Lecture 5

Elasticities

Motivation

Oil Price Jump: Winners and Losers

Could this jump in oil prices throw a wrench in the gears of the world economy?

Bloomberg's Kathleen Hays reports on "Bloomberg Markets: China Open."

(Source: Bloomberg)

3.1. Price elasticity of demand

3.1.1. Definition

3.1.2. Calculating Price elasticity of demand

3.1.3. Classification

3.1.4. Determinants of price elasticity of demand

3.1.5. Price elasticity of demand and total revenue

3.1.6. The meaning of price elasticity of demand

3.2. Cross-price elasticity of demand

3.2.1. Definition

3.2.2. Calculating Cross-price elasticity of demand

3.2.3. Classification

3.2.4. The meaning of cross – price elasticity

3.3. Income elasticity of demand

3.3.1. Definition

3.3.2. Calculating income elasticity of demand

3.3.3. Classification

3.3.4. The meaning of income elasticity of demand

3.1.1 Definition Elasticity . . .

- … is a measure of how much buyers and sellers respond to changes in market conditions
- … allows us to analyze supply and demand with greater precision.

Price Elasticity of Demand

- Price elasticity of demand is the percentage change in quantity demanded given a percent change in the price.
- It is a measure of how much the quantity demanded of a good responds to a change in the price of that good.
- It has negative sign because of the law of demand.
- We only report elasticity in absolute value.

3.1.2 Computing the Price Elasticity of Demand

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

$$|Ed| = \left|\frac{\%\Delta Qd}{\%\Delta P}\right|$$

Price Elasticity = $\frac{\text{Percentage Change in Qd}}{\text{Percentage Change in Price}}$

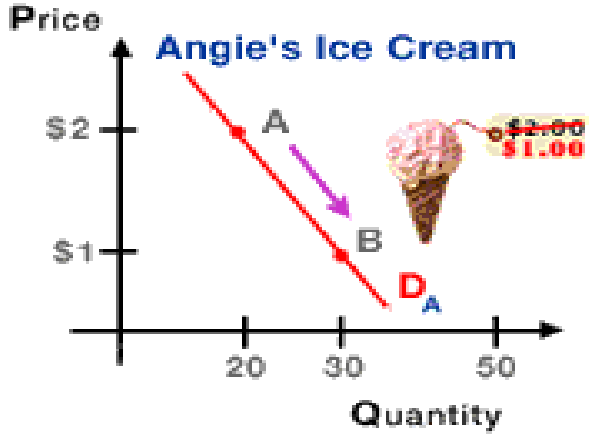
Of Demand

Example

- Suppose that a 10 percent increase in the price of an ice-cream cone causes the amount of ice cream you buy to fall by 20 percent. We calculate your elasticity of demand Ed as:

$$|\text{Ed}| = \left| \frac{-20\%}{10\%} \right| = 2.$$

Elasticity caculated from point A to point B is inconsistent with result calculated from B-A.



from **A** to **B**:

$$\left|\frac{\%\,\Delta\,Q_D}{\%\,\Delta\,P}\right| = \left|\frac{\frac{30-20}{20}}{\%\,\Delta\,P}\right|$$

$$= \left|\frac{\frac{1}{2}}{\frac{1-2}{2}}\right|$$

$$= \left|\frac{\frac{1}{2}}{-\frac{1}{2}}\right|$$

$$= \left|\left(\frac{1}{2}\right)\left(-\frac{2}{1}\right)\right| = |-1| = \boxed{1}$$

Calculating the elasticity of demand

from **B** to **A:**

$$\left|\frac{\%\Delta Q_D}{\%\Delta P}\right| = \left|\frac{\frac{20-30}{30}}{\%\Delta P}\right|$$

$$= \left|\frac{-\frac{1}{3}}{\frac{2-1}{1}}\right|$$

$$= \left|\frac{-\frac{1}{3}}{1}\right|$$

$$= \left|-\frac{1}{3}\right| = \frac{1}{3}$$

elasticity
from **A** to **B** = 1

Computing the Price Elasticity of Demand Using the Midpoint Formula

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

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

Computing the Price Elasticity of Demand

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

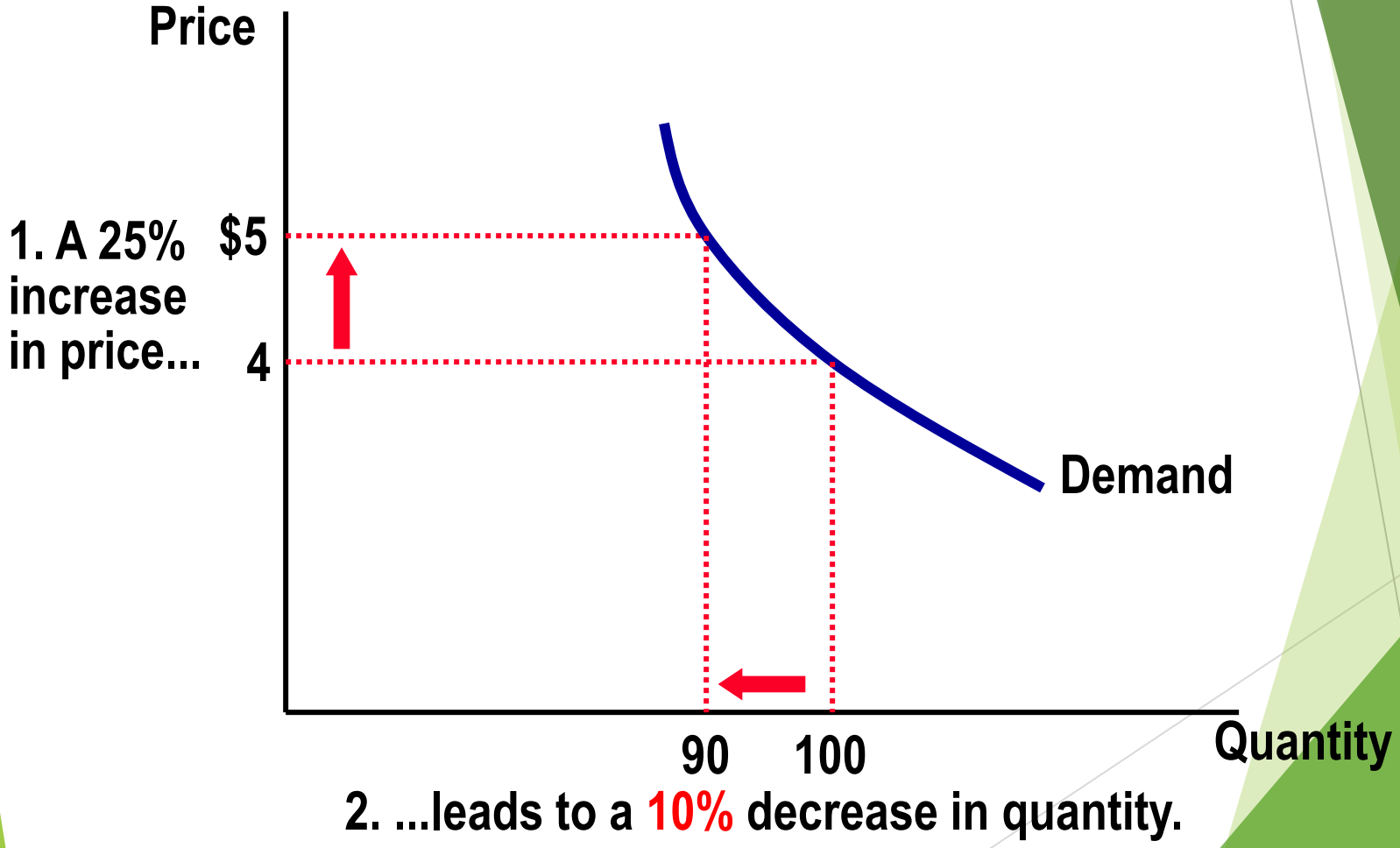
Example: If the price of an ice cream cone increases from $2.00 to $2.20 and the amount you buy falls from 10 to 8 cones, then your elasticity of demand, using the **midpoint formula,** would be calculated as:

$$\frac{\frac{8-10}{(8+10)/2}}{\frac{2.2-2}{(2.2+2)/2}} = -2.32$$

$$|Ed| = 2.32$$

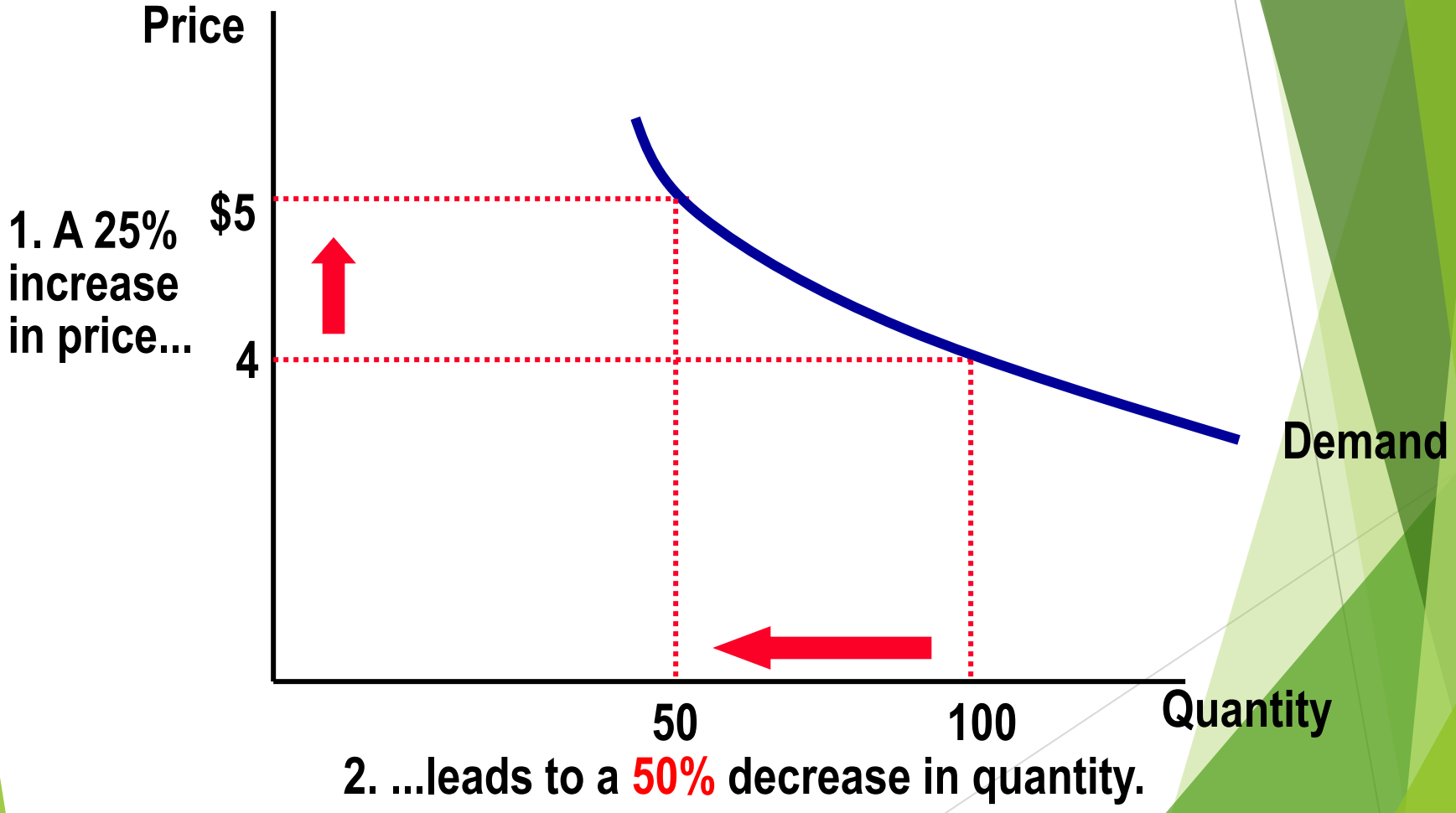
Inelastic Demand: Elasticity is less than 1

Products with inelastic demands receive relatively little response from consumers when the prices change.

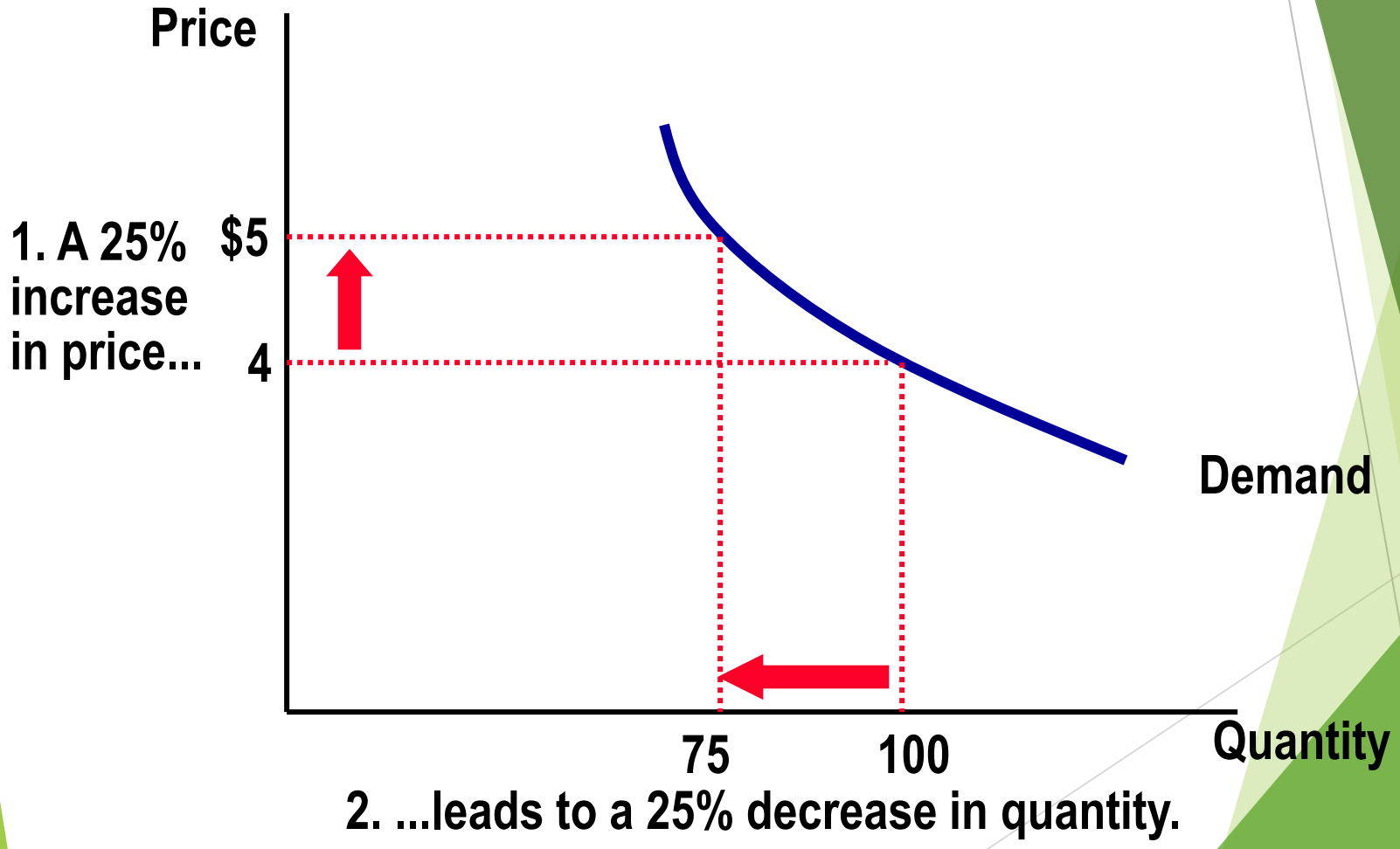


Elastic Demand: Elasticity is greater than 1

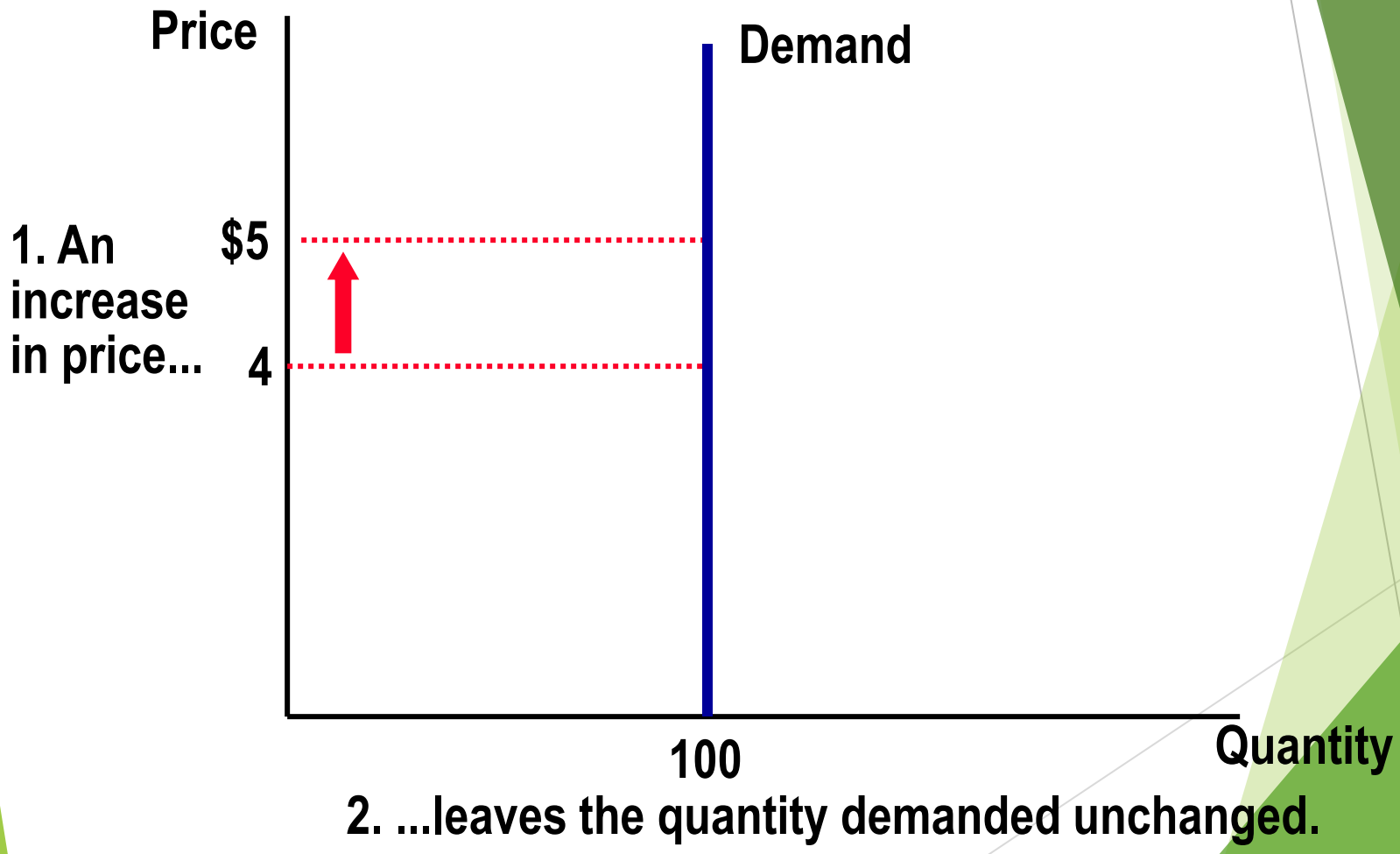
Products with elastic demands receive relatively more response from consumers when the prices change.



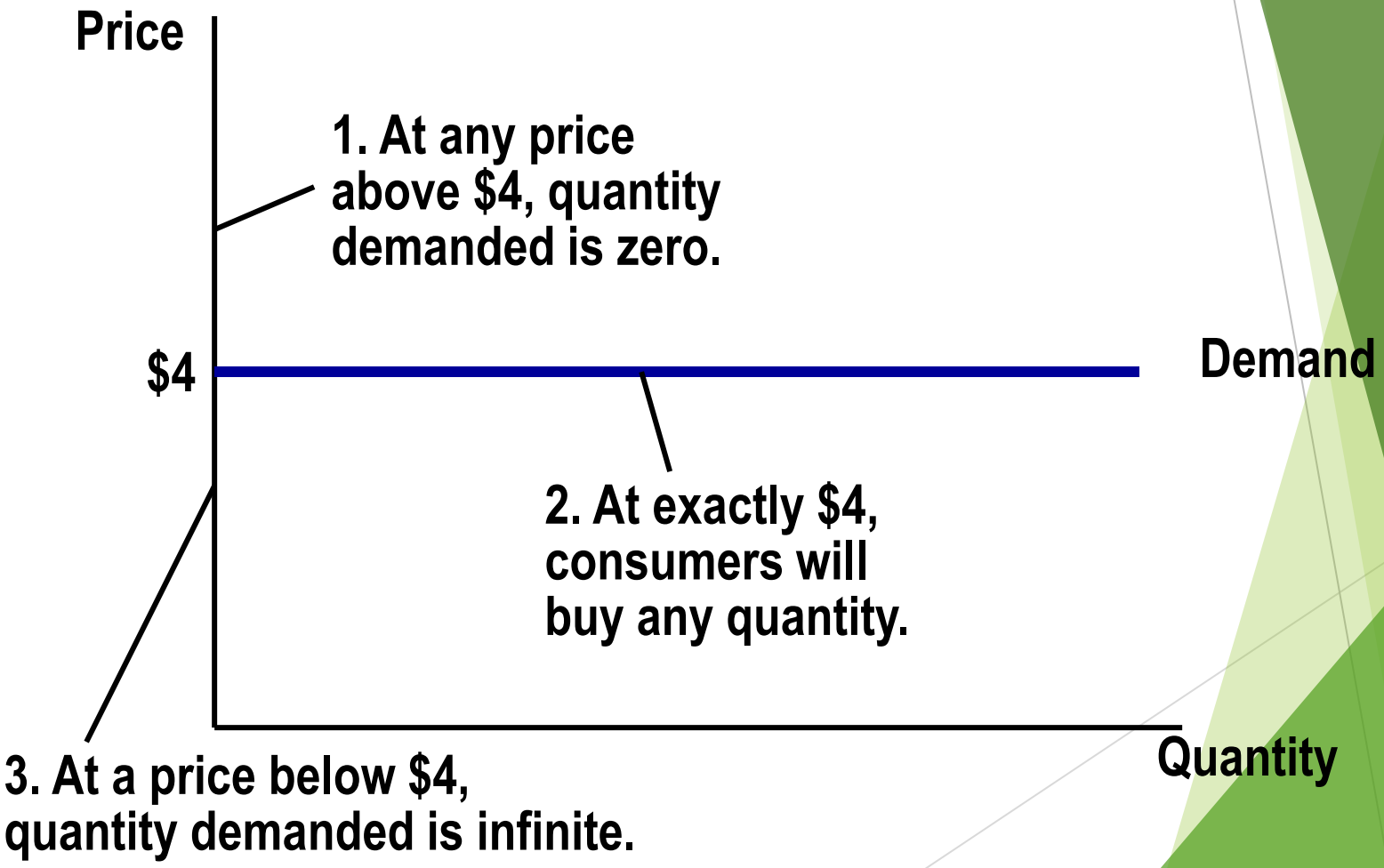
Unit Elastic Demand
- Elasticity equals 1



Perfectly Inelastic Demand
- Elasticity equals 0



Perfectly Elastic Demand
- Elasticity equals infinity



3.1.3. Classification

Inelastic Demand

- Percentage change in price is greater than percentage change in quantity demand.
- Price elasticity of demand is *less than* one.

Elastic Demand

- Percentage change in quantity demand is greater than percentage change in price.
- Price elasticity of demand is *greater than* one.

3.1.3 Classification (cont.)

Unit Elastic Demand

- Percentage change in price is equal percentage change in quantity demand.
- Price elasticity of demand *equals to* one.

Perfect Inelastic Demand

- Price elasticity of demand *equals to zero* .

Perfect Elastic Demand

- Price elasticity of demand *equals infinity* .

3.1.4 Determinants of Price Elasticity of Demand

- *Necessities versus Luxuries*
- *Availability of Close Substitutes*
- *Definition of the Market*
- *Time Horizon*

3.1.4 Determinants of Price Elasticity of Demand (cont.)

Demand tends to be more inelastic :

- if the good is a necessity
- the shorter the time period
- the smaller the number of close substitutes
- the broader defined the market.

3.1.4 Determinants of Price Elasticity of Demand (cont.)

Demand tends to be more elastic :

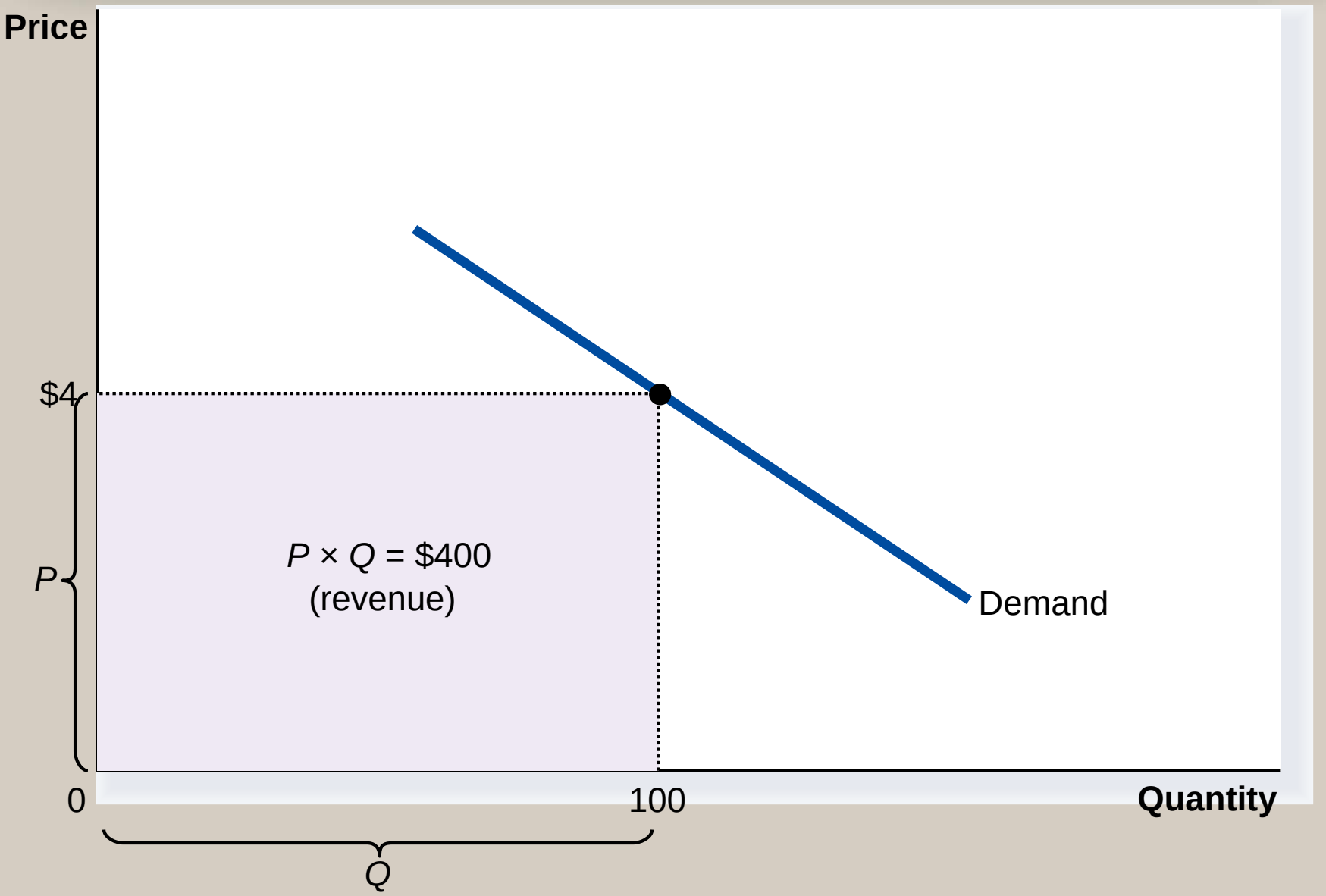
- if the good is a luxury.
- the longer the time period.
- the larger the number of close substitutes.
- the more narrowly defined the market.

3.1.5. Elasticity and Total Revenue

- Total revenue (TR) is the total amount paid by buyers and received by sellers of goods.
- Computed as the unit price of the goods (P) times the quantity sold (Q).

$$TR = P \times Q$$

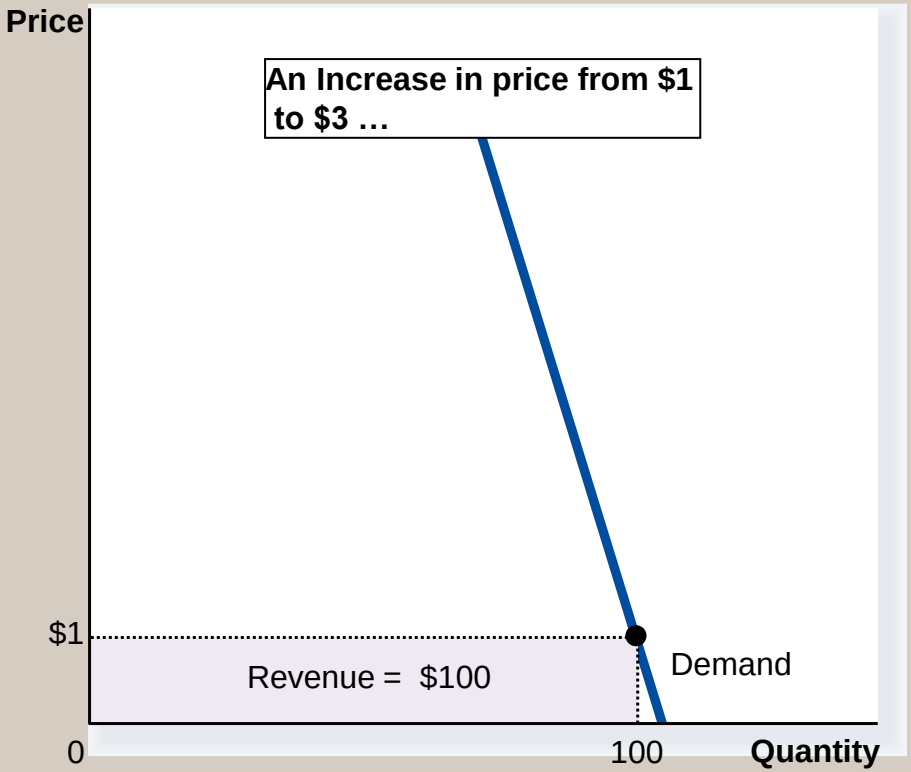
Figure Total Revenue

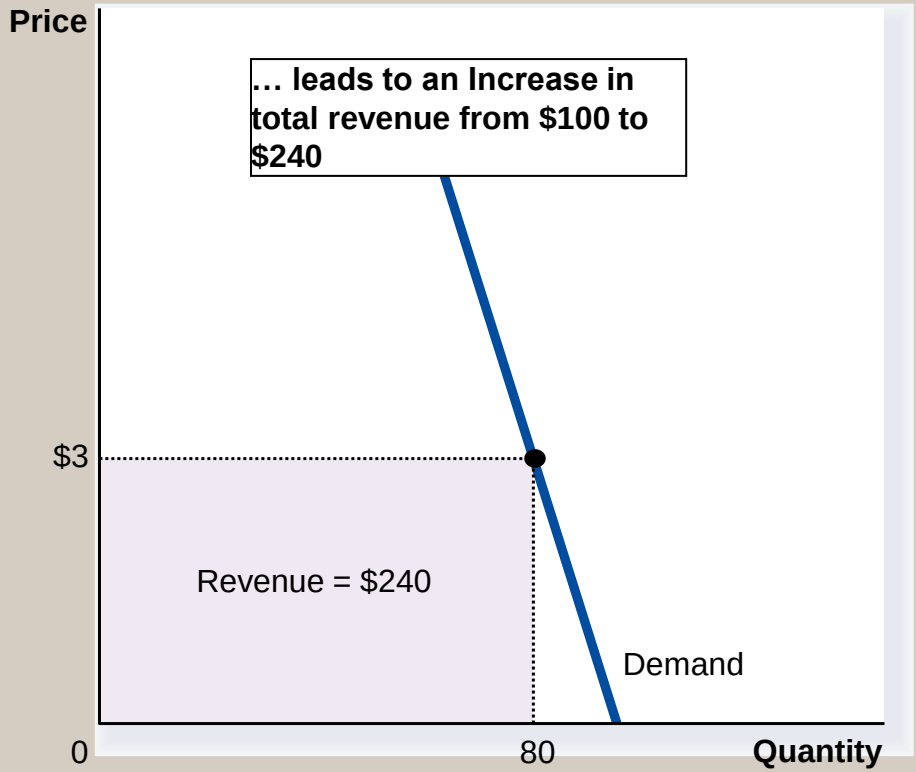


Elasticity and Total Revenue along a Linear Demand Curve

- With an inelastic demand curve, an increase in price leads to a decrease in quantity that is proportionately smaller. Thus, *total revenue increases*.

Figure How Total Revenue Changes When Price Changes: Inelastic Demand

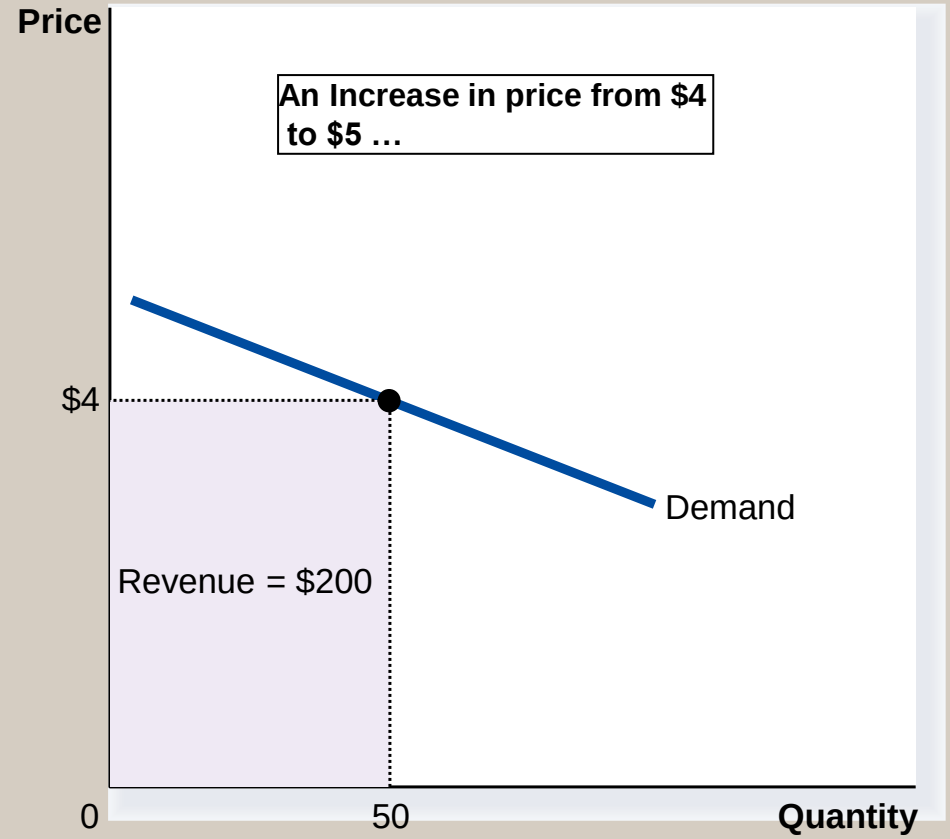


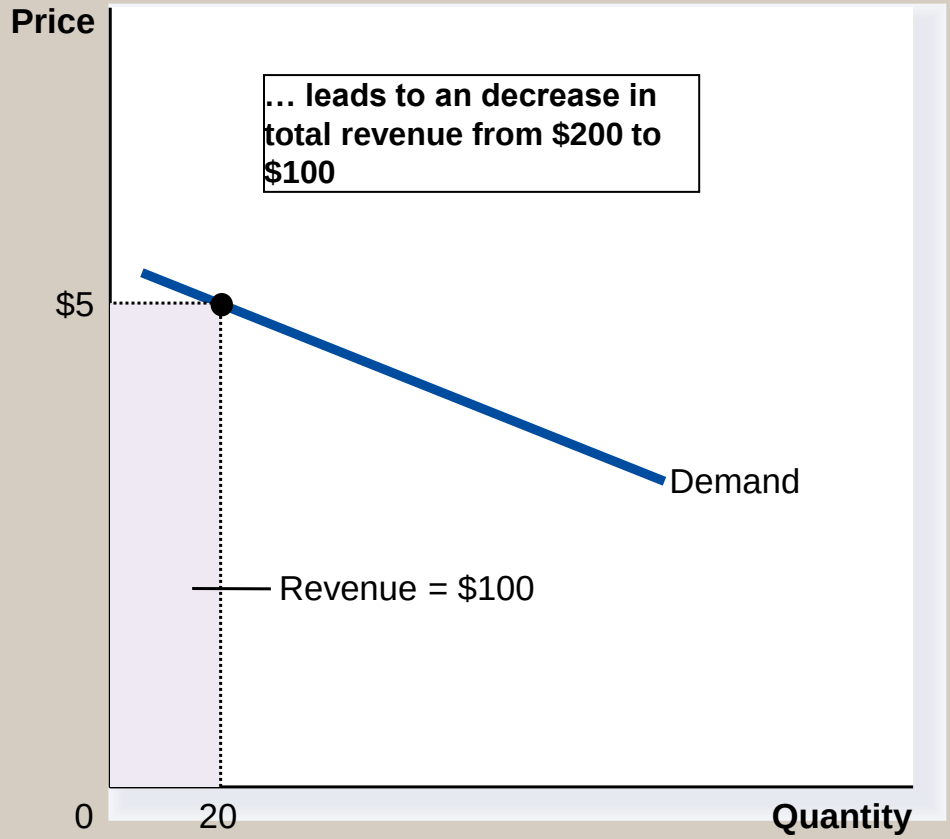


Elasticity and Total Revenue along a Linear Demand Curve

- 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 How Total Revenue Changes When Price Changes: Elastic Demand





Elasticity & Total Revenue Test

- Elastic > 1 if P decreases => TR increases; if P increases TR decreases
- Unit elastic = 1 if ΔP => no ΔTR
- Inelastic < 1 if P decreases => T decreases; if P increases TR increases

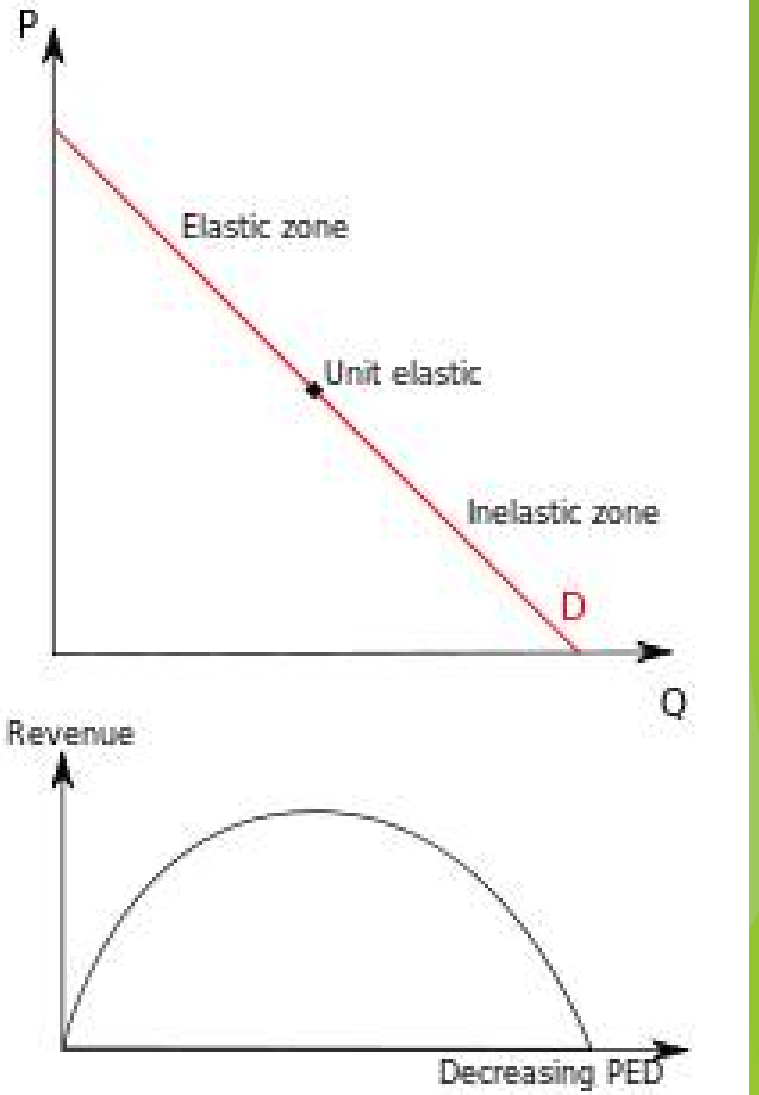
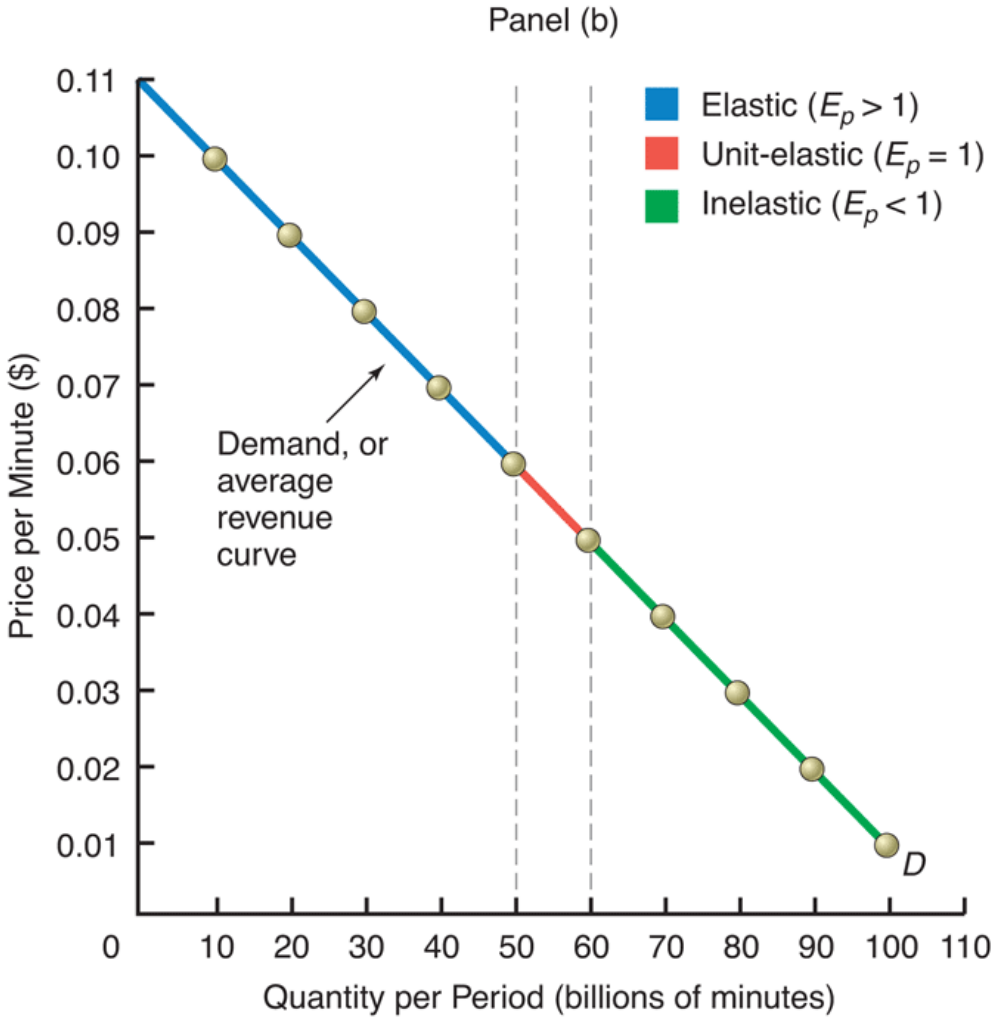


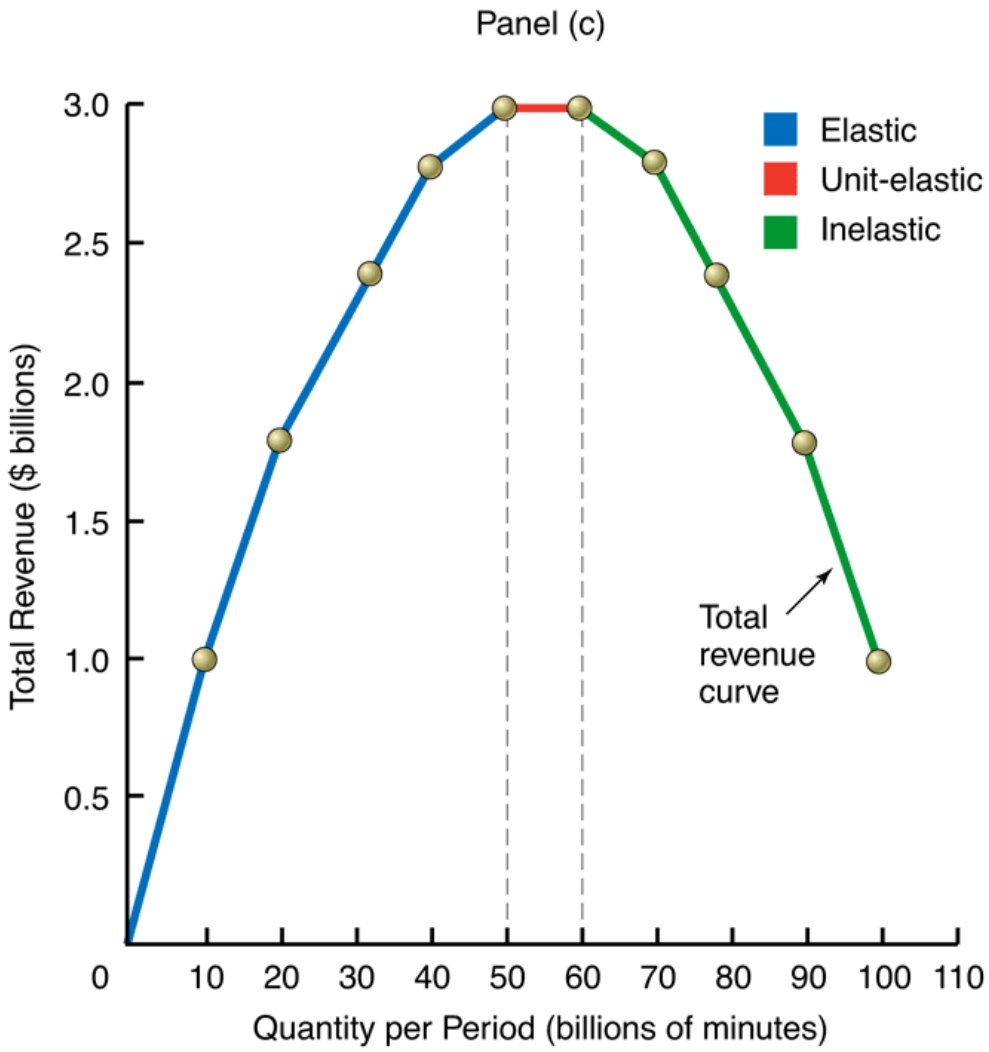
Figure The Relationship Between Price Elasticity of Demand and Total Revenues for Cellular Phone Service, Panel (b)



Panel (a)

(1) Price, P, per Minute of Cellular Phone Service	(2) Quantity Demanded, D (billions of minutes)	(3) Total Revenue ($ billions) = (1) x (2)	(4) Elasticity, E_p = Change in Q / $(Q_1 + Q_2)/2$ ÷ Change in P / $(P_1 + P_2)/2$	
$0.11	0	0		
			21.000	Elastic
0.10	10	1.0		
			6.330	Elastic
0.09	20	1.8		
			3.400	Elastic
0.08	30	2.4		
			2.143	Elastic
0.07	40	2.8		
			1.144	Elastic
0.06	50	3.0		
			1.000	Unit-elastic
0.05	60	3.0		
			.692	Inelastic
0.04	70	2.8		
			.467	Inelastic
0.03	80	2.4		
			.294	Inelastic
0.02	90	1.8		
			.158	Inelastic
0.01	100	1.0		

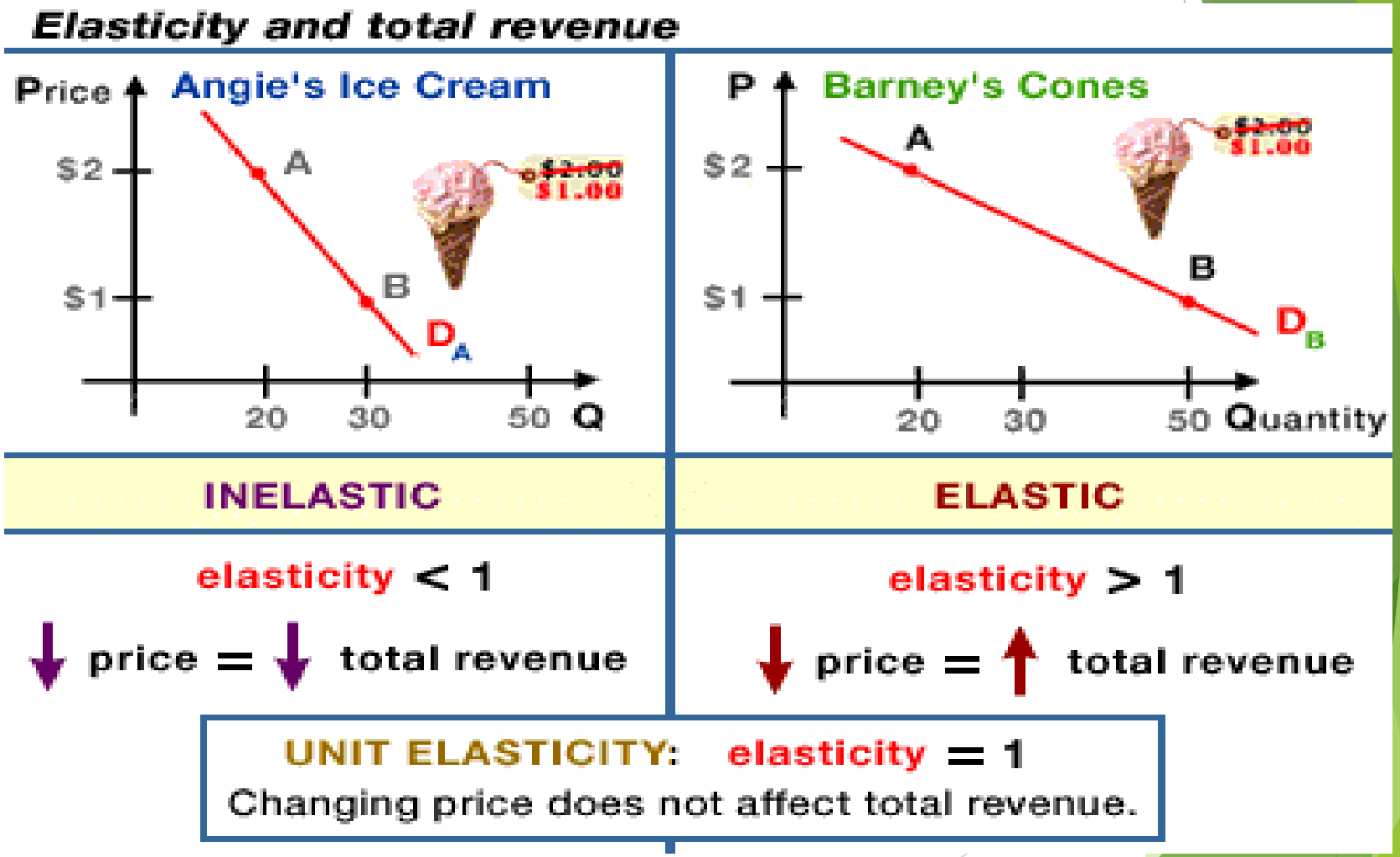
Figure The Relationship Between Price Elasticity of Demand and Total Revenues for Cellular Phone Service, Panel (c)



Relationship Between Price Elasticity of Demand and Total Revenues

Price Elasticity of Demand (E_p)		Effect of Price Change on Total Revenues (TR)	
		Price Decrease	**Price Increase**
Inelastic	($E_p < 1$)	TR ↓	TR ↑
Unit-elastic	($E_p = 1$)	No change in TR	No change in TR
Elastic	($E_p > 1$)	TR ↑	TR ↓

Summary


Elasticity and total revenue
Price
Angie's Ice Cream
$2
$1
A
B
D_A
20
30
50
Q
P
Barney's Cones
$2
$1
A
B
D_B
20
30
50
Quantity
INELASTIC
ELASTIC
elasticity < 1
price = total revenue
elasticity > 1
price = total revenue
UNIT ELASTICITY: elasticity = 1
Changing price does not affect total revenue.

Price strategy:

Should producer increase price of ice-cream to increase total revenue?

	Increase in Total Revenue	Decrease in Total Revenue
Increase in Price	INELASTIC DEMAND	ELASTIC DEMAND
Decrease in Price	ELASTIC DEMAND	INELASTIC DEMAND

Price strategy:

Should the seller increase price of ice-cream to increase total revenue?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3.2. Cross-price elasticity of demand (Ec)

- Elasticity measure that looks at the impact a change in the price of one goods has on the demand of other goods.

$$Ec = \frac{\%\Delta Qd1}{\%\Delta P2}$$

$$Ec = \frac{\text{\% change in quantity demanded of goods 1}}{\text{\% change in price of goods 2}}$$

- Ec: Positive → Goods 1 and Goods 2 are substitutes
- Ec: Negative → Goods 1 and Goods 2 are complements

Recall from chapter 2
Substitutes & Complements

When a fall in the price of one good reduces the demand for another good, the two goods are called substitutes.

When a fall in the price of one good increases the demand for another good, the two goods are called complements.

3.3. Income Elasticity of Demand (Ei)

- Elasticity measure that looks at the impact a change in the income of the consumer has on the demand of the goods.

$$Ei = \frac{\%\Delta Qd}{\%\Delta I}$$

$$Ei = \frac{\text{\% change in quantity demanded}}{\text{\% change in income}}$$

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.

Income Elasticity: Classification

- *Normal Goods*
  - Income Elasticity is positive
  - Income increases → Quantity demanded increases
- *Inferior Goods*
  - Income Elasticity is negative.
  - Income increases → Quantity demanded decreases
- Higher income *raises* the quantity demanded for normal goods but *lowers* the quantity demanded for inferior goods.

3.4. Price Elasticity of supply

3.4.1. Definition

3.4.2. Calculating price elasticity of supply

3.3.3. Classification

3.3.4. The meaning of price elasticity of supply

3.1.4. Definition

The **price elasticity of supply (Es)** measures how much the quantity supplied responds to changes in the price.

3.1.4. Calculating price elasticity of supply

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

$$Es = \frac{\%\Delta Qs}{\%\Delta P}$$

Example

Suppose that an increase in the price of milk from $2.85 to $3.15 a gallon raises the amount that dairy farmers produce from 9,000 to 11,000 gallons. Using the midpoint method, we calculate the percentage change in price as:

Percentage change in price = (3.15 – 2.85) / 3.00 × 100 = 10 percent.

Percentage change in quantity supplied =

(11,000 – 9,000) / 10,000 × 100 = 20 percent.

Price elasticity of supply = 20 percent / 10 percent = 2

Elasticity of 2 indicates that the quantity supplied changes proportionately twice as much as the price

3.1.6. Classification

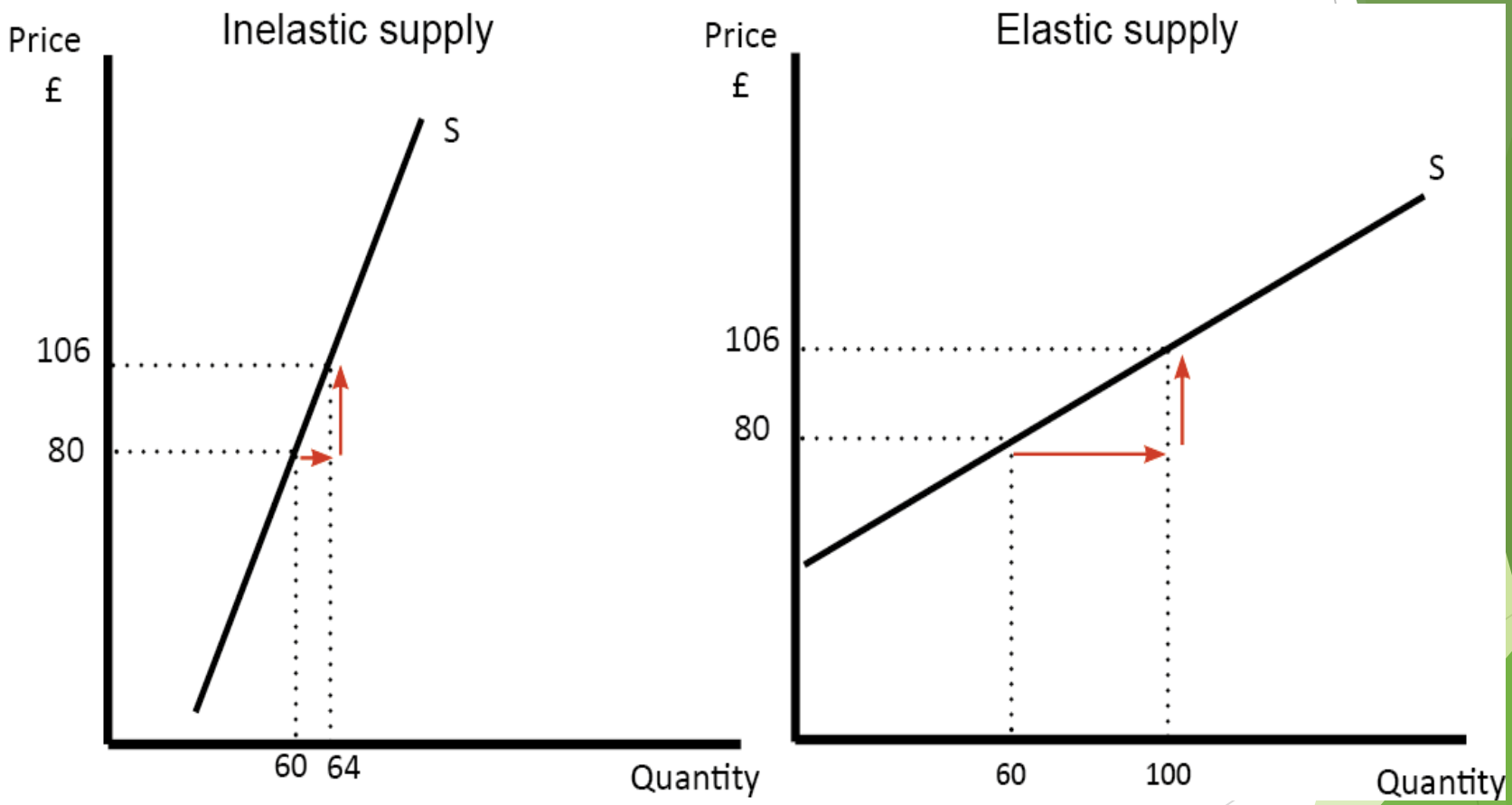
- Supply of a good is said to be *elastic* if the quantity supplied responds substantially to changes in the price. Supply is said to be *inelastic* if the quantity supplied responds only slightly to changes in the price.

- In most markets, a key determinant of the price elasticity of supply is the **time period** being considered. Supply is usually **more elastic in the long run** than in the short run

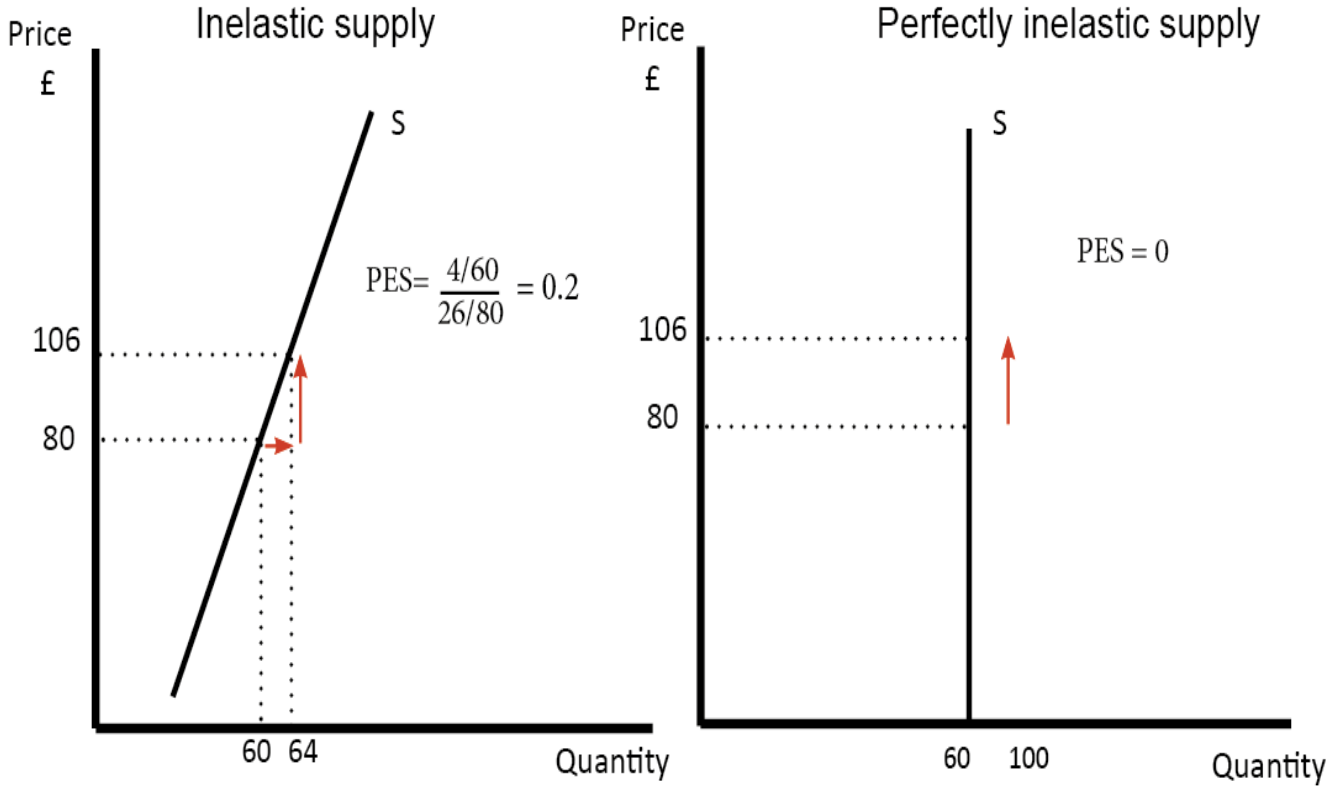
3.1.6. Classification

Classification	Elasticity of Supply
Elastic	Es > 1
Inelastic	Es < 1
Unit elastic	Es = 1
Perfectly elastic	Es = infinity
Perfectly inelastic	Es = 0

Inelastic supply vs elastic supply



Inelastic supply vs perfect inelastic supply



Elastic supply vs perfectly elastic supply

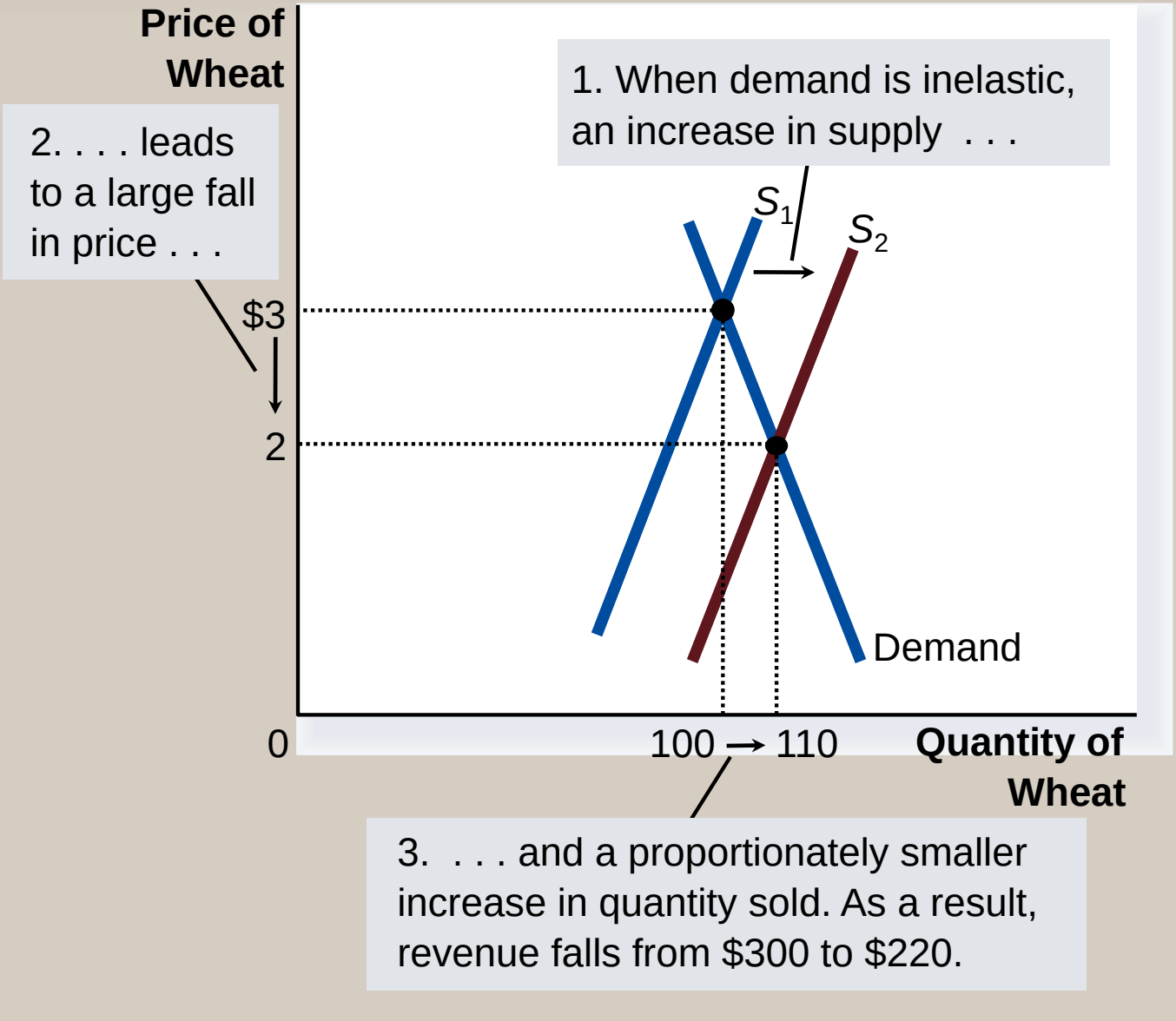
APPLICATION of ELASTICITY

- 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?

THE APPLICATION OF SUPPLY, DEMAND, AND ELASTICITY

- 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 An Increase in Supply in the Market for Wheat



Compute the Price Elasticity of Supply

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

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