Part 2

# Microeconomics of Product Markets

Chapter 5

# Supply and Demand

## Elasticities and Applications

### IN THIS CHAPTER YOU WILL LEARN:

- 5.1 The concept of price elasticity of demand and how to calculate it.
- 5.2 How price elasticity of demand affects total revenue.
- 5.3 The concept of price elasticity of supply and how to calculate it.
- 5.4 The cross and income elasticity of demand and how to calculate them.
- 5.5 To apply the concept of elasticity to various real-world situations.
- 5.6 How price supports in agriculture work.
- 5.7 About the economics of health care.

Modern market economies rely mainly on the activities of consumers, businesses, and resource suppliers to allocate resources efficiently. Those activities and their outcomes are the subject of *microeconomics,* to which we now turn. We begin Part 2 by investigating the behaviours and decisions of consumers and businesses.

In this chapter we extend our previous discussion of demand and supply. First, we introduce three ideas: *price elasticity,* the buying and selling responses of consumers and producers to price changes; *cross elasticity,* the buying response of consumers of one product when the price of another product changes; and *income elasticity,* the buying response of consumers when their incomes change. Second, we discuss a number of real-world applications of the elasticity concept.

## 5.1 Price Elasticity of Demand

The law of demand tells us that consumers will buy more of a product when its price declines and less when its price increases. But how much more or less will they buy?

**price elasticity of demand**
A measure of the responsiveness of buyers to a change in the price of a product or resource.

The responsiveness (or sensitivity) of consumers to a price change is measured by a product's **price elasticity of demand**. For some products—for example, restaurant meals—consumers are highly responsive to price changes. Modest price changes cause very large changes in the quantity purchased. Economists say that the demand for such products is *relatively elastic* or simply *elastic.*

For other products—for example, salt—consumers pay much less attention to price changes. Substantial price changes cause only small changes in the amount purchased. The demand for such products is *relatively inelastic* or simply *inelastic.*

### The Price Elasticity Coefficient and Formula

We measure the degree of price elasticity of demand with the coefficient $E_d$, defined as

$$E_d = \frac{\text{percentage change in quantity demanded of product X}}{\text{percentage change in price of product X}}$$

Let's look at a specific example from Table 5-1, rows 1 to 3, to see how the price elasticity of demand is calculated. This table shows the number of movie tickets demanded (in thousands) per week at each specified price. Let's calculate $E_d$ for, say, the \$5 to \$4 price range. But before we do so, let's look at how we calculate a percentage.

**TABLE 5-1 Price Elasticity of Demand for Movie Tickets as Measured by the Elasticity Coefficient and the Total-revenue Test**

| (1) Total quantity demanded per week (thousands) | (2) Price per unit | (3) Elasticity coefficient, $E_d$ | (4) Total revenue (1) × (2) | (5) Total-revenue test |
|---|---|---|---|---|
| 1 | \$8 | | \$ 8,000 | |
| | | 5.00 | | Elastic |
| 2 | 7 | | 14,000 | |
| | | 2.60 | | Elastic |
| 3 | 6 | | 18,000 | |
| | | 1.57 | | Elastic |
| 4 | 5 | | 20,000 | |
| | | 1.00 | | Unit elastic |
| 5 | 4 | | 20,000 | |
| | | 0.64 | | Inelastic |
| 6 | 3 | | 18,000 | |
| | | 0.38 | | Inelastic |
| 7 | 2 | | 14,000 | |
| | | 0.20 | | Inelastic |
| 8 | 1 | | 8,000 | |

### CALCULATING A PERCENTAGE

To calculate the percentage change in quantity demanded between two points, we divide the change in quantity demanded ($\triangle Q_d$)* by the original quantity demanded ($Q_0$) that we are considering:

$$\%\triangle Q_d = \frac{\text{change in quantity demanded of product X}}{\text{original quantity demanded of product X}} \times 100$$

For example, if the quantity demanded increased from 4 to 5 units, the percentage change in quantity demanded would be calculated as follows:

$$\%\triangle Q_d = \frac{\triangle Q_d}{Q_0} = \frac{1}{4} \times 100 = 25\%$$

To calculate the percentage change in price between two points, we would divide the change in price ($\triangle P$) by the original price ($P_0$):

$$\%\triangle P = \frac{\text{change in price of product X}}{\text{original price of product X}} \times 100$$

For example, if the price dropped from \$5 to \$4, the percentage change in price would be:

$$\%\triangle P = \frac{\triangle P}{P_0} = \frac{1}{5} \times 100 = 20\%$$

### AVERAGE PRICE AND QUANTITY

But we can run into confusion as to which original price or quantity to use when calculating the price elasticity of demand. To avoid such confusion we generally use the *average price* and *average quantity.* Thus, we can restate the price elasticity formula as:

$$E_d = \frac{\text{change in quantity}}{\text{sum of quantities/2}} \div \frac{\text{change in price}}{\text{sum of prices/2}} \times 100$$

In symbol, the formula becomes:

$$E_d = \frac{\triangle Q}{(Q_0 + Q_1)/2} \div \frac{\triangle P}{(P_0 + P_1)/2} \times 100$$

Thus, price elasticity of demand for a price change from \$4 to \$5 and a quantity change from 4 to 5, becomes:

$$E_d = \frac{1}{(4+5)/2} \div \frac{1}{(4+5)/2} \times 100$$

$$= \frac{1}{4.5} \div \frac{1}{4.5} \times 100$$

$$= \frac{22\%}{22\%} = 1$$

## Interpretation of $E_d$

We can interpret the coefficient of price elasticity of demand as follows.

### ELASTIC DEMAND

**elastic demand**
Product demand whose price elasticity is greater than one.

Demand is **elastic** if a specific percentage change in price results in a larger percentage change in quantity demanded. Then $E_d$ will be greater than one. For example, suppose that a 2 percent decline in the price of cut flowers results in a 4 percent increase in quantity demanded. Because $E_d = .04/.02 = 2$, demand for cut flowers is elastic.

*The Greek letter delta ($\triangle$) signifies "change in."

## INELASTIC DEMAND

**inelastic demand**
Product or resource demand for which the price elasticity coefficient is less than one.

If a specific percentage change in price produces a smaller percentage change in quantity demanded, demand is **inelastic**. $E_d$ will be less than one. For example, suppose that a 2 percent decline in the price of coffee leads to only a 1 percent increase in quantity demanded. Because $E_d = .01/.02 = .5$ demand is inelastic.

## UNIT ELASTICITY

**unit elasticity**
Demand or supply for which the elasticity coefficient is equal to one.

The case separating elastic and inelastic demands occurs when a percentage change in price and the resulting percentage change in quantity demanded are the same. For example, suppose that a 2 percent drop in the price of chocolate causes a 2 percent increase in quantity demanded. This special case is termed **unit elasticity** because $E_d$ is exactly one, or unity. In this example, $E_d = .02/.02 = 1$.

## USE OF PERCENTAGES

Note that we use percentages rather than absolute amounts in measuring consumer responsiveness. If we use absolute changes, the choice of units will arbitrarily affect our impression of buyer responsiveness. To illustrate, if the price of a bag of popcorn at the local softball game is reduced from $3 to $2, and consumers increase their purchases from 60 to 100 bags, it appears that consumers are quite sensitive to price changes and, therefore, that demand is elastic. After all, a price change of one unit has caused a change of 40 units in the amount demanded. But by changing the monetary unit from dollars to pennies (why not?), we find that a price change of 100 units (pennies) causes a quantity change of 40 units. This result may falsely lead us to believe that demand is inelastic. We avoid this problem by using percentage changes. This particular price decline is 33 percent whether we measure in dollars ($1/$3) or pennies (100¢/300¢).

Also, by using percentages, we can correctly compare consumer responsiveness to changes in the prices of different products. It makes little sense to compare the effects on quantity demanded of a $1 increase in the price of a $10,000 used car with a $1 increase in the price of a $1 soft drink. Here the price of the used car increased by .01 percent while the price of the soft drink increased by 100 percent.

## ELIMINATION OF THE MINUS SIGN

We know from the downsloping demand curve shown in Chapter 3 that price and quantity demanded are inversely related. Thus, the price elasticity coefficient of demand $E_d$ will always be a negative number. We usually ignore the minus sign and simply present the absolute value of the elasticity coefficient to avoid an ambiguity that might otherwise arise. It can be confusing to say that an $E_d$ of –4 is greater than one of –2. This possible confusion is avoided when we say an $E_d$ of 4 reveals greater elasticity than one of 2.

## EXTREME CASES

**perfectly inelastic demand**
Quantity demanded does not respond to a change in price.

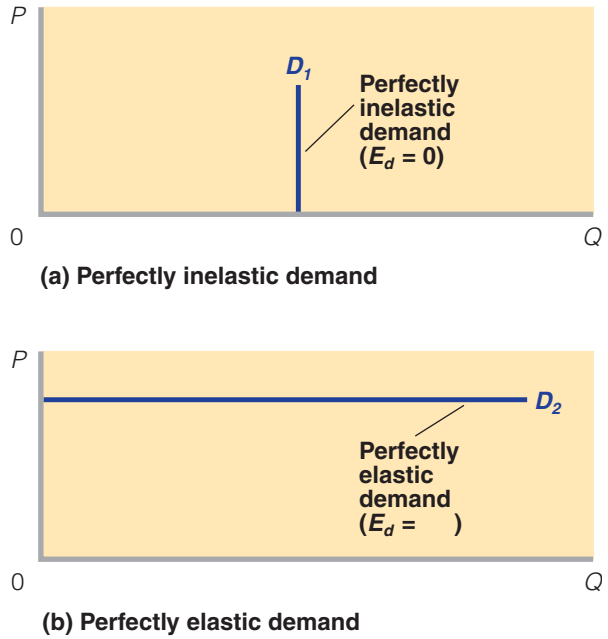
When we say demand is *inelastic,* we do not mean that consumers are completely unresponsive to a price change. In that extreme situation, when a price change results in no change whatsoever in the quantity demanded, economists say that demand is **perfectly inelastic**. The price elasticity coefficient is zero because there is no response to a change in price. Approximate examples include a diabetic's demand for insulin or an addict's demand for heroin. A line parallel to the vertical axis, such as $D_1$ in Figure 5-1(a), shows perfectly inelastic demand graphically.

**perfectly elastic demand**
Quantity demanded can be of any amount at a particular product price.

Conversely, when demand is *elastic,* we do not mean that consumers are completely responsive to a price change. In that extreme situation, when a small price reduction causes buyers to increase their purchases from zero to all they can obtain, the elasticity coefficient is infinite ($= \infty$), and economists say demand is **perfectly elastic**. A line parallel to the horizontal axis, such as $D_2$ in Figure 5-1(b), shows perfectly elastic demand.

**FIGURE 5-1** **Perfectly Inelastic and Perfectly Elastic Demand**

Demand curve $D_1$ in panel (a) represents perfectly inelastic demand ($E_d = 0$). A price increase does not change the quantity demanded. Demand curve $D_2$ in panel (b) represents perfectly elastic demand. A price increase causes quantity demanded to decline from an infinite amount to zero ($E_d = \infty$).




As an exercise, verify the elasticity coefficients for the \$1 to \$2 and \$7 to \$8 ticket price ranges in Table 5-1. The interpretation of $E_d$ for the \$1 to \$2 range is that a 1 percent change in price will change quantity demanded by 0.20 percent. For the \$7 to \$8 range, a 1 percent change in price will change quantity demanded by 5 percent.

## Graphical Analysis

We used the hypothetical data for movie tickets in columns 1 and 2 of Table 5-1 to plot the demand curve $D$ in Figure 5-2(a). The curve illustrates that elasticity typically varies over the different price ranges of the same demand schedule or curve. For all straight-line and most other demand curves, demand is more elastic toward the upper left (the \$5 to \$8 price range of $D$) than toward the lower right (the \$4 to \$1 price range of $D$).

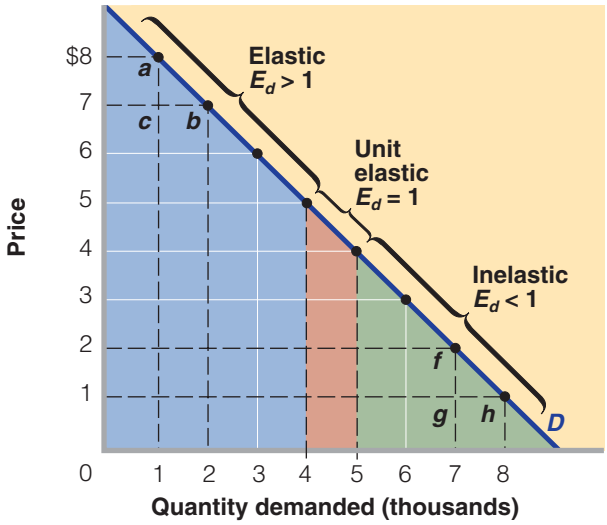
This difference is the consequence of arithmetic properties of the elasticity measure. Specifically, in the upper left segment of the demand curve, the percentage change in quantity is large because the original reference quantity is small. Similarly, the percentage change in price is small in that segment because the original reference price is large. The relatively large percentage change in quantity divided by the relatively small change in price yields a large $E_d$—an elastic demand.

The reverse holds true for the lower right segment of the demand curve. Here the percentage change in quantity is small because the original reference quantity is large; similarly, the percentage change in price is large because the original reference price is small. The relatively small percentage change in quantity divided by the relatively large percentage change in price results in a small $E_d$—an inelastic demand.

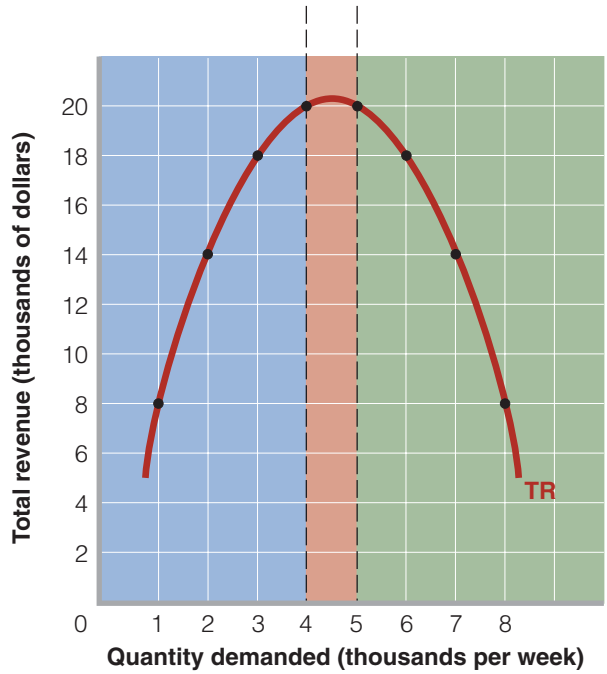
The demand curve in Figure 5-2(a) also illustrates that the slope of a demand curve—its flatness or steepness—is not a sound basis for judging elasticity. The catch is that the slope of the curve is computed from *absolute* changes in price and quantity, while elasticity involves *relative* or

**FIGURE 5-2** **The Relation Between Price Elasticity of Demand for Movie Tickets and Total Revenue**

Demand curve *D* in panel (a) is based on Table 5-1 and is marked to show that the hypothetical weekly demand for movie tickets is elastic at higher price ranges and inelastic at lower price ranges. The total-revenue curve TR in panel (b) is derived from demand curve *D*. When price falls and TR increases, demand is elastic; when price falls and TR is unchanged, demand is unit elastic; when price falls and TR declines, demand is inelastic.




(a) Demand curve




(b) Total-revenue curve

*percentage* changes in price and quantity. The demand curve in Figure 5-2(a) is linear, which by definition means that the slope is constant throughout, but we have demonstrated that such a curve is elastic in its high-price ($8 to $5) range and inelastic in its low-price ($4 to $1) range. ***(Key Question 2)***

**QUICK REVIEW**

- Price elasticity of demand measures the sensitivity of consumers to changes in the price of a product.
- The price elasticity of demand coefficient $E_d$ is the ratio of the percentage change in quantity demanded to the percentage change in price. The averages of the prices and quantities are used as references in calculating the percentage changes.
- When $E_d$ is greater than one, demand is elastic; when $E_d$ is less than one, demand is inelastic; when $E_d$ is equal to one, demand is unit elastic.
- Demand is typically elastic in the high-price (low-quantity) range of the demand curve and inelastic in the low-price (high-quantity) range of the curve.

## 5.2 The Total-revenue Test

**total revenue (TR)**
The total number of dollars received by a firm from the sale of a product in a particular period.

**total-revenue test**
A test to determine elasticity of demand between any two prices.

The importance of elasticity for firms relates to the effect of price changes on total revenue and thus on profits (total revenue minus total costs).

**Total revenue (TR)** is the total amount the seller receives from the sale of a product in a particular period; it is calculated by multiplying the product price ($P$) by the quantity demanded and sold ($Q$). In equation form, $TR = P \times Q$. Total revenue and the price elasticity of demand are related. Indeed, perhaps the easiest way to infer whether demand is elastic or inelastic is to employ the **total-revenue test**, which looks at what happens to total revenue when product price changes.

### Elastic Demand

If demand is elastic, a decrease in price will increase total revenue. Even though a lesser price is received per unit, enough additional units are sold to more than compensate for the lower price. For an example, look at demand curve $D$ in Figure 5-2(a), specifically the elastic-demand region at the upper left. (Disregard Figure 5-2(b) for the moment.) At point $a$ on the curve, price is \$8 and quantity demanded is 1 unit, or 1000 tickets. So total revenue, or price times quantity, is \$8000 (= \$8 × 1000 tickets).

If the price of movie tickets declines to \$7 (point $b$), the quantity demanded becomes 2 units, and total revenue is \$14,000 (= \$2 × 7000 units). As a result of the price decline from \$8 to \$7, total revenue has increased from \$8000 to \$14,000. This increase has occurred because the loss in revenue from the lower price per unit is less than the gain in revenue from the larger quantity demanded at the lower price.

The reasoning is reversible: If demand is elastic, a price increase will reduce total revenue. If we shift from $b$ to $a$ on the demand curve, the gain in total revenue caused by the higher ticket price is less than the loss in revenue from the drop in sales. Combining these results tells us that demand is elastic if a price change causes total revenue to change in the opposite direction.

### Inelastic Demand

If demand is inelastic, a price decrease will reduce total revenue. The modest increase in ticket sales will not offset the decline in revenue per unit, and the net result is that total revenue will decline. To see this, look toward the lower right of demand curve $D$ in Figure 5-2(a), specifically the inelastic-demand region. At point $f$ on the curve, price is \$2 and quantity demanded is 7000 tickets. So total revenue is \$14,000. If the price drops to \$1 (point $h$), quantity demanded increases to 8000 tickets. Total revenue becomes \$8000, which is clearly less than \$14,000.

Again, our analysis is reversible: If demand is inelastic, a price increase will increase total revenue. Together, these results tell us that demand is inelastic if a price change causes total revenue to change in the same direction.

## Unit Elasticity

In the special case of unit elasticity, an increase or a decrease in price leaves total revenue unchanged. In Figure 5-2(a) we find that at the $5 price, 4000 tickets will be sold, yielding total revenue of $20,000. At $4, 5000 tickets will be sold, again resulting in $20,000 of total revenue. The $1 price reduction causes the loss of $4000 in revenue on the 4000 tickets that could have been sold for $5 each. This loss is exactly offset by a $4000 revenue gain resulting from the sale of 1000 more tickets at the lower $4 price.

## Price Elasticity and the Total-revenue Curve

In Figure 5-2(b) we graphed the total revenue per week to the theatre owner that corresponds to each price–quantity combination indicated along demand curve *D* in Figure 5-2(a). Comparison of curves *D* and TR sharply focuses the relationship between elasticity and total revenue. Lowering the ticket price in the elastic range of demand—for example, from $8 to $5—increases total revenue. Conversely, increasing the ticket price in that range reduces total revenue. In both cases, price and total revenue change in opposite directions, confirming that demand is elastic.

The $5 to $4 price range of demand curve *D* reflects unit elasticity. When price either decreases from $5 to $4 or increases from $4 to $5, total revenue remains $20,000. In both cases, price has changed and total revenue has remained constant, confirming that demand is unit elastic when we consider these particular price changes.

In the inelastic range of demand curve *D*, lowering the price—for example, from $4 to $1—decreases total revenue, as shown in Figure 5-2(b). Raising the price boosts total revenue. In both cases, price and total revenue move in the same direction, confirming that demand is inelastic.

Table 5-2 summarizes the characteristics of price elasticity of demand. You should review it carefully. ***(Key Questions 4 and 5)***

## Determinants of Price Elasticity of Demand

What determines the price elasticity of demand? Four main factors stand out.

**TABLE 5-2 Price Elasticity of Demand: A Summary**

| Absolute value of elasticity coefficient | Demand is | Description | Impact on total revenue of a: Price increase | Impact on total revenue of a: Price decrease |
|---|---|---|---|---|
| Greater than 1 ($E_d > 1$) | Elastic or relatively elastic | Quantity demanded changes by a larger percentage than does price | Total revenue decreases | Total revenue increases |
| Equal to 1 ($E_d = 1$) | Unit or unitary elastic | Quantity demanded changes by the same percentage as does price | Total revenue is unchanged | Total revenue is unchanged |
| Less than 1 ($E_d < 1$) | Inelastic or relatively inelastic | Quantity demanded changes by a smaller percentage than does price | Total revenue increases | Total revenue decreases |

## SUBSTITUTABILITY

Generally, *the larger the number of substitute goods that are available, the greater the price elasticity of demand.* We will see later that in a purely competitive market, where by definition many perfect substitutes exist for the product of any specific seller, the demand curve for the single seller is perfectly elastic. If one competitive seller of carrots or potatoes raises its price, buyers will turn to the readily available perfect substitutes provided by its many rivals. Similarly, we would expect the lowering of world trade barriers to increase the elasticity of demand for most products by making more substitutes available. With unimpeded foreign trade, Mercedes and BMWs become effective substitutes for domestic Cadillacs and Lincolns. At the other extreme, we saw earlier that the diabetic's demand for insulin is highly inelastic because no close substitutes exist.

The elasticity of demand for a product depends on how narrowly the product is defined. Demand for Reebok sneakers is more elastic than is the overall demand for shoes. Many other brands are readily substitutable for Reebok sneakers, but there are few, if any, good substitutes for shoes.

## PROPORTION OF INCOME

Other things equal, *the greater the proportion of income spent on a good, the greater the price elasticity of demand for it.* A 10 percent increase in the price of relatively low-priced pencils or chewing gum amounts to a very small proportion of most people's incomes, and quantity demanded will probably decline only slightly. Thus, price elasticity for such items tends to be low. But a 10 percent increase in the price of relatively high-priced automobiles or houses means additional expenditures of perhaps $6000 or $70,000, respectively. These price increases are significant fractions of the annual incomes and budgets of most families, and quantities demanded will likely diminish significantly. Price elasticity for such items tends to be high.

## LUXURIES VERSUS NECESSITIES

In general, the more a good is considered a luxury rather than a necessity, the greater is the price elasticity of demand.

In general, *the more that a good is considered a luxury rather than a necessity, the greater is the price elasticity of demand.* Bread and electricity are generally regarded as necessities; a price increase will not significantly reduce the amount of bread consumed or the amount of lighting and power used in a household. (Note the very low price elasticity coefficient of these goods in Table 5-3.) In an extreme example, a person does not decline an operation for acute appendicitis because the surgeon has found a way to extra-bill.

However, travel vacations and jewellery are luxuries, which, by definition, can easily be forgone. If the prices of travel vacations or jewellery rise, a consumer need not buy them and will suffer no greater hardship without them.

## TIME

Generally, *product demand is more elastic the longer the period under consideration.* Consumers often need time to adjust to changes in prices. When the price of a product rises, it takes time to find and experiment with other products to see whether they are acceptable. Consumers may not immediately reduce their purchases very much when the price of beef rises by 10 percent, but in time they may switch to chicken or fish.

Studies show that short-run demand for gasoline is more inelastic ($E_d = .2$) than is long-run demand ($E_d = .7$). In the short run, people are stuck with their present cars and trucks, but with rising gasoline prices, they will eventually replace them with smaller, more fuel-efficient vehicles.

Table 5-3 shows estimated price elasticity coefficients for several products. Each coefficient reflects some combination of the elasticity determinants just discussed. As an exercise, select two or three of them and explain how they relate to the determinants. ***(Key Question 6)***

**TABLE 5-3 Selected Price Elasticities of Demand**

| Product or service | Coefficient of price elasticity of demand, $E_d$ | Product or service | Coefficient of price elasticity of demand, $E_d$ |
|---|---|---|---|
| Newspapers | .10 | Milk | .63 |
| Electricity (household) | .13 | Household appliances | .63 |
| Bread | .15 | Movies | .87 |
| Major league baseball tickets | .23 | Beer | .90 |
| Telephone service | .26 | Shoes | .91 |
| Sugar | .30 | Motor vehicles | 1.14 |
| Eggs | .32 | Beef | 1.27 |
| Legal services | .37 | China, glassware, tableware | 1.54 |
| Automobile repair | .40 | Restaurant meals | 2.27 |
| Clothing | .49 | Lamb and mutton | 2.65 |
| Gasoline | .60 | | |

Compiled from numerous studies and sources reporting price elasticity of demand.

**QUICK REVIEW**

- When the price of a good changes, total revenue will change in the opposite direction if demand for the good is price elastic, in the same direction if demand is price inelastic, and not at all if demand is unit elastic.
- Price elasticity of demand is greater (1) the larger the number of substitutes available, (2) the higher the price of a product relative to one's budget, (3) the greater the extent to which the product is a luxury, and (4) the longer the period involved.

## Applications of Price Elasticity of Demand

The concept of price elasticity of demand has great practical significance, as the following examples suggest.

### LARGE CROP YIELDS

The demand for most farm products is highly inelastic; $E_d$ is perhaps .20 or .25. As a result, increases in the output of farm products arising from a good growing season or from increased productivity tend to depress both the prices of farm products and the total revenues (incomes) of farmers. For farmers as a group, the inelastic demand for their product means that a large crop may be undesirable. For policymakers it means that achieving the goal of higher total farm income requires that farm output be restricted.

### SALES TAXES

Both federal and provincial governments pay attention to elasticity of demand when selecting goods and services on which to levy sales taxes. If a \$1 tax is levied on a product and 10,000 units are sold, tax revenue will be \$10,000 (= \$1 × 10,000 units sold). If the government raises the tax to

$1.50 but the higher price reduces sales to 5000 because of elastic demand, tax revenue will decline to $7500 (= $1.50 × 5000 units sold). Because a higher tax on a product with elastic demand will bring in less tax revenue, legislatures tend to seek out products that have inelastic demand—such as liquor, gasoline, and cigarettes—when levying sales tax.

## DECRIMINALIZATION OF ILLEGAL DRUGS

<www.drugwarfacts.org/economi.htm>
The drug war and economics

In recent years proposals to legalize drugs have been widely debated. Proponents contend that drugs should be treated like alcohol; they should be made legal for adults and regulated for purity and potency. The war on drugs, it is argued, has been unsuccessful and the associated costs—including enlarged police forces, the construction of more prisons, an overburdened court system, and untold human costs—have increased markedly. Some contend that legalization would reduce drug trafficking significantly by taking the profit out of it. Crack cocaine and heroin, for example, are cheap to produce and could be sold at low prices in legal markets. Because the demand of addicts is highly inelastic, the amounts consumed at the lower prices would increase only modestly. Addicts' total expenditures for cocaine and heroin would decline and so would the street crime that finances those expenditures.

Opponents of legalization say that the overall demand for cocaine and heroin is far more elastic than proponents think. In addition to the inelastic demand of addicts, another market segment's demand is relatively elastic. This segment consists of occasional users, who use hard drugs when the prices are low but who abstain or substitute, say, alcohol when the prices of hard drugs are high. Thus, the lower prices associated with the legalization of hard drugs would increase consumption by occasional users. Also, removal of the legal prohibitions against using drugs might make drug use more socially acceptable, increasing the demand for cocaine and heroin.

Many economists predict that the legalization of cocaine and heroin would reduce street prices by up to 60 percent, depending on whether and how much it was taxed. According to a recent study, price declines of that size would increase the number of occasional users of heroin by 54 percent and the number of occasional users of cocaine by 33 percent. The total quantity of heroin demanded would rise by an estimated 100 percent and the quantity of cocaine demanded would rise by 50 percent.[1] Assuming street prices for both heroin and cocaine rose by 60 percent, such changes in quantity demanded imply price elasticity of demand of 1.66 for heroin and 0.83 for cocaine. Many existing and first-time users might eventually become addicts. The overall result, say the opponents of legalization, would be higher social costs, possibly including an increase in street crime.

## MINIMUM WAGE

The minimum wage prohibits employers from paying workers less than a specified hourly wage. The minimum wage in Canada ranges from a low of $5.80 in Nova Scotia to $8.00 in British Columbia. Critics say that such a minimum wage, if it is above the equilibrium market wage, moves employers upward along their downsloping labour demand curves toward lower quantities of labour demanded, which causes unemployment, particularly among teenage workers. However, workers who remain employed at the minimum wage receive higher incomes than they otherwise would. The amount of income lost by the newly unemployed and the amount of income gained by those who keep their jobs depend on the elasticity of demand for teenage labour. Research suggests that the demand for teenage labour is relatively inelastic. If correct, this means that income gains associated with the minimum wage would exceed income losses. The "unemployment argument" made by critics of the minimum wage would be stronger if the demand for teenage workers were elastic.

[1]Henry Saffer and Frank Chaloupka, "The Demand for Illegal Drugs," *Economic Inquiry*, July 1999, pp. 401–411.

## 5.3 Price Elasticity of Supply

The concept of price elasticity also applies to supply. If producers are relatively responsive to price changes, supply is elastic. If they are relatively insensitive to price changes, supply is inelastic.

We measure the degree of price elasticity of supply with the coefficient $E_s$, defined almost like $E_d$ except that we substitute "percentage change in quantity supplied" for "percentage change in quantity demanded":

$$E_s = \frac{\text{percentage change in quantity supplied of product X}}{\text{percentage change in price of product X}}$$

For reasons explained earlier, the averages, or midpoints, of the before and after quantities supplied and the before and after prices are used as reference points for the percentage changes. Suppose an increase in the price of a good from \$4 to \$6 increases the quantity supplied from 10 units to 14 units. The percentage change in price would be 2/5, or 40 percent, and the percentage change in quantity would be 4/12, or 33 percent: $E_s = .33/.40 = .83$. In this case, supply is inelastic, since the price elasticity coefficient is less than one. If $E_s$ is greater than one, supply is elastic. If it is equal to one, supply is unit elastic. Also, $E_s$ is never negative, since price and quantity supplied are directly related. Thus, there are no minus signs to drop, as was necessary with elasticity of demand.

**price elasticity of supply**
The ratio of the percentage change in quantity supplied of a product or resource to the percentage change in its price.

The main determinant of **price elasticity of supply** is the amount of time producers have to respond to a change in product price. A firm's response to, say, an increase in the price of Christmas trees depends on its ability to shift inputs from the production of other products (whose prices we assume remain constant) to the production of trees. Shifting inputs takes time: the longer the time available, the greater the ability to shift inputs. So, we can expect a greater response, and therefore greater elasticity of supply, the longer a firm has to adjust to a price change.

In analyzing the impact of time on elasticity, we distinguish among the immediate market period, the short run, and the long run.

### Price Elasticity of Supply: The Market Period

**market period**
A period in which producers of a product are unable to change the quantity produced in response to a change in its price.

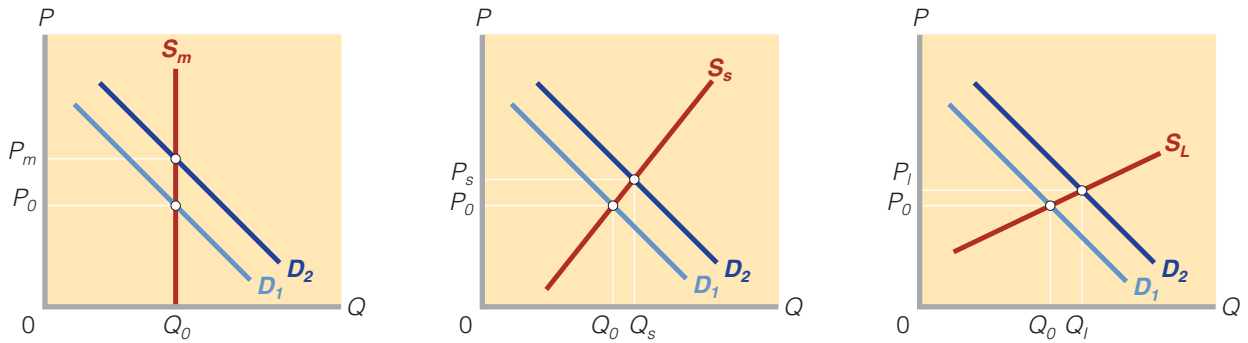
The **market period** is the period that occurs when the time immediately after a change in market price is too short for producers to respond with a change in quantity supplied. Suppose the owner of a small farm in southwestern Ontario brings to market one truckload of tomatoes, which is the entire season's output. The supply curve for the tomatoes is perfectly inelastic (vertical); the farmer will sell the truckload whether the price is high or low. Why? Because the farmer can offer only one truckload of tomatoes even if the price of tomatoes is much higher than anticipated. The farmer might like to offer more tomatoes, but tomatoes cannot be produced overnight. Another full growing season is needed to respond to a higher-than-expected price by producing more than one truckload. Similarly, because the product is perishable, the farmer cannot withhold it from the market. If the price is lower than anticipated, the farmer will still sell the entire truckload.

The farmer's costs of production, incidentally, will not enter into this decision to sell. Though the price of tomatoes may fall far short of production costs, the farmer will nevertheless sell out to avoid a total loss through spoilage. During the market period, our farmer's supply of tomatoes is fixed: only one truckload is offered no matter how high or low the price.

Figure 5-3(a) shows the farmer's vertical supply curve during the market period. Supply is perfectly inelastic because the farmer does not have time to respond to a change in demand, say from $D_1$ to $D_2$. The resulting price increase from $P_0$ to $P_m$ simply determines which buyers get the fixed quantity supplied; it elicits no increase in output.

However, not all supply curves need be perfectly inelastic immediately after a price change. If the product is not perishable and the price rises, producers may choose to increase quantity supplied by drawing down their inventories of unsold, stored goods, causing the market supply curve to attain some positive slope. For our tomato farmer, the market period may be a full growing season; for producers of goods that can be inexpensively stored, there may be no market period at all.

**FIGURE 5-3** Time and the Elasticity of Supply




The greater the amount of time producers have to adjust to a change in demand, here from $D_1$ to $D_2$, the greater will be their output response. In the immediate market period in panel (a), producers have insufficient time to change output, and so supply is perfectly inelastic. In the short run in panel (b), plant capacity is fixed, but changing the intensity of its use can alter output; supply is therefore more elastic. In the long run in panel (c), all desired adjustments, including changes in plant capacity, can be made, and supply becomes still more elastic.

## Price Elasticity of Supply: The Short Run

**short run**
A period of time in which producers are able to change the quantities of some but not all of the resources they employ.

In the **short run**, the plant capacity of individual producers and of the entire industry is fixed. Even so, firms do have time to use their fixed plants more or less intensively. In the short run, our farmer's plant (land and farm machinery) is fixed, but time is available in the short run to cultivate tomatoes more intensively by applying more labour and more fertilizer and pesticides to the crop. The result is a somewhat greater output in response to a presumed increase in demand; this greater output is reflected in a more elastic supply of tomatoes, as shown by figure $S_s$ in Figure 5-3(b). Note now that the increase in demand from $D_1$ to $D_2$ is met by an increase in quantity (from $Q_0$ to $Q_s$), so there is a smaller price adjustment (from $P_0$ to $P_s$) than in the market period. The equilibrium price is, therefore, lower in the short run than in the market period.

## Price Elasticity of Supply: The Long Run

**long run**
A period of time long enough to enable producers of a product to change the quantities of all the resources they employ.

The **long run** is a period long enough for firms to adjust their plant sizes and for new firms to enter (or existing firms to leave) the industry. In the tomato industry, for example, our farmer has time to acquire additional land and buy more machinery and equipment. Furthermore, other farmers may, over time, be attracted to tomato farming by the increased demand and higher price. Such adjustments create a larger supply response, as represented by the more elastic supply curve $S_L$ in Figure 5-3(c). The outcome is a smaller price rise ($P_0$ to $P_1$) and a larger output increase ($Q_0$ to $Q_1$) in response to the increase in demand from $D_1$ to $D_2$. ***(Key Question 10)***

There is no total-revenue test for elasticity of supply. Supply shows a positive or direct relationship between price and amount supplied; the supply curve is upsloping. Regardless of the degree of elasticity or inelasticity, price and total revenue always move together.

# 5.4 Cross Elasticity and Income Elasticity of Demand

Price elasticities measure the responsiveness of the quantity of a product demanded or supplied when its price changes. The consumption of a good also is affected by a change in the price of a related product or by a change in income.

## Cross Elasticity of Demand

**cross elasticity of demand** The ratio of the percentage change in quantity demanded of one good to the percentage change in the price of some other good.

The **cross elasticity of demand** measures how sensitive consumer purchases of one product (say, X) are to a change in the price of some other product (say, Y). We calculate the coefficient of cross elasticity of demand $E_{xy}$ just as we do the coefficient of simple price elasticity, except that we relate the percentage change in the consumption of X to the percentage change in the price of Y:

$$E_{xy} = \frac{\text{percentage change in quantity demanded of product X}}{\text{percentage change in price of product Y}}$$

This cross elasticity (or cross price elasticity) concept allows us to quantify and more fully understand substitute and complementary goods, introduced in Chapter 3.

### SUBSTITUTE GOODS

If cross elasticity of demand is positive, meaning that sales of X move in the same direction as a change in the price of Y, then X and Y are substitute goods. An example is Kodak film (X) and Fuji film (Y). An increase in the price of Kodak film causes consumers to buy more Fuji film, resulting in a positive cross elasticity. The larger the positive cross elasticity coefficient, the greater the substitutability between the two products.

### COMPLEMENTARY GOODS

When cross elasticity is negative, we know that X and Y move together; an increase in the price of one decreases the demand for the other. They are complementary goods. For example, an increase in the price of cameras will decrease the amount of film purchased. The larger the negative cross elasticity coefficient, the greater is the complementarity between the two goods.

### INDEPENDENT GOODS

A zero or near-zero cross elasticity tells us that the two products being considered are unrelated or independent goods. An example is walnuts and film; we would not expect a change in the price of walnuts to have any effect on purchases of film, and vice versa.

### APPLICATIONS

The degree of substitutability of products, measured by the cross elasticity coefficient, is important to businesses and government. For example, suppose that Coca-Cola is considering whether to lower the price of its Sprite brand. Not only will it want to know something about the price elasticity of demand for Sprite (will the price cut increase or decrease total revenue?), it will also be interested in knowing whether the increased sale of Sprite will come at the expense of its Coke brand. How sensitive are the sales of one of its products (Coke) to a change in the price of another of its products (Sprite)? By how much will the increased sales of Sprite reduce the sales of Coke? A low cross elasticity would indicate that Coke and Sprite are weak substitutes for each other and that a lower price for Sprite would have little effect on Coke sales.

Government also implicitly uses the idea of cross elasticity of demand in assessing whether a proposed merger between two large firms will substantially reduce competition and violate the anti-combines laws. For example, the cross elasticity between Coke and Pepsi is high, making them

strong substitutes for each other. Consequently, the government would likely block a merger between the two companies because it would lessen competition. In contrast, the cross elasticity between film and gasoline is low or zero. A merger between Kodak and Petro-Canada would have a minimal effect on competition, so government would be more likely to allow it.

## Income Elasticity of Demand

**income elasticity of demand**
Measures the responsiveness of consumer purchases to income changes.

**Income elasticity of demand** measures the degree to which consumers respond to a change in their income by buying more or less of a particular good. The coefficient of income elasticity of demand, $E_i$, is determined with the formula

$$E_i = \frac{\text{percentage change in quantity demanded}}{\text{percentage change in income}}$$

### NORMAL GOODS

For most goods, the income elasticity coefficient $E_i$ is positive, meaning that more of them are demanded as incomes rise. Such goods are called normal goods, which we first described in Chapter 3. The value of $E_i$ varies greatly among normal goods. For example, income elasticity of demand for automobiles is about +3.00, while income elasticity for most farm products is only about +0.20.

### INFERIOR GOODS

A negative income elasticity coefficient designates an inferior good. Retread tires, cabbage, long-distance bus tickets, used clothing, and muscatel wine are likely candidates. Consumers decrease their purchases of inferior goods as incomes rise.

### INSIGHTS

Coefficients of income elasticity of demand provide insights into the economy. For example, income elasticity helps to explain the expansion and contraction of industries in the Canadian economy. On average, total income in the economy has grown by 2 to 3 percent annually. As income has expanded, industries producing products for which demand is quite income elastic have expanded their outputs. Thus, automobiles ($E_i = +3.0$), housing ($E_i = +1.5$), books ($E_i = +1.4$), and restaurant meals ($E_i = +1.4$) have all experienced strong growth of output. Also, studies show that the demand for health services is income elastic. The implication of this is that the demand on the Canadian health care system will continue to outpace income growth. Meanwhile, industries producing products for which income elasticity is low or negative have tended to grow slowly or to decline. For example, agriculture ($E_i = +0.20$) has grown far more slowly than has the economy's total output. We do not eat twice as much when our incomes double.

As another example, when recessions occur and people's incomes decline, grocery stores fare relatively better than stores selling electronic equipment. People do not substantially cut back on their purchases of food when their incomes fall; income elasticity of demand for food is relatively low. But they do substantially cut back on their purchases of electronic equipment; income elasticity on such equipment is relatively high. ***(Key Questions 12 and 13)***

In Table 5-4 we provide a synopsis of the cross elasticity and income elasticity concepts.

## 5.5 Elasticity and Real-world Applications

Supply and demand analysis and the elasticity concept are applied repeatedly in the remainder of this book. Let's strengthen our understanding of these analytical tools and their significance by examining elasticity and tax incidence.

**TABLE 5-4 Cross and Income Elasticities of Demand**

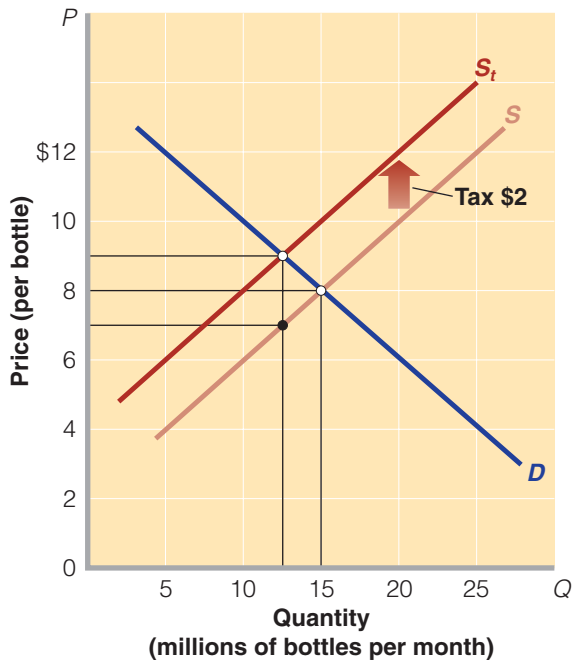
| Value of coefficient | Description | Type of good(s) |
|---|---|---|
| Cross elasticity: | | |
| Positive ($E_{wz} > 0$) | Quantity demanded of W changes in same direction as change in price of Z | Substitutes |
| Negative ($E_{xy} < 0$) | Quantity demanded of X changes in opposite direction from change in price of Y | Complements |
| Income elasticity: | | |
| Positive ($E_i > 0$) | Quantity demanded of the product changes in same direction as change in income | Normal |
| Negative ($E_i < 0$) | Quantity demanded of the product changes in opposite direction from change in income | Inferior |

## Elasticity and Tax Incidence

In Figure 5-4, *S* and *D* represent the pre-tax market for a certain domestic wine from the Niagara Peninsula. The no-tax equilibrium price and quantity are $4 per bottle and 15 million bottles. If the Ontario government levies a tax of $1 per bottle directly on the winery for every bottle sold, who actually pays it?

**FIGURE 5-4 The Incidence of a Tax**

A tax of a specified amount per unit levied on producers, here $2 per unit, shifts the supply curve upward by the amount of the tax per unit: the vertical distance between *S* and $S_t$. This shift results in a higher price (here $9.00) to the consumer and a lower after-tax price (here $7.00) to the producer. Thus, consumers and producers share the burden of the tax in some proportion (here equally at $1.00 per unit).



## DIVISION OF BURDEN

Since provincial government places the tax on the sellers (suppliers), the tax can be viewed as an addition to the marginal cost of the product. Now sellers must get $2 more for each bottle to receive the same per-unit profit they were getting before the tax. While sellers are willing to offer, for example, five million bottles of untaxed wine at $4 per bottle, they must now receive $6 per bottle—$4 plus the $2 tax—to offer the same five million bottles. The tax shifts the supply curve upward (leftward) as shown in Figure 5-4, where $S_t$ is the after-tax supply curve.

The after-tax equilibrium price is $9.00 per bottle, whereas the before-tax price was $8.00. So, in this case, half the $2 tax is paid by consumers as a higher price; the other half must be paid by producers in a lower after-tax per-unit revenue. That is, after paying the $2.00 tax per unit to the provincial government, producers receive $7.00, or $1.00 less than the $8.00 before-tax price. In this instance, consumers and producers share the burden of this tax equally; producers shift half the tax to consumers in a higher price and bear the other half themselves.

Note also that the equilibrium quantity decreases as a result of the tax levy and the higher price it imposes on consumers. In Figure 5-4, that decline in quantity is from 15 million bottles per month to 12.5 million bottles per month.

## ELASTICITIES

If the elasticities of demand and supply were different from those shown in Figure 5-4, the incidence of tax would also be different. Two generalizations are relevant.

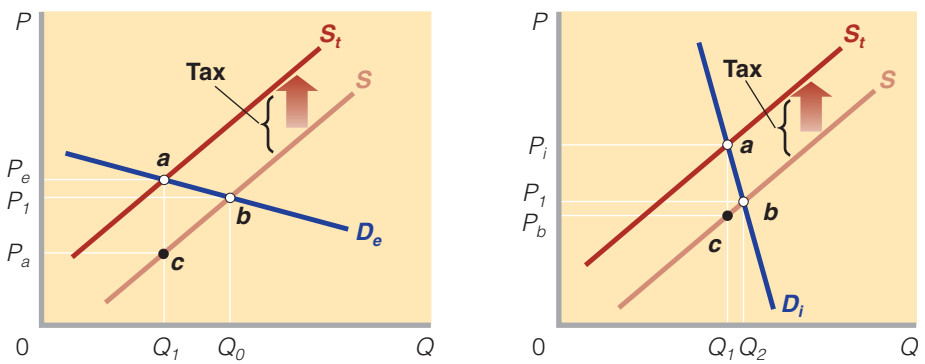
First, *with a specific supply, the more inelastic the demand for the product, the larger the portion of the tax shifted to consumers.* To verify this, sketch graphically the extreme cases where demand is perfectly elastic or perfectly inelastic. In the first case, the incidence of the tax is entirely on sellers; in the second, the tax is shifted entirely to consumers.

Figure 5-5 contrasts the more usual cases where demand is either relatively elastic or relatively inelastic in the relevant price range. With elastic demand, shown in Figure 5-5(a), a small portion of the tax ($P_e - P_1$) is shifted to consumers and most of the tax ($P_1 - P_a$) is borne by the producers. With inelastic demand, shown in Figure 5-5(b), most of the tax ($P_i - P_1$) is shifted to consumers and only a small amount ($P_1 - P_b$) is paid by producers. In both graphs the per-unit tax is represented by the vertical distance between $S_t$ and $S$.

Note also that the decline in equilibrium quantity ($Q_1 - Q_2$) is smaller when demand is more inelastic, which is the basis of our previous applications of the elasticity concept: Revenue-seeking

**FIGURE 5-5 Demand Elasticity and the Incidence of a Tax**

Panel (a): If demand is elastic in the relevant price range, price rises modestly ($P_1$ to $P_e$) when a tax is levied. Hence, the producer bears most of the tax burden. Panel (b): If demand is inelastic, the price to the buyer will increase substantially ($P_1$ to $P_i$) and most of the tax will be shifted to consumers.




(a) Tax incidence and elastic demand

(b) Tax incidence and inelastic demand

legislatures place heavy sales taxes on liquor, cigarettes, and other products whose demands are thought to be inelastic. Since demand for these products is relatively inelastic, the tax does not reduce sales much, so the tax revenue stays high.

Second, *with a specific demand, the more inelastic the supply, the larger the portion of the tax borne by producers.* When supply is elastic, as in Figure 5-6(a), most of the tax ($P_e - P_1$) is shifted to consumers, and only a small portion ($P_1 - P_a$) is borne by sellers. But when supply is inelastic, as in Figure 5-6(b), the reverse is true; the major portion of the tax ($P_1 - P_b$) falls on sellers, and a relatively small amount ($P_i - P_1$) is shifted to buyers. The equilibrium quantity also declines less with an inelastic supply than it does with an elastic supply.

Gold is an example of a product with an inelastic supply, one where the burden of a tax would mainly fall on producers. Conversely, because the supply of baseballs is elastic, producers would pass on to consumers much of a tax on baseballs.

You may want to reverse the analysis and assume that the government levies a (sales) tax on consumers. ***(Key Question 15)***

## Rent Controls

Rent controls are maximum rents established by law (and recently, rent controls have set maximum rent increases for existing tenants). Such laws are well intended; their goals are to protect low-income families from escalating rents caused by perceived housing shortages and to make housing more affordable to the poor.

When controls are first imposed, they usually restrict increases in rents above current levels. The short-run supply curve for rental accommodation is inelastic because it takes landlords some time to react to price changes and bring new units on the market. Most tenants benefit, since the quantity of rental accommodation currently on the market or under construction is not significantly affected. Thus, the program appears to be successful even if shortages begin to appear. Figure 5-7(a) portrays a market for rental accommodation with rents fixed at $R_c$ and a short-run supply curve, $S_s$. A shortage $Q_1 - Q_2$ exists in the short run.

In the long run the shortage of rental accommodation will worsen since the supply of rental accommodation becomes more elastic. Construction of new units decreases and landlords try to convert existing units to other uses or allow them to deteriorate. The supply curve becomes more elastic in the long run, shown by $S_L$ in Figure 5-7(b), making the shortage worse, and increasing it to $Q_1 - Q_3$.

**FIGURE 5-6** **Supply Elasticity and the Incidence of a Tax**

Panel (a): With an elastic supply sales tax results in a large price increase ($P_1$ to $P_e$), and the tax is therefore paid mainly by consumers. Panel (b): If supply is inelastic, the price rise is small ($P_1$ to $P_i$), and sellers will have to bear most of the tax.

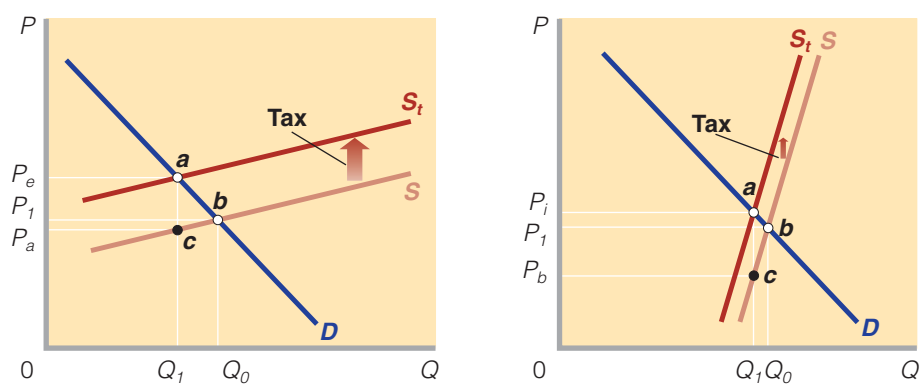
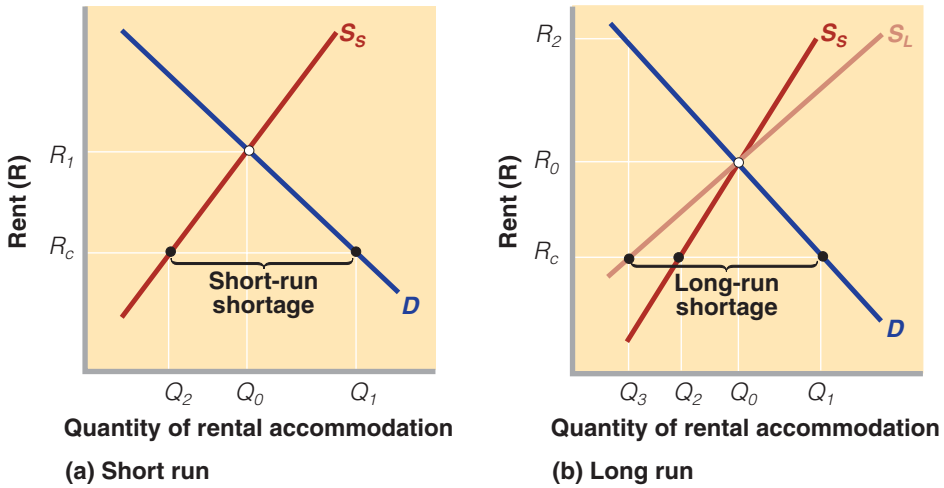


**FIGURE 5-7 Rent Controls**

In the short run (panel a) the supply for rental accommodation is inelastic. If rent controls are set at $R_c$, a shortage of $Q_1 - Q_2$ will occur in the short run. In the long run (panel b), supply becomes more elastic as landlords are able to add or withdraw rental units from the market. In the long run the shortage will worsen to $Q_1 - Q_3$. On the black market, rents of as much as $R_2$ will be charged.




The gradually worsening shortage in the long run leads to several related problems. As in the case of controls on food prices, a black market will emerge. The black market in rental accommodation is often characterized by the charging of "key money." Prospective tenants are often forced to bribe a landlord or a subletting tenant to acquire a particular rental unit. The acceptance of key money is illegal in most jurisdictions with rent controls, but the practice is difficult to stamp out because it is to the advantage of both parties. Those desperate for rental accommodation will have to pay the black market rate of as much as $R_2$, shown in Figure 5-7(b).

## Consider This

### Below-equilibrium Prices

Below-equilibrium pricing should not be associated solely with government policies. Rock superstars, such as Canada's Avril Lavigne, sometimes price their concert tickets below the market-clearing price. The tickets are usually rationed on a first-come, first-served basis, and ticket scalping is common. Why should these stars want to subsidize their fans—at least those fortunate enough to obtain tickets—with below-equilibrium prices? Why not set ticket prices at a higher, market-clearing level and realize more income from a tour?

The answer is that long lines of fans waiting hours or days for bargain-priced tickets catch the attention of the press. (Some of the people in the lines, however, are there to buy tickets for resale!) The millions of dollars' worth of free publicity that results undoubtedly stimulates CD sales, from which much of any musician's income is derived. Thus the gift of below-equilibrium ticket prices from a rock star to fans also benefits the star. And the gift imposes a cost on fans—the opportunity cost of time spent waiting in line to buy tickets.

Incidentally, many people regard the ticket scalping often associated with musical or athletic events as a form of extortion, where the extortionist's (the seller's) gain is the victim's (the buyer's) loss. But the fact that scalping is a voluntary transaction suggests that both seller and buyer gain; otherwise, the exchange would not occur. Such exchanges redistribute assets (tickets) from those who value them less to those who value them more.

**Question: Explain what would occur if a rock star such as Avril Lavigne priced concert tickets at above the market-clearing price.**

Another problem that results from controls is the emergence of a dual rental market if new buildings are exempt from controls. Apartment units whose rents are below market levels are almost always rented informally or with some form of key money attached. The units that have recently come on the market will be offered at rents above the levels that would exist without controls as landlords attempt to compensate for future restrictions on rent increases. Because of discrimination by landlords and the ability to pay key money, middle-class tenants will find it easier to secure units in the controlled market, while the poor will be forced to seek units in the uncontrolled market. Perversely, tenants with higher incomes can be the major beneficiaries of the program.

Rent controls distort market signals and misallocate resources. Too few resources are allocated to rental housing, too many to alternative uses. Ironically, although rent controls are often legislated to lessen the effects of perceived housing shortages, controls are a primary cause of such shortages.

Refer to the Consider This box for other examples of below-equilibrium prices.

## Applications of Price Elasticity of Supply

The idea of price elasticity of supply has widespread applicability, as suggested by the following examples.

### ANTIQUES AND REPRODUCTIONS

There are several places across Canada in which people bring antiques to a central location for appraisal by experts. Some people are pleased to learn that their old piece of furniture or funky folk art is worth a large amount, say, $30,000 or more.

The high price of an antique results from strong demand and limited, highly inelastic supply. Because a genuine antique can no longer be reproduced, the quantity supplied either does not rise or rises only slightly as its price goes up. The higher price might prompt the discovery of a few more of the remaining originals and thus add to the quantity available for sale, but this quantity response is usually quite small. So the supply of antiques and other collectibles tends to be inelastic. For one-of-a-kind antiques, the supply is perfectly inelastic.

Factors such as increased population, higher income, and greater enthusiasm for collecting antiques have increased the demand for antiques over time. Because the supply of antiques is limited and inelastic, those increases in demand have greatly boosted the prices of antiques.

Contrast the inelastic supply of original antiques with the elastic supply of modern "made-to-look-old" reproductions. Such faux antiques are quite popular and widely available. When the demand for reproductions increases, the firms making them simply boost production. Because the supply of reproductions is highly elastic, increased demand raises their price only slightly.

### VOLATILE GOLD PRICES

The price of gold is quite volatile, sometimes shooting upward one period and plummeting downward the next. The main sources of these fluctuations are shifts in demand and highly inelastic supply. Gold production is a costly and time-consuming process of exploration, mining, and refining. Moreover, the physical availability of gold is highly limited. For both reasons, increases in gold prices do not elicit substantial increases in quantity supplied. Conversely, gold mining is costly to shut down and existing gold bars are expensive to store. Price decreases therefore do not produce large drops in the quantity of gold supplied. In short, the supply of gold is inelastic.

The demand for gold is partly derived from the demand for its uses such as for jewellery, dental fillings, and coins. But people also demand gold as a speculative financial investment. They increase their demand for gold when they fear general inflation or domestic or international turmoil that might undermine the value of currency and more traditional investments. They reduce their demand when events settle down. Because of the inelastic supply of gold, even relatively small changes in demand produce relatively large changes in price.

## 5.6 The Economics of Agricultural Price Supports

**price supports**
Government-supported minimum prices for agricultural products.

Canadian federal and provincial agricultural policy aims to protect farmers from fluctuations in farm income. The main tools used are a national income safety net system, and supply programs through marketing boards and **price supports**, which are government-supported minimum prices.

### Net Income Stabilization

An income safety net for all Canadian farmers is provided by the Net Income Stabilization Account (NISA). It is designed to protect farmers from fluctuations in farm income and to provide long-term farm income stability. NISA is essentially a risk management tool. Individual farmers and the federal and provincial governments contribute money annually into a fund. Farmers may withdraw funds when farm income falls below specified trigger levels. There is also crop insurance to protect farmers against crop failure due to the weather or other natural hazards. As with NISA, the individual farmer and the federal and provincial governments contribute to a crop insurance fund.

Canadian federal and provincial agricultural policy aims to protect farmers from fluctuations in farm income.

### Supply Management Programs

Both federal and provincial governments are involved in supply management programs, whose aim is to regulate supply so as to ensure a stable, minimum level of income for Canadian farmers. Supply management is carried out through provincial marketing boards and federal agencies. The three main commodity groups for which marketing boards regulate supply are dairy and poultry products and eggs.

The Canadian Wheat Marketing Board, created in 1935, also manages supply, but also acts as the sole marketing agency for Canadian wheat producers, who are not allowed to sell any of the wheat they produce. In a high-profile case in 2002, a small number of Prairie wheat farmers were jailed for marketing their own wheat (they had actually donated the wheat to a U.S. charity group). These farmers were protesting the monopoly power of the Wheat Marketing Board.

As of 2003, the Wheat Board still had complete control over the price and marketing of western wheat. When farmers deliver their wheat to the Wheat Board, they receive an initial payment per bushel that is 75 percent of the expected average selling price. This is in effect a floor price and is set low enough that the Wheat Board is reasonably certain to be able to sell the wheat at least at that price. The producers subsequently get the full average selling price the Wheat Board is able to get on the domestic and international markets, less transportation costs, storage costs, and administrative expenses. Farmers get the average price the Wheat Board is able to realize over the course of the year.

<www.cwb.ca>
Canadian Wheat Board

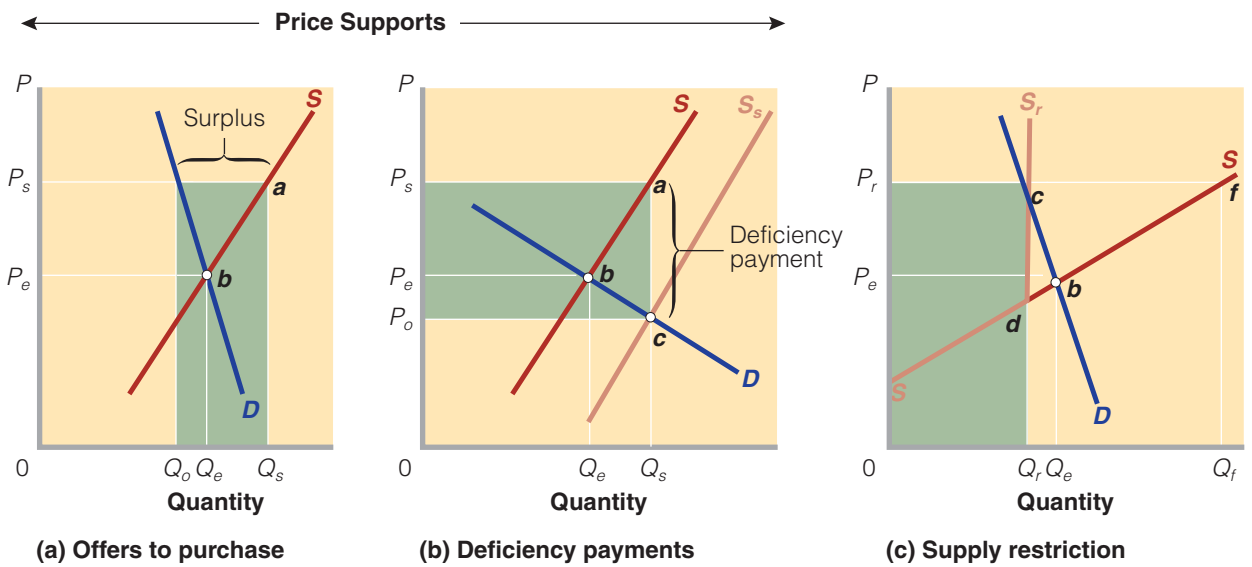
Supply management policies ensure higher incomes to farmers can be accomplished through price supports. There are three basic methods of supporting prices above their market equilibrium values: (1) offers to purchase, (2) deficiency payments, and (3) supply restrictions.

#### OFFERS TO PURCHASE

A marketing board can increase farm income by ensuring that the price farmers get for their produce does not fall below a specified minimum. In Figure 5-8(a) let's assume that the *floor price*—or, as it is commonly called, the support price—is $P_s$. The major effects are as follows:

- ***Surplus output*** The most obvious result is product surplus. Consumers are willing to purchase only $Q_o$ units at the supported price, while farmers will supply $Q_s$ units. The government must buy the surplus ($Q_s - Q_o$) to make the above-equilibrium support price effective. The surpluses are undesirable on two counts. First, their very existence indicates a misallocation of the economy's resources. Government-held surpluses mean that the economy is devoting too many resources to the production of commodities that, at existing supported prices, are not wanted by consumers. Second, since surplus products have to be stored, they will add to the cost of the farm program and, ultimately, to the consumer's tax bill. For example, in the late 1950s the federal government accumulated more than 45 million kilograms of butter as it tried to maintain

**FIGURE 5-8 Price Supports and Supply Restriction**




Panel (a): Offers to purchase result in surpluses. Panel (b): Deficiency payments or subsidies do not result in surpluses. Panel (c): Supply restriction results in neither surpluses nor government payments. All costs (the higher price) are borne by consumers.

an above-equilibrium price. The solution was to convert the butter into butter oil, which the government then sold abroad at half the butter price.

- ***Loss to consumers*** Consumers lose because they pay a higher price ($P_s$ rather than $P_e$) and consume less ($Q_o$ rather than $Q_e$) of the product. They also pay higher taxes to finance the government's purchase of the surplus. In Figure 5-8(a), this added tax burden will amount to the surplus output $Q_o - Q_s$ multiplied by its price, $P_s$. Storage costs add to this tax burden. Unfortunately, the higher food prices fall disproportionately on the poor because they spend a larger portion of their incomes on food.
- ***Gain to farmers*** Farmers gain from price supports. In Figure 5-8(a), gross receipts rise from the free market level of $0P_ebQ_e$ to the larger supported level of area $0P_saQ_s$.

## DEFICIENCY PAYMENTS

**deficiency payments** Subsidies that make up the difference between market prices and government-supported prices.

**Deficiency payments**, another method of price supports, are subsidies that make up the difference between the market price and the government-supported price. In Figure 5-8(b) suppose that the support price is $P_s$. Also, at price $P_s$ farmers expand production from $Q_e$ to $Q_s$. However, with demand as shown by $D$, consumers will only buy $Q_s$ if the price is $P_o$. The government arranges for this to be the market price by simply subsidizing production by the amount $P_o - P_s$. The government makes a deficiency payment to each producer equal to $P_o - P_s$ times the quantity sold.

The total consumer expenditure is $0P_ocQ_s$, and total government expenditure is $0P_sac$ = deficiency payment times $Q_s$. The producers are still on the original supply curve $S$. However, $S_s$ is the supply curve as seen by the consumer and is created by the deficiency payment. When we analyze the economic effect of these payments, two considerations arise: elasticity of supply and demand, and resource overallocation.

**Elasticity of Supply and Demand** The incidence of the subsidy, like the sales tax, depends on the elasticity of the supply and demand curves. In Figure 5-8(b), the combined effects of the elastic demand curve in the price range $P_oP_s$ and the inelastic supply curve result in the subsidy going mostly to the producer: the producer gets $P_eP_s$ of the deficiency payment, the consumer only $P_eP_o$. The effect of elasticity on the incidence of a subsidy is precisely the same as that of a sales tax.

**Comparing Offers to Purchase and Deficiency Payments** Assuming, as we have done, that $P_s$ is the same in both Figures 5-8(a) and (b), farmers will benefit equally from the two programs: their total income will increase in each case. Consumers prefer deficiency payments since they receive a large amount of output ($Q_s$) at a low price ($P_o$). This compares with a high price ($P_s$) and small quantity ($Q_o$) under a program of offers to purchase. But when the subsidies of taxpayers to farmers (the green areas) are taken into account, total payments by the public (consumption expenditures plus tax-financed subsidies) to farmers are identical under both programs.

**Resource Overallocation** A more subtle cost exists in both offers to purchase and deficiency payments. Society loses because price supports contribute to economic inefficiency by encouraging an overallocation of resources to agriculture. A price floor ($P_s$) attracts more resources to the agricultural sector than would the free market price ($P_e$). The market supply curve in Figures 5-8(a) and (b) represents the marginal costs of all farmers producing this product at various outputs $Q_o$. An efficient allocation of resources occurs at point *b*, where the market price $P_e$ is equal to marginal costs. The output $Q_e$ reflects an efficient allocation of resources.

In contrast, the output $Q_s$ associated with the price support $P_s$ represents an overallocation of resources; the marginal cost of the extra production exceeds its marginal benefit to society. Society incurs an *efficiency loss* from the price-support system.

### SUPPLY RESTRICTIONS

Another method of increasing the prices farmers get for their output is to restrict supply. In the case of crops, the government would set the total number of hectares to be planted, and then divide these among existing farmers. This form of supply management is know as **crop restriction**. For farmers producing dairy and poultry products and eggs, the government, through the marketing boards, sets a **quota**, or a maximum amount each farm is allowed to produce.

**crop restriction**
In return for guaranteed prices for their crops, farmers agree to limit the number of hectares they plant in that crop.

**quota**
A restriction on the amount of a product that a farm is allowed to produce in a given period.

Suppose in Figure 5-8(c) that government wants to guarantee farmers price $P_r$. In this case neither offers to purchase nor deficiency payments would work because of the price-elastic supply. An offer to purchase at price $P_r$ results in a surplus of $Q_r - Q_f$ , a greater amount than presently demanded. A deficiency payment program would also not work for the same reason.

In this situation the government-desired price $P_r$ can only be ensured by restricting supply through a quota system. ***(Key Question 16)***

## 5.7 The Economics of Health Care

There is a major controversy over the funding, delivery, and cost of health care in Canada. The heated debate has arisen because some Canadians are concerned about declining standards and increasing waiting time to see specialists and have surgery. The Canadian health care system provides universal access for covered services. There are no user fees across Canada for basic health services, including hospital and physician services. The Canadian health care system is in essence an insurance program funded by both provincial and federal governments, with zero deductibility. To the individual consumer, health services are "free," even if in reality these services are paid by Canadian taxpayers.

We noted in Chapter 3 that competitive markets will eliminate surpluses or shortages of a particular product or service. If markets clear, why are there "shortages" in the current Canadian health care system as manifested through longer waiting times for needed health service?

## Peculiarities of the Health Care Market

Competitive markets bring about both allocative and productive efficiency, two concepts you came across in Chapter 2. But the health care sector in Canada is not a competitive market industry. Indeed, a competitive market system in health care may not be desirable or attainable because of the unique properties of health care. What follows are some of the unique properties of the health care market.

### ETHICAL AND EQUITY CONSIDERATIONS

Ethical questions inevitably intervene in markets when decisions involve the quality of life, or literally life or death. Although we might not consider it immoral if a person cannot buy a Mercedes or a personal computer, Canadians regard the denial of basic health care as unjust. Generally, Canadians look upon health care as an "entitlement" or a "right" and are reluctant to ration it on the basis of price and income.

### ASYMMETRIC INFORMATION

**asymmetric information**
Unequal knowledge by the parties to a market transaction.

Competitive markets may not be fully appropriate in health care delivery because of **asymmetric information**—unequal knowledge possessed by the parties to a market transaction. Health care buyers typically have little or no understanding of the complex diagnostic and treatment procedures, while the physicians who are the health care sellers of those procedures possess detailed information. This creates the unusual situation in which the doctor (supplier) as the agent of the patient (consumer) tells the patient what health care services he or she should consume. For example, if a physician tells a patient she needs a follow-up visit in a few weeks, few health care consumers would be informed enough to know whether such a visit was actually needed.

### THE MORAL HAZARD PROBLEM

**moral hazard problem**
The possibility that individuals or institutions will change their behaviour as a result of a contract or agreement.

The **moral hazard problem** is the tendency of one party to an agreement to alter her or his behaviour in a way which is costly to the other party. Health care insurance can change behaviour in two ways. First, some insured people might be less careful about their health, taking fewer steps to prevent accident or illness. Second, insured individuals have greater incentives to use health care more intensively than they would if they did not have insurance.

### ADVERSE SELECTION

**adverse selection problem**
The problem that arises when information known to the first party to a contract is not known by the second, who then incurs costs.

Another information problem arising from inadequate information is the **adverse selection problem**. This problem arises when information known to the first party to a contract is not known by the second, and, as a result, the second party incurs major costs. In health insurance, the adverse selection problem is that people who are most likely to need insurance payouts are those who buy insurance. Those with the poorest health will seek to buy the most generous health insurance policies. Private insurers, knowing this, will try to attract those clients least likely to get sick. Thus, in a competitive health care industry, people either already sick or at a high risk of serious illness will find it difficult to get health insurance except at very high premiums. Those who cannot afford the high premiums will not be covered if they get sick. In the present Canadian system, government insurance covers every citizen, no matter what their state of health.

### SPILLOVER BENEFITS

The medical care market generates positive externalities (spillover benefits), a concept you learned in Chapter 4. For example, an immunization against polio, smallpox, or measles benefits the immediate purchaser, but it also benefits society because it reduces the risk that other members of society will be infected with highly contagious diseases. Similarly, a healthy labour force is more productive, contributing to the general prosperity and well-being of society. In Chapter 4 we noted that freely functioning markets underallocate resources to products and services that generate spillover benefits. Thus, a competitive health care sector may not deliver as much output as society deems desirable.

In Canada, most essential health care expenses are paid primarily through public insurance.

### THIRD PARTY PAYMENTS: INSURANCE

In Canada most essential health care expenses are paid primarily through public insurance. Health care consumers do not pay out-of-pocket "prices" they would otherwise. The zero prices are distortions that result in "excess" consumption of health care services.

### GRAPHICAL PORTRAYAL

A simple demand and supply model illustrates the effect of health insurance on the health care market. Figure 5-9(a) depicts a competitive market for health care services; curve $D$ shows the demand for health care services if all consumers are uninsured, and $S$ represents the supply of health care services. At market price $P_u$ the equilibrium quantity of health care is $Q_u$. The market clears, and there is no excess demand or supply.

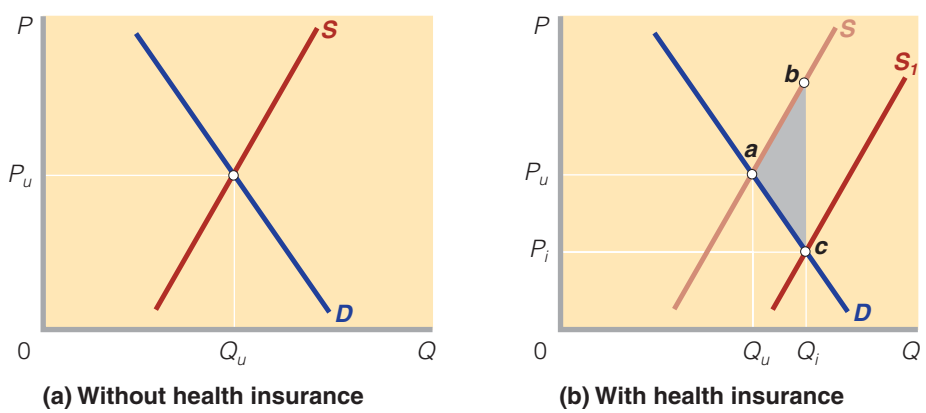
What happens when we introduce private or government health insurance that covers, say, one half of all health care costs? In Figure 5-9(b), with health insurance paying half the price, the consumer is confronted with price $P_i$ ($=\frac{1}{2}P_u$). The health care consumer reacts by purchasing $Q_i$ units rather than $Q_u$. An excess demand for health care services has been created. If the health care consumer does not pay any portion of health care costs, as is the case in Canada, the shortage would become more acute.

## Possible Solutions to Excess Demand

Solutions to the existing excess demand for health care services in Canada come down to either increasing the supply by diverting more tax revenues to health care, or instituting user fees to reduce quantity demanded of health care services. An infusion of more resources is depicted by a rightward shift the supply curve to $S_1$ in Figure 5.9(b). Although increased resources for health care services will resolve the excess demand, there is as yet no consensus as to whether this is the way Canadians want to move.

In Chapter 2 we discussed the necessary tradeoffs that face any society with limited resources. The federal and provincial governments must either divert tax revenues from other government programs or increase taxes to properly fund the health care needs of Canadians. Neither option is pleasant, but more importantly, it is not clear which option the majority of Canadians prefer. Critics argue that even if more resources are made available to the Canadian health care system, it will not solve the current shortage problem. They point out that the demand for health care rises with

**FIGURE 5-9** Insurance and the Overallocation of Resources to Health Care




Panel (a) Without health insurance, the optimal amount of health care consumed is $Q_u$, where the marginal benefit and marginal cost of health care are equal. Panel (b) The availability of private and public insurance reduces the direct price of health care from $P_u$ to $P_i$, resulting in its overconsumption ($Q_i$ rather than $Q_u$) and an overallocation of resources to the health care industry. The area *abc* represents the efficiency loss from that overallocation.

income and the age of its citizens. Both will rise in the future, particularly the number of older Canadians, who generally require more health care services. Critics also point out that there is little competition for the delivery of health care services in Canada, which has created what they see as "inefficiencies" that waste scarce resources.

Proponents of the national health care system in Canada emphasize that compared to the system in the U.S., our system is efficient. Administrative costs of health care delivery are lower in Canada, and the Canadian system costs less than the American system. Canada spends just under 10 percent of Gross Domestic Product (GDP) on health care, while the U.S. health care system consumes almost 14 percent of GDP. The advocates of the existing national health care system in Canada say that even if we have to divert more resources to health care, knowing every Canadian will have the health care he or she needs is a comfort well worth paying for. ***(Key Question 17)***

## QUICK REVIEW

- Price elasticity of supply measures the sensitivity of suppliers to changes in the price of a product. The price elasticity of supply coefficient $E_s$ is the ratio of the percentage change in quantity supplied to the percentage change in price. The elasticity of supply varies directly with the amount of time producers have to respond to the price change.
- The cross elasticity of demand coefficient $E_{xy}$ is computed as the percentage change in the quantity demanded of product X divided by the percentage change in the price of product Y. If the cross elasticity coefficient is positive, the two products are substitutes; if it is negative, they are complements.
- The income elasticity coefficient $E_i$ is computed as the percentage change in quantity demanded divided by the percentage change in income. A positive coefficient indicates a normal good. The coefficient is negative for an inferior good.
- Government-controlled prices in the form of ceilings and floors stifle the rationing function of prices and cause unintended side effects.
- Insurance generally leads to excess consumption of the insured product or service. But many believe that there is a place for public health insurance in Canada because of the peculiarities of the health care market.

## THE LASTword — A Market for Human Organs?

***A market might eliminate the present shortage of human organs for transplant. But many serious objections exist to turning human body parts into commodities for purchase and sale.***

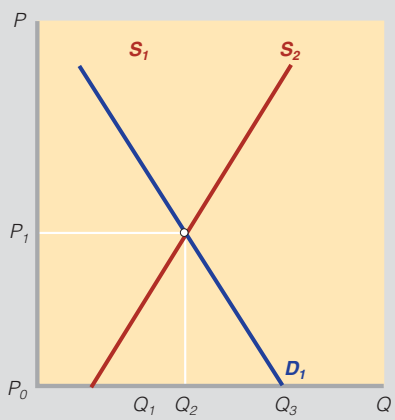
Advances in medical technology make it possible for surgeons to replace some human body parts with donated used parts, much like a mechanic might replace a worn-out alternator in an automobile with one from a junked vehicle. It has become increasingly commonplace in medicine to transplant kidneys, lungs, livers, eye corneas, pancreases, and hearts from deceased individuals to those whose organs have failed or are failing. But surgeons and many of their patients face a growing problem: too few donated organs are available for transplant. Not everyone who needs a transplant can get one. Indeed, an inadequate supply of donated organs causes an estimated 400 Canadian deaths per year.

**Why Shortages?** Seldom, if ever, do we hear of shortages of used auto parts such as alternators, batteries, transmissions, or water pumps. What is different about organs for transplant? One difference is that a market

exists for used auto parts but not for human organs. To understand this situation, observe the demand curve $D_1$ and supply curve $S_1$ in the accompanying figure. The downward slope of the demand curve tells us that if there were a market for human organs, the quantity of organs demanded would be greater at lower prices than at higher prices. Perfectly inelastic supply curve $S_1$ represents the fixed quantity of human organs now donated via consent before death. Because the price of these donated organs is in effect zero, quantity demanded, $Q_3$, exceeds quantity supplied, $Q_1$. The shortage of $Q_3 - Q_1$ is rationed through a waiting list of those in medical need of transplants. Many people die while still on the waiting list.

**Use of a Market** A market for human organs would increase the incentive to donate organs. Such a market might work like this: An individual might specify in a legal document a willingness to sell one or more usable human organs on death or brain death. The person could specify where the money from the sale would go, for example, to family, a church, an educational institution, or a charity. Firms would then emerge to purchase organs and resell them where needed for profit. Under such a system, the supply curve of usable organs would take on the normal upward slope of typical supply curves. The higher the expected price of an organ, the greater the number of people willing to have their organs sold at death. Suppose that the supply curve is $S_2$ in the figure. At the equilibrium price $P_1$, the number of organs made available for transplant ($Q_2$) would equal the number purchased for transplant (also $Q_2$). In this generalized case, the shortage of organs would be eliminated and, of particular importance, the number of organs available for transplanting would rise from $Q_1$ to $Q_2$. More lives would be saved and enhanced than is the case under the present donor system.

**Objections** In view of this positive outcome, why is there no such market for human organs? Critics of market-based solutions have two main objections. The first is a moral objection: Critics feel that turning human organs into commodities commercializes human beings and diminishes the special nature of human life. They say there is something unseemly about selling and buying body organs as if they were bushels of wheat or ounces of gold. Moreover, critics note that the market would ration the available organs (as represented by $Q_2$ in the figure) to people who either can afford them (at $P_1$) or have health insurance for transplants.




Second, a health cost objection suggests that a market for body organs would greatly increase the cost of health care. Rather than obtaining freely donated (although too few) body organs, patients would have to pay market prices for them, increasing the cost of medical care. As transplant procedures are further perfected, the demand for transplants is expected to increase significantly. Rapid increases in demand relative to supply would boost the prices of human organs and thus further contribute to the problem of escalating health care costs.

Supporters of market-based solutions to organ shortages point out that the market is simply being driven underground. Worldwide, an estimated $1 billion annual illegal market in human organs has emerged. As in other illegal markets, the unscrupulous tend to thrive. Those who support legalization say that it would be greatly preferable to legalize and regulate the market for the laws against selling transplantable human organs.

# CHAPTER SUMMARY

## 5.1 PRICE ELASTICITY OF DEMAND

- Price elasticity of demand measures consumer response to price changes. If consumers are relatively sensitive to price changes, demand is elastic. If they are relatively unresponsive to price changes, demand is inelastic.
- The price elasticity coefficient $E_d$ measures the degree of elasticity or inelasticity of demand. The coefficient is found by the formula

$$E_d = \frac{\text{percentage change in quantity demanded of X}}{\text{percentage change in price of X}}$$

  The averages of prices and quantities under consideration are used as reference points in determining percentage changes in price and quantity. If $E_d$ is greater than one, demand is elastic. If $E_d$ is less than one, demand is inelastic. Unit elasticity is the special case in which $E_d$ equals one.
- Perfectly inelastic demand is graphed as a line parallel to the vertical axis; perfectly elastic demand is shown by a line above and parallel to the horizontal axis.
- Elasticity varies at different price ranges on a demand curve, tending to be elastic in the upper left segment and inelastic in the lower right segment. Elasticity cannot be judged by the steepness or flatness of a demand curve.

## 5.2 THE TOTAL-REVENUE TEST

- If total revenue changes in the opposite direction from prices, demand is elastic. If price and total revenue change in the same direction, demand is inelastic. Where demand is of unit elasticity, a change in prices leaves total revenue unchanged.
- The number of available substitutes, the size of an item's price relative to one's budget, whether the product is a luxury or a necessity, and the time given to adjust are all determinants of elasticity of demand.

## 5.3 PRICE ELASTICITY OF SUPPLY

- The elasticity concept also applies to supply. The coefficient of price elasticity of supply is found by the formula

$$E_d = \frac{\text{percentage change in quantity supplied of X}}{\text{percentage change in price of X}}$$

  The averages of the price and quantities under consideration are used as reference points for computing percentage changes. Elasticity of supply depends on the ease of shifting resources between alternative uses, which in turn varies directly with the time producers have to adjust to a particular price change.

## 5.4 CROSS ELASTICITY AND INCOME ELASTICITY OF DEMAND

- Cross elasticity of demand indicates how sensitive the purchase of one product is to changes in the price of another product. The coefficient of cross elasticity of demand is found by the formula

$$E_{xy} = \frac{\text{percentage change in quantity demanded of X}}{\text{percentage change in price of Y}}$$

  Positive cross elasticity of demand identifies substitute goods; negative cross elasticity identifies complementary goods.
- Income elasticity of demand indicates the responsiveness of consumer purchases to a change in income. The coefficient of income elasticity of demand is found by the formula

$$E_i = \frac{\text{percentage change in quantity demanded of X}}{\text{percentage change in income}}$$

  The coefficient is positive for normal goods and negative for inferior goods.

## 5.5 ELASTICITY AND REAL-WORLD APPLICATIONS

- Excise taxes affect supply and, therefore, equilibrium price and quantity. The more inelastic the demand for a product, the greater is the proportion of an excise tax that is shifted to consumers. The greater the inelasticity of supply, the larger the portion of the tax that is borne by the seller.
- Legally fixed prices stifle the rationing function of equilibrium prices. Effective price ceilings result in persistent product shortages, and if an equitable distribution of the product is sought, government must ration the product to consumers. Price floors lead to product surpluses; the government must either purchase these surpluses or eliminate them by imposing restrictions on production or by increasing private demand.

## 5.6 THE ECONOMICS OF AGRICULTURAL PRICE SUPPORTS

- The use of price floors or price supports has many economic effects: (a) surplus production occurs, (b) the incomes of farmers are increased, (c) consumers pay higher prices for farm products, (d) an overallocation of resources to agriculture occurs, and (e) society pays higher taxes to finance the purchase and storage of surplus output.

## 5.7 THE ECONOMICS OF HEALTH CARE

- Special characteristics of the health care market include (a) ethical and equity considerations, (b) an imbalance of information between consumers and suppliers, (c) the moral hazard problem, (d) the adverse selection problem, (e) the presence of spillover benefits, and (f) the payment of most health care expenses by public insurance.

## TERMS AND CONCEPTS

price elasticity of demand, p. 105
elastic demand, p. 106
inelastic demand, p. 107
unit elasticity, p. 107
perfectly inelastic demand, p. 107
perfectly elastic demand, p. 107
total revenue (TR), p. 110
total-revenue test, p. 110
price elasticity of supply, p. 115
market period, p. 115
short run, p. 116
long run, p. 116
cross elasticity of demand, p. 117
income elasticity of demand, p. 118
price supports, p. 124
deficiency payments, p. 125
crop restriction, p. 126
quota, p. 126
asymmetric information, p. 127
moral hazard problem, p. 127
adverse selection problem, p. 127

## STUDY QUESTIONS

1. Explain why the choice between discussing 1, 2, 3, 4, 5, 6, 7, and 8 units or 1000, 2000, 3000, 4000, 5000, 6000, 7000, and 8000 movie tickets makes no difference in determining elasticity in Table 5-1.

2. **KEY QUESTION** Graph the accompanying demand data and then use the midpoint formula for $E_d$ to determine price elasticity of demand for each of the four possible $1 price changes. What can you conclude about the relationship between the slope of a curve and its elasticity? Explain in a non-technical way why demand is elastic in the northwest segment of the demand curve and inelastic in the southeast segment.

| Product price | Quantity demanded |
|---|---|
| $5 | 1 |
| 4 | 2 |
| 3 | 3 |
| 2 | 4 |
| 1 | 5 |

3. Draw two linear demand curves parallel to one another. Demonstrate that for any specific price change, demand is more elastic on the curve closer to the origin.

4. **KEY QUESTION** Calculate total-revenue data from the demand schedule in question 2. Graph total revenue below your demand curve. Generalize about the relationship between price elasticity and total revenue.

5. **KEY QUESTION** How would the following changes in price affect total revenue? That is, would total revenue increase, decline, or remain unchanged?

   a. Price falls and demand is inelastic.
   b. Price rises and demand is elastic.
   c. Price rises and supply is elastic.
   d. Price rises and supply is inelastic.
   e. Price rises and demand is inelastic.
   f. Price falls and demand is elastic.
   g. Price falls and demand is unit elastic.

6. **KEY QUESTION** What are the major determinants of price elasticity of demand? Use those determinants and your own reasoning in judging whether demand for each of the following products is probably elastic or inelastic: (a) bottled water, (b) toothpaste, (c) Crest toothpaste, (d) ketchup, (e) diamond bracelets, (f) Microsoft Windows operating system.

7. What effect would a rule stating that university students must live in university or college dormitories have on the price elasticity of demand for dormitory space? What impact might this in turn have on room rates?

8. "If the demand for farm products is highly price inelastic, a large crop yield may reduce farm incomes." Evaluate this statement and illustrate it graphically.

9. You are chairperson of a provincial tax commission responsible for establishing a program to raise new revenue through sales taxes. Would elasticity of demand be important to you in determining on which products the taxes should be levied? Explain.

10. **KEY QUESTION** In November 1998 Vincent van Gogh's self-portrait sold at auction for $71.5 million. Portray this sale in a demand and supply diagram and comment on the elasticity of supply. Comedian George Carlin once mused, "If a painting can be forged well enough to fool some experts, why is the original so valuable?" Provide an answer.

11. Suppose that because of a legal settlement over health care claims, tobacco companies raise the average price of a pack of cigarettes from $1.95 to $2.45. Also suppose the projected decline in cigarette sales was 8 percent. What does this imply about the elasticity of demand for cigarettes? Explain.

12. **KEY QUESTION** Suppose the cross elasticity of demand for products A and B is +3.6 and for products C and D is −5.4. What can you conclude about how products A and B are related? products C and D?

13. **KEY QUESTION** The income elasticities of demand for movies, dental services, and clothing have been estimated to be +3.4, +1.0, and +0.5, respectively. Interpret these coefficients. What does it mean if an income elasticity coefficient is negative?

14. A recent study found that an increase in the price of beer would reduce the amount of marijuana consumed. Is cross elasticity of demand between the two products positive or is it negative? Are these products substitutes, or are they complements? What might be the logic behind this relationship?

15. **KEY QUESTION** What is the incidence of a tax when demand is highly inelastic? highly elastic? What effect does the elasticity of supply have on the incidence of a tax?

16. **KEY QUESTION** Why is it desirable for price ceilings to be accompanied by government rationing? Why is it desirable for price floors to be accompanied by programs that purchase surpluses, restrict output, or increase demand? Show graphically why price ceilings produce shortages and price floors cause surpluses.

17. **KEY QUESTION** Can insurance cause overconsumption? How does insurance relate to the Canadian national health care system.

18. **(The Last Word)** Do you favour the establishment of a market for donated human organs? Why or why not?

## INTERNET APPLICATION QUESTIONS

1. Go to the McConnell-Brue-Barbiero Web site (Chapter 5) to find the very latest price of gold. Compare that price to the price at the beginning of the day. What was the highest price during the last 12 months? The lowest price? Assume the price fluctuations observed resulted exclusively from changes in demand. Would the observed price changes have been greater or less if the gold supply had they been elastic rather than inelastic? Explain.

2. On the McConnell-Brue-Barbiero Web site (Chapter 5), select NBER Working Papers. In the search space, type "alcohol." Use the titles and summaries of the papers to answer the following questions relating to elasticity:

   a. Do the mentally ill have perfectly inelastic demands for cigarettes and alcohol?

   b. Does alcohol consumption increase in bad times?

   c. What is the effect of cigarette taxes (and smuggling) on the consumption of alcohol? What does that imply about the cross elasticity of demand between the two?

   d. Is binge drinking among college and university students sensitive to the price of alcohol?