

## Chapter 6. Markets, Maximizers, and Efficiency

### Start Up: A Drive in the Country

Suppose you decide to take a drive. For purposes of this example, we will assume that you have a car available, that the weather is pleasant, and that there is an area nearby that will be perfect for your drive. +

Your decision to take this drive is a choice. Since economics deals with choices, we can put economics to work in thinking about it. Economists assume that people make choices that maximize the value of some objective. You are a consumer; we assume that taking a drive is a choice that maximizes your utility—the satisfaction you obtain from your use of goods and services and from the activities you pursue. +

You certainly plan to enjoy the drive; that enjoyment is the benefit you expect from it. But you will give up some things as well. Your drive will take some time, time you could have spent doing something else. It will take some gasoline; what you spend for the gasoline could have been used for something else. The drive will also generate some wear and tear on your car. That will cost you the price of repair and maintenance and reduced resale value of your car. The opportunity cost of your drive will thus include the value of the best other use of your time and the value of the best other use of the funds your drive will require. To maximize utility you will weigh the benefits of the drive against the cost of the drive and maximize the difference between those benefits and costs. +

This chapter introduces the method through which maximizing choices can be made. This method applies not just to your decision to take a drive, but also to Wal-Mart's decision to hire extra workers and to USX Corporation's to produce extra steel. The method we will learn can be applied to the analysis of any choice; we will use it throughout our investigation of microeconomics. +

We will also see how maximizing choices by individuals and by firms can lead to an allocation of resources that generates the greatest gains possible for the economy as a whole. In this analysis, we will put a new item in our toolkit, the method through which individuals and firms maximize, together with demand and supply analysis, to see how the marketplace can guide resources to their best uses. +

We will also examine cases in which maximizing choices do not guide resources to their best uses. That possibility is suggested by another aspect of your choice to take a drive. In addition to the costs you will consider, there will be costs imposed on others. Your drive will pollute the air, so part of the opportunity cost of the drive will be the value of the slightly cleaner air people in your area might have had. Resources such as the air we breathe will almost certainly be misallocated as the result of maximizing choices. We will see just how misallocation of an economy's resources can occur and how this misallocation could be fixed. +

### The Logic of Maximizing Behavior

## LEARNING OBJECTIVES

1. Explain the maximization assumption that economists make in explaining the behavior of consumers and firms.
2. Explain and illustrate the concepts of marginal benefit and marginal cost and apply them to understanding the marginal decision rule.



To say that individuals maximize is to say that they pick some objective and then seek to maximize its value. A sprinter might want to maximize his or her speed; a politician might want to maximize the probability that he or she will win the next election. Economists pay special attention to two groups of maximizers: consumers and firms. We assume that consumers seek to maximize utility and that firms seek to maximize **economic profit**, which is the difference between total revenue and total cost. The costs involved in this concept of economic profit are computed in the economic sense—as the opportunity costs, or value of the best opportunity forgone.

The assumption of maximizing behavior lies at the heart of economic analysis. As we explore its implications, however, we must keep in mind the distinction between models and the real world. Our model assumes that individuals make choices in a way that achieves a maximum value for some clearly defined objective. In using such a model, economists do not assume that people actually go through the calculations we will describe. What economists do argue is that people's behavior is broadly consistent with such a model. People may not consciously seek to maximize anything, but they behave as though they do.

### The Analysis of Maximizing Behavior

The activities of consumers and firms have benefits, and they also have opportunity costs. We assume that given these benefits and costs, consumers and firms will make choices that maximize the **net benefit** of each activity—the total benefit of the activity minus its opportunity cost. The specific measures of benefit and cost vary with the kind of choice being made. In the case of a firm's choices in production, for example, the total benefit of production is the revenue a firm receives from selling the product; the total cost is the opportunity cost the firm incurs by producing it. The net benefit is thus total revenue minus total opportunity cost, or economic profit.

Economists maintain that in order to maximize net benefit, consumers and firms evaluate each activity at the margin—they consider the additional benefit and the additional cost of another unit of the activity. Should you “supersize” your order at McDonald's? Will the additional beverage and the additional french fries be worth the extra cost? Should a firm hire one more worker? Will the benefits to the firm of hiring this worker be worth the additional cost of hiring him or her?

The **marginal benefit** is the amount by which an additional unit of an activity increases its total benefit. It is the amount by which the extra french fries increase your satisfaction, or the extra revenue the firm expects to bring in by hiring another worker. The **marginal cost** is the amount by which an additional unit

of an activity increases its total cost. You will pay more to supersize your McDonald's order; the firm's labor costs will rise when it hires another worker. +

To determine the quantity of any activity that will maximize its net benefit, we apply the **marginal decision rule**: If the marginal benefit of an additional unit of an activity exceeds the marginal cost, the quantity of the activity should be increased. If the marginal benefit is less than the marginal cost, the quantity should be reduced. Net benefit is maximized at the point at which marginal benefit equals marginal cost. The marginal decision rule is at the heart of the economic way of thinking. The rule basically says this: If the additional benefit of one more unit exceeds the extra cost, do it; if not, do not. This simple logic gives us a powerful tool for the analysis of choice. Perhaps more than any other rule in economic analysis, the marginal decision rule typifies the way in which economists analyze problems. We shall apply it in every chapter that follows in the microeconomics portion of this text. +

Maximizing choices must be made within the parameters imposed by some **constraint**, which is a boundary that limits the range of choices that can be made. We assume that a consumer seeks the greatest satisfaction possible within the limits of his or her income or budget. A firm cannot produce beyond the limits of its production capacity at a point in time. +

The marginal decision rule forms the foundation for the structure economists use to analyze all choices. At first glance, it may seem that a consumer seeking satisfaction from, say, pizza has little in common with an entrepreneur seeking profit from the production of custom-designed semiconductors. But maximizing choices always follow the marginal decision rule—and that rule holds regardless of what is being maximized or who is doing the maximizing. +

To see how the logic of maximizing choices works, we will examine a specific problem. We will then extend that problem to the general analysis of maximizing choices. +

### *A Problem in Maximization*

Suppose a college student, Laurie Phan, faces two midterms tomorrow, one in economics and another in accounting. She has already decided to spend 5 hours studying for the two examinations. This decision imposes a constraint on the problem. Suppose that Ms. Phan's goal is to allocate her 5 hours of study so that she increases her total score for the two exams by as much as possible. +

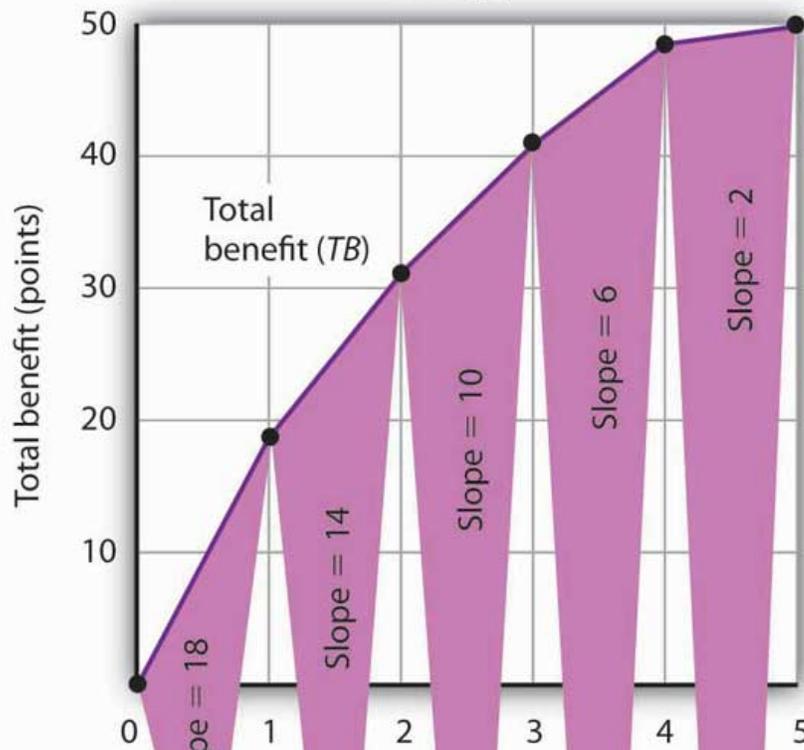
Ms. Phan expects the relationship between the time she spends studying for the economics exam and the total gain in her score to be as given by the second row of the table in Panel (a) of [Figure 6.1, "The Benefits of Studying Economics"](#). We interpret the expected total gain in her score as the total benefit of study. She expects that 1 hour of study will raise her score by 18 points; 2 hours will raise it by 32 points, and so on. These values are plotted in Panel (b). Notice that the total benefit curve rises, but by smaller and smaller amounts, as she studies more and more. The slope of the curve, which in this case tells us the rate at which her expected score rises with increased study time, falls as we travel up and to the right along the curve. +

### **Figure 6.1. The Benefits of Studying Economics**

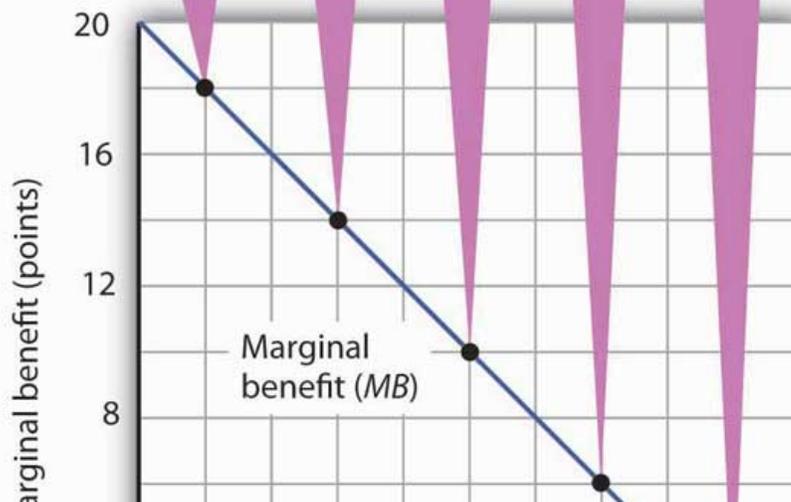
Panel (a)

Hours studying economics	0	1	2	3	4	5
Expected total point gain in test score (total benefit)	0	18	32	42	48	50
Marginal benefit		18	14	10	6	2

Panel (b)



Panel (c)



**The table in Panel (a) shows the total benefit and marginal benefit of the time Laurie Phan spends studying for her economics exam. Panel (b) shows the total benefit curve. Panel (c) shows the marginal benefit curve, which is given by the slope of the total benefit curve in Panel (b).**

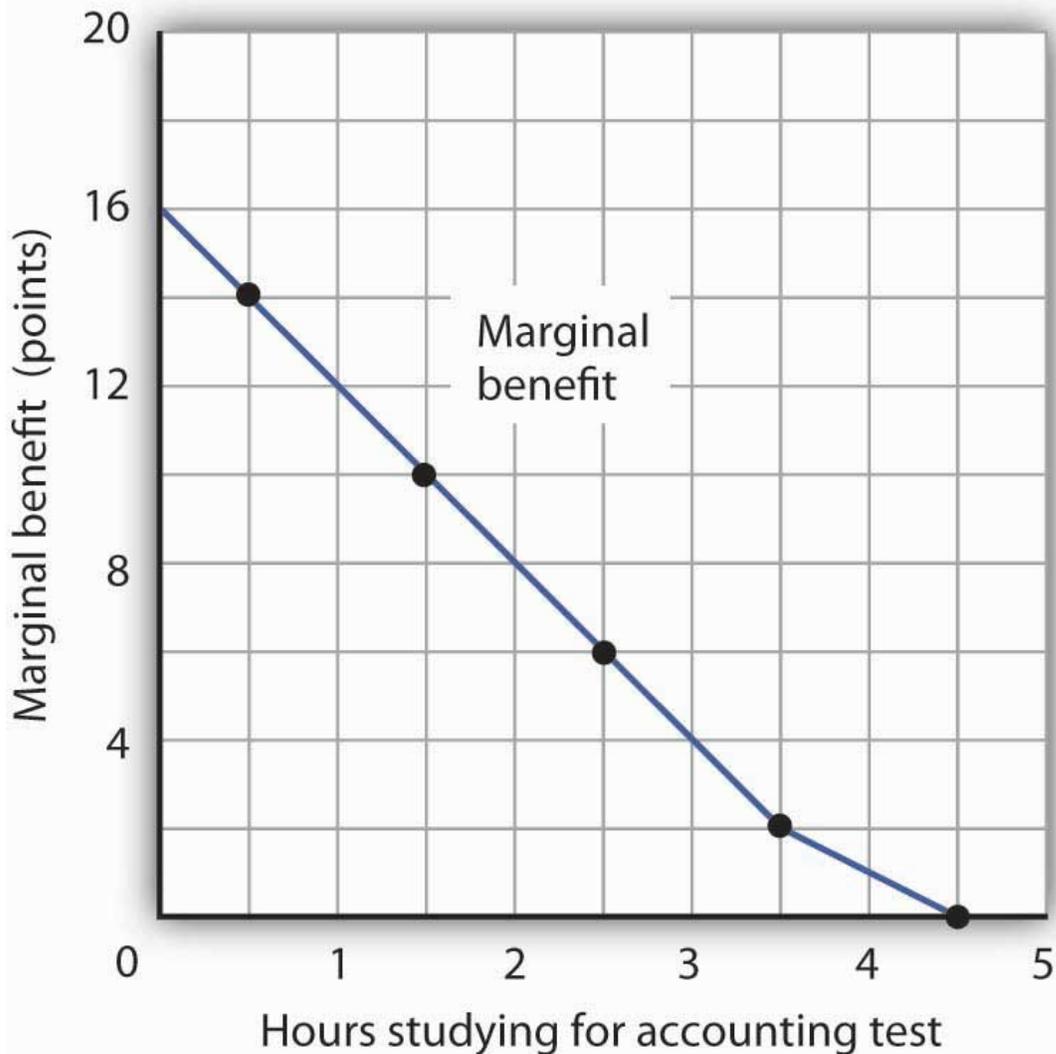


Now look at the third row in the table in Panel (a). It tells us the amount by which each additional hour of study increases her expected score; it gives the marginal benefit of studying for the economics exam. Marginal benefit equals the amount by which total benefit rises with each additional hour of study. Because these marginal benefits are given by the changes in total benefits from additional hours of study, they equal the slope of the total benefit curve. We see this in the relationship between Panels (b) and (c) of [Figure 6.1, “The Benefits of Studying Economics”](#). The decreasing slope of the total benefit curve in Panel (b) gives us the downward-sloping marginal benefit curve in Panel (c).

The marginal benefit curve tells us what happens when we pass from one point to another on the total benefit curve, so we have plotted marginal benefits at the midpoints of the hourly intervals in Panel (c). For example, the total benefit curve in Panel (b) tells us that, when Ms. Phan increases her time studying for the economics exam from 2 hours to 3 hours, her total benefit rises from 32 points to 42 points. The increase of 10 points is the marginal benefit of increasing study time for the economics exam from 2 hours to 3 hours. We mark the point for a marginal benefit of 10 points midway between 2 and 3 hours. Because marginal values tell us what happens as we pass from one quantity to the next, we shall always plot them at the midpoints of intervals of the variable on the horizontal axis.

We can perform the same kind of analysis to obtain the marginal benefit curve for studying for the accounting exam. [Figure 6.2, “The Marginal Benefits of Studying Accounting”](#) presents this curve. Like the marginal benefit curve for studying economics, it slopes downward. Once again, we have plotted marginal values at the midpoints of the intervals. Increasing study time in accounting from 0 to 1 hour increases Ms. Phan’s expected accounting score by 14 points.

### **Figure 6.2. The Marginal Benefits of Studying Accounting**



**The marginal benefit Laurie Phan expects from studying for her accounting exam is shown by the marginal benefit curve. The first hour of study increases her expected score by 14 points, the second hour by 10 points, the third by 6 points, and so on.**

**+**

Ms. Phan's marginal benefit curves for studying typify a general phenomenon in economics. Marginal benefit curves for virtually all activities, including the activities of consumers and of firms, slope downward. Think about your own experience with studying. On a given day, the first hour spent studying a certain subject probably generates a greater marginal benefit than the second, and the second hour probably generates a greater marginal benefit than the third. You may reach a point at which an extra hour of study is unlikely to yield any benefit at all. Of course, our example of Laurie Phan's expected exam scores is a highly stylized one. One could hardly expect a student to have a precise set of numbers to guide him or her in allocating study time. But it is certainly the case that students have a rough idea of the likely payoff of study time in

different subjects. If you were faced with exams in two subjects, it is likely that you would set aside a certain amount of study time, just as Ms. Phan did in our example. And it is likely that your own experience would serve as a guide in determining how to allocate that time. Economists do not assume that people have numerical scales in their heads with which to draw marginal benefit and marginal cost curves. They merely assume that people act as if they did. **+**

The nature of marginal benefits can change with different applications. For a restaurant, the marginal benefit of serving one more meal can be defined as the revenue that meal produces. For a consumer, the marginal benefit of one more slice of pizza can be considered in terms of the additional satisfaction the pizza will create. But whatever the nature of the benefit, marginal benefits generally fall as quantities increase. **+**

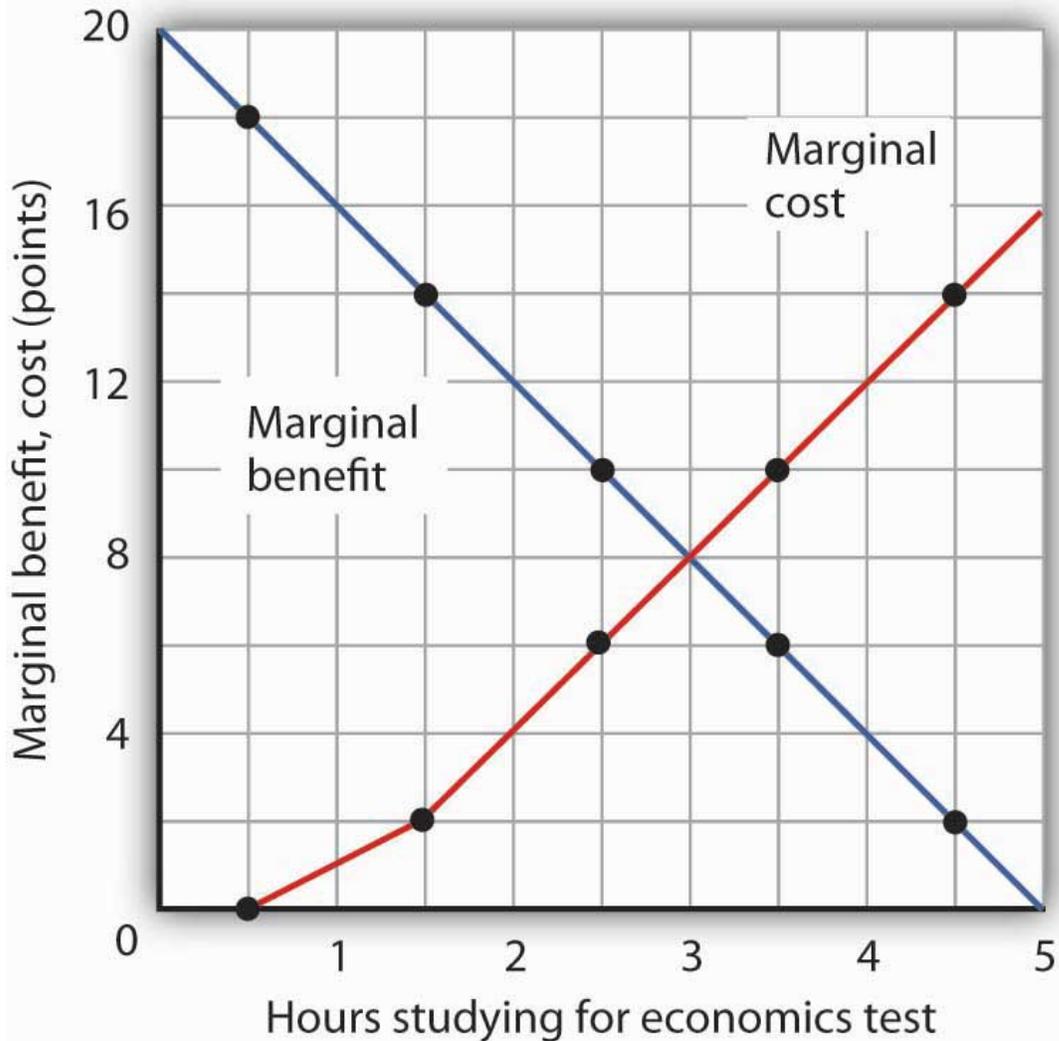
Ms. Phan's falling marginal benefit from hours spent studying accounting has special significance for our analysis of her choice concerning how many hours to devote to economics. In our problem, she had decided to devote 5 hours to studying the two subjects. That means that the opportunity cost of an hour spent studying economics equals the benefit she would have gotten spending that hour studying accounting. **+**

Suppose, for example, that she were to consider spending all 5 hours studying accounting. The marginal benefit curve for studying for her accounting exam tells us that she expects that the fifth hour will add nothing to her score. Shifting that hour to economics would cost nothing. We can say that the marginal cost of the first hour spent studying economics is zero. We obtained this value from the marginal benefit curve for studying accounting in [Figure 6.2, "The Marginal Benefits of Studying Accounting"](#). **+**

Similarly, we can find the marginal cost of the second hour studying economics. That requires giving up the fourth hour spent on accounting. [Figure 6.2, "The Marginal Benefits of Studying Accounting"](#) tells us that the marginal benefit of that hour equals 2—that is the marginal cost of spending the second hour studying economics. **+**

[Figure 6.3, "The Marginal Benefits and Marginal Costs of Studying Economics"](#) shows the marginal cost curve of studying economics. We see that at first, time devoted to studying economics has a low marginal cost. As time spent studying economics increases, however, it requires her to give up study time in accounting that she expects will be more and more productive. The marginal cost curve for studying economics can thus be derived from the marginal benefit curve for studying accounting. [Figure 6.3, "The Marginal Benefits and Marginal Costs of Studying Economics"](#) also shows the marginal benefit curve for studying economics that we derived in Panel (b) of [Figure 6.1, "The Benefits of Studying Economics"](#). **+**

### **Figure 6.3. The Marginal Benefits and Marginal Costs of Studying Economics**



The marginal benefit curve from Panel (c) of [Figure 6.1, "The Benefits of Studying Economics"](#) is shown together with the marginal costs of studying economics. The marginal cost curve is derived from the marginal benefit curve for studying accounting shown in [Figure 6.2, "The Marginal Benefits of Studying Accounting"](#).



Just as marginal benefit curves generally slope downward, marginal cost curves generally slope upward, as does the one in [Figure 6.3, "The Marginal Benefits and Marginal Costs of Studying Economics"](#). In the case of allocating time, the phenomenon of rising marginal cost results from the simple fact that, the more time a person devotes to one activity, the less time is available for another. And the more one reduces the second activity, the greater the forgone marginal benefits are likely to be. That means the marginal cost curve for that first activity rises. 

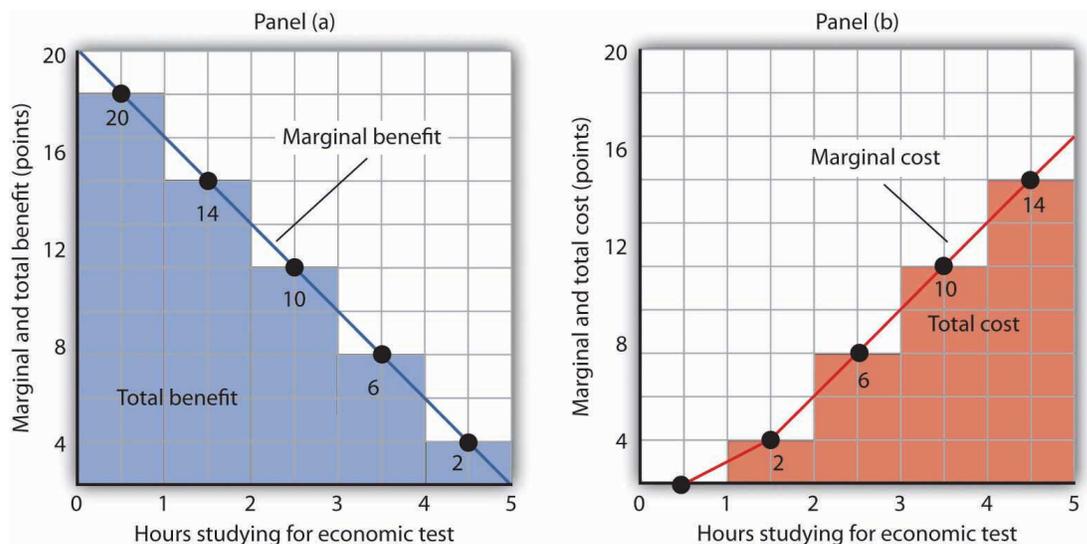
Because we now have marginal benefit and marginal cost curves for studying economics, we can apply the marginal decision rule. This rule says that, to maximize the net benefit of an activity, a decision maker should increase an activity up to the point at which marginal benefit equals marginal cost. That occurs where the marginal benefit and marginal cost curves intersect, with 3 hours spent studying economics and 2 hours spent studying accounting. **+**

### Using Marginal Benefit and Marginal Cost Curves to Find Net Benefits

We can use marginal benefit and marginal cost curves to show the total benefit, the total cost, and the net benefit of an activity. We will see that equating marginal benefit to marginal cost does, indeed, maximize net benefit. We will also develop another tool to use in interpreting marginal benefit and cost curves. **+**

Panel (a) of [Figure 6.4, "The Benefits and Costs of Studying Economics"](#) shows the marginal benefit curve we derived in Panel (c) of [Figure 6.1, "The Benefits of Studying Economics"](#). The corresponding point on the marginal benefit curve gives the marginal benefit of the first hour of study for the economics exam, 18 points. This same value equals the area of the rectangle bounded by 0 and 1 hour of study and the marginal benefit of 18. Similarly, the marginal benefit of the second hour, 14 points, is shown by the corresponding point on the marginal benefit curve and by the area of the shaded rectangle bounded by 1 and 2 hours of study. The total benefit of 2 hours of study equals the sum of the areas of the first two rectangles, 32 points. We continue this procedure through the fifth hour of studying economics; the areas for each of the shaded rectangles are shown in the graph. **+**

**Figure 6.4. The Benefits and Costs of Studying Economics**



**Panel (a) shows the marginal benefit curve of [Figure 6.1, "The Benefits of Studying Economics"](#). The total benefit of studying economics at any given quantity of study time is given approximately by the shaded area below the marginal benefit curve up to that level of study. Panel (b) shows the marginal cost curve from [Figure 6.3, "The Marginal Benefits and Marginal Costs of Studying Economics"](#). The total cost of studying economics at any given**

**quantity of study is given approximately by the shaded area below the marginal cost curve up to that level of study.**

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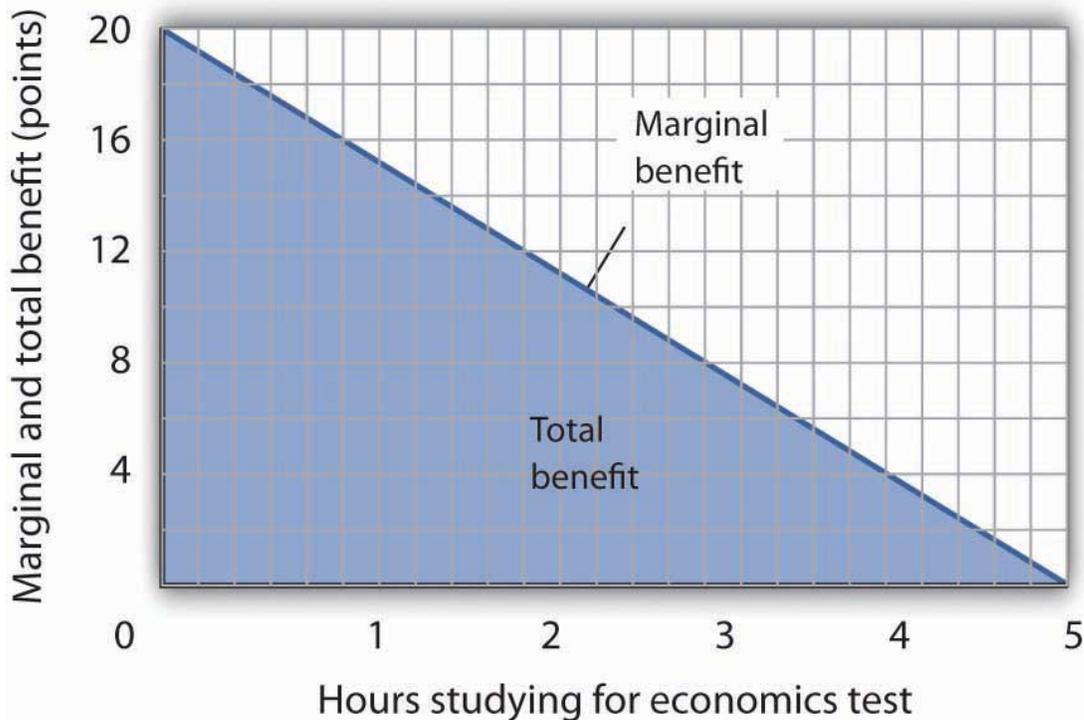
Two features of the curve in Panel (a) of [Figure 6.4, "The Benefits and Costs of Studying Economics"](#) are particularly important. First, note that the sum of the areas of the five rectangles, 50 points, equals the total benefit of 5 hours of study given in the table in Panel (a) of [Figure 6.1, "The Benefits of Studying Economics"](#). Second, notice that the shaded areas are approximately equal to the area under the marginal benefit curve between 0 and 5 hours of study. We can pick any quantity of study time, and the total benefit of that quantity equals the sum of the shaded rectangles between zero and that quantity. Thus, the total benefit of 2 hours of study equals 32 points, the sum of the areas of the first two rectangles. +

Now consider the marginal cost curve in Panel (b) of [Figure 6.4, "The Benefits and Costs of Studying Economics"](#). The areas of the shaded rectangles equal the values of marginal cost. The marginal cost of the first hour of study equals zero; there is thus no rectangle under the curve. The marginal cost of the second hour of study equals 2 points; that is the area of the rectangle bounded by 1 and 2 hours of study and a marginal cost of 2. The marginal cost of the third hour of study is 6 points; this is the area of the shaded rectangle bounded by 2 and 3 hours of study and a marginal cost of 6. +

Looking at the rectangles in Panel (b) over the range of 0 to 5 hours of study, we see that the areas of the five rectangles total 32, the total cost of spending all 5 hours studying economics. And looking at the rectangles, we see that their area is approximately equal to the area under the marginal cost curve between 0 and 5 hours of study. +

We have seen that the areas of the rectangles drawn with Laurie Phan's marginal benefit and marginal cost curves equal the total benefit and total cost of studying economics. We have also seen that these areas are roughly equal to the areas under the curves themselves. We can make this last statement much stronger. Suppose, instead of thinking in intervals of whole hours, we think in terms of smaller intervals, say, of 12 minutes. Then each rectangle would be only one-fifth as wide as the rectangles we drew in [Figure 6.4, "The Benefits and Costs of Studying Economics"](#). Their areas would still equal the total benefit and total cost of study, and the sum of those areas would be closer to the area under the curves. We have done this for Ms. Phan's marginal benefit curve in [Figure 6.5, "The Marginal Benefit Curve and Total Benefit"](#); notice that the areas of the rectangles closely approximate the area under the curve. They still "stick out" from either side of the curve as did the rectangles we drew in [Figure 6.4, "The Benefits and Costs of Studying Economics"](#), but you almost need a magnifying glass to see that. The smaller the interval we choose, the closer the areas under the marginal benefit and marginal cost curves will be to total benefit and total cost. For purposes of our model, we can imagine that the intervals are as small as we like. Over a particular range of quantity, the area under a marginal benefit curve equals the total benefit of that quantity, and the area under the marginal cost curve equals the total cost of that quantity. +

### **Figure 6.5. The Marginal Benefit Curve and Total Benefit**

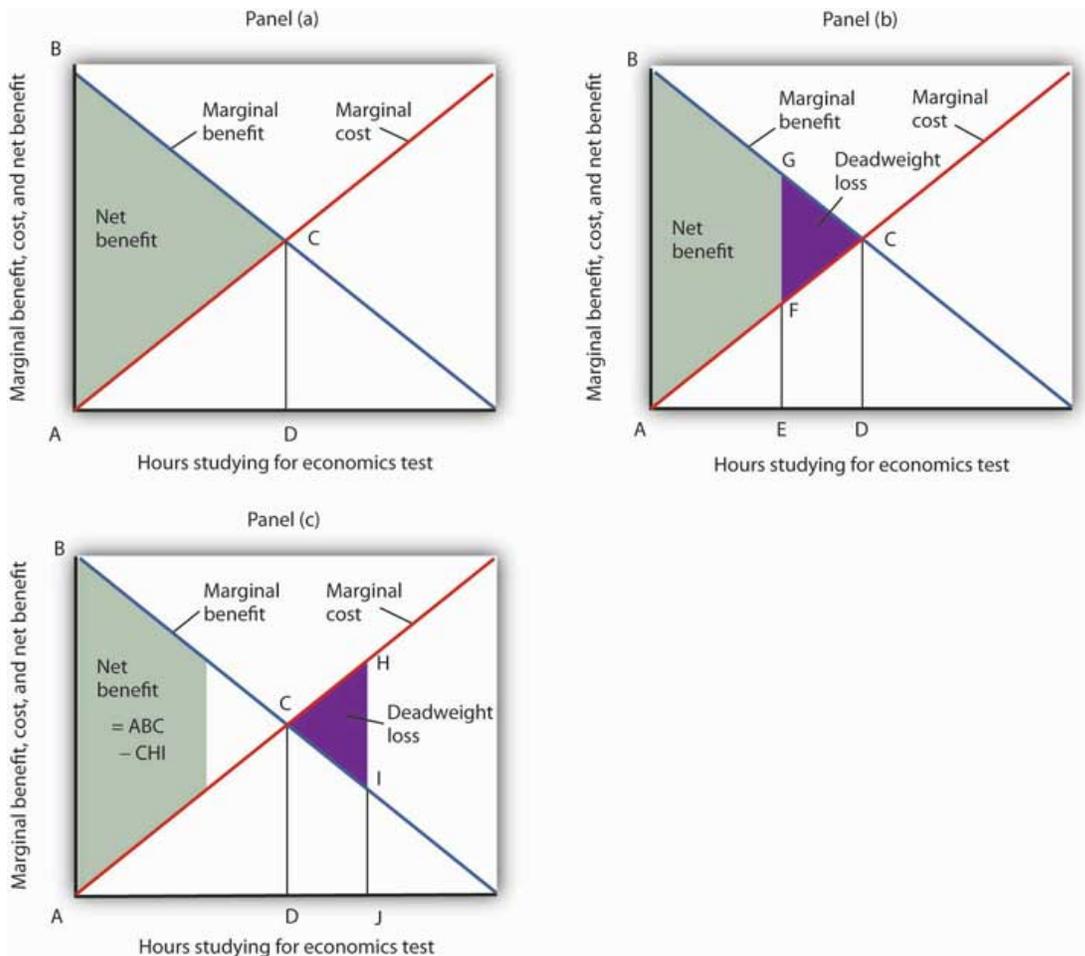


When the increments used to measure time allocated to studying economics are made smaller, in this case 12 minutes instead of whole hours, the area under the marginal benefit curve is closer to the total benefit of studying that amount of time.

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Panel (a) of [Figure 6.6, "Using Marginal Benefit and Marginal Cost Curves to Determine Net Benefit"](#) shows marginal benefit and marginal cost curves for studying economics, this time without numbers. We have the usual downward-sloping marginal benefit curve and upward-sloping marginal cost curve. The marginal decision rule tells us to choose  $D$  hours studying economics, the quantity at which marginal benefit equals marginal cost at point  $C$ . We know that the total benefit of study equals the area under the marginal benefit curve over the range from  $A$  to  $D$  hours of study, the area  $ABCD$ . Total cost equals the area under the marginal cost curve over the same range, or  $ACD$ . The difference between total benefit and total cost equals the area between marginal benefit and marginal cost between  $A$  and  $D$  hours of study; it is the green-shaded triangle  $ABC$ . This difference is the net benefit of time spent studying economics. Panel (b) of [Figure 6.6, "Using Marginal Benefit and Marginal Cost Curves to Determine Net Benefit"](#) introduces another important concept. If an activity is carried out at a level less than the efficient level, then net benefits are forgone. The loss in net benefits resulting from a failure to carry out an activity at the efficient level is called a **deadweight loss**.+

**Figure 6.6. Using Marginal Benefit and Marginal Cost Curves to Determine Net Benefit**



**In Panel (a) net benefits are given by the difference between total benefits (as measured by the area under the marginal benefit curve up to any given level of activity) and total costs (as measured by the area under the marginal cost curve up to any given level of activity). Maximum net benefits are found where the marginal benefit curve intersects the marginal cost curve at activity level D. Panel (b) shows that if the level of the activity is restricted to activity level E, net benefits are reduced from the light-green shaded triangle ABC in Panel (a) to the smaller area ABGF. The forgone net benefits, or deadweight loss, is given by the purple-shaded area FGC. If the activity level is increased from D to J, as shown in Panel (c), net benefits declined by the deadweight loss measured by the area CHI.**

**+**

Now suppose a person increases study time from D to J hours as shown in Panel (c). The area under the marginal cost curve between D and J gives the total cost of increasing study time; it is DCHJ. The total benefit of increasing study time equals the area under the marginal benefit curve between D and J; it is DCIJ. The cost of increasing study time in economics from D hours to J hours exceeds the benefit. This gives us a deadweight loss of CHI. The net benefit of spending J hours studying economics equals the net

benefit of studying for D hours less the deadweight loss, or  $ABC$  minus  $CHI$ . Only by studying up to the point at which marginal benefit equals marginal cost do we achieve the maximum net benefit shown in Panel (a).+

We can apply the marginal decision rule to the problem in [Figure 6.6, "Using Marginal Benefit and Marginal Cost Curves to Determine Net Benefit"](#) in another way. In Panel (b), a person studies economics for E hours. Reading up to the marginal benefit curve, we reach point G. Reading up to the marginal cost curve, we reach point F. Marginal benefit at G exceeds marginal cost at F; the marginal decision rule says economics study should be increased, which would take us toward the intersection of the marginal benefit and marginal cost curves. Spending J hours studying economics, as shown in Panel (c), is too much. Reading up to the marginal benefit and marginal cost curves, we see that marginal cost exceeds marginal benefit, suggesting that study time be reduced.+

This completes our introduction to the marginal decision rule and the use of marginal benefit and marginal cost curves. We will spend the remainder of the chapter applying the model.+

### Heads Up!

It is easy to make the mistake of assuming that if an activity is carried out up to the point where marginal benefit equals marginal cost, then net benefits must be zero. Remember that following the marginal decision rule and equating marginal benefits and costs *maximizes* net benefits. It makes the *difference* between total benefits and total cost as large as possible.+

+

## KEY TAKEAWAYS

- Economists assume that decision makers make choices in the way that maximizes the value of some objective.+
- Maximization involves determining the change in total benefit and the change in total cost associated with each unit of an activity. These changes are called marginal benefit and marginal cost, respectively.+
- If the marginal benefit of an activity exceeds the marginal cost, the decision maker will gain by increasing the activity.+
- If the marginal cost of an activity exceeds the marginal benefit, the decision maker will gain by reducing the activity.+
- The area under the marginal benefit curve for an activity gives its total benefit; the area under the marginal cost curve gives the activity's total cost. Net benefit equals total benefit less total cost.+
- The marginal benefit rule tells us that we can maximize the net benefit of any activity by choosing the quantity at which marginal benefit equals marginal cost. At this quantity, the net benefit of the activity is maximized.+



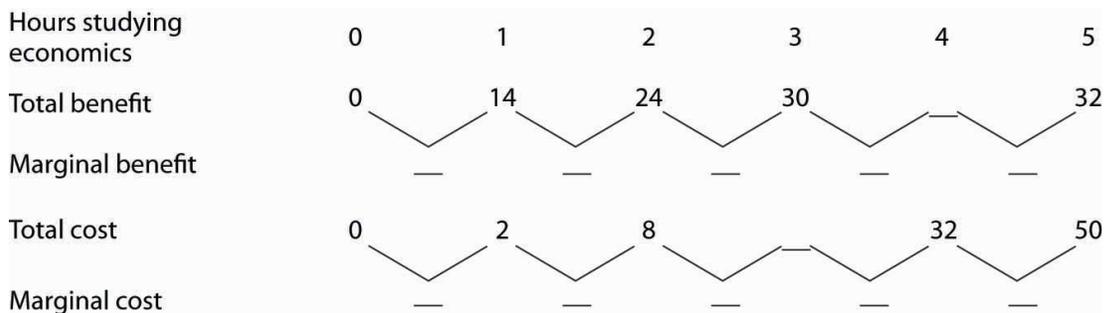
## TRY IT!

Suppose Ms. Phan still faces the exams in economics and in accounting, and she still plans to spend a total of 5 hours studying for the two exams. However, she revises her expectations about the degree to which studying economics and accounting will affect her scores on the two exams. She expects studying economics will add somewhat less to her score, and she expects studying accounting will add more. The result is the table below of expected total benefits and total costs of hours spent studying economics. Notice that several values in the table have been omitted. Fill in the missing values in the table. How many hours of study should Ms. Phan devote to economics to maximize her net benefit?

Hours studying economics	0	1	2	3	4	5
Total benefit	0	14	24	30		32
Total cost	0	2	8		32	50
Net benefit	0	12		12	0	-18

Now compute the marginal benefits and costs of hours devoted to studying economics, completing the table below.

**Figure 6.7.**



Draw the marginal benefit and marginal cost curves for studying economics (remember to plot marginal values at the midpoints of the respective hourly intervals). Do your curves intersect at the “right” number of hours of study—the number that maximizes the net benefit of studying economics?

### Case in Point: Preventing Oil Spills

Figure 6.8.



+

Do we spill enough oil in our oceans and waterways? It is a question that perhaps only economists would ask—and, as economists, we should ask it. +

There is, of course, no virtue in an oil spill. It destroys wildlife and fouls shorelines. Cleanup costs can be tremendous. However, Preventing oil spills has costs as well: greater enforcement expenditures and higher costs to shippers of oil and, therefore, higher costs of goods such as gasoline to customers. The only way to prevent oil spills completely is to stop shipping oil. That is a cost few people would accept. But what is the right balance between environmental protection and the satisfaction of consumer demand for oil? +

Vanderbilt University economist Mark Cohen examined the U.S. Coast Guard's efforts to reduce oil spills through its enforcement of shipping regulations in coastal waters and on rivers. He focused on the costs and benefits resulting from the Coast Guard's enforcement efforts in 1981. On the basis of the frequency of oil spills before the Coast Guard began its enforcement, Mr. Cohen estimated that the Coast Guard prevented 1,159,352 gallons of oil from being spilled in 1981. +

Given that there was a total of 824,921 gallons of oil actually spilled in 1981, should the Coast Guard have attempted to prevent even more spillage? Mr. Cohen estimated that the marginal benefit of preventing one more gallon from being spilled was \$7.27 (\$3.42 in cleanup costs, \$3 less in environmental damage, and \$0.85 worth of oil saved). The marginal cost of preventing one more gallon from being spilled was \$5.50. Mr. Cohen suggests that because the marginal benefit of more vigorous enforcement exceeded the marginal cost, more vigorous Coast Guard efforts would have been justified. +

More vigorous efforts have, indeed, been pursued. In 1989, the Exxon oil tanker Exxon Valdez ran aground, spilling 10.8 million gallons of oil off the coast of Alaska. The spill damaged the shoreline of a national forest, four national wildlife refuges, three national parks, five state parks, four critical habitat areas, and a state game refuge. Exxon was ordered to pay \$900 million in damages; a federal jury found Exxon and the captain guilty of criminal negligence and imposed an additional \$5 billion in punitive damages. In 2008, The Supreme Court reduced the assessment of punitive damages to \$507 million, with the majority arguing that the original figure was too high in comparison to the compensatory damages for a case in which the actions of the defendant, Exxon, were "reprehensible" but not intentional. +

Perhaps the most important impact of the Exxon Valdez disaster was the passage of the Oil Pollution Act of 1990. It increased shipper liability from \$14 million to \$100 million. It also required double-hulled tankers for shipping oil. +

The European Union (EU) has also strengthened its standards for oil tankers. The 2002 breakup of the oil tanker Prestige off the coast of Spain resulted in the spillage of 3.2 million gallons of oil. The EU had planned to ban single-hulled tankers, phasing in the ban between 2003 and 2015. The sinking of the Prestige led the EU to move up that deadline. +

Spill crises have led both the United States and the European Union to tighten up their regulations of oil tankers. The result has been a reduction in the quantity of oil spilled, which was precisely what economic research had

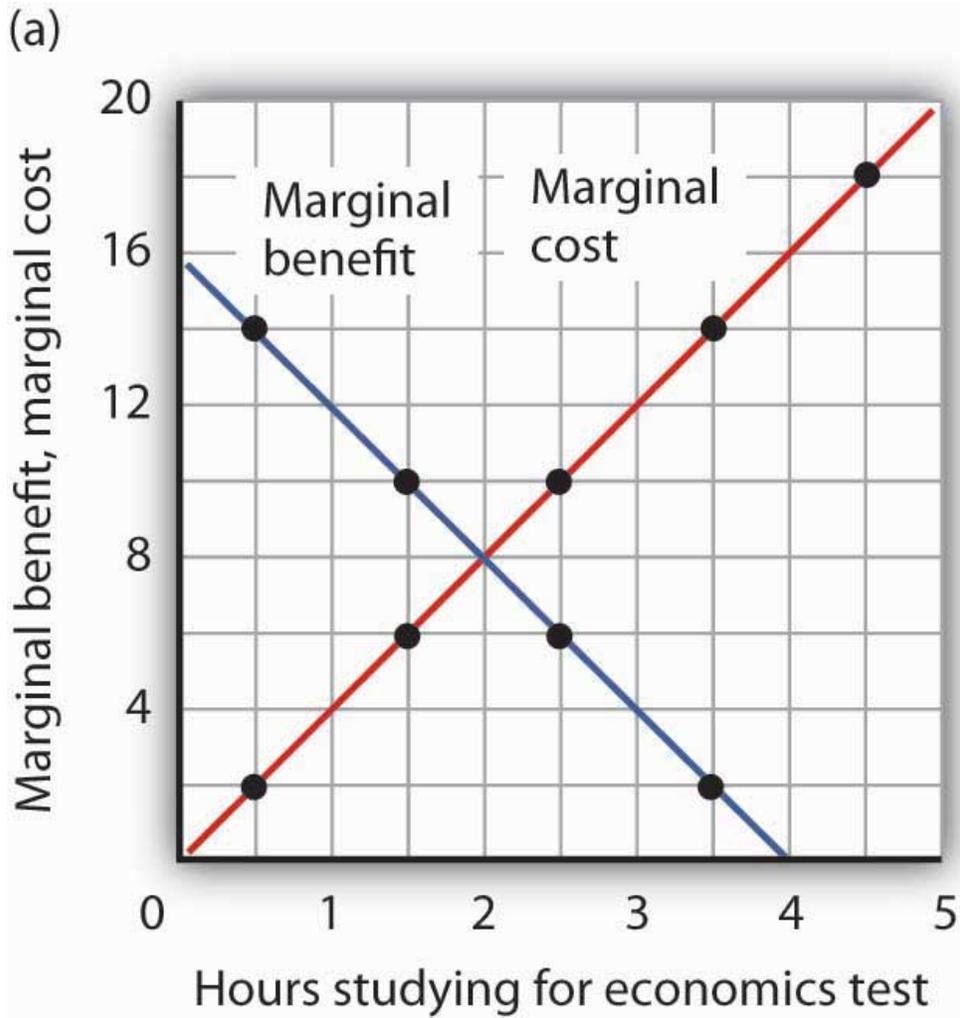
concluded was needed. By 2002, the amount of oil spilled per barrel shipped had fallen 30% from the level three decades earlier. +

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## A N S W E R T O T R Y I T ! P R O B L E M

Here are the completed data table and the table showing total and marginal benefit and cost. +

**Figure 6.9.**



(b)

Hours studying economics	0	1	2	3	4	5
Total benefit	0	14	24	30	32	32
Marginal benefit		14	10	6	2	0
Total cost	0	2	8	18	32	50
Marginal cost		2	6	10	14	18



Ms. Phan maximizes her net benefit by reducing her time studying economics to 2 hours. The change in her expectations reduced the benefit and increased the cost of studying economics. The completed graph of marginal benefit and marginal cost is at the far left. Notice that answering the question using the marginal decision rule gives the same answer.

## Maximizing in the Marketplace

### LEARNING OBJECTIVES

1. Explain what is meant by an efficient allocation of resources in an economy and describe the market conditions that must exist to achieve this goal.
2. Define consumer and producer surplus.
3. Discuss the relationship between efficiency and equity.



In perhaps the most influential book in economics ever written, *An Inquiry into the Nature and Causes of the Wealth of Nations*, published in 1776, Adam Smith argued that the pursuit of self-interest in a marketplace would promote the general interest. He said resources would be guided, as if by an “invisible hand,” to their best uses. That invisible hand was the marketplace.

Smith’s idea was radical for its time; he saw that the seemingly haphazard workings of the marketplace could promote the common good. In this section, we will use the tools we have developed thus far to see the power of Smith’s invisible hand. Efforts by individuals to maximize their own net benefit can maximize net benefit for the economy as a whole.

When the net benefits of all economic activities are maximized, economists say the allocation of resources is **efficient**. This concept of efficiency is broader than the notion of efficient production that we encountered when discussing the production possibilities curve. There, we saw that the economy’s factors of production would be efficient *in production* if they were allocated according to the principle of comparative advantage. That meant producing as much as possible with the factors of production available. The concept of an efficient allocation of resources incorporates production, as in that discussion, but it includes efficiency in the consumption of goods and services as well.

### Achieving Efficiency

Imagine yourself arriving at the store to purchase some food. In your choice, you will weigh your own benefits and costs to maximize your net benefit. The farmers, the distributors, and the grocer have sought to maximize their net benefits as well. How can we expect that all those efforts will maximize net benefits

for the economy as a whole? How can we expect the marketplace to achieve an efficient allocation of food, or of anything else? **+**

One condition that must be met if the market's allocation is to be efficient is that the marketplace must be competitive or function as if it were. We will have a great deal more to say about competitive markets versus less competitive ones in subsequent chapters. For now, we can simply note that a competitive market is one with many buyers and sellers in each market and in which entry and exit are fairly easy. No one controls the price; the forces of demand and supply determine price. **+**

The second condition that must hold if the market is to achieve an efficient allocation concerns property rights. We turn to that topic in the next section. **+**

### *The Role of Property Rights*

A smoothly functioning market requires that producers possess property rights to the goods and services they produce and that consumers possess property rights to the goods and services they buy. **Property rights** are a set of rules that specify the ways in which an owner can use a resource. **+**

Consider the tomato market. Farmers who grow tomatoes have clearly defined rights to their land and to the tomatoes they produce and sell. Distributors who purchase tomatoes from farmers and sell them to grocers have clear rights to the tomatoes until they sell them to grocers. The grocers who purchase the tomatoes retain rights to them until they sell them to consumers. When you buy a tomato, you have the exclusive right to its use. **+**

A system of property rights forms the basis for all market exchange. Before exchange can begin, there must be a clear specification of who owns what. The system of property rights must also show what purchasers are acquiring when they buy rights to particular resources. Because property rights must exist if exchange is to occur, and because exchange is the process through which economic efficiency is achieved, a system of property rights is essential to the efficient allocation of resources. **+**

Imagine what would happen in the market for tomatoes if property rights were not clearly defined. Suppose, for example, that grocers could not legally prevent someone from simply grabbing some tomatoes and leaving without paying for them. If that were the case, grocers would not be likely to offer tomatoes for sale. If it were the case for all grocery items, there would not be grocery stores at all. **+**

Although property rights vary for different resources, two characteristics are required if the marketplace is to achieve an efficient allocation of resources: **+**

1. Property rights must be exclusive. An **exclusive property right** is one that allows its owner to prevent others from using the resource. The owner of a house, for example, has the right to exclude others from the use of the house. If this right did not exist, ownership would have little value; it is not likely that the property could be exchanged in a market. And the inability to sell property would limit the incentive of owners to maintain it. **+**

2. Property rights must be transferable. A **transferable property right** is one that allows the owner of a resource to sell or lease it to someone else. In the absence of transferability, no exchange could occur. +

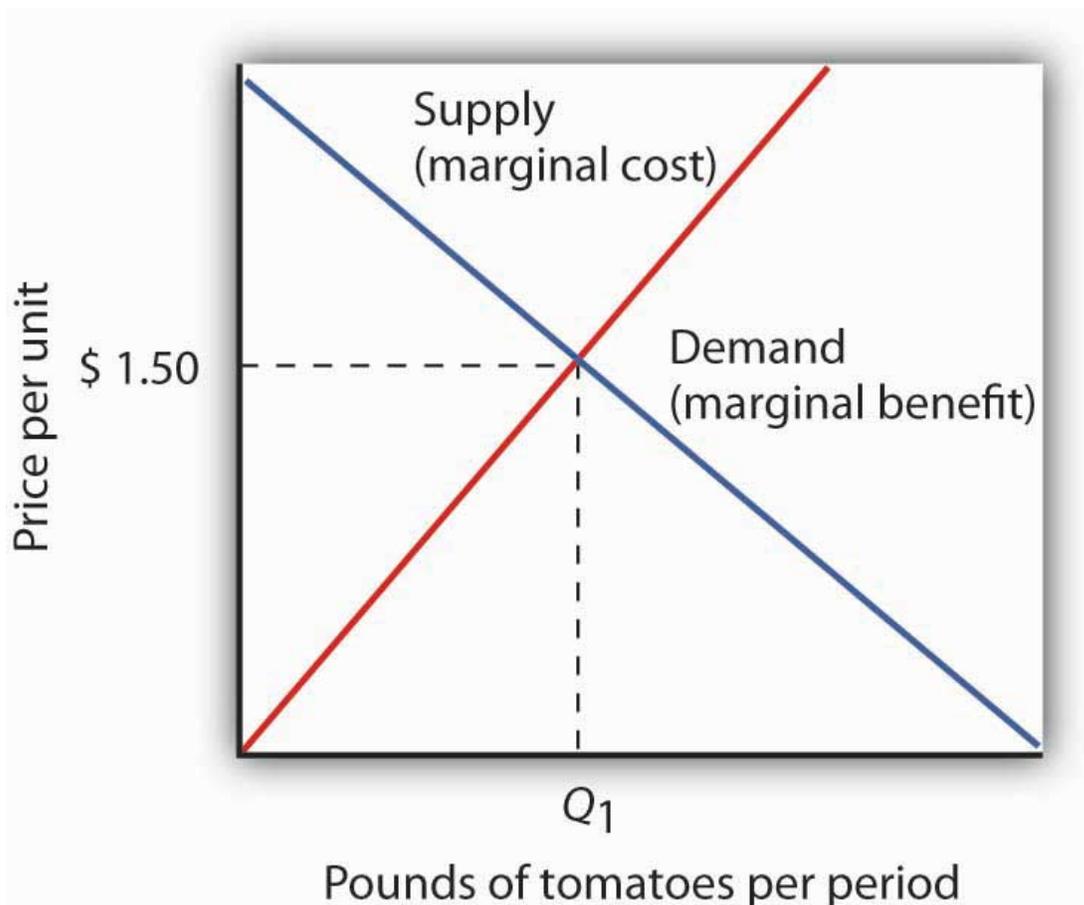
+

### Markets and the Efficiency Condition

A competitive market with well-defined and transferable property rights satisfies the **efficiency condition**. If met, we can assume that the market's allocation of resources will be efficient. +

Consider again your purchase of tomatoes. Suppose the curves of demand and supply for tomatoes are those given in [Figure 6.10, "Demand and Supply and the Efficiency Condition"](#); the equilibrium price equals \$1.50 per pound. Suppose further that the market satisfies the efficiency condition. With that assumption, we can relate the model of demand and supply to our analysis of marginal benefits and costs. +

**Figure 6.10. Demand and Supply and the Efficiency Condition**



**In a competitive market with exclusive and transferable property rights, such as the market for tomatoes, the efficiency condition is met. Buyers and sellers are faced with all of the relevant benefits and costs, and the equilibrium price equals the marginal cost to society of producing**

that good, here \$2.50 per pound. We can interpret the market demand and supply curve as marginal benefit and marginal cost curves, respectively.



The demand curve tells us that the last pound of tomatoes was worth \$1.50; we can think of that as the marginal benefit of the last pound of tomatoes since that is how much consumers were willing to pay. We can say that about any price on a market demand curve; a demand curve can be considered as a marginal benefit curve. Similarly, the supply curve can be considered the marginal cost curve. In the case of the tomato market, for example, the price tells us that the marginal cost of producing the last pound of tomatoes is \$1.50. This marginal cost is considered in the economic sense—other goods and services worth \$1.50 were not produced in order to make an additional pound of tomatoes available.

On what basis can we presume that the price of a pound of tomatoes equals its marginal cost? The answer lies in our marginal decision rule. Profit-maximizing tomato producers will produce more tomatoes as long as their marginal benefit exceeds their marginal cost. What is the marginal benefit to a producer of an extra pound of tomatoes? It is the price that the producer will receive. What is the marginal cost? It is the value that must be given up to produce an extra pound of tomatoes.

Producers maximize profit by expanding their production up to the point at which their marginal cost equals their marginal benefit, which is the market price. The price of \$1.50 thus reflects the marginal cost to society of making an additional pound of tomatoes available.

At the equilibrium price and output of tomatoes, then, the marginal benefit of tomatoes to consumers, as reflected by the price they are willing to pay, equals the marginal cost of producing tomatoes. Where marginal benefit equals marginal cost, net benefit is maximized. The equilibrium quantity of tomatoes, as determined by demand and supply, is efficient.

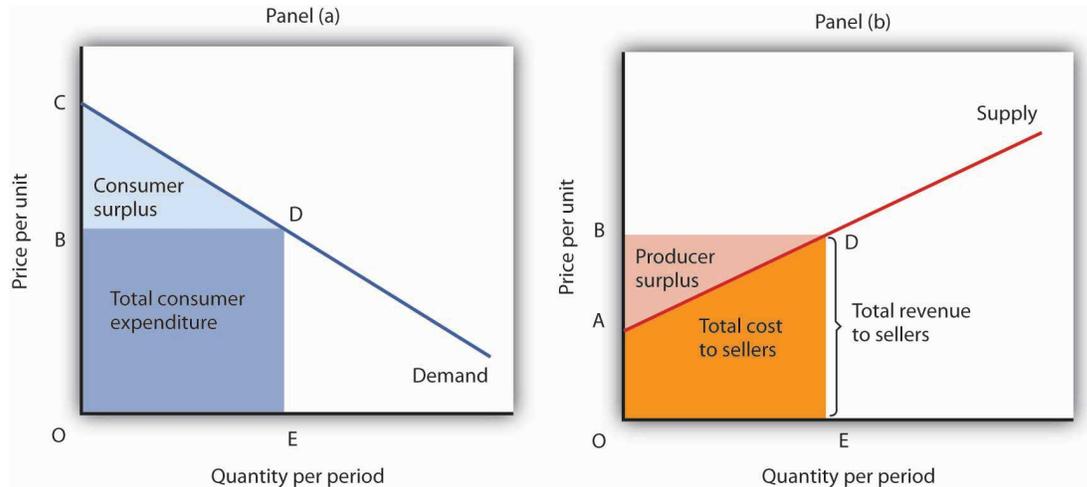
## Producer and Consumer Surplus

Think about the last thing you purchased. You bought it because you expected that its benefits would exceed its opportunity cost; you expected that the purchase would make you better off. The seller sold it to you because he or she expected that the money you paid would be worth more than the value of keeping the item. The seller expected to be better off as a result of the sale. Exchanges in the marketplace have a remarkable property: Both buyers and sellers expect to emerge from the transaction better off.

Panel (a) of [Figure 6.11, "Consumer and Producer Surplus"](#) shows a market demand curve for a particular good. Suppose the price equals OB and the quantity equals OE. The area under the demand curve over the range of quantities from the origin at O to the quantity at E equals the total benefit of consuming OE units of the good. It is the area OCDE. Consumers pay for this benefit; their total expenditures equal the rectangle OBDE, which is the dark shaded region in the graph. Because the total benefits exceed total expenditures, there is a consumer surplus given by the triangle BCD. **Consumer surplus** is the amount by

which the total benefits to consumers from consuming a good exceed their total expenditures on the good. **+**

**Figure 6.11. Consumer and Producer Surplus**



**Consumer surplus [Panel (a)]** measures the difference between total benefit of consuming a given quantity of output and the total expenditures consumers pay to obtain that quantity. Here, total benefits are given by the shaded area OCDE; total expenditures are given by the rectangle OBDE. The difference, shown by the triangle BCD, is consumer surplus.

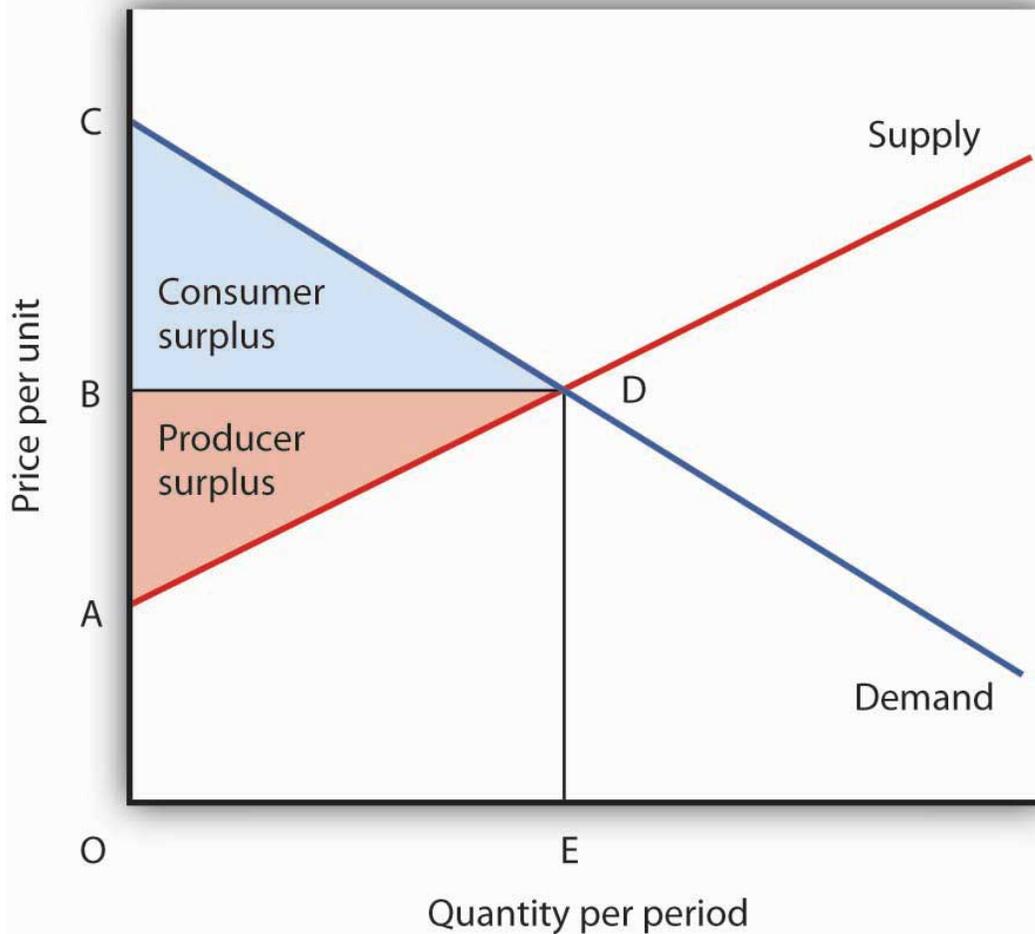
**Producer surplus [Panel (b)]** measures the difference between total revenue received by firms at a given quantity of output and the total cost of producing it. Here, total revenue is given by the rectangle OBDE, and total costs are given by the area OADE. The difference, shown by the triangle ABD is producer surplus. **+**

**+**

Now consider the sellers' side of transactions. Panel (b) of [Figure 6.11, "Consumer and Producer Surplus"](#) shows a market supply curve; recall that it gives us marginal cost. Suppose the market price equals OB and quantity supplied is OE; those are the same values we had in Panel (a). The price times the quantity equals the total revenue received by sellers. It is shown as the shaded rectangle OBDE. The total revenue received by sellers equals total expenditures by consumers. **+**

The total cost to sellers is the area under the marginal cost curve; it is the area OADE. That cost is less than revenue. The difference between the total revenue received by sellers and their total cost is called **producer surplus**. In Panel (b) it is the light-shaded triangle ABD. **+**

**Figure 6.12. Net Benefit: The Sum of Consumer and Producer Surplus**



The sum of consumer surplus and producer surplus measures the net benefit to society of any level of economic activity. Net benefit is maximized when production and consumption are carried out at the level where the demand and supply curves intersect. Here, the net benefit to society equals the area ACD. It is the sum of consumer surplus, BCD, and producer surplus, ABD.

+

We put the demand and supply curves of [Figure 6.11, "Consumer and Producer Surplus"](#) Panels (a) and (b) together in [Figure 6.12, "Net Benefit: The Sum of Consumer and Producer Surplus"](#). The intersection of the two curves determines the equilibrium price, OB, and the equilibrium quantity, OE. The shaded regions give us consumer and producer surplus. The sum of these two surpluses is net benefit. This net benefit is maximized where the demand and supply curves intersect. +

## Efficiency and Equity

Consumer demands are affected by incomes. Demand, after all, reflects ability as well as willingness to pay for goods and services. The market will be more responsive to the preferences of people with high incomes than to those of people with low incomes. +

In a market that satisfies the efficiency condition, an efficient allocation of resources will emerge from any particular distribution of income. Different income distributions will result in different, but still efficient, outcomes. For example, if 1% of the population controls virtually all the income, then the market will efficiently allocate virtually all its production to those same people. +

What is a fair, or equitable, distribution of income? What is an unfair distribution? Should everyone have the same income? Is the current distribution fair? Should the rich have less and the poor have more? Should the middle class have more? Equity is very much in the mind of the observer. What may seem equitable to one person may seem inequitable to another. There is, however, no test we can apply to determine whether the distribution of income is or is not equitable. That question requires a normative judgment. +

Determining whether the allocation of resources is or is not efficient is one problem. Determining whether the distribution of income is fair is another. The governments of all nations act in some way to redistribute income. That fact suggests that people generally have concluded that leaving the distribution of income solely to the market would not be fair and that some redistribution is desirable. This may take the form of higher taxes for people with higher incomes than for those with lower incomes. It may take the form of special programs, such as welfare programs, for low-income people. +

Whatever distribution society chooses, an efficient allocation of resources is still preferred to an inefficient one. Because an efficient allocation maximizes net benefits, the gain in net benefits could be distributed in a way that leaves all people better off than they would be at any inefficient allocation. If an efficient allocation of resources seems unfair, it must be because the distribution of income is unfair. +

### KEY TAKEAWAYS

- In a competitive system in which the interaction of demand and supply determine prices, the corresponding demand and supply curves can be considered marginal benefit and marginal cost curves, respectively. +
- An efficient allocation of resources is one that maximizes the net benefit of each activity. We expect it to be achieved in markets that satisfy the efficiency condition, which requires a competitive market and well-defined, transferable property rights. +
- Consumer surplus is the amount by which the total benefit to consumers from some activity exceeds their total expenditures for it. +
- Producer surplus is the amount by which the total revenues of producers exceed their total costs. +
- An inequitable allocation of resources implies that the distribution of income and wealth is inequitable. Judgments about equity are normative judgments. +



## TRY IT!

Draw hypothetical demand and supply curves for a typical product, say coffee. Now show the areas of consumer and producer surplus. Under what circumstances is the market likely to be efficient? 

### Case in Point: Saving the Elephant Through Property Rights

Figure 6.13.



The African elephant, the world's largest land mammal, seemed to be in danger of extinction in the 20th century. The population of African elephants fell from 1.3 million in 1979 to 543,000 in 1994. The most dramatic loss of elephants came in Kenya, where the population fell from 167,000 early in the 1970s to about 26,000 in 1997, according to the World Wildlife Fund. To combat the slaughter, an international agreement, the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), went into effect in 1989. It banned the sale of ivory. 

Despite CITES and armed patrols with orders to shoot poachers on sight, the poachers continued to operate in Kenya, killing roughly 200 elephants per day. The elephants were killed for their ivory; the tusks from a single animal could be sold for \$2,000 in the black market—nearly double the annual per capita income in Kenya. 

Several African nations, however, have taken a radically different approach. They have established exclusive, transferable property rights in licenses to hunt elephants. In each of these nations, elephant populations have increased. These nations include Botswana, Namibia, South Africa, Tanzania, Zambia, and Zimbabwe. In

Botswana, for example, the elephant population increased from 20,000 in 1981 to 80,000 in 2000. Zimbabwe increased its elephant population from 30,000 in 1978 to nearly 90,000 in 2000. +

Professors Michael A. McPherson and Michael L. Nieswiadomy of the University of North Texas have done a statistical analysis of the determinants of elephant populations in 35 African nations. They found that elephant populations increased in nations that had (a) established exclusive, transferable property rights in licenses to hunt elephants and (b) had stable political systems. Conversely, elephant populations declined in countries that had failed to establish property rights and that had unstable political systems. +

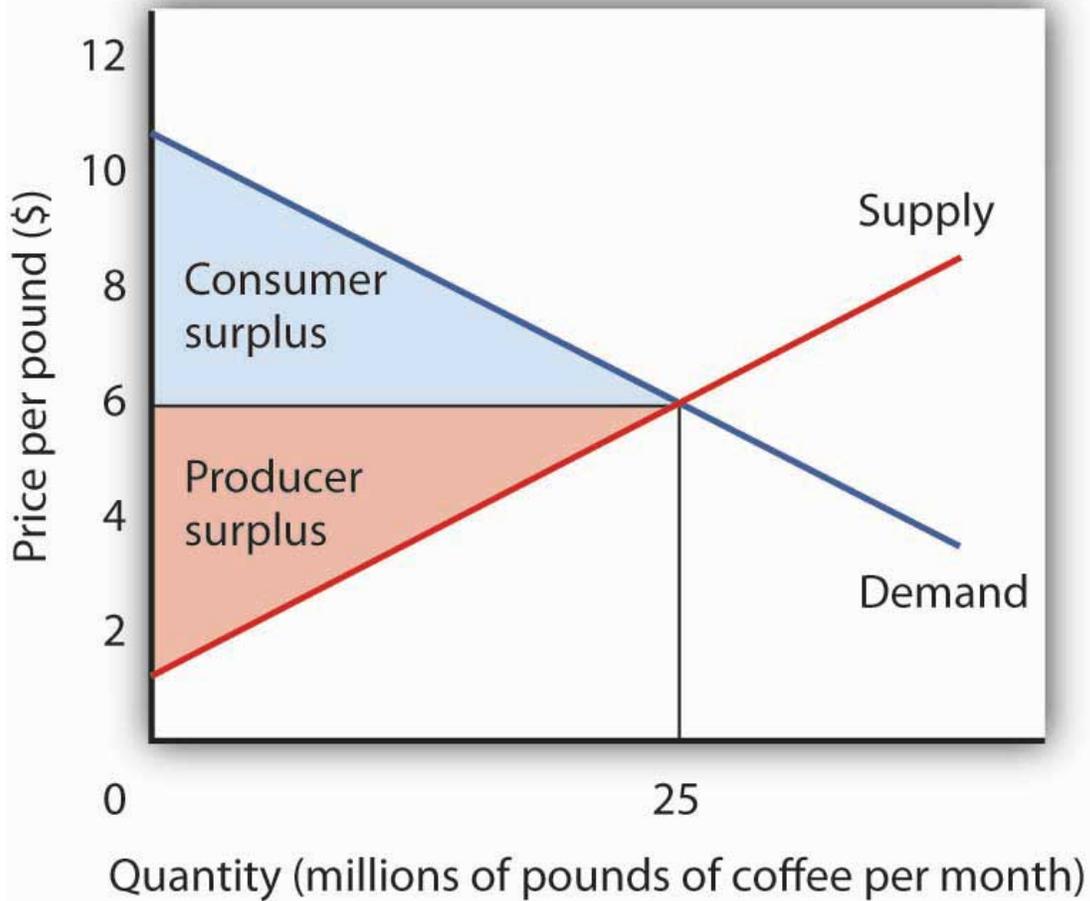
The same appears to be true of the white rhinoceros, a creature whose horns are highly valued in Asia as an aphrodisiac. South Africa sells permits to hunt the creatures for \$25,000 per animal. Its rhinoceros herd has increased from 20 in 1900 to more than 7,000 by the late 1990s. +

There is no "secret" to the preservation of species. Establishing clearly defined, transferable property rights virtually assures the preservation of species. Whether it be buffaloes, rhinoceroses, or elephants, property rights establish a market, and that market preserves species. +

+

A N S W E R T O T R Y I T ! P R O B L E M

**Figure 6.14.**



+

On the assumption that the coffee market is competitive and that it is characterized by well-defined exclusive and transferable property rights, the coffee market meets the efficiency condition. That means that the allocation of resources shown at the equilibrium will be the one that maximizes the net benefit of all activities. The net benefit is shared by coffee consumers (as measured by consumer surplus) and coffee producers (as measured by producer surplus).+