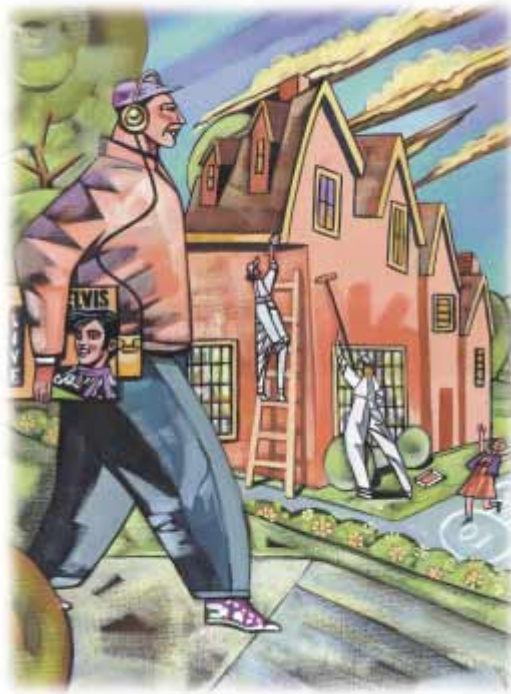


7



CONSUMERS, PRODUCERS, AND THE EFFICIENCY OF MARKETS

When consumers go to grocery stores to buy their turkeys for Thanksgiving dinner, they may be disappointed that the price of turkey is as high as it is. At the same time, when farmers bring to market the turkeys they have raised, they wish the price of turkey were even higher. These views are not surprising: Buyers always want to pay less, and sellers always want to get paid more. But is there a “right price” for turkey from the standpoint of society as a whole?

In previous chapters we saw how, in market economies, the forces of supply and demand determine the prices of goods and services and the quantities sold. So far, however, we have described the way markets allocate scarce resources without directly addressing the question of whether these market allocations are desirable. In other words, our analysis has been *positive* (what is) rather than *normative* (what

IN THIS CHAPTER YOU WILL . . .

Examine the link between buyers' willingness to pay for a good and the demand curve

Learn how to define and measure consumer surplus

Examine the link between sellers' costs of producing a good and the supply curve

Learn how to define and measure producer surplus

See that the equilibrium of supply and demand maximizes total surplus in a market

welfare economics
*the study of how the allocation of
resources affects economic well-being*



should be). We know that the price of turkey adjusts to ensure that the quantity of turkey supplied equals the quantity of turkey demanded. But, at this equilibrium, is the quantity of turkey produced and consumed too small, too large, or just right?

In this chapter we take up the topic of **welfare economics**, the study of how the allocation of resources affects economic well-being. We begin by examining the benefits that buyers and sellers receive from taking part in a market. We then examine how society can make these benefits as large as possible. This analysis leads to a profound conclusion: The equilibrium of supply and demand in a market maximizes the total benefits received by buyers and sellers.

As you may recall from Chapter 1, one of the *Ten Principles of Economics* is that markets are usually a good way to organize economic activity. The study of welfare economics explains this principle more fully. It also answers our question about the right price of turkey: The price that balances the supply and demand for turkey is, in a particular sense, the best one because it maximizes the total welfare of turkey consumers and turkey producers.

CONSUMER SURPLUS

We begin our study of welfare economics by looking at the benefits buyers receive from participating in a market.

WILLINGNESS TO PAY

Imagine that you own a mint-condition recording of Elvis Presley's first album. Because you are not an Elvis Presley fan, you decide to sell it. One way to do so is to hold an auction.

Four Elvis fans show up for your auction: John, Paul, George, and Ringo. Each of them would like to own the album, but there is a limit to the amount that each is willing to pay for it. Table 7-1 shows the maximum price that each of the four possible buyers would pay. Each buyer's maximum is called his **willingness to pay**, and it measures how much that buyer values the good. Each buyer would be eager to buy the album at a price less than his willingness to pay, would refuse to

willingness to pay
*the maximum amount that a buyer
will pay for a good*

Table 7-1

FOUR POSSIBLE BUYERS'
WILLINGNESS TO PAY

BUYER	WILLINGNESS TO PAY
John	\$100
Paul	80
George	70
Ringo	50

buy the album at a price more than his willingness to pay, and would be indifferent about buying the album at a price exactly equal to his willingness to pay.

To sell your album, you begin the bidding at a low price, say \$10. Because all four buyers are willing to pay much more, the price rises quickly. The bidding stops when John bids \$80 (or slightly more). At this point, Paul, George, and Ringo have dropped out of the bidding, because they are unwilling to bid any more than \$80. John pays you \$80 and gets the album. Note that the album has gone to the buyer who values the album most highly.

What benefit does John receive from buying the Elvis Presley album? In a sense, John has found a real bargain: He is willing to pay \$100 for the album but pays only \$80 for it. We say that John receives *consumer surplus* of \$20. **Consumer surplus** is the amount a buyer is willing to pay for a good minus the amount the buyer actually pays for it.

consumer surplus

a buyer's willingness to pay minus the amount the buyer actually pays

Consumer surplus measures the benefit to buyers of participating in a market. In this example, John receives a \$20 benefit from participating in the auction because he pays only \$80 for a good he values at \$100. Paul, George, and Ringo get no consumer surplus from participating in the auction, because they left without the album and without paying anything.

Now consider a somewhat different example. Suppose that you had two identical Elvis Presley albums to sell. Again, you auction them off to the four possible buyers. To keep things simple, we assume that both albums are to be sold for the same price and that no buyer is interested in buying more than one album. Therefore, the price rises until two buyers are left.

In this case, the bidding stops when John and Paul bid \$70 (or slightly higher). At this price, John and Paul are each happy to buy an album, and George and Ringo are not willing to bid any higher. John and Paul each receive consumer surplus equal to his willingness to pay minus the price. John's consumer surplus is \$30, and Paul's is \$10. John's consumer surplus is higher now than it was previously, because he gets the same album but pays less for it. The total consumer surplus in the market is \$40.

USING THE DEMAND CURVE TO MEASURE CONSUMER SURPLUS

Consumer surplus is closely related to the demand curve for a product. To see how they are related, let's continue our example and consider the demand curve for this rare Elvis Presley album.

We begin by using the willingness to pay of the four possible buyers to find the demand schedule for the album. Table 7-2 shows the demand schedule that corresponds to Table 7-1. If the price is above \$100, the quantity demanded in the market is 0, because no buyer is willing to pay that much. If the price is between \$80 and \$100, the quantity demanded is 1, because only John is willing to pay such a high price. If the price is between \$70 and \$80, the quantity demanded is 2, because both John and Paul are willing to pay the price. We can continue this analysis for other prices as well. In this way, the demand schedule is derived from the willingness to pay of the four possible buyers.

Figure 7-1 graphs the demand curve that corresponds to this demand schedule. Note the relationship between the height of the demand curve and the buyers' willingness to pay. At any quantity, the price given by the demand curve shows

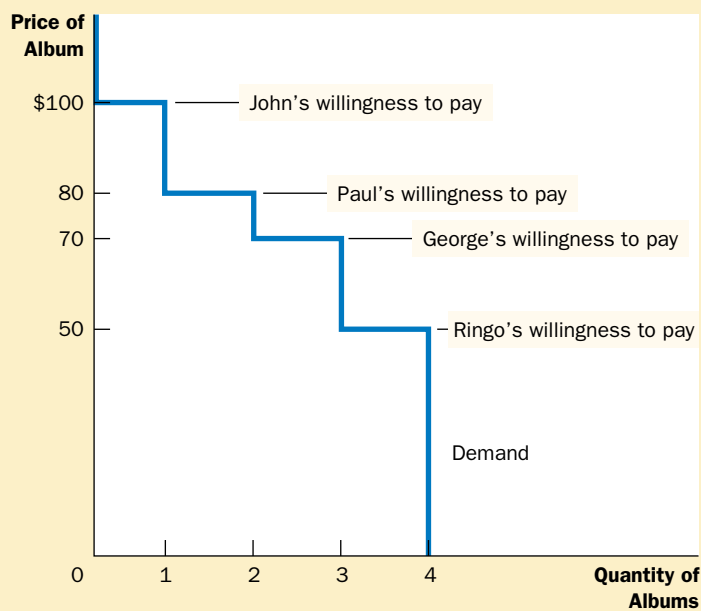
Table 7-2

THE DEMAND SCHEDULE FOR THE BUYERS IN TABLE 7-1

PRICE	BUYERS	QUANTITY DEMANDED
More than \$100	None	0
\$80 to \$100	John	1
\$70 to \$80	John, Paul	2
\$50 to \$70	John, Paul, George	3
\$50 or less	John, Paul, George, Ringo	4

Figure 7-1

THE DEMAND CURVE. This figure graphs the demand curve from the demand schedule in Table 7-2. Note that the height of the demand curve reflects buyers' willingness to pay.



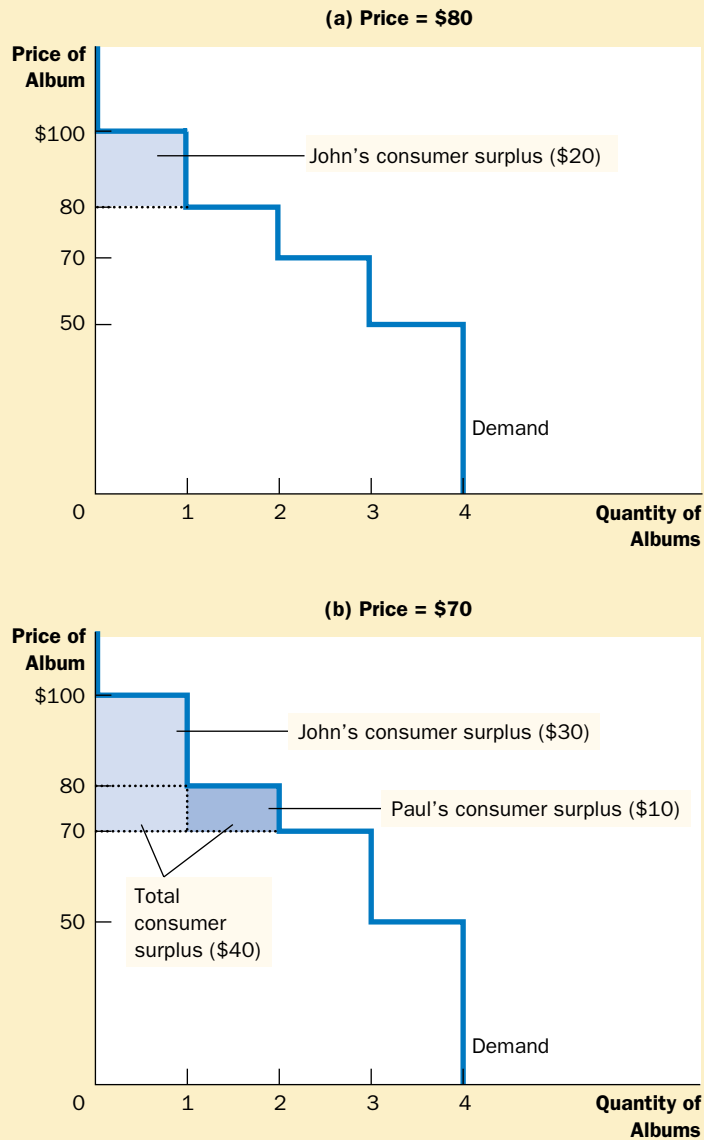
the willingness to pay of the *marginal buyer*, the buyer who would leave the market first if the price were any higher. At a quantity of 4 albums, for instance, the demand curve has a height of \$50, the price that Ringo (the marginal buyer) is willing to pay for an album. At a quantity of 3 albums, the demand curve has a height of \$70, the price that George (who is now the marginal buyer) is willing to pay.

Because the demand curve reflects buyers' willingness to pay, we can also use it to measure consumer surplus. Figure 7-2 uses the demand curve to compute consumer surplus in our example. In panel (a), the price is \$80 (or slightly above), and the quantity demanded is 1. Note that the area above the price and below the demand curve equals \$20. This amount is exactly the consumer surplus we computed earlier when only 1 album is sold.

Panel (b) of Figure 7-2 shows consumer surplus when the price is \$70 (or slightly above). In this case, the area above the price and below the demand curve

Figure 7-2

MEASURING CONSUMER SURPLUS WITH THE DEMAND CURVE. In panel (a), the price of the good is \$80, and the consumer surplus is \$20. In panel (b), the price of the good is \$70, and the consumer surplus is \$40.



equals the total area of the two rectangles: John's consumer surplus at this price is \$30 and Paul's is \$10. This area equals a total of \$40. Once again, this amount is the consumer surplus we computed earlier.

The lesson from this example holds for all demand curves: *The area below the demand curve and above the price measures the consumer surplus in a market.* The reason is that the height of the demand curve measures the value buyers place on the good, as measured by their willingness to pay for it. The difference between this willingness to pay and the market price is each buyer's consumer surplus. Thus, the total area below the demand curve and above the price is the sum of the consumer surplus of all buyers in the market for a good or service.

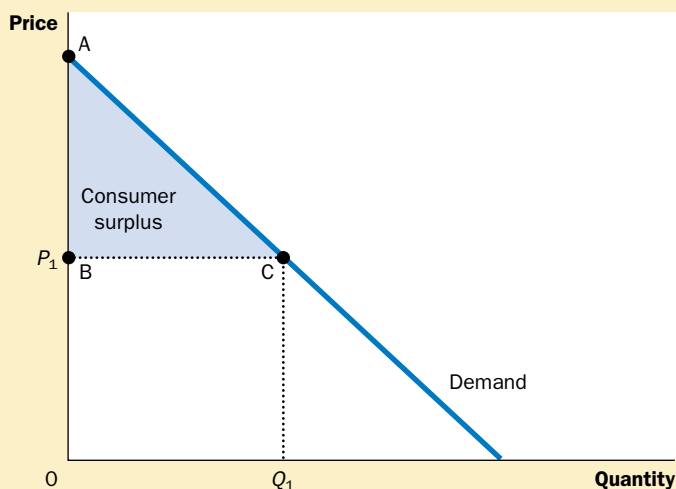
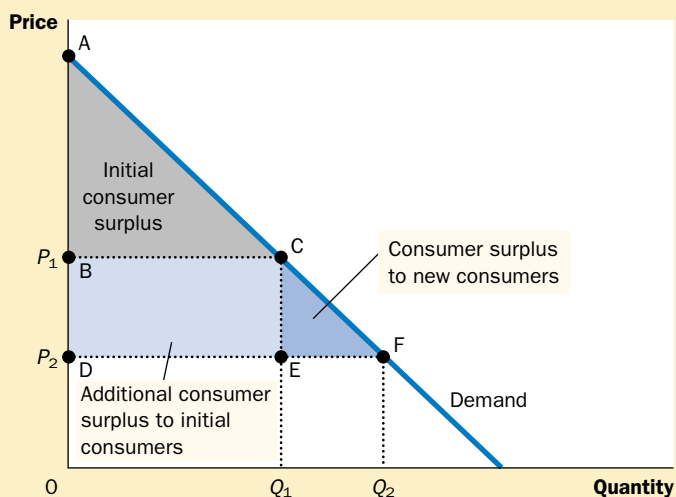
HOW A LOWER PRICE RAISES CONSUMER SURPLUS

Because buyers always want to pay less for the goods they buy, a lower price makes buyers of a good better off. But how much does buyers' well-being rise in response to a lower price? We can use the concept of consumer surplus to answer this question precisely.

Figure 7-3 shows a typical downward-sloping demand curve. Although this demand curve appears somewhat different in shape from the steplike demand curves in our previous two figures, the ideas we have just developed apply nonetheless: Consumer surplus is the area above the price and below the demand curve. In panel (a), consumer surplus at a price of P_1 is the area of triangle ABC.

Figure 7-3

HOW THE PRICE AFFECTS CONSUMER SURPLUS. In panel (a), the price is P_1 , the quantity demanded is Q_1 , and consumer surplus equals the area of the triangle ABC. When the price falls from P_1 to P_2 , as in panel (b), the quantity demanded rises from Q_1 to Q_2 , and the consumer surplus rises to the area of the triangle ADF. The increase in consumer surplus (area BCFD) occurs in part because existing consumers now pay less (area BCED) and in part because new consumers enter the market at the lower price (area CEF).

(a) Consumer Surplus at Price P_1 **(b) Consumer Surplus at Price P_2** 

Now suppose that the price falls from P_1 to P_2 , as shown in panel (b). The consumer surplus now equals area ADF. The increase in consumer surplus attributable to the lower price is the area BCFD.

This increase in consumer surplus is composed of two parts. First, those buyers who were already buying Q_1 of the good at the higher price P_1 are better off because they now pay less. The increase in consumer surplus of existing buyers is the reduction in the amount they pay; it equals the area of the rectangle BCED. Second, some new buyers enter the market because they are now willing to buy the good at the lower price. As a result, the quantity demanded in the market increases from Q_1 to Q_2 . The consumer surplus these newcomers receive is the area of the triangle CEF.

WHAT DOES CONSUMER SURPLUS MEASURE?

Our goal in developing the concept of consumer surplus is to make normative judgments about the desirability of market outcomes. Now that you have seen what consumer surplus is, let's consider whether it is a good measure of economic well-being.

Imagine that you are a policymaker trying to design a good economic system. Would you care about the amount of consumer surplus? Consumer surplus, the amount that buyers are willing to pay for a good minus the amount they actually pay for it, measures the benefit that buyers receive from a good *as the buyers themselves perceive it*. Thus, consumer surplus is a good measure of economic well-being if policymakers want to respect the preferences of buyers.

In some circumstances, policymakers might choose not to care about consumer surplus because they do not respect the preferences that drive buyer behavior. For example, drug addicts are willing to pay a high price for heroin. Yet we would not say that addicts get a large benefit from being able to buy heroin at a low price (even though addicts might say they do). From the standpoint of society, willingness to pay in this instance is not a good measure of the buyers' benefit, and consumer surplus is not a good measure of economic well-being, because addicts are not looking after their own best interests.

In most markets, however, consumer surplus does reflect economic well-being. Economists normally presume that buyers are rational when they make decisions and that their preferences should be respected. In this case, consumers are the best judges of how much benefit they receive from the goods they buy.

QUICK QUIZ: Draw a demand curve for turkey. In your diagram, show a price of turkey and the consumer surplus that results from that price. Explain in words what this consumer surplus measures.

PRODUCER SURPLUS

We now turn to the other side of the market and consider the benefits sellers receive from participating in a market. As you will see, our analysis of sellers' welfare is similar to our analysis of buyers' welfare.

COST AND THE WILLINGNESS TO SELL

cost
the value of everything a seller must give up to produce a good

Imagine now that you are a homeowner, and you need to get your house painted. You turn to four sellers of painting services: Mary, Frida, Georgia, and Grandma. Each painter is willing to do the work for you if the price is right. You decide to take bids from the four painters and auction off the job to the painter who will do the work for the lowest price.

Each painter is willing to take the job if the price she would receive exceeds her cost of doing the work. Here the term **cost** should be interpreted as the painters' opportunity cost: It includes the painters' out-of-pocket expenses (for paint, brushes, and so on) as well as the value that the painters place on their own time. Table 7-3 shows each painter's cost. Because a painter's cost is the lowest price she would accept for her work, cost is a measure of her willingness to sell her services. Each painter would be eager to sell her services at a price greater than her cost, would refuse to sell her services at a price less than her cost, and would be indifferent about selling her services at a price exactly equal to her cost.

When you take bids from the painters, the price might start off high, but it quickly falls as the painters compete for the job. Once Grandma has bid \$600 (or slightly less), she is the sole remaining bidder. Grandma is happy to do the job for this price, because her cost is only \$500. Mary, Frida, and Georgia are unwilling to do the job for less than \$600. Note that the job goes to the painter who can do the work at the lowest cost.

producer surplus
the amount a seller is paid for a good minus the seller's cost

What benefit does Grandma receive from getting the job? Because she is willing to do the work for \$500 but gets \$600 for doing it, we say that she receives *producer surplus* of \$100. **Producer surplus** is the amount a seller is paid minus the cost of production. Producer surplus measures the benefit to sellers of participating in a market.

Now consider a somewhat different example. Suppose that you have two houses that need painting. Again, you auction off the jobs to the four painters. To keep things simple, let's assume that no painter is able to paint both houses and that you will pay the same amount to paint each house. Therefore, the price falls until two painters are left.

In this case, the bidding stops when Georgia and Grandma each offer to do the job for a price of \$800 (or slightly less). At this price, Georgia and Grandma are willing to do the work, and Mary and Frida are not willing to bid a lower price. At a price of \$800, Grandma receives producer surplus of \$300, and Georgia receives producer surplus of \$200. The total producer surplus in the market is \$500.

Table 7-3

THE COSTS OF FOUR POSSIBLE SELLERS

SELLER	COST
Mary	\$900
Frida	800
Georgia	600
Grandma	500

USING THE SUPPLY CURVE TO MEASURE PRODUCER SURPLUS

Just as consumer surplus is closely related to the demand curve, producer surplus is closely related to the supply curve. To see how, let's continue our example.

We begin by using the costs of the four painters to find the supply schedule for painting services. Table 7-4 shows the supply schedule that corresponds to the costs in Table 7-3. If the price is below \$500, none of the four painters is willing to do the job, so the quantity supplied is zero. If the price is between \$500 and \$600, only Grandma is willing to do the job, so the quantity supplied is 1. If the price is between \$600 and \$800, Grandma and Georgia are willing to do the job, so the quantity supplied is 2, and so on. Thus, the supply schedule is derived from the costs of the four painters.

Figure 7-4 graphs the supply curve that corresponds to this supply schedule. Note that the height of the supply curve is related to the sellers' costs. At any quantity, the price given by the supply curve shows the cost of the *marginal seller*, the

Table 7-4

THE SUPPLY SCHEDULE FOR THE SELLERS IN TABLE 7-3

PRICE	SELLERS	QUANTITY SUPPLIED
\$900 or more	Mary, Frida, Georgia, Grandma	4
\$800 to \$900	Frida, Georgia, Grandma	3
\$600 to \$800	Georgia, Grandma	2
\$500 to \$600	Grandma	1
Less than \$500	None	0

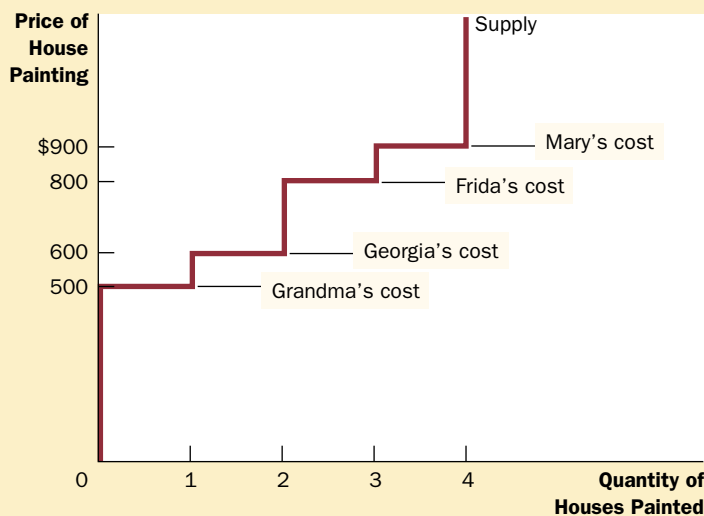


Figure 7-4

THE SUPPLY CURVE. This figure graphs the supply curve from the supply schedule in Table 7-4. Note that the height of the supply curve reflects sellers' costs.

seller who would leave the market first if the price were any lower. At a quantity of 4 houses, for instance, the supply curve has a height of \$900, the cost that Mary (the marginal seller) incurs to provide her painting services. At a quantity of 3 houses, the supply curve has a height of \$800, the cost that Frida (who is now the marginal seller) incurs.

Because the supply curve reflects sellers' costs, we can use it to measure producer surplus. Figure 7-5 uses the supply curve to compute producer surplus in our example. In panel (a), we assume that the price is \$600. In this case, the quantity supplied is 1. Note that the area below the price and above the supply curve equals \$100. This amount is exactly the producer surplus we computed earlier for Grandma.

Panel (b) of Figure 7-5 shows producer surplus at a price of \$800. In this case, the area below the price and above the supply curve equals the total area of the two rectangles. This area equals \$500, the producer surplus we computed earlier for Georgia and Grandma when two houses needed painting.

The lesson from this example applies to all supply curves: *The area below the price and above the supply curve measures the producer surplus in a market.* The logic is straightforward: The height of the supply curve measures sellers' costs, and the difference between the price and the cost of production is each seller's producer surplus. Thus, the total area is the sum of the producer surplus of all sellers.

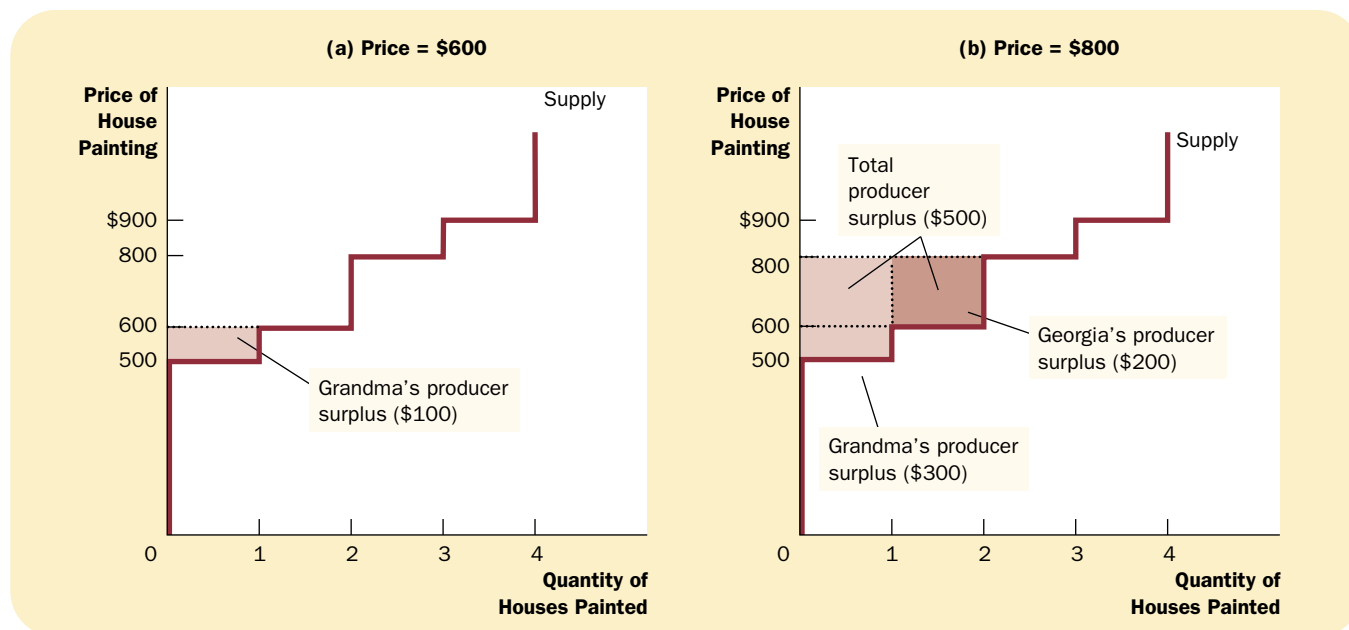


Figure 7-5

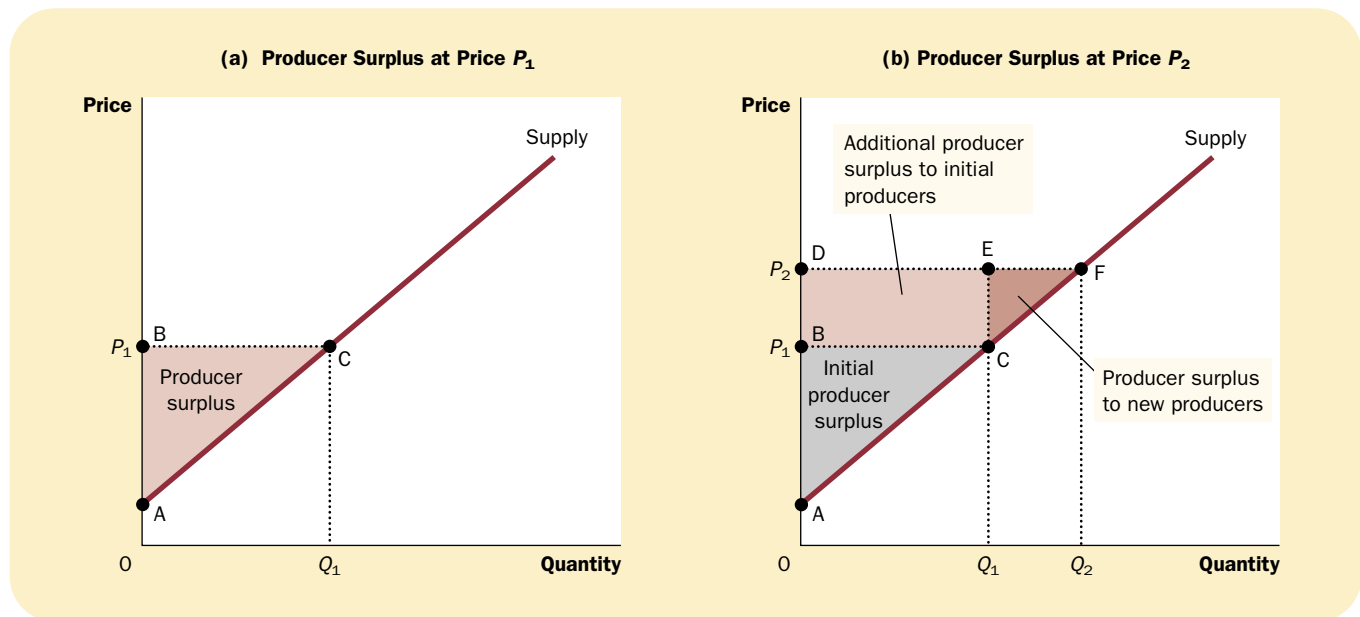
MEASURING PRODUCER SURPLUS WITH THE SUPPLY CURVE. In panel (a), the price of the good is \$600, and the producer surplus is \$100. In panel (b), the price of the good is \$800, and the producer surplus is \$500.

HOW A HIGHER PRICE RAISES PRODUCER SURPLUS

You will not be surprised to hear that sellers always want to receive a higher price for the goods they sell. But how much does sellers' well-being rise in response to a higher price? The concept of producer surplus offers a precise answer to this question.

Figure 7-6 shows a typical upward-sloping supply curve. Even though this supply curve differs in shape from the steplike supply curves in the previous figure, we measure producer surplus in the same way: Producer surplus is the area below the price and above the supply curve. In panel (a), the price is P_1 , and producer surplus is the area of triangle ABC.

Panel (b) shows what happens when the price rises from P_1 to P_2 . Producer surplus now equals area ADF. This increase in producer surplus has two parts. First, those sellers who were already selling Q_1 of the good at the lower price P_1 are better off because they now get more for what they sell. The increase in producer surplus for existing sellers equals the area of the rectangle BCED. Second, some new sellers enter the market because they are now willing to produce the good at the higher price, resulting in an increase in the quantity supplied from Q_1 to Q_2 . The producer surplus of these newcomers is the area of the triangle CEF.



HOW THE PRICE AFFECTS PRODUCER SURPLUS. In panel (a), the price is P_1 , the quantity demanded is Q_1 , and producer surplus equals the area of the triangle ABC. When the price rises from P_1 to P_2 , as in panel (b), the quantity supplied rises from Q_1 to Q_2 , and the producer surplus rises to the area of the triangle ADF. The increase in producer surplus (area BCFD) occurs in part because existing producers now receive more (area BCED) and in part because new producers enter the market at the higher price (area CEF).

Figure 7-6

As this analysis shows, we use producer surplus to measure the well-being of sellers in much the same way as we use consumer surplus to measure the well-being of buyers. Because these two measures of economic welfare are so similar, it is natural to use them together. And, indeed, that is exactly what we do in the next section.

QUICK QUIZ: Draw a supply curve for turkey. In your diagram, show a price of turkey and the producer surplus that results from that price. Explain in words what this producer surplus measures.

MARKET EFFICIENCY

Consumer surplus and producer surplus are the basic tools that economists use to study the welfare of buyers and sellers in a market. These tools can help us address a fundamental economic question: Is the allocation of resources determined by free markets in any way desirable?

THE BENEVOLENT SOCIAL PLANNER

To evaluate market outcomes, we introduce into our analysis a new, hypothetical character, called the benevolent social planner. The benevolent social planner is an all-knowing, all-powerful, well-intentioned dictator. The planner wants to maximize the economic well-being of everyone in society. What do you suppose this planner should do? Should he just leave buyers and sellers at the equilibrium that they reach naturally on their own? Or can he increase economic well-being by altering the market outcome in some way?

To answer this question, the planner must first decide how to measure the economic well-being of a society. One possible measure is the sum of consumer and producer surplus, which we call *total surplus*. Consumer surplus is the benefit that buyers receive from participating in a market, and producer surplus is the benefit that sellers receive. It is therefore natural to use total surplus as a measure of society's economic well-being.

To better understand this measure of economic well-being, recall how we measure consumer and producer surplus. We define consumer surplus as

$$\text{Consumer surplus} = \text{Value to buyers} - \text{Amount paid by buyers}.$$

Similarly, we define producer surplus as

$$\text{Producer surplus} = \text{Amount received by sellers} - \text{Cost to sellers}.$$

When we add consumer and producer surplus together, we obtain

$$\begin{aligned} \text{Total surplus} &= \text{Value to buyers} - \text{Amount paid by buyers} \\ &\quad + \text{Amount received by sellers} - \text{Cost to sellers}. \end{aligned}$$

The amount paid by buyers equals the amount received by sellers, so the middle two terms in this expression cancel each other. As a result, we can write total surplus as

$$\text{Total surplus} = \text{Value to buyers} - \text{Cost to sellers}.$$

Total surplus in a market is the total value to buyers of the goods, as measured by their willingness to pay, minus the total cost to sellers of providing those goods.

If an allocation of resources maximizes total surplus, we say that the allocation exhibits **efficiency**. If an allocation is not efficient, then some of the gains from trade among buyers and sellers are not being realized. For example, an allocation is inefficient if a good is not being produced by the sellers with lowest cost. In this case, moving production from a high-cost producer to a low-cost producer will lower the total cost to sellers and raise total surplus. Similarly, an allocation is inefficient if a good is not being consumed by the buyers who value it most highly. In this case, moving consumption of the good from a buyer with a low valuation to a buyer with a high valuation will raise total surplus.

In addition to efficiency, the social planner might also care about **equity**—the fairness of the distribution of well-being among the various buyers and sellers. In essence, the gains from trade in a market are like a pie to be distributed among the market participants. The question of efficiency is whether the pie is as big as possible. The question of equity is whether the pie is divided fairly. Evaluating the equity of a market outcome is more difficult than evaluating the efficiency. Whereas efficiency is an objective goal that can be judged on strictly positive grounds, equity involves normative judgments that go beyond economics and enter into the realm of political philosophy.

In this chapter we concentrate on efficiency as the social planner's goal. Keep in mind, however, that real policymakers often care about equity as well. That is, they care about both the size of the economic pie and how the pie gets sliced and distributed among members of society.

efficiency

the property of a resource allocation of maximizing the total surplus received by all members of society

equity

the fairness of the distribution of well-being among the members of society

EVALUATING THE MARKET EQUILIBRIUM

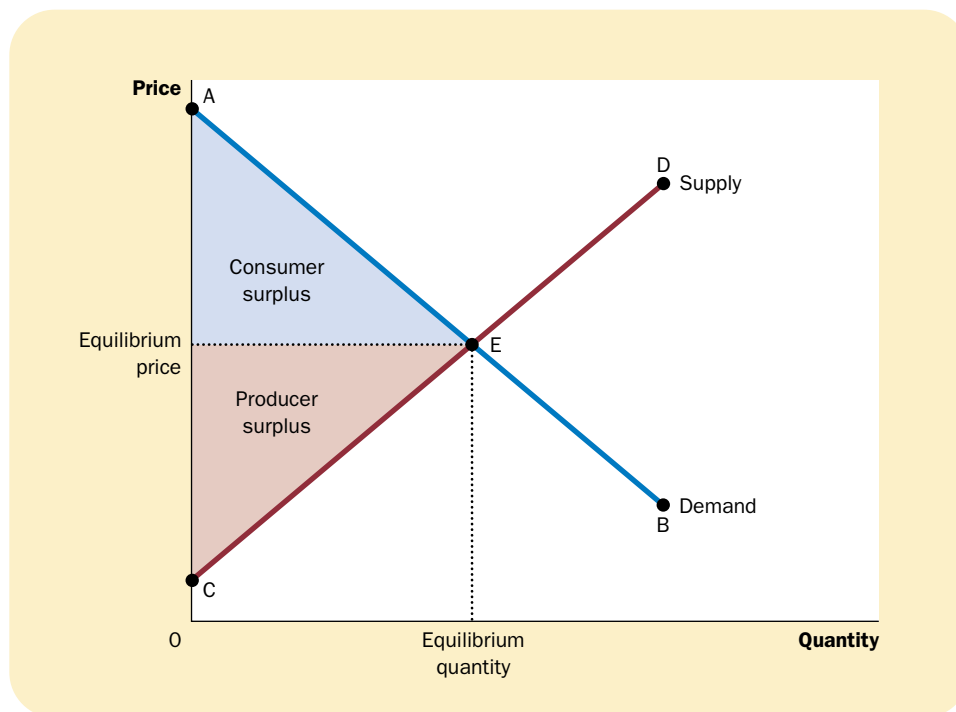
Figure 7-7 shows consumer and producer surplus when a market reaches the equilibrium of supply and demand. Recall that consumer surplus equals the area above the price and under the demand curve and producer surplus equals the area below the price and above the supply curve. Thus, the total area between the supply and demand curves up to the point of equilibrium represents the total surplus from this market.

Is this equilibrium allocation of resources efficient? Does it maximize total surplus? To answer these questions, keep in mind that when a market is in equilibrium, the price determines which buyers and sellers participate in the market. Those buyers who value the good more than the price (represented by the segment AE on the demand curve) choose to buy the good; those buyers who value it less than the price (represented by the segment EB) do not. Similarly, those sellers whose costs are less than the price (represented by the segment CE on the supply curve) choose to produce and sell the good; those sellers whose costs are greater than the price (represented by the segment ED) do not.

These observations lead to two insights about market outcomes:

Figure 7-7

CONSUMER AND PRODUCER SURPLUS IN THE MARKET EQUILIBRIUM. Total surplus—the sum of consumer and producer surplus—is the area between the supply and demand curves up to the equilibrium quantity.



1. Free markets allocate the supply of goods to the buyers who value them most highly, as measured by their willingness to pay.
2. Free markets allocate the demand for goods to the sellers who can produce them at least cost.

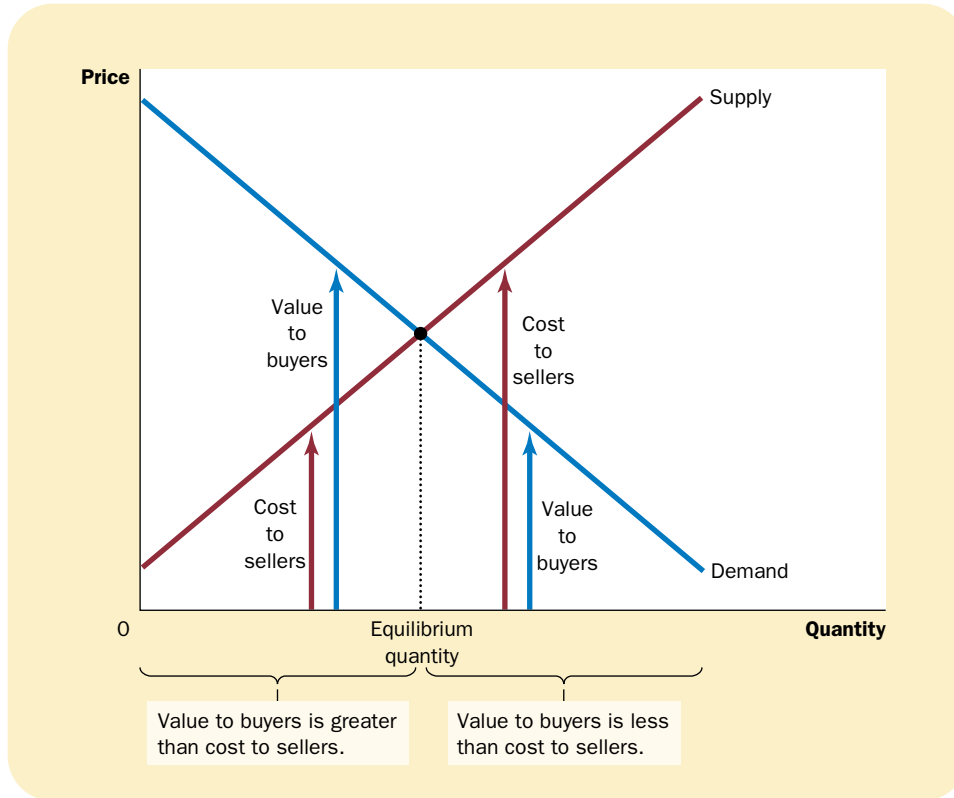
Thus, given the quantity produced and sold in a market equilibrium, the social planner cannot increase economic well-being by changing the allocation of consumption among buyers or the allocation of production among sellers.

But can the social planner raise total economic well-being by increasing or decreasing the quantity of the good? The answer is no, as stated in this third insight about market outcomes:

3. Free markets produce the quantity of goods that maximizes the sum of consumer and producer surplus.

To see why this is true, consider Figure 7-8. Recall that the demand curve reflects the value to buyers and that the supply curve reflects the cost to sellers. At quantities below the equilibrium level, the value to buyers exceeds the cost to sellers. In this region, increasing the quantity raises total surplus, and it continues to do so until the quantity reaches the equilibrium level. Beyond the equilibrium quantity, however, the value to buyers is less than the cost to sellers. Producing more than the equilibrium quantity would, therefore, lower total surplus.

These three insights about market outcomes tell us that the equilibrium of supply and demand maximizes the sum of consumer and producer surplus. In other words, the equilibrium outcome is an efficient allocation of resources. The job of the benevolent social planner is, therefore, very easy: He can leave the market

**Figure 7-8**

THE EFFICIENCY OF THE EQUILIBRIUM QUANTITY. At quantities less than the equilibrium quantity, the value to buyers exceeds the cost to sellers. At quantities greater than the equilibrium quantity, the cost to sellers exceeds the value to buyers. Therefore, the market equilibrium maximizes the sum of producer and consumer surplus.

outcome just as he finds it. This policy of leaving well enough alone goes by the French expression *laissez-faire*, which literally translated means “allow them to do.”

We can now better appreciate Adam Smith’s invisible hand of the marketplace, which we first discussed in Chapter 1. The benevolent social planner doesn’t need to alter the market outcome because the invisible hand has already guided buyers and sellers to an allocation of the economy’s resources that maximizes total surplus. This conclusion explains why economists often advocate free markets as the best way to organize economic activity.

QUICK QUIZ: Draw the supply and demand for turkey. In the equilibrium, show producer and consumer surplus. Explain why producing more turkey would lower total surplus.

CONCLUSION: MARKET EFFICIENCY AND MARKET FAILURE

This chapter introduced the basic tools of welfare economics—consumer and producer surplus—and used them to evaluate the efficiency of free markets. We showed that the forces of supply and demand allocate resources efficiently. That is,

IN THE NEWS

Ticket Scalping



IF AN ECONOMY IS TO ALLOCATE ITS SCARCE resources efficiently, goods must get to those consumers who value them most highly. Ticket scalping is one example of how markets reach efficient outcomes. Scalpers buy tickets to plays, concerts, and sports events and then sell the tickets at a price above their original cost. By charging the highest price the market will bear, scalpers help ensure that consumers with the greatest willingness to pay for the tickets actually do get them. In some places, however, there is debate over whether this market activity should be legal.

Tickets? Supply Meets Demand on Sidewalk

BY JOHN TIERNEY

Ticket scalping has been very good to Kevin Thomas, and he makes no apologies. He sees himself as a classic American entrepreneur: a high school dropout from the Bronx who taught himself a trade, works seven nights a week, earns \$40,000 a year, and at age twenty-six has \$75,000 in savings, all by providing a public service outside New York's theaters and sports arenas.

He has just one complaint. "I've been busted about 30 times in the last year," he said one recent evening, just after making \$280 at a Knicks game. "You learn to deal with it—I give the cops a fake name, and I pay the fines when I have to, but I don't think it's fair. I look at scalping like working as a stockbroker, buying low and selling high. If people are willing to pay me the money, what kind of problem is that?"

It is a significant problem to public officials in New York and New Jersey,



THE INVISIBLE HAND AT WORK

who are cracking down on street scalpers like Mr. Thomas and on licensed ticket brokers. Undercover officers are enforcing new restrictions on reselling tickets at marked-up prices, and the attorneys general of the two states are pressing well-publicized

even though each buyer and seller in a market is concerned only about his or her own welfare, they are together led by an invisible hand to an equilibrium that maximizes the total benefits to buyers and sellers.

A word of warning is in order. To conclude that markets are efficient, we made several assumptions about how markets work. When these assumptions do not hold, our conclusion that the market equilibrium is efficient may no longer be true. As we close this chapter, let's consider briefly two of the most important of these assumptions.

First, our analysis assumed that markets are perfectly competitive. In the world, however, competition is sometimes far from perfect. In some markets, a single buyer or seller (or a small group of them) may be able to control market prices. This ability to influence prices is called *market power*. Market power can cause markets to be inefficient because it keeps the price and quantity away from the equilibrium of supply and demand.

Second, our analysis assumed that the outcome in a market matters only to the buyers and sellers in that market. Yet, in the world, the decisions of buyers and

cases against more than a dozen ticket brokers.

But economists tend to see scalping from Mr. Thomas's perspective. To them, the governments' crusade makes about as much sense as the old campaigns by Communist authorities against "profiteering." Economists argue that the restrictions inconvenience the public, reduce the audience for cultural and sports events, waste the police's time, deprive New York City of tens of millions of dollars of tax revenue, and actually drive up the cost of many tickets.

"It is always good politics to pose as defender of the poor by declaring high prices illegal," says William J. Baumol, the director of the C. V. Starr Center for Applied Economics at New York University. "I expect politicians to try to solve the AIDS crisis by declaring AIDS illegal as well. That would be harmless, because nothing would happen, but when you outlaw high prices you create real problems."

Dr. Baumol was one of the economists who came up with the idea of sell-

ing same-day Broadway tickets for half price at the TKTS booth in Times Square, which theater owners thought dangerously radical when the booth opened in 1973. But the owners have profited by finding a new clientele for tickets that would have gone unsold, an illustration of the free-market tenet that both buyers and sellers ultimately benefit when price is adjusted to meet demand.

Economists see another illustration of that lesson at the Museum of Modern Art, where people wait in line for up to two hours to buy tickets for the Matisse exhibit. But there is an alternative on the sidewalk: Scalpers who evade the police have been selling the \$12.50 tickets to the show at prices ranging from \$20 to \$50.

"You don't have to put a very high value on your time to pay \$10 or \$15 to avoid standing in line for two hours for a Matisse ticket," said Richard H. Thaler, an economist at Cornell University. "Some people think it's fairer to make everyone stand in line, but that forces everyone to engage in a totally unpro-

ductive activity, and it discriminates in favor of people who have the most free time. Scalping gives other people a chance, too. I can see no justification for outlawing it." . . .

Politicians commonly argue that without anti-scalping laws, tickets would become unaffordable to most people, but California has no laws against scalping, and ticket prices there are not notoriously high. And as much as scalpers would like to inflate prices, only a limited number of people are willing to pay \$100 for a ticket. . . .

Legalizing scalping, however, would not necessarily be good news for everyone. Mr. Thomas, for instance, fears that the extra competition might put him out of business. But after 16 years—he started at age ten outside of Yankee Stadium—he is thinking it might be time for a change anyway.

SOURCE: *The New York Times*, December 26, 1992, p. A1.

sellers sometimes affect people who are not participants in the market at all. Pollution is the classic example of a market outcome that affects people not in the market. Such side effects, called *externalities*, cause welfare in a market to depend on more than just the value to the buyers and the cost to the sellers. Because buyers and sellers do not take these side effects into account when deciding how much to consume and produce, the equilibrium in a market can be inefficient from the standpoint of society as a whole.

Market power and externalities are examples of a general phenomenon called *market failure*—the inability of some unregulated markets to allocate resources efficiently. When markets fail, public policy can potentially remedy the problem and increase economic efficiency. Microeconomists devote much effort to studying when market failure is likely and what sorts of policies are best at correcting market failures. As you continue your study of economics, you will see that the tools of welfare economics developed here are readily adapted to that endeavor.

Despite the possibility of market failure, the invisible hand of the marketplace is extraordinarily important. In many markets, the assumptions we made in this

chapter work well, and the conclusion of market efficiency applies directly. Moreover, our analysis of welfare economics and market efficiency can be used to shed light on the effects of various government policies. In the next two chapters we apply the tools we have just developed to study two important policy issues—the welfare effects of taxation and of international trade.

Summary

- ◆ Consumer surplus equals buyers' willingness to pay for a good minus the amount they actually pay for it, and it measures the benefit buyers get from participating in a market. Consumer surplus can be computed by finding the area below the demand curve and above the price.
- ◆ Producer surplus equals the amount sellers receive for their goods minus their costs of production, and it measures the benefit sellers get from participating in a market. Producer surplus can be computed by finding the area below the price and above the supply curve.
- ◆ An allocation of resources that maximizes the sum of consumer and producer surplus is said to be efficient.
- ◆ Policymakers are often concerned with the efficiency, as well as the equity, of economic outcomes.
- ◆ The equilibrium of supply and demand maximizes the sum of consumer and producer surplus. That is, the invisible hand of the marketplace leads buyers and sellers to allocate resources efficiently.
- ◆ Markets do not allocate resources efficiently in the presence of market failures such as market power or externalities.

Key Concepts

welfare economics, p. 142
willingness to pay, p. 142
consumer surplus, p. 143

cost, p. 148
producer surplus, p. 148

efficiency, p. 153
equity, p. 153

Questions for Review

1. Explain how buyers' willingness to pay, consumer surplus, and the demand curve are related.
2. Explain how sellers' costs, producer surplus, and the supply curve are related.
3. In a supply-and-demand diagram, show producer and consumer surplus in the market equilibrium.
4. What is efficiency? Is it the only goal of economic policymakers?
5. What does the invisible hand do?
6. Name two types of market failure. Explain why each may cause market outcomes to be inefficient.

Problems and Applications

1. An early freeze in California sours the lemon crop. What happens to consumer surplus in the market for lemons? What happens to consumer surplus in the market for lemonade? Illustrate your answers with diagrams.
2. Suppose the demand for French bread rises. What happens to producer surplus in the market for French bread? What happens to producer surplus in the market for flour? Illustrate your answer with diagrams.

3. It is a hot day, and Bert is very thirsty. Here is the value he places on a bottle of water:

Value of first bottle	\$7
Value of second bottle	5
Value of third bottle	3
Value of fourth bottle	1

- From this information, derive Bert's demand schedule. Graph his demand curve for bottled water.
 - If the price of a bottle of water is \$4, how many bottles does Bert buy? How much consumer surplus does Bert get from his purchases? Show Bert's consumer surplus in your graph.
 - If the price falls to \$2, how does quantity demanded change? How does Bert's consumer surplus change? Show these changes in your graph.
4. Ernie owns a water pump. Because pumping large amounts of water is harder than pumping small amounts, the cost of producing a bottle of water rises as he pumps more. Here is the cost he incurs to produce each bottle of water:

Cost of first bottle	\$1
Cost of second bottle	3
Cost of third bottle	5
Cost of fourth bottle	7

- From this information, derive Ernie's supply schedule. Graph his supply curve for bottled water.
 - If the price of a bottle of water is \$4, how many bottles does Ernie produce and sell? How much producer surplus does Ernie get from these sales? Show Ernie's producer surplus in your graph.
 - If the price rises to \$6, how does quantity supplied change? How does Ernie's producer surplus change? Show these changes in your graph.
5. Consider a market in which Bert from Problem 3 is the buyer and Ernie from Problem 4 is the seller.
- Use Ernie's supply schedule and Bert's demand schedule to find the quantity supplied and quantity demanded at prices of \$2, \$4, and \$6. Which of these prices brings supply and demand into equilibrium?
 - What are consumer surplus, producer surplus, and total surplus in this equilibrium?
 - If Ernie produced and Bert consumed one less bottle of water, what would happen to total surplus?

- If Ernie produced and Bert consumed one additional bottle of water, what would happen to total surplus?

6. The cost of producing stereo systems has fallen over the past several decades. Let's consider some implications of this fact.
- Use a supply-and-demand diagram to show the effect of falling production costs on the price and quantity of stereos sold.
 - In your diagram, show what happens to consumer surplus and producer surplus.
 - Suppose the supply of stereos is very elastic. Who benefits most from falling production costs—consumers or producers of stereos?
7. There are four consumers willing to pay the following amounts for haircuts:

Jerry: \$7 Oprah: \$2 Sally Jessy: \$8 Montel: \$5

There are four haircutting businesses with the following costs:

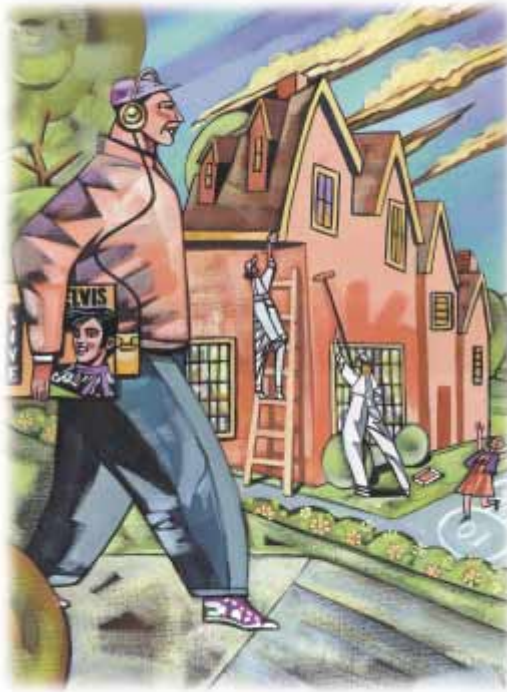
Firm A: \$3 Firm B: \$6 Firm C: \$4 Firm D: \$2

Each firm has the capacity to produce only one haircut. For efficiency, how many haircuts should be given? Which businesses should cut hair, and which consumers should have their hair cut? How large is the maximum possible total surplus?

8. Suppose a technological advance reduces the cost of making computers.
- Use a supply-and-demand diagram to show what happens to price, quantity, consumer surplus, and producer surplus in the market for computers.
 - Computers and adding machines are substitutes. Use a supply-and-demand diagram to show what happens to price, quantity, consumer surplus, and producer surplus in the market for adding machines. Should adding machine producers be happy or sad about the technological advance in computers?
 - Computers and software are complements. Use a supply-and-demand diagram to show what happens to price, quantity, consumer surplus, and producer surplus in the market for software. Should software producers be happy or sad about the technological advance in computers?
 - Does this analysis help explain why Bill Gates, a software producer, is one of the world's richest men?

9. Consider how health insurance affects the quantity of health care services performed. Suppose that the typical medical procedure has a cost of \$100, yet a person with health insurance pays only \$20 out-of-pocket when she chooses to have an additional procedure performed. Her insurance company pays the remaining \$80. (The insurance company will recoup the \$80 through higher premiums for everybody, but the share paid by this individual is small.)
 - a. Draw the demand curve in the market for medical care. (In your diagram, the horizontal axis should represent the number of medical procedures.) Show the quantity of procedures demanded if each procedure has a price of \$100.
 - b. On your diagram, show the quantity of procedures demanded if consumers pay only \$20 per procedure. If the cost of each procedure to society is truly \$100, and if individuals have health insurance as just described, will the number of procedures performed maximize total surplus? Explain.
 - c. Economists often blame the health insurance system for excessive use of medical care. Given your analysis, why might the use of care be viewed as “excessive”?
 - d. What sort of policies might prevent this excessive use?
10. Many parts of California experienced a severe drought in the late 1980s and early 1990s.
 - a. Use a diagram of the water market to show the effects of the drought on the equilibrium price and quantity of water.
 - b. Many communities did not allow the price of water to change, however. What is the effect of this policy on the water market? Show on your diagram any surplus or shortage that arises.
 - c. A 1991 op-ed piece in *The Wall Street Journal* stated that “all Los Angeles residents are required to cut their water usage by 10 percent as of March 1 and another 5 percent starting May 1, based on their 1986 consumption levels.” The author criticized this policy on both efficiency and equity grounds, saying “not only does such a policy reward families who ‘wasted’ more water back in 1986, it does little to encourage consumers who could make more drastic reductions, [and] . . . punishes consumers who cannot so readily reduce their water use.” In what way is the Los Angeles system for allocating water inefficient? In what way does the system seem unfair?
 - d. Suppose instead that Los Angeles allowed the price of water to increase until the quantity demanded equaled the quantity supplied. Would the resulting allocation of water be more efficient? In your view, would it be more or less fair than the proportionate reductions in water use mentioned in the newspaper article? What could be done to make the market solution more fair?

8



APPLICATION: THE COSTS OF TAXATION

Taxes are often a source of heated political debate. In 1776 the anger of the American colonies over British taxes sparked the American Revolution. More than two centuries later Ronald Reagan was elected president on a platform of large cuts in personal income taxes, and during his eight years in the White House the top tax rate on income fell from 70 percent to 28 percent. In 1992 Bill Clinton was elected in part because incumbent George Bush had broken his 1988 campaign promise, "Read my lips: no new taxes."

We began our study of taxes in Chapter 6. There we saw how a tax on a good affects its price and the quantity sold and how the forces of supply and demand divide the burden of a tax between buyers and sellers. In this chapter we extend this analysis and look at how taxes affect welfare, the economic well-being of participants in a market.

**IN THIS CHAPTER
YOU WILL . . .**

***Examine how taxes
reduce consumer
and producer
surplus***

***Learn the meaning
and causes of the
deadweight loss of
a tax***

***Consider why some
taxes have larger
deadweight losses
than others***

***Examine how tax
revenue and
deadweight loss
vary with the size
of a tax***



"You know, the idea of taxation with representation doesn't appeal to me very much, either."

The effects of taxes on welfare might at first seem obvious. The government enacts taxes to raise revenue, and that revenue must come out of someone's pocket. As we saw in Chapter 6, both buyers and sellers are worse off when a good is taxed: A tax raises the price buyers pay and lowers the price sellers receive. Yet to understand fully how taxes affect economic well-being, we must compare the reduced welfare of buyers and sellers to the amount of revenue the government raises. The tools of consumer and producer surplus allow us to make this comparison. The analysis will show that the costs of taxes to buyers and sellers exceeds the revenue raised by the government.

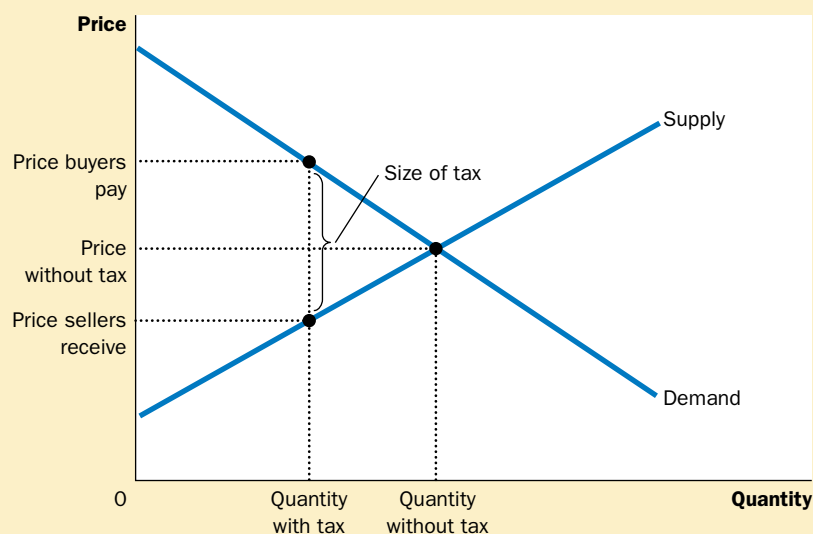
THE DEADWEIGHT LOSS OF TAXATION

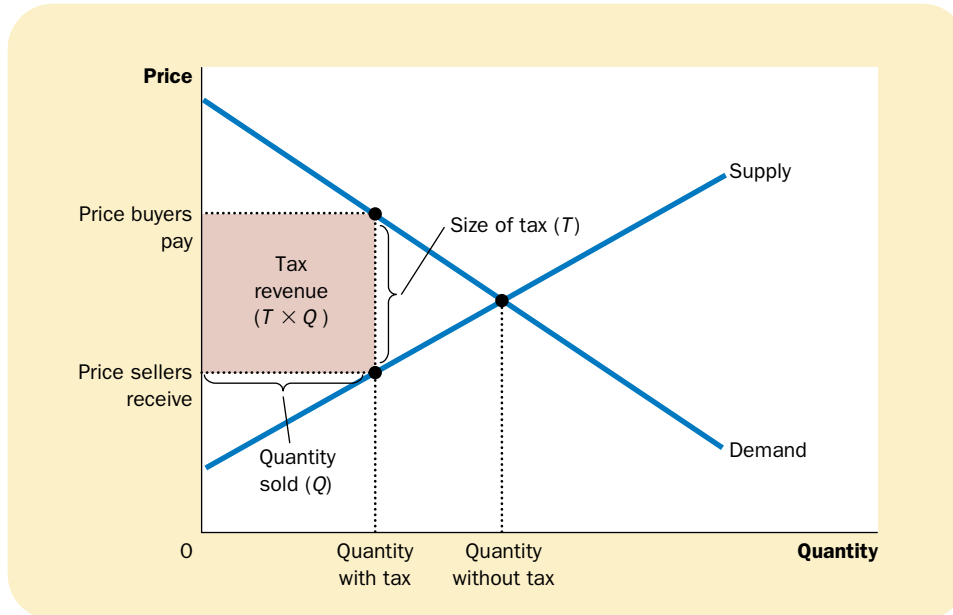
We begin by recalling one of the surprising lessons from Chapter 6: It does not matter whether a tax on a good is levied on buyers or sellers of the good. When a tax is levied on buyers, the demand curve shifts downward by the size of the tax; when it is levied on sellers, the supply curve shifts upward by that amount. In either case, when the tax is enacted, the price paid by buyers rises, and the price received by sellers falls. In the end, buyers and sellers share the burden of the tax, regardless of how it is levied.

Figure 8-1 shows these effects. To simplify our discussion, this figure does not show a shift in either the supply or demand curve, although one curve must shift. Which curve shifts depends on whether the tax is levied on sellers (the supply curve shifts) or buyers (the demand curve shifts). In this chapter, we can simplify the graphs by not bothering to show the shift. The key result for our purposes here

Figure 8-1

THE EFFECTS OF A TAX. A tax on a good places a wedge between the price that buyers pay and the price that sellers receive. The quantity of the good sold falls.



**Figure 8-2**

TAX REVENUE. The tax revenue that the government collects equals $T \times Q$, the size of the tax T times the quantity sold Q . Thus, tax revenue equals the area of the rectangle between the supply and demand curves.

is that the tax places a wedge between the price buyers pay and the price sellers receive. Because of this tax wedge, the quantity sold falls below the level that would be sold without a tax. In other words, a tax on a good causes the size of the market for the good to shrink. These results should be familiar from Chapter 6.

HOW A TAX AFFECTS MARKET PARTICIPANTS

Now let's use the tools of welfare economics to measure the gains and losses from a tax on a good. To do this, we must take into account how the tax affects buyers, sellers, and the government. The benefit received by buyers in a market is measured by consumer surplus—the amount buyers are willing to pay for the good minus the amount they actually pay for it. The benefit received by sellers in a market is measured by producer surplus—the amount sellers receive for the good minus their costs. These are precisely the measures of economic welfare we used in Chapter 7.

What about the third interested party, the government? If T is the size of the tax and Q is the quantity of the good sold, then the government gets total tax revenue of $T \times Q$. It can use this tax revenue to provide services, such as roads, police, and public education, or to help the needy. Therefore, to analyze how taxes affect economic well-being, we use tax revenue to measure the government's benefit from the tax. Keep in mind, however, that this benefit actually accrues not to government but to those on whom the revenue is spent.

Figure 8-2 shows that the government's tax revenue is represented by the rectangle between the supply and demand curves. The height of this rectangle is the size of the tax, T , and the width of the rectangle is the quantity of the good sold, Q . Because a rectangle's area is its height times its width, this rectangle's area is $T \times Q$, which equals the tax revenue.

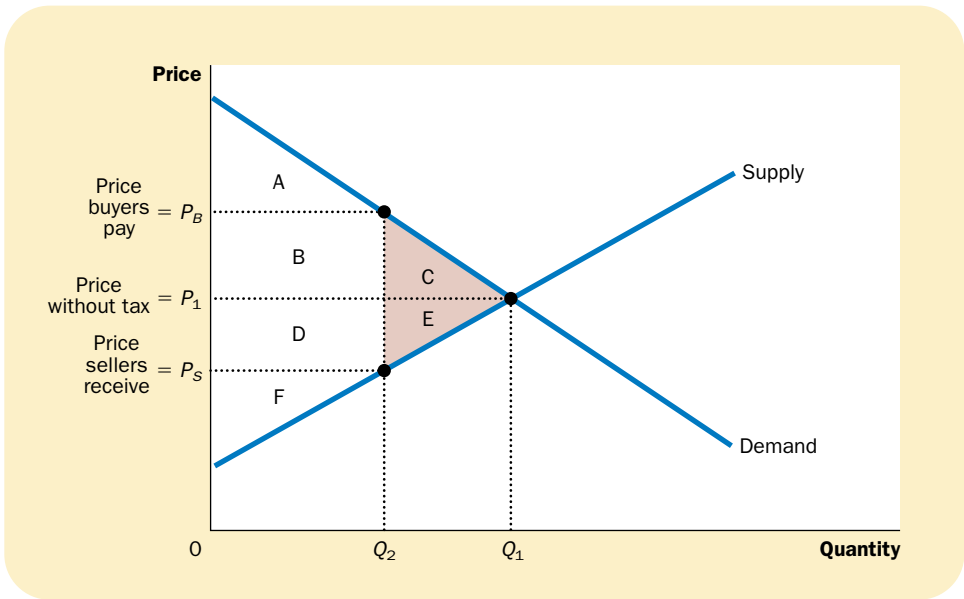
Welfare without a Tax To see how a tax affects welfare, we begin by considering welfare before the government has imposed a tax. Figure 8-3 shows the supply-and-demand diagram and marks the key areas with the letters A through F.

Without a tax, the price and quantity are found at the intersection of the supply and demand curves. The price is P_1 , and the quantity sold is Q_1 . Because the demand curve reflects buyers' willingness to pay, consumer surplus is the area between the demand curve and the price, $A + B + C$. Similarly, because the supply curve reflects sellers' costs, producer surplus is the area between the supply curve and the price, $D + E + F$. In this case, because there is no tax, tax revenue equals zero.

Total surplus, the sum of consumer and producer surplus, equals the area $A + B + C + D + E + F$. In other words, as we saw in Chapter 7, total surplus is the area between the supply and demand curves up to the equilibrium quantity. The first column of Table 8-1 summarizes these conclusions.

Figure 8-3

HOW A TAX AFFECTS WELFARE. A tax on a good reduces consumer surplus (by the area $B + C$) and producer surplus (by the area $D + E$). Because the fall in producer and consumer surplus exceeds tax revenue (area $B + D$), the tax is said to impose a deadweight loss (area $C + E$).



	WITHOUT TAX	WITH TAX	CHANGE
Consumer Surplus	$A + B + C$	A	$-(B + C)$
Producer Surplus	$D + E + F$	F	$-(D + E)$
Tax Revenue	None	$B + D$	$+(B + D)$
Total Surplus	$A + B + C + D + E + F$	$A + B + D + F$	$-(C + E)$

The area $C + E$ shows the fall in total surplus and is the deadweight loss of the tax.

Table 8-1

CHANGES IN WELFARE FROM A TAX. This table refers to the areas marked in Figure 8-3 to show how a tax affects the welfare of buyers and sellers in a market.

Welfare with a Tax Now consider welfare after the tax is enacted. The price paid by buyers rises from P_1 to P_B , so consumer surplus now equals only area A (the area below the demand curve and above the buyer's price). The price received by sellers falls from P_1 to P_S , so producer surplus now equals only area F (the area above the supply curve and below the seller's price). The quantity sold falls from Q_1 to Q_2 , and the government collects tax revenue equal to the area B + D.

To compute total surplus with the tax, we add consumer surplus, producer surplus, and tax revenue. Thus, we find that total surplus is area A + B + D + F. The second column of Table 8-1 provides a summary.

Changes in Welfare We can now see the effects of the tax by comparing welfare before and after the tax is enacted. The third column in Table 8-1 shows the changes. The tax causes consumer surplus to fall by the area B + C and producer surplus to fall by the area D + E. Tax revenue rises by the area B + D. Not surprisingly, the tax makes buyers and sellers worse off and the government better off.

The change in total welfare includes the change in consumer surplus (which is negative), the change in producer surplus (which is also negative), and the change in tax revenue (which is positive). When we add these three pieces together, we find that total surplus in the market falls by the area C + E. *Thus, the losses to buyers and sellers from a tax exceed the revenue raised by the government.* The fall in total surplus that results when a tax (or some other policy) distorts a market outcome is called the **deadweight loss**. The area C + E measures the size of the deadweight loss.

To understand why taxes impose deadweight losses, recall one of the *Ten Principles of Economics* in Chapter 1: People respond to incentives. In Chapter 7 we saw that markets normally allocate scarce resources efficiently. That is, the equilibrium of supply and demand maximizes the total surplus of buyers and sellers in a market. When a tax raises the price to buyers and lowers the price to sellers, however, it gives buyers an incentive to consume less and sellers an incentive to produce less than they otherwise would. As buyers and sellers respond to these incentives, the size of the market shrinks below its optimum. Thus, because taxes distort incentives, they cause markets to allocate resources inefficiently.

deadweight loss

the fall in total surplus that results from a market distortion, such as a tax



DEADWEIGHT LOSSES AND THE GAINS FROM TRADE

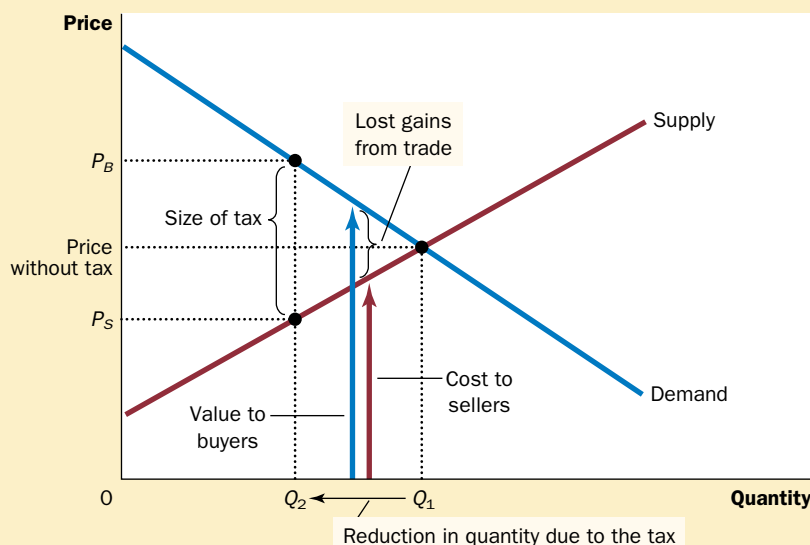
To gain some intuition for why taxes result in deadweight losses, consider an example. Imagine that Joe cleans Jane's house each week for \$100. The opportunity cost of Joe's time is \$80, and the value of a clean house to Jane is \$120. Thus, Joe and Jane each receive a \$20 benefit from their deal. The total surplus of \$40 measures the gains from trade in this particular transaction.

Now suppose that the government levies a \$50 tax on the providers of cleaning services. There is now no price that Jane can pay Joe that will leave both of them better off after paying the tax. The most Jane would be willing to pay is \$120, but then Joe would be left with only \$70 after paying the tax, which is less than his \$80 opportunity cost. Conversely, for Joe to receive his opportunity cost of \$80, Jane would need to pay \$130, which is above the \$120 value she places on a clean house. As a result, Jane and Joe cancel their arrangement. Joe goes without the income, and Jane lives in a dirtier house.

The tax has made Joe and Jane worse off by a total of \$40, because they have lost this amount of surplus. At the same time, the government collects no revenue from Joe and Jane because they decide to cancel their arrangement. The \$40 is pure

Figure 8-4

THE DEADWEIGHT LOSS. When the government imposes a tax on a good, the quantity sold falls from Q_1 to Q_2 . As a result, some of the potential gains from trade among buyers and sellers do not get realized. These lost gains from trade create the deadweight loss.



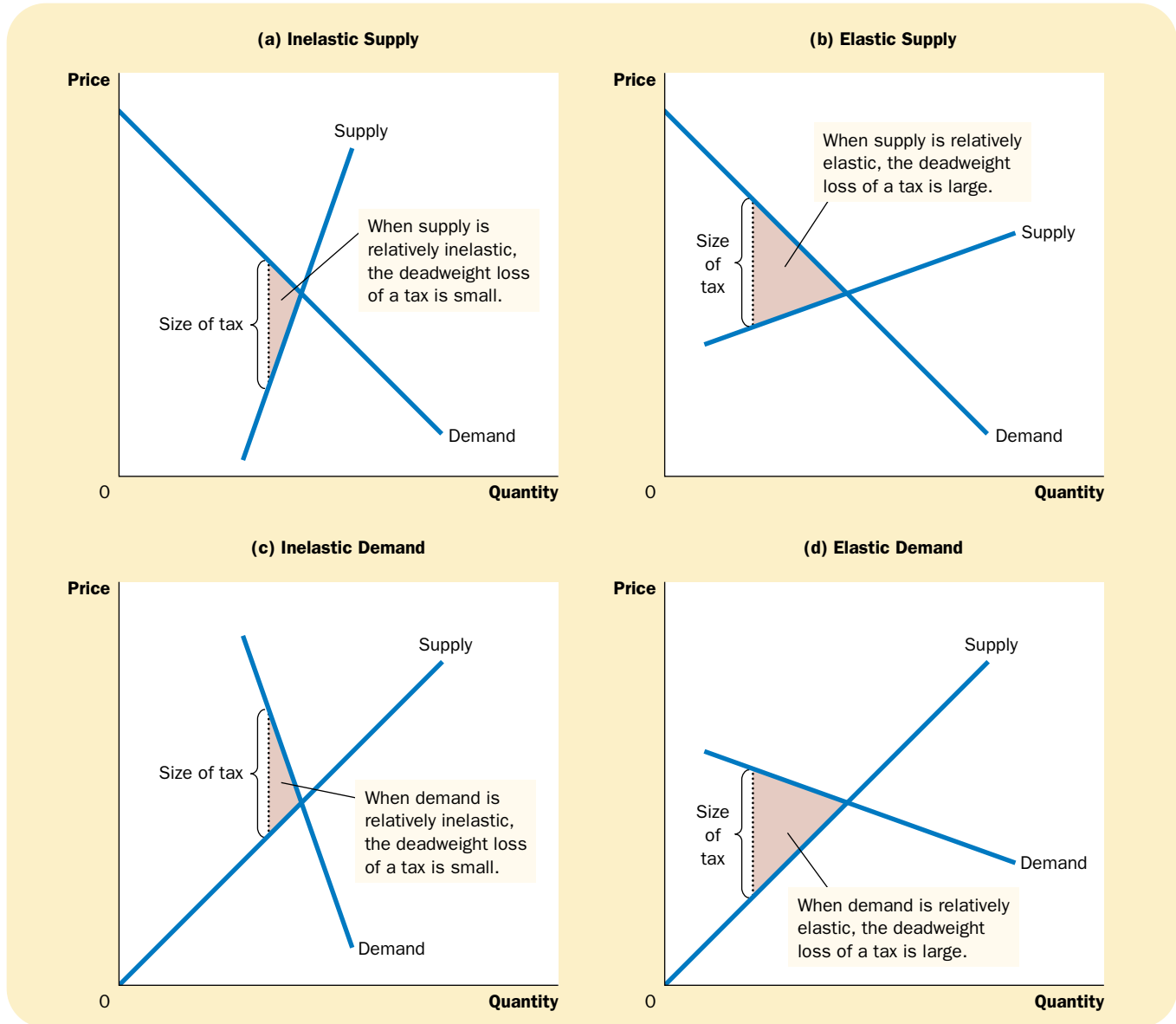
deadweight loss: It is a loss to buyers and sellers in a market not offset by an increase in government revenue. From this example, we can see the ultimate source of deadweight losses: *Taxes cause deadweight losses because they prevent buyers and sellers from realizing some of the gains from trade.*

The area of the triangle between the supply and demand curves (area C + E in Figure 8-3) measures these losses. This loss can be seen most easily in Figure 8-4 by recalling that the demand curve reflects the value of the good to consumers and that the supply curve reflects the costs of producers. When the tax raises the price to buyers to P_B and lowers the price to sellers to P_S , the marginal buyers and sellers leave the market, so the quantity sold falls from Q_1 to Q_2 . Yet, as the figure shows, the value of the good to these buyers still exceeds the cost to these sellers. As in our example with Joe and Jane, the gains from trade—the difference between buyers' value and sellers' cost—is less than the tax. Thus, these trades do not get made once the tax is imposed. The deadweight loss is the surplus lost because the tax discourages these mutually advantageous trades.

QUICK QUIZ: Draw the supply and demand curve for cookies. If the government imposes a tax on cookies, show what happens to the quantity sold, the price paid by buyers, and the price paid by sellers. In your diagram, show the deadweight loss from the tax. Explain the meaning of the deadweight loss.

THE DETERMINANTS OF THE DEADWEIGHT LOSS

What determines whether the deadweight loss from a tax is large or small? The answer is the price elasticities of supply and demand, which measure how much the quantity supplied and quantity demanded respond to changes in the price.



TAX DISTORTIONS AND ELASTICITIES. In panels (a) and (b), the demand curve and the size of the tax are the same, but the price elasticity of supply is different. Notice that the more elastic the supply curve, the larger the deadweight loss of the tax. In panels (c) and (d), the supply curve and the size of the tax are the same, but the price elasticity of demand is different. Notice that the more elastic the demand curve, the larger the deadweight loss of the tax.

Figure 8-5

Let's consider first how the elasticity of supply affects the size of the deadweight loss. In the top two panels of Figure 8-5, the demand curve and the size of the tax are the same. The only difference in these figures is the elasticity of the supply curve. In panel (a), the supply curve is relatively inelastic: Quantity supplied responds only slightly to changes in the price. In panel (b), the supply curve is

relatively elastic: Quantity supplied responds substantially to changes in the price. Notice that the deadweight loss, the area of the triangle between the supply and demand curves, is larger when the supply curve is more elastic.

Similarly, the bottom two panels of Figure 8-5 show how the elasticity of demand affects the size of the deadweight loss. Here the supply curve and the size of the tax are held constant. In panel (c) the demand curve is relatively inelastic, and the deadweight loss is small. In panel (d) the demand curve is more elastic, and the deadweight loss from the tax is larger.

The lesson from this figure is easy to explain. A tax has a deadweight loss because it induces buyers and sellers to change their behavior. The tax raises the price paid by buyers, so they consume less. At the same time, the tax lowers the price received by sellers, so they produce less. Because of these changes in behavior, the size of the market shrinks below the optimum. The elasticities of supply and demand measure how much sellers and buyers respond to the changes in the price and, therefore, determine how much the tax distorts the market outcome. Hence, *the greater the elasticities of supply and demand, the greater the deadweight loss of a tax.*

CASE STUDY THE DEADWEIGHT LOSS DEBATE

Supply, demand, elasticity, deadweight loss—all this economic theory is enough to make your head spin. But believe it or not, these ideas go to the heart of a profound political question: How big should the government be? The reason the debate hinges on these concepts is that the larger the deadweight loss of taxation, the larger the cost of any government program. If taxation entails very large deadweight losses, then these losses are a strong argument for a leaner government that does less and taxes less. By contrast, if taxes impose only small deadweight losses, then government programs are less costly than they otherwise might be.

So how big are the deadweight losses of taxation? This is a question about which economists disagree. To see the nature of this disagreement, consider the most important tax in the U.S. economy—the tax on labor. The Social Security tax, the Medicare tax, and, to a large extent, the federal income tax are labor taxes. Many state governments also tax labor earnings. A labor tax places a wedge between the wage that firms pay and the wage that workers receive. If we add all forms of labor taxes together, the *marginal tax rate* on labor income—the tax on the last dollar of earnings—is almost 50 percent for many workers.

Although the size of the labor tax is easy to determine, the deadweight loss of this tax is less straightforward. Economists disagree about whether this 50 percent labor tax has a small or a large deadweight loss. This disagreement arises because they hold different views about the elasticity of labor supply.

Economists who argue that labor taxes are not very distorting believe that labor supply is fairly inelastic. Most people, they claim, would work full-time regardless of the wage. If so, the labor supply curve is almost vertical, and a tax on labor has a small deadweight loss.

Economists who argue that labor taxes are highly distorting believe that labor supply is more elastic. They admit that some groups of workers may supply their labor inelastically but claim that many other groups respond more to incentives. Here are some examples:

- ◆ Many workers can adjust the number of hours they work—for instance, by working overtime. The higher the wage, the more hours they choose to work.



"LET ME TELL YOU WHAT I THINK ABOUT THE ELASTICITY OF LABOR SUPPLY."

- ◆ Some families have second earners—often married women with children—with some discretion over whether to do unpaid work at home or paid work in the marketplace. When deciding whether to take a job, these second earners compare the benefits of being at home (including savings on the cost of child care) with the wages they could earn.
- ◆ Many of the elderly can choose when to retire, and their decisions are partly based on the wage. Once they are retired, the wage determines their incentive to work part-time.
- ◆ Some people consider engaging in illegal economic activity, such as the drug trade, or working at jobs that pay “under the table” to evade taxes. Economists call this the *underground economy*. In deciding whether to work in the underground economy or at a legitimate job, these potential criminals compare what they can earn by breaking the law with the wage they can earn legally.

In each of these cases, the quantity of labor supplied responds to the wage (the price of labor). Thus, the decisions of these workers are distorted when their labor earnings are taxed. Labor taxes encourage workers to work fewer hours, second earners to stay at home, the elderly to retire early, and the unscrupulous to enter the underground economy.

These two views of labor taxation persist to this day. Indeed, whenever you see two political candidates debating whether the government should provide more services or reduce the tax burden, keep in mind that part of the disagreement may rest on different views about the elasticity of labor supply and the deadweight loss of taxation.

QUICK QUIZ: The demand for beer is more elastic than the demand for milk. Would a tax on beer or a tax on milk have larger deadweight loss? Why?

FYI

Henry George
and the
Land Tax

mayor of New York City (although he finished well ahead of Republican candidate Theodore Roosevelt).

George's proposal to tax land was motivated largely by a concern over the distribution of economic well-being. He deplored the "shocking contrast between monstrous wealth and debasing want" and thought landowners benefited more than they should from the rapid growth in the overall economy.

George's arguments for the land tax can be understood using the tools of modern economics. Consider first supply and demand in the market for renting land. As immigration causes the population to rise and technological progress causes incomes to grow, the demand for land rises over time. Yet because the amount of land is fixed, the supply is perfectly inelastic. Rapid increases in demand together with inelastic supply lead to large increases in the equilibrium rents on land, so that economic growth makes rich landowners even richer.

Now consider the incidence of a tax on land. As we first saw in Chapter 6, the burden of a tax falls more heavily on the side of the market that is less elastic. A tax on land takes this principle to an extreme. Because the elasticity of supply is zero, the landowners bear the entire burden of the tax.

Is there an ideal tax? Henry George, the nineteenth-century American economist and social philosopher, thought so. In his 1879 book *Progress and Poverty*, George argued that the government should raise all its revenue from a tax on land. This "single tax" was, he claimed, both equitable and efficient. George's ideas won him a large political following, and in 1886 he lost a close race for

Consider next the question of efficiency. As we just discussed, the deadweight loss of a tax depends on the elasticities of supply and demand. Again, a tax on land is an extreme case. Because supply is perfectly inelastic, a tax on land does not alter the market allocation. There is no deadweight loss, and the government's tax revenue exactly equals the loss of the landowners.

Although taxing land may look attractive in theory, it is not as straightforward in practice as it may appear. For a tax on land not to distort economic incentives, it must be a tax on raw land. Yet the value of land often comes from improvements, such as clearing trees, providing sewers, and building roads. Unlike the supply of raw land, the supply of improvements has an elasticity greater than zero. If a land tax were imposed on improvements, it would distort incentives. Landowners would respond by devoting fewer resources to improving their land.

Today, few economists support George's proposal for a single tax on land. Not only is taxing improvements a potential problem, but the tax would not raise enough revenue to pay for the much larger government we have today. Yet many of George's arguments remain valid. Here is the assessment of the eminent economist Milton Friedman a century after George's book: "In my opinion, the least bad tax is the property tax on the unimproved value of land, the Henry George argument of many, many years ago."

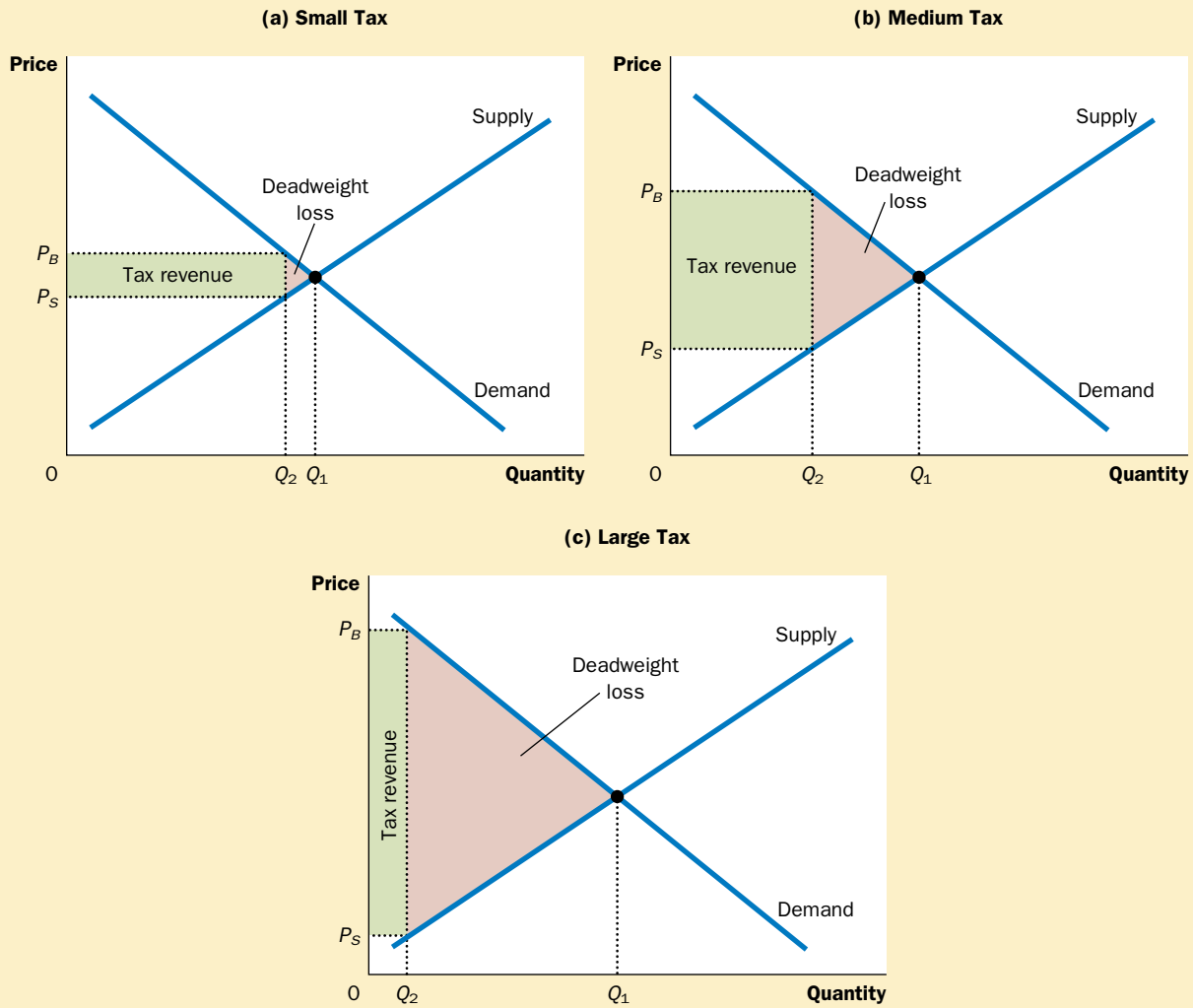


HENRY GEORGE

DEADWEIGHT LOSS AND TAX REVENUE AS TAXES VARY

Taxes rarely stay the same for long periods of time. Policymakers in local, state, and federal governments are always considering raising one tax or lowering another. Here we consider what happens to the deadweight loss and tax revenue when the size of a tax changes.

Figure 8-6 shows the effects of a small, medium, and large tax, holding constant the market's supply and demand curves. The deadweight loss—the reduction in total surplus that results when the tax reduces the size of a market below



DEADWEIGHT LOSS AND TAX REVENUE FROM THREE TAXES OF DIFFERENT SIZE. The deadweight loss is the reduction in total surplus due to the tax. Tax revenue is the amount of the tax times the amount of the good sold. In panel (a), a small tax has a small deadweight loss and raises a small amount of revenue. In panel (b), a somewhat larger tax has a larger deadweight loss and raises a larger amount of revenue. In panel (c), a very large tax has a very large deadweight loss, but because it has reduced the size of the market so much, the tax raises only a small amount of revenue.

Figure 8-6

the optimum—equals the area of the triangle between the supply and demand curves. For the small tax in panel (a), the area of the deadweight loss triangle is quite small. But as the size of a tax rises in panels (b) and (c), the deadweight loss grows larger and larger.

Indeed, the deadweight loss of a tax rises even more rapidly than the size of the tax. The reason is that the deadweight loss is an area of a triangle, and an area

of a triangle depends on the *square* of its size. If we double the size of a tax, for instance, the base and height of the triangle double, so the deadweight loss rises by a factor of 4. If we triple the size of a tax, the base and height triple, so the deadweight loss rises by a factor of 9.

The government's tax revenue is the size of the tax times the amount of the good sold. As Figure 8-6 shows, tax revenue equals the area of the rectangle between the supply and demand curves. For the small tax in panel (a), tax revenue is small. As the size of a tax rises from panel (a) to panel (b), tax revenue grows. But as the size of the tax rises further from panel (b) to panel (c), tax revenue falls because the higher tax drastically reduces the size of the market. For a very large tax, no revenue would be raised, because people would stop buying and selling the good altogether.

Figure 8-7 summarizes these results. In panel (a) we see that as the size of a tax increases, its deadweight loss quickly gets larger. By contrast, panel (b) shows that tax revenue first rises with the size of the tax; but then, as the tax gets larger, the market shrinks so much that tax revenue starts to fall.

CASE STUDY THE LAFFER CURVE AND SUPPLY-SIDE ECONOMICS

One day in 1974, economist Arthur Laffer sat in a Washington restaurant with some prominent journalists and politicians. He took out a napkin and drew a figure on it to show how tax rates affect tax revenue. It looked much like panel (b) of our Figure 8-7. Laffer then suggested that the United States was on the downward-sloping side of this curve. Tax rates were so high, he argued, that reducing them would actually raise tax revenue.

Most economists were skeptical of Laffer's suggestion. The idea that a cut in tax rates could raise tax revenue was correct as a matter of economic theory, but there was more doubt about whether it would do so in practice. There was little evidence for Laffer's view that U.S. tax rates had in fact reached such extreme levels.

Nonetheless, the *Laffer curve* (as it became known) captured the imagination of Ronald Reagan. David Stockman, budget director in the first Reagan administration, offers the following story:

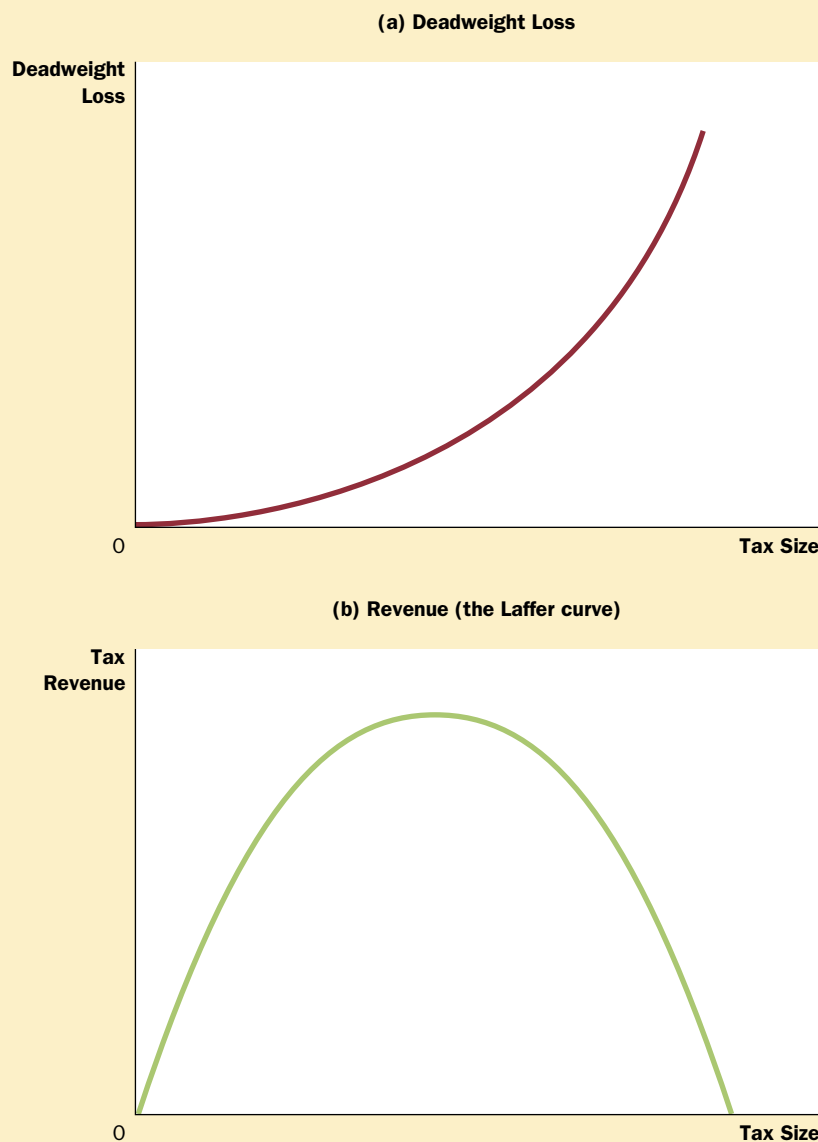
[Reagan] had once been on the Laffer curve himself. "I came into the Big Money making pictures during World War II," he would always say. At that time the wartime income surtax hit 90 percent. "You could only make four pictures and then you were in the top bracket," he would continue. "So we all quit working after four pictures and went off to the country." High tax rates caused less work. Low tax rates caused more. His experience proved it.

When Reagan ran for president in 1980, he made cutting taxes part of his platform. Reagan argued that taxes were so high that they were discouraging hard work. He argued that lower taxes would give people the proper incentive to work, which would raise economic well-being and perhaps even tax revenue. Because the cut in tax rates was intended to encourage people to increase the quantity of labor they supplied, the views of Laffer and Reagan became known as *supply-side economics*.

Subsequent history failed to confirm Laffer's conjecture that lower tax rates would raise tax revenue. When Reagan cut taxes after he was elected, the result

Figure 8-7

HOW DEADWEIGHT LOSS AND TAX REVENUE VARY WITH THE SIZE OF A TAX. Panel (a) shows that as the size of a tax grows larger, the deadweight loss grows larger. Panel (b) shows that tax revenue first rises, then falls. This relationship is sometimes called the Laffer curve.



was less tax revenue, not more. Revenue from personal income taxes (per person, adjusted for inflation) fell by 9 percent from 1980 to 1984, even though average income (per person, adjusted for inflation) grew by 4 percent over this period. The tax cut, together with policymakers' unwillingness to restrain spending, began a long period during which the government spent more than it collected in taxes. Throughout Reagan's two terms in office, and for many years thereafter, the government ran large budget deficits.

Yet Laffer's argument is not completely without merit. Although an overall cut in tax rates normally reduces revenue, some taxpayers at some times may be on the wrong side of the Laffer curve. In the 1980s, tax revenue collected from the richest Americans, who face the highest tax rates, did rise when their taxes were cut. The idea that cutting taxes can raise revenue may be correct if applied to

IN THE NEWS*How to Be Master
of the Universe*

WORLD LEADERS NEED TO UNDERSTAND the costs of taxation, even if the world they're leading happens to be the figment of some game designer's imagination.

Supply-Side Is a Winning Strategy

BY JOHN J. VECCHIONE

Congress may have given up on cutting taxes, but there's one corner of the country where supply-side economics still rules—the computer screens of game enthusiasts.

Not all messages from computer games are antisocial ones. Although we've heard a lot recently about games like Doom, known as "shooters," in what are known as "God games," a player assumes total control of a city, a country, or even a galaxy, deciding everything from

military to economic policy. In SimCity, a player runs a beleaguered municipal administration. In Civilization and its sequels, the player is the leader of a historic empire, such as Stalinist Russia or Elizabethan England, in a scramble for world domination. In Master of Orion, a player is given command of an entire species—whether humans or lizard-like Sakkras—with the goal of conquering the galaxy.

One thing these games have in common: Success requires economic growth, and that can only be achieved by keeping taxes low. Tax rates range from the edenic zero to the punitive 80%. With the proceeds of these taxes the player must build costly military or police forces and the infrastructure to support economic and technological advancement.

Why not simply keep taxes high and meet all the "societal needs" a despot could want? Because . . . keeping taxes high leads the population to produce less. As tax rates increase there is, at first, no easily discernable effect on the populace, except perhaps a few frowns and grumbles. But as soon as taxes reach a certain point—10% in some games, 20% in others—citizens begin to revolt. . . .

In games covering a single city, citizens vote with their feet and begin leaving town. No new jobs are created, and

once-vibrant downtown areas are left with little traffic but plenty of crime. Tax rates that approach 50% or more accelerate the trend. . . .

In the state or galaxy games, similar rules apply. During times of great military conflict or bursts of government construction, tax rates can be increased for a number of years without too much damage to the populace, and revenues do increase from the previous year. The government can simply buy what it needs from increased revenue. But a long war or government building program creates problems in "growing the economy" if tax rates are too high. Production slumps. The busy empire builder finds that his starships are harder to produce. Before long a once mighty empire is tottering on the brink of collapse and the ruler is deposed. The wise ruler keeps taxes as low as possible consistent with enough guns and roads to keep the country safe from a takeover by the enemy. . . .

Who says kids are wasting their time playing computers games?

SOURCE: *The Wall Street Journal*, May 5, 1999, p. A22.

those taxpayers facing the highest tax rates. In addition, Laffer's argument may be more plausible when applied to other countries, where tax rates are much higher than in the United States. In Sweden in the early 1980s, for instance, the typical worker faced a marginal tax rate of about 80 percent. Such a high tax rate provides a substantial disincentive to work. Studies have suggested that Sweden would indeed have raised more tax revenue if it had lowered its tax rates.

These ideas arise frequently in political debate. When Bill Clinton moved into the White House in 1993, he increased the federal income tax rates on high-income taxpayers to about 40 percent. Some economists criticized the policy, arguing that the plan would not yield as much revenue as the Clinton administration estimated. They claimed that the administration did not fully take into

account how taxes alter behavior. Conversely, when Bob Dole challenged Bill Clinton in the election of 1996, Dole proposed cutting personal income taxes. Although Dole rejected the idea that tax cuts would completely pay for themselves, he did claim that 28 percent of the tax cut would be recouped because lower tax rates would lead to more rapid economic growth. Economists debated whether Dole's 28 percent projection was reasonable, excessively optimistic, or (as Laffer might suggest) excessively pessimistic.

Policymakers disagree about these issues in part because they disagree about the size of the relevant elasticities. The more elastic that supply and demand are in any market, the more taxes in that market distort behavior, and the more likely it is that a tax cut will raise tax revenue. There is no debate, however, about the general lesson: How much revenue the government gains or loses from a tax change cannot be computed just by looking at tax rates. It also depends on how the tax change affects people's behavior.

QUICK QUIZ: If the government doubles the tax on gasoline, can you be sure that revenue from the gasoline tax will rise? Can you be sure that the deadweight loss from the gasoline tax will rise? Explain.

CONCLUSION

Taxes, Oliver Wendell Holmes once said, are the price we pay for a civilized society. Indeed, our society cannot exist without some form of taxes. We all expect the government to provide certain services, such as roads, parks, police, and national defense. These public services require tax revenue.

This chapter has shed some light on how high the price of civilized society can be. One of the *Ten Principles of Economics* discussed in Chapter 1 is that markets are usually a good way to organize economic activity. When the government imposes taxes on buyers or sellers of a good, however, society loses some of the benefits of market efficiency. Taxes are costly to market participants not only because taxes transfer resources from those participants to the government, but also because they alter incentives and distort market outcomes.



Summary

- ◆ A tax on a good reduces the welfare of buyers and sellers of the good, and the reduction in consumer and producer surplus usually exceeds the revenue raised by the government. The fall in total surplus—the sum of consumer surplus, producer surplus, and tax revenue—is called the deadweight loss of the tax.
- ◆ Taxes have deadweight losses because they cause buyers to consume less and sellers to produce less, and this change in behavior shrinks the size of the market below the level that maximizes total surplus. Because the elasticities of supply and demand measure how much market participants respond to market conditions, larger elasticities imply larger deadweight losses.
- ◆ As a tax grows larger, it distorts incentives more, and its deadweight loss grows larger. Tax revenue first rises with the size of a tax. Eventually, however, a larger tax reduces tax revenue because it reduces the size of the market.

Key Concepts

deadweight loss, p. 165

Questions for Review

1. What happens to consumer and producer surplus when the sale of a good is taxed? How does the change in consumer and producer surplus compare to the tax revenue? Explain.
2. Draw a supply-and-demand diagram with a tax on the sale of the good. Show the deadweight loss. Show the tax revenue.
3. How do the elasticities of supply and demand affect the deadweight loss of a tax? Why do they have this effect?
4. Why do experts disagree about whether labor taxes have small or large deadweight losses?
5. What happens to the deadweight loss and tax revenue when a tax is increased?

Problems and Applications

1. The market for pizza is characterized by a downward-sloping demand curve and an upward-sloping supply curve.
 - a. Draw the competitive market equilibrium. Label the price, quantity, consumer surplus, and producer surplus. Is there any deadweight loss? Explain.
 - b. Suppose that the government forces each pizzeria to pay a \$1 tax on each pizza sold. Illustrate the effect of this tax on the pizza market, being sure to label the consumer surplus, producer surplus, government revenue, and deadweight loss. How does each area compare to the pre-tax case?
 - c. If the tax were removed, pizza eaters and sellers would be better off, but the government would lose tax revenue. Suppose that consumers and producers voluntarily transferred some of their gains to the government. Could all parties (including the government) be better off than they were with a tax? Explain using the labeled areas in your graph.
2. Evaluate the following two statements. Do you agree? Why or why not?
 - a. "If the government taxes land, wealthy land-owners will pass the tax on to their poorer renters."
 - b. "If the government taxes apartment buildings, wealthy landlords will pass the tax on to their poorer renters."
3. Evaluate the following two statements. Do you agree? Why or why not?
 - a. "A tax that has no deadweight loss cannot raise any revenue for the government."
 - b. "A tax that raises no revenue for the government cannot have any deadweight loss."
4. Consider the market for rubber bands.
 - a. If this market has very elastic supply and very inelastic demand, how would the burden of a tax on rubber bands be shared between consumers and producers? Use the tools of consumer surplus and producer surplus in your answer.
 - b. If this market has very inelastic supply and very elastic demand, how would the burden of a tax on rubber bands be shared between consumers and producers? Contrast your answer with your answer to part (a).
5. Suppose that the government imposes a tax on heating oil.
 - a. Would the deadweight loss from this tax likely be greater in the first year after it is imposed or in the fifth year? Explain.
 - b. Would the revenue collected from this tax likely be greater in the first year after it is imposed or in the fifth year? Explain.
6. After economics class one day, your friend suggests that taxing food would be a good way to raise revenue because the demand for food is quite inelastic. In what sense is taxing food a "good" way to raise revenue? In what sense is it not a "good" way to raise revenue?

7. Senator Daniel Patrick Moynihan once introduced a bill that would levy a 10,000 percent tax on certain hollow-tipped bullets.
 - a. Do you expect that this tax would raise much revenue? Why or why not?
 - b. Even if the tax would raise no revenue, what might be Senator Moynihan's reason for proposing it?
8. The government places a tax on the purchase of socks.
 - a. Illustrate the effect of this tax on equilibrium price and quantity in the sock market. Identify the following areas both before and after the imposition of the tax: total spending by consumers, total revenue for producers, and government tax revenue.
 - b. Does the price received by producers rise or fall? Can you tell whether total receipts for producers rise or fall? Explain.
 - c. Does the price paid by consumers rise or fall? Can you tell whether total spending by consumers rises or falls? Explain carefully. (Hint: Think about elasticity.) If total consumer spending falls, does consumer surplus rise? Explain.
9. Suppose the government currently raises \$100 million through a \$0.01 tax on widgets, and another \$100 million through a \$0.10 tax on gadgets. If the government doubled the tax rate on widgets and eliminated the tax on gadgets, would it raise more money than today, less money, or the same amount of money? Explain.
10. Most states tax the purchase of new cars. Suppose that New Jersey currently requires car dealers to pay the state \$100 for each car sold, and plans to increase the tax to \$150 per car next year.
 - a. Illustrate the effect of this tax increase on the quantity of cars sold in New Jersey, the price paid by consumers, and the price received by producers.
 - b. Create a table that shows the levels of consumer surplus, producer surplus, government revenue, and total surplus both before and after the tax increase.
 - c. What is the change in government revenue? Is it positive or negative?
 - d. What is the change in deadweight loss? Is it positive or negative?
 - e. Give one reason why the demand for cars in New Jersey might be fairly elastic. Does this make the additional tax more or less likely to increase government revenue? How might states try to reduce the elasticity of demand?
11. Several years ago the British government imposed a "poll tax" that required each person to pay a flat amount to the government independent of his or her income or wealth. What is the effect of such a tax on economic efficiency? What is the effect on economic equity? Do you think this was a popular tax?
12. This chapter analyzed the welfare effects of a tax on a good. Consider now the opposite policy. Suppose that the government subsidizes a good: For each unit of the good sold, the government pays \$2 to the buyer. How does the subsidy affect consumer surplus, producer surplus, tax revenue, and total surplus? Does a subsidy lead to a deadweight loss? Explain.
13. (This problem uses some high school algebra and is challenging.) Suppose that a market is described by the following supply and demand equations:

$$Q^S = 2P$$

$$Q^D = 300 - P$$
 - a. Solve for the equilibrium price and the equilibrium quantity.
 - b. Suppose that a tax of T is placed on buyers, so the new demand equation is

$$Q^D = 300 - (P + T).$$

Solve for the new equilibrium. What happens to the price received by sellers, the price paid by buyers, and the quantity sold?
 - c. Tax revenue is $T \times Q$. Use your answer to part (b) to solve for tax revenue as a function of T . Graph this relationship for T between 0 and 300.
 - d. The deadweight loss of a tax is the area of the triangle between the supply and demand curves. Recalling that the area of a triangle is $1/2 \times \text{base} \times \text{height}$, solve for deadweight loss as a function of T . Graph this relationship for T between 0 and 300. (Hint: Looking sideways, the base of the deadweight loss triangle is T , and the height is the difference between the quantity sold with the tax and the quantity sold without the tax.)
 - e. The government now levies a tax on this good of \$200 per unit. Is this a good policy? Why or why not? Can you propose a better policy?

