3-2 DEMAND, SUPPLY, AND EQUILIBRIUM

Demand is the quantity of a good buyers wish to purchase at each conceivable price.

Thus demand is not a particular quantity, such as six bars of chocolate, but rather a full description of the quantity of chocolate the buyer would purchase at each and every price which might be charged. The first column of Table 3-1 shows a range of prices for bars of chocolate. The second column shows the quantities that might be demanded at these prices. Even when chocolate is free, only a finite amount will be wanted. People get sick from eating too much chocolate. As the price of chocolate rises, the quantity demanded falls, other things equal. We have assumed that nobody will buy any chocolate when the price is more than £0.40 per bar. Taken together, columns (1) and (2) describe the demand for chocolate as a function of its price.

Supply is the quantity of a good sellers wish to sell at each conceivable price.

Again, supply is not a particular quantity but a complete description of the quantity that sellers would like to sell at each and every possible price. The third column of Table 3-1 shows how much chocolate sellers wish to sell at each price. Chocolate cannot be produced for nothing. Nobody would wish to supply if they receive a zero price. In our example, it takes a price of at least £0.20 per bar before there is any incentive to supply chocolate. At higher prices it becomes increasingly lucrative to supply chocolate bars and there is a corresponding increase in the quantity of bars that would be supplied. Taken together, columns (1) and (3) describe the supply of chocolate bars as a function of their price.

TABLE 3-1

THE DEMAND FOR AND SUPPLY OF CHOCOLATE

(*) PRICE (£/bar)	(2) DEMAND (million bars/year)	(3) SUPPLY (million bars/year)
0.00	200	0
0.10	160	0
0.20	120	40
0.30	80	80
0.40	40	120
0.50	0	160
0.60	0	200
0.70	0	240

Notice the distinction between *demand* and the *quantity demanded*. Demand describes the behaviour of buyers at every price. At a particular price such as £0.30, there is a particular quantity demanded, namely 80 million bars/year. The term 'quantity demanded' makes sense only in relation to a particular price. A similar distinction applies to *supply* and *quantity supplied*.

In everyday language, we would say that when the demand for football tickets exceeds their supply some people will not get into the ground. Economists must be more precise. At the price charged for tickets, the quantity demanded exceeded the quantity supplied. Although the size of the ground sets an upper limit on the quantity of tickets that can be supplied, a higher ticket price would have reduced the quantity demanded, perhaps leaving empty space in the ground. Yet there has been no change in demand, the schedule describing how many people want admission at each possible ticket price. The quantity demanded has changed because the price has changed.

As in our discussion of tube fares in the previous chapter, we must recognize that the demand schedule relating price and quantity demanded and the supply schedule relating price and quantity supplied are each constructed on the assumption of 'other things equal'. In the demand for tube tickets, the 'other things' were the cost of alternative modes of transport. In the demand for football tickets, one of the 'other things' that is important is whether or not the game is being shown on television. If it is, the quantity of tickets demanded at each and every price will be lower than if the game is not televised. To understand how a market works, we must first explain why demand and supply are what they are. (Is the game on television? Has the ground capacity been extended by building a new stand?) Then we must examine how the price adjusts to balance the quantities supplied and demanded, given the underlying supply and demand schedules relating quantity to price.

Let us think again about the market for chocolate described in Table 3-1. Other things equal, *the lower the price of chocolate, the higher the quantity demanded*. Other things equal, *the higher the price of chocolate, the higher the quantity supplied*. A campaign by dentists warning of the effect of chocolate on tooth decay, or a fall in household incomes, would change the 'other things' relevant to the demand for chocolate. Either of these changes would reduce the demand for chocolate, reducing the quantities demanded at each price. Cheaper cocoa beans, or technical advances in packaging chocolate bars, would change the 'other things' relevant to the supply of chocolate bars. They would tend to increase the supply of chocolate bars, increasing the quantity supplied at each possible price.

The Market and the Equilibrium Price

For the moment, we assume that all these other things remain constant. We wish to combine the behaviour of buyers and sellers described in Table 3-1 to model how the market for chocolate bars would actually work. At low prices, the quantity demanded exceeds the quantity supplied but the reverse is true at high prices. At some intermediate price, which we call the 'equilibrium price', the quantity demanded just equals the quantity supplied.

The *equilibrium price* clears the market for chocolate. It is the price at which the quantity supplied equals the quantity demanded.

Table 3-1 shows that the equilibrium price for chocolate bars is £0.30: 80 million bars per year is the quantity buyers wish to buy and sellers wish to sell at this price. We call 80 million bars per year the *equilibrium quantity*. At prices below £0.30, the quantity demanded exceeds the quantity supplied and some buyers will be frustrated. There is a shortage, what we call *excess demand*. From our previous discussion, you will realize that when economists say there is excess demand they are using a convenient shorthand for the more complicated expression: the quantity demanded exceeds the quantity supplied *at this price*.

Conversely, at any price above £0.30, the quantity supplied exceeds the quantity demanded. Sellers will be left with unsold stock. To describe this surplus, economists use the shorthand *excess supply*, it being understood that this means excess in the quantity supplied *at this price*. Only at £0.30, the equilibrium price, does the quantity demanded equal the quantity supplied. At the equilibrium the market clears and people can buy or sell as much as they want at the equilibrium price.

Will the market for chocolate bars automatically be in equilibrium? If so, what mechanism brings this about? Suppose the price of chocolate is initially £0.50, higher than the equilibrium price. Producers wish to sell 160 million bars per year but nobody wishes to buy at this price. To recoup the money spent in producing chocolate, sellers will have to cut the price to clear their stock. Cutting the price to £0.40 has two effects. It increases the quantity demanded to 40 million bars per year and it reduces the quantity producers wish to supply to 120 million bars per year. Both effects work to reduce the excess supply. Even at £0.40 there is an excess supply of 80 million bars per year, providing an incentive for further price cuts. The process of price-cutting will continue until the equilibrium price of £0.30 is reached and excess supply has been eliminated. At this price the market clears.

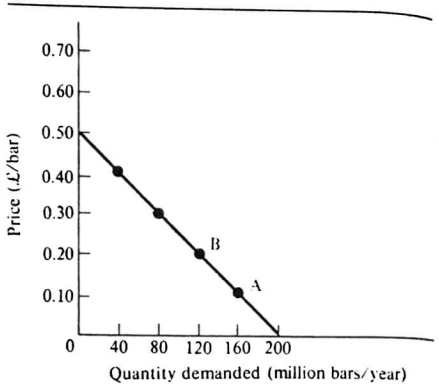
When the initial price lies below the equilibrium price the process works in reverse. At a price of £0.20, the quantity demanded is 120 million bars per year but the quantity supplied is only 40 million bars per year. Sellers will quickly run out of stock and realize they could have charged higher prices. This incentive to raise prices to ration scarce stocks will continue until the equilibrium price is reached, excess demand is eliminated, and the market clears.

At any particular instant, the market price may not be the equilibrium price. If not, there will be either excess supply or excess demand, depending on whether the price lies above or below the

equilibrium price. But these forces themselves provide the incentive to change prices towards the equilibrium price. In this sense, markets are self-correcting.

Later in this book, we shall see that some of the most important issues in economics turn on how quickly prices adjust to restore equilibrium in particular markets. When prices are very flexible, as for example on the stock exchange, where prices can change several times a minute, it may be realistic to simplify the analysis by supposing that the market is always in equilibrium. When prices are less flexible, as for example in many labour markets, where firms and workers negotiate a wage contract that remains in force for a whole year, it may be misleading to simplify by assuming that the market is always in equilibrium. If anything happens during the year to change the equilibrium wage rate, the market may not be able to adjust immediately. We shall then have to study explicitly how the market behaves when it is not in equilibrium.

FIGURE 3-1 THE DEMAND CURVE FOR CHOCOLATE BARS. The demand curve shows the negative relation between price and quantity demanded, holding other things equal. The vertical axis measures the price of chocolate bars and the horizontal axis measures the quantity demanded. The diagram plots the points in the first two columns of Table 3-1. Point *A* shows that 160 million bars per year are demanded at £0.10. Point *B* shows that 120 million bars per year are demanded at £0.20. Plotting all the points and joining them up, we obtain the demand curve.



3-3 DEMAND AND SUPPLY CURVES

Table 3-1 shows demand and supply conditions in the chocolate market and allows us to find the equilibrium price and quantity. It is convenient to approach the same problem diagrammatically using demand and supply curves.

The *demand curve* shows the relation between price and quantity demanded, holding other things constant. In Figure 3-1 we measure on the vertical axis prices of chocolate bars. Corresponding quantities demanded in millions of bars per year are measured on the horizontal axis. The demand curve plots the data in the first two columns of Table 3-1. The point *A* shows that 160 million bars per year are demanded at a price of £0.10. The point *B* shows that 120 million bars per year are demanded at a price of £0.20. Plotting all the points and joining them up, we obtain the demand curve. In our example, this curve happens to be a straight line. As expected, it has a negative slope showing that larger quantities are demanded at lower prices.

The *supply curve* shows the relation between price and quantity supplied, holding other things constant. In Figure 3-2 we plot the supply information given by columns (1) and (3) of Table 3-1. Again we join up the different data points.

In Figure 3-3 we show the demand curve, labelled *DD*, and the supply curve, labelled *SS*, in the same diagram. We can now re-examine our analysis of excess supply, excess demand, and equilibrium. Consider a particular price as represented by a height on the vertical axis. At a price below the equilibrium price, the horizontal distance between the supply curve and the demand curve at this height shows the excess demand at this price. For example, at £0.20 the quantity supplied is 40 million bars per year, the quantity demanded 120 million bars per year, and the

FIGURE 3-2 THE SUPPLY CURVE FOR CHOCOLATE BARS. The supply curve shows the positive relation between the price and quantity supplied, holding other things equal. The diagram plots the points in the first and third columns of Table 3-1. Again we join up the points.

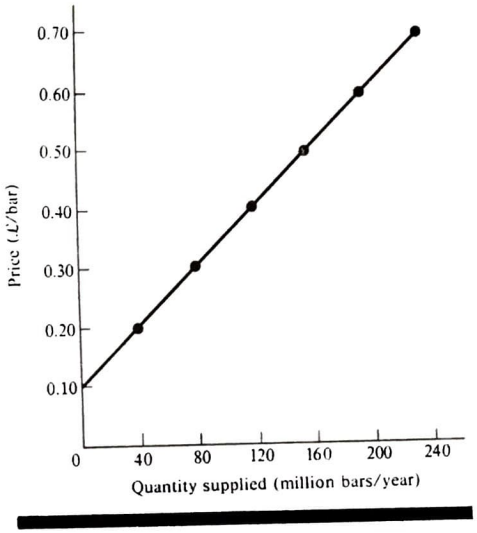
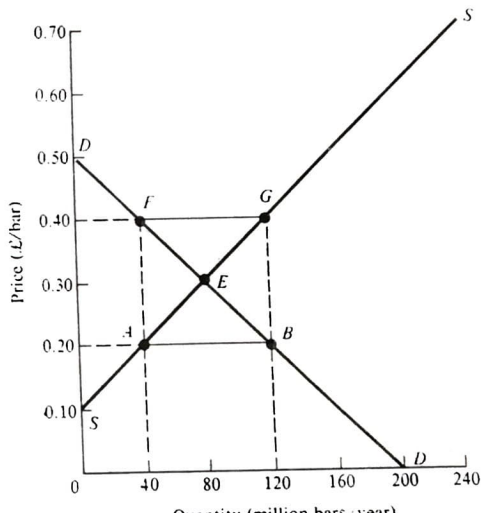


FIGURE 3-3 THE MARKET FOR CHOCOLATE BARS. Market equilibrium occurs at the point *E*, where the price is £0.30; there, the quantity demanded equals quantity supplied equals 80 million bars per year. At prices below the equilibrium price there is excess demand: *AB* shows the excess demand at the price £0.20. At prices above the equilibrium price there is excess supply: *FG* shows the excess supply at the price £0.40.



distance *AB* represents the excess demand of 80 million bars per year. Conversely, at a price above the equilibrium price there is excess supply. At £0.40, 40 million bars per year are demanded, 120 million bars per year are supplied and the horizontal distance *FG* measures the excess supply of 80 million bars per year at this price.

Suppose the price is £0.40. Only 40 million bars per year are sold even though sellers would like to sell 120 million bars per year. How do we know that it is sellers not buyers who are frustrated when their wishes differ? Participation in a market is voluntary. Buyers are not *forced* to buy nor sellers forced to sell. When markets are not in equilibrium, the quantity transacted must be the *smaller* of the quantity supplied and the quantity demanded. Any quantity larger than 40 million bars per year at a price of £0.40 would involve buyers in forced purchases. Similarly, when the price is £0.20, any quantity larger than 40 million bars per year would involve sellers in forced sales.

Market equilibrium is shown by the intersection of the demand curve *DD* and the supply curve *SS*, at a price of £0.30, at which 80 million bars per year are transacted. At any other price, the quantity traded is the smaller of the quantity demanded and the quantity supplied. We can now reconsider *price determination* in the chocolate market. Figure 3-3 implies that there is excess supply at all prices above the equilibrium price of £0.30. Sellers react to unsold stocks by cutting prices. Only when prices have been reduced to the equilibrium price will excess supply be eliminated. The equilibrium position is shown by the point *E*. Conversely, at prices below £0.30 there is excess demand, which bids up the price of chocolate, gradually eliminating excess demand until the equilibrium point *E* is reached. In equilibrium buyers and sellers can trade as much as they wish at the equilibrium price and there is no incentive for any further price changes.

3-4 BEHIND THE DEMAND CURVE

The demand curve in Figures 3-1 and 3-3, like the data in column (2) of Table 3-1, depicts the relation between price and quantity demanded *holding other things constant*. What are those 'other things'? The other things relevant to demand curves can usually be grouped under three headings: the price of related goods, the income of consumers (buyers), and consumer tastes or preferences. We look at each of these in turn.

The Price of Related Goods

In Chapter 2 we discussed the demand for tube travel. We saw that a rise in bus fares or petrol prices would increase the quantity of tube travel demanded at each possible price. In everyday language, we think of buses and private cars as *substitutes* for the tube. Loosely speaking, this means that a journey may be made by bus or car instead of by tube. More precisely, an increase in the price of buses or cars will lead to an increase in the demand for tube travel. Economists use an even more precise definition of substitutes which we shall encounter in Chapter 5, but everyday language gives the right idea of what we mean. Similarly, everyday language suggests that petrol and cars are *complements* because you cannot use a car without also using petrol. A rise in the price of petrol tends to reduce the demand for cars. Again, everyday language gives the right idea although an exact definition of complements will not be given until Chapter 5.

How do these ideas about substitutes and complements relate to the demand for chocolate bars? Clearly, other sweets (mint drops and jelly babies) are substitutes for chocolate. We expect an increase in the price of other sweets to increase the quantity of chocolate demanded at each possible chocolate price, as people substitute away from other sweets towards chocolate. If people buy chocolate to eat at the cinema, films would be a complement for bars of chocolate. A rise in the price of cinema tickets would reduce the demand for chocolate since fewer people will go to the cinema. Nevertheless, it is difficult to think of a lot of goods that are complements for chocolate. This suggests, correctly, that most of the time goods are substitutes for each other. Complementarity, while present in many instances, is usually a more specific feature (record players and records, coffee and milk, shoes and shoelaces).

Before we leave the influence of prices of related goods on the demand for a particular commodity, it should be noted that the development of new products can be viewed within this framework. Technological advances that make possible hand calculators, low fuel consumption cars, or low-calorie beer affect the demand for related goods. One way to think about this is to say that the new product had always been available, but previously its price had been prohibitively high so that nobody could afford it. The technological advance enables the new product to be made available at a much lower price. This will stimulate demand for goods that are complements to the new product (video games may increase the demand for televisions on which they can be played in the home) but reduce the demand for substitutes for the new product (being able to watch films on a home video reduces the demand for going to the cinema).

Consumer Incomes

The second category of 'other things equal' when we draw a particular demand curve is consumer income. When incomes rise, the demand for most goods increases. Typically, consumers buy more of everything. However, there are exceptions.

> A *normal good* is a good for which demand increases when incomes rise. An *inferior good* is a good for which demand falls when incomes rise.

As their name suggests, most goods are normal goods. An example of an inferior good might be cheap but nasty cuts of meat. As household incomes rise, households spend absolutely less on cheap cuts and more on better cuts of meat such as steaks. Inferior goods are typically cheap but low-quality goods which people would prefer not to buy if they could afford to spend a little more.

Tastes

The third category of things held constant along a particular demand curve is consumer tastes or preferences. In part, these are shaped by convenience, custom, and social attitudes. When the Beatles and the Rolling Stones first became popular, the demand for haircuts suddenly fell. The fashion for the mini-skirt reduced the demand for textile material. More recently, the emphasis on health and fitness has increased the demand for jogging equipment, health foods, and sports facilities while reducing the demand for cream cakes, butter, and cigarettes.

3-5 SHIFTS IN THE DEMAND CURVE

We are now in a position to distinguish between movements along a given demand curve and shifts in the demand curve itself. In Figure 3-1 we drew the demand curve for chocolate bars for a given level of the three underlying factors: the price of related goods, incomes, and tastes. Movements along the demand curve isolate the effects of chocolate prices on quantity demanded holding other things equal. Changes in any of these three factors will change the demand for chocolate. Table 3-2 illustrates the effect of a rise in the price of a substitute for chocolate, say ice cream, which leads people to demand more chocolate and less ice cream. At each chocolate price there is a larger quantity of chocolate demanded when ice cream prices are high, since people substitute chocolate for ice cream. In Figure 3-4 we show the same change in ice cream prices leading to a *shift* in the demand curve from *DD* to *D'D'*. The entire demand curve shifts to the right since a higher quantity is demanded at each price.

Changes in the price of ice cream have no effect on the incentives to supply chocolate bars: at each price suppliers will wish to supply the same quantity of chocolate as before. The increase in demand, or rightward shift in the demand curve, changes the equilibrium price and quantity in the chocolate market. Equilibrium has changed from the point *E* to the point *E'*. The new equilibrium price is £0.40 and the new equilibrium quantity is 120 million bars per year. A glance back at Table 3-1 will confirm this.

TABLE 3-2
THE EFFECT OF AN INCREASE IN THE PRICE OF ICE CREAM ON THE DEMAND FOR CHOCOLATE

PRICE OF CHOCOLATE (£/bar)	DEMAND FOR CHOCOLATE AT LOW ICE CREAM PRICE (million bars/year)	DEMAND FOR CHOCOLATE AT HIGH ICE CREAM PRICE (million bars/year)
0.00	200	280
0.10	160	240
0.20	120	200
0.30	80	160
0.40	40	120
0.50	0	80
0.60	0	40
0.70	0	0

We can even sketch how the chocolate market makes the transition from the old equilibrium at E to the new equilibrium at E'. Consider the instant when ice cream prices rise. The demand curve for chocolate shifts from DD to $D'D'$. Until the price changes from £0.30 there is now excess demand EH at this price: 160 million bars per year are now demanded but only 80 million bars per year are supplied. This excess demand puts upward pressure on prices which gradually rise to the new equilibrium price of £0.40, choking the quantity demanded back from 160 million bars per year to 120 million bars per year and providing the incentive to increase the quantity supplied from 80 million bars per year to 120 million bars per year.

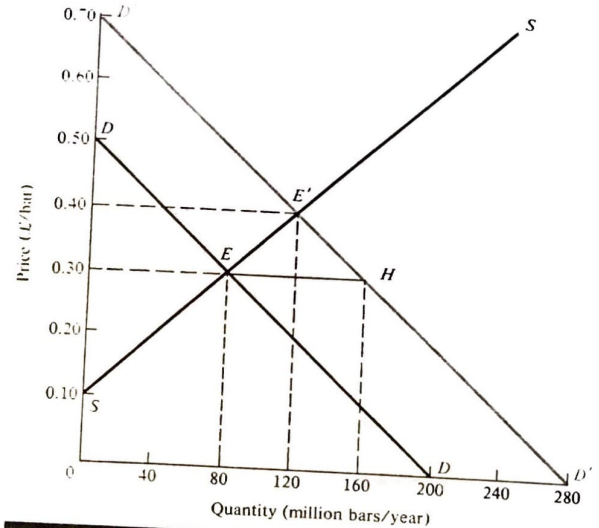


FIGURE 3-4 THE EFFECT OF AN INCREASE IN THE PRICE OF ICE CREAM ON THE DEMAND FOR CHOCOLATE. At low ice cream prices, the demand curve for chocolate is DD and market equilibrium occurs at the point E. Higher ice cream prices raise the demand for chocolate, shifting the demand curve to $D'D'$. At the former equilibrium price there is now excess demand EH, which gradually bids up the price of chocolate until the new equilibrium is reached at E'. Thus the equilibrium price and equilibrium quantity of chocolate rise when the demand curve shifts to the right.

We can draw two general lessons from this example. First, the quantity of chocolate demanded depends on four things: its own price, prices of related goods, incomes, and tastes. We could choose to draw a two-dimensional diagram showing the relation between quantity of chocolate demanded and any one of these four factors. The other three factors would then become the 'other things equal' for this particular diagram. In drawing demand curves, we always choose to single out the price of the commodity itself (here the price of chocolate bars) to put in the diagram with quantity demanded. The other three factors become the 'other things equal' for drawing a particular demand curve, and changes in any of these other three factors will shift the position of demand curves.

Why do we single out the price of the commodity itself to plot against quantity demanded? Chiefly because we are interested in how the market for chocolate works. Prices of related goods, incomes, and tastes are all determined elsewhere in the economy. In particular, by focusing on the price of chocolate, we have been able to show the self-correcting mechanism by which the chocolate market reacts to excess demand or excess supply, inducing changes in chocolate prices within the chocolate market to restore market equilibrium.

Second, our example provided an introduction to the method of analysis by *comparative statics*. This method is commonly used in economics. We began at the equilibrium E in Figure 3-4. Then we changed one of the 'other things equal' categories (here the price of ice cream), which shifted the demand curve and led to a new equilibrium at the point E'. Comparing the equilibrium at E and the equilibrium at E', we can say that a rise in the price of ice cream leads to a rise in the equilibrium price of chocolate and a rise in the equilibrium quantity of chocolate.

> In *comparative static analysis* we change one of the 'other things equal' categories and examine the effect on equilibrium price and quantity.

The analysis is comparative because it compares the old and new equilibrium positions, and it is static because it compares only the two equilibrium positions. In each equilibrium, prices and quantities are unchanging. Comparative static analysis is not interested in the dynamic path by which the economy moves from one equilibrium to the other, only in the point from which it began and the point at which it ends up.

Figure 3-4 may also be used to analyse the effect of a change in one of the 'other things equal' which reduces the demand for chocolate. Suppose the demand curve is initially $D'D'$ and the market begins in equilibrium at the point E'. Let there be a change that reduces the demand for chocolate to DD. This change might be a fall in the price of a chocolate substitute such as ice cream, a fall in consumer incomes, or a change in tastes away from liking chocolate. When the demand curve shifts left to DD, showing less chocolate demanded at each price, the new equilibrium will be given at the point E. At the original price of £0.40 there will be excess supply, which will gradually bid prices down to the new equilibrium price of £0.30. When the demand curve shifts to the left, there is a fall in both the equilibrium price and the equilibrium quantity.

3-6 BEHIND THE SUPPLY CURVE

Before discussing changes that shift supply curves, we discuss in greater detail why increases in price increase the quantity supplied, holding constant all other factors. At low prices, only the most efficient chocolate producers will be able to make any profits producing chocolate. As prices rise, producers who could not previously compete will find that they can now make a profit in the chocolate business and will wish to supply. Moreover, previously existing firms may be able to expand output by working overtime, or buying fancy equipment not justified when selling chocolate at lower prices. In general, higher prices are needed to provide an incentive for firms to produce more chocolate. Other things equal, supply curves slope upward as we move to the right.

Just as we investigated the 'other things equal' along a demand curve, we now examine three categories of 'other things equal' along a supply curve. These categories are: technology available to producers, the cost of inputs (labour, machines, fuel, and raw materials), and government regulation. Along any particular supply curve, all of these are held constant. A change in any of these categories will shift the supply curve by changing the amount producers wish to supply at each price.

Technology

A supply curve is drawn for a given technology. An improvement in technology will shift the supply curve to the right since producers will be willing to supply a larger quantity than previously at each price. An improvement in cocoa refining makes it possible to produce more chocolate for any given total cost. So do improvements in mass production packaging techniques. Faster shipping and better refrigeration may lead to less wastage in spoiled cocoa beans. Each of these technological advances enables firms to supply more at each price.

As a determinant of supply, technology must be interpreted very broadly. It embraces all know-how about production methods, not merely the state of available machinery. In agriculture, the development of disease-resistant seeds is a technological advance. Improved weather forecasting might enable better timing of planting and harvesting. A technological advance is any idea that allows more output from the same inputs as before. Using the terminology of Chapter 1, a technological advance shifts the production possibility frontier outwards.

Input Costs

A particular supply curve is drawn for a given level of input prices. A reduction in input prices (lower wages, lower fuel costs) will induce firms to supply more output at each price, shifting the supply curve to the right. Higher input prices make production less attractive and shift the supply curve to the left. For example, if a late frost destroys much of the cocoa crop, the ensuing scarcity will bid up the price of cocoa beans. Chocolate producers will then wish to supply less chocolate at each price than previously.

Government Regulation

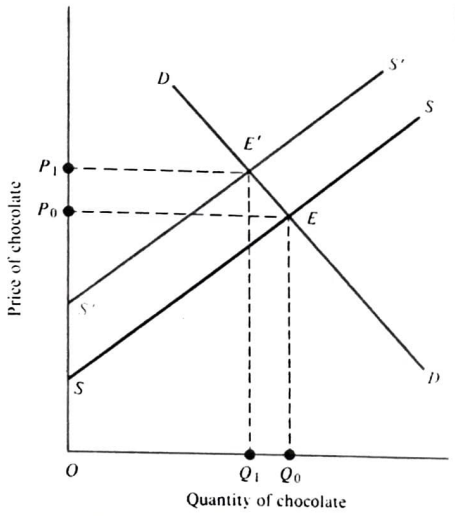
In discussing technology we spoke only of technological advances. Once people have discovered a better production method they are unlikely subsequently to forget it. Government regulations can sometimes be viewed as imposing a technological change that is *adverse* for producers. If so, the effect of regulations will be to shift the supply curve to the left, reducing quantity supplied at each price.

More stringent safety regulations may prevent chocolate producers using the most productive process because it is quite dangerous to workers. Anti-pollution devices may raise the cost of making cars, and regulations to protect the environment may make it unprofitable for firms to extract surface mineral deposits which could have been cheaply quarried but whose extraction now requires expensive landscaping. Whenever government regulations prevent producers from selecting the production methods they would otherwise have chosen, the effect of these regulations is to shift the supply curve to the left.

3-7 SHIFTS IN THE SUPPLY CURVE

Along a given supply curve we hold constant technology, the prices of inputs, and the extent of government regulation. We now undertake a comparative static analysis of what happens when a change in one of these 'other things equal' categories leads to a reduction in supply. Suppose, for example, that an increase in the stringency of safety legislation makes it more expensive to produce chocolate bars in highly mechanized factories. In Figure 3-5 we show a shift to the left in the supply curve from SS to $S'S'$. If we wish to know only the direction, but not the magnitude, of the change in equilibrium price and quantity, it is not necessary to put scale units on the horizontal and vertical axis. Equilibrium shifts from the point

FIGURE 3-5 THE EFFECT OF A REDUCTION IN THE SUPPLY OF CHOCOLATE. The supply curve initially is SS and market equilibrium is at E. A reduction in the supply of chocolate shifts the supply curve to the left and is shown by the new supply curve $S'S'$. The new equilibrium at E' has a higher equilibrium price and a lower equilibrium quantity than the old equilibrium at E.



E to the point E'. Thus equilibrium price rises but equilibrium quantity falls when the supply curve shifts to the left. Conversely, a supply curve shift to the right can be analysed by supposing the supply curve is initially $S'S'$ and the market is in equilibrium at the point E'. A change that increases supply will shift the supply curve to the right, say to the position shown by the supply curve SS. The new equilibrium will be at the point E. Thus an increase in supply leads to a higher equilibrium quantity and a lower equilibrium price.

3-8 THE POPE AND THE PRICE OF FISH

Hypothetical examples are all very well, but it is reassuring to learn that demand and supply analysis works in practice. We report an interesting example based on research by Frederick Bell.[1]

[1] Frederick W. Bell, 'The Pope and the Price of Fish', *American Economic Review*, December 1968.

Until 1966 Roman Catholics were not allowed to eat meat on Fridays and tended to eat fish instead. In 1966 the Pope said that henceforth Catholics could eat meat on Friday. What do you think happened to the average weekly price of fish and average weekly quantity of fish consumed?

In 1966 we should expect the demand curve for fish to shift to the left as in Figure 3-6. Some Catholics who had previously been forced to eat fish no doubt preferred to eat meat and would substitute meat for Friday fish when allowed to do so. This is a simple example of the effect of a change in tastes on the demand curve. Our model predicts that the demand curve should shift from DD to $D'D'$, leading to a fall in the equilibrium price and quantity of fish as equilibrium shifts from the point E to the point E'.

Using data on fish prices and quantities of fish sales in the United States before and after 1966, Bell shows that this is precisely what happened.

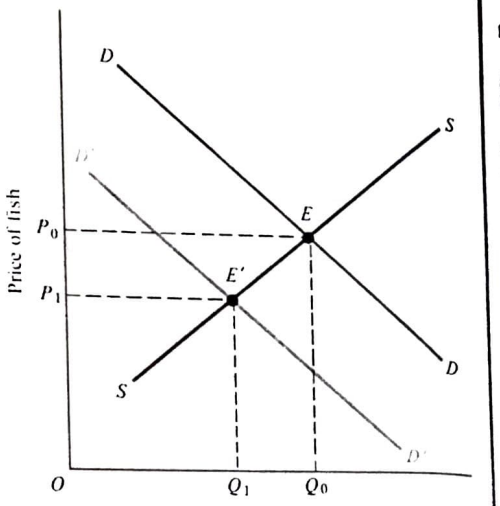


FIGURE 3-6 THE POPE AND THE PRICE OF FISH. Allowing Catholics to eat meat on Fridays leads to a change in tastes for fish. The demand curve shifts from *DD* to *D'D'* and the equilibrium moves from *E* to *E'*. The equilibrium price and quantity of fish fall.

3-9 FREE MARKETS AND PRICE CONTROLS

Free markets allow prices to be determined purely by the forces of supply and demand.

Government actions may shift demand and supply curves, as when changes in safety legislation shift the supply curve, but the government makes no attempt to regulate prices directly. If prices are sufficiently flexible, the pressure of excess supply or excess demand will quickly bid prices in a free market to their equilibrium level. Markets will not be free when effective price controls exist.

Price controls are government rules or laws that forbid the adjustment of prices to clear markets.

Price controls may be *floor* prices (minimum prices) or *ceiling* prices (maximum prices).

Price ceilings make it illegal for sellers to charge more than a specific maximum price and are typically introduced when a shortage of a commodity threatens to raise its price by a substantial amount. High prices are the device by which a free market rations goods in scarce supply. Although high prices are one way to solve the allocation problem, ensuring that only a small quantity of the scarce commodity will be demanded, they may lead to a solution that society believes to be unfair, a normative value judgement. For example, high food prices may lead to considerable hardship among the poor. Faced with a national food shortage, a government might prefer to impose a price ceiling on food so that poor people can continue to buy adequate quantities of food.

In Figure 3-7 we show the market for food. Perhaps war has disrupted imports of food. The supply curve lies far to the left and the free market equilibrium price P_0 is very high. Instead of allowing free market equilibrium at the point *E*, the government imposes a price ceiling at P_1. The quantity sold is then Q_1 and excess demand is given by the distance *AB*. The price ceiling creates

BOX 3-1

AN IMPORTANT DISTINCTION: MOVEMENTS ALONG A CURVE AND SHIFTS OF THE CURVE ITSELF

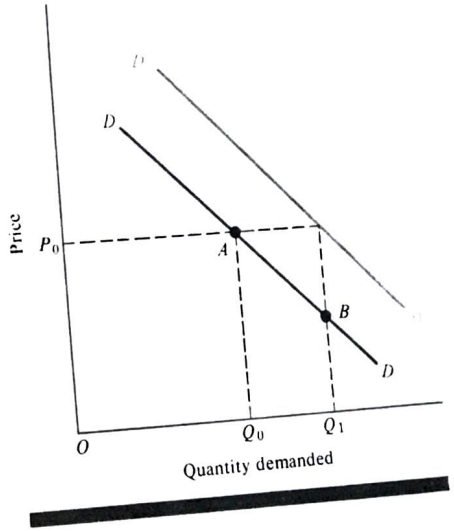
In everyday language we refer to an increase in demand without distinguishing between *shifts* in the demand curve and *movements along* a given demand curve. The accompanying figure shows that, from the point *A* on the demand curve *DD* two quite different 'increases in demand' are possible. One is an increase in the quantity demanded, moving along the curve from *A* to *B*. Such an increase in quantity demanded results from consumer adjustment to a reduction in price.

The second is a shift in the entire demand curve from *DD* to *D'D'*. At the going price P_0 the consumer used to purchase Q_0 but now purchases Q_1. This shift in demand is the response to an increase in the price of a substitute good (decrease in the price of a complement good), an increase in income, or a change of tastes.

The distinction between the two kinds of demand change is very important. Movement along the demand curve represents consumer adjustment to changes in the market price. Shifts in demand, by contrast, represent adjustment to outside factors (other prices, income, tastes) and lead in turn to changes in the equilibrium price and quantity.

The same distinction between movements along a schedule and shifts in the schedule applies on the supply side. Sellers adjust to higher prices by moving along the supply curve. But changes in input prices, technology, or regulation shift the supply curve.

Other things equal, changes in price move us along demand and supply curves. 'Other things equal' is an important reminder that the price of a good is only one determinant of demand and supply. When other determinants change, they lead to shifts in the schedules.



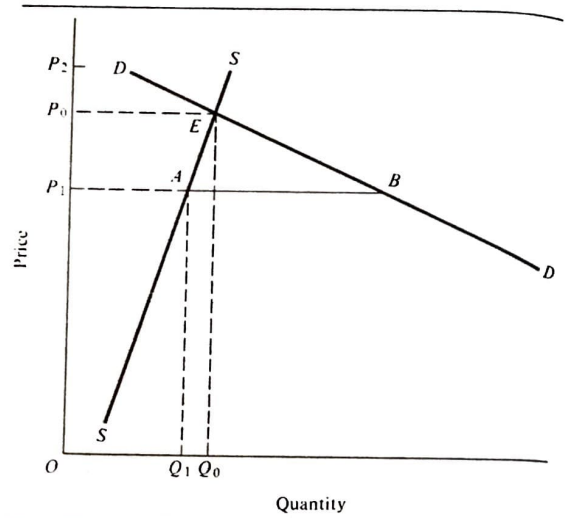


FIGURE 3-7 THE EFFECT OF A PRICE CEILING. Since supply is scarce, the supply curve *SS* lies well to the left. Free market equilibrium occurs at the point *E*. The high price P_0 chokes off quantity demanded to ration scarce supply. A price ceiling at P_1 succeeds in holding down the price but leads to excess demand *AB*. It also reduces quantity supplied from Q_0 to Q_1. A price ceiling at P_2 is irrelevant since the free market equilibrium at *E* can still be attained.

a shortage of supply relative to demand by holding food prices below their equilibrium level.[2]

The ceiling price P_1 allows some of the poor to buy food they could not otherwise have afforded. However, it has reduced total food supplied from Q_0 to Q_1. Furthermore, since there is excess demand *AB* at the ceiling price, some form of rationing must be used to decide which potential buyers are actually supplied. This rationing system could be highly arbitrary. Food suppliers may reserve supplies for their friends, not necessarily the poor. Indeed, suppliers may even accept bribes from those who can afford to pay to jump the queue. We should then say a 'black market' had developed. Holding down the price of food might not help the poor after all. For this reason, the imposition of ceiling prices may be accompanied by government-organized rationing by quota, as in the UK during the Second World War, to ensure that available supply is shared out fairly, independently of ability to pay.

Where price controls are maintained for many years they may have further repercussions. Many countries, including the UK, have imposed rent controls limiting the rent a landlord can charge tenants for accommodation. Intended to provide cheap housing for the poor, such legislation may have perverse effects, as Figure 3-8 illustrates. When the legislation is first introduced, the supply curve *SS* may be very steep. Existing landlords cannot quickly put their accommodation to other uses. Hence a reduction in rents may scarcely diminish the quantity of rental housing supplied. In the short run the total quantity supplied at the ceiling rent R_1 is only a little less than the free market equilibrium quantity Q_0. As time elapses, however, some landlords will respond to lower rents by converting their property for their own use or for sale to purchasers who wish to own their own home. After some time, the supply curve will become flatter, reaching the position *S'S'*. The rent control R_1 now leads to a large reduction to Q_2 in the quantity of rental accommodation supplied. Shortages increase, and less and less housing is available for the poor who cannot afford to buy their own houses.

[2] Notice that a price ceiling imposed at P_2 above the equilibrium price would simply be irrelevant. The free market equilibrium at *E* could still be attained and the price control would make no difference.

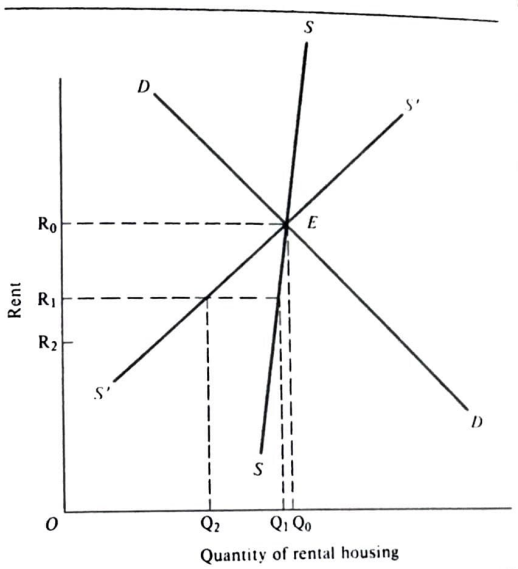


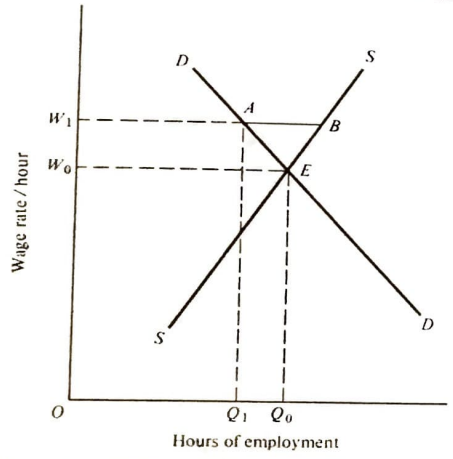
FIGURE 3-8 THE EFFECT OF A RENT CEILING. Given the demand curve *DD* and the supply curve *SS*, free market equilibrium occurs at *E*. If a rent ceiling at R_1 is introduced, initially the quantity supplied falls only from Q_0 to Q_1. Over time, quantity supplied becomes more sensitive to rent and the supply curve rotates to *S'S'*. Rent control now induces a much larger decrease in quantity supplied, which falls to Q_2.

Indeed, this problem may be exacerbated by inflation. Rent ceilings are usually fixed in nominal terms – so many pounds per week. If rent ceilings are not raised in line with inflation, real rents fall. This has the same effect as a reduction in nominal rent ceilings when there is no inflation. It is as if rent ceilings had been reduced to R_2 in Figure 3-8. Quantity supplied falls yet further and shortages or excess demand increase still further. Countries such as the UK, which have had rent ceilings for many years and have failed to raise nominal ceilings in line with inflation, have seen the steady erosion of the supply of rental accommodation as private landlords have quit the business.

Price controls need not have these consequences. We could raise ceiling prices in line with inflation to maintain their real value, and devise fair rationing systems to cope with shortages and excess demand. What should be recognized is the severe administrative burden of operating such a system of controls, both in deciding when and by how much to change the nominal ceiling price and in ensuring that the rationing system works fairly, for it is clearly open to abuse. Only when it is known how a particular system will operate in practice will it be possible to allow society to make a sensible choice between the equilibrium that a free market would determine and the allocations that a controlled market would imply.

Whereas the aim of a ceiling price is to reduce the price for consumers, the aim of a floor price is to raise the price for producers or suppliers. One example of a floor price is a national minimum wage rate per hour, which raises the wage rate received by suppliers of labour. Figure 3-9 shows the demand curve and supply curve for labour. At

FIGURE 3-9 THE EFFECT OF A MINIMUM WAGE. The demand curve for hours DD and the supply curve of hours SS imply free market equilibrium at the point E. A legal minimum wage at W_1 raises hourly wages for those who remain employed but reduces the quantity of hours of employment available from Q_0 to Q_1.



higher wage rates, buyers of labour (firms) demand less labour but suppliers of labour (households) wish to sell more labour. The free market equilibrium is at the point E, where the wage rate is W_0. A minimum wage below W_0 will be irrelevant since the free market equilibrium can still be attained. Suppose, in an effort to help workers, the government imposes a minimum wage at W_1. Firms will demand the quantity Q_1 and there will be excess supply AB. The lucky workers who manage to sell as much labour as they wish will be better off than before, but some workers may be worse off since total number of hours worked has fallen from Q_0 to Q_1.

Many countries set floor prices for agricultural products. Figure 3-10 shows a floor price P_1 for butter. In previous examples we have assumed that the quantity traded would be the smaller of quantity supplied and quantity demanded at the controlled price since private individuals cannot be forced to participate in a market. There is however another possibility: the government may intervene not only to set the control price but also to buy or sell quantities of the good to supplement private purchases and sales.

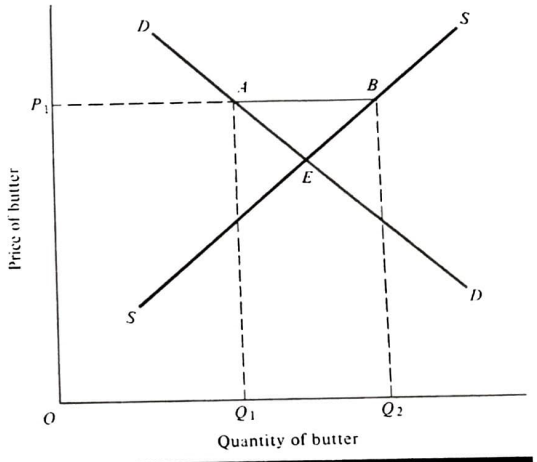
At the floor price P_1 private individuals demand Q_1 but supply Q_2. In the absence of government sales or purchases the quantity traded will be Q_1, the smaller of Q_1 and Q_2. However, the government may agree to purchase the excess supply AB so that neither private suppliers nor private demanders need be frustrated. Because European butter prices are set above the free market equilibrium price as part of the Common Agricultural Policy, European governments have been forced to purchase massive stocks of butter which would otherwise have been unsold at the controlled price. Hence the famous 'butter mountain'.

3-10 DO BUYERS AND SELLERS RESPOND TO PRICE CHANGES?

A key feature of our model of a market is the assumption that buyers and sellers respond to prices. In previous sections we have emphasized comparative static results in analysing free markets. For example, we have seen that an increase in demand will shift the demand curve to the right, increasing both the *equilibrium price* and the *equilibrium quantity*. Similarly, an increase in supply will shift the supply curve to the right, increasing equilibrium quantity but reducing equilibrium price.

For these results to be of much interest we have to believe that the market is usually close to its equilibrium. When supply or demand curves shift, the excess supply or demand at the former equilibrium price initiates price movements that quickly take the market towards its new equilibrium position. For this reasoning to be valid we need the absence of price controls or other restrictions on price adjustment, and we also require that price adjustments by themselves be capable of restoring equilibrium by inducing changes in the quantity supplied and quantity demanded.

FIGURE 3-10 A FLOOR PRICE FOR BUTTER. At the floor price P_1 individuals wish to supply Q_2 units of butter but demand only Q_1 units. In the absence of government purchases of butter only Q_1 will be traded. By buying up the excess supply AB, the government can satisfy both suppliers and consumers at the price P_1.



We have already presented one example that suggests that we need not worry on this score. In Chapter 1 we discussed the OPEC oil price shocks. When OPEC restricted oil supplies in 1973-74 oil consumers had little possibility of quickly substituting other goods for oil as transport and heating fuel, and as an input to petrochemical processes. Since the quantity demanded was likely to be insensitive to the price, it was going to take an enormous price rise to balance quantity supplied and quantity demanded. Before the fact, few people expected the oil price to quadruple. Yet this was what was required to persuade reluctant consumers to economize on oil use and to persuade non-OPEC oil suppliers to extract every barrel of oil possible even from fields such as the North Sea, which were very expensive to exploit. In spite of all the problems, the oil market managed to return to its (new) equilibrium position quite quickly. The transitional period of excess demand, in which willing buyers could not find any sellers with unsold stocks, lasted only a few months.

If markets can cope with the OPEC oil shock they can probably cope with most things. A less dramatic, but still instructive, example is provided by the failure of the UK potato harvest in the mid-1970s because of adverse weather conditions. Table 3-3 shows the behaviour of the UK potato market during those years. Production and consumption of potatoes averaged around 5.5 million tonnes per annum until 1976, the long hot summer, when supply collapsed. Table 3-3 shows how the real price of potatoes responded in that year, rising to £123 per tonne in 1975 prices, more than four times its typical level. By 1978 supply had recovered and prices had fallen back to more usual levels. The high price of 1976 coped with

TABLE 3-3
THE UK MARKET FOR POTATOES

	1973–75	1976	1977	1978	1979–84
Annual consumption (million tonnes)	5.5	4.8	5.4	5.9	5.9
Real price (1975 £/tonne)	38	123	52	27	32

Source: CSO, *Annual Abstract of Statistics*, and *Monthly Digest of Statistics*.

the domestic harvest failure chiefly by choking off the quantity demanded but also partly by making it profitable to import potatoes in spite of the transport costs. Imports of potatoes rose slightly in 1976 to supplement home supply.

In the following chapter we shall encounter additional examples of markets at work, for example in dealing with the coffee frost in Brazil in 1977 when the major source of world coffee supply was disrupted.

BOX 3-2

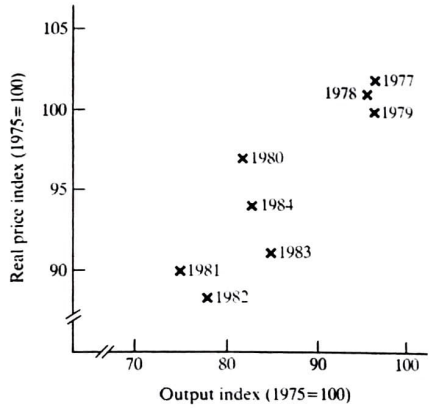
ANATOMY OF PRICE AND QUANTITY CHANGES

The accompanying figure shows data for the real price of timber in the UK and for the quantity of timber produced. Economists are frequently confronted with such data and asked to interpret them. How can we tell what was happening in the UK timber market? Was it a shift in demand, in supply, or in both that caused the low real price and low quantity in 1981–82?

The timber market is a free market. It is probably reasonable to suppose that all the observations represent *equilibrium* prices and quantities. Thus each observation can be viewed as the intersection of a demand and a supply curve. Next, we ask what changes in the 'other things equal' determinants of supply and demand may have led to shifts in supply and demand curves and hence to changes in equilibrium price and quantity. Is it possible that all shifts are supply curve shifts? Try drawing a diagram with a given demand curve and a shifting supply curve. The equilibrium points you will trace out all lie on the given demand curve. If only supply shifts we expect a negative relation between price and quantity. We must rule out this explanation since the data shows that low prices tend to be associated with low quantities.

Suppose the supply curve is fixed but the demand curve shifts. The equilibrium points then all lie on the supply curve and exhibits a positive relation between price and quantity. That fits the data much better.

Of course, in practice there will be shifts in both demand and supply curves. The points in the scatter diagram suggest large fluctuations in the demand curve but relatively small shifts in the supply curve. Try drawing this for yourself. Over this period, demand shifts are much more important in the UK timber market than the supply shifts. In 1980 the demand curve shifted to the left, and it did so again in 1981. This led to falls in both equilibrium price and equilibrium quantity in those years. After 1982, the demand curve shifted to the right again.



Having made a diagnosis, we now attempt to gather corroborating evidence. The volume of construction activity is an important determinant of the demand for timber. An index of UK construction output (1975 = 100) shows that, from an average level of 101.5 for the period 1977–79, construction output fell to 95.9 in 1980 and 84.9 in 1981. This recession in the building industry led to a leftward shift in the demand for timber.

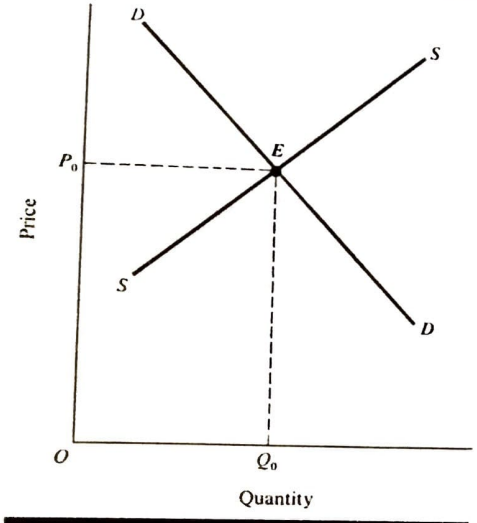
Examining price and quantity data, it is sometimes difficult to disentangle supply shifts and demand shifts. Given only the data from 1977–79, it would have been much harder to be confident that we could interpret the data correctly. Our example really has two lessons. By plotting a scatter diagram it may become evident that the points essentially lie along either a supply curve or a demand curve, suggesting it was the other curve that was shifting. However, we should then bring our economic theory to bear in the search for corroborating evidence. Supply and demand have determinants that differ. Timber supply (the supply curve, *not* the equilibrium quantity supplied) has nothing to do with housing construction, whereas timber demand (the whole demand curve) has nothing to do with forest fires. Because we have an economic theory of what shifts supply or demand curves, we may be able to bring to bear independent evidence (housing starts and forest fires) to interpret the data even where the scatter diagram does not have any obvious pattern at first sight.

3-11 WHAT, HOW, AND FOR WHOM

The free market is one way for society to solve the basic economic questions what, how, and for whom to produce. In this chapter we have begun to see how the market allocates scarce resources among competing uses, and we should take stock of what we have learned.

In Figure 3-11 we show once more a demand curve, a supply curve, and the market equilibrium position *E*. The market decides how much of a good should be produced by finding the price at which the quantity demanded equals the quantity supplied. Other things being equal, more of a good is produced in market equilibrium the higher is the quantity demanded at each price (the further

FIGURE 3-11 FREE MARKET EQUILIBRIUM. Free market equilibrium occurs at the point E. The economy is producing for any consumer willing to purchase this good at price P_0. The producers are all suppliers of the good willing to produce at P_0.



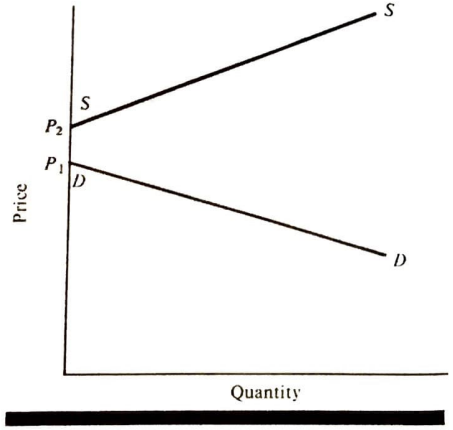
the demand curve lies to the right) and the higher the quantity supplied at each price (the further the supply curve lies to the right).

The market tells us for whom the goods are produced: in equilibrium, the good is purchased by all those consumers willing to pay at least P_0 per unit for the good. The market also tells us who is producing: all those willing to supply at a price of P_0 per unit. Later in this book we shall see that the market also tells us how goods are produced. To answer that question we shall have to learn more about the production side of the economy.

Finally, the market determines what goods are being produced. Nature supplies goods free of charge. People engage in costly production activities only if they are paid. The supply curve tells us how much has to be paid to bring forth quantities of supply. In Figure 3-11 the equilibrium price P_0 persuades producers to supply Q_0. In contrast, Figure 3-12 shows an example of a good that will not be produced. The highest price, P_1, that consumers are prepared to pay is still insufficient to persuade producers to produce. Perhaps in the future technological advances will shift the supply curve sufficiently far to the right that it will then intersect the demand curve at a positive quantity and we shall observe the good in production (electric cars?). Alternatively, changes in taste may sufficiently raise the demand curve that again we will observe production of the good because demand now intersects supply at positive price and quantity (nuclear shelters?), even though consumers currently believe such things are simply not worth the price.

We have seen too that society may not like the answers the market provides. Free markets do *not* provide enough food for everyone to go without hunger, or enough medical care to treat all the sick. They provide food and medical care for those willing and *able to pay* the equilibrium price. Society may adopt the normative judgement

FIGURE 3-12 A GOOD THAT WILL NOT BE PRODUCED. Even P_1, the highest price consumers will pay, is lower than P_2, the minimum price producers require to produce any of this good.



that the poor should be able to enjoy more food and medical care than the free market provides them with. Society may also adopt the normative judgement that, although people are willing and able to pay for pornography, it would be socially better if this activity were banned. Few societies allow completely unrestricted free markets for all commodities. It is because society frequently decides that the allocation of resources should not be the allocation a free market would determine that governments intervene widely to alter the market outcome through direct regulation, taxation, and transfer payments such as unemployment benefit.

SUMMARY

1 Demand is the quantity of a good that buyers wish to buy at each price. Other things equal, the lower the price, the higher the quantity demanded. This relation between price and quantity demanded can be graphically depicted as a demand curve. Demand curves slope downwards.

2 Supply is the quantity of a good sellers wish to sell at each price. Other things equal, the higher the price, the higher the quantity. The supply curve shows graphically the relation between price and quantity supplied. Supply curves slope upwards.

3 The market clears, or is in equilibrium, when the price equates the quantity supplied and the quantity demanded. At this point supply and demand curves intersect or cross. At prices below the equilibrium price there is excess demand (shortage), which itself tends to raise the price. At prices above the equilibrium price there is excess supply (surplus), which itself tends to reduce the price. In a free market, deviations from the equilibrium price tend to be self-correcting.

4 Along a given demand curve, the other things assumed equal are the prices of related goods, consumer incomes, and tastes or habits.

5 An increase in the price of a substitutive good (or decrease in the price of a complement good) will raise the quantity demanded at each price. An increase in consumer income will increase demand for the good if the good is a normal good but decrease demand for the good if it is an inferior good.

6 Along a given supply curve the other things assumed constant are technology, the price of inputs, and the degree of government regulation. An improvement in technology, or a reduction in input prices, will increase the quantity supplied at each price.

7 Any factor inducing an increase in demand shifts the demand curve to the right, increasing equilibrium price and equilibrium quantity. A decrease in demand (leftward shift of the demand curve) reduces both equilibrium price and equilibrium quantity. Any factor increasing supply shifts the supply curve