CHAPTER 2

Supply and Demand

The supply–demand model shows how the competitive interaction of sellers and buyers determines a good's market price and quantity.

Chapter Outline

Learning Objectives

- Understand how the behavior of buyers and sellers can be characterized through demand and supply curves.
- Explain how equilibrium price and quantity are determined in a market for a good or service.
- Analyze how a market equilibrium is affected by changes in demand or supply.
- Explore the effects of government intervention in markets and how a price ceiling impacts price, quantity supplied, quantity demanded, and the welfare of buyers and sellers.
- Show how elasticities provide a quantitative measure of the responsiveness of quantity demanded or supplied to a change in some other variable such as price or income.

As personal computers and word processing programs proliferate, what will happen to the demand for paper? Why did home prices in the San Francisco Bay Area rise so much more than elsewhere in the United States during the economic boom of the 1990s?

Why have fixed retail prices become less common with the advent of the Internet and on-line shopping? If a cable company raises its rates, will total revenues and profit also increase? Will a hike in the government sales tax on cigarettes have an appreciable effect on teen smoking?

A solid grounding in the basics of supply and demand can help us address these and many other real-world questions. The supply–demand model reviewed in this chapter indicates how the competitive interaction of sellers and buyers determines a good's market price and quantity. In addition, the model indicates how the market price and quantity of a good respond to changes in other economic variables such as input costs, technology, consumer preferences, and the prices of other goods. Furthermore, the supply–demand model can be used to analyze the effects of various forms of government intervention in markets. Price controls are the form that we will analyze in this chapter. Finally, we will examine how markets operate from a *quantitative* as well as a *qualitative* perspective. In the business world especially, we often need a quantitative answer to the question of how a change in one economic variable such as consumer income, price, price of another good, or price of an input affects the quantity demanded or supplied of a particular good.

2.1 DEMAND AND SUPPLY CURVES

Markets are composed of buyers and sellers. Our analysis of the behavior of buyers relies on demand curves; supply curves depict the behavior of sellers. Let's begin with the buyer, or demand, side of the market.

The Demand Curve

The amount of a good that a consumer or a group of consumers wishes to purchase depends on many factors: income, age, occupation, education, experience, buyer preferences, taxes, subsidies, expectations, and so on. It also depends on the price of the good. According to the **law of demand**, *the lower the price of a good, the larger the quantity consumers wish to purchase*. To this law we must add an important condition. The relationship will hold only if the other factors affecting consumption, such as income and preferences, do not change at the same time that the good's price changes. The assumption that all other factors remain constant is an important one to keep in mind when examining many relationships in economics.

LAW OF DEMAND
the economic principle that says the lower the price of a good the larger the quantity consumers wish to purchase

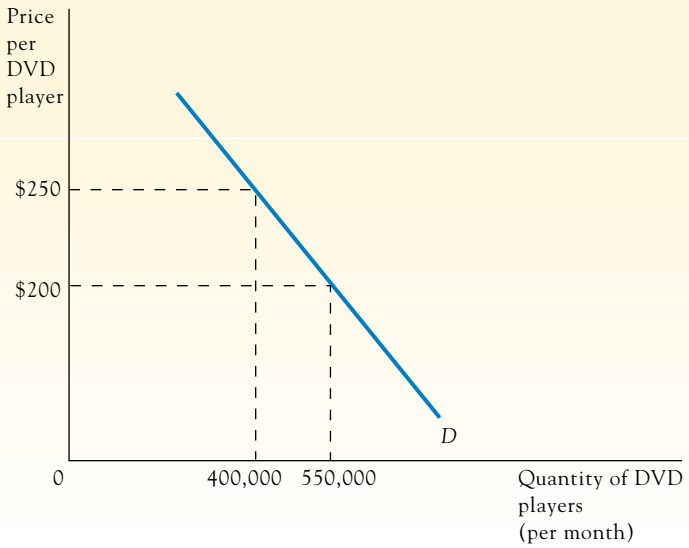
Figure 2.1 shows a hypothetical market demand curve for digital video (or versatile) disc players (DVD players). At each possible price the curve identifies the total quantity desired by consumers. So, at a per-unit price of $250, the *quantity demanded* will be 400,000, while at a per-unit price of $200 the *quantity demanded* will be 550,000. Note that we do not say that *demand* is higher at the lower price, only that the *quantity demanded* is. When economists use the term *demand* by itself (as in demand and supply), we are referring to the entire relationship, the demand curve. *Quantity demanded*, however, refers to one particular quantity on the demand curve.

The negative slope of the demand curve—higher prices associated with lower quantities—is the graphical representation of the law of demand. Economists believe that the demand curves for all, or virtually all, goods and inputs slope downward. As a consequence, the proposition that demand curves have negative slopes has been elevated in economic jargon to the position of a "law." It is probably the most universally valid proposition in economics.

FIGURE 2.1

A Demand Curve

The demand curve *D* shows the quantity of DVD players that consumers will purchase at alternative prices. Its negative slope reflects the law of demand: more DVD players are purchased at a lower price.



A demand curve for a product pertains to a particular time period. For example, the demand curve in Figure 2.1 may refer to consumer buying behavior for July of this year. Another demand curve may be relevant for a different time period. In addition, the information conveyed by the demand curve refers to alternative possibilities for the same time period. If the per-unit price is $250 in July of this year, consumers will purchase 400,000 DVD players; if, instead, it is $200 for the same time period, consumers will purchase 550,000 DVD players.

Although economists usually interpret the curve as showing *the quantities purchased at various prices*, they sometimes use an equivalent interpretation. The demand curve also identifies *the price that consumers will pay for various quantities*. If the demand curve in Figure 2.1 is correct and 400,000 DVD players are placed on the market, consumers will be willing to pay $250 per unit up to the marginal, 400,000th player (400,001 DVD players will not be purchased, according to Figure 2.1, if the per-unit price is $250). If the larger quantity, 550,000, is offered on the market, consumers will purchase the quantity only at the lower per-unit price of $200. That a larger quantity can be sold only at a lower price is another, and equivalent, way of stating the law of demand.

A final point about demand curves: their negative slope is not due only to the presence of more consumers at lower prices. For some goods, like water, the number of consumers will be the same regardless of price, though the amount they use may vary. Increased water consumption when the price is lower reflects greater consumption per person, not more people consuming water. At the other extreme are goods for which more consumption at lower prices results mainly from new consumers entering the market. Personal computers might be such a good. Most goods fall between these extremes—more consumers entering the market, and more consumption per consumer occurring at lower prices. The downward-sloping demand for DVD players is probably due mostly to additional families buying DVD players at lower prices, but some families may purchase more than one because they either have more than one television set or are giving them away as gifts.

APPLICATION 2.1

THE GROSS COST OF GROSCOST: OR HOW ARIZONA LEARNED ABOUT THE LAW OF DEMAND

To promote cleaner air in Arizona, state House Speaker Jeff Groscost successfully sponsored legislation in 2000 encouraging motorists to rely on alternative fuels.[1] The legislation essentially offered a lump-sum state tax refund equal to half of the vehicle's purchase price to buyers of new cars with the capacity to burn alternative fuels such as propane. Previous state law provided a tax credit of 30 to 50 percent of the cost of an alternative-fuel vehicle, but it could only be used to reduce state income taxes owed. Not many people took advantage of that program because very few Arizonans pay more than $1,000 in annual state income taxes.

Under Groscost's legislation, buyers also were granted a license to be able to drive solo in carpool lanes. Furthermore, the bill took out a restriction in the previous law that required vehicle owners to use at least 100 gallons of alternative fuel per year. "We needed to build demand," said Groscost.

Build demand the legislation did. Within four months, almost 30,000 Arizonans had purchased vehicles through the program and garnered an average $20,000 state tax refund per vehicle purchased. The casualties of the program were many—the cost to the state coffers has exceeded $600 million, nearly 10 percent of Arizona's entire $6 billion annual budget. Vital state agencies saw their budgets slashed to come up with the funds to pay for the program. Speaker Groscost got booted out of office. And there was precious little improvement in air quality. This is because many of the vehicles purchased through the program were gas-guzzling sports utility vehicles (SUVs) outfitted with tiny propane tanks (as small as three gallons) that often weren't even connected to the main fuel system.

[1]"If You Paid Half Price for That New SUV, You Must be in Arizona," *Wall Street Journal*, October 26, 2000, pp. A1 and A16.

Shifts in the Demand Curve

As mentioned earlier, many factors influence consumer purchases. A demand curve focuses just on the effect of changes in a product's own per-unit price, with other factors held constant. For example, consumers' incomes are taken to be invariant at all points on a particular demand curve. Now let's consider the other factors, besides the good's price, that might affect the consumption of it. First are the *incomes* of consumers. The level of income is almost certain to affect the amount of goods consumers will purchase; usually, they wish to purchase more when income rises. The term **normal goods** refers to those for which an increase in income leads to greater consumption. Studies indicate that DVD players fall into this category. There are, however, certain goods, called **inferior goods**, whose consumption falls when income rises. Examples of this latter, more rare, category might include hamburger and public transportation. If you won $10 million in the state lottery, would you continue to take the bus?

NORMAL GOODS
those goods for which an increase in income leads to greater consumption

INFERIOR GOODS
those goods whose consumption falls when income rises

COMPLEMENTS
two goods that tend to be consumed together, so consumption of both tends to rise or fall simultaneously

In addition to incomes, the *prices of related goods* also affect the quantity of DVD players consumers will purchase. Related goods fall into two distinct groups: *complements* and *substitutes*. Two goods are **complements** if they tend to be consumed together, so consumption of both goods tends to rise or fall simultaneously. Examples of complements to DVD players include television sets, DVDs, and popcorn. After all, trying to use a DVD player without a television set or discs is difficult. And popcorn, for many consumers, increases the pleasure of using a DVD player. *If two goods are complements, an increase in the price of one leads to a decrease in the demand for the other, and vice versa.* If the price of television sets rises, DVD player consumption will decrease (the demand curve for DVD players shifts in).

SUBSTITUTES
goods that can replace one another in consumption

Substitutes, on the other hand, are goods that can replace one another in consumption. Their consumption is frequently an "either-or" choice since they serve similar purposes, and one or the other may be chosen. For instance, live theater and VCRs are, in the eyes of many consumers, substitutes for DVD players. If two goods are substitutes, an increase in the price of one leads to an increased demand for the other. If the price of live theater rises, DVD player consumption will increase (the demand curve shifts out); DVD players are substituted for theater when theater becomes more expensive.

It is not always readily apparent whether two goods are complements or substitutes for one another. For example, one might think that personal computers and word processing programs would be substitutes for paper since virtual text can be used instead of hard copy. If anything, however, personal computers and word processing programs have proved to be complements to paper. That is, paper usage has increased sharply with the advent of virtual text. This appears to be the case because as technology has made it easier to create and revise text, individuals can obtain hard copies of more files (through the printers that typically accompany personal computers).

TASTES OR PREFERENCES
the feelings of consumers about the desirability of different goods

Consumers' tastes or preferences also affect consumption. By **tastes** or **preferences** we mean the subjective feelings of consumers about the desirability of different goods. Should consumers decide that outdoor exercise is more appealing than watching DVDs—a change in tastes—the purchases of players would drop off. A real-world example concerns Minnesota, where television-based entertainment is less popular than it is, on average, in other states. The phenomenon appears to reflect the fact that Minnesota was settled disproportionately by Scandinavians, who do not regard television-based entertainment as highly as do other ethnic groups in America.

Because tastes are a harder-to-quantify factor than price or income, it may be tempting to omit them from an analysis of demand for a product. To do so, however, can lead to incomplete explanations and inappropriate conclusions. For example, the law of demand applies to the market for beef in India: namely, if the price of beef rises in India, the quantity demanded of beef will fall. Price, by itself, however, cannot explain why per capita beef consumption is so low in India relative to the United States. To understand this requires some knowledge of factors such as religious beliefs and cultural taboos that influence consumer preferences regarding beef in India.

The preceding factors (incomes, prices of related goods, and tastes) are not the only influences on demand beyond the price of the good in question. They are, however, almost certain to be significant for virtually all goods. Thus, we will concentrate on them in the remainder of our analysis.

MOVEMENT ALONG A GIVEN DEMAND CURVE
a change in quantity demanded that occurs in response to a change in price, other factors holding constant

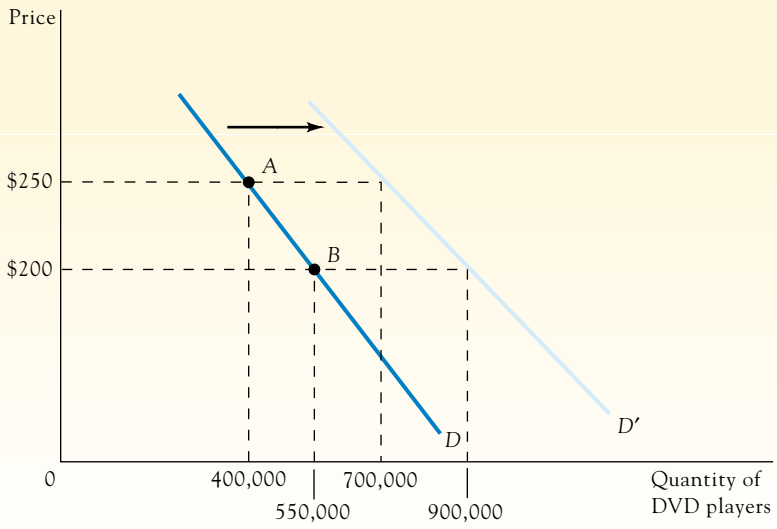
SHIFT OF A DEMAND CURVE
a change in the demand curve itself that occurs with a change in income, in the price of a related good or in tastes and affects the quantity demanded at each possible price

In drawing a demand curve, we assume that incomes, the prices of related goods, and preferences are the same at all points on the curve. The purpose of holding them constant is not to deny that they change but to identify the independent influence of the good's own price on consumer purchases. If incomes, prices of related goods, or preferences do change, the entire demand curve shifts. Figure 2.2 illustrates such a shift. (Note that we begin to use shorthand terms on the axes, *price* and *quantity*. It should be understood that we mean *price per unit* and *quantity per time period.*) Demand curve D, for example, reflects conditions when consumers' annual incomes average $35,000 and the other factors are held constant. If consumers' average annual incomes rise to $45,000 and DVD players are a normal good, consumers will wish to purchase more players at every price than they did before. The change in income produces a *shift in the demand curve* from D to D'. An increase in income *increases demand* for the good (in the normal good case), meaning that the entire demand curve shifts outward or rightward. A *decrease in demand* refers to an inward, or leftward, shift in the demand curve toward the origin. If consumers' preferences shift from being a couch potato and watching DVDs to exercising outdoors, the demand for DVD players will decrease.

To use demand curves correctly, we must distinguish clearly between situations that involve a **movement along a given demand curve** and those that involve a **shift in demand**.

FIGURE 2.2

An Increase in Demand
For a demand curve, other influences besides the price of the good being examined (consumers' incomes, consumers' preferences, prices of related goods, and so on) are held constant at all points along the curve. Changes in these underlying factors normally cause the demand curve to shift. Here, an increase in consumers' incomes causes the demand curve to shift from *D* to *D′* because DVD players are assumed to be a normal good.



A movement along a given demand curve occurs when the quantity demanded changes in response to a change in price of a particular good while the other factors affecting consumption are held constant. This is not a change in the demand curve. An example would be the movement from point *A* to point *B* along demand curve *D* in Figure 2.2. A shift in demand, a movement of the curve itself, occurs when there is a change in income, the price of a related good or tastes, affecting the quantity demanded at each possible price. An example is the movement of the entire demand curve from *D* to *D′* in Figure 2.2.

APPLICATION 2.2 THE EFFECT OF TRAFFIC SCHOOLS ON SPEEDING

Traffic schools, which exist in most states of the United States, provide a useful way to remember the distinction between a movement along a given demand curve and shifts of the demand curve. Traffic schools reflect both a movement along a given demand curve for traffic infractions (such as speeding) and an attempt to shift the entire demand curve for traffic infractions leftward. In the case of speeding, a driver's demand to exceed the speed limit can be taken to depend on factors such as the price of exceeding the limit, the driver's preferences and income, and so on. The price of speeding itself depends on the likelihood of being caught, the cost of a traffic ticket, and the effect of a ticket on a motorist's insurance premium.

In California, individuals who have been issued a moving violation are eligible to attend traffic school once every 18 months. To participate, a traffic violator must pay the moving violation, remit tuition to the traffic school, and spend eight hours in "class." The benefit from attending can be substantial, especially in a state such as California, where auto insurance rates are high. Attending allows the "student" to erase a moving violation from his or her driving record and keeps the violation from resulting in a higher insurance premium.

The effect of traffic schools on the price of speeding violations is surprising: traffic schools lower the price. Even though it takes money and time to attend, the cost of traffic school is less than the cost of higher insurance

rates. To the degree that they lower the price of speeding, traffic schools produce a downward movement along a given demand curve for speeding, thus increasing the quantity of speeding demanded.

In addition to lowering the price of speeding, however, traffic schools also attempt to decrease drivers' tastes for committing moving violations. They do so in a variety of ways. Some employ comedians as instructors in an attempt to promote better driving behavior through humor. Others rely on gore (movies of past accident scenes) or embarrassment (berating individual violators in front of their classmates for their driving mistakes).

Are traffic schools effective at shifting leftward the demand curve for speeding? Studies by the California Department of Motor Vehicles suggest not.[2] Comparing subsequent records of first-time speeders who attend traffic school versus those who do not, and holding constant other factors such as age and gender, the studies find no improvement in driving behavior. Moreover, since traffic schools reduce the price of speeding and move drivers down a given demand curve for speeding, the net effect of traffic schools is to increase the quantity demanded of speeding.

[2]"The Effectiveness of Accredited Traffic Violator Schools in Reducing Accidents and Violations," Department of Motor Vehicles, State of California, September 1979, and *Business Week*, April 28, 1997, p. 120.

The Supply Curve

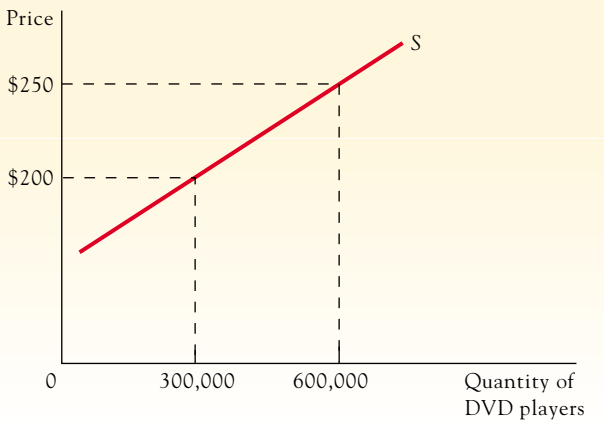
LAW OF SUPPLY
the economic principle that says the higher the price of a good, the larger the quantity firms want to produce

On the supply side of a market, we are interested in the amount of a good that business firms will produce. According to the **law of supply**, the higher the price of a good, the larger the quantity firms want to produce. As with the law of demand, this relationship will necessarily hold only if other factors that affect firms' decisions remain constant when the price of the good changes. The amount firms offer for sale depends on many factors, including the technological know-how concerning production of the good, the cost and productivity of relevant inputs, expectations, employee-management relations, the goals of firms' owners, the presence of any government taxes or subsidies, and so on. The price of the good is also important because it is the reward producers receive for their efforts. The supply curve summarizes the effect of price on the quantity that firms produce.

Figure 2.3 shows a hypothetical market supply curve for DVD players. For each possible price the supply curve identifies the *sum of the quantities offered for sale by the separate firms*. Because all the firms that produce a particular product constitute the industry, this curve is generally called the industry, or market, supply curve. It shows, for example, that at a price

FIGURE 2.3

A Supply Curve
The supply curve *S* shows the quantity of DVD players firms will be willing to produce at alternative prices. It generally slopes upward, indicating that a higher price will result in increased output.



of $200 per DVD player the *quantity supplied* will be 300,000, whereas at a price of $250 the *quantity supplied* will be 600,000. Note that we do not say that *supply* is greater at the higher price, only that the *quantity supplied* is. The term *supply* by itself refers to the entire supply curve, while *quantity supplied* refers to one particular quantity on the curve. This parallels the terminology used for the demand curve.

Supply curves for most goods slope upward. Basically, this upward slope reflects the fact that per-unit opportunity costs rise when more units are produced, so a higher price is necessary to elicit a greater output.[3]

Like the demand curve, the supply curve pertains to a particular period of time. In addition, different points on the supply curve refer to alternative possibilities for the same period of time. Finally, the number of firms producing the good may vary along the supply curve. At low prices some firms may halt production and leave the industry; at high prices new firms may enter the industry.

Shifts in the Supply Curve

The supply curve shows the influence of price on quantity supplied when other factors that also influence output are held constant. When any of the other factors change, the entire supply curve shifts.

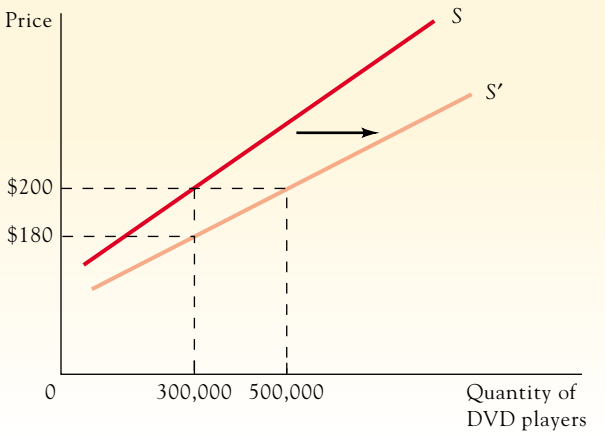
Beyond a good's own price, two determinants of quantity supplied deserve special emphasis. First is the *state of technological knowledge* concerning the various ways a good can be manufactured. Second are the *conditions of supply of inputs*, like labor and energy, that are used to produce the good. Supply conditions for inputs relate to the prices that must be paid for their use. Other factors may be important in particular cases—for example, government in the case of health care, weather in the case of agriculture, and an organization's goals in the case of nonprofit institutions like the Red Cross—but technology and input supply conditions influence all output markets.

In drawing a supply curve, we assume that factors such as technological knowledge and input supply conditions do not vary along the curve. The supply curve shows how variation in price alone affects output. If technology or input supply conditions do change, the

FIGURE 2.4

An Increase in Supply

For a supply curve, technology and input supply conditions are held constant at all points along the curve. Changes in these underlying factors normally cause the supply curve to shift. Here, a technological change causes the supply curve to shift from *S* to *S′*.



[3]In Chapter 9, though, we will see that supply curves for some products may be horizontal. Upward-sloping supply curves, however, are thought to be the most common shape, and we draw them this way here.

MOVEMENT ALONG A GIVEN SUPPLY CURVE
a change in quantity supplied that occurs in response to a change in the good's selling price, other factors holding constant

SHIFT OF A SUPPLY CURVE
a change in the supply curve itself that occurs when the other factors, besides price, that affect output change

supply curve shifts. For instance, if a new technology allows manufacturers to produce DVD players at a lower cost, the supply curve shifts to the right, as illustrated in Figure 2.4. Because producers' costs are now lower due to the technological advance, individual producers will want to produce more at any price. After the technological advance, the quantity supplied is greater at each possible price, as shown by the shift in the supply curve from *S* to *S′*. The rightward shift in the supply curve reflects an *increase in supply*. If there is an increase in supply, each quantity will be available at a lower price than before. For example, before the technological advance, 300,000 DVD players would have been produced only if the price were at least $200; afterward, 300,000 would be produced at a price of $180.

Just as with demand curves, we must distinguish a **movement along a given supply curve** from a **shift in supply**. A movement along a supply curve occurs when the quantity supplied varies in response to a change in the good's selling price while the other factors that affect output hold constant. A shift in the supply curve occurs when the other factors that affect output change.

2.2 DETERMINATION OF EQUILIBRIUM PRICE AND QUANTITY

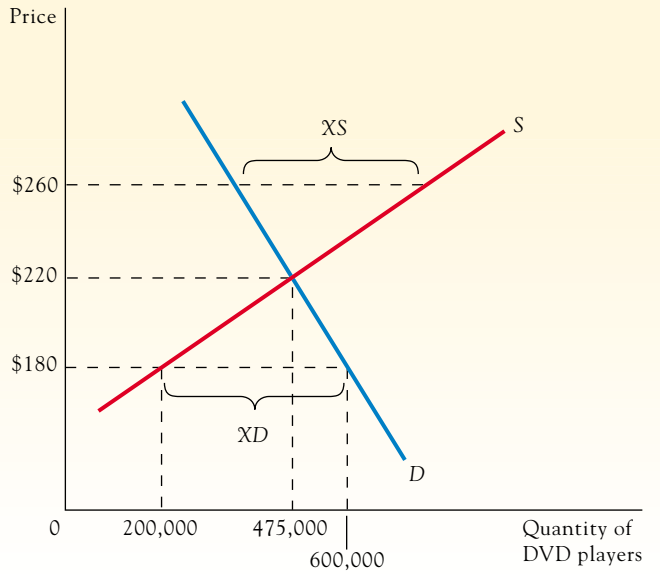
EQUILIBRIUM
a situation in which quantity demanded equals quantity supplied at the prevailing price

The demand curve shows what consumers wish to purchase at various prices, and the supply curve shows what producers wish to sell. When the two are put together, we see that there is only one price at which the quantity consumers wish to purchase exactly equals the quantity firms wish to sell. In Figure 2.5, that price is $220, where consumers wish to purchase 475,000 DVD players and firms wish to sell the same quantity. It is identified by the point of intersection between the supply and demand curves.

The intersection identifies the **equilibrium** price and quantity in the market. Upon reaching equilibrium, price and quantity will remain there. Of course, if the supply or the demand curve shifts, the equilibrium point will change, too. A basic assumption of

FIGURE 2.5

Determination of the Equilibrium Price and Quantity
The intersection of the supply and demand curves identifies the equilibrium price and quantity. Here, at the price of $220, the quantity demanded by consumers exactly equals the quantity supplied by firms. Market forces tend to produce this outcome.



DISEQUILIBRIUM
a situation in which the quantity demanded and the quantity supplied are not in balance

SHORTAGE
excess demand for a good

microeconomic theory is that the independent actions of buyers and sellers tend to move the market toward equilibrium. We can see how this happens if we first imagine that the price is not at its equilibrium level. Suppose, for example, that the price is $180 in Figure 2.5. At $180 the demand curve indicates that consumers want 600,000 DVD players, but the supply curve shows that firms will produce only 200,000 DVD players. This situation is a **disequilibrium**; the quantity demanded exceeds the quantity supplied, so the plans of buyers and sellers are inconsistent. The excess of the amount consumers want over what firms will sell—in this case 400,000 DVD players—is called the *excess demand* (*XD*), or **shortage**, at the price of $180.

How will the people involved—both consumers and business managers—react in this situation? Consumers will be frustrated by not getting as much as they wish and will be willing to pay a higher price to obtain more DVD players. Business managers will see that quantity demanded is greater than quantity supplied and will be prompted to hike their selling price. Consequently, whenever there is a shortage at some price, market forces—defined as the behavior of buyers and sellers in the market—tend to produce a higher price. In this example the price rises to $220. As the price rises, quantity demanded falls below 600,000 (a movement along the demand curve), and quantity supplied increases beyond 200,000 (a movement along the supply curve). The process continues until quantity demanded equals quantity supplied at a price of $220.

SURPLUS
excess supply of a good

Alternatively, if for some reason the price is above $220, the quantity firms wish to sell will be greater than the quantity consumers are willing to buy. An *excess supply* (*XS*), or **surplus**, will exist at a higher-than-equilibrium price. Unsold goods pile up. In this case market forces exert downward pressure on price: firms cut prices rather than accumulate unwanted inventories and consumers realize that they do not have to pay as high a price for the good.

Therefore, at any price other than the equilibrium price, market forces will tend to cause price and quantity to change in the direction of their equilibrium values. The equilibrium position itself will change whenever demand or supply curves shift, so actual markets may, in effect, be pursuing a moving target as they continually adjust toward equilibrium.

APPLICATION 2.3 IS THERE A PARKING SHORTAGE IN MAJOR AMERICAN CITIES?

There are more than 190 million passenger cars and trucks in operation in the United States at any given time, but only slightly more than 100 million controlled (nonprivate) parking spaces. The average car is parked more than 95 percent of the time.

Most urban planning experts disagree with the popular impression that severe parking shortages exist in major cities such as New York, San Francisco, and Boston, saying that no parking shortage is evident. The experts argue that there is plenty of parking, provided that you are willing to pay the prevailing price for a space or walk—two options that many U.S. motorists dislike. As the editor of the *Parking Professional*, a trade magazine for private and municipal parking operators, puts it: "It's not that there is a shortage of spaces, just a shortage of free spaces where people want them to be." Namely, while parking spaces are available at the prices charged by major cities for them, few spaces are available at the lower price of zero that drivers would prefer to see charged.

2.3 ADJUSTMENT TO CHANGES IN DEMAND OR SUPPLY

The most common application of the supply and demand model is to explain or predict how a change in market conditions affects equilibrium price and output. In Figure 2.6a, we see an increase in demand but no change in supply. Demand might increase, for instance, following a report from the Surgeon General's office that watching at least two hours of DVDs per day reduces the risk of heart attack. This report would shift the demand curve for DVD players to the right but leave the supply curve unaffected.

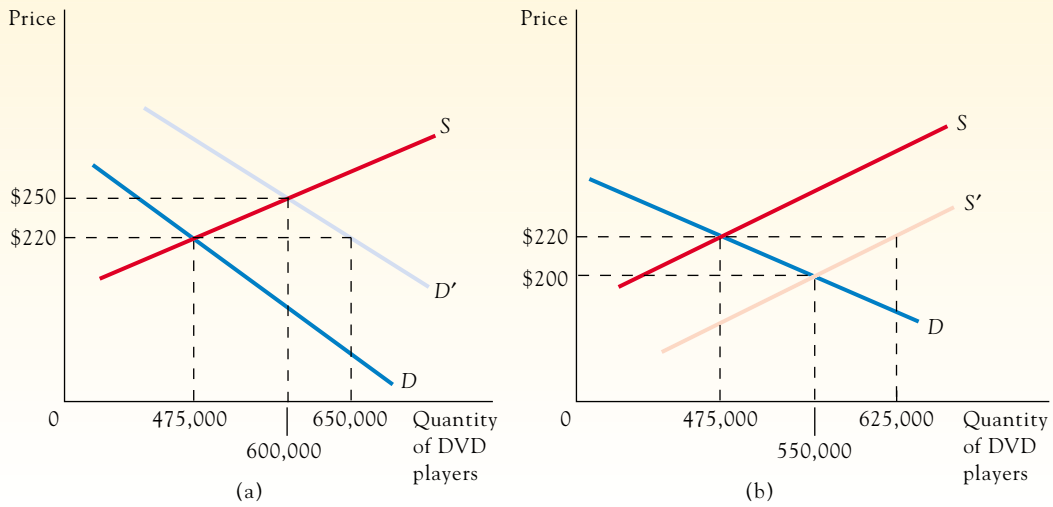
Before demand increases, the equilibrium price and quantity are $220 and 475,000 DVD players, respectively. When the demand curve shifts to D', a shortage will temporarily exist at the original price of $220—quantity demanded (650,000) will exceed quantity supplied (475,000). As a consequence, there will be upward pressure on price. Price will rise, quantity supplied will increase, and quantity demanded will decline until a new equilibrium price and quantity of $250 and 600,000 DVD players, respectively, are determined, as indicated by the intersection of D' and S. Note that the higher output is not described as an increase in supply; only the quantity supplied has increased.

Figure 2.6b shows the effects of an increase in supply when there is no change in demand. Suppose that an advance in technology reduces production costs in the DVD player industry. This event will cause the supply curve of DVD players to shift rightward. At the initial price of $220 firms would now wish to sell more players than consumers would be willing to buy, and a temporary surplus would result. Price would fall, and a new equilibrium with a price of $200 and an output of 550,000 would be established. Note that the greater purchases by consumers at the new equilibrium are not described as an increase in demand. Demand has not increased; quantity demanded has increased because of a lower price.

FIGURE 2.6

Market Adjustments to Changes in Demand and Supply

(a) An increase in demand from D to D', with supply unchanged, leads to a higher equilibrium price and output. (b) An increase in supply from S to S', with demand unchanged, leads to a lower equilibrium price and a higher equilibrium output.



Do real-world markets respond to the forces of supply and demand in the way suggested by the theory? Over time, economists have accumulated a great deal of evidence indicating that they do.

Some recent confirmations of the theory come from such disparate applications as variable-price parking meters and soft-drink vending machines; on-line shopping; and the San Francisco Bay Area housing market. For example, the next generation of parking meters and vending machines are being armed, through computer chips, to adjust the price charged in response to changes in demand—a higher price when traffic is more congested or when the weather is hotter and, consequently, consumer thirsts are greater. The Web has also increased the speed at which market equilibrium adjusts to changes in supply and demand across section after section of the economy. In contrast to traditional retail models, where fixed prices for relatively long periods of time are the norm, the Internet allows for quicker updating of prices and customer feedback. By bringing information about supply and demand together at the moment of sale, on-line shopping increases the alacrity with which equilibrium prices and quantities adjust, in predictable ways, to a change in demand or supply.

The San Francisco Bay Area housing market further testifies to how market equilibrium responds to underlying changes in supply and demand. During the latter half of the 1990s, the price of an average home rose by at least twice as much in and around San Francisco as elsewhere in the country—indeed, by a whopping 25 percent in 1999 relative to 5 percent for the United States as a whole. The reason for this disparity stemmed from the coincident information technology-based economic boom. Silicon Valley, which is an economic engine for the San Francisco Bay Area, vastly outpaced the rest of the United States during the latter half of the 1990s in terms of job growth and minting more millionaires per year than any other place on the planet. As people poured into the area, demand for houses outstripped supply. Houses are a normal good; prices predictably rose as the market sought equilibrium.

APPLICATION 2.4 SUPPLY, DEMAND, AND BABYSITTING

According to the *Wall Street Journal*: "Finding spot babysitters—teens who can pick up where day care or full-time nannies leave off—has gotten so hard that many parents wouldn't think twice about picking a sitter up at softball practice or scheduling their own social events around student government meetings. To hold on to sitters, parents sometimes behave pretty childishly, outbidding rivals, refusing to give the sitter's number to friends, and loading up their refrigerators with bribes."[4] In New York City, the base rate for sitters is $10 per hour, with bonuses if a sitter works beyond the normal week's hours.

Why are parents going to greater lengths to keep good sitters and why is the going rate for babysitting services increasing? The answer boils down to supply and demand. There are more than 7 million girls who are 12 to 15 years old—the prime sitter pool—and roughly 35 million U.S. families with kids 11 years old and younger who need sitters. This imbalance—more families with an interest in babysitting services and fewer potential babysitters—did not exist a few decades ago when the Baby Boom generation (children born after the end of World War II) had yet to enter their prime child-rearing years.

[4]"Why Teenage Sitters Have So Much Power," *Wall Street Journal*, September 26, 1996, pp. B1 and B9.

Using the Supply–Demand Model to Explain Market Outcomes

We have focused so far on how the supply–demand model can be employed to *predict* market outcomes. An increase in the price of gasoline, for example, can be forecast to shift the demand curve for cars leftward (since gasoline and cars are complements) and thus to reduce the equilibrium price and quantity in the market for cars. However, the supply–demand model can also *explain* market outcomes. For example, why has the equilibrium price for, and per capita consumption of, medical care increased so dramatically over the last fifty years? Why is the price of gasoline so high and per capita consumption so much lower in Western Europe than the United States?

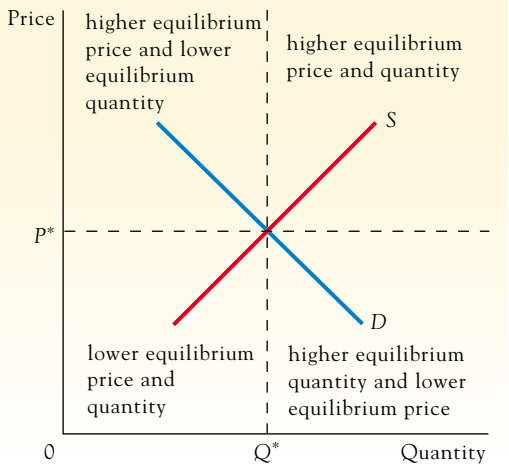
We can use the supply–demand model "in reverse" to explain such puzzling market outcomes in a fairly straightforward way. The first step involves determining how the equilibrium in a market has changed. Suppose, for example, that, as shown in Figure 2.7, we start off with an initial equilibrium price and quantity (P^* and Q^*) determined by the intersection of supply and demand curves (S and D). The initial equilibrium can be altered in four ways, represented by four quadrants.

Once we have determined what quadrant the new equilibrium is in, we can see whether demand or supply has produced the new market outcome. For example, if the new equilibrium is to the northeast of the initial equilibrium, we know that the demand curve has altered the equilibrium: the demand curve shifts to the right to produce a new equilibrium located northeast of the initial one. After we know which curve has produced the new equilibrium, we can attempt to isolate the factor that produced the observed change in market outcome.

Take the case of gasoline in Western Europe. As anybody who has traveled there knows, the per-unit price of gasoline is usually two to three times as high as it is in the United States. Moreover, per capita consumption of gasoline is significantly lower in Western Europe than in the United States. Why is this the case? In Figure 2.7, the Western European per capita equilibrium for gasoline is located to the northwest of the equilibrium in the United States. Its location to the northwest means that the supply curve must be explaining the Western European market outcome. Specifically, the supply curve has to shift to the left to induce a movement in the gasoline market equilibrium to the northwest. Now that we have isolated the supply curve as playing the dominant explanatory role, we can focus on what determinant of supply might be producing such a leftward shift in the supply curve.

Figure 2.7

Using the Supply–Demand Model to Explain Market Outcomes
The supply–demand model can be used "in reverse" to explain market outcomes. By determining where the new equilibrium is relative to the initial equilibrium, it is possible to determine whether the demand or supply curve has produced the new market outcome.



The culprit turns out to be the taxes levied by Western European governments on the sale of gasoline—taxes that significantly raise the cost of supplying gasoline to the market.

The supply–demand model also can be applied, in reverse, to explain the market for medical care. By most measures, per capita consumption and the per-unit price (adjusted for inflation) of medical care have increased over the past half-century in the United States. What is behind this phenomenon? We are clearly to the northeast, in terms of Figure 2.7, of the equilibrium that prevailed at the end of World War II. The demand curve, by shifting to the right, must be playing the explanatory role. One likely reason the demand curve has shifted is growth in consumers' incomes and the fact that medical care is a normal good. As people get richer, they appear to be spending more money on medical care for themselves and their families. (As we shall see in later chapters, however, the full explanation is a bit more complicated.)

2.4 GOVERNMENT INTERVENTION IN MARKETS: PRICE CONTROLS

Markets can be thought of as self-adjusting mechanisms; they automatically adjust to any change affecting the behavior of buyers and sellers in the market. But for this mechanism to operate, the price must be free to move in response to the interplay of supply and demand. When the government steps in to regulate prices, the market does not function in the same way. We can use the supply–demand framework to analyze this form of government intervention.

Policymakers may believe that market-determined prices are either too high or too low. In the former case, they may impose a legislated maximum price, or **price ceiling**. Under a legislated price ceiling it is illegal to charge a price higher than the ceiling. In the latter case, a minimum price, or **price floor**, may be legislated. In this section, we'll analyze price ceilings and show how their economic effects may be directly contrary to the stated objectives of the policymakers who impose them.

PRICE CEILING
a legislated maximum price for a good

PRICE FLOOR
a legislated minimum price for a good

Price ceilings are not uncommon. In the twentieth century, broad-ranging price controls were established at the federal level during several major crises, including World War II, the Korean War, and the Vietnam War. Other examples of price ceilings on specific items include rent control, caps on automobile insurance rates in some states, and federal constraints on the prices that may be charged for human body organs for transplant. We will examine rent control in detail, but keep in mind that the effects of government intervention can be generalized to other markets where price ceilings prevent competitive market forces from determining the equilibrium.

Rent Control

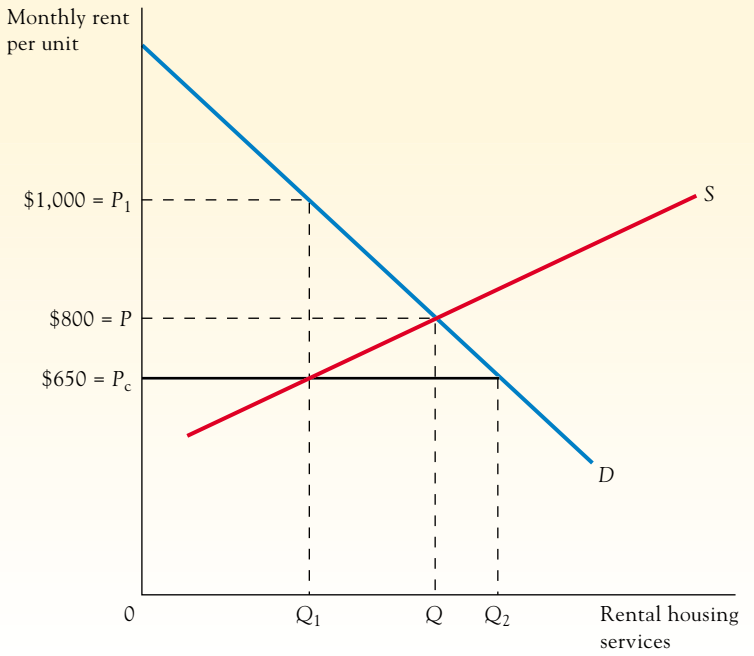
During World War II, many local governments in the United States applied price ceilings to rental housing units, a policy generally referred to as **rent control**. New York City was the only major city to continue rent control after World War II, and it still uses it today. Apart from New York, relatively few cities experimented with rent control until the 1970s, when an increasing number of cities adopted the practice. By 1990, more than two hundred cities were using some form of rent control, including Los Angeles, Washington, Boston, and Newark (although in the last few years the state legislatures in both Massachusetts and California have voted to end local rent control).

RENT CONTROL
price ceilings applied to rental housing units

We can examine the effects of rent control with the aid of Figure 2.8, which shows the supply and demand curves for rental housing units in a particular city. As shown in Figure 2.8, in the absence of rent control, the equilibrium monthly price is P, or $800, and Q is the

FIGURE 2.8

Rent Control
With a legal maximum rent of $650 set below the market equilibrium level of $800, quantity supplied falls from Q to Q_1, and quantity demanded rises to Q_2. The difference, Q_2 minus Q_1, is the excess demand, or shortage, created by the rent control policy.



equilibrium quantity. Rent control imposes a maximum price on a rental unit below the equilibrium level. Suppose that the price is not allowed to rise above P_c, or $650. The first question to answer is whether the law can be effectively enforced. Because tenants are willing to pay a higher price, landlords have an incentive to extract side payments from tenants. Such side payments might include a nonrefundable key deposit; purchase of a parking space or furniture as a condition for renting; or paying for one's own repairs. All these practices have been observed to occur under rent control. In this way, a landlord might charge the regulation $650 in explicit rent, but receive enough extra in side payments to get the effective price closer to the market price.

Let's assume that these methods of circumventing the law are not allowed. (They are, in fact, illegal under most rent control laws.) The price that consumers must pay is lower, and at a lower price the quantity demanded is greater, namely, Q_2. At the lower price, however, the quantity supplied falls to Q_1, because investment in this market becomes less profitable. Fewer new rental units are constructed. New York City, for example, has the lowest rental vacancy rate in the country. And, the number of new rental housing units (per capita) added to the city's total supply of such units is the lowest in the nation. Moreover, owners allow existing units to deteriorate more rapidly by spending less on maintenance for those units. One study found repair expenditures in New York City on rent-controlled apartments to be only half as large as the repair expenditures made on comparable apartments not subject to rent control.[5]

The result of rent control, like that of any other price ceiling applied in a competitive market, is a shortage. The quantity that potential tenants would like to rent, Q_2, is greater than the quantity available, Q_1, and the excess of quantity demanded over quantity

[5]G. Sternlieb, *The Urban Housing Dilemma* (New York: New York Housing and Development Administration, 1972), p. 202.

supplied, Q_1Q_2, measures the shortage. Because only Q_1 units are actually available, the marginal value of housing units to consumers must be at least $1,000 (the height of the demand curve at Q_1). Price, however, cannot legally rise above $650 per month, so producers have no incentive to increase quantity beyond Q_1.

Rent control has effects on other markets, too. Not all people who wish to rent are able to do so, so they must make other living arrangements. Apart from living in a different community, the major alternative is some form of owner-occupied housing. Therefore, the demand for such housing will increase as frustrated apartment hunters turn to home ownership. At the same time, the owners of rent-controlled apartments have an incentive to convert their rental units into owner-occupied units, or condominiums, and sell them to tenants. Typically, communities with rent controls resort to limitations on condominium conversion to prevent the supply of rental units from drying up completely. Because landlords also have an incentive to convert rental units to commercial units (such as stores and business offices) that are not subject to rent control, most communities with rent control also outlaw this practice.

Who Loses, Who Benefits?

Those obviously harmed by rent control are the owners of rental units at the time the policy is implemented. They have invested in the construction or purchase of units in the expectation of being able to charge $800 per month (in our example), but they find their return reduced by law. Although landlords are often depicted as wealthy and easily able to bear the losses imposed by rent control, this is often not the case. While the evidence is sketchy, landlords often have incomes that are no greater than those of their tenants. For example, a 1988 survey of New York landlords found that 30 percent had incomes below $20,000, and half had incomes below $40,000.[6]

Now consider who benefits from rent control. The intended beneficiaries are clear. In virtually all cases proponents of rent control expressly seek to benefit tenants. Economists, however, are skeptical about the degree to which this benefit actually occurs. Indeed, some economists believe that tenants, on average, are worse off under rent control. While lower rents by themselves are good for tenants lucky enough to get a rent-controlled apartment, other changes in the market are not so advantageous.

First, the lower rental price is necessarily accompanied by a lower quantity (quantity falls from Q to Q_1 in Figure 2.8). A lower price is good for tenants, but fewer rental units are not, and the net effect of the two is uncertain. It is conceivable that all tenants are made worse off. To see this, suppose that the quantity of available rental units falls to zero under rent control. A lower price does tenants little good if they cannot find housing. Moreover, all tenants likely will not be affected in the same way. Some tenants may find what they want at the lower rents, while others may not. For example, while former New York Mayor Ed Koch had a rent-controlled apartment in Greenwich Village in 1989 for $352, a recent college graduate was paying $300 to live in a pantry in another person's apartment.[7] (Pantries are apparently not subject to rent control.) The biggest losers among the tenants are, of course, the "potential tenants" who are unable to find rental apartments and must either purchase housing or live elsewhere.

Another disadvantage to tenants of rent control involves its impact on quality. Just as a quantity reduction acts to the detriment of tenants, so does the decrease in quality. Landlords have an incentive to lower costs by reducing maintenance. Normally, they would not do this because they would lose tenants, but because of the rent-control-created shortage they can reduce the value of rental units without driving tenants away. Consequently, tenants get a lower-quality product for the lower price.

[6]Irving Welfeld, *Where We Live* (New York: Simon and Schuster, 1988), p. 146.

[7]William Tucker, "It's a Rotten Life," *Reason* (February 1989), p. 23.

Quality is also likely to suffer when rent control laws have provisions permitting landlords to raise the rent on a unit that becomes vacant. Because such provisions give landlords an incentive to evict tenants, the law typically also has strong anti-eviction provisions. In turn, anti-eviction provisions give landlords the incentive to make tenants as unhappy as possible so they will choose to leave, and one way to do that is to let the rental unit deteriorate. The normal incentive of landlords—to provide a quality unit so tenants will stay a long time—is turned upside down by rent control.

Under rent control, nonprice rationing becomes more prevalent. Since price is not allowed to ration the available quantity among competing consumers, quantity supplied does not equal quantity demanded, and some other way of determining who gets the good and who doesn't must arise. Nonprice rationing can take many forms and works to the disadvantage of some tenants. Because there are many more potential tenants than apartments, landlords can be highly selective. For example, they are likely to favor tenants without children or pets (children and pets increase maintenance and repair costs) and tenants with histories of steady employment at good wage rates (who can be counted on to pay on time).[8] Minorities may not fare well under rent control if landlords have prejudices against them and choose to indulge such prejudices in selecting tenants.

Another form of nonprice rationing is rationing on a first-come, first-served basis. Because of the lack of available units, potential tenants incur the cost of waiting in line (or in a pantry) and searching for that rare commodity, a vacant rent-controlled unit. This factor, of course, adds to the true cost of rental housing since not only the rent but also the cost of time spent waiting and searching must be paid by prospective tenants.

A more obvious form of nonprice rationing is the payment of bribes to secure a rent-controlled unit. Because a rent-controlled apartment is often worth more to tenants than the listed rent, they are willing to pay a "finder's fee" to anyone securing a rental unit for them.

Under rent controls, **black markets** may emerge, with units renting for more than $650. This occurs because prospective tenants are willing to pay more than the legal price for an apartment. In Figure 2.8, when the quantity Q_1 is legally available, tenants are willing to pay as much as P_1—the height of the demand curve at that quantity—for an apartment. Landlords benefit by renting a unit at more than $650, so there is room for transactions that benefit both consumers and producers—which is why black market exchanges are likely to occur. The extent of black market activities will depend on the penalties the government applies to this behavior and how rigorously the penalties are enforced.

BLACK MARKET
an illegal market for a good

While most local governments vigorously police against black market exchanges between landlords and initial tenants, they often look the other way when it comes to the practice of subletting. *Subletting* occurs when the initial tenant rents the apartment to a secondary tenant (generally without the landlord's knowledge). New York City does not actively police against this practice, and as a result most subletting rental rates are at least double the official rent control rates for the same apartments. Since subletting is essentially a black market in rental units, to the extent that cities condone the practice, the rental rates paid by tenants (at least secondary tenants) can end up higher than they would be were there no rent control—P_1 versus P in Figure 2.8.

Rent controls also involve administrative costs. For example, in Santa Monica, California, the Rent Control Board's annual budget exceeded $5 million in certain years. To pay for this budget, each tenant was levied an annual fee of $132. Furthermore, since property taxes are the most important source of revenue for most cities, and rent control lowers the market values of rental properties, a city's tax base is eroded. This loss can be substantial. It

[8]Landlords in rent-controlled cities often screen for and attempt to avoid renting to law students. It seems that such students are prone to practice their future trade on existing landlords.

has been estimated, for example, that property tax revenues fell by 10 to 20 percent in Cambridge, Massachusetts, as a result of rent controls.[9] This means that residents, including tenants, either receive fewer services provided by the city or have to pay higher income taxes.

For all these reasons the benefits to tenants from rent control are likely to be a good deal smaller than it appears on the surface. Generalizing the outcomes for tenants as a group is difficult because particular tenants are likely to be affected in different ways. Probably some tenants benefit, especially those occupying rental units at the time rent control takes effect, but the deterioration of the quality of the units diminishes even their benefits. Other tenants are almost certainly worse off because of the side effects that accompany the lower rents.

APPLICATION 2.5 WHY THE DOCTOR IS NOT IN

Delays are the norm in the United States when trying to see a doctor for medical conditions that are covered by a patient's third-party underwriter—either government-funded programs such as Medicare/Medicaid or insurers and health maintenance organizations (HMOs), whose growth over the past half century has been fueled through a tax break provided by the government to companies who offer their employees health benefits. As you might have guessed, the delays are the result of caps placed by the third parties on doctor reimbursement. The caps lead to a shortage of doctor services relative to the amount that is desired by patients. And, for reasons that we will cover later in this book, the shortage is exacerbated by the fact that patients typically pay only a small portion of the reimbursed amount directly to the doctor (a $5 or $10 co-payment per visit), with the remainder of the reimbursement coming indirectly through the third-party underwriter.

The delays have grown to such an extent that more and more patients are turning to urgent-care facilities and hospital emergency rooms for prompter medical attention. Notwithstanding the higher fees patients must pay directly out of their own pockets for such alternative ways to see a doctor (the co-payments typically range from $50 to $150), the timelier service may be worth it. Of course, as growing numbers of patients turn to urgent care and emergency rooms, the delays for services provided by these sites (which face analogous caps by third-party underwriters) have also increased.

The delays faced by patients in the United States, however, have yet to rival those in Canada, where universal "free" health care is provided by the government to its citizens and user fees have been outlawed since 1984.[10] "Hallway medicine" has become so routine in hospitals across Canada, with patients either waiting for attention or recuperating from operations on hallway stretchers, that the stretcher locations have permanent numbers. An official at a Vancouver hospital estimates that 20 percent of heart attack patients who should be treated within 15 minutes now wait at least an hour. In Toronto, at Canada's most prestigious cancer hospital, hospital lawyers have drawn up a protective waiver for patients to sign indicating that they fully understand the danger of delaying radiation treatment.

There is no comparable crisis in dental and veterinary care in Canada because these sectors still operate without government intervention. As Michael Bliss, a medical historian, notes: "So we have the absurdity in Canada that you can get faster care for your gum disease than your cancer, and probably more attentive care for your dog than your grandmother." Indeed, in the Canadian province of Ontario one man on a lengthy wait list for magnetic resonance imaging (MRI) tests recently reserved a session for himself at a private animal hospital with a machine. He registered under the name Fido.

[10]"Full Hospitals Make Canadians Wait and Look South," *New York Times*, January 16, 2000, p. 3.

[9]Peter Navarro, "Rent Control in Cambridge, Massachusetts," *The Public Interest*, 78 (Winter 1985), pp. 83–100.

APPLICATION 2.6 PRICE CEILINGS CAN BE DEADLY FOR BUYERS

Almost 80,000 people are currently waiting for organ transplants in the United States.[11] Approximately 5,500 of these individuals will die annually at least in part because of a price ceiling of zero imposed on potential organ suppliers. Namely, under the existing American policy, altruistic organ donations are encouraged, whereas it is a criminal offense to sell organs, either during life or after death.

To deal with the increasingly acute shortage of organs for transplant, there has been some hope in recent years that the American Medical Association will at least launch an experimental program permitting the payment of small sums of money ($300 to $3,000) for cadaveric organs. Professor Richard Epstein of the University of Chicago's Law School has been the leading advocate for such an experimental program arguing that it is time to "enact, not repeal, the laws of supply and demand."

[11]This application is based on Richard A. Epstein, "The Market has a Heart," *Wall Street Journal*, February 21, 2002, p. A18.

2.5 ELASTICITIES[12]

ELASTICITIES
measures of the magnitude of the responsiveness of any variable (such as quantity demanded or supplied) to a change in particular determinants

We have so far focused on specifying qualitative relationships between determinants of supply and demand and the actual quantity demanded and quantity supplied of a good. Although qualitative relationships provide meaningful information, they cannot measure the impact produced by a change in a particular determinant on the quantity demanded or supplied of a commodity. In the business world especially, we need to know the quantitative impact of a change in one determinant such as price, income or the price of inputs on the quantity demanded or quantity supplied of a commodity. Quantitative impacts are also often important in the public policy arena. For instance, when considering an increase in the sales tax on cigarettes, government decisionmakers may be concerned about the magnitude of the effect of the tax on the quantity of cigarettes demanded by smokers (perhaps, in particular, by teenage smokers). **Elasticities** measure the magnitude of the responsiveness of any variable (such as quantity demanded and quantity supplied) to a change in particular determinants.

Price Elasticity of Demand

PRICE ELASTICITY OF DEMAND
a measure of how sensitive quantity demanded is to a change in a product's price

Even though we assume that all market demand curves have negative slopes (implying that at a lower price a greater quantity will be purchased), the degree of responsiveness varies widely from one commodity to another. A reduction in the price of cigarettes may lead to an infinitesimal increase in purchases while a reduction in airplane fares may produce a veritable explosion in air travel. The law of demand tells us to expect *some* increase in quantity demanded, but not how much.

The **price elasticity of demand** is a measure of how sensitive quantity demanded is to a change in a product's price. It can be defined as *the percentage change in quantity demanded divided by the percentage change in price*. The ratio will always be negative for any downward-sloping demand curve. For example, if a 10 percent price increase brings about a 20 percent reduction in quantity demanded, the price elasticity of demand is −20 percent/+10 percent, or −2.0. Economists usually drop the minus sign on the understanding that price and quantity demanded always move in different directions and simply refer to the elasticity as being, in this case, 2.0.

[12]A mathematical treatment of some of the material in this section is given in the appendix at the back of the book (pages xxx–xxx).

ELASTIC
the situation in which price elasticity of demand exceeds 1.0 or unity

INELASTIC
the situation in which price elasticity of demand is less than 1.0 or unity

UNIT ELASTIC
the situation in which price elasticity of demand equals 1.0 or unity

Price elasticity of demand provides a quantitative measure of the price responsiveness of quantity demanded along a demand curve. The higher the numerical value of the elasticity, the larger the effect of a price change on quantity. If the elasticity is only 0.2, then a 10 percent price increase will reduce quantity demanded by just 2 percent (2 percent/10 percent = 0.2). Alternatively, if the elasticity is 4.0, a 10 percent price rise will reduce quantity demanded by 40 percent (40 percent/10 percent = 4.0).

If the price elasticity of demand exceeds 1.0, then demand is said to be **elastic**. Elasticity is greater than 1.0 whenever the percentage change in quantity demanded is greater than the percentage change in price, implying that the quantity demanded is relatively responsive to a price change. If the price elasticity of demand is less than 1.0, then demand is said to be **inelastic**. Elasticity is less than 1.0 whenever the percentage change in quantity demanded is less than the percentage change in price, implying that quantity demanded is relatively unresponsive to a price change. When the price elasticity of demand is equal to 1.0, then demand is said to be **unit elastic**, or of unitary elasticity. Unitary elasticity occurs whenever the percentage changes in price and quantity demanded are equal.

Whether demand is elastic, unit elastic, or inelastic determines how a price change will affect total expenditure on the product. Total expenditure equals price times quantity, or $P \times Q$. A change in price affects these terms in offsetting ways. A higher price increases the P term but reduces the Q term (quantity demanded is lower at a higher price). The net effect on total expenditure, therefore, depends on the relative size of the two changes. Put differently, the net effect on total expenditure depends on how responsive quantity is to the price change; it depends on the price elasticity of demand. If a 10 percent increase in price reduces quantity by 10 percent (the unit elastic case), then total expenditure, $P \times Q$, remains unchanged. If a 10 percent increase in price reduces quantity by more than 10 percent (the elastic demand case), then total expenditure will fall because of the sharper reduction in quantity purchased. Finally, if a 10 percent increase in price reduces quantity by less than 10 percent (the inelastic demand case), then total expenditure will rise.

Figure 2.9a depicts a case where a small change in the per-gallon price of gasoline has a large effect on quantity purchased. Demand is elastic in this case since the percentage change in quantity demanded exceeds the percentage change in price. If, for example, price falls from $1.00 to $0.90 per gallon, quantity increases sharply from 100 to 200 gallons. The price reduction increases total expenditure on gasoline from $100 ($1.00 per gallon multiplied by 100 gallons) to $180 ($0.90 multiplied by 200 gallons). Conversely, if the price rises from $0.90 to $1.00, total expenditure falls from $180 to $100. Thus, we see graphically how a price change affects total expenditure when demand is elastic.

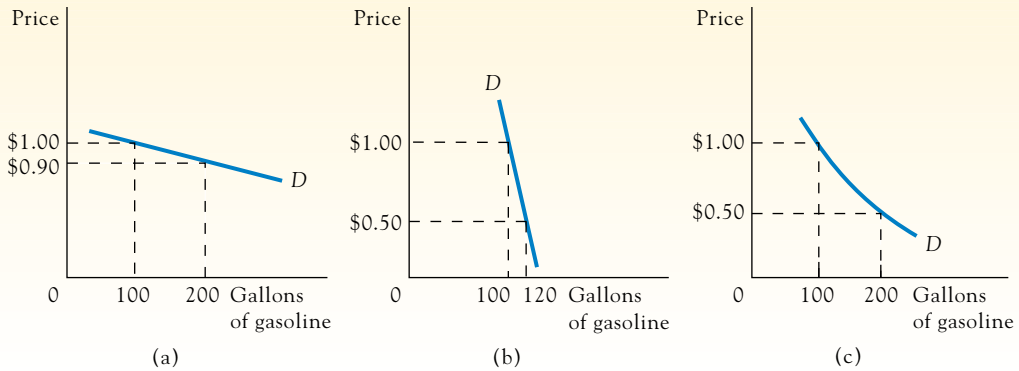
Figure 2.9b examines the relationship between price and total expenditure if the demand for gasoline is very inelastic: a change in price has little effect on quantity. When the price falls from $1.00 to $0.50 per gallon, total expenditure falls from $100 to $60. When price rises from $0.50 to $1.00, total expenditure rises. Figure 2.9c shows the intermediate case of unit elasticity.[13] In this case total expenditure remains unchanged when price varies. Consumers purchase 100 gallons at a price of $1.00 per gallon (total expenditure of $100) and 200 gallons at a price of $0.50 per gallon (total expenditure still $100).

In short, when demand is elastic (elasticity greater than 1.0), price and total expenditure move in opposite directions. When demand is inelastic (elasticity less than 1.0), price and total expenditure move in the same direction. And when demand is unit elastic, total expenditure remains constant when the price varies.

[13]Because the product of price and quantity is unchanged at all points along a demand curve with unit elasticity, such a curve must satisfy the equation $P \times Q = K$ (a constant). This equation describes a rectangular hyperbola.

FIGURE 2.9

Price Elasticity of Demand and Total Expenditure
(a) If demand is elastic, a lower price increases total expenditure. (b) If demand is inelastic, a lower price decreases total expenditure. (c) If demand is unit elastic, a lower price leaves total expenditure unchanged.



Calculating Price Elasticity of Demand

Calculating price elasticity of demand from a pair of price–quantity points is frequently necessary. Suppose that we are given the following price–quantity values for gasoline (where quantity demanded is measured in gallons):

$$P_1 = \$1.00 \quad P_2 = \$0.99$$
$$Q_{d1} = 1{,}000 \quad Q_{d2} = 1{,}005.$$

Our definition of price elasticity of demand is the percentage change in quantity demanded divided by the percentage change in price. This relationship is expressed as a formula, letting η (the Greek letter eta) stand for price elasticity of demand:

$$\eta = \frac{(\Delta Q_d/Q_d)}{(\Delta P/P)}.$$

POINT ELASTICITY FORMULA
$$= \frac{(\Delta Q_d/Q_d)}{(\Delta P/P)}$$

Here, $\Delta Q_d/Q_d$ is the percentage change in quantity demanded, and $\Delta P/P$ is the percentage change in price.[14] In applying this formula—called the **point elasticity formula**—we encounter an ambiguity. While ΔQ_d and ΔP are unambiguously determined (a 5 gallon change in quantity and a \$0.01 change in the per-gallon price), what values should be used for Q_d and P? If we enter the values for P_1 and Q_{d1} into the formula, we obtain:

$$\frac{(\Delta Q_d/Q_{d1})}{(\Delta P/P_1)} = \frac{(5/1{,}000)}{(\$0.01/\$1.00)} = 0.50.$$

Alternatively, if we use P_2 and Q_{d2}, we obtain:

$$\frac{(\Delta Q_d/Q_{d2})}{(\Delta P/P_2)} = \frac{(5/1{,}005)}{(\$0.01/\$0.99)} = 0.49.$$

[14]The Greek letter Δ (delta), as in ΔQ_d, simply means "change in."

Because we are dealing with small changes in this case, which values we choose makes little quantitative difference. There is, however, a slight difference, and it reflects the fact that the percentage change between two prices depends on the direction of the change. If price falls from $1.00 to $0.50 per gallon, this is referred to as a 50 percent decrease (a $0.50 change in price divided by the *initial* price, $1.00). Alternatively, if the price rises from $0.50 to $1.00 per gallon, this is a 100 percent increase (a $0.50 change in price divided by the *initial* price, $0.50). Don't be sidetracked by this arithmetical obscurity. The important point is that some base Q_d and P must be employed in the formula, but for small changes in Q_d and P, which base is chosen makes no significant difference to the results.

There is a substantial difference, however, when a large change in price and quantity is involved. Suppose, for example, that we have the following values:

$$P_1 = \$1.00 \quad P_2 = \$0.50$$
$$Q_{d1} = 1{,}000 \quad Q_{d2} = 2{,}000.$$

By inspection we see that total expenditure is $1,000 (quantity demanded is once again being measured in gallons) at both prices, so we know that demand is unit elastic. Surprisingly, though, it now makes a great deal of difference what base values of P and Q_d we use if we try to apply the point elasticity formula:

$$(\Delta Q_d/Q_{d1})/(\Delta P/P_1) = (1{,}000/1{,}000)/(\$0.50/\$1.00) = 2.0 \text{ and}$$
$$(\Delta Q_d/Q_{d2})/(\Delta P/P_2) = (1{,}000/2{,}000)/(\$0.50/\$0.50) = 0.5.$$

According to one calculation, price elasticity of demand is 2.0; according to the other it is 0.5. Both are wrong, and the true value, unity, lies between these estimates. The basic problem in this case is that the elasticity of demand tends to vary from one point (one P, Q_d combination) to another on the demand curve, and for a large change in price and quantity we need an average value over the entire range. Consequently, when we deal with large changes in price and quantity, we should use the following **arc elasticity formula**:

ARC ELASTICITY FORMULA

$$= \frac{\left[\dfrac{\Delta Q_d}{(1/2)(Q_{d1} + Q_{d2})}\right]}{\left[\dfrac{\Delta P}{(1/2)(P_1 + P_2)}\right]}$$

$$\eta = \frac{\left[\dfrac{\Delta Q_d}{(1/2)(Q_{d1} + Q_{d2})}\right]}{\left[\dfrac{\Delta P}{(1/2)(P_1 + P_2)}\right]}.$$

Note that this formula differs from the point elasticity formula only in using the average of the two quantities, $(1/2)(Q_{d1} + Q_{d2})$, and the average of the two prices, $(1/2)(P_1 + P_2)$. Applying this formula to the preceding figures yields the true value of the elasticity over the entire range of prices considered:

$$\frac{\left[\dfrac{\Delta Q_d}{(1/2)(Q_{d1} + Q_{d2})}\right]}{\left[\dfrac{\Delta P}{(1/2)(P_1 + P_2)}\right]} = \frac{\left[\dfrac{1{,}000}{(1/2)(1{,}000 + 2{,}000)}\right]}{\left[\dfrac{\$0.50}{(1/2)(\$0.50 + \$1.00)}\right]} = 1.0.$$

Thus, we have two formulas. The first works well when small changes in P and Q_d are involved because, in that case, which P and Q_d are used makes little difference. The second formula avoids the problem of having to pick one specific point by using the average values of price and quantity demanded and should be used with large changes in price and quantity demanded.

APPLICATION 2.7 DEMAND ELASTICITY AND CABLE TELEVISION PRICING

Cable systems historically have offered two tiers of service: a "basic" tier numbering 10 or more channels, including programming such as CNN, ESPN, and MTV; and "pay" tiers featuring movie channels such as HBO and Showtime. Subscribers purchase the basic tier as a package. Pay tiers are available separately for an additional specified fee per channel.

While pay tiers have never been subject to government rate control, basic tiers were regulated prior to 1987 and reregulated between 1992 and 1999. From 1987 to 1991 as well as after 1999, however, basic rates were deregulated and cable operators had to determine what price they should charge. Elasticity of demand considerations helped them decide.

As we saw earlier in this section, whether demand is inelastic, unit elastic, or elastic determines how a price change will affect the total expenditure on a product. Calculating basic tier demand elasticity was thus vital to operators interested in finding out whether the rates they were charging under regulation were too low in terms of maximizing profit.

Studies conducted by cable operators found that basic tier demand elasticity at the time of rate deregulation in 1987 was less than unity—between 0.1 and 0.5. The estimated elasticity indicated that profits would increase if basic rates were raised. Two factors are at work here. First, if a firm is operating along an inelastic portion of its demand curve, the total revenue earned from subscribers will increase if the rate is raised. The effect on revenue of a decrease in the number of subscribers will be more than compensated for by the higher rate earned per remaining subscriber when demand is inelastic. Second, at the higher rate, fewer subscribers will be served and the total cost of providing service will be lower. Between the increase in total revenue and the decrease in total cost, the profit earned on basic service will increase (profit is the difference between total revenue and total cost). In sum, operators stood to lose some subscribers but to more than make up for that from the ones they kept.

Relying on estimates that demand elasticity was less than unity, operators began to raise rates following deregulation. Average basic rates increased 75 percent between 1987 and 1991 when they were first free of government control—an amount significantly greater than the inflation rate, even after adjustments made for improvements in programming quality. Operators' profits on basic service increased along with the rates. Analogous changes in basic rates and profits occurred under the more recent period of deregulation (post 1999) as operators once again estimated demand elasticity to be less than unity.

Demand Elasticities Vary Among Goods

We can never know why people respond exactly as they do. Nonetheless, two general factors seem to have a pronounced effect on the elasticity of demand for a particular product.

The first, and most important, factor is the availability and closeness of substitutes. *The more substitutes there are for some product, and the better the substitutes, the more elastic will be the demand for the product.* When there are good substitutes, a change in the price of the product will lead to considerable substitution among products by consumers. The demand for margarine, for example, would probably be quite elastic, because when its price rises, many people would switch to butter. Remember that when we evaluate the elasticity of demand for margarine, we assume the price of butter to be unchanged. Thus, a higher price of margarine (with an unchanged price of butter) leads people to shift from margarine to butter, because they are close substitutes.

The degree to which a good has close substitutes depends in part on how specifically it is defined. A narrowly defined good will frequently have close substitutes, and elasticity will tend to be higher. For example, the elasticity of demand for Dial soap (a very narrowly defined good with many substitutes) will be greater than the elasticity of demand for soap. Along these lines, the demand for any particular brand of some product (such as Cheerios cereal) will be more elastic than the demand for all brands taken together (cereal).

In addition to the number and the quality of substitutes, a second factor that can be important in determining elasticity of demand is the time period over which consumers adjust to a price change. *The longer the time period involved, the fuller is the adjustment consumers can make*. In part, this reflects the fact that it takes time for consumers to learn about a price change, but there are other reasons, too. Consider an increase in the price of electricity. In the month following the price increase, people can cut back their use somewhat by switching lights off more conscientiously, turning thermostats down (if electric heating is used), or turning air conditioners off. The number of ways people can economize on electricity, however, is greater when we consider what they can do over a longer period. Over a year, for example, they can substitute lower-wattage light bulbs for existing light bulbs, convert electric furnaces to oil or gas furnaces, insulate their houses, use portable kerosene heaters, buy appliances that require less electricity, and so on. In short, demand will be more elastic the longer the time period over which consumers can adjust and, in essence, find substitutes.

For many goods, consumers will not require much time to make a full adjustment to a change in price. In these cases the long-run and short-run responses will not differ substantially. Changes in the prices of electricity and gasoline will necessitate major alterations in the consumption of very durable goods (houses, appliances, and cars) before consumers have fully adjusted, and those alterations take time. But for most goods (beer, shoes, wristwatches, meat, televisions, compact discs, and so on) we would not expect the short- and long-run elasticities of demand to be much different.

The Estimation of Demand Elasticities

In practice, estimating elasticities of demand is problematic because elasticity of demand refers to a *given demand curve*, but the demand curve itself is likely to shift over time. Economists have developed some sophisticated techniques (briefly overviewed in Chapter 4) to deal with this problem and to permit estimation of demand elasticities. Table 2.1 lists some selected estimates of elasticities of demand for a variety of products.

As Table 2.1 indicates, the estimates of demand elasticities differ widely among goods. Not surprisingly, cigarettes are in inelastic demand (an elasticity of 0.35). Although people commonly think of medical care consumption as almost totally unresponsive to price, the elasticity of demand for physicians' services is 0.6. While this demand is inelastic, it does imply that a 50 percent increase in price would reduce consumption by fully 30 percent. Some products, such as air travel and automobiles, are apparently in highly elastic demand (in the long run).

TABLE 2.1

SELECTED ESTIMATES OF DEMAND ELASTICITIES

	Short-Run	Long-Run
Cigarettes	—	0.35
Water	—	0.4
Beer	—	0.8
Physicians' services	0.6	—
Gasoline	0.2	0.5–1.5
Automobiles	—	1.5
Chevrolets	—	4.0
Electricity (household utility)	0.1	1.9
Air travel	0.1	2.4

Sources: Hendrik S. Houthakker and Lester D. Taylor, *Consumer Demand in the United States, 1929–1970* (Cambridge, Massachusetts: Harvard University Press, 1966 and 1970 editions); Kenneth G. Elzinga, "The Beer Industry," in *The Structure of American Industry*, edited by Walter Adams (New York: Macmillan, 1977); and James L. Sweeney, "The Response of Energy Demand to Higher Prices: What Have We Learned?" *American Economic Review*, 74, No. 2 (May 1984), pp. 31–37.

One implication of these estimates (and many others that could be cited) should not be missed: they all support the law of demand. Consumers purchase more at a lower price, other things being equal.

APPLICATION 2.8 D.C. LEARNS ABOUT DEMAND ELASTICITY

Two decades ago, Washington, D.C., city officials, hard-pressed for tax revenues, levied a 6 percent tax on the sale of gasoline. As a first approximation (and a reasonable one, it turns out), this tax could be expected to increase the price of gasoline by 6 percent. The elasticity of demand is a key factor in the consequences of this action, because the more sharply the sales of gasoline fall, the less tax revenue the city will raise. Presumably, city officials hoped that gasoline sales would be largely unaffected by the higher price.

Within a few months, however, the amount of gasoline sold had fallen by 33 percent.[15] A 6 percent price increase producing a 33 percent quantity reduction means the price elasticity was about 5.5. And this reaction was only the immediate, or short-run, response. The sharp sales drop meant that tax revenue was not increased. Further indications were that when consumers had fully adjusted to the tax, tax revenues would actually decrease. (There had been a 10 cent per gallon tax before the 6 percent tax was added, so although the 6 percent levy was raising revenue, the gain was largely offset by the loss in revenue from the initial 10 cent tax following the reduction in sales.)

In interpreting this episode, we must recognize that demand elasticities of the type reported in Table 2.1 for gasoline are irrelevant in this case. This was not a general increase in gasoline prices but a rise only within the D.C. city limits. Gasoline sold in the District of Columbia is a narrowly defined product that has good substitutes—gasoline sold in nearby Virginia and Maryland. Higher gasoline prices in the District of Columbia, when the prices charged in Virginia and Maryland are unchanged, will obviously be highly elastic. No economist would be surprised at the results of this tax, but apparently city officials were. Observed one city councilman: "We think of ourselves here in the District as an island to ourselves. But we've got to realize that we're not. We've got to realize that Maryland and Virginia are right out there, and there's nothing to stop people from crossing over the line."

The 6 percent gasoline tax was repealed five months after it was levied. At that time, the mayor of Washington cited "overwhelming evidence" that the tax had not worked and that it had caused "undue hardships both to the consumers of gas . . . and those who operate retail gas businesses."

[15] "Barry Asks Gasoline Tax Repeal," *Washington Post*, November 2, 1980, p. A1.

Three Other Elasticities

Price elasticity of demand is the most important elasticity concept in economics, but we can define elasticity in general as a measure of the response of any variable to the change in some other variable. Two other common elasticity measures that relate to consumer behavior are the income elasticity of demand and the cross-price elasticity of demand. On the supply side, the most important elasticity is price elasticity of supply. The price elasticity of supply measures the responsiveness of quantity supplied to price.

INCOME ELASTICITY OF DEMAND
a measure of how responsive consumption of some item is to a change in income, assuming the price of the good itself remains unchanged

Income Elasticity

The **income elasticity of demand** measures how responsive consumption of some item is to a change in income (I), assuming that the price of the good itself remains unchanged. We define *income elasticity* as the percentage change in consumption of a good Q_d divided by the percentage change in income or (in point elasticity form):

$$\text{income elasticity of demand for a good} = \frac{(\Delta Q_d/Q_d)}{(\Delta I/I)}.$$

For example, if income rises by 10 percent, and a consumer increases purchases of gasoline by 5 percent, then the income elasticity of gasoline is 0.5. Note that the algebraic sign of this elasticity distinguishes between normal and inferior goods. Whenever income elasticity is positive, consumption of the good rises with income, so the good must be normal. Whenever income elasticity is negative, consumption of the good falls when income rises, and the good must be inferior. A unitary income elasticity means the consumer continues to spend the same percentage of income on the good when income rises.

Cross-Price Elasticity of Demand

CROSS-PRICE ELASTICITY OF DEMAND
a measure of how responsive consumption of one good is to a change in the price of a related good

The **cross-price elasticity of demand** measures how responsive consumption of one good is to a change in the price of a related good. We define *cross-price elasticity* as the percentage change in consumption of one good, X, divided by the percentage change in the price of a different good, Y, or (in point elasticity form):

$$\text{cross-price elasticity of demand for X with respect to the price of Y} = \frac{(\Delta Q_{dX}/Q_{dX})}{(\Delta P_Y/P_Y)}.$$

For example, if the price of BMW automobiles rises by 10 percent, and the quantity of Mercedes cars purchased increases by 5 percent, then the cross-price elasticity of demand for Mercedes cars with respect to the price of BMWs is 0.5. Note that cross-price elasticity will be positive when the goods are substitutes (as are BMW and Mercedes cars) and negative when the goods are complements (for example, gasoline and cars). Indeed, the major use of this elasticity is to measure the strength of the complementary or substitute relationship between goods. The concept of cross-price elasticity is widely used in antitrust cases. How a market is defined and how competitive it is depends on the availability of substitutes. One way to ascertain substitutability is with a measure of the cross-price elasticity of demand.

Elasticity of Supply

PRICE ELASTICITY OF SUPPLY
a measure of the responsiveness of the quantity supplied of a commodity to a change in the commodity's own price

The **price elasticity of supply**, or *elasticity of supply*, is a measure of the responsiveness of the quantity supplied of a commodity to a change in the commodity's own price. It is defined as the percentage change in quantity supplied, Q_s, divided by the percentage change in price. Using the Greek letter ϵ (epsilon) to represent price elasticity of supply, we can express it as (in point elasticity form):

$$\epsilon = \frac{(\Delta Q_s/Q_s)}{(\Delta P/P)}.$$

Any upward-sloping supply curve—the increasing per-unit cost case—has a positive elasticity of supply because price and quantity supplied move in the same direction. If per-unit production costs are constant, the supply curve is horizontal, and the price elasticity of supply is infinity. For example, the supply of dimes in terms of nickels is a horizontal curve with a height of 2 at most banks (banks are willing to provide you an additional dime so long as you give them 2 nickels per dime). As the price of dimes rises from 1.99 nickels (a rate at which banks would be unwilling to sell you any dimes in exchange for nickels) to 2 nickels (a rate at which banks would become willing to supply you quite a few dimes in exchange for nickels), the percentage change in quantity supplied (from zero to a lot of dimes) is infinite relative to the percentage change in price (from 1.99 to 2 nickels per dime).

At the opposite extreme, if supply is entirely unresponsive to price, the supply curve is vertical and the elasticity of supply is equal to zero. For example, no matter how high the price gets, it is impossible to produce more original Picasso paintings (although several imposters have attempted to copy the dead artist's style and pass off the result as a Picasso original). The responsiveness of the quantity of Picasso paintings supplied to increases (or decreases) in the price of Picasso paintings is thus zero.

Finally, as in the case of elasticity of demand, when the ratio of the percentage change in quantity supplied to the percentage change in price is greater than unity, we say that supply

is *elastic*. When supply is elastic, an increase in price produces a more than proportionate increase in quantity supplied. When the elasticity of supply is less than unity, supply is *inelastic* and a higher price produces a less than proportionate increase in quantity supplied. When the ratio equals unity, supply is *unit elastic* and a higher price produces a proportionate increase in quantity supplied.

Application 2.9 It Takes Time

Just as with demand, supply tends to become more elastic the longer the time period over which producers can adjust to a price change. For example, Hurricane Andrew struck southern Florida in 1992, destroying or damaging more than 75,000 homes. In the first week after the hurricane hit, the price of lumber doubled in southern Florida. We would expect this kind of effect when demand increases dramatically for a product that, at least in the short run, is in relatively fixed supply. Recall that a given supply (or demand) curve is drawn for a specific time period. The supply curve for lumber was close to vertical in the days immediately after the hurricane, as producers were unable to supply appreciably more lumber despite the doubling in lumber's price. With more time to adjust and ship lumber from elsewhere in the country, however, Hurricane Andrew led to a significant increase in the quantity of lumber supplied to the southern Florida market. Supply elasticity, in other words, became greater as producers had more time to adjust to the hurricane-induced change in the price of lumber.

Note that while many people regarded the doubling in the price of lumber immediately following Hurricane Andrew as *price gouging*, the so-called "gouging" gave lumber suppliers an incentive to ship additional lumber to southern Florida. A legal proscription against an increase in the price of lumber following the hurricane would have wiped out the incentive to ship additional lumber to southern Florida and created a shortage of a commodity critical to the rebuilding process. The so-called price gouging also had a beneficial effect on the demand side: it gave consumers a greater incentive to conserve in their use of lumber and thereby helped bring quantity demanded into equality with quantity supplied in the local lumber market following the hurricane.

Summary

- Most economic issues involve the workings of individual markets.
- In the supply–demand model we analyze the behavior of buyers by using the demand curve.
- The demand curve shows how much people will purchase at different prices when other factors that affect purchases are held constant. The demand curve slopes downward, reflecting the law of demand.
- Analysis of the sellers' side of the market relies on the supply curve, which shows the amount that firms will offer for sale at different prices, other factors being constant. The supply curve typically slopes upward.
- The intersection of the demand and supply curves, reflecting the behavior of buyers and sellers, identifies the equilibrium price and quantity.
- A shift in the supply or demand curve produces a change in the equilibrium price and quantity.
- For the market mechanism to operate, price must be free to adjust to any change affecting the behavior of buyers and sellers in the market. Thus when the government steps in to regulate prices, the market does not function in the same way.
- A government-imposed price ceiling results in a shortage and may lead to diminution in product quality, nonprice rationing, black markets, administrative costs, and increased demand for and supply of substitute goods. Sellers are clearly harmed by the imposition of a price ceiling, and the effect on buyers as a group may not be beneficial.
- Elasticities provide a quantitative measure of the magnitude of the responsiveness of quantity demanded or supplied to a change in some other variable.
- The most important elasticity in economics is price elasticity of demand, which measures how responsive the quantity demanded of a commodity is to a change in the commodity's own price. It is measured by the percentage

change in quantity demanded divided by the percentage change in price.

- When price elasticity exceeds unity, demand is elastic and a lower price expands purchases so sharply that total expenditure rises.
- When price elasticity is less than unity, demand is inelastic, and a lower price leads to a reduction in total expenditure.
- When price elasticity equals unity, demand is unit elastic, and total expenditure is unchanged at a lower price.
- Three other important elasticities are the income elasticity of demand, cross-price elasticity of demand, and price elasticity of supply. They are constructed in a manner analogous to that employed to construct price elasticity of demand and measure, respectively, the responsiveness of quantity demanded to income, the responsiveness of quantity demanded of one good to the price of a related good, and the responsiveness of the quantity supplied of a commodity to the commodity's own price.

REVIEW QUESTIONS AND PROBLEMS

Questions and problems marked with an asterisk have solutions given in Answers to Selected Problems at the back of the book (page xxx).

***2.1.** A newspaper article points out that the price of economics textbooks is up 10 percent this year over last year, and yet the number of textbooks sold is higher this year. The article claims that these figures show that the law of demand does not apply to textbooks. Is there a flaw in this argument?

2.2. A demand curve is drawn holding "other things constant." What does the "other things constant" provision mean, and why is it important to a correct interpretation of the law of demand?

2.3. "Because demand curves and supply curves are always shifting, markets can never attain an equilibrium." Does this imply that the concept of equilibrium is not useful?

2.4. If we know that the (real) price of tennis rackets is higher now than last year, can we conclude that the demand curve shifted out over the year? Explain.

***2.5.** The supply and demand schedules for apples are as follows:

Demand		Supply	
Price per Pound	Quantity Demanded per Year	Price per Pound	Quantity Supplied per Year
$0.90	100,000	$0.60	100,000
0.80	110,000	0.70	120,000
0.70	120,000	0.80	140,000
0.60	135,000	0.90	150,000

Use graphs to answer the following questions.

a. What is the market equilibrium price and quantity?

b. The government agrees to purchase as many pounds of apples as growers will sell at a price of $0.80 per pound. How much will the government purchase, how much will consumers purchase, and how much will be produced?

c. Suppose the government policy in part b remains in effect, but consumer demand increases by 10 percent (consumers will purchase 10 percent more at each price than they did before). What will be the effect on total apple output, purchases by consumers, purchases by the government, and the price of apples?

2.6. In economics, what do we mean by the term *shortage*? In unregulated competitive markets, are there ever shortages? Have you ever heard noneconomists use the term *shortage* with a different meaning?

2.7. "A decrease in supply will lead to an increase in the price, which decreases demand, thus lowering price. Thus, a decrease in supply has no effect on the price of a good." Evaluate this statement.

***2.8.** Consider the market for taxi service in a city. Explain, by using supply and demand curves, how each of the following actions will affect the market. (Consider each case separately.)

a. Bus drivers go on strike.

b. Bus fares increase after a strike by bus drivers.

c. Taxi drivers must pass a competency test, and one-third fail.

d. Gasoline prices increase.

e. Half the downtown parking lots are converted to office buildings.

f. The population of the city increases.

2.9. As a regional manager for American Airlines you have recently undertaken a survey of economy-class load factors (the percentage of economy-class seats that are filled with paying customers) on the Chicago–Columbus, Ohio, route that you service. The survey was conducted over five successive months. For each month, data collected include the one-way fare you charge per economy seat, the price charged by rival United Airlines, the average (monthly) per capita income in the combined Chicago–Columbus market, and the average economy-class load factor for both American and United Airlines. Assume that all other factors (the price charged by Southwest Airlines, the number of flights, the size of planes flown, and so on) have remained constant.

Month	AA Price	UA Price	Income	AA Load Factor	UA Load Factor
1	$110	$112	$2,000	65	60
2	109	110	1,900	62	63
3	110	112	2,100	70	66
4	109	111	1,900	70	61
5	108	110	1,900	68	59

a. On the Chicago–Columbus route, identify the arc price elasticity of demand for American economy seats, the arc in-

come elasticity of demand for American economy seats, and the arc cross-price elasticity of demand for American economy seats with respect to United prices.

b. Based on the data that you have collected, is United a substitute or complement for American in the Chicago–Columbus market? Explain.

c. Are American's economy seats a normal or inferior good in the Chicago–Columbus market? Explain.

d. Would the estimated demand elasticity for your product be larger or smaller if consumers had been given more time to respond to any price change (for example, one year versus one month)?

e. Compared with the price elasticity of demand for United and American, is the demand elasticity for economy seats in general in the Chicago–Columbus market (regardless of which airline provides them) larger or smaller? Explain.

***2.10.** Suppose that the demand elasticity for cigarettes is equal to 2.0. If the demand elasticity for Camel cigarettes is equal to 6.0, must there be at least some cigarette brands with a demand elasticity less than 2.0?

2.11. Suppose that the typical economics student is interested in consuming (and spends all her money on) only two commodities: economics study guides and horror movie passes. An unlimited supply of horror movie passes is available at a price of $5 per pass while an equally unlimited supply of study guides covering endlessly different (and interesting) nuances in economics can be purchased for $30 each. The student currently purchases 20 horror movie passes and 10 study guides per semester. If the typical student's price and income elasticities of demand for horror movie passes are both unity, what is the student's cross-price elasticity of demand for study guides with respect to changes in the price of horror movie passes?

2.12. Suppose that the demand curve for corn is downward-sloping but that the supply curve is perfectly price inelastic at a quantity of Q^* once the corn is harvested. Furthermore, assume that the equilibrium price is $5 per bushel.

a. If the U.S. government decides to enter the market for corn and purchase enough so that the price doubles to $10 per bushel (assume that the corn is given away to Russia), indicate on a supply–demand diagram the amount spent on corn by private American consumers and the amount spent on corn by the U.S. government. If the demand for corn by private American consumers is price inelastic (suppose that demand elasticity is equal to 0.5), which amount is larger—that spent by the government or that spent by private consumers? Explain your answer.

b. An alternative method for helping corn farmers is to have the government pay them a subsidy of $5 per bushel of corn. Show graphically the amount spent on corn by private consumers under this proposal as well as the amount spent by the U.S. government. Again assuming that the demand elasticity for corn is 0.5, is the cost to the government of the subsidy program greater or less than the cost of the program described in part a? Explain your answer.

2.13. Heidi spends all her income on going to the movies regardless of her income level or the price of movie passes. What is her income elasticity of demand for movie passes? What is her price elasticity of demand for movie passes?

***2.14.** Assume that the demand for crack cocaine is inelastic and that users get the funds to pay for crack cocaine by stealing. Suppose that the government increases penalties on suppliers of crack cocaine and thereby reduces supply. What will happen to the amount of crime committed by crack cocaine users?

2.15. If the price of gasoline is $2.00 and the price elasticity of demand is 0.4, how much will a 10 percent reduction in the quantity placed on the market increase the price? Will total spending on gasoline rise? If so, by what percentage?

2.16. Given two parallel, downward-sloping, linear demand curves, is the demand elasticity the same at any given price? Given two downward-sloping, linear demand curves, with one showing consumption to be 50 percent greater than the other demand curve at each price, is the demand elasticity the same at any given price?

2.17. In 1999, the bidding for a human kidney offered on the Internet auction site eBay hit $5.7 million before the company put a stop to it citing a federal law that makes it illegal to sell one's own organs. Using a supply and demand graph, explain this bidding phenomenon given that the federal law mandates a price of zero for the sale of body organs.

2.18. Some opponents of the death penalty are opposed to executing individuals who have been convicted of murder because they believe that murder is an irrational act and that raising the price of murder through capital punishment thus will not have a deterrent effect on prospective murderers. If these opponents are correct in their view of murder being an irrational act, depict what the demand curve for murder looks like. What is the price elasticity of demand for murder according to this view?

2.19. In the antitrust case brought by the Justice Department against Microsoft, explain why the cross-price elasticity of demand between rival operating systems such as Linux and Microsoft's own MS-DOS system might have been of interest in determining Microsoft's ability to control the prevailing price in the operating system market.

2.20. If a cable operator estimates basic tier demand elasticity to equal unity (Application 2.7), will profit be increased by raising rates? Explain. How about if the basic tier demand elasticity is estimated to exceed unity? Explain.

2.21. Some have dubbed the World Wide Web the "World Wide Wait" on account of the delays that may be encountered in searching for information on the Internet. Explain why the delay may be attributable to the government's role in starting the Internet and resistance to levying charges based on usage.

2.22. Consider the case of shopping for a Valentine's Day present. What is likely to be your price elasticity of demand the less time you leave to shop for the present in advance of Valentine's Day, everything else being equal? Explain.