Part

2

Markets and Government

Chapter 3

Competitive Markets: Efficiency and Welfare

Although there is a sense in which property ought to be common, it should in general be private. When everyone has his own separate sphere of interest, there will not be the same ground for quarrels; and they will make more effort, because each man will feel that he is applying himself to what is his own.

Aristotle, *The Politics*

Economic Efficiency ♦ Efficiency in a Single Market ♦ Conditions of Efficiency in all Markets ♦ Efficiency, Equity and Social Welfare ♦ Competitive Markets and Efficiency ♦ Competitive Markets and Equity ♦ Conclusions

In this chapter we discuss the benefits of competitive markets. The case for competitive markets is based on three main propositions. First, market trades are freely chosen actions from which all trading parties expect to benefit. By contrast, government regulations of trades restrict the choices that individuals can make and the benefits from free choices. Second, competitive markets allocate resources efficiently. Price signals reflect scarcities. No central planner is required to calculate scarcities. In response to these prices, it is argued that firms in competitive markets satisfy the wants of consumers better than any alternative system would do. Third, markets promote economic growth by rewarding innovation and risk taking. In this chapter, we examine the second proposition. The other arguments are discussed elsewhere. Specifically, Chapter 5 discusses how markets promote economic growth.

The idea that competitive markets can produce an efficient and equitable allocation of resources is formalised in the First and Second Theorems of Welfare Economics respectively. The theorems are quite technical but understanding them provides important insights into the meaning of economic efficiency and the relationship between efficiency and welfare.

We start the chapter by introducing the concept of economic efficiency. The following sections describe the economic conditions for production and consumption that provide an efficient allocation of resources in a single market and in all markets simultaneously. These conditions are achieved in a system of perfectly competitive markets (the First Welfare Theorem). However, efficient allocations of resources are often inequitable. The Second Welfare Theorem shows that if government can redistribute resource endowments in an equitable way without distorting economic behaviour, a perfectly competitive economy will produce an outcome that is both efficient and fair. However, it turns out that resources cannot be redistributed without distorting behaviour and markets are rarely perfectly competitive. There is therefore an ongoing tension between the model of a perfectly competitive economy and what an actual economy can achieve.

Economic Efficiency

An economy is efficient if it provides the maximum amount of goods that individuals want from the resources available. In an efficient economy all potential gains are exploited. Efficiency maximises the welfare of individuals in the community given their productive endowments and the resources and technology available.

Overall economic efficiency requires three specific kinds of efficiency: production, consumption and product mix efficiency. To describe these terms, we draw on the concept of the **production possibilities frontier** (PPF), which is shown in Figure 3.1. A PPF shows the maximum quantity of goods, in this case food and clothing, which can be produced in any period, given resources and technology. Both goods are represented in equivalent physical units, such as a loaf of bread or a shirt. Once an economy is on the production possibility frontier, food output can increase only if clothing output falls, and vice versa. The PPF also shows how much of each good is given up for a unit increase in the other one. The schedule is usually drawn concave to the origin because the marginal output of a good declines as more resources are applied to its production.

Production possibilities frontier
Shows the maximum quantity of goods that can be produced from given resources and technology

Productive (or technical) efficiency means producing the maximum output of goods from given resources. It means producing each good in the most efficient way (with minimum use of resources). Producing at any point on the PPF is a necessary and sufficient condition for productive efficiency. An allocation of resources is technically efficient if it is impossible to increase the output of one good without decreasing the output of another good. If an economy produces at a point within the PPF envelope, such as at *F*, some resources are employed inefficiently or are unemployed.

Consumption (or exchange) efficiency means that goods are allocated to the individuals who want them. For any given output, at say point *H* in Figure 3.1, consumers will receive the bundle of food and clothing that maximises their satisfaction (utility), given their income and preferences. The consumption (exchange) of goods is efficient if it is impossible to increase the utility of one person without reducing the utility of another person.

Product mix (or overall) efficiency means that firms produce the goods that people want given available production technologies. An economy could produce point *H* output and be technically and exchange efficient but not produce the mix of goods that individuals most

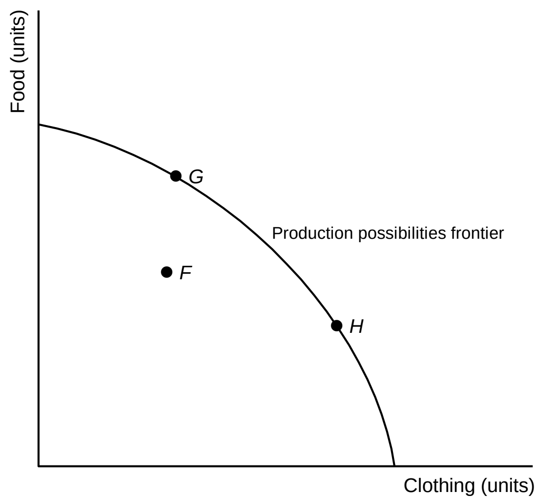

Figure 3.1 Production possibilities frontier

want. A fully efficient economy must produce the desired product mix. This mix depends on the distribution of income and preferences. The preferred mix could be anywhere along the PPF. We describe below how this preferred mix is defined and achieved.

Pareto efficient
A situation such that no one can be made better off without making someone else worse off

When all three efficiency conditions are achieved, the outcome is described as **Pareto efficient**. This means that resources cannot be reallocated so as to make someone better off without making someone else worse off.[1] Conversely, resources are used inefficiently if a reallocation could increase the welfare of one person without reducing the welfare of anyone else.

A reallocation of resources is Pareto efficient (or a Pareto improvement) if it raises the welfare of at least one person and does not reduce the welfare of anyone else. A reallocation is **potentially Pareto efficient** if there are losers but the benefits of a change exceed the costs (the net benefit is positive). In this case it is possible via compensation for some individual(s) to gain from the change and for no one to lose from it. In practice, changes with a positive net benefit are commonly described as efficient. However, if there are any losers the change is not Pareto efficient.

Efficiency in a Single Market

Perfect competition
A market for a homogeneous good with many informed buyers and sellers and free market entry

A basic proposition of economics is that a competitive equilibrium is Pareto efficient. A **competitive equilibrium** exists when a market contains many informed buyers and sellers, there is free entry and supply equals demand. This ensures that all trades that are valued by consumers and producers are made. Any good that consumers value above or equal to its marginal cost of production will be supplied. Goods with a value below the marginal cost of production will not be produced. In this section, we show that a single competitive market achieves an efficient outcome. In the next section, we examine the conditions required for economy-wide efficiency.

Figure 3.2 shows a competitive market with a standard downward-sloping demand curve and upward-sloping supply curve. Note first that the demand curve can be interpreted as a marginal benefit curve. The maximum price that someone is willing to pay for an extra unit of a good reflects the marginal benefit that he or she expects to receive from it. Second, the benefit that consumers obtain from trades (their consumer surplus) is the area between the demand curve and the horizontal price line (P_1), given by areas (A) + (B). Turning to production, the supply curve shows the quantity of goods that firms will supply at given prices. In a competitive market the supply curve is also a marginal cost schedule (it shows the cost of the last unit produced) because each firm maximises operating profit by producing up to the point where marginal cost equals price. There are no fixed costs in the supply schedule in this figure. The producer operating surplus is given by the area between the price line (P_1) and the marginal cost curve. Equilibrium market occurs where demand equals supply at quantity Q_1 and price P_1. Thus, at P_1, Q_1, the sum of benefits to consumers and producers is maximised.

This equilibrium point is Pareto efficient. When supply equals demand, all trades that consumers and producers value are made. The marginal benefit (MB) of an additional unit of output equals the marginal cost (MC). If MB = MC, it is not possible to change the quantity supplied and make someone better off without making another person worse off. On the other hand, suppose that the price is regulated at P_2 and supply reduced to Q_2. At this point, MB > MC. Output can be increased and consumers or producers, or both, can benefit from an increase in output. The loss of consumer and producer surplus is given by the sum of areas (B) + (D). Conversely, if MC > MB, output should be reduced and producers would benefit.

[1] This concept was named after the Italian economist Vilfredo Pareto (1909).

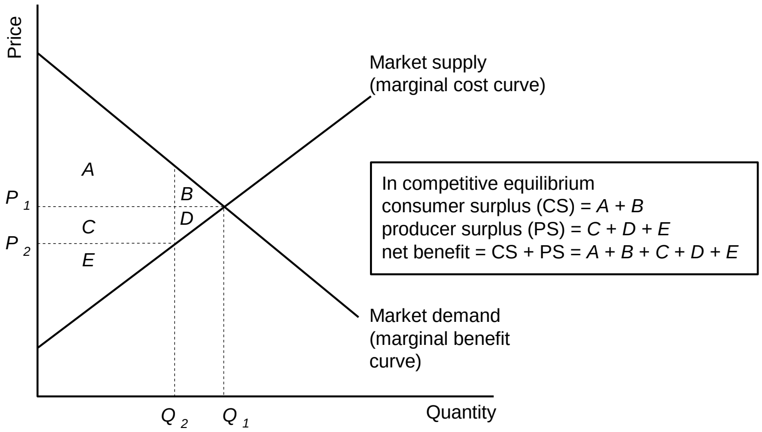

Figure 3.2 Efficiency in a competitive market

Given informed consumers, the critical condition for ensuring that MB = MC is that price equals marginal cost (P = MC). This is a key feature of perfectly competitive markets. Given a downward-sloping demand curve, informed consumers increase their purchases until their marginal benefit equals the market price. On the supply side, in a perfectly competitive market, firms take the market price as given. Production costs are minimised because inefficient firms do not survive. Firms maximise profits by increasing output until the marginal cost of production equals the market price.

It follows that, in perfectly competitive markets, MB = MC, consumer and producer surpluses are maximised and the outcome is Pareto efficient. No buyer or seller can be made better off by a move from Q_1 to another point without making someone else worse off.

However, the conclusion that a perfectly competitive market produces a Pareto-efficient outcome assumes that prices equal marginal cost in all related markets producing substitute or complementary goods. If this condition does not hold, marginal cost pricing in a competitive market may not produce a Pareto-efficient outcome. This important issue, known as the second-best problem, is discussed at several points below (e.g. in the discussion of pricing in Chapter 17).

Conditions for Efficiency in all Markets

We now examine how an efficient economy can achieve the three main efficiency conditions (efficient production, consumption and overall product mix) across all markets. We assume an economy with two individuals (Amy and Ben), two factors of production (labour and capital, e.g. machines), and two goods (clothing and food). Analysis of all markets concurrently is known as general equilibrium analysis.

Efficient production

Efficient production requires efficient use of the factors of production. Labour and capital must be used in such a way that the output of one good cannot be increased without a fall in output of another good. Figure 3.3 overleaf (an Edgeworth–Bowley box diagram) illustrates how this can be achieved.[2]

[2] This box diagram technique is named after two 19th century economists.

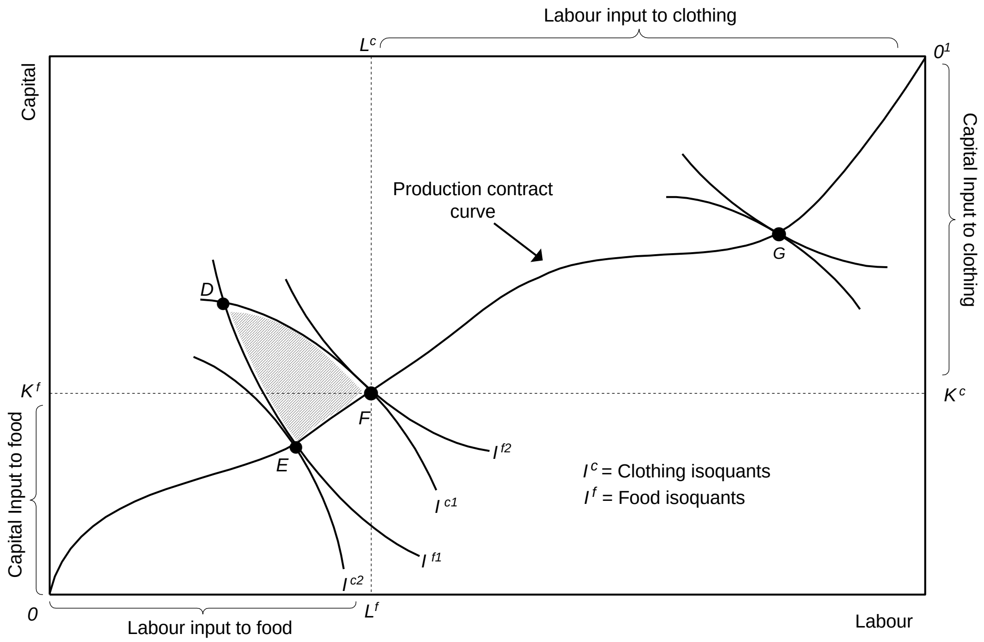

Figure 3.3 Production efficiency

The supply of labour and capital are shown on the horizontal and vertical axes respectively. Resources allocated to food are measured from the bottom left corner of the diagram (with origin *O*). Resources allocated to clothing are measured from the top right corner (with origin O^1). Thus, at point *F*, OL^f units of labour and OK^f units of capital produce food. All other labour and capital resources are employed to produce clothing.

Figure 3.3 also shows production isoquants for food (I^f) and clothing (I^c). An isoquant shows the combinations of inputs that produce a given output. The isoquants for food production are convex to the bottom left corner. Isoquants for clothing are convex to the top right corner. The slope of an isoquant at any point is the marginal rate of technical substitution (MRTS) of capital for labour — this is the marginal trade-off between two factors of production holding output constant. It shows the extra capital needed to maintain output at the same level when there is a marginal fall in labour. Convex isoquants imply a diminishing MRTS. As fewer units of capital (or labour) are employed, increasingly more units of labour (or capital) are required to achieve the given level of output.

Productive efficiency requires that, for any given output of food, output of clothing is maximised. Given convex isoquants, if food is produced at the level corresponding to isoquant I^{f1}, output of clothing is maximised by finding the clothing isoquant that is tangent to I^{f1}. Thus, at point *D* productive efficiency is not achieved. If we move to point *E*, for the same level of food (I^{f1}) more clothing can be produced (I^{c2} is higher than I^{c1}). This is a Pareto improvement. More generally, a move from *D* to anywhere between points *E* and *F* is a Pareto improvement because production of either or both goods increases, with no fall in the output of the other good. At any tangency point, the slopes of the isoquants are the same. This critical condition for production efficiency implies that the MRTS of capital (*K*) for labour (*L*) is the same for production of food (*f*) as for clothing (*c*).

$$MRTS^f{}_{KL} = MRTS^c{}_{KL} \tag{3.1}$$

Equation 3.1 can be generalised to multiple inputs, producers and goods. Efficient production requires that the marginal rate of technical substitution between any two inputs is the same for all producers who use both inputs in any market.

If the marginal rates of technical substitutions are not equal, production is inefficient. Suppose that, at the margin, machines are relatively efficient at producing food. For example, suppose that in food production the marginal output of one machine equals the output of three workers, but that, in production of clothing, the marginal output of one machine equals the output of only two workers. Food output could be increased, with no reduction in output of clothing, by allocating more machines to produce food and more labour to produce clothes.

Note the significance of the curve (*EFG*) that joins the isoquant tangency points. This curve shows all efficient combinations of food and clothing output that can be produced from the labour and capital available. The *EFG* line is known as the production contract curve. The output combinations on this curve define all points along the PPF.

Efficient consumption

Efficient consumption requires that, for any given incomes and preferences of consumers, goods are exchanged so as to maximise their satisfaction. Suppose that some point on the PPF is achieved and that Amy prefers clothes and Ben likes food. What shares of food and clothes would be efficient and how would markets achieve these shares?

Figure 3.4 presents an Edgeworth–Bowley box diagram for consumption. Here, the output of food and clothing are shown along the horizontal and vertical axes respectively. Note that this box can be viewed as sitting within a PPF, with the top right-hand corner touching the PPF. Amy's consumption of food and clothing is measured from this corner. Ben's consumption is measured from the left bottom corner. The diagram also shows the preference (indifference) curves of Amy and Ben for food and clothing.

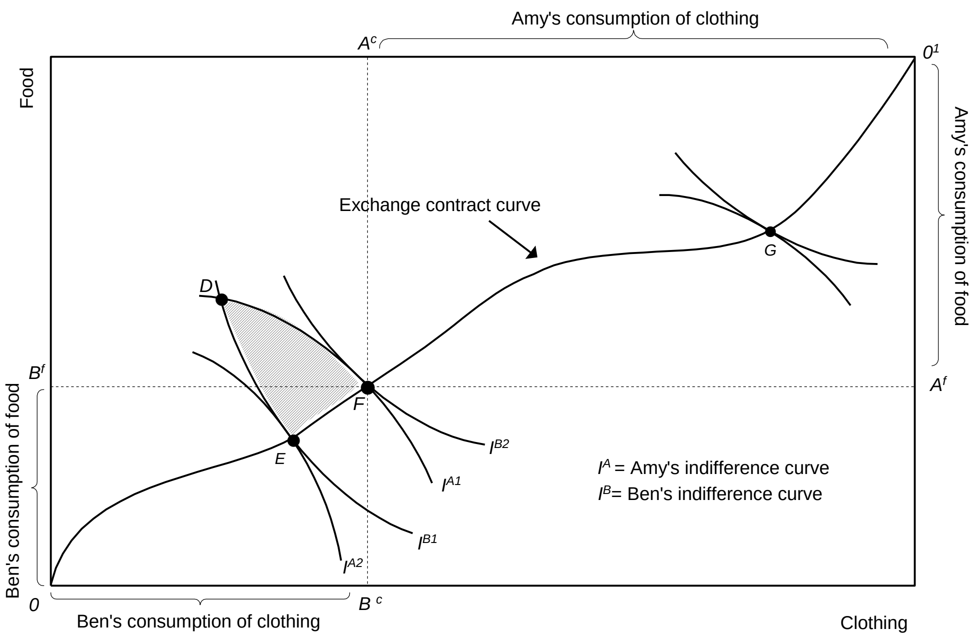

Figure 3.4 Consumption (exchange) efficiency

An indifference curve shows the combinations of food and clothing that provide a constant level of utility for each individual. For Ben, the curves (I^B) are convex to the bottom left corner; for Amy, they (I^A) are convex to the top right corner. Both are presumed to prefer a balanced set of goods to an unbalanced one. The slope of an indifference curve at any point is the marginal rate of substitution (MRS) of food for clothes — this is the marginal trade-off between two goods holding utility constant. It shows the extra amount of food needed to maintain utility at the same level when there is a marginal fall in amount of clothes. Convex indifference curves imply a diminishing MRS. As fewer units of food (or clothes) are consumed, increasingly more units of clothes (or food) are required to maintain the same level of utility.

Pareto efficiency requires that for any level of utility achieved by one individual, the utility of the other one must be maximised. Say, initially they are exchanging at point *D*. For Ben's given level of utility here (I^{B1}) it is possible to increase Amy's utility from I^{A1} to I^{A2} by moving to point *E*, where Amy obtains her highest utility (given Ben's utility) because her indifference curve is at a tangent to Ben's.

This move is a Pareto improvement. Indeed, a move from *D* to anywhere between points *E* and *F* is a Pareto improvement because the utility of either or both persons would increase. At *E*, the slope of Amy's and Ben's indifference curve is the same. At this point, Amy's marginal rate of substitution of food for clothes is the same as Ben's:

$$MRS_{fc}^{A} = MRS_{fc}^{B} \qquad (3.2)$$

where *A* stands for Amy and *B* for Ben.

A move from *D* to *G* is not Pareto efficient. Ben is better off at *G* than at *D* but Amy is less well off. However, at *G,* the MRSs are equal. Thus, a move from *D* to *G* is a potential Pareto improvement.

Consider the implications if this marginal equality did not apply. Suppose that Amy is willing to exchange three units of food for an extra shirt, but that Ben would require only two units of food in return for giving up one shirt. Both would be better off if Ben gave shirts to Amy in exchange for food. The exchange should continue until Amy and Ben accept the same marginal rate of exchange.

The exchange conditions in Equation 3.2 can be generalised across all consumers and all goods. Pareto efficiency requires that the marginal rates of substitution between any pair of goods must be the same for each individual who consumes the goods on offer. If this condition is not met, exchange could make at least one person better off without making someone else worse off.

Two more points should be made. First, the efficient MRS may change if the distribution of income changes. In Figure 3.4, the MRS at point *F* may be different from the MRS at point *E*. Second, the various efficient exchange points shown in Figure 3.4 make up the Pareto-efficient exchange contract curve ($OEFGO^1$ in Figure 3.4).

General product mix or overall efficiency

The third efficiency requirement is that firms must produce the mix of goods that individuals want given production constraints. The point on the PPF must be the preferred point given individuals' incomes and preferences. To satisfy this condition the value of a marginal unit of a good must be the same for consumers as for producers. Therefore, the marginal rate at which consumers wish to exchange food for clothing must equal the marginal rate at which producers can transform food into clothing. Formally,

$$MRS_{fc}^{A} = MRS_{fc}^{B} = MRT_{fc} \qquad (3.3)$$

where MRT_{fc} is the marginal rate of transformation of food into clothing, that is, the rate at which the economy transforms clothes into food (the negative of the slope of the PPF).

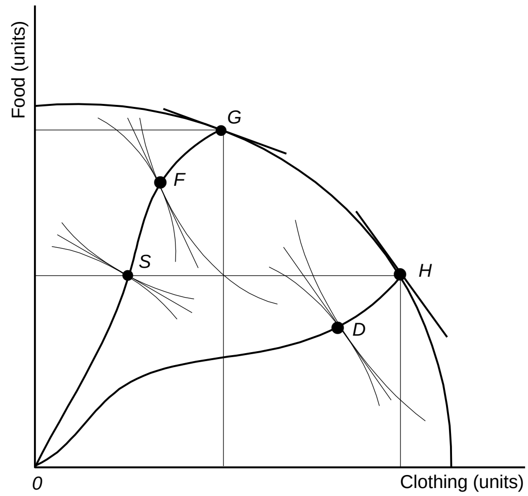

Figure 3.5 General (product mix) efficiency

Of course, clothing is not transformed directly into food. Rather the resources used can be employed for another purpose. Thus, an MRT_{fc} of 3:1 implies that three units of food can be produced by forgoing one unit of clothing. Suppose that MRS_{fc} = 4:1, which states that consumers are willing to give up four units of food for each unit of clothing forgone, and that MRT_{fc} = 3:1. This implies that more clothing should be produced until equilibrium is achieved at some ratio between 4:1 and 3:1.

The product-mix (overall) efficiency condition of Equation 3.3 is illustrated in Figure 3.5. Graphically the slope of the indifference curves must equal the slope of the PPF. Suppose that the economy is on the PPF at point G. The implied consumption Edgeworth–Bowley box for this output has origins at *O* and at *G* (corresponding to *O* and O^1 respectively in Figure 3.4). Assume also that the allocation *F* of the total output between consumers is efficient so that *F* is on the efficient exchange contract curve *OG* (which is the locus of points of tangency of Amy and Ben's indifference curves). Now suppose that the common slope of their indifference curves at *F* is not equal to the slope of the PPF at *G*. This means that $MRS^A_{fc} = MRS^B_{fc} > MRT_{fc}$.

Because the indifference curves at *F* have a steeper slope than the PPF at *G*, consider shifting inputs from food to clothes production, moving down PPF to *H*. This creates a new consumption Edgeworth–Bowley box with the same *O* origin but *G* shifted to *H*. We give Amy the same consumption bundle as before so that her consumption allocation is now at *D* where the distance *DH* = *FG*. Amy is therefore on the same indifference curve: her indifference curves drawn at *F* and *D* are the same measured from the origins *G* and *H* respectively. So, Amy's utility is not affected by this change in output mix. Ben's consumption is still measured from *O*. However, he is better off at *D* than at *F* because *D* lies above his indifference curve through *F*. Thus, the change in the allocation from *F* to *D* is a Pareto improvement. At *D*, Equation 3.3 is satisfied. Firms are producing the mix of goods that consumes want.

Work-leisure efficiency

The analysis above assumes that individuals can choose an efficient mix of work and leisure. Work–leisure efficiency requires that the marginal rate at which someone is willing to substitute leisure for income (market goods) should equal the marginal rate at which he or she can transform leisure into income.

$$MRS_{ly}^{A} = MRT_{ly}^{A} \tag{3.4}$$

where l is leisure and y is income. If the value of Amy's marginal output exceeds the value that she places on her leisure time, Amy is under-employed.

Efficiency, Equity and Social Welfare

So far, we have taken the distribution of income as given and determined efficient outcomes. However, many of these outcomes would be inequitable. To examine the relationship between efficiency, equity and welfare we introduce the related concepts of a point utility possibilities curve and the utility possibilities frontier.

A **point utility possibilities curve** (PUPC) shows the maximum utilities that individuals can obtain from different distributions of a given output of goods. Equivalently, it shows the utilities that Amy and Ben derive from points along the exchange contract curve. Take a point on the PPF in Figure 3.5, such as *G*, and distribute this output in all possible proportions from all output going to Amy to all to Ben. This replicates the contract curve *OG* in Figure 3.5. This would produce a PUPC such as *GG* in Figure 3.6. Now if we adopt the same process for output mix *H* we may get PUPC *HH*. In this way PUPCs may be drawn for any output along the PPF and for any division of this output. Note that PUPCs may cross if individuals have different preferences, for example if Amy prefers clothes and Ben prefers food.

Note also that points *F* and *S* in Figure 3.6 represent the same allocations as *F* and *S* in Figure 3.5. As we have seen, point *F* does not satisfy the overall product-mix efficiency condition because the MRSs at this point are greater than MRT. Given Amy and Ben's incomes and preferences, there will be another output combination at which more clothes and less food are produced which can make one or both of Amy and Ben better off than at *F*. There will be a point such as *D* on *HH*, which is Pareto superior to *F*.

Utility possibilities frontier
Shows the maximum utility one person can achieve given the utility of the other person

The **utilities possibilities frontier** (UPF) shows the maximum utility that Amy or Ben can achieve, given the level of utility obtained by the other party for any set of goods. Graphically it is the outer envelope of all points of Pareto efficiency. Figure 3.6 shows the outer envelope for just two points on the PPF. The full UPF is derived from a complete set of product mixes of food and clothing and a complete set of income distributions (for given tastes). If the PUPCs cross, the UPF is a jagged curve as in Figure 3.6 or Figure 3.7.

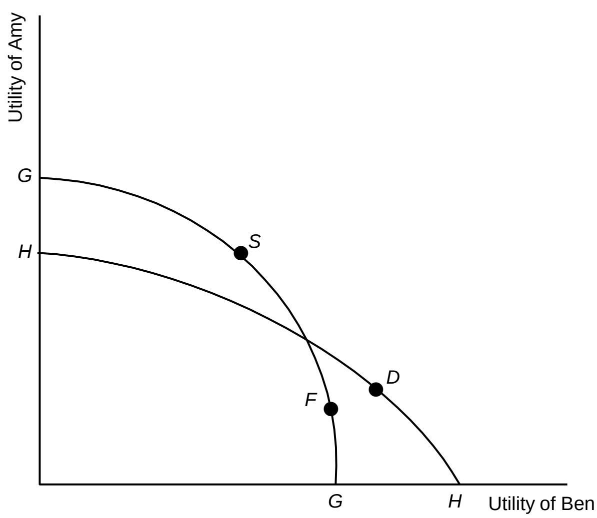

Figure 3.6 Point utility possibilities curves and the utility possibilities frontier

By describing all points on the UPF as (Pareto) efficient and by not choosing between these points, economists are attempting to make statements about the nature of markets and efficiency without making judgements about the social value of alternative distributions of welfare.

Value judgements and social welfare

However, value judgements cannot be avoided.[3] Even the concept of Pareto efficiency, when interpreted as a welfare criterion, embodies three value judgements. First, the welfare of society depends only on some defined welfare of individuals and there is no social interest beyond this. Second, each individual is the best judge of their own welfare. Third, social welfare is an increasing function of the welfare of all individuals. If Amy's utility increases when Ben's stays constant, the change is Pareto efficient and society is said to be better off. Amy and Ben's utilities are assumed to be independent. But this may not be so.

More fundamentally all positions on the UPF cannot be regarded as equally desirable. Pareto efficient points include positions where Amy or Ben has minimal welfare. Such positions are usually unacceptable. Other points on the UPF are more equitable and usually more desirable. Indeed some points off the UPF may be more desirable than some points on it. This highlights a critical difference between efficiency and optimality. An optimal outcome takes into account efficiency and equity.

To take both efficiency and equity into account, we need a **social welfare function** that expresses social welfare as a function of the level and distribution of utilities of individuals. Thus suppose that social welfare (W) is:

Social welfare function
A function that relates the overall welfare of society to the welfare of its members

$$W = f(u_1, u_2, \ldots u_n) \tag{3.5}$$

where u represents utility and there are $1 \ldots n$ citizens.[4] We can allow for distributional concerns by giving differential weights to u_i (the utility of each individual). A social welfare function enables us to rank social states and choose between Pareto-efficient outcomes.[5] However, the choice of social welfare function requires ethical judgement(s).

Similar problems arise when considering any use of resources. Most uses affect someone adversely, so that limiting decisions to Pareto-efficient improvements would be highly restrictive. As we have noted, economists often describe a use of resources as efficient if the net benefit is positive (there is a potential Pareto improvement). If the gainers compensate the losers, the resource usage would result, after compensation, in at least one person gaining and no one losing. This approach underlies much policy analysis (see discussions relating to cost-benefit analysis in Chapters 7 and 8). However, if compensation is not achieved, as it often is not, there is again a trade-off between efficiency and equity.

Figure 3.7 illustrates the idea of a social welfare function. In the figure, W_1, W_2, and W_3 represent the social indifference curves from Equation 3.5 for a two-person economy. A social indifference curve is a locus of points which provide equal social welfare for various combinations of utilities between Amy and Ben.

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[3] Value judgements involve a judgement as to what is good. This in turn involves a subjective and unprovable ethical judgement

[4] This individualistic social welfare function (SWF) is known as a Bergson–Samuelson SWF. Various forms of SWF are discussed in Chapter 7.

[5] Formally, the public policy aim may be represented as maximising social welfare ($W = f(u_1, u_2)$) subject to constraints. The constraints are the preferences of consumers ($u_1 = f(x_1, y_1)$ and $u_2 = f(x_2, y_2)$), production technology ($x = f(K_x, L_x)$, $Y = f(K_y, L_y)$) and resource constraints ($K = K_x + K_y$ and $L = L_x + L_y$), where x and y are goods and K and L are capital and labour respectively.

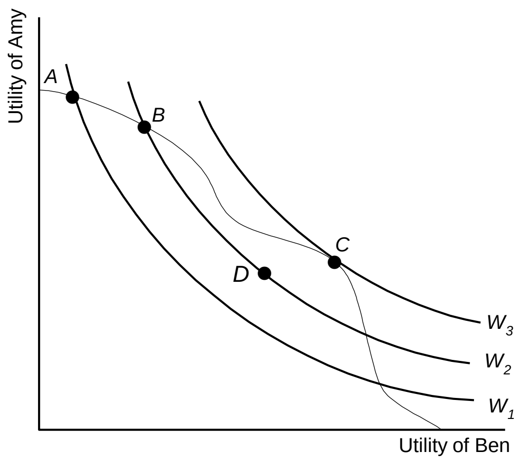

Figure 3.7 Utility possibilities and social welfare

In Figure 3.7, the higher the value of the suffix, the higher the level of welfare. Given the UPF, social welfare is maximised at *C*. Starting from *A* or *B*, a redistribution of income from Amy to Ben increases social welfare. Further, given the social welfare function as shown by the social indifference curves, a movement from *A* to *D* would also increase welfare, even though *D* is not on the UPF, with the gain in equity more than compensating for the loss of efficiency. However, in the absence of knowledge of a specific social welfare function (and it is not possible to achieve this by economic reasoning alone), one cannot reach the preferred decision.

Competitive Markets and Efficiency

What kind of economy achieves production, consumption and product mix efficiency? The answer is a perfectly competitive economy.[6] The First Theorem of Welfare Economics states that if there are markets for all goods and all markets are perfectly competitive, an economy achieves a Pareto-efficient outcome.[7]

The key features of a perfectly competitive market are that there are many buyers and sellers, the sellers are supplying similar goods and firms can freely enter or exit the market. There are no excess profits. Also buyers and sellers are assumed to be well informed about prices and the quality of goods. Given these conditions, the market collectively determines all factor and product prices. No one firm or individual can affect a price. All buyers pay the same price for a similar good. Prices adjust to clear all excess demand and supply, equilibrium quantities and prices are achieved, and all Pareto-efficient trades are made.

Consider first productive efficiency. In a perfectly competitive market inefficient firms will not survive. Each firm employs factors until the value of their marginal product (VMP) equals their price.[8] Suppose that the rental price (*r*) of a machine is twice the price of a unit of labour (*w*). Each firm will purchase machines until their marginal product (MP) falls to two times the marginal product of labour. The marginal rate at which capital is substituted for labour equals

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[6] For a more formal (mathematical) proof of the First Theorem of Welfare Economics, see most intermediate microeconomic texts, for example Varian (2006).

[7] In theory, an omniscient government managing a complete command and control economy could also achieve a Pareto-efficient allocation of resources

[8] VMP is the change in revenue due to the sale of the additional output contributed by the hiring of one more unit of a factor of production

the ratio of the marginal product of labour to the marginal product of capital, which in turn equals the price ratio of labour to capital.

$$MRTS^{f}_{KL} = MRTS^{c}_{KL} = \frac{MP_L}{MP_K} = \frac{w}{r} \quad (3.6)$$

Because all firms face the same input prices, all firms employ the same marginal rate of technical substitution between inputs, as in Equation 3.1. This ensures productive efficiency.

Turning to consumption, following demand theory (see Chapter 6), all consumers are assumed to behave in accordance with a systematic set of preferences and to aim to maximise utility given market prices and income constraints. Individuals maximise their utility when the marginal rate at which they wish to substitute one good for another is in inverse proportion to the relative prices of the two goods. For example, if Amy is willing to substitute three units of food for one unit of clothing, the price of food must be one-third of the price of clothing. Thus, we have

$$MRS^{A}_{fc} = MRS^{B}_{fc} = \frac{P_c}{P_f} \quad (3.7)$$

Because all individuals face the same relative prices in competitive markets, all individuals have the same marginal rates of substitution. This ensures efficient consumption.

Third, consider product mix efficiency. To show that a perfectly competitive market produces an efficient mix of products, it is useful to express the MRT in terms of marginal cost (MC). MC is the incremental cost of one more unit of output. Recall that MRT is the slope of the PPF. The slope also represents the ratio of the marginal costs of producing clothing and food. The marginal cost of producing clothes is the food forgone. Conversely, the marginal cost of food is clothing forgone. Thus,

$$MRT_{fc} = \frac{MC_c}{MC_f} \quad (3.8)^{9}$$

In perfect competition, the market determines the price of a product and producers expand output until marginal cost equals price. Therefore,

$$\frac{MC_c}{MC_f} = \frac{P_c}{P_f} \quad (3.9)$$

Combining Equations 3.8 and 3.9, the marginal rate at which clothes are transformed into food must equal the price ratio of food to clothing. Equation 3.7 shows that the MRSs of all consumers equal the same price ratio. Therefore a perfectly competitive market satisfies the necessary condition for product mix efficiency, Equation 3.3, that the MRTs by all producers for all goods equal the MRSs of all consumers for those same goods.[10]

Finally we should note that a perfectly competitive market also produces an efficient amount of work and leisure. In a competitive labour market the wage equals the value of the marginal product of labour. Employment expands so long as the value of the marginal product exceeds the value of leisure. In equilibrium, the wage and the marginal product equal the opportunity cost of leisure forgone.

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9 $MC_f = \Delta TC_f/\Delta f$ and $MC_f = \Delta TC_c/\Delta c$. Suppose that at some point on the PPF, a small amount of resources valued at ΔTC is transferred from producing food to producing clothing. Now, the change in resource costs in food (i.e. ΔTC_f) and that in clothes (i.e. ΔTC_c) both equal ΔTC. Thus $MC_c/MC_f = (\Delta TC_c/\Delta c)/(\Delta TC_f/\Delta f) = \Delta f/\Delta c$, which is the slope of the PPF ($=MRT_{fc}$)

10 Equation 3.9 is another way to represent the efficiency condition. It shows that the marginal cost of each commodity must be reflected in its price. Thus if the opportunity cost of a commodity is relatively high, efficiency requires that its price be relatively high—this is because the high price signals the consumers to economise its use.

The work–leisure efficiency condition is not met in uncompetitive labour markets, where employers or employees restrict entry into the labour force in some way. Government regulations and taxation also distort the conditions for work–leisure efficiency.

Implications of the First Theorem of Welfare Economics

The First Welfare Theorem provides the formal basis for the efficiency of markets. By showing that a complete set of competitive markets produces a Pareto-efficient outcome, it formalises Adam Smith's famous argument that individuals in the pursuit of their own interests are led by the invisible hand of a competitive market to work in the general interest. Government's role in ensuring that resources are allocated efficiently would be limited to ensuring the effective operation of competition in all factor and goods markets.

This would not be a small task. Government would establish and enforce the rules for the economy, the interactions between private parties and the interactions between private agents and government. Government would establish and protect property rights and the commercial system of contracts and exchange. Fulfilment of contracts is essential for an effective market system.

However, the First Theorem has three major limitations. First, few markets are perfectly competitive. Most economies contain various imperfectly competitive markets, in which one or more of the requirements of a perfectly competitive market do not exist. In some sectors, for example for some environmental goods, there are no markets at all. When the conditions for perfect competition do not exist, there is said to be market failure and a potential role for government in the allocation of resources is established. Second, in the model of the economy described above, human capital and technology are taken as given. As we will see in Chapter 5, a perfectly competitive economy can produce an efficient inter-temporal allocation of resources. However, the perfect competition model of the economy does not explain technological change or economic growth. Third, the First Theorem says nothing about the equitable distribution of income. Pareto efficiency ensures only that some point on the UPF is achieved. But many positions on this frontier are socially unacceptable. The socially preferred outcome depends on equity as well as efficiency criteria. We now address this issue.

Competitive Markets and Equity

As we have seen, at many points on a UPF the distribution of welfare can be highly unequal. For example, in Figure 3.7 points *A* and *B* represent high levels of utility for Amy and low levels for Ben. To determine an optimal outcome, we need a method for choosing between points on the UPF and possibly also between some states of welfare that are not on the frontier. For this we need a social welfare function (SWF) that will enable us to rank economic states. Needless to say the choice of SWF depends critically on views about equity. These issues are taken up in Chapter 7. For the discussion here, we suppose that there is an agreed SWF and that social states can be ranked and we consider the implications for competitive markets and the role of government.

The Second Theorem of Welfare Economics. This is where the Second Theorem steps in. This theorem states that any Pareto-efficient allocation (any point on the UPF) can be achieved by perfectly competitive markets if society starts with the appropriate distribution of resources or if resources can be so redistributed without cost. Suppose that, with the existing distribution of wealth, a competitive market would produce an outcome at point *B* in Figure 3.7, but that society prefers point *C*. The Second Theorem shows that any position such as *C* can be achieved by a lump sum redistribution of *initial individual endowments* followed by the operations of perfectly competitive markets (see, for example, Varian 2006). A lump sum transfer is a fixed amount that does not change with a change in circumstance of the taxed entity. It is difficult to achieve a move from *B* to *C* after *B* has been achieved because this implies that a specific set of goods has been produced. A redistribution of these goods might not produce a move from *B* to *C*.

The Second Theorem has important implications. It shows, in principle, that decentralised competitive markets combined with individualised lump sum transfers can achieve any desired distribution of welfare subject to production constraints. Moreover, government could achieve this result without intervening subsequently in the allocation of resources in markets. Equity and efficiency would thus be separated. If this were feasible, government would be responsible for ensuring an appropriate set of initial endowments. The competitive economy would then ensure an efficient and optimal allocation of resources.

The Second Theorem assumes that endowments can be redistributed without distorting the use of resources. This means that any redistribution must not disturb the marginal conditions necessary for Pareto efficiency (Equations 3.1 to 3.3) or the critical relevant price relativities (Equations 3.6 to 3.9). Nor must government distort the critical condition for an efficient work–leisure split, namely that workers receive the full value of their marginal output. If income taxation or any other method of redistributing income distorts any of these marginal relationships, there will be a loss of output and/or utility.

Endowments can be redistributed without cost if individualised lump sum transfers are possible. A transfer (a tax or a grant) is a **lump sum transfer** when the amount of the transfer is not affected by the taxpayer's or recipient's actions. In this case the transfer would not affect an individual's incentive to work or consume or undertake any other form of economic activity. Prices would still equate to marginal cost. If lump sum transfers are possible, government could redistribute income to achieve any desired Pareto-efficient outcome.

Lump sum transfer
A transfer that is not affected by the behaviour of the taxpayer or the recipient

However, individualised lump sum transfers based on an individual's capacity are virtually impossible to achieve. Taxes or grants that are based on behaviour are liable to change behaviour and are therefore not lump sum taxes. Lump sum taxes based on fixed personal attributes, such as a person's height, sex or IQ, are likely to be arbitrary or unfair, or both. Moreover, virtually all transfers relate to behaviour in one way or another and are likely to change behaviour. This means that they almost always have some efficiency effects and result in some loss of real income as a trade-off for a gain in equity.

Conclusions

An efficient economy produces the goods that people most want at least cost. In itself, this is desirable. However, an efficient economy does not guarantee equity and indeed may be quite inequitable.

The conditions for an efficient allocation of resources provide a valuable guide to how resources should be allocated. Efficient production requires that the marginal rate of technical substitution between any two factors of production must be the same for all firms who use both factors. Efficient consumption requires that the marginal rates of substitution between any pair of goods must be the same for each individual who consumes the goods on offer. Overall product mix efficiency requires that the economy must produce goods in combinations that match people's willingness to pay for them. This occurs when the marginal rate at which firms can transform any two goods equals the marginal rate at which consumers wish to exchange the goods. Work–leisure efficiency requires that individuals receive the value of their marginal product.

The unifying requirement for all these conditions of efficiency is that the prices for all factors of production and for all goods should equal their marginal cost. This is achieved in a perfectly competitive economy. Accordingly, a perfectly competitive economy achieves a Pareto-efficient allocation of resources (an economy where no one can be made better off without making someone worse off). If individualised lump sum transfers can then effect a desired redistribution of endowments, a perfectly competitive economy can produce an equitable as well as an efficient outcome.

The general equilibrium economy portrayed here is based on standardised (homogeneous) goods in a static environment. In more complex models, goods are characterised by four main features—their location, time and uncertainty, as well as their homogeneous quality. Advanced texts, for example Hindricks and Myles (2006), show that, if markets exist for all goods with all these characteristics, perfectly competitive economies can achieve an efficient allocation of resources over time. However, even these more complex models of the economy often take technology as given. As we see in Chapter 5, technical progress (and economic growth) is facilitated in a competitive economy. This is an important additional advantage of competitive markets.

However, no economy is perfectly competitive. In all economies market failures occur because of non-existent, incomplete and imperfectly competitive markets. When market failures exist, markets do not produce an efficient allocation of resources. Moreover, if there are several market failures and two or more conditions for efficiency are not satisfied, achievement of the other conditions is not necessarily beneficial. This is known as the second-best problem. In such cases an examination of policy options is required.

Finally, individualised lump sum transfers as a function of individuals' capacities are both unfeasible and would change incentives and behaviours. This means that society can achieve a more equitable distribution of income only by sacrificing some efficiency in use of resources.

Summary

- An efficient economy produces the maximum amount of goods that people want given their preferences and the productive resources and technology available.
- An economy is described as Pareto efficient if no one can be made better off without someone else being made worse off. There are no unexploited economic gains.
- Overall economic (Pareto) efficiency requires that production and consumption (exchange) are efficient and that the optimum mix of goods is produced.
- These efficiency conditions are achieved in a perfectly competitive economy. A key reason is that in such an economy the prices of all factors of production and of all goods equal their marginal costs.
- However, an efficient economy is not necessarily equitable because some people have low earning capacity.
- If government could redistribute resources using individualised lump sum transfers, then a perfectly competitive market could produce efficient and fair outcomes.
- In practice, markets are far from complete or perfectly competitive. Also, government cannot redistribute resources without affecting individual behaviour and distorting markets.
- Therefore, government involves regulation of markets, redistribution of income and trade-offs between efficient and equitable outcomes.

Questions

1. What is the relationship between achieving Pareto efficiency and maximising net social benefit defined as the difference between total benefits and total costs?
2. When can win–win outcomes occur rather than outcomes where there are gainers and losers?
3. How are the utility possibilities frontier and the production possibilities frontier related? Why does the utility possibilities frontier matter?
4. The First Welfare Theorem claims that competitive markets result in a Pareto-efficient outcome. Explain briefly why. What is the relevance of the assumptions that producers maximise profits and consumers maximise utility?
5. Determine the equilibrium quantity and price in a competitive market for shirts, assuming the supply of shirts is given by $Q^S = 20 + 4P$ and the demand for shirts is $Q^D = 65 - 5P$. Will this equilibrium outcome be Pareto efficient?
6. Amy and Ben have different tastes such that Amy wants a large number of shirts and Ben wants large quantities of beer. But in market equilibrium they are prepared to exchange the same amount of beer for a shirt. Explain this apparent paradox.
7. Suppose that a manufacturing company requires either three units of capital or two units of labour to maintain a given level of output, while a service company would require two units of labour for each unit of capital for its level of output. What is the marginal rate of technical substitution of inputs for each firm? Does this represent a situation of efficient production? Why/why not?
8. Suppose that an economy produces two goods, clothes and food. At current margins, consumers are willing to exchange four units of food for one unit of clothing and firms can produce one unit of clothing at the expense of two units of food. Is this an efficient allocation? To be efficient, should the economy produce more clothes or more food?
9. Why is it inefficient to charge two consumers different prices for the same good? Airlines often charge passengers different prices for similar seats on the same flight. Is this consistent with efficient consumption?
10. Consider an economy that produces clothes and bread. Explain why the economy will not produce an efficient mix of products if a tax is imposed on the consumption of shirts but not on bread. What kind of deadweight loss will be incurred?
11. Discuss the following propositions.
    i. A move from a point within the utility possibilities frontier to a point on the frontier is always a Pareto improvement.
    ii. A Pareto improvement is a necessary and sufficient condition for an increase in social welfare.
12. If all outcomes from a competitive economy are efficient, why do we need a social welfare function?

Further Reading

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