Chapter 3

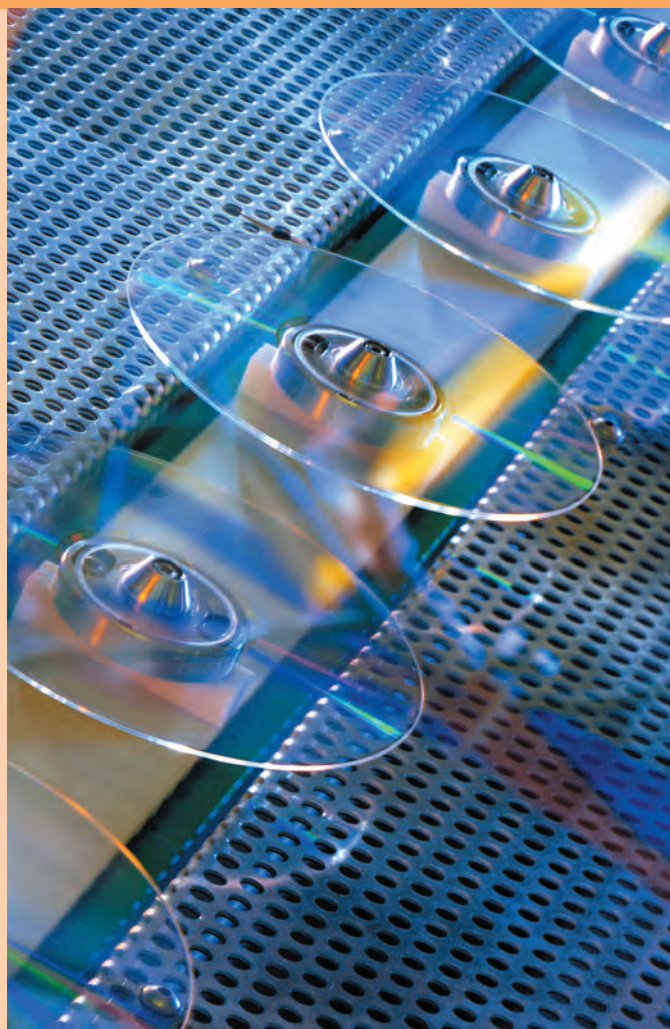
Demand and Supply

After studying this chapter you will be able to:

- Describe a competitive market and think about a price as an opportunity cost
- Explain the main influences on demand
- Explain the main influences on supply
- Explain how demand and supply determine prices and quantities bought and sold
- Use demand and supply to make predictions about changes in prices and quantities

CDs to Burn!

Why do some prices like those of CDs and mobile phones slide, while others like the prices of houses rocket, and yet others like the price of bananas follow a roller-coaster ride? Find out in this chapter. And put what you learn to work explaining why the price of electricity rocketed in France and Germany in 2003 in *Reading Between the Lines* at the end of the chapter.



Price and Opportunity Cost

When you need a new pair of running shoes, want a sandwich or a bottle of water, decide to upgrade your CD player, or need to go home for the holidays, you must find a place where people sell those items or offer those services. The place in which you find them is a *market*. You learned in Chapter 2 (p. 44) that a market is any arrangement that enables buyers and sellers to get information and to do business with each other.

A market has two sides: buyers and sellers. There are markets for *goods* such as apples and hiking boots, for *services* such as haircuts and tennis lessons, for *resources* such as computer programmers and earth-movers, and for other manufactured *inputs* such as memory chips and car parts. There are also markets for money such as the euro and the dollar and for financial securities such as BP shares. Only our imagination limits what can be traded in markets.

Some markets are physical places where buyers and sellers meet and where an auctioneer or a broker helps to determine the prices. Examples of this type of market are the London Stock Exchange and the Billingsgate Fish Market.

Some markets are groups of people spread around the world who never meet and know little about each other but are connected through the Internet or by telephone and fax. Examples are the e-commerce markets and currency markets.

But most markets are unorganized collections of buyers and sellers. You do most of your trading in this type of market. An example is the market for football boots. The buyers in this multi-million pound a year market are the several million people who play football (or who want to make an exotic fashion statement).

The sellers are the tens of thousands of retail sports equipment and footwear stores. Each buyer can visit several different stores, and each seller knows that the buyer has a choice of stores.

A Competitive Market

Markets vary in the intensity of competition that buyers and sellers face. In this chapter, we're going to study a **competitive market** – a market that has many buyers and many sellers, so no single buyer or seller can influence the price.

Producers offer items for sale only if the price is high enough to cover their opportunity cost. And consumers respond to changing opportunity cost by seeking cheaper alternatives to expensive items.

We are going to study the way people respond to *prices* and the forces that determine prices. But to pursue these tasks, we need to understand the relationship between a price and an opportunity cost.

Money Price and Relative Price

In everyday life, the *price* of an object is the number of pounds or euros that must be given up in exchange for it. Economists refer to this price as the **money price**.

The *opportunity cost* of an action is the highest valued alternative forgone. If, when you buy a coffee, the highest-valued thing you forgo is some chewing gum, then the opportunity cost of the coffee is the *quantity* of gum forgone. We can calculate the quantity of gum forgone from the money prices of coffee and gum.

If the money price of coffee is £1 a cup and the money price of gum is 50 pence a pack, then the opportunity cost of one cup of coffee is two packs of gum. To calculate this opportunity cost, we divide the price of a cup of coffee by the price of a pack of gum and find the *ratio* of one price to the other. The ratio of one price to another is called a **relative price**, and a *relative price is an opportunity cost*.

We can express the relative price of coffee in terms of gum or any other good. The normal way of expressing a relative price is in terms of a "basket" of all goods and services. To calculate this relative price, we divide the money price of a good by the money price of a "basket" of all goods (called a *price index*). The resulting relative price tells us the opportunity cost of the good in terms of how much of the "basket" we must give up to buy it.

The theory of demand and supply that we are about to study determines *relative prices*, and the word "price" means *relative* price. When we predict that a price will fall, we do not mean that its *money* price will fall – although it might. We mean that its *relative* price will fall. That is, its price will fall *relative* to the average price of other goods and services.

Review Quiz

1 What is the distinction between a money price and a relative price?
2 Explain why a relative price is an opportunity cost.
3 Think of examples of goods whose money price and relative price have risen and have fallen.

Let's begin our study of demand and supply, starting with demand.

Demand

If you demand something, then you

1 Want it,

2 Can afford it, and

3 Plan to buy it.

Wants are the unlimited desires or wishes that people have for goods and services. How many times have you thought that you would like something "if only you could afford it" or "if it weren't so expensive"? Scarcity guarantees that many – perhaps most – of our wants will never be satisfied. Demand reflects a decision about which wants to satisfy.

The **quantity demanded** of a good or service is the amount that consumers plan to buy during a given time period at a particular price. The quantity demanded is not necessarily the same as the quantity actually bought. Sometimes the quantity demanded exceeds the amount of goods available, so the quantity bought is less than the quantity demanded.

The quantity demanded is measured as an amount per unit of time. For example, suppose that you buy one cup of coffee a day. The quantity of coffee that you demand can be expressed as 1 cup per day, 7 cups per week, or 365 cups per year.

Many factors influence buying plans and one of them is price. We look first at the relationship between the quantity demanded of a good and its price. To study this relationship, we keep all other influences on buying plans the same and we ask: How, other things remaining the same, does the quantity demanded of a good change as its price changes?

The law of demand provides the answer.

The Law of Demand

The **law of demand** states:

> **Other things remaining the same, the higher the price of a good, the smaller is the quantity demanded; and the lower the price of a good, the greater is the quantity demanded.**

Why does a higher price reduce the quantity demanded? For two reasons:

- Substitution effect
- Income effect

Substitution Effect

When the price of a good rises, other things remaining the same, its *relative* price – its opportunity cost – rises. Although each good is unique, it has *substitutes* – other goods that can be used in its place. As the opportunity cost of a good rises, people buy less of that good and more of its substitutes.

Income Effect

When the price of a good rises and other influences on buying plans remain unchanged, the price rises *relative* to incomes. Faced with a higher price and unchanged income, people cannot afford to buy all the things they previously bought. They must decrease the quantities demanded of at least some goods and services, and normally, the good whose price has increased will be one of the goods that people buy less of.

To see the substitution effect and the income effect at work, think about the effects of a change in the price of a recordable compact disc – a CD-R. Several different goods are substitutes for a CD-R. For example, a tape and pre-recorded CD provide services similar to those of a CD-R.

Suppose that a CD-R initially sells for £3 and then its price falls to £1.50. People now substitute CD-Rs for audiotapes and pre-recorded CDs – the substitution effect. And with a budget that now has some slack from the lower price of a CD-R, people buy more CD-Rs – the income effect. The quantity of CD-Rs demanded increases for these two reasons.

Now suppose that a CD-R initially sells for £3 and then the price doubles to £6. People now substitute pre-recorded CDs and audiotapes for CD-Rs – the substitution effect. Faced with a tighter budget, people buy fewer CD-Rs – the income effect. The quantity of CD-Rs demanded decreases for these two reasons.

Demand Curve and Demand Schedule

You are now about to study one of the two most used curves in economics: the demand curve. And you are going to encounter one of the most critical distinctions: the distinction between *demand* and *quantity demanded*.

The term **demand** refers to the entire relationship between the price of the good and the quantity demanded of the good. Demand is illustrated by the demand curve and the demand schedule. The term *quantity demanded* refers to a point on a demand curve – the quantity demanded at a particular price.

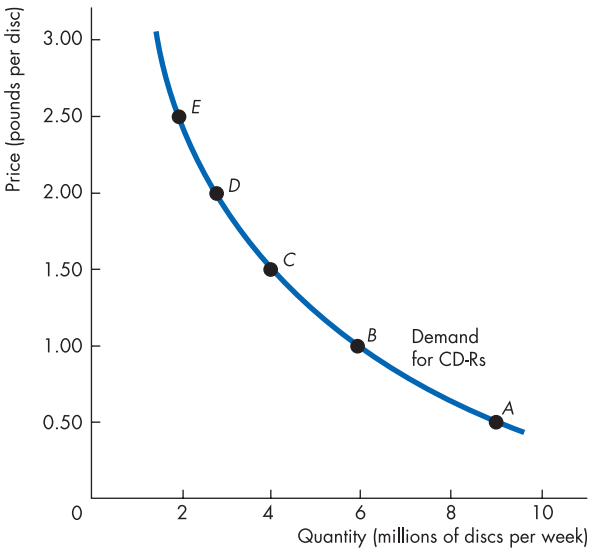
Figure 3.1 shows the demand curve for CD-Rs. A **demand curve** shows the relationship between the quantity demanded of a good and its price when all other influences on consumers' planned purchases remain the same.

The table in Figure 3.1 is the *demand schedule*, which lists the quantities demanded at each price when all the other influences on consumers' planned purchases remain the same. For example, if the price of a CD-R is 50 pence, the quantity demanded is 9 million a week. If the price is £2.50, the quantity demanded is 2 million a week. The other rows of the table show the quantities demanded at prices of £1.00, £1.50 and £2.00.

We graph the demand schedule as a demand curve with the quantity demanded of CD-Rs on the *x*-axis and the price of a CD-R on the *y*-axis. The points on the demand curve labelled *A* through *E* correspond to the rows of the demand schedule. For example, point *A* on the graph shows a quantity demanded of 9 million discs a week at a price of 50 pence a disc.

Figure 3.1

The Demand Curve



	Price (pounds per disc)	Quantity demanded (millions of discs per week)
A	0.50	9
B	1.00	6
C	1.50	4
D	2.00	3
E	2.50	2

The table shows a demand schedule for CD-Rs. At a price of 50 pence a disc, 9 million a week are demanded; at a price of £1.50 a disc, 4 million a week are demanded. The demand curve shows the relationship between quantity demanded and price, everything else remaining the same. The demand curve slopes downward: As price decreases, the quantity demanded increases.

The demand curve can be read in two ways. For a given price, the demand curve tells us the quantity that people plan to buy. For example, at a price of £1.50 a disc, the quantity demanded is 4 million discs a week. For a given quantity, the demand curve tells us the maximum price that consumers are willing and able to pay for the last disc available. For example, the maximum price that consumers will pay for the 6 millionth disc is £1.00.

Willingness and Ability to Pay

We can also view a demand curve as a willingness-and-ability-to-pay curve. And the willingness and ability to pay is a measure of *marginal benefit*.

If a small quantity is available, the highest price that someone is willing and able to pay for one more unit is high. As the quantity available increases, the marginal benefit falls and the highest price that someone is willing and able to pay falls along the demand curve.

In Figure 3.1, if only 2 million discs are available each week, the highest price that someone is willing to pay for the 2 millionth disc is £2.50. But if 9 million discs are available each week, someone is willing to pay 50 pence for the last disc bought.

A Change in Demand

When any factor that influences buying plans other than the price of the good changes, there is a **change in demand**. Figure 3.2 illustrates an increase in demand. When demand increases, the demand curve shifts rightward and the quantity demanded is greater at each and every price. For example, at a price of £2.50, on the original (blue) demand curve, the quantity demanded is 2 million discs a week. On the new (red) demand curve, the quantity demanded is 6 million discs a week. Look closely at the numbers in the table in Figure 3.2 and check that the quantity demanded is greater at each price.

Six main factors bring changes in demand. They are changes in:

1 The prices of related goods
2 Expected future prices
3 Income
4 Expected future income
5 Population
6 Preferences

1 Prices of Related Goods

The quantity of a good that consumers plan to buy depends on the prices of its substitutes. A **substitute** is a good that can be used in place of another good. A bus ride is a substitute for a train ride and a pre-recorded CD is a substitute for a CD-R. If the price of a pre-recorded CD rises, people buy fewer CDs and more CD-Rs. The demand for CD-Rs increases.

The quantity of a good that people plan to buy also depends on the prices of its complements. A **complement** is a good that is used in conjunction with another good. Fish and chips are complements and so are CD-Rs and CD burners. If the price of a CD burner falls, people buy more CD burners *and more* CD-Rs. A fall in the price of a CD burner increases the demand for CD-Rs in Figure 3.2.

2 Expected Future Prices

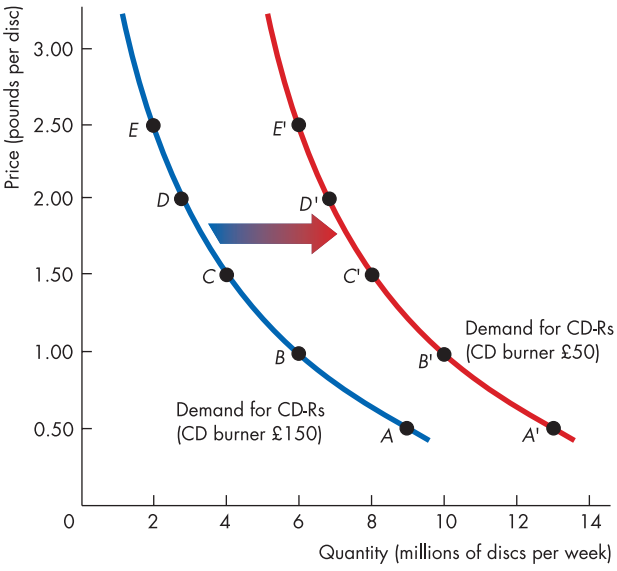
If the price of a good is expected to rise in the future and if the good can be stored, the opportunity cost of obtaining the good for future use is lower today than it will be when the price has increased. So people retime their purchases – they substitute over time. They buy more of the good now before its price is expected to rise (and less later), so the demand for the good increases.

For example, suppose that Spain is hit by a frost that damages the season's orange crop. You expect the price of orange juice to rise in the future. So you fill your freezer with enough frozen juice to get you through the next six months. Your current demand for frozen orange juice has increased, and your future demand has decreased.

Similarly, if the price of a good is expected to fall in the future, the opportunity cost of buying the good today is high relative to what it is expected to be in the future. So again, people retime their purchases. They buy less of the good now before its price falls, so the

Figure 3.2

An Increase in Demand



	Original demand schedule (CD burner £150) Price (pounds per disc)	Quantity demanded (millions of discs per week)		New demand schedule (CD burner £50) Price (pounds per disc)	Quantity demanded (millions of discs per week)
A	0.50	9	*A'*	0.50	13
B	1.00	6	*B'*	1.00	10
C	1.50	4	*C'*	1.50	8
D	2.00	3	*D'*	2.00	7
E	2.50	2	*E'*	2.50	6

A change in any influence on buyers' plans other than the price of the good itself results in a new demand schedule and a shift of the demand curve. A change in the price of a CD burner changes the demand for CD-Rs.

At a price of £1.50 a disc, 4 million discs a week are demanded when a CD burner costs £150 (row *C* of the table) and 8 million CD-Rs a week are demanded when a CD burner costs £50. A *fall* in the price of a CD burner *increases* the demand for CD-Rs. The demand curve shifts *rightward,* as shown by the shift arrow and the resulting red curve.

demand for the good decreases today and increases in the future.

Computer prices are constantly falling, and this fact poses a dilemma. Will you buy a new computer now, in time for the start of the academic year, or will you wait until the price has fallen some more?

Because people expect computer prices to keep falling, the current demand for computers is less (the future demand is greater) than it otherwise would be.

3 Income

Consumers' income influences demand. When income increases, consumers buy more of most goods, and when income decreases, consumers buy less of most goods. Although an increase in income leads to an increase in the demand for *most* goods, it does not lead to an increase in the demand for *all* goods. A **normal good** is one for which demand increases as income increases. An **inferior good** is one for which demand decreases as income increases. Long-distance transport has examples of both normal goods and inferior goods. As incomes increase, the demand for air travel (a normal good) increases and the demand for long-distance bus trips (an inferior good) decreases.

4 Expected future income

When expected future income increases, demand might increase. For example, a sales person gets the news that she will receive a big bonus at the end of the year, so she decides to buy a new car right now.

5 Population

Demand also depends on the size and the age structure of the population. The larger the population, the greater is the demand for all goods and services; the smaller the population, the smaller is the demand for all goods and services.

For example, the demand for parking spaces or cinema seats or CD-Rs or just about anything that you can imagine is much greater in London than it is in Lands End.

Also, the larger the proportion of the population in a given age group, the greater is the demand for the goods and services used by that age group. For example, the number of older people is increasing relative to the number of babies. As a result, the demand for walking frames and nursing home services is increasing at a faster pace than that at which the demand for prams and nappies is increasing.

Table 3.1

The Demand for CD-Rs

The Law of Demand

The quantity of CD-Rs demanded

Decreases if:	*Increases if:*
◆ The price of a CD-R rises	◆ The price of a CD-R falls

Changes in Demand

The demand for CD-Rs

Decreases if:	*Increases if:*
◆ The price of a substitute falls	◆ The price of a substitute rises
◆ The price of a complement rises	◆ The price of a complement falls
◆ The price of a CD-R is expected to fall in the future	◆ The price of a CD-R is expected to rise in the future
◆ Income falls*	◆ Income rises*
◆ Expected future income falls	◆ Expected future income rises
◆ The population decreases	◆ The population increases

*A CD-R is a normal good.

6 Preferences

Demand depends on preferences. *Preferences* are an individual's attitudes towards goods and services. For example, a rock music fanatic has a much greater preference for CD-Rs than does a tone-deaf technophobe. As a consequence, even if they have the same incomes, their demands for CD-Rs will be very different.

Table 3.1 summarizes the influences on demand and the direction of those influences.

A Change in the Quantity Demanded versus a Change in Demand

Changes in the factors that influence buyers' plans cause either a change in the quantity demanded or a change in demand. Equivalently, they cause either a movement along the demand curve or a shift of the demand curve. The distinction between a change in the quantity demanded and a change in demand is the same as that between a movement along the demand curve and a shift of the demand curve.

A point on the demand curve shows the quantity demanded at a given price. So a movement along the demand curve shows a **change in the quantity demanded**. The entire demand curve shows demand. So a shift of the demand curve shows a *change in demand*. Figure 3.3 illustrates and summarizes these distinctions.

Movement Along the Demand Curve

If the price of a good changes but everything else remains the same, there is a movement along the demand curve. Because the demand curve slopes downward, a fall in the price of a good increases the quantity demanded of it and a rise in the price of the good decreases the quantity demanded of it – the law of demand.

In Figure 3.3, if the price of a good falls when everything else remains the same, the quantity demanded of that good increases and there is a movement down the demand curve D_0. If the price rises when everything else remains the same, the quantity demanded of that good decreases and there is a movement up the demand curve D_0.

A Shift of the Demand Curve

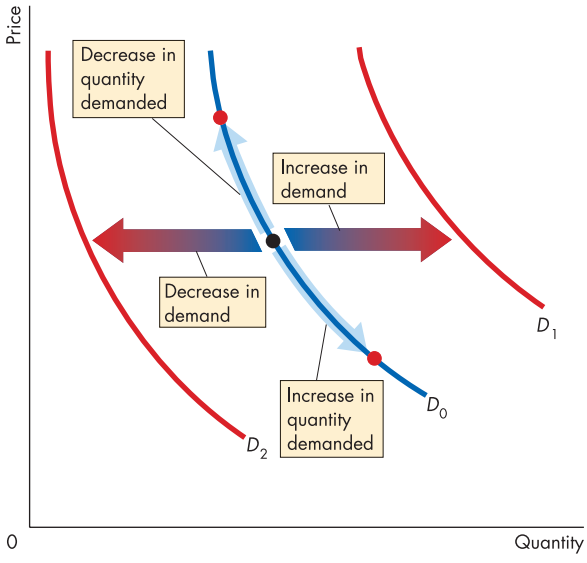
If the price of a good remains constant but some other influence on buyers' plans changes, there is a change in demand for that good. We illustrate a change in demand as a shift of the demand curve. For example, if the price of a CD burner falls, consumers buy more CD-Rs regardless of the price of a CD-R. That is what a rightward shift of the demand curve shows – more CD-Rs are bought at each and every price.

In Figure 3.3, when any influence on buyers' planned purchases changes, other than the price of the good, there is a *change in demand* and the demand curve shifts. Demand *increases* and the demand curve *shifts rightward* (to the red demand curve D_1) if the price of a substitute rises, the price of a complement falls, the expected future price of the good rises, income increases (for a normal good), expected future income increases, or the population increases.

Demand *decreases* and the demand curve *shifts leftward* (to the red demand curve D_2) if the price of a substitute falls, the price of a complement rises, the expected future price of the good falls, income decreases (for a normal good), expected future income decreases, or the population decreases. (For an inferior good, the effects of changes in income are in the direction opposite to those described above.)

Figure 3.3

A Change in the Quantity Demanded versus a Change in Demand



When the price of the good changes, there is a movement along the demand curve and *a change in the quantity demanded,* shown by the blue arrows on demand curve D_0.

When any other influence on buyers' plans changes, there is a shift of the demand curve and a *change in demand.* An increase in demand shifts the demand curve rightward (from D_0 to D_1). A decrease in demand shifts the demand curve leftward (from D_0 to D_2).

Review Quiz

1. Define the quantity demanded of a good or service.
2. What is the law of demand and how do we illustrate it?
3. If a fixed amount of a good is available, what does the demand curve tell us about the price that consumers are willing to pay for that fixed quantity?
4. List all the influences on buying plans that change demand and for each influence say whether it increases or decreases demand.
5. What happens to the quantity of Palm Pilots demanded and the demand for Palm Pilots if the price of a Palm Pilot falls and all other influences on buying plans remain the same?

Supply

If a firm supplies a good or a service, the firm

1 Has the resources and technology to produce it,
2 Can profit from producing it, and
3 Plans to produce it and sell it.

A supply is more than just having the *resources* and the *technology* to produce something. *Resources and technology* are the constraints that limit what is possible.

Many useful things can be produced, but they are not produced because it is profitable to do so. (No one produces electric bed-making machines, for example!) Supply reflects a decision about which technologically feasible items to produce.

The **quantity supplied** of a good or service is the amount that producers plan to sell during a given time period at a particular price. The quantity supplied is not necessarily the same amount as the quantity actually sold. Sometimes the quantity supplied is greater than the quantity demanded, so the quantity bought is less than the quantity supplied.

Like the quantity demanded, the quantity supplied is measured as an amount per unit of time. For example, suppose that Ford produces 1,000 cars a day. The quantity of cars supplied by Ford can be expressed as 1,000 a day, 7,000 a week, or 365,000 a year. Without the time dimension, we cannot tell whether a particular number is large or small.

Many factors influence selling plans and again, one of them is price. We look first at the relationship between the quantity supplied of a good and its price. And again, as we did when we studied demand, to isolate this relationship, we keep all other influences on selling plans the same and we ask: How, other things remaining the same, does the quantity supplied of a good change as its price changes?

The law of supply provides the answer.

The Law of Supply

The **law of supply** states:

> **Other things remaining the same, the higher the price of a good, the greater is the quantity supplied; and the lower the price of a good, the smaller is the quantity supplied.**

Why does a higher price increase the quantity supplied? It is because *marginal cost increases*. As the quantity produced of any good increases, the marginal cost of producing the good increases. (You can refresh your memory of increasing marginal cost in Chapter 2, p. 35.)

It is never worth producing a good if the price received for it does not at least cover the marginal cost of producing it. So when the price of a good rises, other things remaining the same, producers are willing to incur a higher marginal cost and increase production. The higher price brings forth an increase in the quantity supplied.

Let's now illustrate the law of supply with a supply curve and a supply schedule.

Supply Curve and Supply Schedule

You are now going to study the second of the two most used curves in economics: the supply curve. And you're going to learn about the critical distinction between *supply* and *quantity supplied*.

The term **supply** refers to the entire relationship between the quantity supplied and the price of a good. Supply is illustrated by the supply curve and the supply schedule. The term *quantity supplied* refers to a point on a supply curve – the quantity supplied at a particular price.

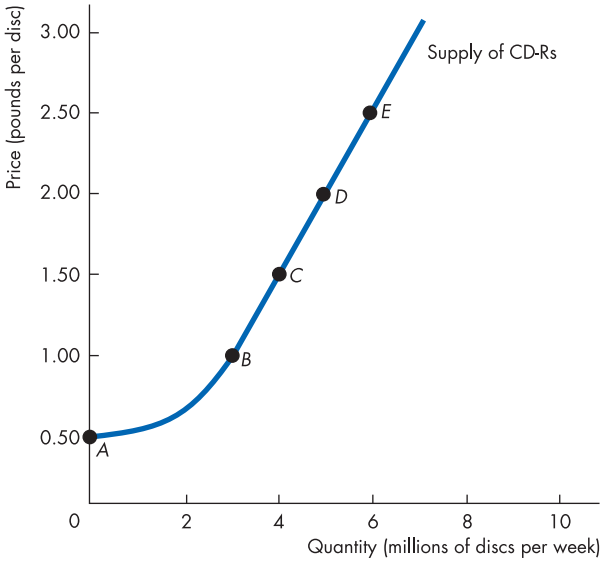
Figure 3.4 shows the supply curve of CD-Rs. A **supply curve** shows the relationship between the quantity supplied of a good and its price when all other influences on producers' planned sales remain the same. The supply curve is a graph of a supply schedule.

The table in Figure 3.4 sets out the supply schedule for CD-Rs. A *supply schedule* lists the quantities supplied at each price when all the other influences on producers' planned sales remain the same. For example, if the price of a CD-R is 50 pence, the quantity supplied is zero – in row *A* of the table. If the price of a disc is £1.00, the quantity supplied is 3 million discs a week – in row *B*. The other rows of the table show the quantities supplied at prices of £1.50, £2.00, and £2.50.

To make a supply curve, we graph the quantity supplied on the *x*-axis and the price on the *y*-axis, just as in the case of the demand curve. The points on the supply curve labelled *A* through *E* correspond to the rows of the supply schedule. For example, point *A* on the graph shows a quantity supplied of zero at a price of 50 pence a disc.

Figure 3.4

The Supply Curve



	Price (pounds per disc)	Quantity supplied (millions of discs per week)
A	0.50	0
B	1.00	3
C	1.50	4
D	2.00	5
E	2.50	6

The table shows the supply schedule of CD-Rs. For example, at a price of £1.00, 3 million discs a week are supplied; at a price of £2.50, 6 million discs a week are supplied. The supply curve shows the relationship between the quantity supplied and price, everything else remaining the same. The supply curve usually slopes upward: As the price of a good increases, so does the quantity supplied.

A supply curve can be read in two ways. For a given price, it tells us the quantity that producers plan to sell at that price. And for a given quantity, it tells us the minimum price that producers are willing to accept for that quantity.

Minimum Supply Price

The supply curve, like the demand curve, has two interpretations. It is the minimum-supply-price curve. It tells us the lowest price at which someone is willing to sell another unit.

If a small quantity is produced, the lowest price at which someone is willing to sell one more unit is low. But if a large quantity is produced, the lowest price at which someone is willing to sell one more unit is high.

In Figure 3.4, if 6 million discs a week are produced, the lowest price that a producer is willing to accept for the 6 millionth disc is £2.50. But if only 4 million discs are produced each week, a producer is willing to accept £1.50 for the 4 millionth disc.

A Change in Supply

When any factor that influences selling plans other than the price of the good changes, there is a **change in supply**. Five main factors bring changes in supply. They are changes in:

1 The prices of factors of production
2 The prices of related goods produced
3 Expected future prices
4 The number of suppliers
5 Technology

1 Prices of Factors of Production

To see why prices of factors of production influence supply, think about the supply curve as a minimum-supply-price curve. If a costs of production rise, the lowest price a producer is willing to accept rises, so supply decreases. For example, during 2001, the price of jet fuel increased and the supply of air transport decreased. A rise in the wages of disc producers decreases the supply of CD-Rs.

2 Prices of Related Goods Produced

The prices of related goods and services that firms produce influence supply. For example, if the price of a pre-recorded CD rises, the supply of CD-Rs decreases. CD-Rs and pre-recorded CDs are *substitutes in production* – goods that can be produced by using the same resources. If the price of beef rises, the supply of leather increases. Beef and leather are *complements in production* – goods that must be produced together.

3 Expected Future Prices

If the price of a good is expected to rise, the return from selling the good in the future is higher than it is today. So supply decreases today and increases in the future.

4 The Number of Suppliers

The larger the number of firms that produce a good, the greater is the supply of the good. And as firms enter an industry, the supply in that industry increases. As firms leave an industry, the supply in that industry decreases.

5 Technology

The term "technology" is used broadly to mean the way that factors of production are used to produce a good. Technology changes both positively and negatively. A positive technology change occurs when a new method is discovered that lowers the cost of producing a good. An example is new methods used in the factories that make CDs. A negative technology change occurs when an event such as extreme weather or natural disaster increases the cost of producing a good. A positive technology change increases supply, and a negative technology change decreases supply.

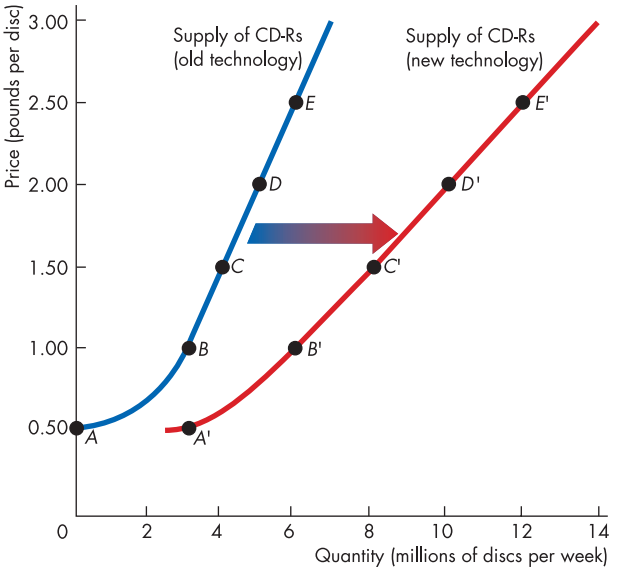
Figure 3.5 illustrates an increase in supply. When supply increases, the supply curve shifts rightward and the quantity supplied is larger at each and every price.

For example, at a price of £1.00, on the original (blue) supply curve, the quantity supplied is 3 million discs a week. On the new (red) supply curve, the quantity supplied is 6 million discs a week. Look closely at the numbers in the table in Figure 3.5 and check that the quantity supplied is larger at each price.

Table 3.2 summarizes the influences on supply and the directions of those influences.

Figure 3.5

An Increase in Supply



Original supply schedule (Original technology)			New supply schedule (New technology)		
	Price (pounds per disc)	Quantity supplied (millions of discs per week)		Price (pounds per disc)	Quantity supplied (millions of discs per week)
A	0.50	0	*A'*	0.50	3
B	1.00	3	*B'*	1.00	6
C	1.50	4	*C'*	1.50	8
D	2.00	5	*D'*	2.00	10
E	2.50	6	*E'*	2.50	12

A change in any influence on sellers' plans other than the price of the good itself results in a new supply schedule and a shift of the supply curve. For example, if CD producers invent a new, cost-saving technology, the supply of CD-Rs changes.

At a price of £1.50 a disc, 4 million discs a week are supplied when producers use the old technology (row *C* of the table) and 8 million discs a week are supplied when producers use the new technology. An advance in technology *increases* the supply of CD-Rs. The supply curve shifts *rightward*, as shown by the shift arrow and the resulting red curve.

A Change in the Quantity Supplied versus a Change in Supply

Changes in the factors that influence producers' planned sales cause either a change in the quantity supplied or a change in supply. Equivalently, they cause either a movement along the supply curve or a shift of the supply curve.

A point on the supply curve shows the quantity supplied at a given price. A movement along the supply curve shows a **change in the quantity supplied**. The entire supply curve shows supply. A shift of the supply curve shows a *change in supply*.

Figure 3.6 illustrates and summarizes these distinctions. If the price of a good falls and everything else remains the same, the quantity supplied of that good decreases and there is a movement down the supply curve S_0. If the price of a good rises and everything else remains the same, the quantity supplied increases and there is a movement up the supply curve S_0. When any other influence on selling plans changes, the supply curve shifts and there is a *change in supply*. If the supply curve is S_0 and if production costs fall, supply increases and the supply curve shifts to the red supply curve S_1. If production costs rise, supply decreases and the supply curve shifts to the red supply curve S_2.

Table 3.2

The Supply of CD-Rs

The Law of Supply

The quantity of CD-Rs supplied

Decreases if:	*Increases if:*
◆ The price of a CD-R falls	◆ The price of a CD-R rises

Changes in Supply

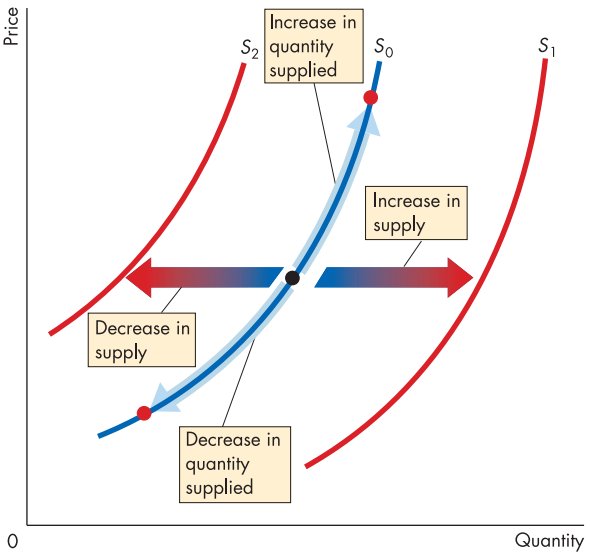
The supply of CD-Rs

Decreases if:	*Increases if:*
◆ The price of factor of production used to produce CD-Rs rises	◆ The price of factor of production used to produce CD-Rs falls
◆ The price of a substitute in production rises	◆ The price of a substitute in production falls
◆ The price of a complement in production falls	◆ The price of a complement in production rises
◆ The price of a CD-R is expected to rise in the future	◆ The price of a CD-R is expected to fall in the future
◆ The number of CD-R producers decreases	◆ The number of CD-R producers increases ◆ A more efficient technology for producing CD-Rs is used

*A CD-R is a normal good.

Figure 3.6

A Change in the Quantity Supplied versus a Change in Supply



When the price of the good changes, there is a movement along the supply curve and *a change in the quantity supplied,* shown by the blue arrows on supply curve S_0.

When any other influence on selling plans changes, there is a shift of the supply curve and a *change in supply*. An increase in supply shifts the supply curve rightward (from S_0 *to* S_1), and a decrease in supply shifts the supply curve leftward (from S_0 *to* S_2).

Review Quiz

1. Define the quantity supplied of a good or service.
2. What is the law of supply and how do we illustrate it?
3. What does the supply curve tell us about the price at which firms will supply a given quantity of a good?
4. List all the influences on selling plans, and for each influence say whether it changes supply.
5. What happens to the quantity of Palm Pilots supplied and the supply of Palm Pilots if the price of a Palm Pilot falls?

Your next task is to use what you've learned about demand and supply and understand how prices and quantities are determined.

Market Equilibrium

We have seen that when the price of a good rises, the quantity demanded *decreases* and the quantity supplied *increases*. We are now going to see how prices coordinate the plans of buyers and sellers and achieve equilibrium.

Equilibrium is a situation in which opposing forces balance each other. Equilibrium in a market occurs when the price balances the plans of buyers and sellers. The **equilibrium price** is the price at which the quantity demanded equals the quantity supplied. The **equilibrium quantity** is the quantity bought and sold at the equilibrium price. A market moves towards its equilibrium because:

- Price regulates buying and selling plans.
- Price adjusts when plans don't match.

Price as a Regulator

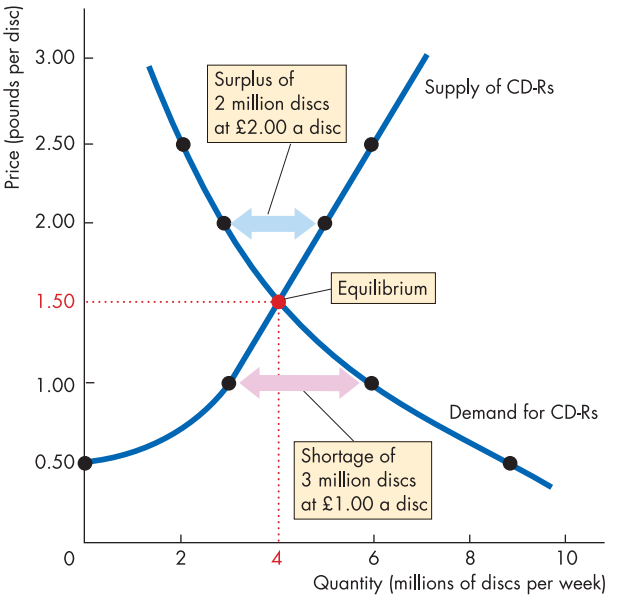
The price of a good regulates the quantities demanded and supplied. If the price is too high, the quantity supplied exceeds the quantity demanded. If the price is too low, the quantity demanded exceeds the quantity supplied. There is one price at which the quantity demanded equals the quantity supplied. Let's work out what that price is.

Figure 3.7 shows the market for CD-Rs. The table shows the demand schedule (from Figure 3.1) and the supply schedule (from Figure 3.4). If the price of a disc is 50 pence, the quantity demanded is 9 million discs a week, but no discs are supplied. There is a shortage of 9 million discs a week. This shortage is shown in the final column of the table. At a price of £1.00 a disc, there is still a shortage, but only of 3 million discs a week. If the price of a disc is £2.50, the quantity supplied is 6 million discs a week, but the quantity demanded is only 2 million. There is a surplus of 4 million discs a week. The one price at which there is neither a shortage nor a surplus is £1.50 a disc. At that price, the quantity demanded equals the quantity supplied: 4 million discs a week. The equilibrium price is £1.50 a disc, and the equilibrium quantity is 4 million discs a week.

Figure 3.7 shows that the demand curve and the supply curve intersect at the equilibrium price of £1.50 a disc. At each price *above* £1.50 a disc, there is a surplus. For example, at £2.00 a disc, the surplus is 2 million discs a week, as shown by the blue arrow.

Figure 3.7

Equilibrium



Price (pounds per disc)	Quantity demanded	Quantity supplied	Shortage (–) or surplus (+)
	(millions of discs per week)		
0.50	9	0	–9
1.00	6	3	–3
1.50	**4**	**4**	**0**
2.00	3	5	+2
2.50	2	6	+4

The table lists the quantities demanded and quantities supplied as well as the shortage or surplus of discs at each price. If the price is £1.00 a disc, 6 million discs a week are demanded and 3 million are supplied. There is a shortage of 3 million discs a week, and the price rises.

If the price is £2.00 a disc, 3 million discs a week are demanded and 5 million are supplied. There is a surplus of 2 million discs a week, and the price falls.

If the price is £1.50 a disc, 4 million discs a week are demanded and 4 million are supplied. There is neither a shortage nor a surplus. Neither buyers nor sellers have any incentive to change the price. The price at which the quantity demanded equals the quantity supplied is the equilibrium price.

At each price *below* £1.50 a disc, there is a shortage of discs. For example, at £1.00 a disc, the shortage is 3 million discs a week, as shown by the red arrow.

Price Adjustments

You've seen that if the price is below equilibrium, there is a shortage and that if the price is above equilibrium, there is a surplus. But can we count on the price to change and eliminate a shortage or surplus? We can, because such price changes are beneficial to both buyers and sellers. Let's see why the price changes when there is a shortage or a surplus.

A Shortage Forces the Price Up

Suppose the price of a CD-R is £1. Consumers plan to buy 6 million discs a week, and producers plan to sell 3 million discs a week. Consumers can't force producers to sell more than they plan, so the quantity that is actually offered for sale is 3 million discs a week. In this situation, powerful forces operate to increase the price and move it towards the equilibrium price. Some producers, noticing lines of unsatisfied consumers, raise the price. Some producers increase their output. As producers push the price up, the price rises towards its equilibrium. The rising price reduces the shortage because it decreases the quantity demanded and increases the quantity supplied. When the price has increased to the point at which there is no longer a shortage, the forces moving the price stop operating and the price comes to rest at its equilibrium.

A Surplus Forces the Price Down

Suppose the price of a CD-R is £2. Producers plan to sell 5 million discs a week, and consumers plan to buy 3 million discs a week. Producers cannot force consumers to buy more than they plan, so the quantity that is actually bought is 3 million discs a week. In this situation, powerful forces operate to lower the price and move it towards the equilibrium price. Some producers, unable to sell the quantities of discs they planned to sell, cut their prices. In addition, some producers scale back production. As producers cut the price, the price falls towards its equilibrium. The falling price decreases the surplus because it increases the quantity demanded and decreases the quantity supplied. When the price has fallen to the point at which there is no longer a surplus, the forces moving the price stop operating and the price comes to rest at its equilibrium.

The Best Deal Available for Buyers and Sellers

When the price is below equilibrium, it is forced up towards the equilibrium. Why don't buyers resist the increase and refuse to buy at the higher price? Because they value the good more highly than the current price and they cannot satisfy all their demands at the current price. In some markets – for example, the auction markets that operate on eBay – the buyers might even be the ones who force the price up by offering to pay higher prices.

When the price is above equilibrium, it is bid down towards the equilibrium. Why don't sellers resist this decrease and refuse to sell at the lower price? Because their minimum supply price is below the current price and they cannot sell all they would like to at the current price. Normally, it is the sellers who force the price down by offering lower prices to gain market share from their competitors.

At the price at which the quantity demanded equals the quantity supplied neither buyers nor sellers can do business at a better price. Buyers pay the highest price they are willing to pay for the last unit bought, and sellers receive the lowest price at which they are willing to supply the last unit sold.

When people freely make offers to buy and sell and when buyers try to buy at the lowest possible price and sellers try to sell at the highest possible price, the price at which trade takes place is the equilibrium price – the price at which the quantity demanded equals the quantity supplied. The price coordinates the plans of buyers and sellers, and no one has an incentive to change it.

Review Quiz

1. What is the equilibrium price of a good or service?
2. Over what range of prices does a shortage arise?
3. Over what range of prices does a surplus arise?
4. What happens to the price when there is a shortage?
5. What happens to the price when there is a surplus?
6. Why is the price at which the quantity demanded equals the quantity supplied the equilibrium price?
7. Why is the equilibrium price the best deal available for both buyers and sellers?

Predicting Changes in Price and Quantity

The demand and supply theory that we have just studied provides us with a powerful way of analyzing influences on prices and the quantities bought and sold. According to the theory, a change in price stems from a change in demand, a change in supply, or a change in both demand and supply. Let's look first at the effects of a change in demand.

A Change in Demand

What happens to the price and quantity of CD-Rs if the demand for CD-Rs increases? We can answer this question with a specific example. Between 1998 and 2001, the price of a CD burner fell from £150 to £50. Because the CD burner and CD-R discs are complements, the demand for discs increased, as is shown in the table in Figure 3.8. The original demand schedule and the new one are set out in the first three columns of the table. The table also shows the supply schedule for CD-Rs.

When demand increases, there is a shortage at the original equilibrium price of £1.50 a disc. To eliminate the shortage, the price must rise. The price that makes the quantity demanded and quantity supplied equal again is £2.50 a disc. At this price, 6 million discs are bought and sold each week. When demand increases, both the price and the quantity increase.

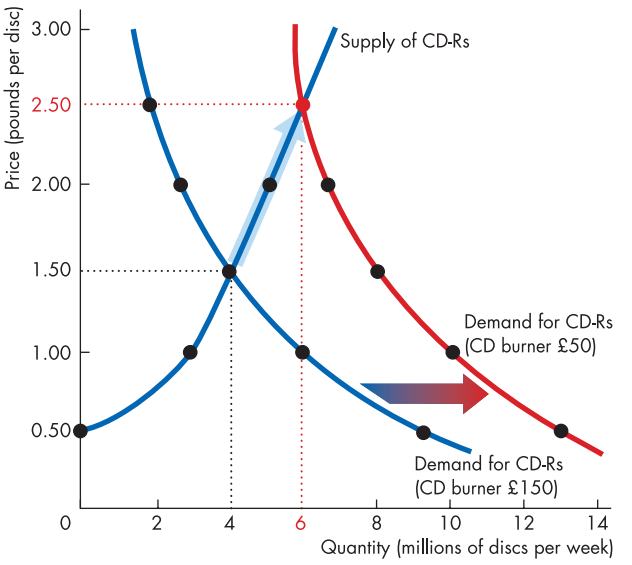
Figure 3.8 shows these changes. The figure shows the original demand for and supply of CD-Rs. The original equilibrium price is £1.50 a disc, and the quantity is 4 million discs a week. When demand increases, the demand curve shifts rightward. The equilibrium price rises to £2.50 a disc, and the quantity supplied increases to 6 million discs a week, as highlighted in the figure. There is an *increase in the quantity supplied* but *no change in supply* – a movement along, but no shift of, the supply curve.

To see the effect of a decrease in demand, start at a price of £2.50 a disc with 6 million discs a week, and then work out what happens if demand decreases to its original level. Such a decrease in demand might arise from a fall in the price of an MP3 player (a substitute for CD-R technology).

The decrease in demand shifts the demand curve leftward. The equilibrium price falls to £1.50 a disc, and the equilibrium quantity decreases to 4 million discs a week.

Figure 3.8

The Effects of a Change in Demand



Price (pounds per disc)	Quantity demanded (millions of discs per week)		Quantity supplied (millions of discs per week)
	CD burner £150	CD burner £50	
0.50	9	13	0
1.00	6	10	3
1.50	**4**	8	**4**
2.00	3	7	5
2.50	2	**6**	**6**

With the price of a CD burner at £150, the demand for CD-Rs is the blue demand curve. The equilibrium price is £1.50 a disc, and the equilibrium quantity is 4 million discs a week. When the price of a CD burner falls from £150 to £50, the demand for CD-Rs increases and the demand curve shifts rightward to become the red curve.

At £1.50 a disc, there is now a shortage of 4 million discs a week. The price of a disc rises to a new equilibrium of £2.50. As the price rises to £2.50, the quantity supplied increases – shown by the blue arrow on the supply curve – to the new equilibrium quantity of 6 million discs a week. Following an increase in demand, the quantity supplied increases but supply does not change – the supply curve does not shift.

We can now make our first two predictions:

1 **When demand increases, both the price and the quantity increase.**

2 **When demand decreases, both the price and the quantity decrease.**

A Change in Supply

When Verbatim and other producers introduce new cost-saving technologies in their CD-R production plants, the supply of CD-Rs increases. The table in Figure 3.9 shows the new supply schedule (the same as that in Figure 3.5). What are the new equilibrium price and quantity? The answer is highlighted in the table: the price falls to £1.00 a disc, and the quantity increases to 6 million a week. You can see why by looking at the quantities demanded and supplied at the original price of £1.50 a disc. The quantity supplied at that price is 8 million discs a week, and there is a surplus of discs. The price falls. Only when the price is £1.00 a disc does the quantity supplied equal the quantity demanded.

Figure 3.9 illustrates the effect of an increase in supply. It shows the demand curve for CD-Rs and the original and new supply curves. The initial equilibrium price is £1.50 a disc, and the quantity is 4 million discs a week. When the supply increases, the supply curve shifts rightward. The equilibrium price falls to £1.00 a disc, and the quantity demanded increases to 6 million discs a week, highlighted in the figure. There is an *increase in the quantity demanded* but *no change in demand* – a movement along, but no shift of, the demand curve.

We can reverse this change in supply. If we start out at a price of £1.00 a disc with 6 million discs a week being bought and sold, we can work out what happens if supply decreases to its original level. Such a decrease in supply might arise from an increase in the cost of labour or raw materials. The decrease in supply shifts the supply curve leftward. The equilibrium price rises to £1.50 a disc, and the equilibrium quantity decreases to 4 million discs a week.

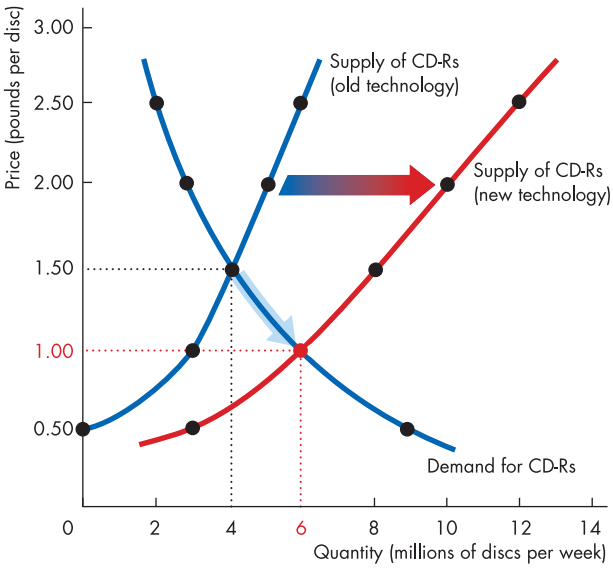
We can now make two more predictions:

1 **When supply increases, the quantity increases and the price falls.**

2 **When supply decreases, the quantity decreases and the price rises.**

Figure 3.9

The Effects of a Change in Supply



Price (pounds per disc)	Quantity demanded (millions of discs per week)	Quantity supplied (millions of discs per week)	
		Old technology	New technology
0.50	9	0	3
1.00	**6**	3	**6**
1.50	**4**	**4**	8
2.00	3	5	10
2.50	2	6	12

With the old technology, the supply of CD-Rs is shown by the blue supply curve. The equilibrium price is £1.50 a disc, and the equilibrium quantity is 4 million discs a week. When the new technology is adopted, the supply of CD-Rs increases and the supply curve shifts rightward to become the red curve.

At £1.50 a disc, there is now a surplus of 4 million discs a week. The price of a CD-R falls to a new equilibrium of £1.00 a disc. As the price falls to £1.00, the quantity demanded increases – shown by the blue arrow on the demand curve – to the new equilibrium quantity of 6 million discs a week. Following an increase in supply, the quantity demanded increases but demand does not change – the demand curve does not shift.

A Change in Both Demand and Supply

You can now predict the effects of a change in either demand or supply on the price and the quantity but what happens if *both* demand and supply change together? To answer this question, we look first at the case in which demand and supply move in the same direction and then we look at the case in which they move in opposite directions.

Demand and Supply Change in the Same Direction

We've seen that an increase in the demand for CD-Rs raises its price and increases the quantity bought and sold. And we've seen that an increase in the supply of CD-Rs lowers its price and increases the quantity bought and sold. Let's now examine what happens when both of these changes occur together.

The table in Figure 3.10 brings together the numbers that describe the original quantities demanded and supplied and the new quantities demanded and supplied after the fall in the price of the CD burner and the improved CD-R production technology. These same numbers are illustrated in the graph. The original (blue) demand and supply curves intersect at a price of £1.50 a disc and a quantity of 4 million discs a week. The new (red) supply and demand curves also intersect at a price of £1.50 a disc but at a quantity of 8 million discs a week.

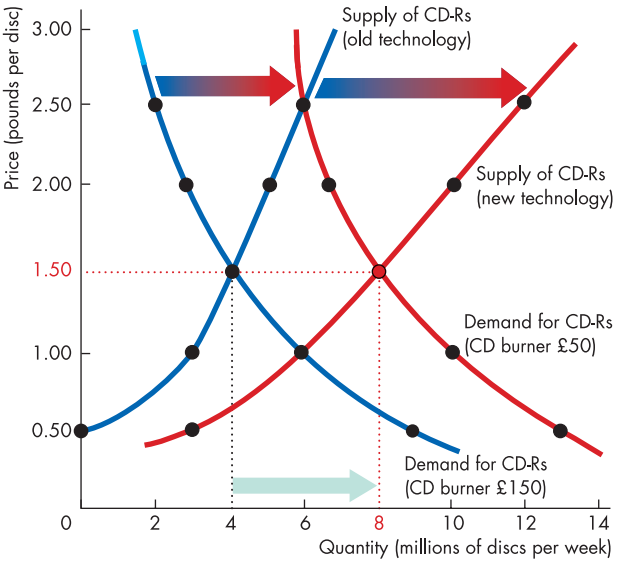
An increase in either demand or supply increases the quantity. So when both demand and supply increase, so does the equilibrium quantity. An increase in demand raises the price, and an increase in supply lowers the price, so we can't say whether the price will rise or fall when demand and supply increase together. In this example, the price does not change. But notice that if demand increases by slightly more than the amount shown in the figure, the equilibrium price will rise. And if supply increases by slightly more than the amount shown in the figure, the equilibrium price will fall.

We can now make two more predictions:

1. **When *both* demand and supply increase, the quantity increases and the price might increase, decrease, or remain the same.**
2. **When *both* demand and supply decrease, the quantity decreases and the price might increase, decrease, or remain the same.**

Figure 3.10

The Effects of an Increase in Both Demand and Supply



Price (pounds per disc)	Original quantities (millions of discs per week)		New quantities (millions of discs per week)	
	Quantity demanded (CD burner £150)	Quantity supplied (old technology)	Quantity demanded (CD burner £50)	Quantity supplied (new technology)
0.50	9	0	13	3
1.00	6	3	10	6
1.50	**4**	**4**	**8**	**8**
2.00	3	5	7	10
2.50	2	6	6	12

When the price of a CD burner is £150 and firms use the old technology to produce discs, the price of a disc is £1.50 and the quantity is 4 million discs a week.

A fall in the price of the CD burner increases the demand for CD-Rs and improved technology increases the supply of CD-Rs. The new supply curve intersects the new demand curve at £1.50 a disc, the same price as before, but the equilibrium quantity increases to 8 million discs a week. These increases in demand and supply increase the quantity but leave the price unchanged.

Demand and Supply Change in Opposite Directions

Suppose that demand and supply change together in *opposite* directions. A new technology increases the supply of CD-Rs. But now the price of an MP3 download rises. An MP3 download is a *complement* of a CD-R. With more costly MP3 downloads, some people switch from buying CD-Rs to buying pre-recorded CDs. The demand for CD-Rs decreases.

The table in Figure 3.11 describes the original and new demand and supply schedules and the original (blue) and new (red) demand and supply curves. The original equilibrium price is £2.50 a disc, and the quantity is 6 million discs a week. The new supply and demand curves intersect at a price of £1.00 a disc and at the original quantity of 6 million discs a week.

A decrease in demand or an increase in supply lowers the price. So when a decrease in demand and an increase in supply occur together, the price falls.

A decrease in demand decreases the quantity, and an increase in supply increases the quantity, so we can't say for sure which way the quantity will change when demand decreases and supply increases at the same time. In this example, the quantity doesn't change. But notice that if demand had decreased by slightly more than is shown in the figure, the quantity would have decreased. And if supply had increased by slightly more than is shown in the figure, the quantity would have increased.

We can make two more predictions:

1. **When demand decreases and supply increases, the price falls and the quantity might increase, decrease, or remain the same.**
2. **When demand increases and supply decreases, the price rises and the quantity might increase, decrease, or remain the same.**

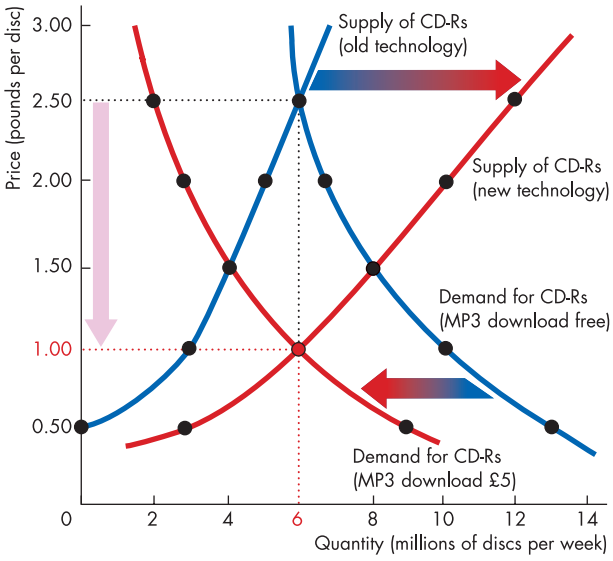
Review Quiz

1 What is the effect on the price of a CD-R and the quantity of CD-Rs if (a) the price of a PC falls or (b) the price of an MP3 download rises or (c) more firms produce CD-Rs or (d) CD-R producers' wages rise or (e) any two of these events occur together? (Draw the diagrams!)

To complete your study of demand and supply, take a look at *Reading Between the Lines* on pp. 70–71, which looks at the rocketing price of electricity in 2003.

Figure 3.11

The Effects of a Decrease in Demand and an Increase in Supply



Price (pounds per disc)	Original quantities (millions of discs per week): Quantity demanded (MP3 download free)	Original quantities (millions of discs per week): Quantity supplied (old technology)	New quantities (millions of discs per week): Quantity demanded (MP3 download £5)	New quantities (millions of discs per week): Quantity supplied (new technology)
0.50	13	0	9	3
1.00	10	3	**6**	**6**
1.50	8	4	4	8
2.00	7	5	3	10
2.50	**6**	**6**	2	12

When MP3 downloads are free and firms use the old technology to produce discs, the price of a CD-R is £2.50 and the quantity is 6 million discs a week.

A rise in the price of an MP3 download decreases the demand for CD-Rs and improved technology increases the supply of CD-Rs. The new equilibrium price is £1.00 a disc, a lower price, but in this case the quantity remains constant at 6 million discs a week. This decrease in demand and increase in supply lower the price but leave the quantity unchanged.

Reading Between the Lines

Demand and Supply: Europe's Electricity Price Surge

The Business, 10 November 2003

Electricity prices rocket as Europe feels the heat

Tim Webb

Electricity prices are rocketing across Europe as a result of soaring temperatures and power shortages. Some nuclear power stations were offline in France and Germany this weekend as the temperatures of rivers, used to cool reactors, became too hot.

In France, which relies on nuclear power for 75% of its electricity, at least 14 reactors were offline last weekend, representing about one quarter of its total nuclear capacity. Increased use of air-conditioning means demand for electricity in summer can be as great as in winter.

In Germany, electricity prices surged on Friday as temperatures rose. . . . The price of peak time power, which is the average price between 8am and 8pm, for delivery on Monday was up 59% to €170 per megawatt hour (£119). . . .

Last week, . . . the Italian national grid cut off big industrial users . . . The operator was forced to call in spare capacity from France, Spain, Slovenia and Switzerland to avert a repeat of the blackouts which hit the country at the end of June.

. . . In the UK, prices for next-day delivery have rocketed by 300% since the beginning of the month, with power for Monday delivery trading at £73 mw/h on Friday . . . At the end of last month, before the latest heatwave, prices were hovering below £20mw/h, close to their long-term average.

. . . England and Wales will have a power deficit of 1,440mw on Monday. . . . The shortfall will be made up by importing power through the Interconnector, the power cable linking Britain to France. . . .

France . . . has power connections with the largest markets in Europe. . . . If prices in France are high, prices in other parts of Europe are also likely to be higher.

The Essence of the Story

- In hot weather, some nuclear power stations in France and Germany must be shut down because the temperature of river water is too high to cool them.
- At the same time, more people use air conditioning and the demand for electricity rises.
- In these conditions, electricity prices surge. The price in Germany rose 59 per cent from €107 to €170 per megawatt hour. In the United Kingdom it rose by 300 per cent to £73 megawatt/hour.
- The power system in France, Germany, the United Kingdom and some other countries is interconnected.
- If the price is high in one of these countries, it is likely to be high in all of them.

Economic Analysis

- Figure 1 shows the market for electricity in Germany. On 8 November 2003, the supply curve was S_0 and the demand curve was D_0. The equilibrium price was €107 per megawatt hour (mwh) and the quantity was 1 million megawatts (mw) at point *A*.
- On 9 November 2003, hot weather brought an increase in the demand for electricity and the demand curve shifted rightward from D_0 to D_1.
- If the supply of electricity remained constant at S_0, the equilibrium price would rise to €150 per mwh and the equilibrium quantity would increase to 1.5 million mw at point *B*. The higher price would bring an increase in the quantity of electricity supplied shown by a movement along supply curve S_0.
- But the supply of electricity did not remain constant. High river temperatures closed some power stations, so the supply of electricity decreased and the supply curve shifted leftward from S_0 to S_1.
- The equilibrium price increased to €170 per mwh and the equilibrium quantity was 1.3 million mw at point *C*.
- Figure 2 shows the UK market for electricity. On 8 November, 2003, the supply curve was S_0 and the demand curve was D_0. The equilibrium price was £70 per mwh and the quantity was Q_0.
- On 9 November 2003, hot weather brought an increase in the demand for electricity and the demand curve shifted rightward from D_0 to D_1.
- Electricity delivered in the United Kingdom is a *substitute in production* for electricity delivered in Germany (and in other interconnected parts of Europe). A rise in the price of electricity in Germany decreases the supply of electricity in the United Kingdom and the UK supply curve shifts leftward to S_1.
- The equilibrium price of electricity in the United Kingdom rose to £73 per mwh and equilibrium quantity increased to Q_1.

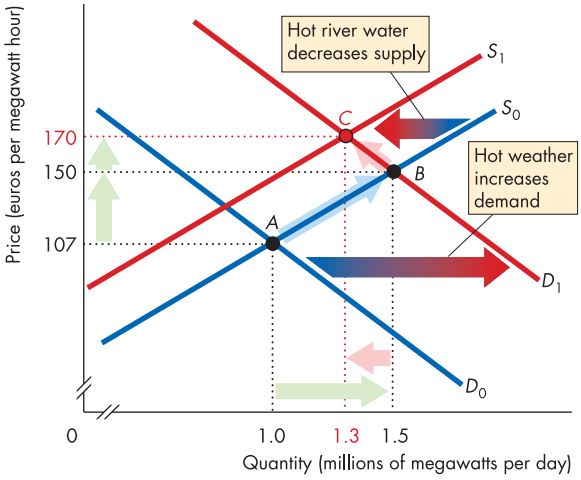


Figure 1 The German market for electricity

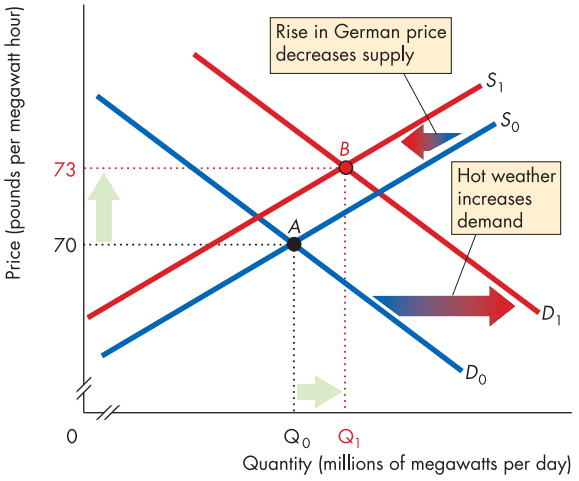


Figure 2 The UK market for electricity

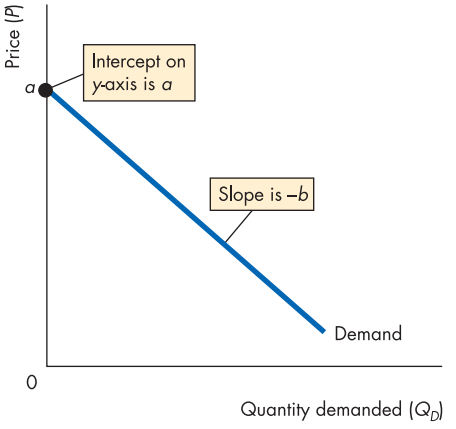
Mathematical Note
Demand, Supply and Equilibrium

Demand Curve

The law of demand states that as the price of a good or service falls, the quantity demanded of it increases. We illustrate the law of demand by setting out a demand schedule, drawing a graph of the demand curve, or writing down an equation. When the demand curve is a straight line, the following linear equation describes it:

$$P = a - bQ_D$$

where P is the price and Q_D is the quantity demanded. The a and b are positive constants.



The demand equation tells us three things:

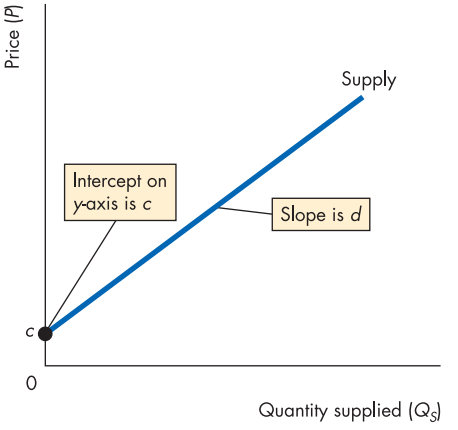
1. The price at which no one is willing to buy the good (Q_D is zero). That is, if the price is a, then the quantity demanded is zero. You can see the price a on the graph. It is the price at which the demand curve hits the y-axis – what we call the demand curve's "intercept on the y-axis".
2. As the price falls, the quantity demanded increases. If Q_D is a positive number, then the price P must be less than a. And as Q_D gets larger, the price P becomes smaller. That is, as the quantity increases, the maximum price that buyers are willing to pay for the good falls.
3. The constant b tells us how fast the maximum price that someone is willing to pay for the good falls as the quantity increases. That is, the constant b tells us about the steepness of the demand curve. The equation tells us that the slope of the demand curve is $–b$.

Supply Curve

The law of supply states that as the price of a good or service rises, the quantity supplied of it increases. We illustrate the law of supply by setting out a supply schedule, drawing a graph of the supply curve, or writing down an equation. When the supply curve is a straight line, the following linear equation describes it:

$$P = c + dQ_S$$

where P is the price and Q_S the quantity supplied. The c and d are positive constants.

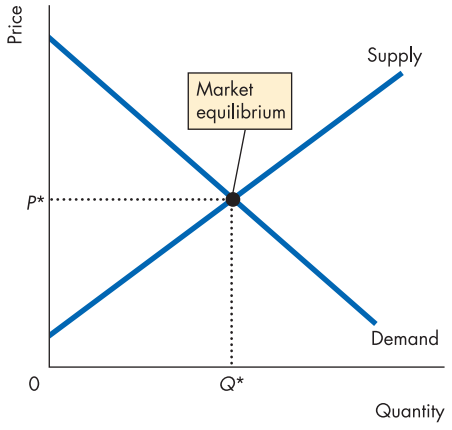


The supply equation tells us three things:

1. The price at which no one is willing to sell the good (Q_S is zero). If the price is c, then the quantity supplied is zero. You can see the price c on the graph. It is the price at which the supply curve hits the y-axis – what we call the supply curve's "intercept on the y-axis".
2. As the price rises, the quantity supplied increases. If Q_S is a positive number, then the price P must be greater than c. And as Q_S increases, the price P gets larger. That is, as the quantity increases, the minimum price that sellers are willing to accept rises.
3. The constant d tells us how fast the minimum price at which someone is willing to sell the good rises as the quantity increases. That is, the constant d tells us about the steepness of the supply curve. The equation tells us that the slope of the supply curve is d.

Market Equilibrium

Demand and supply determine market equilibrium. Figure 3 shows the equilibrium price (P^*) and equilibrium quantity (Q^*) at the intersection of the demand curve and the supply curve.



We can use the equations to find the equilibrium price and equilibrium quantity. The price of a good will adjust until the quantity demanded equals the quantity supplied. That is:

$$Q_D = Q_S$$

So at the equilibrium price (P^*) and equilibrium quantity (Q^*):

$$Q_D = Q_S = Q^*$$

To find the equilibrium price and equilibrium quantity: first substitute Q^* for Q_D in the demand equation and Q^* for Q_S in the supply equation. Then the price is the equilibrium price (P^*), which gives:

$$P^* = a - bQ^*$$

$$P^* = c + dQ^*$$

Notice that:

$$a - bQ^* = c + dQ^*$$

Now solve for Q^*:

$$a - c = bQ^* + dQ^*$$

$$a - c = (b + d)Q^*$$

$$Q^* = \frac{a - c}{b + d}$$

To find the equilibrium price (P^*) substitute for Q^* in either the demand equation or the supply equation.

Using the demand equation:

$$P^* = a - b\left(\frac{a - c}{b + d}\right)$$

$$P^* = \frac{a(b + d) - b(a - c)}{b + d}$$

$$P^* = \frac{ad + bc}{b + d}$$

Alternatively, using the supply equation:

$$P^* = c + d\left(\frac{a - c}{b + d}\right)$$

$$P^* = \frac{c(b + d) + d(a - c)}{b + d}$$

$$P^* = \frac{ad + bc}{b + d}$$

An Example

The demand for ice cream is:

$$P = 400 - 2Q_D$$

The supply of ice cream is:

$$P = 100 + 1Q_S$$

The price of an ice cream is expressed in pence and the quantities are expressed in ice creams per day.

To find the equilibrium price (P^*) and equilibrium quantity (Q^*), substitute Q^* for Q_D and Q_S and substitute P^* for P.

That is:

$$P^* = 400 - 2Q^*$$

$$P^* = 100 + 1Q^*$$

Now solve for Q^*:

$$400 - 2Q^* = 100 + 1Q^*$$

$$300 = 3Q^*$$

$$Q^* = 100$$

And:

$$P^* = 400 - 2(100) = 200$$

The equilibrium price is £2 an ice cream, and the equilibrium quantity is 100 ice creams per day.

Summary

Key Points

Price and Opportunity Cost (p. 54)

- A competitive market is one that has so many buyers and sellers that no one can influence the price.
- Opportunity cost is a relative price.
- Demand and supply determine relative prices.

Demand (pp. 55–59)

- Demand is the relationship between the quantity demanded of a good and its price when all other influences on buying plans remain the same.
- The higher the price of a good, other things remaining the same, the smaller is the quantity demanded – the law of demand.
- Demand depends on the prices of substitutes and complements, expected future prices, income, expected future income, population, and preferences.

Supply (pp. 60–63)

- Supply is the relationship between the quantity supplied of a good and its price when all other influences on selling plans remain the same.
- The higher the price of a good, other things remaining the same, the greater is the quantity supplied – the law of supply.
- Supply depends on the prices of resources used to produce a good, the prices of related goods produced, expected future prices, the number of suppliers, and technology.

Market Equilibrium (pp. 64–65)

- At the equilibrium price, the quantity demanded equals the quantity supplied.
- At prices above equilibrium, there is a surplus and the price falls.
- At prices below equilibrium, there is a shortage and the price rises.

Predicting Changes in Price and Quantity (pp. 66–69)

- An increase in demand brings a rise in the price and an increase in the quantity supplied. (A decrease in demand brings a fall in the price and a decrease in the quantity supplied.)
- An increase in supply brings a fall in the price and an increase in the quantity demanded. (A decrease in supply brings a rise in the price and a decrease in the quantity demanded.)
- An increase in demand and an increase in supply bring an increased quantity, but the price might rise, fall, or remain the same. An increase in demand and a decrease in supply bring a higher price, but the quantity might increase, decrease, or remain the same.

Key Figures

Figure 3.1 The Demand Curve, 56
Figure 3.3 A Change in the Quantity Demanded Versus a Change in Demand, 59
Figure 3.4 The Supply Curve, 61
Figure 3.6 A Change in the Quantity Supplied Versus a Change in Supply, 63
Figure 3.7 Equilibrium, 64
Figure 3.8 The Effects of a Change in Demand, 66
Figure 3.9 The Effects of a Change in Supply, 67

Key Terms

Change in demand, 56
Change in supply, 61
Change in the quantity demanded, 59
Change in the quantity supplied, 62
Competitive market, 54
Complement, 57
Demand, 55
Demand curve, 56
Equilibrium price, 64
Equilibrium quantity, 64
Inferior good, 58
Law of demand, 55
Law of supply, 60
Money price, 54
Normal good, 58
Quantity demanded, 55
Quantity supplied, 60
Relative price, 54
Substitute, 57
Supply, 60
Supply curve, 60

Problems

***1** What is the effect on the price of an audiotape and the quantity of audiotapes sold if:

- **a** The price of a CD rises?
- **b** The price of a Walkman rises?
- **c** The supply of CD players increases?
- **d** Consumers' incomes increase?
- **e** Workers who make audiotapes get a pay rise?
- **f** The price of a Walkman rises at the same time as the workers who make audiotapes get a pay rise?

2 What is the effect on the price of a DVD player and the quantity of DVD players sold if:

- **a** The price of a DVD rises?
- **b** The price of a DVD falls?
- **c** The supply of DVD players increases?
- **d** Consumers' incomes decrease?
- **e** The wage rate of workers who produce DVD players increases?
- **f** The wage rate of workers who produce DVD players rises and at the same time the price of a DVD falls?

***3** Suppose that the following events occur one at a time:

- **(i)** The price of crude oil rises.
- **(ii)** The price of a car rises.
- **(iii)** All speed limits on highways are abolished.
- **(iv)** Robot technology cuts car production costs.

Which of these events will increase or decrease (state which):

- **a** The demand for petrol?
- **b** The supply of petrol?
- **c** The quantity of petrol demanded?
- **d** The quantity of petrol supplied?

4 Suppose that the following events occur one at a time:

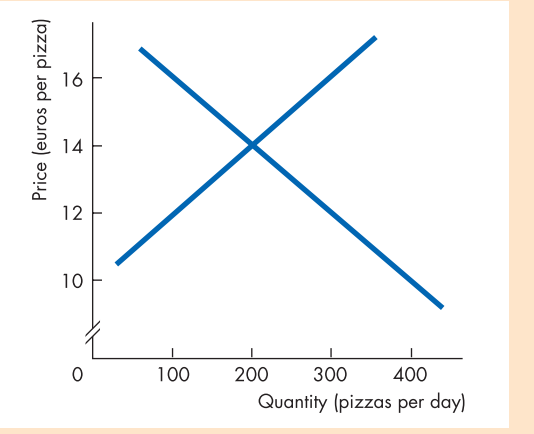
- **(i)** The price of airfares halve.
- **(ii)** The price of beef falls.
- **(iii)** A cheap, strong cloth, a close substitute for leather, is invented.
- **(iv)** A new high-speed technology for cutting leather is invented.

Which of these events will increase or decrease (state which):

- **a** The demand for leather bags?
- **b** The supply of leather bags?
- **c** The quantity of leather bags demanded?
- **d** The quantity of leather bags supplied?

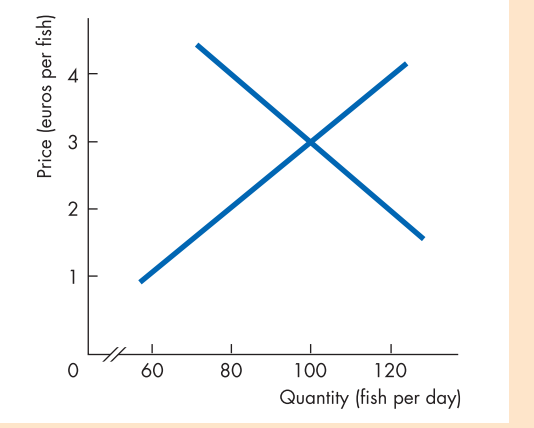
*Solutions to odd-numbered problems are available on *Parkin Interactive*.

***5** The figure illustrates the market for pizza.



- **a** Label the curves in the figure.
- **b** What are the equilibrium price of a pizza and the equilibrium quantity of pizza?

6 The figure illustrates the market for fish.



- **a** Label the curves in the figure.
- **b** What are the equilibrium price of fish and the equilibrium quantity of fish?

***7** The table sets out the demand and supply schedules for chewing gum.

Price (pence per packet)	Quantity demanded (millions of packets a week)	Quantity supplied (millions of packets a week)
20	180	60
30	160	80
40	140	100
50	120	120
60	100	140
70	80	160
80	60	180

a Draw a graph of the gum market and mark in the equilibrium price and quantity.

b Suppose that chewing gum is 70 pence a packet. Describe the situation in the gum market and explain how the price of gum adjusts.

8 The demand and supply schedules for crisps are

Price (pence per bag)	Quantity demanded (millions of bags per week)	Quantity supplied (millions of bags per week)
50	160	130
60	150	140
70	140	150
80	130	160
90	120	170
100	110	180

a Draw a graph of the crisps market and mark in the equilibrium price and quantity.

b Suppose that crisps are 60 pence a bag. Describe the situation in the market for crisps and explain how the price adjusts.

***9** In problem 7, suppose that a fire destroys some gum-producing factories and the supply of gum decreases by 40 million packs a week.

a Has there been a shift of or a movement along the supply curve of gum?

b Has there been a shift of or a movement along the demand curve for gum?

c What are the new equilibrium price and equilibrium quantity of gum?

10 In problem 8, suppose a new dip comes onto the market, which is very popular and the demand for crisps increases by 30 million bags per week.

a Has there been a shift of or a movement along the supply curve of crisps?

b Has there been a shift of or a movement along the demand curve for crisps?

c What are the new equilibrium price and equilibrium quantity of crisps?

***11** In problem 9, suppose an increase in the teenage population increases the demand for gum by 40 million packs per week at the same time as the fire occurs. What are the new equilibrium price and quantity of gum?

12 In problem 10, suppose that a virus destroys several potato farms with the result that the supply of crisps decreases by 40 million bags a week at the same time as the dip comes onto the market. What are the new equilibrium price and quantity of crisps?

Critical Thinking

1 Study *Reading Between the Lines*, pp. 70–71 and then:

a Explain why the Italian national grid cut off the electricity supply to big industrial users in November 2003.

b Explain the impact of this move on the market for electricity in Italy.

c Draw demand and supply curves to illustrate the impact of the heat wave on the price and quantity of electricity in Italy in November 2003.

Web Exercises

Use the links at *Parkin Interactive* to work the following exercises.

1 Obtain data on the prices and quantities of wheat.

a Make a figure similar to Figure 3.7 on p. 64 to illustrate the market for wheat in 2001 and 2002.

b Show the changes in demand and supply and the changes in the quantity demanded and the quantity supplied that are consistent with the price and quantity data.

2 Obtain data on the price of oil.

a Describe how the price of oil has changed over the past five years.

b Draw a demand-supply graph to explain what happens to the price when there is an increase or a decrease in supply and no change in demand.

c What do you predict would happen to the price of oil if a new drilling technology permitted deeper ocean sources to be used?

d What do you predict would happen to the price of oil if a clean and safe nuclear technology were developed?

e What do you predict would happen to the price of oil if cars were powered by batteries instead of by internal combustion engines?

3 Read the *Economics in History* on Discovering the Laws of Demand and Supply and then:

a Explain why there was so much interest in trying to understand the principles of demand and supply during the period of the Industrial Revolution.

b Explain why Alfred Marshall is considered to be the 'father' of modern economics.