CHAPTER

# 5 Market Outcomes and Tax Incidence

### Taxes on firms do not affect consumers.

MISCONCEPTION

Many people believe that when the government taxes businesses, consumers catch a break because firms pay the tax. If only life worked that way! As this chapter explains, who actually pays the tax often is quite different from the party that is legally responsible for making the tax payment.

Gasoline prices are a common and visible sign of the market at work. It is hard not to notice when gasoline prices rise or fall because every gas station posts its prices prominently. But there are a few things you might not know. First, gasoline taxes vary significantly from state to state, and they vary wildly from country to country. In many places, taxes add a significant amount to the price. For example, the price of gasoline throughout Europe is often double that in the United States, largely because of much higher gasoline taxes. At the same time, the governments of certain oil-rich countries, such as Venezuela and Saudi Arabia, subsidize gasoline so that their citizens pay less than the market price. In countries where gasoline is subsidized, consumers drive their cars everywhere, mass transportation is largely unavailable, and there is less concern for fuel efficiency. As you might imagine, the opposite is true in countries with high gasoline taxes, where consumers drive less, use public transportation more often, and tend to purchase fuel-efficient vehicles.

What do gasoline taxes and subsidies around the world have in common? They are all folded into the price you see at the pump, which might lead you to believe that the seller is paying all of the tax or receiving the entire subsidy. Nothing could be further from the truth. The firm will try to pass along the tax to consumers in the form of higher prices. Likewise, in countries with subsidies, the firm must pass along lower prices to consumers. After reading this chapter, you will understand how this process works.

We begin this chapter by discussing consumer and producer surplus, two concepts that illustrate gains from trade. These concepts help us measure the efficiency of markets and the effects of taxation. Then we examine how taxation creates distortions in economic behavior by altering the incentives that people and firms face when consuming and producing goods that are taxed.

## BIG QUESTIONS

- **What are consumer surplus and producer surplus?**
- **When is a market efficient?**
- **Why do taxes create deadweight loss in otherwise efficient markets?**

## What Are Consumer Surplus and Producer Surplus?

Markets create value by bringing together buyers and sellers so that consumers and producers can mutually benefit from trade. **Welfare economics** is the branch of economics that studies how the allocation of resources affects economic well-being. In this section, we develop two concepts that help us measure the value that markets create: *consumer surplus* and *producer surplus*.

In competitive markets, the equilibrium price is simultaneously low enough to attract consumers and high enough to encourage producers. This balance between demand and supply enhances the *welfare* (well-being) of society. That is not to say that society's welfare depends solely on markets. People also find satisfaction in many nonmarket settings, including spending time with their families and friends and doing hobbies and charity work. We incorporate aspects of personal satisfaction into our economic model in Chapter 16. For now, let's focus on how markets enhance human welfare.

### Consumer Surplus

How much will they pay for an economics textbook?

Consider three students: Frank, Beanie, and Mitch (you may recognize these names from the movie *Old School*). Like students everywhere, each one has a maximum price he is willing to pay for a new economics textbook. Beanie owns a successful business, so for him the cost of a new textbook does not present a financial hardship. Mitch is a business major who really wants to do well in economics. Frank is not serious about his studies. Table 5.1 shows the value that each student places on the textbook. This value, called the **willingness to pay**, is the maximum price a consumer will pay for a good or service. The willingness to pay is also known as the *reservation price*. In an auction or a negotiation, the willingness to pay, or reservation price, is the price beyond which the consumer decides to walk away from the transaction.

TABLE 5.1

**Willingness to Pay for a New Economics Textbook**

| Buyer | Willingness to pay |
|---|---|
| Beanie | $200 |
| Mitch | 150 |
| Frank | 100 |

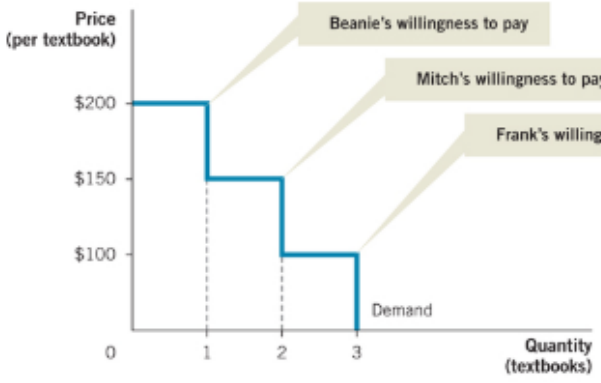
Consider what happens when the price of the book is $151. If Beanie purchases the book at $151, he pays $49 less than the $200 maximum he was willing to pay. He values the textbook at $49 more than the purchase price, so buying the book makes him better off.

**Consumer surplus** is the difference between the willingness to pay for a good (or service) and the price that is paid to get it. While Beanie gains $49 in consumer surplus, a price of $151 is more than either Mitch or Frank is willing to pay. Because Mitch is willing to pay only $150, if he purchases the book he will experience a consumer loss of $1. Frank's willingness to pay is $100, so if he buys the book for $151 he will experience a consumer loss of $51. Whenever the price is greater than the willingness to pay, a rational consumer will decide not to buy.

## Using Demand Curves to Illustrate Consumer Surplus

In the previous section, we discussed consumer surplus as a dollar amount. We can illustrate it graphically with a demand curve. Figure 5.1 shows the demand curve drawn from the data in Table 5.1. Notice that the curve looks like a staircase with three steps—one for each additional textbook purchase. Each point on a market demand curve corresponds to a specific number of units sold.

**FIGURE 5.1**




| Price (per textbook) | Buyers | Quantity demanded (textbooks) |
|---|---|---|
| More than $200 | None | 0 |
| $151 to $200 | Beanie | 1 |
| $101 to $150 | Mitch, Beanie | 2 |
| $100 or less | Frank, Mitch, and Beanie | 3 |

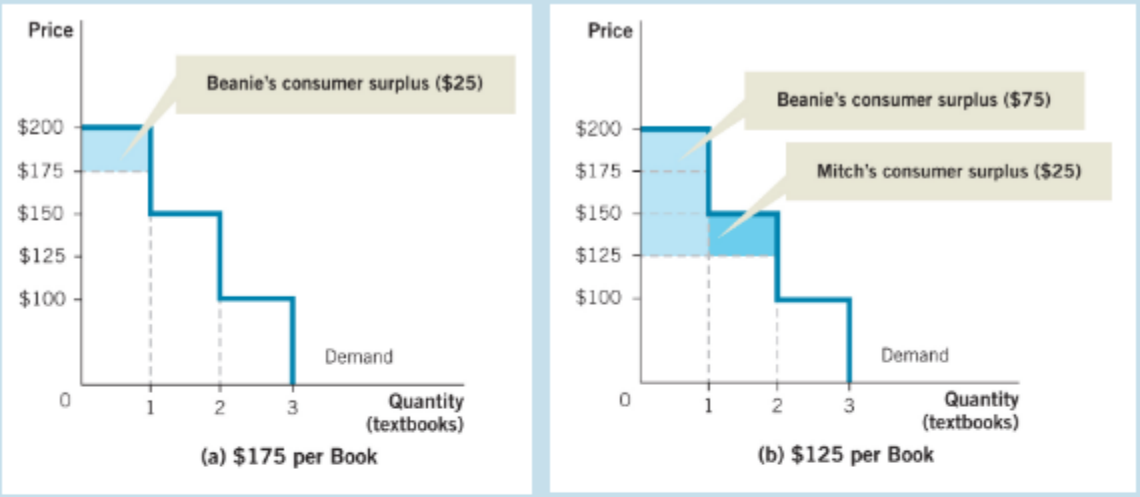
**Demand Curve for an Economics Textbook**

The demand curve has a step for each additional textbook purchase. As the price goes down, more students buy the textbook.

At any price above $200, none of the students wants to purchase a textbook. This relationship is evident on the *x* axis where the quantity demanded is 0. At any price between $151 and $200, Beanie is the only buyer, so the quantity demanded is 1. At prices between $101 and $150, Beanie and Mitch are both willing to buy the textbook, so the quantity demanded is 2. Finally, if the price is $100 or less, all three students are willing to buy the textbook, so the quantity demanded is 3. As the price falls, the quantity demanded increases.

We can measure the total extent of consumer surplus by examining the area under the demand curve for each of our three consumers, as shown in Figure 5.2. In panel (a), the price is $175, and only Beanie decides to buy. Because his willingness to pay is $200, he is better off by $25, which is his consumer surplus. The light blue area under the demand curve and above the price represents the benefit Beanie receives from purchasing a textbook at a price of $175. When the price drops to $125, as shown in panel (b), Mitch also decides to buy a textbook. Now the total quantity demanded is 2. Mitch's willingness to pay is $150, so his consumer surplus, represented by the darker blue area, is $25. However, since Beanie's willingness to pay is $200, his consumer surplus rises from $25 to $75. So a textbook price of $125 raises the total consumer surplus to $75 + $25 = $100. In other words, lower prices create more consumer surplus in this market—and in any other.

**FIGURE 5.2**




**Determining Consumer Surplus from a Demand Curve**

(a) At a price of $175, Beanie is the only buyer, so the quantity demanded is 1. (b) At a price of $125, Beanie and Mitch are both willing to buy the textbook, so the quantity demanded is 2.

## Producer Surplus

Sellers also benefit from market transactions. In this section, our three students discover that they are good at economics and decide to go into the tutoring business. They do not want to provide this service for free, but each has a different minimum price. The **willingness to sell** is the minimum price a seller will accept to sell a good or service. Table 5.2 shows each tutor's willingness to sell his services.

**TABLE 5.2**

**Willingness to Sell Tutoring Services**

| Seller | Willingness to sell |
|---|---|
| Beanie | $30/hr |
| Mitch | $20/hr |
| Frank | $10/hr |

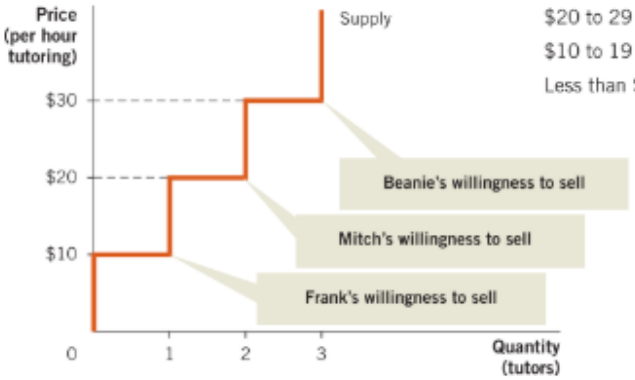
Consider what happens at a tutoring price of $25 per hour. Because Frank is willing to tutor for $10 per hour, every hour that he tutors at $25 per hour earns him $15 more than his willingness to sell. This extra $15 per hour is his producer surplus. **Producer surplus** is the difference between the willingness to sell a good or service and the price that the seller receives. Mitch is willing to tutor for $20 per hour and earns a $5 producer surplus for every hour he tutors at $25 per hour. Finally, Beanie's willingness to tutor, at $30 per hour, is more than the market price of $25. If he tutors, he will have a producer loss of $5 per hour.

How do producers determine their willingness to sell? They must consider two factors: the direct costs of producing the good and the indirect costs, or opportunity costs. Students who are new to economics often mistakenly assume that the cost of producing an item is the only cost to consider in making the decision to produce. But producers also have opportunity costs. Beanie, Mitch, and Frank each has a unique willingness to sell because each has a different opportunity cost. Beanie owns his own business, so for him the time spent tutoring is time that he could have spent making money elsewhere. Mitch is a business student who might otherwise be studying to get better grades. Frank is neither a businessman nor a serious student, so the $10 he can earn in an hour of tutoring is not taking the place of other earning opportunities or studying more to get better grades.

## Using Supply Curves to Illustrate Producer Surplus

Continuing our example, the supply curve in Figure 5.3 shows the relationship between the price for an hour of tutoring and the number of tutors who are willing to work. As you can see on the supply schedule (the table within the figure), at any price less than $10 per hour, no one wants to tutor. At prices between $10 and $19 per hour, Frank is the only tutor, so the quantity supplied is 1. Between $20 and $29 per hour, Frank and Mitch are willing to tutor, so the quantity supplied rises to 2. Finally, if the price is $30 or more, all three friends are willing to tutor, so the quantity supplied is 3. As the price they receive for tutoring rises, the number of tutors increases from 0 to 3.

**FIGURE 5.3**



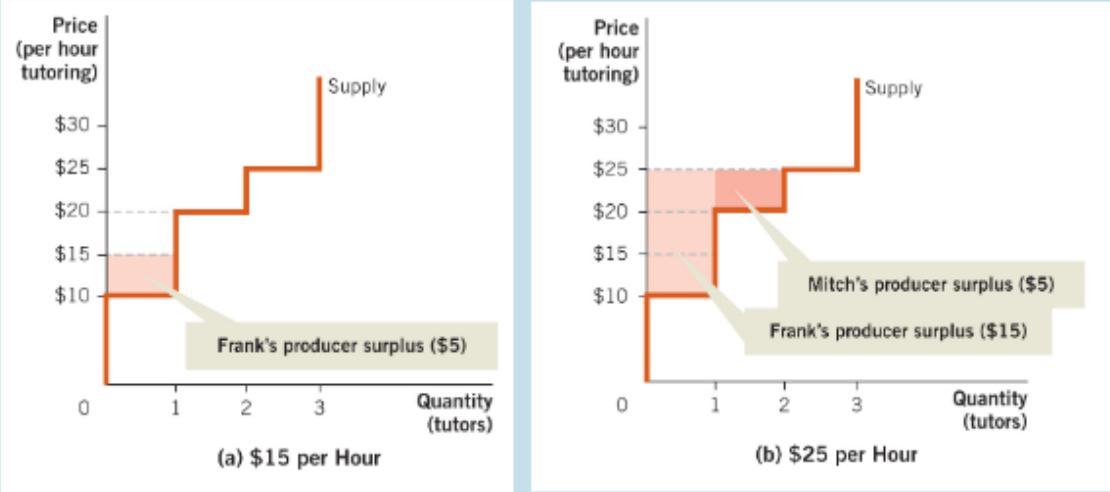

| Price (per hour tutoring) | Sellers | Quantity supplied (tutors) |
|---|---|---|
| $30 or more | Frank, Mitch, Beanie | 3 |
| $20 to 29 | Frank, Mitch | 2 |
| $10 to 19 | Frank | 1 |
| Less than $10 | None | 0 |

**Supply Curve for Economics Tutoring**

The supply curve has three steps, one for each additional student who is willing to tutor. Progressively higher prices will induce more students to become tutors.

What do these relationships between price and quantity supplied tell us about producer surplus? Let's turn to Figure 5.4. By examining the area above the supply curve, we can measure the extent of producer surplus. In panel (a), the price of an hour of tutoring is $15. At that price, only Frank decides to tutor. Since he would be willing to tutor even if the price were as low as $10 per hour, he is $5 per hour better off tutoring. Frank's producer surplus is represented by the light red area between the supply curve and the price of $15. Because Beanie and Mitch do not tutor when the price is $15 per hour, they do not receive any producer surplus. In panel (b), the price for tutoring is $25 per hour. At this price, Mitch also decides to tutor. His willingness to tutor is $20, so when the price is $25 per hour, his producer surplus is $5 per hour, represented by the darker red area. Since Frank's willingness to tutor is $10, at $25 per hour his producer surplus rises to $15 per hour. By looking at the shaded boxes in panel (b), we see that an increase in the rates for tutoring raises the combined producer surplus of Frank and Mitch to $15 + $5 = $20 per hour.

**FIGURE 5.4**




**Determining Producer Surplus from a Supply Curve**

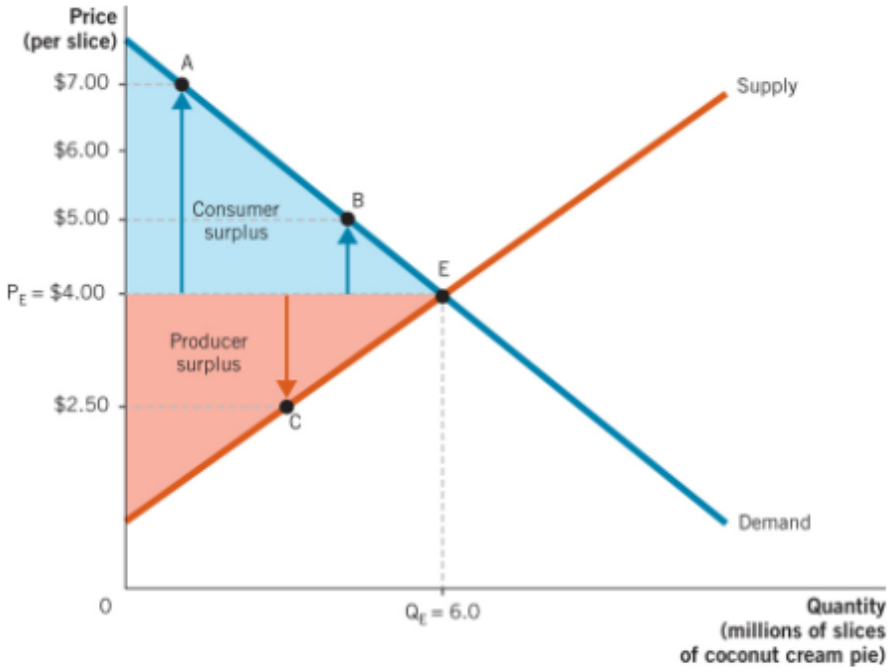
(a) The price of an hour of tutoring is $15. At this price, only Frank decides to tutor. (b) The price for tutoring is $25 per hour. At this price, Mitch also decides to tutor.

## When Is a Market Efficient?

We have seen how consumers benefit from lower prices and how producers benefit from higher prices. When we combine the concepts of consumer and producer surplus, we can build a complete picture of the welfare of buyers and sellers. Adding consumer and producer surplus gives us **total surplus**, also known as **social welfare**, because it measures the well-being of all participants in a market, absent any government intervention. Total surplus is the best way economists have to measure the benefits that markets create.

Figure 5.5 illustrates the relationship between consumer surplus and producer surplus for a slice of coconut cream pie. The demand curve shows that some customers are willing to pay more for a slice of pie than others. Likewise, some sellers (producers) are willing to sell pie for less than others.

**FIGURE 5.5**




**Consumer and Producer Surplus for Coconut Cream Pie**

Consumer surplus is the difference between the willingness to pay along the demand curve and the equilibrium price, $P_E$. It is illustrated by the blue triangle. Producer surplus is the difference between the willingness to produce along the supply curve and the equilibrium price. It is illustrated by the red triangle.

Let's say that Russ is willing to pay $7.00 for a slice of pie, but when he gets to the store he finds it for $4.00. The difference between the price he is willing to pay, represented by point A, and the price he actually pays, represented by E (the equilibrium price), is $3.00 in consumer surplus, as indicated by the blue arrow showing the distance from $4.00 to $7.00. Russ's friend Audrey is willing to pay $5.00 for a slice of pie, but, like Russ, she finds it for $4.00. Therefore, she receives $1.00 in consumer surplus, as indicated by the blue arrow at point B showing the distance from $4.00 to $5.00. In fact, all consumers who are willing to pay more than $4.00 are better off when they purchase the slice of pie at $4.00. We can show this total area of consumer surplus on the graph as the blue triangle bordered by the demand curve, the $y$ axis, and the equilibrium price ($P_E$). At every point in this area, consumers who are willing to pay more than the equilibrium price for pie are better off.

Continuing with Figure 5.5, to identify producer surplus we follow a similar process. Suppose that Ellen's Bakery is willing to sell coconut pie for $2.50 per slice, represented by point C. Because the equilibrium price is $4.00, the business makes $1.50 per slice in producer surplus, as indicated by the red arrow at point C showing the distance from $4.00 to $2.50. If we think of the supply curve as representing the costs of many different sellers, we can calculate the total producer surplus as the red triangle bordered by the supply curve, the $y$ axis, and the equilibrium price. The blue triangle (consumer surplus) and the red triangle (producer surplus) describe the increase in total surplus, or social welfare, created by the production and exchange of the good at the equilibrium price. At the equilibrium quantity of 6 million slices of pie, output and consumption reach the largest possible combination of producer and consumer surplus. In the region of the graph beyond 6 million units, buyers and sellers will experience a loss of surplus.

The buyer and seller each benefit from this exchange.

When an allocation of resources maximizes total surplus, the result is said to be **efficient**. In Figure 5.5, efficiency occurs at point E, where the market is in equilibrium. To think about why the market creates the largest possible total surplus, or social welfare, it is important to recall how the market allocates resources. Consumers who are willing to pay more than the market equilibrium price will buy the good because they will enjoy the consumer surplus. Producers who are willing to sell the good for less than the market equilibrium price will enjoy the producer surplus. In addition, consumers with a low willingness to buy (less than $4.00 per slice) and producers with a high willingness to sell (more than $4.00 per slice) do not participate in the market. Therefore, the equilibrium output at point E maximizes the total surplus and is also an efficient allocation of resources.

## The Efficiency-Equity Debate

When modeling behavior, economists assume that participants in a market are rational decision-makers. That is, we assume that producers will always operate in the region of the triangle that represents producer surplus and that consumers will always operate in the region of the triangle that represents consumer surplus. We do not, for example, expect Russ to pay more than $7.00 for a slice of pie or Ellen's Bakery to sell pie for less than $2.50 per slice. In other words, for the market to work efficiently, voluntary instances of consumer loss must be rare. We assume that self-interest helps to ensure that all participants benefit from an exchange.

Efficiency only requires that the pie get eaten. Equity is a question of how the pie gets divided.

However, the fact that both parties benefit from an exchange does not mean that both parties benefit equally. Economists are also interested in the distribution of the gains. **Equity** refers to the fairness of the distribution of benefits among the members of a society. In a world where no one cared about equity, only efficiency would matter and no particular division would be preferred. Another way of thinking about fairness versus efficiency is to consider a pie. If our only concern is efficiency, we will simply want to make sure that none of the pie goes to waste. But if we care about equity, we will also care about how the pie is shared, perhaps making sure that everyone gets a bite of the pie or at least has access to the pie.

In our first look at consumer and producer surplus, we have assumed that markets produce efficient outcomes. But in the real world, efficient outcomes are not guaranteed. Markets also fail; their efficiency can be compromised in a number of ways. We discuss market failure in much greater detail in subsequent chapters. For now, all you need to know is that failure can occur.

# Why Do Taxes Create Deadweight Loss in Otherwise Efficient Markets?

Taxes provide many benefits. Taxes help to pay for many of society's needs—public transportation, schools, police, the court system, and the military, to name just a few. Most of us take these services for granted, but without taxes it would be impossible to pay for them. How much do all of these services cost? When you add all the federal, state, and local government budgets in the United States, you get over $6 trillion a year in taxes!

Spending tax dollars incurs opportunity costs, because the money could have been used in other ways. In this section, we use the concepts of consumer and producer surplus to explain the effect of taxation on social welfare and market efficiency. Taxes come in many sizes and shapes. There are taxes on personal income, payroll, property, corporate profits, sales, and inheritance, for example. Fortunately, we do not have to examine the entire tax code all at once. In the pages that follow, we explore the impact of taxes on social welfare by looking at one of the simplest taxes, the *excise tax*.

## Tax Incidence

Economists want to know how taxes affect the choices that consumers and producers make. When a tax is imposed on an item, do buyers switch to alternative goods that are not taxed? How do producers respond when the products they sell are taxed? Because taxes cause prices to rise, they can affect how much of a good or service is bought and sold. This outcome is especially evident with **excise taxes**, which are taxes levied on a particular good or service. For example, all 50 states levy excise taxes on cigarettes, but the amount assessed varies tremendously. In New York, cigarette taxes are over $4.00 per pack, while in a handful of tobacco-producing states (including Virginia and North Carolina), the excise tax is less than $0.50 per pack. Overall, excise taxes, such as those on cigarettes, alcohol, and gasoline, account for less than 4% of all tax revenues. But because we can isolate changes in consumer behavior that result from taxes on one item, excise taxes help us understand the overall effect of a tax.

In looking at the effect of a tax, economists are also interested in the **incidence** of taxation, which refers to the burden of taxation on the party who pays the tax. To understand this idea, consider a $1.00 tax on milk purchases. We consider two cases: a tax placed directly on buyers and a tax placed directly on sellers.

### Example 1: Tax on Buyers

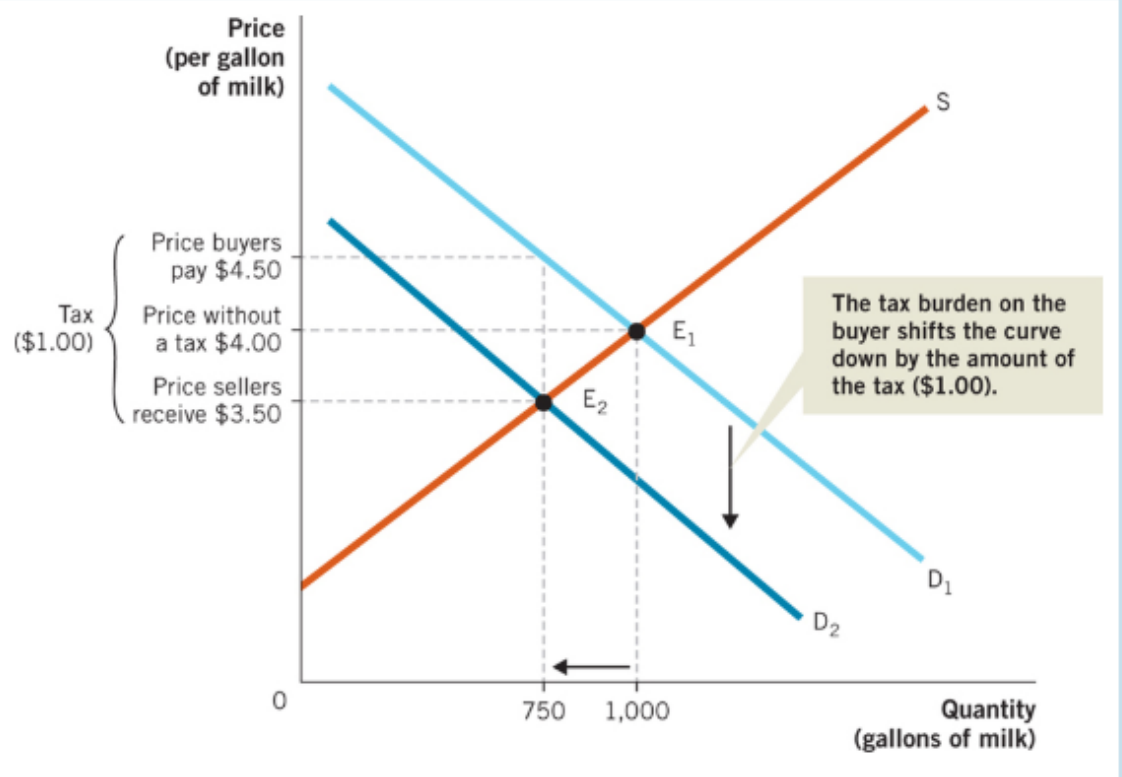
Each time a consumer buys a gallon of milk, the cash register adds $1.00 in tax. This means that to purchase the milk, the consumer must be willing to pay the price of the milk plus the $1.00 tax.

The result of the $1.00 tax on milk is shown in Figure 5.6. Because of the tax, consumers' willingness to pay for milk goes down, and the demand curve shifts left from $D_1$ to $D_2$. Why does the demand curve shift? The extra cost makes consumers less likely to buy milk at every price, which causes the entire demand curve to shift left. The intersection of the new demand curve ($D_2$) with the existing supply curve (S) creates a new equilibrium price of $3.50 ($E_2$), which is $0.50 lower than the original price of $4.00 per gallon. But even though the base price is lower, consumers are still worse off. Because they must also pay part of the $1.00 tax, the total price to them rises to $4.50 per gallon.


Why do we place excise taxes on cigarettes . . .


. . . and gasoline?

**FIGURE 5.6**




**A Tax on Buyers**

**A Tax on Buyers**

After the tax, the new equilibrium price ($E_2$) is \$3.50, but the buyer must also pay \$1.00 in tax. Therefore, despite the drop in equilibrium price, the buyer still pays more for a gallon of milk: \$4.50 instead of the original equilibrium price of \$4.00. A similar logic applies to the producer. Because the new equilibrium price after the tax is \$0.50 lower, the producer shares the tax incidence equally with the buyer in this example. The consumer pays \$0.50 more, and the seller nets \$0.50 less.

At the same time, because the new equilibrium price after the tax is \$0.50 lower than it was before the tax, the producer splits the tax incidence with the buyer. The producer receives \$0.50 less, and the buyer pays \$0.50 more.

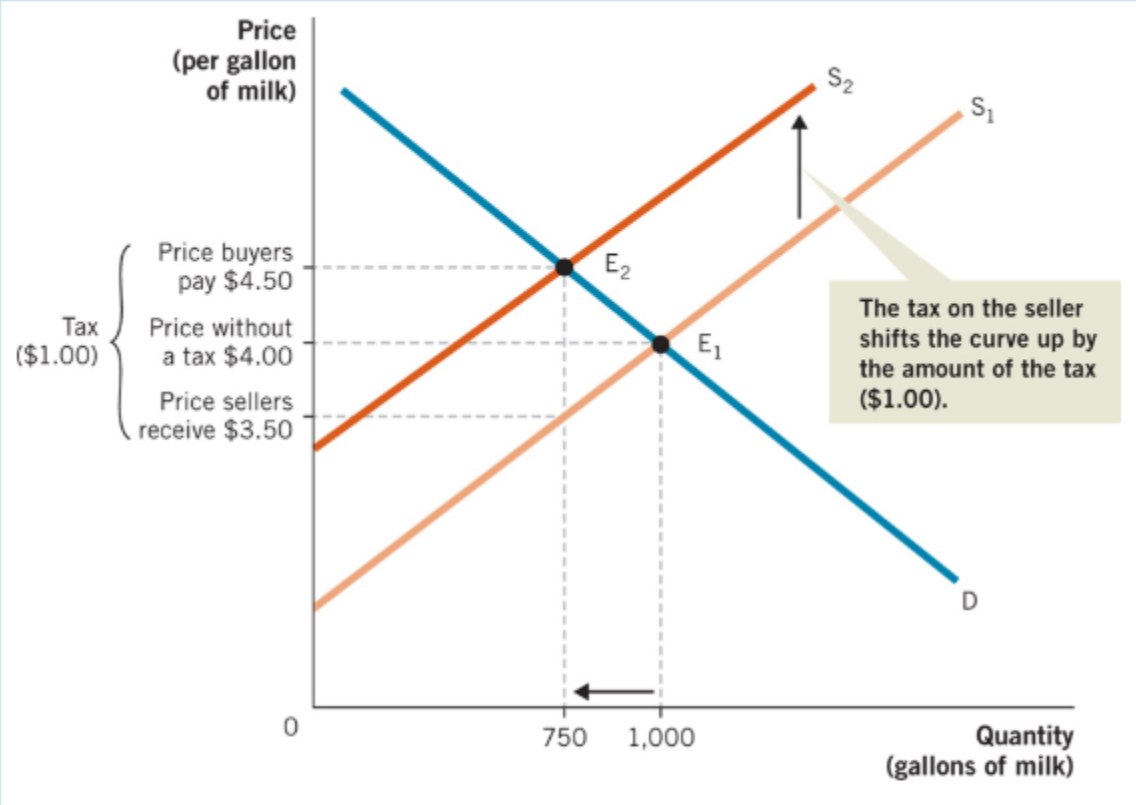
The tax on milk purchases also affects the amount sold in the market, which we also see in Figure 5.6. Because the after-tax equilibrium price ($E_2$) is lower, producers of milk reduce the quantity they sell to 750 gallons. Therefore, the market for milk becomes smaller than it was before the good was taxed.

Excise taxes are rarely levied on consumers because these taxes are highly visible. If you were reminded that you have to pay a \$1.00 tax every time you buy a gallon of milk, it would be hard for you to ignore the tax. As a result, politicians often prefer to place the tax on the seller.

### Example 2: Tax on Sellers

Now let's look at what happens when the \$1.00 tax on milk is placed on sellers. Figure 5.7 shows the result. First, look at the shift in the supply curve. Why does it shift? The \$1.00-per-gallon tax on milk lowers willingness to sell, which causes producers to offer less milk at every price level. As a result, the entire supply curve shifts left in response to the tax that milk producers owe the government. The intersection of the new supply curve ($S_2$) with the existing demand curve creates a new equilibrium price ($E_2$) of \$4.50 per gallon—which is \$0.50 higher than the original equilibrium price of \$4.00 ($E_1$). This higher equilibrium price occurs because the seller passes part of the tax increase along to the buyer in the form of a higher price. However, the seller is still worse off. After the tax, the new equilibrium price is \$4.50 per gallon, but \$1.00 goes as tax to the government. Therefore, despite the rise in price, the seller nets only \$3.50 per gallon, which is \$0.50 less than the original equilibrium price.

**FIGURE 5.7**




**A Tax on Sellers**

After the tax, the new equilibrium price ($E_2$) is $4.50, but $1.00 must be paid in tax to the government. Therefore, despite the rise in price, the seller nets only $3.50. Similar logic applies to the consumer. Because the new equilibrium price after the tax is $0.50 higher, the consumer shares the $1.00-per-gallon tax incidence equally with the seller. The consumer pays $0.50 more, and the seller nets $0.50 less.

The tax also affects the amount of milk sold in the market. Because the new equilibrium price after the tax is higher, consumers reduce the quantity demanded from 1,000 gallons to 750 gallons.

### So Who Bears the Incidence of the Tax?

It's important to notice that the result in Figure 5.7 looks much like that in Figure 5.6 because it does not matter whether a tax is levied on the buyer or the seller. The tax places a wedge of $1.00 between the price that buyers ultimately pay ($4.50) and the net price that sellers ultimately receive ($3.50), regardless of who is actually responsible for paying the tax.

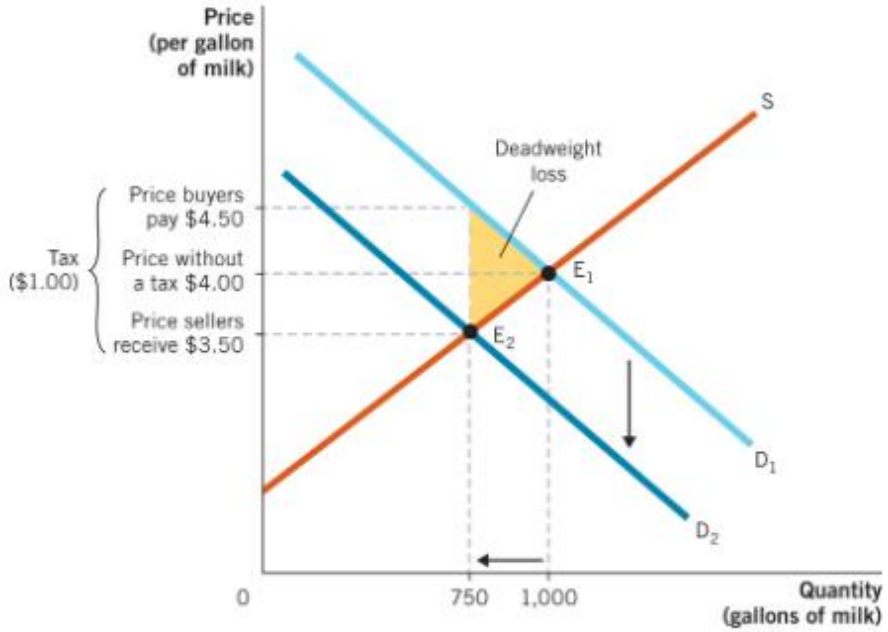
Continuing with our milk example, when the tax was levied on sellers, they were responsible for collecting the entire tax ($1.00 per gallon), but they transferred $0.50 of the tax to the consumer by raising the market price to $4.50. Similarly, when the tax was levied on consumers, they were responsible for paying the entire tax, but they essentially transferred $0.50 of it to producers, because the market price fell to $3.50. Therefore, we can say that the incidence of a tax is independent of whether it is levied on the buyer or the seller. However, depending on the price elasticity of supply and demand, the tax incidence need not be shared equally, as we will see later. All of this means that the government doesn't get to determine whether consumers or producers bear the tax incidence—the market does!

## Deadweight Loss

Recall that economists measure economic efficiency by looking at total consumer and producer surplus. We have seen that a tax raises the total price consumers pay and lowers the net price producers receive. For this reason, taxes reduce the amount of economic activity. **Deadweight loss** is the decrease in economic activity caused by market distortions.

In the previous section, we observed that the tax on milk caused the amount purchased to decline from 1,000 to 750 gallons—a reduction of 250 gallons sold in the market. In Figure 5.8, the yellow triangle represents the deadweight loss caused by the tax. When the price rises to $4.50 per gallon, consumers who would have paid between $4.01 and $4.50 will no longer purchase milk. Likewise, the reduction in the price the seller can charge means that producers who were willing to sell a gallon of milk for between $3.50 and $3.99 will no longer do so. The combined reductions in consumer and producer surplus equal the deadweight loss produced by a $1.00 tax on milk.

**FIGURE 5.8**




**The Deadweight Loss from a Tax**

The yellow triangle represents the deadweight loss caused by the tax. When the price rises, all consumers who would have paid between $4.01 and $4.50 no longer purchase milk. Likewise, the reduction in revenue the seller receives means that producers who were willing to sell a gallon of milk for between $3.50 and $3.99 will no longer do so.

## Conclusion

Let's return to the misconception we started with: taxes on firms do not affect consumers. This misconception is almost entirely false. The government largely taxes goods that have inelastic demand, which means that firms are able to transfer most of the tax incidence to consumers through higher prices.

In the first part of this chapter, we learned that society benefits from unregulated markets because they generate the largest possible total surplus. However, society also needs the government to provide an infrastructure for the economy. The taxation of specific goods and services gives rise to a form of market failure called deadweight loss, which reflects reduced economic activity. Thus, any intervention in the market requires a deep understanding of how society will respond to the incentives created by the legislation. In addition, unintended consequences can affect the most well-intentioned tax legislation and, if the process is not well thought through, can cause inefficiencies with far-reaching consequences. None of this means that taxes are undesirable. Rather, society must balance (1) the need for tax revenues and the programs those revenues help fund with (2) trade-offs in the market.

## ANSWERING THE BIG QUESTIONS

**What are consumer surplus and producer surplus?**

- Consumer surplus is the difference between the willingness to pay for a good or service and the price that is paid to get it. Producer surplus is the difference between the price that the seller receives and the price at which the seller is willing to sell the good or service.
- Total surplus (social welfare) is the sum of consumer and producer surplus that exists in a market.

**When is a market efficient?**

- Markets maximize consumer and producer surplus, provide goods and services to buyers who value them most, and reward sellers who can produce goods and services at the lowest cost. As a result, markets create the largest amount of total surplus possible.
- Whenever an allocation of resources maximizes total surplus, the result is said to be efficient. However, economists are also interested in the distribution of the surplus. Equity refers to the fairness of the distribution of the benefits within the society.

**Why do taxes create deadweight loss in otherwise efficient markets?**

- Deadweight loss occurs because taxes increase the purchase price, which causes consumers to buy less and producers to supply less. Deadweight loss can be lessened by taxing goods or services that have inelastic demand or supply.
- Economists are also concerned about the incidence of taxation. Incidence refers to the burden of taxation on the party who pays the tax through higher prices, regardless of whom the tax is actually levied on. The incidence is determined by the balance between the elasticity of supply and the elasticity of demand.

## CONCEPTS YOU SHOULD KNOW

consumer surplus (p. 153)
deadweight loss (p. 166)
efficient (p. 160)
equity (p. 160)
excise taxes (p. 163)
incidence (p. 163)
producer surplus (p. 155)
social welfare (p. 158)
total surplus (p. 158)
welfare economics (p. 152)
willingness to pay (p. 153)
willingness to sell (p. 155)

## QUESTIONS FOR REVIEW

1. Explain how consumer surplus is derived from the difference between the willingness to pay and the market equilibrium price.
2. Explain how producer surplus is derived from the difference between the willingness to sell and the market equilibrium price.
3. Why do economists focus on consumer and producer surplus and not on the possibility of consumer and producer loss? Illustrate your answer on a supply and demand graph.
4. How do economists define efficiency?
5. What type of goods should be taxed in order to minimize deadweight loss?
6. Suppose that the government taxes a good that has very elastic demand. Illustrate what will happen to consumer surplus, producer surplus, tax revenue, and deadweight loss on a supply and demand graph.
7. What happens to tax revenues as tax rates increase?

## STUDY PROBLEMS

1. A college student enjoys eating pizza. Her willingness to pay for each slice is shown in the following table:

| Number of pizza slices | Willingness to pay (per slice) |
|---|---|
| 1 | $6 |
| 2 | 5 |
| 3 | 4 |
| 4 | 3 |
| 5 | 2 |
| 6 | 1 |
| 7 | 0 |

   a. If pizza slices cost $3 each, how many slices will she buy? How much consumer surplus will she enjoy?
   b. If the price of slices falls to $2, how much consumer surplus will she enjoy?

2. A cash-starved town decides to impose a $6 excise tax on T-shirts sold. The following table shows the quantity demanded and the quantity supplied at various prices.

| Price per T-shirt | Quantity demanded | Quantity supplied |
|---|---|---|
| $19 | 0 | 60 |
| 16 | 10 | 50 |
| 13 | 20 | 40 |
| 10 | 30 | 30 |
| 7 | 40 | 20 |
| 4 | 50 | 10 |

   a. What are the equilibrium quantity demanded and the quantity supplied before the tax is implemented? Determine the consumer and producer surplus before the tax.
   b. What are the equilibrium quantity demanded and quantity supplied after the tax is implemented? Determine the consumer and producer surplus after the tax.
   c. How much tax revenue does the town generate from the tax?

3. Andrew pays $30 to buy a potato cannon, a cylinder that shoots potatoes hundreds of feet. He was willing to pay $45. When Andrew's friend Nick learns that Andrew bought a potato cannon, he asks Andrew if he will sell it for $60, and Andrew agrees. Nick is thrilled, since he would have paid Andrew up to $80 for the cannon. Andrew is also delighted. Determine the consumer surplus from the original purchase and the additional surplus generated by the resale of the cannon.

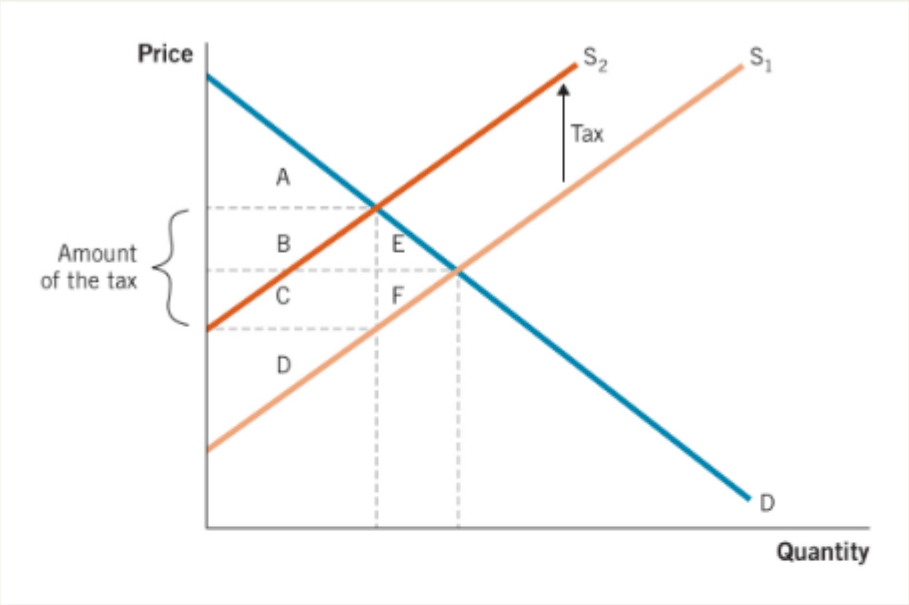
4. If the government wants to raise tax revenue, which of the following items are good candidates for an excise tax? Why?
   a. granola bars
   b. cigarettes
   c. toilet paper
   d. automobile tires
   e. bird feeders

5. If the government wants to minimize the deadweight loss of taxation, which of the following items are good candidates for an excise tax? Why?
   a. bottled water
   b. prescription drugs
   c. oranges
   d. batteries
   e. luxury cars

CLICK TO HIDE ANSWER

5. a. Many good substitutes are available: consumers can drink tap water, filtered water, or other healthy beverages instead of bottled water. Therefore, bottled water is not a good candidate for an excise tax.
   b. Taxing prescription drugs will generate significant revenues without reducing sales much, if at all. There is almost no deadweight loss because consumers have few, if any, alternatives. Thus, prescription drugs are a good candidate for an excise tax.
   c. Consumers can select many other fruits to replace oranges. The deadweight loss will be quite large. Therefore, oranges are not a good candidate for an excise tax.
   d. Without batteries, many devices won't work. The lack of substitutes makes demand quite inelastic, so the deadweight loss will be small. Thus, batteries are an excellent candidate for an excise tax.
   e. Wealthy consumers can spend their income in many ways. They do not have to buy luxury cars. As a result, the tax will create a large amount of deadweight loss. Therefore, luxury cars are a poor candidate for an excise tax.

6. A new medical study indicates that eating blueberries helps prevent cancer. If the demand for blueberries increases, what will happen to the size of the consumer surplus and producer surplus? Illustrate your answer by shifting the demand curve appropriately and labeling the new and old areas of consumer and producer surplus.
7. Use the following graph to answer questions a–f.
   a. What area represents consumer surplus before the tax?
   b. What area represents producer surplus before the tax?
   c. What area represents consumer surplus after the tax?
   d. What area represents producer surplus after the tax?
   e. What area represents the tax revenue after the tax?
   f. What area represents the deadweight loss after the tax?




**8.** The cost of many electronic devices has fallen appreciably since they were first introduced. For instance, computers, cell phones, microwave ovens, and calculators not only provide more functions but also do so at a lower cost. Illustrate the impact of lower production costs on the supply curve. What happens to the size of the consumer surplus and producer surplus? If consumer demand for cell phones is relatively elastic, who is likely to benefit the most from the lower production costs?

**9.** Suppose that the demand for a concert, $Q_D$, is represented by the following equation, where P is the price of concert tickets and Q is the number of tickets sold:

$$Q_D = 2500 - 20P$$

The supply of tickets, $Q_S$, is represented by the equation

$$Q_S = -500 + 80P$$

a. Find the equilibrium price and quantity of tickets sold. (***Hint***: Set $Q_D = Q_S$ and solve for the price, P, and then plug the result back into either of the original equations to find $Q_E$.)

b. Carefully graph your result from part a.

c. Calculate the consumer surplus at the equilibrium price and quantity. (***Hint***: Because the area of consumer surplus is a triangle, you will need to use the formula for the area of a triangle, $\frac{1}{2}$ × base × height, to solve the problem.)

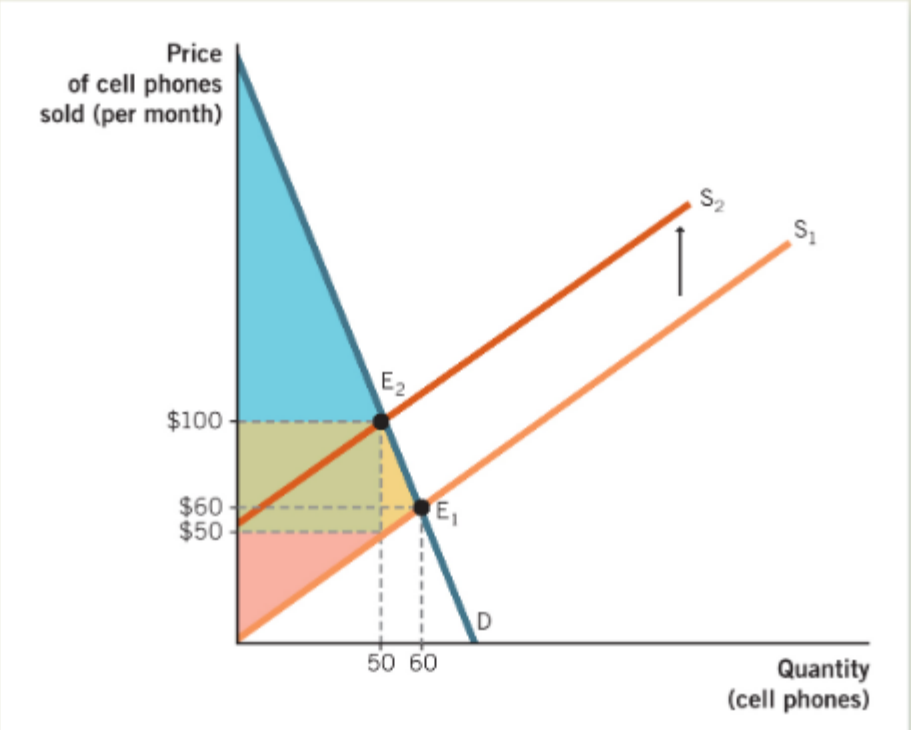
**10.** In this chapter, we focused on the effect of taxes on social welfare. However, governments also subsidize goods, making them cheaper to buy or sell. How would a $2,000 subsidy on the purchase of a new hybrid car impact the consumer surplus and producer surplus in the hybrid-car market? Use a supply and demand diagram to illustrate your answer. Does the subsidy create deadweight loss?

**11.** Suppose that a new $50 tax is placed on each new cell phone sold. Use the information in the following graph to answer these questions.

a. What is the incidence of the tax?

b. What is the deadweight loss of the tax?

c. What is the amount of tax revenue generated?



CLICK TO HIDE ANSWER

**11.a.** After the tax is implemented, the market price rises from \$60 to \$100; but because sellers must pay \$50 to the government, they net only \$50. Tax incidence measures the share of the tax paid by buyers and sellers. Because the market price rises by \$40 (from \$60 to \$100), buyers are paying \$40 of the \$50 tax, or $\frac{4}{5}$. Because the net price falls by \$10 (from \$60 to \$50), sellers are paying \$10 of the \$50 tax, or $\frac{1}{5}$.

**b.** The deadweight loss is represented by the decrease in the total surplus found in the yellow triangle. To compute the amount of the deadweight loss, we need to determine the area inside the triangle. The area of a triangle is found by taking $\frac{1}{2}$ × base × height. The triangle is sitting on its side, so the height of the triangle is 10 (60 – 50) and the base is \$50 (\$100 – \$50). Hence the deadweight loss is $\frac{1}{2}$ × 10 × \$50 = \$250.

**c.** The tax revenue is represented by the green area. You can calculate the tax revenue by multiplying the amount of the tax (\$50) by the number of units sold after the tax (50), which equals \$2,500.

**12.** A well-known saying goes, "Honesty is not only morally right, it is also highly efficient." Explain why firms that practice honesty lead to more social welfare than firms that practice dishonesty.

CLICK TO SHOW ANSWER

**13.** We defined deadweight loss as the decrease in economic activity caused by market distortions. One place where we see deadweight loss is during Halloween's trick-or-treat. Children of all ages return home with bags of candy, some of which they love and others that they don't care for. A lot of candy ends up uneaten. In this context, we can think of uneaten candy as not being distributed effectively by the market; therefore, deadweight loss occurs. What ways can you think of to improve how candy is given away during trick-or-treat so that children would receive more candies that they enjoy? Provide three possible solutions.