

## Module - I (08 hours)

**Engineering Economics**- Nature, Scope, Basic problems of an economy, Micro Economics and Macro Economics.

**Demand** - Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand & its measurement (Simple numerical problems to be solved ), Demand Forecasting – Meaning

**Supply**-Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).

### **Text Book for Reading :**

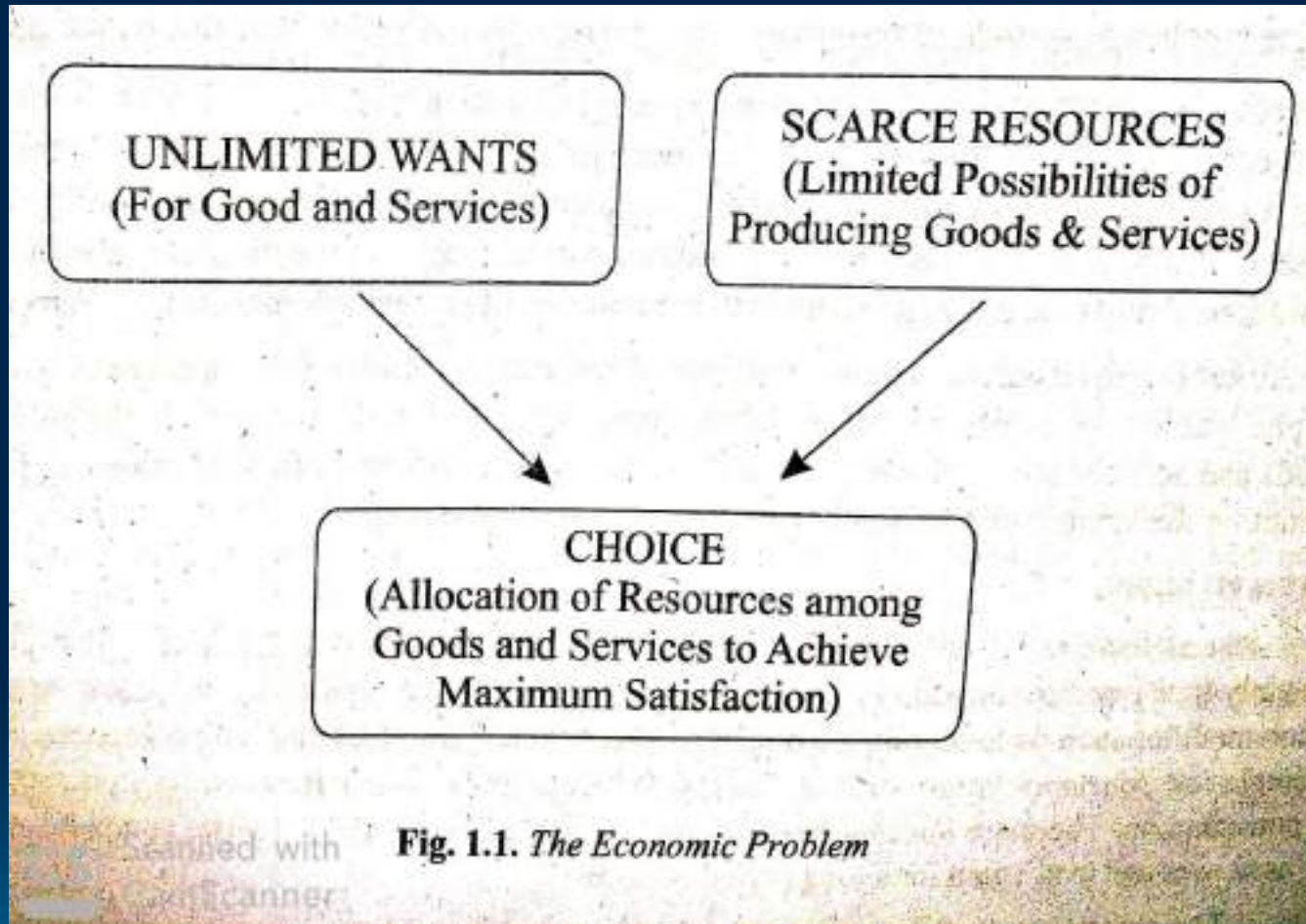
1. Principles of Economics by Deviga Vengedasalam & Karunakaran Madhavan, Oxford Publication

# Some of the e-resources of the book have taken from the book for explaining to the students in the class purposes only.

# Wants and Scarcity

- When wants exceed the resources available to satisfy them, there is **scarcity**.
- Scarcity : The pervasive Economic Problem
- Faced with scarcity, people must make choices.
- Economics is the study of choices people make to cope with scarcity.
- ***Economics deals with the allocation of scarce resources among alternative uses to satisfy human wants.***

# The Economic Problem



# Basic Economic Problems

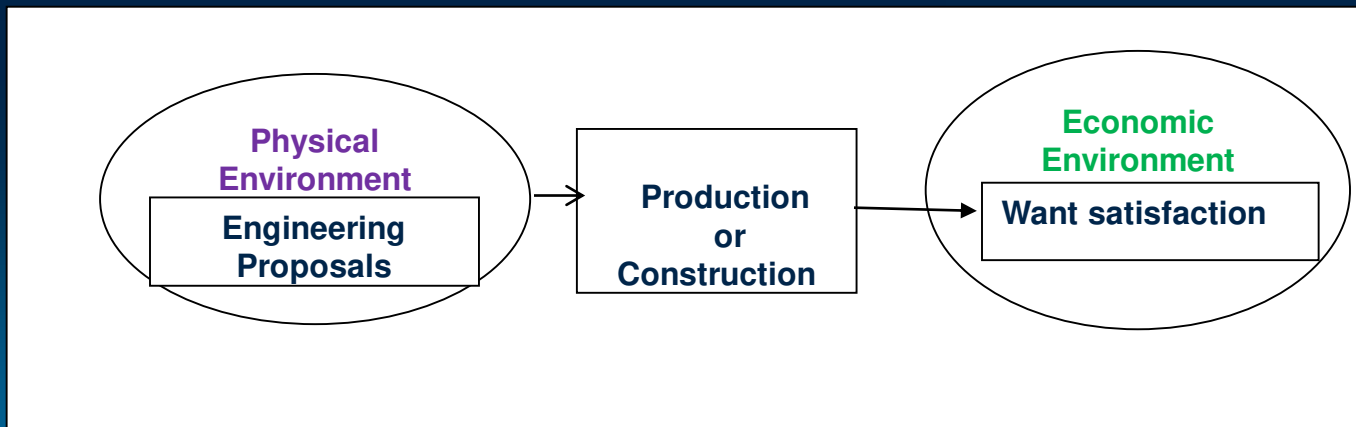
- **What communities are being produced and in what quantities (What to produce)?**
  - Resource Allocation
- **By what methods are these commodities produced? (How to produce )?**
  - Labour Intensive or Capital Intensive?
- **How is society's output of goods and services divided among its members? (For whom to produce )?**
  - Distribution of Income

# Economics

- **Economics** is the science which deals with production, distribution and consumption of goods and services.
- **Microeconomics** : Branch of economics that deals with the behavior of individual economic units—consumers, firms, workers, and investors—as well as the markets that these units comprise.
- **Macroeconomics**: Branch of economics that deals with aggregate economic variables, such as the level and growth rate of national output, interest rates, unemployment, and inflation.

# Engineering Economics

- ✓ *Engineering* is an application of science.
- ✓ It is an art composed of the skill and ingenuity in adopting knowledge to the uses of the humanity.
- ✓ Engineering is **primarily a producer activity**. Essentially a physical process with the objective being the **maximization of physical efficiency**.
- ✓ Ex. Photo electrical effect, solar cooker





# Engineering Economy

- The objective of engineering economy is to prepare engineers to cope effectively with the bi-environmental nature of engineering application.

- Types of Efficiency :

- Efficiency of a system is generally defined as the ratio of its output to input. The efficiency can be classified into **technical efficiency** and **economic efficiency**.

- Technical efficiency

- *It is the ratio of the output to input of a physical system* (diesel engine, machine working in a shop floor, a furnace etc.)

$$\text{Technical efficiency}(\%) = \frac{\text{Output}}{\text{Input}} \times 100$$

# Economic efficiency

- Economic efficiency is the ratio of output to input of a business system.

- Economic efficiency (%) =

$$\frac{\text{Output}}{\text{Input}} \times 100 = \frac{\text{Worth}}{\text{Cost}} \times 100$$

- “**Worth**” is the annual revenue generated by way of operating the business and “**cost**” is the total annual expenses incurred out the business.

- *For undertaking to be successful / survival and growth of any business, the **economic efficiency** should be more than 100%.*

***Economic efficiency is also called “Productivity”.***



# There are several ways of improving productivity

- Increased output for the same input : **Ex. Layout**
- Decrease input for the same output : **Ex. Substitute raw material**
- Less proportionate increase in the output is more than that of the input.

**Ex. Introducing the new product**

4. When proportionate decrease in input is more than that of the output.

**Ex. Dropping an uneconomical product from the existing product mix.**

5. Simultaneous increase in output and decrease in input.

**Ex. Introduction of advanced automated technologies like robots and automated guided vehicle system**

# Engineering Economics

- Engineering economy is the discipline concerned with the economic aspects of engineering, it involves the systematic evaluation of the costs and benefits of proposed technical projects.
- **Engineering economics** deals with the methods that enable one to take economic decisions towards **minimizing costs** and / or **maximizing benefits to business organizations.**

# Theories and Models

- In economics, explanation and prediction are based on **theories**. Theories are developed to explain observed phenomena in terms of a set of basic rules and assumptions.
- A **model** is a mathematical representation, based on economic theory, of a firm, a market, or some other entity.

## Positive versus Normative Analysis:

- **Positive analysis:** Analysis describing relationships of cause and effect.
- **Normative analysis:** Analysis examining questions of what ought to be.

# Cardinal Utility Analysis

- Want satisfying power of an article / good / services
- *Utility is the quality or capacity of a good which enables it to satisfy a human want.*
- **The Cardinal Measurability of utility:** Numerical score representing the satisfaction that a consumer gets from a given market basket.
- **Utilities are Independent**
- **Constant Marginal Utility of Money**
- **Introspection**
  - (from one's own experience – Judging what happens in one's own mind.)

# DEFINITION OF DEMAND

Demand is defined as the ability and willingness to buy specific quantities of goods in a given period of time at a particular price, *ceteris paribus*.

***Ceteris Paribus means holding other factors constant while some other factors change***

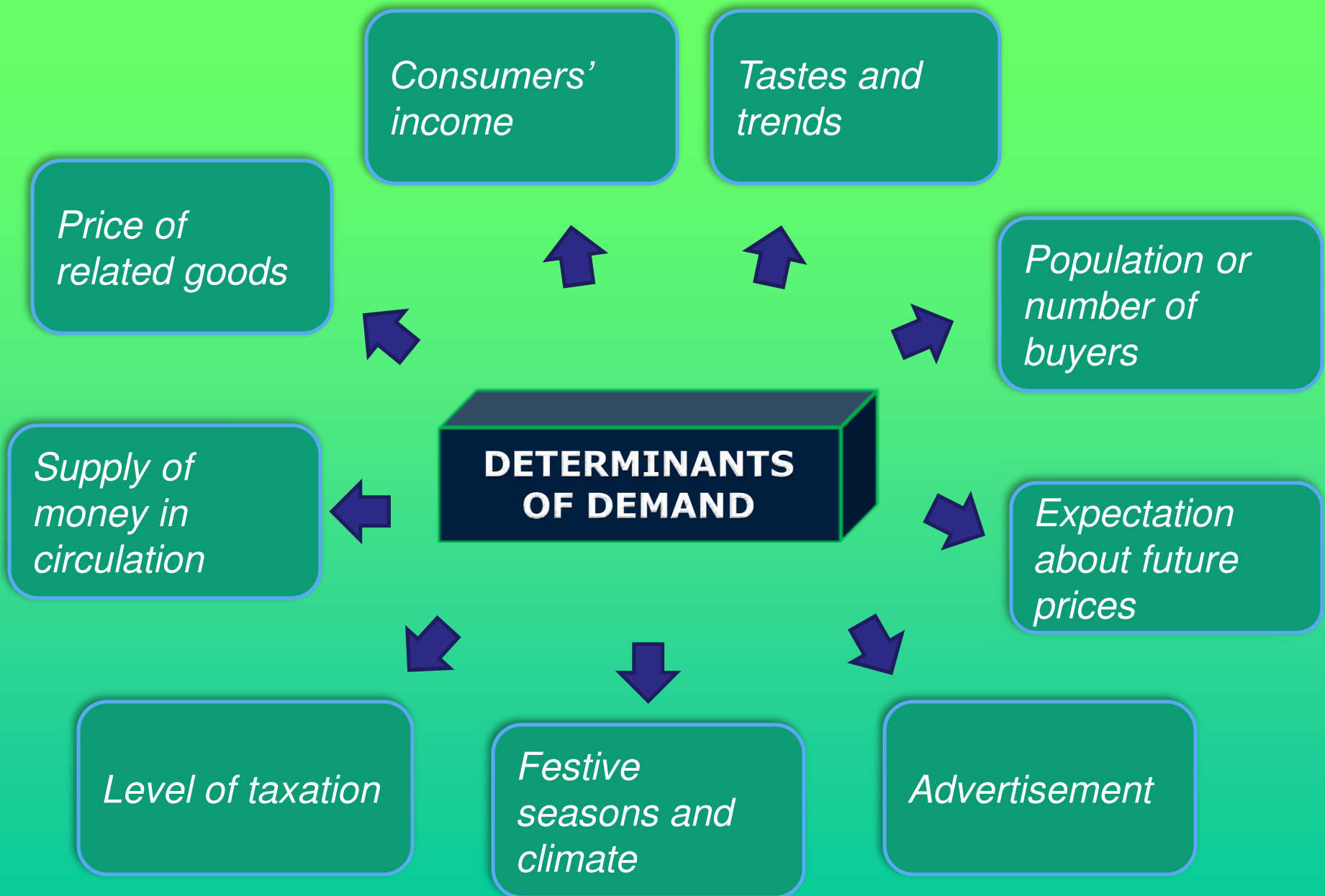
# Demand Analysis

- ✓ ***Demand = willingness to buy + ability to pay***
- ✓ ***The desire for a good or service backed by willingness and ability to pay for it.***
- ✓ or, “A schedule of the quantities of a good that a buyers are willing and able to purchase at each possible price during a period of time, Ceteris paribus (all other things held constant).”
- ✓ ***Demand is always expressed at a particular price, place and time.***

# Determinants of Demand

- **General Factors** : Prices of the product, income of the consumer, tastes and preference of the consumer, price of the related goods
- **Additional factors related to luxury goods and durables**: Consumer's expectations of future prices, consumers expectations of future income
- **Additional factors related to market demand**: Population, social economic and demographic distribution of consumer





| Price Demand                                     | Income Demand   | Cross Demand   |
|--|---|--|
| Relationship between price and quantity demanded | Relationship between income and quantity demanded         | <p>The demand for a good is also affected by the price of its substitute or complementary goods. Cross demand can be divided into two: <b>Joint demand</b> and <b>competitive demand</b></p> <p>Ex. Coffee &amp; Tea, Car &amp; Petrol</p> |
| Price demand curve has always a negative slopes  | Income Demand curve has both negative and positive slopes | <p>Cross Demand of Substitutes</p> <p>Cross Demand of complementary</p>  |

# DEMAND FUNCTION

It is the functional relationship between the price of the good and the quantity of that good purchased in a given time period. **or,**

➤ ***Demand Function states that the quantity of a commodity is inversely related to price.***

$$Q_d = f ( p, y, p_r, T )$$

Where  $Q_d$  = quantity demanded

$P$  = price of the commodity

$y$  = income of the individual

$p_r$  = prices of the closely related goods

$T$  = tastes of the consumer

$$\text{Ex. } Q = 20 - 12 P \quad [q=f(p)]$$

# LAW OF DEMAND

Law of demand states that the higher the price of a good, the lower is the quantity demanded for that good and the lower the price, the higher is the quantity demanded, ceteris paribus.



# Assumptions

1. Tastes and preferences of consumers remain unchanged.
2. Consumers income remain the same
3. Prices of related goods (complement or substitutes) should remain unchanged.
4. Goods should not have any prestige value.

# DEMAND SCHEDULE AND CURVE

**Demand Schedule**

| Price | Quantity |
|-------|----------|
| 5     | 2        |
| 4     | 4        |
| 3     | 6        |
| 2     | 8        |
| 1     | 10       |

**Demand Curve**



# Why inverse relationship?

- **Income effect:**
- **Substitution effect:** a fall in the price makes many consumer shift their purchases from the high priced commodity to the low priced substitutes which ultimately increases demand.
- **Price effect**
- **Law of Diminishing Marginal utility:**
- **Entry and exit of the buyers**



# INDIVIDUAL AND MARKET DEMAND

## INDIVIDUAL DEMAND

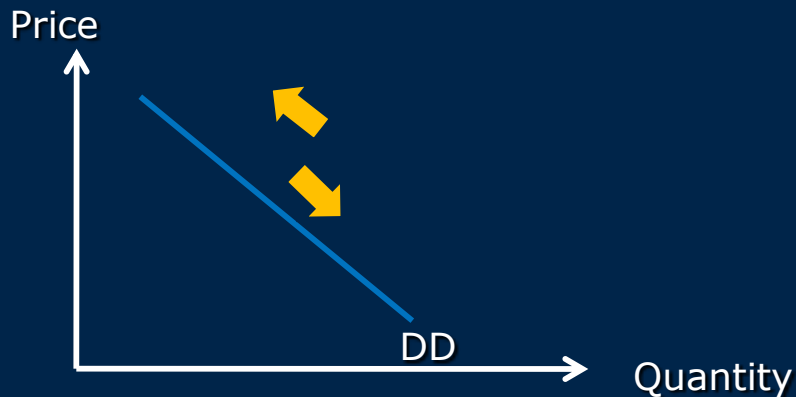
The relationship between the quantity of a good demanded by a single individual and its price.

## MARKET DEMAND

The relationship between the total quantity of a good demanded by adding all the quantities demanded by all consumers in the market and its price.

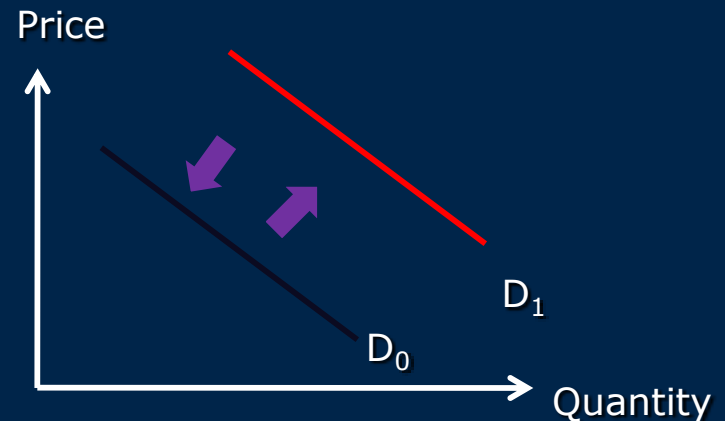
# CHANGES IN QUANTITY DEMANDED VS. CHANGES IN DEMAND

## CHANGES IN QUANTITY DEMANDED



- ❖ Movement along DD curve
- ❖ Price changes and other factors are constant
- ❖ Upward movement ➡ *Decrease in quantity demanded (**Contraction**)*
- ❖ Downward movement ➡ *Increase in quantity demanded (**Expansion**)*

## CHANGES IN DEMAND



- ❖ **Shift** in the demand curve
- ❖ Occurs when there are ***changes in other factors*** but price remains constant
- ❖ Increase in Demand ( $D_0 \rightarrow D_1$ )
- ❖ Decrease in Demand ( $D_1 \rightarrow D_0$ )

# Exceptions to the Law of Demand

- **Giffen paradox or Giffen Effect / Giffen Goods :**  
Giffen goods or inferior goods are normally consumed by those in the lower income group.
- **Status symbol commodity -**
- **Speculation -**
- **War or emergency –**
- **High-price Goods**
- **Demonstration effect**
- **Ignorance effect**
- **Demand for necessities**

# Engel's Law:

- **As income increases, the percentage expenditure on food and other necessities of life decreases and vice versa**

# PRICE ELASTICITY OF DEMAND

## DEFINITION:

Measures the sensitivity/responsiveness of the quantity demanded due to a change in its price.

# PRICE ELASTICITY OF DEMAND (cont.)

## FORMULA:

$$\epsilon_d = \frac{\% \Delta \text{Quantity Demanded}}{\% \Delta \text{Price}}$$

$$\epsilon_d = \frac{Q_2 - Q_1}{Q_1} \times \frac{P_1}{P_2 - P_1}$$

# Kinds of Price Elasticity of Demand

- A. Perfectly Elastic Demand
- B. Perfectly Inelastic Demand
- C. Relatively Elastic Demand
- D. Relatively Inelastic Demand
- E. Unit Elastic Demand

# Higher prices do not always result in greater total revenue. A price change can either increase or decrease total revenue , depending on the nature of demand function.

# Suppose a firm increases the prices of the product by 2 percent and QTD decreases by 3%, the price elasticity would be  $-1.5$ .

# Price elasticity is always negative



# DEGREE OF ELASTICITY

## Perfectly Inelastic Demand

*A condition in which the quantity demanded does not change as the price changes.*

## Inelastic Demand

*A large percentage of change in the price of a good will only affect a small percentage of change in the quantity demanded.*

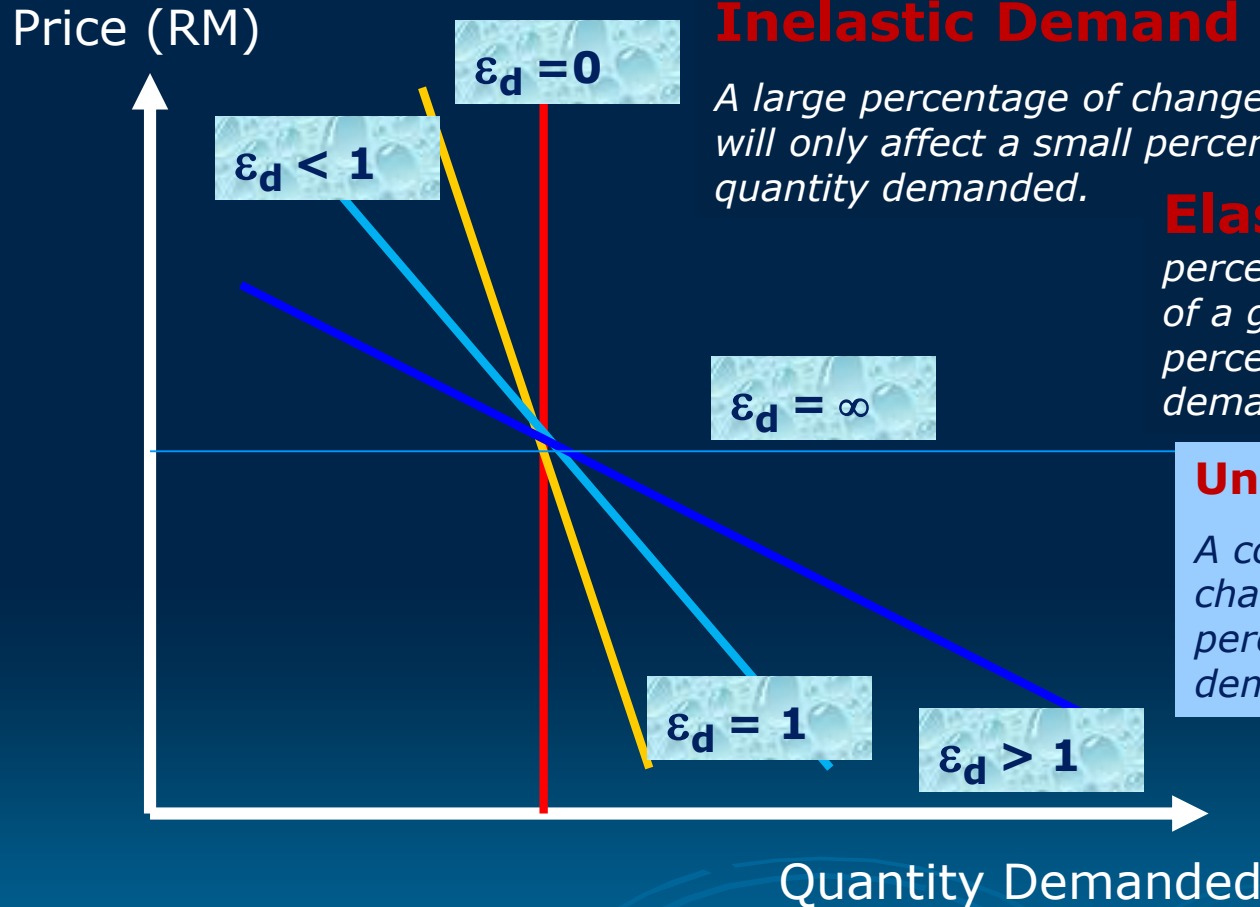
**Elastic Demand** *A small percentage of change in the price of a good will lead to larger percentage of change in quantity demanded.*

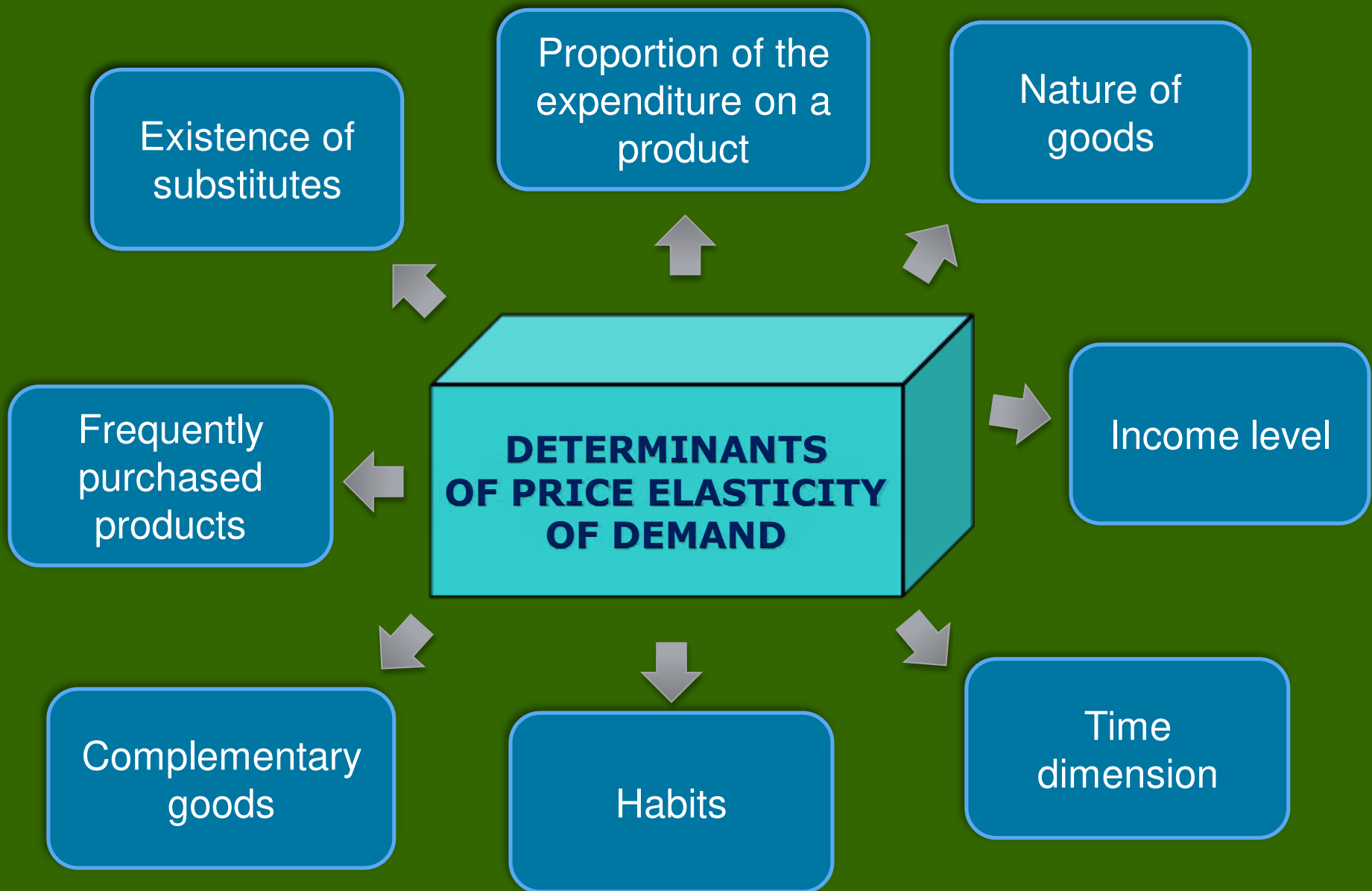
## Unitary Elastic Demand

*A condition in which percentage changes in price equals to percentage changes in quantity demanded.*

## Perfectly Elastic Demand

*A condition in which a small percentage of change in price leads to an infinite percentage of change in the quantity demanded.*





# Measurement of Price Elasticity

- Total outlay or Expenditure Method
- The Point Method
- The Arc Method

# Total Outlay or Expenditure Method

- The change in price and the consequent change in outlay on the purchase of the commodity

This method relates two things :

1. The change in price and
2. Change in quantity demanded.

✓ A given change in price does not cause any change in the total amount of **money spent** on the purchase of the commodity (i.e.  $e = 1$ )

✓ if the outlay varies inversely with changes in price then, elasticity of demand is greater than unity, **demand is elastic.**

✓ if the outlay varies directly with changes in price, elasticity of demand is less than unity, **demand is inelastic.**

# Arc Method

✓ In real life, we do not possess information about the change in price and the quantity demanded for the commodity

$$E_d = \frac{\text{Difference in Quantity}}{\text{Sum of Quantity}} \div \frac{\text{Difference in price}}{\text{Sum of price}}$$

*Symbolically the formulae*

$$E_d = \frac{(Q - Q_1)}{(Q + Q_1)} \div \frac{(P - P_1)}{(P + P_1)}$$

**Q = Original quantity, Q<sub>1</sub> = new quantity after change, P = Original Price, P<sub>1</sub> = new price after change**

### Case – I (Inelastic Demand)

Price

Rs 5

Rs.4

Quantity

100 units

110 units

**Arc Elasticity =  $0.43 < 1$**

### Case – II (Elastic Demand)

Price

Rs 10

Rs. 5

Quantity

50 units

110 units

**Arc Elasticity =  $1.2 > 1$**

### Case – III (Unitary Elastic )

Price

Rs 10

Rs. 5

Quantity

50 units

100 units

**Arc Elasticity =  $1 = 1$**

# Income Elasticity of Demand

➤ It is the ratio of proportionate change in quantity demanded to proportionate change in income

➤  $E_y = \left( \frac{dQ}{Q} \right) \times \frac{Y}{Q}$

➤  $E_y$  = Proportionate change in qtd./ Proportionate change in income

❖ IED is positive for normal goods,

❖ If IED is small = luxury goods

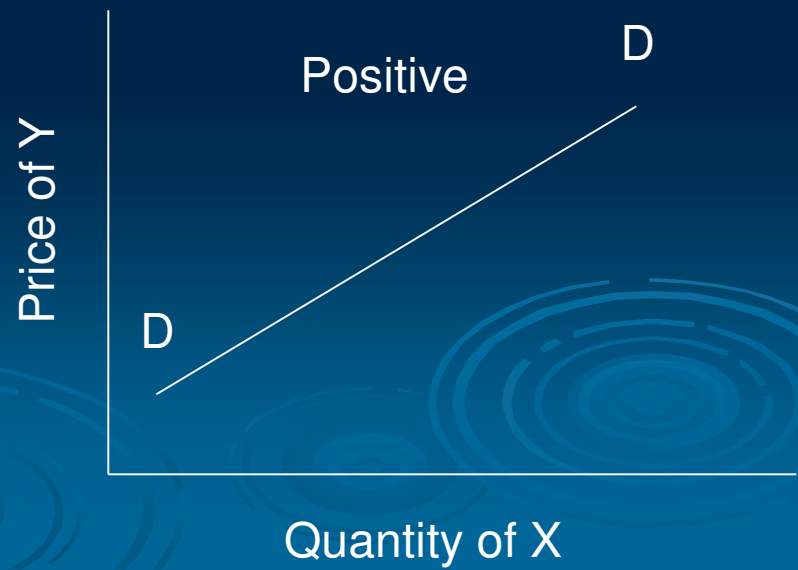


# Cross Elasticity of Demand

- The relationship between the two commodities either *substitutive* or *complementary*

$$\text{Cross Elasticity of Demand} = \frac{\text{Percentage change in quantity demanded } X}{\text{Percentage change in the price of } Y}$$

**CED = infinitive or Zero**  
**(degree of substitutability)**



- ✓ If **no substitution exists** = CED is Zero
- ✓ In case of complementary goods / Joint demand goods  
= **CED is negative**
- ✓ **CED is positive** = When X and Y are good substitutes
- ✓ **CED is high** = When X and Y are close substitutes
- ✓ **CED is infinitive** = When X and Y are perfect substitutes
- ✓ **CED is Zero** = When X and Y are not related to each other
- ✓ **CED is negative** = When X and Y are complements

# Supply

Supply is defined as the ability and willingness to sell or produce a particular product and services in a given period of time at a particular price, *ceteris paribus*.

***The supply of a good is the given quantity offered for the sale in a given market at a given time at various prices.***

# Supply Function

$$S_x = f(P_x, C, T, G, N)$$

Where,

$P_x$  = Price of the commodity

$C$  = Cost of Production (wages, interest, rent and prices of raw materials)

$T$  = State of Technology

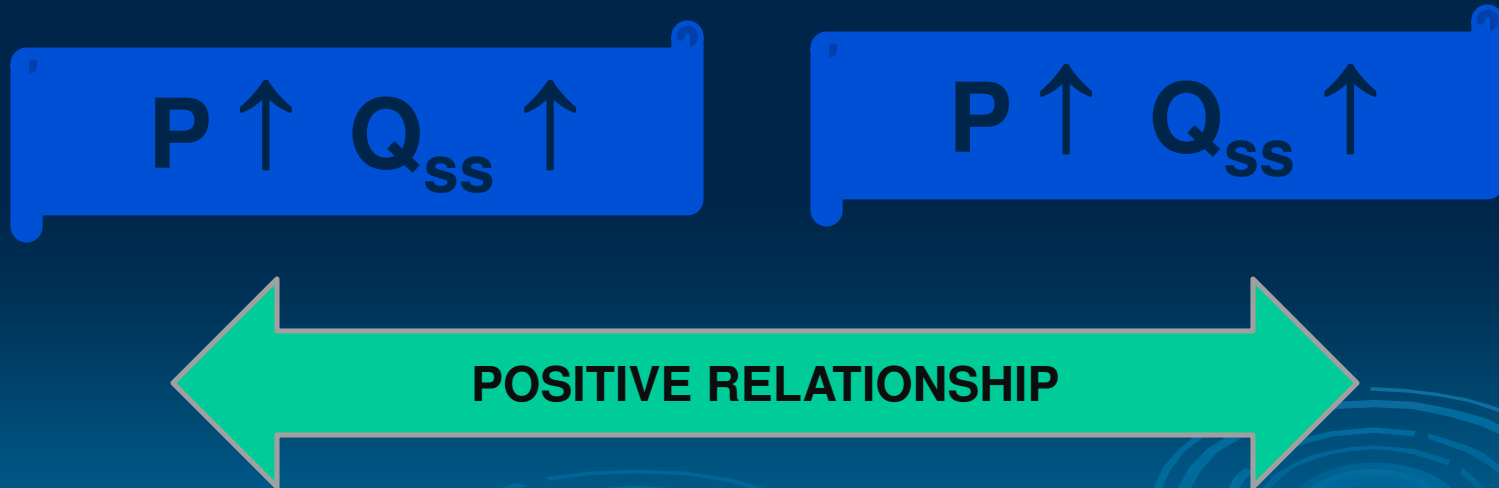
$G$  = Government policy regarding taxes and subsidies ( $G$ )

$N$  = Other factors like number of firms

The **supply function** of a commodity represents the quantity of the commodity that would be supplied at a price, levels of technology, input prices and all other factors that influence supply.

# LAW OF SUPPLY

*Law of supply states that the higher the price of a good, the greater is the quantity supplied for that good and the lower the price of a good, the lower is the quantity supplied, ceteris paribus.*

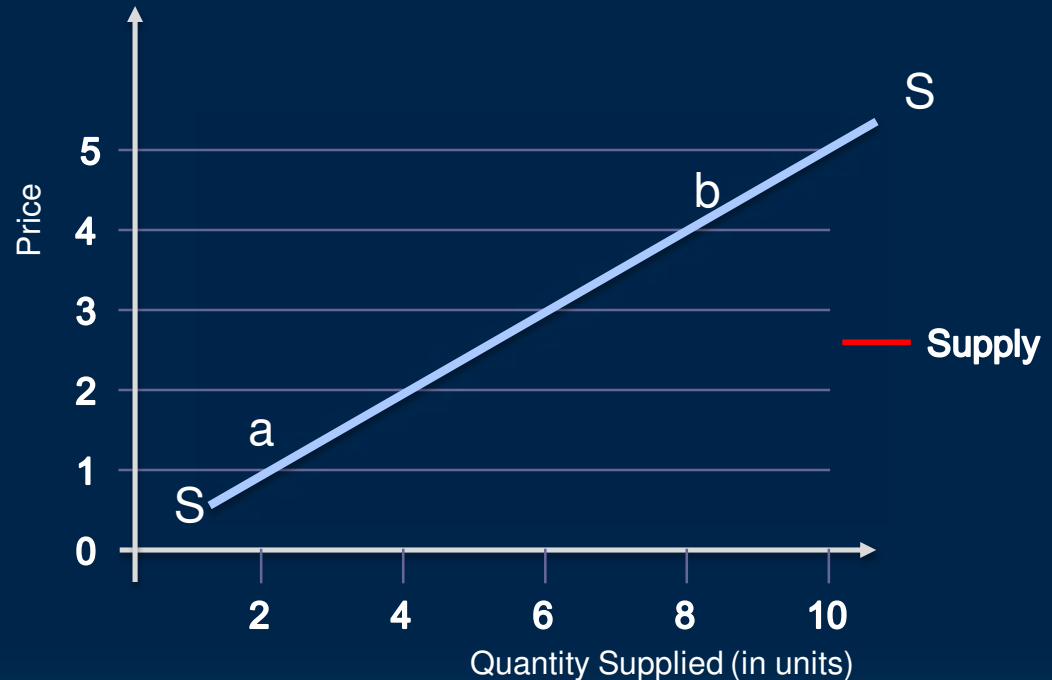


# SUPPLY SCHEDULE AND CURVE

Supply Schedule

| Price | Quantity |
|-------|----------|
| 5     | 10       |
| 4     | 8        |
| 3     | 6        |
| 2     | 4        |
| 1     | 2        |

Supply Curve



- The **supply curve (SS)** is the graphical representation of a supply schedule. It represents the quantities supplied of a commodity at different price levels. When the price is Rs 1, the quantity supplied is 2 units whereas the price increases to Rs 5 the quantity supplied to 10 units.

# INDIVIDUAL AND MARKET SUPPLY

## INDIVIDUAL SUPPLY

The relationship between the quantity of a product supplied by a single seller and its price.

## MARKET SUPPLY

The relationship between the total quantity of a product supplied by adding all the quantities supplied by all sellers in the market and its price.

# Determinants of Supply

- **Prices of related goods :**

- A) Substitute goods**

- Supply of a product will decrease when there is an increase in the price of a substitute product i.e. **Pepsi & Coco cola**. If the price of Pepsi increases, the quantity supplied will increase (as per the law of supply) and the quantity of coco cola will decrease).

- B) Complementary goods**

- An increase in the price of a product will increase in the supply of a complementary good i.e. pen & Ink. When the price of a pen increases, the quantity supplied for pens will increase (as per the law of supply) and the supply of ink will increase, since both are complementary goods.

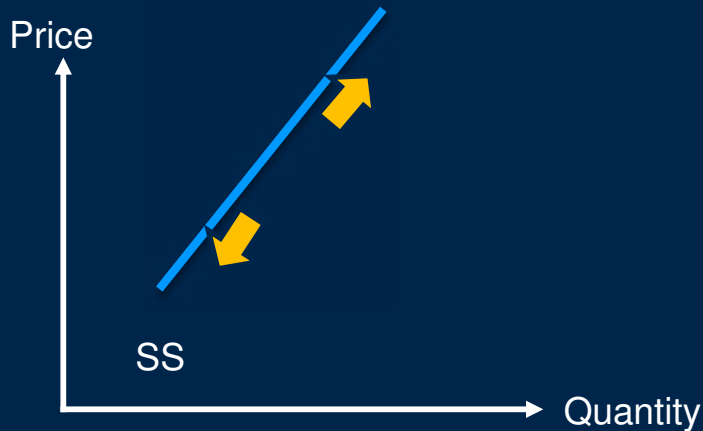


# Determinants of Supply

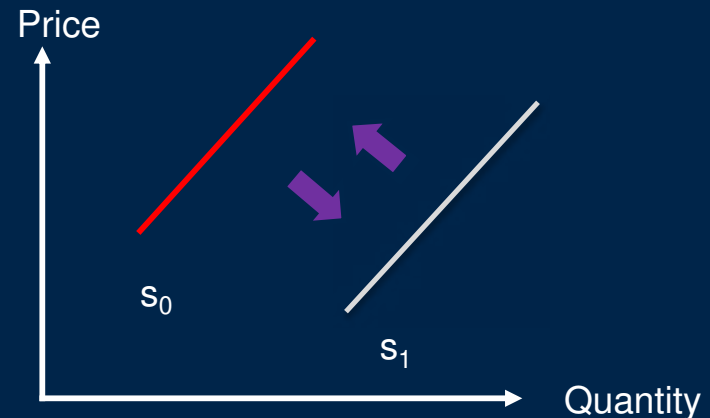
- **Cost of production :**
  - Supply will change in response to the factors of production (labour, capital or land).
- **Expectations about future prices :**
  - The higher the expected future price of a product, the smaller the current supply of the product, and vice versa.
- **Technological advancement :**
  - New technologies that enable producers to use fewer factors of production will lower the cost of production and increase supply.
- **Number of sellers:**
- **Government policies :** a) Taxes : will decrease the supply b) Subsidies : will increase the supply.
- Improvements in infrastructure

# CHANGE IN QUANTITY SUPPLIED VS. CHANGE IN SUPPLY

## CHANGE IN QUANTITY SUPPLIED



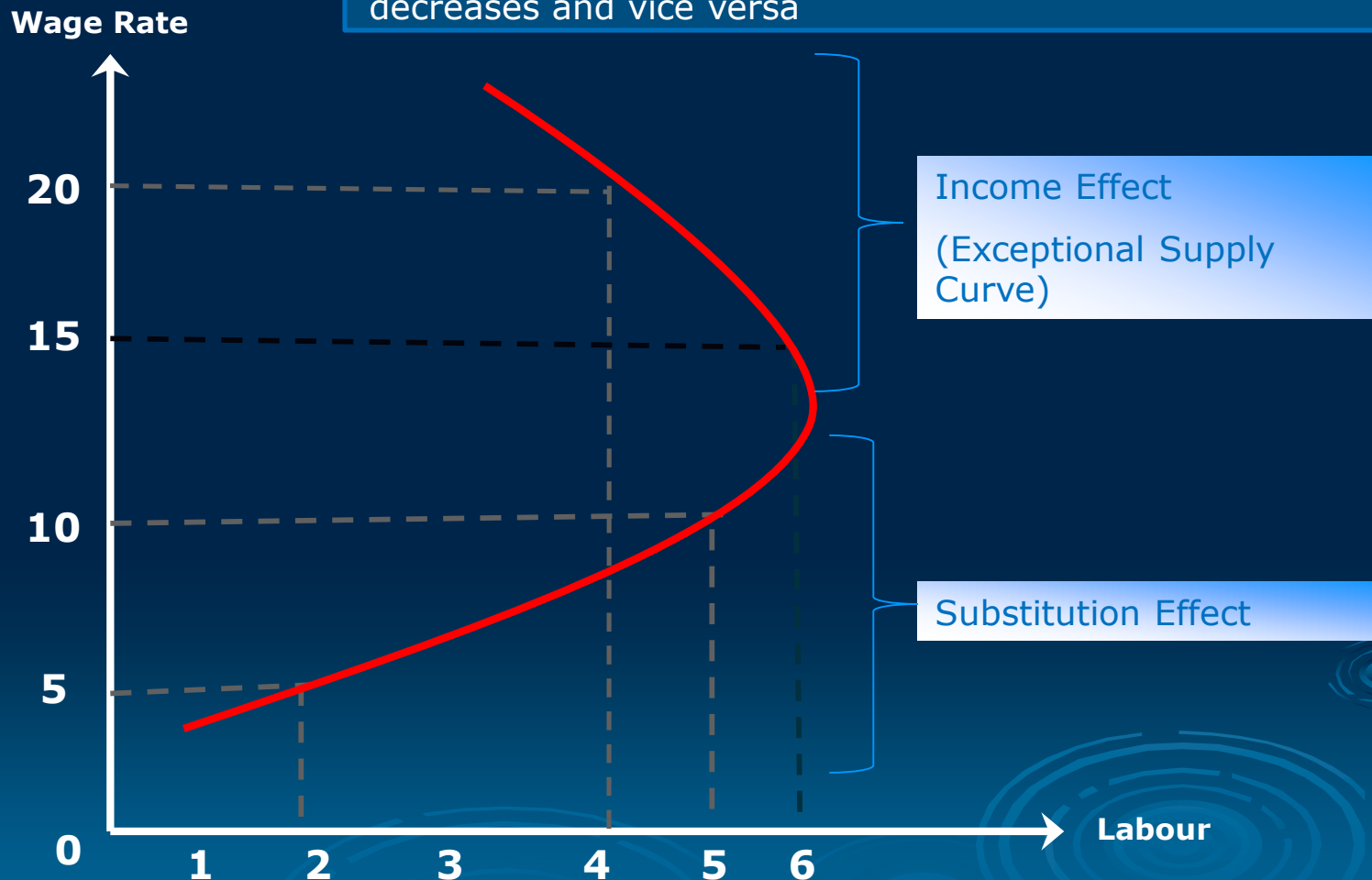
- ❖ Movement along supply curve
- ❖ Price changes and other factors are constant
- ❖ Downward movement ➡ *Decrease in quantity supplied (Contraction)*
- ❖ Upward movement ➡ *Increase in quantity supplied (Expansion)*



- ❖ **Shift** in the supply curve
- ❖ Occurs when there are **changes in other factors** but the price remains constant
- ❖ Increase in Supply ( $S_0 \rightarrow S_1$ )
- ❖ Decrease in Supply ( $S_1 \rightarrow S_0$ )

# EXCEPTIONAL SUPPLY

**Exceptional Supply is the opposite of the Law of Supply** where as price increases, the quantity supplied decreases and vice versa



# PRICE ELASTICITY OF SUPPLY

## DEFINITION:

Measures the sensitivity/responsiveness of the quantity supplied due to a change in the price of a product or service.

# PRICE ELASTICITY OF SUPPLY (cont.)

## FORMULA:

$$\epsilon_{ss} = \frac{\% \Delta \text{Quantity Supplied}}{\% \Delta \text{Price}}$$

$$\epsilon_{ss} = \frac{Q_2 - Q_1}{Q_1} \times \frac{P_1}{P_2 - P_1}$$

# DEGREE OF ELASTICITY

## Elastic Supply

*A small percentage of change in the price of a good will lead to larger percentage of change in the quantity supplied.*

## Inelastic Supply

*A large percentage of change in the price of a good will only affect a small percentage of change of the quantity supplied.*

## Unitary Elastic Supply

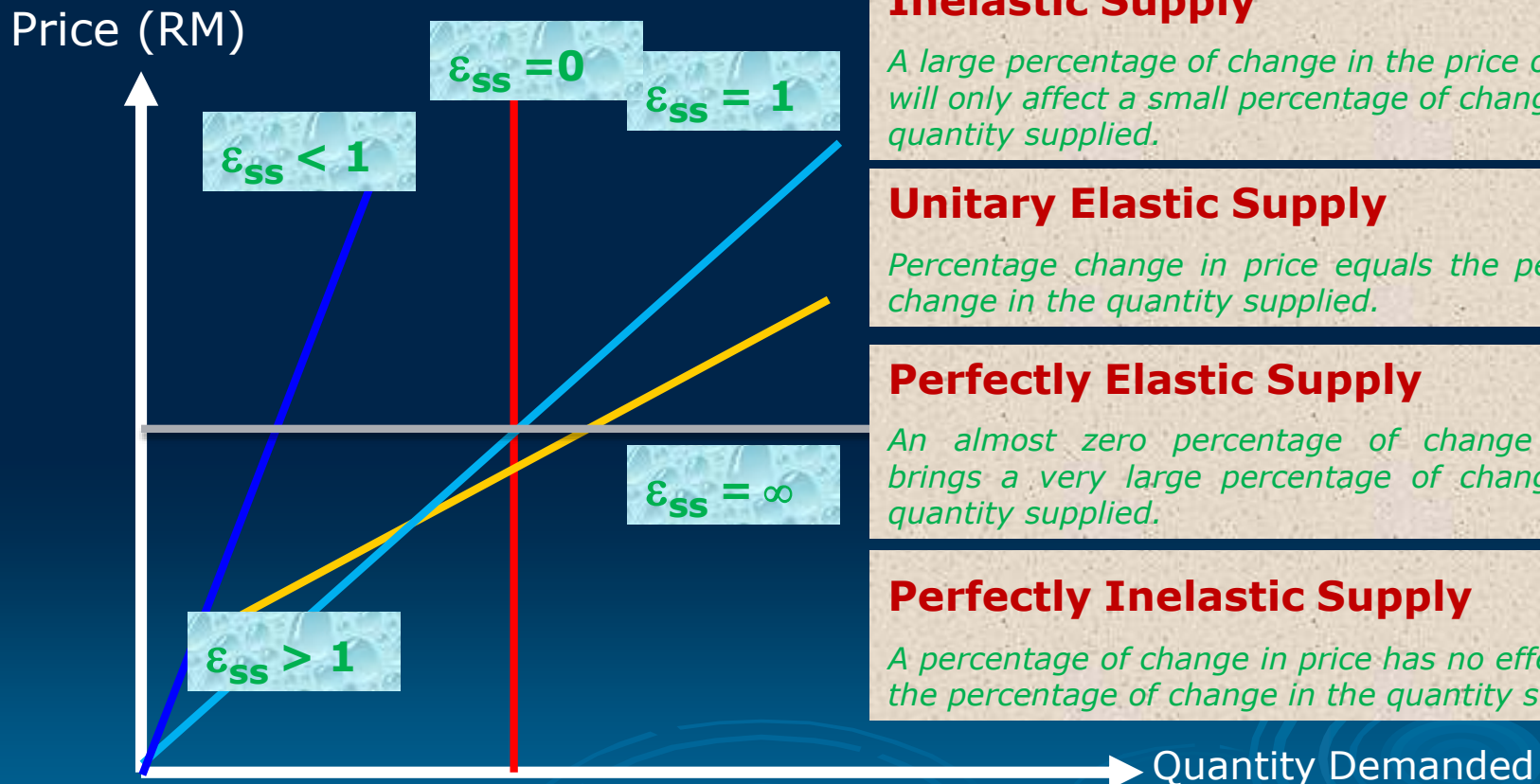
*Percentage change in price equals the percentage change in the quantity supplied.*

## Perfectly Elastic Supply

*An almost zero percentage of change in price brings a very large percentage of change in the quantity supplied.*

## Perfectly Inelastic Supply

*A percentage of change in price has no effect on the percentage of change in the quantity supplied.*



# Determinants of Price Elasticity of Supply

## ➤ **Technological dimensions :**

- Modern methods of production expand output, and thus, the supply tends to be elastic.

## ➤ **Time dimensions :**

- In the short term, supply tends to be inelastic due to insufficient time to organize and adjust supply to demand (Agricultural Products). In the long term, supply tends to be elastic. (Ex: Manufacturing Products)

## ➤ **Availability and mobility of factors of production:**

- Availability of land, labour, capital, then factors such as labour can easily move from one occupation to another.

## ➤ **Nature of the market:**

- When products can be sold in different markets, supply become more elastic.

## ➤ **Perishability:**

- Ex : Fruits and vegetables the supply tends to be inelastic.



# DEMAND FORECASTING

- Demand forecasting is an estimate of sales in ₹ or physical units for specified future period under a proposed marketing plan.

*(American Marketing Association)*

- *Demand forecasting as the scientific and analytical estimation of demand for a product (good or service) for a particular period of time. It is the process of determining how much of which product is needed **when** and **where**. It involves the estimation of the level of demand, extent and magnitude of demand, responsiveness of demand (elasticity) to a proposed change in price, income of consumer, price of other goods (complements or substitutes) and other determinants.*



# Question Answer for Discussion

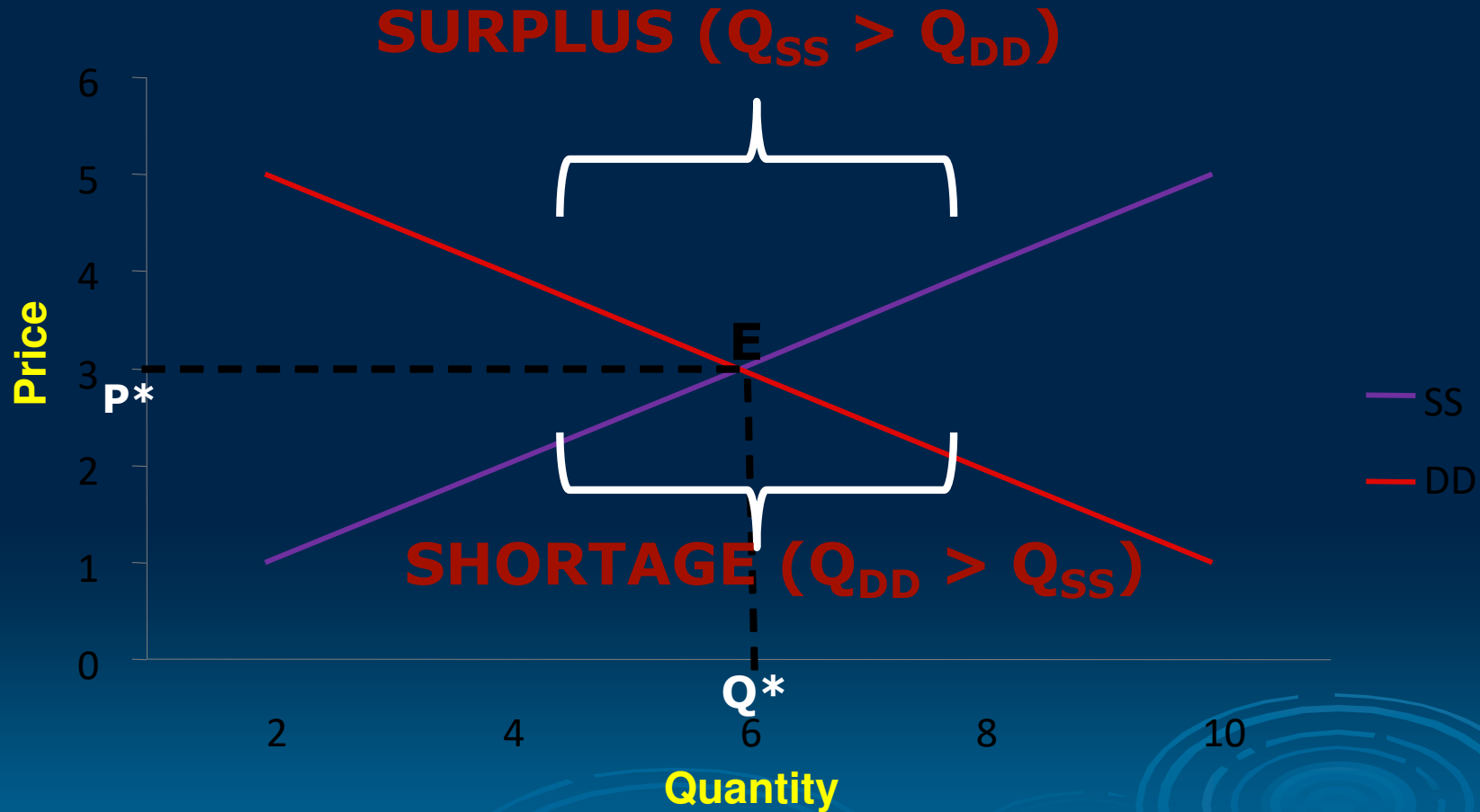
1. When the price per cartoon Coca Cola falls from ₹ 16 to ₹ 14, the quantity demanded increases from 200 to 300 cartoons per month. On the other hand, the demand for Pepsi falls from 250 to 200 cartoons per month.
  - A. Calculate the price elasticity of demand.
  - B. If the price of coca cola increases, what will happen to the total revenue of Coca Cola.
  - C. Calculate the cross elasticity of demand between Coca Cola and Pepsi.
2. The demand for readymade cloth is  $Q = 50 - 10 P + 0.4 Y$   
Where, Q, P & Y, are quantity, price and income respectively. Assume that  $P = 4$  and  $Y = 100$ 
  - i. Interpret the equation
  - ii. Find Price Elasticity and Income Elasticity at the given price and income levels.

# Determination of Market Equilibrium

A market equilibrium is a situation when **quantity demanded** and **quantity supplied** are **equal** and there is no tendency for price or quantity to change.

$$Q_{DD} = Q_{SS}$$

# EQUILIBRIUM PRICE AND OUTPUT

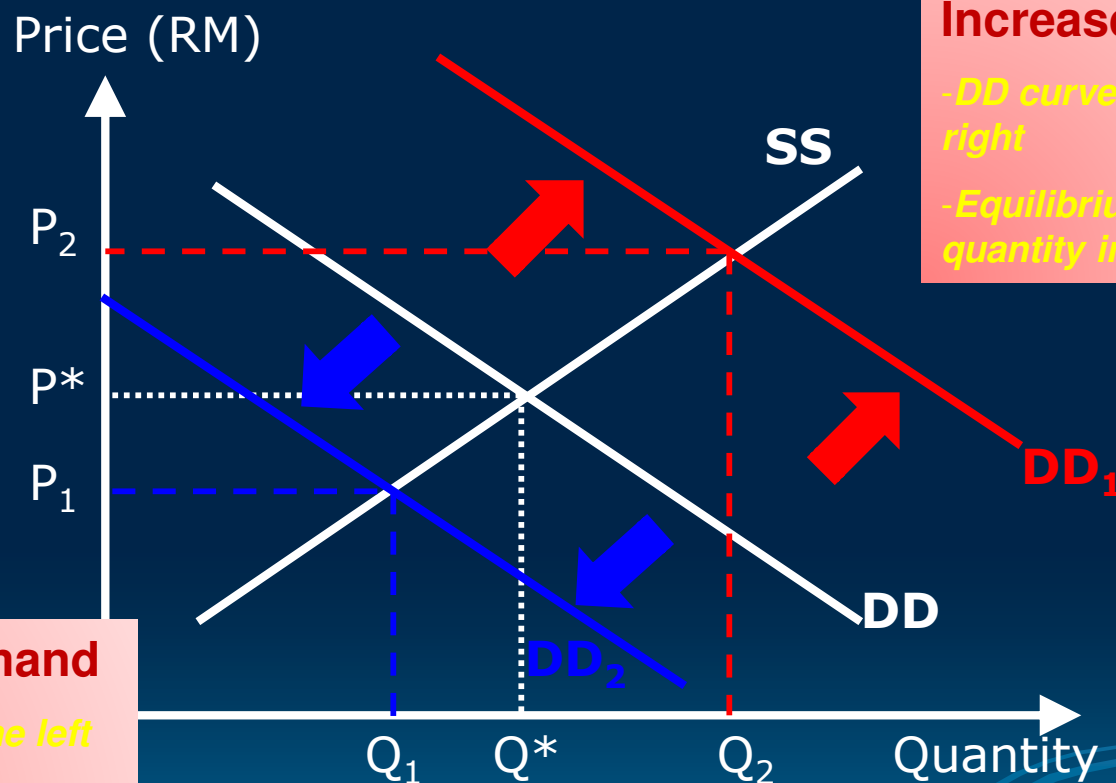


# EQUILIBRIUM PRICE AND OUTPUT

| Price | Quantity Demanded | Quantity Supplied | Market Condition | Market Prices |
|-------|-------------------|-------------------|------------------|---------------|
| 5     | 2                 | 10                | SURPLUS          | Falls         |
| 4     | 4                 | 8                 | SURPLUS          | Falls         |
| 3     | 6                 | 6                 | EQUILIBRIUM      | Equilibrium   |
| 2     | 8                 | 4                 | SHORTAGE         | Rises         |
| 1     | 10                | 2                 | SHORTAGE         | Rises         |

# CHANGES IN DEMAND

Assume supply is constant



## Increase in Demand

- DD curve shifts to the right
- Equilibrium price and quantity increase

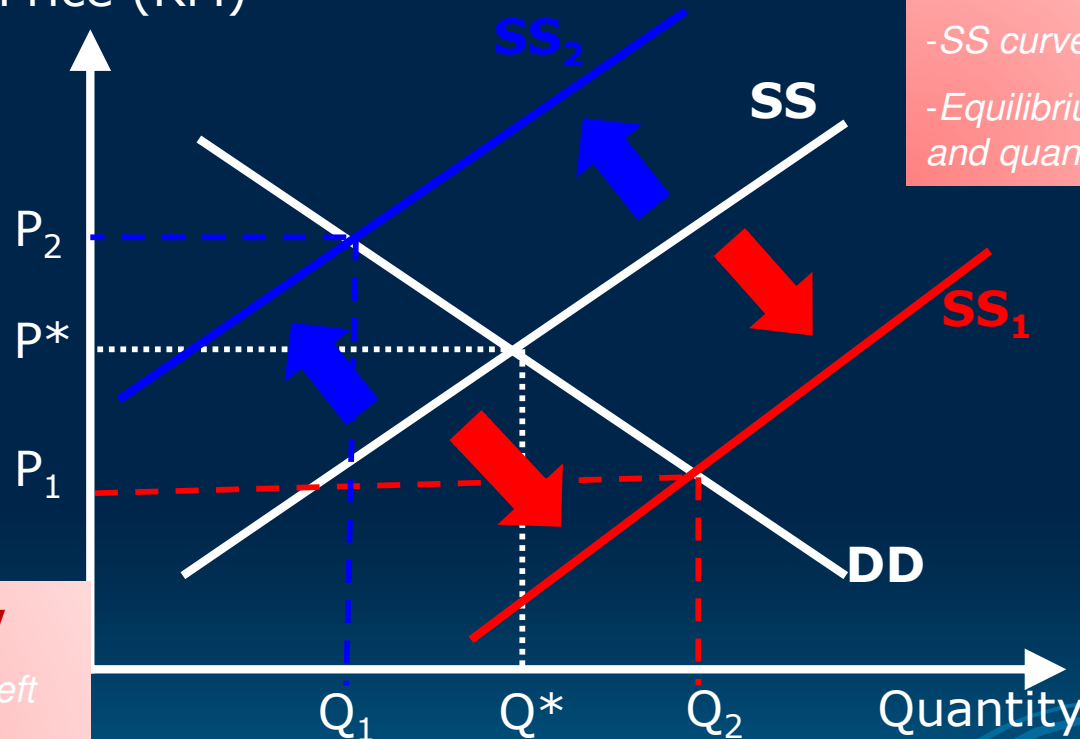
## Decrease in Demand

- DD curve shifts to the left
- Equilibrium price and quantity decrease

# CHANGES IN SUPPLY

**Assume demand is constant**

Price (RM)



## **Increase in Supply**

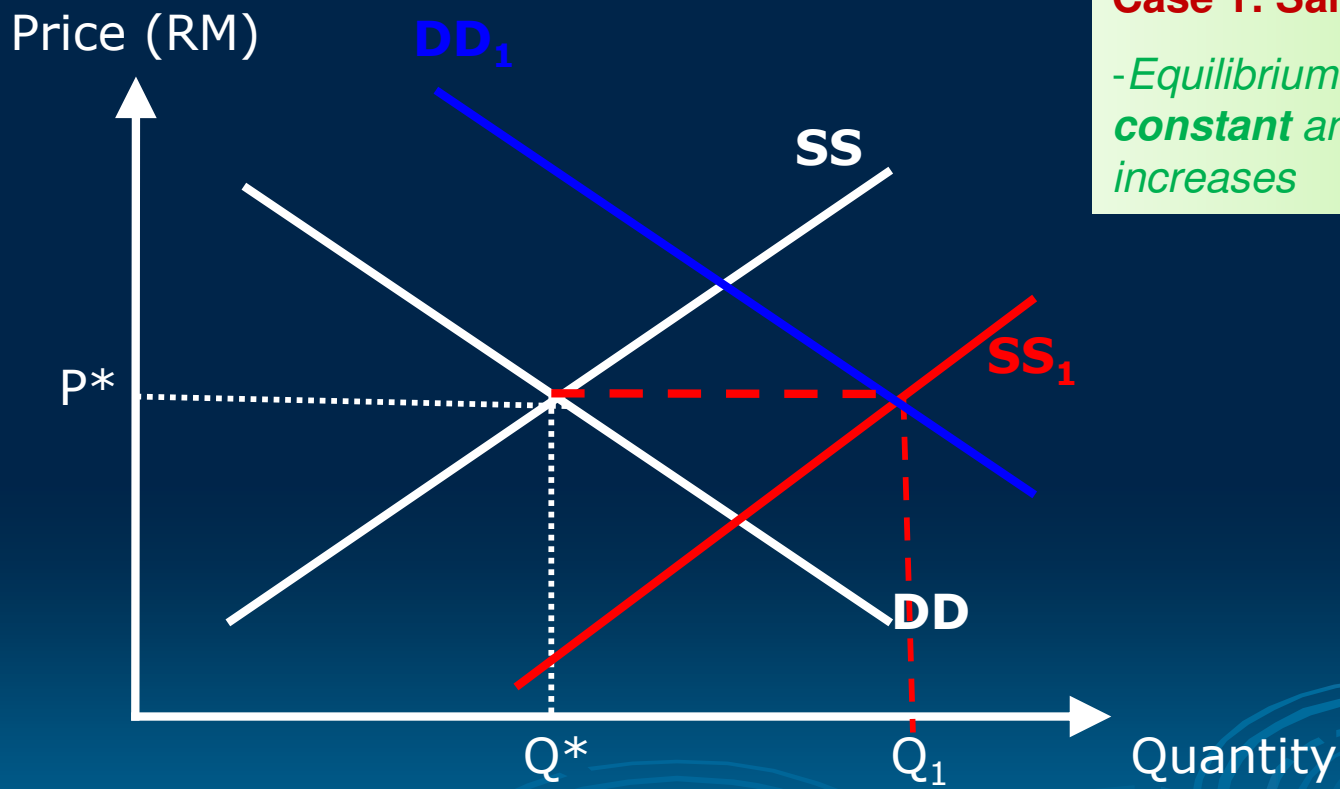
- SS curve shifts to the right
- Equilibrium price decreases and quantity increases

## **Decrease in Supply**

- SS curve shifts to the left
- Equilibrium price increases and quantity decreases

# CHANGES IN BOTH DEMAND AND SUPPLY

## SUPPLY AND DEMAND BOTH INCREASE

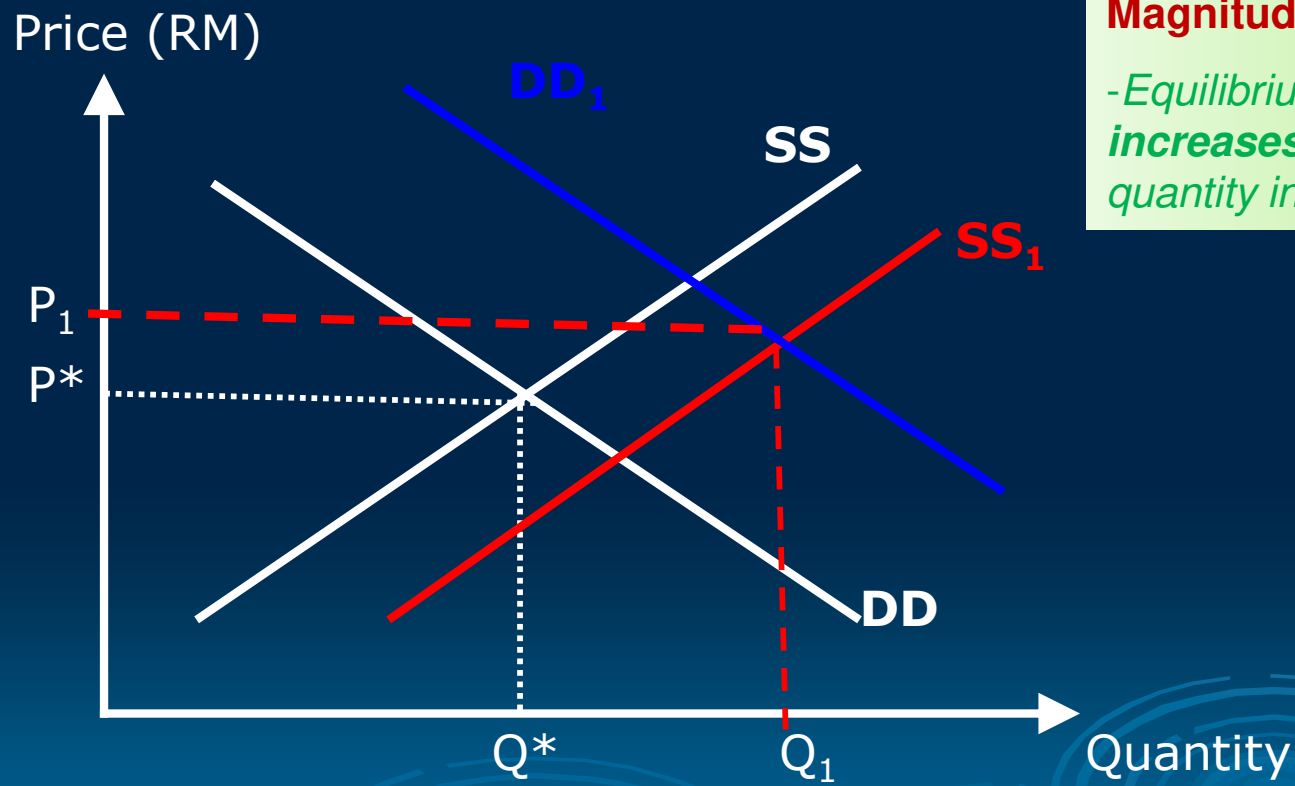


### Case 1: Same magnitude

-Equilibrium price is **constant** and quantity increases

# CHANGES IN BOTH DEMAND AND SUPPLY (cont.)

## SUPPLY AND DEMAND BOTH INCREASE



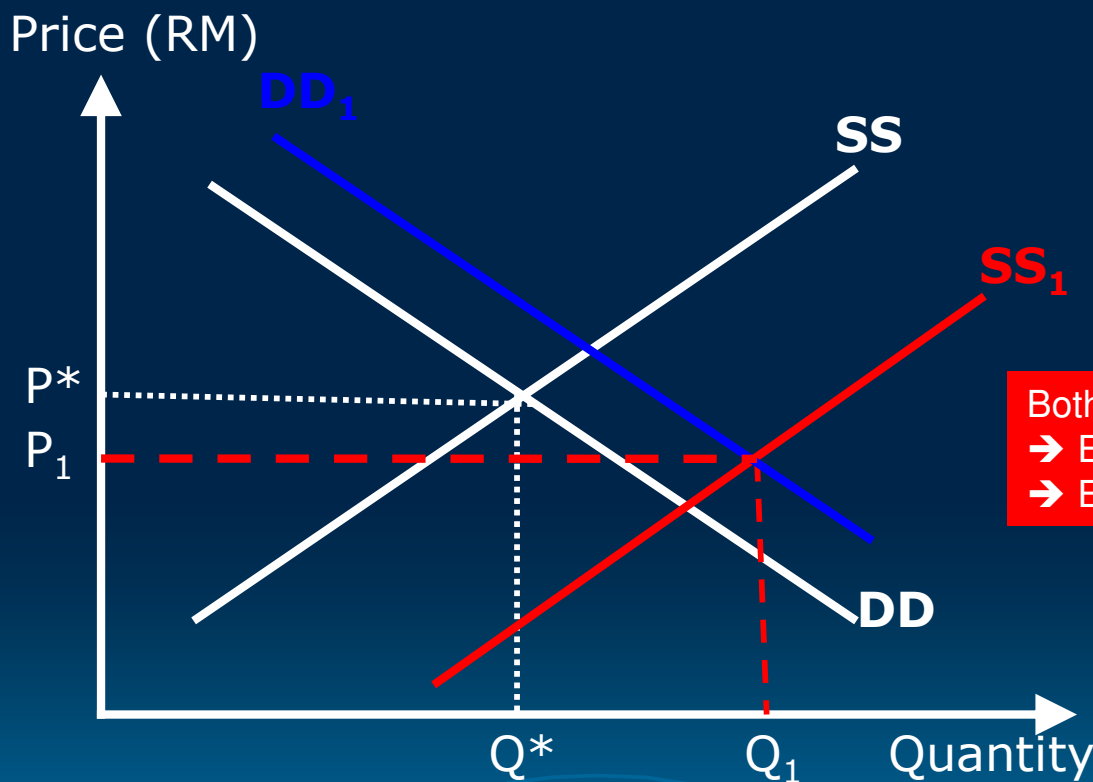
### Case 2: Different Magnitude

-Equilibrium price **increases** and quantity increases



# CHANGES IN BOTH DEMAND AND SUPPLY (cont.)

## SUPPLY AND DEMAND BOTH INCREASE



**Case 3: Different Magnitude**

-Equilibrium price **decreases** and quantity increases

Both DD and SS increase  
→ Equilibrium quantity increase  
→ Equilibrium price is uncertain

# Question Answer for Discussion

Let us now sum up the short run equilibrium condition

Consider the following market demand and supply curves in a perfectly competitive industry as  $D: q = 25 - 0.5P$  and  $S: q = 10 + 1.0P$ . Now, consider a firm in this industry whose cost function is  $C = 25 - 2Q + 4Q^2$ . Should this firm produce in the short run? If it produces then in how much quantity should it produce?

*Solution:*

The market equilibrium price is  $25 - 0.5P = 10 + 1.0P$  ( $D = S$ )

$$\Rightarrow P = 10 \text{ and } Q = 20$$

The cost function of the firm is  $C = 25 - 2q + 4q^2$

For profit maximisation  $MR = MC = P$

$$\Rightarrow MC = -2 + 8q = P$$
$$q = 1/8 (P + 2)$$

The firm will produce as long as the  $AR \geq AVC$

$$TVC = -2q + 4q^2$$
$$\Rightarrow AVC = -2 + 4q$$

AVC is a linear function and has no minimum. The firm would produce that quantity which is:  
 $q = 1/8 (P + 2) = 1/8 (10 + 2) = 1.5$  units

$$TR = 10 \cdot 1.5 = 15$$
$$TC = 25 - 2(1.5) + 4(1.5)^2$$
$$\Rightarrow TC = 31$$

There is a loss of Rs.  $31 - 15 =$  Rs. 16. This is less than the total fixed cost of Rs. 25. Therefore, the firm would produce 1.5 units and incur a loss of Rs. 16.