

Elasticities

- 6.1 Price Elasticity of Demand
- 6.2 Total Revenue and the Price Elasticity of Demand
- 6.3 Other Types of Demand Elasticities
- 6.4 Price Elasticity of Supply

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

price elasticity of demand

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

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

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.

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 ($E_D < 1$)

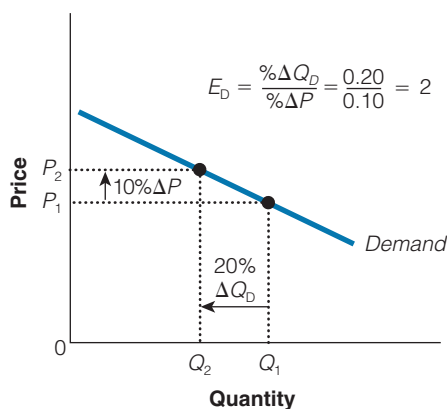
unit elastic demand

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

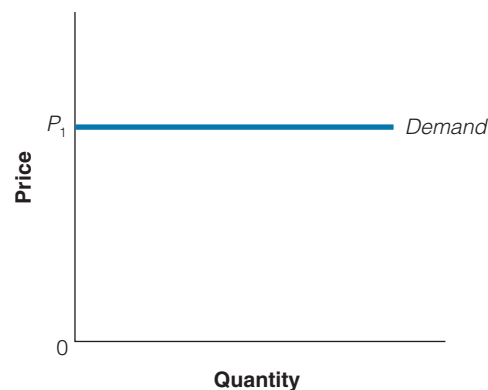
Elastic Demand

a. Elastic Demand ($E_D > 1$)

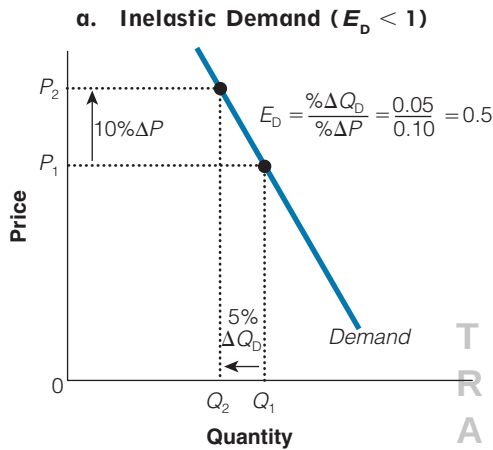


A small percentage change in price leads to a larger percentage change in quantity demanded.

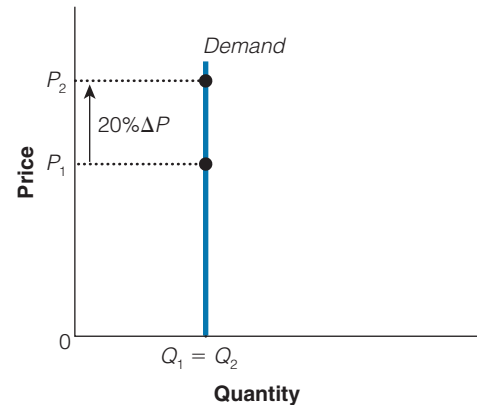
b. Perfectly Elastic Demand ($E_D = \infty$)



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.

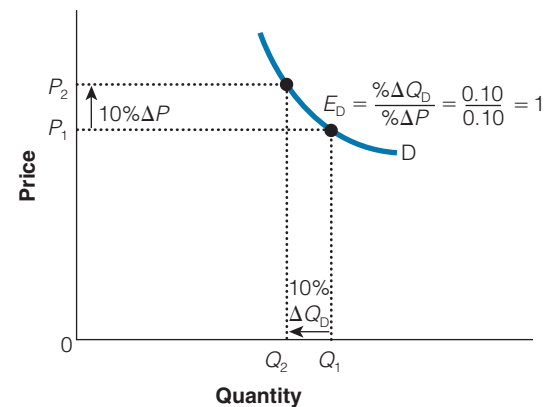
increase in price will lead to a 10 percent reduction in quantity demanded. This relationship is illustrated in Exhibit 3.

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


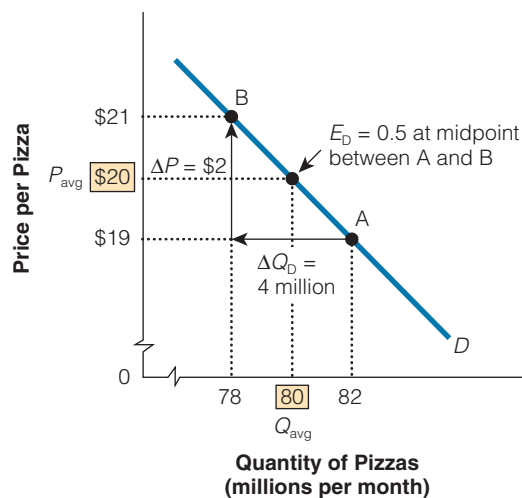
The percentage change in quantity demanded is the same as the percentage change in price that caused it ($E_D = 1$).



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

demand, 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



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.



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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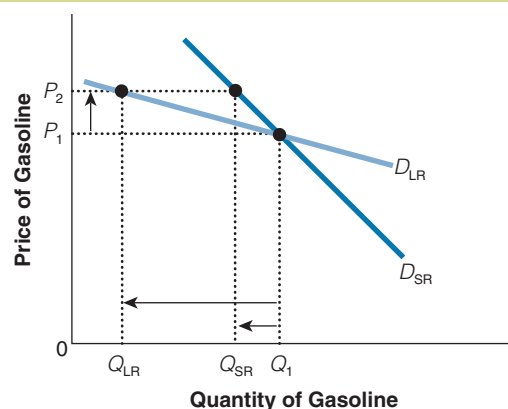


Some studies show that a 10 percent increase in the price of cigarettes will lead to a 7 percent reduction in the quantity demanded of youth smoking. In this price range, however, demand is still inelastic at -0.7 . Of course, proponents of higher taxes to discourage underage smoking would like to see 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 .

TRAVIS - KENDALL

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

Total Revenue and the Price Elasticity of Demand

6.2

What is total revenue?

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

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

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

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

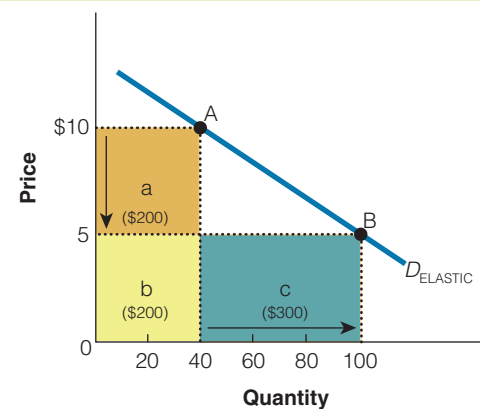
or

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

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

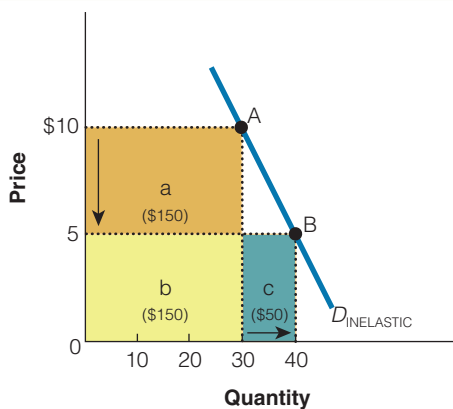


At point A, total revenue is \$400 (\$10 $\times$ 40 = \$400), or area a + b. If the price falls to \$5 at point B, the total revenue is \$500 (\$5 $\times$ 100 = \$500), or area b + c. Total revenue increased by \$100. We can also see in the graph that total revenue increased, because the area b + c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

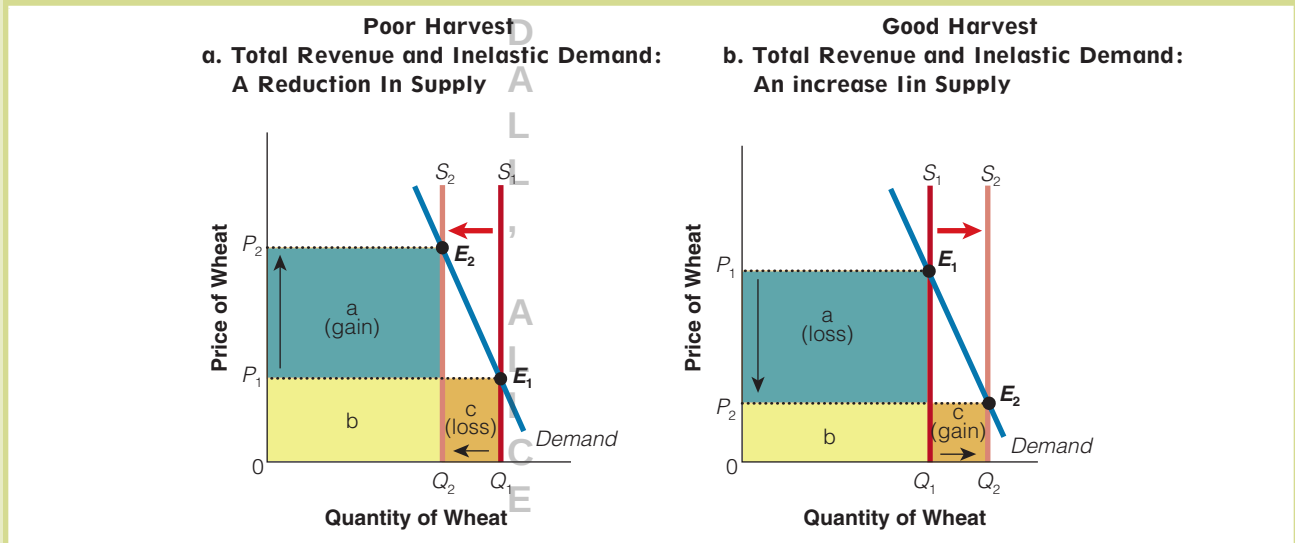
off; but collectively, farmers can profit from events that reduce crop size—and they do, because the demand for most agricultural products is inelastic. Interestingly, if all farmers were hurt equally, say losing one-third of their crop, each farmer would be better off. Of course, consumers would be 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

demanded 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

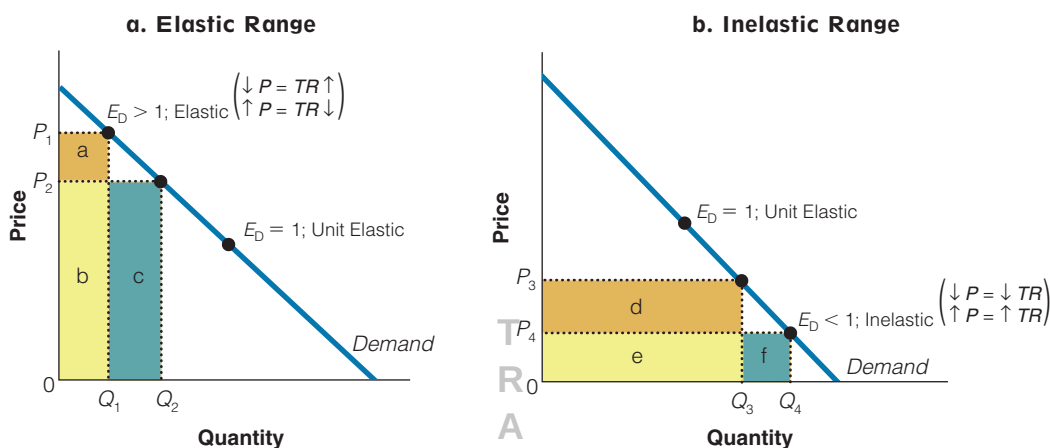


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revenue. Exhibit 4 shows a linear (constant slope) demand curve. In Exhibit 4(a), we see that when the price falls on the upper half of the demand curve from P_1 to P_2 , and quantity demanded increases from Q_1 to Q_2 , total revenue increases. That 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.

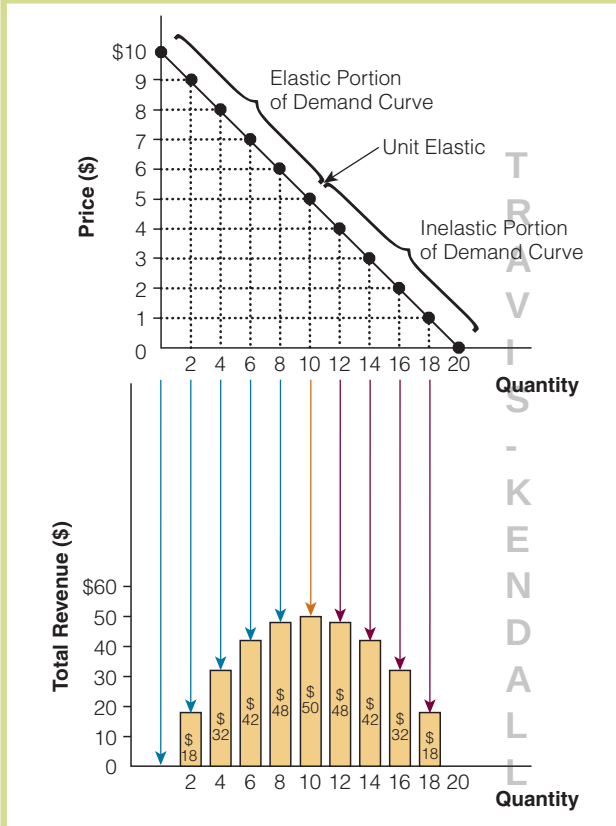
(continued)

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



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

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

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

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



- If the cross-price elasticity of demand between two goods is negative, we know that
 - they are substitutes.
 - they are complements.
 - they are both inferior goods.
 - they are both normal goods.
 - 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
 - both A and B are normal goods.
 - both A and B are inferior goods.
 - A is a normal good, but B is an inferior good.
 - A is an inferior good, but B is a normal good.
 - 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
 - X is a substitute for Y, and X is a normal good.
 - X is a substitute for Y, and X is an inferior good.
 - X is a complement for Y, and X is a normal good.
 - X is a complement for Y, and X is an inferior good.
 - Which of the following statements is true?
 - 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.
 - If the sign on the cross-price elasticity is positive, the two goods are substitutes; if it is negative, the two goods are complements.
 - The income elasticity of demand is the percentage change in demand divided by the percentage change in consumer's income.
 - If the income elasticity is positive, then the good is a normal good; if it is negative, the good is an inferior good.
 - All of the above are true statements.
-
- How does the cross-price elasticity of demand tell you whether two goods are substitutes? Complements?
 - How does the income elasticity of demand tell you whether a good is normal? Inferior?
 - 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?
 - 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)?
 - 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. d 2. a 3. d 4. e

Price Elasticity of Supply

6.4

What is the price elasticity of supply?

How does time affect the supply elasticity?

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

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.

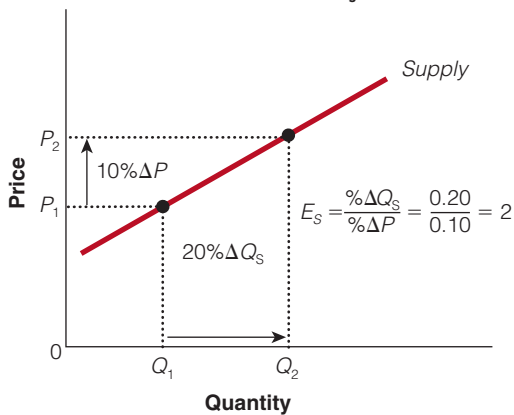
How Does Time Affect Supply Elasticities?

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

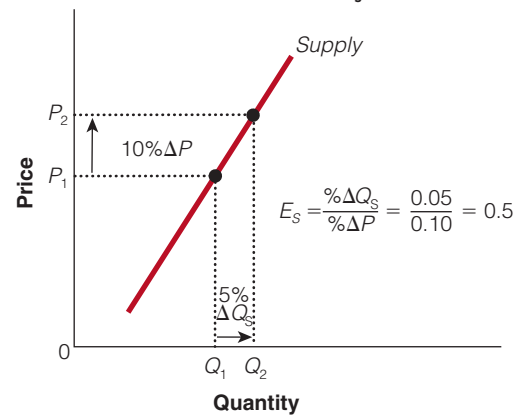
The Price Elasticity of Supply

a. Elastic Supply ($E_s > 1$)



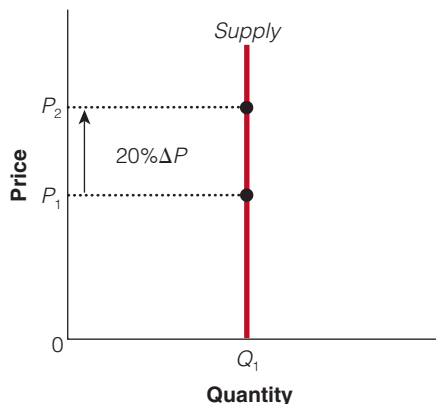
A change in price leads to a larger percentage change in quantity supplied.

b. Inelastic Supply ($E_s < 1$)



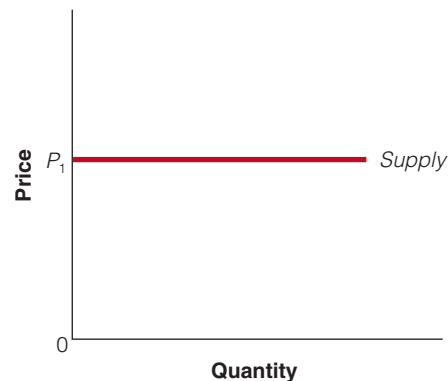
A change in price leads to a smaller percentage change in quantity supplied.

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.

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.

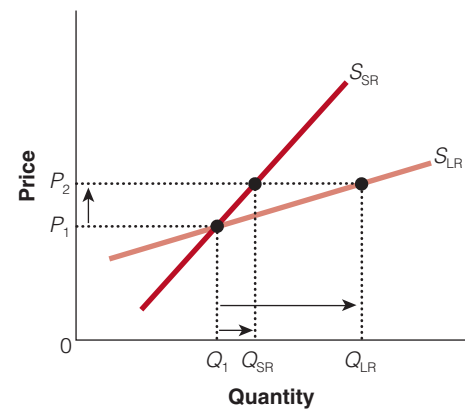
Yachts, Taxes, and Elasticities

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?



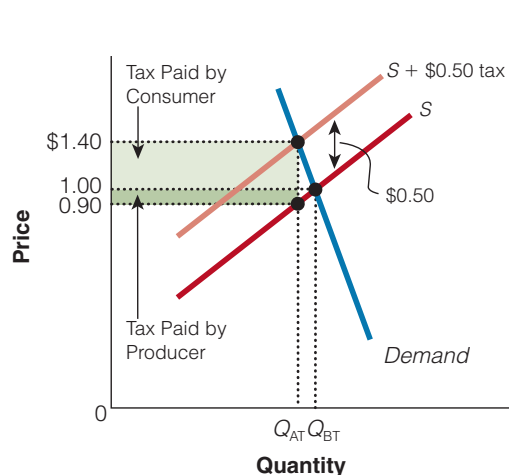
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If the demand for yachts is elastic, will most of a luxury tax on yachts get passed on to producers of yachts? And if so, how will that impact employment in the boat-building industry?

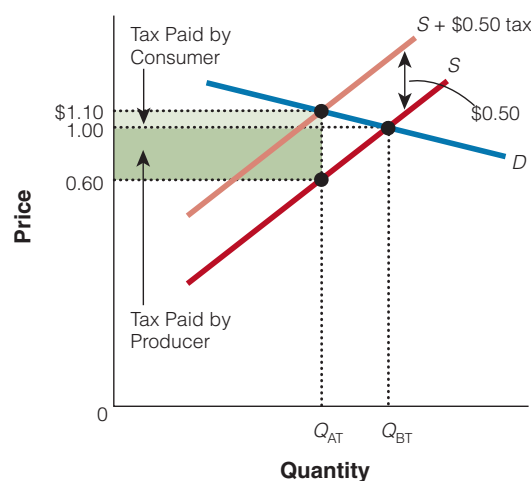
section 6.4
 exhibit 3

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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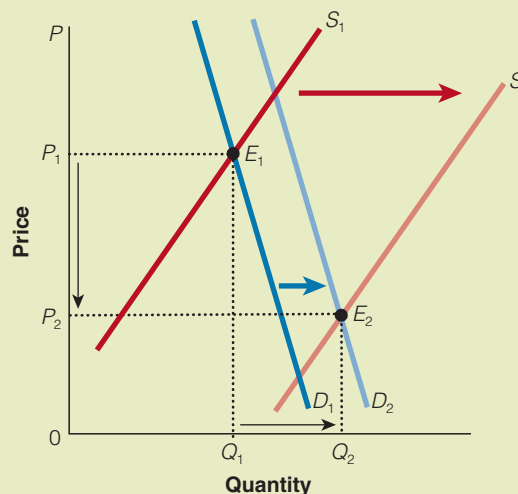
than Congress thought. Remember, when demand is relatively more elastic than supply, most of the tax is passed on to the seller—in this case, the boat industry (workers and retailers). And supply was relatively inelastic because boat factories are not easy to change in the short run. So sellers received 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

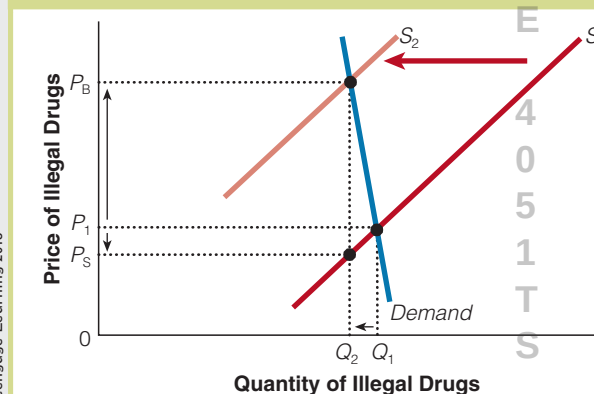
The United States spends billions of dollars a year to halt the importation of illegal drugs across the border. Although these efforts are clearly targeted at suppliers, who really pays the higher enforcement and evasion costs? The government crackdown has increased the probability of apprehension and 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*.

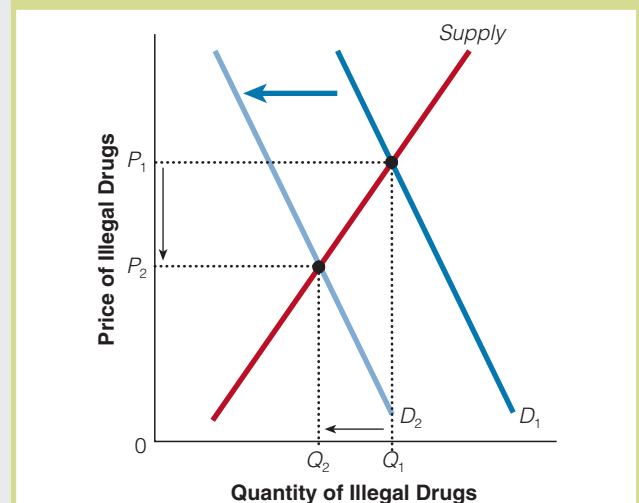
It is also possible that the elasticity of demand for illegal drugs may be more elastic in the long run than the short run. In the short run, as the price rises, the quantity demanded falls less than proportionately because of the addictive nature of illegal drugs (this relationship is also true for 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

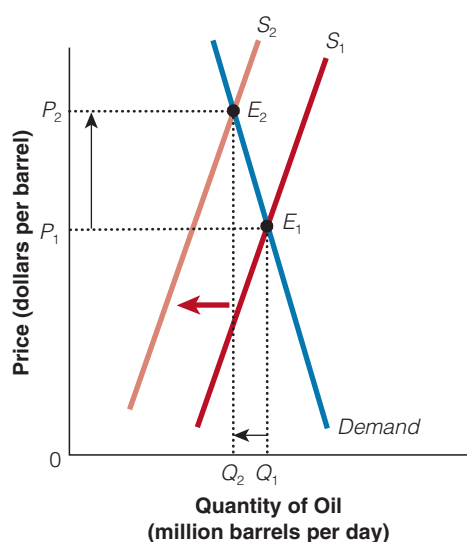
Oil Prices

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).

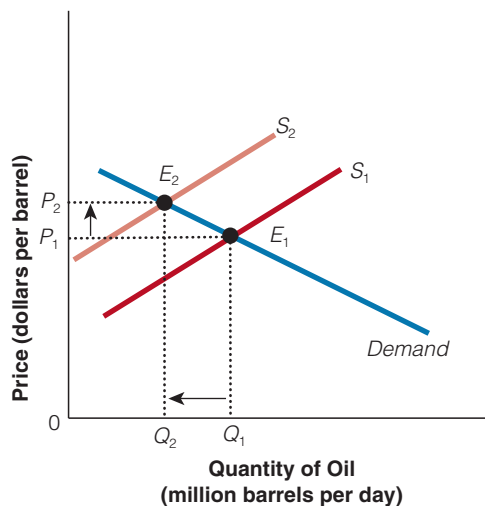
However, in the long run, demand and supply are more elastic. At higher prices, consumers will replace gas guzzlers with more fuel-efficient cars, and non-OPEC oil producers will expand exploration and production. Thus, in the long run, when supply and demand are much more elastic, the same size reduction 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 _____.
13. 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.
 14. The income elasticity of demand is defined as the percentage change in the _____ by the percentage change in _____.
 15. The price elasticity of supply measures the sensitivity of the quantity _____ to changes in the price of the good.
 16. The price elasticity of supply is defined as the percentage change in the _____ divided by the percentage change in _____.
 17. Goods with a supply elasticity that is greater than 1 are called relatively _____ in supply.
 18. When supply is inelastic, a 1 percent change in the price of a good will induce a _____ 1 percent change in the quantity supplied.
 19. 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.
 20. The relative _____ determines the distribution of the tax burden for a good.
 21. 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. rises; quantity demanded 11. fall; quantity demanded 12. upper; elasticity; 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.

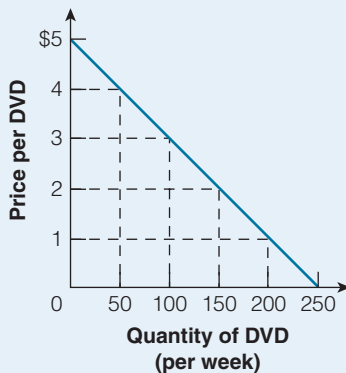
3. How do the relative elasticities of supply and demand determine who bears the greater burden of a tax?

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?

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.



COURTESY OF ROBERT L. SEXTON

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?

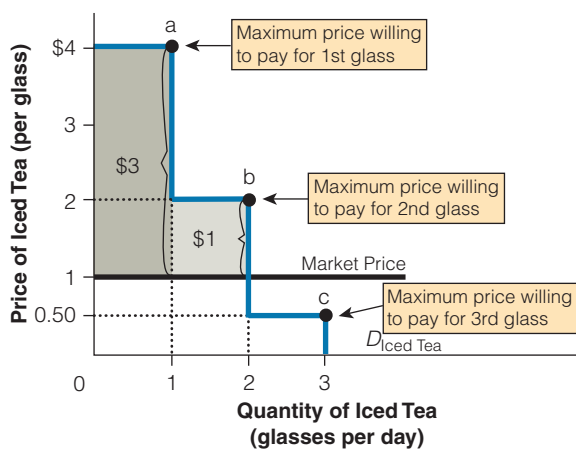
Price Changes and Changes in Consumer Surplus

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

section 7.1 exhibit 1

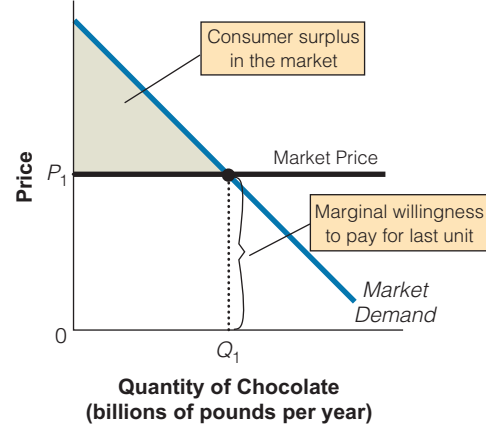
Julie’s Consumer Surplus for Iced Tea



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

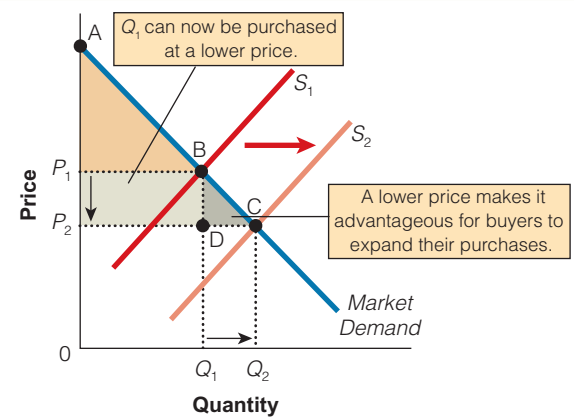
As we have just seen, the difference between what a consumer would be willing and able to pay for a given quantity of a good and what a consumer actually has to pay is called consumer surplus. The parallel concept for producers is called producer surplus. **Producer surplus** is the difference between 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 .

producer surplus

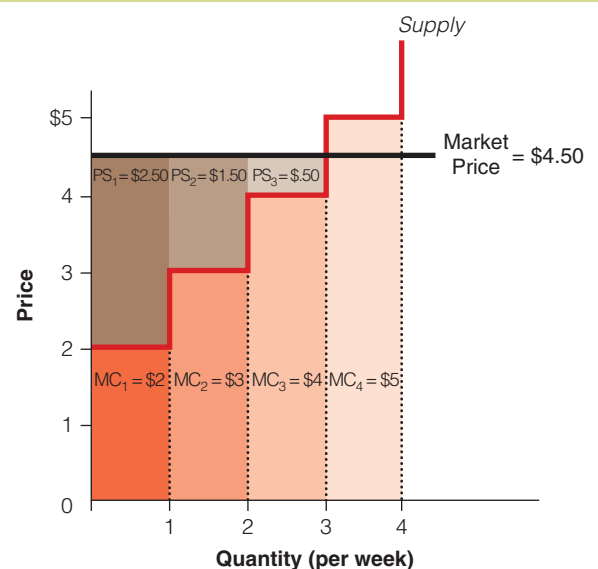
the difference between what a producer is paid for a good and the cost of producing that unit of the good; for the market, it is the sum of all the individual sellers' producer surpluses—the area above the market supply curve and below the market price

marginal cost

the cost of producing one more unit of a good

section 7.1 exhibit 4

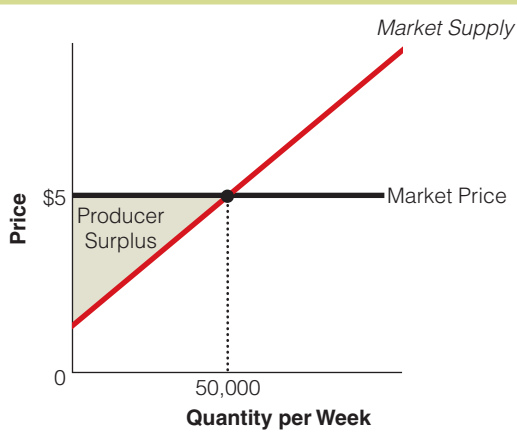
A Firm's Producer Surplus



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.

section 7.1
exhibit 5

Market Producer Surplus

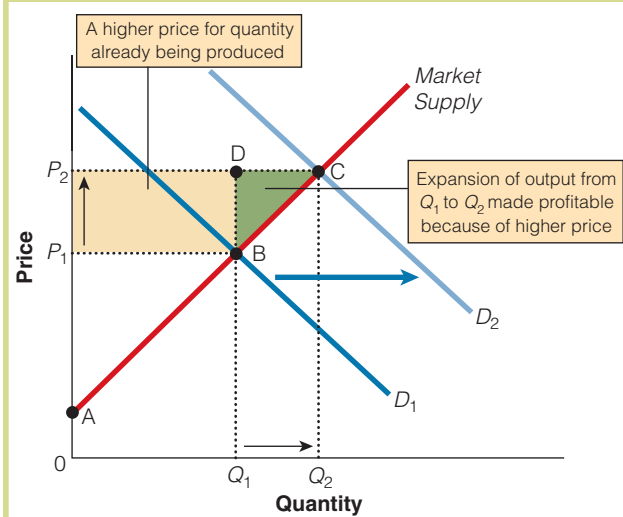


The market producer surplus is the shaded area above the supply curve and below the market price up to the quantity produced, 50,000 units.

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section 7.1
exhibit 6

Impact of an Increase in Demand on Producer Surplus

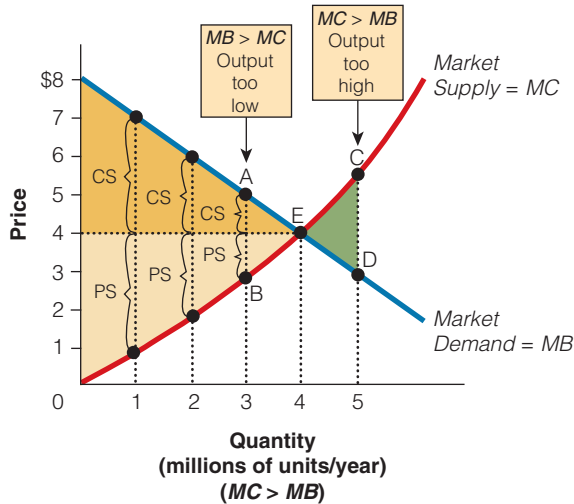


A higher market price due to an increase in market demand will increase total producer surplus. The initial producer surplus at P_1 is the area ABP_1 . The increase in producer surplus from the higher price is area P_2CBP_1 .

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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.



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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 ($T \times Q_2$).

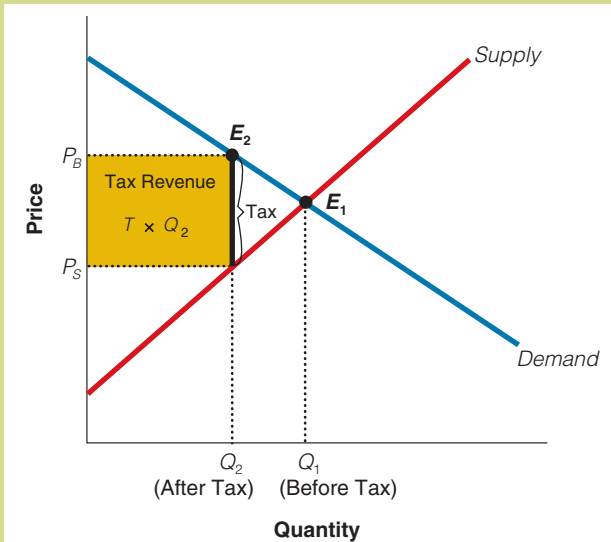
In Exhibit 2, we can now use consumer and producer surpluses to measure the amount of welfare loss associated with a tax. First, consider the amounts of consumer and producer surplus before the tax. Before the tax is imposed, the price is P_1 and the quantity is Q_1 ; at that price and output, the amount 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?

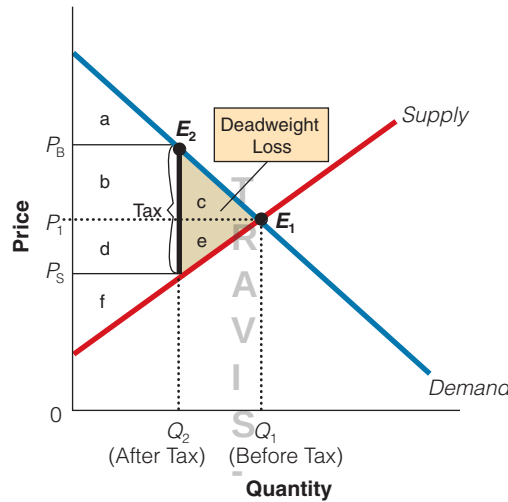
A If the demand and supply curves are both equally elastic, as in Exhibit 2, both consumers and

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.

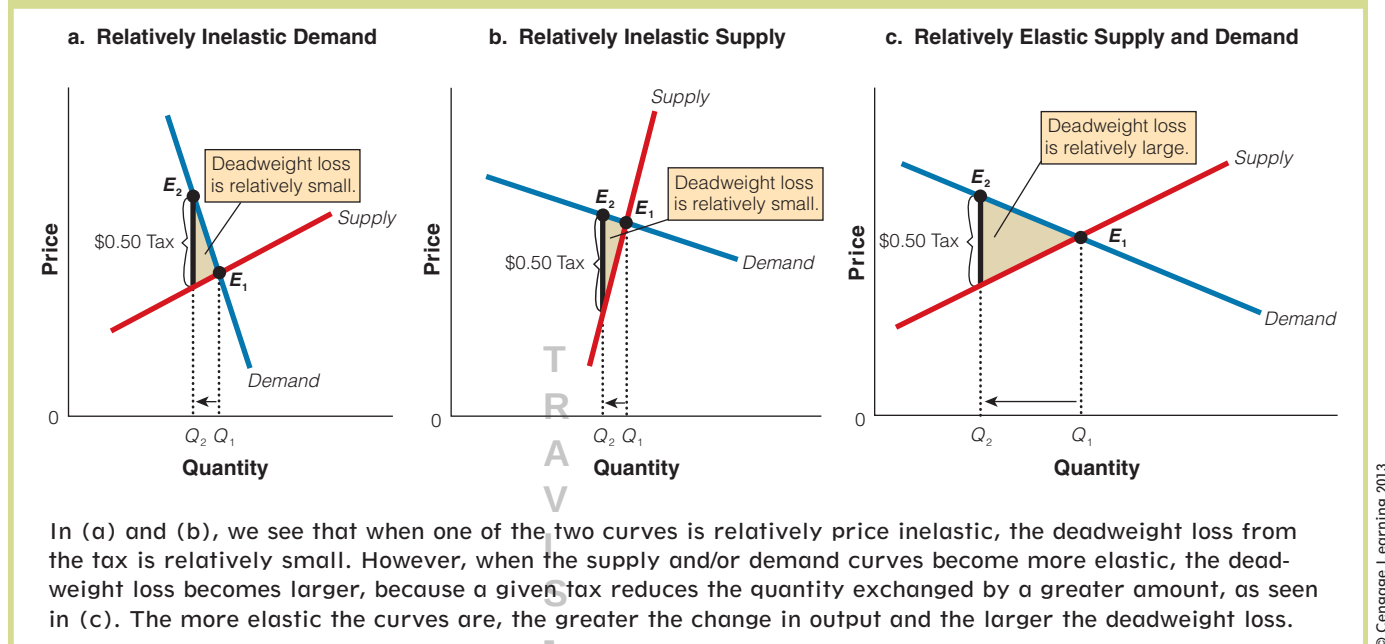
Elasticity and the Size of the Deadweight Loss

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


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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 .

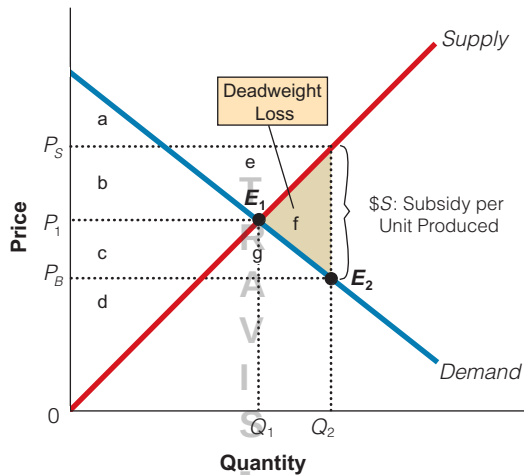


If taxes cause deadweight loss, why don't subsidies cause welfare gains?

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)	$a + b + c + d$	$a + b + c + d - f$	$-f$

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?

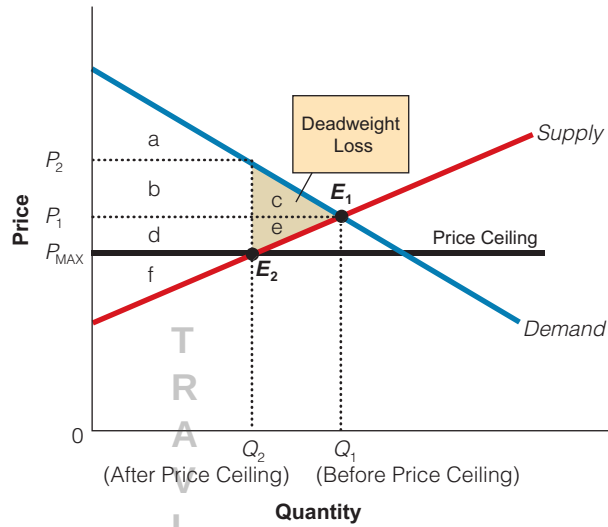
As we saw in Chapter 5, price controls involve the use of the power of the government to establish prices different from the equilibrium market price that would otherwise prevail. The motivations for price controls vary with the markets under consideration. A maximum, or ceiling, is often set for goods 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

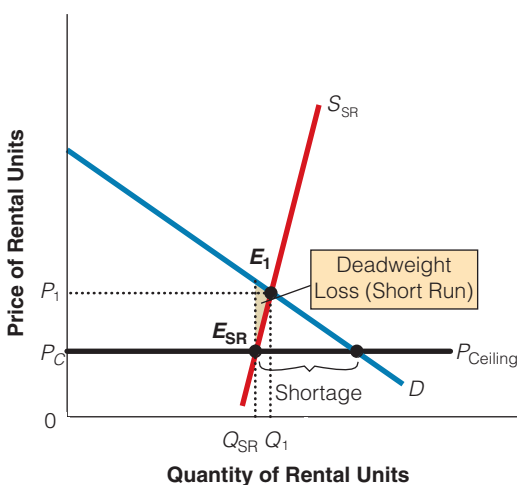


Is it possible that removing rent controls in New York City is good economics but bad politics?

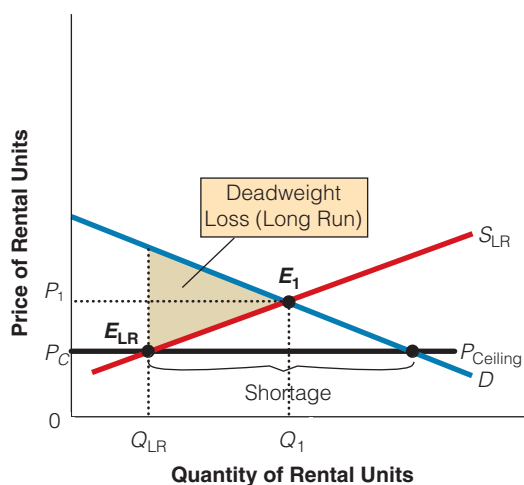
section 7.2 exhibit 6

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

a. Deadweight Loss of Rent Control—Short Run



b. Deadweight Loss of Rent Control—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.

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.

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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.

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_S ; that is, the quantity $Q_S - Q_2$. 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_S ; 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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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.

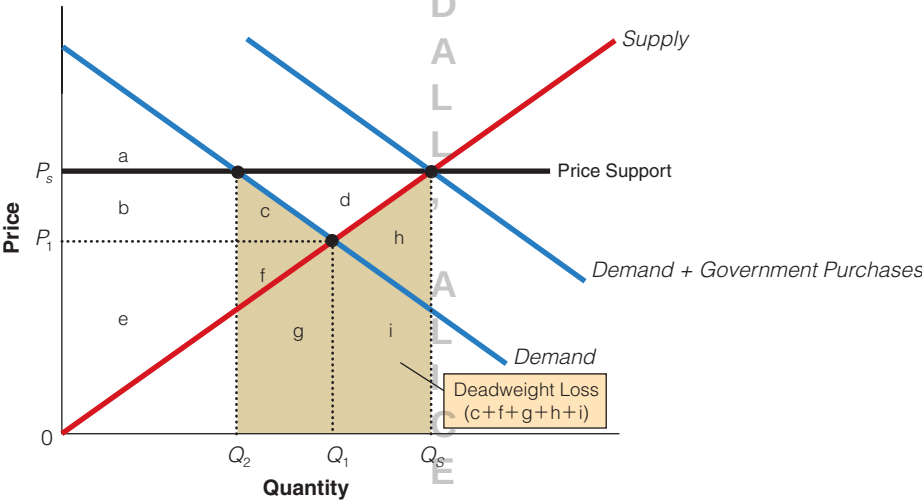


Wouldn't it cost less to give farmers money directly rather than through price supports?

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).



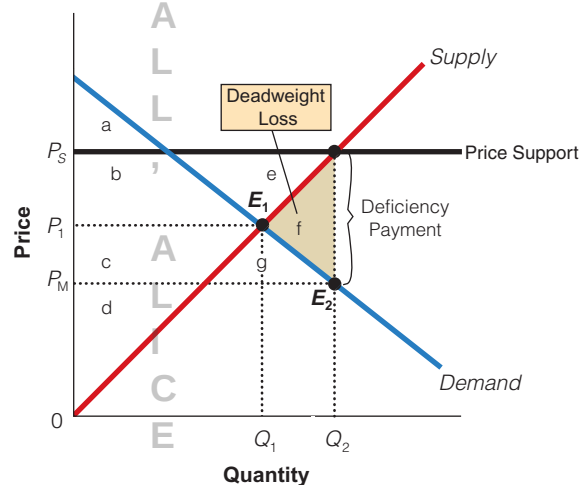
Are deficiency payment programs more efficient than traditional price supports?

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:

1. 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 _____.
2. We can think of the demand curve as a _____ curve.
3. 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).
4. A lower market price due to an increase in supply will _____ consumer surplus.
5. A(n) _____ is the difference between what a producer is paid for a good and the cost of producing that unit of the good.
6. We can think of the supply curve as a(n) _____ curve.
7. 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.
8. 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.
9. The total welfare gain to the economy from trade in a good is the sum of the _____ and _____ created.
10. 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.
11. 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.
12. 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 _____.
13. When there is a subsidy, the market _____ relative to the efficient level of output.
14. Because the _____ leads to the production of more than the efficient level of output, a(n) _____ results.
15. With a(n) _____, any possible gain to consumers will be more than offset by the losses to producers.
16. With a price floor where the government buys up the surplus, the cost to the government is _____ than the gain to _____.
17. 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.
18. 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 of supply and demand 7. already; output 8. maximum; minimum 9. consumer surplus; producer surplus 10. as large 11. higher; lower; gains 12. elasticities 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?

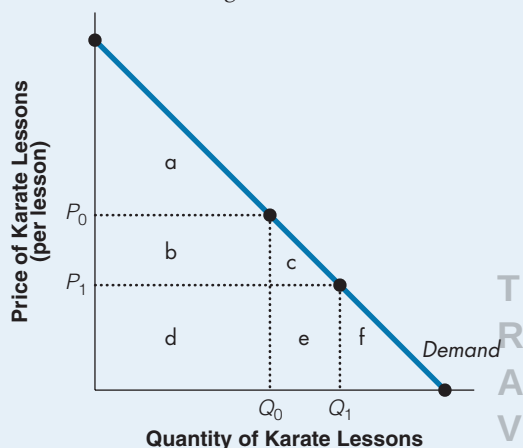
Subsidies cause people to produce units of output whose benefits (without the subsidy) are less than the costs, reducing the total gains from trade.

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

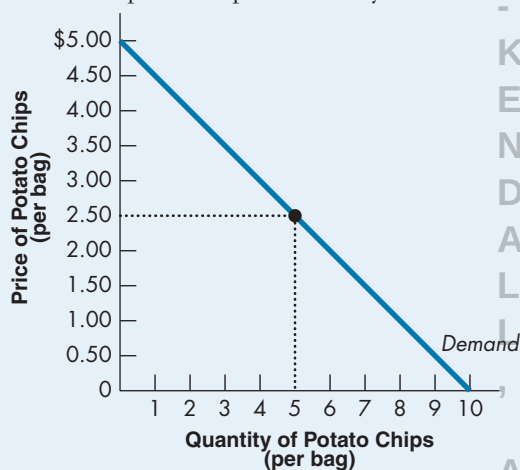
Both tend to increase output beyond the efficient level, so that units whose benefits (without the subsidy) are less than the costs, reducing the total gains from trade in the same way; further, the dollar cost of the deficiency payments are equal to the dollar amount of taxes necessary to finance the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

Problems

1. Refer to the following exhibit.

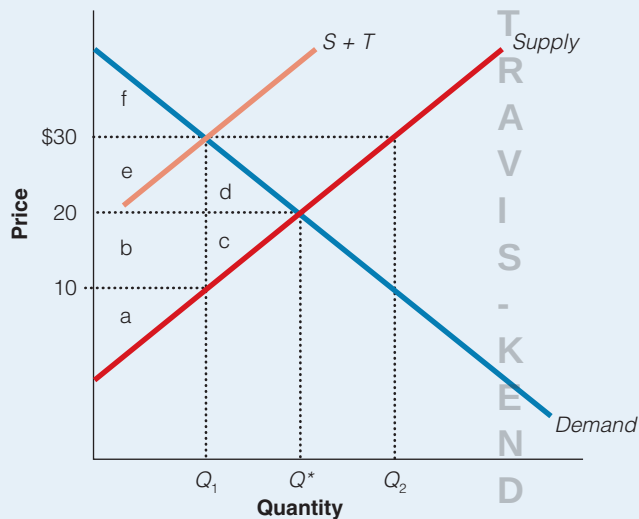


- If the price of each karate lesson is P_0 , the consumer surplus is equal to what area?
 - If the price falls from P_0 to P_1 , the change in consumer surplus is equal to what area?
2. Steve loves potato chips. His weekly demand curve is shown in the following exhibit.

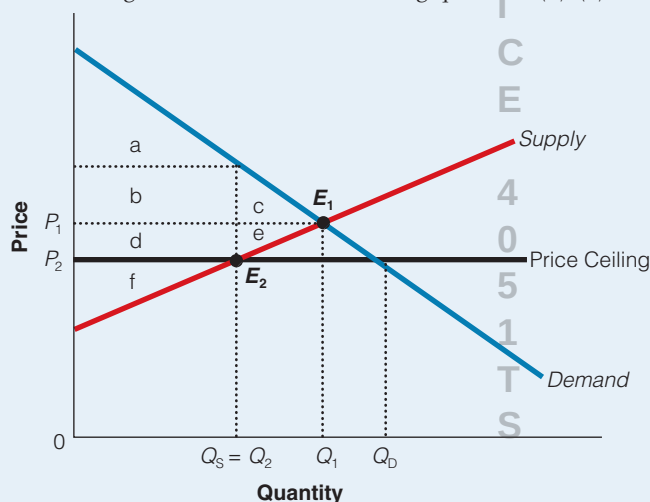


- How much is Steve willing to pay for one bag of potato chips?
 - How much is Steve willing to pay for a second bag of potato chips?
 - If the actual market price of potato chips is \$2.50, and Steve buys five bags as shown, what is the value of his consumer surplus?
 - What is Steve's total willingness 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?
- luxury yachts
 - alcohol
 - motor homes
 - cigarettes
 - gasoline
 - 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).

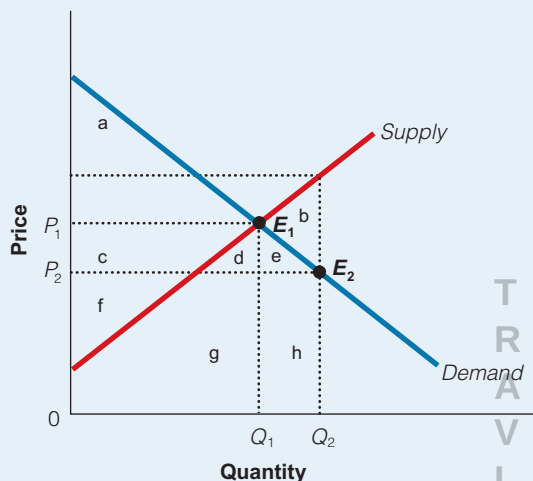


- At the equilibrium price before the tax is imposed, what area represents consumer surplus? What area represents producer surplus?
 - Say that a tax of $\$T$ per unit is imposed in the industry. What area now represents consumer surplus? What area represents producer surplus?
 - What area represents the deadweight cost of the tax?
 - 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).

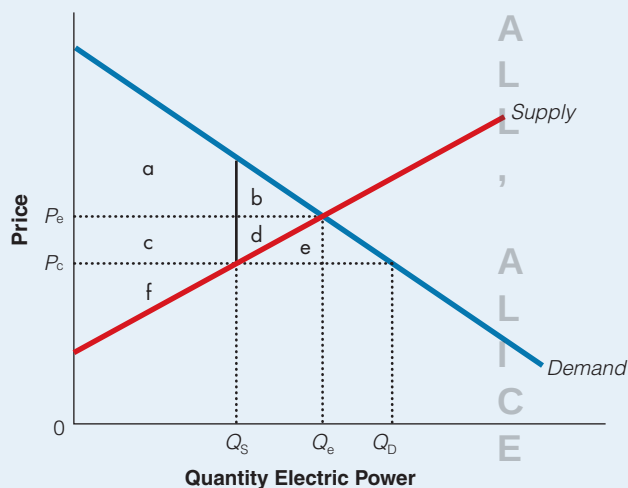


- At the initial equilibrium price, what area represents consumer surplus? What area represents producer surplus?
- After the price ceiling is imposed, what area represents consumer surplus? What area represents producer surplus?
- What area represents the deadweight loss cost of the price ceiling?

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



- At the competitive output, Q_1 , what area represents the consumer surplus? What area represents the producer surplus?
 - At the larger output, Q_2 , what area represents the consumer surplus? What area represents the producer surplus?
 - 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.



- What was the loss imposed on consumers by this price ceiling?
- What was the loss imposed on producers by this price ceiling?
- What was the total loss imposed on California by this price ceiling?
- Using this exhibit, explain the brownouts in California.
- 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.