Elasticity . . .

- … allows us to analyze supply and demand with greater precision.

- … is a measure of how much buyers and sellers respond to changes in market conditions

THE ELASTICITY OF DEMAND

- The *price elasticity of demand* is a measure of how much the quantity demanded of a good responds to a change in the price of that good.

- When we talk about *elasticity*, that responsiveness is always measured in percentage terms.

- Specifically, the price elasticity of demand is the percentage change in quantity demanded due to a percentage change in the price.

The Price Elasticity of Demand and Its Determinants

- Availability of Close Substitutes

- Necessities versus Luxuries

- Definition of the Market

- Time Horizon

The Price Elasticity of Demand and Its Determinants

- Demand tends to be more elastic:
    - the larger the number of close substitutes.
    - if the good is a luxury.
    - the more narrowly defined the market.
    - the longer the time period.

Computing the Price Elasticity of Demand

- The price elasticity of demand is computed as the percentage change in the quantity demanded divided by the percentage change in price.

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

Computing the Price Elasticity of Demand

- Example: If the price of an ice cream cone increases from $2.00 to $2.20 and the amount you buy falls from 10 to 8 cones, then your elasticity of demand would be calculated as:

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

$$\frac{\dfrac{(10-8)}{10} \times 100}{\dfrac{(2.20-2.00)}{2.00} \times 100} = \frac{20\%}{10\%} = 2$$

The Midpoint Method: A Better Way to Calculate Percentage Changes and Elasticities

- The midpoint formula is preferable when calculating the price elasticity of demand because it gives the same answer regardless of the direction of the price change.

$$\text{Price elasticity of demand} = \frac{(Q_2 - Q_1)/[(Q_2 + Q_1)/2]}{(P_2 - P_1)/[(P_2 + P_1)/2]}$$

The Midpoint Method: A Better Way to Calculate Percentage Changes and Elasticities

- Example: If the price of an ice cream cone increases from $2.00 to $2.20 and the amount you buy falls from 10 to 8 cones, then your elasticity of demand, using the midpoint formula, would be calculated as:

$$\frac{\dfrac{(10-8)}{(10+8)/2}}{\dfrac{(2.20-2.00)}{(2.00+2.20)/2}} = \frac{22\%}{9.5\%} = 2.32$$

The Variety of Demand Curves

- Inelastic Demand
  - Quantity demanded does not respond strongly to price changes.
  - Price elasticity of demand is less than one.
- Elastic Demand
  - Quantity demanded responds strongly to changes in price.
  - Price elasticity of demand is greater than one.

Computing the Price Elasticity of Demand

$$E_D = \frac{(100-50)\big/(100+50)/2}{(4.00-5.00)\big/(4.00+5.00)/2}$$

$$= \frac{67\,\text{percent}}{-22\,\text{percent}} = -3$$

Price

$5

4

Demand

0   **50**   **100**   **Quantity**

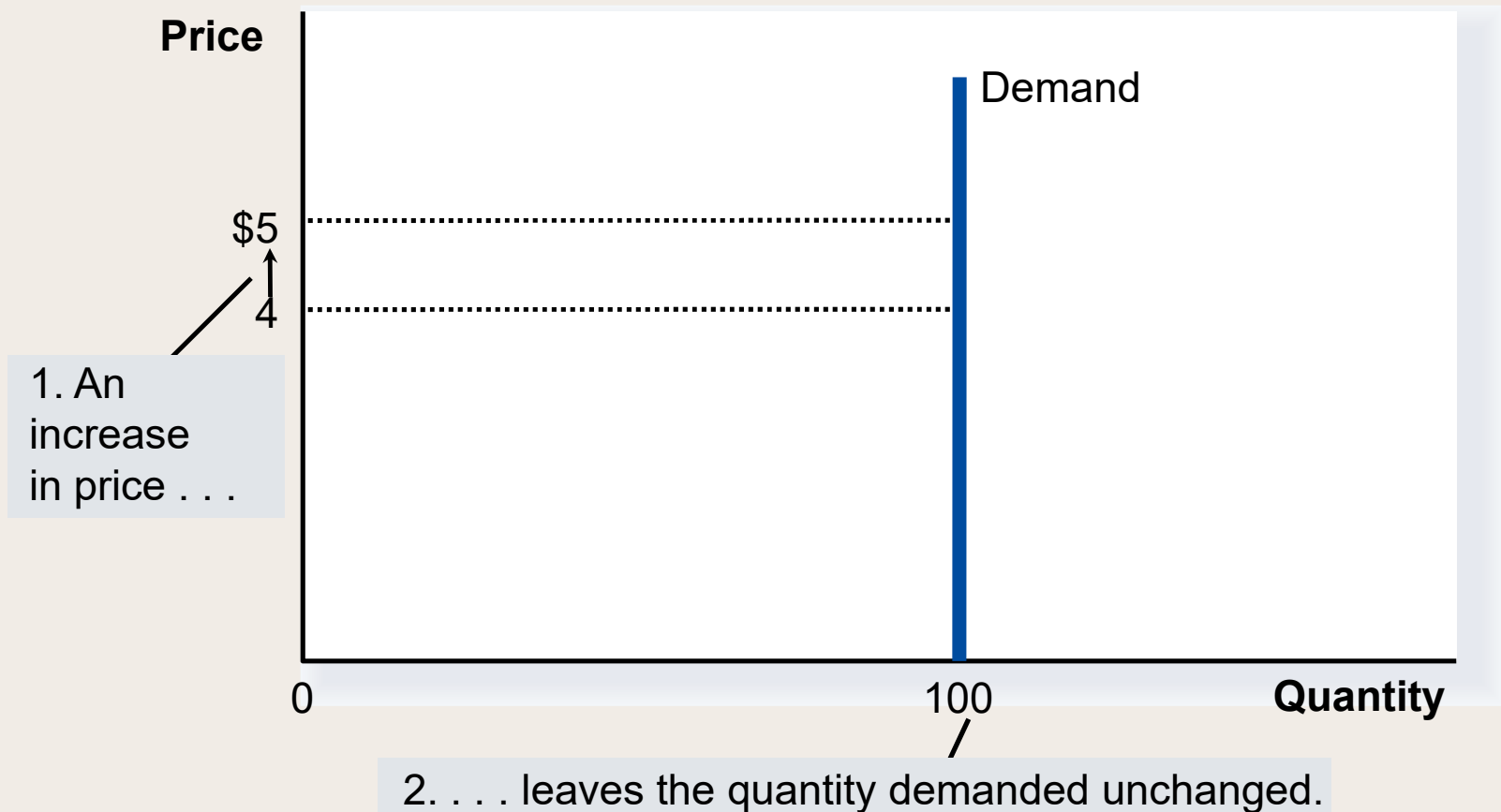Demand is price elastic.

The Variety of Demand Curves

- Perfectly Inelastic
  - Quantity demanded does not respond to price changes.

- Perfectly Elastic
  - Quantity demanded changes infinitely with any change in price.

- Unit Elastic
  - Quantity demanded changes by the same percentage as the price.

The Variety of Demand Curves

- Because the price elasticity of demand measures how much quantity demanded responds to the price, it is closely related to the slope of the demand curve.

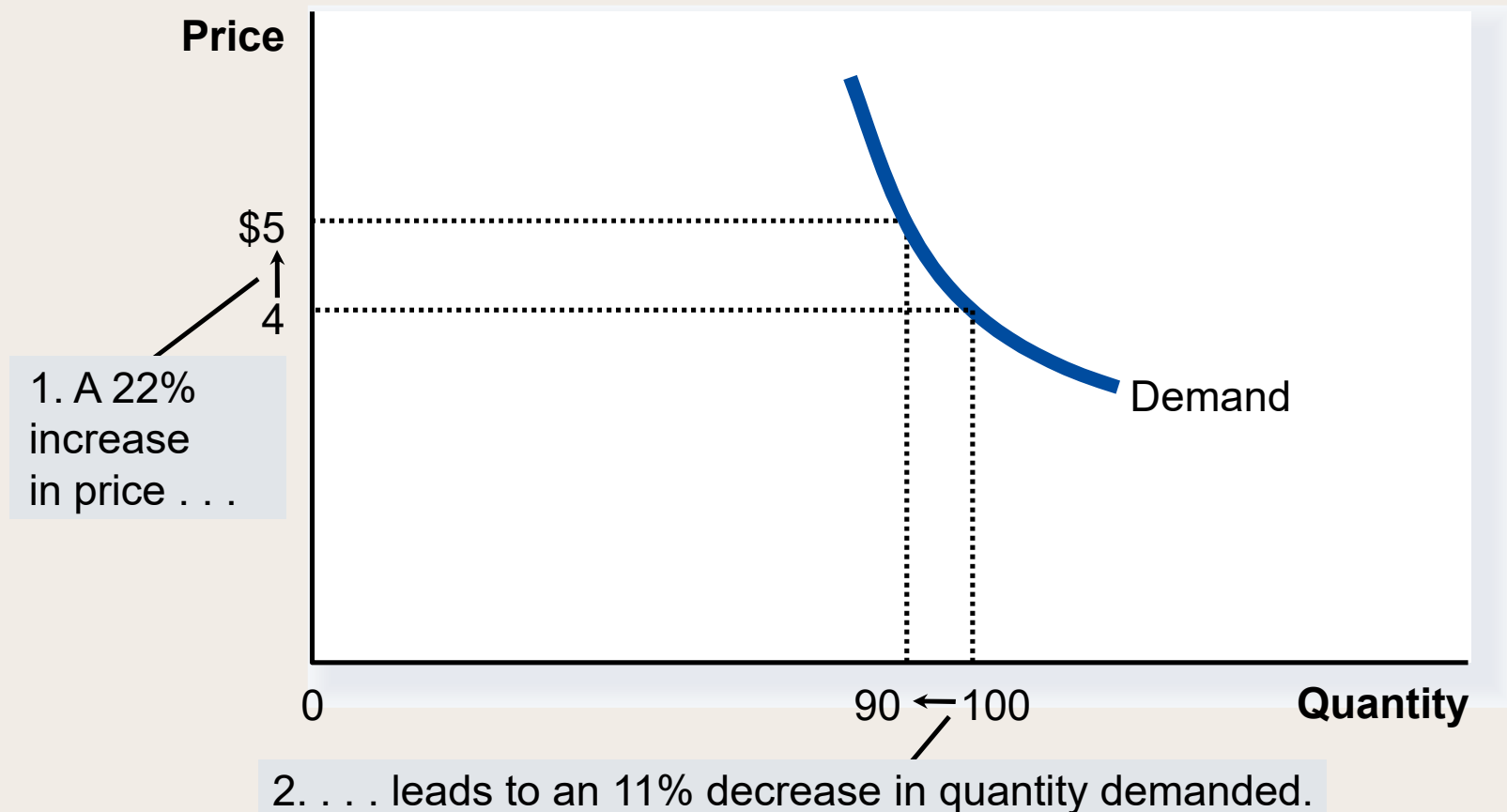- But it is not the same thing as the slope!

Figure 1 The Price Elasticity of Demand

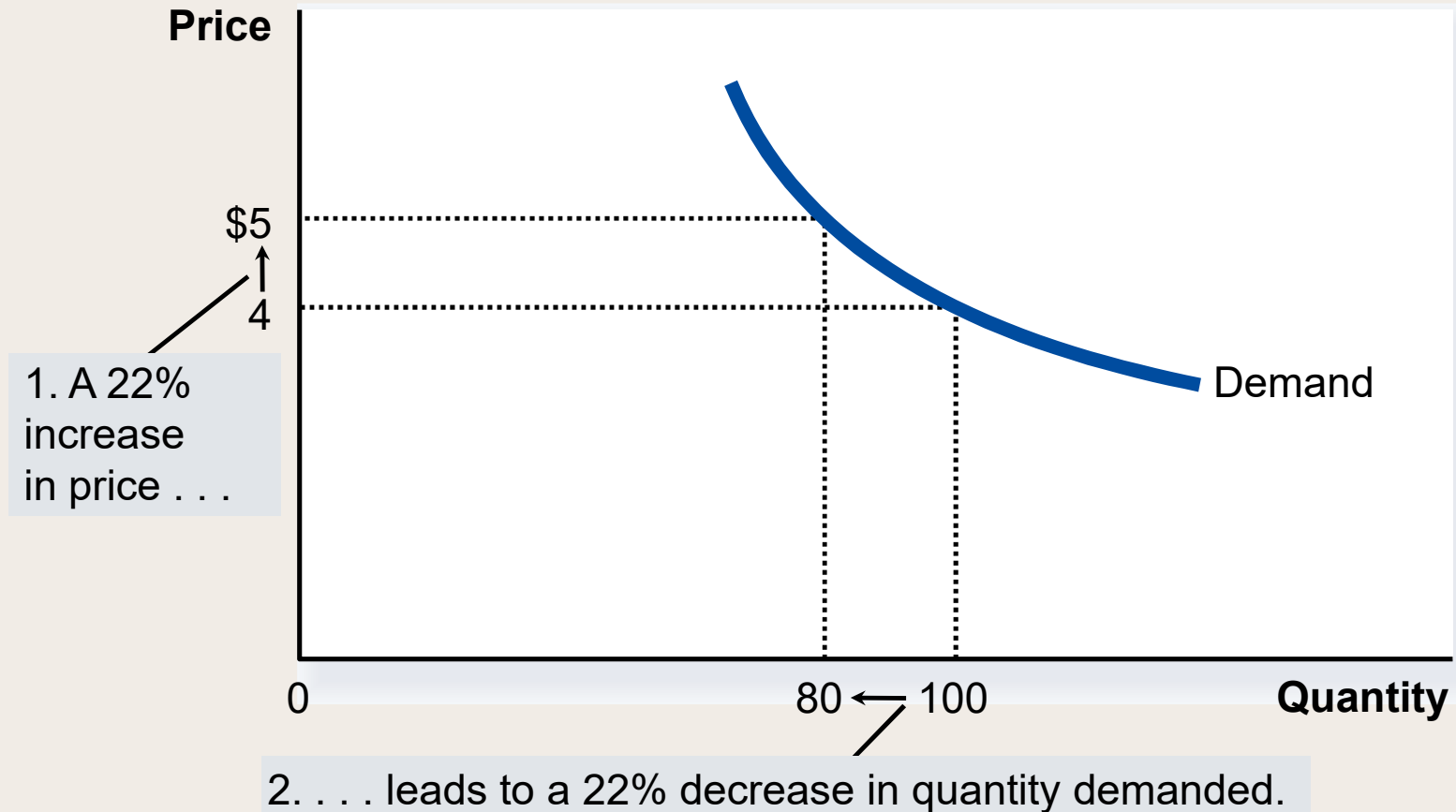## (a) Perfectly Inelastic Demand: Elasticity Equals 0

Price

Demand

$5

4

1. An increase in price . . .

0

100

Quantity

2. . . . leaves the quantity demanded unchanged.

Figure 1 The Price Elasticity of Demand

(b) Inelastic Demand: Elasticity Is Less Than 1

Price

$5

4

1. A 22% increase in price . . .

Demand

0   90 ← 100   **Quantity**

2. . . . leads to an 11% decrease in quantity demanded.

© 2007 Thomson South-Western

Figure 1 The Price Elasticity of Demand

(c) Unit Elastic Demand: Elasticity Equals 1

Price

$5

4

1. A 22% increase in price . . .

Demand

0   80 ← 100   **Quantity**

2. . . . leads to a 22% decrease in quantity demanded.

Figure 1 The Price Elasticity of Demand

(d) Elastic Demand: Elasticity Is Greater Than 1

Price

$5

4

Demand

1. A 22% increase in price . . .

0   50   100   **Quantity**

2. . . . leads to a 67% decrease in quantity demanded.

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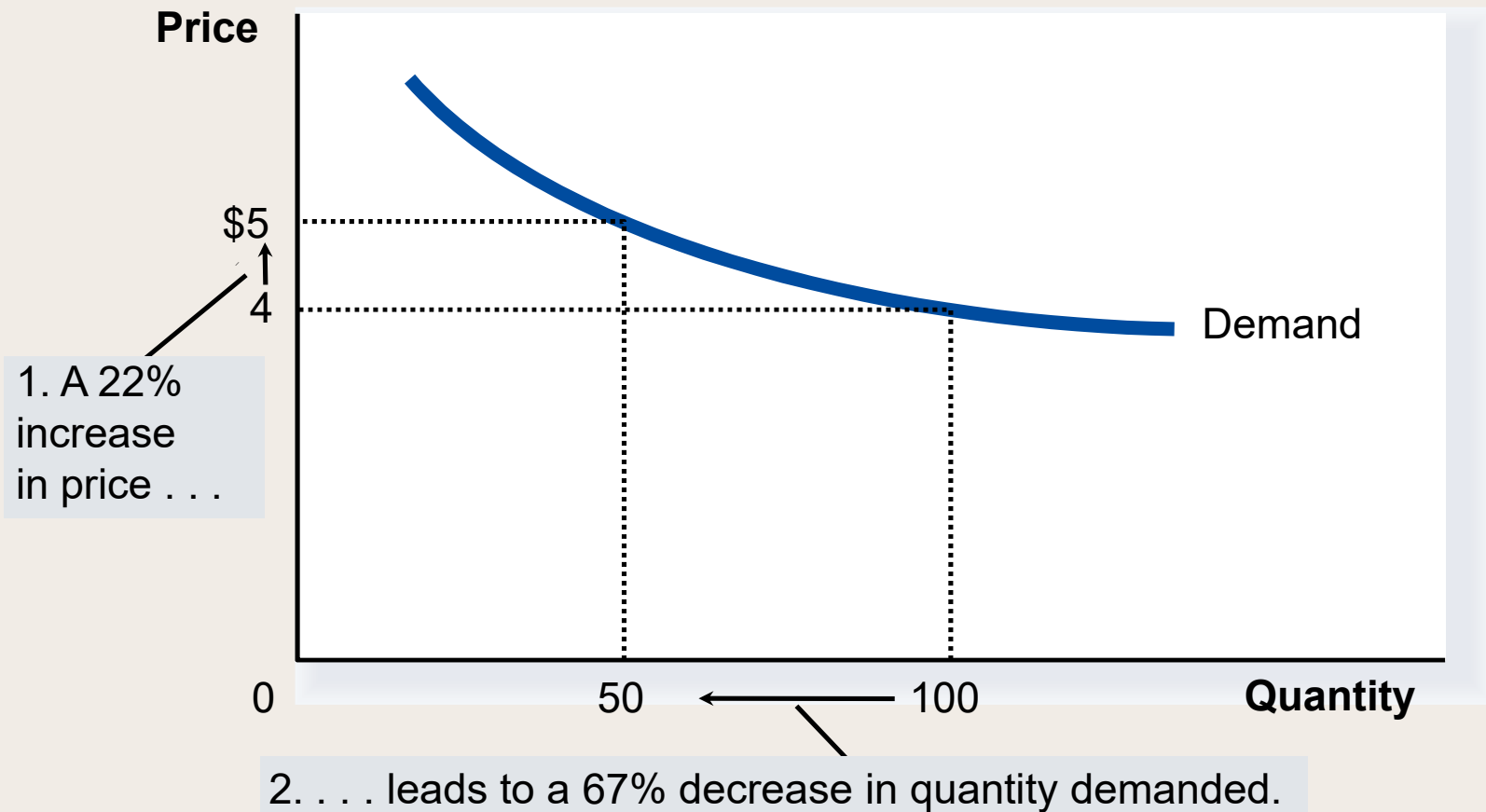
Figure 1 The Price Elasticity of Demand

(e) Perfectly Elastic Demand: Elasticity Equals Infinity

Price

1. At any price above $4, quantity demanded is zero.

$4 ——————————————————— Demand

2. At exactly $4, consumers will buy any quantity.

0

Quantity
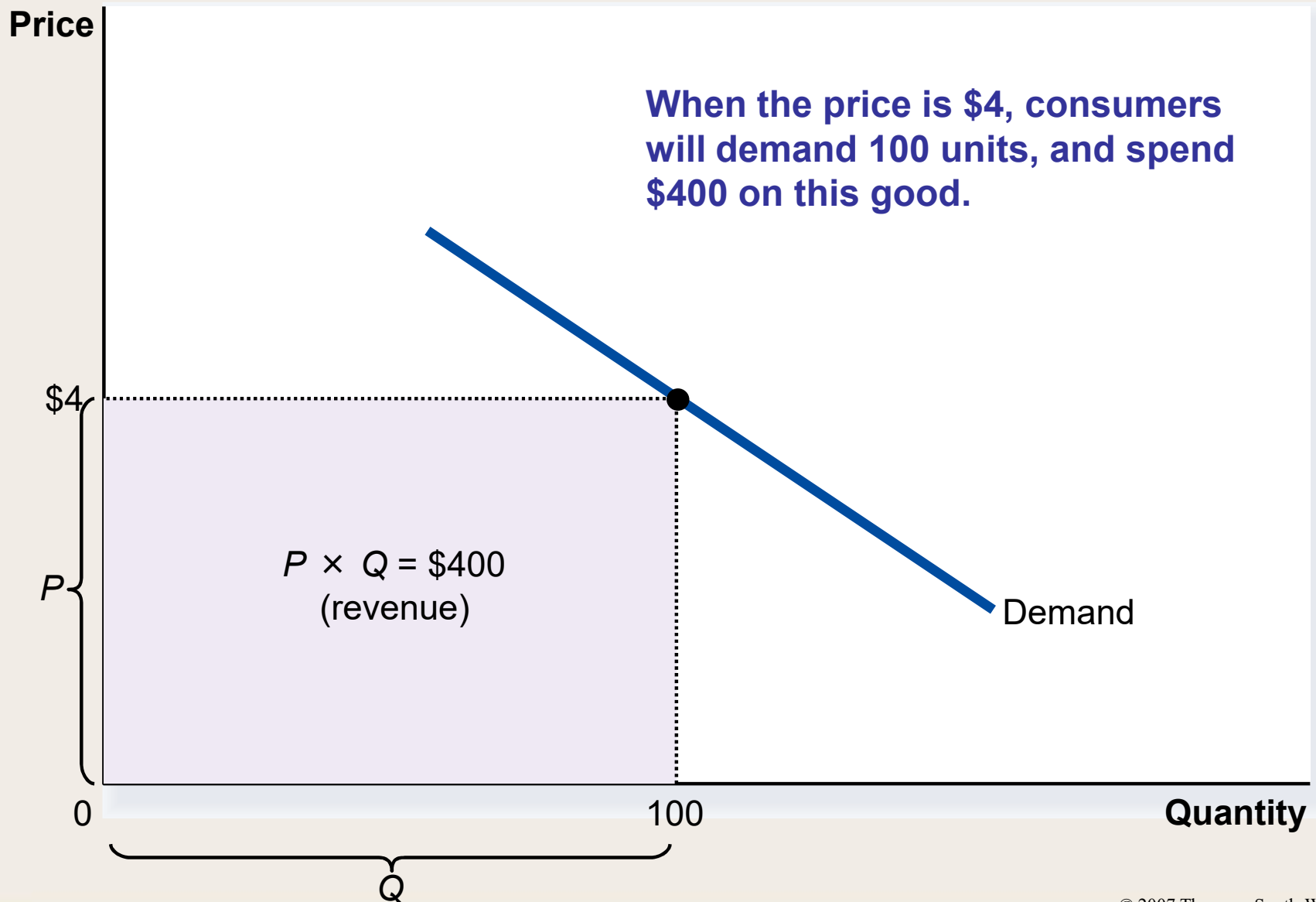
3. At a price below $4, quantity demanded is infinite.
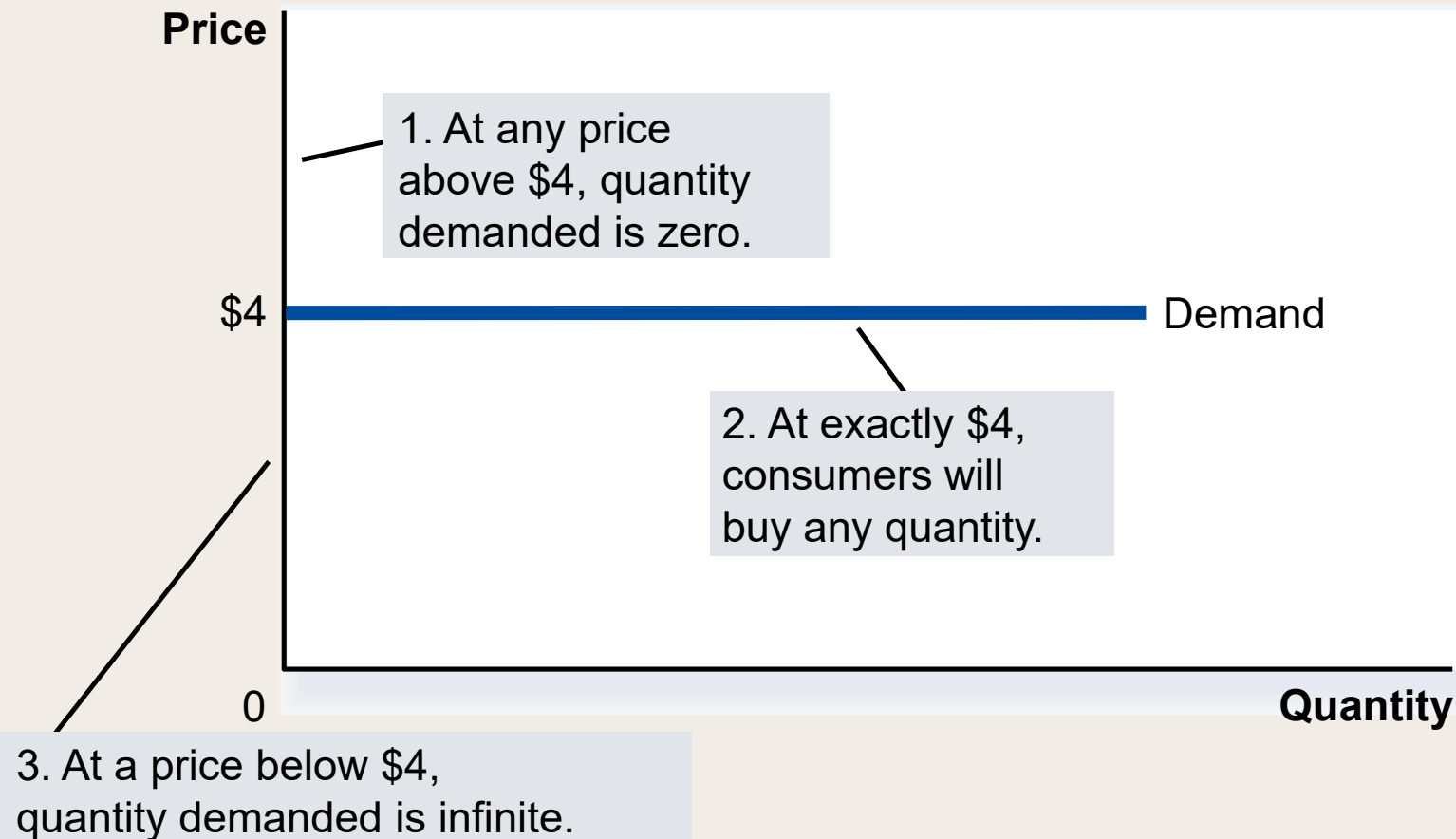
Total Revenue and the Price Elasticity of Demand

- *Total revenue* is the amount paid by buyers and received by sellers of a good.

- Computed as the price of the good times the quantity sold.
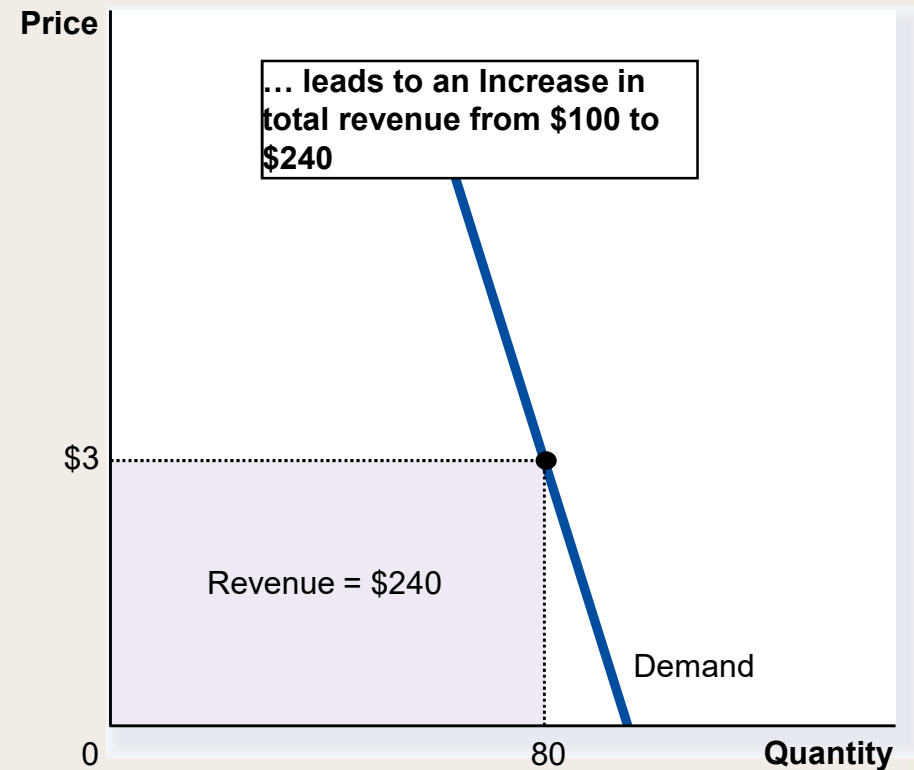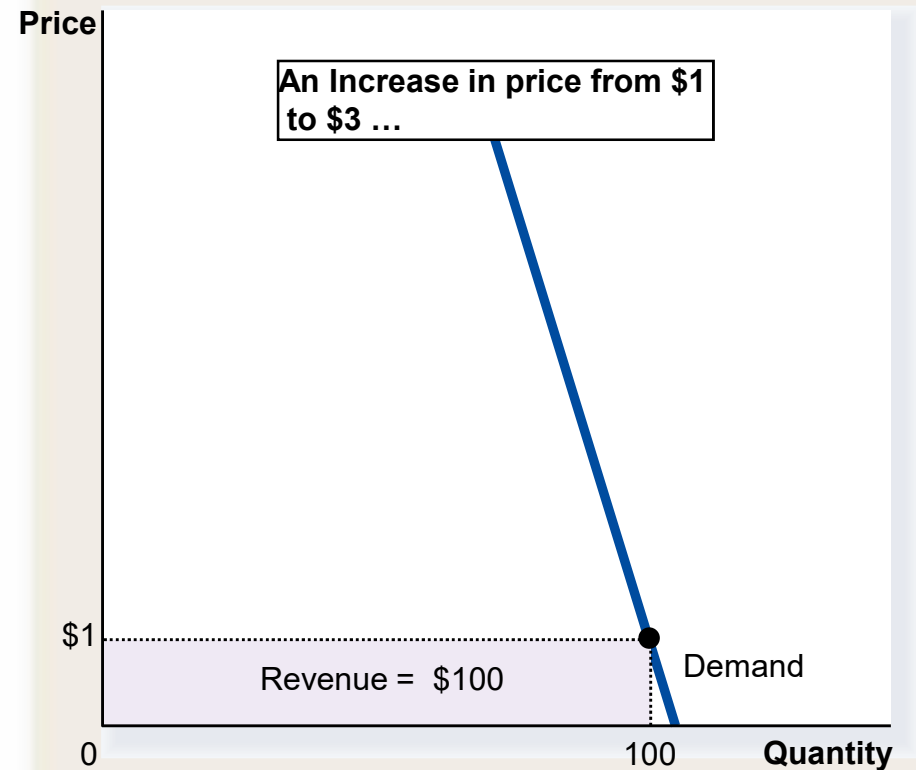
$$TR = P \times Q$$

Figure 2 Total Revenue

Price

When the price is $4, consumers will demand 100 units, and spend $400 on this good.

$4

$P \times Q = \$400$
(revenue)

P

Demand

0   100   **Quantity**

Q

Elasticity and Total Revenue along a Linear Demand Curve

- With an inelastic demand curve, an increase in price leads to a decrease in quantity that is proportionately smaller. Thus, total revenue increases.
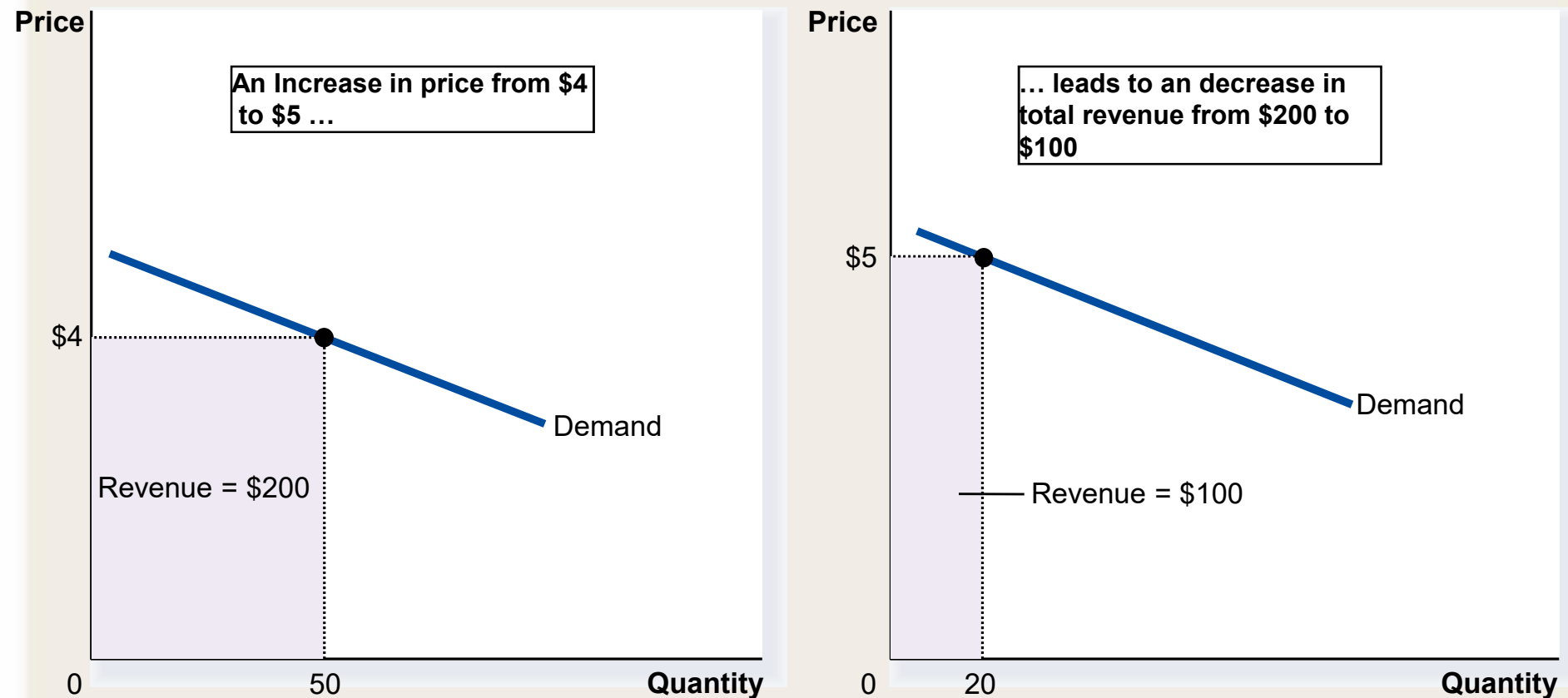
Figure 3 How Total Revenue Changes When Price Changes: Inelastic Demand

Price

An Increase in price from $1 to $3 …

$1

Revenue = $100

Demand

0   100   **Quantity**

Price

… leads to an Increase in total revenue from $100 to $240

$3

Revenue = $240

Demand

0   80   **Quantity**

Elasticity and Total Revenue along a Linear Demand Curve

- With an elastic demand curve, an increase in the price leads to a decrease in quantity demanded that is proportionately larger. Thus, *total revenue decreases*.

Figure 3 How Total Revenue Changes When Price Changes: Elastic Demand

An Increase in price from $4 to $5 …

Price

$4

Revenue = $200

Demand

0   50   Quantity

… leads to an decrease in total revenue from $200 to $100

Price
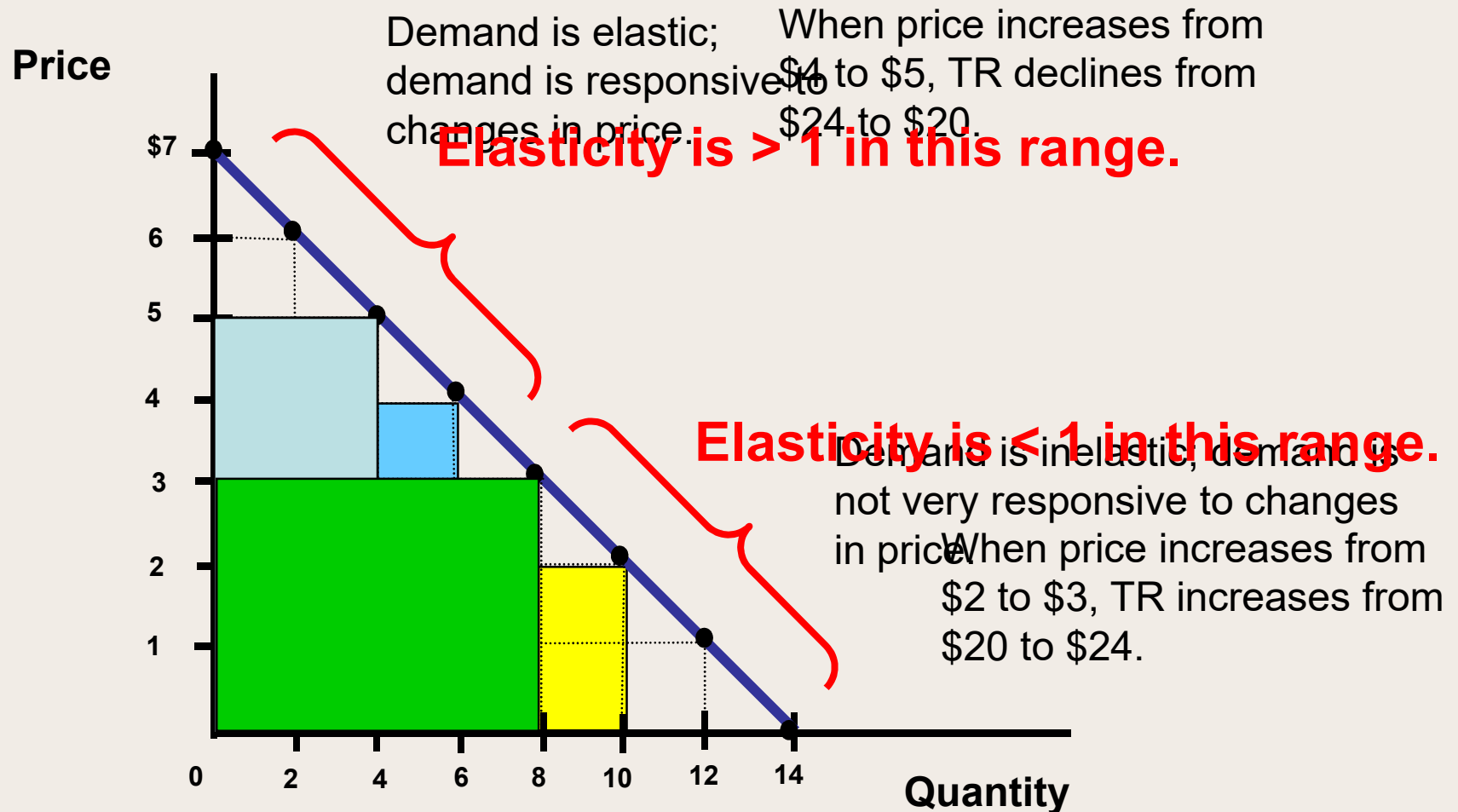
$5

Revenue = $100

Demand

0   20   Quantity

Note that with each price increase, the Law of Demand still holds – an increase in price leads to a decrease in the quantity demanded. It is the change in TR that varies!

Elasticity of a Linear Demand Curve

Price	Quantity	Total Revenue (Price × Quantity)	Percent Change in Price	Percent Change in Quantity	Elasticity	Description
$7	0	$0				
6	2	12	15	200	13.0	Elastic
5	4	20	18	67	3.7	Elastic
4	6	24	22	40	1.8	Elastic
3	8	24	29	29	1.0	Unit elastic
2	10	20	40	22	0.6	Inelastic
1	12	12	67	18	0.3	Inelastic
0	14	0	200	15	0.1	Inelastic

Figure 4 Elasticity of a Linear Demand Curve

Price

Demand is elastic; demand is responsive to changes in price.

When price increases from $4 to $5, TR declines from $24 to $20.

Elasticity is > 1 in this range.

Elasticity is < 1 in this range.

Demand is inelastic; demand is not very responsive to changes in price. When price increases from $2 to $3, TR increases from $20 to $24.

Quantity

Other Demand Elasticities

- Income Elasticity of Demand

  - *Income elasticity of demand* measures how much the quantity demanded of a good responds to a change in consumers' income.

  - It is computed as the percentage change in the quantity demanded divided by the percentage change in income.

Other Demand Elasticities

- Computing Income Elasticity

$$\text{Income elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in income}}$$

Remember, all elasticities are measured by dividing one percentage change by another

Other Demand Elasticities

- Income Elasticity
  - Types of Goods
    - Normal Goods
    - Inferior Goods
  - Higher income raises the quantity demanded for normal goods but lowers the quantity demanded for inferior goods.

Other Demand Elasticities

- Income Elasticity

  - Goods consumers regard as necessities tend to be income inelastic

    - Examples include food, fuel, clothing, utilities, and medical services.

  - Goods consumers regard as luxuries tend to be income elastic.

    - Examples include sports cars, furs, and expensive foods.

Other Demand Elasticities

- *Cross-price elasticity of demand*
  - A measure of how much the quantity demanded of one good responds to a change in the price of another good, computed as the percentage change in quantity demanded of the first good divided by the percentage change in the price of the second good

$$\text{Cross-price elasticity of demand} = \frac{\%\text{change in quantity demanded of good 1}}{\%\text{change in price of good 2}}$$

THE ELASTICITY OF SUPPLY

- *Price elasticity of supply* is a measure of how much the quantity supplied of a good responds to a change in the price of that good.

- Price elasticity of supply is the percentage change in quantity supplied resulting from a percentage change in price.

Figure 5 The Price Elasticity of Supply

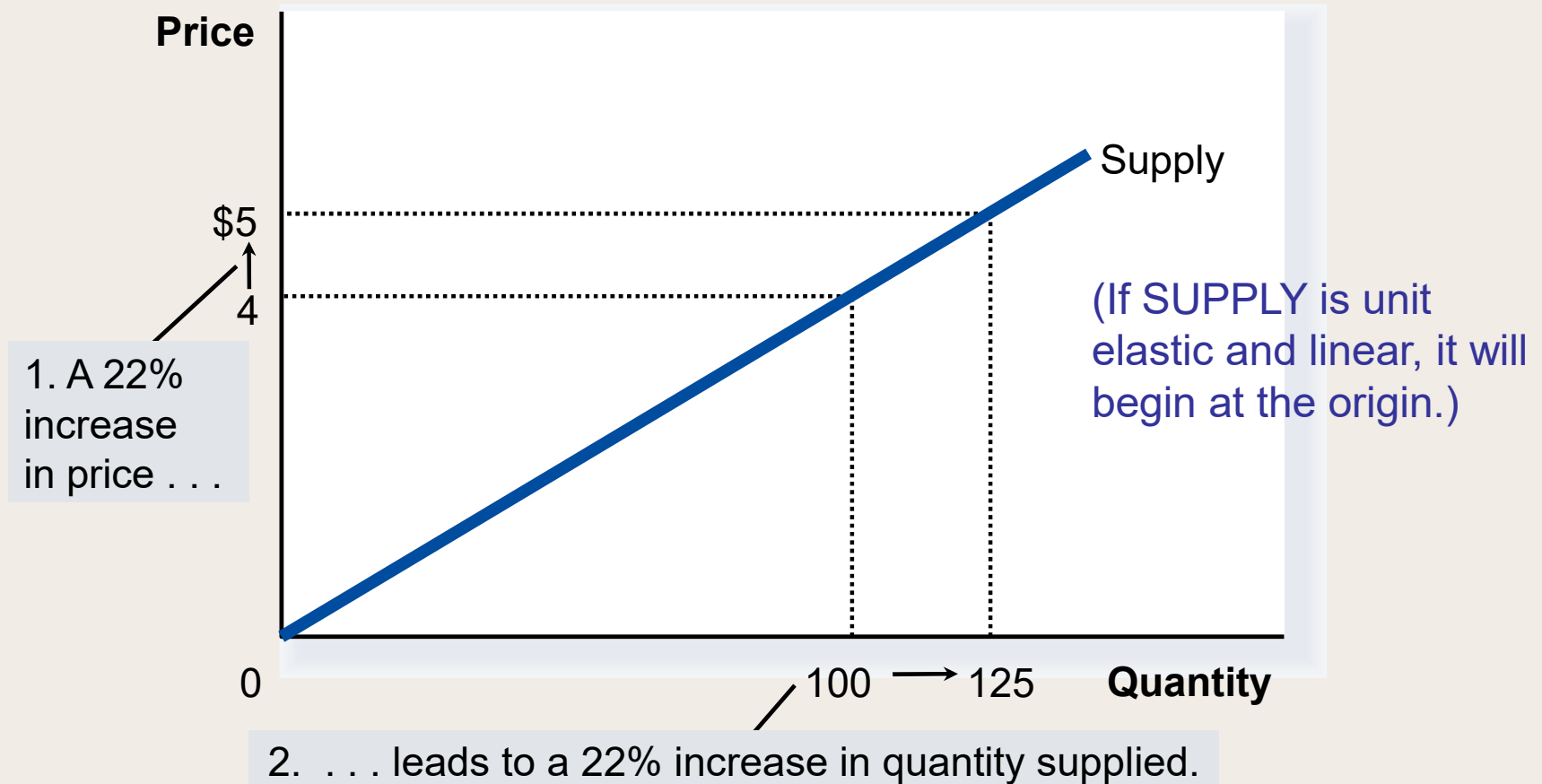### (a) Perfectly Inelastic Supply: Elasticity Equals 0

Price

Supply

$5

4

1. An increase in price . . .

0   100   **Quantity**

2. . . . leaves the quantity supplied unchanged.
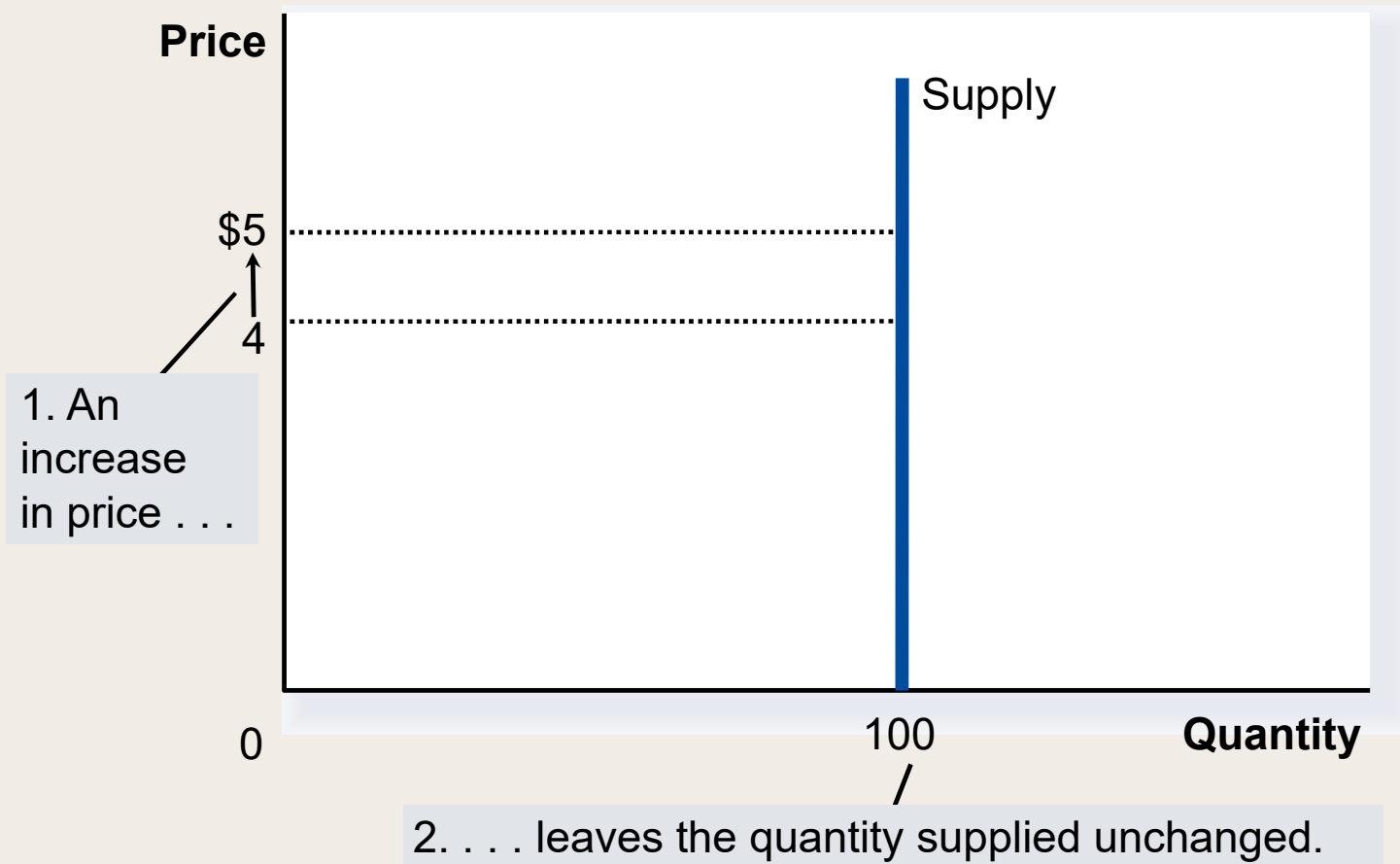
Figure 5 The Price Elasticity of Supply

(b) Inelastic Supply: Elasticity Is Less Than 1

Price

$5

4

1. A 22% increase in price . . .

Supply

0   100 → 110   **Quantity**

2. . . . leads to a 10% increase in quantity supplied.
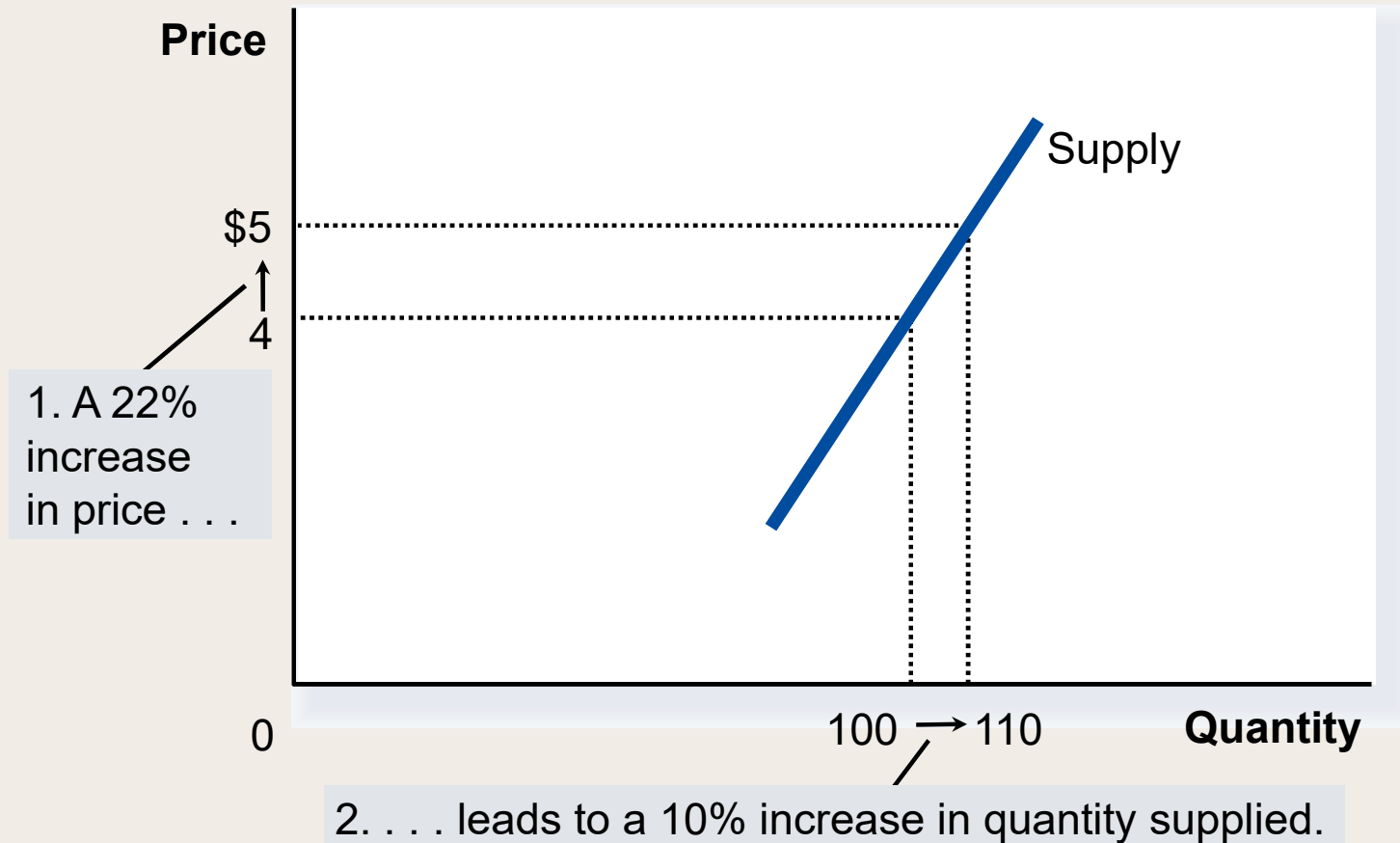
Figure 5 The Price Elasticity of Supply

(c) Unit Elastic Supply: Elasticity Equals 1

Price

Supply

$5

4

1. A 22% increase in price . . .

(If SUPPLY is unit elastic and linear, it will begin at the origin.)

0   100 ⟶ 125   **Quantity**

2. . . . leads to a 22% increase in quantity supplied.

Figure 5 The Price Elasticity of Supply

(d) Elastic Supply: Elasticity Is Greater Than 1

Price

Supply

$5

4

1. A 22% increase in price . . .

0

100 → 200

Quantity

2. . . . leads to a 67% increase in quantity supplied.
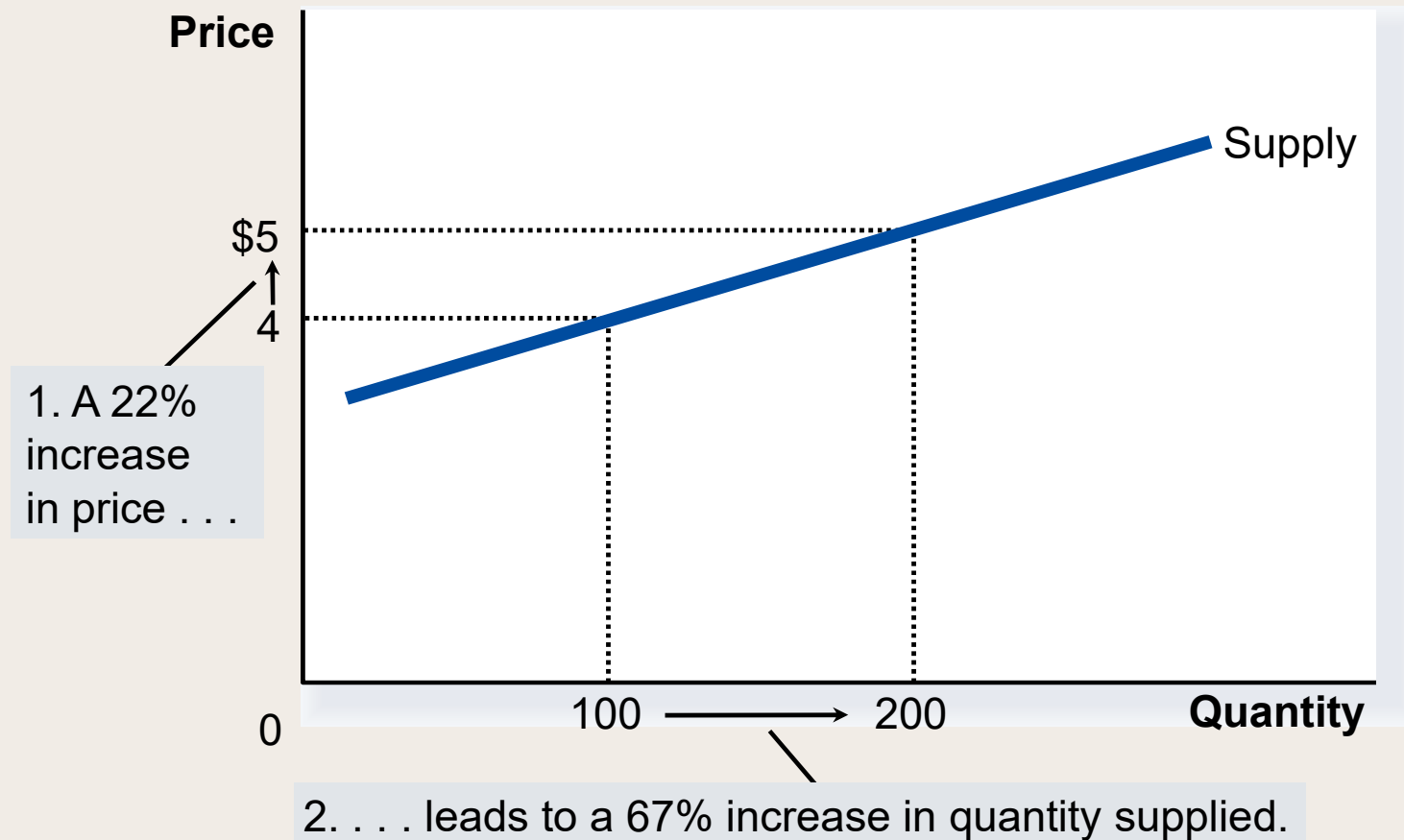
Figure 5 The Price Elasticity of Supply

(e) Perfectly Elastic Supply: Elasticity Equals Infinity

Price

1. At any price above $4, quantity supplied is infinite.

$4 ——————————————————— Supply

2. At exactly $4, producers will supply any quantity.

0

Quantity

3. At a price below $4, quantity supplied is zero.
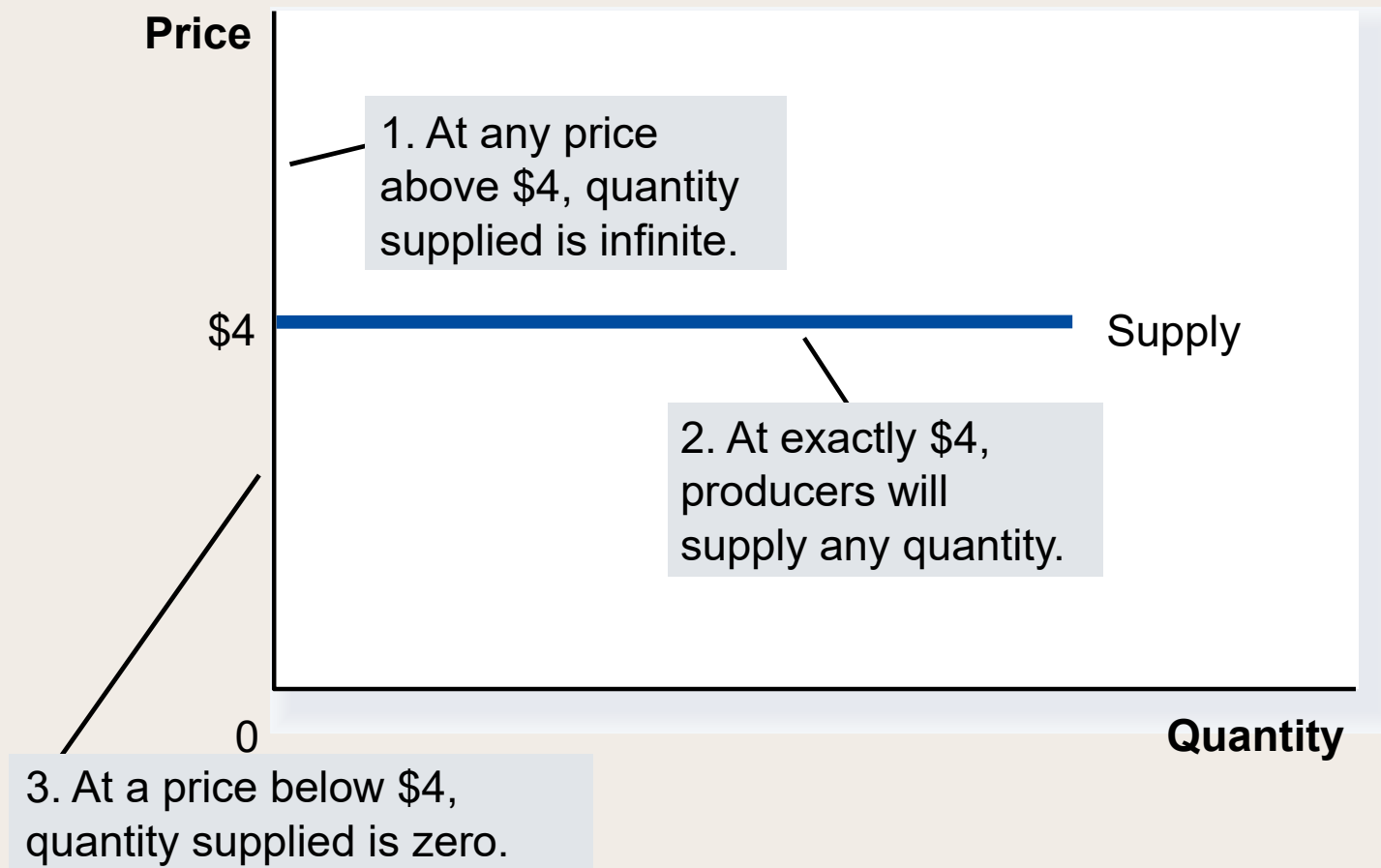
The Price Elasticity of Supply and Its Determinants

- Ability of sellers to change the amount of the good they produce.
  - Beach-front land is inelastic.
  - Books, cars, or manufactured goods are elastic.
- Time period
  - Supply is more elastic in the long run.

Computing the Price Elasticity of Supply

- The price elasticity of supply is computed as the percentage change in the quantity supplied divided by the percentage change in price.

$$\text{Price elasticity of supply} = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

THREE APPLICATIONS OF SUPPLY, DEMAND, AND ELASTICITY

- Can good news for farming be bad news for farmers?

- What happens to wheat farmers and the market for wheat when university agronomists discover a new wheat hybrid that is more productive than existing varieties?

Can Good News for Farming Be Bad News for Farmers?

- Examine whether the supply or demand curve shifts.

- Determine the direction of the shift of the curve.

- Use the supply-and-demand diagram to see how the market equilibrium changes.

Figure 7 An Increase in Supply in the Market for Wheat

Price of Wheat

2. . . . leads to a large fall in price . . .

1. When demand is inelastic, an increase in supply . . .

S_1

S_2

$3

2

Demand

0

100 → 110

Quantity of Wheat
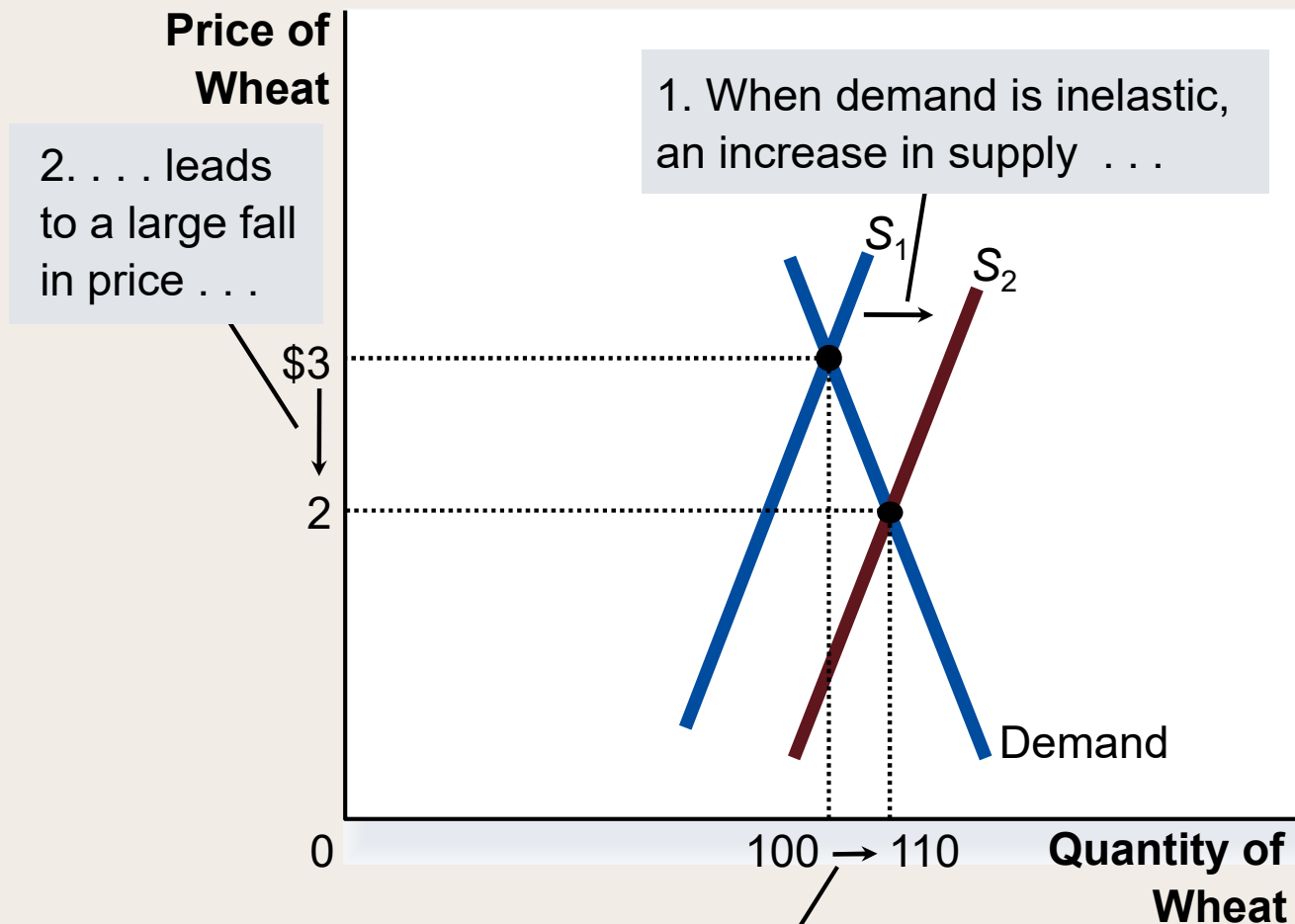
3. . . . and a proportionately smaller increase in quantity sold. As a result, revenue falls from $300 to $220.

Compute the Price Elasticity of Demand When There Is a Change in Supply

$$E_D = \frac{\dfrac{100 - 110}{(100 + 110)\,/\,2}}{\dfrac{3.00 - 2.00}{(3.00 + 2.00)\,/\,2}}$$

$$= \frac{-0.095}{0.4} \approx -0.24$$

Demand is inelastic.

Why Did OPEC Fail to Keep the Price of Oil High?

- Supply and Demand can behave differently in the short run and the long run
  - In the short run, both supply and demand for oil are relatively inelastic
  - But in the long run, both are elastic
    - Production outside of OPEC
    - More conservation by consumers

Does Drug Interdiction Increase or Decrease Drug-Related Crime?

- Drug interdiction impacts sellers rather than buyers.

  - Demand is unchanged.
  - Equilibrium price rises although quantity falls.

- Drug education impacts the buyers rather than sellers.

  - Demand is shifted.
  - Equilibrium price and quantity are lowered.

Figure 9 Policies to Reduce the Use of Illegal Drugs

Drug Interdiction

Price of Drugs

S_2

S_1

It is amazing how useful knowledge of elasticities can be!

D_1

Quantity of Drugs

Drug Education

Price of Drugs

S_1

D_1

D_2
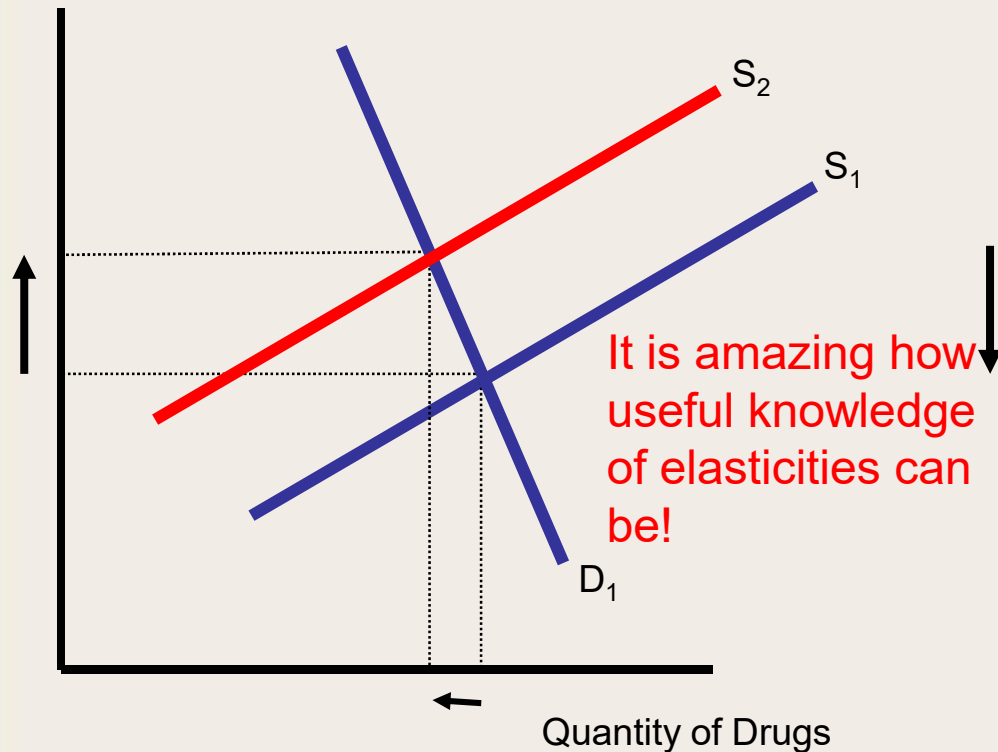
Quantity of Drugs

The demand for illegal drugs is inelastic.

Interdiction, but interdiction shifts the supply, while education shifts the demand.

The changes in quantities (and TR) are remarkable.

In each case, the new price lifts the same.
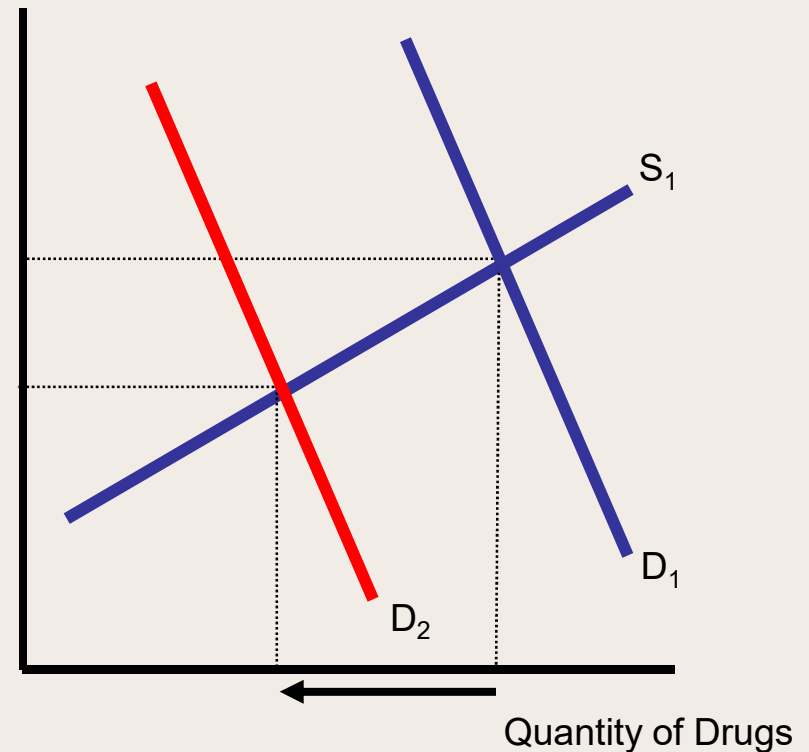
But in one market the price goes up.

And in the other it goes down.

- In a free, unregulated market system, market forces establish equilibrium prices and exchange quantities.

- While equilibrium conditions may be efficient, it may be true that not everyone is satisfied.

- One of the roles of economists is to use their theories to assist in the development of policies.

CONTROLS ON PRICES

- Are usually enacted when policymakers believe the market price is unfair to buyers or sellers.

- Result in government-created price ceilings and floors.

CONTROLS ON PRICES

- *Price Ceiling*

  – A legal *maximum* on the price at which a good can be sold.

- *Price Floor*

  – A legal *minimum* on the price at which a good can be sold.

How Price Ceilings Affect Market Outcomes

- Two outcomes are possible when the government imposes a price ceiling:
  - The price ceiling is not binding if set above the equilibrium price.
  - The price ceiling is binding if set below the equilibrium price, leading to a shortage.

Figure 1 A Market with a Price Ceiling

(a) A Price Ceiling That Is Not Binding

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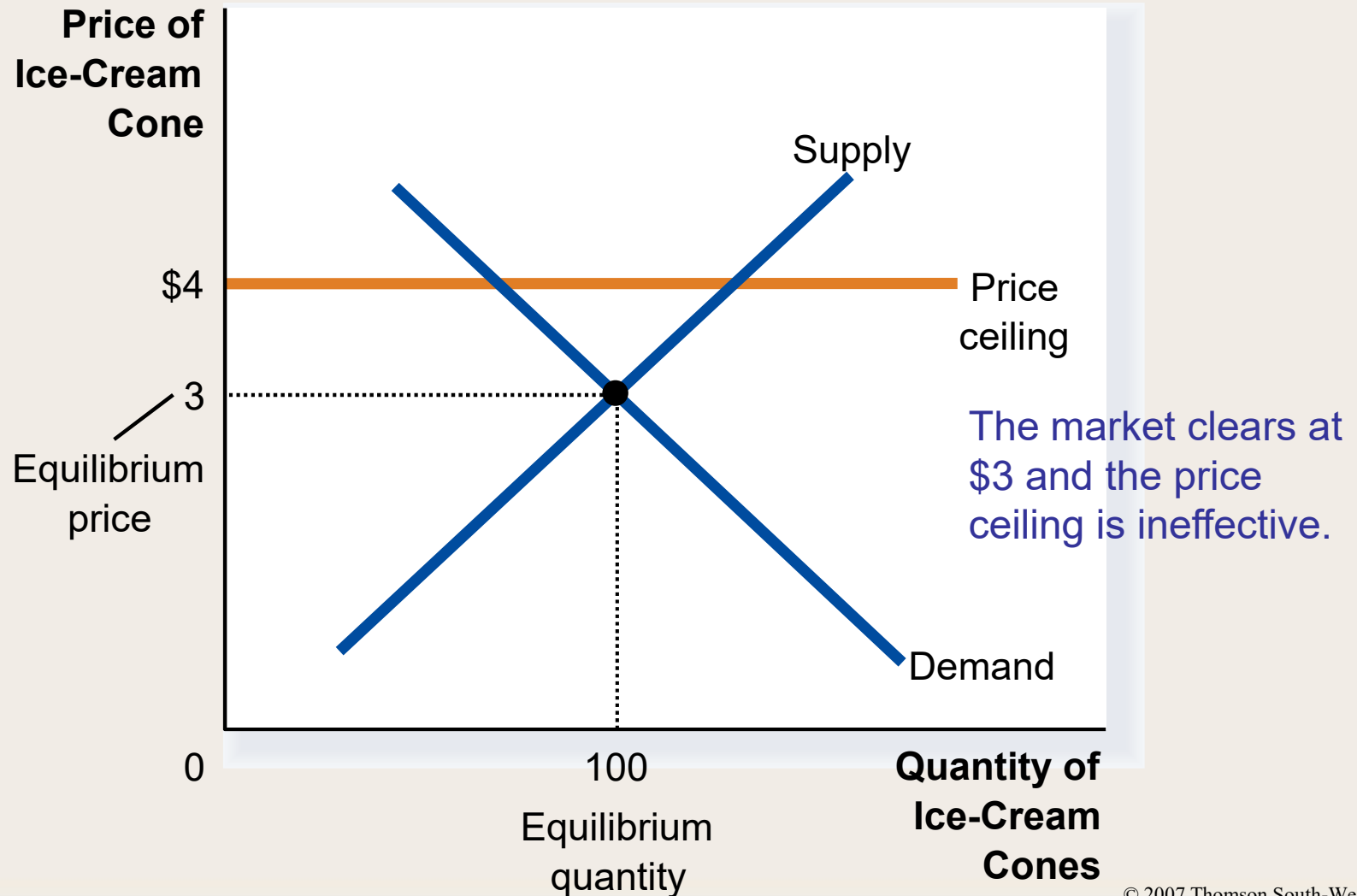
Figure 1 A Market with a Price Ceiling

(b) A Price Ceiling That Is Binding
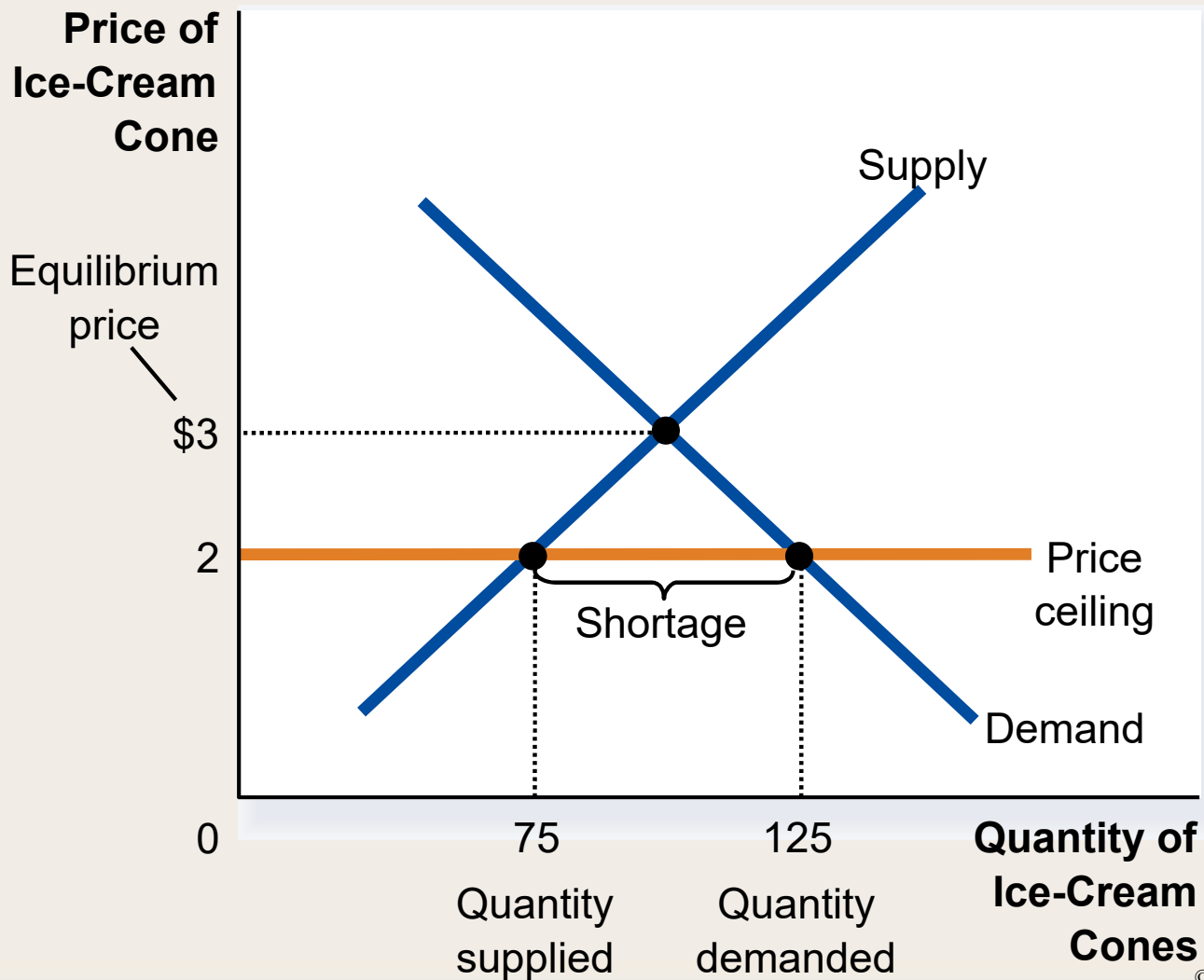
How Price Ceilings Affect Market Outcomes

- Effects of Price Ceilings
- A binding price ceiling creates
  - Shortages because $Q_D > Q_S$.
    - Example: Gasoline shortage of the 1970s
  - Nonprice rationing
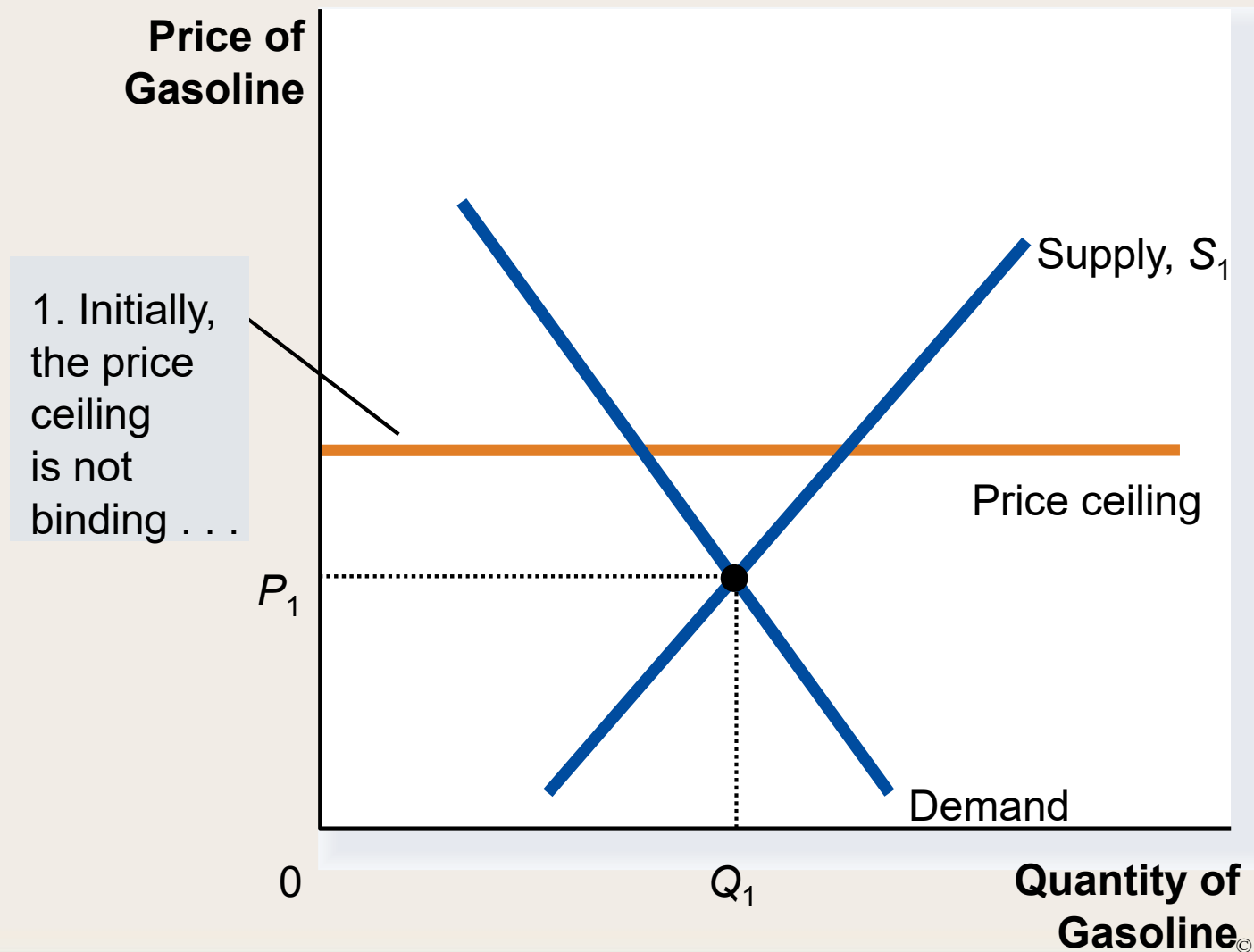   - Examples: Long lines, discrimination by sellers

CASE STUDY: Lines at the Gas Pump

- In 1973, OPEC raised the price of crude oil in world markets. Crude oil is the major input in gasoline, so the higher oil prices reduced the supply of gasoline.
- What was responsible for the long gas lines?
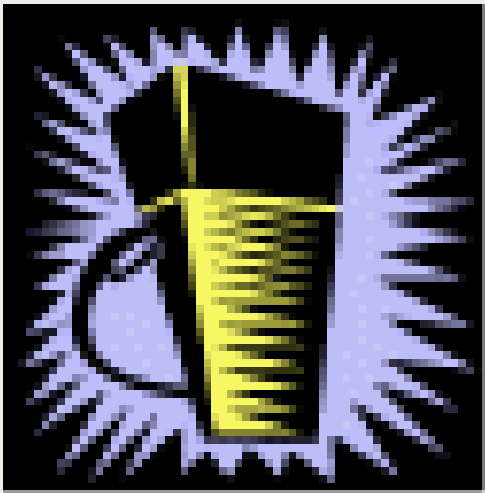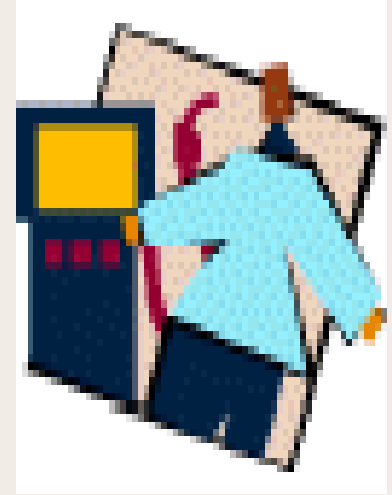
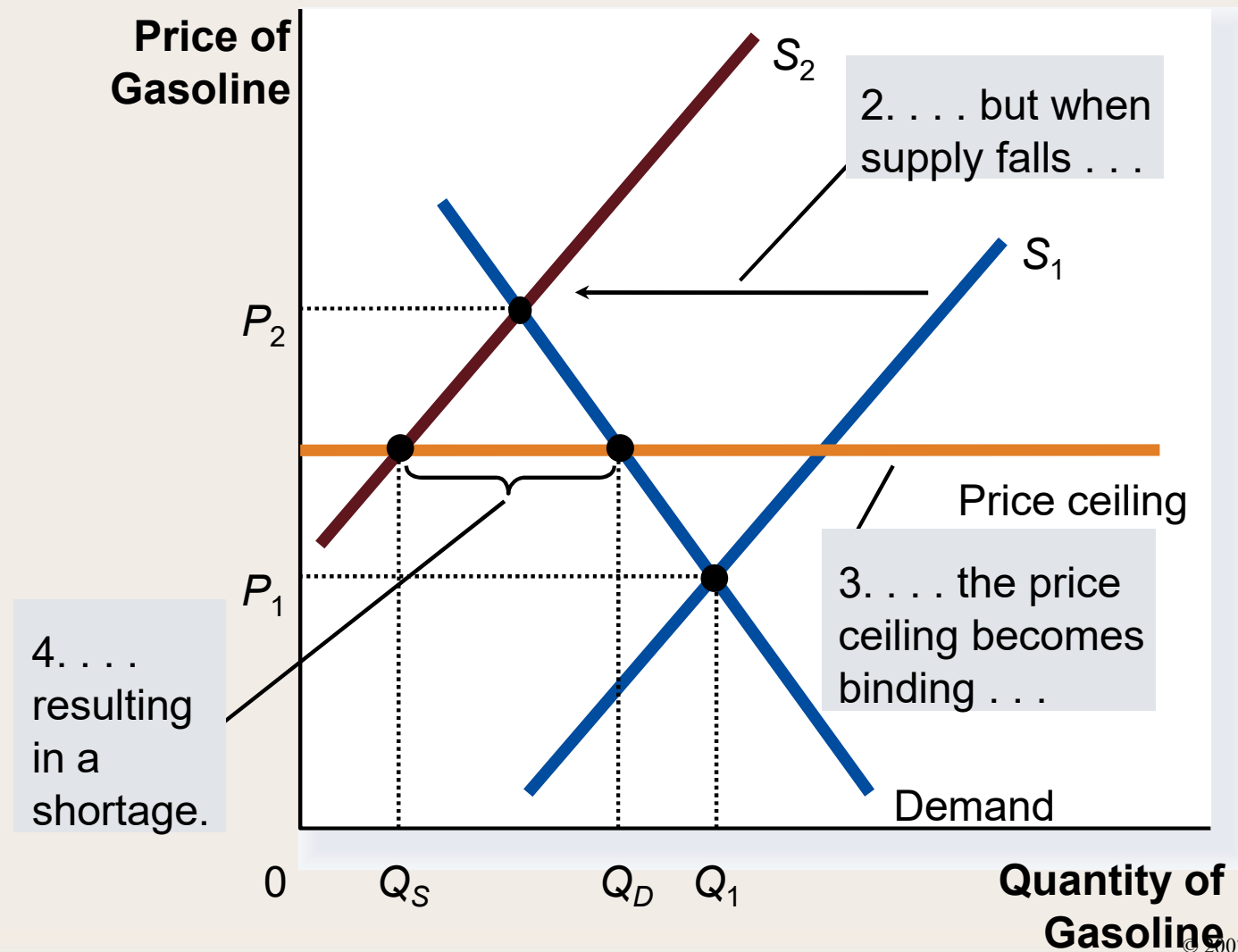- Economists blame government regulations that limited the price oil companies could charge for gasoline.

Figure 2 The Market for Gasoline with a Price Ceiling

(a) The Price Ceiling on Gasoline Is Not Binding

Price of Gasoline

1. Initially, the price ceiling is not binding . . .

Supply, S_1

Price ceiling

P_1

Demand

0   Q_1 Quantity of Gasoline

Figure 2 The Market for Gasoline with a Price Ceiling

(b) The Price Ceiling on Gasoline Is Binding

Price of Gasoline

S_2

2. . . . but when supply falls . . .

S_1

P_2

Price ceiling

P_1

3. . . . the price ceiling becomes binding . . .

4. . . . resulting in a shortage.

Demand

0   Q_S Q_D Q_1 Quantity of Gasoline

- Rent controls are ceilings placed on the rents that landlords may charge their tenants.

- The goal of rent control policy is to help the poor by making housing more affordable.

- One economist called rent control "the best way to destroy a city, other than bombing."

Figure 3 Rent Control in the Short Run and in the Long Run

(a) Rent Control in the Short Run
(supply and demand are inelastic)

Rental Price of Apartment

Supply

Controlled rent

Shortage

Demand

0

Quantity of Apartments
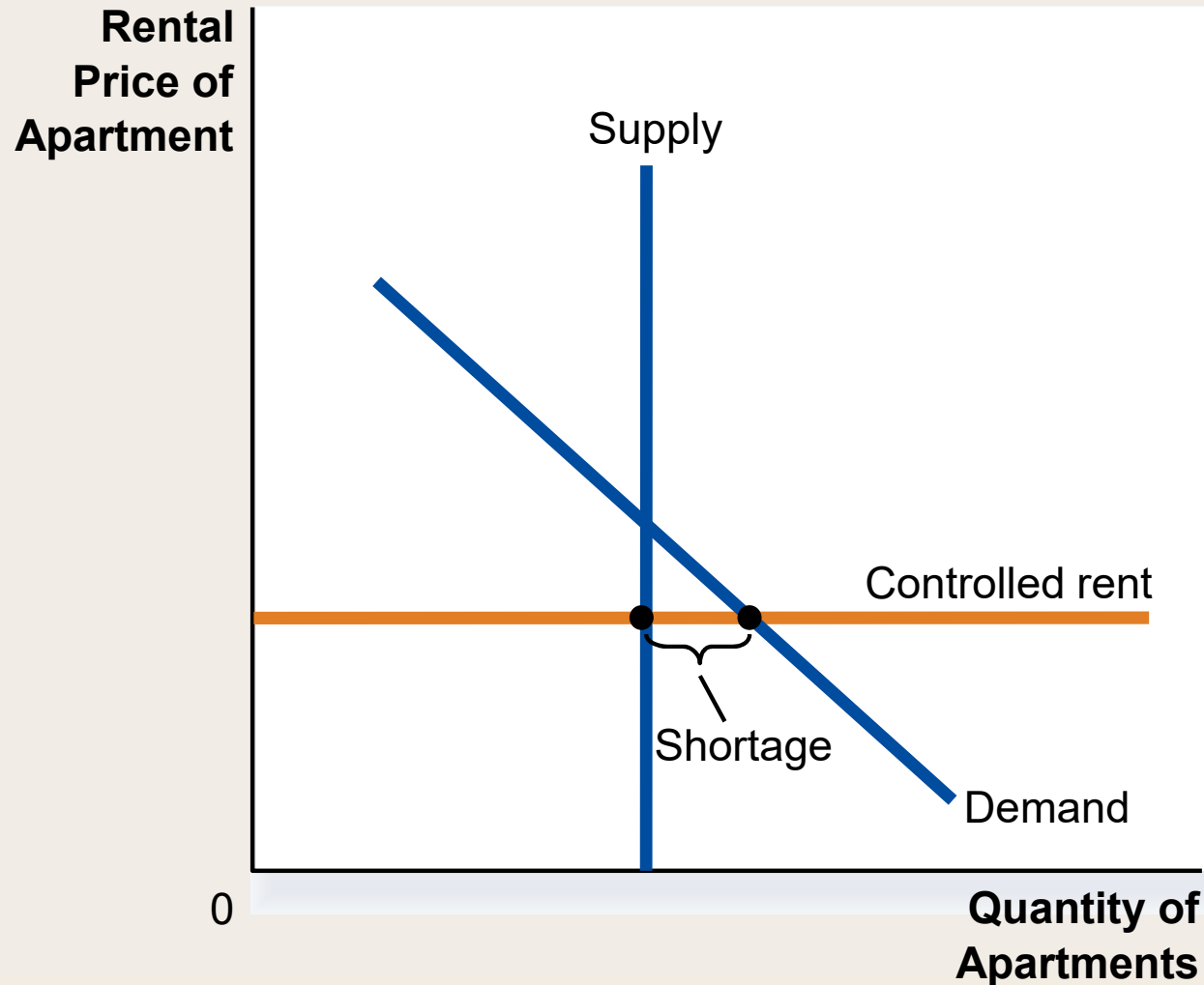
Figure 3 Rent Control in the Short Run and in the Long Run

(b) Rent Control in the Long Run
(supply and demand are elastic)
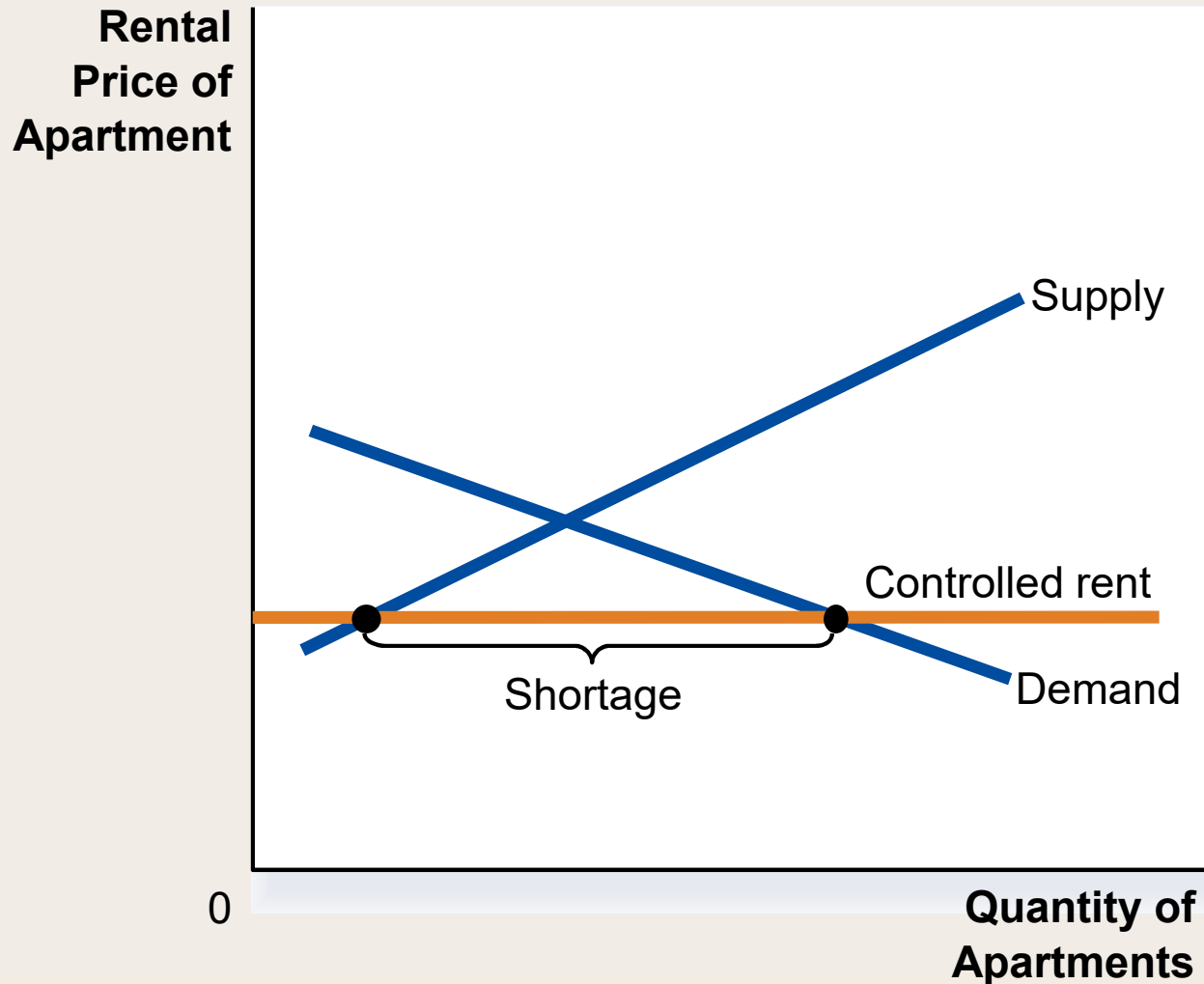
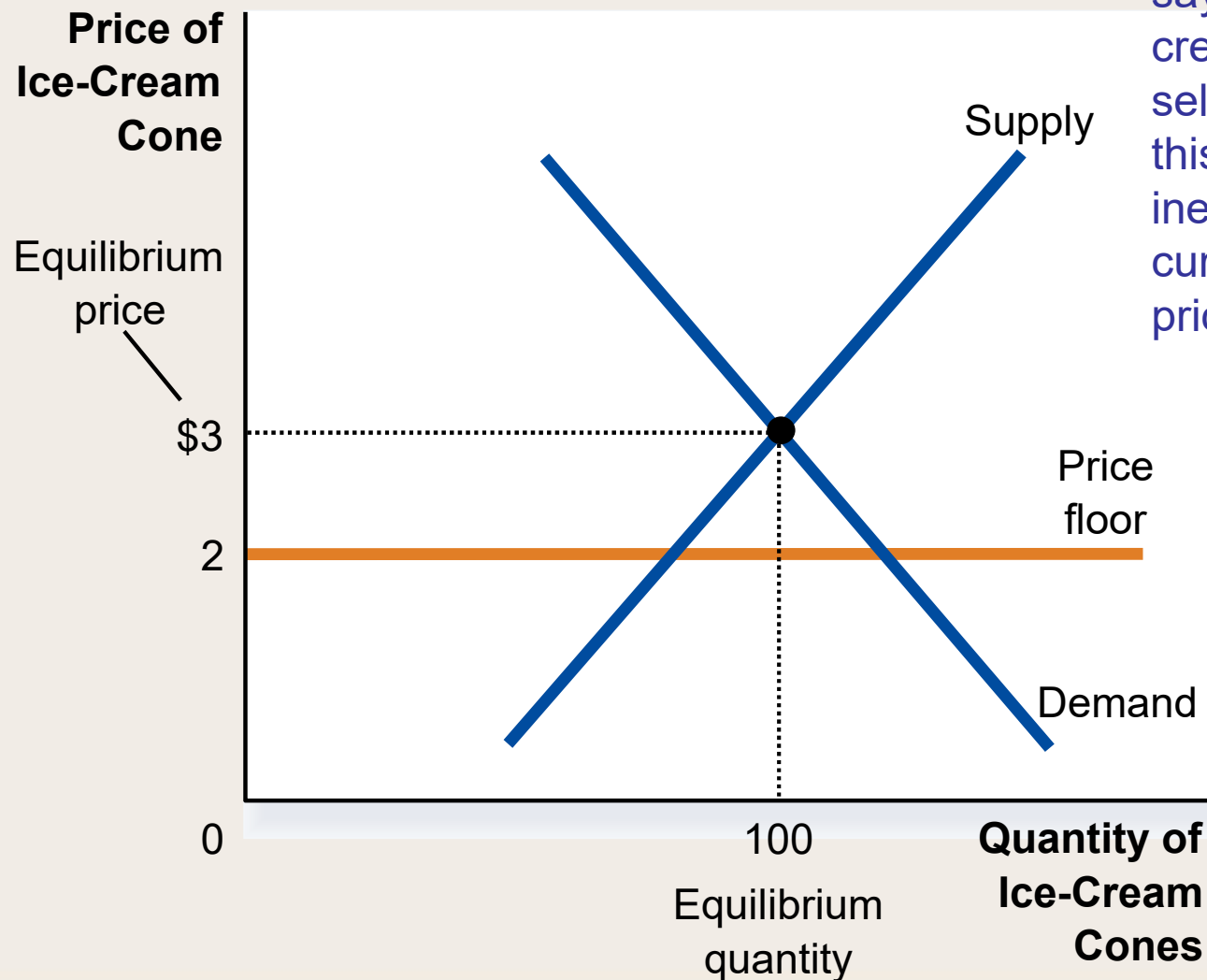**How Price Floors Affect Market Outcomes**

- When the government imposes a price floor, two outcomes are possible.

  – The price floor is not binding if set below the equilibrium price.

  – The price floor is binding if set above the equilibrium price, leading to a surplus.

Figure 4 A Market with a Price Floor

(a) A Price Floor That Is Not Binding

The government says that ice-cream cones must sell for at least $2; this legislation is ineffective at the current market price.

Price of Ice-Cream Cone

Equilibrium price

Supply

$3

2

Price floor

Demand

0

100

Equilibrium quantity

Quantity of Ice-Cream Cones

Figure 4 A Market with a Price Floor

(b) A Price Floor That Is Binding
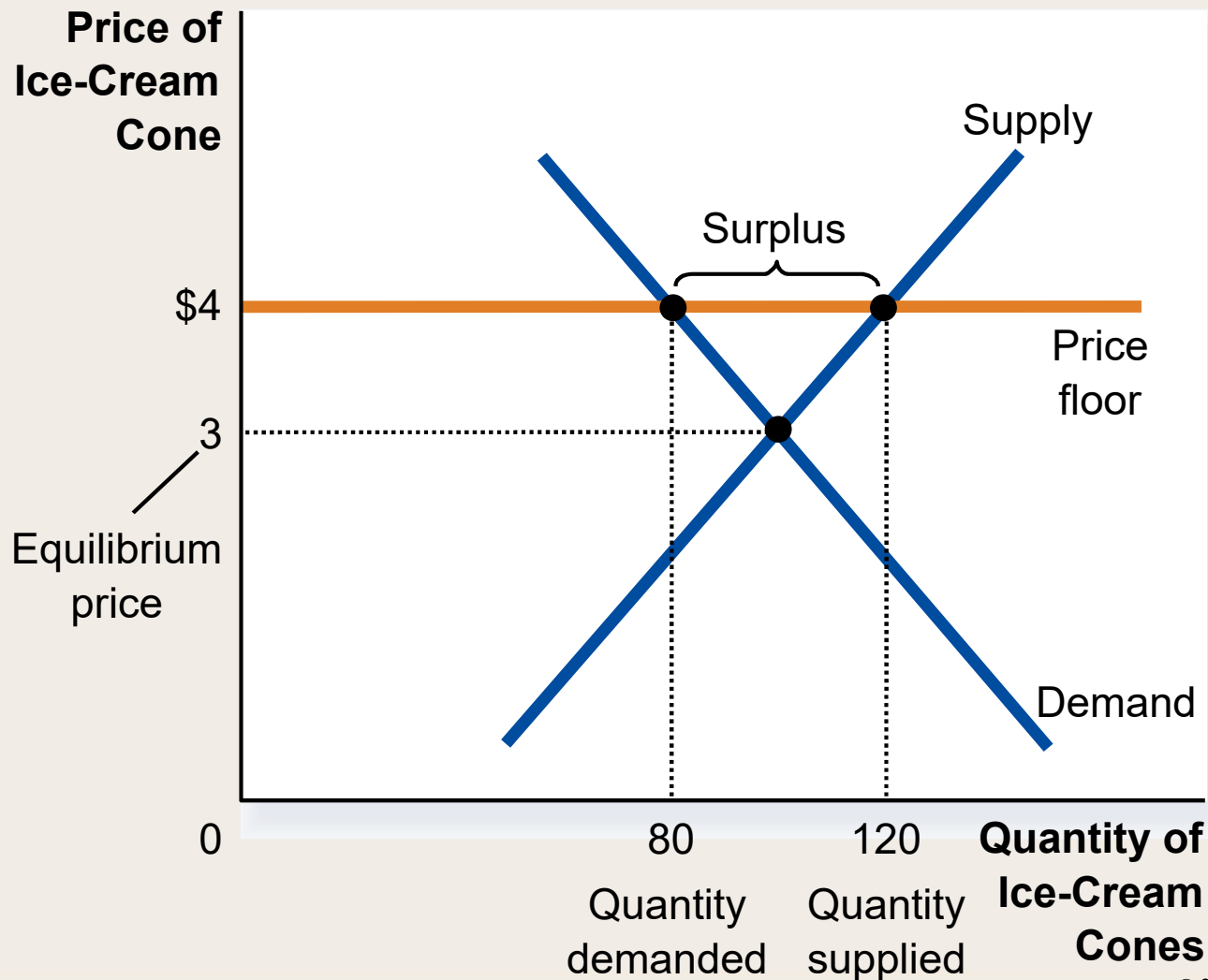
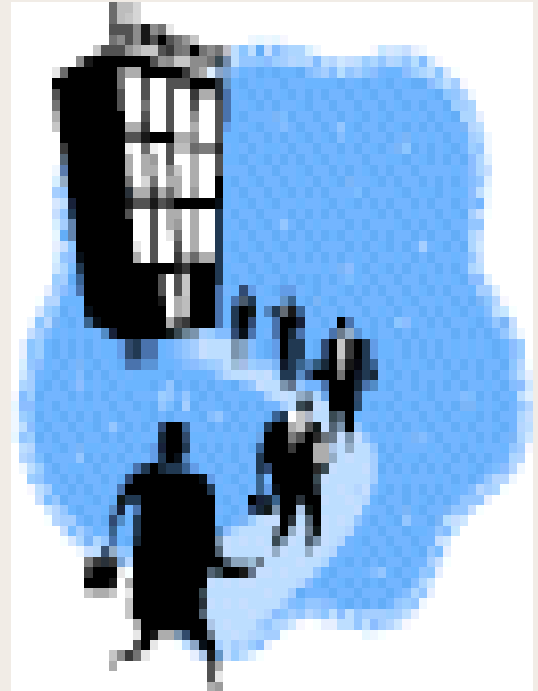**How Price Floors Affect Market Outcomes**

- A price floor prevents supply and demand from moving toward the equilibrium price and quantity.

- When the market price hits the floor, it can fall no further, and the market price equals the floor price.

How Price Floors Affect Market Outcomes

- A binding price floor causes . . .

    – a surplus because $Q_S > Q_D$.

    – nonprice rationing is an alternative mechanism for rationing the good, using discrimination criteria.

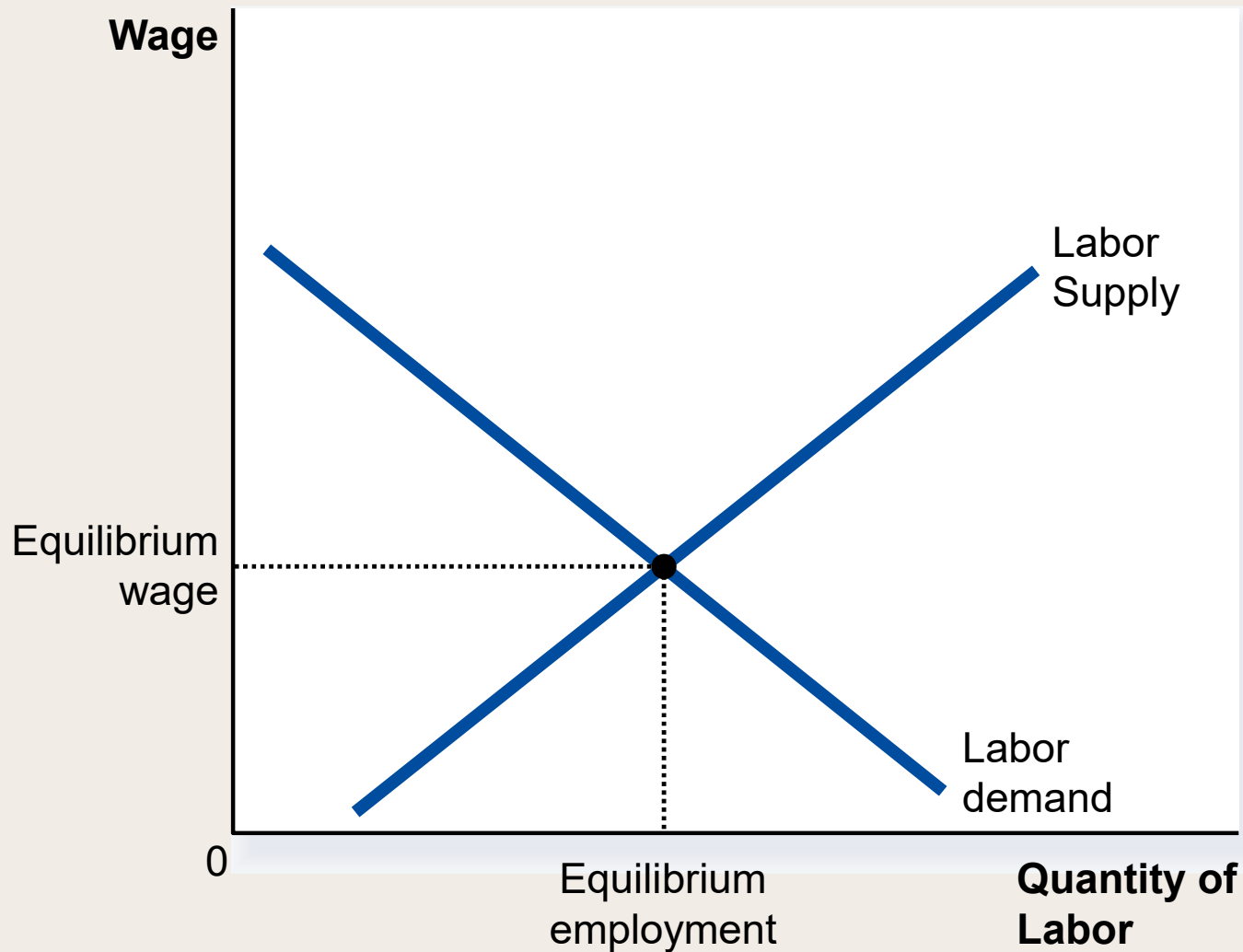   - Examples: The minimum wage, agricultural price supports

CASE STUDY: The Minimum Wage

- An important example of a price floor is the minimum wage.

- Minimum wage laws dictate the lowest price possible for labor that any employer may pay.
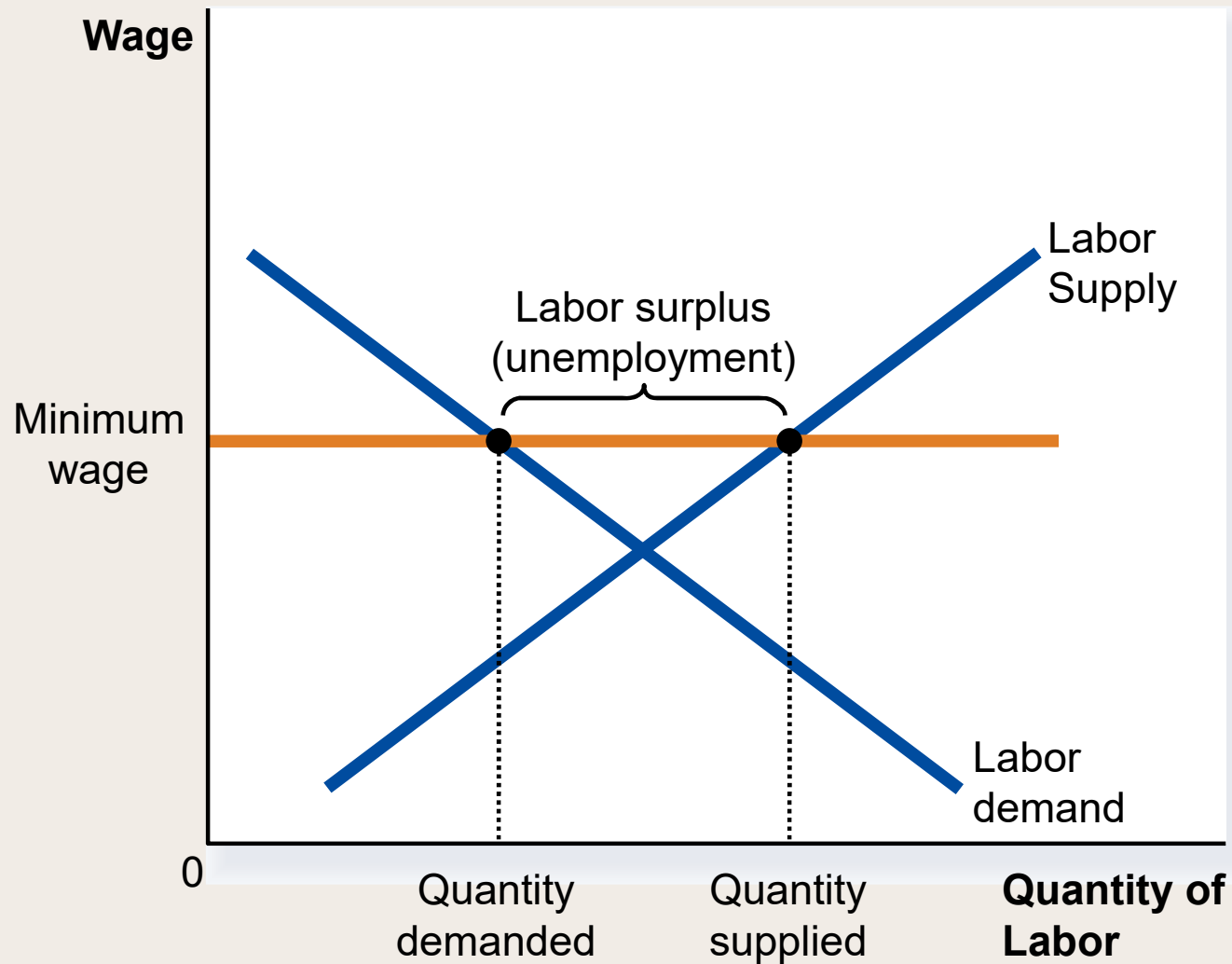
Figure 5 How the Minimum Wage Affects the Labor Market

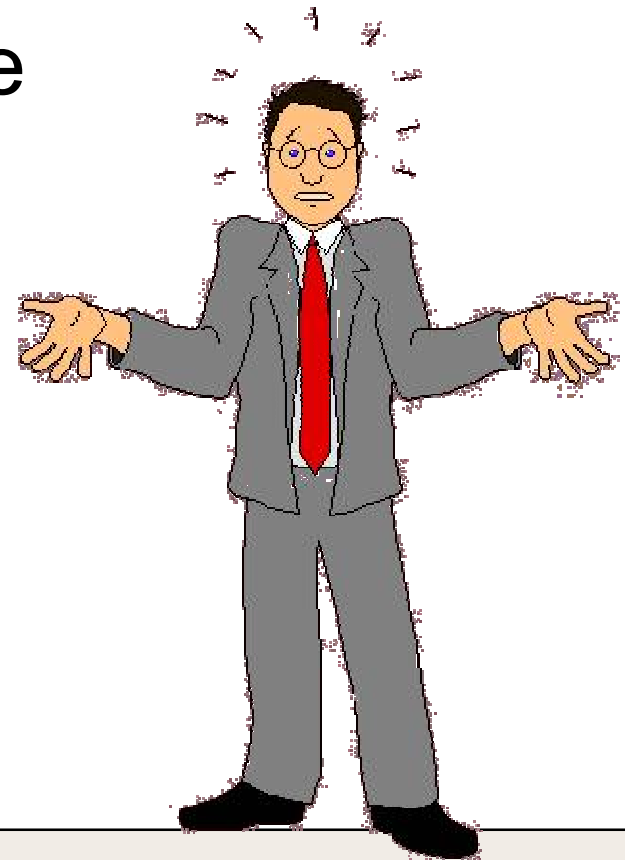# Figure 5 How the Minimum Wage Affects the Labor Market

TAXES

- Governments levy taxes to raise revenue for public projects.

- Taxes discourage market activity.

- When a good is taxed, the quantity sold is smaller.
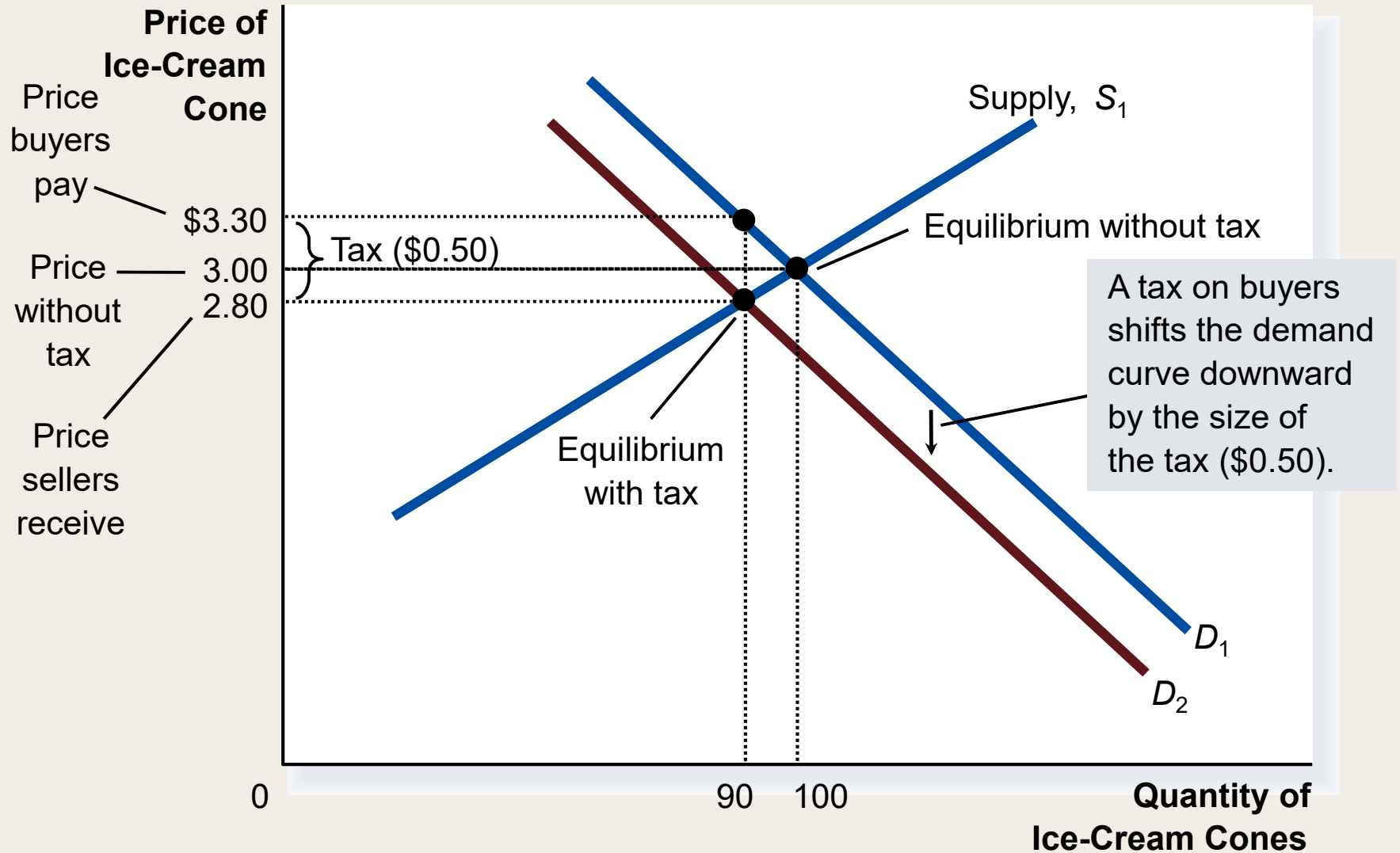
- Buyers and sellers share the tax burden.

How Taxes on Buyers Affect Market Outcomes

- Elasticity and tax incidence
  - *Tax incidence* is the manner in which the burden of a tax is shared among participants in a market.
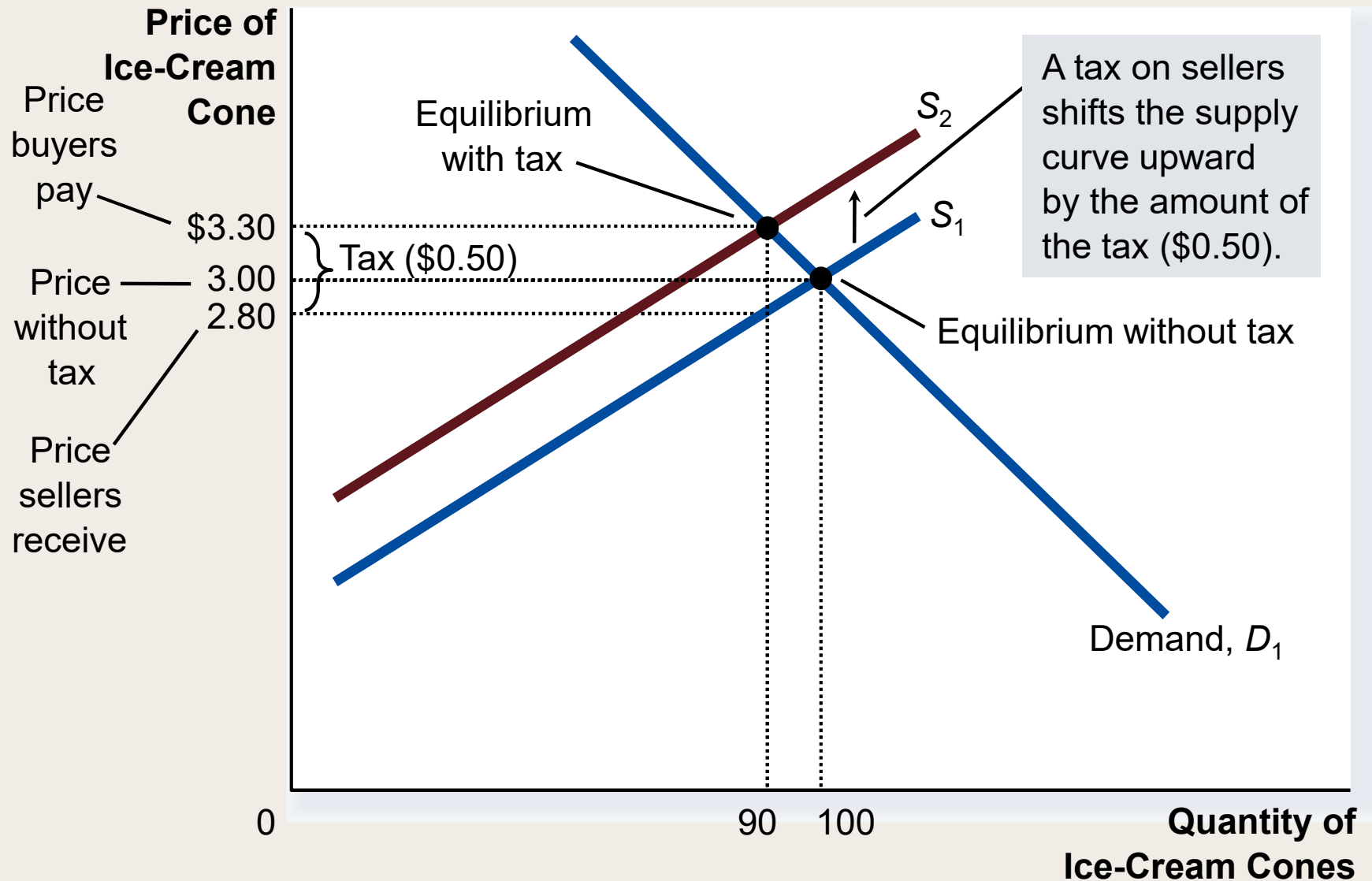
How Taxes on Buyers Affect Market Outcomes

- Elasticity and Tax Incidence
  - Tax incidence is the study of who bears the burden of a tax.
  - Taxes result in a change in market equilibrium.
  - Buyers pay more and sellers receive less, regardless of whom the tax is levied on.

Figure 6 A Tax on Buyers

Price of Ice-Cream Cone

Price buyers pay — $3.30

Price without tax — 3.00

2.80

Price sellers receive

Tax ($0.50)

Equilibrium without tax

Supply, S_1

A tax on buyers shifts the demand curve downward by the size of the tax ($0.50).

Equilibrium with tax

D_1

D_2

0   90   100

Quantity of Ice-Cream Cones

Figure 7 A Tax on Sellers

Price of Ice-Cream Cone

Price buyers pay — $3.30

Equilibrium with tax

Tax ($0.50)

Price without tax — 3.00

2.80

Price sellers receive

S_2

S_1

A tax on sellers shifts the supply curve upward by the amount of the tax ($0.50).

Equilibrium without tax
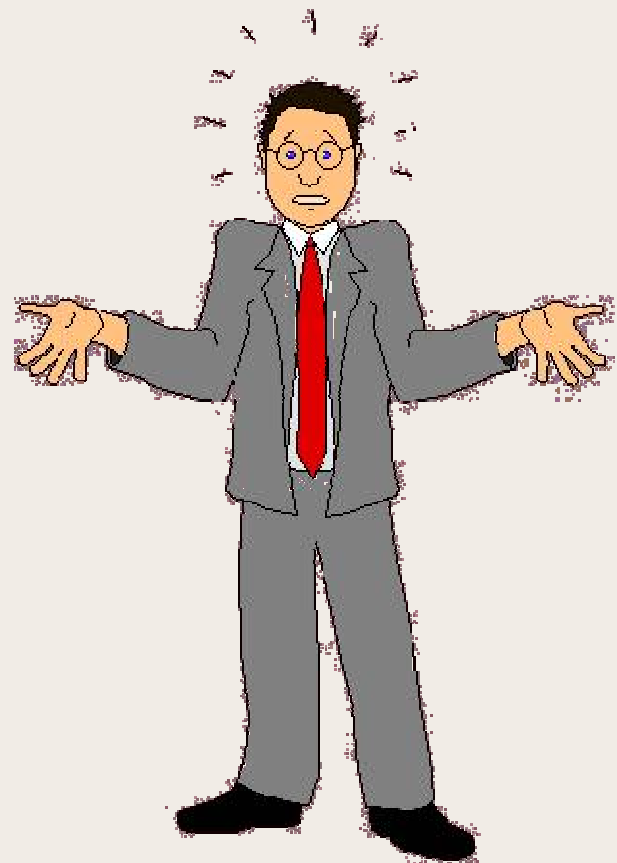
Demand, D_1

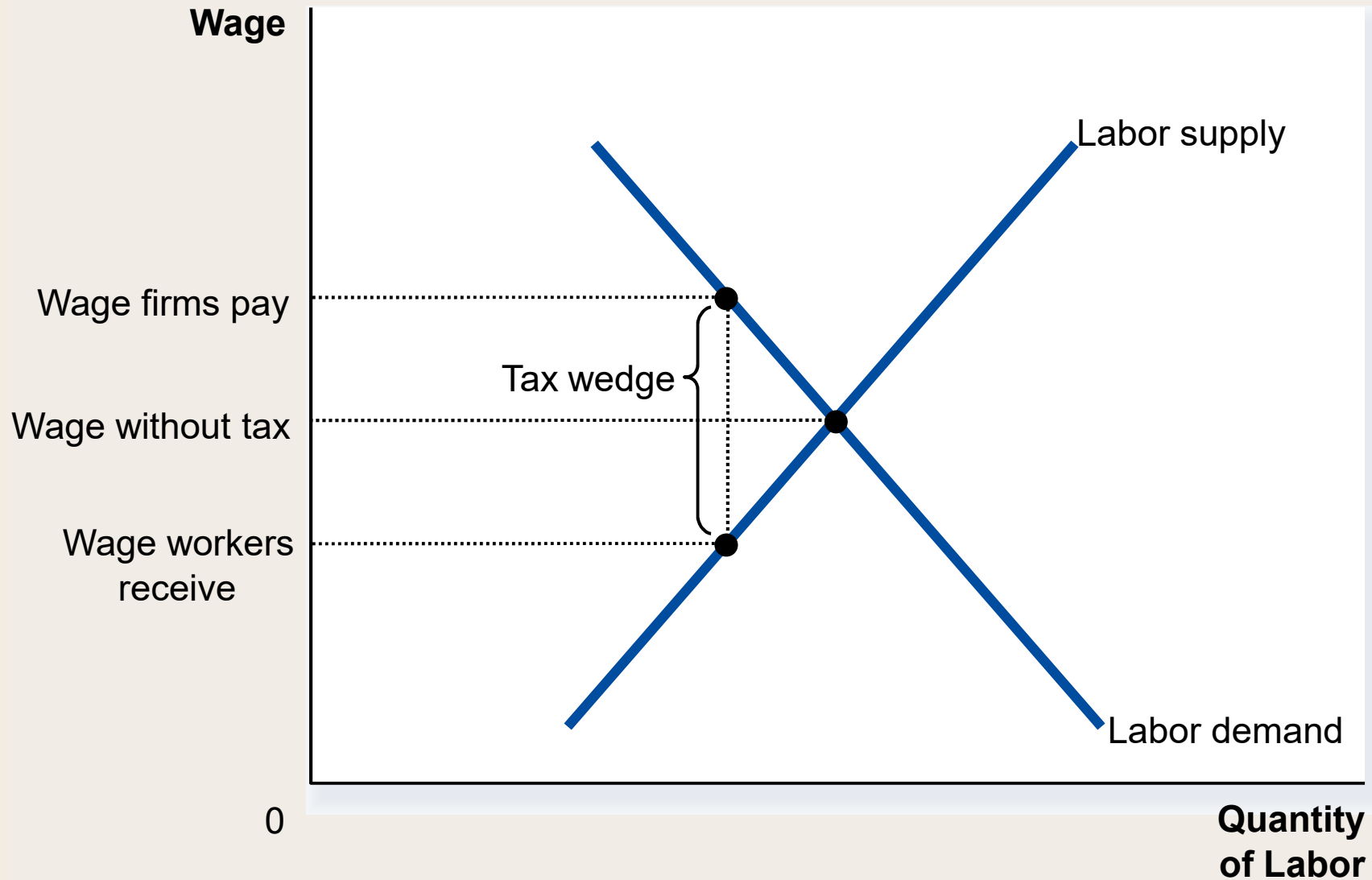0   90 100   **Quantity of Ice-Cream Cones**

Elasticity and Tax Incidence

- What was the impact of tax?
  - Taxes discourage market activity.
  - When a good is taxed, the quantity sold is smaller.
  - Buyers and sellers share the tax burden.

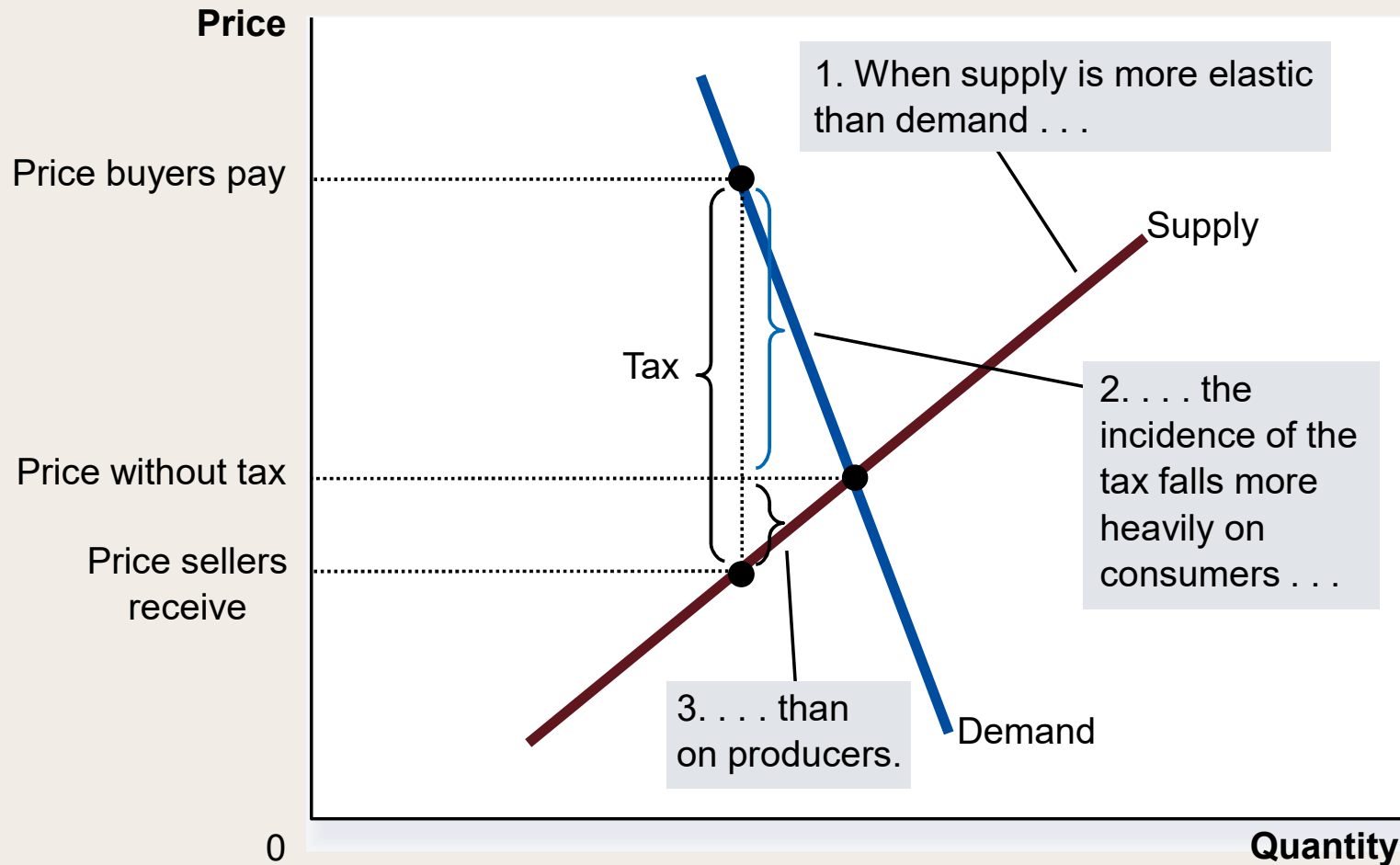# Figure 8 A Payroll Tax

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Elasticity and Tax Incidence

- In what proportions is the burden of the tax divided?

- How do the effects of taxes on sellers compare to those levied on buyers?

- The answers to these questions depend on the elasticity of demand and the elasticity of supply.

Figure 9 How the Burden of a Tax Is Divided

(a) Elastic Supply, Inelastic Demand

Price

Price buyers pay

1. When supply is more elastic than demand . . .

Supply

Tax

2. . . . the incidence of the tax falls more heavily on consumers . . .

Price without tax

Price sellers receive

3. . . . than on producers.

Demand

0

Quantity

Figure 9 How the Burden of a Tax Is Divided

(b) Inelastic Supply, Elastic Demand

Price

Price buyers pay

Price without tax

Price sellers receive

1. When demand is more elastic than supply . . .

Supply

3. . . . than on consumers.

Tax

2. . . . the incidence of the tax falls more heavily on producers . . .

Demand

0
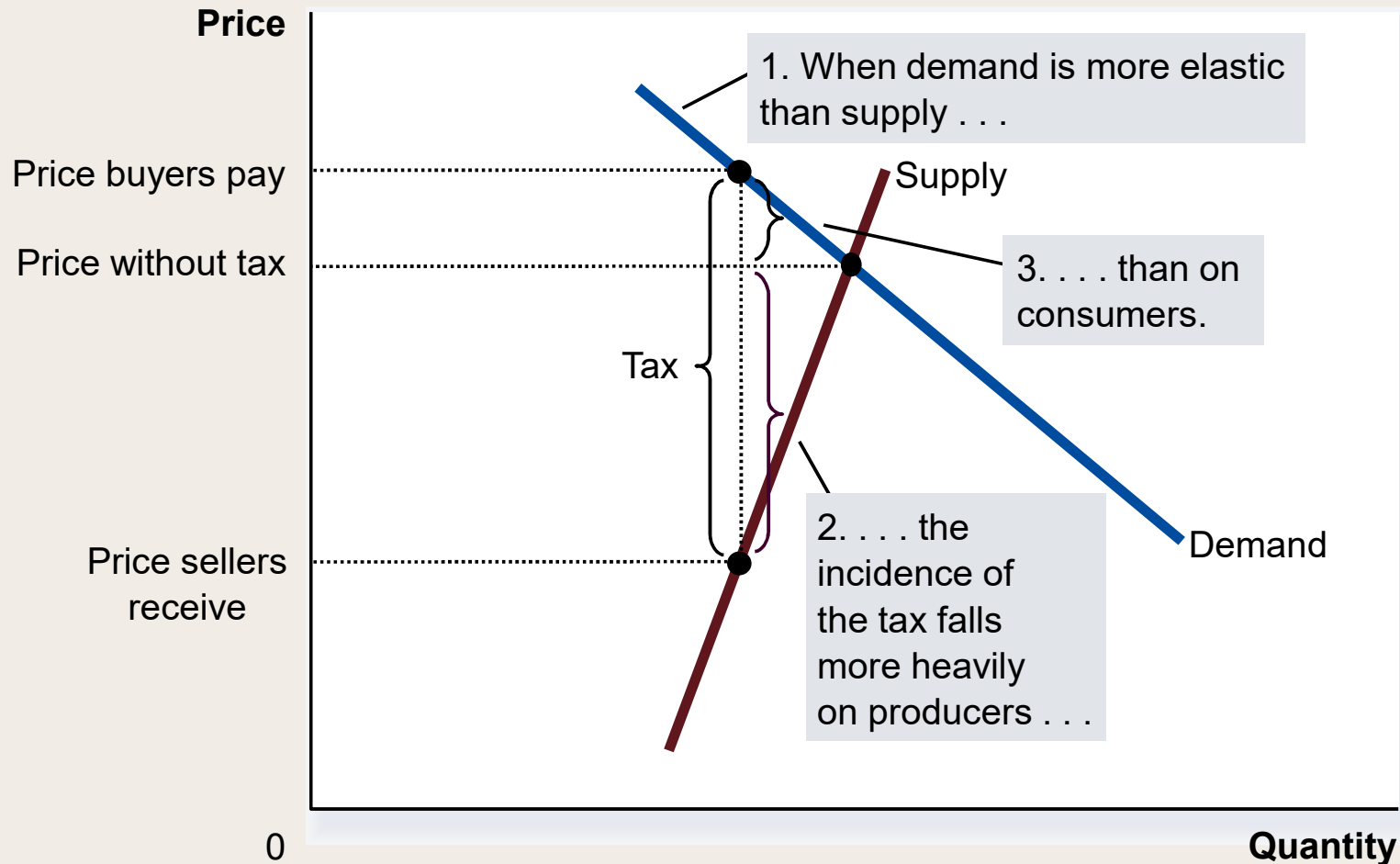
Quantity

Elasticity and Tax Incidence

So, how is the burden of the tax divided?

The burden of a tax falls more heavily on the side of the market that is less elastic.

Summary

- Price elasticity of demand measures how much the quantity demanded responds to changes in the price.

- Price elasticity of demand is calculated as the percentage change in quantity demanded divided by the percentage change in price.

  – If a demand curve is elastic, total revenue falls when the price rises.

  – If it is inelastic, total revenue rises as the price rises.

Summary

- The income elasticity of demand measures how much the quantity demanded responds to changes in consumers' income.

- The cross-price elasticity of demand measures how much the quantity demanded of one good responds to the price of another good.

- The price elasticity of supply measures how much the quantity supplied responds to changes in the price.

Summary

- In most markets, supply is more elastic in the long run than in the short run.

- The price elasticity of supply is calculated as the percentage change in quantity supplied divided by the percentage change in price.

- The tools of supply and demand can be applied in many different types of markets.

Summary

- Price controls include price ceilings and price floors.

- A price ceiling is a legal maximum on the price of a good or service.
  - An example is rent control.

- A price floor is a legal minimum on the price of a good or a service.
  - An example is the minimum wage.

Summary

- Taxes are used to raise revenue for public purposes.

- When the government levies a tax on a good, the equilibrium quantity of the good falls.

- A tax on a good places a wedge between the price paid by buyers and the price received by sellers.

Summary

- The incidence of a tax refers to who bears the burden of a tax.

- The incidence of a tax does not depend on whether the tax is levied on buyers or sellers.

- The incidence of the tax depends on the price elasticities of supply and demand.

- The burden tends to fall on the side of the market that is less elastic.