the equilibrium price. We have already done this in our discussion of Figure 2.9 (page 30). As we know, the equilibrium price in this diagram is $3. For any price other than $3, there will be excess demand or excess supply. If quantity demanded is greater than quantity supplied, there is excess demand. If quantity supplied is greater than quantity demanded, there is excess supply.

You should review Figure 2.9 and calculate (on your own) the amount of excess supply or excess demand that arises at each price. Note that when P = $3, excess demand = excess supply = 0.

Test your understanding 2.7

1 You are given a demand function $Q_d = a–bP$, where a = 500 and b = 2, and a supply function $Q_s = c+dP$, where c = –100 and d = 2. P is in $ and Q is in thousand units per week. **(a)** Calculate the equilibrium price and quantity. **(b)** Plot the demand and supply functions for the price range P = $50 to P = $200, and identify the equilibrium price and quantity on your graph. **(c)** When P = $190, $170, $125, $85, determine whether there is excess demand or excess supply, and calculate the amount of this in each case. **(d)** Explain how excess demand and excess supply work to restore equilibrium in the market.

2 Using the demand and supply functions of question 1, assume due to a demographic change, 300 thousand more units per week are demanded at each price, while due to a technological change, 300 thousand more units per week are supplied at each price. **(a)** State the new demand and supply functions and plot them in your graph. **(b)** Calculate the new equilibrium price and quantity. **(c)** Explain why the new equilibrium price is the same as the initial one while the new equilibrium quantity is larger.

3 (a) Given the demand function $Q_d = 27–0.7P$ and the supply function $Q_s = –5+0.9P$, where P is in € and Q is in million units per month, calculate the equilibrium price and quantity. **(b)** Plot the demand and supply functions, and identify the equilibrium price and quantity on your graph. **(c)** When P = €10, €15, €25, €30, determine whether there is excess demand or excess supply, and calculate the amount of this in each case. **(d)** Assume that the slope of the demand function falls to –0.9. State the new demand function, and **(e)** outline the effect on the steepness of the demand curve. **(f)** Assume the slope of the supply function falls to 0.7. State the new supply function, and **(g)** outline the effect on the steepness of the supply curve.

2.6 The role of the price mechanism and market efficiency

The role of the price mechanism in resource allocation

Prices determined by the forces of supply and demand in competitive markets serve some important functions that we now turn to.

Scarcity, choice and opportunity cost in resource allocation

♦ Explain why scarcity necessitates choices that answer the 'What to produce?' question.
♦ Explain why choice results in an opportunity cost.

In Chapter 1 we saw that the condition of scarcity forces societies to make choices. As the production possibilities model illustrated (Figure 1.1, page 5), assuming the economy is producing on its production possibilities curve (*PPC*), it must decide on what particular point on the *PPC* it wishes to produce. This involves a choice about *what to produce*, which is a decision on one aspect of resource allocation. It also involves a choice about which of its available resources and in what quantities, it will allocate to produce the combination of goods and services it has chosen. This is a choice on the *how to produce* question of resource allocation.

Now if a society decides to change the combination of goods it wishes to produce, in other words move from one point to another on its *PPC*, it will reallocate its resources, meaning that a new answer will be given to the *what to produce* and *how to produce* questions. Such a resource reallocation can be seen in the economy's move from point B to point C on the *PPC* of Figure 1.1. Note that this reallocation of resources involves an *opportunity cost*, since in order to produce more of one good, there must be a sacrifice of another good. In the model of Figure 1.1, an increase in computer production from 17 to 25 units in the move from point B to point C has an opportunity cost (or sacrifice) of 9 (= 35–26) microwave ovens.

The condition of scarcity forces societies to make choices about the *what to produce* economic question, which is a resource allocation question. Choices involve an opportunity cost because of foregone (or sacrificed) alternatives that could have been chosen instead.

This brings us to an important question. How does a society make a choice about where to be on its *PPC*?

Who decides, and how is this decision carried out? In a market economy, it is simply prices in free markets, resulting from the interactions of demanders and suppliers, which make the decisions and carry them out.

Prices as signals and incentives and the allocation of resources

♦ Explain, using diagrams, that price has a signalling function and an incentive function, which result in a reallocation of resources when prices change as a result of a change in demand or supply conditions.

We have learned that when markets operate under competitive conditions, market demand and market supply, composed of numerous individual demanders and suppliers, determine equilibrium prices and quantities for goods (and services and resources). At these equilibrium positions, the buying and selling choices of all buyers and sellers are satisfied and are in balance. This market mechanism, working through prices, is known as the *invisible hand of the market*, a phrase first used by Adam Smith, the famous Scottish economist of the 18th century known as the 'Father of Economics'. The invisible hand succeeds in co-ordinating the buying and selling decisions of thousands or millions of decision-makers in an economy without any central authority. The *what to produce* question of resource allocation is answered because firms produce only those goods consumers are willing and able to buy, while consumers buy only those goods producers are willing and able to supply; and the *how to produce* question of resource allocation is answered because firms use those resources and technologies in their production process that they are willing and able to pay for.

How do prices and markets achieve the task of resource allocation?

The key to the market's ability to allocate resources can be found in the role of **prices as signals** and **prices as incentives**. As signals, prices communicate information to decision-makers. As incentives, prices motivate decision-makers to respond to the information.

We will examine the signalling and incentive functions of prices by use of the following two examples.

An example from a product market

Suppose consumers decide they would like to eat more strawberries because of their health benefits (a change in tastes); demand increases and the demand curve shifts to the right from D_1 to D_2 in Figure 2.16(a). At the initial price, P_1, this results in a shortage equal to the
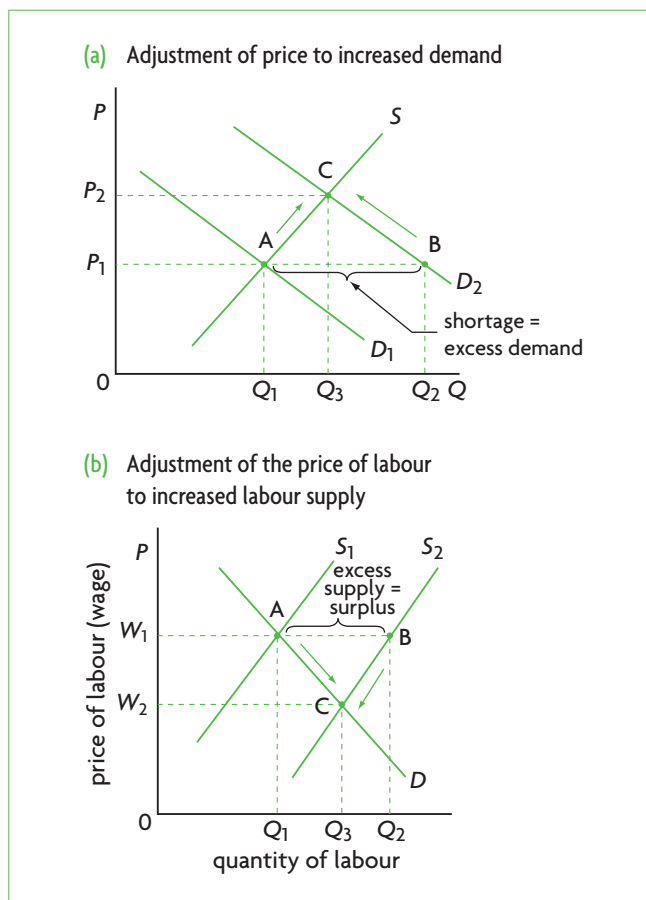

(a) Adjustment of price to increased demand

(b) Adjustment of the price of labour to increased labour supply

Figure 2.16 Price as a signal and incentive

difference between Q_2 and Q_1: the quantity demanded Q_2, due to the increase in demand to D_2, is larger than quantity supplied, Q_1. The price of strawberries therefore begins to rise, and will continue to rise until the shortage has disappeared. This happens at price P_2 and quantity Q_3, given by the point of intersection of the supply curve with the new demand curve, D_2.

What has happened? The new, higher price signalled or conveyed information to producers that a shortage in the strawberry market had emerged. The increase in price is also an incentive for producers to increase the quantity of strawberries supplied; at the higher price, strawberry production is more profitable, so producers move along the supply curve from point A to point C, increasing quantity supplied from Q_1 to Q_3. But the new, higher price is a signal and incentive for consumers: it signals that strawberries are now more expensive, and is an incentive for them to buy fewer strawberries. They therefore move along the new demand curve from B to C, buying fewer strawberries than at the original price P_1 (Q_3 is smaller than Q_2). The increase in the price of strawberries resulted in a *reallocation of resources*. More resources are now allocated to strawberry production. (This affects the answer to the *what to produce* question of resource allocation.)

An example from a resource market

The second example is from the labour market (a resource market). The vertical axis in Figure 2.16(b) measures the price of labour (the wage) and the horizontal axis the quantity of labour. Firms are interested in buying labour services, and their demand for labour is given by D. Owners of labour services (workers) supply their labour in the labour market, and the initial supply of labour is shown by S_1.[3]

Assume that because of immigration (foreign workers enter the country), the supply of labour increases, so the labour supply curve shifts to S_2. At the old wage, W_1, there is a surplus of labour shown by the difference between Q_2 and Q_1 of labour. The surplus causes the wage to start falling, and this falls until the surplus has disappeared. The new equilibrium wage is W_2, and the equilibrium quantity of labour Q_3, given by the intersection of D with S_2.

The falling wage has acted as a signal and an incentive. It signalled to firms that there was a surplus in the labour market, and it provided them with an incentive to hire more labour; therefore, they move along the labour demand curve from point A to point C (Q_3 is larger than Q_1). The lower wage is also a signal to workers, providing them with the incentive to move along the new supply curve, S_2, from B to C, where they offer less of their services at the lower wage (Q_3 is less than Q_2). With firms and workers responding to price signals and incentives, there occurred a reallocation of labour resources with firms now producing output with a larger quantity of labour. (This affects the answer to the *how to produce* question of resource allocation.)

Test your understanding 2.8

1 Using the production possibilities model, explain the relationship between scarcity, choice and opportunity cost.

2 What is the relationship between scarcity, choice and the *what to produce* basic economic question? How does this relate to resource allocation?

3 How do prices help answer the *how* and *what to produce* questions of resource allocation?

4 Consider the market for coffee, and suppose that the demand for coffee falls (because of a fall in the price of tea, a substitute good), leading to a new equilibrium price and quantity of coffee. Using diagrams, explain the role of price as a signal and as an incentive for consumers and for firms in reallocating resources.

5 Consider the labour market, and suppose the supply of labour falls (due to large-scale departure of workers to another country), resulting in a new equilibrium price and quantity of labour. Using diagrams, explain the role of price as a signal and as an incentive for workers (the suppliers of labour) and firms (the demanders of labour) in reallocating resources.

Real world focus

Rising prices of wheat and corn

Over the last few years, global demand for wheat has increased, driving wheat prices up. Whereas the price per bushel of wheat was $3.15 in 2006, this had climbed to about $7.00 in the summer of 2010. In the United States, there are expectations that more farmland will be planted to wheat as farmers try to take advantage of the highest wheat prices in years. Farmers are already clearing land for the fall (autumn) wheat planting.

In the meantime, a massive drought reduced the wheat crop by at least one-fifth in Russia, causing a wheat shortage. Russia had been a major wheat exporter, but the Russian government said it will ban wheat exports this year.

Corn prices have also been rising, due to moisture damage in corn plants that caused corn yields (output per unit of land) to fall. There are fears that higher corn prices will lead to higher meat prices, as corn is important feed for livestock, as well as higher ethanol prices (ethanol is a biofuel sometimes made of corn).

Source: Adapted from Mark Ranzenberger, 'Price of wheat rising' in *The Morning Sun*, 30 August 2010; Dan Piller, 'Rising corn prices also affect ethanol, cattle' in *Kansas City Star*, 13 October 2010.

Applying your skills

Using diagrams in each case, explain:

1 the effect of higher demand for wheat on wheat prices

2 the signalling and incentive role of wheat prices for US wheat farmers

3 the effect of the drought in Russia on the wheat market

4 the effect of higher corn prices on meat and ethanol prices.

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[3] The demand curve has the usual downward-sloping shape, because as the wage falls, firms are prompted to hire more labour and so the quantity of labour demanded increases. The supply curve has the usual upward-sloping shape because the higher the wage, the more willing workers will be to supply their labour in the market.

Efficiency in competitive markets

Efficiency broadly means making the best possible use of resources. We will now examine efficiency more closely and will study the role of competitive markets in achieving efficiency.

The meaning of efficiency in competitive markets

Economic efficiency is known more precisely as *allocative efficiency*, which refers to producing the combination of goods mostly wanted by society. In fact, it means more than this. Allocative efficiency is achieved when the economy allocates its resources so that no one can become better off in terms of increasing their benefit from consumption without someone else becoming worse off. In other words, the benefits from consumption are maximised for the whole of society.

If a society realises allocative efficiency, it must be the case that *productive efficiency* is also being achieved. Productive efficiency, introduced in Chapter 1 (page 5), refers to producing goods by using the fewest possible resources (producing at the lowest possible cost). As you may remember, productive efficiency is necessary for the economy to be producing on its *PPC*.

Why is it that we cannot have allocative efficiency for a society without having productive efficiency as well? The reasoning is the following. If there were productive *inefficiency*, some firms would not be using the fewest possible resources for their production. By getting rid of the inefficient firms through a reallocation of resources so that all production takes place by efficient firms, the economy would produce more output. It would then be possible to make some consumers better off without making anyone worse off. Therefore, as long as there is any productive inefficiency in the economy, it is not possible to have allocative efficiency.

While productive efficiency is necessary for achieving allocative efficiency, it is not enough. In addition, efficient producers must be producing the 'right' combination of goods that society prefers. A simple way to understand this is to consider that allocative efficiency is reached when a society produces and consumes *at its preferred point on its PPC*. Since productive efficiency is necessary to be on the *PPC*, it follows that achieving allocative efficiency means that productive efficiency is also achieved.

Since allocative efficiency refers to producing what consumers mostly want, it answers the *what to produce* question in the best possible way. Since productive efficiency means producing with the fewest possible resources, it answers the *how to produce* question

in the best possible way. As we will see below, the competitive market realises allocative (and therefore also productive) efficiency:

> The competitive market realises **allocative efficiency**, producing the combination of goods mostly wanted by society, thus answering the *what to produce* question in the best possible way. This means *productive efficiency* is also realised, involving production with the fewest possible resources, thus answering the *how to produce* question in the best possible way. These conditions are also known as *economic efficiency* or *Pareto optimality*.[4]

Introducing consumer and producer surplus

To understand how efficiency is achieved by the competitive market economy, we will study two new concepts:

- consumer surplus
- producer surplus.

Consumer surplus

> ◆ Explain the concept of consumer surplus.
> ◆ Identify consumer surplus on a demand and supply diagram.

Consumer surplus is defined as the highest price consumers are willing to pay for a good minus the price actually paid. In a competitive market, the price actually paid is determined at the market equilibrium by supply and demand. Consumer surplus is shown in Figure 2.17 as the shaded area between the demand (or marginal benefit) curve, and the equilibrium price P_e. It represents the difference between total benefits consumers receive from buying a good and the price paid to receive them.

Consumer surplus indicates that whereas many consumers were willing to pay a higher price to get the good, they actually received it for less. For example, many consumers were willing to pay price P_2 to get quantity Q_a, yet they got Q_a by paying only the lower price P_e. The difference between P_2 and P_e is consumer surplus for quantity Q_a. Similarly, many consumers were willing to pay price P_3 in order to get quantity Q_b, yet they got it by paying only P_e. Again, the difference $P_3 - P_e$ is consumer surplus for quantity Q_b. The same principle applies to all possible prices between
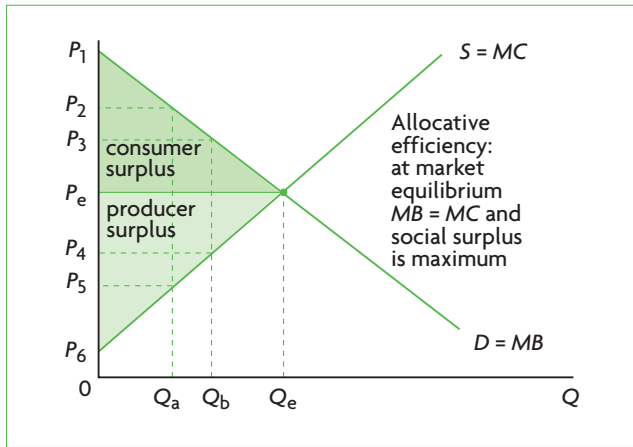

Figure 2.17 Consumer and producer surplus in a competitive market

the highest price P_1 and the equilibrium price P_e. Therefore, all the consumers who were willing to pay a higher price than P_e to get the good received some benefit over and above what they actually paid for the good. This extra benefit is called consumer surplus.

Producer surplus

Producer surplus is defined as the price received by firms for selling their good minus the lowest price that they are willing to accept to produce the good. The lowest price they are willing to accept represents the firms' cost of producing an extra unit of the good (or marginal cost), and is shown by the supply curve. (The logic behind this is very simple: the lowest price that the firm is willing to accept must be just enough to cover its cost of producing each extra unit; this cost is known as **marginal cost**, abbreviated as *MC*.) Producer surplus is shown as the area above the firms' supply curve and below the price received by firms, P_e, which is determined in the market. As we can see in Figure 2.17, firms that were willing to produce quantity Q_a for price P_5 actually received price P_e. The difference $P_e - P_5$ is producer surplus for quantity P_a. Similarly, the producer surplus for quantity Q_b is given by the price P_e actually received minus P_4 that the firms were willing to accept for producing Q_b. The same principle applies to all possible prices between the lowest price P_6 and the equilibrium price P_e. Therefore, producer surplus is shown by the shaded area between the equilibrium price P_e and the supply curve.

Competitive market equilibrium: maximum social surplus and allocative efficiency

Competitive market equilibrium and maximum social surplus

At the point of competitive market equilibrium, the sum of consumer and producer surplus is maximum, or the greatest it can be. To see why, consider what would happen if any quantity less than Q_e were produced in Figure 2.17. If, say, Q_b is produced, the sum of consumer plus producer surplus would be smaller, as this sum would be equal to the shaded area between the demand and supply curves *only up to output Q_b*. It follows, then, that the sum of consumer plus producer surplus is maximised at the point of market equilibrium. The sum of consumer and producer surplus is known as **social surplus** (or **community surplus**).[5]

At the point of competitive market equilibrium, social surplus, defined as the sum of consumer plus producer surplus, is maximum.

Let's now examine the importance of maximum social surplus at the point of competitive market equilibrium.

Market equilibrium and allocative efficiency

As we know, market equilibrium occurs at the point of intersection of the demand and supply curves, but depending on how we interpret the demand and supply curves, market equilibrium can be thought of differently. If we interpret the demand curve as a marginal benefit (*MB*) curve, and the supply curve as a marginal cost (*MC*) curve, then market equilibrium occurs where $MB = MC$. The equality of *MB* with *MC* tells us that the extra benefit to society of getting one more unit of the good is equal to the extra cost to society of producing one more unit of the good. When this happens, society's resources are being used to produce the 'right' quantity of the good; in other words, society has allocated the 'right' amount of resources to the production of the good, and is producing the quantity of the good that is mostly wanted by society. *This is none other than allocative efficiency*, and is shown in Figure 2.17.

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[5] Note that the term 'surplus' is used in two senses in this chapter. In one sense it refers to 'excess supply' (see page 31) and in the other it refers to benefits received by consumers and producers. You can avoid confusing the two concepts by noting that whenever the term is used on its own, it refers to excess supply.

(To understand this, consider that if $MB > MC$, then society would be placing a greater value on the last unit of the good produced than it costs to produce it, and so more of it should be produced. If $MC > MB$, then it would be costing society more to produce the last unit of the good produced than the value society puts on it, and so less should be produced. If $MC = MB$, then just the 'right' quantity of the good is being produced.)

Putting the above points together, we can conclude that at the point of competitive market equilibrium, where $MB = MC$, and where the sum of social (consumer plus producer surplus) is maximum, the economy achieves allocative (and therefore also productive) efficiency.[6] For allocative (and productive) efficiency to be achieved for an entire economy, the condition $MB = MC$, indicating maximum social surplus, must hold in all markets.

> At the point of competitive market equilibrium shown in Figure 2.17, production of a good occurs where $MB = MC$, which is also *where social surplus, or the sum of consumer plus producer surplus is maximum.* This means that markets are achieving allocative (as well as productive) efficiency, producing the quantity of goods mostly wanted by society at the lowest possible cost. Society is making the best possible use of its scarce resources.

When the competitive market realises allocative efficiency, we say that 'social welfare' is maximised. What does this mean? The term **welfare** in a general sense refers to the well-being of society. Here, it is being used in a special sense to refer to maximum social surplus, or where $MB = MC$. *Social welfare* in this context is part of a branch of economics called *welfare economics*, which examines the conditions under which competitive markets work well, meaning that they make the best possible use of scarce resources. We can therefore say that:

> In competitive markets, when $MB=MC$, or when social surplus is maximum, social welfare is maximum.

A word of caution

We have seen that the competitive market succeeds in achieving allocative (and productive) efficiency, thus addressing the *what to produce* and *how to produce* questions in the best possible way, ensuring the best possible use of scarce resources. This idea suggests that there should not be government intervention in markets, as these work very well on their own. However, there are two important issues that arise, calling into question the idea that governments should not intervene.

The first is that efficiency can only arise under a number of very strict and highly unrealistic conditions that are practically never met in the real world. In the real world the market fails with respect to achieving both allocative and productive efficiency. Market failures are an important justification for government intervention (see Chapter 5).

The second is that the competitive market is unable to provide a satisfactory answer to the *for whom to produce* question, or output and income distribution, thus also inviting some government intervention. The topic of distribution and what can be done to improve outcomes will be examined in Chapter 11. It is also discussed in the Theory of knowledge feature on page 45.

These observations do not lessen the significance of the market's potential advantages; they only point out that in the real world, there is a need for government policies to counteract the failings of markets, thus allowing them to realise their potential advantages. There are important reasons why economists study the competitive market extensively, even though this is not fully achievable in practice. One is that government policies undertaken for reasons unrelated to efficiency can be assessed with respect to their efficiency consequences (see Chapter 4). Another is that it can form the basis for government policies that try to create conditions in the real world that allow actual economies to come closer to achieving economic efficiency (see Chapter 5). A third is that it provides standards for economic efficiency against which actual outcomes, which are less than perfectly efficient, can be assessed (Chapters 4 and 7).

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[6] We can use the concept of producer surplus to explain why the achievement of allocative efficiency, where $MB = MC$, means the achievement also of productive efficiency. Suppose that firms in some markets are not producing at the lowest possible cost, i.e. they are productively inefficient. As they compete with each other to lower their costs, resources are transferred from the higher cost firms to lower cost firms. With lower costs, these firms will also have a lower minimum price they are willing to accept for selling their output, and therefore a greater producer surplus (since producer surplus is the price firms receive minus the lowest price they are willing to accept). Producer surplus will continue to increase as long as resources can be shifted out of higher cost producers and into lower cost producers, and will be maximised when all output is produced by firms producing at the lowest possible cost. Once the market produces at $MB = MC$, then it is no longer possible to increase producer surplus, and all producers are producing at the lowest possible cost.