chapter 15

Welfare economics

Learning outcomes

By the end of this chapter, you should understand:

1. what we mean by welfare economics
2. horizontal and vertical equity
3. the concept of Pareto efficiency
4. how the 'invisible hand' may achieve efficiency
5. the concept of market failure
6. why partial removal of distortions may be harmful
7. the problem of externalities and possible solutions
8. how monopoly power causes market failure
9. distortions from pollution and congestion
10. why missing markets create distortions

Chapter 1 noted that markets are not the only way society can resolve what, how and for whom to produce. Communist economies relied heavily on central direction or command. Are markets a good way to allocate scarce resources? What is a 'good' way? Is it fair some people earn much more than others in a market economy? These are not positive issues about how the economy works but normative issues about how well it works. They are normative because the assessment depends on the value judgements adopted by the assessor.

Welfare economics deals with normative issues. It does not describe how the economy works but assesses how well it works.

Left- and right- wing parties disagree about how well a market economy works. The right believes the market fosters choice, incentives and efficiency. The left emphasises the market's failings and the need for government intervention. What lies behind the disagreement? Two themes recur in our discussion of welfare economics in Part 3. The first is *allocative efficiency*. Is the economy getting the most out of its scarce resources or are they being squandered? The second is *equity*. How fair is the *distribution* of goods and services between different members of society?

15.1 Equity and efficiency

Horizontal equity is the identical treatment of identical people. **Vertical equity** is the different treatment of different people in order to reduce the consequences of these innate differences.

Equity

Whether or not either concept of equity is desirable is a pure value judgement. Horizontal equity rules out discrimination between people whose economic characteristics and performance are identical. Vertical equity is the Robin Hood principle of taking from the rich to give to the poor.

Many people agree that horizontal equity is a good thing. In contrast, although few people believe that the poor should starve, the extent to which resources should be redistributed from the 'haves' to the 'have-nots' to increase vertical equity is an issue on which people disagree.

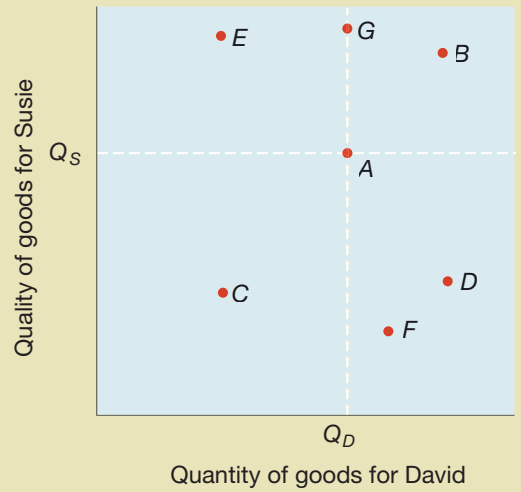
Efficient resource allocation

A resource allocation is a complete description of who does what and who gets what.

Suppose that allocations are made by a central dictator. Feasible allocations depend on the technology and resources available to the economy. The ultimate worth of any allocation depends on consumer tastes, which determine how people value what they are given.

Figure 15.1 shows an economy with only two people, David and Susie. The initial allocation at A gives David a quantity of goods Q_D and Susie a quantity Q_S. Are society's resources being wasted? By reorganizing things, suppose society can produce at B, to the north-east of A. If David and Susie assess utility by the quantity of goods they get themselves, and if they would each rather have more goods than fewer, B is a better allocation than A. Both David and Susie get more. It is inefficient to produce at A if production at B is possible. Similarly, a move from A to C makes both David and Susie worse off. If it is possible to be at A, it is inefficient to be at C.

Figure 15.1 Allocating goods to two people



Provided people assess their own utility by the quantity of goods that they themselves receive, B is a better allocation than A which in turn is a better allocation than C. But a comparison of A with points such as D, E or F, requires us to adopt a value judgement about the relative importance to us of David's and Susie's utility.

What about a move from A to E or F? One person gains, the other person loses. Whether this change is desirable depends on how we value David's utility relative to Susie's. If we think David's utility is very important we might prefer A to F, even though Susie's utility is reduced.

Value judgements about equity or fairness get mixed up with our attempt to make statements about waste or inefficiency. Since different people will make different value judgements, there is no unambiguous answer to the question of whether a move from A to D, E or F is desirable. It depends who makes the assessment.

For a given set of consumer tastes, resources and technology, an allocation is Pareto-efficient if there is no other feasible allocation that makes some people better off and nobody worse off.

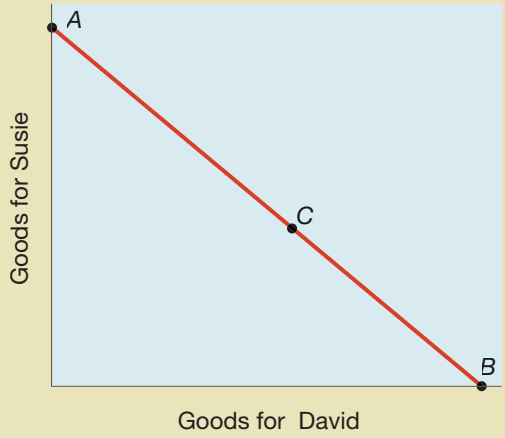
To try to separate the discussion of equity from the discussion of efficiency, modern welfare economics uses the idea of *Pareto efficiency* named after the economist Vilfredo Pareto.

In Figure 15.1 a move from A to B or A to G is a *Pareto gain*. Susie is better off, David no worse off. If B or G is feasible, A is *Pareto-inefficient*. A free lunch is available.

A move from A to D makes David better off but Susie worse off. The Pareto criterion has nothing to say about this change. To evaluate it, we need a judgement about the relative value of David's and Susie's utility. The Pareto principle is of limited use in comparing allocations on efficiency grounds. It only allows us to evaluate moves to the north-east or the south-west in Figure 15.1. Yet it is the most we can say about efficiency without making value judgements about equity.

Figure 15.2 takes the argument a stage further. By reorganizing production, we can make the economy produce anywhere inside or on the frontier AB. From inside the frontier, a Pareto

Figure 15.2 The efficient frontier



The frontier *AB* shows the maximum quantity of goods which the economy can produce for one person given the quantity of goods being produced for the other person. All points on the frontier are Pareto-efficient. David can only be made better off by making Susie worse off, and vice versa. The distribution of goods between David and Susie is much more equal at point *C* than at points *A* or *B*.

gain can be achieved by moving to the north-east on to the frontier. Any point inside the frontier is Pareto-inefficient. Someone can be made better off without making the other worse off. But *all* points on the frontier are Pareto-efficient. One person can get more only by giving the other person less. Since no Pareto gain is possible, every point on the frontier is Pareto-efficient.

Thus society should never choose an inefficient allocation inside the frontier. Which of the efficient points on the frontier is most desirable will depend on the value judgement about the relative value of David's and Susie's utility, a judgement about equity.

15.2 Perfect competition and Pareto-efficiency

Will a free market economy find a Pareto-efficient allocation, or must it be guided there by government intervention?

Competitive equilibrium in free markets

Suppose there are many producers and many consumers, but only two goods, meals and films. Each market is a free, unregulated market and is perfectly competitive. In equilibrium, suppose the price of meals is £5 and the price of films is £10. Labour is the variable factor of production and workers can move freely between industries. We now argue through seven steps.

1 The last film yields consumers £10 worth of extra utility. If it yielded less (more) extra utility than its £10 purchase price, the last consumer would buy less (more) films. Similarly, the last meal must yield consumers £5 worth of extra utility. Hence consumers could swap 2 meals (£10 worth of utility) for 1 film (£10 worth of utility) without changing their utility.
2 Since each firm sets price equal to marginal cost *MC*, the *MC* of the last meal is £5 and the *MC* of the last film is £10.

3 Labour earns the same wage rate in both industries in competitive equilibrium. Otherwise, workers would move to the industry offering higher wages.
4 The *MC* of output in either industry is the wage divided by the marginal physical product of labour *MPL*. Higher wages raise marginal cost but a higher *MPL* means fewer extra workers are needed to make an extra unit of output.
5 Wages are equal in the two industries but the marginal cost of meals (£5) is half the marginal cost of films (£10). Hence, the *MPL* is twice as high in the meal as in the film industry.
6 Hence reducing film output by 1 unit, transferring the labour thus freed to the meals industry, raises output of meals by 2 units. The *MPL* is twice as high in meals as in films. Feasible resource allocation between the two industries allows society to swap 2 meals for 1 film.
7 Step one says that consumers can swap 2 meals for 1 film without changing their utility. Step six says that, by reallocating resources, producers swap an output of 2 meals for 1 film. Hence there is no feasible reallocation of resources that can make society better off. Since no Pareto gain is possible, the initial position – competitive equilibrium in both markets – is Pareto-efficient.

Notice the crucial role that prices play in this remarkable result. Prices do two things. First, they ensure that the initial position of competitive equilibrium is indeed an *equilibrium*. By balancing the quantities supplied and demanded, prices ensure that the final quantity of goods being consumed can be produced. They ensure that it is a feasible allocation.

But in *competitive* equilibrium prices perform a second role. Each consumer and each producer is a price-taker and cannot affect market prices. In our example, each consumer knows that the equilibrium price of meals is £5 and the equilibrium price of films is £10. Knowing nothing about the actions of other consumers and producers, each consumer automatically ensures that the last film purchased yields twice as much utility as the last meal purchased. Otherwise that consumer could rearrange purchases out of a given income to increase her utility.

Thus by her individual actions facing given prices, each consumer arranges that 1 film could be swapped for 2 meals with no change in utility. Similarly, every producer, merely by setting its own marginal cost equal to the price of its output, ensures that the marginal cost of films is twice the marginal cost of meals. Thus it takes society twice as many resources to make an extra film rather than an extra meal. By rearranging production, transferring labour between industries, society can swap 2 meals for 1 film, exactly the trade off that leaves consumer utility unaffected.

Thus, as if by an 'invisible hand', prices are guiding individual consumers and producers, each pursuing only self-interest, to an allocation of the economy's resources that is Pareto-efficient. Nobody can be made better off without someone else being worse off.

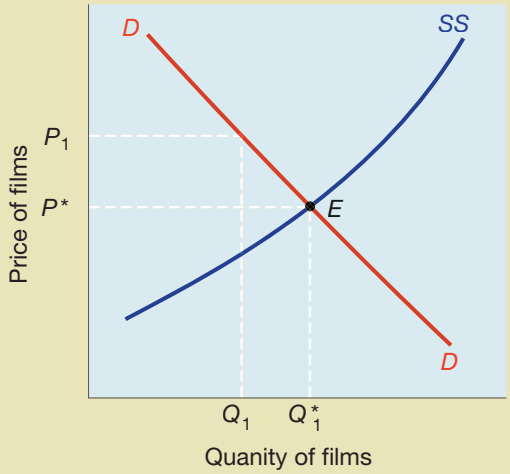
Figure 15.3 makes the same point. *DD* is the market demand curve for one of the goods, say films. At a price P_1 a quantity of films Q_1 is demanded. The last film demanded yields consumers P_1 pounds worth of utility, otherwise they would buy a different quantity. Hence *DD* shows also the marginal utility of the last unit of films that consumers purchase. When Q_1 films are purchased, the last film yields exactly P_1 pounds worth of extra utility to consumers.

In a competitive industry, the supply curve for films *SS* is also the marginal cost of films. The variable factor, labour, is paid its marginal value product in each industry. Labour mobility ensures wage rates are equal in the two industries. Hence the marginal cost of making the last film is the value of the meals sacrificed by using the last worker to make films not meals.

Prices ensure that both industries are in equilibrium. Figure 15.3 shows that in equilibrium at *E* the marginal utility of the last film equals its marginal cost. But the marginal cost of the last film is the value of meals sacrificed, the price of meals multiplied by the meals forgone

by using labour to make that last film. However, the meals industry is also in equilibrium. An equivalent diagram for the meals industry shows that the equilibrium price of meals is also the marginal utility of the last meal purchased. Hence the value of meals sacrificed to make the last film is also the marginal utility of the last meal times the number of meals sacrificed.

Figure 15.3 Competitive equilibrium and Pareto-efficiency



At any output such as Q_1 the last film must yield consumers P_1 pounds worth of extra utility; otherwise they would not demand Q_1. The supply curve *SS* for the competitive film industry is also the marginal cost of films. If the meals industry is in competitive equilibrium, the price of a meal is also the value of its marginal utility to consumers. Thus the marginal cost of a film is not only its opportunity cost in meals but is also the value of the marginal utility consumers would have derived from those meals. Hence at any film output below Q^* the marginal utility of films exceeds the marginal utility of meals sacrificed to produce an extra film. Above Q^* the marginal utility of films is less than the marginal utility of meals sacrificed. The equilibrium point *E* for films and the corresponding equilibrium point in the market for meals thus ensure that resources are efficiently allocated between the two industries. No reallocation could make all consumers better off.

Thus, provided the *meals* industry is in competitive equilibrium, the marginal cost curve for the *film* industry is the extra pounds worth of utility sacrificed by using scarce resources to make another film instead of extra meals. It is the opportunity cost in utility terms of the resources being used in the film industry. And equilibrium in the film industry, by equating the marginal utility of films to the marginal utility of the meals sacrificed to make the last film, guarantees that society's resources are allocated efficiently.

At any output of films below the equilibrium quantity Q^*, the marginal consumer benefit of another film exceeds the marginal consumer valuation of the meals that would have to be sacrificed to produce that extra film. At any output of films above Q^*, society is devoting too many resources to the film industry. The marginal value of the last film is less than the marginal value of the meals that could have been produced by transferring resources to the meals industry. Competitive equilibrium ensures that there is no resource transfer between industries that would make all consumers better off.

Equity and efficiency

The previous section showed that there are many Pareto-efficient allocations, each with a different distribution of utility between different members of society. A competitive equilibrium in all markets generates a particular Pareto-efficient allocation. What determines which one?

People have different innate abilities, different human capital and different wealth. These differences mean people earn different incomes in a market economy. They also affect the pattern of consumer demand. Brazil, with a very unequal distribution of income and wealth, has a high demand for luxuries such as servants. In more egalitarian Denmark, nobody can afford servants.

Different inheritances of ability, capital and wealth thus imply different demand curves and determine different equilibrium prices and quantities. In principle, by varying the distribution of initial income-earning potential, we could make the economy pick out each possible Pareto-efficient allocation as its competitive equilibrium.

Here is an attractive idea. The government is elected to express the value judgements of the majority. If the market gets the economy to the Pareto-efficient frontier, the government can make the value judgement about which point on this frontier the economy should attain. Every competitive equilibrium is Pareto-efficient. Different efficient allocations correspond to differ-

ent initial distributions of income-earning potential in a competitive economy. Can the government confine itself to redistributing income and wealth through taxation and welfare benefits *without having to intervene to ensure that resources are allocated efficiently?*

This seems a powerful case for the free enterprise ideal. The government should let markets get on with the job of allocating resources efficiently. We do not need regulations, investigatory bodies or state-run enterprises. Nor need the free enterprise ideal be uncompassionate. The government can redistribute income without impairing the efficient functioning of a free market economy. The right-wing case can be backed up by rigorous economic arguments.

However, the left-wing case can also be made. Remember the qualifications in the above argument. *Under certain conditions* free markets lead to a Pareto-efficient allocation. These conditions explain the difference between the two views of how a market economy works. The right believes that they are *minor* qualifications that do not seriously challenge the case for a free market economy. The left believes that the qualifications are so serious that substantial government intervention is necessary to *improve* the way the economy works.

15.3 Distortions and the second best

A **distortion** exists if society's marginal cost of producing a good does not equal society's marginal benefit from consuming that good.

Competitive equilibrium is efficient because the independent actions of producers setting marginal cost equal to price, and consumers setting marginal benefits equal to price, ensure that the marginal cost of producing a good just equals its marginal benefit to consumers.

Taxation as a distortion

To finance subsidies to the poor, a government must tax the incomes of rich people or the goods rich people buy. Suppose everyone buys meals but only the rich can afford to go to the cinema. A subsidy for the poor can be financed by a tax on films.

In Figure 15.4 the pre-tax price of films to consumers exceeds the post-tax price received by makers of films. The difference between the two prices is the tax on each film. Consumers equate the tax-inclusive price to the value of the marginal benefit they receive from the last film, but suppliers equate the marginal cost of films to the lower net-of-tax price of films.

In competitive equilibrium the price system no longer equates the social marginal cost of making films with the social marginal benefit of consuming films. The marginal benefit of another film exceeds its marginal cost. The tax on films induces too few films. Making another film adds more to social benefit than to social cost.

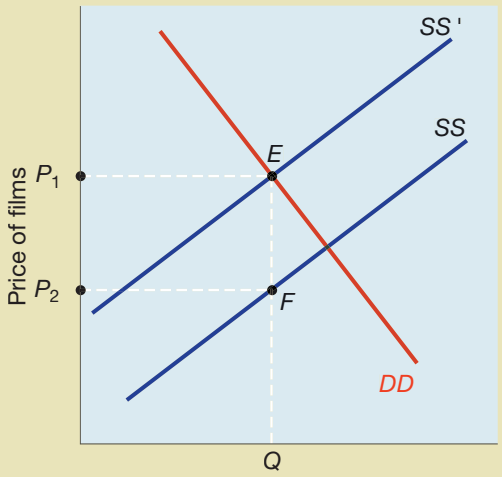
Earlier, we showed that the marginal cost of a film equals the value of the extra meals that society could have had instead. When films are taxed, the marginal social benefit of another film exceeds its marginal cost, and hence exceeds the marginal social benefit of the extra meals that society could have had by using resources differently. By transferring labour from meals into films, society could make some people better off without making anyone else worse off.

A similar argument holds for any other commodity we tax. A tax causes a discrepancy between the price the purchaser pays and the price the seller receives. The 'invisible hand' no longer equates marginal social benefits of resources in different uses.

The choice between efficiency and equity is now clear. If the economy is perfectly competitive, and if the government is happy with the current income distribution, competitive free-market equilibrium is efficient and the income distribution desirable.

However, if as a pure value judgement the government dislikes this income distribution, it has to tax some people to provide subsidies for others. Yet the very act of raising taxes *introduces*

Figure 15.4 A tax on films



DD shows the demand for films and the marginal benefit of the last film to consumers. *SS* shows the quantity of films supplied at each price received by producers and is also the marginal social cost of producing films. Suppose each unit of films bears a tax equal to the vertical distance *EF*. To show the tax-inclusive price required to induce producers to produce each output, we must draw the new supply curve *SS'* that is a constant vertical distance *EF* above *SS*. The equilibrium quantity of films is *Q*. Consumers pay P_1 producers receive a price P_2 and the tax per film is the distance *EF*. At the equilibrium quantity *Q* the marginal benefit is *P* but the marginal social cost is P_2. Society would make a net gain by producing more films. Hence the equilibrium quantity *Q* is socially inefficient.

a distortion. The resulting equilibrium has a more desirable distribution but is less efficient. Governments may have to make trade-offs between efficiency and equity.

One explanation for differing political attitudes to the market economy is a difference in value judgements about equity. Later, we will see that there may also be disagreements in positive economics. We consider other distortions in the next section. Before leaving our tax example, there is one final point to make.

The second best

The **first-best allocation** has no distortions and is fully efficient.

When there is no distortion in the market for *meals*, a tax on *films* leads to an inefficient allocation. If we could abolish the tax on films neither industry would be distorted and we get the *first-best* allocation.

Suppose, however, that we cannot get rid of the tax on films. The government needs tax revenue to pay for national defence or its EU budget contribution. Given an unavoidable tax on films, at least it should not tax meals as well.

This plausible view is in fact *quite wrong*. Suppose both industries are in equilibrium but there is a tax on films. Above, we saw that too few films are produced and consumed. By implication, too many meals are therefore produced and consumed. Given an inevitable tax on films, a tax on meals would help not hinder.

A suitable tax on meals could restore the original relative price of meals and films. With only two goods this would restore the first best. However, there is always a third good, leisure. Households reduce consumption of leisure in order to supply labour for work. Taxing meals

and films gets the right balance between meals and films, but makes the price of both wrong relative to the price of leisure. With higher taxes, the net wage falls, changing the implicit price of leisure.

In contrast to the *first-best* allocation, when we achieve full efficiency by removing all distortions, we have now developed the principle of the *second best*. Suppose we care only about efficiency but there is an inevitable distortion somewhere else in the economy that we cannot remove. It is inefficient to treat other markets as if that distortion did not exist. In the meals industry it is inefficient to equate private marginal cost and private marginal benefit, the efficient outcome in the absence of a film tax. Rather, it is efficient to introduce deliberately a new distortion in meals to help counterbalance the unavoidable distortion in the meals industry.

The **first-best** removes all distortions. The **second best** is the most efficient outcome that can be achieved conditional on being unable to remove some distortions.

The theory of the second best says that, if there must be a distortion, it is a mistake to concentrate the distortion in one market. It is more efficient to spread its effect more thinly over a wide range of markets.

Several applications of this general principle are found in the ensuing chapters. The real world in which we live provides several inevitable distortions. Given their existence, the argument of this section implies that the government may *increase* the overall efficiency of the whole economy by introducing *new* distortions to offset those that already exist. By now you will want to know the source of these inevitable distortions that the government could take action to offset.

15.4 Market failure

In the absence of any distortions, competitive equilibrium is efficient. We use the term *market failure* to cover all the circumstances in which market equilibrium is inefficient. Distortions then prevent the 'invisible hand' from allocating resources efficiently. We now list the possible sources of distortions that lead to market failure.

Imperfect competition

Only perfect competition makes firms equate marginal cost to price and thus to marginal consumer benefit. Under imperfect competition, producers set marginal cost equal to marginal revenue, which is below the price for which the last unit is sold. Since consumers equate price to marginal benefit, marginal benefit exceeds marginal cost in imperfectly competitive industries. Such industries produce too little. Higher output would add more to consumer benefit than to production costs or the opportunity cost of the resources used.

Equity

Redistributive taxation induces allocative distortions by driving a wedge between the price the consumer pays and the price the producer receives.

Externalities

Externalities are things like pollution, noise and congestion. One person's actions have direct costs or benefits for other people but the individual does not take these into account. Much of the rest of this chapter examines this distortion. The problem arises because there is no market

for things like noise. Hence markets and prices cannot ensure that the marginal benefit you get from making a noise equals the marginal cost of that noise to other people.

Other missing markets: future goods, risk and information

These are also commodities for which markets are absent or limited. In Chapter 13 we saw how moral hazard and adverse selection inhibit the setting up of insurance markets to deal with risk. As with externalities, we can't expect markets to allocate resources efficiently if the markets do not exist.

BOX 15-1 Rent-seeking

In America, lobbyists get the early plane to Washington DC. In Europe, they go to Brussels. Over expense-account lunches, the business of persuasion is conducted. What has this to do with efficiency or inefficiency? If the aim is to provide information to policy makers, it is possible that, like informative advertising, efficiency is increased. But lobbying goes much further.

Suppose a lecturer walks into a class and deposits on the table an open suitcase containing £10 000 in used banknotes. She gives a brilliant class for an hour but nobody is listening. The students are working out if there is a way to make off with the loot. Ian Ironfist is worried how to stop his rival Sam Slugger doing likewise. Ironfist and Slugger can be seen in the lecture parting with their own cash to assemble rival armies of students to fight the lunchtime battle for the suitcase. Microeconomic theory absorbed during the hour's lecture? Zero.

Sources of inefficiency? Everybody's time was wasted. At the start of the class, society has one suitcase with £10 000, plus loose change in people's pockets. After the lunchtime fight, society will still have one suitcase, £10 000 and some loose change. There was no net increase in goods and services during the morning. It was a zero-sum game that had no value added for society. The prospect of economic rent or pure surplus – a suitcase worth £10 000 – led the students to spend their valuable resources (cash in their pocket, time available for learning economics) trying to compete for and capture the jackpot. Distributional fights are a source of inefficiency. Successful societies keep these to a minimum.

Government intervention in the economy to offset market failures can, in principle, improve efficiency. It can also create opportunities for rent-seeking. Suppose the government regulates the award of franchises to operate railway lines, TV stations or lotteries. Rival bidders use up huge amounts of real resources trying to outdo one another. Privately, winning is so important that it is worth spending a lot to raise the chances of success. But socially it is close to a zero-sum game. One supplier of railway, TV or lottery services may be little better than another. Encouraging competition between prospective suppliers is good only if the social gain from finding the best supplier rather than an inferior one outweighs the social value of the resources the bidders use up in their war to win the award. Where society decides to intervene to combat market failure, it should still think which form of intervention minimizes government failure. Rent-seeking is one channel through which such government failure may occur.

Now you've read this section, why not test your understanding by visiting the Online Learning Centre at www.mcgraw-hill.co.uk/textbooks/begg.

15.5 Externalities

A chemical firm discharges waste into a lake, polluting the water. It affects the production of anglers (fewer fish, harder to catch) or the consumption of swimmers (dirty water). Without a

An **externality** arises if one person's production or consumption physically affects the production or consumption of others.

'market' for pollution, the firm can pollute the lake without cost. Its self-interest leads it to pollute until the marginal benefit of polluting (cheaper production of chemicals) equals its own marginal cost of polluting, which is zero. It ignores the marginal cost pollution imposes on anglers and swimmers.

Conversely, by painting your house you make the whole street look nicer and give consumption benefits to your neighbour. But you paint only up to the point at which your own marginal benefit equals the marginal cost of the paint you buy and the time you spend. Your marginal costs are also society's marginal costs but society's marginal benefits exceed your own. Hence, there is too little house painting.

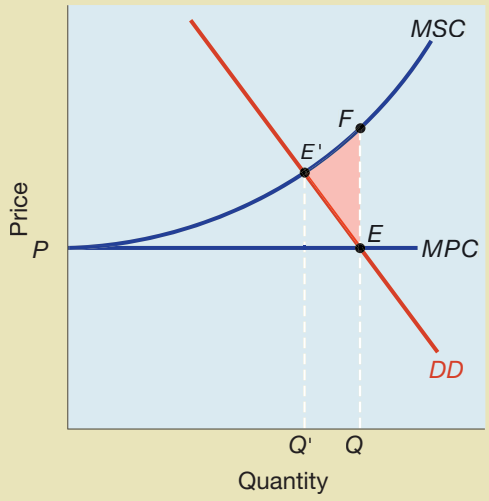
In both cases there is a divergence between the individual's comparison of marginal costs and benefits and society's comparison of marginal costs and benefits. Free markets cannot induce people to take account of indirect effects if there is no market in these indirect effects.

Divergences between private and social costs and benefits

Suppose a chemical firm pollutes a river, the quantity of pollution rising with output. Downstream, companies use river water as an input in making sauce for baked beans. At low chemical output, pollution is negligible. The river dilutes the small amounts of pollutant discharged by the chemical producer. As the discharge rises, the costs of pollution rise sharply. Food processers must worry about water purity and build expensive purification plants. Still higher levels of pollution start to corrode their pipes.

Figure 15.5 shows the marginal *private cost MPC* of producing chemicals. For simplicity, we treat *MPC* as constant. It also shows the marginal *social cost MSC* of chemical production. At any output, the divergence between marginal private cost and marginal social cost is the marginal *production externality*. The demand curve *DD* shows how much consumers will pay for the output of the chemical producer. If that firm is a price-taker, equilibrium is at *E* and the chemical producer's output is *Q*, at which the marginal private cost equals the price of the firm's output.

Figure 15.5 The social cost of a production externality



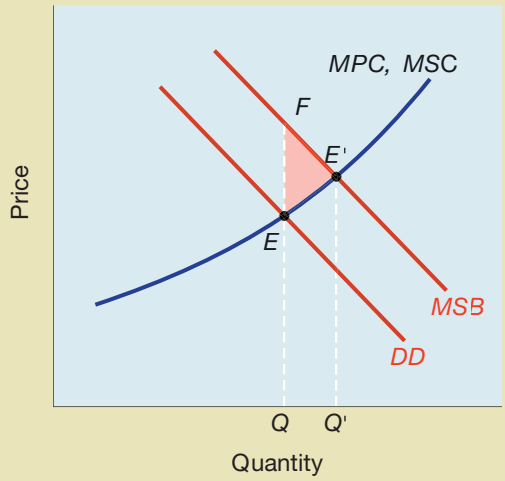
Competitive equilibrium occurs at *E*. The market clears at a price *P* which producers equate to marginal private cost *MPC*. But pollution causes a production externality which makes the marginal social cost *MSC* exceed the marginal private cost. The socially efficient output is at *E'* where marginal social cost and marginal social benefit are equal. The demand curve *DD* measures the marginal social benefit because consumers equate the value of the marginal utility of the last unit to the price. By inducing an output *Q* in excess of the efficient output *Q'* free market equilibrium leads to a social cost equal to the area of the triangle *E'FE*. This shows the excess of social cost over social benefit in moving from *Q'* to *Q*.

At this output *Q*, the marginal social cost *MSC* exceeds the marginal social benefit of chemicals, given by the height of the demand curve *DD*. The market for chemicals ignores the production externality inflicted on other firms. At *Q* the marginal social benefit of the last output unit is less than the marginal social cost inclusive of the production externality. Output *Q* is inefficient. By reducing the output of chemicals, society saves more in social cost than it loses in social benefit. Society could make some people better off without making anyone worse off.

The efficient output is *Q'*, at which the marginal social benefit equals the marginal social cost. *E'* is the efficient point. How much does society lose by producing at the free market equilibrium *E'*, not the efficient point *E*? The vertical distance between the

marginal social cost *MSC* and the marginal social benefit shows the marginal social loss of producing the last output unit. By overexpanding from Q' to Q, society loses the triangle $E'EF$ in Figure 15.5. This is the social cost of the market failure caused by the production externality of pollution.[1]

Figure 15.6 A beneficial consumption externality



With no production externality, marginal private cost and marginal social cost coincide. *DD* measures the marginal private benefit and free market equilibrium occurs at *E*. The beneficial consumption externality makes marginal social benefit *MSB* exceed marginal private benefit. *E'* is the socially efficient point. By producing *Q* instead of the efficient output *Q'*, free market equilibrium wastes the triangle *EFE'*.

Production externalities make social and private marginal costs diverge. A consumption externality makes private and social marginal benefits diverge. Figure 15.6 shows a beneficial consumption externality. Planting roses in your front garden also makes your neighbours happy.

With no production externality, *MPC* is both the private and social marginal cost of planting roses. It is the cost of the plants and the opportunity cost of your time. *DD* is the marginal private benefit. Comparing your own costs and benefits, you plant a quantity *Q* of roses.

But you ignore the consumption benefit to your neighbours. The marginal social benefit *MSB* exceeds your marginal private benefit. The free market equilibrium is at *E*, but the efficient output is Q' since marginal social benefit and marginal social cost are equated at E'.

Society could gain the triangle EFE', the excess of social benefits over social costs, by increasing the quantity of roses from *Q* to Q'. This triangle measures the social cost of the market failure that makes equilibrium output too low.

Property rights and externalities

Your neighbour's tree obscures your light, a harmful consumption externality. If the law says that you must be compensated for any damage suffered, your neighbour has to pay up or cut back the tree.

He likes the tree and wants to know how much it would take to compensate you to leave the tree at its current size. Figure 15.7 shows the marginal benefit *MB* that he gets from the last inch of tree and the marginal cost *MC* to you of that last inch. At the tree's current size S_1 the total cost to you is the area $OABS_1$. This is the marginal cost *OA* of the first inch, plus the marginal cost of the second inch, and so on to the existing size S_1. The area $OABS_1$ is what you need in compensation if the tree size is S_1.

Your neighbour is about to pay up when his daughter, an economics student, points out that at size S_1 the marginal benefit of the last inch to him is less than the marginal cost to you, the amount you must be compensated for that last inch on the tree. It is not worth her dad having a tree this big. Nor, she points out, is it worth cutting the tree down altogether. The first inch yields a higher marginal benefit to him than the amount that you need in compensation to offset your marginal cost of that first inch. A tiny tree has little effect on your light.

[1] Conversely, a farmer who spends money on pest control reduces pests on nearby farms. If production externalities are beneficial, the marginal social cost is below the marginal private cost. Suppose we swap the labels *MSC* and *MPC* in Figure 15.5. Free market equilibrium is at E' but *E* is now the efficient allocation.

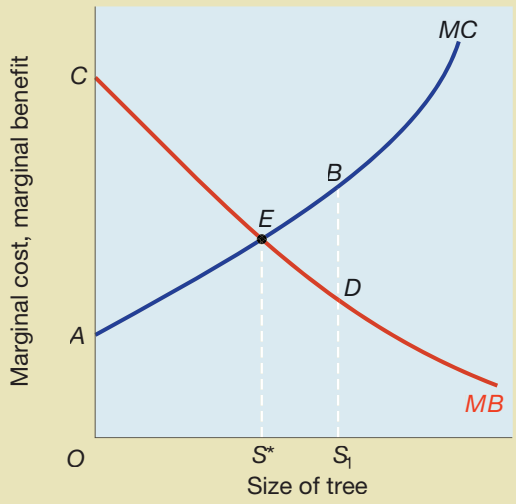
At the efficient tree size S^* the marginal benefit to your neighbour equals the marginal cost to you. Above S^* he cuts back the tree, since the marginal cost (and compensation) exceeds his marginal benefit. Below S^* he increases the tree size, and pays you marginal compensation that is less than his marginal benefit. At the efficient size S^* your total cost is the area $OAES^*$. This is the compensation you are paid.

Since a larger tree benefits one party but hurts the other party, *the efficient tree size and efficient quantity of the externality is not zero*. It is where the marginal benefit equals the marginal cost.

Property rights are the power of residual control, including the right to be compensated for externalities.

Property rights affect who compensates whom, a distributional implication. Suppose there is no law requiring compensation. Instead of letting his tree to grow to S_1, inflicting a huge cost on you, you bribe your neighbour to cut it back. You compensate him for the loss of his marginal benefit. You would pay to have the tree cut back as far as S^* but no further. Beyond that size, you pay more in compensation for loss of marginal benefit than you save yourself in lower cost of the externality. So you pay a *total* of EDS_1S^* to compensate for the loss of benefit in cutting the tree back from S_1 to S^*. Who has the property rights determines who pays whom, but does not affect the efficient quantity that the bargain determines. It is always worth reaching the point at which the marginal benefit to one of you equals the marginal cost to the other.

Figure 15.7 The efficient quantity of an externality



MB and *MC* measure the marginal benefit to our neighbour and marginal cost to you of a tree of size S^*. The efficient size is S where the marginal cost and benefit are equal. Beginning from a size S, you might bribe your neighbour the value S^*EDS, to cut back to S^*. Below S^* you would have to pay more than it is worth to you to have the tree cut back further. Alternatively, your neighbour might pay you the value $OAES^*$ to have a tree of size S^*. Property rights, in this case whether you are legally entitled to compensation for loss of light to your garden, determine who compensates whom but not the outcome S^* of the bargain.

Property rights have a distributional implication – who compensates whom – but also achieve the efficient allocation. They set up the 'missing market' for the externality. The market ensures that the price equals the marginal benefit and the marginal cost and hence equates the two.

Economists say that property rights 'internalize' the externality. If people must pay for it they will take its effects into account in making private decisions and there will no longer be market failure. Why then do externalities like congestion and pollution remain a problem? Why don't private individuals establish the missing market through a system of bribes or compensation?

There are two reasons why it is hard to set up this market. The first is the cost of organizing the market. A factory chimney dumps smoke on a thousand gardens nearby, but it is costly to collect £1 from each household to bribe the factory to cut back to the efficient amount. Second, there is a *free-rider* problem.

A **free-rider**, unable to be excluded from consuming a good, has no incentive to buy it.

Someone knocks on your door and says: 'I'm collecting bribes from people who mind the factory smoke falling on their gardens. The money will be used to bribe the factory to cut back. Do you wish to contribute? I am going round 1000 houses nearby.' Whether you mind or not, you say: 'I don't mind, and won't contribute.' If everybody else pays, the factory will cut back and you cannot be prevented from getting the benefits. The smoke won't fall exclusively on your garden just because you alone didn't pay.

Regardless of what other people contribute, your dominant strategy is to be a *free-rider*. Everyone else reasons similarly, hence no one pays, even though you are all better off paying and getting the smoke cut back.

15.6 Environmental issues

When there is no implicit market for pollution, pollutants are overproduced. Private producers ignore the costs they impose on others. In equilibrium, social marginal cost exceeds social marginal benefit.

If the private sector cannot organize charges for the marginal externalities pollution creates, perhaps government can? By charging (through taxes) for the divergence between marginal private and social cost, the government can induce private producers to take account of the costs inflicted on others. This argument for pollution taxes or congestion charges is examined in the next chapter.

Pollution taxes, especially for water pollution, are used in many countries. But most policy takes a different approach, imposing pollution standards to regulate the quantities of pollution allowed.

Air pollution

Since the Clean Air Act of 1956, UK governments have designated clean air zones in which certain pollutants, notably smoke caused by burning coal, are illegal. The number of designated clean air zones has risen steadily. Table 15.1 shows a big fall in smoke pollution in the UK.

Table 15.1 Smoke emission, UK (million tonnes per annum)

1958	1974	2003
2.0	0.8	0.1

Sources: *Digest of Environmental Protection and Water Statistics*; ONS, *Social Trends*.

Adding lead to petrol improves the fuel economy of cars. However, lead emissions from car exhausts are an atmospheric pollutant harmful to people's health. Since 1972 the UK government has steadily reduced the quantity of lead permitted in petrol. Lead emission into the UK atmosphere has fallen from over 8000 tonnes a year in 1975 to only 1000 tonnes a year, even though consumption of petrol has risen dramatically.

Water pollution

Since 1951 governments in the UK have also imposed controls on discharges into inland waters. Although we think of *industrial* effluent, sewage is a more important source of pollution. Since 1970 regional water authorities in England and Wales spent (at 2000 prices) over £3 billion a year on water purification and sewage treatment. Another key source of water pollution is nitrates used to fertilize agricultural land. The EU has laid down tough standards for water purity that will take many years to achieve.

Evaluating UK pollution policy

Direct regulation of pollution has been a mixed success. Cutting smoke pollution, which used to mix with winter fog to create dense 'smog', has been a big success. Many rivers are also cleaner and fish have reappeared.

In other cases, regulation was less successful. It is hard to enforce regulations such as those that prevent ships discharging oil at sea. UK beaches still feature on the EU blacklist. Coal-fired power stations still emit large quantities of sulphur dioxide.

Was the government tough enough on polluters? Recall that the efficient quantity of pollution is not zero. The fact that pollution still exists does not prove that policy has been too feeble.

Pollution control has often been crude and simple. Calculations of social marginal costs and benefits of cutting back pollution are rare. Measuring costs and benefits is difficult. In deciding how much to cut lead emissions from cars, we can estimate the marginal social cost of producing cars with anti-pollution exhaust systems and the marginal social cost of cars that use more fuel per mile. But even if doctors were unanimous about the effects of lead emission on health, how should society value a marginal increase in the health of current and future generations?

This is not merely a question of efficiency but also of equity, both within the current generation – poor inner-city children are more vulnerable to arrested development caused by inhaling lead-polluted air – and across generations. Today's consumers bear the cost of the clean up but its benefits accrue largely to future consumers.

Prices versus quantities

If free markets tend to overpollute, society can cut pollution either by regulating the quantity of pollution or by using the price system to discourage such activities by taxing them. Is it more sensible to intervene through the tax system than to regulate quantities directly?

Many economists prefer taxes to quantity restrictions. If each firm is charged the same price or tax for a marginal unit of pollution, each firm equates the marginal cost of reducing pollution to the price of pollution. Any allocation in which different firms have different marginal costs of reducing pollution is inefficient. If firms with low marginal reduction costs contract further and firms with high marginal reduction costs contract less, lower pollution is achieved at less cost.

The main problem with using taxes rather than quantity restrictions is uncertainty about outcome. Suppose pollution beyond a critical level has disastrous consequences, for example irreversibly damaging the ozone layer. By regulating the quantity directly, society can ensure a disaster is avoided. Indirect control, through taxes or charges, runs the risk that the government does its sums wrong and set the tax too low. Pollution is then higher than intended and may be disastrous.

Regulating the total quantity of pollution, with spot checks on compliance by individual producers, is a simple policy that avoids the worst outcomes. However, by ignoring differences in the marginal cost of reducing pollution across different polluters, it does not reduce pollution in the way that is cost-minimizing to society.

Lessons from the United States

The US has gone furthest in trying to use property rights and the price mechanism to cut back pollution efficiently. The US Clean Air Acts established an environmental policy that includes an *emissions trading programme* and *bubble policy*.

BOX 15-2 Atmosphere of pollution

Chlorofluorocarbons (CFCs), gases used in things like aerosols, are destroying the ozone layer that protects the earth from solar rays. Without this sunscreen, more people develop skin cancer. Organizing international cutbacks in atmospheric pollution is difficult: each country wants to free-ride, enjoying the benefits of other countries' cutbacks but making no contribution of its own. The Montreal Protocol on substances that deplete the ozone layer was signed by nearly 50 countries in 1987. Before the Protocol, projected ozone depletion was 5 per cent by 2025 and 50 per cent by 2075. In the Protocol, countries agreed to take steps to reduce ozone depletion to 2 per cent by 2025 with no further deterioration thereafter. Such optimistic aims are hard to achieve.

A second type of atmospheric pollution is even more important. The greenhouse effect arises from emissions of CFCs, methane, nitrous oxide and, especially, carbon dioxide. Greenhouse gases are the direct result of pollution and the indirect result of the atmosphere's reduced ability to absorb them. Plants convert carbon dioxide into oxygen. Chopping down forests to clear land for cattle, as global demand for hamburgers rises, has accelerated the greenhouse effect.

The consequence is global warming. People in London and Stockholm get better suntans, people in Africa face drought and famine. As icecaps melt, the sea rises, flooding low-lying areas. By 2070 the temperature will have risen by 4 °C, and the sea by 45 centimetres. As with acid rain, organizing collective international cutbacks has been difficult.

In 1997 the Kyoto Protocol agreed national targets for lower emissions of greenhouse gases. Becoming binding in 2008–12, the Kyoto deal would have cut emissions by 5 per cent relative to the 1990 level, but by much more relative to the growth that a do-nothing policy would have allowed. The table shows 1990 levels, actual behaviour in the 1990s and the target for 2012.

	1990 emissions (million tonnes)	2012 target (% change from 1990 level)
Japan	1190	– 6
USA	5713	– 7
Germany	1204	–21
UK	715	–12
Italy	532	– 6
France	498	0
Spain	301	+15

In 2001 US President George W Bush announced that the United States would not ratify the Kyoto Protocol because it did not oblige poorer countries such as India and China to do their share of pollution reduction. In July 2001, after a meeting in Bonn, 178 countries decided to proceed with a weaker version of the Kyoto Protocol, despite the refusal of the United States to participate.

The Acts lay down a minimum standard for air quality and impose pollution emission controls to particular polluters. Any polluter emitting less than their specified amount gets an *emission reduction credit* (ERC), which can be sold to another polluter wanting to exceed its allocated pollution limit. Thus, the total quantity of pollution is regulated but firms that can reduce pollution cheaply have an incentive to do so, and sell off the ERC to firms for which pollution reduction is more expensive. We get closer to the efficient solution in which the marginal cost of pollution reduction is equalized across firms.

When a firm has many factories, the bubble policy applies pollution controls to the firm as a whole. The firm can cut back most in the plants in which pollution reduction is cheapest.

Thus, the US policy combines 'control over quantities' for aggregate pollution, where the risks and uncertainties are greatest, with 'control through the price system' for allocating efficiently the way these overall targets are achieved.

BOX 15-3 EU climate targets in trouble?

Experts in the emerging market for climate-friendly investment fear a key scheme to cut the amount of carbon dioxide (CO_2) reaching the atmosphere could fail. The controversy centres on the EU Emissions Trading Scheme which comes into force next year and forms a central plank of the policy to meet the targets set by the Kyoto climate change agreement. Most countries are still well adrift of those targets which require EU emissions to be 8 per cent below 1990 levels over the period 2008–12. Adapted from BBC News Online, 30 April 2004.

A market in emission permits should create a financial incentive to invest in cleaner technology. But such a system will only work if the price of permits is higher than the cost of investing in lower emission production technologies. The concern at present is that governments within the EU are oversupplying permits to business, leading to an excess supply and a fall in the price of permits. For 2004 Italy has provided permits which are 111 per cent of total CO_2 emissions in 2000. As a result the forward market in permits fell from #eu12 per tonne of CO_2 to #eu6 per tonne.

However, there are other considerations. The UK government has suggested that it will restrict the supply of permits to the extent that the UK more than meets it obligations under the Kyoto agreement. However, business is concerned that the resulting higher price of emission permits will place UK business at a significant costs disadvantage to its EU rivals.

Country	CO_2 emissions (tonnes per capita)
UK	9.3
France	6.3
Germany	10.5
Italy	7.3
Netherlands	11.0
Czech Republic	12.0

Source: OECD

15.7 Other missing markets: time and risk

The previous two sections were devoted to a single idea. When externalities exist, free market equilibrium is inefficient because the externality itself does not have a market or a price. People take no account of the costs and benefits their actions inflict on others. Without a market for externalities the price system cannot bring marginal costs and marginal benefits of these externalities into line. We now discuss other 'missing markets', those for time and for risk.

The present and the future are linked. People save, or refrain from consumption, today in order to consume more tomorrow. Firms invest, reducing current output by devoting resources to training or building, in order to produce more tomorrow. How should society make plans today for the quantities of goods produced and consumed in the future? Ideally everyone makes plans such that the social marginal cost of goods in the future just equals their social marginal benefit.

Chapter 13 discussed a *forward market*, in which buyers and sellers make contracts today for goods delivered in the future at a price agreed today. Suppose there is a forward market for copper in 2008. Consumers equate the marginal benefit of copper in 2008 to the forward price, which producers equate to the marginal cost of producing copper for 2008. With a complete set of forward markets for all commodities for all future dates, producers and consumers today make consistent plans for future production and consumption of all goods, and the social marginal benefits of every future good equal its social marginal cost.

Chapter 13 explained why few forward markets exist. You can trade gold but not cars or washing machines. Since nobody knows the characteristics of next year's model of a car or a washing machine, we cannot write legally binding contracts easily enforced when the goods are delivered. Without these forward markets, the price system cannot equate the marginal cost and marginal benefits of planned future goods.

There are also few *contingent* or insurance markets for dealing with risk. People usually dislike risk. It reduces their utility. Does society undertake the efficient amount of risky activities?

A complete set of insurance markets lets risk be transferred from those who dislike risk to those who will bear risk at a price. The equilibrium price equates social marginal costs and benefits of risky activities. However, adverse selection and moral hazard inhibit the organization of private insurance markets. If some risky activities are uninsurable at any price, the price system cannot guide society to equate social marginal costs and benefits.

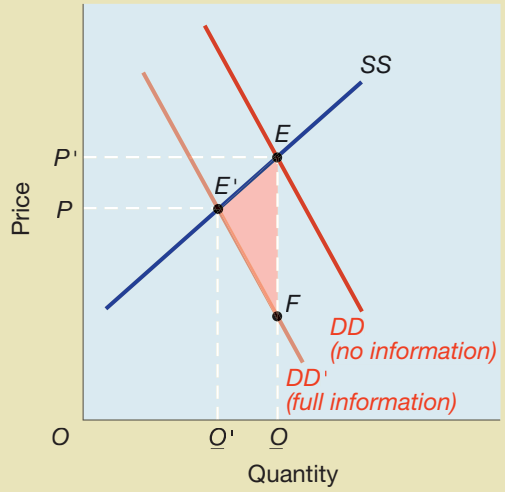
Future goods and risky goods are examples of commodities with missing markets. Like externalities, these are market failures. Free market equilibrium is generally efficient. And the theory of the second best tells us that when some markets are distorted, we probably don't want other markets to be completely distortion free.

13.3 Demand by a single consumer

Information is incomplete because gathering information is costly. This leads to inefficiency. A worker unaware that exposure to benzene may cause cancer may work for a lower wage than if this information is widely available. The firm's production cost understates the true social cost and the good is overproduced. Governments regulate health, safety and quality standards because they recognize the danger of market failure.

UK examples include the Health and Safety at Work Acts, legislation to control food and drugs production, the Fair Trading Act governing consumer protection and various traffic and motoring regulations. Such legislation aims to encourage the provision of information that lets individuals more accurately judge costs and benefits, and aims to set and enforce standards designed to reduce the risks of injury or death.

Figure 15.8 Information and unsafe goods



Consumers cannot individually discover the safety risks associated with a particular good. Free market equilibrium occurs at *E*. A government agency now provides information about the product. As a result, the demand curve shifts down and the new equilibrium is at *E'* where the *true* or full information value of an extra unit of the good equals its marginal social cost. Providing information prevents a welfare cost *E'EF* that arises when uninformed consumers use the wrong marginal valuation of the benefits of the good.

Providing information

Figure 15.8 shows the supply curve *SS* for a drug that is potentially harmful. *DD* is the demand curve if consumers do not know the danger. In equilibrium at *E* the quantity *Q* is produced and consumed.

With full information about the dangers, people would buy less of the drug. The demand curve *DD'* shows the marginal consumer benefit with full information. The new equilibrium at *E'* avoids the deadweight burden *EE'F* from overproduction of the drug.

If information were free to collect, everyone would know the true risks. From the social gain *EE'F* we should subtract the resources needed to discover this information. Free market equilibrium is at *E* because it is not worth each individual checking up privately on each drug on the market. It makes sense for society to have a single regulatory body to check drugs, and a law whose enforcement entitles individuals to assume that drugs have been checked as safe.

Certification of safety or quality need not be carried out by the government. Sotheby's certify

Rembrandts, the AA will check out a used car for you, and drunk drivers may send half their blood sample to a private certification agency to corroborate the results of the police analysis.

Two factors inhibit the use of private certification in many areas of health and safety. First, the public perceives a conflict between the profit motive and the incentive to tell the truth. Public officials may be less easily swayed.

Second, a private certification agency might have to decide standards. What margin of error should be built into safety regulations? How safe must a drug be to get a certificate? These are issues of public policy. They involve externalities and have distributional implications. Even if society uses private agencies to *monitor* regulations, it usually sets the standards itself.

Imposing standards

The public interest is important when little is known about a product and where the consequences of any error may be catastrophic. Few believe that safety standards for nuclear power stations can be adequately determined by the private sector.

In imposing standards, governments raise the private cost of production by preventing firms from adopting the cost-minimizing techniques they otherwise would use. Sometimes the government has better information than the private sector. Sometimes, standards compensate for externalities neglected by the private firm. Sometimes standards reflect a pure value judgement based on distributional considerations. One contentious area is the value of human life itself.

Politicians often claim, ridiculously, that human life is beyond economic calculation and must be given absolute priority at any cost. The UK government repeated this assurance after the Paddington rail disaster in October 1999. An economist will make two points in reply. First, it is *impossible* to implement such an objective. It is too costly in resources to try to eliminate *all* risks of premature death. Sensibly, we do not go this far. Second, in occupational and recreational choices, for example driving racing cars or going climbing, people take risks. Society must ask how much more risk-averse it should be than the people it is trying to protect.

Beyond some point, the marginal social cost of further risk reduction exceeds the marginal social benefit. It takes a huge effort to make the world just a little safer and the resources might have been used elsewhere to greater effect. Zero risk does not make economic sense. We need to know the costs of making the world a little safer and we need to encourage society to decide how much it values the benefits. By shying away from the 'unpleasant' task of spelling out the costs and benefits, society induces an inefficient allocation in which marginal costs and marginal benefits of saving life are very different in different activities.

SUMMARY

- Welfare economics deals with normative issues or value judgements. Its purpose is not to describe how the economy works but to assess how well it works.
- Horizontal equity is the equal treatment of equals and vertical equity the unequal treatment of unequals. Equity is concerned with the distribution of welfare across people. The desirable degree of equity is a pure value judgement.
- A resource allocation is a complete description of what, how and for whom goods are produced. To separate as far as possible the concepts of equity and efficiency, economists use Pareto efficiency. An allocation is Pareto-efficient if no reallocation of resources would

make some people better off without making others worse off. If an allocation is inefficient it is possible to achieve a Pareto gain, making some people better off and none worse off. Many reallocations make some people better off and others worse off. We cannot say whether such changes are good or bad without making value judgements to compare different people's welfare.

- For a given level of resources and a given technology, the economy has an infinite number of Pareto-efficient allocations that differ in the distribution of welfare across people. For example, every allocation that gives all output to one individual is Pareto-efficient. But there are many more allocations that are inefficient.
- Under strict conditions, competitive equilibrium is Pareto-efficient. Different initial distributions of human and physical capital across people generate different competitive equilibria corresponding to each possible Pareto-efficient allocation. When price-taking producers and consumers face the same prices, marginal costs and marginal benefits are equated to prices (by the individual actions of producers and consumers) and hence to each other.
- In practice, governments face a conflict between equity and efficiency. Redistributive taxation drives a wedge between prices paid by consumers (to which marginal benefits are equated) and prices received by producers (to which marginal costs are equated). Free market equilibrium will not equate marginal cost and marginal benefit and there will be inefficiency.
- Distortions occur whenever free market equilibrium does not equate marginal social cost and marginal social benefit. Distortions lead to inefficiency or market failure. Apart from taxes, there are three other important sources of distortions: imperfect competition (failure to set price equal to marginal cost), externalities (divergence between private and social costs or benefits), and other missing markets in connection with future goods risky goods or other informational problems.
- When only one market is distorted the first-best solution is to remove the distortion, thus achieving full efficiency. The first-best criterion relates only to efficiency. Governments caring sufficiently about redistribution might still prefer inefficient allocations with more vertical equity. However, when a distortion cannot be removed from one market it is not generally efficient to ensure that all other markets are distortion-free. The theory of the second best says that it is more efficient to spread inevitable distortions thinly over many markets than to concentrate their effects in a few markets.
- Production externalities occur when actions by one producer directly affect the production costs of another producer, as when one firm pollutes another's water supply. Consumption externalities mean one person's decisions affect another consumer's utility directly, as when my garden gives pleasure to neighbours. Externalities shift indifference curves or production functions.
- Externalities lead to divergence between private and social costs or benefits because there is no implicit market for the externality itself. When only a few people are involved, a system of property rights may establish the missing market. The direction of compensation will depend on who has the property rights. Either way, it achieves the efficient quantity of the externality at which marginal cost and marginal benefit are equated. The efficient solution is rarely a zero quantity of the externality. Transactions costs and the free-rider problem may prevent implicit markets being established. Equilibrium will then be inefficient.
- When externalities lead to market failure the government could set up the missing market by

pricing the externality through taxes or subsidies. If it were straightforward to assess the efficient quantity of the externality and hence the correct tax or subsidy, and straightforward to monitor the quantities produced and consumed, such taxes or subsidies would allow the market to achieve an efficient resource allocation.

- In practice, governments often regulate externalities such as pollution or congestion by imposing standards that affect quantities directly rather than by using the tax system to affect production and consumption indirectly. Overall quantity standards may fail to equate the marginal cost of pollution reduction across different polluters, in which case the allocation will not be efficient. However, simple standards may use up fewer resources in monitoring and enforcement and may prevent disastrous outcomes when there is uncertainty.
- Moral hazard, adverse selection, and other informational problems prevent the development of a complete set of forward markets and contingent markets. Without these markets the price system cannot equate social marginal cost and benefit for future goods or risky activities.
- Incomplete information may lead to inefficient private choices. Health, quality and safety regulations are designed both to provide information and to express society's value judgements about intangibles, such as life itself. By avoiding explicit consideration of social costs and benefits, government policy may be inconsistent in its implicit valuation of health or safety in different activities under regulation.

REVIEW QUESTIONS

1. An economy has 10 units of goods to share out between two people. (x,y) means that the first person gets a quantity *x*, the second person a quantity *y*. For each of the allocations (a) to (e), say whether they are (i) efficient and (ii) equitable: (a) [10,0] (b) [7,2] (c) [5,5] (d) [3,6] (e) [0,10]. What does 'equitable' mean? Would you prefer allocation (d) to allocation (e)?

2. The price of meals is £1 and of films £5. There is perfect competition and no externality. What can we say about (a) the relative benefit to consumers of a marginal film and a marginal meal; (b) the relative marginal production cost of films and meals; (c) the relative marginal product of variable factors in the film and meal industries? Why is this equilibrium is efficient?

3. In deciding to drive a car in the rush hour, you think about the cost of petrol and the time of the journey. Do you slow other people down by driving? Is this an externality? Will too many or too few people drive cars in the rush hour? Should commuter parking in cities be restricted?

4. In 1885, 200 people died when the steam boiler exploded on a Mississippi river boat. Jeremiah Allen and three friends formed a private company offering to insure any boiler that they had inspected for safety. Boiler inspections caught on and explosion rates plummeted. Would Jeremiah Allen's company have been successful if it had certified boilers but not insured them as well? Explain.

5. (a) Why might society ban drugs that neither help nor harm the diseases they are claimed to cure? (b) If regulatory bodies are blamed for bad things that happen despite regulations (a train crash) but not blamed for good things prevented by too much regulation (rapid

availability of a safe and useful drug), will regulatory bodies over-regulate activities under their scrutiny?

6 *Common fallacies* Why are these statements wrong? (a) Society should ban all toxic discharges. (b) Anything governments can do the market can do better. (c) Anything the market can do the government can do better.

To check you answers to these questions, go to pages 000–000.

To help you grasp the key concepts of this chapter check out the extra resources posted on the Online Learning Centre at www.mcgraw-hill.co.uk/textbooks/begg. There are quick test questions, economics examples and access to Powerweb articles, all for free!

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