# CHAPTER 16

# General Equilibrium and Economic Efficiency

*For* the most part, we have studied individual markets in isolation. Yet markets are often interdependent-conditions in one can affect prices and outputs in others either because one good is an input to the production of another good or because two goods are substitutes or complements. In this chapter we see how a *general equilibrium analysis* can be used to take these interrelationships into account.

We also expand the concept of economic efficiency that we introduced in Chapter 9, and we discuss the benefits of a competitive market economy. To do this, we first analyze economic efficiency, beginning with the exchange of goods among people or countries. We then use this analysis of exchange to .discuss whether the outcomes generated by an economy are equitable. To the extent that these outcomes are deemed to be inequitable, government can help redistribute income.

We then go on to describe the conditions that an economy must satisfy if it is to produce and distribute goods efficiently. We explain why a perfectly competitive market system satisfies those conditions. We also show why free international trade can expand the production possibilities of a country and make its consumers better off. Most markets, however, are not perfectly competitive, and many deviate substantially from that ideal. In the final section of the chapter (as a preview to our detailed discussion of market failure in Chapters 17 and 18), we discuss why markets may fail to work efficiently.

# 16.1 *General Equilibrium Analysis*

So far our discussions of market behavior have been largely based on *partial equilibrium analysis.* When determining the equilibrium prices and quantities in a market, we presumed that the activity in that market had little or no effect on other markets. For example, in Chapters 2 and 9, we presumed that the wheat market was largely independent of the markets for related products, such as corn and soybeans.

Often a partial equilibrium analysis of this sort is sufficient to understand market behavior. However, market interrelationships can be important. For example, in Chapter 2 we saw how a change in the price of one good can affect the demand for another if they are complements or substitutes, and in Chapter 8 we saw that an increase in a firm's input demand can cause both the market price of the input and the product price to rise.

Unlike partial equilibrium analysis, *general equilibrium analysis determines the prices and quantities in all markets simultaneously,* and it explicitly takes feedback effects into account. A *feedback effect* is a price or quantity adjustment in one market caused by price and quantity adjustments in related markets. Suppose, for example, that the U.S. government taxes oil imports. This would immediately shift the supply curve for oil to the left (because foreign oil is more expensive) and raise the price of oil. But the effect of the tax would not end there. The higher price of oil would increase the demand for and then the price of natural gas. The higher natural gas price would in turn cause oil demand to rise (shift to the right) and increase the oil price even more. The oil and the natural gas markets would continue to interact until eventually an equilibrium would be reached in which the quantity demanded and quantity supplied were equated in both markets.

In practice, a complete general equilibrium analysis, which evaluates the effects of a change in one market on *all* other markets, is not feasible. Instead, we confine ourselves to two or three markets that are closely related. For example, when looking at a tax on oil, we might also look at markets for natural gas, coal, and electricity.

## Two Interdependent Markets-Moving to General Equilibrium

To study the interdependence of markets, .let's examine the competitive markets for videocassette rentals and movie theater tickets. The two markets are closely related because the widespread ownership of videocassette recorders has given, most consumers the option of watching movies at home as well as at the theater. Changes in pricing policies that affect one market are likely to affect the other market, which in turn causes feedback effects in the first market.

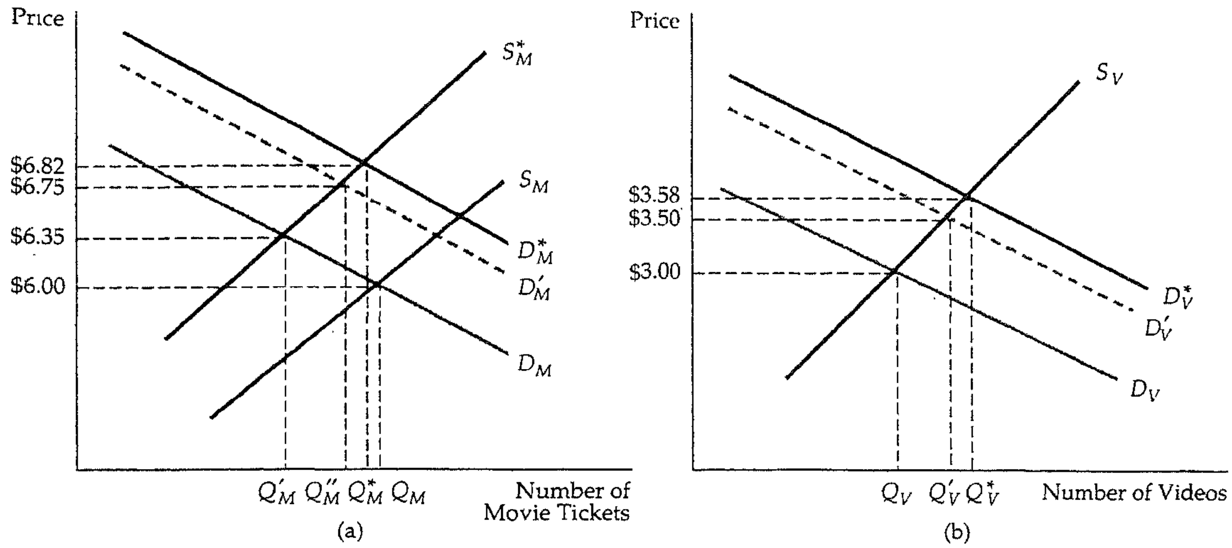


**FIGURE 16.1 Two Interdependent Markets: Movie Tickets and Videocassette Rentals.** When markets are interdependent, the prices of all products must be simultaneously determined. Here a tax on movie tickets shifts the supply of movies upward from $S_M$ to $S^*_M$, shown in (a). The higher price of movie tickets ($6.35 rather than $6.00) initially shifts the demand for videocassettes upward (from $D_V$ to $D'_V$), causing the price of videos to rise (from $3.00 to $3.50), shown in (b). The higher video price feeds back into the movie ticket market, causing demand to shift from $D_M$ to $D'_M$ and the price of movies to increase from $6.35 to $6.75. This continues until a general equilibrium is reached, shown as the intersection of $D^*_M$ and $S^*_M$ in (a), with a movie ticket price of $6.82, and the intersection of $D^*_V$ and $S_V$ in (b), with a video price of $3.58.

Figures 16.1a and 16.1b show the supply and demand curves for videos and movies. In 16.1a'the price of movie tickets is initially $6, and the market is in equilibrium at the intersection of $D_M$ and $S_M$. In Figure 16.1b the video market is also in equilibrium with a price of$3.

Now suppose that the government places a tax of $1 on each movie ticket purchased. The effect of this tax is determined on a partial equilibrium basis by shifting the supply curve for movies upward by $1, from $S_M$ to $S_M^*$ Figure 16.1a. Initially, this causes the price of movies to increase to $6.35 and the quantity of movie tickets sold to fall from $Q_M$ to $Q'_M$. This is as far as a partial equilibrium analysis takes us. But we can go further with a general equilibrium analysis by (1) looking at the effects of the movie tax on the market for videos, and (2) seeing whether there are any feedback effects from the video market to the movie market.

The movie tax affects the market for videos because movies and videos are substitutes. A higher movie price shifts the demand for videos from $D_V$ to $D_{V'}$

in Figure 16.1b. This, in turn, causes the rental price of videos to increase from $3.00 to $3.50. Note that a tax on one product can affect the prices and sales of other products-something that policymakers should remember when designing tax policies.

What about the market for movies? The original demand curve for movies presumed that the price of videos was unchanged at $3.00. That price is now $3.50, however, so the demand for movies will shift upward, from $D_M$ to $D'_M$ in Figure 16.1a. The new equilibrium price of movies (at the intersection of $S^*_M$ and $D'_M$) is now $6.75, instead of $6.35, and the quantity of movie tickets purchased has increased from $Q'_M$ to $Q''_M$. Thus, a partial equilibrium analysis would have underestimated the effect of the tax on the price of movies. The video market is so closely related to the market for movies that to determine the tax's full effect, we need a general equilibrium analysis.

## The Attainment of General Equilibrium

This analysis is not yet complete. The change in the market price of movies will generate a feedback effect on the price of videos, which in turn will affect the price of movies, and so on. In the end, we must determine the equilibrium prices and quantities of *both* movies and videos simultaneously. The equilibrium movie price of $6.82 is given in Figure 16.1a by the intersection of the equilibrium supply and demand curves for movie tickets ($S^*_M$ and $D^*_M$), and the equilibrium video price of $3.58 is given in Figure 16.1b by the intersection of the equilibrium supply and demand curves for'videos ($S_V$ and $D^*_V$). These are the correct general equilibrium prices because the video market supply and demand curves have been drawn on the assumption that the price of movie tickets is $6.82, and the movie ticket curves have been drawn on the assumption that the price of videos is $3.58. In other words, both sets of curves are consistent with the prices in related markets, and we have no reason to expect that the supply and demand curves in either market will shift further.[1]

Note that even if we were only interested in the market for movies, it would be important to account for the videocassette market when determining the impact of a movie tax. A partial equilibrium analysis *would understate* the effect on the tax,leading us to conclude that the tax will increase the price of movie tickets from $6 to $6.35. A general equilibrium analysis, however, shows us that the impact of the tax on the price of movie tickets is greater-the price would increase to $6.82.

Movies and videocassettes are substitute goods. By drawing diagrams analogous to those in Figure 16.1, you should be able to convince yourself that if

[1] To find the general equilibrium prices (and quantities) in practice, we must simultaneously find two prices that equate quantity demanded and quantity supplied in all related markets. For our two markets, this would mean finding the solution to four equations (supply of movie tickets, demand for movie tickets, supply of videos, and demand for videos) in four unknowns.

the goods in question are *complements,* a partial equilibrium analysis will *overstate* the impact of a tax. (Think about gasoline and automobiles. A tax on gasoline will cause its price to go up, but this will reduce demand for automobiles, which in turn reduces the demand for gasoline, causing its price to fall somewhat.)

## EXAMPLE 16.1 THE INTERDEPENDENCE OF INTERNATIONAL MARKETS

Because Brazil and the United States compete in the world soybean market, Brazilian regulation of its own soybean market can significantly affect the U.S. soybean market, which in turn can have feedback effects on the Brazilian market. This led to unexpected results when Brazil adopted a regulatory policy aimed at increasing short-run domestic supplies and long-run exports of soybeans.[2]

During the late 1960s and early 1970s, the Brazilian government limited the export of soybeans, causing the price in Brazil to fall. It hoped that making soybeans cheaper in Brazil would encourage the domestic sale of soybeans and stimulate the domestic demand for soybean products. Eventually the export controls were to be removed, and Brazilian exports were expected to increase.

This expectation was based on a partial equilibrium analysis of the Brazilian soybean market. In fact, the reduction in Brazilian exports increased the price and production of soybeans in the United States, as well as U.S. exports. This made it more difficult for Brazil to export soybeans, even after the controls were removed.

Figure 16.2 shows the consequences of the program. The bottom two lines show Brazilian soybean exports, and the top two lines refer to the U.S. In each case, actual exports are shown as a black line, and the estimated levels of U.S. and Brazilian exports *had the Brazilian government regulations not gone into effect* are shown as red and blue lines, respectively. (The lines diverge from approximately 1970 forward because that's when the major export controls were put into effect.) The figure shows that soybean exports from Brazil would have been higher, and exports from the United States lower, without the regulatory program. In 1977, for example, Brazilian soybean exports were 73 percent lowei than they would have been had the government not intervened. However, between 1973 and 1978, U.S. soybean exports were over 30 percent higher than they would otherwise have been.

Thus, Brazilian soybean policy was misguided, and hurt Brazil in the long run. Policymakers failed to take into account the effect of this policy on the U.S. production and export of soybeans.

[2] This example presents a simplified version of the analysis in Gary W Williams and Robert L. Thompson, "Brazilian Soybean Policy: The International Effects of Intervention," *American Journal of Agricultural Economics* 66 (1984): 488-498.

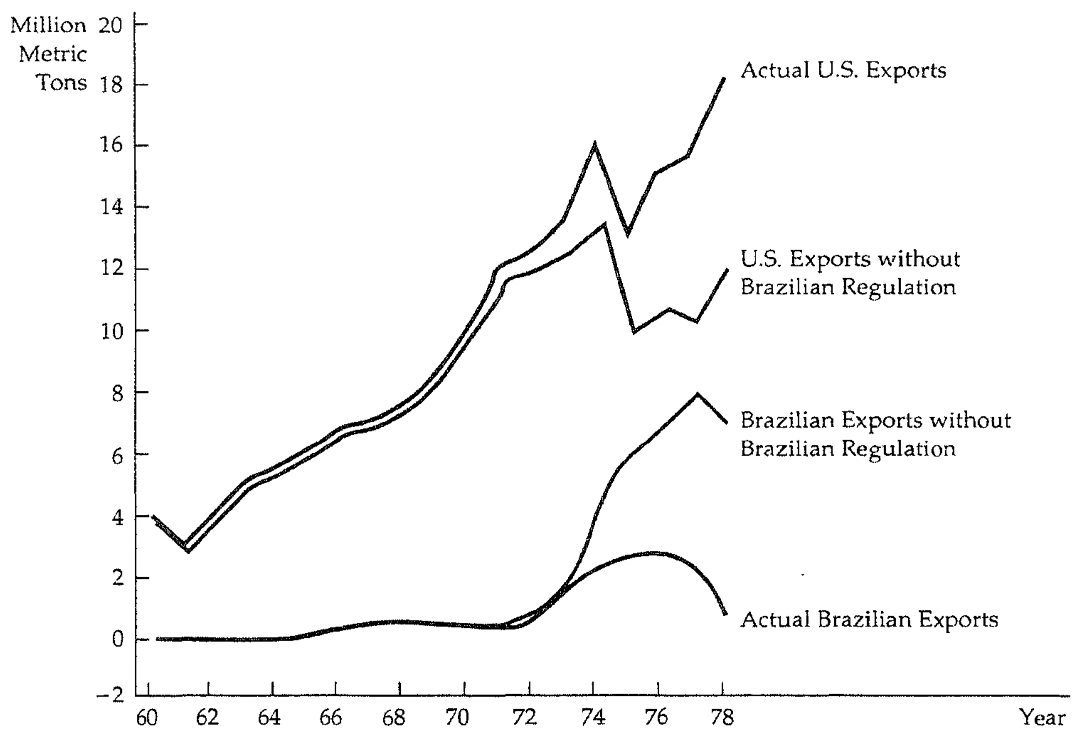


**FIGURE 16.2 Soybean Exports-Brazil and the United States.** World competition in the soybean market makes the Brazilian and U.S. export markets highly interactive. As a result of the general equilibrium nature of these markets, regulations to stimulate Brazil's market were counterproductive in the long run. Brazil's actual exports of soybeans were lower (and U.S. exports higher) than they would have been without the regulatory policy.

## 16.2 *Efficiency in Exchange*

In Chapter 9 we saw that an unregulated competitive market is efficient because it maximizes consumer and producer surplus. To examine the concept of economic efficiency in more detail, we begin with an *exchange economy,* analyzing the behavior of two consumers who can trade either of two goods between themselves. (The analysis also applies to trade between two countries.) Suppose the two goods are initially allocated so that both consumers can make themselves better off by trading with each other. This means that the initial allocation of goods is economically *inefficient. In an efficient allocation of goods,* *no one can be made better off without making someone else worse off.* In the subsections that follow, we show why mutually beneficial trades result in an efficient allocation of goods.

## The Advantages of Trade

As a rule, voluntary trade between two people or two countries is mutually beneficial.[3] To see how trade makes people better off, lets look at a two-person exchange in detail. Our analysis is based on two important assumptions:

1. Both people know each other's preferences.
2. Exchanging goods involves zero *transaction costs.*

Suppose James and Karen have 10 units of food and 6 units of clothing between them. Table 16.1 shows that initially James has 7 units of food and 1 unit of clothing, and Karen has 3 units of food and 5 units of clothing. To decide whether a trade between James and Karen would be advantageous, we need to know their preferences for food and clothing. Suppose that because Karen has a lot of clothing and little food, her marginal rate of substitution (MRS) of food for clothing is 3. (To get 1 unit of food, she will give up 3 units of clothing.) However, James's MRS of food for clothing is only ½. (He will give up only ½ a unit of clothing to get 1 unit of food.)

There is thus room for mutually advantageous trade because James values clothing more highly than Karen does, whereas Karen values food more highly than James does. To get another unit of food, Karen would be willing to trade up to 3 units of clothing. But James will give up 1 unit of food for ½ unit of clothing. The actual terms of the trade depend on the bargaining process. Among the possible outcomes are a trade of 1 unit of food (by James) for anywhere between ½ and 3 units of clothing (from Karen).

Suppose Karen offers James 1 unit of clothing for 1 unit of food, and James agrees. Both will be better off. James will have more clothing, which he values

**TABLE 16.1** The Advantage of Trade

| Individual | Initial Allocation | Trade | Final Allocation |
|---|---|---|---|
| James | 7F, 1C | −1F, +1C | 6F, 2C |
| Karen | 3F, 5C | +1F, −1C | 4F, 4C |

[3] There are several situations in which trade may not be advantageous. First, limited information may lead people to believe that trade will make them better off when in fact it will not. Second, people may be coerced into making trades, either by physical threats or by the threat of future economic reprisals. Third, as we saw in Chapter 13, barriers to free trade can sometimes provide a strategic advantage to a country.

more than food, and Karen will have more food, which she values more than clothing. Whenever two consumers' MRSs are different, there is room for mutually beneficial trade because the allocation of resources is inefficient-trading will make both consumers better off. Conversely, to achieve economic efficiency, the two consumers' MRSs must be equal.

This important result also holds when there are many goods and consumers: *An allocation of goods is efficient only if the goods are distributed so that the marginal rate of substitution between any two pairs of goods is the same for all consumers.*

## The Edgeworth Box Diagram

If trade is beneficial, which trades can occur? Which of those trades will allocate goods efficiently among customers, and how much better off will consumers then be? We can answer these questions for any two-person, two-good example by using a diagram called an Edgeworth box.[4]

Figure 16.3 shows an Edgeworth box in which the horizontal axis describes the number of units of food, and the vertical axis the units of clothing. The length of the box is 10 units of food, the total quantity of food available, and its height is 6 units of clothing, the total quantity of clothing available.

In the Edgeworth box each point describes the market baskets of *both* consumers. James's holdings are read from the origin at $O_J$, and Karen's holdings are read in reverse direction from the origin at $O_K$. For example, point *A* represents the initial allocation of food and clothing. Reading on the horizontal axis from left to right at the bottom of the box, we see that James has 7 units of food, and reading upward along the vertical axis on the left of the diagram, 1 unit of clothing. Thus, for James, A represents 7F and 1C. This leaves 3F and 5C for Karen. Karen's allocation of food (3F) is read from right to left at the top of the box diagram beginning at $O_K$, and her allocation of clothing (5C) from top to bottom at the right-of the box diagram.

We can also see the effect of the trade between Karen and James. James gives up IF in exchange for 1C, moving from *A* to *B*. Karen gives up 1C and obtains IF, also moving from *A* to *B*. Point *B* thus represents the market baskets of both James and Karen after the mutually beneficial trade.

## Efficient Allocations

A trade from *A* to *B* thus made both Karen and James better off. But is *B* an efficient allocation? The answer depends on whether James's and Karen's MRSs are the same at *B*, which in turn depends on the shape of their indif-

[4] The Edgeworth Box is named after political economist F.Y. Edgeworth, who suggested its use in his 1881 book *Mathematical Psychics: An Essay on the Application ofMathematics to the Moral Sciences* (New York: August M. Kelley, 1953).

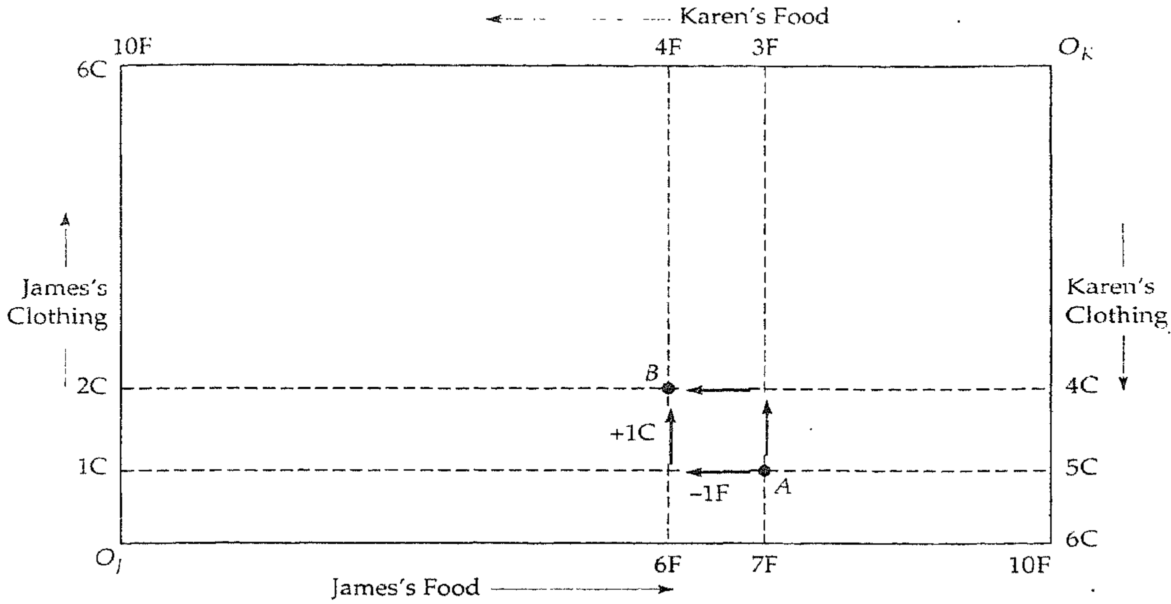


**FIGURE 16.3 Exchange in an Edgeworth Box.** Each point in the Edgeworth box simultaneously represents James's and Karen's market baskets of food and clothing. At *A*, for example, James has 7 units of food and 1 unit of clothing, and Karen has 3 units of food and 5 units of clothing.

ference curves. Figure 16.4 shows several indifference curves for both James and Karen. James's indifference curves are drawn in the usual way, because his allocations are measured from the origin $O_J$. But for Karen, we have rotated the indifference curves 180 degrees, so that the origin is at the upper right-hand corner of the box. Karen's indifference curves are convex, just like James's-we simply see them from a different perspective.

Now that we are familiar with the two sets of indifference curves, let's examine the curves labeled $U_J^1$ and $U_K^1$ that pass through the initial allocation at *A*. Both James's and Karen's MRSs give the slope of their indifference curves at A. James's is equal to ½, Karen's to 3. The shaded area between these two indifference curves represents all possible allocations of food and clothing that would make both James and Karen better off than at A. In other words, it describes all possible mutually beneficial trades.

Starting at *A*, any trade that moved the allocation of goods outside the shaded area would make one of the two consumers worse off, and should not occur. We saw that the move from *A* to *B* was mutually beneficial. But in Figure 16.4, *B* is not an efficient point because indifference curves $U_J^2$ and $U_K^2$ intersect.This means that James's and Karen's MRSs are not the same, and that the allocation is not efficient. This illustrates an important point: *Even if a trade from an inefficient allocation makes both people better off, the new allocation is not necessarily efficient.*

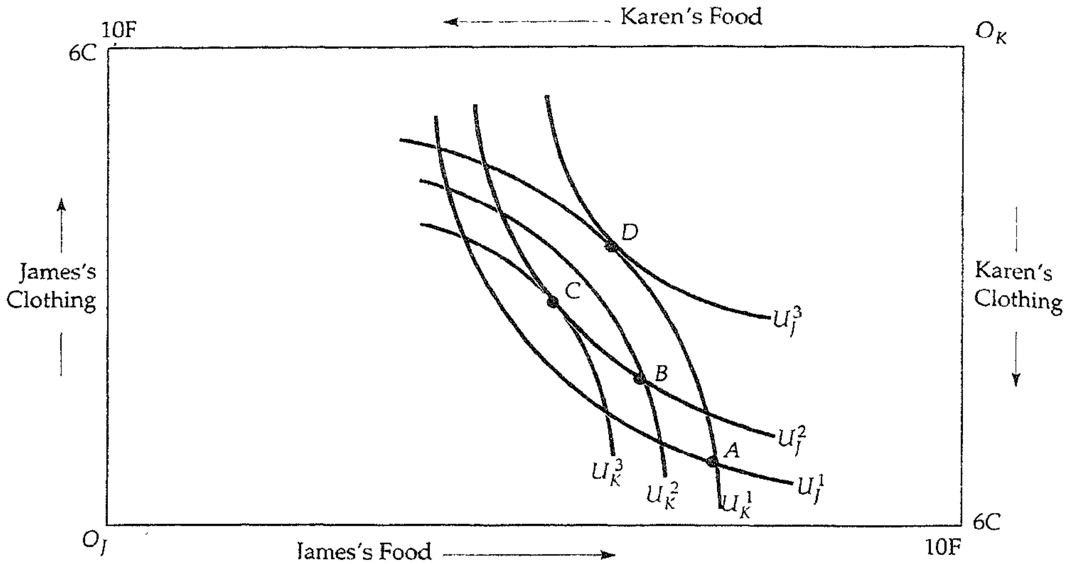


**FIGURE 16.4 Efficiency in Exchange.** The Edgeworth box illustrates the possibilities for each consumer to increase his or her satisfaction by trading goods. If $A$ gives the initial allocation of resources, the tan-shaded area describes all mutually beneficial trades.

Suppose that from $B$ an additional trade is made, with James giving up another unit of food to obtain another unit of clothing and Karen giving up a unit of clothing for a unit of food. Point $C$ in Figure 16.4 gives the new allocation. At $C$, the MRSs of both people are identical, which is why the indifference curves are tangent there. When the indifference curves are tangent, the MRSs are the same, so that one person cannot be made better off without making the other person worse off. As a result, $C$ represents an efficient allocation.

Of course, $C$ is not the only possible efficient outcome of a bargain between James and Karen. For example, if James is an effective bargainer, a trade might change the allocation of goods from $A$ to $D$, where indifference curve $U_J^3$ is tangent to indifference curve $U_K^1$. This would leave Karen no worse off than she was at $A$ and James much better off. And because no further trade is possible, $D$ is an efficient allocation. Thus $C$ and $D$ are both efficient allocations, although James prefers $D$ to $C$, and Karen prefers $C$ to $D$. In general, it is difficult to predict the allocation that will be reached in a bargain because it depends on the bargaining ability of the people involved.

## The Contract Curve

We have seen that from an initial allocation many possible efficient allocations can be reached through mutually beneficial trade. To find *all possible efficient allocations of food and clothing between Karen* and James, we would look for all

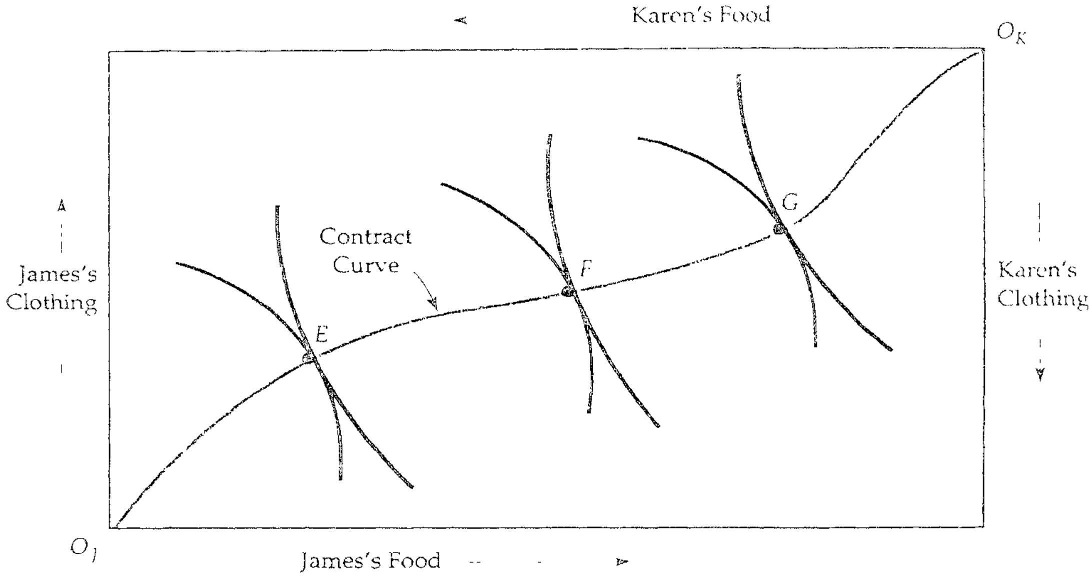


**FIGURE 16.5 The Contract Curve.** The contract curve contains all allocations for which consumers' indifference curves are tangent. Every point on the curve is efficient because one person cannot be made better off without making the other person worse off.

[redacted]
points of tangency between each of their indifference curves. Figure 16.5 shows the curve drawn through all such efficient allocations; it is called the *contract curve.*

The contract curve shows all allocations from which no mutually beneficial trade can be made. These allocations are sometimes called *Pareto efficient* allocations, after Italian economist Vilfredo Pareto (1848-1923), who developed the concept of efficiency in exchange: *An allocation is Pareto efficient if goods cannot be reallocated to make someone better off without making someone else worse off.* In Figure 16.5 three allocations labeled *E, F,* and *G* are Pareto efficient, although each involves a different distribution of food and clothing, because one person could not be made better off without making someone else worse off.

Several properties of the contract curve may help us understand the concept of efficiency in exchange. Once a point on a contract curve, such as £, has been chosen, there is no way to move to another point on the contract-curve, say *F*, without making one person worse off (in this case, Karen). Without making further comparison between James's and Karen's preferences, we cannot compare allocations *E* and F-we simply know that both are efficient. In this sense Pareto efficiency is a modest goal: It says that we should make all mutually beneficial exchanges, but it does not say which exchanges are best. Pareto. efficiency can be a powerful concept, however. If a change would improve efficiency, it is in *everyone's* self-interest to support it.

[redacted]

We can frequently improve efficiency even when one aspect of a proposed change makes someone worse off. We need only include a second change, so that the *combined* set of changes leaves someone better off and no one worse off than before. Suppose, for example, that we propose to eliminate a quota on automobile imports into the United States. U.S. consumers would then enjoy lower prices and a greater selection of cars, but some U.S. auto workers would lose their jobs. But if eliminating the quota were combined with federal tax breaks and job relocation subsidies for auto workers, so that U.S. consumers would be better off (after accounting for the cost of the job subsidies) and U.S. auto workers no worse off, the result would increase efficiency.

## Consumer Equilibrium in a Competitive Market

In a two-person exchange, the outcome can depend on the bargaining power of the two parties. However, competitive markets have many buyers and sellers, so if people do not like the terms of an exchange, they can look for another seller who offers better terms. As a result, each buyer and seller takes the price of the goods as fixed and decides how much to buy and sell at those prices. We can show how competitive markets lead to efficient exchange by using the Edgeworth box to mimic a competitive market. Suppose, for example, that there are many Jameses and many Karens. This allows us to think of each individual James and Karen as a price taker, even though we are working with only a two-person box diagram.

Figure 16.6 shows the opportunities for trade when we start at the allocation given by point *A*, and when the prices of both food and clothing are equal to 1. (The actual prices don't matter; what matters is the price of food relative to the price of clothing.) When the prices of food and clothing are equal, each unit of food can be exchanged for one unit of clothing. As a result, the price line *PP'* in the diagram, which has a slope of -1, describes all possible allocations that exchange can achieve.

Suppose each James decides to buy 2 units of clothing and sell 2 units of food in exchange. This would move each from *A* to *C* and increase satisfaction from indifference curve $U_J^1$ to $U_J^2$. Meanwhile, each Karen buys 2 units of food and sells 2 units of clothing. This would move each from A to C as well increasing satisfaction from indifference curve $U_K^1$ to $U_K^2$.

We choose prices for the two goods so that the quantity of food demanded by each Karen is equal to the quantity of food that each James wishes to sell, and the quantity of clothing demanded by each James is equal to the quantity of food that each Karen wishes to sell. As a result, the markets for food and clothing are in equilibrium. An *equilibrium is a set of prices at which the quantity demanded equals the quantity supplied in every market.* This is also a *competitive equilibrium* because allsuppliers and demanders are price takers.

Not all prices are consistent with an equilibrium. For example, if the price of food is 1 and the price of clothing is 3, food must be exchanged for clothing on a 3-to-1 basis. But then each James will be unwilling to trade any food to get additional clothing because his MRS of clothing for food is only ½. Each

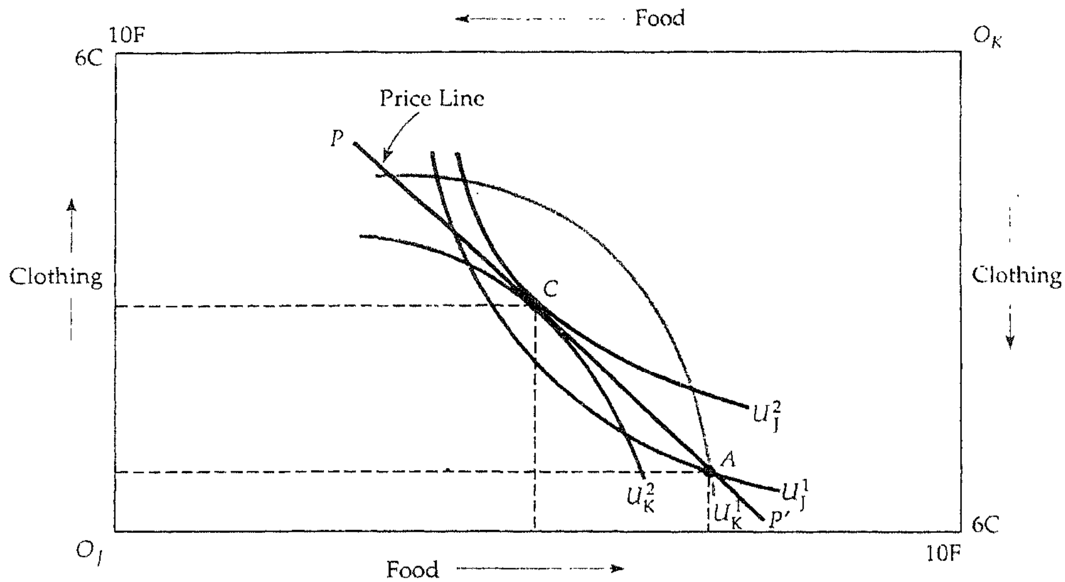


**FIGURE 16.6 Competitive Equilibrium.** In a competitive market the prices of the two goods determine the terms of exchange among consumers. If *A* is the initial allocation of goods, and the price line *PP'* represents the ratio of prices, the competitive market will lead to an equilibrium at *C*, the point of tangency of both indifference curves. As a result, the competitive equilibrium is efficient.

Karen, on the other hand, would be happy to sell clothing to get more food, but has no one to trade with. The market is therefore in *disequilibrium* because the quantity demanded is not equal to the quantity supplied.

This disequilibrium should only be temporary. In a competitive market, prices will adjust if there is *excess demand* in some markets (the quantity demanded of one good is greater than the quantity supplied) and *excess supply* in others (the quantity supplied is greater than the quantity demanded). In our example, each Karen's demand for food is greater than each James's willingness to sell it, whereas each Karen's willingness to trade clothing is greater than each James's demand for it. As a result of this excess demand for food and excess supply of clothing, we would expect the price of food to increase relative to the price of clothing. And as the price changed, so would the demands of all those in the market. Eventually, the prices would adjust until an equilibrium was reached. In our example, the price of both food and clothing might be 2; we know from the previous analysis that when the price of clothing is equal to the price of food, the market will be in competitive equilibrium. (Recall that only relative prices matter; prices of 2 for clothing and food are equivalent to prices of 1 for each.)

Note the important difference between exchange with two people and an economy with many people. When only two people are involved, bargaining leaves an indeterminate outcome. However, when many people are involved, the prices of the goods are determined by the combined choices of demanders and suppliers of goods.

We can see from point *C* in Figure 16.6 that *the allocation in a competitive equilibrium is efficient.* Point *C* must occur at the tangency of two indifference curves. If it did not, one of the people would not be maximizing his satisfaction. This result holds both in an exchange framework and in a general equilibrium setting in which all markets are perfectly competitive. It is the most direct way of illustrating how Adam Smith's *invisible hand* works. According to this *first theorem of welfare economics, if everyone trades in the marketplace, and all mutually beneficial trades are completed, the resulting equilibrium allocation will be economically efficient*[5]

Let's summarize what we know about a competitive equilibrium from the consumer's perspective. First, because the indifference curves are tangent, all marginal rates of substitution between consumers are equal. Second, because each indifference curve is tangent to the price line, each person's MRS of clothing for food is equal to the ratio of the prices of the two goods. Formally, if $P_C$ and $P_F$ are the two prices

$$\boxed{\text{MRS}^J_{FC} = P_C/P_F = \text{MRS}^K_{FC}} \quad (16.1)$$

To achieve an efficient allocation when there are many consumers (and many producers) is not easy. It can be done if all markets are perfectly competitive. But efficient outcomes can also be achieved by other means-for example, through a centralized system in which the government allocates all goods and services. The competitive solution is often preferred because it allocates resources with a minimum of information. All consumers must know their own preferences and the prices they face, but consumers do not need to know what is being produced, or the demands of other consumers. Other allocation methods need more information, and as a result they become difficult and cumbersome to manage.

## 16.3 *Equity and Efficiency*

We have shown that different efficient allocations of goods are possible, and we have seen how a perfectly competitive economy generates an efficient allocation. But are efficient allocations equitable? Unfortunately, economists and others disagree both about how to define equity and how to quantify it. Any such view would involve subjective comparisons of utility, and reasonable

[5] The *second theorem of welfare economics* states that if individual preferences are convex, then every efficient allocation (every point on the contract curve) is a competitive equilibrium for some initial allocation of goods.

people could disagree about how to make these comparisons. In this section we discuss this general point and then illustrate it in a particular case by showing that there is no reason to believe that the allocation associated with a competitive equilibrium will be equitable.

## The Utility Possibilities Frontier

Recall that every point on the contract curve in our two-person exchange economy shows the levels of utility that James and Karen can achieve. In Figure 16.7 we put the information from the Edgeworth box in a different form. James's utility is measured on the horizontal axis and Karen's on the vertical axis. Any point in the Edgeworth box corresponds to a point in Figure 16.7 because every allocation generates utility for both people. Every movement to the right in Figure 16.7 represents an increase in James's utility, and every upward movement an increase in Karen's.

The *utility possibilities frontier represents all allocations that are efficient.* Point 0; is one extreme in which James has no goods and therefore zero utility, while point OK is the opposite extreme where Karen has no goods. All other points on the frontier, such as *E, F*, and *G*, correspond to points on the contract curve, so that one person cannot be made better off without making the other worse off. Point *H*, however, represents an inefficient allocation because any trade within the tan-shaded area makes one or both parties better off. At *L* both people

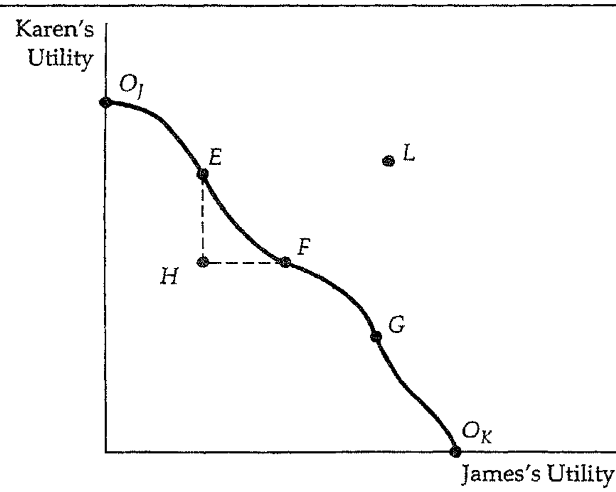


**FIGURE 16.7 Utility Possibilities Frontier.** The utility possibilities frontier shows the levels of satisfaction that each of two people achieve when they have traded to an efficient outcome on the contract curve. Points *E, F*, and *G* correspond to points on the contract curve and are efficient. Point *H* is inefficient because any trade within the tan-shaded area will make one or both people better off.

would be better off, but *L* is not attainable because there is not enough of both goods to generate the levels of utility that the point represents.

It might seem reasonable to conclude that an allocation must be efficient to be equitable. Compare point *H* with *F* and £. Both *F* and *E* are efficient, and (relative to *H)* each makes one person better off without making the other worse off. We might agree, therefore, that it is inequitable to James or Karen or both for an economy to yield allocation H, as opposed to *F* or *E*.

But suppose *H* and *G* are the only possible allocations. Is *G* more equitable than *H*? Not necessarily Compared with *H, G* yields more utility for James and less for Karen. Some people may feel that *H* is more equitable than *G*; others may feel the opposite. We can conclude, therefore, that *one inefficient allocation of resources may be more equitable than another efficient allocation.*

The problem is how to define an equitable allocation. Even if we restrict ourselves to all points on the utility possibilities frontier, which point is the most equitable? *The answer depends on what one thinks equity entails,* and, therefore, on the interpersonal comparisons of utility that one is willing to make.

In economics, we often use a *social welfare function* to describe the particular weights that are applied to each individual's utility in determining what is socially desirable. One social welfare function, the *utilitarian,* weights everyone's utility equally and consequently maximizes the total utility of all members of society.[6] Each social welfare function can be associated with a particular view about equity. But some views do not explicitly weight individual utilities and cannot therefore be represented by a social welfare function. For example, a market-oriented view argues that the outcome of the competitive market process is equitable because it rewards those who are most able and who work the hardest.[7] If *E* is the competitive equilibrium allocation, for example, *E* would be deemed to be more equitable than *F*, even though the goods are less equally allocated.

When more than two people are involved, the meaning of the word equity becomes even more complex. The *Rawlsian* view[8] emphasizes that an equal distribution of resources may remove the incentive that most productive people have to work hard (because the wealth they achieve will be taxed away). This view allows inequalities, if these inequalities make the least-well-off person in society better off. According to Rawls, *the most equitable allocation maximizes the utility of the least-well-off person in society.* The Rawlsian perspective could be *egalitarian,* involving an equal allocation of goods among all members of society, but it need not be. Suppose that by rewarding more productive people more highly than less productive people, we can get the most productive people to work harder. This could produce more goods and services, some of which could then be reallocated to make the poorest members of society better off.

The four views of equity in Table 16.2 move roughly from most to least egalitarian. The egalitarian view explicitly requires equal allocations, while the

[6] One of the important developers of utilitarian thought was Jeremy Bentham (1748-1832). See *An Introduction to the Principle of Morals and Legislation* (London: Oxford University Press, 1907).

[7] See Robert Nozick, *Anarchy, State, and Utopia* (New York: Basic Books, 1974).

[8] See John Rawls, A *Theory of Justice* (New York: Oxford University Press, 1971).

**TABLE 16.2** Four Views of Equity

1. Egalitarian-all members of society receive equal amounts of goods
2. Rawlsian-maximize the utility of the least-well-off person
3. Utilitarian-maximize the total utility of all members of society
4. Market-oriented-the market outcome is the most equitable

Rawlsian puts a heavy weight on equality (otherwise some would be much worse off than others). The utilitarian is likely to require some difference between the best- and worst-off members of society. Finally, the market-oriented view may lead to substantial inequality in the allocations of goods and services.

### Equity and Perfect Competition

A competitive equilibrium leads to a Pareto efficient outcome that may or may not be equitable. In fact, a competitive equilibrium could occur at any point on the contract curve, depending on the initial allocation. Imagine, for example, that the initial allocation gave all food and clothing to Karen. This would be at $O_J$ in Figure 16.7, and Karen would have no reason to trade. Point $O_J$ would then be a competitive equilibrium, as would point $O_K$ and all intermediate points on the contract curve.

Because efficient allocations are not necessarily equitable, society must rely to some extent on government to redistribute income or goods among households to achieve equity goals. These goals can be reached through the tax system-a progressive income tax redistributes income from the wealthy to the poor, for example. The government can also provide public services, such as medical aid to the poor (Medicare), or it can transfer funds through programs such as Food Stamps.

Unfortunately, all programs that redistribute income in our society are costly. Taxes may encourage individuals to work less or cause firms to devote resources to avoiding taxes rather than to producing output. So as a practical matter, there is a trade-off between the goals of equity and efficiency.[9]

## 16.4 *Efficiency in Production*

Having described the conditions required to achieve an efficient allocation in the exchange of two goods, we now consider the efficient use of inputs in the production process. We assume there are fixed total supplies of two inputs,

[9] This tradeoff between equity and efficiency is stated clearly by Arthur Okun in *Equality and Efficiency: The Big Tradeoff* (Washington, D.C: The Brookings Institution, 1975).

labor and capital, that are needed to produce the same two products, food and clothing. Instead of only two people, however, we now assume that many consumers own the inputs to production (including labor) and earn income by selling them. This income, in turn, is allocated between the two goods.

This framework links together the various supply and demand elements of the economy. People supply inputs to production and then use the income this brings to demand and consume goods and services. When the price of one input increases, the individuals who supply a lot of that input earn more income and consume more of one of the two goods. This in turn increases the demand for the inputs needed to produce the good and has a feedback effect on the price of those inputs. Only a general equilibrium analysis can find the prices that equate supply and demand in every market.

## Production in the Edgeworth Box

We will continue to use the Edgeworth box diagram, but rather than measure goods on each axis as we did before, we will now measure inputs to the production process. Figure 16.8 shows a box diagram in which labor input is measured, along the horizontal axis, and capital input on the vertical axis. Fifty hours of labor and thirty hours of capital are available for the production process. In our earlier analysis of exchange, each origin represented an individual; now each origin represents an output. The food origin is $O_F$, and $O_C$ is the clothing origin. The only difference between the production analysis and the exchange analysis is that now we measure inputs rather than outputs in the diagram, and we focus on two outputs rather than two consumers.

Each point in the diagram represents the labor and capital inputs to the production of food and clothing. For example, *A* represents the input of 35 hours of labor and 5 hours of capital in the production of food,and the input of 15 hours of labor and 25 hours of capital in the production of clothing. Every way in which labor and capital can be combined to produce the two goods is represented by a point in the diagram.

A series of production isoquants shows the levels of output produced with the various input combinations. Each isoquant represents the total production of a good that can be obtained, without distinguishing the firm or firms that produced it. We have drawn three food isoquants representing 50, 60, and 80 units of food output. The isoquants for food look just like the isoquants we worked with in Chapter 6, but we have rotated the clothing isoquants by 180 degrees, so that they can be read from the point of view of the origin $O_C$. For example, the isoquant 50F represents all combinations of labor and capital that combine to produce 50 units of food, while 25C represents all combinations of labor and capital that combine to produce 25 units of clothing.

We have also drawn three isoquants representing 10, 25, and 30 units of clothing. These isoquants increase in output as we move from upper right to lower left, again because one or both inputs have increased. Now we can see

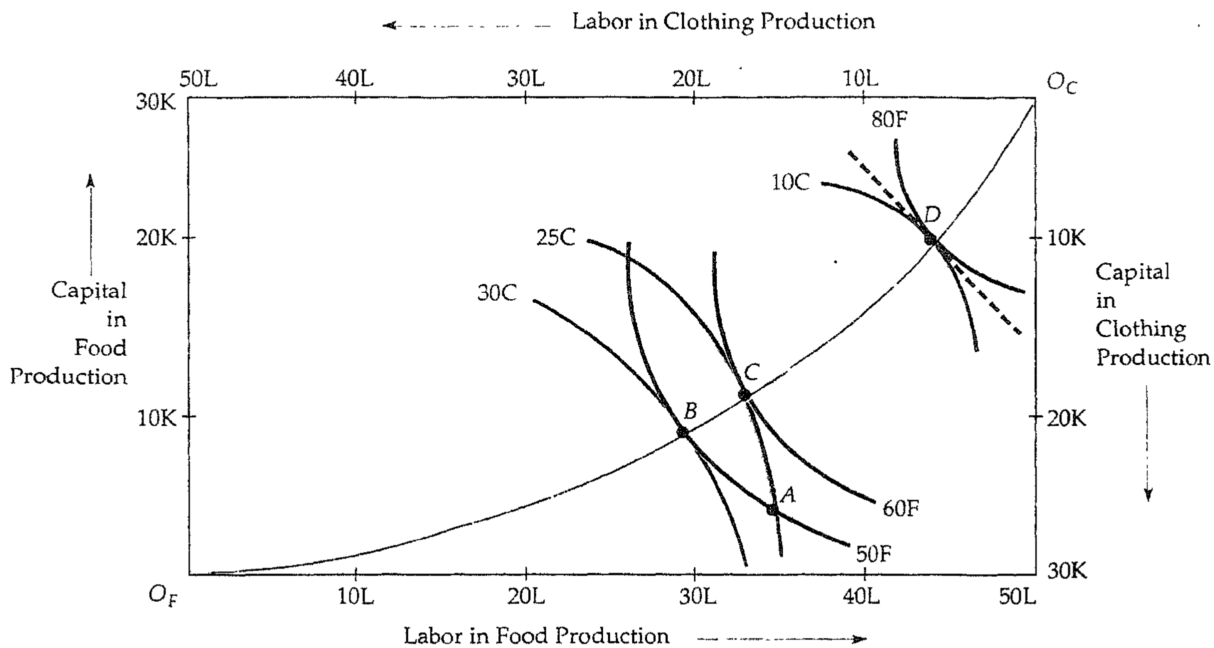


**FIGURE 16.8 Efficiency in Production.** In an Edgeworth production box with two fixed inputs and two goods, an efficient use of inputs occurs when the isoquants for the two goods are tangent. If production initially uses the inputs described by *A*, the tan-shaded area shows the region in which more of both outputs can be produced by re-arranging input use. Points *B*, *C*, and *D* are on the production contract curve and involve efficient input use.

that A simultaneously represents 50 units of food and 25 units of clothing, each associated with a different combination of production inputs.

## Input Efficiency

To see how inputs can be combined efficiently, we must find the various combinations of inputs that can be used to produce each of the two outputs. A particular allocation of inputs into the production process is *technically efficient* if the output of one good cannot be increased without decreasing the output of another good. Efficiency in production is not a new concept; in Chapter 6 we saw that a production function represents the maximum output that can be achieved with a given set of inputs. Here we are extending the concept to the production of two goods rather than one.

Figure 16.8 shows that inputs are allocated inefficiently if reallocating them generates more of one or both goods. The allocation at *A* is clearly inefficient because any input combination in the tan-shaded area generates more of both food and clothing. For example, we can move from *A* to *B* by switching some labor from the production of food to the production of clothing, and some capital from the production of clothing to the production of food. This generates the same amount of food (50 units), but a larger amount of clothing (from 25 to 30 units).

Points *B* and *C* in Figure 16.8 are both efficient allocations, as are all points lying on the curve that connects $O_F$ to $O_C$. Each of these points is a point of tangency of two isoquants, just as every point on the exchange contract curve represents a point of tangency of two indifference curves. The *production contract curve* represents all technically efficient combinations of inputs. Every point that does not lie on this production contract curve is inefficient because the two isoquants that pass through the point intersect. When two isoquants intersect, as at point *A*, labor and capital can be reallocated to increase the output of at least one of the two goods. From *A*, we have seen that any allocation within the shaded area increases the production of both goods-so *A* is technically inefficient.

## Producer Equilibrium in a Competitive Input Market

If input markets are competitive, a point of efficient production will be achieved. Let's see why. If the labor and capital markets are perfectly competitive, then the wage rate *w* will be the same in all industries. Likewise, the rental price of capital *r* will be the same whether capital is used in the food or clothing industry. We know from Chapter 7 that if producers of food and clothing minimize production costs, they will use combinations of labor and capital so that the ratio of the marginal products of the two inputs is equal to the ratio of the input prices:

$$MP_L/MP_K = w/r$$

But we also showed that the ratio of the marginal products of the two inputs is equal to the marginal rate of technical substitution of labor for capital $MRTS_{LK}$. As a result,

$$MRTS_{LK} = w/r \qquad (16.2)$$

Since the MRTS is the slope of the firm's isoquant, for a competitive equilibrium to occur in the input market, each producer must use labor and capital so that the slopes of the isoquants are equal to one another and to the ratio of the prices of the two inputs. As a result, *the competitive equilibrium lies on the production contract curve, and the competitive equilibrium is efficient in production.*

Where we end up on the production contract curve depends on consumers' demands for the two goods. For example, suppose consumers demand much more food than clothing. One possible competitive equilibrium occurs at *D* in Figure 16.8. Here, the food producer minimizes the cost of producing 80 units of food by employing 43 units of labor and 20 units of capital. The clothing producer generates 10 units of clothing with 7 units of labor and 10 units of capital. The wage rate is equal to the rental price of capital, so the isocost lines have a slope of -1 in the diagram. At these prices neither producer will wish to purchase additional production inputs.

It is easy to check that if we begin at a point off the contract curve, both producers will find it advantageous to hire labor or rent capital so that they can reallocate their inputs to minimize costs. It is also clear from the diagram in Figure 16.8 that the input market has no unique competitive equilibrium. Efficiency in the use of inputs can involve the production of much food and little clothing, or vice versa.

## The Production Possibilities Frontier

The *production possibilities frontier* shows the various combinations of food and clothing that can be produced with fixed inputs of labor and capital. The frontier in Figure 16.9 is derived from the production contract curve in Figure 16.8. Each point on both the contract curve and the production possibilities frontier describes an efficiently produced level of both food and clothing.

We have labeled the points on the frontier to correspond to the points on the production contract curve. Point $O_F$ represents one extreme, in which only clothing is produced, and $O_C$ represents the other extreme, in which only food is produced. Points *B*, *C*, and *D* are the three other labeled points from the contract curve of Figure 16.8.

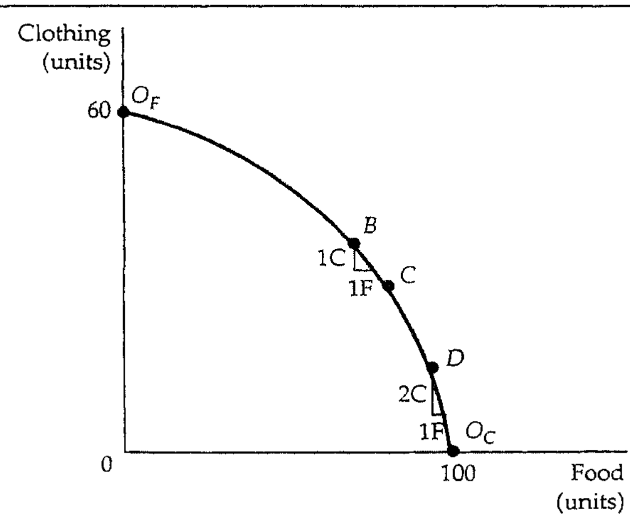


**FIGURE 16.9 Production Possibilities Frontier.** The production possibilities frontier shows all efficient combinations of outputs. Points *B*, *C*, and *D* are taken from comparable points on the production contract curve. The production possibilities frontier is concave because its slope (the marginal rate of transformation) increases as the level of production of food increases.

The production possibilities frontier is downward sloping because to produce more food efficiently,one must switch inputs from the production of clothing, which in turn lowers the clothing production level. Because all points lying within the frontier are inefficient, they are off the production contract curve.

The production possibilities frontier is concave (bowed in); i.e., its slope increases in magnitude as more food is produced. To describe this, we define *the marginal rate of transformation of food for clothing* (MRT) as the magnitude of the slope of the frontier at each point. The MRT measures how much clothing must be given up to produce one additional unit of food. For example, at *B* on the frontier, the MRT is 1 because 1 unit of clothing must be given up to obtain one additional unit of food. At *D*, however, the MRT is 2 because 2 units of clothing must be given up to obtain one more unit of food.

Note that as we increase the production of food by moving along the production possibilities frontier, the MRT increases.[10] This happens because the productivity of labor and capital differs depending on whether the inputs are used to produce more food or clothing. Suppose we begin at $O_F$, where only clothing is produced. Now we remove some labor and capital from clothing production, where their marginal products are relatively low, and put them into food production, where their marginal products are high. Then, to obtain the first unit of food, very little clothing production is lost (the MRT is much less than 1). But as we move along the frontier and produce less clothing, the productivities of labor and capital in clothing production rise and the productivities of labor and capital in food production fall. At *B*, the productivities are equal, and the MRT is 1. Continuing along the frontier, we note that the input productivities in clothing rise more, and the productivities in food decrease, so the MRT becomes greater than 1.

We could also have described the shape of the production possibilities frontier in terms of the costs of production. At $O_F$, where very little clothing output is lost to produce additional food, the marginal cost of producing food is very low (a lot of output is produced with very little input), and the marginal cost of producing clothing is very high (it takes a lot of both inputs to produce another unit of clothing). Thus, when the MRT is low, so is the ratio of the marginal cost of producing food $MC_F$ to the marginal cost of producing clothing $MC_C$.In fact, *the slope of the production possibilities frontier measures the marginal cost of producing one good relative to the marginal cost of producing the other.* The curvature of the production possibilities frontier follows directly from the fact that the marginal cost of producing food relative to the marginal cost of producing clothing is increasing. At every point along the frontier, the following condition holds:

$$MRT = MC_F / MC_C \qquad (16.3)$$

[10]The production possibilities frontier need not have a continually increasing MRT Suppose, for example, that there were strongly decreasing returns to scale in the production of food. Then as inputs were moved from clothing to food production the amount of clothing that must be given up to obtain one more unit of food would decline.

At *B*, for example, the MRT is equal to 1. Here, when inputs are switched from clothing to food production, one unit of output is lost and one is gained. If the input cost of producing one unit of either good is $100, the ratio of the marginal costs would be $100/$100, or 1. Equation (16.3) also holds at *D* (and at every other point on the frontier). Suppose the inputs needed to produce 1 unit of food cost $160. Then, the marginal cost of food would be $160, but the marginal cost of clothing would be only $80 ($160/2 units of clothing). As a result the ratio of the marginal costs, 2, is equal to the MRT.

## Output Efficiency

For an economy to be efficient, goods must not only be produced at minimum cost, *goods must also be produced in combinations that match people's willingness to pay for them.* To understand this, recall from Chapter 3 that the marginal rate of substitution of clothing for food (MRS) measures the consumer's willingness to pay for an additional unit of food by consuming less clothing. But the marginal rate of transformation measures the cost of an additional unit of food in terms of producing less clothing. An economy produces output efficiently only if, for each consumer,

$$\text{MRS} = \text{MRT} \tag{16.4}$$

To see why this condition is necessary for efficiency, suppose the MRT equals 1, but the MRS equals 2. Then consumers are willing to, give up 2 units of clothing to get 1 unit of food, but the cost of getting the additional food is only 1 unit of lost clothing. Clearly, too little food is being produced. To achieve efficiency, food production must be increased, so that the MRS falls and the MRT increases until the two are equal. The outcome is efficient only when MRS = MRT for all pairs of goods.

Figure 16.10 shows this important efficiency condition graphically. Here, we have superimposed one consumer's indifference curves on the production possibilities frontier from Figure 16.9. Note that *C* is the only point on the production possibilities frontier that maximizes the consumer's satisfaction. Although all points on the production frontier are technically efficient, they do not all involve the most efficient production of goods from the consumer's perspective. At the point of tangency of the indifference curve and the production frontier, the MRS (the slope of the indifference curve) and the MRT (the slope of the production frontier) are equal.

If you were a planner in charge of managing an economy, you would face a difficult problem. To achieve efficiency you must equate the marginal rate of transformation with the marginal rate of substitution of the consumer. But if different consumers have different preferences for food and clothing, how can you decide what levels of food and clothing to produce and what amount of each to give to every consumer, so that all consumers have the same MRS? The informational and logistical costs of doing this are enormous. (That is one reason why centrally planned economies, like that of the former Soviet Union,

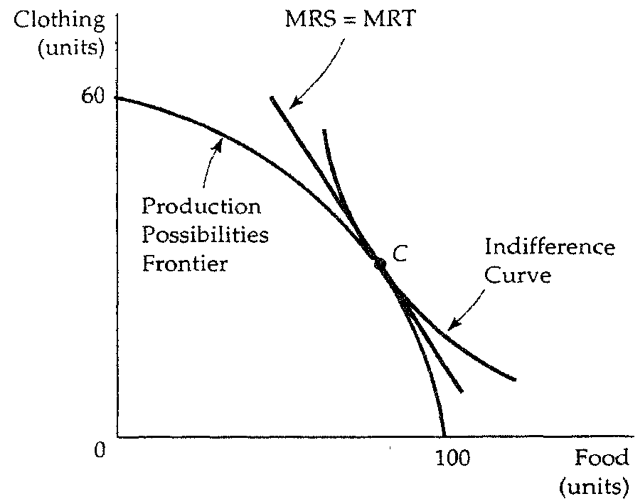


**FIGURE 16.10 Output Efficiency.** The efficient combination of outputs is produced when the marginal rate of transformation between the two goods (which measures the cost of producing one good relative to-the other) is equal to the consumer's marginal rate of substitution (which measures the marginal benefit of consuming one good relative to the other).

performed so poorly.) Fortunately, a well-functioning competitive market system can achieve the same efficient outcome at relatively low cost.

## Efficiency in Output Markets

When output markets are perfectly competitive, all consumers allocate their budgets so their marginal rates of substitution between two goods are equal to the price ratio. For our two goods, food and clothing,

$$MRS = P_F/P_C$$

At the same time, each profit-maximizing firm will produce its output up to the point at which price is equal to marginal cost. Again, for our two goods,

$$P_F = MC_F \text{ and } P_C = MC_C$$

Because the marginal rate of transformation is equal to the ratio of the marginal costs of production, it follows that

$$MRT = MC_F/MC_C = P_F/P_C = MRS \qquad (16.5)$$

When output and input markets are competitive, production will be efficient in that the MRT is equal to the MRS. This condition is just another version of the marginal benefit-marginal cost rule discussed in Chapter 4. There we saw that consumers buy additional units of a good to the point at which the marginal benefit of consumption is equal to the marginal cost. Here the production of food and clothing is chosen so that the marginal benefit of consuming another unit of food is equal to the marginal cost of producing food, and the same is true for the consumption and production of clothing.

Figure 16.11 shows that efficient competitive output markets are achieved when production and consumption choices are separated. Suppose the market generates a price ratio of $P_F^1/P_C^1$. If producers are using inputs efficiently, they will produce food and clothing at *A*, where the price ratio is equal to the MRT, the slope of the production possibilities frontier. When faced with this budget constraint, however, consumers will consume at *B*, where they maximize their level of satisfaction (on indifference curve $U_2$). Because the producer wants to produce $F_1$ units of food, but consumers want to buy $F_2$, there will be an excess demand for food. Correspondingly, because .consumers wish to buy $C_2$ units of clothing, but producers wish to sell $C_1$, there will be an excess supply of clothing. Prices in the market will then adjust-the price of food will rise and that of clothing will fall. As price ratio $P_F/P_C$ increases, the price line will move along the production frontier.

An equilibrium results when the price ratio is $P_F^*/P_C^*$ at *C*. Here, producers want to sell F* units or food and *C** units or clothing, and consumers want to

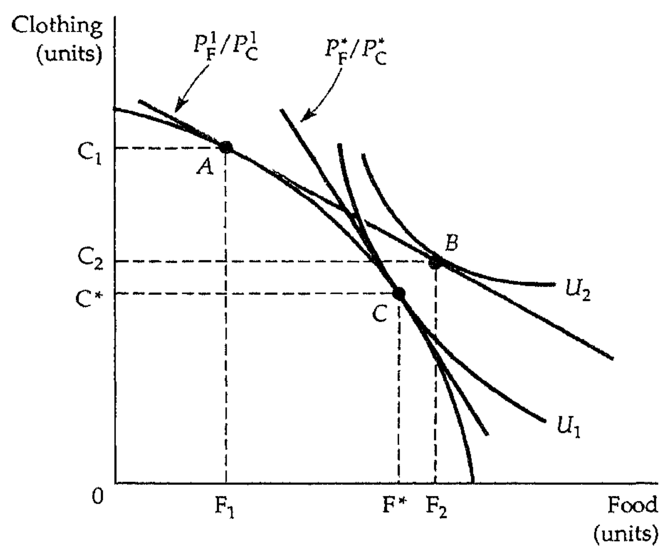


**FIGURE 16.11 Competition and Output Efficiency.** In a competitive output market, people consume to the point where their marginal rate of substitution is equal to the price ratio. Producers choose outputs so that the marginal rate of transformation is equal to the price ratio. Because the MRS equals the MRT, the competitive output market is efficient. Any other price ratio will lead to an excess demand for one good and an excess supply of the other.

buy the same amounts. At this equilibrium, the MRT and the MRS are equal, so again the competitive equilibrium is efficient.

## 16.5 *The Gains from Free Trade*

That there are gains from international trade in an exchange economy is clear-we have seen that two persons or two countries can benefit by trading to reach a point on the contract curve. However, there are additional gains from trade when the economies of two countries differ so that one country has a *comparative advantage* in producing one good, while a second country has a comparative advantage in producing another.

### Comparative Advantage

*Country 1 has a comparative advantage over country 2 in producing a good if the cost of producing that good, relative to the cost of producing other goods, in* I, *is lower than the cost of producing the good in* 2, *relative to the cost of producing other goods in* 2. Note that comparative advantage is not the same as *absolute* advantage. A country has an absolute advantage in producing a good if its cost is lower than the cost in another country. A comparative advantage, on the other hand, implies that a country's cost, *relative to the costs of other goods it produces,* is lower than the other country's.

When each of two countries has a comparative advantage, they are better off producing what they are best at, and purchasing the rest. To see this, suppose that the first country, Holland, has an *absolute* advantage in producing both cheese and wine. A worker there can produce a pound of cheese in one hour, and a gallon wine in two hours. In Italy, on the other hand, it takes a worker six hours to produce a pound of cheese and three hours to produce a gallon of wine. The production relationships are summarized in Table 16.3.[11]

**TABLE 16.3** Hours of Labor Required to Produce

| | Cheese (1lb.) | Wine (1gal.) |
|---|---|---|
| Holland | 1 | 2 |
| Italy | 6 | 3 |

[11] This example is based on "World Trade:- Jousting for Advantage," *The Economist* (Sept 22,1990): 5-40.

Holland has a *comparative* advantage over Italy in producing cheese, since Holland's cost of cheese production (in terms of hours of labor used) is half its cost of producing wine, whereas Italy's cost of producing cheese is twice its cost of producing wine. Likewise,Italy has a comparative advantage in producing wine, which it can produce at half the cost of producing cheese.

The comparative advantage of each country determines what happens when there is trade between the two countries. The outcome will depend on the price of each good relative to the other when trade occurs. To see how this might work, suppose that with trade one gallon of wine sells for the same price as one pound of cheese in both Holland and Italy.

Without trade, with 24 hours of labor input, Holland could produce 24 pounds of cheese, 12 gallons of wine, or a combination of the two, such as 18 pounds of cheese and 3 gallons of wine. But Holland can do better. For every hour of labor Holland can produce one pound of cheese, which it can trade for one gallon of wine; if the wine were produced at home, two hours of labor would be required. It is, therefore, in Holland's interest to specialize in the production of cheese, which it will export to Italy in exchange for wine. If, for example, Holland produced 24 pounds of cheese and traded 6, it would be able to consume 18 pounds of cheese and 6 gallons of wine, a definite improvement over the 18 pounds of cheese and 3 gallons of wine available in the absence of trade.

Italy is also better off with trade. Note that without trade, with the same 24 hours of labor input, Italy can produce 4 pounds of cheese, 8 gallons of wine, or a combination of the two,, such as 3 pounds of cheese and 2 gallons of wine. On the other hand, with every hour of labor Italy can produce one-third of a gallon of wine, which it can trade for one-third of a pound of cheese. If it produced cheese at home, twice as much time would be involved, so specialization in wine production is advantageous for Italy. Suppose that Italy produced 8 gallons of wine and traded 6; then it would be able to consume 6 pounds of cheese and 2 gallons of wine, likewise an improvement over the 3 pounds of cheese and 2 gallons of wine available without trade.

## An Expanded Production Possibilities Frontier

When there is comparative advantage, international trade has the effect of allowing a country to consume outside its production possibilities frontier. This can be seen graphically in Figure 16.12, which shows a production possibilities frontier for Holland. Suppose initially that Holland has been prevented from trading with Italy because of a protectionist trade barrier. The outcome of the competitive process in Holland is that production is at point A, on indifference curve $U_1$, where the MRT and the pre-trade relative price of wine and cheese is 2. If Holland were able to trade, it would want to export two pounds of cheese in exchange for one gallon of wine.

Suppose now that the trade barrier is dropped, and Holland and Italy are both open to trade; suppose also that as a result of differences in demand and

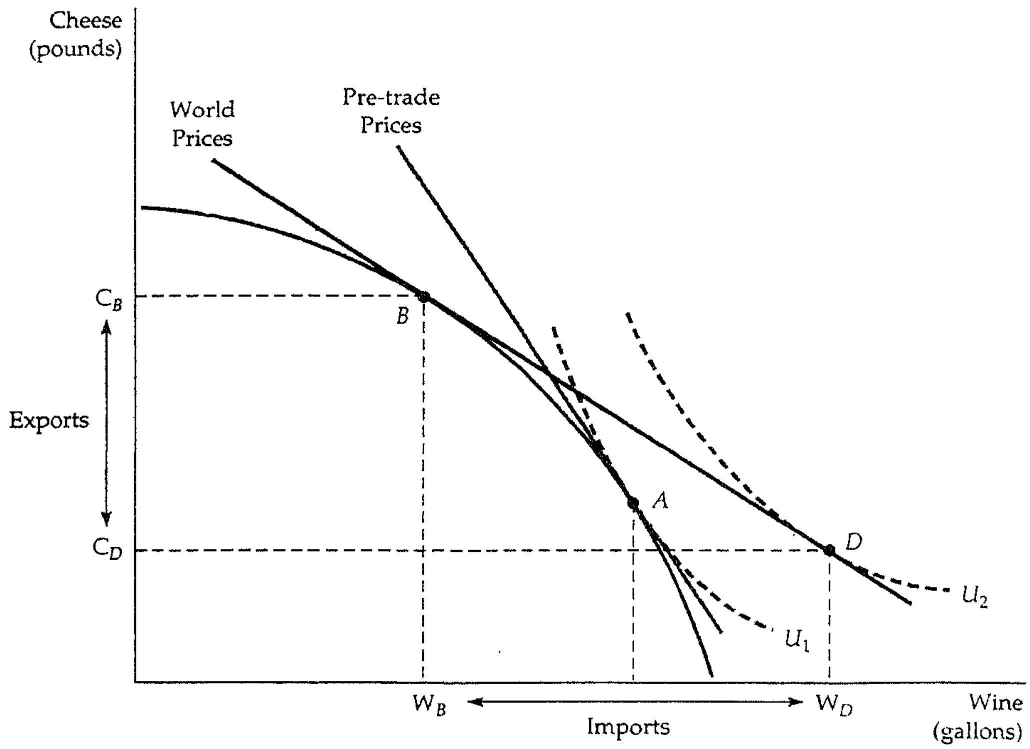


**FIGURE 16.12 The Gains from Trade.** Without trade, production and consumption are at point $A$, corresponding to a relative price of cheese to wine of 2 to 1. With trade at a relative price of 1 cheese to 1 wine, domestic production is now at $B$, while domestic consumption is at $D$. Free trade has allowed utility to increase from $U_1$ to $U_2$-

costs in the two countries, trade occurs on a one-to-one basis. Holland will find it advantageous to produce at point *B*, the point of tangency of the 1/1 price line and Holland's production possibilities frontier.

That is not the end of the story, however. Point *B* represents the production decision in Holland (Holland will produce less wine and more cheese domestically once the trade barrier has been removed). But, with trade, consumption will occur at point *D*, at which the higher indifference curve $U2$ is tangent to the trade price line. Thus, trade has the effect of expanding Holland's consumption choices beyond its production possibilities frontier. Holland will import $W_D$-$W_B$ units of wine and export $C_B$- $C_D$ units of cheese.

With trade each country will undergo a number of important adjustments. As Holland imports wine, the production of, domestic wine will fall as will employment in the wine industry. Cheese production will increase, however, as will the number of jobs in that industry. Workers with job-specific skills may find it difficult to change the nature of their employment. Thus, not everyone in Holland will gain as the result of free trade. Consumers will clearly be better off, but producers of wine and workers in the wine industry are likely to be worse off, at least temporarily.

## EXAMPLE 16.2 THE EFFECTS OF AUTOMOBILE IMPORT QUOTAS

Governments can use quotas and tariffs to discourage imports and stimulate domestic production. But these devices can restrict or alter consumer choices and thereby generate substantial output inefficiencies. One recent example is the U.S. imposition of quotas on imports of Japanese automobiles.

During the past three decades, the U.S. automobile industry has faced increasing world competition. In 1965, for example, imports were only 6.1 percent of total domestic sales. This percentage increased, however, to 28.8 percent in 1980, when the industry earned a negative profit rate of -9.3 percent on its investment. Part of the industry's difficulty was due to higher-quality, lower-priced Japanese cars. To deal with these problems, the automobile industry convinced the government to negotiate a voluntary export restraint (VER) agreement with the Japanese in 1981. The VER limited Japanese exports to the United States to 1.68 million cars per year as compared with the 2.5, million cars imported in 1980. It was argued that the quotas would give U.S. automobile manufacturers time to retool their machines and restructure their union agreements to compete effectively in the world market.

How did these quotas affect the world market? Did they help or hurt American consumers and producers? Answers to these questions require a general equilibrium analysis of the Japanese and U.S. automobile industries, as well as the markets for labor, materials, and other inputs to the production process.

The evidence suggests that the quotas did little to help the industry retool; U.S. manufacturers had already begun to restructure their production toward smaller and more fuel-efficient cars during the late 1970s. (Real investment expenditures increased by 88 percent from 1975-1976 to 1979-1980, for example.) The quotas initially forced the Japanese to sell fewer cars, but Japanese prices rose nearly $1000 per car in 1981-82 and in later years, causing a $2 billion per year increase in revenues. In turn, the higher Japanese prices increased the demand for U.S. cars, which allowed the U.S. auto industry to increase its prices, wages, and profits. The increased profits were between $900 million and $1.4 billion, substantially less than the Japanese revenue gain. Finally, U.S. consumers were made worse off by the policy because U.S. automobile prices were approximately $350 to $400 per car higher than they would have been without the export restrictions.[12]

The quotas initially benefitted U.S. automobile workers. Without quotas, domestic sales would have been about 500,000 units lower in the early 1980s, which translates into about 26,000 jobs. But the higher prices cost consumers

[12] See Robert W. Crandall, "Import Quotas and the Automobile Industry: The Costs of Protectionism," *The Brookings Review* (Summer 1984); 8-16.

well over $4.3 billion dollars, which means that each job that was retained cost approximately $160,000 ($4.3 billion/26,000). The VER was thus an extremely inefficient way to increase domestic employment.

In recent years, the voluntary quota program has had little effect on automobile imports. In 1991, for example, Japan exported 1.8 million cars to the United States, even though the voluntary quota was 2.3 million. By March 1992 Japan opted to voluntarily lower the limit to 1.65 million and by April 1992 the program was eliminated. Yet, despite the reduction in imported cars, Japan's share of the U.S. automobile market increased from 20.5 percent in 1981 to 30.3 percent in 1991. The explanation for this remarkable trend is simple: The production of Japanese automobiles in U.S. plants has increased substantially over the past decade. It seems doubtful that this trend will be easily overcome; the 1992 requirement that 70 percent of the parts used by Japanese automakers in the United States be U.S.made is unlikely to be significantly effective.

## EXAMPLE 16.3 THE COSTS AND BENEFITS OF SPECIAL PROTECTION

The demands for protectionist policies have increased steadily during the 1980s and into the 1990s. Protectionism can take many forms; they include tariffs and quotas of the kind that we analyzed in Chapter 9, regulatory hurdles, subsidies to domestic producers, and controls on the use of foreign exchange. Table 16.4 highlights one recent study of U.S.-imposed trade restrictions.[13]

Since one of the major purposes of protectionism is to protect jobs in particular industries, it is not surprising that these policies create gains to producers. The costs, however, involve losses to consumers, and a substantial reduction in economic efficiency. These efficiency losses are the sum of the loss of producer surplus resulting from inefficient excess domestic production and the loss of consumer surplus resulting from higher domestic prices and lower consumption.

As the table shows, the textiles and apparel industry is the largest source of efficiency losses. While there were substantial gains to producers, consumer losses are larger in each case. In addition, efficiency losses from excess (inefficient) domestic production of textiles and reduced domestic consumption of imported textile products were also large-an estimated $4.85 billion. The second largest source of inefficiency was 'the dairy industry, where losses amounted to $1.37 billion.

Finally, note that the efficiency cost of helping domestic producers varies considerably across industries. In textiles the ratio of efficiency costs to pro-

[13]This example is based on Cletus Coughlin, K. Alee Chrystal, and Geoffrey E. Wood, "Protectionist Trade Policies: A Survey of Theory, Evidence and Rationale," *Federal Reserve Bank of St. Louis* (January/February 1988): 12-30. The data in the table are taken from Gary Clyde Hufbauer, Diane T Berliner, and Kimberty Ann ElMott, 'Trade Protection in the United States: 31 Case Studies," *Institute for International Economics* (1986).

**Table 16.4 Quantifying the Costs of Protection**

| Industry | Producer Gains[14] ($1,000,000) | Consumer Losses[15] ($1,000,000) | Efficiency Losses[16] ($1,000,000) |
|---|---|---|---|
| Book Manufacturing | 305 | 500 | 29 |
| Orange Juice | 390 | 525 | 130 |
| Textiles and Apparel | 22,000 | 27,000 | 4,850 |
| Carbon Steel | 3,800 | 6,800 | 330 |
| Color TVs | 190 | 420 | 7 |
| Sugar | 550 | 930 | 130 |
| Dairy Products | 5,000 | 5,500 | 1,370 |
| Meat | 1,600 | 1,800 | 145 |

ducer gains is 22 percent, and in dairy products it is 27 percent; only orange juice is higher (33.3 percent). However, much lower ratios-apply to color TVs (3.7 percent), carbon steel (8.7 percent), and book manufacturing (9.5 percent).

## 16.6 *An Overview-The Efficiency of Competitive Markets*

Our analysis of general equilibrium and economic efficiency is now complete. We have shown that a perfectly competitive system of input and output markets will achieve an economically efficient outcome. The competitive system builds on the self-interested goals of consumers and producers, and on the ability of market prices to convey information to both parties. In the next two chapters, we will discuss why markets fail and what government can do about it. First, however, we should sum up the conditions required for economic efficiency and the particular conditions that a perfectly competitive market system satisfies.

1. *Efficiency in Exchange.* All allocations must lie on the exchange contract curve, so that every consumer's marginal rate of substitution of food for clothing is the same:

$$MRS^{J}_{FC} = MRS^{K}_{FC}$$

[14] Producer gains in this tariff case are defined as the area of trapezoid A in Figure 9.16.

[15] Consumer losses are the sum of areas *A*, *B*, *C*, and *D* in Figure 9.16.

[16] These are given by triangles *B* and *C* in Figure 9.16.

A competitive market achieves this efficient outcome because for consumers the tangency of the budget line and the highest attainable indifference curve assure that

$$MRS^{J}_{FC} = P_F/P_C = MRS^{K}_{FC}$$

2. *Efficiency in the Use of Inputs in Production.* All input combinations must lie on the production contract curve, so that every producer's marginal rate of technical substitution of labor for capital is equal in the production of both goods:

$$MRTS^{F}_{LK} = MRTS^{C}_{LK}$$

A competitive market achieves this efficient outcome because each producer maximizes profit by choosing labor and capital inputs so that the ratio of the input prices is equal to the marginal rate of technical substitution:

$$MRTS^{F}_{LK} = w/r = MRTS^{C}_{LK}$$

3. *Efficiency in the Output Market.* The mix of outputs must be chosen so that the, marginal rate of transformation between outputs is equal to consumers' marginal rates of substitution:

$$MRT_{FC} = MRS_{FC} \text{(for all consumers)}$$

A competitive market achieves this efficient outcome because profit-maximizing producers increase their output to the point at which marginal cost equals price:

$$P_F = MC_F, P_C = MC_C$$

As a result,

$$MRT_{FC} = MC_F/MC_C = P_F/P_C$$

But consumers maximize their satisfaction in competitive markets only if

$$P_F/P_C = MRS_{FC} \text{ (for all consumers)}$$

Therefore,

$$MRS_{FC} = MRT_{FC}$$

and the efficiency conditions are satisfied.

## 16.7 *Why Markets Fail*

We can give two different interpretations of the conditions required for efficiency. The first stresses that competitive markets work, and that we ought to ensure that the prerequisites for competition hold, so that resources can be efficiently allocated. The second stresses that the prerequisites for competition are unlikely to hold, and that we ought to concentrate on how to deal with market failures. Thus far we have focused on the first interpretation. For the remainder of the book, we concentrate on the second.

Competitive markets fail for four basic reasons: *market power, incomplete information, externalities*, and *public goods*. We will discuss each in turn.

## Market Power

We saw in Chapters 10 and 14 that inefficiency arises when a producer or supplier of a factor input has market power. Suppose, for example, that the producer of food in our Edgeworth box diagram has monopoly power. It therefore chooses the output quantity at which marginal revenue (rather than price) is equal to marginal cost, and sells less output at a price higher than in a competitive market. The lower output will mean a lower marginal cost of food production. Meanwhile, the freed-up production inputs will be allocated to produce clothing, whose marginal cost will increase. As a result, the marginal rate of transformation will decrease, because $MRT_{FC} = MC_F/MC_C$. We might end up, for example, at *A* on the production possibilities frontier in Figure 16.11. Producing too little food and too much clothing is an output inefficiency because firms with market power use a different price in their output decisions than consumers use in their consumption decisions.

A similar argument would apply to market power in an input market. Suppose that unions gave workers market power over the supply of their labor in the production of food. Too little labor would then be supplied to the food industry at too high a wage ($w_F$), and too much labor to the clothing industry at too low a wage ($w_C$). In the clothing industry, the input efficiency conditions would be satisfied because $MRTS^C_{LK} = w_C/r$ But in the food industry, the wage paid would be greater than the wage in the clothing industry. Therefore, $MRTS^F_{LK} = w_F/r > w_C/r = MRTS^C_{LK}$. The result is input inefficiency because efficiency requires that the marginal rates of technical substitution be equal in the production of all goods.

## Incomplete Information

If consumers do not have accurate information about market prices or product quality, the market system will not operate efficiently. This lack of information may give producers an incentive to supply too much of some products and too little of others. In other cases, some consumers may not buy a product even though they would benefit from doing so, while other consumers buy products that leave them worse off. For example, consumers may buy pills that guarantee weight loss, only to find that the pills have no medical value. Finally, a lack of information may prevent some markets from ever developing. It may, for example, be impossible to purchase certain kinds of insurance because suppliers of insurance lack adequate information about who is likely to be at risk.

Each of these informational problems can lead to competitive market inefficiency. We will describe informational inefficiencies in detail in Chapter 17, and see whether government intervention might cure them.

## Externalities

The price system works efficiently because market prices convey information to both producers and consumers. Sometimes, however, market prices do not reflect the activities of either producers or consumers. There is an *externality* when a consumption or production activity has an indirect effect on other consumption or production activities that is not reflected directly in market prices. As we explained in Section 9.2, the word "externality" is used because the effects on others (whether benefits or costs) are external to the market.

Suppose, for example, that a steel plant dumps effluent in a river, which makes a recreation site downstream unsuitable for swimming or fishing. There is an externality because the steel production does not bear the true cost of waste water and hence uses too much waste water to produce its steel. This causes an input inefficiency. If this externality prevails throughout the industry, the price of steel (which is equal to the marginal cost of production) will be lower than if the cost of production reflected the effluent cost. As a result, too much steel will be produced, and there will be an output inefficiency.

We will discuss externalities, and ways to deal with them, in Chapter 18.

## Public Goods

The last source of market failure arises when the market fails to supply goods that many consumers value. A *public good* is a good that can be made available cheaply to many consumers, but once the good is provided to some consumers, it is very difficult to prevent others from consuming it. For example, suppose a firm is considering whether to undertake research on a new technology for which it cannot obtain a patent. Once the invention is made public, others can duplicate it. As long as it is difficult to exclude other firms from selling the product, the research will be unprofitable.

Thus, markets undersupply public goods. We will see in Chapter 18 that the government can sometimes resolve this problem either by supplying the good itself or by altering the incentives for private firms to produce it.

# *Summary*

1. Partial equilibrium analyses of markets assume that related markets are unaffected. General equilibrium analyses examine all markets simultaneously, taking into account feedback effects of other markets on the market being studied.
2. An allocation is efficient when no consumer can be made better off by trade without making someone else worse off. When consumers make all mutually advantageous trades, the outcome is efficient and lies on the contract curve.

3. A competitive equilibrium describes a set of prices and quantities, so that when each consumer chooses his or her most preferred allocation, the quantity demanded is equal to the quantity supplied in every market. All competitive equilibrium allocations lie on the exchange contract curve and are Pareto efficient.
4. The utility possibilities frontier measures all efficient allocations in terms of the levels of utility that each person achieves. Although both individuals prefer some allocations to an inefficient allocation, not *every* efficient allocation must be so preferred. Thus, an inefficient allocation can be more equitable than an efficient one.
5. Because a competitive equilibrium need not be equitable, the government may wish to help redistribute wealth from rich to poor. Because such redistribution is costly, there is some conflict between equity and efficiency.
6. An allocation of production inputs is technically efficient if the output of one good cannot be increased without decreasing the output of some other good. All points of technical efficiency lie on the production contract curve and represent points of tangency of the isoquants for the two goods.
7. A competitive equilibrium in input markets occurs when the marginal rate of technical substitution between pairs of inputs is equal to the ratio of the prices of the inputs.
8. The production possibilities frontier measures all efficient allocations in terms of the levels of output that can be produced with a given combination of inputs. The marginal rate of transformation of food for clothing increases as more food and less clothing are produced. The marginal rate of transformation is equal to the ratio of the marginal cost of producing food to the marginal cost of producing clothing.
9. Efficiency in the allocation of goods to consumers is achieved only when the marginal rate of substitution of one good for another in consumption (which is the same for all consumers) is equal to the marginal rate of transformation of one good for another in production.
10. When input and output markets are perfectly competitive, the marginal rate of substitution (which equals the ratio of the prices of the goods) will equal the marginal rate of transformation (which equals the ratio of the marginal costs of producing the goods).
11. Free international trade expands a country's production possibilities frontier. As a result, consumers will be better off.
12. Competitive markets may be inefficient for four reasons. First, firms or consumers may have market power in input or output markets. Second, consumers or producers may have incomplete information and may therefore err in their consumption and production decisions. Third, externalities may be present. Fourth, some socially desirable public goods may not be produced.

# *Questions for Review*

1. Why can feedback effects make a general equilibrium analysis substantially different from a partial equilibrium analysis?

2. In the Edgeworth box diagram, explain how one point can simultaneously represent the market baskets owned by two consumers.

**3.** In the analysis of exchange using the Edgeworth box diagram, explain why both consumers' marginal rates of substitution are equal at every point on the contract curve.

**4.** "Since all points on a contract curve are efficient, they are all equally desirable from a social point of view." Do you agree with this statement? Explain.

**5.** How does the utility possibilities frontier relate to the contract curve?

**6.** In the Edgeworth production box diagram, what conditions must hold for an allocation to be on the production contract curve? Why is a competitive equilibrium on the contract curve?

**7.** How is the production possibilities frontier related to the production contract curve?

**8.** What is the marginal rate of transformation (MRT)? Explain why the MRT of one good for another is equal to the ratio of the marginal costs of producing the two goods.

**9.** Explain why goods will not be distributed efficiently among consumers if the MRT is not equal to the consumers' marginal rate of substitution.

**10.** Why can free trade between two countries make consumers of both countries better off?

**11.** What are the four major sources of market failure? In each case, explain briefly why the competitive market does not operate efficiently.

# *Exercises*

**1.** In the analysis of an exchange between two people, suppose both people have identical preferences. Will the contract curve be a straight line? Explain. (Can you think of a counterexample?)

**2.** Give an example of conditions when the production possibilities frontier might not be concave.

**3.** A monopsonist buys labor for less than the competitive wage. What type of inefficiency will this use of monopsony power cause? How would your answer change if the monopsonist in the labor market were also a monopolist in the output market?

**4.** Jane has 8 liters of soft drinks and 2 sandwiches. Bob, on the other hand, has 2 liters of soft drinks and 4 sandwiches. With these endowments, Jane's marginal rate of substitution (MRS) of soft drinks for sandwiches is three, and Bob's MRS is equal to one. Draw an Edgeworth box diagram to show whether this allocation of resources is efficient. If it is, explain why. If it is not, what exchanges will make both parties better off?

**5.** The Acme Corporation produces $x$ and y units of goods Alpha and Beta, respectively.

**a.** Use a production possibility frontier to explain how the willingness to produce more or less Alpha depends on the marginal rate of transformation of Alpha or Beta.

**b.** Consider two cases of production extremes: (i) Acme produces zero units of Alpha initially, or (ii) Acme produces zero units of Beta initially. If Acme always tries to stay on its production possibility frontier, describe the initial positions of cases (i) and (ii). What happens as the Acme Corporation begins to produce *both* goods?

**6.** In the context of our analysis of the Edgeworth production box, suppose a new invention causes a constant-returns-to-scale production process for food to become a sharply increasing-returns process. How does this change affect the production contract curve?

**7.** Suppose gold (G) and silver (S) are substitutes for each other because both serve as hedges against inflation. Suppose also that the supplies of both are fixed in the short run ($Q_G = 50$, and $Q_S = 200$), and that the demands for gold and silver are given by the following equations:

$$P_G = 850 - Q_G + 0.5P_S$$
$$P_S = 540 - Q_S + 0.2P_G$$

**a.** What are the equilibrium prices of gold and silver?

**b.** Suppose a new discovery of gold increases the quantity supplied by 85 units. How will this discovery affect the prices of both gold and silver?