demand curves slope downward.

A change in price leads to a change in quantity demanded, which is the same as a movement along the demand curve. A change in something other than price can lead to a change in demand, which is a shift of the demand curve itself.

One example of a change in something other than price is the imposition of a sales tax, paid directly by consumers to the government. (For purposes of drawing the demand curve, we do not view the tax as a form of price increase. When coffee sells for 50¢ plus 10¢ tax per cup, we say that the price is 50¢, not 60¢.) Consider the effect of a sales tax on coffee. The sales tax makes coffee less desirable at any given (pretax) price and so causes the demand curve to shift downward. In fact, we can calculate that the demand curve will shift downward by a vertical distance equal to the amount of the tax.

The law of supply says that when the price of a good goes up, the quantity supplied goes up. For any individual or any group of individuals, and for any particular good, we can draw a supply curve. The supply curve shows, for each possible price, how much of the good those individuals will provide in a specified period of time. Another way to state the law of supply is: Supply curves slope upward.

A change in price leads to a change in quantity supplied, which is the same as a movement along the supply curve. A change in something other than price can lead to a change in supply, which is a shift of the supply curve itself.

One example of a change in something other than price is the imposition of an excise tax, paid directly by suppliers to the government. Consider the effect of an excise tax on coffee. The excise tax makes providing coffee less desirable at any given price and so causes the supply curve to shift leftward. (The resulting curve is called a lower supply curve, because it has shifted leftward. Geometrically, it lies above and to the left of the original supply curve.) In fact, we can calculate that the supply curve will shift upward by a vertical distance equal to the amount of the tax.

The equilibrium point is the point at which the supply and demand curves intersect. The corresponding equilibrium price is the only price at which the quantity supplied is equal to the quantity demanded. Therefore, it is reasonable to expect that this will be the price prevailing in the market. We make the assumption that this is indeed the case. Later in the book, we will discover that there are many circumstances in which this assumption is well warranted.

Because the point of equilibrium is determined by the supply and demand curves, it can change only if either the supply or the demand curve changes. To see how a change in circumstances affects market prices and quantities, we first decide how it affects the supply and demand curves and then see where the equilibrium point has moved.

As an example, we can examine the effects of a sales tax on coffee. The sales tax causes the demand curve to shift down by the amount of the tax. This leads to a reduction in quantity and a reduction in the market price. The market price is reduced by less than the amount of the tax. To acquire a cup of coffee, a demander must now pay the new market price plus tax; this adds up to a new posttax price to demanders that is higher than the old equilibrium price.

Another example is the effect of an excise tax on coffee. This shifts the supply curve to the left (vertically, it shifts it up by the amount of the tax), leading to a smaller quantity and an increase in the market price. The market price goes up by less than the amount of the tax. When a supplier sells a cup of coffee, he earns the market price minus the amount of the tax; this leaves him with a new posttax price to suppliers that is less than the old equilibrium price.

The sales and excise taxes both reduce quantity, reduce the posttax price to suppliers, and raise the posttax price to demanders. A simple geometric argument shows that the magnitudes of these effects are all the same regardless of whether the tax is legally imposed on demanders or on suppliers. We summarize this by saying that the economic incidence of a tax is independent of its legal incidence. For example, an increase in the Social Security tax will affect both employers and employees in exactly the same way regardless of whether the employers or the employees are required to pay the tax.

Author Commentary   www.cengage.com/economics/landsburg

The author has written a number of thought-provoking articles relevant to each chapter's topics. These can be found on the text Web site at www.cengage.com/economics/landsburg. Click on the Author Commentary button on the left side of the screen, select your chapter, and then select the articles listed here. Additional articles can be found through an archive search for the name Landsburg on the Slate magazine home page at http://slate.msn.com.

AC1.   Many factors can shift the supply curve. See this article for an example of how home ownership can affect the supply of labor.

AC2.   More political activity will be supplied if politicians receive public financing.

Review Questions

R1. When the price of a good goes up, do we expect to see a change in demand or a change in quantity demanded? Do we expect to see a movement along the demand curve or a shift of the demand curve itself?

R2. Give an example of something that might cause a change in the demand for ball-point pens.

R3. Which of the following could cause a change in the demand for rice, and which could cause a change in the quantity demanded of rice? (a) A change in the price of wheat. (b) A change in the price of rice.

R4. How is the demand curve for cars affected by a $100 sales tax on cars? Explain why the demand curve shifts in this way.

R5. How is the supply curve for cars affected by a $100 excise tax on cars? Explain why the supply curve shifts in this way.

R6. If the demand for compact discs rises, what happens to the price and quantity of compact discs? Give an example of something that might cause such a rise in demand.

R7. If the supply of compact discs rises, what happens to the price and quantity of compact discs? Give an example of something that might cause such a rise in supply.

R8. Repeat problems 6 and 7, replacing the word "rises" with the word "falls."

R9. Explain what is meant by the phrase, "The economic incidence of a tax is independent of its legal incidence." Explain the geometric argument that leads to this conclusion.

Numerical Exercises

N1. Suppose the demand curve for oranges is given by the equation

$$Q = -200 \bullet P + 1{,}000$$

with quantity (Q) measured in oranges per day and price (P) measured in dollars per orange. The supply curve is given by

$$Q = 800 \bullet P$$

Compute the equilibrium price and quantity of oranges.

N2. Suppose that an excise tax of 50¢ apiece is imposed on oranges. If the original supply and demand curves are as in Exercise N1, what are the equations for the new supply and demand curves? What is the new equilibrium price and quantity of oranges? What is the new posttax price from the supplier's point of view? Illustrate your answer by drawing supply and demand curves.

N3. Repeat Exercise N2 for a 50¢ sales tax instead of a 50¢ excise tax.

N4. Suppose that an excise tax of 20¢ apiece and a sales tax of 30¢ apiece are imposed simultaneously. Answer again all of the questions in Exercise N2.

Problem Set

1. **True or False:** If a law were passed requiring all cars sold in the United States to get at least 40 miles per gallon of gasoline, then Americans would surely use less gasoline.

2. **True or False:** The discovery of a new method of birth control that is safer, cheaper, more effective, and easier to use than any other method would reduce the number of unwanted pregnancies.

3. Can you think of some other "goods," such as murder and reckless driving, that are not traded in the traditional economic marketplace but for which people nevertheless have demand curves? For each of these goods, what would it mean for the demand curve to be unusually steep? Unusually flat?

4. Suppose the enrollment at your university unexpectedly declines. **True or False:** Apartment owners in the area will face higher vacancy rates and might raise their rents to compensate.

5. **True or False:** If the demand for lettuce falls, the price will fall, causing the demand to go back up.

6. Nosmo King is an anti-smoking crusader who finds that people who don't recognize him sometimes offer him a cigarette. He always takes the cigarette and throws it away. This happens ten times a year, and Nosmo figures that this way there are ten fewer cigarettes for other people to smoke.

   a. How does Nosmo's policy affect the demand and supply curves for cigarettes?

   b. How does Nosmo's policy affect the equilibrium quantity of cigarettes?

   c. Is Nosmo correct in believing that he reduces the number of cigarettes that other people smoke? Is he correct in believing that he reduces it by ten per year? How do you know?

7. The following item appeared in a major daily newspaper: Does this observation in fact violate the laws of supply and demand?

Though sales are down, prices continue to rise in apparent violation of the law of supply and demand.
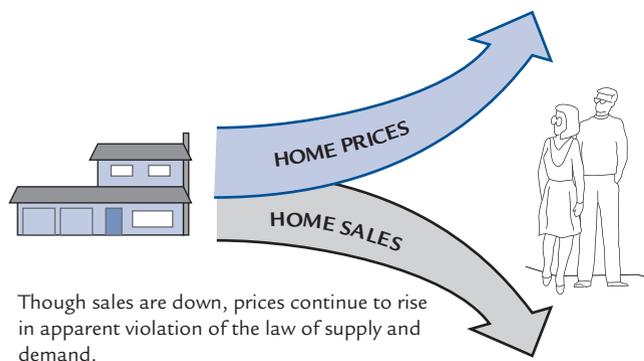
8. A socially conscious student has decided to reduce his meat consumption by one pound per week. **True or False:** That way, there will be one more pound of meat each week for somebody else to eat.

9. **True or False:** If we observe that fewer cars are being purchased this year than last year, then we should expect the price of cars to fall.

10. In 2003, mad cow disease was first detected in American cattle.

    a. What do you expect happened to the demand for American beef?

    b. What do you expect happened to the price of American beef?

    c. In fact, in the aftermath of the mad cow scare, the price of American beef fell by about 15% and Americans' beef consumption increased. Can you reconcile this observation with the laws of supply and demand? (Hint: The price of beef is determined in a world market, whereas the demand curve is the sum of American demand and foreign demand.)

11. The demand and supply for catnip are given by the following tables:

Demand		Supply	
Price	Quantity	Price	Quantity
$.50/lb	10 lb	$.50/lb	4 lb
1.00	9	1.00	5
1.50	8	1.50	6
2.00	7	2.00	7
2.50	4	2.50	10
3.00	3	3.00	11

What quantity is sold in equilibrium, and at what price?

12.   **a.** Suppose in problem 11 that a sales tax of $2 per pound is imposed on catnip. What is the new market price of catnip? What price do demanders actually pay? What is the new equilibrium quantity?

    b. Suppose instead that an excise tax of $2 per pound is imposed on catnip. What is the new market price of catnip? What price do suppliers actually collect? What is the new equilibrium quantity?

    c. As a consumer of catnip, would you prefer to live in a world with a sales tax or with an excise tax? How about if you were a supplier of catnip?

**13.** The following diagram shows the supply and demand for cupcakes (with quantity measured in dozens).
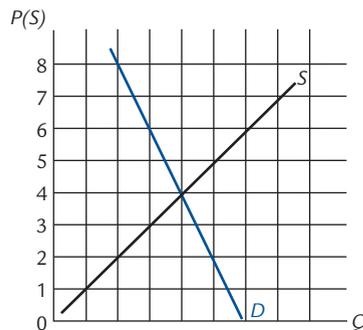
    a. Suppose the government imposes a new sales tax of $6 per dozen cupcakes. What will the new price of cupcakes be?

    b. Suppose the government imposes a new excise tax of $6 per dozen cupcakes. What will the new price of cupcakes be?

14. In each of the following circumstances, what would happen to the price and the quantity consumed of corn?

   a. The price of fertilizer goes up.

   b. The price of wheat goes up.

   c. An epidemic wipes out half the population.

   d. The wages of industrial workers go up.

15. How would each of the following circumstances affect the price and quantity of beef sold?

   a. The price of chicken falls.

   b. The price of grazing land falls.

   c. There is a report that beef consumption increases longevity.

   d. Average incomes rise.

   e. The price of leather, which is produced from the hides of beef cattle after they are slaughtered, rises.

16. Suppose that the demand curve for lettuce is perfectly vertical. How will an excise tax on lettuce affect the market price?

17. **True or False:** Suppliers' ability to pass on an excise tax to demanders depends on the strength of demand. If the demand curve is very high, a large percentage of the excise tax will be passed on, whereas if demand is very low, suppliers will have to pay most of the tax themselves.

18. At a price of $10,000 apiece, Japanese producers are willing to sell any quantity of compact cars that Americans want to buy. **True or False:** An excise tax on Toyotas sold in the United States would be paid entirely by Americans.

19. Upper Slobbovians smoke 10 million cigarettes per year; so do Lower Slobbovians. To discourage smoking, each country imposes an excise tax of 50¢ per pack. As a result, the price of cigarettes rises by 35¢ per pack in Upper Slobbovia, but by only 15¢ per pack in Lower Slobbovia. **True or False:** The Upper Slobbovian excise tax discourages smoking more effectively (that is, it leads to a bigger decrease in smoking) than the Lower Slobbovian excise tax. *Answer on the assumption that the supply curves for cigarettes are identical in both countries.* Justify your answer.

20. **True or False:** If there are currently 5,000 homeless people in New York City, and if the city builds housing for 1,000 people, then there will be 4,000 homeless people in New York City. (Answer assuming that nobody moves in or out of the city as a result of the new housing project.)

21. Answer the following questions (and fully justify your answers):

   a. If the demand curve for eggs shifts to the right by 100 eggs, in which direction does the price change?

   b. If the supply curve for eggs shifts to the left by 100 eggs, in which direction does the price change?

   c. Which of the two price changes you've just considered is bigger?

22. Suppose an excise tax of 10¢ per apple would cause the price of apples to rise from 20¢ apiece to 23¢ apiece. What would be the effect of a sales tax of 10¢ per apple?

23. Apples currently sell for 20¢ apiece. Label each of the following sentences *certainly true, possibly true*, or *certainly false* and justify your answers.

   a. A 10¢ sales tax would cause the price of apples to fall to 15¢, but a 10¢ excise tax would cause the price of apples to rise to 25¢.

   b. A 10¢ sales tax would cause the price of apples to rise to 25¢, but a 10¢ excise tax would cause the price of apples to fall to 15¢.

   c. A 10¢ sales tax would cause the price of apples to fall to 15¢, and so would a 10¢ excise tax.

   d. A 10¢ sales tax would cause the price of apples to rise to 25¢, and so would a 10¢ excise tax.

   e. A 10¢ sales tax would cause the price of apples to fall to 17¢, and a 10¢ excise tax would cause the price of apples to rise to 27¢.

24. Gasoline currently sells for $3 a gallon. Suppose the government simultaneously institutes a sales tax of 10¢ per gallon and an excise subsidy of 10¢ per gallon. (The "excise subsidy" means that every time you sell a gallon of gasoline, you get a dime from the government.) What is the new price of gasoline? Are demanders helped or hurt by this pair of policies? What about suppliers?

25. The diagram below shows the demand and supply for hamburgers on your college campus.

   a. Suppose your college announces a new plan to improve student life: Any time you buy a hamburger anywhere on campus, you can bring your receipt to the administration building and trade it for a $5 bill. How much does the price of hamburgers change?

   b. Suppose instead that the college announces a different plan: It will pay $5 per hamburger to anyone who sells hamburgers on campus. How much does the price of hamburgers change?

   c. Which plan is better for the students who like to eat hamburgers? Explain your reasoning.
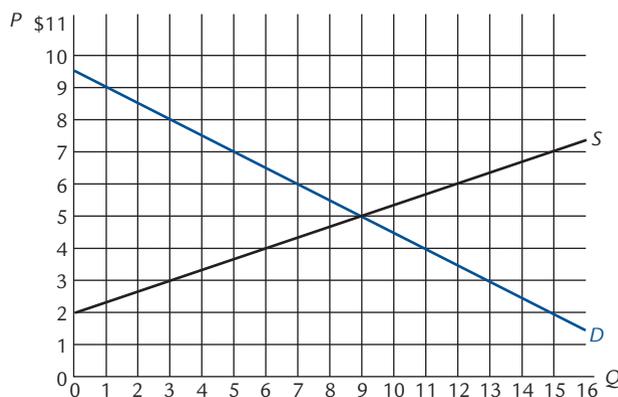
26. Suppose that the government wants to increase Social Security taxes by $1 per hour of work and is undecided between increasing the tax on workers and increasing the tax on employers. According to the last sentence of this chapter, "the resolution of this conflict ultimately makes not one bit of difference to anybody."

    a. Explain the meaning of the quoted sentence, in terms that could be understood by a person who had never taken an economics course.

    b. Use graphs to explain why the quoted sentence must be true, in terms that could be understood by your fellow students.

27. Eggs currently sell for $10 a dozen. Suppose the government imposes *both* a sales tax of $1 per egg *and* an excise subsidy of $5 per egg ("excise subsidy" means that sellers receive $5 from the government for each egg they sell). Fill in the blanks in this sentence:

"The new price of eggs will be somewhere between _____ and _____."

Justify your answer graphically.

28. It currently costs $500 to install a new shower in your house. A new law requires each new shower to come with digital hot and cold water controls instead of the old-fashioned knobs that everyone uses today. Installing the digital controls costs the manufacturers an extra $200 per shower. Customers value the digital controls at $50 per shower.

    a. Illustrate how the demand and supply curves for showers shift as a result of the new law.

    b. What happens to the price of a new shower? (Give either the exact new price or a range in which the new price must fall.)

    c. Who gains from this new law: Buyers, sellers, both, or neither? Justify your answer.