## Exchange, Efficiency, and Prices



Voluntary exchange, or trade, is mutually beneficial to the parties involved in the transaction.

## Chapter Outline

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## Learning Objectives

- Understand why voluntary exchange is mutually beneficial.
- Define what economists mean by efficiency in exchange and delineate the benefits associated with the promotion of such efficiency.
- Show how competitive markets promote efficient distributions of goods between consumers.
Explore the extent to which price and nonprice mechanisms for rationing goods across consumers serve to promote efficiency.
n Chapters 3 through 5 we concentrated on the way a typical consumer reacts to changes in his or her budget line. Higher or lower prices or incomes, subsidies, and taxes produce generally predictable responses. The consequences of a consumer's choices for participants on the selling side of markets have so far been ignored. Of course, the budget line itself, indicating relative prices, reflects the willingness of others to trade with the consumer on specified terms, but now we will emphasize more explicitly that a consumer's market choices involve exchanges between the consumer and other people.

To investigate the essential two-sidedness of market transactions, we examine pure exchange. At the outset our analysis will focus on two consumers who start with specified quantities of two goods and engage in barter. This model may seem remote from real-world behavior, and to some extent, it is. But the intention here is to focus on the nature and consequences of voluntary exchanges between people, and the pure exchange model provides the simplest means possible.

Most economic activity occurs through a series of voluntary exchanges. U.S. consumers buy Nokia cellphones with some of their dollars. The dollars spent on Nokia cell phones are eventually used by the various Nokia stakeholders (workers, management, stockholders, and so on) to buy consumer goods of interest to them. Indirectly, therefore, Nokia stakeholders exchange consumer goods for consumer goods. General Electric workers exchange their labor for money and then exchange money for various consumer goods, so indirectly they exchange labor for consumer goods. A model that permits us to see why voluntary exchanges occur and what their consequences are thus turns out to be quite useful.

## ECONOMIC

 EFFICIENCY with regard to exchange, economic efficiency represents a distribution of goods across consumers in which no one consumer can be made better off without hurting another consumer

The model presented in this chapter is useful for two fundamental reasons. First, it allows us to demonstrate one of the most important principles of economics: namely, that voluntary exchange, or trade, is mutually beneficial to the parties involved in the transaction. Although the principle that such exchange represents a "win-win" for the parties involved is often questioned, especially in the public policymaking arena, it is one of the most critical lessons to be learned from the study of economics.

Second, the model developed in this chapter allows us to introduce the concept of economic efficiency. A central tenet of economics, efficiency in exchange means that goods are distributed across consumers such that no one consumer can be made better off without hurting another consumer. We will show why pursuing such distributions of goods is a desirable objective, and how competitive markets promote efficiency in exchange.

## 6.1

## Two-PERSON EXCHANGE

People engage in exchanges, or trades, because they expect to benefit. When an exchange is voluntary, with parties in agreement on the terms of the trade, the strong presumption is that both benefit. Such a presumption follows from the fact that each party had the option of refusing to trade but instead chose to engage in the exchange. If Jean-Claude van Damme rents a tearjerker movie from a Blockbuster video store, his action must mean he prefers the movie rental to the money he exchanges for it. Also, the sale must mean Blockbuster prefers the money to keeping the movie in the store. Both parties benefit from the exchange.

The fundamental point can be stated simply: voluntary exchange is mutually beneficial. The truth of this basic economic proposition may seem obvious, but it is widely doubted. For example, many people assume that the prosperity of successful businesspeople must have come at the expense of their customers or workers. Economic activity, however, is not like a sports contest in which, if there are winners, there must be losers. The voluntary exchanges through which economic activity is organized can generate win-win outcomes.

There are, of course, some qualifications to the basic proposition that voluntary exchange is mutually beneficial. First, it presupposes that fraud or trickery has not taken place. If van Damme pays for his video rental with a bad check, Blockbuster will be worse off. Second, the benefit achieved refers to the expectations of the parties at the time of the transaction. Van Damme may rent a tear-jerker but after watching it decide he would have been better off keeping the money. Nonetheless, at the time he rented the movie, he must have believed the opportunity to view it was worth more than the money.

Setting aside these qualifications, let's look at voluntary exchange in more detail. Suppose that there are only two consumers, Mr. Edge and Ms. Worth, and only two goods, ballet and football tickets. Assume that Edge and Worth begin with specific quantities of each good. Edge's initial market basket (endowment) is 35 ballet and 5 football tickets; Worth's initial market basket is 5 ballet and 45 football tickets. In the end Mr. Edge and Ms. Worth may choose not to consume their initial market baskets. Instead, they may decide to trade with one another and end up with different combinations of football and ballet tickets.

Under what conditions will Edge and Worth find it advantageous to trade? In this setting, whether trade occurs depends crucially on the relative importance of the two goods to each consumer. Let's suppose that Mr. Edge, given his initial basket, would be willing to give up five ballet tickets to obtain one more football ticket: his marginal rate of substitution is $5 \mathrm{~B} / 1 \mathrm{~F}$. Ms. Worth, on the other hand, would be willing to give up only one ballet ticket for one more football ticket: her marginal rate of substitution is $1 B / 1 F$. In this case the relative importance of the goods differs between Edge and Worth, as indicated by their different MRSs; thus, a mutually beneficial exchange can take place. Let's see how. (The numerical data of this example are summarized in Table 6.1 for convenience.)

Given their initial holdings, Edge values football more highly than Worth does relative to ballet. He is willing to give up as many as five ballet tickets to obtain another football

## TABLE 6.1

## EDGEWORTH

 EXCHANGE BOX a diagram for examining the allocation of fixed total quantities of two goods between two consumersGAINS FROM EXCHANGE

| Consumer | Initial Market <br> Basket | MRS $_{\text {FB }}$ | Trade | New Market <br> Basket After Trade |
| :--- | :---: | :---: | :---: | :---: |
| Mr. Edge | $35 B+5 F$ | $5 B / 1 F$ | $-3 B+1 F$ | $32 B+6 F$ |
| Ms. Worth | $5 B+45 F$ | $1 B / 1 F$ | $+3 B-1 F$ | $8 B+44 F$ |

ticket. Worth, in contrast, is willing to give up one football ticket if she receives at least one ballet ticket in return. (Note that if Worth's MRS is $1 B / 1 F$, she will give up $1 B$ for $1 F$, or, alternatively, $1 F$ in return for $1 B$. For a small movement in either direction along the indifference curve, 1 F trades for 1 B without affecting her well-being.) Put differently, Edge would pay $5 B$ to get $1 F$, while Worth would be willing to sell him $1 F$ for $1 B$. There is room for a mutually beneficial trade. Suppose that Edge offers Worth three ballet tickets for one football ticket, and she accepts. Edge will be better off after the exchange because he would have been willing to pay as much as $5 B$ for the football ticket, but he got it for $3 B$. Worth will also be better off because she would have sold the football ticket for as little as $1 B$ but instead received 3B. Therefore, this exchange will leave both parties better off: they prefer their new market baskets to their initial holdings. (See Table 6.1.)

## The Edgeworth Exchange Box Diagram

The way two parties may both gain from exchange illustrates a simple idea: "You have what I want, and I have what you want, so let's trade!" While this statement conveys intuitively what is involved, a deeper understanding of voluntary exchange is important. A new graphical device, the Edgeworth exchange box, can give us that understanding.

The Edgeworth exchange box diagram can be used to examine the allocation of fixed total quantities of two goods between two consumers. ${ }^{1}$ Figure 6.1 shows the box diagram appropriate for the numerical example just discussed. The horizontal and vertical dimensions of the box indicate the total quantities of the two goods. The length of the box indicates the total amount of football tickets held by the two consumers, 50 , and the height of the box indicates the total amount of ballet tickets, 40 .

By interpreting the box in a certain way, we can show all the possible ways 50 football tickets and 40 ballet tickets can be divided between Mr. Edge and Ms. Worth. Let's measure Edge's holdings of football tickets horizontally from point $\mathrm{O}_{\mathrm{E}}$ and his holdings of ballet tickets vertically from the same point. In effect, $\mathrm{O}_{\mathrm{E}}$ is the origin of the diagram for purposes of measuring the number of football and ballet tickets possessed by Edge. Point A shows the market basket for Edge that contains 35 B and 5 F ; it is, in fact, his initial market basket from our numerical illustration.

One ingenious aspect of the Edgeworth box is that point A also indicates Worth's market basket. Because the number of football tickets held by both parties is fixed at 50 , placing Edge at point A with 5 football tickets means Worth holds the remaining 45 tickets. This amount is shown in the diagram by measuring Worth's football holdings to the left from point $0_{\mathrm{w}}$. Worth has 45 football tickets: point A in effect divides the horizontal dimension of the box, 50F, between Edge (5F) and Worth (45F). Point A also indicates Worth's ballet holdings by measuring them down from point $0_{\mathrm{w}}$. Since combined ballet holdings equal 40 , Edge has 35 , and the remaining 5 tickets belong to Worth.

Now consider point C, which identifies a different market basket for both Edge and Worth. Edge's market basket at C contains 32 B and 6 F , while Worth's contains 8 B and 44 F . (The totals still add to 50 F and 40 B .) In fact, the movement from point $A$ to point $C$

[^0]
## The Edgeworth Exchange Box

The horizontal dimension of the box measures the total number of football tickets, and the vertical dimension measures the total number of ballet tickets. When the origins of the consumers are $O_{\mathrm{E}}$ and $O_{\mathrm{w}}$ each point in the box represents a specific division of the goods between the consumers.

illustrates the exchange between Edge and Worth in our numerical example. In moving from $A$ to $C$, Edge has given up $3 B$ and gained $1 F$, while Worth has gained $3 B$ and given up 1F. The movement from $A$ to $C$ shows graphically what happens when Edge buys one football ticket from Worth and pays for it with three ballet tickets.

## The Edgeworth Exchange Box with Indifference Curves

Because the points in the Edgeworth box identify alternative market baskets that each party may consume, we can use indifference curves to represent each person's preferences regarding the alternatives, as in Figure 6.2a. Edge's indifference curves, $U_{\mathrm{E} 3}$ and $U_{\mathrm{E} 4}$ require little explanation. Because Edge's market baskets are measured in the normal way, from his origin at the southwest corner, these curves have their familiar shapes.

Worth's indifference curves, $U_{\mathrm{W} 3}, U_{\mathrm{W} 4}$, and so on, may appear odd at first glance. Recall that the origin, for purposes of measuring Worth's consumption, is the northeast corner, $0_{\mathrm{w}}$, and her indifference curves are relative to this origin. Compared with the usual graphic representation, all we have done is rotated Worth's indifference map 180 degrees and placed the origin in the northeast corner. The small insert in Figure 6.2a should make this manipulation clear: it shows how the normal indifference map has been inverted to place the origin at $0_{\mathrm{w}}$ in the box diagram. Worth's indifference curves also have normal shapes; we are just looking at them upside down.

Now let's use this construction for our original example once again. Point A in Figure 6.2a identifies Edge's and Worth's initial market baskets. The indifference curves corresponding to the initial market baskets (passing through point A) are $U_{\mathrm{E} 3}$ and $U_{\mathrm{W} 3}$. Note that these curves intersect at point $A$, because we assume that the marginal rates of substitution differ for the two consumers. The slope of $U_{\mathrm{E} 3}$ at point $A$ is $5 \mathrm{~B} / 1 \mathrm{~F}$, while the slope of

## FIGURE 6.2

## Gains from Trade

(a) Point $A$ shows the initial division of goods. Edge's and Worth's indifference curves through point $A$ intersect, transcribing the shaded lens-shaped area. Both parties would be better off with any division of goods lying inside the lens-shaped area. It is thus in the interest of both parties to work out an exchange that will move them into this area. (b) Once the two parties reach a point such as $E$, where their indifference curves are tangent, no further trade is possible that will benefit both parties. Any movement from point $E$ would harm at least one of the two parties.

(a)

(b)
$U_{\mathrm{W} 3}$ is $1 \mathrm{~B} / 1 \mathrm{~F}$. The area that lies between these two curves-the shaded area in the graphis highly significant. Every point inside the shaded area represents a market basket for each consumer that is preferred to basket A. In other words, within this area both consumers would be on higher indifference curves compared with their initial curves at point $A$.

The shaded lens-shaped area in Figure 6.2a illustrates the potential benefit from exchange, and it is possible to arrange exchanges between Worth and Edge so that they move into this area and both benefit. For example, if Edge purchases one football ticket from Worth and pays for it with three ballet tickets (as we discussed earlier), then they move from A to C. Note that both Edge and Worth are better off (that is, on higher indifference curves) at point $C$ than they were at point $A$.

Starting at point A, any voluntary exchanges that occur will necessarily involve movements into the lens-shaped area of mutual gain. If they moved outside the shaded area, one or both parties would be worse off (on a lower indifference curve), so such a trade would never be mutually agreed to. For example, a move from point $A$ to point $D$ (lying outside the shaded area) would never be agreed to by Worth. It would put her on a lower indifference curve than the one that she is on, $U_{\mathrm{w} 3}$, at point A . The basic economic proposition illustrated here is that exchanges will tend to take place as long as both parties continue to benefit. After moving from point A to point C , both parties may still benefit from further exchanges: $U_{\mathrm{E} 4}$ and $U_{\mathrm{W} 4}$ intersect at point $C$, carving out a smaller lens-shaped area of mutually beneficial potential exchanges. For example, Edge might trade his ballet tickets for Worth's football tickets again in such a way as to move into this smaller lens-shaped area and make both parties better off than they are at point $C$.

We have seen that, starting at point $A$, voluntary exchange can benefit both parties by moving them into the lens-shaped area defined by indifference curves $U_{\mathrm{E} 3}$ and $U_{\mathrm{W} 3}$. However, once they reach a point such as $E$ in Figure 6.2b, where their indifference curves are tangent, no further trade is possible that will benefit both. Any movement from point $E$ would harm at least one of the two (as an inspection will show), so the injured party would never agree to such an exchange. A tangency of indifference curves implies that the two consumers' marginal rates of substitution are equal. The process of trading from point $A$, where the MRSs differ, tends to bring the MRSs into equality. As Edge acquires more football tickets and gives up ballet tickets, his MRS becomes lower: his indifference curve is flatter at point $E$ than it is at A. As Worth gets more ballet tickets and gives up football tickets, her MRS becomes greater: her indifference curve is steeper at point $E$ than at A.

Where the marginal rates of substitution differ, mutually beneficial trade between the parties is possible. Differing MRSs imply intersecting indifference curves and a corresponding lensshaped area of potential mutual gain in the Edgeworth box diagram. Predictably, then, voluntary exchanges will occur to realize the potential gain.

We should mention one final point. Our theory does not permit us to predict exactly where in the lens-shaped area the consumers will end up. Although there should be a tendency for trade to continue until it is no longer mutually beneficial-until a tangency is reached-this condition does not identify a unique outcome. For example, if Edge is a very astute trader, he might persuade Worth to agree to an exchange from point $A$ to a point near $H$ in Figure 6.2 b where Worth is scarcely any better off (she would be no better off at H); then the lion's share of the potential mutual benefit goes to Edge. Conversely, if Worth is a sharp bargainer, they might end up at a point near G.

The reason for the indeterminacy is that we are assuming only two potential traders, one buyer and one seller, so this setting is not a competitive one (many buyers and sellers). When only two parties participate in the exchange process, elements of haggling and strategy appear, because each tries to conceal from the other how much he or she wants the trade so as to get the best terms. Thus, we are unable to predict the exact terms of the exchange, except to note a tendency for any exchanges that occur to benefit both parties to some degree.

# APPLICATION E゙, ' THEBENEFITS OF EXCHANGE AND EBAY 

Testament to the proposition that voluntary exchange represents a win-win for participating parties is provided by the growth of consumer-to-consumer (C2C) e-commerce. ${ }^{2}$ The largest supplier of C2C services, eBay, was founded in 1995 by Pierre Omidyar, a 31-year-old software developer who wanted to help his fiancée trade Pez dispensers online. Through the Webbased community pioneered by eBay, buyers and sellers can socialize, discuss topics of shared interest, and conduct business in a common trading environment. By 2002, eBay had roughly 50 million registered users around the world, earned more than $\$ 1$ billion in annual revenues, and featured more than 18,000 categories of goods including collectibles, antiques, sports memorabilia, Beanie Babies, jewelry, and books. On a typical day of trading covered by a feature story in Newsweek, the listed items included a castle in Tucson, a designer wedding gown, Tickle Me Elmo toys, a Daewoo hatchback, and a photograph of young Abraham Lincoln.

While eBay offers the marketplace, the consumers who connect through the marketplace do all the work. When the auction is over, the high bidder and the seller

2"The eBay Way of Life," Newsweek, June 17, 2002, pp. 51-60.
contact each other, usually by e-mail, to finalize the purchase. The earnings to eBay come from fees paid by sellers to post items and a commission that is tied to the sale price. The fact that eBay has been consistently profitable since its founding, even through the recent economic downturn, attests both to the win-win nature of voluntary exchange and to the financial benefits that can accrue to companies who successfully provide lowcost mechanisms for parties with differing marginal rates of substitution to connect. Because their marginal rates of substitution differ, the connected parties' indifference curves intersect in their relevant Edgeworth exchange box (as illustrated by a point such as A in Figure 6.2a) and there is room to move into a lens-shaped area of mutual benefit through trade.

Of course, there are some challenges associated with ensuring that Internet-based C2C exchange is mutually beneficial. For example, a seller may misrepresent the quality of an item put up for auction. In an attempt to address such potential problems, eBay allows sellers and buyers to rate each other at the end of a transaction. Transaction insurance and escrow arrangements are also offered by eBay and allow users to validate prospective trading partners' identities and past histories.

## 6.2

## PARETO OPTIMALITY

another term for economic efficiency

## EfFICIENCY IN THE DISTRIBUTION OF GOODS ${ }^{3}$

Economic efficiency-or, as it is sometimes called, Pareto optimality ${ }^{4}$-is a characteristic, highly regarded by economists, of some resource allocations. Noneconomists do not generally hold it in such high esteem; they frequently disparage it because they believe it relates only to materialistic values or monetary costs and ignores human needs. This criticism misconstrues the meaning of economic efficiency as economists use the term. Quite the opposite of a materialistic focus, efficiency is defined in terms of the well-being of people. Roughly speaking, an efficient outcome is one that makes people as well off as possible. A full treatment of the concept of efficiency is important in appreciating its use in economic analysis.

In this chapter we consider economic efficiency as it relates to the way fixed total quantities of goods are distributed among consumers. Two consumers and two goods are analyzed, just as before, but the results generalize easily to larger numbers. Moreover, the concept of

[^1]
## CONTRACT CURVE

in an Edgeworth exchange box, a line drawn through all the efficient distributions


## INEFFICIENCY

an allocation of goods in which it is possible, through a change in the distribution, to benefit one party without harming the other

economic efficiency can be applied in other settings, such as deciding what level of output of a particular good is most efficient. Clearly, overall efficiency in resource allocation involves more than just an efficient distribution of goods, but an efficient distribution is an important part of the overall concept. We discuss other aspects of economic efficiency in later chapters.

Suppose that we have 50 football tickets and 40 ballet tickets to divide between our friends, Mr. Edge and Ms. Worth. There are innumerable ways to distribute 50F and 40B between two consumers. The Edgeworth box diagram not only identifies all the possibilities but also shows how alternative distributions affect the well-being of both parties. Previously, we used the Edgeworth box to show how Edge and Worth, starting with certain market baskets, could exchange products to reach a preferred position. Now, however, the Edgeworth box is used in a different way; we wish to consider all the points in the diagram, not just those that Edge and Worth can reach by voluntary trade starting from some initial endowment. In other words, let's imagine that a philanthropist is going to give 50 F and 40 B to Edge and Worth and is devising ways that this might be done. Some ways are efficient, and some are inefficient, as we will see.

Figure 6.3 is an Edgeworth box that shows different ways of dividing the given quantities of football and ballet tickets between Edge and Worth. Several indifference curves for both people have been drawn so that we can see their preferences among the various possibilities. We begin by defining efficiency relative to this setting. An efficient distribution of fixed total quantities of goods is one in which it is not possible, through any change in the distribution, to benefit one person without making some other person worse off.

In the diagram, the points where Edge's and Worth's indifference curves are tangent show efficient distributions. Point $E$, for example, satisfies the definition of efficiency. If we change the distribution from point $E$ by moving to any other point, either Edge or Worth will be worse off (that is, on a lower indifference curve). For example, a move to point $L$ makes Ms. Worth worse off, a move to point $M$ makes Mr. Edge worse off, and so forth. Thus, point $E$ is an efficient distribution of football and ballet tickets. Note, though, that it is not unique; indeed, any point of tangency between indifference curves defines an efficient distribution. At point $J$, for example, $U_{\mathrm{W} 7}$ is tangent to $U_{\mathrm{E} 2}$. Any move from point $J$ will harm at least one of the two consumers, so point $J$ is an efficient distribution. Point $K$ also represents an efficient distribution, as do other points of tangency not drawn in. A line drawn through all the efficient distributions is called the contract curve. It is shown as CC in Figure 6.3, and it identifies all the efficient ways of dividing the two goods between the consumers.

An alternative but equivalent way of defining efficiency may be helpful. An efficient distribution is one that makes one party as well off as possible for a given level of well-being for the second party. For example, suppose that we consider the given level of well-being indicated by $U_{\mathrm{W} 2}$ for Worth. She is equally well off at points $L$ and $K$, or any other point on $U_{\mathrm{W} 2}$. Among all the possible combinations of football and ballet tickets that keep Worth on $U_{\mathrm{W} 2}$, Edge is best off at point $K$. Point $K$ places him on the highest indifference curve possible, assuming Worth stays on $U_{\mathrm{w} 2}$. Because point $K$ makes Edge as well off as possible for a given level of well-being ( $U_{\mathrm{w} 2}$ ) for Worth, it is an efficient distribution. Similarly, if we hold Worth on $U_{\mathrm{w} 5}$, point $E$ is best for Edge. Consequently, the same set of tangency points is defined when we look at efficiency in this way.

The contract curve identifies all efficient ways to divide football and ballet tickets between Edge and Worth. In contrast, all points off the contract curve are inefficient allocations. Inefficiency may be defined as follows: an allocation of goods in which it is possible, through a change in the distribution, to benefit one party without harming the other.

In Figure 6.3, all points off the contract curve satisfy this definition of inefficiency. Consider point $L$. If we change the distribution from point $L$ to point $K$, Edge will be better off without harming Worth-she remains on the same indifference curve, $U_{\mathrm{W}_{2}}$. Alternatively,

## FIGURE 6.3

## Efficient Distributions and the Contract Curve

A distribution of goods for which the consumers' indifference curves are tangent is efficient. We cannot change the distribution without making at least one of them worse off. There are many efficient distributions, as shown by the contract curve CC, which connects the points of tangency.

we can move from point $L$ to point $E$, which benefits Worth while leaving Edge's well-being unchanged. Note, in fact, that an inefficient allocation, such as point $L$, permits a change that benefits both parties. That is, a move from point $L$ to any point on the contract curve between points $E$ and $K$ will leave both Edge and Worth on higher indifference curves than the ones that they are on at point $L$.

If we select any point off the contract curve and draw Edge's and Worth's indifference curves through this point, the curves will intersect. The intersecting indifference curves will circumscribe a lens-shaped area within which both parties will be on higher indifference curves. Because this is true of every point off the contract curve, all these points represent inefficient distributions of the goods.

By this means, all the ways that the goods can be divided between Edge and Worth can be characterized as either efficient or inefficient. Inefficient distributions are shown as points where the indifference curves of the two parties intersect, that is, where $M R S_{F B}^{E} \neq M R S_{F B}^{W}$. This inequality implies, just as with our initial numerical example (Table 6.1), that the consumers place different values on the two goods, so both will prefer a different distribution. Efficient distributions are shown by the contract curve, which connects the points of tangency between indifference curves. Thus, efficient distributions are characterized by an equality between marginal rates of substitution, or $M R S_{\mathrm{FB}}^{\mathrm{E}}=\mathrm{MRS} S_{\mathrm{FB}}^{W}$. At those points the consumers' relative valuations of the two goods are equal, and no further change that will benefit both parties is possible.

## Efficiency and Equity

For any inefficient point there are many efficient points on the contract curve that both parties prefer. This can be seen by looking at any point such as $L$ located off the contract curve in Figure 6.3. In this case points between $E$ and $K$ on the contract curve are better from

the concept of fairness
both Edge's and Worth's viewpoints than point L. Most people would probably agree that the efficient points between $E$ and $K$ are preferred to the inefficient point $L$.

Now suppose that two efficient points are compared, points $E$ and $K$, for instance. Which of these is "better"? Because both points are efficient, the concept of efficiency provides no help in choosing between the two, yet there is a marked difference between $E$ and $K$. Edge is better off at point $K$ than at point $E$, while Worth is better off at point $E$ than at point $K$. Moving from $K$ to $E$ benefits Worth at Edge's expense; moving from $E$ to $K$ benefits Edge at Worth's expense. To judge one efficient point superior to another requires deciding whose well-being is more important, and there is no objective basis for such a decision. In the economist's jargon, interpersonal comparisons of utility cannot be made scientifically, so there is no objective way to demonstrate that one efficient point is preferred to another.

If a philanthropist has to choose how to divide the football and ballet tickets between Edge and Worth, on what basis could the choice between points $E$ and $K$ be made? The decision would have to be based on something other than efficiency because both points are efficient. Equity, or fairness, might provide the basis for the decision. However, although we all have views of what is equitable or fair, our views differ: there is no agreed-upon definition of what constitutes equity. For that reason economics does not provide a formula that allows us to state that one efficient point is better than any other.

Note also the critical role that the initial endowment plays in determining which of all of the efficient points on the contract curve in Figure 6.3 are attainable through voluntary exchange. For example, starting from endowment point $L$, all points between $E$ and $K$ on the contract curve are attainable through voluntary exchange. Any other points on the contract curve, however, are not attainable. Edge would never agree voluntarily to move to point $J$ if the initial endowment is $L$. Point $J$ lies on a lower indifference curve for Edge than does point $L$. Nevertheless, Edge may end up at point $J$ if we start from an initial endowment that is less favorable to Edge than $L$, an endowment such as $M$ (point $M$ lies on a lower indifference curve for Edge than does point $L$ ).

While voluntary exchange serves to promote efficiency starting from any initial endowment of goods, we can see that the "fairness" of any efficient distributive outcome hinges critically on the initial endowment. The economist's objective criteria of Pareto optimality does not provide us a means of judging the relative desirability of different initial endowments. Much as there are no objective criteria for deciding on the relative worth of all the different efficient outcomes lying on a contract curve, there are no objective criteria for evaluating the desirability of different endowments such as points $L$ and $M$. Once again, this judgment must be based on normative, or equity, considerations. And people disagree on what equity implies for initial endowments, as they do over the desirability of various possible distributive outcomes that can emerge from voluntary exchange.

In sum, economics offers an objective means to see why for any initial inefficient point there always exist efficient points preferred by all parties. A choice among initial endowment points or between different efficient distributive outcomes, however, requires that normative considerations be brought into play: some subjective judgment about which of the parties is more deserving relative to others. The objective dictates of Pareto optimality cannot help us make these normative judgments.

## COMPETITIVE EQUILIBRIUM AND EFFICIENT DISTRIBUTION

In the two-person model of exchange, the exact outcome of bargaining cannot be predicted. We can expect the parties to haggle over the terms of exchange (the price), with the result depending on which one is the superior negotiator. In the real world, however, buyers and

## PRICE TAKER

an individual who cannot affect the prevailing market price
sellers might not haggle over prices, especially when there are many buyers and sellers in any given market. In such cases, each party is not limited to dealing with another specific party-there are alternatives. It would do you little good, for example, to try to bargain over the price of a video rental; if you offer a price below the going rate, the video rental store manager will simply wait for another customer. Similarly, if the manager tries to extract a higher price from you, you will probably rent your movies from another store. The existence of alternative buyers and sellers greatly limits the influence any one of them can have on the price. People simply find alternative sources if the deal offered by one person is not as good as what can be obtained elsewhere.

With many buyers and sellers, each individual will behave like a price taker. Consumers acting individually cannot affect the price perceptibly by haggling. They take the price as given and buy or sell whatever quantities they wish at that price. What determines the price in this many-person setting? It is, of course, the interaction of supply and demand, because we are now dealing with a competitive market. Namely, the overall demand for and supply of a good across all individual market participants with their respective initial holdings and preferences determine the market price. Once this market price is determined, individual participants must decide how much of the good they wish to buy or sell.

Let's rejoin Edge and Worth and extend our two-person model to show the outcome when the competitive equilibrium is attained and market participants are price takers. We can illustrate the nature of this equilibrium for Edge and Worth by using the Edgeworth box diagram. In Figure 6.4, Edge and Worth begin with the initial holdings shown at point $A$. Suppose that the market-determined price of one football ticket is three ballet tickets.

## FIGURE 6.4

## Competitive Exchange

In a competitive equilibrium, market actors are price takers-they all confront a uniform price for football tickets equal to 3 ballet tickets per football ticket. Each party faces the budget line $Z Z^{\prime}$, and the equilibrium is at point $E$-an efficient outcome.


Then, both Edge and Worth confront the budget line $2 Z^{\prime}$, which has a slope of $3 B / 1 F$. At that price, Edge prefers to move to point $E$, purchasing 4 football tickets in exchange for 12 ballet tickets. Confronted with $\mathrm{ZZ}^{\prime}$, Worth also prefers point $E$, selling 4 football tickets for 12 ballet tickets. If both Edge and Worth take the price ( $3 \mathrm{~B} / 1 \mathrm{~F}$ ) as given and are the only two market participants, the quantity of football tickets demanded by Edge (4) is exactly equal to the quantity Worth wants to sell at that price. The price of 3 ballet tickets per football ticket is therefore an equilibrium price.

Remember that the preceding example investigates price-taking behavior, while assuming that there are only two market participants. In general, price-taking behavior results from the presence of many market participants. And the equilibrium price will be one where the total amount of football tickets demanded by buyers such as Edge in our preceding example equals the quantity sellers such as Worth are willing to supply. If the price were lower, there would be a shortage of football tickets, and the price would rise. If the price were higher, there would be a surplus of tickets, and the price would fall. The tangency of indifference curves at point $E$ in Figure 6.4 simply illustrates the balance between quantities demanded and supplied at the competitive equilibrium price in a twoperson setting.

Another implication of the competitive equilibrium should not be missed: the final equilibrium point is an efficient allocation. This can be seen in Figure 6.4 by noting that point $E$ is a point of tangency between indifference curves and therefore lies on the contract curve. In a pure exchange model, this conclusion illustrates Adam Smith's famous "invisible hand" theorem: each trader, concerned only with furthering his or her own interest, is led to exchange to a socially efficient result. All the potential gains from voluntary exchange are realized in a competitive market.

There is another way of showing that a competitive equilibrium produces an efficient allocation. Specifically, recall from earlier in this chapter that an efficient distribution in our two-person (Edge and Worth), two-good (football and ballet tickets) case requires that:

$$
\begin{equation*}
M R S_{F B}^{E}=M R S_{F B}^{W} . \tag{1}
\end{equation*}
$$

Because Edge and Worth make their consumption decisions independently of one another in a competitive market setting, it might seem unlikely that this condition will be satisfied. Consider, however, the equilibrium conditions that result when each person allocates his or her income in the appropriate way:

$$
\begin{align*}
& M R S_{F B}^{E}=P_{F} / P_{B} ; \text { and }  \tag{2}\\
& M R S_{F B}^{W}=P_{F} / P_{B} . \tag{3}
\end{align*}
$$

Chapter 3 demonstrated that each consumer purchases a market basket such that his or her marginal rate of substitution equals the price ratio. Because the prices are the same for both consumers, each consumer's MRS is equal to the same price ratio, and so the MRSs are equal to one another. Thus, condition (1) is satisfied.

Let's look at this matter graphically. Panels (a) and (b) in Figure 6.5 show Mr. Edge and Ms. Worth in competitive equilibrium. In panel (a), on his budget line $\mathrm{ZZ}^{\prime}$, Edge is at point E consuming 23 ballet tickets and 9 football tickets. Worth is consuming 17 ballet and 41 football tickets at point $E$ in panel (b). Note, however, that the slopes of their budget lines are equal. Because they face the same market prices for football and ballet, $P_{F} / P_{B}$ (equal to $3 B / 1 F$ in the diagram) is the same for both of them. Thus, the slope of Edge's indifference curve at his optimal consumption point, $3 \mathrm{~B} / 1 \mathrm{~F}$, equals the slope of Worth's indifference curve at her optimal point.

Panels (a) and (b) of Figure 6.5, of course, are nothing more than the components of Figure 6.4, the Edgeworth box diagram for the total quantities of football and ballet, 50 F and

## FIGURE 6.5

## A Market-Determined Distribution Is Efficient

(a) Edge's optimal consumption point is $E$. (b) Worth's optimal point is also $E$. Even though each consumer acts independently, they both seek to equate their $M R S$ to the same market-determined price of ballet passes per football ticket, $Z Z^{\prime}$. An efficient distribution results.


40B, consumed by Edge and Worth. To see this, start with Edge's budget line, $\mathrm{ZZ}^{\prime}$, from panel (a) of Figure 6.5. Then, rotate Worth's indifference map from panel (b) 180 degrees, superimposing her optimal consumption point, $E$, on Edge's optimal point and ensuring that her rotated indifference curve $U_{\mathrm{W} 2}$ is tangent to Worth's budget line $Z Z^{\prime}$ at $E$ in panel (a). Because they are tangent to the same budget line $2 Z^{\prime}$, Edge's and Worth's indifference curves $U_{\mathrm{E} 2}$ and $U_{\mathrm{W} 2}$ are also tangent to each other at point $E$. Thus, the distribution of goods described by points $E$ in the two graphs is an efficient one: there is no other way to divide 50 F and 40 B that would not make at least one of the two consumers worse off.

Over any period of time the market distributes, or rations, goods among consumers. Although each consumer acts independently in choosing a market basket, the result is an efficient distribution. This outcome depends on two conditions. First, the prices of goods must be the same for all consumers; this condition ensures that every consumer's budget line will have the same slope. Second, consumers must be able to purchase whatever quantity they want at those prices; this condition ensures that every consumer can select a market basket for which the marginal rate of substitution equals the ratio of the prices of the goods.

Reaching an efficient distribution, albeit not the only possible efficient distribution, is no small feat. No philanthropist or government agency knows the preferences of millions of consumers. To attain any efficient outcome in this setting is a considerable achievement. When consumers must pay for the products they consume, self-interest leads them to utilize their knowledge of their own preferences, and these preferences are reflected in the market basket they select. Because their decisions are guided by the same relative prices confronting other consumers, the result is a coordination among purchase plans that would be difficult to achieve any other way.

0ver the past half-century, California has experienced several water "shortages." During these shortages, quantity demanded exceeds quantity supplied at the prices for which water is sold by the federal and state government to California's various water districts and ultimately to consumers. Rather than relying on price and exchange mechanisms to deal with the shortages, policymakers have discouraged water use (through either voluntary or mandatory conservation programs) and spent tax dollars on the procurement of additional water supplies, such as through desalination of seawater. There has even been talk of building a massive pipeline to transport glacial water from Alaska.

Water is sold in acre-foot units (the amount of water it takes to flood an acre of land to a depth of one foot). The prices for which water is sold vary substantially by district. Agricultural districts are allocated 85 percent of the state's water at prices ranging from $\$ 20$ to $\$ 80$ per acre-foot. Urban districts account for 85 percent of the state's population but are allocated only 15 percent of the water at prices of around $\$ 100$ per acre-foot (the resource cost of producing water generally ranges from $\$ 100$ to $\$ 200$ per acre-foot). Trade in allocated water rights by consumers in the state's various districts is prohibited.

As one can imagine, the manner in which water is priced and allocated produces some tremendous inefficiencies. The low prices and relatively plentiful allocations to agricultural districts make it profitable to grow hay in Death Valley; allow California to be one of America's major rice-producing states-despite the fact that rice growing requires a monsoon climate while California is generally classified as semi-arid; lead farmers in
the Central Valley to water their crops through either open-trough irrigation systems or aerial spraying (processes through which over half the water evaporates); and result in the state's cows consuming more water (either directly or indirectly through crops such as alfalfa and hay) than does the state's human population.

In California's cities, the limited allocations of water and the policy of either encouraging or mandating conservation result in water "police" being hired to crack down on leaking faucets and lush lawns; lead newspapers to publish the names of the 100 largest water "hogs" in town; and necessitate the establishment of special judiciary panels to hear cases of residents appealing their allotted quotas (for reasons such as additional children or a booming business). More than 175,000 appeals were filed the last time the Metropolitan Water District of Los Angeles instituted mandatory, nonprice rationing. Perhaps the funniest one involved a man who wanted to start a worm farm. Policymakers had to check with researchers at several universities to determine the right amount of water to allot the appellant.

Given the existing pricing and allocation policies, Californians would be better off if urban residents could purchase some of the water allocated to farmers. With existing endowments and preferences for water versus other goods, in other words, urban residents would be willing to pay more for additional acre-feet than the value those acre-feet generate for farmers through the production of agricultural products. The prohibition on trading of water allocations, however, prevents California's water consumers from being on their contract curve and thereby achieving Pareto optimality.

## Should Diamondback Ticket SCALPERS BE DISPARAGED OR DEIFIED?

The Arizona Diamondbacks baseball team won a thrilling World Series victory over the New York Yankees in 2001. While the owner of the Diamond-
backs, Jerry Colangelo, and other team management members had a lot to be pleased about that year, they groused publicly about the extent to which ticket scalp-
ing had undermined the value of their business. Ticket scalping involves the operation of a secondary market and the resale of tickets by original recipients to other interested consumers.

Arizona State University economist Stephen Happel responded to the grousing by noting that the Diamondbacks management should be thankful for the existence of ticket scalpers since they, if anything, enhanced the value of the organization while promoting mutually beneficial exchange: ${ }^{5}$

Colangelo needs to remember three points. First, don't have team officials complaining in the pa-

[^2]pers about scalpers' prices when a $\$ 9$ season ticket was $\$ 110$ for the World Series (a 1,122 percent markup). Second, don't complain about how scalpers are making money unfairly off you. Simply wait and charge higher prices: voluntary exchange benefits both parties and your after-the-fact argument implies you want to have your cake and eat it too. Third, you need a secondary ticket market created by scalpers. Without vibrant resale opportunities, far fewer season tickets are sold, since fans do not want to attend 81 home baseball... games. They attend a select number of games and unload excess tickets in the secondary market. Scalpers bring in people who otherwise wouldn't go, thereby contributing to team revenues via concession sales.

## Price and Nonprice Rationing and Efficiency

In open markets, prices serve a rationing function in determining how much of available quantities each consumer will get. The rationing function and whether it is accomplished efficiently or inefficiently are what this chapter is all about. We conclude our analysis with an example that illustrates the relationship between the demand curve treatment of rationing problems and the Edgeworth box approach emphasized in previous sections.

Figure 6.6 b shows the market demand and supply curves for gasoline. Because our emphasis is on the rationing of fixed supplies, the supply curve is drawn as vertical (perhaps reflecting a very short-run situation). With the $S$ supply curve, the per-gallon price is $\$ 1.00$ and quantity is 150 gallons. Now suppose that there is a sharp reduction in supply to 100 gallons so that the supply curve shifts from $S$ to $S^{\prime}$ (because of a foreign oil embargo, perhaps). The market response is an increase in price to $\$ 2.00$ per gallon. Consumers are induced by the higher price to restrict their use of gasoline to the available quantity.

By looking at Figure 6.6a, we see what this price increase means for the individual consumers in the market. Once again, we consider only two consumers, Edge and Worth, whose demand curves are $d_{\mathrm{E}}$ and $d_{\mathrm{W}}$. When the price reaches $\$ 2.00$, each consumer moves up his or her demand curve, cutting back on any gasoline use that is valued at less than $\$ 2.00$ per gallon. The final optimal consumption points are $A$ and $B$, with Worth purchasing 70 gallons and Edge purchasing 30 gallons. The sum of their purchases, 100 gallons, is, of course, the total quantity purchased, shown in Figure 6.6b.

Their adjustment to the higher price represents an efficient rationing of the reduced quantity available. Consider how this result would appear if the final equilibrium were shown in an Edgeworth box. Edge, in buying 30 gallons, consumes at a point where his marginal rate of substitution between outlays on all other goods and gasoline is $\$ 2.00$ per gallon. Similarly, Worth, in buying 70 gallons, consumes at a point where her marginal rate of substitution between outlays on all other goods and gasoline is $\$ 2.00$ per gallon. Their marginal rates of substitution are equal, and if this situation were depicted in an Edgeworth box, it would look qualitatively like point $E$ in Figure 6.4. ${ }^{6}$ Edge's and Worth's indifference curves

[^3]
## FIGURE 6.6

## Gasoline Rationing

Nonprice rationing will generally lead to an inefficient distribution. We can illustrate an inefficient distribution by differences in the demand prices of consumers. When each consumer receives 50 gallons of gasoline, Worth's demand price is $\$ 3.00$ and Edge's is $\$ 1.20$, implying that both would be better off with a different distribution.

would have the same slope at their optimal consumption points and so would be tangent in the box diagram. Consequently, allowing the market price to ration the available quantities between the consumers leads to an efficient distribution of goods.

We can better appreciate the significance of the rationing problem by speculating on how it might be resolved if price were not allowed to perform this function. For example, suppose that when the supply of gasoline falls, the government does not allow the price to rise but instead imposes a price ceiling at $\$ 1.00$ per gallon. In that event the total quantity demanded exceeds the total quantity available, but somehow the combined use of Edge and Worth must be restricted to 100 gallons. Suppose that the government implements a rationing scheme by using ration coupons, as it did in World War II. (In fact, during the Arab oil embargo of 1973-1974, the government again proposed the use of ration coupons and printed 3.8 billion, but the coupons were never used.) One hundred ration coupons will be printed and distributed to Edge and Worth. To purchase a gallon of gasoline, the consumer must pay $\$ 1.00$ and turn in one ration coupon; because only 100 coupons are available, gasoline purchases will not exceed the available supply. Resale of the coupons is not permitted.

The problem, then, is how to divide the ration coupons between Edge and Worth. Suppose that each receives 50 coupons: then neither could purchase more than 50 gallons. In Figure 6.6a, this solution puts both Edge and Worth at point $R$, each paying $\$ 1.00$ per gallon and receiving 50 gallons. Both, however, place a value greater than $\$ 1.00$ on gasoline at that consumption level. When Worth buys 50 gallons, her marginal value of gasoline is $\$ 3.00$ per gallon. This marginal value is indicated by $A^{\prime}$, the height of her demand curve at 50 gallons. (Remember from Chapter 2 that the demand curve's height reflects the maximum a consumer is willing to pay for an incremental unit of a good.) A marginal value of $\$ 3.00$ per gallon also implies that Worth's marginal rate of substitution between outlays on all other goods and gasoline is $\$ 3.00$ per gallon when only 50 gallons are available. In other words, it is the maximum dollar outlay on all other goods that she is willing to give up to get an additional gallon of gasoline at 50 gallons. Edge's marginal value of gasoline is $\$ 1.20$ at

50 gallons as reflected by his demand curve's height at $\mathrm{B}^{\prime}$. Because Worth places a higher marginal value on gasoline than Edge does, this method of rationing gasoline is inefficient.

We could also show this coupon-rationing equilibrium in an Edgeworth box; it would be depicted by a point where Edge's and Worth's indifference curves intersect. (Qualitatively, it would look like point A in Figure 6.4.) Because Worth would be willing to pay just under $\$ 3.00$ for another gallon of gas, and Edge would be willing to give up a gallon for just over $\$ 1.20$, both would be better off if Worth could buy gasoline (or coupons) from Edge. The government will not allow her to do so in our example, however, so mutually advantageous trades cannot occur. In this situation a black market in gasoline (or coupons) may well arise.

Thinking about how to distribute gasoline ration coupons suggests how difficult it is to reach an efficient outcome if voluntary exchange and market-determined prices are not allowed to perform their rationing function. The essence of efficient rationing is to distribute a good so that its marginal value is the same among consumers, but without knowing the preferences of all consumers, it is a virtually impossible task. For this reason any type of nonprice rationing system is almost certain to involve some inefficiency in the way goods are distributed among consumers.

Pointing out the inefficiency of nonprice rationing programs is not to claim that these forms of rationing are undesirable. The purpose of price ceilings is generally to benefit consumers at the expense of producers. Clearly, producers are harmed, but the significance of this inefficiency is that it also diminishes the benefit to consumers. In our example, both consumers would be better off-without further harming producers-if they could exchange gasoline until their marginal values are brought into equality.

Of course, the long-run effect of the price ceiling on quantity supplied has been neglected so as to focus on the rationing problem. Our purpose in this section has been to illustrate inefficiency in the distribution of a given supply by using consumers' demand curves, because this approach provides an alternative to the use of Edgeworth box diagrams.

## APPLIEATION E.A! THE BENEFITS AND COSTS

 OF RATIONING BY WAITINGA.n equal allocation of ration coupons or a lottery are not the only nonprice ways of rationing a good that is in short supply at the existing price. Sometimes, as in the example of rent control discussed in Chapter 2, a price-controlled good is allocated to buyers on a firstcome, first-served basis. This rationing-by-waiting approach has the advantage that, if there are no costs to waiting, consumers placing the highest marginal value on a good have the greatest incentive to get in line to purchase the good. To the extent that consumers placing the highest marginal value on a good are at the head of the line, efficiency in the distribution of the good among consumers is promoted.

Rationing by waiting, however, has its costs if consumers have something else that they could be doing besides waiting in line. For example, a study examined the
effects of a price ceiling applied to a Chevron station in Ventura, California, in 1980 versus two competing stations not subject to the same price ceiling. ${ }^{?}$ (Stations owned and operated by integrated oil companies were subject to the price ceiling while those operated by independent or franchised dealers were not.) The study found that the price at the Chevron station was $\$ 0.19$ per gallon lower than at the competing stations. Because of the lower price, long lines formed at the Chevron station, and the average time a consumer spent waiting in line was 15 minutes. By contrast, there was no waiting at the competing stations.

[^4]The study surveyed customers at the various stations and estimated the customers' opportunity cost of time based on their employment and income characteristics. The study found that a significant percentage of the increase in consumer surplus generated by the price ceiling was dissipated through the costs of having to wait in line to buy the low-priced Chevron gasoline. Specifically, once the costs of waiting were accounted for, consumers received only 49 percent of the increase in consumer surplus generated by the
price ceiling at the Chevron station. Moreover, the study pointed out that there is no guarantee that if costs are associated with waiting, the consumers placing the highest marginal value on a good will also be the ones with the lowest opportunity cost of time. To the extent that high-marginal-value customers also have a high opportunity cost of time, they will be discouraged from waiting in line and a rationing-bywaiting scheme will not allocate the good across consumers in an efficient manner.

## SUMMARY

- Voluntary exchange is mutually beneficial.
- The Edgeworth exchange box shows that differing marginal rates of substitution (MRS) imply the possibility of mutually beneficial exchange. The prospect of mutual gain gives rise to voluntary exchange.
- A distribution of goods between consumers is efficient if any change in the distribution will harm at least one of them. The many distributions that satisfy this definition are shown as points on the contract curve in the Edgeworth exchange box, along which consumers' MRSs are equal.
- Equity is another criterion for evaluating economic arrangements, especially when determining whether one efficient distribution is to be preferred to another.
- The distribution of goods implied by a competitive market equilibrium is efficient. Because each consumer strives to equate his or her MRS to the same price ratio that confronts other consumers, consumers' MRSs end up being equal to one another.
- Some economic arrangements can lead to an inefficient distribution of goods. The allocation of water in California across various users coupled with a prohibition of trade in allocated water supplies is an example.


## REVIEW QUESTIONS AND PROBLEMS

Questions and problems marked with an asterisk have solutions given in Answers to Selected Problems at the back of the book (page $x x x-x x x)$.
6.1. What do the dimensions of the Edgeworth exchange box signify? How does a point in the box identify the distribution of goods between two consumers? What does a point on one of the sides of the box indicate? What does it mean if we are located at one of the corners of the box? (Examine each corner separately.)
6.2. What does a vertical movement inside the Edgeworth exchange box signify? Would a voluntary trade ever be shown by a vertical movement? What does a horizontal movement signify? Would a voluntary trade ever be shown by a horizontal movement?
*6.3. John has 40 gallons of gasoline ( G ) and 20 bags of sugar (S); for that market basket, John's $\mathrm{MRS}_{\mathrm{SG}}$ is $3 \mathrm{G} / 1 \mathrm{~S}$. Maria has 40 gallons of gasoline and 50 bags of sugar; for that market bas-
ket, Maria's $M R S^{\text {SG }}$ is $1 \mathrm{G} / 1 \mathrm{~S}$. Use a numerical example to explain how a trade can benefit both of them. Illustrate the trade by using an Edgeworth exchange box, showing that both consumers reach higher indifference curves.
6.4. Define efficiency and inefficiency in the context of the distribution of goods between two consumers. If the distribution lies inside an Edgeworth box, how does knowledge of the consumers' marginal rates of substitution permit us to tell whether the distribution is efficient?
*6.5. John has 40 gallons of gasoline and no bags of sugar; for that market basket his $M R S_{S G}$ is $1 G / 1 S$. Maria has 20 gallons of gasoline and 20 bags of sugar; Maria's $M R S_{\mathrm{SG}}$ is $3 \mathrm{G} / 1 \mathrm{~S}$. Is this arrangement an efficient distribution of goods? Show, using an Edgeworth box.
6.6. When John has 40 gallons of gasoline and 20 bags of sugar, his $\mathrm{MRS}_{\mathrm{SG}}$ is $5 \mathrm{G} / 1 \mathrm{~S}$. When Maria has 40 gallons of gasoline and 50 bags of sugar, her $M R S_{S G}$ is $1 \mathrm{G} / 1 \mathrm{~S}$. If John exchanges nine of
his gallons of gasoline for three of Maria's bags of sugar, both their MRSs after the exchange are 3G/1S. Are they both better off? Show, using an Edgeworth box.
*6.7. Given his initial endowment of gasoline and sugar, John's $\mathrm{MRS}_{\mathrm{SG}}$ is $4 \mathrm{G} / 1 \mathrm{~S}$; given Maria's initial endowment, her $\mathrm{MRS}_{\mathrm{SG}}$ is $2 \mathrm{G} / 1 \mathrm{~S}$. If the government collects a tax of 3G for each unit of $S$ traded, can John and Maria engage in mutually beneficial exchange? Compared to the absence of the tax, who is harmed by it? Who benefits?
6.8. Bill and Hillary confront the same market prices for health care and hamburgers. Bill's optimal consumption point is a corner equilibrium where he consumes only hamburgers; Hillary's optimal point involves consumption of both health care and hamburgers. Are their MRSs equal? Does the distribution lie on the contract curve? Support your answer by constructing the relevant Edgeworth box.
*6.9. How is an equal distribution of goods shown in the Edgeworth box diagram? Is an equal distribution efficient?
6.10. Scrooge is the only moneylender in town-a monopo-list-and he charges exorbitant interest rates. If you borrow money from Scrooge, does this practice illustrate the principle that voluntary trade is mutually beneficial?
*6.11. An owner of an apartment building converts the units into condominiums, evicting the current tenants. Is this situation an example of voluntary trade? Is it an example of mutually beneficial trade?
6.12. "Private markets ration goods among consumers in an efficient way." Explain what this statement means. Does it imply that there is no basis for thinking that some other distribution would be better?
6.13. Tickets to the National Football League's (NFL's) championship game, the Super Bowl, are sold by the League at a below-market-clearing price. This policy produces a shortage. To allocate the relatively scarce tickets, the NFL typically employs a nonprice rationing scheme. For example, during a recent season, the League allowed all interested buyers to submit an application for up to two Super Bowl tickets. The NFL then conducted a lottery to determine which of the submitted applications would be honored. Explain why the nonprice rationing scheme employed by the NFL results in an inefficient distribution of goods. Can the NFL's insistence that the state in which the Super Bowl is played prohibit ticket scalping be justified on efficiency or equity grounds? Explain.
6.14. Use the analytical framework of this chapter to explain why ticket scalping frequently occurs at college athletic events. (Why does it occur at some events and not at others?) Who benefits and who is harmed by this practice? Should steps be taken to suppress ticket scalping?
*6.15. Denny gives each of his two daughters a glass of milk and six cookies for lunch. The two daughters want to trade so that one will drink the two glasses of milk and the other will eat the dozen cookies. Does economic analysis imply that Denny should allow his children to engage in this trade?
6.16. Why is water allocated the way it is in California? Why don't policymakers allow trading of rights to water allocations across the state's various water districts? Why might farmers not support the allowance of such trading?
6.17. Landing fees at many airports are based on aircraft weight. However, these fees do not accurately measure the cost associated with a landing or takeoff. This is because the opportunity cost of a plane using a runway primarily reflects the amount of time that other aircraft no longer have access to the runway and this amount of time is largely independent of the weight of a plane. If landing fees at heavily-used airports are set below market-clearing levels and are based on aircraft weight, explain why there may be some significant costs associated with such an approach.
6.18. The U.S. government designates particular amounts of the electromagnetic spectrum for certain telecommunications uses: broadcast television; wireless; radio; and so on. In the interest of economic efficiency, should trade be allowed between holders of government-sanctioned rights to the various portions of the spectrum? That is, should the owner of a certain amount of spectrum targeted for radio be allowed to sell the asset to another individual who believes that the value of the spectrum would be greater if it was devoted to cellular phone service?
6.19. Economics suggests that, among a choice of different points on a contract curve, a more equal distribution of goods across consumers is preferable to a less equitable distribution. True, false, or uncertain? Explain.
6.20. "An efficient distribution of goods is always to be preferred to an inefficient distribution." True, false, or uncertain? Explain.
6.21. Starting from Point $L$ in Figure 6.3, explain what factors determine where on the contract curve segment between $E$ and K Edge and Worth are likely to end up.


[^0]:    ${ }^{1}$ The Edgeworth box is named for F. Y. Edgeworth, who hinted at such a construction in 1881 in his Mathematical Psychics: An Essay on the Application of Mathematics to the Moral Sciences (New York: August Kelly, 1953).

[^1]:    ${ }^{3}$ A mathematical treatment of some of the material in this section is given in the appendix at the back of the book (pages $x x x-x x x$ ).
    ${ }^{4}$ Named after the Italian economist Vilfredo Pareto (1848-1923), who first systematically formulated the concept in Cours d'Economie Politique (Lausanne: F. Rouge, 1897).

[^2]:    ${ }^{5}$ Stephen Happel, "Ticket Scalpers Play Fair in our Free-Market System," Arizona Republic, December 30, 2001, p. V3.

[^3]:    ${ }^{6}$ In this case, however, the vertical dimension of the Edgeworth box would measure the total amount of gasoline across the two consumers while the horizontal dimension measured the total dollar outlay on all other goods.

[^4]:    ${ }^{7}$ Robert T. Deacon and Jon Sonstelie, "Rationing by Waiting and the Value of Time: Results From a Natural Experiment," Journal of Political Economy, 93 No. 4 (October 1985), pp. 627-647.

