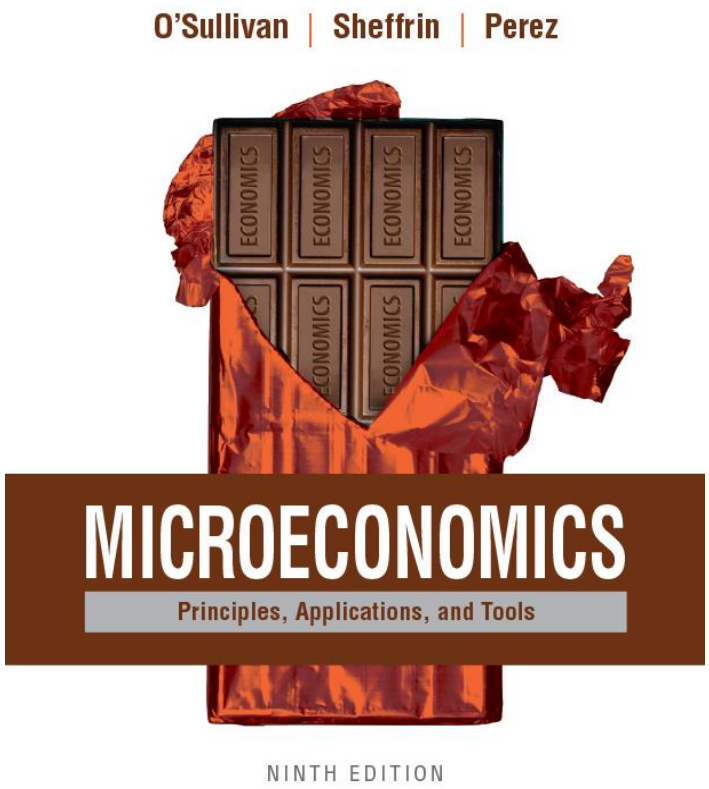
Microeconomics: Principles, Applications, and Tools

NINTH EDITION



Chapter 5

Elasticity: A Measure of Responsiveness

Pearson

Learning Objectives

5.1 List the determinants of the price elasticity of demand

5.2 Use price elasticity of demand to predict changes in quantity and total revenue

5.3 Explain how the price elasticity of demand varies along a linear demand curve

5.4 Define the income elasticity and cross-price elasticity of demand

5.5 List the determinants of the price elasticity of supply

5.6 Use demand and supply elasticities to predict changes in equilibrium prices

5.1 THE PRICE ELASTICITY OF DEMAND

- **Price elasticity of demand (E_d)**
  A measure of the responsiveness of the quantity demanded to changes in price; equal to the absolute value of the percentage change in quantity demanded divided by the percentage change in price.

$$E_d = \left| \frac{\text{percentage change in quantity demanded}}{\text{percentage change in price}} \right|$$

5.1 THE PRICE ELASTICITY OF DEMAND

Computing Percentage Changes and Elasticities

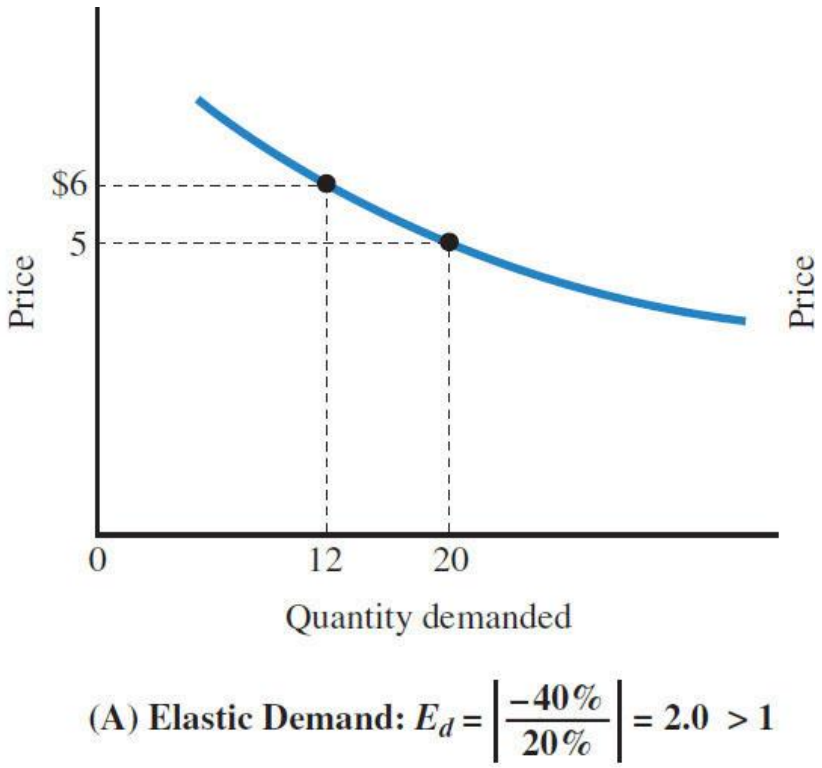
TABLE 5.1 Computing Price Elasticity with Values and Midpoints

		Price	Quantity
Data	Initial	$20	100
	New	22	80
		Price	**Quantity**
Computation with initial-value method	Percentage change	$10\% = \frac{\$2}{\$20} \times 100$	$-20\% = -\frac{20}{100} \times 100$

5.1 THE PRICE ELASTICITY OF DEMAND

Price Elasticity and the Demand Curve

- **Elastic demand**
  The price elasticity of demand is greater than one, so the percentage change in quantity exceeds the percentage change in price.

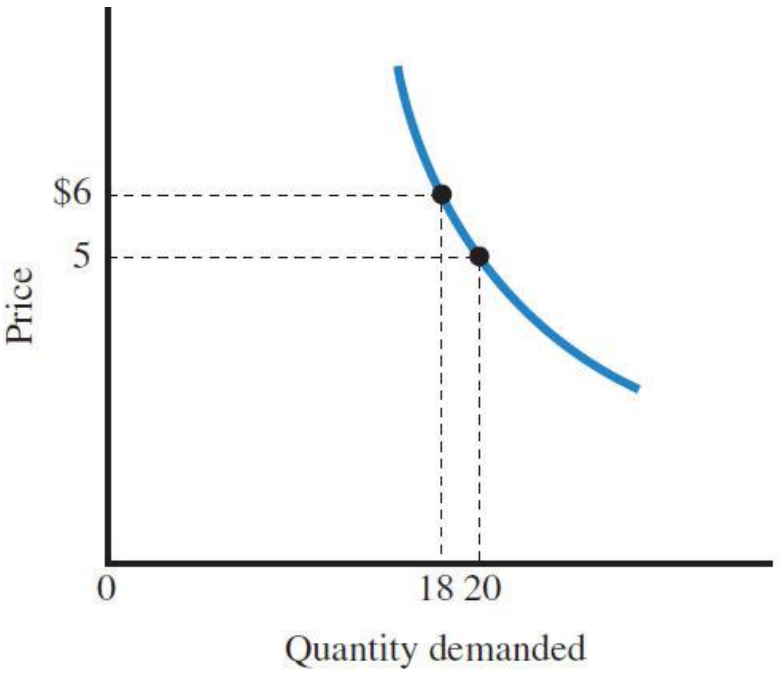


▲ FIGURE 5.1
Elasticity and Demand Curves

5.1 THE PRICE ELASTICITY OF DEMAND

Price Elasticity and the Demand Curve

- **Inelastic demand**
  The price elasticity of demand is less than one, so the percentage change in quantity is less than the percentage change in price.



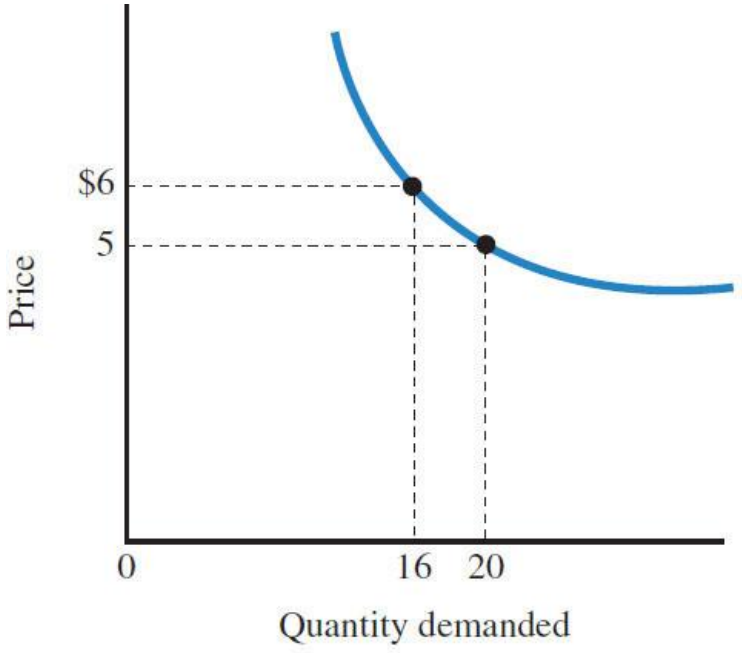
(B) Inelastic Demand: $E_d = \left| \frac{-10\%}{20\%} \right| = 0.50 < 1$

▲ **FIGURE 5.1** (Continued)
Elasticity and Demand Curves

5.1 THE PRICE ELASTICITY OF DEMAND

Price Elasticity and the Demand Curve

- **Unit elastic demand**
  The price elasticity of demand is one, so the percentage change in quantity equals the percentage change in price.



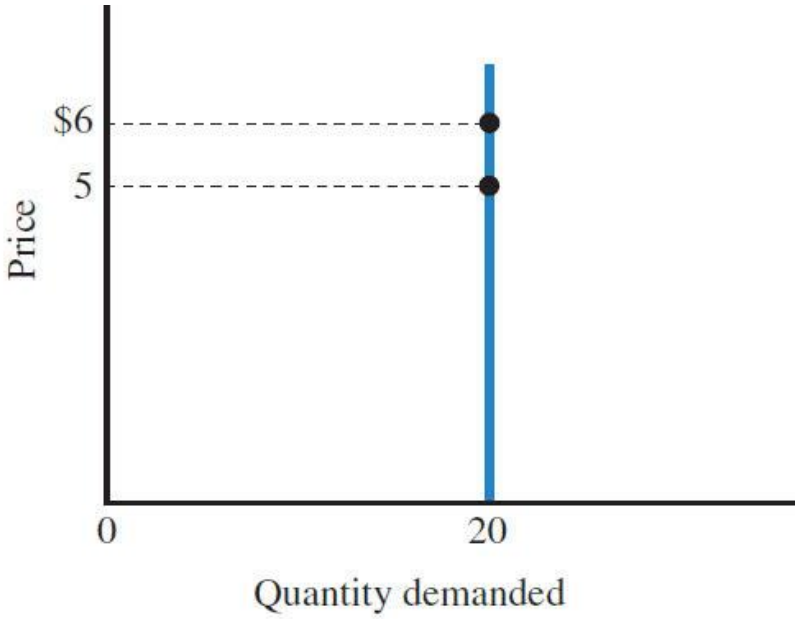
(C) Unit Elastic Demand: $E_d = \left| \frac{-20\%}{20\%} \right| = 1$

▲ FIGURE 5.1 (Continued)
Elasticity and Demand Curves

5.1 THE PRICE ELASTICITY OF DEMAND

Price Elasticity and the Deman Curve

- **Perfectly inelastic demand**
  The price elasticity of demand is zero.



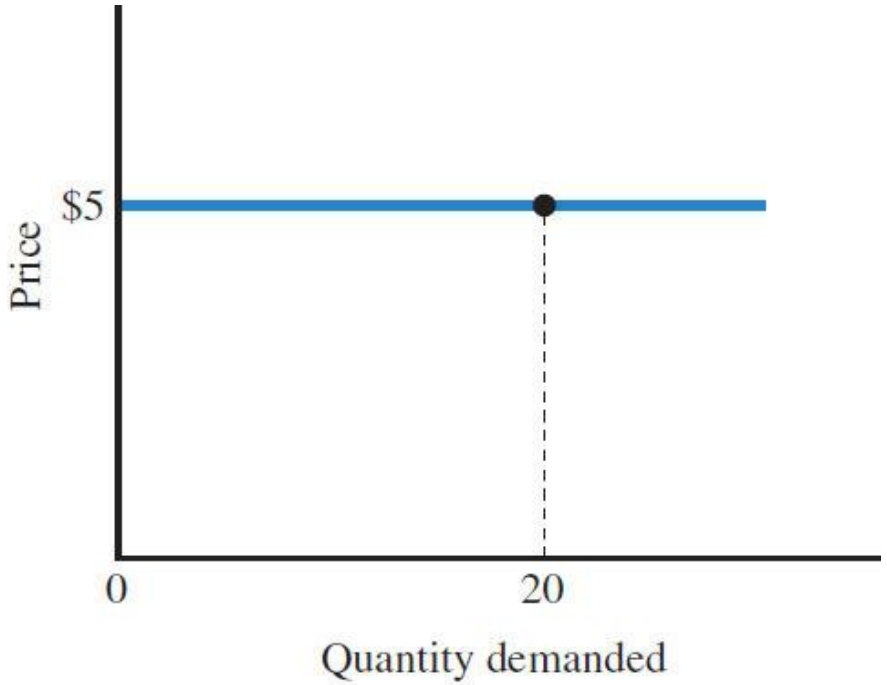
(D) Perfectly Inelastic Demand: $E_d = \left| \frac{0\%}{20\%} \right| = 0$

▲ **FIGURE 5.1** (Continued)
Elasticity and Demand Curves

5.1 THE PRICE ELASTICITY OF DEMAND

Price Elasticity and the Demand Curve

- **Perfectly elastic demand**
  The price elasticity of demand is infinite.



(E) Perfectly Elastic Demand: $E_d = \infty$

▲ **FIGURE 5.1** (Continued)
Elasticity and Demand Curves

5.1 THE PRICE ELASTICITY OF DEMAND

Elasticity and the Availability of Substitutes

TABLE 5.2 Price Elasticities of Demand for Selected Products1

	Product	Price Elasticity of Demand
Inelastic	Salt	0.1
	Food (wealthy countries)	0.15
	Weekend canoe trips	0.19
	Water	0.2
	Coffee	0.3
	Physician visits	0.25
	Sport fishing	0.28
	Gasoline (short run)	0.25
	Eggs	0.3
	Cigarettes	0.3
	Food (poor countries)	0.34
	Shoes and footwear	0.7
	Gasoline (long run)	0.6
Unit elastic	Housing	1.0
	Fruit Juice	1.0
Elastic	Automobiles	1.2
	Foreign travel	1.8
	Motorboats	2.2
	Restaurant meals	2.3
	Air travel	2.4
	Movies	3.7
	Specific brands of coffee	5.6

5.1 THE PRICE ELASTICITY OF DEMAND

Other Determinants of the Price Elasticity of Demand

TABLE 5.3 Determinates of Elasticity

Factor	**Demand is relatively elastic if …**	**Demand is relatively inelastic if …**
Availability of substitutes	There are many substitutes.	There are few substitutes.
Passage of time	a long time passes.	a short time passes.
Fraction of consumer budget	is large.	is small.
Necessity	the product is a luxury.	the product is a necessity.

APPLICATION 1

A CLOSER LOOK AT THE ELASTICITY OF DEMAND FOR GASOLINE

APPLYING THE CONCEPTS #1: How does the elasticity of demand vary over time?

We've seen that the demand for gasoline is more elastic in the long run, when consumers have more opportunity to respond to changes in price. A recent study explores two sorts of response to higher gasoline prices.

- First, when the price increases, people drive fewer miles, so there are fewer cars on the road.
- A second response to higher prices is to switch to more fuel-efficient cars.

TABLE 5.4 Gasoline Prices, Traffic Volume, and Fuel Efficiency

Elasticity of	Short Run (1 year)	Long Run (5 years)
Traffic Volume	0.10	0.30
Fuel Efficiency	0.15	0.40

Source: Based on Phil Goodwin, Joyce Dargay, and Mark Hanly, "Elasticities of Road Traffic and Fuel Consumption with Respect to Price and Income: A Review," *Transport Review* 24, no.3 (2004): 275–292.

5.2 USING PRICE ELASTICITY

Predicting Changes in Quantity

If we have values for two of the three variables in the elasticity formula, we can compute the value of the third. The three variables are:

(1) the price elasticity of demand itself,

(2) the percentage change in quantity, and

(3) the percentage change in price.

Specifically, we can rearrange the elasticity formula:

percentage change in quantity demanded = percentage change in price × E_d

5.2 USING PRICE ELASTICITY

Beer Prices and Highway Deaths

- We can use the concept of price elasticity to predict the effects of a change in the price of beer on drinking and highway deaths among young adults.
- The price elasticity of demand for beer among young adults is about 1.30.
- If a state imposes a beer tax that increases the price of beer by 10 percent, we would predict that beer consumption will decrease by 13 percent:
  - %change in quantity demanded = %change in price x E_d
  - 10% x 1.30 =13%
- The number of highway deaths among young adults is roughly proportional to their beer consumption, so the number of deaths will also decrease by 13 percent.

5.2 USING PRICE ELASTICITY

Cigarette Prices and Teenagers

- Another ongoing policy objective is to reduce smoking by teenagers.
- Under the 1997 federal tobacco settlement, cigarette prices increased by about 62 cents per pack, a percentage increase of about 25 percent.
- The demand for cigarettes by teenagers is elastic, with an elasticity of 1.3
- Therefore, a 25 percent price hike will reduce teen smoking by 32.5%
  - %change in quantity demanded = 25% x 1.30 = 32.5%
- About half the decrease in consumption occurs because fewer teenagers will become smokers, and the other half occurs because each teenage smoker will smoke fewer cigarettes.

5.2 USING PRICE ELASTICITY

Price Elasticity and Total Revenue

- **Total revenue**
  The money a firm generates from selling its product.
- total revenue = price per unit × quantity sold
- What happens to Total Revenue if price goes up?
  - Good News: You get more for each unit sold
  - Bad News: You sell fewer units
- Effect on TR depends on which effect is bigger, i.e. whether the price elasticity is less than or greater than one.

5.2 USING PRICE ELASTICITY

TABLE 5.5 Price and Total Revenue with Different Elasticities of Demand

Elastic Demand: $E_d = 2.0$		
Price	**Quantity Sold**	**Total Revenue**
$10	100	
11	80	
Inelastic Demand: $E_d = 0.50$		
Price	**Quantity Sold**	**Total Revenue**
100	10	
120	9	

5.2 USING PRICE ELASTICITY

Elastic versus Inelastic Demand

TABLE 5.6 Price Elasticity and Total Revenue

Elastic Demand: E_d > 1.0		
If price …	**Total revenue …**	**Because the percentage change in quantity is …**
↑	↓	Larger than the percentage change in price.
↓	↑	Larger than the percentage change in price.
Inelastic Demand: E_d < 1.0		
If price …	**Total revenue …**	**Because the percentage change in quantity is …**
↑	↑	Smaller than the percentage change in price.
↓	↓	Smaller than the percentage change in price.

5.2 USING PRICE ELASTICITY

Market versus Brand Elasticity

- Recall the chapter opener about the coffee producer.
- The question is whether a price cut will increase or decrease the firm's total revenue.
- Although general demand for coffee is inelastic (price elasticity of demand = 0.3) the demand for specific brands is elastic (price elasticity of demand = 5.6)
- Therefore, a price cut on a specific brand of coffee will increase a firm's total revenue.

5.2 USING PRICE ELASTICITY

Bus Fares and Deficits

- In every large city in the United States, the public bus system runs a deficit Here is the exchange between two city officials:
  - Buster: “A fare increase is a great idea. We’ll collect more money from bus riders, so revenue will increase, and the deficit will shrink.”
  - Bessie: “Wait a minute, Buster. Haven’t you heard about the law of demand? The increase in the bus fare will decrease the number of passengers taking buses, so we’ll collect less money, not more, and the deficit will grow.”
- Who’s right? It depends on the price elasticity of demand for bus ridership.
- The price elasticity of demand for bus ridership in the typical city is 0.33, meaning that a 10 percent increase in fares will decrease ridership by only about 3.3 percent.
- Because demand for bus travel is inelastic, the good news associated with a fare hike (10 percent more revenue per rider) will dominate the bad news (3.3 percent fewer riders), and total fare revenue will increase.
- In other words, an increase in fares will reduce the transit deficit, so Buster is right.

5.2 USING PRICE ELASTICITY

Why Are Bumper Crops Bad News for Farmers?

- Suppose favorable weather generates a “bumper crop” for soybeans that is 30 percent larger than last year’s harvest.
- The bumper crop brings good news and bad news for farmers.

  The good news is that they will sell more bushels of soybeans.

  The bad news is that the increase in supply will decrease the equilibrium price of soybeans, so farmers will get less money per bushel.
- Unfortunately for farmers, the demand for soybeans and many other agricultural products is inelastic.
- With inelastic demand, consumers need a large price reduction to buy more of the product. Therefore, to increase the quantity demanded of soybeans by 30 percent to meet the higher supply, the price must decrease by more than 30 percent.

5.2 USING PRICE ELASTICITY

Antidrug Policies and Property Crime

- What is the connection between antidrug policies and property crimes
- The government uses various policies to restrict the supply of illegal drugs, and the decrease in supply increases the equilibrium price.
- Because the demand for illegal drugs is inelastic, the increase in price will increase total spending on illegal drugs.
- A drug addict supports his or her habit by stealing, will commit more property crimes to pay for the drugs.
- There is a trade off. A policy that increases drug prices, will reduce consumption, but will also increase the amount of crime committed by drug addicts who continue to abuse drugs.

APPLICATION 2

VANITY PLATES AND THE ELASTICITY OF DEMAND

APPLYING THE CONCEPTS #2: How does an increase in price affect total expenditures?

- The radio quiz show *Wait Wait . . . Don't Tell Me!* recently asked the following question: Which state has the highest number of vanity license plates?
- The correct answer is Virginia, where over 10 percent of cars have vanity license plates such as 10SNE1 and GLBLWRMR.
- An economist might have extended the question to ask why there are so many vanity plates in Virginia.
  - Although Virginians may be unusually vain, a more plausible explanation is that the price of vanity plates is only $10, or about one-third of the average price in the United States.
  - According to a recent study, the demand for vanity plates in Virginia is inelastic, with a price elasticity of demand equal to 0.26.
  - If the state increased the price, the total revenue from vanity plates would increase.

5.3 ELASTICITY AND TOTAL REVENUE FOR A LINEAR DEMAND CURVE

Price Elasticity along a Linear Demand Curve

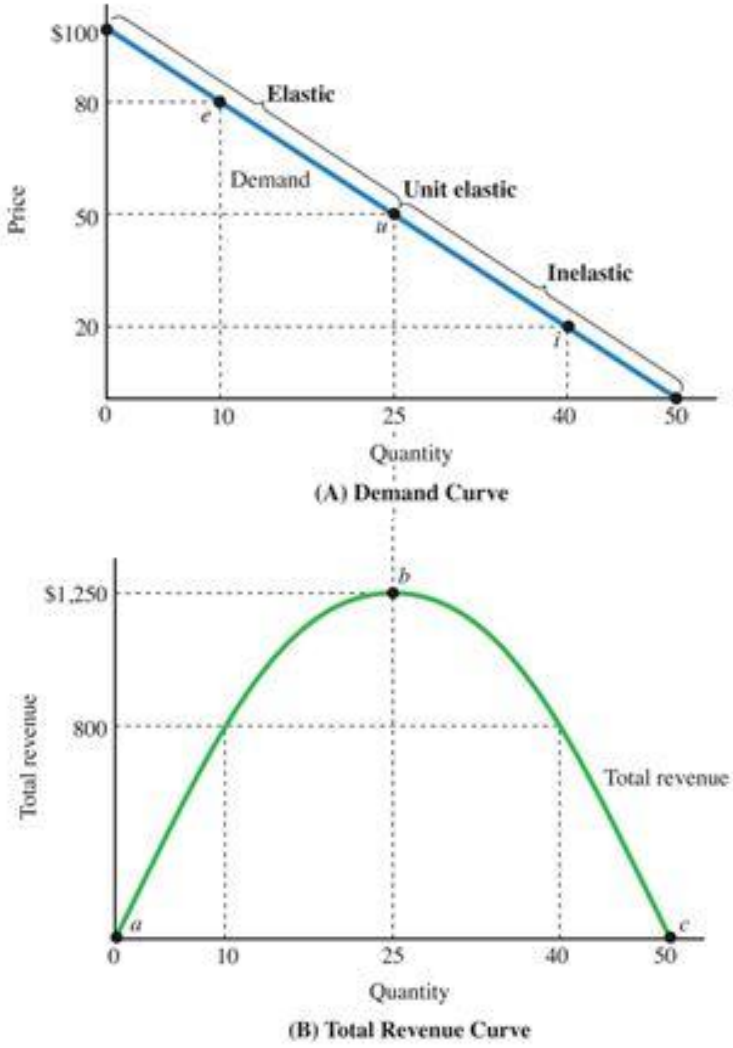
Demand is elastic along the upper half of a linear demand curve (between points *a* and *b* on the total-revenue curve).

Demand is inelastic along the lower half of a linear demand curve (between points *b* and *c*).

Total revenue is maximized at the midpoint of a linear demand curve (point *u*), where demand is unit elastic.

percentage change in quantity demanded = percentage change in price × E_d

total revenue = price per unit × quantity sold



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5.3 ELASTICITY AND TOTA
FOR A LINEAR DEMAND C

Price Elasticity along a Linear Demand C

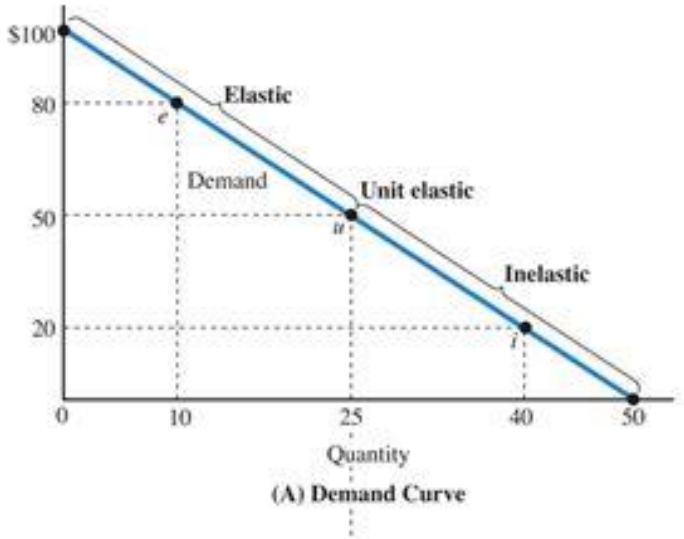

TABLE 5.7 Elasticity of Demand along a Linear Demand Cur

A Starting Point	B Change in Price	C Percentage Change in Price	D Change in Quantity	E Percentage Change in Quantity	F Elasticity of Demand
e: Elastic	–$2	$\frac{-\$2}{\$80} = -2.5\%$	+1	$\frac{1}{10} = 10\%$	$\left\lvert\frac{10\%}{-2.5\%}\right\rvert = 4$
u: Unit elastic	–$2	$\frac{-\$2}{\$50} = -4\%$	+1	$\frac{1}{25} = 4\%$	$\left\lvert\frac{4\%}{-4\%}\right\rvert = 1$
i: inelastic	–$2	$\frac{-\$2}{\$20} = -10\%$	+1	$\frac{1}{40} = 2.5\%$	$\left\lvert\frac{2.5\%}{-10\%}\right\rvert = 0.25$

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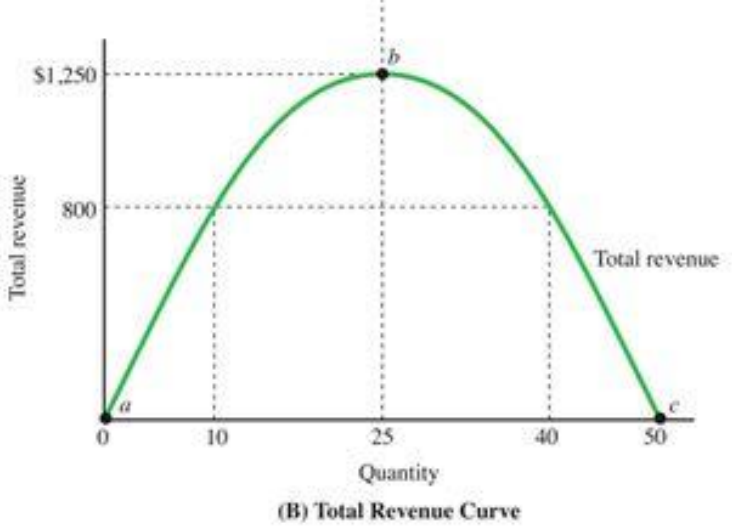
5.3 ELASTICITY AND TOT
FOR A LINEAR DEMAND

Elasticity and Total Revenue for a Line



- Panel B of Figure 5.2 shows the relationship between the linear demand curve.
- Demand is elastic along the upper half of a linear demand curve, which means that a decrease in price will increase the quantity sold by a larger percentage amount. As a result, total revenue will increase, as shown by the positively sloped total-revenue curve between points *a* and *b*.
- In contrast, demand is inelastic along the lower half of a linear demand curve, which means that a decrease in price will increase the quantity sold by a smaller percentage amount. As a result, total revenue will decrease, as shown by the negatively sloped total-revenue curve between points *b* and *c*.
- The total-revenue curve reaches its maximum at the midpoint of the linear demand curve, where demand is unit elastic. In Figure 5.2, demand is unit elastic at point *u* on the demand curve, so total revenue reaches its maximum at $1,250 at point *b* on the total-revenue curve.

5.4 OTHER ELASTICITIES OF DEMAND

Income Elasticity of Demand

- **Income elasticity of demand**
  A measure of the responsiveness of demand to changes in consumer income; equal to the percentage change in the quantity demanded divided by the percentage change in income.

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

Cross-Price Elasticity of Demand

- **Cross-price elasticity of demand**
  A measure of the responsiveness of demand to changes in the price of another good; equal to the percentage change in the quantity demanded of one good (*X*) divided by the percentage change in the price of another good (*Y*).

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

TABLE 5.8 Income and Cross-Price Elasticities for Different Types of Goods

This elasticity	Is Positive for …	Is Negative for …
Income elasticity	Normal goods	Inferior goods
Cross-price elasticity	Substitute goods	Complementary goods

5.5 THE PRICE ELASTICITY OF SUPPLY

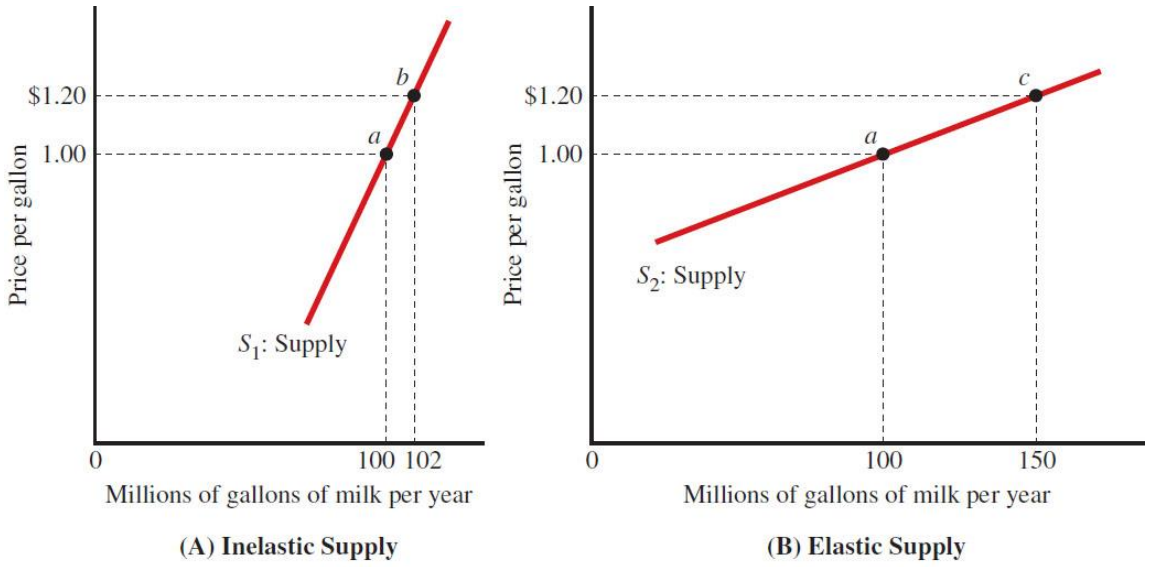
- **Price elasticity of supply**
  A measure of the responsiveness of the quantity supplied to changes in price; equal to the percentage change in quantity supplied divided by the percentage change in price.

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

5.5 THE PRICE ELASTICITY OF SUPPLY

(A) The supply curve is relatively steep. A 20 percent increase in price increases the quantity supplied by 2 percent, implying a supply elasticity of 0.10.

(B) The supply curve is relatively flat. A 20 percent increase in price increases the quantity supplied by 50 percent, implying a supply elasticity of 2.5.



▲ FIGURE 5.3 The Slope of the Supply Curve and Supply Elasticity

5.5 THE PRICE ELASTICITY OF SUPPLY

What Determines the Price Elasticity of Supply?

- The price elasticity of supply is determined by how rapidly production costs increase as the total output of the industry increases. If the marginal cost increases rapidly, the supply curve is relatively steep and the price elasticity is relatively low.

5.5 THE PRICE ELASTICITY OF SUPPLY

The Role of Time: Short-Run versus Long-Run Supply Elasticity

Time is an important factor in determining the price elasticity of supply for a product. The market supply curve is positively sloped because of two responses to an increase in price:

- *Short run.* A higher price encourages existing firms to increase their output by purchasing more materials and hiring more workers.
- *Long run.* New firms enter the market and existing firms expand their production facilities to produce more output.

The short-run response is limited because of the principle of diminishing returns.

PRINCIPLE OF DIMINISHING RETURNS

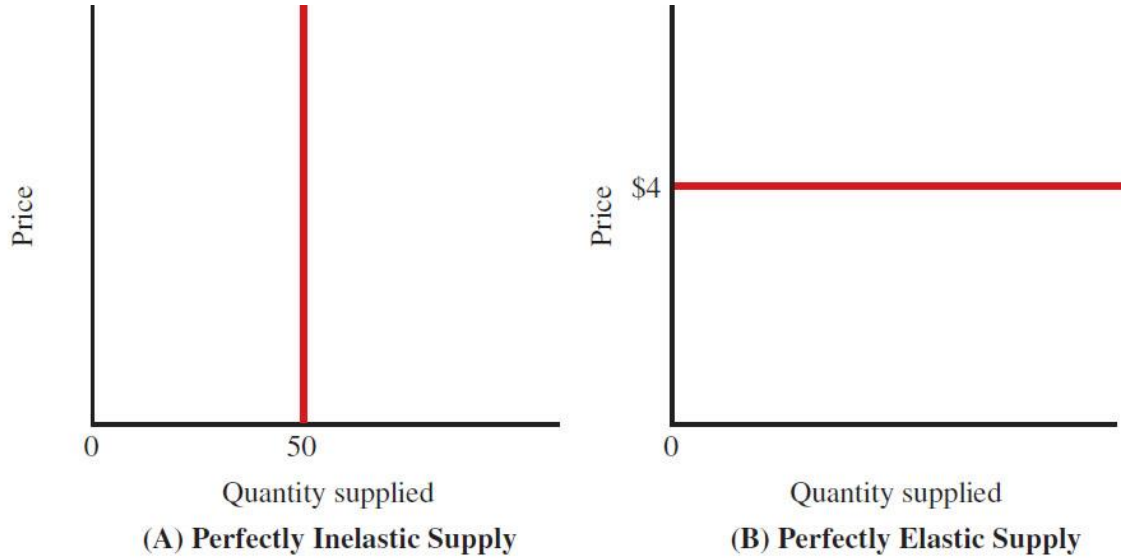
Suppose output is produced with two or more inputs, and we increase one input while holding the other input or inputs fixed. Beyond some point—called the point of *diminishing returns*—output will increase at a decreasing rate.

5.5 THE PRICE ELASTICITY OF SUPPLY

Extreme Cases: Perfectly Inelastic Supply and Perfectly Elastic Supply

In Panel A, the quantity supplied is the same at every price, so the price elasticity of supply is zero.

In Panel B, the quantity supplied is infinitely responsive to changes in price, so the price elasticity of supply is infinite.



▲ FIGURE 5.4 Perfectly Inelastic Supply and Perfectly Elastic Supply

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5.5 THE PRICE ELASTICITY OF SUPPLY

Extreme Cases: Perfectly Inelastic Supply and Perfectly Elastic Supply

- **Perfectly inelastic supply**
  The price elasticity of supply equals zero.
- **Perfectly elastic supply**
  The price elasticity of supply is equal to infinity.

Predicting Changes in Quantity Supplied

percentage change in quantity supplied = E_s × percentage change in price

APPLICATION 5

THE SHORT-RUN AND LONG-RUN ELASTICITY OF THE SUPPLY OF COFFEE

APPLYING THE CONCEPTS #5: Why is supply more price-elastic in the long run?

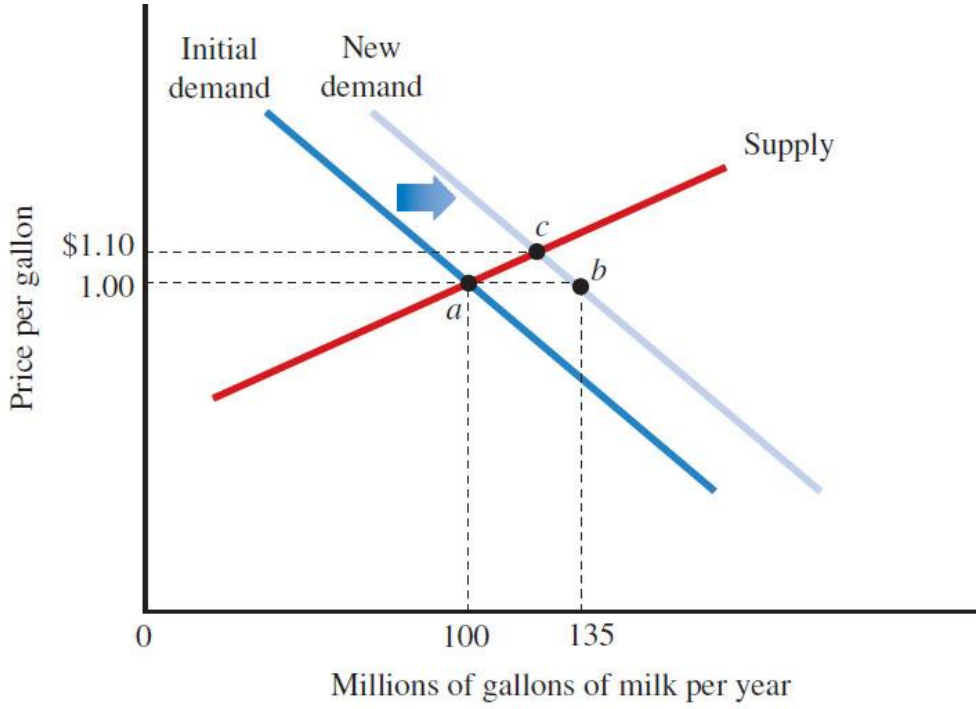
- The coffee industry provides a good example of the difference between the short-run and long-run price elasticity of supply. The price elasticity of supply over a one-year period is relatively low: If the price of coffee beans increases by 20 percent and stays there for a year, the quantity of coffee supplied will increase by a relatively small amount. A newly planted coffee bush takes 3-5 years to yield marketable beans.
- In the short run, an increase in coffee production requires more beans harvested per bush, which is possible with more fertilizer and water.
- In the long run, coffee farmers can plant more bushes so a sustained increase in price generates a larger increase in quantity supplied.

5.6 USING ELASTICITIES TO PREDICT CHANGES IN PRICES

The Price Effects of a Change in Demand

An increase in demand shifts the demand curve to the right, increasing the equilibrium price.

In this case, a 35 percent increase in demand increases the equilibrium price by 10 percent. Using the price-change formula, 10% = 35% / (2.5 + 1.0).



▲ FIGURE 5.5 An Increase in Demand Increases the Equilibrium Price

5.6 USING ELASTICITIES TO PREDICT CHANGES IN PRICES

The Price Effects of a Change in Demand

Under what conditions will an increase in demand cause a relatively small increase in price?

- *Small increase in demand.*
- *Highly elastic demand.*
- *Highly elastic supply.*

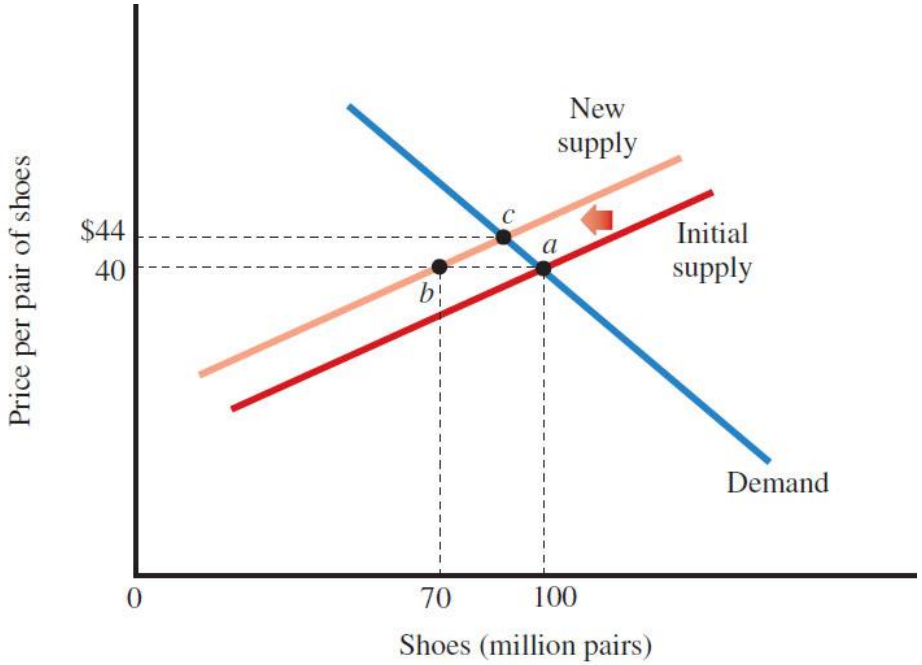
$$\text{percentage change in equilibrium price} = \frac{\text{percentage change in demand}}{E_s + E_d}$$

5.6 USING ELASTICITIES TO PREDICT CHANGES IN PRICES

The Price Effects of a Change in Supply

An import restriction on shoes decreases the supply of shoes, shifting the market supply curve to the left and increasing the equilibrium price from $40 to $44.

In this case, a 30 percent reduction in supply increases the equilibrium price by 10 percent. Using the price-change formula, 10% = –(–30% / (2.3 + 0.70)).



▲ FIGURE 5.6 A Decrease in Supply Increases the Equilibrium Price

5.6 USING ELASTICITIES TO PREDICT CHANGES IN PRICES

The Price Effects of a Change in Supply

Under what conditions will a decrease in supply cause a relatively small increase in price?

- *Small decrease in supply.*
- *Highly elastic demand.*
- *Highly elastic supply.*

$$\text{percentage change in equilibrium price} = -\frac{\text{percentage change in supply}}{E_s + E_d}$$

APPLICATION 6

A BROKEN PIPELINE AND THE PRICE OF GASOLINE

APPLYING THE CONCEPTS #6: How does a decrease in supply affect the equilibrium price?

- In the chapter opener, a pipeline break decreased the supply of gasoline to the city of Phoenix by 30 percent and increased the equilibrium price by only 40 percent. Given a short-run price elasticity of demand for gasoline of 0.20, a price increase of 150 percent would be required to decrease the quantity demanded by 30 percent. Why did the price increase by only 40 percent?

- To predict a change in the equilibrium price, we must look at both sides of the market, demand and supply. When the Texas pipeline broke, gasoline sellers in Phoenix switched to the West Coast pipeline. The increase in the Phoenix retail price allowed Phoenix sellers to outbid sellers in other cities for gasoline produced by West Coast refineries. This is the law of supply in action: the increase in the Phoenix price diverted gasoline from other cities, reducing the impact of the pipeline break. As a result, the equilibrium price increased by only 40 percent, not the 150 percent that would have occurred in the absence of the supply boost from West Coast refineries.

- We can use the price-change formula to illustrate this case. Suppose the price elasticity of supply is 0.55 and the price elasticity of demand is 0.20. In this case, a 30 percent decrease in supply generates a 40 percent increase in the equilibrium price:

Learning Objectives

5.1 List the determinants of the price elasticity of demand

5.2 Use price elasticity of demand to predict changes in quantity and total revenue

5.3 Explain how the price elasticity of demand varies along a linear demand curve

5.4 Define the income elasticity and cross-price elasticity of demand

5.5 List the determinants of the price elasticity of supply

5.6 Use demand and supply elasticities to predict changes in equilibrium prices

KEY TERMS

Cross-price elasticity of demand

Elastic demand

Income elasticity of demand

Inelastic demand

Perfectly elastic demand

Perfectly elastic supply

Perfectly inelastic demand (E_d)

Perfectly inelastic supply

Price elasticity of demand

Price elasticity of supply

Total revenue

Unit elastic demand

Questions?

Inelastic Demand

Elastic Demand