

Chapter 5

Efficiency and Equity

After studying this chapter you will be able to:

- ◆ Define efficiency
- ◆ Distinguish between value and price and define consumer surplus
- ◆ Distinguish between cost and price and define producer surplus
- ◆ Explain the conditions under which markets move resources to their highest-valued uses and the sources of inefficiency in our economy
- ◆ Explain the main ideas about fairness and evaluate claims that markets result in unfair outcomes

More for Less

We try to use our time and spend our incomes in ways that get the most out of our limited resources. Producers strive to cut costs and make the largest possible profit. With everyone pursuing self-interest, what happens to the social interest? Do markets deliver an outcome that is best for everyone? And why, in the market for air travel, do customers end up paying different prices for the same trip? Find some answers in this chapter and in *Reading Between the Lines* at the end of the chapter.



Efficiency and Social Interest

When does the pursuit of self-interest also serve the social interest? Economists have thought hard about this question and have most to say about one aspect of the “social interest”, allocative efficiency.

Allocative efficiency (defined in Chapter 2, p. 37) occurs when it is not possible to produce more of one good without giving up the production of some other good that is valued more highly. Achieving allocative efficiency also means that it is not possible to make someone better off without making someone else worse off. Allocative efficiency does not depend on the distribution of economic benefit. In principle, we can all agree that one situation, *A*, is efficient and another situation, *B*, is inefficient. Efficiency is not a cold, mechanical concept. It is a concept based on value, and value is based on people’s feelings. For example, if people value a nuclear-free environment more highly than they value cheap electric power, it is efficient to use higher-cost, non-nuclear technologies to produce electricity.

Let’s review the idea of allocative efficiency by returning to the example of Chapter 2 and thinking about the efficient quantity of pizzas. To produce more pizzas, we must give up some other goods and services. For example, we might give up some sandwiches. So to produce more pizzas, we forgo sandwiches. If we have fewer pizzas, we can have more sandwiches. What is the efficient quantity of pizzas to produce? The answer depends on marginal benefit and marginal cost.

Marginal Benefit

If we consume one more pizza, we receive a marginal benefit. **Marginal benefit** is the benefit that a person receives from consuming one more unit of a good or service. The marginal benefit from a good or service is measured as the maximum amount that a person is willing to pay for one more unit of it. So the marginal benefit from a pizza is the maximum amount of other goods and services that people are willing to give up to get one more pizza. The marginal benefit from pizza decreases as the quantity of pizzas consumed increases – the principle of *decreasing marginal benefit*.

We can express the marginal benefit from a pizza as the number of sandwiches that people are willing to forgo to get one more pizza. But we can also express marginal benefit as the pound value of other goods and services that people are willing to forgo. Figure 5.1 shows the marginal benefit from pizza expressed in this

way. As the quantity of pizza increases, the value of other items that people are willing to forgo to get one more pizza decreases.

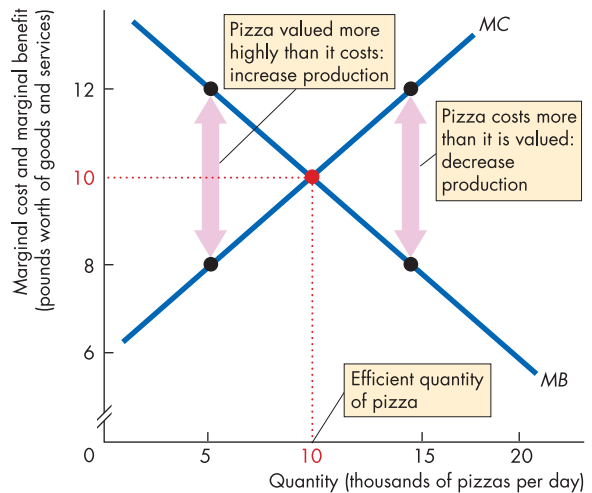
Marginal Cost

If we produce one more pizza, we incur a marginal cost. **Marginal cost** is the opportunity cost of producing *one more unit* of a good or service. The marginal cost of a good or service is measured as the value of the best alternative forgone. So the marginal cost of a pizza is the value of the best alternative forgone to get one more pizza. The marginal cost of a pizza increases as the quantity of pizza produced increases – the principle of *increasing marginal cost*.

We can express marginal cost as the number of sandwiches we must forgo to produce one more pizza. But we can also express marginal cost as the pound value of other goods and services we must forgo.

Figure 5.1

The Efficient Quantity of Pizza



The marginal benefit curve (*MB*) shows what people *are willing to forgo* to get one more pizza. The marginal cost curve (*MC*) shows what people *must forgo* to get one more pizza. If fewer than 10,000 pizzas a day are produced, marginal benefit exceeds marginal cost. Greater value can be obtained by producing more pizzas. If more than 10,000 pizzas a day are produced, marginal cost exceeds marginal benefit. Greater value can be obtained by producing fewer pizzas. If 10,000 pizzas a day are produced, marginal benefit equals marginal cost and the efficient quantity of pizza is available.

Figure 5.1 shows the marginal cost of pizza expressed in this way. As the quantity of pizza produced increases, the value of other items we must forgo to produce yet one more pizza increases.

Efficiency and Inefficiency

To determine the efficient quantity of pizza, we compare the marginal cost of a pizza with the marginal benefit of a pizza. There are three possible cases:

- ◆ Marginal benefit exceeds marginal cost
- ◆ Marginal cost exceeds marginal benefit
- ◆ Marginal benefit equals marginal cost

Marginal Benefit Exceeds Marginal Cost

Suppose the quantity of pizzas produced is 5,000 a day. Figure 5.1 shows that at this quantity, the marginal benefit of a pizza is £12. That is, when the quantity of pizzas available is 5,000 a day, people are willing to pay £12 for the 5,000th pizza.

Figure 5.1 also shows that the marginal cost of the 5,000th pizza is £8. That is, to produce one more pizza, the value of other goods and services that we must forgo is £8. If pizza production increases from 4,999 to 5,000, the value of the additional pizza is £12 and its marginal cost is £8. If this pizza is produced, the value of the pizza produced exceeds the value of the goods and services we must forgo by £8. Resources will be used more efficiently – they will create more value – if we produce an extra pizza and fewer other goods and services. This same reasoning applies all the way up to the 9,999th pizza. Only when we get to the 10,000th pizza does marginal benefit not exceed marginal cost.

Marginal Cost Exceeds Marginal Benefit

Suppose the quantity of pizzas produced is 15,000 a day. Figure 5.1 shows that at this quantity, the marginal benefit of a pizza is £8. That is, when the quantity of pizzas available is 15,000 a day, people are willing to pay £8 for the 15,000th pizza.

Figure 5.1 also shows that the marginal cost of the 15,000th pizza is £12. That is, to produce one more pizza, the value of the other goods and services that we must forgo is £12.

If pizza production decreases from 15,000 to 14,999, the value of the one pizza forgone is £8 and its marginal cost is £12. So if this pizza is not produced, the value of the other goods and services produced exceeds the value

of the pizza forgone by £8. Resources will be used more efficiently – they will create more value – if we produce one fewer pizza and more other goods and services. This same reasoning applies all the way down to the 10,001st pizza. Only when we get to the 10,000th pizza does marginal cost not exceed marginal benefit.

Marginal Benefit Equals Marginal Cost

Suppose the quantity of pizzas produced is 10,000 a day. Figure 5.1 shows that at this quantity, the marginal benefit of a pizza is £10. That is, when the quantity of pizzas available is 10,000 a day, people are willing to pay £10 for the 10,000th pizza.

Figure 5.1 also shows that the marginal cost of the 10,000th pizza is £10. That is, to produce one more pizza, the value of other goods and services that we must forgo is £10.

In this situation, we cannot increase the value of the goods and services produced by either increasing or decreasing the quantity of pizza. If we increase the quantity of pizza, the 10,001st pizza costs more to produce than it is worth. And if we decrease the quantity of pizza produced, the 9,999th pizza is worth more than it costs to produce. So when marginal benefit equals marginal cost, resource use is efficient.

Review Quiz

- 1 If the marginal benefit of a pizza exceeds the marginal cost of a pizza are we producing too much pizza and too little of other goods and services, or are we producing too little pizza and too much of other goods and services?
- 2 If the marginal cost of a pizza exceeds the marginal benefit of a pizza are we producing too much pizza and too little of other goods and services, or are we producing too little pizza and too much of other goods and services?
- 3 What is the relationship between the marginal benefit of a pizza and the marginal cost of a pizza when we are producing the efficient quantity of pizza?

Does a competitive market in pizza produce the efficient quantity of pizza? Let's begin to answer this question.

Value, Price and Consumer Surplus

To investigate whether a competitive market is efficient, we need to learn about the connection between demand and marginal benefit and the connection between supply and marginal cost.

Value, Willingness to Pay and Demand

In everyday life we talk about “getting value for money.” When we use this expression we are distinguishing between *value* and *price*. Value is what we get and the price is what we pay.

The **value** of one more unit of a good or service is its *marginal benefit*. Marginal benefit can be expressed as the maximum price that people are *willing to pay* for another unit of the good or service. The willingness to pay for a good or service determines the demand for it.

In Figure 5.2(a) the demand curve shows the quantity demanded at each price. For example, when the price of

a pizza is £10, the quantity demanded is 10,000 pizzas a day. In Figure 5.2(b), the demand curve shows the maximum price that people are willing to pay when there is a given quantity. For example, when 10,000 pizzas a day are available, the most that people are willing to pay for a pizza is £10. This second interpretation of the demand curve means that the marginal benefit from the 10,000th pizza is £10.

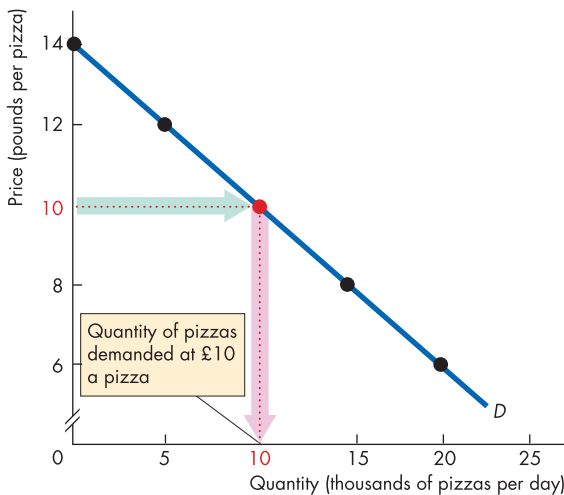
When we draw a demand curve, we use a *relative price*, not a *money price*. A relative price is expressed in euro units, but it measures the number of pounds worth of other goods and services forgone to obtain one more unit of the good in question (see Chapter 3, p. 54). So a demand curve tells us the quantity of other goods and services that people are willing forgo to get an additional unit of a good. But this is what a marginal benefit curve tells us too. So:

A demand curve is a marginal benefit curve.

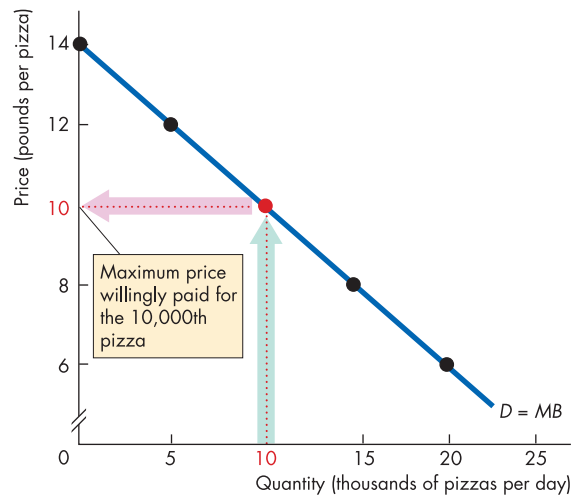
We don't always have to pay the maximum price that we are willing to pay. When we buy something, we often get a bargain. Let's see how.

Figure 5.2

Demand, Willingness to Pay and Marginal Benefit



(a) Price determines quantity demanded



(b) Quantity determines willingness to pay

The demand curve for pizza, D , shows the quantity of pizza demanded at each price, other things remaining the same. The demand curve also shows the maximum price that consumers are willing to pay for the last pizza if a given quantity of pizza is available. In part (a) at a price of £10, the quantity demanded is 10,000 pizzas a day.

In part (b), if 10,000 pizzas a day are available, the maximum price that consumers are willing to pay for the 10,000th pizza is £10. So the demand curve is also the marginal benefit curve.

Consumer Surplus

When people buy something for less than it is worth to them, they receive a consumer surplus. A **consumer surplus** is the value of a good minus the price paid for it, summed over the quantity bought.

To understand consumer surplus, let's look at Lisa's demand for pizza in Figure 5.3. Lisa likes pizza, but the marginal benefit she gets from it decreases quickly as her consumption increases.

To keep things simple, suppose Lisa can buy pizza by the slice. If a pizza costs £1.40 a slice, Lisa spends her fast-food budget on items that she values more highly than pizza. At £1.20 a slice, she buys 10 slices a week. At £1 a slice, she buys 20 slices a week; at 80 pence a slice, she buys 30 slices a week; and at 60 pence a slice, she eats nothing but pizza and buys 40 slices a week.

Lisa's demand curve for pizza in Figure 5.3 is also her *willingness-to-pay* or marginal benefit curve. It tells us that if Lisa can have only 10 slices a week, she is willing to pay £1.20 for the 10th slice. Her marginal benefit from the 10th slice is £1.20. If she can have 20 slices a week, she is willing to pay £1 for the 20th slice. Her marginal benefit from the 20th slice is £1.

Figure 5.3 also shows Lisa's consumer surplus from pizza when the price is £1 a slice. At this price, she buys 20 slices a week. The most that Lisa is willing to pay for the 20th slice is £1, so its marginal benefit equals the price she pays for it.

But Lisa is willing to pay almost £1.40 for the first slice. So the marginal benefit from this slice is close to 40 pence more than she pays for it. So on her first slice of pizza, she receives a *consumer surplus* of almost 40 pence. At a quantity of 10 slices of pizza a week, Lisa's marginal benefit is £1.20 a slice. So on the 10th slice, she receives a consumer surplus of 20 pence.

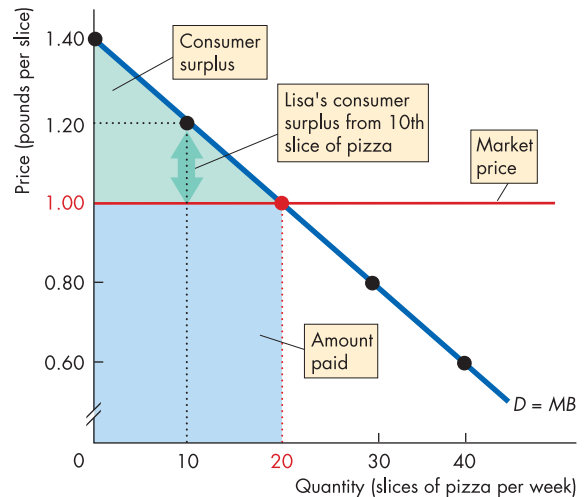
To calculate Lisa's consumer surplus, we find the consumer surplus on each slice she buys and add them together. This sum is the area of the green triangle – the area below the demand curve and above the market price line. This area is equal to the base of the triangle (20 slices a week) multiplied by the height of the triangle (40 pence a slice) divided by 2, which is £4.

The area of the blue rectangle in Figure 5.3 shows what Lisa pays for pizza, which is £20. This area is equal to 20 slices a week multiplied by £1 a slice.

All goods and services are like the pizza example you've just studied. Because of decreasing marginal benefit, people receive more benefit from their consumption than the amount they pay.

Figure 5.3

A Consumer's Demand and Consumer Surplus



Lisa's demand curve for pizza tells us that at £1.40 a slice, she does not buy pizza. At £1.20 a slice, she buys 10 slices a week; at £1 a slice, she buys 20 slices a week. Lisa's demand curve is also her marginal benefit curve, so her demand curve also tells us that she is willing to pay £1.20 for the 10th slice and £1 for the 20th slice. She actually pays £1 a slice – the market price – and buys 20 slices a week. She spends £20 a week on pizza – the area of the blue rectangle. Lisa's consumer surplus from pizza is £4 – the area of the green triangle.

Review Quiz

- 1 Explain how to measure the value or marginal benefit from a good or service.
- 2 Explain the relationship between marginal benefit and the demand curve.
- 3 What is consumer surplus and how is it measured?

You've seen how we distinguish between value – marginal benefit – and price. And you've seen that buyers receive a consumer surplus because marginal benefit exceeds price. Next, we're going to study the connection between supply and marginal cost and learn about producer surplus.

Cost, Price and Producer Surplus

What you are going to learn about cost, price and producer surplus parallels the related ideas of value, price and consumer surplus that you've just studied.

Firms are in business to make a profit. To do so, they must sell their output for a price that exceeds the cost of production. Let's investigate the relationship between cost and price in more detail.

Cost, Minimum Supply-price and Supply

When firms earn profit, they receive more (or at least receive no less) for the sale of a good or service than the cost of producing it. Just as consumers distinguish between *value* and *price*, so producers distinguish between *cost* and *price*. Cost is what a producer gives up and price is what a producer receives.

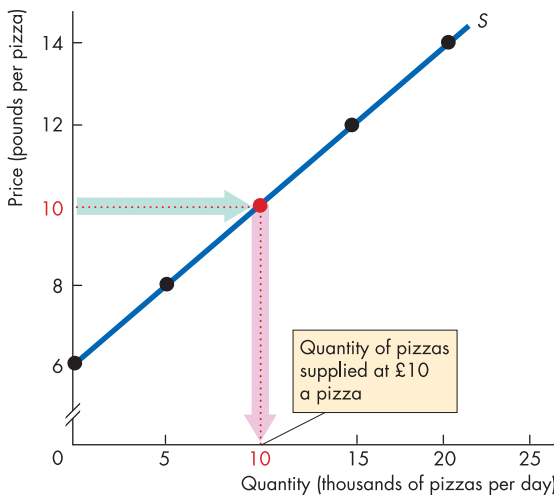
The cost of producing one more unit of a good or service is its *marginal cost*. The marginal cost is the minimum price that producers must receive to induce them to produce another unit of the good or service. This minimum acceptable price determines the quantity supplied.

In Figure 5.4(a), the supply curve shows the quantity supplied at each price. For example, when the price of a pizza is £10, the quantity supplied is 10,000 pizzas a day. In Figure 5.7(b), the supply curve shows the minimum price which producers must be offered to produce a given quantity of pizza. For example, the minimum price which producers must be offered to get them to produce 10,000 pizzas a day is £10 a pizza. This second view of the supply curve means that the marginal cost of the 10,000th pizza is £10. The supply curve S is also the marginal cost curve, MC .

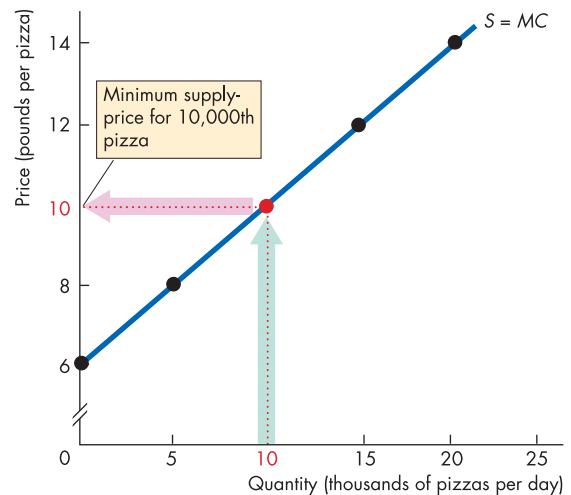
Because the price is a relative price, a supply curve tells us the quantity of other goods and services that firms *must forgo* to produce one more unit of the good. But a marginal cost curve also tells us the quantity of

Figure 5.4

Supply, Minimum Supply-price and Producer Surplus



(a) Price determines quantity supplied



(b) Quantity determines minimum supply-price

The supply curve of pizza, S , shows the quantity of pizza supplied at each price, other things remaining the same. The supply curve of pizza also shows the minimum price that producers must be offered for the last pizza to produce a given quantity. Part (a) shows that at a price of £10, the quantity supplied is 10,000 pizzas a day.

Part (b) shows that to get firms to produce 10,000 pizzas a day, the minimum price that producers must be offered for the 10,000th pizza is £10. So the supply curve is also the marginal cost curve.

other goods and services that firms must forgo to get one more unit of the good. So:

A supply curve is a marginal cost curve.

If the price producers receive exceeds the cost they incur, they earn a producer surplus. This producer surplus is analogous to consumer surplus.

Producer Surplus

When the price exceeds marginal cost, the firm obtains a producer surplus. A **producer surplus** is the price of a good minus the opportunity cost of producing it, summed over the quantity sold. To understand producer surplus, let's look at Mario's supply of pizza in Figure 5.5.

Mario can produce pizza or bake bread that people like a lot. The more pizza he bakes, the less bread he can bake. His opportunity cost of pizza is the value of the bread he must forgo. This opportunity cost increases as Mario increases his production of pizza. If a pizza sells for only £6, Mario produces no pizzas. He uses his kitchen to bake bread. Pizza just isn't worth producing. But at £8 a pizza, Mario produces 50 pizzas a day, and at £10 a pizza, he produces 100 pizzas a day.

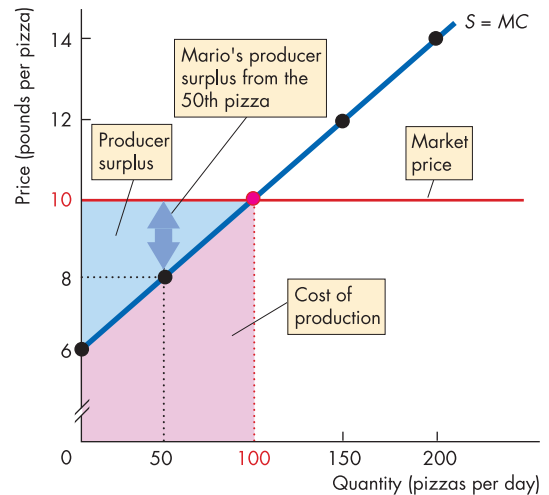
Mario's supply curve of pizza is also his *minimum supply price* curve. It tells us that if Mario can sell only one pizza a day, the minimum that he must be paid for it is £6. If he can sell 50 pizzas a day, the minimum that he must be paid for the 50th pizza is £8, and so on.

Figure 5.5 also shows Mario's producer surplus. If the price of a pizza is £10 Mario plans to sell 100 pizzas a day. The minimum that he must be paid for the 100th pizza is £10. So its opportunity cost is exactly the price he receives for it. But his opportunity cost of the first pizza is only £6. So this first pizza costs £4 less to produce than he receives for it. Mario receives a *producer surplus* from his first pizza of £4. He receives a slightly smaller producer surplus on the second pizza, less on the third, and so on until he receives no producer surplus on the 100th pizza.

Figure 5.5 shows Mario's producer surplus as the blue triangle formed by the area above the supply curve and below the price line. This area is equal to the base of the triangle (100 pizzas a day) multiplied by the height (£4 a pizza) divided by 2, which equals £200 a day. Figure 5.5 also shows Mario's opportunity costs of production as the red area below the supply curve, which is £800 a day.

Figure 5.5

A Producer's Supply and Producer Surplus



Mario's supply curve of pizza tells us that at a price of £6, Mario plans to sell no pizzas. At a price of £8, he plans to sell 50 pizzas a day; and at a price of £10, he plans to sell 100 pizzas a day. Mario's supply curve also tells us that the minimum he must be offered is £8 for the 50th pizza a day and £10 for the 100th pizza a day.

If the market price is £10 a pizza, he sells 100 pizzas a day and receives £1,000. The red area shows Mario's cost of producing pizza, which is £800 a day, and the blue area shows his producer surplus, which is £200 a day.

Review Quiz

- 1 Explain the relationship between the marginal cost or opportunity cost of producing a good or service and the minimum supply price – the minimum price that producers must be offered.
- 2 Explain the relationship between marginal cost and the supply curve.
- 3 What is producer surplus? How do we measure it?

Consumer surplus and producer surplus can be used to measure the efficiency of a market. Let's see how we can use these concepts to study the efficiency of a competitive market.

Is the Competitive Market Efficient?

Figure 5.6 shows the market for pizza. The market forces that you studied in Chapter 3 (pp. 64–65) will pull the pizza market to its equilibrium price of £15 a pizza and equilibrium quantity of 10,000 pizzas a day. Buyers enjoy a consumer surplus (green area) and sellers enjoy a producer surplus (blue area). But is this competitive equilibrium efficient?

Efficiency of Competitive Equilibrium

The demand curve tells us the marginal benefit from pizza. If the only people who benefit from pizza are the people who buy it, then the demand curve for pizza measures the marginal benefit to the entire society from pizza. We call the marginal benefit to the entire society, marginal social benefit, *MSB*. In this case, the demand curve *D* is also the *MSB* curve.

You've also seen that the supply curve tells us the marginal cost of pizza. If the only people who bear the cost of pizza are the people who produce it, then the supply curve of pizza measures the marginal cost to the entire society of pizza. We call the marginal cost to the entire society, marginal social cost, *MSC*.

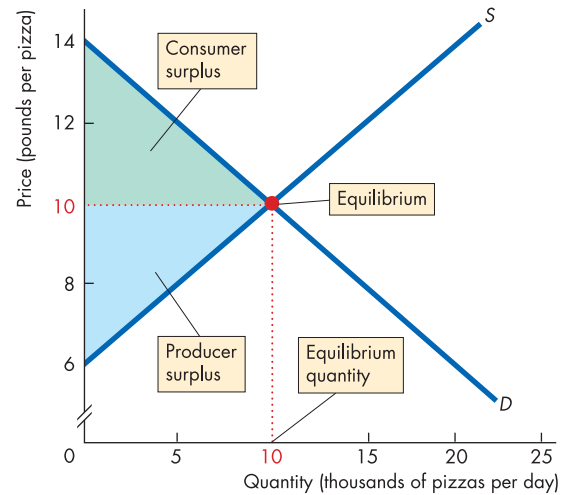
In this case, the supply curve *S* is also the *MSC* curve. So where the demand curve and the supply curve intersect in part (a), marginal social benefit equals marginal social cost in part (b). This condition delivers an efficient use of resources for the entire society. If production is less than 10,000 pizzas a day, the marginal pizza is valued more highly than its opportunity cost. If production exceeds 10,000 pizzas a day, the marginal pizza costs more to produce than the value that consumers place on it. Only when 10,000 pizzas a day are produced is the marginal pizza worth exactly what it costs.

The competitive market pushes the quantity of pizza produced to its efficient level of 10,000 a day. If production is less than 10,000 pizzas a day, a shortage raises the price, which increases production. If production exceeds 10,000 pizzas a day, a surplus lowers the price, which decreases production. So, a competitive pizza market is efficient.

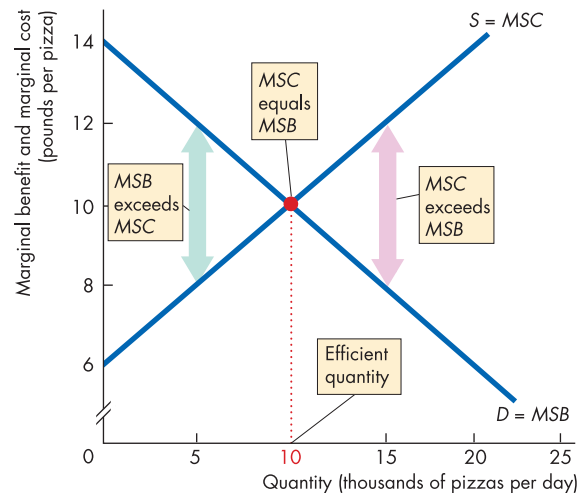
Notice that when the efficient quantity is produced, the sum of consumer surplus and producer surplus is maximized. Buyers and sellers acting in their self-interest end up promoting the social interest.

Figure 5.6

An Efficient Market for Pizza



(a) Equilibrium and surpluses



(b) Efficiency and marginal benefit and marginal cost

Competitive equilibrium in part (a) occurs when the quantity demanded equals the quantity supplied. Consumer surplus is the area under the demand curve and above the price – the green triangle. Producer surplus is the area above the supply curve and below the price – the blue triangle.

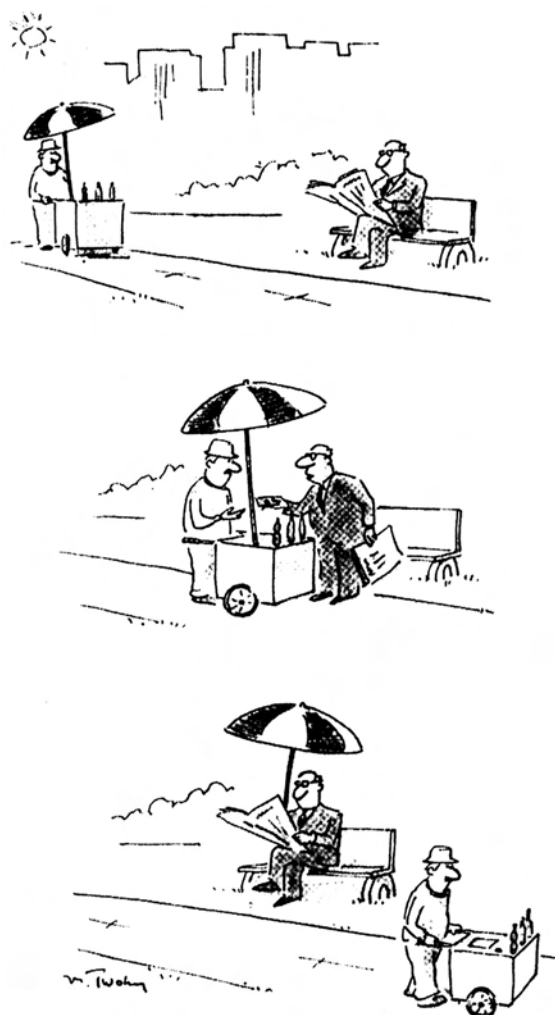
Resources are used efficiently in part (b) when marginal social benefit, *MSB*, equals marginal social cost, *MSC*. The efficient quantity in part (b) is the same as the equilibrium quantity in part (a). The competitive pizza market produces the efficient quantity of pizza. At the competitive equilibrium, the sum of the consumer surplus and the producer surplus is maximized.

The Invisible Hand

Writing in his book, *The Wealth of Nations*, in 1776, Adam Smith was the first to suggest that competitive markets send resources to the uses in which they have the highest value.

Smith wrote: “It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own interest.” He believed that each participant in a market is “led by an invisible hand to promote an end [the efficient use of resources] which was no part of his intention”.

You can see the invisible hand at work in the cartoon. The cold drinks vendor has both cold drinks and shade. He has an opportunity cost of each and a minimum supply price of each. The reader on the park bench has a marginal benefit from a cold drink and from shade. You can see that the marginal benefit from shade exceeds the price, but the price of a cold drink exceeds its marginal benefit. The transaction that occurs creates producer surplus and consumer surplus. The vendor obtains a producer surplus from selling the shade for more than its opportunity cost, and the reader obtains a consumer surplus from buying the shade for less than its marginal benefit. In the third frame of the cartoon, both the consumer and the producer are better off than they were in the first frame. The umbrella has moved to its highest-valued use.



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The Invisible Hand at Work Today

The invisible hand relentlessly performs the activities illustrated in the cartoon to achieve the outcome shown in Figure 5.6. And rarely has the market been working as hard as it is today. Think about some of the changes taking place in our economy that the market is guiding towards an efficient use of resources.

New technologies have cut the cost of producing computers. As these advances have occurred, supply has increased and the price has fallen. Lower prices have encouraged an increase in the quantity of computers demanded of this now less costly tool. The marginal benefit from computers is brought to equality with their marginal cost.

An early frost cuts the supply of grapes. With fewer grapes available, the marginal benefit from grapes increases. A shortage of grapes raises their price, so the market allocates the smaller quantity available to the people who value them most highly.

Market forces persistently bring marginal cost and marginal benefit to equality and maximize the sum of consumer surplus and producer surplus.

Obstacles to Efficiency

Although markets generally do a good job at sending resources to where they are most highly valued, they do not always get it right. Sometimes, markets produce too much of a good or service, and sometimes they produce too little. The most significant obstacles to achieving an efficient allocation of resources in a market economy are:

- ◆ Price ceilings and price floors
- ◆ Taxes, subsidies and quotas
- ◆ Monopoly
- ◆ External costs and external benefits
- ◆ Public goods and common resources

Price Ceilings and Price Floors

A *price ceiling* is a regulation that makes it illegal to charge a price higher than a specified level. An example is a price ceiling on housing rents, which some local and regional authorities impose. A *price floor* is a regulation that makes it illegal to pay a price below a specified level. An example is the minimum wage. The presence of a price ceiling or a price floor blocks the market forces and might result in a quantity produced that differs from the efficient quantity. (We study price ceiling and price floors in Chapter 6.)

Taxes, Subsidies and Quotas

Taxes increase the prices paid by buyers and lower the prices received by sellers. Taxes decrease the quantity produced. All kinds of goods are taxed, but the highest taxes are on petrol, alcohol and tobacco.

Subsidies, which are payments by the government to producers, decrease the prices paid by buyers and increase the prices received by sellers. Subsidies increase the quantity produced.

Quotas, which are limits to the quantity that a firm is permitted to produce, restrict output below the efficient quantity. Farms are sometimes subject to quotas. (We study quotas in Chapter 6.)

Monopoly

A *monopoly* is a firm that has sole control of a market. For example, Microsoft has a near monopoly on operating systems for personal computers. Although a monopoly can earn large profit, it prevents the market from achieving an efficient use of resources. The goal of a monopoly is to maximize profit. To achieve this goal, it produces less than the efficient quantity and raises its price. (We study monopoly in Chapter 12.)

External Costs and External Benefits

An *external cost* is a cost borne not by the producer but borne by other people. When an electric power utility burns coal to generate electricity, it produces acid rain that damages vegetation and crops. The utility does not consider the cost of pollution when it decides the quantity of electric power to supply. Its supply is based on its own production costs, not on the costs that it inflicts on others. As a result, the utility produces more power than the efficient quantity.

An *external benefit* is a benefit that accrues to people other than the buyer of a good. When an old building is

restored, lots of people get pleasure from seeing it. But the building's owner only thinks about her marginal benefit when she decides whether to do the restoration. So the demand for restoring buildings does not include all the benefits that accrue. In this case, the quantity falls short of the efficient quantity. (We study external costs and external benefits in Chapter 15.)

Public Goods and Common Resources

A *public good* is a good or service that is consumed simultaneously by everyone, even if they don't pay for it. Examples are national defence and the enforcement of law and order. Competitive markets would produce too small a quantity of public goods because of a *free-rider problem* – it is not in each person's interest to buy her or his share of a public good. So a competitive market produces less than the efficient quantity.

Common resources are resources that no one owns and that everyone can use. Examples are the fish in the ocean and city parks. A competitive market generally leads to the overuse of such resource (We study public goods and common resources in Chapter 16.)

The obstacles to efficiency that we've just reviewed result in two possible outcomes:

- ◆ Underproduction
- ◆ Overproduction

Underproduction

Suppose that one firm owned all the pizza outlets in a city and that it produces only 5,000 pizzas a day. Figure 5.7(a) shows that at this quantity, consumers are willing to pay £12 for the marginal pizza – marginal benefit is £12. The marginal cost of a pizza is only £10. So people are willing to pay more for a pizza than what producers must be offered.

The sum of consumer surplus and producer surplus is decreased by the amount of the grey triangle in Figure 5.7(a). This triangle is called **deadweight loss**. **Deadweight loss** is the decrease in consumer surplus and producer surplus that results from producing an inefficient quantity of the good.

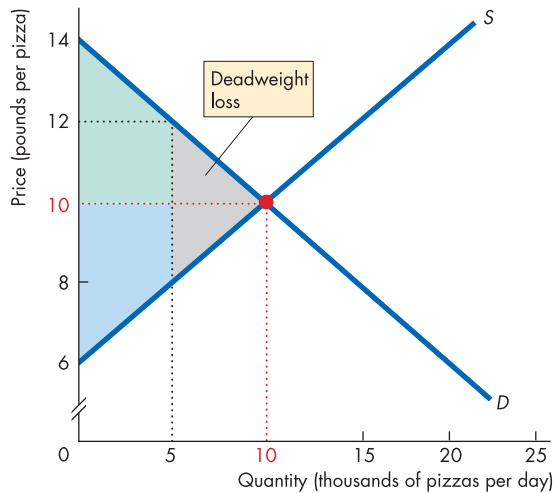
The 5,000th pizza brings a benefit of £12 and costs only £8 to produce. If we don't produce this pizza, we are wasting £4. Similar reasoning applies all the way up to the 9,999th pizza. By producing more pizza and less of other goods and services, we get more value from our resources.

The deadweight loss is borne by the entire society. It is not a loss for the consumers and a gain for the producer. It is a *social loss*.

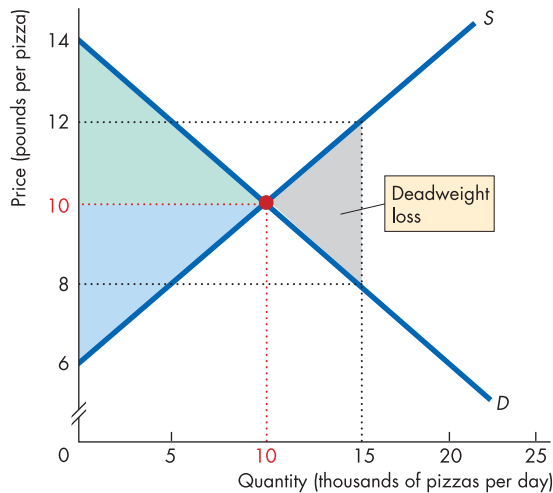
Figure 5.7



Underproduction and Overproduction



(a) Underproduction



(b) Overproduction

If pizza production is cut to only 5,000 a day, a deadweight loss (the grey triangle) arises in part (a). Consumer surplus and producer surplus (the green and blue areas) are reduced. At 5,000 pizzas, the benefit of one more pizza exceeds its cost. The same is true for all levels of production up to 10,000 pizzas a day.

If production increases to 15,000 pizzas a day, a deadweight loss arises in part (b). At 15,000 pizzas a day, the cost of the 15,000th pizza exceeds its benefit. The cost of each pizza above 10,000 exceeds its benefit. Consumer surplus plus producer surplus equals the sum of the green and blue areas minus the deadweight loss triangle.

Overproduction

Suppose the pizza lobby gets the government to pay the pizza producers a fat subsidy and that production increases to 15,000 a day. Figure 5.7(b) shows that at this quantity, consumers are willing to pay only £8 for the marginal pizza but the opportunity cost of this pizza is £12. It now costs more to produce the marginal pizza than consumers are willing to pay for it. The gap gets smaller as production approaches 10,000 pizzas a day, but it is present at all quantities greater than 10,000 a day.

The deadweight loss from overproduction is shown by the grey triangle in Figure 5.7(b). The sum of consumer surplus and producer surplus is smaller than its maximum by the amount of deadweight loss. The 15,000th pizza brings a benefit of only £8 but costs £12 to produce. If we produce this pizza, we are wasting £4. Similar reasoning applies all the way down to the 10,001st pizza. By producing less pizza and more of other goods and services, we get more value from our resources.

Review Quiz

- 1 Do competitive markets use resources efficiently? Explain why or why not.
- 2 Do markets with a price ceiling or price floor, taxes, subsidies or quotas, monopoly, external costs or external benefits, or public goods or common resources result in the quantity produced being the efficient quantity?
- 3 What is deadweight loss and under what conditions does it occur?
- 4 Does a deadweight loss occur in a competitive market when the quantity produced equals the competitive equilibrium quantity and the resource allocation is efficient?

You now know the conditions under which the resource allocation is efficient. You've seen how a competitive market can be efficient and you've seen some impediments to efficiency.

But is an efficient allocation of resources fair? Does the competitive market provide people with fair incomes for their work? And do people always pay a fair price for the things they buy? Don't we need the government to step into some competitive markets to prevent the price from rising too high or falling too low? We'll now study these questions.

Is the Competitive Market Fair?

When a natural disaster strikes, such as a severe winter storm or a major flood, the prices of many essential items jump. The reason the prices jump is that some people have a greater demand and greater willingness to pay when the items are in limited supply. So the higher prices achieve an efficient allocation of scarce resources. News reports of these price hikes almost never talk about efficiency. Instead, they talk about **equity** or fairness. The claim often made is that it is unfair for profit-seeking dealers to cheat the victims of natural disaster.

Similarly, when low-skilled people work for a wage that is below what most would regard as a “living wage”, the media and politicians talk of employers taking unfair advantage of their workers.

How do we decide whether something is fair or unfair? You know when *you* think something is unfair. But how do you know? What are the *principles* of fairness?

Philosophers have tried for centuries to answer this question. Economists have offered their answers too. But before we look at the proposed answers, you should know that there is no universally agreed upon answer.

Economists agree about efficiency. That is, they agree that it makes sense to make the economic pie as large as possible and to bake it at the lowest possible cost. But they do not agree about equity. That is, they do not agree about what are fair shares of the economic pie for all the people who make it. The reason is that ideas about fairness are not exclusively economic ideas. They touch on politics, ethics and religion. Nevertheless, economists have thought about these issues and have a contribution to make. So let’s examine the views of economists on this topic.

To think about fairness, think of economic life as a game – a serious game. All ideas about fairness can be divided into two broad groups. They are:

- ◆ It’s not fair if the *result* isn’t fair
- ◆ It’s not fair if the *rules* aren’t fair

It’s not Fair if the *Result* isn’t Fair

The earliest efforts to establish a principle of fairness were based on the view that the result is what matters. The general idea was that it is unfair if people’s incomes are too unequal. It is unfair that bank presidents earn millions of pounds a year while bank tellers earn only thousands of pounds a year. It is unfair that a shop owner enjoys a large profit and her customers pay higher prices in the aftermath of a flood.

There was a lot of excitement during the nineteenth century when economists thought they had made the incredible discovery that efficiency requires equality of incomes. To make the economic pie as large as possible, it must be cut into equal pieces, one for each person. This idea turns out to be wrong, but there is a lesson in the reason that it is wrong. So this nineteenth century idea is worth a closer look.

Utilitarianism

The nineteenth century idea that only equality brings efficiency is called *utilitarianism*. **Utilitarianism** is a principle that states that we should strive to achieve “the greatest happiness for the greatest number”. The people who developed this idea were known as utilitarians. They included some famous thinkers, such as Jeremy Bentham and John Stuart Mill.

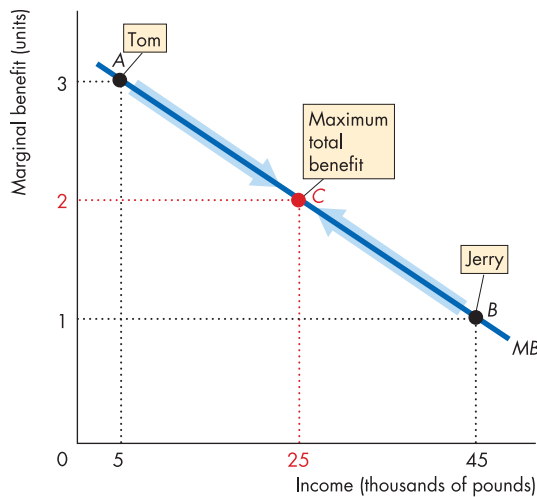
Utilitarianism argues that to achieve “the greatest happiness for the greatest number”, income must be transferred from the rich to the poor up to the point of complete equality – to the point that there are no rich and no poor.

They reasoned in the following way: first, everyone has the same basic wants and are similar in their capacity to enjoy life. Second, the greater a person’s income, the smaller is the marginal benefit of a pound. The millionth pound spent by a rich person brings a smaller marginal benefit to that person than the marginal benefit of the thousandth pound spent by a poorer person. So by transferring a pound from the millionaire to the poorer person, more is gained than is lost and the two people added together are better off.

Figure 5.8 illustrates this utilitarian idea. Tom and Jerry have the same marginal benefit curve, *MB*. (Marginal benefit is measured on the same scale of 1 to 3 for both Tom and Jerry.) Tom is at point *A*. He earns £5,000 a year, and his marginal benefit of a pound is 3. Jerry is at point *B*. He earns £45,000 a year, and his marginal benefit of a pound is 1. If a pound is transferred from Jerry to Tom, Jerry loses 1 unit of marginal benefit and Tom gains 3 units. So together, Tom and Jerry are better off. They are sharing the economic pie more efficiently. If a second pound is transferred, the same thing happens: Tom gains more than Jerry loses. And the same is true for every pound transferred until they both reach point *C*. At point *C*, Tom and Jerry have £25,000 each, and each has a marginal benefit of 2 units. Now they are sharing the economic pie in the most efficient way. It is bringing the greatest attainable happiness to Tom and Jerry

Figure 5.8

Utilitarian Fairness



Tom earns £5,000 and has 3 units of marginal benefit at point A. Jerry earns £45,000 and has 1 unit of marginal benefit at point B. If income is transferred from Jerry to Tom, Jerry's loss is less than Tom's gain. Only when each of them has £25,000 and 2 units of marginal benefit (at point C) can the sum of their total benefit increase no further.

The Big Trade-off

One big problem with the utilitarian ideal of complete equality is that it ignores the costs of making income transfers. The economist, Arthur Okun, in his book *Equality and Efficiency: The Big Tradeoff*, described the process of redistributing income as like trying to transfer water from one barrel to another with a leaky bucket. The more we try to increase equity by redistributing income, the more we reduce efficiency. Recognizing the cost of making income transfers leads to what is called the **big trade-off** – a trade-off between efficiency and fairness.

The big trade-off is based on the following facts. Income can be transferred from people with high incomes to people with low incomes only by taxing the high incomes. Taxing people's income from employment makes them work less. It results in the quantity of labour being less than the efficient quantity. Taxing people's income from capital makes them save less. It results in the quantity of capital being less than the efficient quantity. With smaller quantities of both labour and capital, the quantity of goods and

services produced is less than the efficient quantity. The economic pie shrinks.

The trade-off is between the size of the economy and the degree of equality with which its produce is shared. The greater the amount of income redistribution through income taxes, the greater the inefficiency – the smaller is the economic pie.

A second source of inefficiency arises because a pound taken from a rich person does not end up as a pound in the hands of a poorer person. Some of it is spent on administration of the tax and transfer system. The cost of tax-collection agency, the Inland Revenue, and the welfare administering agency, the Department of Work and Pensions, must be paid with some of the taxes collected. Also, taxpayers hire accountants, auditors and lawyers to help ensure that they pay the correct amount of taxes. These activities use skilled labour and capital resources that could otherwise be used to produce goods and services that people value.

You can see that when all these costs are taken into account, taking a pound from a rich person does not give a pound to a poor person. It is even possible that with high taxes, those with low incomes end up being worse off. Suppose, for example, that highly taxed entrepreneurs decide to work less hard and shut down some of their businesses. Low-income workers get fired and must seek other, perhaps even lower-paid, work.

Because of the big trade-off, those who say that fairness is equality propose a modified version of utilitarianism.

Make the Poorest as Well Off as Possible

A Harvard philosopher, John Rawls, proposed a modified version of utilitarianism in a classic book entitled *A Theory of Justice*, published in 1971. Rawls says that, taking all the costs of income transfers into account, the fair distribution of the economic pie is the one that makes the poorest person as well off as possible. The incomes of rich people should be taxed and, after paying the costs of administering the tax and transfer system, what is left should be transferred to the poor. But the taxes must not be so high that they make the economic pie shrink to the point that the poorest person ends up with a smaller piece. A bigger share of a smaller pie can be less than a smaller share of a bigger pie. The goal is to make the piece enjoyed by the poorest person as big as possible. Most likely this piece will not be an equal share.

The "fair results" idea requires a change in the results after the game is over. Some economists say these changes are themselves unfair and propose a different way of thinking about fairness.

It's not Fair if the *Rules* aren't Fair

The idea that it's not fair if the rules aren't fair is based on a fundamental principle that seems to be hard-wired into the human brain. It is the **symmetry principle**. The symmetry principle is the requirement that people in similar situations be treated similarly. It is the moral principle that lies at the centre of all the big religions. It says, in some form or other, "behave towards others in the way you expect them to behave towards you".

In economic life, this principle translates into *equality of opportunity*. But equality of opportunity to do what? This question is answered by the late Harvard philosopher, Robert Nozick, in a book entitled *Anarchy, State, and Utopia*, published in 1974.

Nozick argues that the idea of fairness as an outcome or result cannot work and that fairness must be based on the fairness of the rules. He suggests that fairness obeys two rules. They are:

- 1 The state must enforce laws that establish and protect private property.
- 2 Private property may be transferred from one person to another only by voluntary exchange.

The first rule says that everything that is valuable must be owned by individuals and that the state must ensure that theft is prevented. The second rule says that the only legitimate way a person can acquire property is to buy it in exchange for something else that the person owns. If these rules, which are fair rules, are followed, then the economic pie is shared, provided that the pie is baked by people, each one of whom voluntarily provides services in exchange for a share of the pie offered in compensation.

These rules satisfy the symmetry principle. And if these rules are not followed, the symmetry principle is broken. You can see these facts by imagining a world in which the laws are not followed.

First, suppose that some resources or goods are not owned. They are common property. Then everyone is free to participate in a grab to use these resources or goods. The strongest will prevail. But when the strongest prevails, the strongest effectively *owns* the resources or goods in question and prevents others from enjoying them.

Second, suppose that we do not insist on voluntary exchange for transferring ownership of resources from one person to another. The alternative is *involuntary* transfer. In simple language, the alternative is theft.

Both of these situations violate the symmetry principle. Only the strong get to acquire what they want.

The weak end up with only the resources and goods that the strong don't want.

In contrast, if the two rules of fairness are followed, everyone, strong and weak, is treated in a similar way. Everyone is free to use their resources and human skills to create things that are valued by themselves and others and to exchange the fruits of their efforts with each other. This is the only set of arrangements that obeys the symmetry principle.

Fairness and Efficiency

If private property rights are enforced and if voluntary exchange takes place in a competitive market, resources will be allocated efficiently if there are no:

- 1 Price ceilings and price floors.
- 2 Taxes, subsidies and quotas.
- 3 Monopolies.
- 4 External costs and external benefits.
- 5 Public goods and common resources.

And according to the Nozick rules, the resulting distribution of income and wealth will be fair. Let's study a concrete example to examine the claim that if resources are allocated efficiently, they are also allocated fairly.

A Price Hike in a Natural Disaster

A severe winter storm has frozen the pipes that deliver drinking water to a city. With no thaw in sight, the price of bottled water jumps from £1 a bottle to £8 a bottle in the 30 or so shops that have water for sale.

First, let's agree that the water is being used *efficiently*. There is a fixed amount of bottled water in the city, and given the quantity available, some people are willing to pay £8 to get a bottle. The water goes to the people who value it most highly. Consumer surplus and producer surplus are maximized.

So the water resources are being used efficiently. But are they being used fairly? Shouldn't people who can't afford to pay £8 a bottle get some of the available water for a lower price that they can afford? Isn't the fair solution for the shops to sell water for a lower price that people can afford? Or perhaps it might be fairer if the government bought the water and then made it available to people through a government store at a "reasonable" price. Let's think about these alternative solutions to the water problem of this city. Should water somehow be made available at a more reasonable price?

Shop Offers Water for £5

Suppose that Kris, a shop owner, offers water at £5 a bottle. Who will buy it? There are two types of buyers. Harry is an example of one type. He values water at £8 – is willing to pay £8 a bottle. Recall that given the quantity of water available, the equilibrium price is £8 a bottle. If Harry buys the water, he consumes it. Harry ends up with a consumer surplus of £3 on the bottle, and Kris receives £3 less of producer surplus.

David is an example of the second type of buyer. David would not pay £8 for a bottle. In fact, he wouldn't even pay £5 to consume a bottle of water.

But he buys a bottle for £5. Why? Because he plans to sell the water to someone who is willing to pay £8 to consume it. When David buys the water, Kris again receives a producer surplus of £3 *less* than she would receive if she charged the going market price. David now becomes a water dealer. He sells the water for the going price of £8 and earns a producer surplus of £3.

So by being public-spirited and offering water for less than the market price, Kris ends up £3 a bottle worse off and the buyers end up £3 a bottle better off. The same people consume the water in both situations. They are the people who value the water at £8 a bottle. But the distribution of consumer surplus and producer surplus is different in the two cases. When Kris offers the water for £5 a bottle, she ends up with a smaller producer surplus and Harry and David end up with a larger consumer surplus and producer surplus.

So which is the fair arrangement? The one that favours Kris or the one that favours Harry and David? The fair rules view is that both arrangements are fair. Kris voluntarily sells the water for £5 so, in effect, she is helping the community to cope with its water problem. It is fair that she should help, but the choice is hers. She owns the water. It is not fair that she should be compelled to help.

Government Buys Water

Now suppose instead that the government buys all the water. The going price is £8 a bottle, so that's what the government pays. Now the government offers the water for sale for £1 a bottle, its "normal" price.

The quantity of water supplied is exactly the same as before. But now, at £1 a bottle, the quantity demanded is much larger than the quantity supplied. There is a shortage of water.

Because there is a large water shortage, the government decides to ration the amount that anyone may buy. Everyone is allocated one bottle. So everyone lines up to

collect his or her bottle. Two of these people are Harry and David. Harry, you'll recall, is willing to pay £8 a bottle. David is willing to pay less than £5. But they both get a bargain. Harry drinks his £1 bottle and enjoys a £7 consumer surplus. What does David do? Does he drink his bottle? He does not. He sells it to another person who values the water at £8. And he enjoys a £7 producer surplus from his temporary water-trading business.

So the people who value the water most highly consume it. But the consumer and producer surpluses are distributed in a different way from what the free market would have delivered. Again the question arises, which arrangement is fair?

The main difference between the government scheme and Kris's private charitable contributions lies in the fact that to buy the water for £8 and sell it for £1, the government must tax someone £7 for each bottle sold. So whether this arrangement is fair depends on whether the taxes are fair.

Taxes are an involuntary transfer of private property so, according to the fair rules view, taxes are unfair. But most economists, and most people, think that there is such a thing as a fair tax. So it seems that the fair rules view needs to be weakened a bit. Agreeing that there is such a thing as a fair tax is the easy part. Deciding what is a fair tax brings endless disagreement and debate.

Review Quiz

- 1 What are the two big approaches to fairness?
- 2 Explain the utilitarian idea of fairness and what is wrong with it.
- 3 Explain the big trade-off and the idea of fairness developed to deal with it.
- 4 What is the main idea of fairness based on fair rules? Explain your answer.

You've now studied the two biggest issues that run right through the whole of economics: efficiency and equity, or fairness. In the next chapter, we study some sources of inefficiency and unfairness. And at many points throughout this book – and in your life – you will return to and use the ideas about efficiency and fairness that you've learned in this chapter. *Reading Between the Lines* on pp. 112–113 looks at fairness and efficiency in the EU market for airline tickets.

Reading Between the Lines

Inefficiency: European Airline Ticket Pricing

The Guardian, 20 December 2003

EC launches airline ticket price inquiry

Andrew Osborn

The European Commission launched a surprise investigation into air ticket prices yesterday, asking British Airways, British Midland and Virgin Atlantic whether they unfairly vary their ticket prices from one European country to another.

Responding to hundreds of complaints, Brussels said it suspected that airlines are charging customers wildly different prices for identical flights, depending upon where the ticket is bought.

The services of the Commission have written to 18 European airlines asking each of them whether it charges different prices for the same ticket depending on the country of residence. . . . Such a pricing policy, the Commission suggested, may be in breach of the EU's internal market rules.

The Commission . . . claimed that price differences were sometimes as much as 300%.

Other airlines it contacted included Air France, Aer Lingus, Alitalia, Lufthansa, KLM, Finnair, Olympic Airlines, Iberia and SAS. . . .

Low fair airlines such as Ryanair were not implicated. The 18 airlines have until the end of February to explain their pricing policies. . . . The Commission claimed that the pricing problems appeared to be particularly acute for internet purchases where firms use a customer's postal or credit card address to determine country of residence . . .

Air France defended its pricing policy. "There is a cost linked to providing a passenger in a foreign city with a ticket," said a spokesman.

SAS added that airlines had the right to tailor their prices to different countries. "We have different prices depending on where you buy. It's correct to set the price according to the market situation in each country."

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The Essence of the Story

- ◆ European airlines are charging different prices for the same flights, depending upon where the ticket is bought.
- ◆ The European Commission believes that this pricing policy might be unfair. It is investigating the pricing policy of 18 major European airlines.
- ◆ The price for the same ticket can vary by as much as 300 per cent.
- ◆ The airlines say the price differences reflect real costs and market differences.

Economic Analysis

- ◆ The European Commission would like airline tickets to be sold in competitive markets.
- ◆ Figure 1 illustrates a competitive market for flights from London to Paris.
- ◆ The demand curve, D , is also the marginal benefit curve MB . This curve tells us the value to consumers of one more trip.
- ◆ The supply curve, S , is also the marginal cost curve, MC . This curve tells us the cost of transporting an additional passenger from London to Paris.
- ◆ In a competitive market, equilibrium occurs at point A , the intersection of the demand curve and the supply curve.
- ◆ The equilibrium price is £50 and the number of passengers is Q_A per week. Production is efficient because marginal benefit equals marginal cost and the sum of the consumer surplus (green area) and producer surplus (blue area) is maximized.
- ◆ The European Commission suspects that the market for flights from London to Paris is not efficient because some passengers are charged a lot more than £50 for the trip.
- ◆ If the average price is £75, then Figure 2 shows that the number of passengers is Q_B .
- ◆ At point B , the market is inefficient because marginal benefit exceeds marginal cost and a deadweight loss (grey area) arises.
- ◆ At point B , producer surplus is greater than at point A and consumer surplus is smaller. But deadweight loss decreases the sum of the consumer surplus and producer surplus.

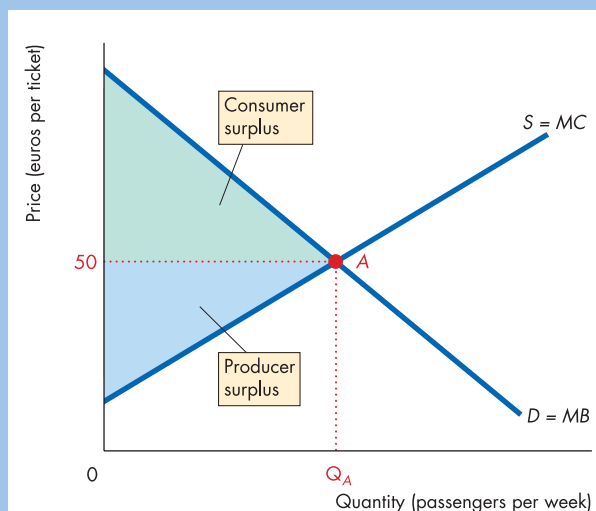


Figure 1 Efficient quantity

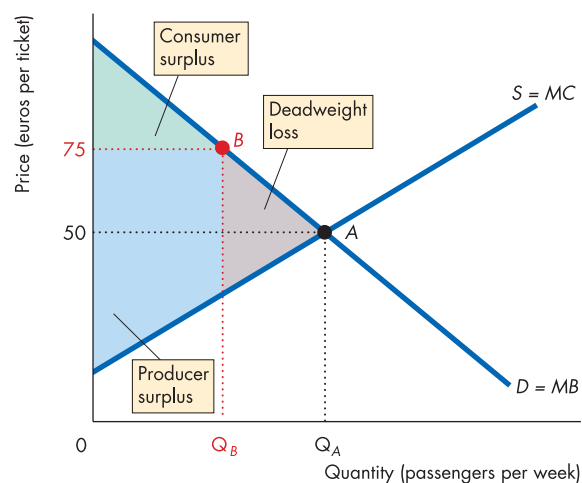


Figure 2 Inefficient quantity

Summary

Key Points

Efficiency and Social Interest

(pp. 98–99)

- ◆ The marginal benefit received from a good or service – the benefit of consuming one additional unit – is the *value* of the good or service to its consumers.
- ◆ The marginal cost of a good or service – the cost of producing one additional unit – is the *opportunity cost* of one more unit to its producers.
- ◆ Resources allocation is efficient when marginal benefit equals marginal cost.

Value, Price and Consumer Surplus

(pp. 100–101)

- ◆ Marginal benefit is measured by the maximum price that consumers are willing to pay for a good or service, which is also demand.
- ◆ Value is what people are *willing to pay*; price is what people *must pay*.
- ◆ Consumer surplus equals value minus price, summed over the quantity consumed.

Cost, Price and Producer Surplus

(pp. 102–103)

- ◆ Marginal cost is measured by the minimum price producers must be offered to increase production by one unit, which is also supply.
- ◆ Opportunity cost is what producers pay; price is what producers receive.
- ◆ Producer surplus equals price minus opportunity cost, summed over the quantity produced.

Is the Competitive Market Efficient?

(pp. 104–107)

- ◆ In a competitive equilibrium, marginal benefit equals marginal cost and resource allocation is efficient.

- ◆ Monopoly restricts production and creates deadweight loss.
- ◆ A competitive market provides too small a quantity of public goods because of the free-rider problem.
- ◆ A competitive market provides too large a quantity of goods and services that have external costs and too small a quantity of goods and services that have external benefits.

Is the Competitive Market Fair?

(pp. 108–111)

- ◆ Ideas about fairness divide into two groups: those based on the notion that the *results* are not fair, and those based on the notion that the *rules* are not fair.
- ◆ Fair results ideas require income transfers from the rich to the poor.
- ◆ Fair rules ideas require property rights and voluntary exchange.

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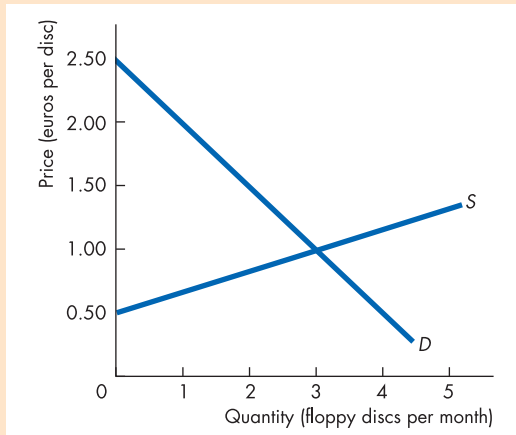
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Key Terms

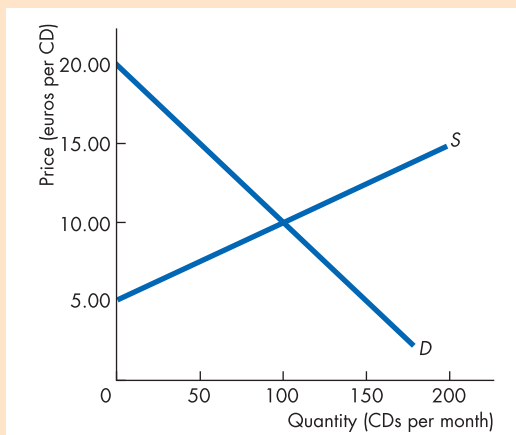
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Problems

- *1** The figure shows the demand for and supply of floppy discs.



- What are the equilibrium price and equilibrium quantity of floppy discs?
 - Calculate the amount that consumers paid for floppy discs.
 - What is the consumer surplus?
 - What is the producer surplus?
 - Calculate the cost of producing the floppy discs.
 - What is the efficient quantity of floppy discs?
- 2** The figure shows the market for CDs.



- What are the equilibrium price and equilibrium quantity of CDs?
- Calculate the amount that consumers paid for CDs.
- What is the consumer surplus?

- What is the producer surplus?
- Calculate the cost of producing the CDs.
- What is the efficient quantity of CDs?

- *3** The table gives the demand and supply schedules for sandwiches.

Price (pounds per sandwich)	Quantity demanded	Quantity supplied
	(sandwiches per hour)	
0	400	0
1	350	50
2	300	100
3	250	150
4	200	200
5	150	250
6	100	300
7	50	350
8	0	400

- What is the maximum price that consumers are willing to pay for the 250th sandwich?
 - What is the minimum price that producers are willing to accept for the 250th sandwich?
 - Are 250 sandwiches a day less than or greater than the efficient quantity?
 - If the sandwich market is efficient, what is the consumer surplus? (Draw the graph.)
 - If the sandwich market is efficient, what is the producer surplus? (Draw the graph.)
 - If sandwich makers produce 250 a day, what is the deadweight loss? (Draw the graph.)
- 4** The table gives the demand and supply schedules for sunscreen.

Price (pounds per bottle)	Quantity demanded	Quantity supplied
	(bottles per day)	
0	900	0
1	800	100
2	700	200
3	600	300
4	500	400
5	400	500
6	300	600
7	200	700
8	100	800
9	0	900

- What is the maximum price that consumers are willing to pay for the 300th bottle?
- What is the minimum price that producers are willing to accept for the 300th bottle?

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

- c Are 300 bottles a day less than or greater than the efficient quantity? (Draw the graph.)
- d If the market for sunscreen is efficient, what is the consumer surplus? (Draw the graph.)
- e If the market for sunscreen is efficient, what is the producer surplus? (Draw the graph.)
- f If sunscreen bottlers produce 300 bottles a day, what is the deadweight loss?
- *5 The table gives the demand and supply schedules for train travel for Ben, Beth and Bill.

Price (pence per passenger mile)	Quantity demanded (passenger miles)		
	Ben	Beth	Bill
5	550	350	70
10	500	300	60
20	450	250	50
30	400	200	40
40	350	150	30
50	300	100	20
60	250	50	10
70	200	0	0

- a If the price of train travel is 40 pence a passenger mile, what is the consumer surplus of each traveller?
- b If the price of train travel is 40 pence a passenger mile, which traveller has the largest consumer surplus? Explain why.
- c If the price of train travel rises to 50 pence a passenger mile, what is the change in consumer surplus of each traveller?
- 6 The table gives the demand and supply schedules for airline travel for Ann, Arthur and Abby.

Price (pounds per passenger mile)	Quantity demanded (passenger miles)		
	Ann	Arthur	Abby
3.75	550	700	350
5.00	500	600	300
6.25	450	500	250
7.50	400	400	200
8.75	350	300	150
10.00	300	200	100
11.25	250	100	50
12.50	200	0	0

- a If the price is £10 a passenger mile, what is the consumer surplus of each traveller?
- b If the price is £10 a passenger mile, which traveller has the largest consumer surplus? Explain why.
- c If the price falls to £7.50 a passenger mile, what is the change in consumer surplus of each traveller?

Critical Thinking

- Study Reading *Between the Lines* on pp. 112–113 and then answer the following questions:
 - Suppose British Airways charges a higher price for a trip from London to Paris to someone who buys the ticket in Denmark than it does to someone who buys the ticket in London. Would this policy lead to underproduction or overproduction of trips from London to Paris for people who buy the ticket in Denmark? Use the concepts of marginal benefit, marginal cost, price, consumer surplus and producer surplus to explain your answer.
 - If the airlines are correct when they say that their pricing system just reflects differences in costs of selling tickets to people in different regional markets, what would be the impact of removing the pricing system?
- Explain how you would calculate your consumer surplus on an item that you buy regularly.
- Write a short description of how you would determine whether the allocation of your time between studying different subjects is efficient. In what units would you measure marginal benefit and marginal cost? Use the concepts of marginal benefit, marginal cost, price, consumer surplus and producer surplus in your answer.

Web Exercise

Use the links on *Parkin Interactive* to work the following exercise.

- In 2001, the European Commission investigated why the prices of DVDs in the European Union were higher than those in the United States. The price differential was maintained because regional tagging of DVDs made the US DVDs unreadable on European players. Consider the impact of regional tagging and then answer the following questions:
 - Does regional tagging lead to underproduction or overproduction of DVDs? Use the concepts of marginal benefit, marginal cost, price, consumer surplus and producer surplus to explain why.
 - As DVD rewriting technology becomes cheaper, more pirate copies will be made and they will sell at very low prices. How will piracy change consumer surplus and producer surplus of legitimate EU DVD producers? Will the DVD market be more efficient? Explain your answer.
 - If EU producers are correct when they say that the tagging system raises their cost above those of US producers, what will be the impact of removing regional tagging on the producer surplus in Europe?