

Elasticities

- 6.1 Price Elasticity of Demand
- 6.2 Total Revenue and the Price Elasticity of Demand
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If a rock band increases the price it charges for concert tickets, what impact will that have on ticket sales? More precisely, will ticket sales fall a little or a lot? Will the band make more money by lowering the price or by raising the price? This chapter will allow you to answer these types of question and more.

Some of the results in this chapter may surprise you. A huge flood in the Midwest that destroyed much of this year's wheat crop would leave some wheat farmers better off. Ideal weather that led to a bountiful crop of

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wheat everywhere would leave wheat farmers worse off. As you will soon find out, these issues hinge importantly on the tools of elasticity.

In this chapter, we will also see the importance of elasticity in determining the effects of taxes. If a tax is levied on the seller, will the seller pay all of the taxes? If the tax were levied on the buyer—who pays the larger share of taxes? We will see that elasticity is critical in the determination of tax burden. Elasticities will also help us to more fully understand many policy issues—from illegal drugs to luxury taxes. For example, Congress were to impose a large tax on yachts, what do you think would happen to yacht sales? What would happen to employment in the boat industry?

Price Elasticity of Demand

6.1

📁 What is price elasticity of demand?

📁 How do we measure consumers' responses to price changes?

📁 What determines the price elasticity of demand?

In learning and applying the law of demand, we have established the basic fact that quantity demanded changes inversely with change in price, *ceteris paribus*. But how much does quantity demanded change? The extent to which a change in price affects quantity demanded may vary considerably from product to product and over the various price ranges for the same product. The **price elasticity of demand** measures the responsiveness of quantity demanded to a change in price. Specifically, price elasticity is defined as the percentage change in quantity demanded divided by the percentage change in price, or

$$\text{Price elasticity of demand } (E_D) = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

Note that, following the law of demand, price and quantity demanded show an inverse relationship. For this reason, the price elasticity of demand is, in theory, always negative. But in practice and for simplicity, this quantity is always expressed in absolute value terms—that is, as a positive number.

price elasticity of demand

the measure of the responsiveness of quantity demanded to a change in price

Is the Demand Curve Elastic or Inelastic?

It is important to understand the basic intuition behind elasticities, which requires a focus on the percentage changes in quantity demanded and price.

Think of elasticity as an elastic rubber band. If the quantity demanded is responsive to even a small change in price, we call it elastic. On the other hand, if even a huge change in price results in only a small change in quantity demanded, then the demand is said to be inelastic. For example, if a 10 percent increase in the price leads to a 50 percent reduction in the quantity demanded, we say that demand is elastic because the quantity demanded is sensitive to the price change.

$$E_D = \frac{\% \Delta Q_D}{\% \Delta P} = \frac{50\%}{10\%} = 5$$



Think of price elasticity like an elastic rubber band. When small price changes greatly affect, or “stretch,” quantity demanded, the demand is elastic, much like a very stretchy rubber band. When large price changes can’t “stretch” demand, however, then demand is inelastic, more like a very stiff rubber band.

Demand is elastic in this case because a 10 percent change in price led to a larger (50 percent) change in quantity demanded.

Alternatively, if a 10 percent increase in the price leads to a 1 percent reduction in quantity demanded, we say that demand is *inelastic* because the quantity demanded did not respond much to the price reduction.

$$E_D = \frac{\% \Delta Q_D}{\% \Delta P} = \frac{1\%}{10\%} = 0.10$$

Demand is inelastic in this case because a 10 percent change in price led to a smaller (1 percent) change in quantity demanded.

Types of Demand Curves

Economists refer to a variety of demand curves based on the magnitude of their elasticity. A demand curve, or a portion of a demand curve, can be elastic, inelastic, or unit elastic.

Demand is **elastic** when the elasticity is greater than 1 ($E_D > 1$)—the quantity demanded changes proportionally more than the price changes. In this case, a given percentage increase in price, say 10 percent, leads to a larger percentage change in quantity demanded, say 20 percent, as seen in Exhibit 1(a). If the curve is *perfectly elastic*, the demand curve is horizontal. The elasticity coefficient is infinity because even the slightest change in price will lead to a huge change in quantity demanded—for example, a tiny increase in price will cause the quantity demanded to fall to zero. In Exhibit 1(b), a *perfectly elastic* demand curve (horizontal) is illustrated.

Demand is **inelastic** when the elasticity is less than 1; the quantity demanded changes proportionally less than the price changes. In this case, a given percentage (for example, 10 percent) change in price is accompanied by a smaller (for example, 5 percent) reduction in quantity demanded, as seen in Exhibit 2(a). If the demand curve is *perfectly inelastic*, the quantity demanded is the same regardless of the price. The elasticity coefficient is zero because the quantity demanded does not respond to a change in price. This relationship is illustrated in Exhibit 2(b).

Goods for which E_D equals one ($E_D = 1$) are said to have **unit elastic demand**. In this case, the quantity demanded changes proportionately to price changes. For example, a 10 percent

elastic

when the percentage change in quantity demanded is greater than the percentage change in price ($E_D > 1$)

inelastic

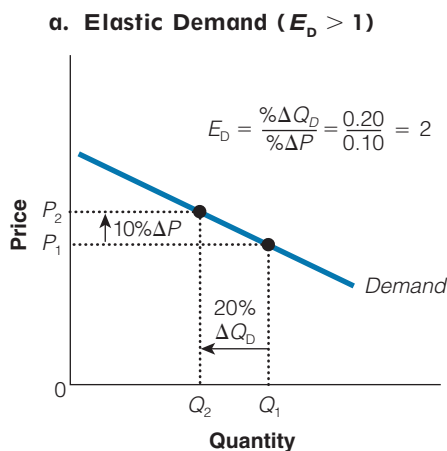
when the percentage change in quantity demanded is less than the percentage change in price ($E_D < 1$)

unit elastic demand

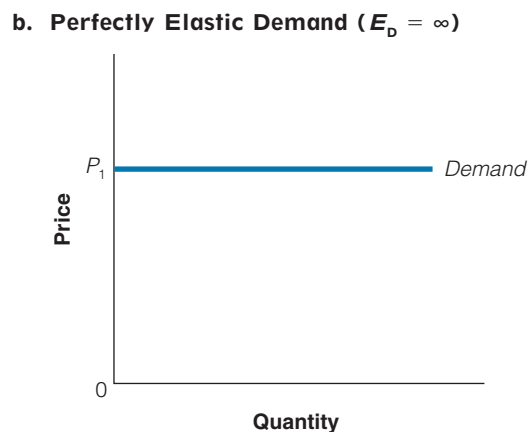
demand with a price elasticity of 1; the percentage change in quantity demanded is equal to the percentage change in price

section 6.1 exhibit 1

Elastic Demand



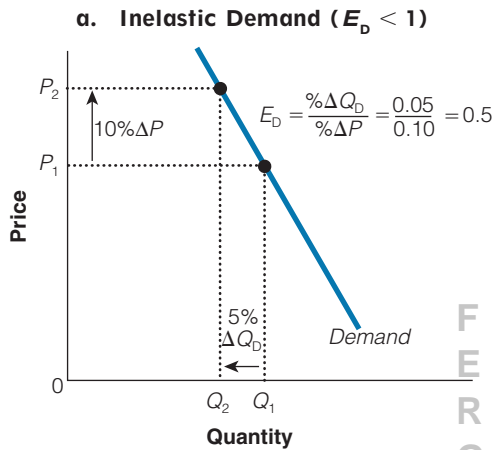
A small percentage change in price leads to a larger percentage change in quantity demanded.



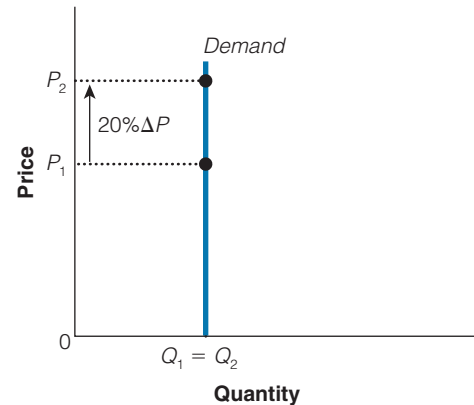
A small percentage change in price will change quantity demanded by an infinite amount.

section 6.1
exhibit 2

Inelastic Demand



A change in price leads to a smaller percentage change in quantity demanded.

b. Perfectly Inelastic Demand ($E_D = 0$)

The quantity demanded does not change regardless of the percentage change in price.

increase in price will lead to a 10 percent reduction in quantity demanded. This relationship is illustrated in Exhibit 3.

The price elasticity of demand is closely related to the slope of the demand curve. Generally speaking, the flatter the demand curve passing through a given point, the more elastic the demand. The steeper the demand curve passing through a given point, the less elastic the demand.

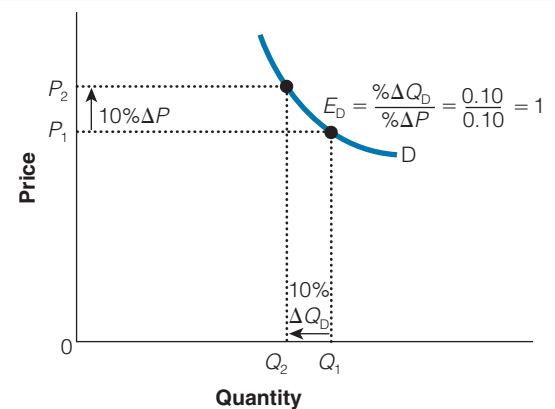
Calculating the Price Elasticity of Demand: The Midpoint Method

To get a clear picture of exactly how the price elasticity of demand is calculated, consider the case for a hypothetical pizza market. Say the price of pizza increases from \$19 to \$21. If we take an average between the old price, \$19, and the new price, \$21, we can calculate an average price of \$20. Exhibit 4 shows that as a result of the increase in the price of pizza, the quantity demanded has fallen from 82 million pizzas to 78 million pizzas per year. If we take an average between the old quantity demanded, 82 million, and the new quantity demanded, 78 million, we have an average quantity demanded of 80 million pizzas per year. That is, the \$2 increase in the price of pizza has led to a 4-million pizza reduction in quantity demanded. How can we figure out the price elasticity of demand?

You might ask why we are using the average price and average quantity. The answer is that if we did not use the average amounts, we would come up with different values for the elasticity of demand depending on whether we moved up or down the demand curve. When the change in price and quantity are of significant magnitude, the exact meaning of the term *percentage change* requires clarification, and the terms *price* and *quantity* must be defined more precisely. The issue thus is, should the percentage change be figured on the basis of price and quantity before or after the change has occurred? For example, a price rise from \$10 to \$15 constitutes a 50 percent change if the original price (\$10) is used in figuring

section 6.1
exhibit 3

Unit Elastic Demand



The percentage change in quantity demanded is the same as the percentage change in price that caused it ($E_D = 1$).

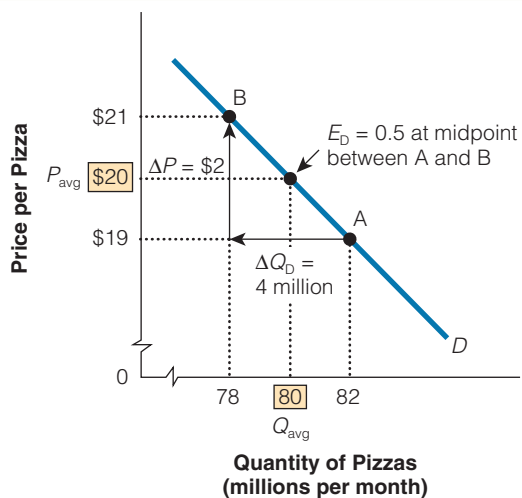


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Does it matter whether we move up or down the demand curve when we calculate the price elasticity of demand?

section 6.1
exhibit 4

Calculating the Price Elasticity of Demand



The price elasticity of demand is found with the formula

$$\frac{\Delta Q_D / Q_{\text{avg}}}{\Delta P / P_{\text{avg}}}$$

the percentage ($\$5/\10), or a 33 percent change if the price after the change ($\$15$) is used ($\$5/\15). For small changes, the distinction is not important, but for large changes, it is. To avoid this confusion, economists often use this average technique. Specifically, we are actually calculating the elasticity at a midpoint between the old and new prices and quantities.

Now to figure out the price elasticity of demand, we must first calculate the percentage change in price. To find the percentage change in price, we take the change in price (ΔP) and divide it by the average price (P_{avg}). (Note: The Greek letter delta, Δ , means “change in.”)

$$\text{Percentage change in price} = \Delta P / P_{\text{avg}}$$

In our pizza example, the original price was \$19, and the new price is \$21. The change in price (ΔP) is \$2, and the average price (P_{avg}) is \$20. The percentage change in price can then be calculated as

$$\begin{aligned} \text{Percentage change in price} &= \$2/\$20 \\ &= 1/10 = 0.10 = 10\% \end{aligned}$$

Next, we must calculate the percentage change in quantity demanded. To find the percentage change in quantity

demanded, we take the change in quantity demanded (ΔQ_D) and divide it by the average quantity demanded (Q_{avg}).

$$\text{Percentage change in quantity demanded} = \Delta Q_D / Q_{\text{avg}}$$

In our pizza example, the original quantity demanded was 82 million, and the new quantity demanded is 78 million. The change in quantity demanded (ΔQ_D) is 4 million, and the average quantity demanded (Q_{avg}) is 80 million. The percentage change in quantity demanded can then be calculated as

$$\begin{aligned} \text{Percentage change in} \\ \text{quantity demanded} &= 4 \text{ million}/80 \text{ million} = 1/20 = 0.05 = 5\% \end{aligned}$$

Because the price elasticity of demand is equal to the percentage change in quantity demanded divided by the percentage change in price, the price elasticity of demand for pizzas between point A and point B can be shown as

$$\begin{aligned} E_D &= \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}} \\ &= \frac{\Delta Q_D / Q_{\text{avg}}}{\Delta P / P_{\text{avg}}} = \frac{4 \text{ million}/80 \text{ million}}{\$2/\$20} \\ &= \frac{1/20}{1/10} = \frac{5\%}{10\%} = 0.5 \end{aligned}$$



Why are demand curves for goods with close substitutes more elastic?

The Determinants of the Price Elasticity of Demand

As you have learned, the elasticity of demand for a specific good refers to movements along its demand curve as its price changes. A lower price will increase quantity demanded, and a higher price will reduce quantity demanded. But what factors will influence the magnitude of

the change in quantity demanded in response to a price change? That is, what will make the demand curve relatively more elastic (where Q_D is responsive to price changes), and what will make the demand curve relatively less elastic (where Q_D is less responsive to price changes)?

For the most part, the price elasticity of demand depends on three factors: (1) the availability of close substitutes, (2) the proportion of income spent on the good, and (3) the amount of time that has elapsed since the price change.

Availability of Close Substitutes

Goods *with* close substitutes tend to have more elastic demands. Why? Because if the price of such a good increases, consumers can easily switch to other now relatively lower-priced substitutes. In many examples, such as one brand of root beer as opposed to another, or different brands of gasoline, the ease of substitution will make demand quite elastic for most individuals. Goods *without* close substitutes, such as insulin for diabetics, cigarettes for chain smokers, heroin for addicts, or emergency medical care for those with appendicitis or broken legs, tend to have inelastic demands.

The degree of substitutability can also depend on whether the good is a necessity or a luxury. Goods that are necessities, such as food, have no ready substitutes and thus tend to have lower elasticities than do luxury items, such as jewelry.

When the good is broadly defined, it tends to be less elastic than when it is narrowly defined. For example, the elasticity of demand for food, a broad category, tends to be inelastic over a large price range because few substitutes are available for food. But for a certain type of food, such as pizza, a narrowly defined good, it is much easier to find a substitute—perhaps tacos, burgers, salads, burritos, or chili fries. That is, the demand for a particular type of food is more elastic because more and better substitutes are available than for food as an entire category.

Proportion of Income Spent on the Good

The smaller the proportion of income spent on a good, the lower its elasticity of demand. If the amount spent on a good relative to income is small, then the impact of a change in its price on one's budget will also be small. As a result, consumers will respond less to price changes for small-ticket items than for similar percentage changes in large-ticket items, where a price change could potentially have a large impact on the consumer's budget. For example, a 50 percent increase in the price of salt will have a much smaller impact on consumers' behavior than a similar percentage increase in the price of a new automobile. Similarly, a 50 percent increase in the cost of private university tuition will have a greater impact on students' (and sometimes parents') budgets than a 50 percent increase in textbook prices.

Time

For many goods, the more time that people have to adapt to a new price change, the greater the elasticity of demand. Immediately after a price change, consumers may be unable to locate good alternatives or easily change their consumption patterns. But as time passes, consumers have more time to find or develop suitable substitutes and to plan and implement changes in their patterns of consumption. For example, drivers may not



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If bus fares increase, will ridership fall a little or a lot? It all depends on the price elasticity of demand. If the price elasticity of demand is elastic, a 50-cent price increase will lead to a relatively large reduction in bus travel as riders find viable substitutes. If the price elasticity of demand is inelastic, a 50-cent price increase will lead to a relatively small reduction in bus ridership as riders are not able to find good alternatives to bus transportation.



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Unlike most tangible items (such as specific types of food or cars), there are few substitutes for a physician and medical care when you have an emergency. Because the number of available substitutes is limited, the demand for emergency medical care is relatively inelastic.



What impact does time have on elasticity?

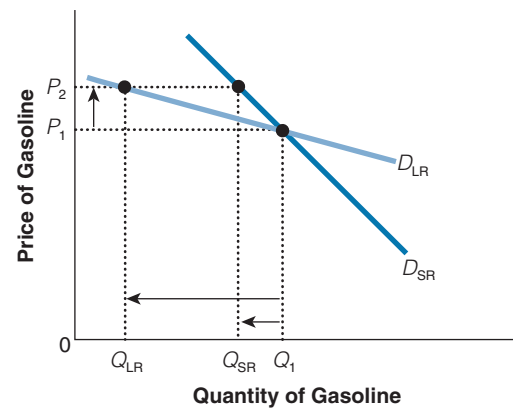
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Some studies show that a 10 percent increase in the price of cigarettes will lead to a 7 percent reduction in the quantity demanded of youth smoking. In this price range, however, demand is still inelastic at -0.7 . Of course, proponents of higher taxes to discourage underage smoking would like to see a more elastic demand, where a 10 percent increase in the price of cigarettes would lead to a reduction in quantity demanded of more than 10 percent. However, compared to adults, younger people are more likely to smoke fewer cigarettes in response to a price change (a tax increase). The elasticity of demand for cigarettes for 24- to 26-year-olds is -0.20 and for 27- to 29-year-olds it is -0.09 .

section 6.1 exhibit 5

Short-Run and Long-Run Demand Curves



For many goods, such as gasoline, price is much more elastic in the long run than in the short run because buyers have more time to find suitable substitutes or change their consumption patterns. In the short run, the increase in price from P_1 to P_2 has only a small effect on the quantity demanded for gasoline. In the long run, the effect of the price increase will be much larger.

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respond immediately to an increase in gas prices, perhaps believing it to be temporary. However, if the price persists over a longer period, we would expect people to drive less, buy more fuel-efficient cars, move closer to work, carpool, take the bus, or even bike to work. So for many goods, especially nondurable goods (goods that do not last a long time), the short-run demand curve is generally less elastic than the long-run demand curve, as illustrated in Exhibit 5.

Estimated Price Elasticities of Demand

Because of shifts in supply and demand curves, researchers have a difficult task when trying to estimate empirically the price elasticity of demand for a particular good or service. Despite this difficulty, Exhibit 6 presents some estimates for the price elasticity of demand for certain goods. As you would expect, certain goods like medical care, air travel, and gasoline are all relatively price inelastic in the short run because buyers have fewer substitutes. On the other hand, air travel in the long run is much more sensitive to price (elastic) because the available substitutes are much more plentiful. Exhibit 6 shows that the price elasticity of demand for air travel is 2.4, which means that a 1 percent increase in price will lead to a 2.4 percent reduction in quantity demanded. Notice, in each case where the data are available, the estimates of the long-run price elasticities of demand are greater than the short-run price elasticities of demand. In short, the price elasticity of demand is greater when the price change persists over a longer time periods.

section 5.1
exhibit 6
Price Elasticities of Demand for Selected Goods

Good	Short Run	Long Run
Salt	—	0.1
Air travel	0.1	2.4
Gasoline	0.2	0.7
Medical care and hospitalization	0.3	0.9
Jewelry and watches	0.4	0.7
Physician services	0.6	—
Alcohol	0.9	3.6
Movies	0.9	3.7
China, glassware	1.5	2.6
Automobiles	1.9	2.2
Chevrolets	—	4.0

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SOURCES: Adapted from Robert Archibald and Robert Gillingham, "An Analysis of the Short-Run Consumer Demand for Gasoline Using Household Survey Data," *Review of Economics and Statistics* 62 (November 1980): 622–628; Hendrik S. Houthakker and Lester D. Taylor, *Consumer Demand in the United States: Analyses and Projections* (Cambridge, Mass.: Harvard University Press, 1970), pp. 56–149; Richard Voith, "The Long-Run Elasticity of Demand for Commuter Rail Transportation," *Journal of Urban Economics* 30 (November 1991): 360–372.

SECTION QUIZ

- Price elasticity of demand is defined as the _____ change in quantity demanded divided by the _____ change in price.
 - total; percentage
 - percentage; marginal
 - marginal; percentage
 - percentage; percentage
 - total; total
- Demand is said to be _____ when the quantity demanded is not very responsive to changes in price.
 - independent
 - inelastic
 - unit elastic
 - elastic
- When demand is inelastic,
 - price elasticity of demand is less than 1.
 - consumers are not very responsive to changes in price.
 - the percentage change in quantity demanded resulting from a price change is less than the percentage change in price.
 - all of the above are correct.
- Which of the following will not tend to increase the elasticity of demand for a good?
 - an increase in the availability of close substitutes
 - an increase in the amount of time people have to adjust to a change in the price
 - an increase in the proportion of income spent on the good
 - all of the above will increase the elasticity of demand for a good

(continued)

SECTION QUIZ (Cont.)



5. Which of the following would tend to have the most elastic demand curve?
 - a. automobiles
 - b. Chevrolet automobiles
 - c. (a) and (b) would be the same
 - d. none of the above
 6. Price elasticity of demand is said to be greater
 - a. the shorter the period of time consumers have to adjust to price changes.
 - b. the longer the period of time consumers have to adjust to price changes.
 - c. when there are fewer available substitutes.
 - d. when the elasticity of supply is greater.
 7. The long-run demand curve for gasoline is likely to be
 - a. more elastic than the short-run demand curve for gasoline.
 - b. more inelastic than the short-run demand curve for gasoline.
 - c. the same as the short-run demand curve for gasoline.
 - d. more inelastic than the short-run supply of gasoline.
 8. Demand curves for goods tend to become more inelastic
 - a. when more good substitutes for the good are available.
 - b. when the good makes up a larger portion of a person's income.
 - c. when people have less time to adapt to a given price change.
 - d. when any of the above is true.
 - e. in none of the above situations.
-
1. What question is the price elasticity of demand designed to answer?
 2. How is the price elasticity of demand calculated?
 3. What is the difference between a relatively price elastic demand curve and a relatively price inelastic demand curve?
 4. What is the relationship between the price elasticity of demand and the slope at a given point on a demand curve?
 5. What factors tend to make demand curves more price elastic?
 6. Why would a tax on a particular brand of cigarettes be less effective at reducing smoking than a tax on all brands of cigarettes?
 7. Why is the price elasticity of demand for products at a 24-hour convenience store likely to be lower at 2 A.M. than at 2 P.M.?
 8. Why is the price elasticity of demand for turkeys likely to be lower, but the price elasticity of demand for turkeys at a particular store at Thanksgiving likely to be greater than at other times of the year?

Answers: 1. d 2. b 3. d 4. d 5. b 6. b 7. a 8. c

3
4
1
5
B
U

6.2

Total Revenue and the Price Elasticity of Demand

What is total revenue?

Does the price elasticity of demand vary along a linear demand curve?

What is the relationship between total revenue and the price elasticity of demand?

How Does the Price Elasticity of Demand Impact Total Revenue?

The price elasticity of demand for a good also has implications for total revenue. **Total revenue (TR)** is the amount sellers receive for a good or service. Total revenue is simply the price of the good (P) times the quantity of the good sold (Q): $TR = P \times Q$. The elasticity of demand will help to predict how changes in the price will impact total revenue earned by the producer for selling the good. Let's see how this works.

total revenue (TR) the amount sellers receive for a good or service, calculated as the product price times the quantity sold

In Exhibit 1, we see that when the demand is price elastic ($E_D > 1$), total revenues will rise as the price declines, because the percentage increase in the quantity demanded is greater than the percentage reduction in price. For example, if the price of a good is cut in half (say from \$10 to \$5) and the quantity demanded more than doubles (say from 40 to 100), total revenue will rise from \$400 ($\$10 \times 40 = \400) to \$500 ($\$5 \times 100 = \500). Equivalently, if the price rises from \$5 to \$10 and the quantity demanded falls from 100 to 40 units, then total revenue will fall from \$500 to \$400. As this example illustrates, if the demand curve is relatively elastic, total revenue will vary inversely with a price change.

You can see from the following what happens to total revenue when demand is price elastic. (*Note:* The size of the price and quantity arrows represents the size of the percentage changes.)

When Demand Is Price Elastic

$$\downarrow TR = \uparrow P \times \downarrow Q$$

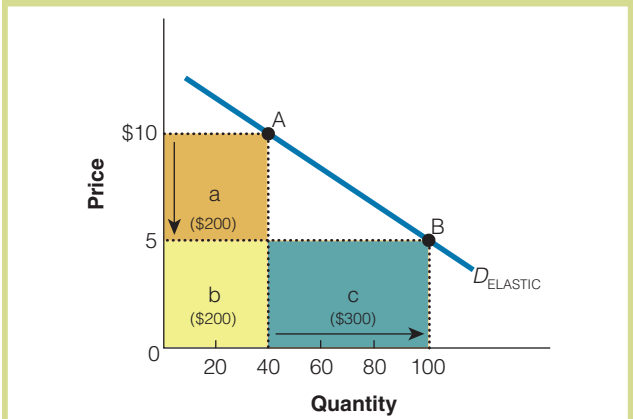
or

$$\uparrow TR = \downarrow P \times \uparrow Q$$

On the other hand, if demand for a good is relatively inelastic ($E_D < 1$), the total revenue will be lower at lower prices than at higher prices because a given price reduction will be accompanied by a proportionately smaller increase in quantity demanded. For example, as shown in Exhibit 2, if the price of a good is cut (say from \$10 to \$5) and the quantity demanded less than doubles (say it increases from 30 to 40), then total revenue will fall from \$300 ($\$10 \times 30 = \300) to \$200 ($\$5 \times 40 = \200). Equivalently, if the price increases from \$5 to \$10 and the quantity demanded falls from 40 to 30, total revenue will increase from \$200 to \$300. To summarize, then: If the demand curve is inelastic, total revenue will vary directly with a price change.

section 6.2 exhibit 1

Elastic Demand and Total Revenue



At point A, total revenue is \$400 ($\$10 \times 40 = \400), or area a + b. If the price falls to \$5 at point B, the total revenue is \$500 ($\$5 \times 100 = \500), or area b + c. Total revenue increased by \$100. We can also see in the graph that total revenue increased, because the area b + c is greater than area a + b, or $c > a$.

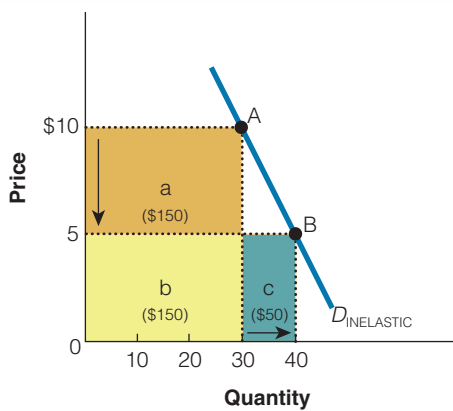
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Can the relationship between price and total revenue tell you whether a good is elastic or inelastic?

section 6.2
exhibit 2

Inelastic Demand and Total Revenue



At point A, total revenue is \$300 ($\$10 \times 30 = \300), or area a + b. If the price falls to \$5 at point B, the total revenue is \$200 ($\$5 \times 40 = \200), or area b + c. Total revenue falls by \$100. We can also see in the graph that total revenue decreases, because area a + b is greater than area b + c, or $a > c$.

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How is it possible that elasticity changes along a straight lined demand curve when the slope is constant?

When Demand Is Price Inelastic

$$\uparrow TR = \uparrow P \times \downarrow Q$$

or

$$\downarrow TR = \downarrow P \times \uparrow Q$$

In this case, the “net” effect on total revenue is reversed but easy to see. (Again, the size of the price and quantity arrows represents the size of the percentage changes.)

Price Elasticity Changes along a Linear Demand Curve

As already shown (Section 6.1, Exhibit 1), the slopes of demand curves can be used to estimate their *relative* elasticities of demand: The steeper one demand curve is relative to another, the more inelastic it is relative to the other. However, except for the extreme cases of perfectly elastic and perfectly inelastic curves, great care must be taken when trying to estimate the degree of elasticity of one demand curve from its slope. In fact, as we will soon see, a straight-line demand curve with a constant slope will change elasticity continuously as you move up or down it. It is because the slope is the ratio of changes in the two variables (price and quantity) while the elasticity is the ratio of percentage changes in the two variables.

We can easily demonstrate that the elasticity of demand varies along a linear demand curve by using what we already know about the interrelationship between price and total

Use what you've learned

Elasticities and Total Revenue

Q Is a poor wheat harvest bad for all farmers and is a great wheat harvest good for all farmers? (Hint: Assume that demand for wheat is inelastic—the demand for food is generally inelastic.)

A Without a simultaneous reduction in demand, a reduction in supply from a poor harvest results in higher prices. With that, if demand for the wheat is inelastic over the pertinent portion of the demand curve, the price increase will cause farmers' total revenues to rise. As shown in Exhibit 3(a), if demand for the crop is inelastic, an increase in price will cause farmers to lose the revenue indicated by area c. They will, however, experience an increase in revenue equal to area a, resulting in an overall increase in total revenue equal to area



COURTESY OF ROBERT L. SEXTON

a – c. Clearly, if some farmers lose their entire crop because of, say, bad weather, they will be worse

(continued)

use what you've learned

Elasticities and Total Revenue (Cont.)

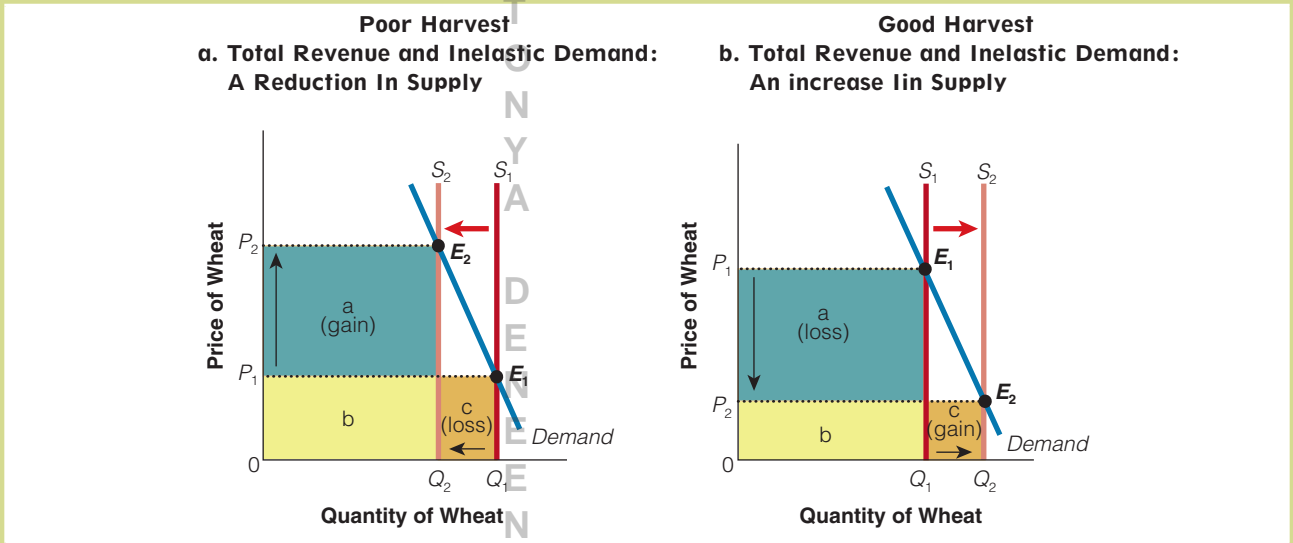
off; but collectively, farmers can profit from events that reduce crop size—and they do, because the demand for most agricultural products is inelastic. Interestingly, if all farmers were hurt equally, say losing one-third of their crop, each farmer would be better off. Of course, consumers would be worse off, because the price of agricultural products would be higher. Alternatively, what if phenomenal weather led to record wheat harvests or a technological advance led to more productive wheat farmers? Either event would increase the supply from S_1 to S_2 in Exhibit 3(b). The increase in supply leads to a decrease in price, from P_1 to P_2 . Because the demand for wheat is inelastic, the quantity sold of wheat rises less than proportionately to the fall in the price. That is, in percentage terms, the price falls more than the quantity

demand rises. Each farmer is selling a few more bushels of wheat, but the price of each bushel has fallen even more, so collectively wheat farmers will experience a decline in total revenue despite the good news.

The same is also true for the many government programs that attempt to help farmers by reducing production—crop restriction programs. These programs, like droughts or floods, tend to help farmers because the demand for food is relatively inelastic. But it hurts consumers who now have to pay a higher price for less food. Farm technology may be good for consumers because it shifts the supply curve to the right and lowers prices. However it may be bad for some small farmers because it could put them out of business. See Exhibit 3(b).

section 6.2 exhibit 3

Elasticities and Total Revenue

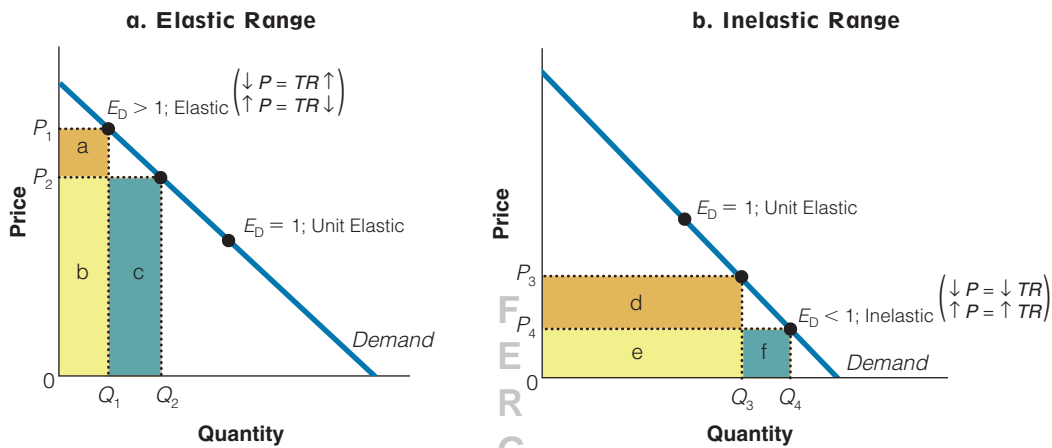


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revenue. Exhibit 4 shows a linear (constant slope) demand curve. In Exhibit 4(a), we see that when the price falls on the upper half of the demand curve from P_1 to P_2 , and quantity demanded increases from Q_1 to Q_2 , total revenue increases. That is, the new area of total revenue (area b + c) is larger than the old area of total revenue (area a + b). It is also true that if price increased in this region (from P_2 to P_1), total revenue would fall, because b + c is greater than a + b. In this region of the demand curve, then, there is a negative relationship between price and total revenue. As we discussed earlier, this is characteristic of an elastic demand curve ($E_D > 1$).

section 6.2
 exhibit 4

Price Elasticity along a Linear Demand Curve



The slope is constant along a linear demand curve, but the elasticity varies. Moving down along the demand curve, the elasticity is elastic at higher prices and inelastic at lower prices. It is unit elastic between the inelastic and elastic ranges.



Is a good wheat harvest always good for all wheat farmers?

Exhibit 4(b) illustrates what happens to total revenue on the lower half of the same demand curve. When the price falls from P_3 to P_4 and the quantity demanded increases from Q_3 to Q_4 , total revenue actually decreases, because the new area of total revenue (area e + f) is less than the old area of total revenue (area d + e). Likewise, it is clear that an increase in price from P_4 to P_3 would increase total revenue. In this case, there is a positive relationship between price and total revenue, which, as we discussed, is characteristic of an inelastic demand curve ($E_D < 1$). Together, parts (a) and (b) of Exhibit 4 illustrate that, although the slope remains constant, the elasticity of a linear demand curve changes along the length of the curve—from relatively elastic at higher price ranges to relatively inelastic at lower price ranges.

 use
 what you've learned

Elasticity Varies along a Linear Demand Curve

Q Why do economists emphasize elasticity at the current price?

A Because for most demand (and supply) curves, the price elasticity varies along the curve. Thus, for most goods we usually refer to a particular point or a section of the demand (or supply) curves. In Exhibit 5, we see that the upper half of the straight-line demand curve is elastic and the

lower half is inelastic. Notice on the lower half of the demand curve, a higher (lower) price increases (decreases) total revenue—that is, in this lower region, demand is inelastic. However, on the top half of the demand curve, a lower (higher) price increases (decreases) total revenue—that is, in this region demand is elastic.

For example, when the price increases from \$2 to \$3, the total revenue increases from \$32 to \$42—an increase in price increases total revenue, so demand is inelastic in this portion of the demand curve.

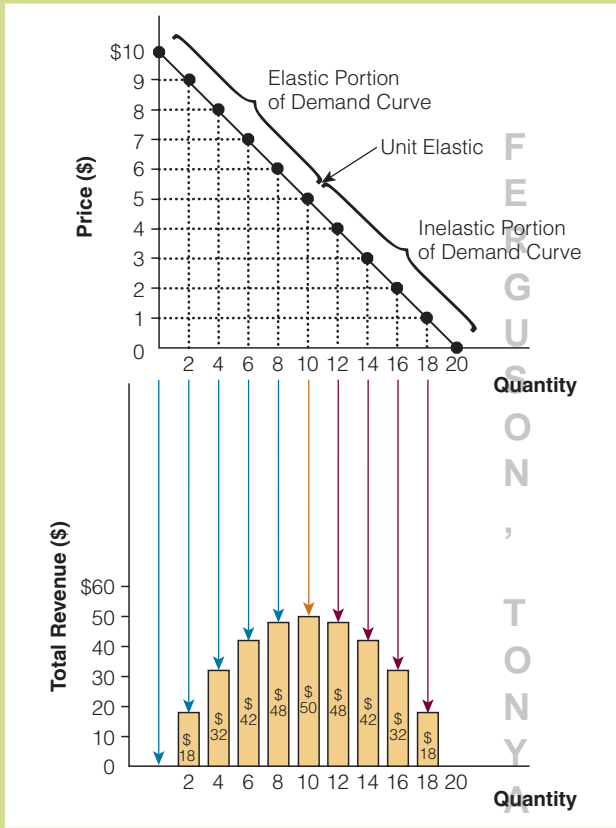
(continued)

use
what you've learned

Elasticity Varies along a Linear Demand Curve (Cont.)

section 6.2
exhibit 5

Elasticity Varies along a Linear Demand Curve



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But when the price increases from \$8 to \$9, the total revenue falls from \$32 to \$18—an increase in price lowers total revenue, so demand is elastic in this portion of the demand curve.

Specifically, when the price is high and the quantity demanded is low, this portion of the demand curve is elastic. Why? It is because a \$1 reduction in price is a smaller percentage change when the price is high than when it is low. Similarly, an increase in 2 units of output is a larger percentage change when quantity demanded is lower. So we have a relatively small change in price leading to a proportionately greater change in quantity demanded—that is, demand is elastic on this portion of the demand curve. Of course, the opposite is true when the price is low and the quantity demanded is high. Why? It is because a \$1 change in price is a larger percentage change when the price is low and an increase in 2 units of output is a smaller percentage change when the quantity demanded is larger. That is, a relatively larger percentage change in price will lead to a relatively smaller change in quantity demanded—demand is relatively inelastic on this portion of the demand curve.

SECTION QUIZ

- When the local symphony recently raised the ticket price for its summer concerts in the park, the symphony was surprised to see that its total revenue had actually decreased. The reason was that the elasticity of demand for tickets was
 - unit elastic.
 - unit inelastic.
 - inelastic.
 - elastic.
- A straight-line demand curve would
 - have the same elasticity along its entire length.
 - have a higher elasticity of demand near its top than near its bottom.
 - have a lower elasticity of demand near its bottom than near its top.
 - be relatively inelastic at high prices, but relatively elastic at low prices.

(continued)

SECTION QUIZ (Cont.)



3. Which of the following is a true statement?
 - a. Total revenue is the price of the good times the quantity sold.
 - b. If demand is price elastic, total revenue will vary inversely with a change in price.
 - c. If demand is price inelastic, total revenue will vary in the same direction as a change in price.
 - d. A linear demand curve is more price elastic at higher price ranges and more price inelastic at lower price ranges, and it is unit elastic at the midpoint.
 - e. All of the above are true statements.
4. If demand was relatively inelastic in the short run, but elastic in the long run, a price increase would _____ total revenue in the short run and _____ total revenue in the long run.
 - a. increase; increase
 - b. increase; decrease
 - c. decrease; increase
 - d. decrease; decrease

-
1. Why does total revenue vary inversely with price if demand is relatively price elastic?
 2. Why does total revenue vary directly with price if demand is relatively price inelastic?
 3. Why is a linear demand curve more price elastic at higher price ranges and more price inelastic at lower price ranges?
 4. If demand for some good was perfectly price inelastic, how would total revenue from its sales change as its price changed?
 5. Assume that both you and Art, your partner in a picture-framing business, want to increase your firm's total revenue. You argue that in order to achieve this goal, you should lower your prices; Art, on the other hand, thinks that you should raise your prices. What assumptions are each of you making about your firm's price elasticity of demand?

Answers: 1. d 2. b 3. e 4. b

6.3

Other Types of Demand Elasticities

📁 What is the cross-price elasticity of demand? 📁 What is the income elasticity of demand?

The Cross-Price Elasticity of Demand

The price of a good is not the only factor that affects the quantity consumers will purchase. Sometimes the quantity of one good demanded is affected by the price of a related good. For example, if the price of potato chips falls, what is the impact, if any, on the demand for soda (a complement)? Or if the price of soda increases, to what degree will the demand for iced tea (a substitute) be affected? The cross-price elasticity of demand measures both the direction and magnitude of the impact that a price change for one good will have on the demand for another good. Specifically, the **cross-price elasticity of demand** is defined as the percentage change in the demand of one good (good A) divided by the percentage change in price of another good (good B), or

$$\text{Cross-price elasticity demand} = \frac{\% \Delta \text{ in the demand for Good A}}{\% \Delta \text{ in the price for Good B}}$$

cross-price elasticity of demand

the measure of the impact that a price change of one good will have on the demand of another good

The cross-price elasticity of demand indicates not only the degree of the connection between the two variables but also whether the goods in question are substitutes or complements for one another.

Calculating the Cross-Price Elasticity of Demand

Let's calculate the cross-price elasticity of demand between soda and iced tea, where a 10 percent increase in the price of soda results in a 20 percent increase in the demand for iced tea. In this case, the cross-price elasticity of demand would be +2 ($+20\% \div +10\% = +2$).

Consumers responded to the soda price increase by buying less soda (moving along the demand curve for soda) and increasing the demand for iced tea (shifting the demand curve for iced tea). In general, if the cross-price elasticity is positive, we can conclude that the two goods are substitutes because the price of one good and the demand for the other move in the same direction.

As another example, let's calculate the cross-price elasticity of demand between potato chips and soda, where a 10 percent decrease in the price of potato chips results in a 30 percent increase in the demand for soda. In this case, the cross-price elasticity of demand is -3 ($+30\% \div -10\% = -3$). The demand for chips increases as a result of the price decrease, as consumers then purchase additional soda to wash down those extra bags of salty chips. Potato chips and soda, then, are complements. In general, if the cross-price elasticity is negative, we can conclude that the two goods are complements because the price of one good and the demand for the other move in opposite directions.

Cross-Price Elasticity and Sodas

According to economist Jean-Pierre Dube, Coca-Cola is a good substitute for Pepsi—the cross-price elasticity is a 0.34. In other words, a 10 percent increase in the price of a Pepsi 12-pack will lead to an increase in the sales of Coca-Cola 12-packs by 3.4 percent. But six-packs of Coca-Cola and Diet Coke are even a better substitute with a cross-price elasticity of 1.15; a 10 percent increase in the price of a six-pack of Diet Coke will lead to a 11.5 percent increase in the sales of six-packs of Coca-Cola. And a 10 percent increase in the price of a 12-pack of Mountain Dew will lead to a 7.7 percent increase in the sales of 12-packs of Pepsi.



A 10 percent increase in the price of a six-pack of Diet Coke will lead to a 11.5 percent increase in the sales of six-packs of Coca-Cola. That is a cross-price elasticity of 1.15.

The Income Elasticity of Demand

Sometimes it is useful to measure how responsive demand is to a change in income. The income elasticity of demand is a measure of the relationship between a relative change in income and the consequent relative change in demand, *ceteris paribus*. The income elasticity of demand coefficient not only expresses the degree of the connection between the two variables, but it also indicates whether the good in question is normal or inferior. Specifically, the **income elasticity of demand** is defined as the percentage change in the demand divided by the percentage change in income, or

$$\text{Income elasticity of demand} = \frac{\% \Delta \text{ in demand}}{\% \Delta \text{ in income}}$$

income elasticity of demand

the percentage change in demand divided by the percentage change in consumer's income

Calculating the Income Elasticity of Demand

Let's calculate the income elasticity of demand for lobster, where a 10 percent increase in income results in a 15 percent increase in the demand for lobster. In this case, the income elasticity of demand is +1.5 ($+15\% \div +10\% = +1.5$). Lobster, then, is a normal good

because an increase in income results in an increase in demand. In general, if the income elasticity is positive, then the good in question is a normal good because income and demand move in the same direction.

In comparison, let's calculate the income elasticity of demand for beans, where a 10 percent increase in income results in a 15 percent decrease in the demand for beans. In this case, the income elasticity of demand is -1.5 ($-15\% \div +10\% = -1.5$). In this example, then, beans are an inferior good because an increase in income results in a decrease in the demand for beans. If the income elasticity is negative, then the good in question is an inferior good because the change in income and the change in demand move in opposite directions.

SECTION QUIZ



1. If the cross-price elasticity of demand between two goods is negative, we know that
 - a. they are substitutes.
 - b. they are complements.
 - c. they are both inferior goods.
 - d. they are both normal goods.
2. If the income elasticity of demand for good A is 0.5 and the income elasticity of demand for good B is 1.5, then
 - a. both A and B are normal goods.
 - b. both A and B are inferior goods.
 - c. A is a normal good, but B is an inferior good.
 - d. A is an inferior good, but B is a normal good.
3. If good X has a negative cross-price elasticity of demand with good Y and good X also has a negative income elasticity of demand, then
 - a. X is a substitute for Y, and X is a normal good.
 - b. X is a substitute for Y, and X is an inferior good.
 - c. X is a complement for Y, and X is a normal good.
 - d. X is a complement for Y, and X is an inferior good.
4. Which of the following statements is true?
 - a. The cross-price elasticity of demand is the percentage change in the demand of one good divided by the percentage change in the price of another good.
 - b. If the sign on the cross-price elasticity is positive, the two goods are substitutes; if it is negative, the two goods are complements.
 - c. The income elasticity of demand is the percentage change in demand divided by the percentage change in consumer's income.
 - d. If the income elasticity is positive, then the good is a normal good; if it is negative, the good is an inferior good.
 - e. All of the above are true statements.

1. How does the cross-price elasticity of demand tell you whether two goods are substitutes? Complements?
2. How does the income elasticity of demand tell you whether a good is normal? Inferior?
3. If the cross-price elasticity of demand between potato chips and popcorn was positive and large, would popcorn makers benefit from a tax imposed on potato chips?
4. As people's incomes rise, why will they spend an increasing portion of their incomes on goods with income elasticities greater than 1 (DVDs) and a decreasing portion of their incomes on goods with income elasticities less than 1 (food)?
5. If people spent three times as much on restaurant meals and four times as much on DVDs as their incomes doubled, would restaurant meals or DVDs have a greater income elasticity of demand?

Answers: 1. a 2. a 3. d 4. e

6.4

Price Elasticity of Supply

What is the price elasticity of supply?

How does the relative elasticity of supply and demand determine the tax burden?

How does time affect the supply elasticity?

What Is the Price Elasticity of Supply?

According to the law of supply, there is a positive relationship between price and quantity supplied, *ceteris paribus*. But by how much does quantity supplied change as price changes? It is often helpful to know the degree to which a change in price changes the quantity supplied. The **price elasticity of supply** measures how responsive the quantity sellers are willing and able to sell is to changes in price. In other words, it measures the relative change in the quantity supplied that results from a change in price. Specifically, the price elasticity of supply (E_s) is defined as the percentage change in the quantity supplied divided by the percentage change in price, or

price elasticity of supply

the measure of the sensitivity of the quantity supplied to changes in price of a good

$$E_s = \frac{\% \Delta \text{ in the quantity supplied}}{\% \Delta \text{ in price}}$$

Calculating the Price Elasticity of Supply

The price elasticity of supply is calculated in much the same manner as the price elasticity of demand. Consider, for example, the case in which it is determined that a 10 percent increase in the price of artichokes results in a 25 percent increase in the quantity of artichokes supplied after, say, a few harvest seasons. In this case, the price elasticity is +2.5 ($+25\% \div +10\% = +2.5$). This coefficient indicates that each 1 percent increase in the price of artichokes induces a 2.5 percent increase in the quantity of artichokes supplied.

Types of Supply Curves

As with the elasticity of demand, the ranges of the price elasticity of supply center on whether the elasticity coefficient is greater than or less than 1. Goods with a supply elasticity that is greater than 1 ($E_s > 1$) are said to be relatively elastic in supply. With that, a 1 percent change in price will result in a greater than 1 percent change in quantity supplied. In our example, artichokes were elastic in supply because a 1 percent price increase resulted in a 2.5 percent increase in quantity supplied. An example of an *elastic supply curve* is shown in Exhibit 1(a).

Goods with a supply elasticity that is less than 1 ($E_s < 1$) are said to be inelastic in supply. In other words, a 1 percent change in the price of these goods will induce a proportionately smaller change in the quantity supplied. An example of an *inelastic supply curve* is shown in Exhibit 1(b).

Finally, two extreme cases of price elasticity of supply are perfectly inelastic supply and perfectly elastic supply. In a condition of *perfectly inelastic supply*, an increase in price will not change the quantity supplied. In this case the elasticity of supply is zero. For example, in a sports arena in the short run (that is, in a period too brief to adjust the structure), the number of seats available will be almost fixed, say at 20,000 seats. Additional portable seats might be available, but for the most part, even if a higher price is charged, only 20,000 seats will be available. We say that the elasticity of supply is zero, which describes a perfectly inelastic supply curve. Famous paintings, such as Van Gogh's *Starry Night*, provide another example: Only one original exists; therefore, only one can be supplied, regardless of price. An example of this condition is shown in Exhibit 1(c).



What does it mean if the supply of elasticity is less than 1? greater than 1?



Immediately after harvest season is over, the supply of pumpkins is inelastic. That is, even if the price for pumpkins rises, say 10 percent, the amount of pumpkins produced will change hardly at all until the next harvest season. Some pumpkins may be grown in greenhouses (at a much higher price to consumers), but most farmers will wait until the next growing season.

At the other extreme is a perfectly elastic supply curve, where the elasticity equals infinity, as shown in Exhibit 1(d). In a condition of *perfectly elastic supply*, the price does not change at all. It is the same regardless of the quantity supplied, and the elasticity of supply is infinite. Firms would supply as much as the market wants at the market price (P_1) or above. However, firms would supply nothing below the market price because they would not be able to cover their costs of production. Most cases fall somewhere between the two extremes of perfectly elastic and perfectly inelastic.

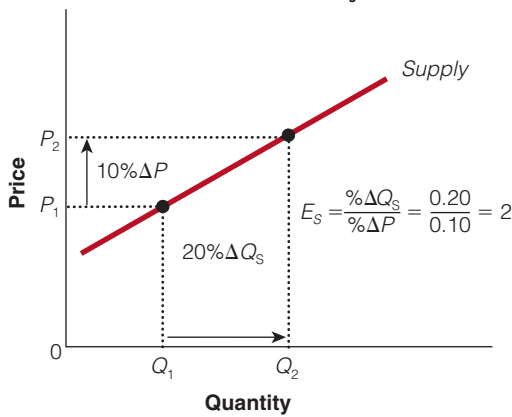
How Does Time Affect Supply Elasticities?

Time is usually critical in supply elasticities (as well as in demand elasticities), because it is more costly for sellers to bring forth and release products in a shorter period. For example, higher wheat prices may cause farmers to grow more wheat, but big changes cannot occur until the next growing season. That is, immediately after harvest season, the supply of wheat is relatively inelastic, but over a longer time extending

section 6.4
exhibit 1

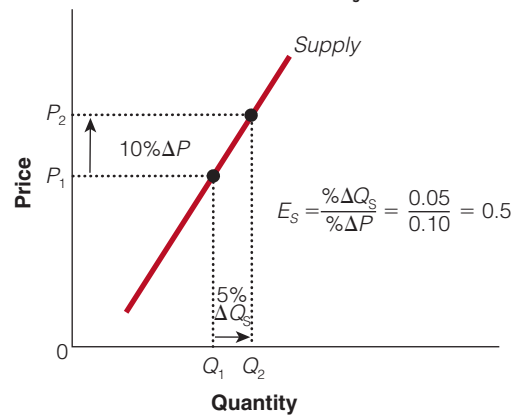
The Price Elasticity of Supply

a. Elastic Supply ($E_s > 1$)



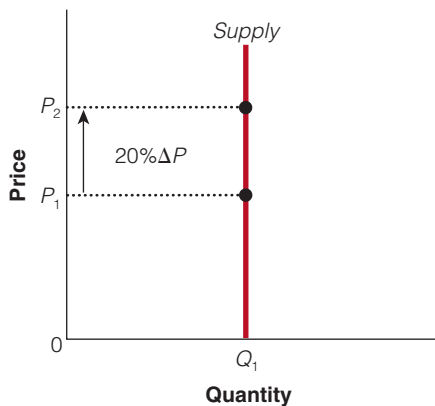
A change in price leads to a larger percentage change in quantity supplied.

b. Inelastic Supply ($E_s < 1$)



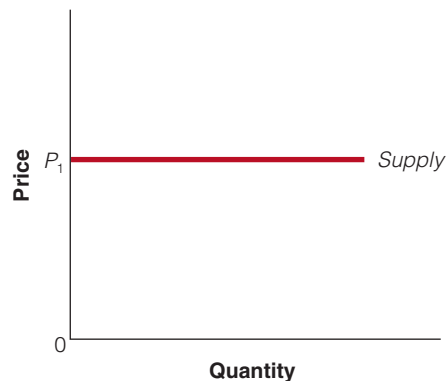
A change in price leads to a smaller percentage change in quantity supplied.

c. Perfectly Inelastic Supply ($E_s = 0$)



The quantity supplied does not change regardless of the change in price.

d. Perfectly Elastic Supply ($E_s = \infty$)



Even a small percentage change in price will change quantity supplied by an infinite amount.

PEPUSON, TONYA DENEEEN 3415BU

over the next growing period, the supply curve becomes much more elastic. Thus, supply tends to be more elastic in the long run than in the short run, as shown in Exhibit 2.

In the short run, firms can increase output by using their existing facilities to a greater capacity, paying workers to work overtime, and hiring additional workers. However, firms will be able to change output much more in the long run when firms can build new factories or close existing ones. In addition, some firms can enter as others exit. In other words, the quantity supplied will be much more elastic in the long run than in the short run.

Elasticities and Taxes: Combining Supply and Demand Elasticities

Who pays the tax? Someone may be legally required to send the check to the government but that is not necessarily the party that bears the burden of the tax.

The relative elasticity of supply and demand determines the distribution of the tax burden for a good. As we will see, if demand is relatively less elastic than supply in the relevant tax region, the largest portion of the tax is paid by the consumer. However, if demand is relatively more elastic than supply in the relevant tax region, the largest portion of the tax is paid by the producer.

In Exhibit 3(a), the pretax equilibrium price is \$1.00 and the pretax equilibrium quantity is Q_{BT} —the quantity before tax. If the government imposes a \$0.50 tax on the seller, the supply curve shifts vertically by the amount of the tax (just as if an input price rose \$0.50).

When demand is relatively less elastic than supply in the relevant region, the consumer bears more of the burden of the tax. For example, in Exhibit 3(a), the demand curve is relatively less elastic than the supply curve. In response to the tax, the consumer pays \$1.40 per unit, \$0.40 more than the consumer paid before the tax increase. The producer, however, receives \$0.90 per unit, which is \$0.10 less than the producer received before the tax.

In Exhibit 3(b), demand is relatively more elastic than the supply in the relevant region. Here we see that the greater burden of the same \$0.50 tax falls on the producer. That is, the producer is now responsible for \$0.40 of the tax, while the consumer only pays \$0.10. In general, then, the tax burden falls on the side of the market that is relatively less elastic.

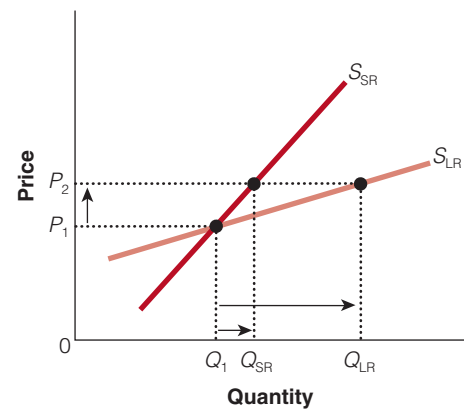
Yachts, Taxes, and Elasticities

In 1991, Congress levied a 10 percent luxury tax. The tax applied to the “first retail sale” of luxury goods with sales prices above the following thresholds: automobiles \$30,000; boats, \$100,000; private planes, \$250,000; and furs and jewelry, \$10,000. The Congressional Budget Office forecasted that the luxury tax would raise about \$1.5 billion over five years. However, in 1991, the luxury tax raised less than \$30 million in tax revenues. Why? People stopped buying items subject to the luxury tax.

Let’s focus our attention on the luxury tax on yachts. Congress passed this tax thinking that the demand for yachts was relatively inelastic and that the tax would have only a small impact on the sale of new yachts. However, the people in the market for new boats had plenty of substitutes—used boats, boats from other countries, new houses, vacations, and so on. In short, the demand for new yachts was more elastic

section 6.4 exhibit 2

Short-Run and Long-Run Supply Curves



For most goods, supply is more elastic in the long run than in the short run. For example, if the price of a certain good increases, firms have an incentive to produce more but are constrained by the size of their plants. In the long run, they can increase their capacity and produce more.

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Why does supply tend to be more elastic in the long run than in the short run?



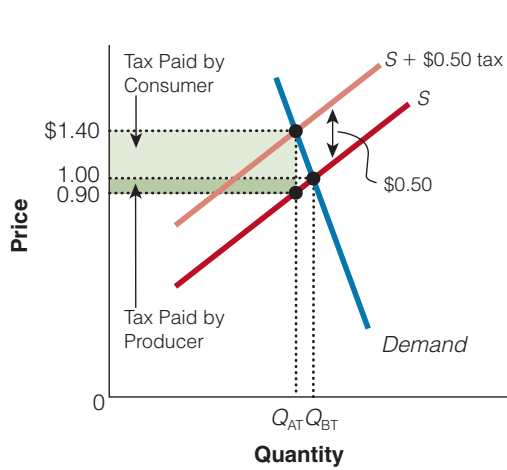
ELENA ELISSEVASHUTTERSTOCK.COM

If the demand for yachts is elastic, will most of a luxury tax on yachts get passed on to producers of yachts? And if so, how will that impact employment in the boat-building industry?

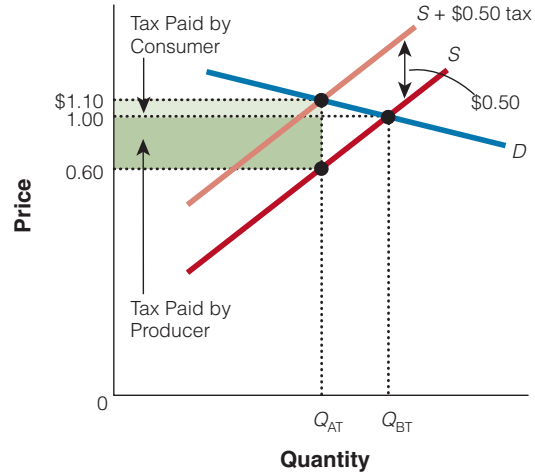
section 6.4
exhibit 3

Elasticity and the Burden of Taxation

a. Demand Is Relatively Less Elastic Than Supply



b. Demand Is Relatively More Elastic Than Supply



When demand is less elastic (or more inelastic) than supply, the tax burden falls primarily on consumers, as shown in (a). When demand is more elastic than supply, as shown in (b), the tax burden falls primarily on producers.

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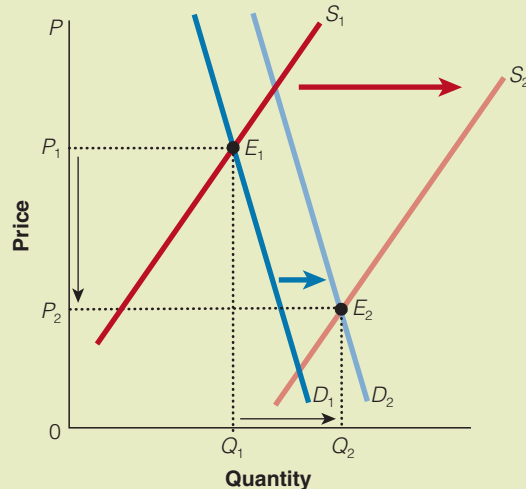
than Congress thought. Remember, when demand is relatively more elastic than supply, most of the tax is passed on to the seller—in this case, the boat industry (workers and retailers). And supply was relatively inelastic because boat factories are not easy to change in the short run. So sellers received a lower price for their boats, and sales fell. In the first year after the tax, yacht retailers reported a 77 percent drop in sales, and approximately 25,000 workers were laid off. The point is that incorrectly predicting elasticities can lead to huge social, political, and economic problems. After intense lobbying by industry groups, Congress repealed the luxury tax on boats in 1993, and on January 1, 2003, the tax on cars finally expired.

Use what you've learned

Farm Prices Fall over the Last Half-Century

Q In the last half-century, farm prices experienced a steady decline—roughly 2 percent per year. Why?

A The demand for farm products grew more slowly than supply. Productivity advances in agriculture caused large increases in supply. And because of the inelastic demand for farm products, farmers' incomes fell considerably. That is, the total revenues ($P \times Q$) that farmers collected at the higher price, P_1 , was much greater, area $0P_1E_1Q_1$, than the total revenue collected by farmers now when prices are lower, P_2 , at area $0P_2E_2Q_2$.



in the news **Drugs across the Border**

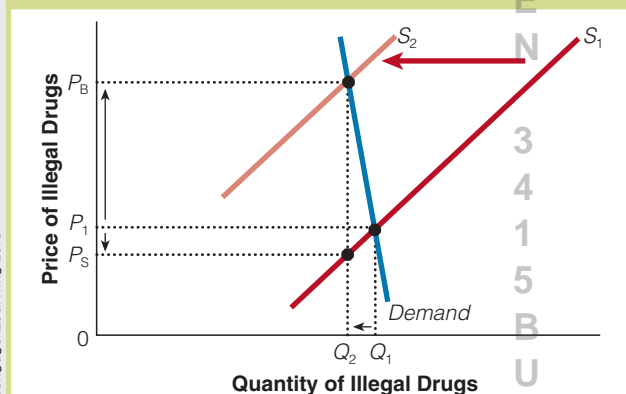
The United States spends billions of dollars a year to halt the importation of illegal drugs across the border. Although these efforts are clearly targeted at suppliers, who really pays the higher enforcement and evasion costs? The government crackdown has increased the probability of apprehension and conviction for drug smugglers. That increase in risk for suppliers increases their cost of doing business, raising the cost of importing and distributing illegal drugs. This would shift the supply curve for illegal drugs to the left, from S_1 to S_2 , as seen in Exhibit 4. For most drug users—addicts, in particular—the price of drugs such as cocaine and heroin lies in the highly inelastic region of the demand curve. Because the demand for drugs is relatively inelastic in this region, the seller would be able to shift most of this cost onto the consumer (think of it as similar to the tax shift just discussed). The buyer now has to pay a much higher price, P_B , and the seller receives a slightly lower price, P_S . That is, enforcement efforts increase the price of illegal drugs, but only a small reduction in quantity demanded results from this price increase. Increased enforcement efforts may have unintended consequences due to the fact that buyers bear the majority of the burden of this price increase. Tighter smuggling controls may, in fact, result in higher levels of burglary, muggings, and white-collar crime, as more cash-strapped buyers search for alternative ways of funding their increasingly expensive habit. In addition, with the huge financial rewards in the drug trade, tougher enforcement and higher

illegal drug prices could lead to even greater corruption in law enforcement and the judicial system.

These possible reactions do not mean we should abandon our efforts against illegal drugs. Illegal drugs can impose huge personal and social costs—billions of dollars of lost productivity and immeasurable personal tragedy. However, solely targeting the supply side can have unintended consequences. Policy makers may get their best results by focusing on a reduction in demand—changing user preferences. For example, if drug education leads to a reduction in the demand for drugs, the demand curve will shift to the left—reducing the price and the quantity of illegal drugs exchanged, as shown in Exhibit 5. The remaining drug users, at Q_2 , will now pay a lower price, P_2 . This lower price for drugs will lead to fewer drug-related crimes, *ceteris paribus*.

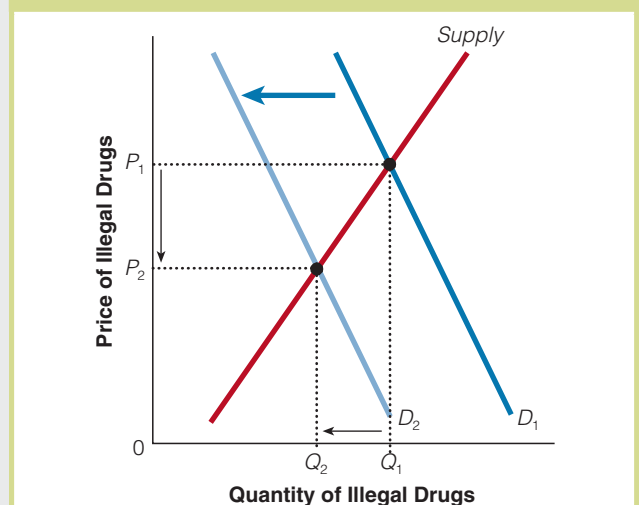
It is also possible that the elasticity of demand for illegal drugs may be more elastic in the long run than the short run. In the short run, as the price rises, the quantity demanded falls less than proportionately because of the addictive nature of illegal drugs (this relationship is also true for goods such as tobacco and alcohol). However, in the long run, the demand for illegal drugs may be more elastic; that is, the higher price may deter many younger, and poorer, people from experimenting with illegal drugs.

section 4.4
exhibit 4 Government Effort to Reduce the Supply of Illegal Drugs



section 6.4
exhibit 5

Drug Education Reduces Demand



use

what you've learned

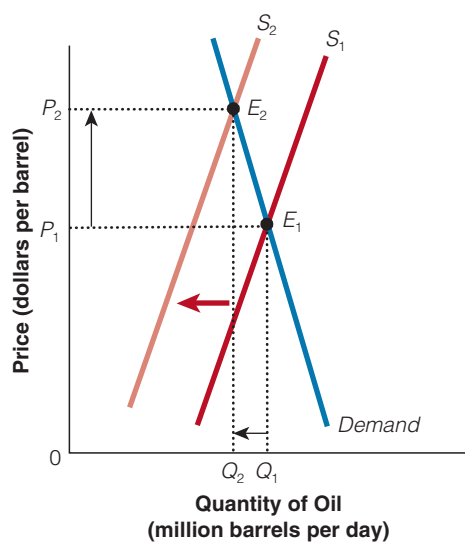
Oil Prices

One reason that small changes in supply (or demand) lead to large changes in oil prices and small changes in quantity is because of the inelasticity of demand (and supply) in the short run. Because bringing the production of oil to market takes a long time, the elasticity of supply is relatively low—supply is inelastic. Few substitutes for oil products (e.g., gasoline) are available in the short run, as seen in Exhibit 6(a).

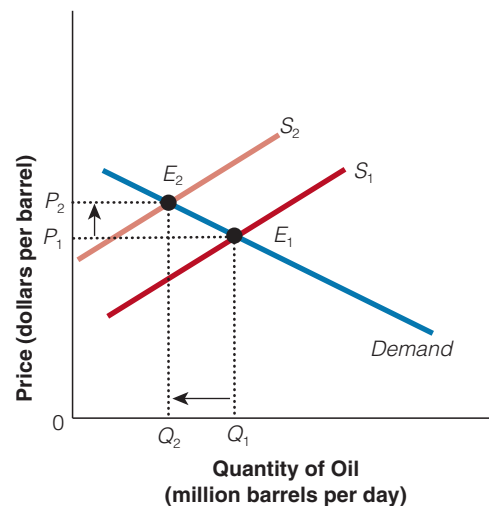
However, in the long run, demand and supply are more elastic. At higher prices, consumers will replace gas guzzlers with more fuel-efficient cars, and non-OPEC oil producers will expand exploration and production. Thus, in the long run, when supply and demand are much more elastic, the same size reduction in supply will have a smaller impact on price, as seen in Exhibit 6(b).

 section 6.4
 exhibit 6

a. Oil Prices in the Short Run



b. Oil Prices in the Long Run



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SECTION QUIZ

- For a given increase in price, the greater the elasticity of supply, the greater the resulting
 - decrease in quantity supplied.
 - decrease in supply.
 - increase in quantity supplied.
 - increase in supply.
- If the demand for gasoline is highly inelastic and the supply is highly elastic, and then a tax is imposed on gasoline, it will be paid
 - largely by the sellers of gasoline.
 - largely by the buyers of gasoline.
 - equally by the sellers and buyers of gasoline.
 - by the government.

(continued)

SECTION QUIZ (Cont.)



3. Which of the following statements is true?
 - a. The price elasticity of supply measures the relative change in the quantity supplied that results from a change in price.
 - b. If the supply price elasticity is greater than 1, it is elastic; if it is less than 1, it is inelastic.
 - c. Supply tends to be more elastic in the long run than in the short run.
 - d. The relative elasticity of supply and demand determines the distribution of the tax burden for a good.
 - e. All of the statements above are true.
4. Which of the following statements is true?
 - a. The price elasticity of supply measures the relative change in the quantity supplied that results from a change in price.
 - b. When supply is relatively elastic, a 10 percent change in price will result in a greater than 10 percent change in quantity supplied.
 - c. Goods with a supply elasticity that is less than 1 are called relatively inelastic in supply.
 - d. Who bears the burden of a tax has nothing to do with who actually pays the tax at the time of the purchase.
 - e. All of the statements above are true.

1. What does it mean to say the elasticity of supply for one good is greater than that for another?
2. Why does supply tend to be more elastic in the long run than in the short run?
3. How do the relative elasticities of supply and demand determine who bears the greater burden of a tax?

Answers: 1. c 2. b 3. e 4. e

Interactive Summary

Fill in the blanks:

1. The price elasticity of demand measures the responsiveness of quantity _____ to a change in price.
2. The price elasticity of demand is defined as the percentage change in _____ divided by the percentage change in _____.
3. If the price elasticity of demand is elastic, it means the quantity demanded changes by a relatively _____ amount than the price change.
4. If the price elasticity of demand is inelastic, it means the quantity demanded changes by a relatively _____ amount than the price change.
5. A demand curve or a portion of a demand curve can be relatively _____, _____, or relatively _____.
6. For the most part, the price elasticity of demand depends on the availability of _____, the _____ spent on the good, and the amount of _____ people have to adapt to a price change.
7. The elasticity of demand for a Ford automobile would likely be _____ elastic than the demand for automobiles, because there are more and better substitutes for a certain type of car than for a car itself.
8. The smaller the proportion of income spent on a good, the _____ its elasticity of demand.
9. The more time that people have to adapt to a new price change, the _____ the elasticity of demand. The more time that passes, the more time consumers have to find or develop suitable _____ and to plan and implement changes in their patterns of consumption.
10. When demand is price elastic, total revenues will _____ as the price declines because the percentage increase in the _____ is greater than the percentage reduction in price.
11. When demand is price inelastic, total revenues will _____ as the price declines because the percentage increase in the _____ is less than the percentage reduction in price.
12. When the price falls on the _____ half of a straight-line demand curve, demand is relatively _____.

- _____ . When the price falls on the lower half of a straight-line demand curve, demand is relatively _____ .
- The cross-price elasticity of demand is defined as the percentage change in the _____ of good A divided by the percentage change in _____ of good B.
 - The income elasticity of demand is defined as the percentage change in the _____ by the percentage change in _____ .
 - The price elasticity of supply measures the sensitivity of the quantity _____ to changes in the price of the good.
 - The price elasticity of supply is defined as the percentage change in the _____ divided by the percentage change in _____ .

- Goods with a supply elasticity that is greater than 1 are called relatively _____ in supply.
- When supply is inelastic, a 1 percent change in the price of a good will induce a _____ 1 percent change in the quantity supplied.
- Time is usually critical in supply elasticities because it is _____ costly for sellers to bring forth and release products in a shorter period of time.
- The relative _____ determines the distribution of the tax burden for a good.
- If demand is relatively _____ elastic than supply in the relevant region, the largest portion of a tax is paid by the producer.

Answers: 1. demanded 2. quantity demanded; price 3. larger 4. smaller 5. elasticity; unit elasticity; inelastic 6. close substitutes; proportion of income; time 7. more 8. lower 9. greater; substitutes 10. rise; quantity demanded 11. fall; quantity demanded 12. upper; elastic; inelastic 13. demand; price 14. demand; price 15. supplied 16. quantity supplied; price 17. elastic 18. less than 19. more 20. more 21. more

Key Terms and Concepts

price elasticity of demand 157
elastic 158
inelastic 158

unit elastic demand 158
total revenue (TR) 165
cross-price elasticity of demand 170

income elasticity of demand 171
price elasticity of supply 173

Section Quiz Answers

6.1 Price Elasticity of Demand

1. What question is the price elasticity of demand designed to answer?

The price elasticity of demand is designed to answer the question: How responsive is quantity demanded to changes in the price of a good?

2. How is the price elasticity of demand calculated?

The price elasticity of demand is calculated as the percentage change in quantity demanded, divided by the percentage change in the price that caused the change in quantity demanded.

3. What is the difference between a relatively price elastic demand curve and a relatively price inelastic demand curve?

Quantity demanded changes relatively more than price along a relatively price elastic segment of a

demand curve, while quantity demanded changes relatively less than price along a relatively price inelastic segment of a demand curve.

4. What is the relationship between the price elasticity of demand and the slope at a given point on a demand curve?

At a given point on a demand curve, the flatter the demand curve, the more quantity demanded changes for a given change in price, so the greater is the elasticity of demand.

5. What factors tend to make demand curves more price elastic?

Demand curves tend to become more elastic, the larger the number of close substitutes available for the good, the larger proportion of income spent on the good, and the greater the amount of time that buyers have to respond to a change in the good's price.

6. Why would a tax on a particular brand of cigarettes be less effective at reducing smoking than a tax on all brands of cigarettes?

A tax on one brand of cigarettes would allow smokers to avoid the tax by switching brands rather than by smoking less, but a tax on all brands would raise the cost of smoking any cigarettes. A tax on all brands of cigarettes would therefore be more effective in reducing smoking.

7. Why is the price elasticity of demand for products at a 24-hour convenience store likely to be lower at 2 A.M. than at 2 P.M.?

Fewer alternative stores are open at 2 A.M. than at 2 P.M., and with fewer good substitutes, the price elasticity of demand for products at 24-hour convenience stores is greater at 2 P.M.

8. Why is the price elasticity of demand for turkeys likely to be lower, but the price elasticity of demand for turkeys at a particular store at Thanksgiving likely to be greater than at other times of the year?

For many people, far fewer good substitutes are acceptable for turkey at Thanksgiving than at other times, so that the demand for turkeys is more inelastic at Thanksgiving. But grocery stores looking to attract customers for their entire large Thanksgiving shopping trip also often offer and heavily advertise turkeys at far better prices than normally. This means shoppers have available more good substitutes and a more price elastic demand curve for buying a turkey at a particular store than usual.

6.2 Total Revenue and the Price Elasticity of Demand

1. Why does total revenue vary inversely with price if demand is relatively price elastic?

Total revenue varies inversely with price if demand is relatively price elastic, because the quantity demanded (which equals the quantity sold) changes relatively more than price along a relatively elastic demand curve. Therefore, total revenue, which equals price times quantity demanded (sold) at that price, will change in the same direction as quantity demanded and in the opposite direction from the change in price.

2. Why does total revenue vary directly with price, if demand is relatively price inelastic?

Total revenue varies in the same direction as price, if demand is relatively price inelastic, because the quantity demanded (which equals the quantity sold) changes relatively less than price along a relatively inelastic demand curve. Therefore, total revenue, which equals price times quantity demanded (and sold) at that price, will change in the same direc-

tion as price and in the opposite direction from the change in quantity demanded.

3. Why is a linear demand curve more price elastic at higher price ranges and more price inelastic at lower price ranges?

Along the upper half of a linear (constant slope) demand curve, total revenue increases as the price falls, indicating that demand is relatively price elastic. Along the lower half of a linear (constant slope) demand curve, total revenue decreases as the price falls, indicating that demand is relatively price inelastic.

4. If demand for some good was perfectly price inelastic, how would total revenue from its sales change as its price changed?

A perfectly price inelastic demand curve would be one where the quantity sold did not vary with the price. In such an (imaginary) case, total revenue would increase proportionately with price—a 10 percent increase in price with the same quantity sold would result in a 10 percent increase in total revenue.

5. Assume that both you and Art, your partner in a picture-framing business, want to increase your firm's total revenue. You argue that in order to achieve this goal, you should lower your prices; Art, on the other hand, thinks that you should raise your prices. What assumptions are each of you making about your firm's price elasticity of demand?

You are assuming that a lower price will increase total revenue, which implies you think the demand for your picture frames is relatively price elastic. Art is assuming that an increase in your price will increase your total revenue, which implies he thinks the demand for your picture frames is relatively price inelastic.

6.3 Other Types of Demand Elasticities

1. How does the cross-price elasticity of demand tell you whether two goods are substitutes? Complements?

Two goods are substitutes when an increase (decrease) in the price of one good causes an increase (decrease) in the demand for another good. Substitutes have a positive cross-price elasticity. Two goods are complements when an increase (decrease) in the price of one good decreases (increases) the demand for another food. Complements have a negative cross-price elasticity.

2. How does the income elasticity of demand tell you whether a good is normal? Inferior?

If demand for a good increases (decreases) when income rises (falls), it is a normal good and has a positive income elasticity. If demand for a good decreases (increases) when income rises (falls), it is an inferior good and has a negative income elasticity.

3. If the cross-price elasticity of demand between potato chips and popcorn was positive and large, would popcorn makers benefit from a tax imposed on potato chips?

A large positive cross-price elasticity of demand between potato chips and popcorn indicates that they are close substitutes. A tax on potato chips, which would raise the price of potato chips as a result, would also substantially increase the demand for popcorn, increasing the price of popcorn and the quantity of popcorn sold, increasing the profits of popcorn makers.

4. As people's incomes rise, why will they spend an increasing portion of their incomes on goods with income elasticities greater than 1 (DVDs) and a decreasing portion of their incomes on goods with income elasticities less than 1 (food)?

An income elasticity of 1 would mean people spent the same fraction or share of their income on a particular good as their incomes increase. An income elasticity greater than 1 would mean people spent an increasing fraction or share of their income on a particular good as their incomes increase, and an income elasticity less than 1 would mean people spent a decreasing fraction or share of their income on a particular good as their incomes increase.

5. If people spent three times as much on restaurant meals and four times as much on DVDs as their incomes doubled, would restaurant meals or DVDs have a greater income elasticity of demand?

DVDs would have a higher income elasticity of demand (4) in this case than restaurant meals (3).

6.4 Price Elasticity of Supply

1. What does it mean to say the elasticity of supply for one good is greater than that for another?

For the elasticity of supply for one good to be greater than for another, the percentage increase in quantity supplied that results from a given percentage change in price will be greater for the first good than for the second.

2. Why does supply tend to be more elastic in the long run than in the short run?

Just as the cost of buyers changing their behavior is lower the longer they have to adapt, which leads to long-run demand curves being more elastic than short-run demand curves, the same is true of suppliers. The cost of producers changing their behavior is lower the longer they have to adapt, which leads to long-run supply curves being more elastic than short-run supply curves.

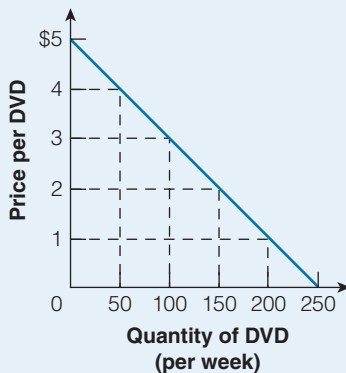
3. How do the relative elasticities of supply and demand determine who bears the greater burden of a tax?

When demand is more elastic than supply, the tax burden falls mainly on producers; when supply is more elastic than demand, the tax burden falls mainly on consumers.

Problems

- In each of the following cases, indicate which good you think has a relatively *more* price elastic demand and identify the most likely reason, in terms of the determinants of the elasticity of demand (more substitutes, greater share of budget, or more time to adjust).
 - cars or Chevrolets
 - salt or housing
 - going to a New York Mets game or a Cleveland Indians game
 - natural gas this month or over the course of a year
- How might your elasticity of demand for copying and binding services vary if your work presentation is next week versus in two hours?
- The San Francisco Giants want to boost revenues from ticket sales next season. You are hired as an economic consultant and asked to advise the Giants whether to raise or lower ticket prices next year. If the elasticity of demand for Giants game tickets is estimated to be -1.6 , what would you advise? If the elasticity of demand equals -0.4 ?

4. For each of the following pairs, identify which one is likely to exhibit more elastic demand.
 - a. shampoo; Paul Mitchell Shampoo
 - b. air travel prompted by an illness in the family; vacation air travel
 - c. paper clips; an apartment rental
 - d. prescription heart medication; generic aspirin
5. Using the midpoint formula for calculating the elasticity of demand, if the price of a good fell from \$42 to \$38, what would be the elasticity of demand if the quantity demanded changed from:
 - a. 19 to 21?
 - b. 27 to 33?
 - c. 195 to 205?
6. Explain why using the midpoint formula for calculating the elasticity of demand gives the same result whether price increases or decreases, but using the initial price and quantity instead of the average does not.
7. Why is a more narrowly defined good (pizza) likely to have a greater elasticity of demand than a more broadly defined good (food)?
8. If the elasticity of demand for hamburgers equals -1.5 and the quantity demanded equals 40,000, predict what will happen to the quantity demanded of hamburgers when the price increases by 10 percent. If the price falls by 5 percent, what will happen?
9. Evaluate the following statement: “Along a downward-sloping linear demand curve, the slope and therefore the elasticity of demand are both ‘constant.’”
10. If the midpoint on a straight-line demand curve is at a price of \$7, what can we say about the elasticity of demand for a price change from \$12 to \$10? What about from \$6 to \$4?
11. Assume the following weekly demand schedule for Sunshine DVD Rentals in Cloverdale.



- a. When Sunshine DVD Rentals lowers its rental price from \$4 to \$3, what happens to its total revenue?
 - b. Between a price of \$4 and a price of \$3, is the demand for Sunshine DVD Rentals in Cloverdale elastic or inelastic?
 - c. Between a price of \$2 and a price of \$1, is the demand for Sunshine DVD Rentals in Cloverdale elastic or inelastic?
12. The Cowtown Hotel is the only first-class hotel in Fort Worth, Texas. The hotel owners hired economics advisors for advice about improving the hotel's profitability. They suggested the hotel could increase this year's revenue by raising prices. The owners asked, “Won't raising prices reduce the quantity of hotel rooms demanded and increase vacancies?” What do you think the advisors replied? Why would they suggest increasing prices?
 13. A movie production company faces a linear demand curve for its film, and it seeks to maximize total revenue from the film's distribution. At what level should the price be set? Where is demand elastic, inelastic, or unit elastic? Explain.
 14. Isabella always spends \$50 on red roses each month and simply adjusts the quantity she purchases as the price changes. What can you say about Isabella's elasticity of demand for roses?
 15. If taxi fares in a city rise, what will happen to the total revenue received by taxi operators? If the fares charged for subway rides, a substitute for taxi rides, do not change, what will happen to the total revenue earned by the subway as a result?
 16. Mayor George Henry has a problem. He doesn't want to anger voters by taxing them because he wants to be reelected, but the town of Gapville needs more revenue for its schools. He has a choice between taxing tickets to professional basketball games or taxing food. If the demand for food is relatively inelastic while the supply is relatively elastic, and if the demand for professional basketball games is relatively elastic while the supply is relatively inelastic, in which case would the tax burden fall primarily on consumers? In which case would the tax burden fall primarily on producers?

17. Indicate whether a pair of products are substitutes, complements, or neither based on the following estimates for the cross-price elasticity of demand:
 - a. 0.5.
 - b. -0.5.
18. Using the midpoint formula for calculating the elasticity of supply, if the price of a good rose from \$95 to \$105, what would be the elasticity of supply if the quantity supplied changed from:
 - a. 38 to 42?
 - b. 78 to 82?
 - c. 54 to 66?
19. Why is an increase in price more likely to decrease the total revenue of a seller in the long run than in the short run?
20. If both supply curves and demand curves are more elastic in the long run than in the short run, how does the incidence of a tax change from the short run to the long run as a result? What happens to the revenue raised from a given tax over time, *ceteris paribus*?
21. Assume you had the following observations on U.S. intercity rail travel: Between 1990 and 1993 rail travel increased from 17.5 passenger miles per person to 19 passenger miles per person. At the same time, neither per-mile railroad price or incomes changed but the per-mile price of intercity airline travel increased by 7.5 percent. Between 1995 and 1998 per capita incomes rose by approximately 13 percent while the price of travel by rail and plane stayed constant. Intercity rail travel was 20 passenger miles per person in 1995 and 19.5 in 1998. Assuming the demand for travel didn't change between these periods,
 - a. calculate the income elasticity of demand for intercity rail travel.
 - b. calculate the cross-price elasticity of demand for intercity rail travel.
 - c. Indicate whether air travel and rail travel are substitutes or complements. Is intercity rail travel a normal or an inferior good?

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Market Efficiency and Welfare

- 7.1 Consumer Surplus and Producer Surplus
- 7.2 The Welfare Effects of Taxes, Subsidies, and Price Controls

We can use the tools of consumer and producer surplus to study the welfare effects of government policy—rent controls, taxes, and agricultural support prices. To economists, welfare does not mean a government payment to the poor; rather, it is a way that we measure the impact of a policy on a particular group, such as consumers or producers. By calculating the changes in producer and consumer surplus that result from government intervention, we can measure the impact of such policies on buyers and sellers. For example, economists and policy makers may want to know how much a consumer or producer might benefit or be harmed by a tax or subsidy that alters the equilibrium price and quantity of a good or service. Take the the price support programs for farmers. The intent is to help poor farmers, not to hurt consumers and taxpayers. However, most

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of the farm subsidies go to large corporations, not poor farmers. Between 2002 and 2009, U.S. farmers received an average of \$16.4 billion of direct government subsidies per year. In earlier chapters, we saw how the market forces of supply and demand allocate society's scarce resources. However, we did not discuss whether this outcome was desirable or to whom. Are the price and output that result from the equilibrium of supply and demand right from society's standpoint?

Using the tools of consumer and producer surplus, we can demonstrate the *efficiency* of a competitive market. In other words, we can show that the equilibrium price and quantity in a competitive market maximize the economic welfare of consumers and producers. Maximizing total surplus (the sum of consumer and producer surplus) leads to an efficient allocation of resources. Efficiency makes the size of the economic pie as large as possible. How we distribute that economic pie (equity) is the subject of future chapters. Efficiency can be measured on objective, positive grounds while equity involves normative analysis.

Let's begin by presenting the most widely used tool for measuring consumer and producer welfare.

Consumer Surplus and Producer Surplus

7.1

What is consumer surplus?

What is producer surplus?

How do we measure the total gains from trade?

Consumer Surplus

In a competitive market, consumers and producers buy and sell at the market equilibrium price. However, some consumers will be willing and able to pay more for the good than they have to. But they would never knowingly buy something that is worth less to them. That is, what a consumer actually pays for a unit of a good is usually less than the amount she is *willing* to pay. For example, would you be willing to pay more than the market price for a rope ladder to get out of a burning building? Would you be willing to pay more than the market price for a tank of gasoline if you had run out of gas on a desolate highway in the desert? Would you be willing to pay more than the market price for an anti-venom shot if you had been bitten by a rattlesnake? **Consumer surplus** is the monetary difference between the amount a consumer is willing and able to pay for an additional unit of a good and what the consumer actually pays—the market price. Consumer surplus for the whole market is the sum of all the individual consumer surpluses for those consumers who have purchased the good.



Imagine it is 115 degrees in the shade. Do you think you would get more consumer surplus from your first glass of iced tea than you would from a fifth glass?

Marginal Willingness to Pay Falls as More Is Consumed

Suppose it is a hot day and iced tea is going for \$1 per glass, but Julie is willing to pay \$4 for the first glass (point a), \$2 for the second glass (point b), and \$0.50 for the third glass (point c), reflecting the law of demand. How much consumer surplus will Julie receive? First,

consumer surplus the difference between the price a consumer is willing and able to pay for an additional unit of a good and the price the consumer actually pays; for the whole market, it is the sum of all the individual consumer surpluses



What happens to marginal willingness to pay as greater quantities are consumed in a given period?

it is important to note the general fact that if the consumer is a buyer of several units of a good, the earlier units will have greater marginal value and therefore create more consumer surplus, because *marginal willingness to pay* falls as greater quantities are consumed in any period. In fact, you can think of the demand curve as a marginal benefit curve—the additional benefit derived from consuming one more unit. Notice in Exhibit 1 that Julie’s demand curve for iced tea has a step-like shape. This is demonstrated by Julie’s willingness to pay \$4 and \$2 successively for the first two glasses of iced tea. Thus, Julie will receive \$3 of consumer surplus for the first glass (\$4 – \$1) and \$1 of consumer surplus for the second glass (\$2 – \$1), for a total consumer surplus of \$4, as seen in Exhibit 1. Julie will not be willing to purchase the third glass, because her willingness to pay is less than its price (\$0.50 versus \$1.00).

In Exhibit 2, we can easily measure the consumer surplus in the market by using a market demand curve rather than an individual demand curve. In short, the market consumer surplus is the area under the market demand curve and above the market price (the shaded area in Exhibit 2). The market for chocolate contains millions of potential buyers, so we will get a smooth demand curve. That is, each of the million of potential buyers has their own willingness to pay. Because the demand curve represents the *marginal benefits* consumers receive from consuming an additional unit, we can conclude that all buyers of chocolate receive at least some consumer surplus in the market because the marginal benefit is greater than the market price—the shaded area in Exhibit 2.



What happens to consumer surplus if there is a decrease in supply?

Price Changes and Changes in Consumer Surplus

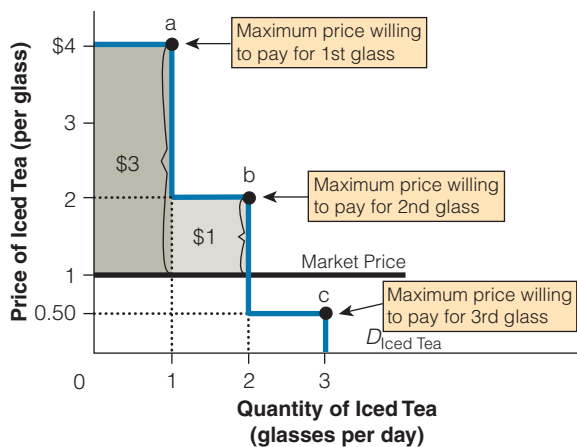
Imagine that the price of your favorite beverage fell because of an increase in supply. Wouldn't you feel better off? An increase in supply and a lower price will increase your consumer surplus for each unit you were already consuming and will also increase your consumer surplus from additional purchases at the lower price. Conversely, a decrease in supply and increase in price will lower your consumer surplus.

Exhibit 3 shows the gain in consumer surplus associated with, say, a technological advance that shifts the supply curve to the right. As a result, equilibrium price falls (from

D E N E E N 3 4 1 5 B U

section 7.1
exhibit 1

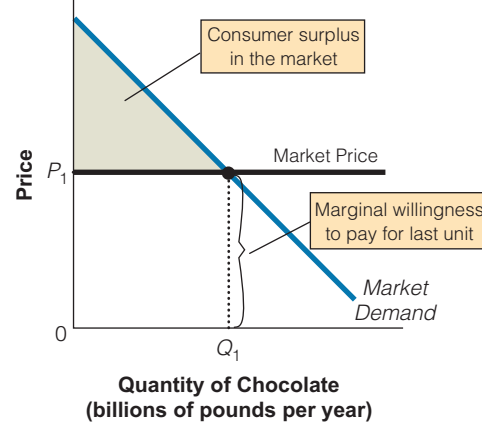
Julie’s Consumer Surplus for Iced Tea



Julie receives \$3 of consumer surplus for the first glass of iced tea and \$1 of consumer surplus for the second glass. Her total consumer surplus is \$4.

section 7.1
exhibit 2

Consumer Surplus for Chocolate: A Smooth-Shaped Demand Curve



The area below the market demand curve but above the market price is called consumer surplus. It is represented by the shaded area. The market demand curve is smooth because many buyers purchase chocolate each year.

P_1 to P_2) and quantity rises (from Q_1 to Q_2). Consumer surplus then increases from area P_1AB to area P_2AC , or a gain in consumer surplus of P_1BCP_2 . The increase in consumer surplus has two parts. First, there is an increase in consumer surplus, because Q_1 can now be purchased at a lower price; this amount of additional consumer surplus is illustrated by area P_1BDP_2 in Exhibit 3. Second, the lower price makes it advantageous for buyers to expand their purchases from Q_1 to Q_2 . The net benefit to buyers from expanding their consumption from Q_1 to Q_2 is illustrated by area BCD .

Producer Surplus

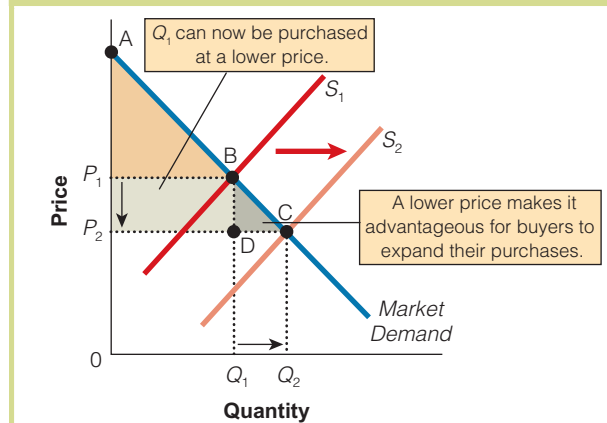
As we have just seen, the difference between what a consumer would be willing and able to pay for a given quantity of a good and what a consumer actually has to pay is called consumer surplus. The parallel concept for producers is called producer surplus. **Producer surplus** is the difference between what a producer is paid for a good and the cost of producing one unit of that good. Producers would never knowingly sell a good that is worth more to them than the asking price. Imagine selling coffee for half of what it cost to produce—you won't be in business very long with that pricing strategy. The supply curve shows the minimum amount that sellers must receive to be willing to supply any given quantity; that is, the supply curve reflects the marginal cost to sellers. The **marginal cost** is the cost of producing one more unit of a good. In other words, the supply curve is the marginal cost curve, just like the demand curve is the marginal benefit curve. Because some units can be produced at a cost that is lower than the market price, the seller receives a surplus, or a net benefit, from producing those units. For each unit produced, the producer surplus is the difference between the market price and the marginal cost of producing that unit. For example, in Exhibit 4, the market price is \$4.50. Say the firm's marginal cost is \$2 for the first unit, \$3 for the second unit, \$4 for the third unit, and \$5 for the fourth unit. Because producer surplus for a particular unit is the difference between the market price and the seller's cost of producing that unit, producer surplus would be as follows: The first unit would yield \$2.50; the second unit would yield \$1.50; the third unit would yield \$.50; and the fourth unit would add nothing to producer surplus, because the market price is less than the seller's cost.

When there are a lot of producers, the supply curve is more or less smooth, like in Exhibit 5. Total producer surplus for the market is obtained by summing all the producer surpluses of all the sellers—the area above the market supply curve and below the market price up to the quantity actually produced—the shaded area in Exhibit 5. Producer surplus is a measurement of how much sellers gain from trading in the market. Producer surplus represent the benefits that lower costs producers receive by selling at the market price.

Suppose an increase in market demand causes the market price to rise, say from P_1 to P_2 ; the seller now receives a higher price per unit, so additional producer surplus is generated. In Exhibit 6, we see the additions to producer surplus. Part of the added surplus (area P_2DBP_1) is due to a higher price for the quantity already being produced (up to Q_1) and part (area DCB) is due to the expansion of output made profitable by the higher price (from Q_1 to Q_2).

section 7.1 exhibit 3

Impact of an Increase in Supply on Consumer Surplus



As a result of the increase in supply, the price falls from P_1 to P_2 . The initial consumer surplus at P_1 is the area P_1AB . The increase in the consumer surplus from the fall in price is from P_1 to P_2 .

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producer surplus

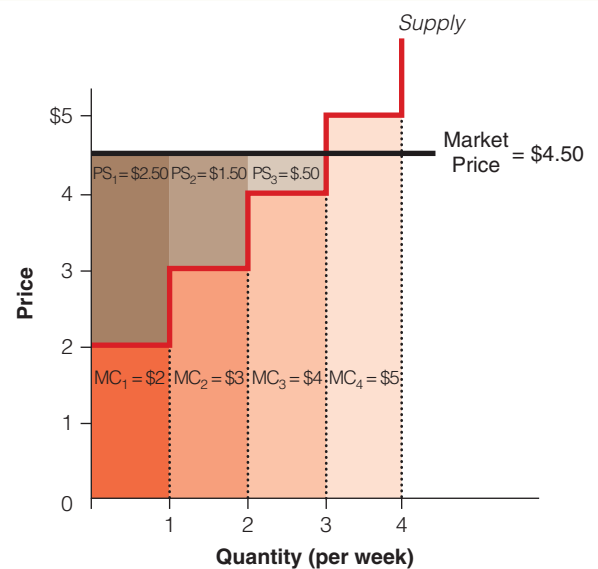
the difference between what a producer is paid for a good and the cost of producing that unit of the good; for the market, it is the sum of all the individual sellers' producer surpluses—the area above the market supply curve and below the market price

marginal cost

the cost of producing one more unit of a good

section 7.1 exhibit 4

A Firm's Producer Surplus

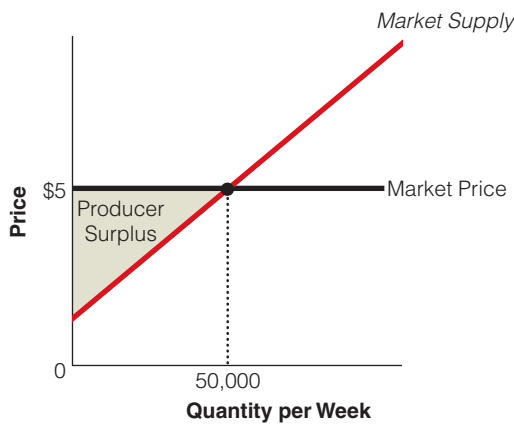


The firm's supply curve looks like a staircase. The marginal cost is under the stair and the producer surplus is above the red stair and below the market price for each unit.

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section 7.1
exhibit 5

Market Producer Surplus

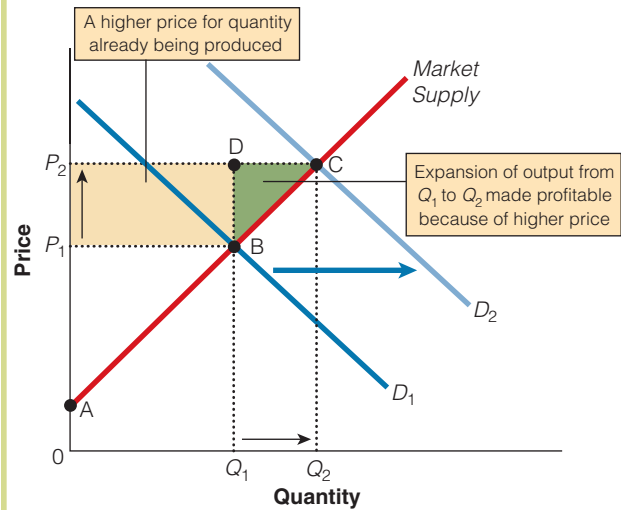


The market producer surplus is the shaded area above the supply curve and below the market price up to the quantity produced, 50,000 units.

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section 7.1
exhibit 6

Impact of an Increase in Demand on Producer Surplus

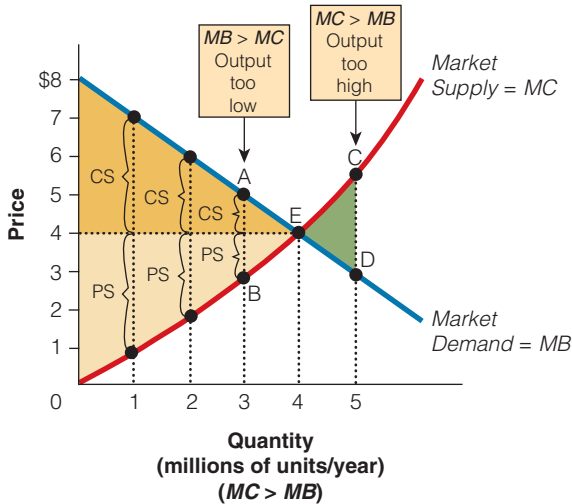


A higher market price due to an increase in market demand will increase total producer surplus. The initial producer surplus at P_1 is the area ABP_1 . The increase in producer surplus from the higher price is area P_2CBP_1 .

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section 7.1
exhibit 7

Consumer and Producer Surplus



Increasing output beyond the competitive equilibrium output, 4 million units, decreases welfare, because the cost of producing this extra output exceeds the value the buyer places on it ($MC > MB$)—producing 5 million units rather than 4 million units leads to a deadweight loss of area ECD . Reducing output below the competitive equilibrium output level, 4 million units, reduces total welfare, because the buyer values the extra output by more than it costs to produce that output—producing 3 million units rather than 4 million units leads to a deadweight loss of area EAB , $MB > MC$, only at equilibrium, E , is $MB = MC$.

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Market Efficiency and Producer and Consumer Surplus

With the tools of consumer and producer surplus, we can better analyze the total gains from exchange. The demand curve represents a collection of maximum prices that consumers are willing and able to pay for additional quantities of a good or service. It also shows the marginal benefits derived by consumers. The supply curve represents a collection of minimum prices that suppliers require to be willing and able to supply each additional unit of a good or service. It also shows the marginal cost of production. Both are shown in Exhibit 7. For example, for the first unit of output, the buyer is willing to pay up to \$7, while the seller would have to receive at least \$1 to produce that unit. However, the equilibrium price is \$4, as indicated by the intersection of the supply and demand curves. It is clear that the two would gain from getting together and trading that unit, because the consumer would receive \$3 of consumer surplus ($\$7 - \4), and the producer would receive \$3 of producer surplus ($\$4 - \1). Both would also benefit from trading the second and third units of output—in fact, both would benefit from trading every unit up to the market equilibrium output. That is, the buyer purchases the good, except for the very last unit, for less than the maximum amount she would have been willing to pay; the seller receives for the good, except for the last unit, more than the minimum amount for which he would have been willing to supply the good. Once the equilibrium output is reached at the equilibrium price, all the mutually

beneficial trade opportunities between the demander and supplier will have taken place, and the sum of consumer surplus and producer surplus is maximized. This is where the marginal benefit to buyers is equal to the marginal cost to producers. Both buyer and seller are better off from each of the units traded than they would have been if they had not exchanged them.

It is important to recognize that, in this case, the **total welfare gains** to the economy from trade in this good is the sum of the consumer and producer surpluses created. That is, consumers benefit from additional amounts of consumer surplus, and producers benefit from additional amounts of producer surplus. Improvements in welfare come from additions to both consumer and producer surpluses. In competitive markets with large numbers of buyers and sellers, at the market equilibrium price and quantity, the net gains to society are as large as possible.

Why would it be inefficient to produce only 3 million units? The demand curve in Exhibit 7 indicates that the buyer is willing to pay \$5 for the 3 millionth unit. The supply curve shows that it only costs the seller \$3 to produce that unit. That is, as long as the buyer values the extra output by more than it costs to produce that unit, total welfare would increase by expanding output. In fact, if output is expanded from 3 million units to 4 million units, total welfare (the sum of consumer and producer surpluses) will increase by area AEB in Exhibit 7.

What if 5 million units are produced? The demand curve shows that the buyer is only willing to pay \$3 for the 5 millionth unit. However, the supply curve shows that it would cost about \$5.50 to produce that 5 millionth unit. Thus, increasing output beyond equilibrium decreases total welfare, because the cost of producing this extra output is greater than

total welfare gains the sum of consumer and producer surpluses



Why is total welfare maximized at the competitive equilibrium output?

in the news **Gift Giving and Deadweight Loss**

Only about 15 percent of gifts during the holiday are money. Money fits the description as an efficient gift. An efficient gift is one that the recipient values at least as much as it costs the giver.

There are a lot of unwanted gifts that recipients receive during the holidays. What do people do with their unwanted gifts? Many people exchange or repackage unwanted gifts. Gift cards are becoming more popular. While they provide less flexibility to recipients than cash, gift cards might be seen as less "tacky" than cash. So why don't more people give cash and gift cards?

Over the past 20 years, University of Minnesota Professor Joel Waldfogel has done numerous surveys asking gift recipients about the items they've received: Who bought it? What did the buyer pay? What's the most you would have been willing to pay for it? Based on these surveys, he's concluded that we value items we receive as gifts 20 percent less, per dollar spent, than items we buy for ourselves. Given the \$65 billion in U.S. holiday spending per year, that means we get \$13 billion less in satisfaction than we would receive if we spent that money the usual way on ourselves. That is, deadweight loss

is about \$13 billion a year, the difference between the price of the gifts and the value to their recipients.

Of course, people may derive satisfaction from trying to pick "the perfect gift." If that is the case, then the deadweight loss would be smaller. In addition, gift giving can provide a signal. If you really love a person, you will try to get enough information and spend enough time to get the right gift. This sends a strong signal that a gift card or money does not provide. If the recipients are adult children, they may already know of your affection for them so sending a gift card or cash might be less offensive.



NEWPORT NEWS DAILY PRESS/MCT/LANDOV

the value the buyer places on it. If output is reduced from 5 million units to 4 million units, total welfare will increase by area ECD in Exhibit 7.

Not producing the efficient level of output, in this case 4 million units, leads to what economists call a **deadweight loss**. A deadweight loss is the reduction in both consumer and producer surpluses—it is the net loss of total surplus that results from the misallocation of resources.

In a competitive equilibrium, supply equals demand at the equilibrium. This means that the buyers value the last unit of output consumed by exactly the same amount that it cost to produce. If consumers valued the last unit by more than it cost to produce, welfare could be increased by expanding output. If consumers valued the last unit by less than it cost to produce, then welfare could be increased by producing less output.

In sum, *market efficiency* occurs when we have maximized the sum of consumer and producer surplus, when the margin of benefits of the last unit consumed is equal to the marginal cost of productivity, $MB = MC$.

deadweight loss net loss of total surplus that results from an action that alters a market equilibrium



How do we know when we have achieved market efficiency?

great
economic thinkers

Alfred Marshall (1842–1924)

Alfred Marshall was born outside of London in 1842. His father, a domineering man who was a cashier for the Bank of England, wanted nothing more than for Alfred to become a minister. But the young Marshall enjoyed math and chess, both of which were forbidden by his authoritarian father. When he was older, Marshall turned down a theological scholarship to Oxford to study at Cambridge, with the financial support of a wealthy uncle. Here he earned academic honors in mathematics. Upon graduating, Marshall set upon a period of self-discovery. He traveled to Germany to study metaphysics, later adopting the philosophy of agnosticism, and moved on to studying ethics. He found within himself a deep sorrow and disgust over the condition of society. He resolved to use his skills to lessen poverty and human suffering, and in wanting to use his mathematics in this broader capacity, Marshall soon developed a fascination with economics.

Marshall became a fellow and lecturer in political economy at Cambridge. He had been teaching for nine years when, in 1877, he married a former student, Mary Paley. Because of the university's celibacy rules, Marshall had to give up his position at Cambridge. He moved on to teach at University College at Bristol and at Oxford. But in 1885, the rules were relaxed and Marshall returned to Cambridge as the Chair in Political Economy, a position that he held until 1908, when he resigned to devote more time to writing.

Before this point in time, economics was grouped with philosophy and the "moral sciences." Marshall

fought all of his life for economics to be set apart as a field all its own. In 1903, Marshall finally succeeded in persuading Cambridge to establish a separate economics course, paving the way for the discipline as it exists today. As this event clearly demonstrates, Marshall exerted a great deal of influence on the development of economic thought in his time. Marshall popularized the heavy use of illustration, real-world examples, and current events in teaching, as well as the modern diagrammatic approach to economics. Relatively early in his career, it was being said that Marshall's former students occupied half of the economic chairs in the United Kingdom. His most famous student was John Maynard Keynes.

Marshall is most famous for refining the marginal approach. He was intrigued by the self-adjusting and self-correcting nature of economic markets, and he was also interested in time—how long did it take for markets to adjust? Marshall coined the analogy that compares the tools of supply and demand to the blades on a pair of scissors—that is, it is fruitless to talk about whether it was supply or demand that determined the market price; rather, one should consider both in unison. After all, the upper blade is not of more importance than the lower when using a pair of scissors to cut a piece of paper. Marshall was also responsible for refining some of the most important tools in economics—elasticity and consumer and producer surplus. Marshall's book *Principles of Economics* was published in 1890; immensely popular, the book went into eight editions. Much of the content in *Principles* is still at the core of microeconomics texts today.

 SECTION QUIZ


1. In a supply and demand graph, the triangular area under the demand curve but above the market price is
 - a. the consumer surplus.
 - b. the producer surplus.
 - c. the marginal cost.
 - d. the deadweight loss.
 - e. the net gain to society from trading that good.
2. Which of the following is not true about consumer surplus?
 - a. Consumer surplus is the difference between what consumers are willing to pay and what they actually pay.
 - b. Consumer surplus is shown graphically as the area under the demand curve but above the market price.
 - c. An increase in the market price due to a decrease in supply will increase consumer surplus.
 - d. A decrease in market price due to an increase in supply will increase consumer surplus.
3. Which of the following is not true about producer surplus?
 - a. Producer surplus is the difference between what sellers are paid and their cost of producing those units.
 - b. Producer surplus is shown graphically as the area under the market price but above the supply curve.
 - c. An increase in the market price due to an increase in demand will increase producer surplus.
 - d. All of the above are true about producer surplus.
4. At the market equilibrium price and quantity, the total welfare gains from trade are measured by
 - a. the total consumer surplus captured by consumers.
 - b. the total producer surplus captured by producers.
 - c. the sum of consumer surplus and producer surplus.
 - d. the consumer surplus minus the producer surplus.
5. In a supply and demand graph, the triangular area under the demand curve but above the supply curve is
 - a. the consumer surplus.
 - b. the producer surplus.
 - c. the marginal cost.
 - d. the deadweight loss.
 - e. the net gain to society from trading that good.
6. Which of the following are true statements?
 - a. The difference between how much a consumer is willing and able to pay and how much a consumer has to pay for a unit of a good is called consumer surplus.
 - b. An increase in supply will lead to a lower price and an increase in consumer surplus; a decrease in supply will lead to a higher price and a decrease in consumer surplus.
 - c. Both (a) and (b) are true.
 - d. None of the above is true.
7. Which of the following are true statements?
 - a. Producer surplus is the difference between what a producer is paid for a good and the cost of producing that good.
 - b. An increase in demand will lead to a higher market price and an increase in producer surplus; a decrease in demand will lead to a lower market price and a decrease in producer surplus.
 - c. We can think of the demand curve as a marginal benefit curve and the supply curve as a marginal cost curve.
 - d. Total welfare gains from trade to the economy can be measured by the sum of consumer and producer surpluses.
 - e. All of the above are true statements.

(continued)

SECTION QUIZ (Cont.)



1. What is consumer surplus?
2. Why do the earlier units consumed at a given price add more consumer surplus than the later units consumed?
3. Why does a decrease in a good's price increase the consumer surplus from consumption of that good?
4. Why might the consumer surplus from purchases of diamond rings be less than the consumer surplus from purchases of far less expensive stones?
5. What is producer surplus?
6. Why do the earlier units produced at a given price add more producer surplus than the later units produced?
7. Why does an increase in a good's price increase the producer surplus from production of that good?
8. Why might the producer surplus from sales of diamond rings, which are expensive, be less than the producer surplus from sales of far less expensive stones?
9. Why is the efficient level of output in an industry defined as the output where the sum of consumer and producer surplus is maximized?
10. Why does a reduction in output below the efficient level create a deadweight loss?
11. Why does an expansion in output beyond the efficient level create a deadweight loss?

Answers: 1. a 2. c 3. d 4. c 5. e 6. c 7. e

7.2

The Welfare Effects of Taxes, Subsidies, and Price Controls

What are the welfare effects of a tax?

What are the welfare effects of subsidies?

What is the relationship between a deadweight loss and price elasticities?

What are the welfare effects of price controls?

welfare effects the gains and losses associated with government intervention in markets

In the previous section we used the tools of consumer and producer surplus to measure the efficiency of a competitive market—that is, how the equilibrium price and quantity in a competitive market lead to the maximization of aggregate welfare (for both buyers and sellers). Now we can use the same tools, consumer and producer surplus, to measure the welfare effects of various government programs—taxes and price controls. When economists refer to the **welfare effects** of a government policy, they are referring to the gains and losses associated with government intervention. This use of the term should not be confused with the more common reference to a welfare recipient who is getting aid from the government.

Using Consumer and Producer Surplus to Find the Welfare Effects of a Tax

To simplify the explanation of elasticity and the tax incidence, we will not complicate the illustration by shifting the supply curve (tax levied on sellers) or demand curve (tax levied on buyers) as we did in Section 6.4. We will simply show the result a tax must cause. The tax is illustrated by the vertical distance between the supply and demand curves at the new after-tax output—shown as the bold vertical line in Exhibit 1. After the tax, the buyers pay a higher price, P_B , and the sellers receive a lower price, P_S ; and the equilibrium quantity of

the good (both bought and sold) falls from Q_1 to Q_2 . The tax revenue collected is measured by multiplying the amount of the tax times the quantity of the good sold after the tax is imposed ($T \times Q_2$).

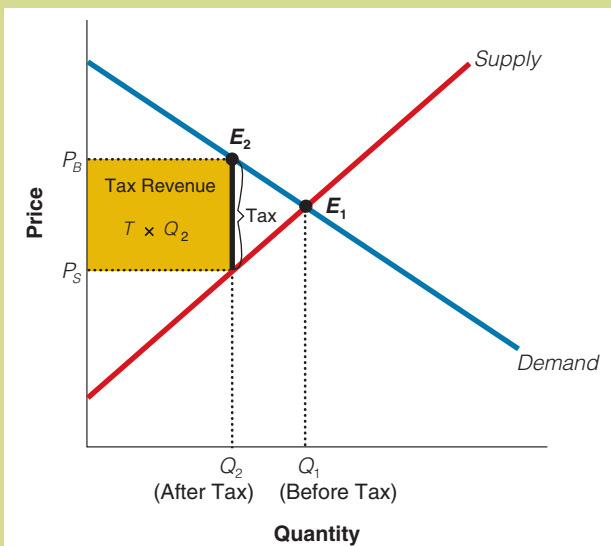
In Exhibit 2, we can now use consumer and producer surpluses to measure the amount of welfare loss associated with a tax. First, consider the amounts of consumer and producer surplus before the tax. Before the tax is imposed, the price is P_1 and the quantity is Q_1 ; at that price and output, the amount of consumer surplus is area $a + b + c$, and the amount of producer surplus is area $d + e + f$. To get the total surplus, or total welfare, we add consumer and producer surpluses, area $a + b + c + d + e + f$. Without a tax, tax revenues are zero.

After the tax, the price the buyer pays is P_B , the price the seller receives is P_S , and the output falls to Q_2 . As a result of the higher price and lower output from the tax, consumer surplus is smaller—area a . After the tax, sellers receive a lower price, so producer surplus is smaller—area f . However, some of the loss in consumer and producer surpluses is transferred in the form of tax revenues to the government, which can be used to reduce other taxes, fund public projects, or be redistributed to others in society. This transfer of society's resources is not a loss from society's perspective. The net loss to society can be found by measuring the difference between the loss in consumer surplus (area $b + c$) plus the loss in producer surplus (area $d + e$) and the gain in tax revenue (area $b + d$). The reduction in total surplus is area $c + e$, or the shaded area in Exhibit 2. This deadweight loss from the tax is the reduction in producer and consumer surpluses minus the tax revenue transferred to the government.

Deadweight loss occurs because the tax reduces the quantity exchanged below the original output level, Q_1 , reducing the size of the total surplus realized from trade. The problem is that the tax distorts market incentives: The price to buyers is higher than before the tax, so they consume less; and the price to sellers is lower than before the tax, so they produce less. These effects lead to deadweight loss, or market inefficiencies—the waste associated with not producing the efficient level of output. That is, the tax causes a deadweight loss because it prevents some mutual beneficial trade between buyers and sellers.

section 7.2
exhibit 1

Supply and Demand of a Tax



After the tax, the buyers pay a higher price, P_B , and the sellers receive a lower price, P_S ; and the equilibrium quantity of the good (both bought and sold) falls from Q_1 to Q_2 . The tax revenue collected is measured by multiplying the amount of the tax times that quantity of the good sold after the tax is imposed ($T \times Q_2$).



How do taxes distort market incentives?

Use
what you've learned

Should We Use Taxes to Reduce Dependency on Foreign Oil?

Q What if we placed a \$0.50 tax on gasoline to reduce dependence on foreign oil and to raise the tax revenue?

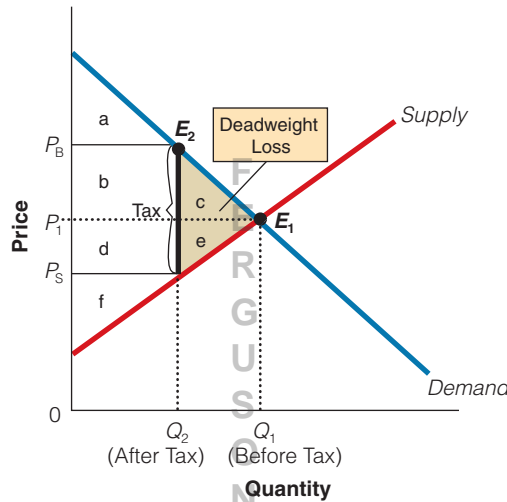
A If the demand and supply curves are both equally elastic, as in Exhibit 2, both consumers and

producers will share the burden equally. The tax collected would be $b + d$, but total loss in consumer surplus ($b + c$) and producer surplus ($d + e$) would be greater than the gains in tax revenue. Not surprisingly, both consumers and producers fight such a tax every time it is proposed.

section 7.2
exhibit 2

Welfare Effects of a Tax

The net loss to society due to a tax can be found by measuring the difference between the loss in consumer surplus (area b + c) plus the loss in producer surplus (area d + e) and the gain in tax revenue (area b + d). The deadweight loss from the tax is the reduction in the consumer and producer surpluses minus the tax revenue transferred to the government, area c + e.



	Before Tax	After Tax	Change
Consumer Surplus	a + b + c	a	-b - c
Producer Surplus	d + e + f	f	-d - e
Tax Revenue ($T \times Q_2$)	zero	b + d	b + d
Total Welfare	a + b + c + d + e + f	a + b + d + f	-c - e

All taxes lead to deadweight loss. The deadweight loss is important because if the people are to benefit from the tax, then more than \$1 of benefit must be produced from \$1 of government expenditure. For example, if a gasoline tax leads to \$100 million in tax revenues and \$20 million in deadweight loss, then the government needs to provide a benefit to the public of more than \$120 million with the \$100 million revenues.

Elasticity and the Size of the Deadweight Loss

The size of the deadweight loss from a tax, as well as how the burdens are shared between buyers and sellers, depends on the price elasticities of supply and demand. In Exhibit 3(a) we can see that, other things being equal, the less elastic the demand curve, the smaller the deadweight loss. Similarly, the less elastic the supply curve, other things being equal, the smaller the deadweight loss, as shown in Exhibit 3(b). However, when the supply and/or demand curves become more elastic, the deadweight loss becomes larger, because a given tax reduces the quantity exchanged by a greater amount, as seen in Exhibit 3(c). Recall that elasticities measure how responsive buyers and sellers are to price changes. That is, the more elastic the curves are, the greater the change in output and the larger the deadweight loss.

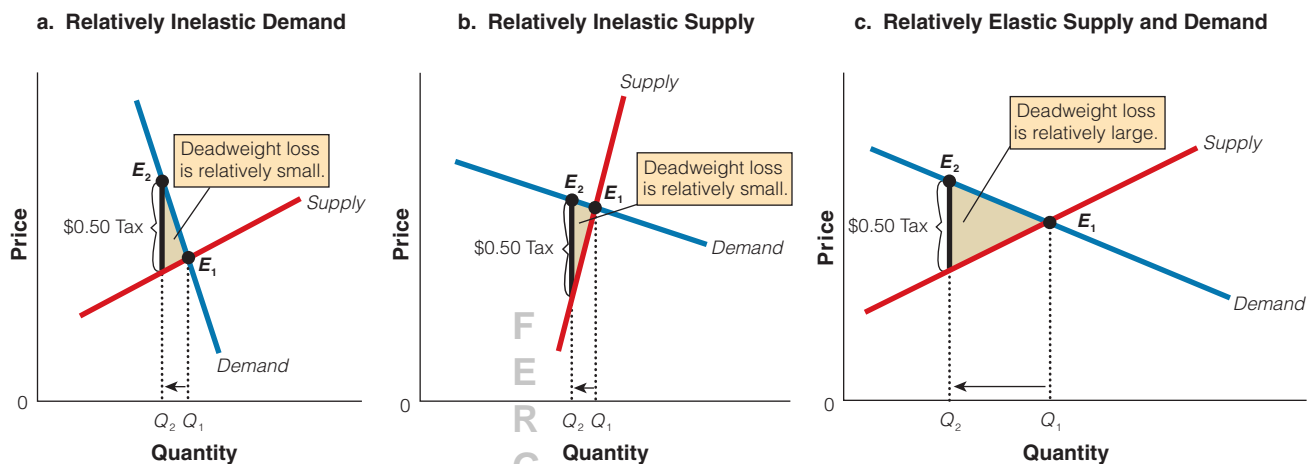
Elasticity differences can help us understand tax policy. Goods that are heavily taxed, such as alcohol, cigarettes, and gasoline, often have a relatively inelastic demand curve in the short run, so the tax burden falls primarily on the buyer. It also means that the deadweight



Does the elasticity affect the size of the deadweight loss?

section 7.2
exhibit 3

Elasticity and Deadweight Loss



In (a) and (b), we see that when one of the two curves is relatively price inelastic, the deadweight loss from the tax is relatively small. However, when the supply and/or demand curves become more elastic, the deadweight loss becomes larger, because a given tax reduces the quantity exchanged by a greater amount, as seen in (c). The more elastic the curves are, the greater the change in output and the larger the deadweight loss.

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loss to society is smaller for the tax revenue raised than if the demand curve were more elastic. In other words, because consumers cannot find many close substitutes in the short run, they reduce their consumption only slightly at the higher after-tax price. Even though the deadweight loss is smaller, it is still positive, because the reduced after-tax price received by sellers and the increased after-tax price paid by buyers reduces the quantity exchanged below the previous market equilibrium level.

The Welfare Effects of Subsidies

If taxes cause deadweight or welfare losses, do subsidies create welfare gains? For example, what if a government subsidy (paid by taxpayers) was provided in a particular market? Think of a subsidy as a negative tax. Before the subsidy, say the equilibrium price was P_1 and the equilibrium quantity was Q_1 , as shown in Exhibit 4. The consumer surplus is area $a + b$, and the producer surplus is area $c + d$. The sum of producer and consumer surpluses is maximized ($a + b + c + d$), with no deadweight loss.

In Exhibit 4, we see that the subsidy lowers the price to the buyer to P_B and increases the quantity exchanged to Q_2 . The subsidy results in an increase in consumer surplus from area $a + b$ to area $a + b + c + g$, a gain of $c + g$. And producer surplus increases from area $c + d$ to area $c + d + b + e$, a gain of $b + e$. With gains in both consumer and producer surpluses, it looks like a gain in welfare, right? Not quite. Remember that the government is paying for this subsidy, and the cost to government (taxpayers) of the subsidy is area $b + e + f + c + g$ (the subsidy per unit times the number of units subsidized). That is, the cost to government (taxpayers), area $b + e + f + c + g$, is greater than the gains to consumers, $c + g$, and the gains to producers, $b + e$, by area f . Area f is the deadweight or welfare loss to society from the subsidy because it results in the production of more than the competitive market equilibrium, and the market value of that expansion to buyers is less than the marginal cost of producing that expansion to sellers. In short, the market overproduces relative to the efficient level of output, Q_1 .

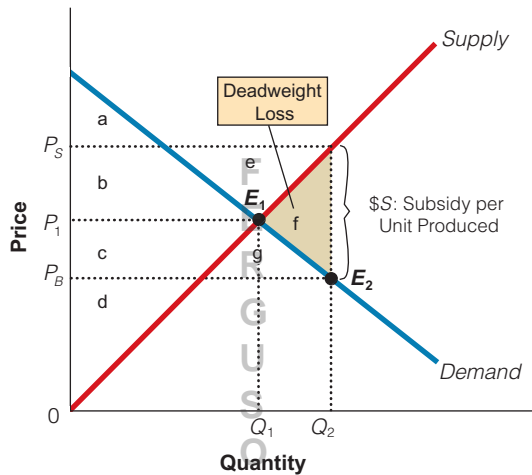


If taxes cause deadweight loss, why don't subsidies cause welfare gains?

section 7.2
exhibit 4

Welfare Effects of a Subsidy

With a subsidy, the price producers receive (P_S) is the price consumers pay (P_B) plus the subsidy ($\$S$). Because the subsidy leads to the production of more than the efficient level of output Q_1 , a deadweight loss results. For each unit produced between Q_1 and Q_2 , the supply curve lies above the demand curve, indicating that the marginal benefits to consumers are less than society's cost of producing those units.



	Before Tax Subsidy	After Tax Subsidy	Change
Consumer Surplus (CS)	$a + b$	$a + b + c + g$	$c + g$
Producer Surplus (PS)	$c + d$	$c + d + b + e$	$b + e$
Government (Taxpayers, G)	zero	$-b - e - f - c - g$	$-b - e - f - c - g$
Total Welfare (CS + PS - G)	$a + b + c + d$	$a + b + c + d - f$	$-f$

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Price Ceilings and Welfare Effects



Do consumers and producers both gain with a subsidy if it lowers the price to consumers and raises the price to producers? How about taxpayers?

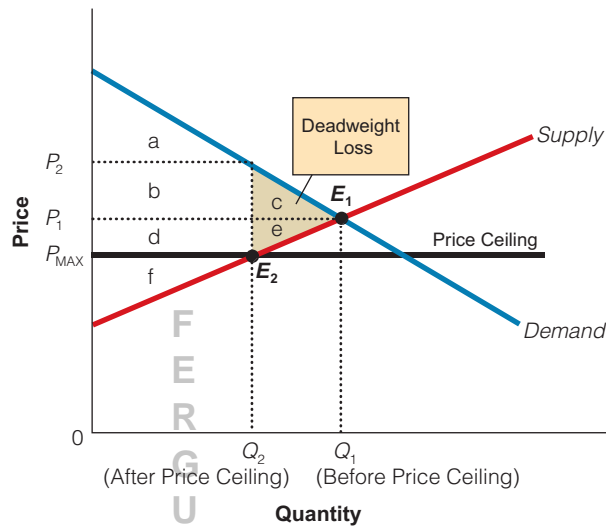
As we saw in Chapter 5, price controls involve the use of the power of the government to establish prices different from the equilibrium market price that would otherwise prevail. The motivations for price controls vary with the markets under consideration. A maximum, or ceiling, is often set for goods deemed important, such as housing. A minimum price, or floor, may be set on wages because wages are the primary source of income for most people, or on agricultural products, in order to guarantee that producers will get a certain minimum price for their products.

If a price ceiling (that is, a legally established maximum price) is binding and set below the equilibrium price at P_{MAX} , the quantity demanded will be greater than the quantity supplied at that price, and a shortage will occur. At this price, buyers will compete for the limited supply, Q_2 .

We can see the welfare effects of a price ceiling by observing the change in consumer and producer surpluses from the implementation of the price ceiling in Exhibit 5. Before the price ceiling, the buyer receives area $a + b + c$ of consumer surplus at price P_1 and quantity Q_1 . However, after the price ceiling is implemented at P_{MAX} , consumers can buy the good at a lower price but cannot buy as much as before (they can only buy Q_2 instead of Q_1). Because consumers can now buy Q_2 at a lower price, they gain area d of consumer surplus after the price ceiling. However, they lose area c of consumer surplus because they can only purchase Q_2 rather than Q_1 of output. Thus, the change in consumer surplus is $d - c$. In this case, area d is larger than area e and area c and the consumer gains from the price ceiling.

section 7.2
exhibit 5

Welfare Effects of a Price Ceiling



	Before Price Ceiling	After Price Ceiling	Change
Consumer Surplus (CS)	$a + b + c$	$a + b + d$	$d - c$
Producer Surplus (PS)	$d + e + f$	f	$-d - e$
Total Welfare (CS + PS)	$a + b + c + d + e + f$	$a + b + d + f$	$-c - e$

If area d is larger than area c , consumers in the aggregate would be better off from the price ceiling. However, any possible gain to consumers will be more than offset by the losses to producers, area $d + e$. Price ceiling causes a deadweight loss of $c + e$.

The price the seller receives for Q_2 is P_{MAX} (the ceiling price), so producer surplus falls from area $d + e + f$ before the price ceiling to area f after the price ceiling, for a loss of area $d + e$. That is, any possible gain to consumers will be more than offset by the losses to producers. The price ceiling has caused a deadweight loss of area $c + e$.

There is a deadweight loss because less is sold at Q_2 than at Q_1 ; and consumers value those units between Q_2 and Q_1 by more than it cost to produce them. For example, at Q_2 , consumers will value the unit at P_2 , which is much higher than it cost to produce it—the point on the supply curve at Q_2 .

Applications of Consumer and Producer Surplus

Rent Controls

If consumers use no additional resources, search costs, or side payments for a rent controlled unit, the consumer surplus is equal to $a + b + d$ in Exhibit 5. If landlords were able to extract P_2 from renters, consumer surplus would be reduced to area a . Landlords are able to collect higher “rent” using a variety of methods. They might have the tenant slip them a couple hundred dollars each month; they might charge a high rate for parking in the garage; they might rent used furniture at a high rate; or they might charge an exorbitant key price—the price for changing the locks for a new tenant. These types of arrangements take place in so-called black markets—markets where goods are transacted outside the boundaries of the law. One problem is that law-abiding citizens will be among those least likely to find a rental



Who gains and who loses with rent controls? Is there a difference between a rent controlled price in the short run versus the long run?

unit. Other problems include black market prices that are likely to be higher than the price would be if restrictions were lifted and the inability to use legal means to enforce contracts and resolve disputes.

If the landlord is able to charge P_2 , then the area $b + d$ of consumer surplus will be lost by consumers and gained by the landlord. This redistribution from the buyer to the seller does not change the size of the deadweight loss; it remains area $c + e$.

The measure of the deadweight loss in the price ceiling case may underestimate the true cost to consumers. At least two inefficiencies are not measured. One, consumers may spend a lot of time looking for rental units because vacancy rates will be very low—only Q_2 is available and consumers are willing to pay as much as P_2 for Q_2 units. Two, someone may have been lucky to find a rental unit at the ceiling price, P_{MAX} , but someone who values it more, say at P_2 , may not be able to find a rental unit.

It is important to distinguish between deadweight loss, which measures the overall efficiency loss, and the distribution of the gains and losses from a particular policy. For example, as a rent control tenant, you may be pleased with the outcome—a lower price than you would ordinarily pay (a transfer from landlord to tenant) providing that you can find a vacant rent-controlled unit.

Rent Controls—Short Run versus Long Run

In the absence of rent control (a price ceiling), the equilibrium price is P_1 and the equilibrium quantity is Q_1 , with no deadweight loss. However, a price ceiling leads to a

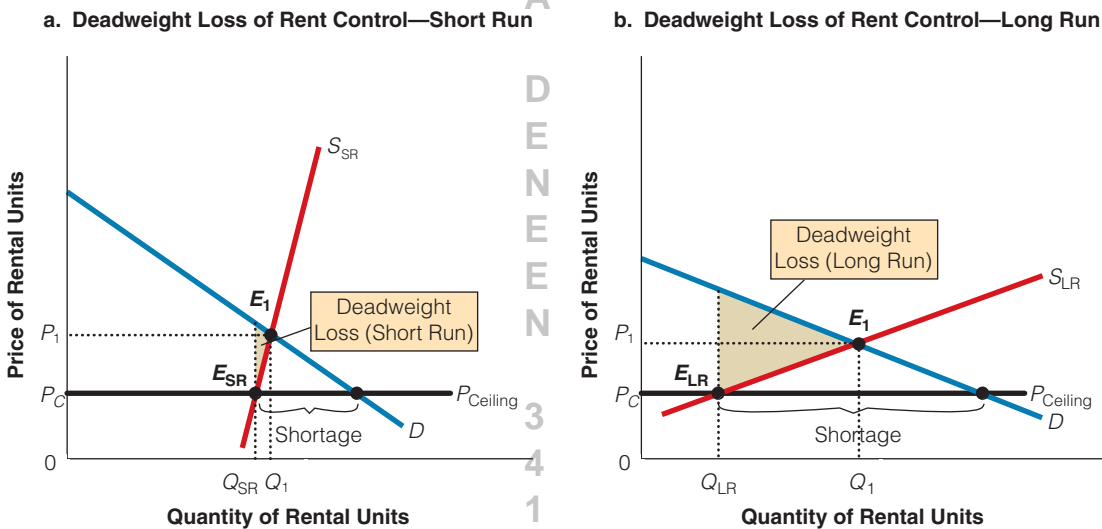


REUTERS/LUCAS JACKSON

Is it possible that removing rent controls in New York City is good economics but bad politics?

section 7.2
exhibit 6

Deadweight Loss of Rent Control: Short Run vs. Long Run



The reduction in rental units in response to the rent ceiling price P_c is much smaller in the short run (Q_1 to Q_{SR}) than in the long run (Q_1 to Q_{LR}). The deadweight loss is also much greater in the long run than in the short run, as indicated by the shaded areas in the two graphs. In addition, the size of the shortage is much greater in the long run than in the short run.

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deadweight loss, but the size of the deadweight loss depends on elasticity: The deadweight loss is greater in the short run (less elastic supply) than the long run (more elastic supply). Why? A city that enacts a rent control program will not lose many rental units in the next week. That is, even at lowered legal prices, roughly the same number of units will be available this week as last week; thus, in the short run the supply of rental units is virtually fixed—relatively inelastic, as seen in Exhibit 6(a). In the long run, however, the supply of rental units is much more elastic; landlords respond to the lower rental prices by allowing rental units to deteriorate and building fewer new rental units. In the long run, then, the supply curve is much more elastic, as seen in Exhibit 6(b). It is also true that demand becomes more elastic over time as buyers respond to the lower prices by looking for their own apartment (rather than sharing one) or moving to the city to try to rent an apartment below the equilibrium rental price. What economic implications do these varying elasticities have on rent control policies?

In Exhibit 6(a), only a small reduction in rental unit availability occurs in the short term as a result of the newly imposed rent control price—a move from Q_1 to Q_{SR} . The corresponding deadweight loss is small, indicated by the shaded area in Exhibit 6(a). However, the long-run response to the rent ceiling price is much larger: The quantity of rental units falls from Q_1 to Q_{LR} , and the size of the deadweight loss and the shortage are both larger, as seen in Exhibit 6(b). Hence, rent controls are much more harmful in the long run than the short run, from an efficiency standpoint.

Price Floors

Since the Great Depression, several agricultural programs have been promoted as assisting small-scale farmers. Such a price-support system guarantees a minimum price—promising a dairy farmer a price of \$4 per pound for cheese, for example. The reasoning is that the equilibrium price of \$3 is too low and would not provide enough revenue for small-volume farmers to maintain a “decent” standard of living. A price floor sets a minimum price that is the lowest price a consumer can legally pay for a good.

The Welfare Effects of a Price Floor When the Government Buys the Surplus

In the United States, price floors have been used to increase the price of dairy products, tobacco, corn, peanuts, soybeans and many other goods since the Great Depression. The government sets a price floor that guarantees producers will get a certain price. To ensure the support price, the government buys as much output as necessary to maintain the price at that level.

Who gains and who loses under price-support programs? In Exhibit 7, the equilibrium price and quantity without the price floor are at P_1 and Q_1 , respectively. Without the price floor, consumer surplus is area $a + b + c$, and producer surplus is area $e + f$, for a total surplus of area $a + b + c + e + f$.

To maintain the price support, the government must buy up the excess supply at P_3 ; that is, the quantity $Q_3 - Q_2$. As shown in Exhibit 7, the government purchases are added to the market demand curve ($D +$ government purchases). This additional demand allows the price to stay at the support level. After the price floor is in effect, price rises to P_3 ; output falls to Q_2 ; consumer surplus falls from area $a + b + c$ to area a , a loss of $b + c$; Some of the loss of consumer

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Price controls are often advocated by special interest groups. Price controls reduce the quantity of goods and services produced, thus depriving consumers of some goods and services whose value would exceed their cost.



In an effort to help producers of the cheese commonly grated over spaghetti, fettuccine and other pastas, the Italian government is buying 100,000 wheels of Parmigiano Reggiano and donating them to charity. This is similar to the price floors where the government buys up the surplus.

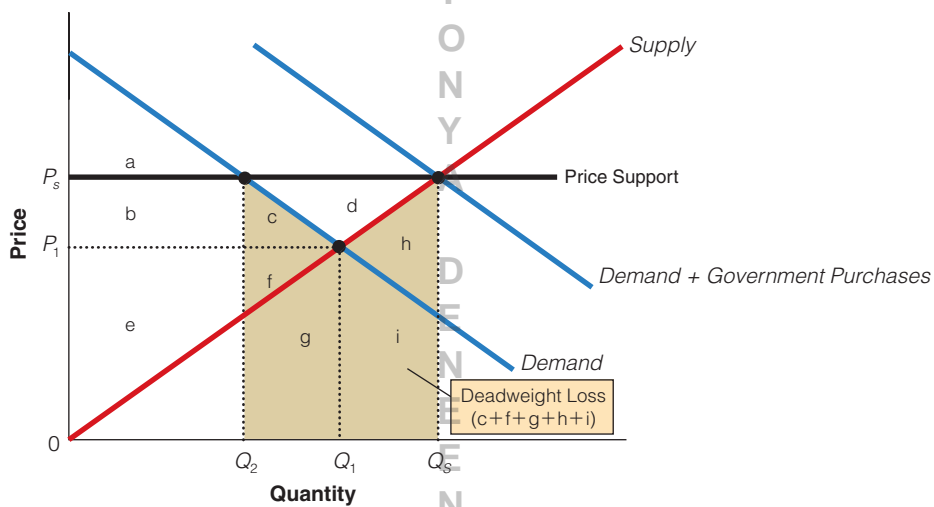


Wouldn't it cost less to give farmers money directly rather than through price supports?

surplus occurs because at the higher price, P_s , some consumers will buy less of the good or not buy the good at all. Consumers also lose area b because they now have to pay a higher price, P_s , for Q_2 output. However, the policy was not intended to help the consumer, but to help the producer. And it does. Producer surplus increases from area e + f to area b + c + d + e + f, a gain of area b + c + d. If those changes were the end of the story, we would say that producers gained (area b + c + d) more than consumers lost (area b + c), and, on net, society would benefit by area d from the implementation of the price support. However, those changes are *not* the end of the story. The government (taxpayers) must pay for the surplus it buys, area c + d + f + g + h + i. That is, the cost to government is area c + d + f + g + h + i. The total welfare cost of the program is found by adding the change in consumer surplus (lost area b + c) and the change in producer surplus (gained area b + c + d) and then subtract the government costs. After adding the change in consumer surplus to the change in producer surplus we end up with a + d than we subtract the government costs c + d + f + g + h + i. Assuming no alternative use of the surplus the government purchases, the result is a deadweight loss from the price floor of area c + f + g + h + i. Why? Consumers are consuming less than the previous market equilibrium output, eliminating mutually beneficial exchanges, while sellers are producing more than is being consumed, with the excess production stored, destroyed, or exported. If the objective is to help the farmers, wouldn't it be less costly to just give them the money directly rather than through price supports? Then the program would only cost b + c + d. However, price supports may be more palatable from a political standpoint than an outright handout.

section 7.2
exhibit 7

Welfare Effects of a Price Floor When Government Buys the Surplus



	Before Price Support	After Price Support	Change
Consumer Surplus (CS)	a + b + c	a	-b - c
Producer Surplus (PS)	e + f	b + c + d + e + f	b + c + d
Government (Taxpayers, G)	zero	-c - d - f - g - h - i	-c - d - f - g - h - i
Total Welfare	a + b + c + e + f	a + b + e - g - h - i	-c - f - g - h - i

After the price support is implemented, the price rises to P_s and output falls to Q_2 ; the result is a loss in consumer surplus of area b + c but a gain in producer surplus of area b + c + d. However, these changes are not the end of the story, because the cost to the government (taxpayers), area c + d + f + g + h + i, is greater than the gain to producers, area d, so the deadweight loss is area c + f + g + h + i.

Deficiency Payment Program

Another possibility is the deficiency payment program. In Exhibit 8, if the government sets the support price at P_s , producers will supply Q_2 and sell all they can at the market price, P_M . The government then pays the producers a deficiency payment (DP)—the vertical distance between the price the producers receive, P_M , and the price they were guaranteed, P_s . Producer surplus increases from area $c + d$ to area $c + d + b + e$, which is a gain of area $b + e$, because producers can sell a greater quantity at a higher price. Consumer surplus increases from area $a + b$ to area $a + b + c + g$, which is a gain of area $c + g$, because consumers can buy a greater quantity at a lower price. The cost to government ($Q_2 \times DP$), area $b + e + f + c + g$, is greater than the gains in producer and consumer surpluses (area $b + e + c + g$), and the deadweight loss is area f . The deadweight loss occurs because the program increases the output beyond the efficient level of output, Q_1 . From Q_1 to Q_2 , the marginal cost to sellers for producing the good (the height of the supply curve) is greater than the marginal benefit to consumers (the height of the demand curve).



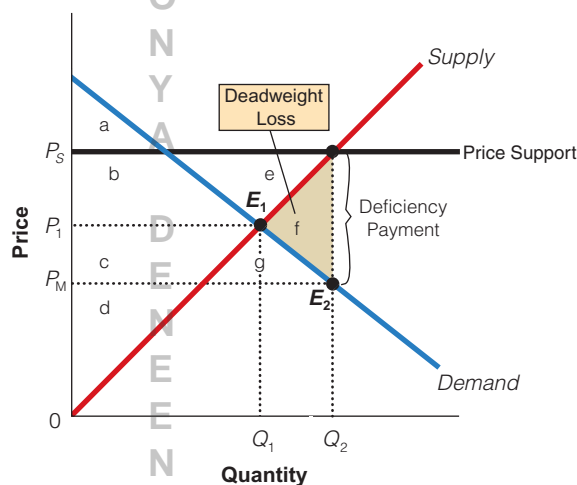
Are deficiency payment programs more efficient than traditional price supports?

Compare area f in Exhibit 8 with the much larger deadweight loss for price supports in Exhibit 7. The deficiency payment program does not lead to the production of crops that will not be consumed, or to the storage problem we saw with the previous price-support program in Exhibit 7.

The purpose of these farm programs is to help poor farmers. However, large commercial farms (roughly 10 percent of all farms) receive the bulk of the government subsidies. Small farms receive less than 20 percent of the farm subsidies. Many other countries around the world also provide subsidies to their farmers.

section 7.2
exhibit 8

Welfare Effects of a Deficiency Payment Plan



	Before Plan	After Plan	Change
Consumer Surplus (CS)	$a + b$	$a + b + c + g$	$c + g$
Producer Surplus (PS)	$c + d$	$c + d + b + e$	$b + e$
Government (Taxpayers, G)	zero	$-b - e - f - c - g$	$-b - e - f - c - g$
Total Welfare (CS + PS - G)	$a + b + c + d$	$a + b + c + d - f$	$-f$

The cost to government (taxpayers), area $b + e + f + c + g$, is greater than the gains to producer and consumer surplus, area $b + e + c + g$. The deficiency payment program increases the output level beyond the efficient output level of Q_1 . From Q_1 to Q_2 , the marginal cost of producing the good (the height of the supply curve) is greater than the marginal benefit to the consumer (the height of the demand curve)—area f .

 SECTION QUIZ


1. In a supply and demand graph, the triangular area between the demand curve and the supply curve lost because of the imposition of a tax, price ceiling, or price floor is
 - a. the consumer surplus.
 - b. the producer surplus.
 - c. the marginal cost.
 - d. the deadweight loss.
 - e. the net gain to society from trading that good.
2. After the imposition of a tax,
 - a. consumers pay a higher price, including the tax.
 - b. consumers lose consumer surplus.
 - c. producers receive a lower price after taxes.
 - d. producers lose producer surplus.
 - e. all of the above occur.
3. With a subsidy,
 - a. the price producers receive is the price consumers pay plus the subsidy.
 - b. the subsidy leads to the production of more than the efficient level of output.
 - c. there is a deadweight loss.
 - d. all of the above are true.
4. In the case of a price floor, if the government buys up the surplus,
 - a. consumer surplus decreases.
 - b. producer surplus increases.
 - c. a greater deadweight loss occurs than with a deficiency payment system.
 - d. all of the above are true.
5. The longer a price ceiling is left below the equilibrium price in a market, the _____ is the reduction in the quantity exchanged and the _____ is the resulting deadweight loss.
 - a. greater; greater
 - b. greater; smaller
 - c. smaller; greater
 - d. smaller; smaller
6. With a deficiency payment program,
 - a. the government sets the target price at the equilibrium price.
 - b. producer and consumer surplus falls.
 - c. there is a deadweight loss because the program increases the output beyond the efficient level of output.
 - d. all of the above are true.

-
1. Could a tax be imposed without a welfare cost?
 2. How does the elasticity of demand represent the ability of buyers to “dodge” a tax?
 3. If both supply and demand were highly elastic, how large would the effect be on the quantity exchanged, the tax revenue, and the welfare costs of a tax?
 4. What impact would a larger tax have on trade in the market? What will happen to the size of the deadweight loss?
 5. What would be the effect of a price ceiling?
 6. What would be the effect of a price floor if the government does not buy up the surplus?
 7. What causes the welfare cost of subsidies?
 8. Why does a deficiency payment program have the same welfare cost analysis as a subsidy?

Answers: 1. d 2. e 3. d 4. d 5. a 6. c

Interactive Summary

Fill in the blanks:

- The monetary difference between the price a consumer is willing and able to pay for an additional unit of a good and the price the consumer actually pays is called _____.
- We can think of the demand curve as a _____ curve.
- Consumer surplus for the whole market is shown graphically as the area under the market _____ (willingness to pay for the units consumed) and above the _____ (what must be paid for those units).
- A lower market price due to an increase in supply will _____ consumer surplus.
- A(n) _____ is the difference between what a producer is paid for a good and the cost of producing that unit of the good.
- We can think of the supply curve as a(n) _____ curve.
- Part of the added producer surplus when the price rises as a result of an increase in demand is due to a higher price for the quantity _____ being produced, and part is due to the expansion of _____ made profitable by the higher price.
- The demand curve represents a collection of _____ prices that consumers are willing and able to pay for additional quantities of a good or service, while the supply curve represents a collection of _____ prices that suppliers require to be willing to supply additional quantities of that good or service.
- The total welfare gain to the economy from trade in a good is the sum of the _____ and _____ created.
- In competitive markets, with large numbers of buyers and sellers at the market equilibrium price and quantity, the net gains to society are _____ as possible.
- After a tax is imposed, consumers pay a(n) _____ price and lose the corresponding amount of consumer surplus as a result. Producers receive a(n) _____ price after tax and lose the corresponding amount of producer surplus as a result. The government _____ the amount of the tax revenue generated, which is transferred to others in society.
- The size of the deadweight loss from a tax, as well as how the burdens are shared between buyers and sellers, depends on the relative _____.
- When there is a subsidy, the market _____ relative to the efficient level of output.
- Because the _____ leads to the production of more than the efficient level of output, a(n) _____ results.
- With a(n) _____, any possible gain to consumers will be more than offset by the losses to producers.
- With a price floor where the government buys up the surplus, the cost to the government is _____ than the gain to _____.
- With no alternative use of the government purchases from a price floor, a(n) _____ will result because consumers are consuming _____ than the previous market equilibrium output and sellers are producing _____ than is being consumed.
- With a deficiency payment program, the deadweight loss is _____ than with an agricultural price support program when the government buys the surplus.

Answers: 1. consumer surplus 2. marginal benefit 3. demand curve; market price 4. increase 5. producer surplus 6. marginal cost 7. already; output 8. maximum; minimum 9. consumer surplus; producer surplus 10. as large 11. higher; lower; gains 12. elasticities of supply and demand 13. overproduces 14. subsidy; deadweight loss 15. price ceiling 16. greater; producers 17. deadweight loss; less; more 18. smaller

Key Terms and Concepts

consumer surplus 187
producer surplus 189

marginal cost 189
total welfare gains 191

deadweight loss 192
welfare effects 194

Section Quiz Answers

7.1 Consumer Surplus and Producer Surplus

1. What is consumer surplus?

Consumer surplus is defined as the monetary difference between what a consumer is willing to pay for a good and what the consumer is required to pay for it.

2. Why do the earlier units consumed at a given price add more consumer surplus than the later units consumed?

Because what a consumer is willing to pay for a good declines as more of that good is consumed, the difference between what he is willing to pay and the price he must pay also declines for later units.

3. Why does a decrease in a good's price increase the consumer surplus from consumption of that good?

A decrease in a good's price increases the consumer surplus from consumption of that good by lowering the price for those goods that were bought at the higher price and by increasing consumer surplus from increased purchases at the lower price.

4. Why might the consumer surplus from purchases of diamond rings be less than the consumer surplus from purchases of far less expensive stones?

Consumer surplus is the difference between what people would have been willing to pay for the amount of the good consumed and what they must pay. Even though the marginal value of less expensive stones is lower than the marginal value of a diamond ring to buyers, the difference between the total value of the far larger number of less expensive stones purchased and what consumers had to pay may well be larger than that difference for diamond rings.

5. What is producer surplus?

Producer surplus is defined as the monetary difference between what a producer is paid for a good and the producer's cost.

6. Why do the earlier units produced at a given price add more producer surplus than the later units produced?

Because the earlier (lowest cost) units can be produced at a cost that is lower than the market price, but the cost of producing additional units rises, the earlier units produced at a given price add more producer surplus than the later units produced.

7. Why does an increase in a good's price increase the producer surplus from production of that good?

An increase in a good's price increases the producer surplus from production of that good because it results in a higher price for the quantity already being produced and because the expansion in output in response to the higher price also increases profits.

8. Why might the producer surplus from sales of diamond rings, which are expensive, be less than the producer surplus from sales of far less expensive stones?

Producer surplus is the difference between what a producer is paid for a good and the producer's cost. Even though the price, or marginal value, of a less expensive stone is lower than the price, or marginal value of a diamond ring to buyers, the difference between the total that sellers receive for those stones in revenue and the producer's cost of the far larger number of less expensive stones produced may well be larger than that difference for diamond rings.

9. Why is the efficient level of output in an industry defined as the output where the sum of consumer and producer surplus is maximized?

The sum of consumer surplus plus producer surplus measures the total welfare gains from trade in an industry, and the most efficient level of output is the one that maximizes the total welfare gains.

10. Why does a reduction in output below the efficient level create a deadweight loss?

A reduction in output below the efficient level eliminates trades whose benefits would have exceeded their costs; the resulting loss in consumer surplus and producer surplus is a deadweight loss.

11. Why does an expansion in output beyond the efficient level create a deadweight loss?

An expansion in output beyond the efficient level involves trades whose benefits are less than their costs; the resulting loss in consumer surplus and producer surplus is a deadweight loss.

7.2 The Welfare Effects of Taxes, Subsidies, and Price Controls

1. Could a tax be imposed without a welfare cost?

A tax would not impose a welfare cost only if the quantity exchanged did not change as a result—only

when supply was perfectly inelastic or in the non-existent case where the demand curve was perfectly inelastic. In all other cases, a tax would create a welfare cost by eliminating some mutually beneficial trades (and the wealth they would have created) that would otherwise have taken place.

2. How does the elasticity of demand represent the ability of buyers to “dodge” a tax?

The elasticity of demand represents the ability of buyers to “dodge” a tax, because it represents how easily buyers could shift their purchases into other goods. If it is relatively low cost to consumers to shift out of buying a particular good when a tax is imposed on it—that is, demand is relatively elastic—they can dodge much of the burden of the tax by shifting their purchases to other goods. If it is relatively high cost to consumers to shift out of buying a particular good when a tax is imposed on it—that is, demand is relatively inelastic—they cannot dodge much of the burden of the tax by shifting their purchases to other goods.

3. If both supply and demand were highly elastic, how large would the effect be on the quantity exchanged, the tax revenue, and the welfare costs of a tax?

The more elastic are supply and/or demand, the larger the change in the quantity exchanged that would result from a given tax. Given that tax revenue equals the tax per unit times the number of units traded after the imposition of a tax, the smaller after-tax quantity traded would reduce the tax revenue raised, other things equal. Because the greater change in the quantity traded wipes out more mutually beneficial trades than if demand and/or supply was more inelastic, the welfare cost in such a case would also be greater, other things equal.

4. What impact would a larger tax have on trade in the market? What will happen to the size of the deadweight loss?

A larger tax creates a larger wedge between the price including tax paid by consumers and the price net of tax received by producers, resulting in a greater increase in prices paid by consumers and a greater

decrease in price received by producers, and the laws of supply and demand imply that the quantity exchanged falls more as a result. The number of mutually beneficial trades eliminated will be greater and the consequent welfare cost will be greater as a result.

5. What would be the effect of a price ceiling?

A price ceiling reduces the quantity exchanged, because the lower regulated price reduces the quantity sellers are willing to sell. This lower quantity causes a welfare cost equal to the net gains from those exchanges that no longer take place. However, that price ceiling would also redistribute income, harming sellers, increasing the well-being of those who remain able to buy successfully at the lower price, and decreasing the well-being of those who can no longer buy successfully at the lower price.

6. What would be the effect of a price floor if the government does not buy up the surplus?

Just as in the case of a tax, a price floor where the government does not buy up the surplus reduces the quantity exchanged, thus causing a welfare cost equal to the net gains from the exchanges that no longer take place. However, that price floor would also redistribute income, harming buyers, increasing the incomes of those who remain able to sell successfully at the higher price, and decreasing the incomes of those who can no longer sell successfully at the higher price.

7. What causes the welfare cost of subsidies?

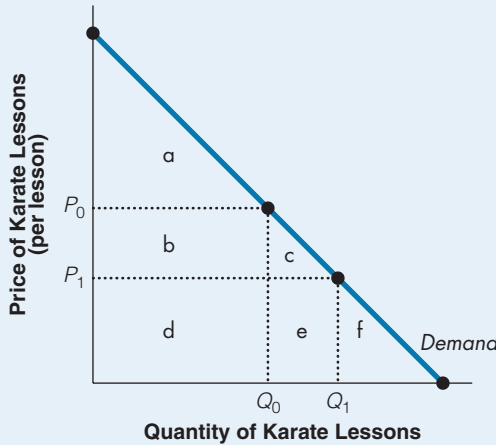
Subsidies cause people to produce units of output whose benefits (without the subsidy) are less than the costs, reducing the total gains from trade.

8. Why does a deficiency payment program have the same welfare cost analysis as a subsidy?

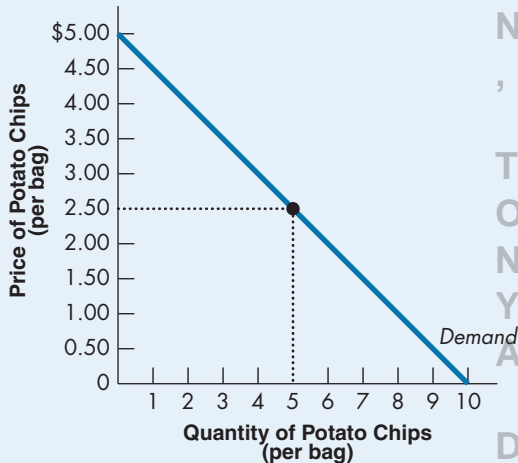
Both tend to increase output beyond the efficient level, so that units whose benefits (without the subsidy) are less than the costs, reducing the total gains from trade in the same way; further, the dollar cost of the deficiency payments are equal to the dollar amount of taxes necessary to finance the subsidy, in the case where each increases production the same amount.

Problems

1. Refer to the following exhibit.

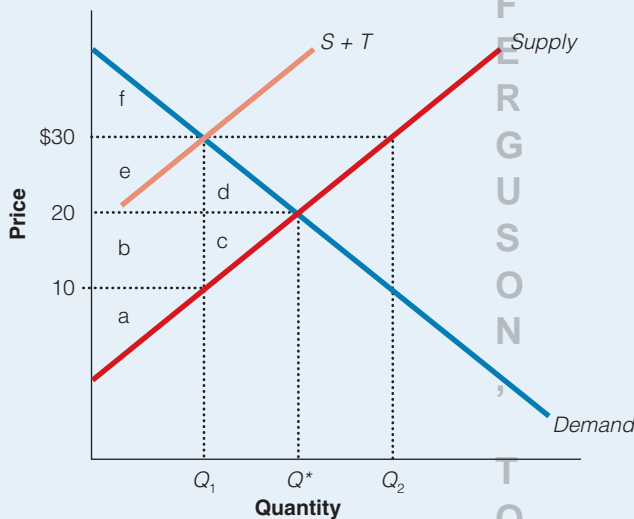


- If the price of each karate lesson is P_0 , the consumer surplus is equal to what area?
 - If the price falls from P_0 to P_1 , the change in consumer surplus is equal to what area?
2. Steve loves potato chips. His weekly demand curve is shown in the following exhibit.

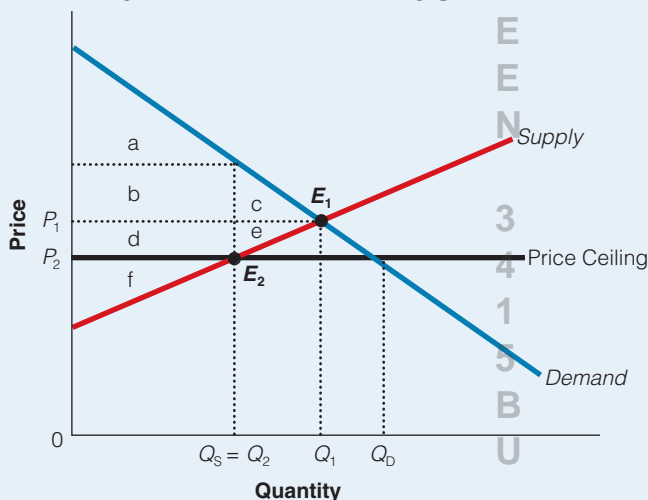


- How much is Steve willing to pay for one bag of potato chips?
 - How much is Steve willing to pay for a second bag of potato chips?
 - If the actual market price of potato chips is \$2.50, and Steve buys five bags as shown, what is the value of his consumer surplus?
 - What is Steve's total willingness to pay for five bags?
- If a freeze ruined this year's lettuce crop, show what would happen to consumer surplus.
 - If demand for apples increased as a result of a news story that highlighted the health benefits of two apples a day, what would happen to producer surplus?
 - How is total surplus (the sum of consumer and producer surpluses) related to the efficient level of output? Using a supply and demand curve, demonstrate that producing less than the equilibrium output will lead to an inefficient allocation of resources—a deadweight loss.
 - If the government's goal is to raise tax revenue, which of the following are good markets to tax?
 - luxury yachts
 - alcohol
 - movies
 - gasoline
 - grapefruit juice

7. Which of the following do you think are good markets for the government to tax if the goal is to boost tax revenue? Which will lead to the least amount of deadweight loss? Why?
 - a. luxury yachts
 - b. alcohol
 - c. motor homes
 - d. cigarettes
 - e. gasoline
 - f. pizza
8. Elasticity of demand in the market for one-bedroom apartments is 2.0, elasticity of supply is 0.5, the current market price is \$1,000, and the equilibrium number of one-bedroom apartments is 10,000. If the government imposes a price ceiling of \$800 on this market, predict the size of the resulting apartment shortage.
9. Use the diagram to answer the following questions (a–d).

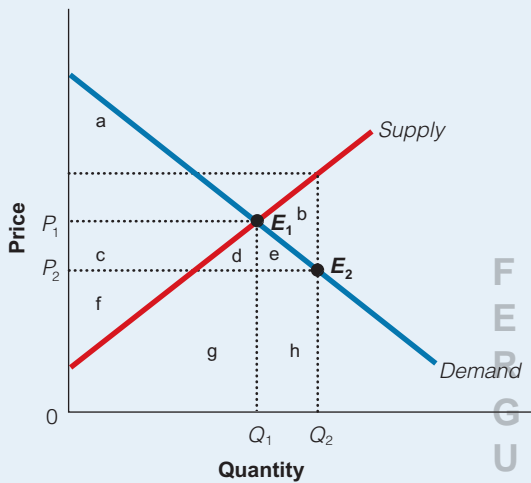


- a. At the equilibrium price before the tax is imposed, what area represents consumer surplus? What area represents producer surplus?
 - b. Say that a tax of $\$T$ per unit is imposed in the industry. What area now represents consumer surplus? What area represents producer surplus?
 - c. What area represents the deadweight cost of the tax?
 - d. What area represents how much tax revenue is raised by the tax?
10. Use consumer and producer surplus to show the deadweight loss from a subsidy (producing more than the equilibrium output). (*Hint:* Remember that taxpayers will have to pay for the subsidy.)
 11. Use the diagram to answer the following questions (a)–(c).

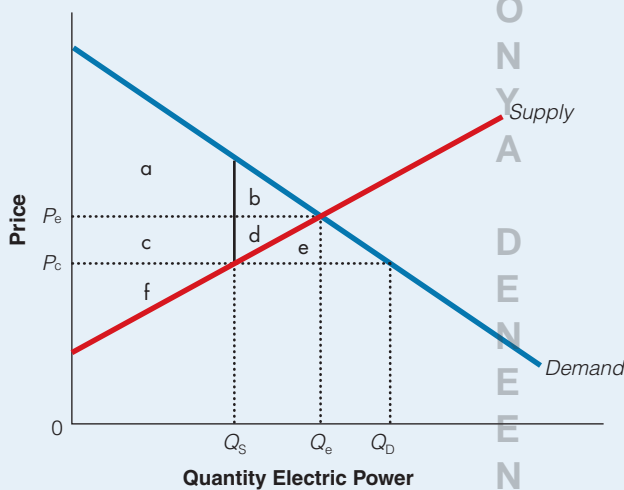


- a. At the initial equilibrium price, what area represents consumer surplus? What area represents producer surplus?
- b. After the price ceiling is imposed, what area represents consumer surplus? What area represents producer surplus?
- c. What area represents the deadweight loss cost of the price ceiling?

12. Use the diagram to answer the following questions (a)–(c).



- a. At the competitive output, Q_1 , what area represents the consumer surplus? What area represents the producer surplus?
 - b. At the larger output, Q_2 , what area represents the consumer surplus? What area represents the producer surplus?
 - c. What area represents the deadweight loss of producing too much output?
13. The 2000–2001 California energy crisis produced brownouts, utility company bankruptcies, and worries about high prices. The California electric power regulatory program imposed price ceilings on electricity sold to consumers. The following exhibit describes the California situation with P_s as the price ceiling. Answer the following questions referring to this exhibit.



- a. What was the loss imposed on consumers by this price ceiling?
- b. What was the loss imposed on producers by this price ceiling?
- c. What was the total loss imposed on California by this price ceiling?
- d. Using this exhibit, explain the brownouts in California.
- e. What would have to be true for consumers to support market set prices? Use the exhibit to explain why there might not be support among consumers for raising prices.

Market Failure

- 8.1 Externalities
- 8.2 Public Policy and the Environment
- 8.3 Property Rights and the Environment
- 8.4 Public Goods
- 8.5 Asymmetric Information

If a road is crowded, it creates a negative externality. That is, when one more car enters a roadway, all the other drivers must go a little more slowly. Highway space can be overused because we pay so little for it. At some particular times, such as at rush hours, if we charge a zero money price, a shortage of road space will result. Many big cities, such as London, have set up tolls to charge higher prices to travel downtown during the weekdays; the higher price brings the market closer to equilibrium.

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In the last several chapters, we concluded that markets are efficient. But we made some assumptions about how markets work. If these assumptions do not hold, our conclusion about efficiency may be flawed. What are the assumptions?

First, in our model of supply and demand, we assumed that markets are perfectly competitive—many buyers and sellers exchanging similar goods in an environment where buyers and sellers can easily enter and exit the market. This is not always true. In some markets, few firms may have control over the market price. When firms can control the market price, we say that they have market power. This market power can cause inefficiency because it will lead to higher prices and lower quantities than the competitive solution.

Sometimes the market system fails to produce efficient outcomes because of side effects economists call *externalities*. Another possible source of market failure is that competitive markets provide less than the efficient quantity of public goods. A public good is a good or service that someone can consume simultaneously with everyone else, even if he or she doesn't pay for it. For example, everyone enjoys the benefits of national defense and yet it would be difficult to exclude anyone from receiving these benefits. The problem is that if consumers know it is too difficult to exclude them, then they could avoid paying their share of the public good (take a free ride), and producers would find it unprofitable to provide the good. Therefore, the government provides important public goods such as national defense.

Many economists believe that asymmetric information can cause market failures. *Asymmetric information* is a situation where some people know what other people don't know. This can lead to adverse selection where an informed party benefits in an exchange by taking advantage of knowing more than the other party.

8.1

Externalities

What is a negative externality?

What is a positive externality?

How are negative externalities internalized?

How are positive externalities internalized?

externality a benefit or cost from consumption or production that spills over onto those who are not consuming or producing the good

positive externality when benefits spill over to an outside party who is not involved in producing or consuming the good

negative externality when costs spill over to an outside party who is not involved in producing or consuming the good

Even if the economy is competitive, it is still possible that the market system fails to produce the efficient level of output because of side effects economists call **externalities**. With **positive externalities**, the private market supplies too little of the good in question (such as education). In the case of **negative externalities** (such as pollution), the market supplies too much. Both types of externalities are caused by economic agents—producers and consumers—receiving the wrong signals. That is, the free market works well in providing most goods but does less well without regulations, taxes, and subsidies in providing others.

Negative Externalities in Production

The classic example of a negative externality in production is air pollution from a factory, such as a steel mill. If the firm uses clean air in production and returns dirty air to the atmosphere, it creates a negative externality. The polluted air “spills over” to outside parties. Now people in the neighboring communities may experience higher incidences of disease, dirtier houses, and other property damage. Such damages are real costs; but because no one owns the air, the firm does not have to pay for its use, unlike the other resources the firm uses in

production. A steel mill pays for labor, capital, energy, and raw materials because it must compensate the owners of those inputs for their use. If a firm can avoid paying the costs it imposes on others—the external costs—it has lowered its own costs of production, but not the true costs to society.

Examples of negative externalities are numerous: the roommate who plays his stereo too loud at 2:00 A.M., the neighbor’s dog that barks all night long or leaves “messages” on your front lawn, or the gardener who runs the leaf blower on full power at 7:00 A.M. on the weekend. Driving our cars may be another area in which people don’t bear the full costs of their choices. We pay the price to purchase cars, as well as to maintain, insure, and fuel them—those are the private costs. But do we pay for all of our external costs such as emissions, congestion, wear and tear on our highways, and the possible harm to those driving in cars smaller than ours?



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What are externalities? Are they always bad?



Externalities exist when some of the costs or benefits associated with production and/or consumption of a good or service falls on someone other than the producers or consumers of the product or service.

When a price fails to reflect all the costs of a product, too much of it is produced and/or consumed.

Graphing Negative External Costs in Production

Let’s take a look at the steel industry. In Exhibit 1, we see the market for steel. Notice that at each level of output, the first supply curve, $S_{Private}$ is lower than the second, S_{Social} . The reason is simple: $S_{Private}$ only includes the private costs to the firm—the capital, entrepreneurship, land, and labor for which it must pay. However, S_{Social} includes all of these costs, plus the external costs that production imposes on others. If the firm could somehow be required to compensate society for the damage it causes, the cost of production for the firm would increase and would shift the supply curve to the left. That is, the true social cost of producing steel is represented by S_{Social} in Exhibit 1. The equilibrium at P_2 and Q_2 is efficient. The market equilibrium is not efficient because the true supply curve is above the demand curve at Q_1 . At Q_1 the marginal benefits (point a) are less than the marginal cost (point b) and society would be better off if the firm produced less steel. The deadweight loss from overproduction is measured by the shaded area in Exhibit 1. From society’s standpoint, Q_2 is the efficient level of output because it represents all the costs (private plus external costs) associated with the production of this good. If the suppliers of steel are not aware of or not responsible for the external costs, they will tend to produce too much, Q_1 from society’s standpoint and efficiency would be improved if less were produced and consumed.

What Can the Government Do to Correct for Negative Externalities?

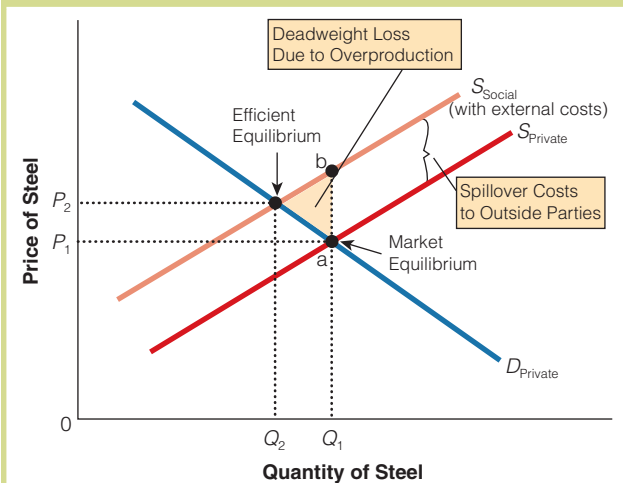
The government can intervene in market decisions in an attempt to take account of these negative externalities. It may do this by estimating the amount of those external costs and then taxing the manufacturer by that amount, forcing the manufacturer to internalize (bear) the costs.

Pollution Taxes

Pollution taxes are designed to internalize negative externalities. If government could impose a pollution tax equal to the exact size of the external cost, then the firm would produce the efficient level of output, Q_2 . That is, the tax would shift the supply curve for steel leftward to S_{Social} and would provide an incentive for the firm to produce at the socially optimum level of output. Additionally, tax revenues would

section 8.1 exhibit 1

Negative Externalities in Production



When a negative externality in production is present, firms do not bear the full cost of their actions, and they will produce more than the efficient level of output: Q_1 rather than Q_2 . $S_{Private}$ reflects the private cost of the firm. S_{Social} reflects the private costs plus the external (or spillover) costs that the steel production imposes on others. If the supply curve is $S_{Private}$, the market equilibrium is at P_1 and Q_1 . This level is not efficient and leads to a deadweight loss—the shaded area. However, when the supply curve is S_{Social} , then the equilibrium occurs at P_2 and Q_2 , which is the efficient equilibrium.



In the United States, people deposit large amounts of solid waste as litter on beaches, campgrounds, highways, and vacant lots. Some of this litter is removed by government agencies, and some of it biodegrades over many years. Several solutions are possible for the litter problem. Stiffer fines and penalties and more aggressive monitoring could be employed. Alternatively, through education and civic pride, individuals and groups could be encouraged to pick up trash.

to further reduce pollution levels in their plant and consequently lower the tax they would have to pay. Under regulation, a firm has little incentive to further reduce emissions once it reaches the predetermined level set by the regulated standard.

For example, a gas tax is a form of pollution tax: It helps reduce the externalities of pollution and congestion. The higher the tax, then fewer vehicles are on the road, fewer miles are driven, and more fuel efficient vehicles are purchased, each of which leads to less congestion and pollution. Therefore, the pollution tax, unlike other taxes, can enhance economic efficiency while generating revenue for the government.

Many economists like the gas tax because it is easy to collect, difficult for users to avoid, and encourages fuel economy. It puts the tax on highway users but completely internalizing the externality may cost much more than U.S. drivers are currently charged. In Europe, the gas tax is over \$4 per gallon.

Positive Externalities in Consumption

Unlike negative externalities, positive externalities benefit others. For some goods, the individual consumer receives all the benefits. If you buy a hamburger, for example, you get all its benefits. On the other hand, consider education. This is a positive externality in consumption whose benefits extend beyond the individual consumer of education. Certainly, when you “buy” an education, you receive many of its benefits: greater future income, more choice of future occupations, and the consumption value of knowing more about life as a result of learning. However, these benefits, great as they may be, are not all the benefits associated with your education. You may be less likely to be unemployed or commit crimes; you may end up curing cancer or solving some other social problem. These nontrivial benefits are the positive external benefits of education.

The government frequently subsidizes education. Why? Presumably because the private market does not provide enough. It is argued that the education of

be generated that could be used to compensate those who had suffered damage from the pollution or in some other productive way.

Regulation

Alternatively, the government could use regulation. The government might simply prohibit certain types of activities that cause pollution or force firms to adopt a specific technology to reduce their emissions. However, regulators would have to know the best available technology for each and every industry. The purchase and use of new pollution-control devices will increase the cost of production and shift the supply curve to the left, from S_{Private} to S_{Social} .

Which Is Better—Pollution Tax or Regulation?

Most economists agree that a pollution tax, or a corrective tax, is more efficient than regulation. The pollution tax is good because it gets rid of the externality and moves society closer to the efficient level of output. The tax also gives firms an incentive to find and apply new technology



Secondhand smoke is a negative externality. According to the U.S. Surgeon General, the health effects of secondhand smoke are more pervasive than previously thought. A recent report claims that exposure to secondhand smoke at home or the office increases the nonsmokers' risk of developing heart disease by 25 to 30 percent and lung cancer by 20 to 30 percent over their lifetimes. It is especially dangerous for children living with smokers.

a person benefits not only that person but all society, because a more informed citizenry can make more intelligent collective decisions, which benefits everyone.

Public health departments sometimes offer “free” inoculations against certain communicable diseases, such as influenza, because by protecting one group of citizens, everyone gets some protection; if one citizen is prevented from getting the disease, that person cannot pass it on to others. Many governmental efforts in the field of health and education are justified on the basis of positive externalities. Of course, because positive externalities are often difficult to measure, it is hard to demonstrate empirically whether many governmental education and health programs achieve their intended purposes.

In short, the presence of positive externalities interferes with reaching economic efficiency because of the tendency for the market to underallocate (produce too little) of this good.

Graphing Positive External Benefits of Consumption

Let’s take the case of a new vaccine against the common cold. The market for the vaccine is shown in Exhibit 2. The demand curve, D_{Private} , represents the prices and quantities that buyers would be willing to pay in the private market to reduce their probability of catching the common cold. The supply curve shows the amounts that suppliers would offer for sale at different prices. However, at the equilibrium market output, Q_1 , the output of vaccinations falls far short of the efficient level, Q_2 . Why? Many people benefit from the vaccines, including those who do not have to pay for them; they are now less likely to be infected because others took the vaccine. If we could add the benefits derived by nonpaying consumers, the demand curve would shift to the right, from D_{Private} to D_{Social} . The greater level of output, Q_2 , that would result if D_{Social} were the observed demand reflects the efficient output level.

The market equilibrium at P_1 and Q_1 is not efficient because D_{Social} is above D_{Private} for all levels of output between Q_1 and Q_2 . That is, at Q_1 the marginal benefits (D_{Social}) at point b are greater than the marginal cost (S_{Social}) at point a. Consequently, a deadweight loss is associated with the underproduction. In short, too little of the good is produced. Because producers are unable to collect payments from all those who benefit from the good or service, the market has a tendency to underproduce. In this case, the market is not producing enough vaccinations from society’s standpoint and an *underallocation* of resources occurs.

Technology Spillover

Another potentially important positive externality is called a technology spillover. One firm’s research and production can spill over to increase another firm’s access to technological advances. For example, in technology industries like semiconductors, bioengineering and software design, one firm’s innovations are often imitated and improved on by other firms. The firm benefits from the new knowledge, but that knowledge also generates positive externalities that spill over to other firms. That is one reason why many technology firms are clustered together in California’s Silicon Valley. That clustering allows workers to more easily share knowledge and collaborate in a rapidly changing industry.



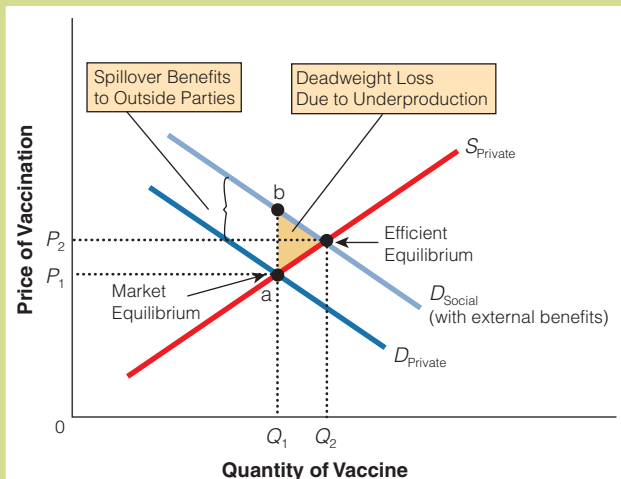
Government can use taxes or regulation to correct for excessive output of a good whose production generates external costs.

When a price fails to reflect all the benefits of a product, too little of the product is produced and consumed.

The government can use subsidies to help correct for insufficient output of a good that generates external benefits, or it can regulate output directly to correct for underproduction or underconsumption of a good.

section 8.1 exhibit 2

Positive Externalities in Consumption



The private demand curve plus external benefits is presented as the demand curve D_{Social} . This demand curve is to the right of the private demand curve, D_{Private} . At Q_1 the marginal benefits (point b) are greater than the marginal cost (point a) leading to a deadweight loss—the shaded area. The market equilibrium output, Q_1 , falls short of the efficient level of output, Q_2 . The market produces too little of the good or service.



Did you know that according to the NHTSA, 20 percent of injury crashes in 2009 involved reports of distracted driving. And of those killed in distracted driving-related crashes, 995 involved reports a cell phone as a distraction (18% of fatalities in distraction-related crashes). The age group with the greatest proportion of distracted drivers was the under-20 age group. In an insurance industry study, drivers who use handheld devices are four times as likely to get into crashes serious enough to injure themselves. According to a University of Utah study, using a cell phone while driving, whether it's handheld or hands-free, delays a driver's reactions as much as having a blood alcohol concentration at the legal limit of .08 percent. That is, driving while texting can create a serious negative externality.

What Can the Government Do to Correct for Positive Externalities?

How could society correct for this market failure? Two particular methods of achieving the higher preferred output are subsidies and regulation.

Subsidies

Government could provide a subsidy—either give refunds to individuals who receive an inoculation or provide an incentive for businesses to give their employees “free” inoculations at the office. If the subsidy was exactly equal to the external benefit of inoculation, the demand curve would shift from D_{Private} to D_{Social} , resulting in an efficient level of output, Q_2 .

Regulation

The government could also pass a regulation requiring each person to get an inoculation. This approach would also shift the demand curve rightward toward the efficient level of output.

In summary, with positive externalities, the private market supplies too little of the good in question (such as education or inoculations for communicable diseases). In the case of negative externalities, the market supplies too much. In either case, buyers and sellers are receiving the wrong signals. The producers and consumers are not doing what they do because they are evil; rather, whether well-intentioned or ill-intentioned, they are behaving according to the incentives they face. The free market, then, works fine in providing most goods, but it functions less well without regulations, taxes, and subsidies in providing others.

Nongovernmental Solutions to Externalities

Sometimes externality problems can be handled by individuals without the intervention of government, where people may decide to take steps on their own to minimize negative externalities. Moral and social codes may prevent some people from littering, driving gas-guzzling cars, or using gas-powered mowers and log-burning fireplaces. The same self-regulation also applies to positive externalities. Philanthropists, for example, frequently donate money to public and private schools. In part, this must be because they view the positive externalities from education as a good buy for their charitable dollars.

 SECTION QUIZ


1. The presence of negative externalities leads to a misallocation of societal resources because
 - a. whenever external costs are imposed on outside parties, the good should not be produced at all.
 - b. less of the good than is ideal for society is produced.
 - c. some costs are associated with production that the producer fails to take into consideration.
 - d. the government always intervenes in markets when negative externalities are present, and the government is inherently inefficient.
2. A tax equal to the external cost on firms that emit pollutants would
 - a. provide firms with the incentive to increase the level of activity creating the pollution.
 - b. provide firms with the incentive to decrease the level of activity creating the pollution.
 - c. provide firms with little incentive to search for less environmentally damaging production methods.
 - d. not reduce pollution levels at all.
3. In the case of a good whose production generates negative externalities,
 - a. those not directly involved in the market transactions are harmed.
 - b. internalizing the externality would tend to result in a greater output of the good.
 - c. too little of the good tends to be produced.
 - d. a subsidy would be the appropriate government corrective action.
 - e. all of the above are true.
4. If firms were required to pay the full social costs of the production of goods, including both private and external costs, other things being equal, there would probably be a(n)
 - a. increase in production.
 - b. decrease in production.
 - c. greater misallocation of resources.
 - d. decrease in the market price of the product.
5. Which of the following will most likely generate positive externalities of consumption?
 - a. a hot dog vendor
 - b. public education
 - c. an automobile
 - d. a city bus
 - e. a polluting factory
6. Assume that production of a good imposes external costs on others. The market equilibrium price will be _____ and the equilibrium quantity _____ for efficient resource allocation.
 - a. too high; too high
 - b. too high; too low
 - c. too low; too high
 - d. too low; too low
7. Assume that production of a good generates external benefits of consumption. The market equilibrium price of the good will be _____ and the equilibrium quantity _____ for efficient resource allocation.
 - a. too high; too high
 - b. too high; too low
 - c. too low; too high
 - d. too low; too low

(continued)

SECTION QUIZ (Cont.)



8. In the case of externalities, appropriate government corrective policy would be
- taxes in the case of external benefits and subsidies in the case of external costs.
 - subsidies in the case of external benefits and taxes in the case of external costs.
 - taxes in both the case of external benefits and the case of external costs.
 - subsidies in both the case of external benefits and the case of external costs.
 - none of the above; the appropriate thing to do would be to do nothing.
-
- Why are externalities also called spillover effects?
 - How do external costs affect the price and output of a polluting activity?
 - How can the government intervene to force producers to internalize external costs?
 - How do external benefits affect the output of an activity that causes them?
 - How can the government intervene to force external benefits to be internalized?
 - Why do most cities have more stringent noise laws for the early morning and late evening hours than for during the day?

Answers: 1. c 2. b 3. a 4. b 5. b 6. c 7. d 8. b

8.2

Public Policy and the Environment

- 📁 What is the “best” level of pollution?
- 📁 What is a pollution tax?
- 📁 What are command and control regulations?
- 📁 What are transferable pollution rights?

Why Is a Clean Environment Not Free?

In many respects, a clean environment is no different from any other desirable good. In a world of scarcity, we can increase our consumption of a clean environment only by giving up something else. The problem that we face is choosing the combination of goods that does the most to enhance human well-being. Few people would enjoy a perfectly clean environment if they were cold, hungry, and generally destitute. On the other hand, an individual choking to death in smog is hardly to be envied, no matter how great his or her material wealth.

Only by considering the additional cost as well as the additional benefit of increased consumption of all goods, including clean air and water, can decisions on the desirable combination of goods to consume be made properly.

The Costs and Benefits of Pollution Control

It is possible, even probable, that pollution elimination, like nearly everything else, is subject to diminishing returns. Initially, a large amount of pollution can be eliminated fairly inexpensively, but getting rid of still more pollution may prove more costly. Likewise, it is also possible that the marginal benefits from eliminating “crud” from the air might decline as more and more pollution is eliminated. For example, perhaps some pollution elimination initially would have a profound impact on health costs, home repair expenses, and so

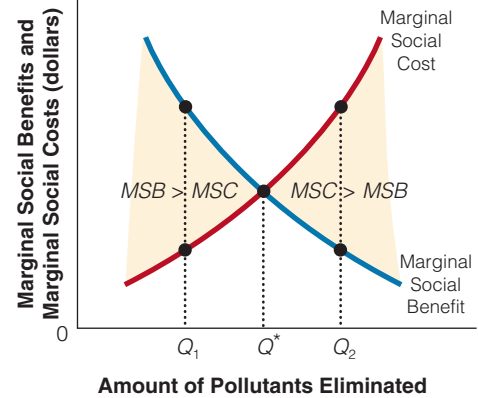
on, but as pollution levels fall, further elimination of pollutants brings fewer marginal benefits.

The cost-benefit trade-off just discussed is illustrated in Exhibit 1, which examines the marginal social benefits and marginal social costs associated with the elimination of air pollution. In the early 1960s, as a nation we had few regulations on pollution control, and as a result, private firms had little incentive to eliminate the problem. In the context of Exhibit 1, we may have spent Q_1 on controls, meaning that the marginal social benefits of greater pollution control expenditures exceeded the marginal costs associated with having the controls. Investing more capital and labor to reduce pollution is efficient in such a situation.

Optimum pollution control occurs when Q^* of pollution is eliminated. Up to that point, the benefits from the elimination of pollution exceed the marginal costs, both pecuniary and nonpecuniary, of the pollution control. Overly stringent compliance levels force companies to control pollution to the level indicated by Q_2 in Exhibit 1, where the additional costs from the controls far outweigh the environmental benefits. It should be stated, however, that increased concerns about pollution have probably caused the marginal social benefit curve to shift to the right over time, increasing the optimal amount of pollution control. Because of measurement problems, however, it is difficult to state whether we are generally below, at, or above the optimal pollution level.

section 8.2
exhibit 1

Marginal Costs and Benefits of Pollution Controls



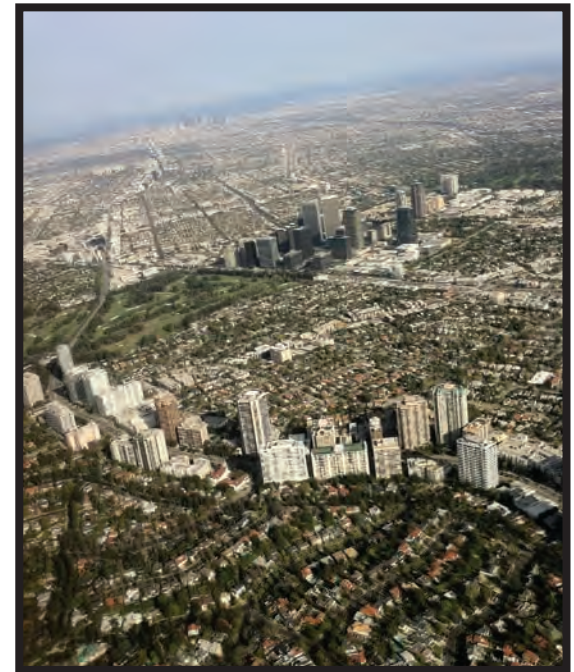
Pollution has costs and benefits. At output Q_1 , pollution control is inadequate; on the other hand, elimination of Q_2 pollution will entail marginal costs that exceed the marginal benefits. Only at Q^* is pollution control expenditure at an optimum level. Of course, in practice, it is difficult to know exactly the position and slope of these curves.

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Measuring Externalities

How much damage, at the margin, does a steel mill's air pollution do to nonconsumers of the steel? No one really knows because no market fully measures those costs. Indeed, the costs are partly nonpecuniary, meaning that no outlay of money occurs. Even though we pay dollars to see the doctor for respiratory ailments and pay dollars to repaint pollution-caused peeling on buildings, we do not make explicit money payments for the visual pollution and undesirable odors that the mill might produce as a byproduct of making steel. Nonpecuniary costs are real costs and potentially have a monetary value that can be associated with them, but assessing that value in practical terms is immensely difficult. You might be able to decide how much you would be willing to pay to live in a pollution-free world, but no current mechanism allows anyone to express the perceived monetary value of having clear air to breathe and smell. Even some pecuniary, or monetary, costs are difficult to truly measure: How much respiratory disease is caused by pollution and how much by other factors? Environmental economists continue to make progress in valuing these difficult to measure damages.

Even though measuring externalities, both negative and positive, is often nearly impossible, it does not necessarily mean that it is better to ignore the externality and allow the market solution to operate. As already explained, the market solution will almost certainly result in excessive output by polluters unless some intervention occurs. What form should the intervention take?



COURTESY OF ROBERT L. SEXTON

Can skyscrapers be good for the environment? People who live in the city drive less, use more public transportation, and also use less electricity and home heating because they tend to live in smaller living spaces compared to suburbanites. As a result, central city residents may emit less carbon into the atmosphere than suburbanites.



At the turn of the 20th century, horses and carriages were the predominant form of transportation in New York City. During inclement weather, the city was knee high in mud and manure. Horses that died on the job had to be dealt with as well. Ironically, the solution to the pollution problem was the horseless carriage—the automobile.



How can we determine the optimum level of pollution control?

Command and Control Policies: Regulation

One approach to dealing with externalities is to require private enterprise to produce their outputs in a manner that would reduce negative externalities below the amounts that would persist in the absence of regulation. For example, the Environmental Protection Agency (EPA) was established by the Clean Air Act of 1970 to serve as a watchdog over the production of goods and services in areas where externalities, especially negative externalities, exist. The EPA's main duty is to enforce environmental standards.

However, the EPA might also require a firm to use a certain technology to reduce emissions. In order to design good policies, the government regulators need information on specific industries and the technologies they could employ. This is not easy information for the government to obtain.

For example, the EPA may identify and then enforce a standard equal to the maximum amount of pollution that firms can produce per unit of output per year. To be effective in pollution reduction, of course, these standards must result in less pollution than would exist in the absence of regulation. The regulations, then, force companies to find less pollution-intensive ways of producing goods and services. Or in the case of consumer products that pollute—such as automobiles, for example—manufacturers have been forced to reduce the emissions from the products themselves. In 1984, the federal government required that auto producers install catalytic converters in new cars to reduce auto emissions.

would exist in the absence of regulation. The regulations, then, force companies to find less pollution-intensive ways of producing goods and services. Or in the case of consumer products that pollute—such as automobiles, for example—manufacturers have been forced to reduce the emissions from the products themselves. In 1984, the federal government required that auto producers install catalytic converters in new cars to reduce auto emissions.

Pollution Taxes: A Market-Based Policy

Using taxes to internalize external costs is appealing because it allows the relatively efficient private sector to operate according to market forces in a manner that takes socially important spillover costs into account. A major objection to the use of such taxes and subsidies is that, in most cases, it is difficult to measure externalities with any precision. Choosing a tax rate involves some guesswork, and poor guessing might lead to a solution that is far from optimal. But it is likely to be better than ignoring the problem. In spite of the severe difficulties in measurement, however, many economists would like to see greater effort made to force internalization of externalities through taxes rather than using alternative approaches. Why? We know that firms will seek out the least-expensive (in terms of using society's scarce resources) approaches to cleanup because they want more profits.

Transferable Pollution Rights

Economists see an opportunity to control pollution through a government-enforced system of property rights. In this system, the government issues **transferable pollution rights** that give the holder the right to discharge a specified amount (smaller than the uncontrolled amount) of pollution into the air. In this plan, firms have an incentive to lower their levels of pollution because they can sell their permits if they go unused. Specifically, firms that can lower their emissions at the lowest costs will do so and trade their pollution rights to firms that cannot reduce their pollution levels as easily. That is, each polluter—required either to reduce pollution to the level allowed by the number of rights it holds or buy more rights—will be motivated to eliminate all pollution that is cheaper than the price of pollution rights. The crucial advantage to the pollution rights approach comes from the fact that the rights are private property and can be sold.

transferable pollution rights

a right given to a firm to discharge a specified amount of pollution; its transferable nature creates incentive to lower pollution levels



What is the advantage to the pollution rights approach?

It is worth emphasizing that this least-cost pattern of abatement does not require any information about the techniques of pollution abatement on the part of the government—more specifically, the EPA. The EPA does not need to know the cheapest abatement strategy for each and every polluter. Faced with a positive price for pollution rights, each polluter has every motivation to discover and use the cheapest way to reduce pollution. Nor does the EPA need to know anything about the differences in abatement costs among polluters. Each polluter is motivated to reduce pollution as long as the cost of reducing one more unit is less than the price of pollution rights. The information and incentives generated by private ownership and market exchange of these pollution rights automatically leads to the desirable pattern of pollution.

The pollution rights approach also creates an incentive for polluters to develop improved pollution abatement technologies.

The prospect of buying and selling pollution permits would allow firms to move into an area that is already as polluted as allowed by EPA standards. Under the tradeable permits policy, the firm can set up operation by purchasing pollution permits from an existing polluter in the area. This type of exchange allows the greatest value to be generated with a given amount of pollution. It also encourages polluters to come up with cheaper ways of reducing pollution, because the firm that reduces pollution is able to sell its pollution credits to others, making pollution reduction profitable.



LARRY GOLDSTEIN/GETTY IMAGES

Pulp and paper mills pollute our environment. The pulp and paper industry is one of the largest and most polluting industries in North America. One of the primary environmental concerns is the use of chlorine-based bleaches and resultant toxic emissions to air, water, and soil.

SECTION QUIZ

- Taxes on the emissions of polluting firms are primarily intended to
 - encourage firms to reduce product prices.
 - encourage firms to increase production of output.
 - raise revenue for general spending needs.
 - encourage firms to pollute less.
- An ideal pollution tax
 - does not affect the quantity of the good produced.
 - forces a firm to internalize the externality.
 - causes a polluting firm to increase production to the socially efficient level of output.
 - leads to a reduction in price to the consumer of the polluting firm's output.
- If compliance standards are too stringent,
 - the marginal social benefit of pollution reduction may outweigh the marginal social cost of pollution reduction.
 - the marginal social cost of pollution reduction may outweigh the marginal social benefit of pollution reduction.
 - the marginal social cost of pollution reduction will just equal the marginal social benefit from pollution reduction.
 - none of the above is correct.
- An advantage that emission taxes and tradable emissions permits have over compliance standards is that the former
 - work well even if pollution output cannot be accurately measured.
 - result in equal levels of pollution abatement across all firms.
 - make it in the interests of firms to reduce pollution in the most efficient manner possible.
 - reduce pollution to zero.

(continued)

SECTION QUIZ (Cont.)



5. Which of the following is *not* an advantage of transferable pollution rights?
- They create incentives for polluters to develop cheaper ways to reduce pollution.
 - They allow the greatest value of output to be produced with a given amount of pollution.
 - They require polluters to reduce emissions, regardless of the cost.
 - The rights are private property and may be bought or sold freely.
-
- How does pollution control lead to both rising marginal costs and falling marginal benefits?
 - How is the optimal amount of pollution control determined, in principle?
 - How do command and control policies act to internalize external costs?
 - How could transferable pollution rights lead to pollution being reduced at the lowest possible opportunity cost?
 - What are the objectives of an ideal pollution control policy from the perspective of economists interested in resource allocation?

Answers: 1. d 2. b 3. b 4. c 5. c

8.3

Property Rights and the Environment

📁 What is the relationship between externalities and property rights?

📁 What is the Coase theorem?

The existence of externalities and the efforts to deal with them in a manner that will enhance the social good can be considered a question of the nature of property rights. If the EPA limits the soot that a steel company emits from its smokestack, then the property rights of the steel company with respect to its smokestack have been altered or restricted. Similarly, zoning laws restrict how property owners can use their property. Sometimes, to deal with externalities, governments radically alter arrangements of property rights.

Indeed, the entire matter of dealing with externalities ultimately evolves into a question of how property rights should be altered. If no externalities existed in the world, reasons for prohibiting property owners from using their property in any manner they voluntarily chose would be few. Ultimately, then, externalities involve an evaluation of the legal arrangements under which we operate our economy and thus illustrate one area where law and economics merge.



What is the Coase theorem?

Coase theorem

where property rights are defined in a clear-cut fashion, and externalities are internalized if transaction costs are low

The Coase Theorem

In a classic paper, Nobel laureate Ronald Coase observed that when the benefits are greater than the costs for some course of action (say, environmental cleanup), potential transactions can make some people better off without making anyone worse off. This idea is known as the **Coase theorem**. To appreciate this important insight, consider the following problem: A cattle rancher lives downstream from a paper mill. The paper mill dumps waste into the stream, which injures the rancher's cattle. If the rancher is not compensated, an externality exists.

Suppose the courts have established (perhaps because the paper mill was there first) that the property rights to use (or abuse) the stream reside with the mill. If the benefits of cleanup are greater than the costs, the rancher should be willing to pay the mill owner to

stop polluting. Let's assume that the rancher's benefits (say \$10,000) from the cleanup undertaken by the mill are greater than the cost (say \$5,000). If the rancher were to offer \$7,500 to the mill owner to clean up the stream, both the rancher and the mill owner would be better off than with continued pollution. If, on the other hand, the rancher had the property rights to the stream, and the mill owner received a sufficiently high benefit from polluting the river, then it would be rational for the mill owner to pay the rancher up to the point where the marginal benefit to the mill owner of polluting equaled the marginal damage to the rancher from pollution.

Transaction Costs and the Coase Theorem

The mill owner and rancher example hinges critically on low transaction costs. Transaction costs are the costs of negotiating and executing an exchange, excluding the cost of the good or service bought. For example, when buying a car, it is usually rational for the buyer to spend some time searching for the "right" car and negotiating a mutually agreeable price.

Suppose instead that the situation involved 1,000 ranchers and 10 mill owners. Trying to coordinate the activity between the ranch owners and mill owners would be almost impossible. Now imagine the complexities of more realistic cases: 12 million people live within 60 miles of downtown Los Angeles. Each of them is damaged a little by a large number of firms and other individuals (for example, automobile drivers) in Los Angeles.

It thus becomes apparent why the inefficiencies resulting from pollution control are not eliminated by private negotiations. First is the issue of ambiguity regarding property rights in air, water, and other environmental media. Firms that have historically polluted resent controls, giving up their rights to pollute only if bribed, yet consumers feel they have the right to breathe clean air and use clean bodies of water. These conflicting positions must be resolved in court, with the winner being, of course, made wealthier. Second, transaction costs increase greatly with the number of transactors, making it next to impossible for individual firms and citizens to negotiate private agreements. Finally, the properties of air or water quality (and similar public goods) are such that additional people can enjoy the benefits at no additional cost and cannot be excluded from doing so. Hence, in practice, private agreements are unlikely to solve many problems of market failure.

It is, however, too easy to jump to the conclusion that governments should solve any problems that cannot be solved by private actions. No solution may be possible, or all solutions may involve costs that exceed benefits. In any event, the ideas developed in this chapter should enable you to think critically about such problems and the difficulties in formulating appropriate policies.



COURTESY OF ROBERT L. SEXTON

If a rancher lives downstream from a polluting factory and the courts have given the rights to the factory to pollute, economists say that the property rights to pollute are well defined. However, the rancher may be able to negotiate privately and pay the polluting firm to reduce the amount of pollution—and make both parties better off.

SECTION QUIZ

1. According to the Coase theorem, one way to deal with an externality problem when transaction costs are low is
 - a. for the government to impose pollution taxes.
 - b. for the government to make certain that property rights are well-defined.
 - c. for the government to issue transferable pollution permits.
 - d. for the government to impose compliance standards.

(continued)

SECTION QUIZ (Cont.)



2. The Coase theorem suggests that private solutions to externality problems
 - a. can lead to an optimal allocation of resources if private parties can bargain at relatively low cost.
 - b. result in the efficient outcome under all conditions.
 - c. will result in the same distribution of wealth no matter how property rights are assigned.
 - d. will result in different efficiency levels of production, depending crucially on how property rights are assigned.
3. In the case of a private solution to the externality problem, the distribution of rights
 - a. restricts the ability of private parties to properly price the externalities.
 - b. enhances the market incentive to reach an efficient solution.
 - c. determines who bears the cost of the solution but does not affect the efficient result.
 - d. affects the efficiency of the outcome, but does not determine who bears the cost.
4. Pollution reduction will be achieved for the least cost when
 - a. large polluters are required to reduce pollution by a greater extent than small polluters.
 - b. small polluters are required to reduce pollution by a greater extent than large polluters.
 - c. all firms are required to reduce pollution by a proportionate amount.
 - d. all firms are required to reduce pollution by an equal absolute amount.
 - e. the cost of reducing pollution by an additional unit is the same for all polluting firms.

1. Why can externalities be considered a property rights problem?
2. Why, according to the Coase theorem, will externalities tend to be internalized when property rights are clearly defined and information and transaction costs are low?
3. How do transaction costs limit the market's ability to efficiently solve externality problems?

Answers: 1. b 2. a 3. c 4. e

8.4

Public Goods



What is a public good? Is it any good that is purchased by the government?

public good

a good that is nonrivalrous in consumption and nonexcludable

private good

a good with rivalrous consumption and excludability

- ☞ What is a public good?
- ☞ What is the free-rider problem?
- ☞ Why does the government provide public goods?

- ☞ What is a common resource good?
- ☞ What is the tragedy of the commons?

Private Goods versus Public Goods

Externalities are not the only culprit behind resource misallocation. A **public good** is another source of market failure. As used by economists, this term refers not to how these particular goods are purchased—by a government agency rather than some private economic agent—but to the properties that characterize them. In this section, we learn the difference between private goods, public goods, and common resources.

Private Goods

A **private good** such as a cheeseburger has two critical properties in this context; it is rival and excludable. First, a cheeseburger is rival in consumption because if one person eats a particular cheeseburger, nobody else can eat the same cheeseburger. Second, a cheeseburger

is excludable. It is easy to keep someone from eating your cheeseburger by not giving it to him. Most goods in the economy, like food, clothing, cars, and houses are private goods that are rival and excludable.

Public Goods

The consumption of public goods, unlike private goods, is neither rival nor excludable. A public good is not rival because everyone can consume the good simultaneously; that is, one person's use of it does not diminish another's ability to use it. A public good is likewise *not excludable* because once the good is produced, it is prohibitively costly to exclude anyone from consuming the good. Consider national defense. Everyone enjoys the benefits of national defense (not rival) and it would be too costly to exclude anyone from those benefits (not excludable). That is, once the military has its defense in place, everyone is protected simultaneously (not rival) and it would be prohibitively costly to exclude anyone from consuming national defense (not excludable).

Another example of a public good is a flood control project. A flood control project would allow all the people who live in the flood plain area to enjoy the protection of the new program simultaneously (not rival). It would also be very difficult to exclude someone who lived in the middle of the project who said she did not want to pay (not excludable).

Public Goods and the Free-Rider Problem

The fact that a public good is not rival and not excludable makes the good difficult to produce privately. Some would know they could derive the benefits from the good without paying for it, because once it is produced, it is too difficult to exclude them. Some would try to take a *free ride*—derive benefits from something they did not pay for. Let's return to the example of national defense. Suppose the private protection of national defense is actually worth \$100 to you. Assume that 100 million households in the United States are willing to make a \$100 contribution for national defense. These contributions would add up to \$10 billion. You might write a check for \$100, or you might reason as follows: "If I don't give \$100 and everybody else does, I will be equally well protected plus derive the benefits of \$100 in my pocket." Taking the latter course represents a rational attempt to be a **free rider**. The rub is that if everyone attempts to take a free ride, the ride will not exist.

The free-rider problem prevents the private market from supplying the efficient amounts of public goods. That is, no private firm would be willing to supply national defense because people can consume it without paying for it—the free rider problem. Therefore, the government provides important public goods such as national defense.

The Government and Benefit-Cost Analysis

Everything the government provides has an opportunity cost. What is the best level of national defense? More national defense means less of something else that society may value more, like



STOCKTREK/GETTY IMAGES

Voters may disagree on whether we have too much or too little, but most agree that we must have national defense. If national defense were provided privately and people were asked to pay for the use of national defense, many would be free riders, knowing they could derive the benefits of the good without paying for it. For this reason, the government provides important public goods, such as national defense.



Public goods provide benefits to more than one person at a time, and their use cannot be restricted to only those people who have paid to use them.

free rider
deriving benefits from something not paid for



LOWE LLAGUNO/SHUTTERSTOCK.COM

Is busking, or street entertaining, a public good? The nonpaying public can benefit so you have a free rider problem. It is difficult to exclude someone from the pitch (where buskers play). However, if the street entertainers are really good, it is possible that local vendors will pay them because they may attract customers. Did you know busking has been around since the Roman Empire?



If an outdoor firework program is not rival, and not excludable, is it a public good? How about a tornado siren in a small town?

TARAS VYSHNYA/SHUTTERSTOCK.COM

health care or Social Security. To be efficient, additional goods from the public sector must also follow the rule of rational choice—pursue additional government activities if and only if the expected marginal benefits exceed the expected marginal costs. It all comes back to the adage—there are no free lunches.

In addition, there is also the problem of assessing the value of these goods. Consider the case of a new highway. Before it builds the highway, the appropriate government agency will undertake a benefit-cost analysis of the situation. In this case, it must evaluate consumers' willingness to pay for the highway against the costs that will be incurred for construction and maintenance. However, those individuals who want the highway have an incentive to exaggerate their desire for it. At the same time, individuals who will be displaced or otherwise harmed by the highway have an incentive to exaggerate the harm that will be done to them. Together, these elements make it difficult for the government to accurately assess benefits and costs.

Ultimately, their evaluations are reduced to educated guesses about the net impact, weighing both positive and negative effects, of the highway on all parties concerned.

Common Resources and the Tragedy of the Commons

In many cases we do not have exclusive private property rights to things such as the air around us or the fish in the sea. They are common resources—goods that are owned by everyone and therefore not owned by anyone. When a good is not owned by anyone, individuals feel little incentive to conserve or use the resource efficiently.

A **common resource** is a rival good that is nonexcludable; that is, nonpayers cannot be easily excluded from consuming the good, and when one unit is consumed by one person, it means that it cannot be consumed by another. Fish in the vast ocean waters are a good example of a common resource. They are rival because fish are limited—a fish taken by one person is not available for others. They are nonexcludable because it is prohibitively costly to keep anyone from catching them—almost anyone with a boat and a fishing rod could catch one. Common resources can lead to the tragedy of the commons. This is the case of private incentives failing to provide adequate maintenance of of public resources.

Other examples of common resources where individuals have relatively free access and the resources can be easily exploited are congested roads and the Internet. “Free” way is a misnomer. No one owns the space on the freeway. Because there are no property rights to the freeway, you cannot exclude others from driving on and sharing the freeway. When you occupy a part of the freeway, you are keeping others from using that portion. So, all drivers compete for limited space, causing a negative externality in the form of congestion.

The Internet poses a similar problem. If everyone attempts to access the same website at the same time, overcrowding occurs and congestion can cause the site to slow down.

There are two possible solutions to the common property rights problem. First, the government, through taxes and fees, can attempt to internalize the externality. To prevent road congestion, the government could charge drivers a toll—a corrective tax on congestion—or it could charge higher tolls on bridges during rush hour. A gasoline tax would be an inferior policy solution because while it would reduce driving, it would not necessarily reduce driving during peak periods. Similarly, the government can charge fees to reduce congestion in national parks during peak periods. They can have restrictions through licensing on hunting and fishing to control animal populations.

Second, the government could assign private property rights to common resources. For example, private fish farms have become more profitable as overfishing depletes the stock of fish in open waters.

common resource
a good that is rival in consumption and non excludable

EGS
economic
content
standards

Governments provide an alternative method to markets for supplying goods and services when it appears that the benefits to society of doing so outweigh the costs to society. Not all individuals will bear the same costs or share the same benefits of those policies.

A government policy to correct a market imperfection is not justified economically if the cost of implementing it exceeds its expected benefits.

ERIC ISSELÉE/SHUTTERSTOCK.COM



Poachers in Africa hunt elephants for their tusks. Where no one owns them, allowing owners to capture both the benefits and the costs from them, elephants roam free and they are treated as a common resource. Poachers are numerous in those places and each poacher has an incentive to kill as many elephants as possible to get their tusks before someone else does. Kenya is one example, where, since 1975, the elephant population in Kenya has fallen from 170,000 to 30,000. On the other hand, the elephant population in Zimbabwe has increased from 20,000 to over 100,000 over the same period. Why? Zimbabwe allows safari hunting on private property, allowing effective ownership of the elephants on that property and providing the ability to protect its herds against poachers and the incentive to efficiently manage its herds.

SECTION QUIZ

1. The market system fails to provide the efficient output of public goods because
 - a. people place no value on public goods.
 - b. private firms cannot restrict the benefits from those goods to consumers who are willing to pay for them.
 - c. public enterprises can produce those goods at lower cost than private firms.
 - d. public goods create widespread spillover costs.
2. Public goods, like national defense, are usually funded through government because
 - a. no one cares about them, because they are public.
 - b. it is prohibitively difficult to withhold national defense from someone unwilling to pay for it.
 - c. they cost too much for private firms to produce them.
 - d. they provide benefits only to individuals, and not firms.
3. A public good is both _____ in consumption and _____.
 - a. nonrivalrous; exclusive
 - b. nonrivalrous; nonexclusive
 - c. rivalrous; exclusive
 - d. rivalrous; nonexclusive
4. Public goods
 - a. do not need to be produced by government.
 - b. are subject to the free rider problems.
 - c. tend to be underproduced in the marketplace.
 - d. All of the above are true.
5. A common resource
 - a. is rivalrous in consumption.
 - b. is nonexcludable.
 - c. can lead to the tragedy of the commons.
 - d. All of the above are true.

(continued)

SECTION QUIZ (Cont.)



1. How are public goods different from private goods?
2. Why does the free-rider problem arise in the case of public goods?
3. In what way can government provision of public goods solve the free-rider problem?
4. What is a common resource?
5. What is the tragedy of the commons?

Answers: 1. b 2. b 3. b 4. d 5. d

8.5

Asymmetric Information

What is asymmetric information?

What is moral hazard?

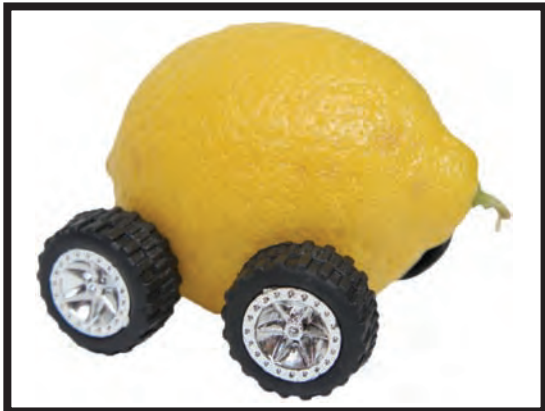
What is adverse selection?

What Is Asymmetric Information?

asymmetric information
when the available information is initially distributed in favor of one party relative to another in an exchange

When the available information is initially distributed in favor of one party relative to another, **asymmetric information** is said to exist. Suppose you just bought a used car that had 3,000 miles on the odometer. The car was in pristine shape—no dents, no scratches, good tires and so on. Would you be willing to pay close to the same price for this car as you would for a new car (same model, same accessories) from the dealer? Probably not, because you are going to suspect that something is wrong with the car.

Sellers are at an information advantage over potential buyers when selling a used car because they have more information about the car than does the potential buyer. However, potential buyers know that sellers are more likely to sell a lemon. As a result, potential buyers will offer a lower price than they would if they could be certain of the quality. This is known as the lemon problem. Without incurring significant quality detection costs, such as having it inspected by a mechanic, the potential buyer is at an informational disadvantage relative to the seller. It is rational for the seller to claim that the car is in good shape and has no known defects, but the potential buyer cannot detect whether the car is a lemon or not without incurring costs. If the quality detection costs are sufficiently high, a solution is to price all used cars as if they are average quality. That is, used cars of the same year, make, and model generally will be offered at the same price, regardless of their known conditions. The seller of a lemon will then receive a payment that is more than the car is worth, and the seller of a relatively high-quality car will receive less than the car is worth. However, if a seller of a high-quality car does *not* receive what the car would sell for if the potential buyer knew its quality, the seller will rationally withdraw the offer to sell the car. Given the logical response of sellers of higher-than-average quality



Because the seller of a car has more information than the buyer has, the potential buyer does not know whether the car is a cherry or a lemon. So the buyer guesses the car is average quality and consequently he offers an average price. The owner of a carefully maintained, good used car will be unable to get a high enough price to make selling that car worthwhile. Consequently, owners of good cars will not place their cars on the used car market. But those with cars of less than average quality will dump their cars on the market. Hence, the lemon problem.

cars, the average quality of used cars on the market will fall, and consequently, many people will avoid buying in the used-car market. In other words, the bad cars will drive the good cars out of the market. Thus, fewer used cars are bought and sold because fewer good cars are offered for sale. That is, information problems reduce economic efficiency. A situation where an informed party benefits in an exchange by taking advantage of knowing more than the other party is called **adverse selection**.

This distortion in the used-car market resulting from adverse selection can be reduced by the buyer acquiring more information so that the buyer and seller have equal information. In the used-car example, it might mean that an individual buyer would demand that an independent mechanic do a detailed inspection of the used car or that the dealership provide an extended warranty. A warranty provides a credible signal that this dealer is not selling lemons. In addition, new services such as carfax.com allow you to pay to find the history of a used car before you buy it. These services help eliminate the adverse selection problem because buyers have more information about the product they are buying.

The least-cost solution would have sellers reveal their superior information to potential buyers. The problem is that it is not individually rational for the seller to provide a truthful and complete disclosure, a point that is known by a potential buyer. Only if the seller is punished for not truthfully revealing exchange-relevant information will a potential buyer perceive the seller's disclosure as truthful.

Adverse selection also occurs in the insurance market. Imagine an auto insurance company that has a one-size-fits-all policy for its insurance premiums. Careful drivers would be charged the same premium as careless drivers. The company would assess the average risk of accidents for all drivers and then set the premium. Of course, this would be very appealing to careless drivers, who are more likely to get in an accident, but not very appealing to careful drivers, who have a much lower probability of getting in an accident. Under this pricing scheme, the bad drivers would drive the good drivers out of the market. Good drivers would be less likely to buy a policy, thinking that they are paying too much, since they are less likely to get in an accident than a careless driver. Many good drivers would exit the market, leaving a disproportionate share of bad drivers—exactly what the insurance companies do not want—people with a higher risk of getting in accidents. So what do they do?

Insurance companies set premiums according to the risk associated with particular groups of drivers, so good drivers do not exit the market. One strategy they use for dealing with adverse selection is called *screening*, where they use observable information about people to reveal private information. For example, a 17-year-old male driving a sports car will be charged a much higher premium than a 40-year-old female driving a minivan, even if he is a careful driver. Or someone with a good driving record or good grades gets a discount on his insurance. Insurance companies have data on different types of drivers and the probability of those drivers being in accidents, and they use these data to set insurance premiums. They may be wrong on an individual case (the teenager may be accident-free for years), but they are likely to be correct on average.

Reputation and Standardization

Asymmetric information is also present in other markets like rare stamps, coins, paintings, and sports memorabilia where the dealer (seller) knows more about the product than does the potential buyer. Potential buyers want to be assured that these items are authentic, not counterfeits. Unless the seller can successfully provide evidence of the quality of the product, bad products will tend to drive good products out of the market, resulting in a market failure.

adverse selection

a situation where an informed party benefits in an exchange by taking advantage of knowing more than the other party



AP PHOTO/CP, AARON HARRIS

When players get traded from one team to another, a potential asymmetric information and adverse selection problem occurs—especially with pitchers. The team that is trading the pitcher knows more about his medical past, his pitching mechanics, his demeanor on and off the field, and so on, than the team that is trading for him. Even though trades are not finalized until the player passes a physical, many ailments or potential problems may go undetected.



When confronted with the choice between a little known motel and a reputable hotel chain, like Holiday Inn or Hilton, you may pick the national chain because of its reputation.

One method that sellers can use to convince potential buyers that their products are high quality is *reputation*. For example, if a supermarket has a reputation of selling fresh produce, you are more likely to shop there. The same is true when you choose an electrician, plumber, or physician. In the used car market, the dealer might advertise how long he has been in business. This provides a signal that he has many satisfied customers. Therefore, he is likely to sell more used cars. In short, if there is a reputation of high quality, it will minimize the market failure problem.

However, there may be cases where it is difficult to develop a reputation. For example, take a restaurant or a motel on a desolate highway. These establishments may not receive repeat customers. Customers have little idea of the quality of food, the probability of bedbugs, and so on. In this case, *standardization* is important.

Asymmetric Information and Job Market Signaling

Why does non-job-related schooling raise your income? Why would salaried workers work longer hours—putting in 60 to 70 hours a week? The reason is this behavior provides a useful signal to the employer about the person's intelligence and work ethic.

Signaling is important because it reduces information costs associated with asymmetric information; the seller of labor (potential employee) has more information about her work ethic and reliability than the buyer of labor (potential employer). Imagine how costly it would be to try out 150 potential employees for a job. In short, signals provide a measure that can help reduce asymmetric information and lower hiring costs.

There are strong signals and weak signals. Wearing a nice suit to work would be a weak signal because it does not necessarily distinguish a highly productive worker from a less productive worker—a less productive worker can dress well too. To provide a strong signal, it must be harder for a low productivity worker to give the signal than a high productivity worker. Education is a strong signal in labor markets because it requires achievements that many low productivity workers may find too difficult to obtain. The education signal is also relatively easy to measure—years of education, grade point average, highest degree attained, reputation of the university of college, rigor of courses attempted, and so on. Education can clearly improve a person's productivity; even if it did not, however, it would be a useful signal because more productive people find it easier to obtain education than lazy people. Furthermore, productive people are more likely to attain more education in order to signal to their employer that they are productive. So it may not just be the knowledge obtained from a college education, it may be the effort that you are signaling—something you presumably already had before you entered college. So according to the signaling model, workers go to college, not for the knowledge gained, but to send the important signal that they are highly productive.

In all likelihood, education provides knowledge and enhances productivity. However, it also sends an important signal. For example, many firms will not hire managers without an MBA because of the knowledge potential employees gained in courses like finance and economics, but also because an MBA sends a powerful signal that the worker is disciplined and hard working.

Durable Goods, Signals, and Warranties

Why are people reluctant to buy durable goods like televisions, refrigerators, and cameras without a warranty? Warranties are a signal. Honest and reliable firms find it less expensive to provide a warranty than dishonest firms do. The dilemma for consumers is that they are trying to distinguish the good brands from the bad brands. One way to do this is to see what kind of warranty the producer offers. Low-quality items would require more frequent and expensive servicing than high-quality items. Thus, producers of low-quality items will tend

to not offer extensive warranties. In short, extensive warranties signal high quality, while low-quality items without extensive warranties signal poor quality. With this knowledge, consumers will pay more for high-quality products with good warranties.

What Is Moral Hazard?

Another information problem is associated with the insurance market and is called moral hazard. If an individual is fully insured for fire, theft, auto, life, and so on, what incentives will this individual have to take additional precautions from risk? For example, a person with auto insurance may drive less cautiously than would a person without auto insurance.

Insurance companies do, however, try to remedy the adverse selection problem by requiring regular checkups, discounts for nonsmokers, charging different deductibles and different rates for different age and occupational groups, and so on.

Additionally, those with health insurance may devote less effort and resources to staying healthy than those who are not covered. The problem, of course, is that if the insured are behaving more recklessly than they would if they were not insured, the result might be much higher insurance rates. The **moral hazard** arises from the fact that it is costly for the insurer to monitor the behaviors of the insured party. Suppose an individual knew that his car was protected with a “bumper-to-bumper” warranty. He might have less incentive to take care of the car, despite the manufacturer’s contract specifying that the warranty was only valid under “normal wear and tear.” It would be too costly for the manufacturer to detect if a product failure was the consequence of a manufacturing defect or the abuse of the owner-user.

Adverse Selection versus Moral Hazard

Don’t confuse adverse selection and moral hazard. Adverse selection is the phenomenon that occurs when one party in the exchange takes advantage of knowing more than the other party. Moral hazard involves the action taken *after* the exchange, such as if you were a nonsmoker who had just bought a life insurance policy and then started smoking heavily.

Winner’s Curse

Suppose you and five other classmates were asked to bid on a jar of pennies. Nobody knows how many pennies are in the jar and you are not allowed to open the jar. The winner gets the jar of pennies. Let’s say there are 500 pennies (\$5) in the jar and you win by bidding \$7. You are happy you won the bid until they count the pennies and you realize you just paid \$7 for \$5 worth of pennies. A common-value auction is where the auctioned item has the same value for all buyers but the value is unknown prior to the bidding. We call this a **winner’s curse** because in this case the “winner” is overly optimistic and bids more for an item than its worth. Therefore, the winner could end up being worse off (cursed) than the loser.

The problem also occurs because value is subjective. In some cases bidders have a difficult time establishing an item’s value. Without complete information, participants with limited skill in establishing valuation may overpay for an item. Historically, we have seen this when speculative bubbles in the stock or real estate markets occur. In such cases, investors with little skill in valuation and incomplete information tend to push prices beyond their true value.

However, an actual overpayment will generally occur only if the winner fails to account for the winner’s curse when bidding. So despite its dire-sounding name, the winner’s curse does not necessarily have ill effects.

The severity of the winner’s curse tends to increase with the number of bidders. This is because the more bidders, the more likely it is that some of them have overestimated the auctioned item’s value. The more serious your

moral hazard

taking additional risks because you are insured, thus lowering the cost to you of taking those risks



Does the winner’s curse apply to all auctions?

winner’s curse

a situation that arises in certain auctions where the winner is worse off than the loser because of an overly optimistic value placed on the good



Bid on this jar of pennies and you may get it. Winners will often be overeager to win and overbid. In the winner’s curse, the most optimistic buyer wins, but may overpay as a result, leaving the winner worse off.

error of overbidding, the more likely you are to win. However, if you win you probably made a serious error. The best strategy may be to underbid. If the winner normally overestimates the true value by 20 percent then you might offer 80 percent of what you think the item is worth. That way, if you happen to win by overbidding you won't "get taken to the cleaners." You might also choose not to participate in auctions likely to generate a winner's curse.

There is often confusion that winner's curse applies to the winners of all auctions. However, it is worth repeating here that for auctions based on the private value someone places on a good (i.e., when the item is desired independent of its value in the market), the winner's curse does not arise.

The winner's curse can also occur with underbidding, where people offer to do a job for less than other bidders. Imagine you need to hire a landscaper, so you get estimates from various landscapers. Who is likely to win? Probably, the landscaper with the lowest estimate. However, he may not think he won if he underestimated the amount of work required in your yard.

SECTION QUIZ



1. Adverse selection refers to
 - a. the phenomenon that occurs when one party in an exchange takes advantage of knowing more than another party.
 - b. the tendency for individuals to alter their behavior once they are insured against loss.
 - c. the tendency for individuals to engage in insurance fraud.
 - d. both (b) and (c).
2. If, after you buy a car with air bags, you start to drive recklessly, it would be an illustration of
 - a. the moral hazard problem.
 - b. the free-rider problem.
 - c. the adverse selection problem.
 - d. the "lemon" problem.
3. In the market for insurance, the moral hazard problem leads
 - a. those most likely to collect on insurance to buy it.
 - b. those who buy insurance to take fewer precautions to avoid the insured risk.
 - c. those with more prior insurance claims to be charged a higher premium.
 - d. to none of the above.
4. The winner's curse
 - a. is more likely the fewer the bidders.
 - b. is more likely the more frequently a good is purchased.
 - c. is more likely when a good is being purchased because of its expected future market value.
 - d. is a myth.

1. How do substantial warranties offered by sellers of used cars act to help protect buyers from the problem of asymmetric information and adverse selection? Why might too extensive a warranty lead to a moral hazard problem?
2. If where you got your college degree acted as a signaling device to potential employers, why would you want the school from which you graduated to raise its academic standards after you leave?
3. Why might withdrawals in several classes send a poor signal to potential employers?
4. Why is the winner's curse less likely for repeat-purchase items?

Answers: 1. a 2. a 3. b 4. c

Interactive Summary

Fill in the blanks:

1. Sometimes the market system fails to produce efficient outcomes because of side effects economists call _____.
2. Whenever an activity has physical impacts on individuals not directly involved in the activity, if the impact on the outside party is negative, it is called a _____; if the impact is positive, it is called a _____.
3. If a firm can avoid paying the external costs it imposes on others, it _____ its own costs of production but not the _____ cost to society.
4. If the government taxed a manufacturer by the amount of those external costs it imposes on others, it would force the manufacturer to _____ the costs.
5. The benefits of a product or service that spill over to an outside party not involved in producing or consuming the good are called _____.
6. If suppliers are unaware of or not responsible for the external costs created by their production, the result is a(n) _____ of scarce resources to the production of the good.
7. Because producers are unable to collect payments from all who are benefiting from the good or service, the market has a tendency to _____ goods with external benefits.
8. In the case of either external benefits or external costs, buyers and sellers are receiving the wrong signals: The apparent benefits or costs of some actions differ from the _____ benefits or costs.
9. Unlike the consumption of private goods, the consumption of public goods is both _____ and _____.
10. Pollution reduction, like other forms of production, is subject to _____ returns.
11. The marginal cost of pollution abatement _____ with increasing levels of abatement.
12. The optimal quantity of pollution is where the _____ of pollution abatement equals the _____ from pollution abatement.
13. Compliance standards should be stricter where the marginal benefit from pollution reduction is _____.
14. Eliminating nearly all pollution would be economically _____, because the marginal _____ would exceed the marginal _____.
15. The economically ideal tax to impose on a polluter would be _____ the marginal external costs imposed on others by its production.
16. Compared to compliance standards, pollution taxes lead to abatement by firms who can do so at the _____ cost.
17. The imposition of per-unit pollution taxes would likely be _____ costly than compliance standards for the same degree of pollution abatement.
18. Firms buy and sell rights to pollute under a system of _____ rights.
19. Transferable pollution rights _____ work when the EPA does not know the cheapest way for polluters to reduce their emissions, because they make it in polluters' interests to reduce pollution the cheapest way.
20. Under a system of transferable pollution rights, firms with high costs of abatement would likely be _____, and firms with low costs of abatement would be _____.
21. Problems of external costs are largely a question of how _____ should be assigned.
22. _____, the costs of negotiating and executing exchanges, must be low for well-defined property rights to allow externalities to be internalized.
23. According to the Coase theorem, markets can internalize externalities as long as _____ are well-defined and _____ costs are low.
24. When large numbers of individuals are affected by an external cost, the transaction costs of using voluntary negotiation to internalize it is likely to be _____.
25. If once a good is produced it is prohibitively costly to exclude anyone from consuming the good, consumption of that good is called _____.
26. If everyone can consume a good simultaneously, it is _____.
27. When individuals derive the benefits of a good without paying for it, it is called a(n) _____.
28. The government may be able to overcome the free-rider problem by _____ the public good and imposing taxes to pay for it.
29. Goods that are owned by everyone and therefore not owned by anyone are called _____ resources.
30. A common resource is a(n) _____ good that is _____.

31. Fish in the vast ocean are a good example of a(n) _____ resource.
32. The failure of private incentives to provide adequate maintenance of public resources is known to economists as the _____.
33. When the available information is initially distributed in favor of one party relative to another, _____ is said to exist.
34. The existence of _____ may give rise to signaling behavior.
35. When one party enters into an exchange with another party that has more information, we call it _____ selection.
36. A college education can provide a(n) _____ about a person's intelligence and perseverance.
37. Good warranties are an example of _____ behavior that takes place because the _____ may know the actual quality of durable goods better than the _____.
38. _____ arises from the cost involved for the insurer to monitor the behaviors of the insured party.
39. The _____ occurs when the winner of an auction overpays.
40. The winner's curse is less likely for items that are purchased _____/infrequently and where there is a larger/_____ number of bidders.

Answers: 1. externalities 2. negative externality; positive externality 3. lowers; true 4. internalize (bear) 5. positive externalities 6. overallocation 7. underproduce 8. true social 9. nonexcludable; nonrivalrous 10. diminishing 11. rises 12. marginal benefit; marginal cost 13. greater 14. inefficient; costs; benefits 15. equal to 16. lower 17. less 18. transferable pollution 19. can 20. buyers; sellers 21. property rights 22. Transaction costs 23. property rights; transaction 24. large 25. nonexcludable 26. nonrivalrous 27. free ride 28. providing 29. common 30. rival; nonexcludable 31. common 32. tragedy of the commons 33. asymmetric information 34. asymmetric information 35. adverse 36. signal 37. signaling; sellers; buyers 38. Moral hazard 39. winner's curse 40. frequently; smaller

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Section Quiz Answers

8.1 Externalities

1. Why are externalities also called spillover effects?

An externality exists whenever the benefits or costs of an activity impact individuals outside the market mechanism. That is, some of the effects spill over to those who have not voluntarily agreed to bear them or compensate others for them, unlike the voluntary exchange of the market.

2. How do external costs affect the price and output of a polluting activity?

If the owner of a firm that pollutes does not have to bear the external costs of pollution, she can ignore those real costs of pollution to society. The result is that the private costs she must pay are less than the true social costs of production, so that the market output of the polluting activity is greater, and the resulting market price less, than it would be

if producers did have to bear the external costs of production.

3. How can the government intervene to force producers to internalize external costs?

If the government could impose a tax or fee on producers equal to the external costs imposed on people without their consent, producers would have to take those costs into account. The result would be that those costs would no longer be external costs, but internalized by producers.

4. How do external benefits affect the output of an activity that causes them?

External benefits are benefits that spill over to others, because the party responsible need not be paid for those benefits. Therefore, some of the benefits of an activity to society will be ignored by the relevant decision makers in this case, and the result will be a smaller output and a higher price for goods that generate external benefits to others.

5. How can the government intervene to force external benefits to be internalized?

Just as taxes can be used to internalize external costs imposed on others, subsidies can be used to internalize external benefits generated for others.

6. Why do most cities have more stringent noise laws for the early morning and late evening hours than for during the day?

The external costs to others from loud noises in residential areas early in the morning and late in the evening are higher, because most residents are home and trying to sleep, than when many people are gone at work or are already awake in the daytime. Given those higher potential external costs, most cities impose more restrictive noise laws for nighttime hours to reduce them.

8.2 Public Policy and the Environment

1. How does pollution control lead to both rising marginal costs and falling marginal benefits?

The marginal costs of pollution control rise for the same reason it is true of other goods. Pollution will be reduced in the lowest cost manner first. Once lower cost pollution control methods are exhausted, if we wish to reduce pollution further, we will have to turn to progressively more costly methods. The marginal benefits from pollution controls will fall, because the value of reducing crud in the atmosphere is higher, the more crud there is. As controls reduce the level of crud in the air, the marginal benefit of further crud reductions will fall.

2. How is the optimal amount of pollution control determined, in principle?

In principle, the optimal amount of pollution control is the amount at which the marginal social benefit of pollution reduction equals the marginal cost of pollution reduction. But there is no clear agreement about what those marginal benefits or costs are, leading to disagreements about the optimal amount of pollution.

3. How do command and control policies act to internalize external costs?

By forcing companies to find less pollution-intensive ways of production rather than imposing the costs of additional pollution on others, they are forced to internalize those costs formerly imposed on others.

4. How could transferable pollution rights lead to pollution being reduced at the lowest possible opportunity cost?

Transferable pollution rights would create a market for pollution reduction. Every polluter would then find it profitable to reduce pollution as long as they could do it more cheaply than the price of a pollution right. Therefore, producers would employ the

lowest-cost pollution control methods for a given amount of pollution reduction.

5. What are the objectives of an ideal pollution control policy from the perspective of economists interested in resource allocation?

An ideal pollution control strategy from the perspective of economists interested in resource allocation would reduce pollution to the efficient level, it would do so at the lowest possible opportunity cost, and it would create incentives to motivate advances in pollution abatement technology.

8.3 Property Rights and the Environment

1. Why can externalities be considered a property rights problem?

If the rights to clean air, water, and so on, were clearly owned, those that infringe on those rights would be forced to compensate the owners. Such costs would be internalized, rather than external, to the relevant decision makers. Therefore, externalities are the result of the absence of clear and enforceable property rights in certain goods.

2. Why, according to the Coase theorem, will externalities tend to be internalized when property rights are clearly defined and information and transaction costs are low?

When property rights are clearly defined and information and transaction costs are low, whoever wants to exercise their right faces an opportunity cost of what others would pay for that right. That opportunity cost, represented by the potential payment from others to sell the right, is what forces decision makers to internalize what would otherwise be an externality.

3. How do transaction costs limit the market's ability to efficiently solve externality problems?

Transaction costs limit the ability of the market mechanism to internalize externalities, because trading becomes more difficult. The free-rider problem—where those who benefit from some action cannot be forced to pay for it—also hinders the ability for voluntary trade across markets to generate efficient levels of goods such as cleaner air.

8.4 Public Goods

1. How are public goods different from private goods?

Private goods are rival in consumption (we can't both consume the same unit of a good) and exclusive (nonpayers can be prevented from consuming the good unless they pay for it). Public goods are nonrival in consumption (more than one person can

consume the same good) and nonexclusive (nonpayers can't be effectively kept from consuming the good, even if they don't voluntarily pay for it).

2. Why does the free-rider problem arise in the case of public goods?

The free-rider problem arises in the case of public goods because people cannot be prevented from enjoying the benefits of public goods once they are provided. Therefore, people have an incentive not to voluntarily pay for those benefits, making it difficult or even impossible to finance the efficient quantity of public goods through voluntary market arrangements.

3. In what way can government provision of public goods solve the free-rider problem?

The government can overcome the free-rider problem by forcing people to pay for the provision of a public good through taxes.

4. What is a common resource?

A common resource good is rival in consumption but nonexcludable.

5. What is the tragedy of the commons?

Common resource goods often lead to overuse because if no one owns the resource, they are not likely to consider the cost of their use of the resource on others. This is the so-called tragedy of the commons. This problem has led to overfishing. Of course, you could remove the common and make the resource private property, but assigning private property rights to a vast ocean area would be virtually impossible.

8.5 Asymmetric Information

1. How do substantial warranties offered by sellers of used cars act to help protect buyers from the problem of asymmetric

information and adverse selection? Why might too extensive a warranty lead to a moral hazard problem?

In the used car market, the seller has superior information about the car's condition, placing the buyer at an information disadvantage. It also increases the chance that the car being sold is a "lemon." A substantial warranty can provide the buyer with valuable additional information about the condition of the car, reducing both asymmetric information and adverse selection problems.

Too extensive a warranty (e.g., an unlimited "bumper-to-bumper" warranty) will give the buyer less incentive to take care of the car because the buyer is effectively insured against the damage that lack of care would cause.

2. If where you got your college degree acted as a signaling device to potential employers, why would you want the school from which you graduated to raise its academic standards after you leave?

If an employer used your college's academic reputation as a signal of your likely "quality" as a potential employee, you want the school to raise its standards after you graduate, because it would improve the average quality of its graduates, improving the quality it signals about you to an employer.

3. Why might withdrawals in several classes send a poor signal to potential employers? It would indicate a failure to stick to difficult tasks relative to other students.

4. Why is the winner's curse less likely for repeat-purchase items?

Repeat purchases reveal good information on the actual value of items.

Problems

- Indicate which of the following activities create a positive externality, a negative externality, or no externality at all.
 - During a live theater performance, an audience member's cell phone loudly rings.
 - You are given a flu shot.
 - You purchase and drink a soda during a break from class.
 - A college fraternity and sorority clean up trash along a two-mile stretch on the highway.
 - A firm dumps chemical waste into a local water reservoir.
 - The person down the hall in your dorm plays loud music while you are trying to sleep.
- Draw a standard supply-and-demand diagram for televisions, and indicate the equilibrium price and output.
 - Assuming that the production of televisions generates external costs, illustrate the effect of the producers being forced to pay a tax equal to the external costs generated, and indicate the equilibrium output.
 - If instead of generating external costs, television production generates external benefits, illustrate the effect of the producers being given a subsidy equal to the external benefits generated, and indicate the equilibrium output.

3. For each of the following goods, indicate whether they are nonrival and/or nonexclusive. Indicate whether they are private or public goods.
 - a. hot dogs
 - b. cable TV
 - c. broadcast TV
 - d. automobiles
 - e. national defense
 - f. pollution control
 - g. parking in a parking structure
 - h. a sunset
 - i. admission to a theme park
4. Is a lighthouse a public good if it benefits many ship owners? What if it primarily benefits ships going to a port nearby?
5. Why do you think buffaloes became almost completely extinct on the Great Plains but cattle did not? Why is it possible that you can buy a buffalo burger in a store or diner today?
6. What kind of problems does the government face when trying to perform a cost-benefit analysis of whether or how much of a public project to produce?
7. How does a TV broadcast have characteristics of a public good? What about cable services such as HBO?
8. In order to get a license to practice in the United States, foreign-trained veterinarians must take an exam given by the American Veterinary Association. Only 48 people per year are allowed to take the exam, which is administered at only two universities. The fee for the exam, which must be booked at least 18 months in advance, was recently raised from \$2,500 to \$6,000. What effects does this clinical competency exam have on the number of veterinarians practicing in the United States? Do you think it improves the quality of veterinary services?
9. How would the adverse selection problem arise in the insurance market? How is it like the “lemon” used-car problem?
10. In terms of signaling behavior:
 - a. Why is wearing a suit a weaker signal of ability than higher educational achievement?
 - b. Why do some majors in college provide more powerful signals to future employers than others?
 - c. Why could double-majoring provide a more powerful labor market signal than having a single major?
 - d. How would you explain why students might be said to “overinvest” in grades as opposed to learning course material?
11. In terms of winner’s curse:
 - a. Why is the winner’s curse unlikely for frequently purchased goods?
 - b. Why would the winner’s curse be more likely as the number of bidders increases?
 - c. Why would we expect there to be no winner’s curse for goods desired for their own private value, unlike the case of purchases based on a good’s market value to others?
12. In terms of moral hazard:
 - a. Why does someone’s willingness to pay a large deductible on an insurance policy tell an insurer something valuable about the seriousness of the moral hazard problem they might expect from the policyholder?
 - b. Why does car insurance that explicitly excludes insuring the car for commercial use act to reduce moral hazard?
 - c. Why does vehicle insurance based in part on miles driven reduce moral hazard problems?
 - d. Why would a GPS monitor that can record the location and the speed a rental car is driven help reduce the moral hazard problem that rental companies are exposed to?