E114 : **Principles of Economics**

First grade

First term

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Chapter 4

Elasticity

Lecture learning outcomes

1. Price elasticity of demand

2. Cross elasticity of demand

3. Income elasticity of demand,

4. Price elasticity of supply

1. Price Elasticity of Demand (PED)

- A measure of the sensitivity of the quantity demanded to price changes.

- The price elasticity of demand measures how strongly buyers respond to a change in the price of a good.

- The **price elasticity of demand** is a units-free measure of the responsiveness of the quantity demanded of a good to a change in its price when all other influences on buying plans remain the same.

1. Price Elasticity of Demand (PED)

- PED can be calculated as follows:

$$PED = \frac{\textit{Percentage change in quantity demanded}}{\textit{Percentage change in price}} = \frac{\%\Delta Q}{\%\Delta P}$$

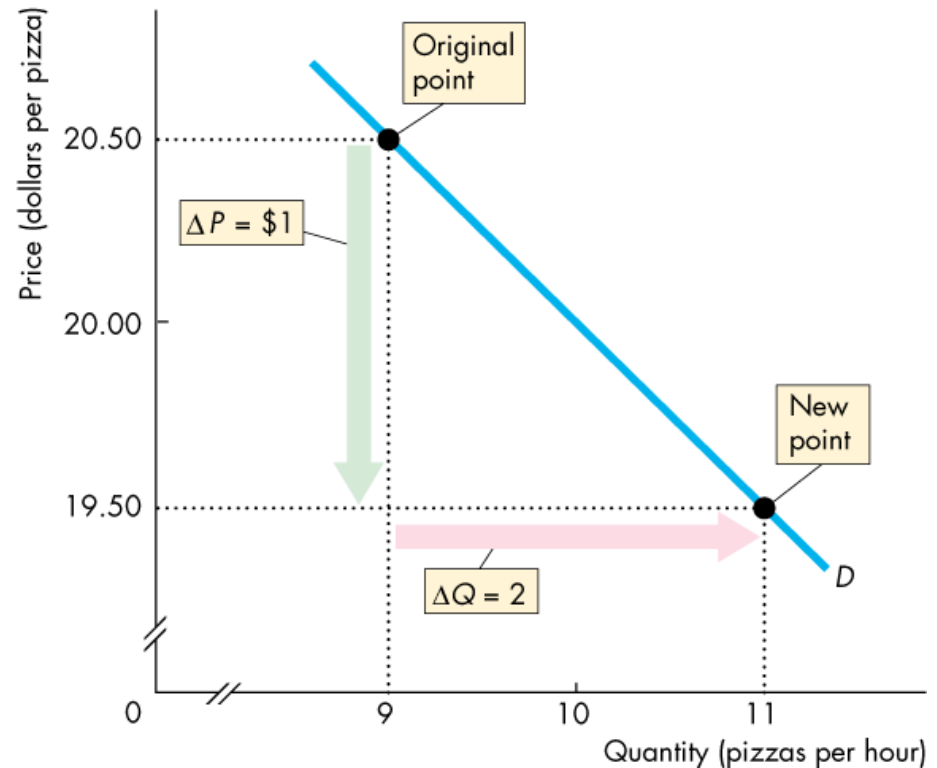$$\%\Delta Q = \frac{\Delta Q}{\overline{Q}} \times 100$$

Where $\overline{Q} = \frac{Q_1 + Q_2}{2}$

$$\%\Delta P = \frac{\Delta P}{\overline{P}} \times 100$$

Where $\overline{P} = \frac{P_1 + P_2}{2}$

- The price initially is $20.50 and the quantity demanded is 9 pizzas an hour.

- The price falls to $19.50 and the quantity demanded increases to 11 pizzas an hour.

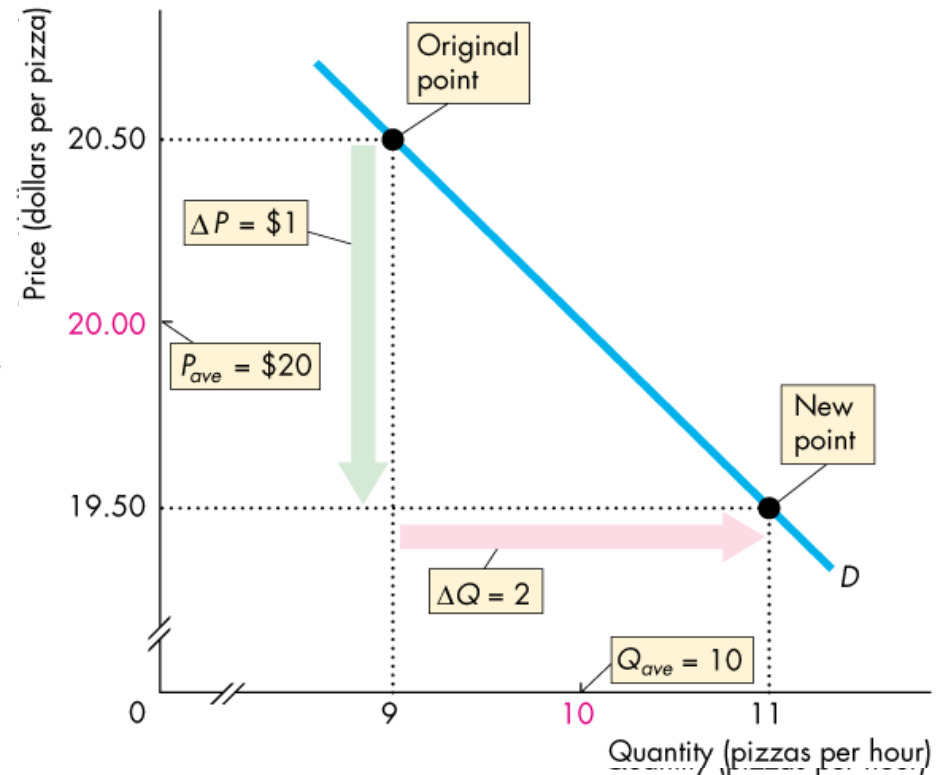- The price falls by $1 and the quantity demanded increases by 2 pizzas an hour.

1. Price Elasticity of Demand (PED)

1. The average price ($\overline{P}$) is $20

$$\overline{P} = \frac{P_1 + P_2}{2}$$

$$= \frac{20.5 + 19.5}{2} = 20$$

2. The average quantity demanded ($\overline{Q}$) is 10 per hour

$$\overline{Q} = \frac{Q_1 + Q_2}{2}$$

$$= \frac{9 + 11}{2} = 10$$
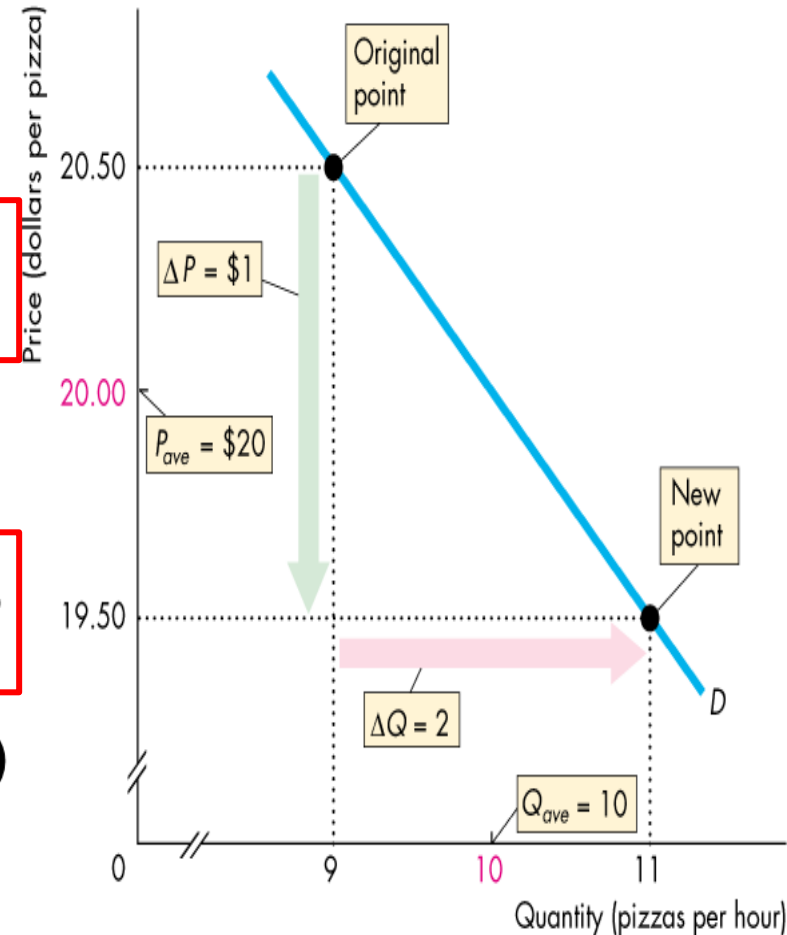
3. The percentage change in quantity demanded

$$\%\Delta Q = \frac{\Delta Q}{\overline{Q}} = \frac{11-9}{10} \times 100 = \frac{2}{10} \times 100 = 20\%$$

4. The percentage change in price

$$\%\Delta P = \frac{\Delta P}{\overline{P}} = \frac{19.5-20.5}{20} \times 100 = \frac{-1}{20} \times 100 = -5\%$$

5. The Price elasticity of demand (PED)

$$PED = \frac{\%\Delta Q}{\%\Delta P} = \frac{20\%}{-5\%} = -4$$

The formula yields a negative value, because price and quantity move in opposite directions.

But it is the *magnitude (size)*, or absolute value, that reveals how responsive the quantity change has been to a price change.

So, what does the above calculated elasticity imply?

The above calculated elasticity implies that one percent decrease in the price of pizza will increase the quantity demanded of pizza by 4 percent.

1. Price Elasticity of Demand (PED)

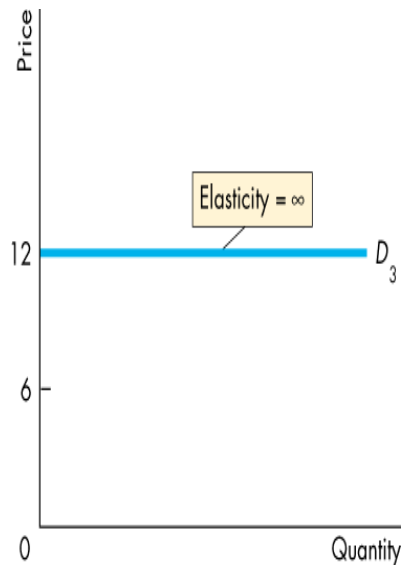Price elasticity of demand

Perfect elastic	elastic	Unit elastic	inelastic	Perfect inelastic
PED = ∞	PED >1	PED = 1	PED <1	PED = 0

(c) Perfectly elastic demand
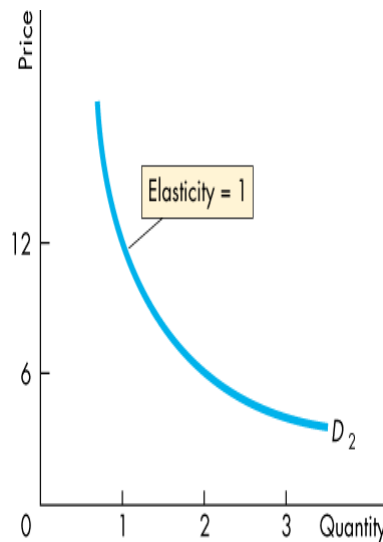
(b) Unit elastic demand
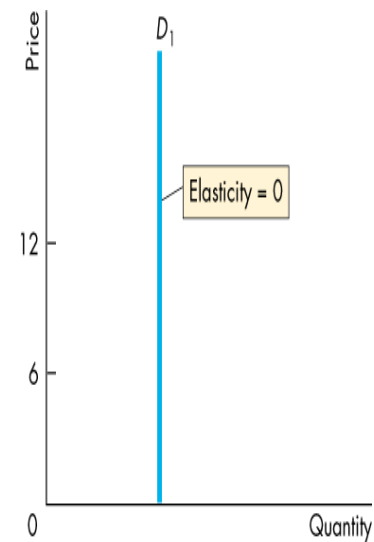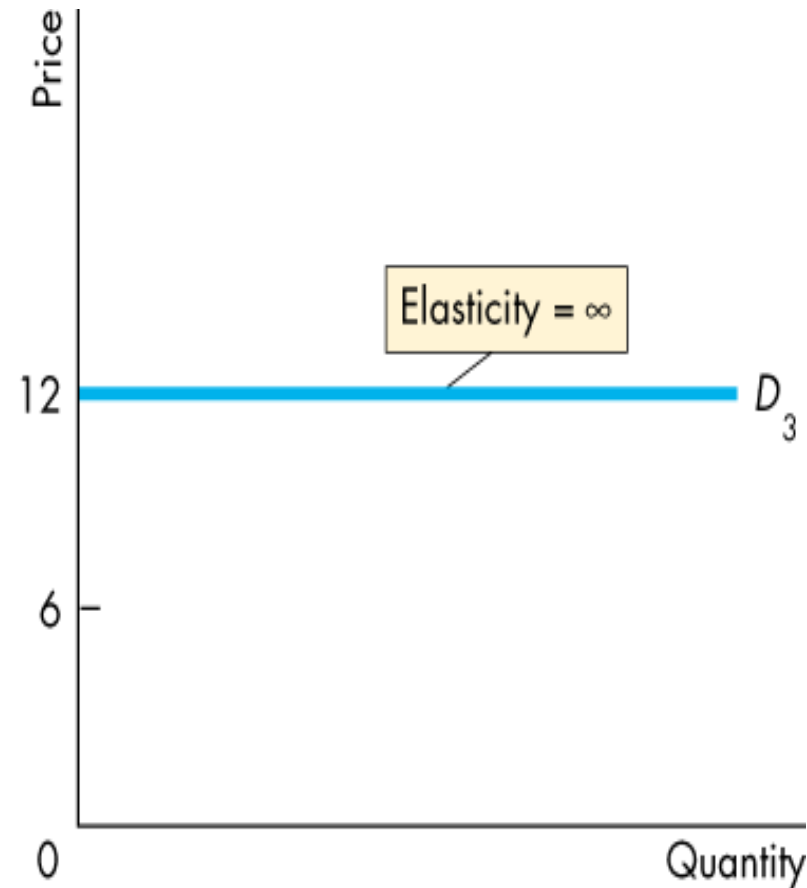
(a) Perfectly inelastic demand

1- Perfect elastic demand

- If the percentage change in the quantity demanded is infinitely large when the price just changes, then the PED is **infinite**.

- A perfectly elastic demand is a **horizontal demand curve.**

- Example:

 A soft drink from two campus machines located side by side. If the price of one machine is lower than the other, by even a small amount say one cent, no one buys from the machine with higher price and thus there would be very large increase in the quantity demanded from the other

Price

Elasticity = ∞

12 ──────────────────── D₃

6 ─

0   Quantity

(c) Perfectly elastic demand

2- elastic demand

➤ If the **percentage change in the quantity demanded** **is** *greater than* **the percentage change in price**, then the price elasticity of demand is **greater than 1**.

➤ **Examples**:

• cars and furniture and cell phones are examples of goods that have elastic demand.

3- unit elastic demand

➢ If the **percentage change in the quantity demanded equals the percentage change in price**, the price elasticity of demand equals **one.**

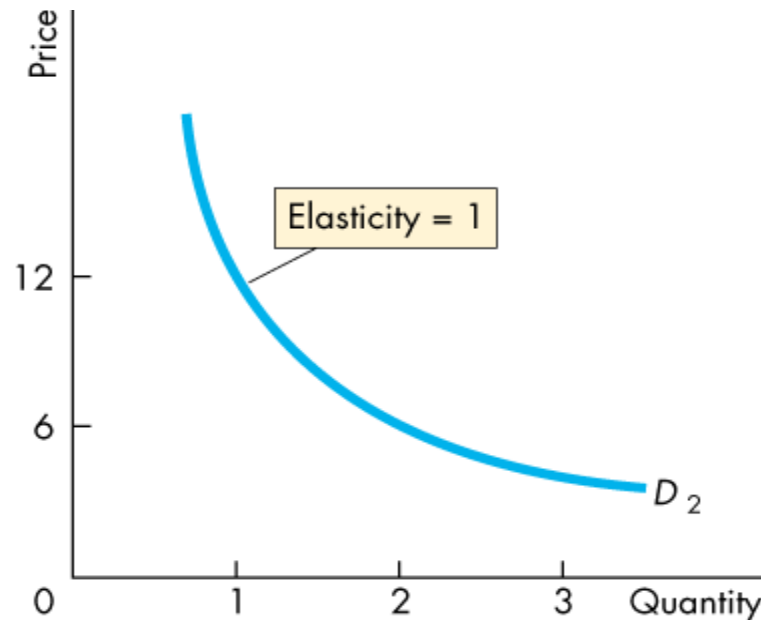(b) Unit elastic demand

1. Price Elasticity of Demand (PED)

4- inelastic demand

➢ If the percentage change in the quantity demanded **is** *smaller* than the percentage change in price, then the price elasticity of demand **is less than 1**.

➢ Examples:

food and energy products

5- Perfectly Inelastic Demand

➢ If the **quantity demanded** **doesn't change** when **the price changes**, the price elasticity of demand is **zero**.

➢ The demand curve is vertical. The quantity demanded is constant regardless of the price (change in it is zero) so the price elasticity is zero.

Example:

insulin which is highly important to some diabetics that if the price rise or fall, they do not change the quantity they buy.
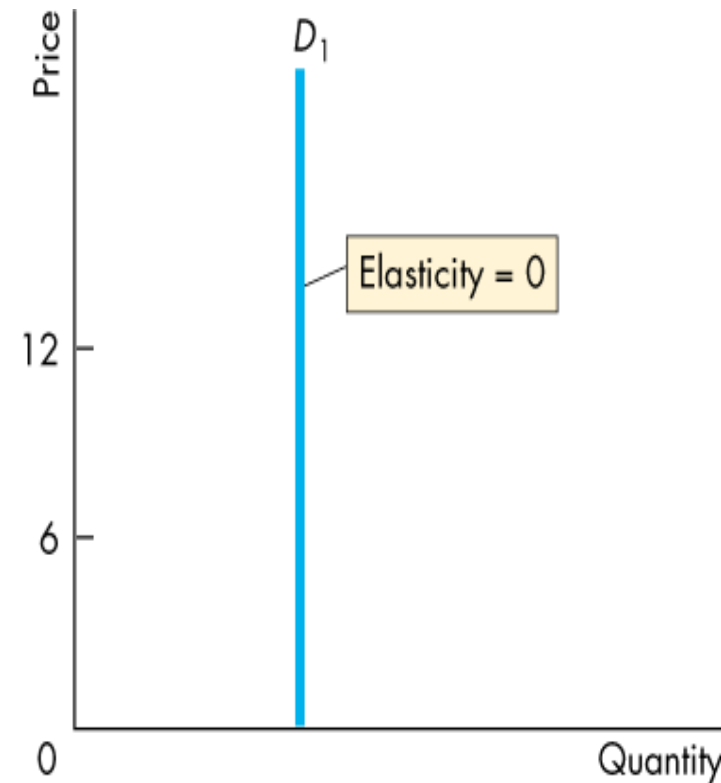
(a) Perfectly inelastic demand

1. Price Elasticity of Demand (PED)

Good or Service	Elasticity
Elastic Demand	
Metals	1.52
Electrical engineering products	1.39
Mechanical engineering products	1.30
Furniture	1.26
Motor vehicles	1.14
Instrument engineering products	1.10
Professional services	1.09
Transportation services	1.03
Inelastic Demand	
Gas, electricity, and water	0.92
Chemicals	0.89
Drinks (all types)	0.78
Clothing	0.64
Tobacco	0.61
Banking and insurance services	0.56
Housing services	0.55
Agricultural and fish products	0.42
Books, magazines, and newspapers	0.34
Food	0.12
Oil	0.05

1. Price Elasticity of Demand (PED)

TABLE 4.1 A Compact Glossary of Elasticities

Price Elasticities of Demand

A relationship is described as	When its magnitude is	Which means that
Perfectly elastic	Infinity	The smallest possible increase in price causes an infinitely large decrease in the quantity demanded*
Elastic	Less than infinity	The percentage decrease in the quantity demanded exceeds the percentage increase in price
Unit elastic	1	The percentage decrease in the quantity demanded equals the percentage increase in price
Inelastic	Less than 1 but greater than zero	The percentage decrease in the quantity demanded is less than the percentage increase in price
Perfectly inelastic	Zero	The quantity demanded is the same at all prices

*In each description, the directions of change may be reversed. For example, in this case, the smallest possible *decrease* in price causes an infinitely large *increase* in the quantity demanded.

1. Price Elasticity of Demand (PED)

Total Revenue and Elasticity

The **total revenue** from the sale of good or service equals the price of the good multiplied by the quantity sold.
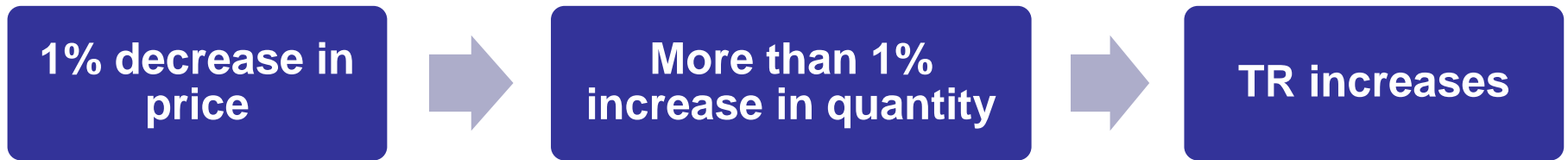
$$Total\ Revenue\ (TR) = P \times Q$$

When the price changes, total revenue also changes.

But a rise in price doesn't always increase total revenue.

1. Price Elasticity of Demand (PED)

The **change in total revenue** due to a change in price **depends on the elasticity of demand**:

- **If demand is *elastic:***

| 1% decrease in price | → | More than 1% increase in quantity | → | TR increases |

- **If demand is *inelastic***

| 1% decrease in price | → | less than 1% increase in quantity | → | TR decrease |

- **If demand is *unit elastic*,**

| 1% decrease in price | → | 1% increase in quantity | → | TR stays constant |
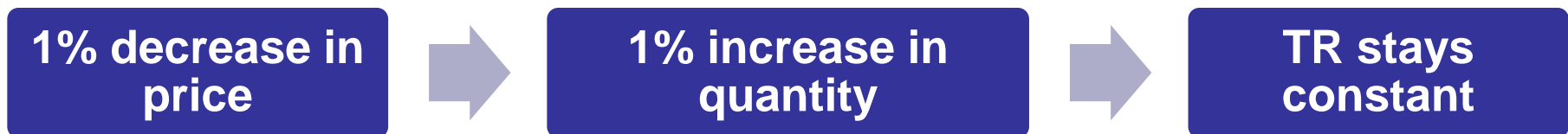
1. Price Elasticity of Demand (PED)

The **total revenue test** is a method of estimating the price elasticity of demand by observing the change in total revenue that results from a price change (when all other influences on the quantity sold remain the same).

- If a price cut increases total revenue, demand is elastic.

- If a price cut decreases total revenue, demand is inelastic.

- If a price cut leaves total revenue unchanged, demand is unit elastic.

1. Price Elasticity of Demand (PED)

FIGURE 4.5 Elasticity and Total Revenue
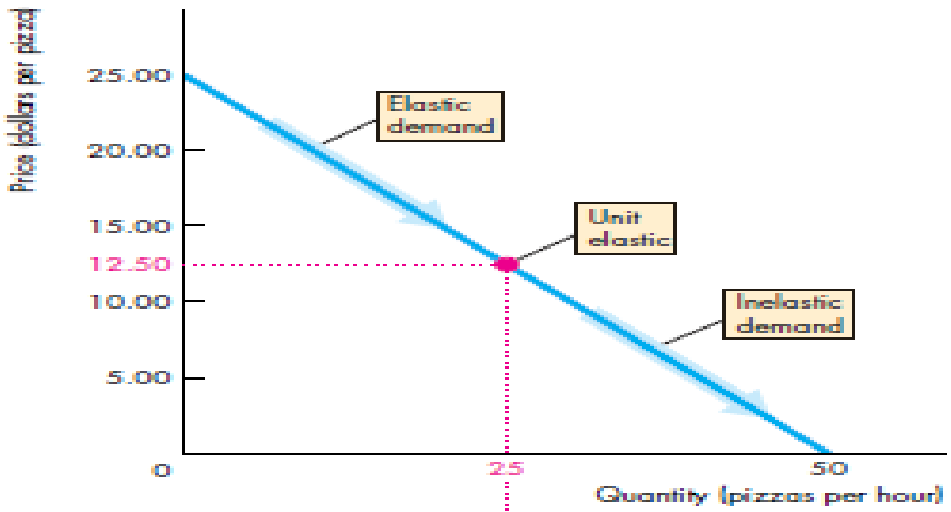
(a) Demand
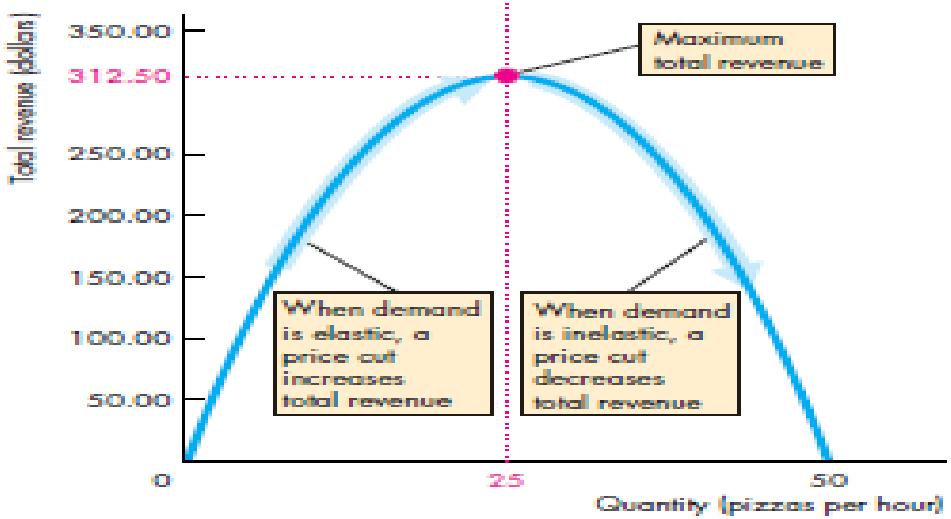
(b) Total revenue

1. Price Elasticity of Demand (PED)

The elasticity of demand for a good depends on:

- **The closeness of substitutes:**

- **The proportion of income spent on the good**

- **The time elapsed since a price change**

Closeness of Substitutes

The closer the substitutes for a good or service, the more elastic are the demand for the good or service.

Oil from which gasoline is made has no close substitute. So the demand for oil is inelastic.

Plastics are close substitutes for metals, so the demand for metal is elastic.

Necessities, such as food or housing, generally have inelastic demand.

Luxuries, such as exotic vacations, generally have elastic demand.

1. Price Elasticity of Demand (PED)

Proportion of Income Spent on the Good

- The greater the proportion of income consumers spend on a good, the larger is the elasticity of demand for that good.

- Think about the demand for chewing gum and housing. If the price of a gum doubles, you consume almost as much as before (demand for gum is inelastic). If apartment rents doubles, you either look for more students to share accommodation with you (demand for housing is not as inelastic as the demand for gum).

Time Elapsed Since Price Change

- The more time consumers have to adjust to a price change, or the longer that a good can be stored without losing its value, the more elastic is the demand for that good.

Cross Elasticity of Demand (CED)

The **CED** is a measure of the responsiveness of demand for a good to a change in the price of a *substitute* or a *complement*, other things remaining the same.

The formula for calculating the cross elasticity is:

$$PED = \frac{Percentage\ change\ in\ quantity\ demanded}{Percentage\ change\ in\ price\ of\ substitute\ or\ complment}$$

2. Cross Elasticity of Demand (CED)

The **cross elasticity** of demand for a *substitute* is **positive**.

Example: Suppose that the price of pizza is constant and people buy 9 pizzas an hour. Then the price of a burger rises from $1.50 to $2.50. No other influence on buying plans changes and the quantity of pizzas bought increases to 11 an hour. **Calculate the CED- for pizza.**

Answer:

$$\%\Delta Q = \frac{\Delta Q}{\bar{Q}} = \frac{11-9}{10} \times 100 = \frac{2}{10} \times 100 = 20\%$$

$$\%\Delta P = \frac{\Delta P}{\bar{P}} = \frac{2.5 - 1.5}{2} \times 100 = \frac{+1}{2} \times 100 = +50\%$$

$$CED = \frac{\%\Delta Q}{\%\Delta P} = \frac{20\%}{50\%} = 0.4$$

Burger is a substitute for pizza. So, when the price of a burger rises, the demand for pizza increases. Hence, the demand curve for pizza shifts rightward.

2. Cross Elasticity of Demand (CED)

The **cross elasticity** of demand for a *complement* is **negative**

Example: Suppose that the price of pizza is constant and 11 pizzas an hour are bought. Then the price of a soft drink rises from $1.50 to $2.50. No other influence on buying plans changes and the quantity of pizzas bought falls to 9 an hour. **Calculate CED for pizza.**

Answer:

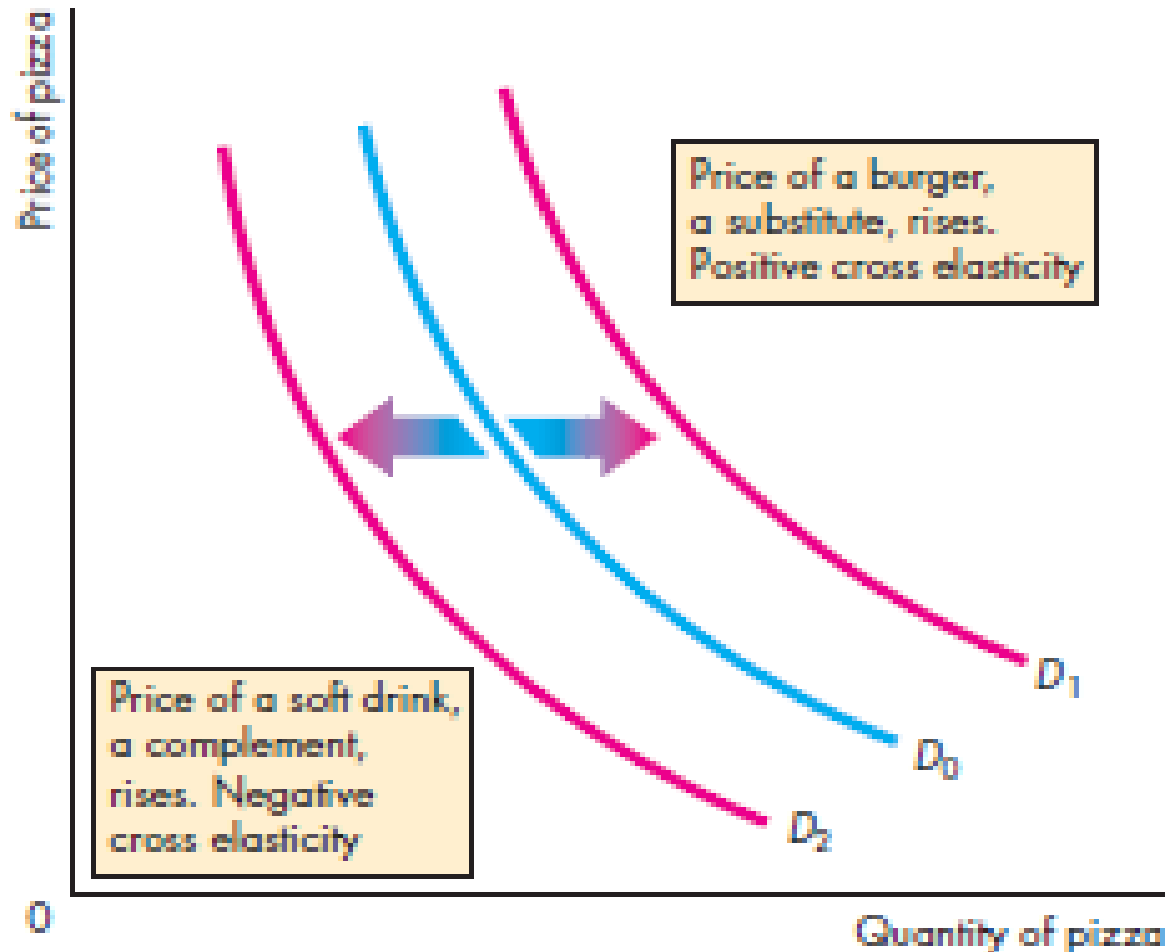$$\%\Delta Q = \frac{\Delta Q}{\bar{Q}} = \frac{9-11}{10} \times 100 = \frac{-2}{10} \times 100 = -20\%$$

$$\%\Delta P = \frac{\Delta P}{\bar{P}} = \frac{2.5 - 1.5}{2} \times 100 = \frac{+1}{2} \times 100 = +50\%$$

$$CED = \frac{\%\Delta Q}{\%\Delta P} = \frac{-20\%}{50\%} = -0.4$$

Pizza and soft drinks are complements and, hence, when the price of a soft drink rises, the demand for pizza decreases. The demand curve for pizza shifts leftward.

2. Cross Elasticity of Demand (CED)

FIGURE 4.6 Cross Elasticity of Demand

Price of a burger, a substitute, rises. Positive cross elasticity

Price of a soft drink, a complement, rises. Negative cross elasticity

D_1

D_0

D_2

Price of pizza

Quantity of pizza

0

2. Cross Elasticity of Demand (CED)

TABLE 4.1   A Compact Glossary of Elasticities

Cross Elasticities of Demand

A relationship is described as	When its value is	Which means that
Close substitutes	Large	The smallest possible increase in the price of one good causes an infinitely large increase in the quantity demanded of the other good
Substitutes	Positive	If the price of one good increases, the quantity demanded of the other good also increases
Unrelated goods	Zero	If the price of one good increases, the quantity demanded of the other good remains the same
Complements	Negative	If the price of one good increases, the quantity demanded of the other good decreases

*In each description, the directions of change may be reversed. For example, in this case, the smallest possible *decrease* in price causes an infinitely large *increase* in the quantity demanded.

3. Income Elasticity of Demand (IED)

Income Elasticity of Demand (IED)

The **IED** measures how the quantity demanded of a good responds to a change in income, other things remaining the same.

The formula for calculating the income elasticity of demand is

$$PED = \frac{Percentage\ change\ in\ quantity\ demanded}{Percentage\ change\ in\ income}$$

Example:

Suppose that the price of pizza is constant and 9 pizzas an hour are bought. Then incomes rise from $975 to $1,025 a week. No other influence on buying plans changes and the quantity of pizzas sold increases to 11 an hour. **Calculate IED for pizza**
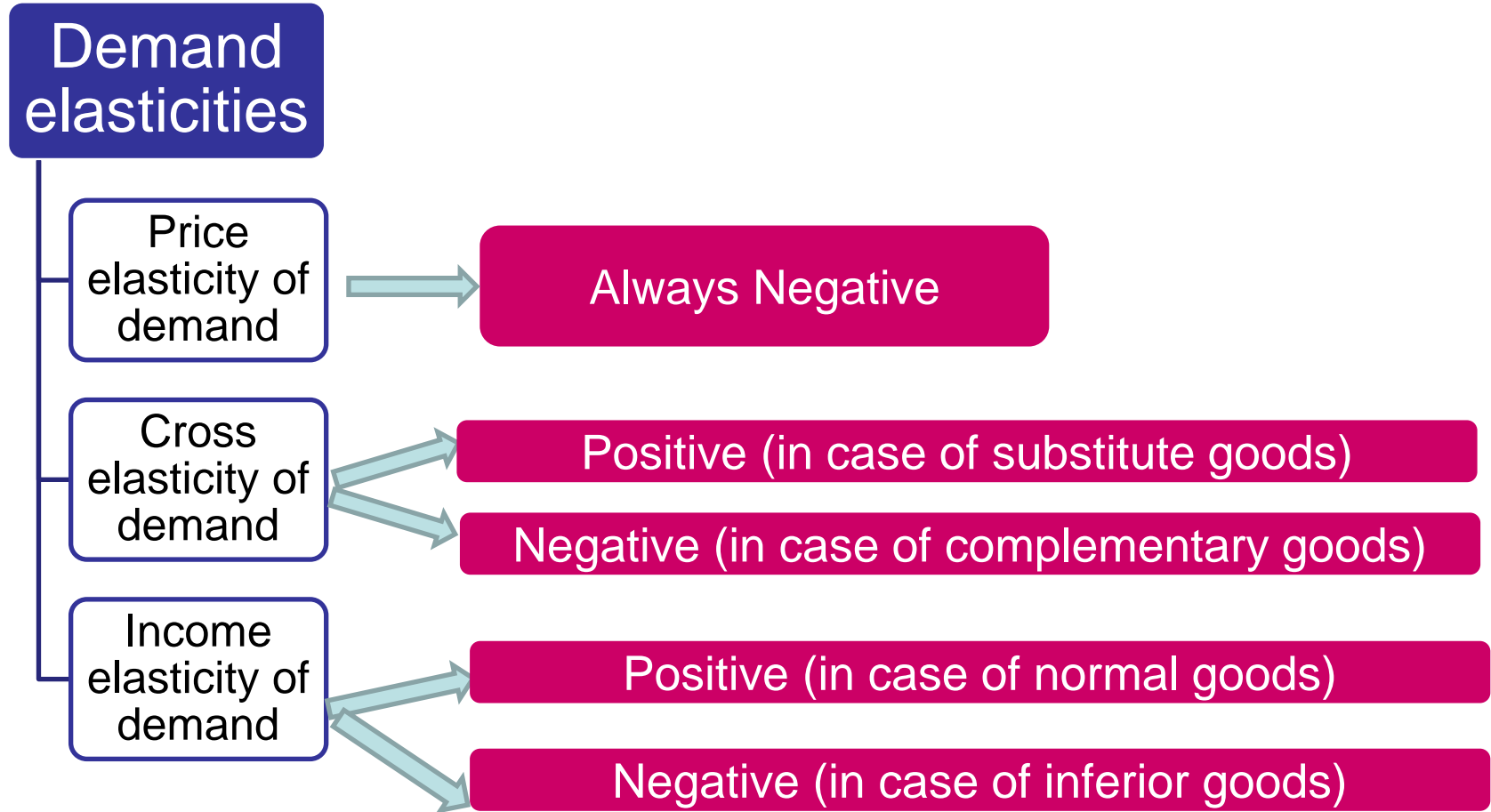
3. Income Elasticity of Demand (IED)

$$\%\Delta Q = \frac{\Delta Q}{\bar{Q}} = \frac{11-9}{1000} \times 100 = \frac{+2}{10} \times 100 = +20\%$$

$$\%\Delta Y = \frac{\Delta Y}{Y} = \frac{1025-975}{1000} \times 100 = \frac{+50}{1000} \times 100 = +5\,\%$$

$$IED = \frac{\%\Delta Q}{\%\Delta Y} = \frac{+20\%}{+5\%} = +4$$

- The demand for pizza is income elastic and pizza is normal good.

- If the income elasticity of demand is greater than zero but less than 1, demand is *income inelastic* and the good is a *normal good*.

- If the income elasticity of demand is less than zero (negative) the

Elasticities of Demand- summary

Demand elasticities

- **Price elasticity of demand** → Always Negative

- **Cross elasticity of demand**
  - Positive (in case of substitute goods)
  - Negative (in case of complementary goods)

- **Income elasticity of demand**
  - Positive (in case of normal goods)
 - Negative (in case of inferior goods)

4. Elasticity of Supply (PES)

A measure of the responsiveness of the quantity supplied to a price change.

The **elasticity of supply** measures the responsiveness of the quantity supplied to a change in the price of a good when all other influences on selling plans remain the same. Elasticity of supply is calculated using the following formula:

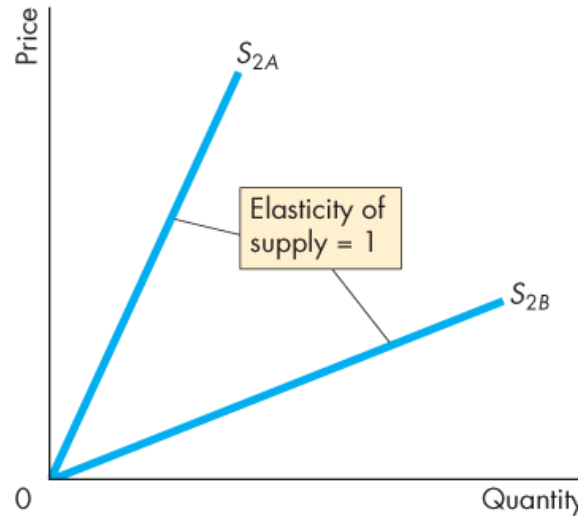$$PES = \frac{Percentage\ change\ in\ quantity\ supplied}{Percentage\ change\ in\ price}$$

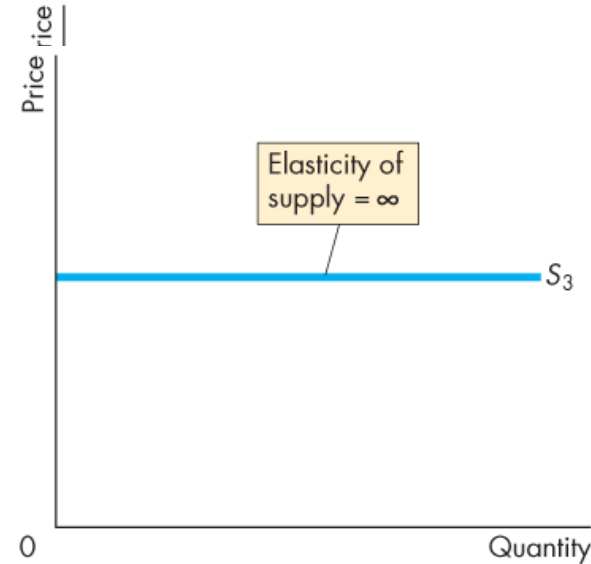# 4. Elasticity of Supply (PES)
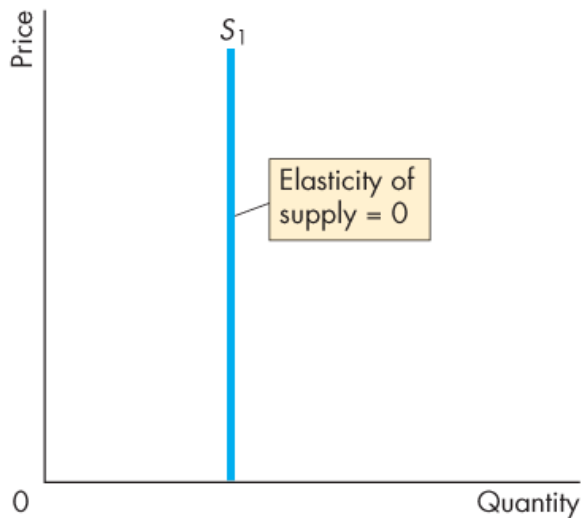
(a) Perfectly inelastic supply

(b) Unit elastic supply

(c) Perfectly elastic supply

| *perfectly inelastic* if the supply curve is vertical and the elasticity of supply is 0 | Supply is *unit elastic* if the supply curve is linear and passes through the origin | Supply is *perfectly elastic* if the supply curve is horizontal and the elasticity of supply is infinite |

Van Gogh painting

Wheat and corn

4. Elasticity of Supply (PES)

The Factors That Influence the Elasticity of Supply

The elasticity of supply depends on

- Resource substitution possibilities

- Time frame for supply decision

Resource Substitution Possibilities

The easier it is to substitute among the resources used to produce a good or service, the greater is its elasticity of supply.

Some goods and services can be produced only by using unique or rare productive resources. These items have a low, perhaps even a zero, elasticity of supply.

Time Frame for Supply Decision: we distinguish three time frames of supply:

(1)Momentary supply: When the price of a good changes, the immediate response of the quantity supplied is determined by the momentary supply of that good.

➢ **Perfectly inelastic momentary supply**

Some goods, such as fruits and vegetables, have a vertical supply curve. The quantities supplied depend on crop-planting decisions made earlier. In the case of oranges, for example, planting decisions have to be made many years in advance of the crop being available.

➤ **perfectly elastic momentary supply**

some goods such as a **Long-distance phone calls** have a **perfectly elastic monetary supply**

When many people simultaneously make a call, there is a big surge in the demand for telephone cables, computer switching, and satellite time.

The quantity supplied increases, but the price remains constant.

(2) Short-run supply:

- Most goods have an inelastic short-run supply.

- To increase output in the short run, firms must work their labour force overtime and perhaps hire additional workers.

- To decrease their output in the short run, firms either lay off workers or reduce their hours of work.

- Over time, firms can make more adjustments, perhaps training additional workers or buying additional tools and other equipment.

4. Elasticity of Supply (PES)

(3) Long-run supply is the most elastic.

The more time that passes after a price change, the greater is the elasticity of supply.

The response of the quantity supplied to a price change after all the technologically possible ways of adjusting supply have been utilized is determined by long-run supply.

TABLE 4.1 A Compact Glossary of Elasticities

Elasticities of Supply

A relationship is described as	When its magnitude is	Which means that
Perfectly elastic	Infinity	The smallest possible increase in price causes an infinitely large increase in the quantity supplied
Elastic	Less than infinity but greater than 1	The percentage increase in the quantity supplied exceeds the percentage increase in the price
Unit elastic	1	The percentage increase in the quantity supplied equals the percentage increase in the price
Inelastic	Greater than zero but less than 1	The percentage increase in the quantity supplied is less than the percentage increase in the price
Perfectly inelastic	Zero	The quantity supplied is the same at all prices

*In each description, the directions of change may be reversed. For example, in this case, the smallest possible *decrease* in price causes an infinitely large *increase* in the quantity demanded.