Competitive Dynamics and Government

Usually, when we wish to acquire goods and services—a new digital music player, a pair of shoes in the right size and style, a last-minute holiday package to a Caribbean island—they can be bought quickly and conveniently. In this chapter, we will analyze in more detail the ways in which competitive markets accomplish this task. In particular, we will look at the concept of elasticity and its effect on the interplay of demand and supply. We will also see how governments may choose to intervene in particular markets by establishing price controls. The dynamics of competitive markets can help or hinder government policies in ways that are often unavoidable—and occasionally the source of considerable political debate as well.

> There is no resting place for an enterprise in a competitive economy.
>
> – ALFRED P. SLOAN, AMERICAN BUSINESSMAN

LEARNING OBJECTIVES After this chapter, you will be able to

LO 1	LO 2	LO 3	LO 4
Describe price elasticity of demand, its relation to other demand elasticities, and its impact on sellers' revenues	**Define price elasticity of supply and identify the links between production periods and supply**	**Identify how price elasticities of demand and supply determine the impact of an excise tax on consumers and producers**	**Explain how governments use price controls to override the "invisible hand" of competition**

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3.1 | Price Elasticity of Demand [1-5]

How can we refine our analysis of the role of demand and its impact in particular markets? One of the most important ways is by studying further the relationship between changes in price and quantity demanded. For example, from Chapter 2 we know that if the price of a computer game falls, then the number of games purchased rises. But by how much? If price is reduced by half, will quantity demanded double or triple, or will it rise by a smaller proportion, such as 10 percent or 20 percent? To answer these questions, we need to understand the **price elasticity of demand** (also called demand elasticity). Price elasticity of demand is the extent to which consumers, and the quantity they demand, respond to a change in price.

price elasticity of demand: the responsiveness of a product's quantity demanded to a change in its price

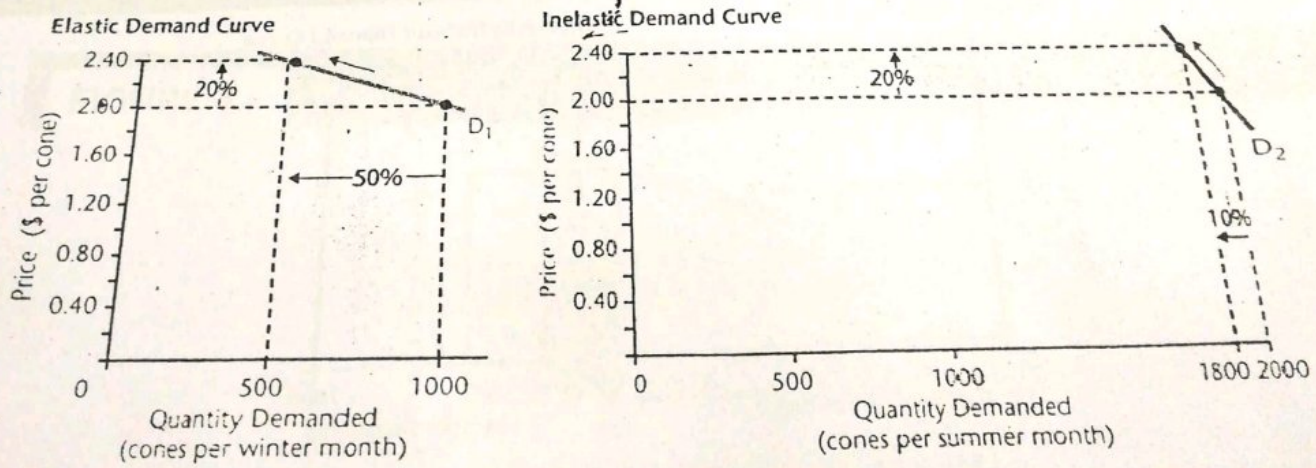
Elastic and Inelastic Demand

Consumers can be very responsive or very unresponsive to price changes. Consider Figure 3.1, which shows the demand curves for a sidewalk vendor selling ice-cream cones in two seasons. During the winter, the vendor raises her price from $2 to $2.40, which is an increase of 20 percent [= (($2.40 − $2.00)/$2.00) × 100%]. The result is that monthly quantity demanded drops from 1000 to 500 cones, which is a decrease of 50 percent [= ((500 − 1000)/1000) × 100%]. If a given percentage change in price causes a *larger* percentage change in a product's quantity demanded, the product has **elastic demand**. Thus, the vendor faces elastic demand in the winter, as shown on the graph on the left. In the summer, greater demand for ice-cream cones pushes demand to the right. In addition, when the vendor increases her price in the summer by 20 percent, from $2 to $2.40, monthly quantity demanded only decreases from 2000 to 1800 cones, or by 10 percent. If a given percentage change in price causes a *smaller* percentage change in quantity demanded, the product has **inelastic demand**. The graph on the right shows an inelastic demand for ice-cream cones.

elastic demand: demand for which a percentage change in a product's price causes a larger percentage change in quantity demanded

inelastic demand: demand for which a percentage change in a product's price causes a smaller percentage change in quantity demanded

FIGURE 3.1 Elastic and Inelastic Demand Curves



For the elastic demand curve (D_1) shown on the left graph, a 20 percent increase in price leads to a greater 50 percent decrease in quantity demanded. The graph on the right shows an inelastic demand curve (D_2). The same 20 percent increase in price now leads to a smaller 10 percent decrease in quantity demanded.

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Perfectly Elastic and Perfectly Inelastic Demand

perfectly elastic demand: demand for which a product's price remains constant regardless of quantity demanded

There are two extreme cases of demand elasticity. When a product has **perfectly elastic demand**, its price remains constant whatever quantities are demanded. Because price never varies, the demand curve is horizontal, as shown in Figure 3.2, on the left. Consider the example of an individual producer, a soybean farmer, who is a *price-taker*. **This means that the farmer has no influence over the market price of soybeans, since the farmer's operations are too insignificant to affect the market.** This farmer would face demand as illustrated by the demand curve D_3. Because the same price of $100 per tonne of soybeans applies at all possible amounts demanded, the farmer faces a perfectly elastic demand curve. In contrast, when a product has **perfectly inelastic demand**, its quantity demanded is completely unaffected by price. This situation creates a vertical demand curve, as shown in Figure 3.2, on the right. An example is the demand for insulin: since this product is essential to people who have diabetes, they are willing to pay any price for a certain quantity of insulin. This means that the market demand curve for insulin (D_4) is vertical at a given quantity demanded, such as 1000 L.

perfectly inelastic demand: demand for which a product's quantity demanded remains constant regardless of price

Price Elasticity of Demand and Total Revenue

total revenue: the total income earned from a product, calculated by multiplying the product's price by its quantity demanded

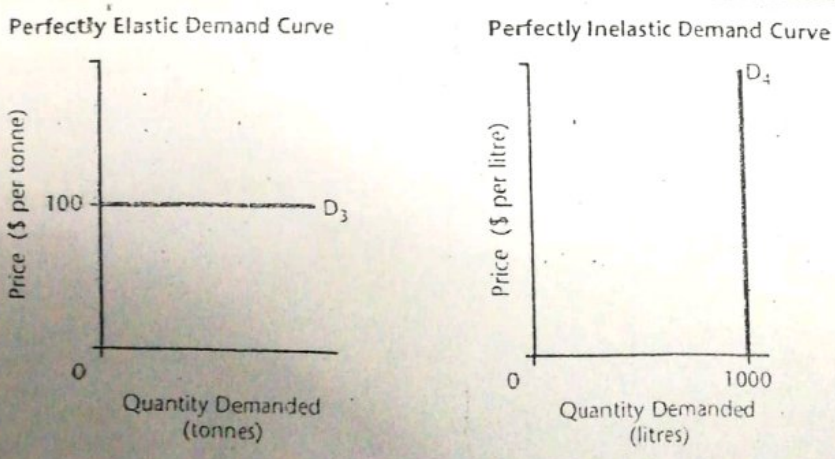
Demand elasticity plays a role in determining what effect a price change has on **total revenue** (TR). Total revenue is defined, either for an individual business or for all businesses producing the same product, as the price of a product multiplied by its quantity demanded:

$$TR = P \times Q_d$$

For example, if the price of a certain product is $4 and 1000 units are purchased, then the total revenue generated is $4000 (= $4 × 1000).

Consider how a rise in a product's price affects the total revenue of businesses selling the product. The higher price, by itself, increases the revenue pocketed by the sellers, but the accompanying decrease in quantity demanded has the opposite effect. The price elasticity of demand determines which of these two effects—the increase in price or the decrease in quantity demanded—has the greater influence on the sellers' total revenue.

FIGURE 3.2 Perfectly Elastic and Perfectly Inelastic Demand



A single soybean farmer might face a perfectly elastic demand curve, as shown on the left graph, with a constant price. In contrast, a producer of insulin might face a vertical or perfectly inelastic demand curve, as shown on the right graph, with the quantity demanded constant.

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THINKING ECONOMICS

Is the slope of the demand curve related to the price elasticity of demand?

There is no automatic connection between the slope of the demand curve and a product's price elasticity of demand. This is because the slope of the demand curve reflects the change in price divided by the change in quantity demanded, while elasticity is expressed in terms of percentage changes in price and quantity demanded. There is a loose connection between the two concepts, however, as shown in Figure 3.i. When two demand curves—one fairly flat and one more steep—are drawn on the same set of axes, the flatter curve (D_1) is more elastic than the steeper curve (D_2) over a given price range. This is because the flatter curve (D_1) is associated with a greater adjustment in quantity demanded and hence a more elastic demand.

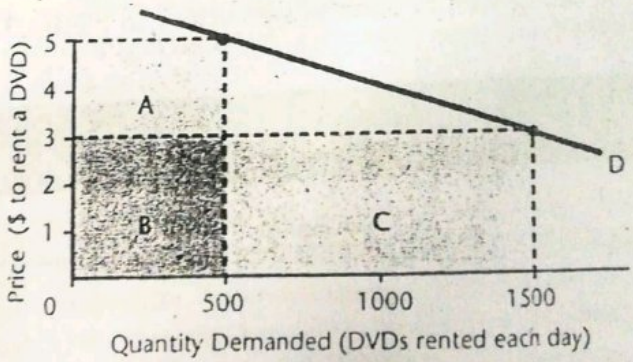
QUESTION Is there an automatic connection between the slope of the demand curve and the price elasticity of demand in the case of perfectly elastic and perfectly inelastic demand curves?

ELASTIC DEMAND

If demand for a product is elastic, price changes cause large variations in quantity demanded. Since a price increase of a certain percentage causes an even bigger percentage decrease in quantity demanded, the sellers' total revenue is reduced. Likewise, a price decrease of a certain percentage causes an even bigger percentage increase in quantity demanded, thus raising total revenue for the sellers. So, when demand is elastic, total revenue and price have an inverse relationship—total revenue changes in the opposite direction to the change in price.

Consider an example. All-U-Want Movies faces an elastic demand for DVD rentals, as shown in Figure 3.3. At a price of $5 per DVD, 500 DVDs are rented each day. The store's total revenue at this point on the demand curve is $2500 (= $5 × 500 DVDs). This total revenue is represented by the area of the shaded rectangle AB. At a price of $3 per DVD, 1500 DVDs are rented each day, pushing up total revenue to $4500 (= $3 × 1500 DVDs), which is represented by the shaded area BC. Therefore, a decrease in price raises the store's total revenue because the effect of the price decrease is outweighed by the effect of the increased quantity demanded.

FIGURE 3.3 Revenue Changes with Elastic Demand



With elastic demand, a 40 percent decrease in the rental price from $5 to $3 causes a larger 200 percent increase in daily rentals. Total revenue for the business increases from the area AB to the area BC. Thus, the changes in price and total revenue are in opposite directions. (Note that area C is greater than area A.)

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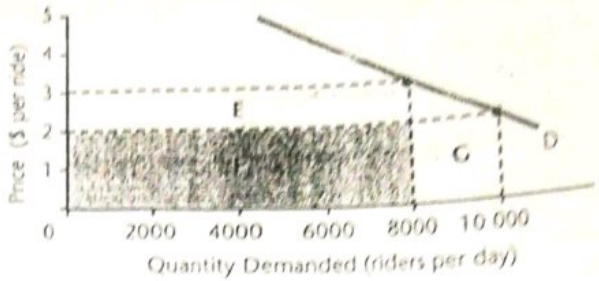
FIGURE 3.4 Revenue Changes with Inelastic Demand



Because demand is inelastic, a 50 percent rise in the price of the ride causes a smaller 20 percent drop in daily ridership. As a result, total revenue for the ride's operator grows from area FG to area EF. The changes in price and total revenue are, therefore, in the same direction. (Note that area E is greater than area G.)

INELASTIC DEMAND

When the demand for a product is inelastic, changes in price have less effect on quantity demanded. Since an increase in price leads to a smaller percentage decrease in quantity demanded, the sellers' total revenue increases. Similarly, a decrease in price causes a smaller percentage increase in quantity demanded, thus causing total revenue to fall. Therefore, when demand is inelastic, price and total revenue have a direct relationship—total revenue shifts in the same direction as the change in price. Take, for example, a ride at an amusement park that has inelastic demand, as shown in Figure 3.4. With a price of $2, there are 10 000 riders a day. Total revenue for the ride's operator, therefore, is $20 000, as shown by the shaded area FG. If price increases to $3, there are 8000 riders a day and a total revenue of $24 000, as shown by the shaded area EF. Therefore, an increase in price adds to the total revenue because the price increase more than compensates for the reduced quantity demanded.

UNIT-ELASTIC DEMAND

unit-elastic demand: demand for which a percentage change in price causes an equal change in quantity demanded

In the case of **unit-elastic demand**, a percentage change in price causes an equal percentage change in quantity demanded. Thus, when demand is unit-elastic, a price change leaves total revenue unchanged. This is because the revenue gain caused by a price increase is precisely offset by the lost revenue due to the decrease in quantity demanded. The effect of a price change on total revenue in this case is summarized, along with all other possible cases, in Figure 3.5.

FIGURE 3.5 Price Elasticity of Demand and Changes in Total Revenue

	Price Change	Change in Total Revenue
Elastic Demand	up	down
	down	up
Inelastic Demand	up	up
	down	down
Unit-Elastic Demand	up	unchanged
	down	unchanged

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Factors That Affect Price Elasticity of Demand

Four factors affect a product's price elasticity of demand: the portion of consumer incomes devoted to buying the product, consumer access to substitutes, whether the product is a necessity or a luxury, and the time consumers have to adjust to price changes.

PORTION OF CONSUMER INCOMES

If the price of a product represents a hefty portion of consumer incomes, consumers will be more responsive to price changes. For consumers who are deciding whether or not to buy a flat-screen TV, for example, a price change can often determine whether or not they make the purchase. If prices of flat-screen TVs are cut in half, quantity demanded will rise by a considerably higher percentage—an important reason why flat-screen TVs are such a popular Boxing Day sale item. In contrast, consumers who are deciding how much sugar to buy pay little attention to price; a 50 percent drop in the price will cause a much smaller percentage increase in the amount of sugar purchased. The demand for big purchases, therefore, tends to be more elastic than the demand for smaller purchases.

ACCESS TO SUBSTITUTES

If there are many close substitutes for a product, consumers will be more responsive to changes in the product's price because they have more options and can easily change their buying patterns. The demand for a particular brand of low-top athletic shoes, for example, will be more elastic than the demand for athletic shoes in general. If only one brand becomes more expensive, its quantity demanded will plummet as consumers substitute cheaper brands. A rise in the price of all athletic shoes, however, will not radically affect quantities purchased. As this example illustrates, the more narrowly a product is defined, the more elastic its demand will be.

NECESSITIES VERSUS LUXURIES

Recall that necessities are essential items—such as bread and milk—that satisfy basic wants. Consumers tend to buy similar amounts of necessities, regardless of their price; thus, necessities tend to have inelastic demand. In contrast, such products as tourist travel, expensive sports cars, and yachts are luxuries that buyers can easily live without. Because these items are expendable, their demand tends to be elastic.

TIME

Demand tends to become elastic over time. In the short run, consumers do not generally respond greatly to price. For example, immediately after a price increase, consumers of nachos will not modify their buying habits significantly, and users of furnace oil will continue to purchase furnace oil, regardless of price. Over time, however, consumers change their habits and needs: nacho-eaters might reduce their consumption, and homeowners might change their furnaces to use less fuel.

Calculating Price Elasticity of Demand

It is possible to quantify elasticity—that is, give it a numerical value. The larger this numerical value (e_d), the greater the price sensitivity—or price elasticity—of the product's demand. If e_d is greater than 1, then quantity demanded is sensitive to price changes, and demand is elastic. If e_d is less than 1, the quantity demanded is comparatively unresponsive to price changes, and demand is inelastic. If e_d is 1, then the product is unit-elastic.

Recall the case of All-U-Want Movies (Figure 3.3), which rents out 500 DVDs a day at a price of $5 each and 1500 DVDs when the price drops to $3. All-U-Want Movies can use the following formula to calculate the price elasticity of demand. In the

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formula, Q_d stands for quantity demanded, and Δ stands for change. (The symbol Δ is the Greek capital letter "delta," which signifies a change in some variable.)

$$e_d = \frac{\Delta Q_d \div \text{average } Q_d}{\Delta \text{ price} \div \text{average price}}$$

$$= \frac{(1500 - 500) \div [(1500 + 500) \div 2]}{(\$3 - \$5) \div [(\$3 + \$5) \div 2]}$$

$$= \frac{1000 \div 1000}{-\$2 \div \$4}$$

$$= \frac{1}{\frac{-1}{2}}$$

$$= (-)2$$

Recall that we identified whether demand curves were elastic or inelastic by comparing percentage changes in quantity demanded and price. To calculate these percentage changes, we divided the absolute changes in both quantity demanded and in price by their respective initial values. While this is the simplest procedure, it is not sufficiently exact when calculating numerical values for elasticity. Instead of using the initial values for quantity demanded and price, we incorporate the average values of these two variables in our formula. Over a given range of a demand curve, these average values are the same no matter whether we are moving up or down the demand curve. This useful property does not apply to the initial values of either quantity demanded or price, which are different depending on where we start on the demand curve.

So, in the numerator and denominator of this formula, the changes in quantity demanded and price, respectively, are divided by each variable's average value. The average quantity demanded is the value at the midpoint between the old and new quantities demanded, and is found by adding together the new and old quantities demanded and then dividing by 2. The same method is used to derive the average price, which is the value at the midpoint between the old and new prices, and is the sum of the new and the old prices divided by 2. Therefore, in the example of All-U-Want Movies, e_d is 2, which means that a certain percentage change in price (calculated using average price) causes twice that percentage change in quantity demanded (calculated using average quantity demanded). Note that the answer is a pure number with no units attached. Also, it always has a negative sign, because its formula's numerator and denominator necessarily have different signs. Because it is customary to define the numerical value of the price elasticity of demand in terms of the number's absolute value, this negative sign is usually cancelled out of the final answer; the negative sign is ignored, so the number is always considered to be positive.

Elasticity and Linear Demand Curves

It is possible to calculate the price elasticity for various ranges along a linear demand curve. A linear demand curve's slope is constant, given the definition of slope as the change in price over change in quantity demanded—the "rise" over the "run." We can see this in Figure 3.6, which shows a hypothetical market demand curve for sports drinks. Anywhere along this curve, quantity demanded rises by 1 million sports drinks for each $1 drop in price, giving a slope of −1 millionth. But the curve's elasticity coefficient, which is the ratio of the relative changes in quantity demanded and price, varies as we move along the curve. Between prices $5 and $4, the coefficient has a value of (−)9. Then, for each new lower pair of prices, the coefficient drops—to 2.33 (between $4 and $3), 1 (between $3 and $2), 0.43 (between $2 and $1), and finally 0.11 (between $1 and $0).

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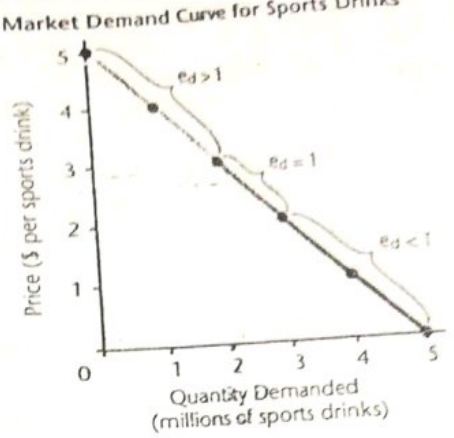
FIGURE 3.6 Elasticity and a Linear Demand Curve

Market Demand Schedule for Sports Drinks

Price ($ per sports drink)	Quantity Demanded (millions of sports drinks)	Price Elasticity of Demand (e_d)
5	0	
4	1	
3	2	1.00
2	3	0.43
1	4	0.11
0	5	



The slope of this linear demand curve is always −1 millionth. But at any price range above $3, this linear demand curve is elastic, with a price elasticity (e_d) greater than 1. Between prices $3 and $2, the curve is unit-elastic, given an e_d equal to 1. Finally, at any price range below $2, the curve is inelastic, and e_d is less than 1.

The reason for the varying values of price elasticity is that at high prices (such as $5 and $4), the $1 price change is made smaller when dividing by average price ($4.50). At the same time, the change in quantity demanded (1 million sports drinks) is made larger when compared with average quantity demanded (500,000). The result is an elasticity coefficient greater than 1, with the curve being elastic in its upper range. But further down the demand curve, the relationship between price and quantity is reversed. At low values of price (such as $1 and $0), the same $1 price change is made larger when compared with average price ($0.50), while the high values for quantity demanded (4 million and 5 million sports drinks) mean the change in quantity demanded of 1 million sports drinks is made smaller relative to the average quantity (4.5 million sports drinks). The elasticity coefficient is, therefore, less than 1, and the curve is inelastic in its lower range. Finally, in the curve's middle range, the relative changes in price and quantity demanded just balance one another so that the curve in this range is unit-elastic.

The implication of this illustration is clear: it is best to be careful when referring to a linear demand curve as either elastic or inelastic.

Income and Cross-Price Elasticities

The price elasticity of demand is not the only elasticity concept relating to demand. We can also measure the extent to which a product's quantity demanded varies with changes in consumer income or the price of another product.

Income elasticity (e_I) is defined as the responsiveness of a product's quantity demanded to an adjustment in consumer income. It is calculated as the ratio of the changes in quantity demanded and consumer income, with each change divided by its respective average value. The formula for income elasticity is, therefore, similar to the mathematical expression for the price elasticity of demand. It is the ratio of the change in quantity demanded (ΔQ_d) divided by its average value, over the change in consumer income (ΔI) divided by its average value. For example, if an increase in average

income elasticity: the responsiveness of a product's quantity demanded to a change in average consumer income

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consumer income from $20 000 to $40 000 causes the quantity demanded of computer tablets to rise from 1000 to 2000, then income elasticity of computer tablets is 1.

$$e_i = \frac{\Delta Q_d \div \text{average } Q_d}{\Delta I \div \text{average } I}$$

$$= \frac{(2000 - 1000) \div [(2000 + 1000)/2]}{(\$40\,000 - \$20\,000) \div [(\$40\,000 + \$20\,000)/2]}$$

$$= \frac{1000 \div 1500}{\$20\,000 \div \$30\,000}$$

$$= \frac{1/1.5}{2/3}$$

$$= 1$$

Unlike the case of the price elasticity of demand, the income elasticity's sign is important. For an inferior product, this elasticity is negative because changes in consumer incomes and quantity demanded are in opposite directions. To illustrate, lower consumer incomes increase purchases of canned meat, giving a negative denominator and positive numerator in the formula. In contrast, income elasticity is positive for a normal product because changes in consumer income and the product's quantity demanded are in the same direction. For example, higher consumer incomes mean more purchases of normal products, such as digitial music players, giving both a positive numerator and a positive denominator. While the income elasticity of normal products that are necessities, such as milk and bread, is positive but relatively low (between 0 and 1), for luxuries, such as caviar or expensive jewellery, the income elasticity is higher (greater than 1).

cross-price elasticity: *the responsiveness of a product's quantity demanded to a change in the price of another product*

Another demand-related elasticity is **cross-price elasticity** (e_{xy}), defined as the responsiveness of quantity demanded of one product (x) to a change in price of another (y). In mathematical terms, the formula for cross-price elasticity is the ratio of the changes in quantity demanded of product x (ΔQ_d) and the price of product y (ΔPy) with each change divided by the respective average value. For example, if a drop in the price of computer tablets from $1000 to $500 causes the quantity demanded of laptop computers to fall from 5000 to 3000, then cross-price elasticity of these two products is 0.75.

$$e_{xy} = \frac{\Delta Q_d \div \text{average } Q_d}{\Delta P_y \div \text{average } P_y}$$

$$= \frac{(3000 - 5000) \div [(3000 + 5000)/2]}{(\$500 - \$1000) \div [(\$500 + \$1000)/2]}$$

$$= \frac{-2000 \div 4000}{-\$500 \div \$750}$$

$$= \frac{-1/2}{-2/3}$$

$$= 0.75$$

The cross-price elasticity's sign differs, depending on whether products x and y are substitutes or complementary. When one product is a substitute for the other, as in the case of computer tablets and laptops, the cross-price elasticity is positive. This is because the changes in both x's quantity demanded and y's price are in the same direction. On the other hand, the cross-price elasticity for complementary products is negative. An increase in the quantity demanded of DVDs, for example, might be caused by a fall in the price of DVD players.

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CHAPTER REVIEW

1. **Price elasticity of demand** is the responsiveness of a product's quantity demanded to changes in the product's price. When demand is elastic, a given percentage change in price causes a larger percentage change in quantity demanded. When demand is inelastic, a given percentage change in price causes a smaller percentage change in quantity demanded.

2. Demand is perfectly elastic when the price of a product is constant at all quantities demanded. Demand is perfectly inelastic when the quantity demanded of a product is constant at all prices. Demand is unit-elastic when a percentage change in price causes an equal percentage change in quantity demanded.

3. Price and total revenue have an inverse relationship when demand is elastic, but a direct relationship when demand is inelastic. When demand is unit-elastic, total revenue is constant, regardless of price.

4. Four factors affect the price elasticity of demand of a product: the portion of consumer incomes the product accounts for, access to substitute products, whether the product is a luxury or a necessity, and the amount of time that elapses after a price change.

5. Other demand-related elasticity concepts include income elasticity, which measures the sensitivity of a product's quantity demanded to a change in consumer income, and cross-price elasticity, which measures the sensitivity of a product's quantity demanded to a change in another product's price.

3.1 PRACTICE QUESTIONS

1. Should we be careful when referring to a linear demand curve as either elastic or inelastic? Why?
2. Annual purchases of tablet computers in a certain market are 10 000 at a price of $3000, 20 000 at a price of $2000, and 30 000 at a price of $1000.
   a. Find the producers' total revenue at each price.
   b. On the basis of your answer to part a, is the market demand curve for tablet computers elastic or inelastic in the price range $3000 to $2000? in the price range $2000 to $1000?
   c. Calculate the numerical values of demand elasticity in the two relevant price ranges.
   d. Are your answers to parts b and c consistent?
   e. Using the EconGraphKit, available at the Online Learning Centre (www.mcgrawhill.ca/olc/lovewell), draw the demand curve for tablet computers and highlight the rectangles showing total revenue at each of the three prices. Are the changes in these areas consistent with your answers to parts b and c? Explain.
3. Calculate the appropriate elasticity coefficient in each of the following cases.
   a. A drop in the price of hydrogen-powered cars from $25 000 to $20 000 causes purchases of gasoline-powered cars to fall from 1 million to 750 000 per year.
   b. Monthly purchases of smart phones rise from 15 000 to 17 500 when the average price of smart phones decreases from $500 to $400.
   c. A fall in average consumer incomes from $80 000 to $50 000 raises weekly purchases of canned sardines from 2000 to 3000 cans.

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3.2 | Price Elasticity of Supply

price elasticity of supply: the responsiveness of a product's quantity supplied to a change in price

Just as the price elasticity of demand measures the responsiveness of consumers to a change in a product's price, the **price elasticity of supply** (also called supply elasticity) measures the responsiveness of producers (and the quantities they supply) to changes in the product's own price.

Elastic and Inelastic Supply

elastic supply: supply for which a percentage change in a product's price causes a larger percentage change in quantity supplied

In the case of **elastic supply**, a certain percentage change in the product's price leads to a larger percentage change in its quantity supplied. In other words, the quantity that producers are willing to offer for sale is very responsive to price changes. Consider the example of a tomato producer, as in Figure 3.7. As shown on the graph on the left, if the price of tomatoes increases by 50 percent, from $2 to $3 per kilogram, the quantity of tomatoes supplied annually increases from 100 000 to 200 000 kg—a 100 percent increase. If, as shown on the graph on the right, the identical 50 percent price increase for tomatoes causes a much smaller 20 percent increase in quantity supplied—from 100 000 to 120 000 kg—then we have **inelastic supply**. In other words, if a product has inelastic supply, a given percentage change in price results in a smaller percentage change in quantity supplied.

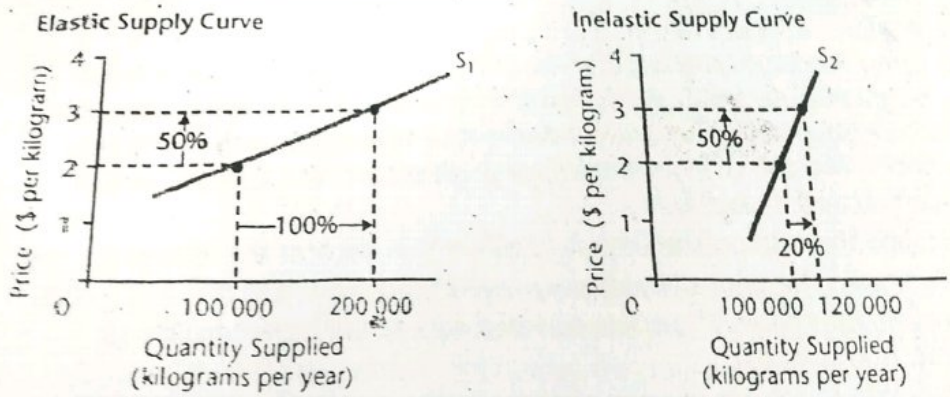
inelastic supply: supply for which the percentage change in a product's price causes a smaller percentage change in quantity supplied

As in the case of the price elasticity of demand, the price elasticity of supply is not the same as the slope of the supply curve. However, when two supply curves are drawn on the same set of axes, as in Figure 3.7, then—over a certain price range—the flatter curve (S_1) is more likely to be elastic than the steeper curve (S_2).

Factors That Affect Price Elasticity of Supply

The main factor that affects the price elasticity of supply is the passage of time. In competitive markets, three production periods can be distinguished: the immediate run, the short run, and the long run. The price elasticity of supply differs in each period. Figure 3.8 illustrates elasticity for each of the three production periods in the market for strawberries.

FIGURE 3.7 Elastic and Inelastic Supply



An elastic supply curve (S_1) is shown on the left. A 50 percent increase in price leads to a greater 100 percent increase in quantity supplied. The graph on the right shows an inelastic demand curve (S_2). The same 50 percent increase in price now leads to a smaller 20 percent increase in quantity supplied.

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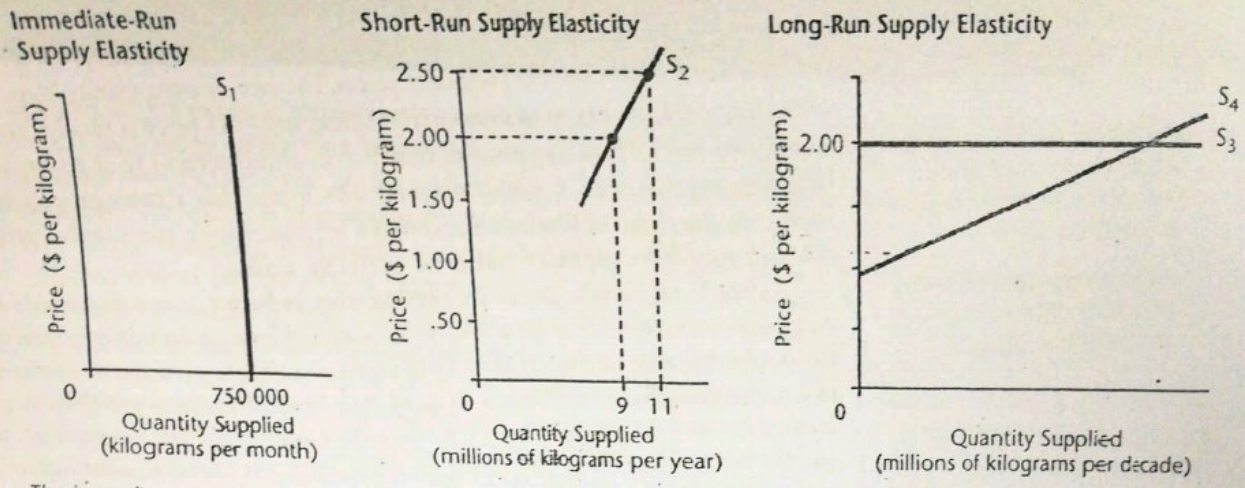
FIGURE 3.8 Time and Price Elasticity of Supply



The immediate-run supply curve S_1 is perfectly inelastic, since a price change does not affect quantity supplied. The short-run supply curve S_2 is either elastic or inelastic, with quantity supplied varying in the same direction as price. The long-run supply curve S_3 shows the case of a constant-cost industry, where supply is perfectly elastic, since price is constant for every possible quantity supplied. The long-run supply curve S_4 shows the case of an increasing-cost industry, where price rises as quantity supplied expands.

THE IMMEDIATE RUN

The **immediate run** is the period during which businesses in a certain industry can make no changes in the quantities of resources they use. In the case of strawberry farming, the immediate run may be a month. For example, if the price of strawberries suddenly jumps as a result of an increase in demand, then, during the immediate run, farmers are unable to increase their production. Because quantity supplied is constant, the supply curve (S_1), shown on the left, is vertical at a quantity, such as 750 000 kg. Thus, for the immediate run, the supply is said to be **perfectly inelastic**.

immediate run: the production period during which none of the resources required to make a product can be varied

perfectly inelastic supply: supply for which a product's quantity supplied remains constant regardless of price

THE SHORT RUN

The **short run** is the period during which the quantity of at least one of the resources used by businesses in an industry cannot be varied. In the case of strawberry farming, a period of less than a single growing season is bound to be short run. If there is a rise in the price of strawberries from $2 to $2.50, then during the short run, farmers can increase their production by, for example, using more labour and maximizing the crop with mulch or fertilizers, but they cannot bring more land into production until the next growing season. In this case, illustrated on the middle graph, the price rise causes an increase in quantity supplied from 9 to 11 million kilograms. The supply curve (S_2) for the short run may be either elastic or inelastic. This depends on whether a given percentage change in price causes a bigger or smaller percentage variation in quantity supplied.

short run: the production period during which at least one of the resources required to make a product cannot be varied

THE LONG RUN

In the **long run**, the quantities of all resources used in an industry can be varied. Also, businesses may enter or leave the industry. In the case of strawberry farming, the long run is a period longer than a single growing season—perhaps as long as a decade. Over this period, a rise in the price of strawberries will cause a temporary increase in strawberry farmers' profits beyond what they have been in the past. The lure of these greater profits leads to more resources being devoted to strawberry production. Not only will

long run: the production period during which all resources required to make a product can be varied, and businesses may either enter or leave the industry

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existing farmers expand their operations, but new farmers will enter the market. Both these changes increase the quantity supplied of strawberries. Two results are then possible, depending on what happens to price in the long run at the new, higher production levels.

constant-cost industry: an industry that is not a major user of any single resource

If strawberry farming is a **constant-cost industry**, one that is not a major user of any resource, the increase in quantity supplied following a short-run rise in the price of strawberries has no effect on resource prices. The lure of extra profits keeps production expanding, and the price of strawberries falling, until this price is finally driven back to its original level. Thus, the price of strawberries always returns to the same level in the long run, regardless of quantity supplied. This means that a constant-cost industry, as shown on the right in Figure 3.8, exhibits a horizontal long-run supply curve (S_3). For the long run, then, supply is said to be **perfectly elastic**.

perfectly elastic supply: supply for which a product's price remains constant, regardless of quantity supplied

increasing-cost industry: an industry that is a major user of at least one resource

If strawberry farming is an **increasing-cost industry**, it is a major user of at least one resource. Therefore, a greater quantity supplied leads to an increase in the price of this single resource, such as land or farm machinery. Again, a short-run rise in the price of strawberries causes production to grow as farmers take advantage of extra profits. As long as the lure of profits remains, price is driven down in the long run to its lowest possible level, but price is now above its initial level, since farmers face higher per-unit costs. Hence, the long-run supply curve (S_4) has a positive (upward) slope but is very elastic, showing that quantities supplied are highly sensitive to price changes.

Calculating the Price Elasticity of Supply

The numerical value of the price elasticity of supply (e_s) is calculated in a similar way to the price elasticity of demand. When e_s has a value greater than 1, quantity supplied is sensitive to price changes, and supply is elastic. If e_s is less than 1, quantity supplied is comparatively unresponsive to price changes, and supply is inelastic.

Consider the case of the tomato industry with an elastic supply curve (Figure 3.7). When the price of tomatoes rises from $2 to $3 a kilogram, the quantity supplied by farmers increases from 100 000 to 200 000 kg. The value of the price elasticity of supply for this industry can be found using the following formula, in which Q, stands for quantity supplied.

$$e_s = \frac{\Delta Q_s \div \text{average } Q_s}{\Delta \text{ price} \div \text{average price}}$$

$$= \frac{(200\,000 - 100\,000) \div [(200\,000 + 100\,000) \div 2]}{(\$3 - \$2) \div [(\$3 + \$2) \div 2]}$$

$$= \frac{100\,000 \div 150\,000}{\$1 \div \$2.50}$$

$$= \frac{0.667}{0.4}$$

$$= 1.67$$

Therefore, the tomato suppliers face a price elasticity of supply of 1.67, which means that a certain percentage change in price causes a percentage change in quantity supplied that is 1.67 times as large (when both percentage changes are calculated using average values). Because there is a direct relationship between price and quantity supplied, the changes in these two variables are always in the same direction. Thus, the numerator and the denominator of the supply elasticity formula are either both positive or both negative, giving a final answer that is always positive. Like the numerical value of demand elasticity, this is a pure number with no units attached.

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THINKING ABOUT ECONOMICS

Do decreasing-cost industries exist?

Yes, they do. For example, some industries in the information technology sector have witnessed a marked decrease in product costs as the industries have expanded. The example of computer chips is particularly telling. According to Moore's Law, developed in 1965 by one of the founders of chipmaker Intel, the processing power of computer chips doubles every 12 months. So far, Moore's Law has been correct, reducing the real price of processing power since the 1960s by 99.9999 percent, and making innovations such as laptops, tablets, and portable MP3 players a reality. With continued advances in computing, there is no reason why this pace of growth cannot continue. Similar trends are emerging in the biotechnology industry, especially in the fast-rising field of genetics. For example, the cost of DNA sequencing is estimated to have fallen to a hundred-thousandth of what it was as recently as 1999, and predictions are that this staggering reduction of costs could continue on the same path in decades to come. However, the problem in extending the analysis of long-run supply elasticity to such scenarios is that industries with a pattern of decreasing costs will probably not be perfectly competitive; the advantages of "bigness" for the leading businesses in the industry are simply too large to be ignored.

QUESTION Presuming a decreasing-cost industry is competitive, what would the slope of its long-run supply curve be?

CHAPTER REVIEW

1. Price elasticity of supply is the responsiveness of a product's quantity supplied to changes in the product's price.
2. When supply is elastic, a given percentage change in price causes a larger percentage change in quantity supplied. When supply is inelastic, a given percentage change in price causes a smaller percentage change in quantity supplied.
3. Price elasticity of supply is dependent mainly on the production period. In the immediate run, supply is perfectly inelastic, meaning a change in price has no effect on quantity supplied. In the short run, supply may be elastic or inelastic.
4. In the long run, price elasticity of supply depends on the industry's use of resources. In a constant-cost industry (not a major user of any one resource), supply in the long run is perfectly elastic, with a constant price at all possible quantities supplied. In an increasing-cost industry (a major user of at least one resource), the long-run supply is very elastic, with price rising gradually at higher quantities supplied.

3.2 | PRACTICE QUESTIONS

1. In a certain lettuce market, the price rises from $1 to $1.20 per head. For each case below, determine the value of e_s and describe the shape of the supply curve.
   a. In the immediate run, monthly quantity supplied remains constant at 80 000 heads.

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b. In the short run, annual quantity supplied rises from 1 million to 1.2 million heads.

c. In the long run, the price of lettuce returns to $1 as quantity supplied continues to expand.

2. Based on your answer to part c, is this a constant-cost or increasing-cost industry?

3. Using the EconGraphKit, available at the Online Learning Centre, draw the three supply curves.

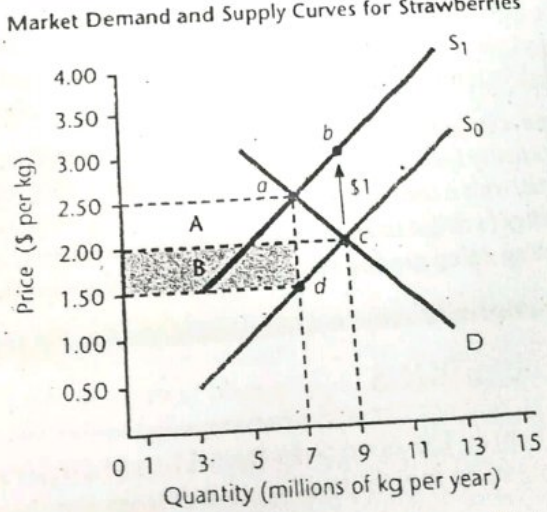
3.3 | Excise Taxes

LO3 The Impact of an Excise Tax

excise tax: a tax on a particular product expressed as a dollar amount per unit of quantity

One common application of elasticity is in analyzing the effect of an **excise tax**, which is a tax on a particular good or service expressed as a dollar amount per unit of quantity. For example, a tax of $1 per kilogram may be imposed in the market for strawberries highlighted in the previous chapter. Figure 3.9 shows its impact. The supply curve for producers remains at S_0, because the price producers see does not include the tax. But the supply curve facing consumers becomes S_1, since the price consumers see now includes an extra amount of $1 per kilogram at every possible quantity level. For example, at the initial quantity of 9 million kilograms, the price of strawberries seen by producers is $2, found at point *c* on S_0. Meanwhile, the price seen by consumers is $3, found at the corresponding point *b* on S_1.

FIGURE 3.9 The Impact of an Excise Tax



A $1 excise tax per kg causes the supply curve seen by strawberry consumers to shift to S_1. At the initial equilibrium, consumers pay a price of $3 (point *b*) and producers receive a price of $2 (point *c*). At the new equilibrium, consumers pay a price of $2.50, producers receive a price of $1.50, and the total tax payment is equally divided—area A paid by consumers and area B by producers.

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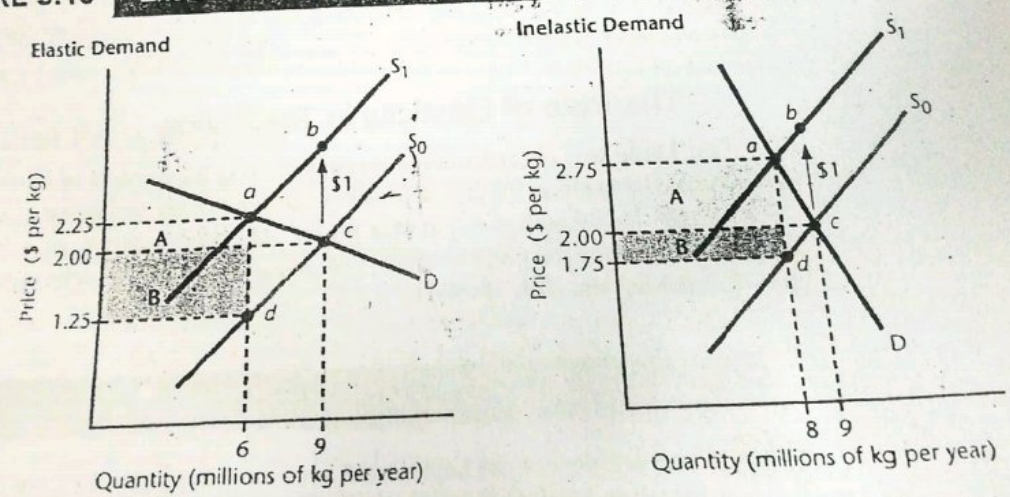
The after-tax equilibrium is at point *a*, where the demand curve D crosses the new supply curve S_1 at a quantity of 7 million kilograms. The equilibrium quantity therefore drops because of the tax. For consumers, price is now $2.50, as shown by point *a*. For producers, price is $1 less at $1.50, shown by the corresponding point *d* on S_0.

The common myth is that excise taxes are always passed onto consumers. Figure 3.9 shows this myth to be untrue. Typically both consumers and producers pay a portion of any excise tax. In this market, half the tax is paid by consumers and half by producers. Graphically, the $7 million tax payment is shown by the shaded area AB in Figure 3.9. Area A represents the $3.5 million payment by consumers, found by multiplying the tax-induced $0.50 price rise by the quantity of 7 million kilograms of strawberries. Likewise, area B represents the $3.5 million paid by producers, found by multiplying the corresponding $0.50 price drop by the quantity of 7 million kilograms.

The Effect of Price Elasticity of Demand

The division of the tax burden is not always equal. One factor that affects this division is the price elasticity of the market demand curve. Figure 3.10 shows two possible demand curves for strawberries. In the left-hand graph, the relevant range of the demand curve is relatively elastic. In this case, the tax portion paid by consumers, as represented by area A, is smaller than that paid by producers, represented by area B. In contrast, the right-hand graph has a demand curve that is relatively inelastic in the relevant range. Consequently, the portion paid by consumers (area A) is larger than that paid by producers (area B). As a general rule, whenever supply is given, a more inelastic demand curve means a greater portion of an excise tax is paid by consumers.

FIGURE 3.10 Excise Taxes and Demand Elasticity



In the left-hand graph, a $1 excise tax causes supply as seen by consumers to shift to S_1. Initially consumers see a price of $3 (point b). At the new equilibrium, consumers pay a price of $2.25 (point a) while producers receive a price of $1.25. Because D is elastic, producers pay more of the tax (area B) than do consumers (area A). When D is inelastic, as in the right-hand graph, however, consumers pay more of the tax (area A) than do producers (area B).

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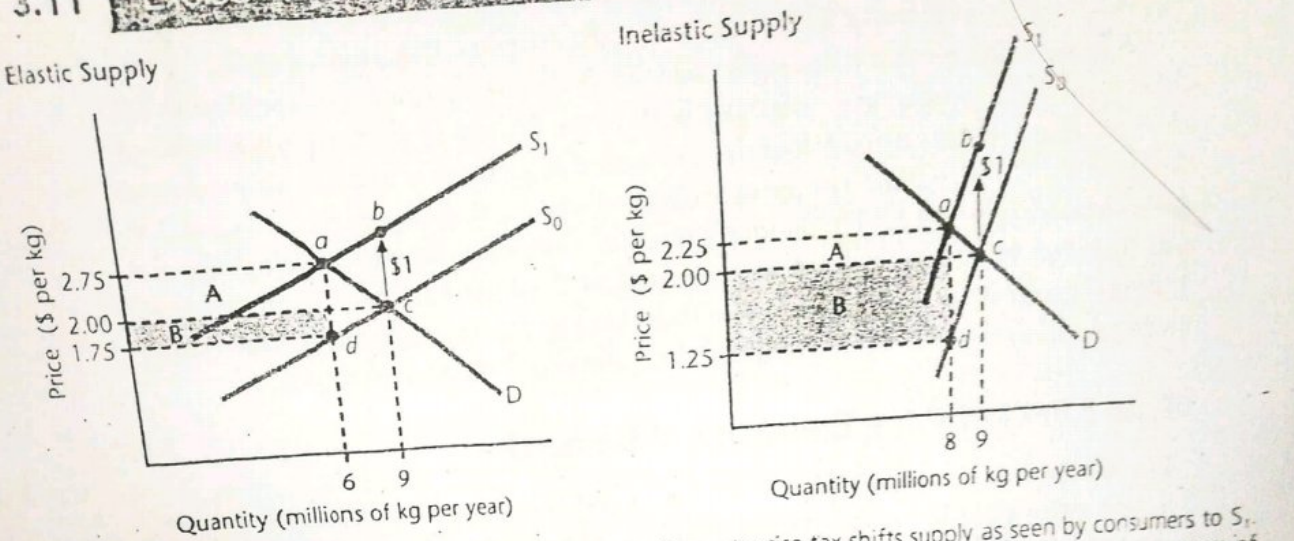
FIGURE 3.11 Excise Taxes and Supply Elasticity



In the left-hand graph, consumers initially pay a price of $3 (point *b*) after an excise tax shifts supply as seen by consumers to S_1. At the new equilibrium, the price for consumers is $2.75 and for producers is $1.75. Because S is elastic, consumers pay more of the tax (area A) than do producers (area B). However, if S is inelastic, as in the right-hand graph, producers pay more of the tax (area B) than do consumers (area A).

The Effect of Price Elasticity of Supply

The division of the tax burden also depends on the price elasticity of supply, as shown in Figure 3.11. In the left-hand graph, supply is relatively elastic. Here the tax portion paid by consumers (area A) exceeds that paid by producers (area B). In the right-hand graph, the relatively inelastic supply curve means that the tax portion paid by consumers is now exceeded by that paid by producers. This is shown by the fact that area B exceeds area A. As a general rule, when demand is given, a more inelastic supply curve means a greater portion of an excise tax is paid by producers.

The Role of Elasticity in Tax Policy

These two general rules governing the relative burdens of an excise tax for consumers and producers explain why public authorities are so interested in estimating price elasticities of both demand and supply when considering an excise tax. The combined impact of the price elasticities of demand and supply determine which group ends up paying the bulk of the tax.

BRIEF REVIEW

1. The division of the payment of an excise tax between consumers and producers depends on the extent to which the resulting price rise seen by consumers compares with the price drop seen by producers.
2. With supply given, a more inelastic demand means that a larger portion of an excise tax is paid by consumers.
3. With demand given, a more inelastic supply means that a larger portion of an excise tax is paid by producers.

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3.3 | PRACTICE QUESTIONS

1. Using the EconGraphKit, available at the Online Learning Centre, draw a graph showing a market with an inelastic demand curve and an elastic supply curve. Then show how an excise tax affects this market. Do consumers or producers pay the greater burden of this tax? Explain.
2. Again using the EconGraphKit, available at the Online Learning Centre, draw a graph displaying a market with an elastic demand curve and an inelastic supply curve. Now show how an excise tax affects this market. Do consumers or producers pay the greater burden? Explain.

3.4 | Price Controls

LO4

price floor: a legal minimum price

price ceiling: a legal maximum price

Sometimes governments see fit to control prices, thus overriding the forces of demand and supply and the "invisible hand" of competition. There are two types of price controls. **A price floor** is a legal minimum price. To be effective, such a floor must be set above the price that would otherwise exist in equilibrium. **A price ceiling** is a legal maximum price. This ceiling will be effective only if set below the equilibrium price. An example is rent controls. **Notice that "floor" and "ceiling" have special meanings in economics. Unless a price floor is higher than equilibrium, it will have no effect on the price prevailing in the market. Similarly, a price ceiling must be lower than equilibrium to be relevant.**

Demand and supply can be used to analyze the effects of government programs to control prices. Because analyzing price controls also involves weighing one goal against another, the analysis depends on value judgments and so is part of normative economics.

Agricultural Price Supports

Agricultural markets provide a useful example of the potential difficulties encountered by competitive producers.

Given the nature of demand and supply for most agricultural products, farmers face product prices that can fluctuate widely. Such products as milk and wheat are viewed as necessities by consumers, so demand curves for these items are inelastic, especially in the short run. Similarly, the short-run supply curves for most agricultural products are inelastic because farmers find it difficult to vary quantity supplied over brief time periods.

Inelastic demand and supply in agricultural markets mean that changes in either demand or supply lead to relatively large price changes. This is illustrated in Figure 3.12, using a hypothetical market for wheat. A decrease in the supply of wheat, due to unfavourable weather, leads to a fairly small decrease in the equilibrium quantity but a considerable rise in price.

Unstable prices, therefore, can cause large fluctuations in farmers' incomes. In the years when prices are high, farmers can make substantial revenues, but low prices cause revenues to plummet. Over the long term, farmers also face pressures from the introduction of more sophisticated and expensive production techniques. These techniques make small producers less able to compete with large agribusinesses, especially when they are forced to sell to one of a few food-processing companies that dominate many

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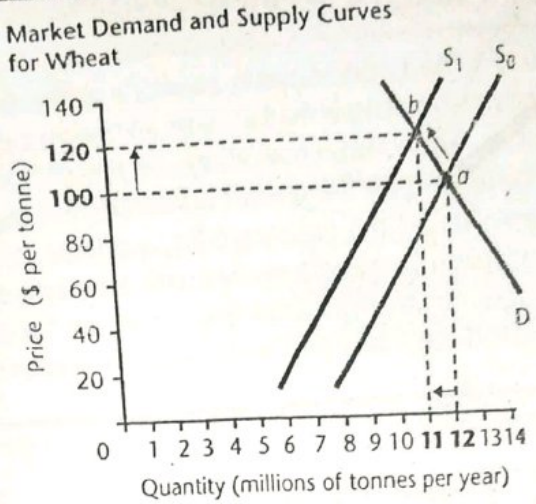
FIGURE 3.12 Price Fluctuations in Agriculture

Market Demand and Supply Schedules for Wheat

Price ($ per tonne)	Quantity Demanded (D) (millions of tonnes)	Quantity Supplied (S_0) (S_1)
$140	10	14 → 12
120	11	13 → 11
100	12	12 → 10
80	13	11 → 9
60	14	10 → 8



Because both the demand and the supply for wheat are inelastic in the short run, a decrease in supply caused by such a factor as unfavourable weather has a relatively large effect on price, with its equilibrium value rising 20 percent. At the same time, equilibrium quantity adjusts by a smaller percentage.

agricultural markets. Consequently, many Canadian farmers have decided that the returns from agriculture are no longer worth the effort. The total number of Canadian farms is undergoing a gradual but persistent decline, as shown in Figure 3.13.

To counter these difficulties, farmers often request that governments intervene in markets to stabilize prices at favourable levels. In the past, federal and provincial governments have usually responded positively to these demands, not only out of a desire to stabilize prices and farm incomes, but also because the family farm represents a traditional institution that many Canadians wish to see maintained through government intervention.

As outlined in the article "To the Limit," available at the book's Online Learning Centre, one type of government-sponsored program is the imposition of an agricultural marketing board to restrict output. Another type of government program is price supports.

FIGURE 3.13 Total Number of Farms in Canada (thousands)

Year	Canada	NL	PE	NS	NB	QC	ON	MB	SK	AB	BC
1931	728.6	n.a.	12.9	39.4	34.0	136.0	192.2	54.2	136.5	97.4	26.1
1941	732.8	n.a.	12.2	33.0	31.9	154.7	178.2	58.0	138.7	99.7	26.4
1951	623.1	3.6	10.1	23.5	26.4	134.3	150.0	52.4	112.0	84.3	26.4
1961	480.9	1.8	7.3	12.5	11.8	95.8	121.3	43.3	94.0	73.2	20.0
1971	366.1	1.0	4.5	6.0	5.5	61.3	94.7	35.0	77.0	62.7	18.4
1981	318.4	0.7	3.2	5.1	4.1	48.1	82.4	29.4	67.3	58.1	20.0
1991	280.1	0.7	2.4	3.9	3.2	38.1	68.6	25.7	60.8	57.2	19.2
2001	246.9	0.6	1.8	3.9	3.0	32.1	59.7	21.1	50.6	53.7	20.3
2006	229.4	0.6	1.7	3.8	2.8	30.7	57.2	19.1	44.3	49.4	19.8

The total number of Canadian farms has fallen consistently since 1931. This trend is reflected in each of the provinces, although there have been several periods during which the number of farms in some provinces has stayed constant or even increased.

Sources: Adapted from the Statistics Canada publication "Historical Overview of Canadian Agriculture (data and analytical products: 1996 Census of Agriculture)," Catalogue 93-358, August 1997, pp. 2–43; "Snapshot of Canadian Agriculture," December 11, 2007, Table 2 (http://www.statcan.ca/english/agcensus2006/articles/snapshot.htm).

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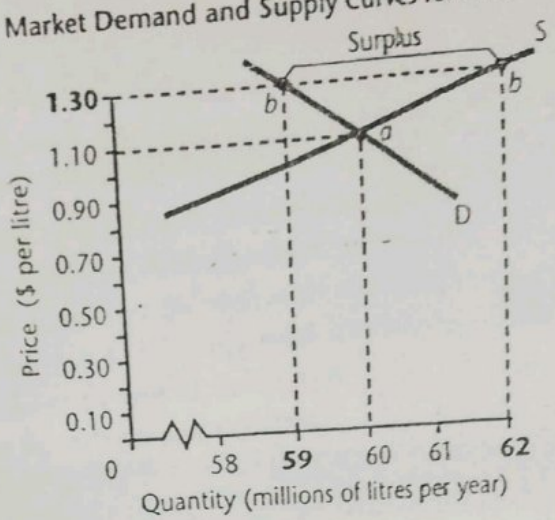
FIGURE 3.14 Effects of Price Supports

Market Demand and Supply Schedules for Milk

Price ($ per litre)	Quantity Demanded (D) (millions of litres)	Quantity Supplied (S) (millions of litres)
$1.30	59	62
1.10	60	60
0.90	61	58



Because the equilibrium price for milk (point a) is considered too low, the government agency imposes a price floor. This creates a milk surplus, at points b. As long as the demand and supply curves remain the same, this surplus will recur each year, and the government agency's stock of milk will increase.

illustrated by a hypothetical market for milk in Figure 3.14. Without government intervention, this market would reach an equilibrium price of $1.10 per litre and an associated quantity of 60 million litres sold per year. A government agency pays a minimum price, such as $1.30, which is above the equilibrium level. The floor price has two effects: quantity demanded decreases from 60 to 59 million litres, and quantity supplied increases from 60 to 62 million litres. Both effects lead to a surplus of the commodity of 3 million litres per year (= 62 million − 59 million), which the government agency purchases.

WINNERS AND LOSERS

Farmers are the obvious winners from price supports. The program causes both price and quantity supplied to increase, and also raises farmers' revenues. Consumers lose because of the higher prices they pay, while taxpayers lose because they must foot the

THINKING ABOUT ECONOMICS

Are minimum wages another example of price supports?

Yes. Minimum wages apply in the markets for labour, which, like perfectly competitive product markets, exhibit a downward-sloping demand curve and an upward-sloping supply curve. The negative slope of the demand curve reflects the fact that demanders of labour (i.e., employers) tend to cut back on the numbers of workers they hire at higher wage rates, while the positively-sloped supply curve shows that higher wage rates will tend to cause more workers to offer their labour in the market. As long as a particular labour market is competitive, then a minimum wage set above the equilibrium wage rate will tend to cause a surplus of labour at the prevailing minimum wage. In the case of labour markets, this surplus represents unemployed labour.

QUESTION **In which sorts of labour markets do you think a set minimum wage will most likely exceed the equilibrium wage rate—a market for skilled labour or one for unskilled labour? Why?**

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bill for the government agency's purchases of surplus products. Finally, by causing economic resources to be devoted to the production of unneeded agricultural surpluses, this program also works to the disadvantage of society as a whole. Are the benefits to farmers worth the costs to consumers, taxpayers, and the rest of society? The answer to this question depends on how important you consider the stability and health of the farming sector to be in relation to the costs of supporting the agricultural sector.

Rent Controls

Another way that governments override the "invisible hand" of competition is with price ceilings, which are upper limits to a price, such as rent. For example, a rent-control program was imposed on rental housing in Ontario in the 1970s due to pressure from tenant lobby groups, with capped rent increases kept below the rate of inflation. Figure 3.15 shows the effect of rent controls in a hypothetical large community with a competitive rental market, assuming that all rental units in this market are identical. Without a rent-control program, equilibrium in the market would occur at a monthly rent per unit of $1000 and a total of 2000 units rented per month. Controls push rents below the equilibrium level, to a value of $600. Consequently, quantity demanded increases from 2000 to 2300 units as more consumers enter the market. At the same time, quantity supplied falls from 2000 to 1500 units as landlords find it it less profitable to remain in the rental market and thus provide fewer units than before.

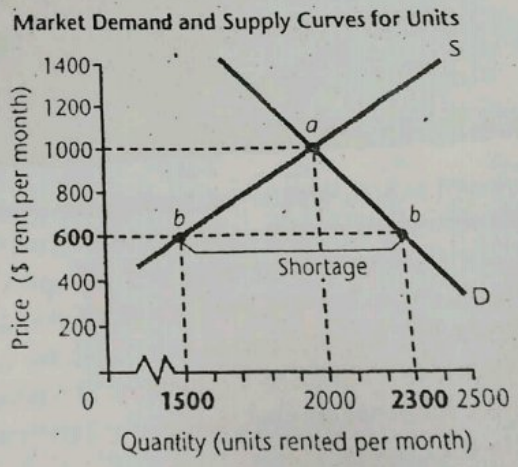
Quantity supplied is reduced in two ways: new rental construction is cut back, and some existing buildings are demolished or converted to other uses. The result of this artificially low rent is a shortage of 800 (= 2300 − 1500) rental units. This shortage makes itself felt through a low vacancy rate for units. This means an unusually small percentage of units are available for rent at any given time.

As a rule, shortages foster underground markets. In the case of rental housing, some landlords and tenants who are subletting their apartments to other tenants charge a fee for preference among people on waiting lists. These fees, or bribes, are known as "key money" and are illegal. To get around the law, key money often takes imaginative forms, such as forced purchases of furnishings at exorbitant prices.

FIGURE 3.15 Effects of Rent Controls

Market Demand and Supply Schedules for Units

Price ($ rent per month)	Quantity Demanded (D) (units rented per month)	Quantity Supplied (S) (units rented per month)
$1400	1700	2500
1000	2000	2000
600	2300	1500



Rent controls force price below the equilibrium level, from point a to points b. Quantity demanded rises at the new price, while quantity supplied falls. The price ceiling thus causes a shortage.

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WINNERS AND LOSERS

According to critics, even though rent controls may appear to offer tenants some short-run protection, in the long run they harm society as a whole by driving economic resources away from an important housing market and creating a shortage. Because of the restraints placed on landlords in setting their own price, they are particularly hurt by such controls. Some tenants gain from controls, especially middle-class tenants who have the connections and credentials to acquire the most desirable units. However, the shortage caused by controls pushes many poorer tenants into unregulated units, such as basement flats and rooming houses, with rents that are often higher than for units in the controlled market. Therefore, not only do rent controls lower the stock of rental housing, but they can affect different income groups unfairly. Further practice involving the market effects of a price ceiling such as rent controls can be found in the simulation accompanying this chapter at the book's Online Learning Centre.

CHAPTER REVIEW

1. For various reasons, governments sometimes choose to intervene in markets to override the "invisible hand" of competition. Price controls are one form of intervention and take the form of price floors and price ceilings.
2. Setting a price floor, or a minimum allowable price, in a competitive market tends to cause surpluses.
3. Setting a price ceiling, or a maximum allowable price, in a competitive market tends to cause shortages.

3.4 PRACTICE QUESTIONS

1. For each of the following price controls, outline the costs and benefits for consumers and producers.
   a. A rent ceiling of $500 per month is imposed in a market where equilibrium rent would otherwise be $650.
   b. A price floor of $2 per kg is set in a market for cheddar cheese. Without this program, the equilibrium price for cheddar cheese would be $1.50.
   c. A rent ceiling of $700 per month is imposed in a market where the equilibrium rent would otherwise be $600.

LAST WORD

This chapter extended the basics of demand and supply studied in Chapter 2 to examine in more detail how buyers and sellers interact in private markets. The concept of elasticity allowed us to see how consumer decisions affect the sellers' total revenue, and how supply factors affect price and quantity in various production periods. We then looked at some of the ways that government chooses to intervene in private markets—either by levying excise taxes or by imposing price controls. In the following chapters, we will further explore the ways in which businesses and consumers interact in particular markets, and examine other forms of intervention that governments use to amend market outcomes.

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1. Explain why the demand curve for ice-cream cones in the left-hand graph of Figure 3.1 is more elastic than that in the right-hand graph.

2. Explain whether demand for each of the following is likely to be inelastic, elastic, or unit-elastic. Given your answers, outline whether the sellers' total revenue will increase, decrease, or stay constant if each item's price increases.
   a. milk
   b. a particular model of digital camera
   c. yachts

3. In each case below, determine the effect on the sellers' total revenue and identify whether the demand curve is elastic, inelastic, or unit-elastic:
   a. Price falls from $2 to $1.50 along the market demand curve for strawberries (D_m) shown in Figure 2.2 in Chapter 2.
   b. Price rises from $150 to $200 along the original demand for skis (D_0) shown in Figure 2.4 in Chapter 2.
   c. Price drops from $12 to $8 along the demand curve for CDs shown on p. 6 of the Skills Resource, available at the Online Learning Centre.

4. a. Use the table below to draw a graph showing the market demand curve and supply curve (D_5 and S_0) for a hypothetical market for leather jackets. On your graph, indicate the equilibrium price and quantity.

Market Demand and Supply Schedules for Leather Jackets

Price ($ per jacket)	Quantity Demanded (jackets per year)	Quantity Supplied (jackets per year)
$300	69 000	108 000
250	77 000	77 000
200	86 000	53 000
150	94 000	31 000
100	103 000	19 000

   b. Due to an increase in the number of producers in this market, the annual quantity supplied in this market increases by 33 000 jackets at every price. On the same graph you drew in part a, show the new market supply curve (S_1) and indicate the new equilibrium price and quantity.

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c. Calculate the change in total revenue for producers in this market due to the shift from S_0 to S_1. Is the demand for leather jackets between the old and new equilibrium points inelastic or elastic? Explain.

5. a. Use the market demand schedule for canoes shown below to find the total revenue at each given price.

Market Demand Schedule for Canoes

Price ($ per canoe)	Quantity Demanded (canoes per month)
$800	400
600	800
400	1200
200	1600

b. On the basis of your answer to part a, state whether the market demand for canoes is elastic, inelastic, or unit-elastic in the three price ranges $800 to $600, $600 to $400, and $400 to $200.

c. Compute the numerical values of the price elasticity of demand in the three relevant price ranges.

d. Are your answers to parts b and c consistent? Explain.

e. Graph the market demand curve for canoes (D) and calculate the numerical value of its slope. Does a demand curve with a constant slope have a constant numerical elasticity? Explain.

6. Calculate the appropriate elasticity coefficient in each of the following cases:
   a. Annual purchases of tablet computers rise from 200 000 to 300 000 when average consumer incomes increase from $50 000 to $70 000.
   b. Consumer A's monthly magazine purchases fall from four to three magazines when the price she pays each month for unlimited access to the Internet decreases from $20 to $10.
   c. Weekly purchases of packs of chewing gum rise from 1.2 million to 1.7 million packs when the price declines from $1 to 85 cents.
   d. A fall in the average price of smart phones from $300 to $200 increases purchases of smart phone apps from 1 million to 1.5 million per month.
   e. A rise in the price of wheat from $110 to $135 per tonne increases the amount supplied by wheat farmers from 8 million to 9 million tonnes.

7. In the silver market, producers offer 1 million ounces for sale each month at the initial price of $6 per ounce. The price then rises to $8.
   a. What happens to the quantity supplied of silver in the immediate run at the new $8 price? Sketch the immediate-run supply curve to explain your answer.
   b. In what direction will the quantity supplied of silver change in the short run at the new $8 price? Sketch the short-run supply curve to explain your answer.
   c. How will the price of silver change in the long run if this is a constant-cost industry? an increasing-cost industry? Sketch long-run supply curves to explain your answers.

8. a. Compute the numerical values of the price elasticity of supply for the market supply curve for strawberries (S) shown in Figure 2.5 in the two price ranges $1.50 to $2, and $2 to $2.50.
   b. Is the supply elastic, inelastic, or unit-elastic between prices $1.50 and $2.50?
   c. Must a supply curve with a constant slope have a constant numerical elasticity? Explain.

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9. **a.** Using the table below, draw a graph showing the demand curve (D) and the initial supply curve (S_0) for milkshakes. Identify the equilibrium price and quantity before the imposition of an excise tax.

Market Demand and Supply Schedules for Milkshakes

Price ($ per shake)	Quantity Demanded (millions of shakes per year)	Quantity Supplied (millions of shakes per year)
	D	S_0
$2.00	2	14
1.90	6	12
1.80	10	10
1.70	14	8
1.60	18	6
1.50	22	4
1.40	26	2

b. To raise funds for the government, an excise tax of 30 cents per milkshake is imposed in this market. Draw the new supply curve S_1 facing consumers, and find the new equilibrium point. Then calculate the total tax payment made by consumers and producers. Which group pays most of the tax? Why?

10. **a.** Sketch a graph showing a market with a perfectly elastic supply curve. If an excise tax is levied in this market, how is the burden of payment shared between consumers and producers? Explain.

b. Sketch a graph showing a market with a perfectly elastic demand curve. How is the burden of payment of an excise tax shared between consumers and producers in such a market? Explain.

11. **a.** Using the table below, draw a graph showing the demand curve (D_0) and the short-run supply curve (S_0) for cream cheese. Identify the equilibrium price and quantity in the absence of government intervention, and calculate consumers' total expenditure and the total revenue received by producers.

Market Demand and Supply Schedules for Cream Cheese

Price ($ per kilogram)	Quantity Demanded (thousands of kilograms per year)	Quantity Supplied (thousands of kilograms per year)	
	D_0	S_0	S_1
$4.50	560	1350 →	1890
4.00	590	1130 →	1420
3.50	630	890 →	960
3.00	670	670 →	670
2.50	700	440 →	380

b. After lobbying by the dairy industry, government imposes a price support for cream cheese of $4 per kilogram and agrees to purchase any unsold portion of the product at the $4 price. Outline the short-run effect of this program on consumers and producers.

c. In the long run, the annual supply curve for cream cheese becomes S_1. How do the long-run effects of the $4 price support differ from the short-run effects on consumers and producers?

d. Is the price-support program more costly to taxpayers in the short run or in the long run? Explain.

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12. For the schedules below, draw a graph showing the original demand curve (D_0) and supply curve (S_0) for apartments in a particular community.

Market Demand and Supply Schedules for Apartments

Price ($ per month)	Quantity Demanded (thousands of units rented per month)			Quantity Supplied (thousands of units rented per month)
	D_0	→	D_1	S_0
$800	14.5	→	18.4	18.4
700	17.3	→	21.2	17.3
600	19.5	→	23.4	16.4
500	22.0	→	25.9	15.6
400	23.7	→	27.6	14.2

a. Identify the equilibrium price and quantity in the absence of government intervention.
b. Using your graph, outline how a $500 price ceiling imposed by government affects this market. Make sure to distinguish between tenants who are able to find apartments at the ceiling price and those who are unable to do so.
c. An increase in the price of single-family dwellings in the community causes the demand for apartments to shift from D_0 to D_1. Draw this demand curve on your graph and explain how it influences the impact of the $500 ceiling price on tenants.

13. (Advanced Question)
The total annual revenue for producers of a given product called widgets is always $10 million, regardless of the price.
a. On the basis of this information, plot the market demand curve for widgets.
b. How would you describe the elasticity of this demand curve? Explain.

14. (Policy Discussion Question)
Access the online article *How Rent Control Drives Out Affordable Housing* (at **http://www.cato.org/pubs/pas/pa-274.html**).
a. Using the arguments in the article, explain how low-income tenants are often hurt by rent controls.
b. Outline why rent controls become more difficult to eliminate the longer they have been in existence in a particular community.
c. Though the article makes a case against rent controls, can you think of any arguments that can be made against abolishing rent controls that are already in place?

http://www.cato.org/pubs/pas/pa-274.html

INTERNET-BASED DATA QUESTIONS

1. Access Statistics Canada's E-STAT site (at **http://www.statcan.gc.ca/estat/licence-eng.htm**).
a. On the basis of the information found in "Agriculture," generate a map showing the average age of farmers in each Canadian province at the time of the last census.
b. In which province(s) is the average age of farmers the lowest? the highest?

http://www.statcan.gc.ca/estat/licence-eng.htm

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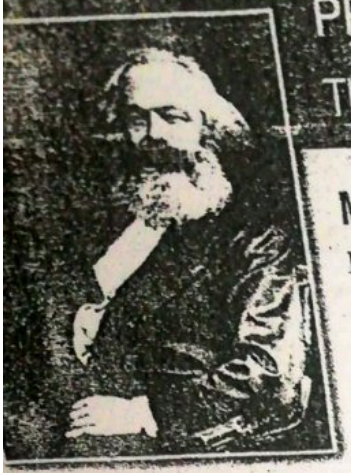
PROPHET OF CAPITALISM'S DOOM

The Economic Theories of Karl Marx



KARL MARX

MARX AND HIS INFLUENCE

Karl Marx (1818–1883) is best known as the founder of the international socialist and communist movements. He was born in the German state of Prussia, studied philosophy, and worked as a journalist before beginning his career as a political activist. Exiled from both Germany and France, he moved to England where, with his close friend Friedrich Engels (1820–1895), he applied his revolutionary views to the fields of philosophy, history, and economics.

Of these three subjects, it was what he called "the confounded ramifications of political economy" that gave him the most headaches. In his mammoth three-volume work, *Das Kapital*, Marx developed his theory of economics. He concluded that capitalism, by its very nature, was unjust.

MARX'S VIEW OF CAPITALISM

Marx's years in England allowed him to witness first-hand the effects of the British Industrial Revolution. By the mid-1800s, manufacturing was the mainstay of Britain's economy, and a large portion of the population had moved from rural areas to the burgeoning new cities in the hope of finding jobs in manufacturing. In the long run, the industrial transformation experienced in Britain enhanced the economic well-being of the majority of citizens of industrialized countries. But in Marx's day, the benefits of the Industrial Revolution seemed to be limited to the wealthier members of society. Living conditions were horrendous for the labouring classes in the rapidly expanding urban areas:

> And what cities! It was not merely that smoke hung over them and filth impregnated them, that the elementary public services—water-supply, sanitation, street-cleaning, open spaces, and so on—could not keep pace with the mass migration of men into cities, thus producing, especially after 1830, epidemics of cholera, typhoid and an appalling constant toll [from] air pollution and water pollution... The new city populations...[were] pressed into overcrowded and bleak slums, whose very sight froze the heart of the observer.[1]

MARX'S THEORY OF CAPITALISM

The Labour Theory of Value Marx blamed these conditions on capitalism itself. His attack was based on his "labour theory of value," in which prices of products depend on how much labour goes into producing them. According to this theory, only company owners (whom Marx called capitalists) have the financial resources to hire workers and sell the resulting output. By paying wages that are less than the value workers contribute to production, company owners are able to skim off a portion of value for themselves. By doing this, they engage in capitalist exploitation of their workforce.

The Theory of Exploitation An example will help explain Marx's theory. It may take a worker four hours to make a shirt and eight hours to make a suit. According to Marx, the price of the shirt should then be half that of the suit. say, the prices of the two products are $40 and $80, respectively. If so, workers producing either two shirts or

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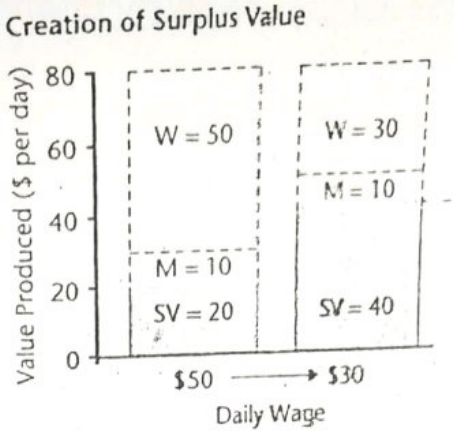
FIGURE A Marx's Theory of Exploitation

Creation of Surplus Value
(when producing 2 shirts or 1 suit)

	$50 Wage	$30 Wage
Daily wage (W)	$50	$30
Materials and machine wear and tear (M)	$10	$10
Surplus value (SV)	$20	$40
Total value	$80	$80
Exploitation rate (SV/W)	2/5	4/3



If daily wages are reduced from $50 to $30, daily surplus value extracted from each worker is increased (the shaded portions on the bar graphs). As a result, surplus value as a proportion of daily wages also increases.

one suit in an eight-hour day create $80 of value. Let us assume that daily wages in the textile trade are $50 and that the cost of materials plus daily wear and tear on the machines each worker uses is $10. The portion of value kept by the capitalist, or each worker's "surplus value," is, therefore, $20 [= $80 − ($50 + $10)] as shown in Figure A.

DYNAMICS OF CAPITALISM

With time, Marx argued, the rate of exploitation by capitalists would worsen, meaning surplus value would increase as a proportion of the daily wage. This could happen either through further decreases in wages or a lengthening of the workday.

Decreased Wages Capitalists try to slash wages as much as possible. The daily wage in our example could drop from $50 to $30, while the cost of materials, plus the wear and tear on machines, remains constant at $10. As a result, surplus value would rise to $40 [= $80 − ($30 + $10)]. Surplus value as a proportion of the daily wage would then increase from $20/$50 to $40/$30.

Lengthening of the Workday Capitalists also have an incentive to raise the number of hours workers put in each day. This expands the daily value created by each worker. As long as the daily wage remains the same, surplus value as a proportion of this wage would again rise.

COMMUNIST REVOLUTION

Marx believed that capitalist exploitation would worsen the living standards of workers until, finally, workers would violently revolt, first in the nations of Western Europe, which were most industrialized at the time Marx was writing, and later in other parts of the world. The overthrow of capitalism would usher in a socialist age based on common

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ownership of property. Once socialist ownership had been consolidated, true communism would arrive. Governments would disappear and people would be able to live in complete liberty. Society's guiding principle would then be "from each according to his abilities, and to each according to his needs."[2]

RELEVANCE FOR TODAY

Marx's theories have been the source of continuing controversy. His detractors challenge the usefulness of the labour theory of value and the notion of surplus value. They argue that other economic resources, such as capital and entrepreneurship, make their own contributions to production and that owners of these resources must receive a payment so that they will keep supplying their resources to businesses.

At the same time, Marx's theories had a significant impact throughout the 20th century. Socialists—who advocate that the community as a whole own and control the means of production, distribution, and exchange—have held power in many parts of the world. Among socialists, communists accepted the bulk of Marx's theories and applied them in countries subject to communist rule. In a country such as China, which is still officially communist, the influence of Marxist theory can be seen in the major role that government plays in regulating the economy and controlling many sectors through state-owned firms. In most nations, however, any influence Marx has had is less direct. Labour movements, for example, owe much to Marx's theories of capitalist exploitation. Through gradual reform, rather than revolution, socialists in such countries as Canada have played a major part in social reform and in creating modern mixed economies in which governments are much more important than they were a century or more ago.

Notes

[1] Adapted from *Industry and Empire: From 1750 to the Present Day* by E.J. Hobsbawm (Penguin Books, 1969). Copyright © E.J. Hobsbawm, 1968, 1969. Reprinted by permission.

[2] Karl Marx, *Critique of the Gotha Program*, 1875.

1. For the textile industry example given previously, imagine that each worker's wage is raised from $50 to $60 per day, while other costs remain the same. Create a bar graph to show the resulting change in surplus value per worker. How does surplus value change as a proportion of the daily wage?

2. Imagine that the daily wage of a textile worker remains at $50, but the workday is lengthened to 12 hours, causing each worker to raise production to $120 per day and increasing the other costs (materials and wear on machines) to $15 per worker.
   a. Create a bar graph to show the new surplus value per worker.
   b. Explain how surplus value changes as a proportion of the daily wage.
   c. Explain whether company owners are worse off or better off as a result of the lengthened workday.

3. Average living standards for workers in most capitalist countries have risen significantly since the period when Marx was writing. Outline two reasons why Marx's prediction of falling living standards for workers in these countries has proven to be incorrect.

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