INTRODUCTION TO ECONOMICS

(ECON 1011)

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CHAPTER TWO

THEORY OF DEMAND AND SUPPLY

OUTLINE

- Theory of Demand
- Theory of Supply
- Market Equilibrium
- Elasticity
  - Elasticity of Demand
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- Summary

THEORY OF DEMAND

INTRODUCTION

- The words **demand, desire and want** are often interchangeably used to express what an **individual needs** and what he **would like to acquire**.
- However, in economics, the term demand has a **specific meaning**, which is **different** from what we use it in our day to day activities.
- Individuals or households may desire or wish to have goods and services that they think will satisfy their needs. However, having desire by itself **does not** necessarily mean that the person or the family may **actually possess** the items.

- This means that desire to have goods and services **alone is not enough to own** them because they are not free goods.

- In order to have the desired goods and services, an individual or households, **not only should have desires**, but should also **have the ability**, i.e., the means by which the goods and or services can be obtained.

In economics, a desire for goods and services backed by the ability and willingness to buy those goods and services in a given period of time is generally referred to as D e m a n d .

- Hence, when economists talk about demand, they **are not referring** to the wish, desire, want or need of an individual or a household to have a good or service.

Demand indicates different amount of a given commodity which an individual buyer is willing and able to buy at various prices during a given period of time, given other things remain unchanged (ceteris paribus).

- From the definition of demand, we can understand that:

- **The consumer is willing to have that product.**
- However, having a wish alone is not enough to talk about demand.
- **The consumer should have the ability to buy the product.**
- Willingness without ability to buy a product is a **mere wish**; it cannot be realized. In short, his/her desire should be backed by his/her **purchasing power.** In other words, if the consumer is willing to buy but is not able to pay, his/her desire will **not become demand**.
- Similarly, if the consumer has the ability to pay but is not willing to pay, his/her **desire will not be called demand.**

- **Demand is time specific.**

- This is because the quantity of a product that buyers are willing and able to buy **varies with time.**

- We may say demand refers to an **effective desire**. A desire becomes an **'effective desire'** or **demand** only when it is backed by the following three factors: ability to pay for the good desired, willingness to pay the price of the good desired, and availability of the good itself.

Demand vs. Quantity Demand

- Note that quantity demand and demand are two different concepts.

Quantity Demand:

- Refers to a specific quantity of the commodity that a consumer is willing and able to buy at a **specific price level**.

Demand:

- Refers to the **whole relationship** between various possible price of a product and the corresponding quantities demanded for the product., keeping other things remain unchanged.

Demand Schedule, Curve and Function

- If demand refers to the relationship that exists between price of a product and the amount of a commodity purchased(quantity demanded) then it can be represented by: a **Table, Graph or Equation**.

1. **Demand Schedule:** is a table or a tabular statement that shows the relationship between the various price of a product and the corresponding different quantities of a commodity demanded.

- Demand schedules are of two types:
  - **i. Individual demand schedule**
  - **ii. Market demand schedule**

i. Individual Demand Schedule is a tabular statement which shows the quantity of a commodity demanded by an **individual household** at various alternate prices per time period.

Table 2.1: Individual Demand Schedule

Price (Per kg)	Quantity Demanded
10	4
15	3
22	1

ii. Market Demand Schedule is a tabular statement which shows the different quantities of a commodity demanded by **different households** or **consumers** in a market at various alternate prices per time period.

Table 2.2: Market Demand Schedule

Price (Per kg)	X`s Demand	Y`s Demand	Market Demand (X+Y)
10	4	6	10
15	3	4	7
22	1	2	3

- From the above two tables, we noticed that as price continues to fall, the respective quantity demand increases, and as price increases, quantity demand decreases. This means that when the price of a product decrease, consumers buy more, and when price increases they buy less, assuming all other determinants of demand are kept constant.

- Such an inverse or negative relationship between price and quantity demand, holding other things remain constant, is called **the law of demand**.

The Law of Demand states that, other things being equal, as price of a product increase, quantity demand decreases, and as price decreases quantity demand increases. In short this law states that there is **an inverse relationship** between the price of a commodity and its quantity demand.

Note:.

- Law of demand depends on the basic assumption of **other things being equal (ceteris paribus)**. By other things we mean factors other than price which affect the demand for a commodity.
- For the law to **operate correctly**, there should be no change in any of these determinants. We may summarize the assumptions of the law of demand as follows:
  - There should be no change in prices of related goods
  - Tastes and preferences of the consumer should remain constant
  - There should be no change in the income of the consumers
  - The size of the population should remain constant
  - Distribution of income and wealth should be equal
  - There should be perfect competition in the market.

2. Demand Curve is a graphical representation of the relationship between different quantities of a commodity demanded by an individual at different prices per time period.

- Demand curves also are of two types
  - i. Individual demand curve
  - ii. Market demand curve

i. Individual Demand Curve: refers to the curve which expresses graphically the relationship between different quantities of a commodity demanded by **an individual** at different prices per time period.

- The negative slope of the demand curve reflects **the law of demand**.

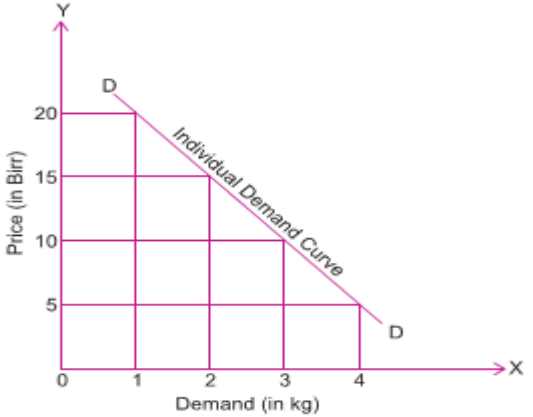


Figure 2.1: Individual Demand curve

ii. Market Demand Curve: refers to the curve which express graphically the relationship between different quantities of a commodity demanded by **different households** or consumers **at different prices** per time period. It shows the demand of a whole market for a commodity.

- The market demand curve below is obtained by **horizontally summing** individual demands curves. It expresses the relationship between different quantities of a commodity demanded by X and Y at different prices.

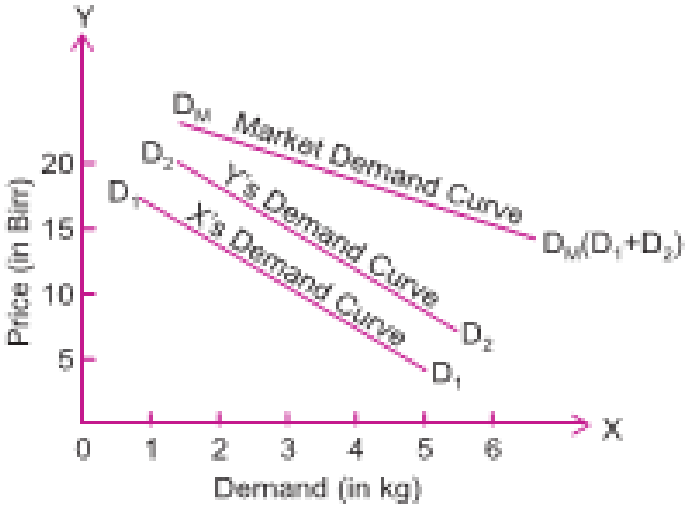


Figure 2.2: Individual and Market Demand Curves

Note: Demand curve normally **slopes downwards** to the right. It is also known as the **negative slope** of the demand curve, indicating an inverse relationship between the price of the commodity and its quantity demand.

3. Demand Function: is a mathematical equation that expressed relationship between price and quantity demanded, keep all other things remaining the same. **It is defined as:**

$$Q = f(P)$$

- The demand function gives quantity demanded as a negative function of price. The most widely used functional form is a **linear demand curve**, which is given as:

$$Q = a - bP$$

- What do you think is the slope of this demand function?

Ok. It is '$-b$'.

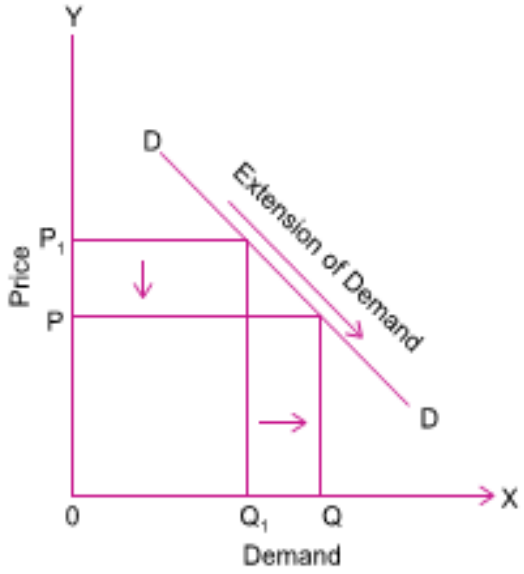
Movement along vs. Shift in the Demand Curve

- **Movement along a Demand Curve:** or **Change in Quantity Demand** refers to that change in the quantity demanded of a product because of changes in the prices of that product while other factors affecting demand remaining the same (unchanged).

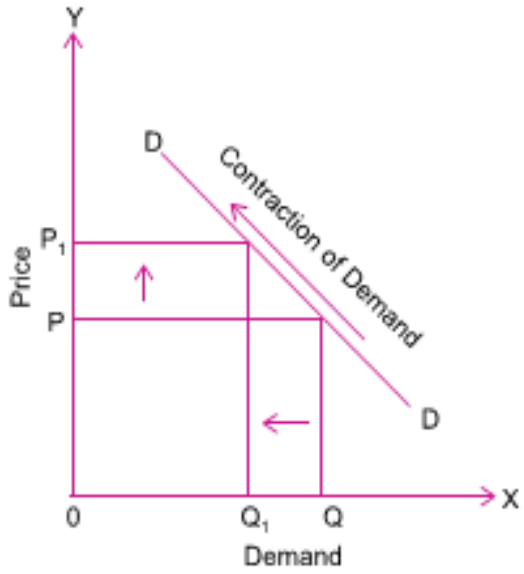
- In short, **Movement along a Demand Curve** shows change in quantity demanded occurs due to change only in the price of the commodity itself.

- The consumer buys larger quantities at lower prices and lower quantities at higher prices. Therefore, such movements take the consumer from one point on the demand curve to another point on the **same demand curve**.

- Here the movement is either **upward or downward** - along the same demand curve. **Downward movement** along the demand curve is called **extension of demand**, while the **upward movement** as **contraction of demand.**



Extension of demand



Contraction of demand

Figure 2.3: Movement along the Demand Curve

♠ Shift in the Demand Curve or Change in Demand:

- The demand curve is drawn on the assumption that other things remain the same. If, however, the factors assumed constant changes, their effect would be **shifting the demand curve**.

- In other words, **Shift in the Demand Curve** refers a change in the demand schedule or a shift of the entire demand curve due to a changes in one or more of the factors that affect demand **except the price of own good**.

- In this situation, there is an either **rightward shift** **or** **leftward shift** in the demand curve itself.

- **Increase in demand** is shown by outward shift (**rightward shift**) of the demand curve, whereas inward shift (**leftward shift**) of the demand curve represents **decrease in demand**.

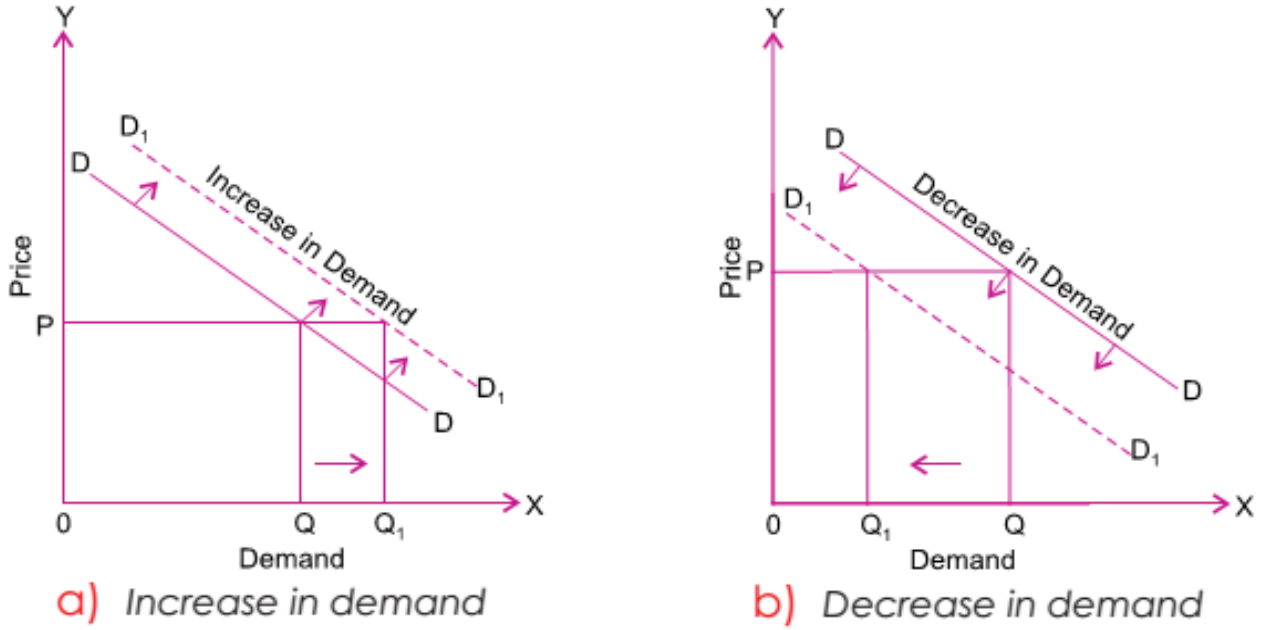


Figure 2.4: Shift of the Demand Curve

Determinants of Demand

- The demand for a commodity is determined or influenced by a number of factors. Some of these important factors are the following:
  - **Own price of the product**
  - Taste or preference of consumers
  - Income of the consumers
  - Price of related goods
  - Consumers expectation of income and price
  - Number of buyers in the market
  - Climatic Condition

Remember: A change in any of the above listed factors except the price of the good will **change the demand**, while a change in the price, other factors remain constant will bring **change in quantity demanded**.

- In short, other things remaining the same, if price increases, quantity demanded decreases, and if price decreases, quantity demanded increases.

- For this reason the first determinant, **price of the product**, is known as **own-price determinant of demand**. The remaining determinants i.e., those factors listed above other than price are called **demand shifters** or **non-own price determinants of demand**.

- Now let us examine how each of these factor affect demand.

Effects of Non-Own Price Determinants of Demand

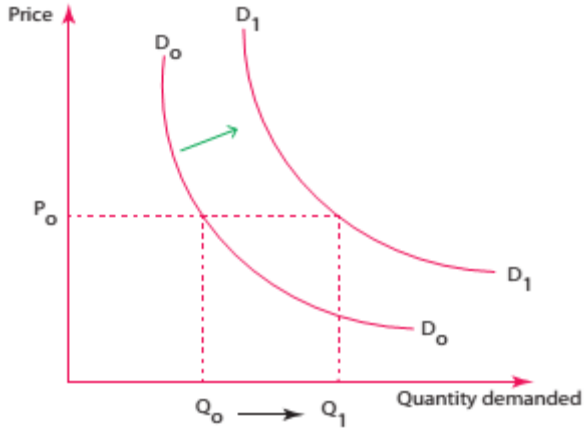
i. Effects of Change in Taste and Preference

- When the taste of a consumer changes **in favor of a good**, her/his demand will increase, and the opposite is true. The amount demanded of a commodity depends on **consumer tastes and preferences**.
- If a consumer has a good tastes or preference for a to certain commodities, then he will demand that commodity and this leads to increase in the demand for that commodity.
- **Example**: If wearing jeans becomes the fashion of the day, then consumers tends to buy more jeans than before at the ongoing price and vice versa.

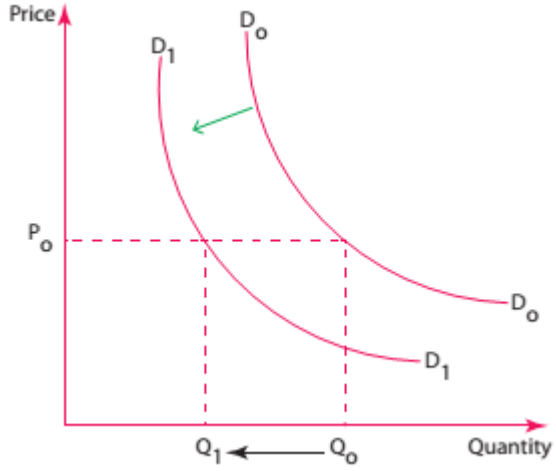
ii. Effects of Change in Income

- The effect of a change in income of a consumer on demand for a commodity **depends on the nature of the product**.
- Goods are classified into two categories depending on how a change in income affects their demand. These are **normal and inferior goods.**
- **Normal Goods:** are goods whose demand increases as income increase, and decrease as income decreases. While **Inferior Goods** are those goods whose demand is inversely related with income.
- Inferior goods include Bus rides, Shiro wot, Moga(Berebarso) shoe, etc.

- In general, inferior goods are **poor quality goods** with relatively **lower price,** and buyers of such goods are expected to shift to better quality goods as their income increases. However, the classification of goods into normal and inferior **is subjective** and it is usually dependent on the **socio-economic development of the nation.**



Demand curve for Normal Goods



Demand curve for Inferior Goods

Figure 2.5 Effects of change in income on goods

iii. Effects of Change in Prices of Related Goods:

- Changes in the prices of related goods also affect the demand for a commodity. Two goods are said to be **related goods** if a change in the price of one good affects the demand for another good.
- There are two types of related goods: **Substitute and Complimentary**.

A. Substitute Goods:

- Substitute goods are those goods which can be **used in place of each other** to satisfy a given want. In other words, two goods are said to be substitute when they are **alternative to each other**.
- That is why they are also called **Competitive goods.**

- If the price of Coca Cola increases consumers will shift from the consumption of Coca Cola to Pepsi Cola. This implies increase in the price of Coca Cola results in the increase of the demand for Pepsi Cola.

- **In general, if two goods are substitutes, then price of one good and the demand for the other are directly related.**

B. Complementary Goods:

- Complementary goods are those goods which are **used together** to satisfy a given want. In other words, Complimentary goods, are those goods which are **jointly consumed.** For example, Sugar and Coffee, Cars and Petrol, pen and ink are complements of each other. They all are consumed together.

- Thus, if the **price of car increases**, its quantity demand will decrease, and this will lead to a **decrease in the demand** for petrol and vice-versa. The inverse is true for decrease in the price of sugar.

- **In general if two goods are complements, then price of one good and the demand for the other are inversely related.**

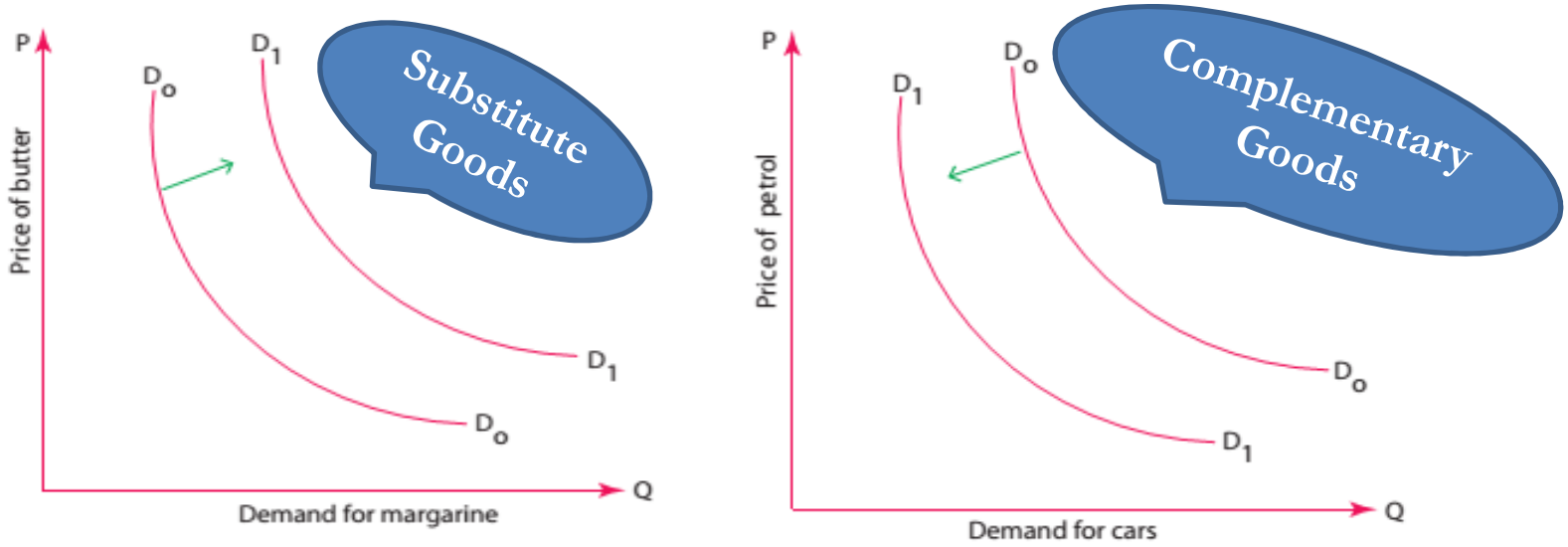


Figure 2.6 Effects of Change in Price of Related Goods

iv. Effects of change in consumer expectation of income and price

- Consumers expectation about future income and price of a product will have an impact on current demand for the product.
- **Consumers expectation about future income** affect current demand for a product. But its impact would depend upon the **nature of the product**.
- If consumers expect their **income to increase in the future**, they would **increase their current consumption** of a normal good through current borrowing and **decrease for an inferior good**.
- On the other hand, if they expect income to **decrease in the future** they will reduce current consumption for normal goods and increase for inferior.

- The same is true for price i.e., if there is an **expectation of increase in the price** of a commodity in the near future, consumers will start demanding more of it today so as to avoid unnecessary expenditure in the future.

- This causes an increase in current demand for the product, and **shifts demand curve to the right.** Contrary to that, if the price of that commodity is likely to fall in near future, consumers will start demanding less of that commodity today, and **demand curve shifts to the left.**

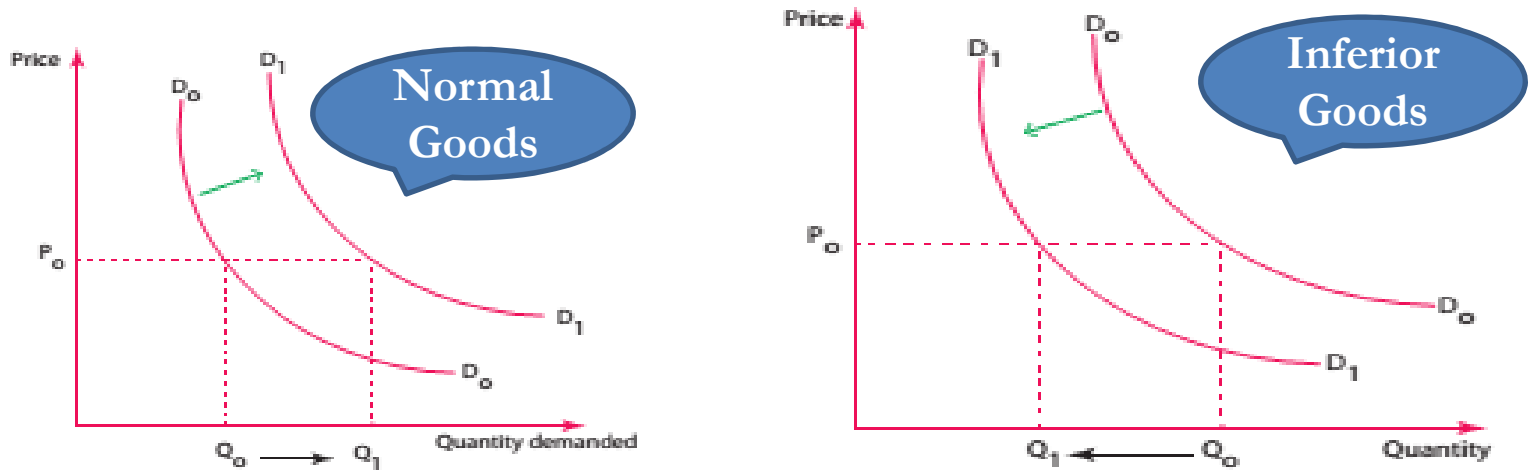


Figure 2.7 Effects of higher income expectation on normal and inferior goods

v. Number of Buyers in the Market

- Since market demand is the horizontal sum of individual demand, an increase in the number of buyers will increase demand, while a decrease in the number of buyers will decrease demand.

vi. Climatic Condition:

- The demand for a commodity is also affected by climate.
- For example, demand for woolen clothes increases in cold seasons. On the other hand, demand for coolers, cotton clothes etc., increases in hot seasons. Thereby shift the demand curve to the right.

THEORY OF SUPPLY

- Just like 'demand', the term 'supply' has its own specific meaning.
- In economics we define supply as follows:

Supply refers to various quantities of a commodity that producers or seller are willing and able to offer/provide for sale at different prices in a given period of time, other things remaining unchanged.

- Like demand, supply refers **not only** to the **willingness** of sellers to provide goods or services but also **the ability to do so**. It should also be time specific because supply of a product per day is different from time to time.

Supply vs. Quantity Supply

- Note that quantity supply and supply are two different concepts.

Quantity Supply

- Quantity supply refers to a specific quantity of goods and services that a supplier or a producer is willing and able to sell at **a specific price**.

Supply

- Supply refers to the **whole relationship** between possible prices of a product and the corresponding quantity supplied.
- If supply refers to the relationship between price of a product and the quantities supplied, then it can be presented in the form of a **table, graph or mathematical equation.**

Supply Schedule, Curve and Function

1. **Supply Schedule:** is a tabular representation of the relationship between the various prices of a product and the corresponding quantities supplied, other things remain unchanged.

- Supply schedules are of two types:

  i Individual supply schedule.

  ii Market supply schedule

i. **Individual Supply Schedule:** is a tabular statement which shows the different quantities of a commodity offered for sale by **an individual firm** at different prices per time period.

Table 2.3: Individual supply schedule

Price (Per kg)	Quantity Supplied
5	15
8	20
12	28

- The above supply schedule shows different quantities of a commodity supplied by **an individual firm** at different prices.

ii. **Market Supply Schedules:** is derived by horizontally adding the quantity supplied of the product **by all sellers** at each price.

Table 2.4 Market Supply Schedule

Price (per kg)	Supply of Firm (X)	Supply of Firm (Y)	Market Supply (X+Y)
5	15	12	27
8	20	18	38
12	28	25	53

- The above market supply schedule or table shows the different quantities of a commodity supplied by different firms at different prices.

2. Supply Curve

- A supply curve conveys the same information as a supply schedule.
- But it is a **graphical representation** of a supply schedule showing the quantity supplied at various prices, ceteris paribus.
- Supply curves also are of two types:

  i Individual supply curve

  ii Market supply curve

I. **Individual Supply Curve**: refers to the curve which expresses graphically the relationship between different quantities of a commodity supplied by an **individual firm** at different prices per time period.

- The supply curve **slopes upward** as we go from the **left to the right**. This means, as the price rises, more is offered for sale and vice-versa.

II. Market(Industry) Supply Curve: is obtained by horizontally summing individual supplies at market price. The market supply is the **horizontal summation** of individual supply curves.

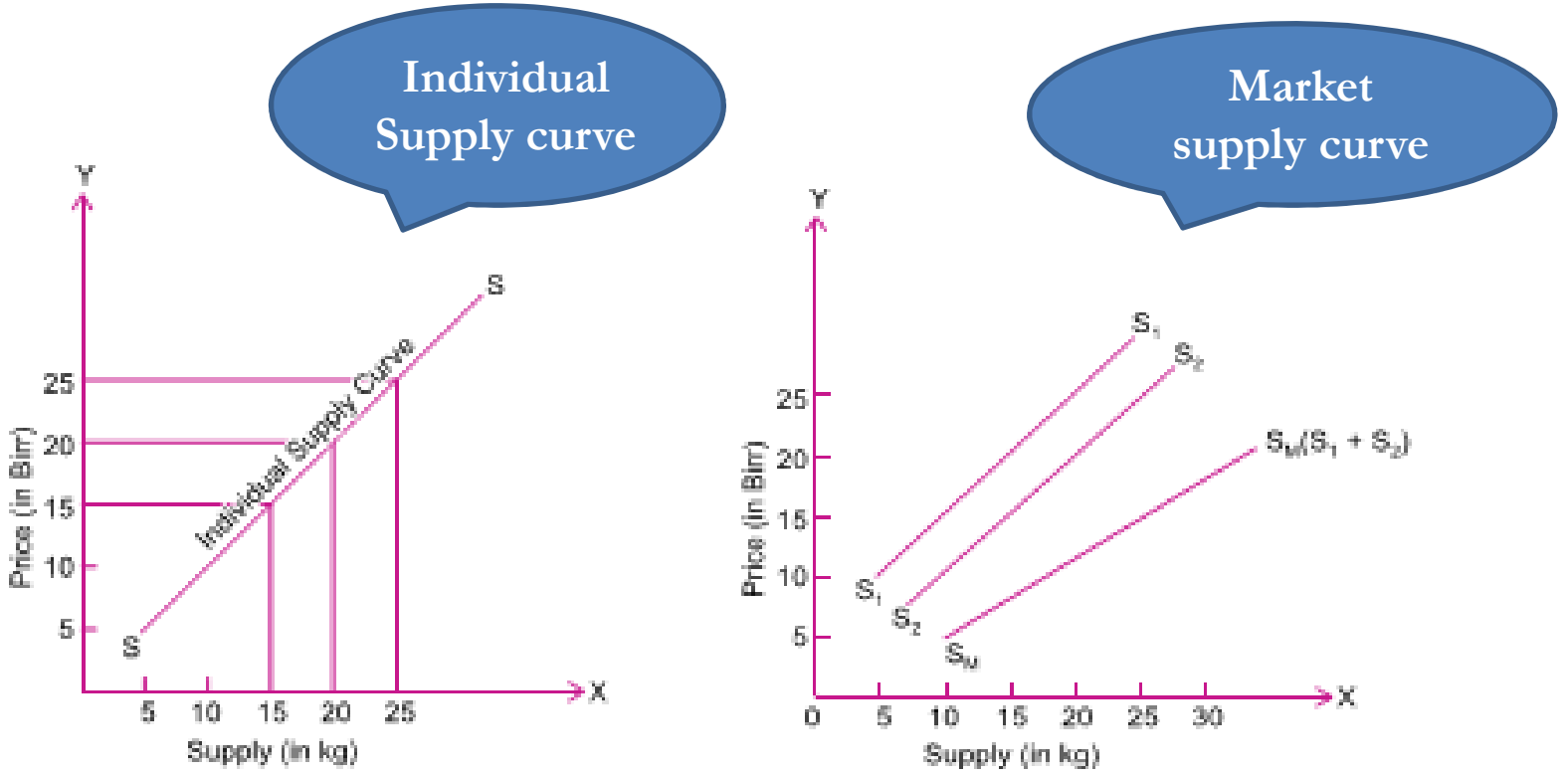


Figure 2.8: Individual and Market supply curve

3. Supply Function

- Supply function shows the **functional relationship** between price and quantity supplied, ceteris paribus. It is generally defined as:

$$Q = f(P)$$

- The most widely used functional form is the linear supply curve, is given as:

$$Q = c + dP$$

- The slope of the supply function is "***d***".

The Law of Supply: states that there is a direct relationship between the price of a commodity and its quantity supply.

In other words, this law states that, other things being equal, as price of a product increase, quantity supply of a product increases, and as price decrease, quantity supply also decrease.

- A supply curve normally **slopes upwards** to the right. It is also known as the **positive slope of the supply curve**, indicating a direct relationship between the price of the commodity and its supply.

- For the law, to operate there should be no change in any of other factors.
- **We may summarize the assumptions of the law of supply as follows:**
  - There should be no change in the prices of related goods
  - There should be no change in the prices of factors of production
  - There should be no change in the goals of the firm
  - There should be no change in the state of technology
  - The income of the buyers and sellers should remain constant.

Movement along Vs. Shifts in the Supply Curve

♠ Movement along a Supply Curve (change in quantity supplied):

- A change in quantity supplied resulting from change in the price of the product is represented as a **movement along the same supply curve**. Graphically, it is shown by movement from one point to another point on the same supply curve.

- In this case, we move along the same supply curve either **upwards or downwards.** The **upward movement** along the supply curve is **extension of supply** (that is, more quantity supplied at a higher prices).

- Whereas the **downward movement** is **contraction of supply** (that is, less quantity supplied at a lower prices).

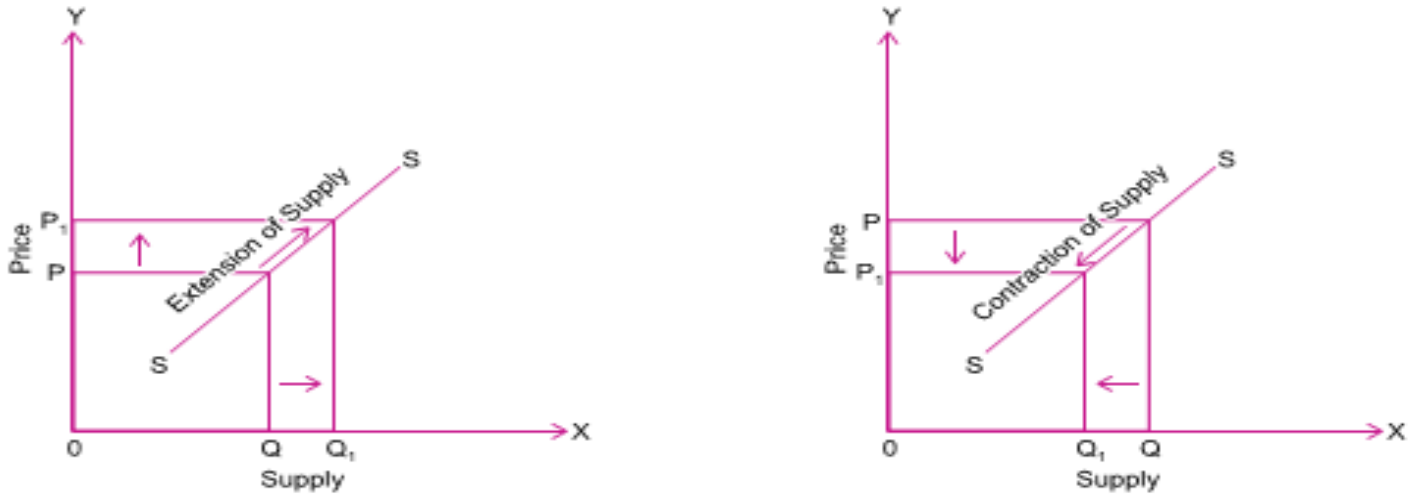


Figure 2.9 Movement along the supply curve

♠ Shift in the Supply Curve (Change in Supply):

- In this situation, the entire supply curve itself shifts to a new location either to right or to the left. **Rightward shift** of supply curve indicates **increase in supply**, while **leftward shift** indicates **decrease** in supply.

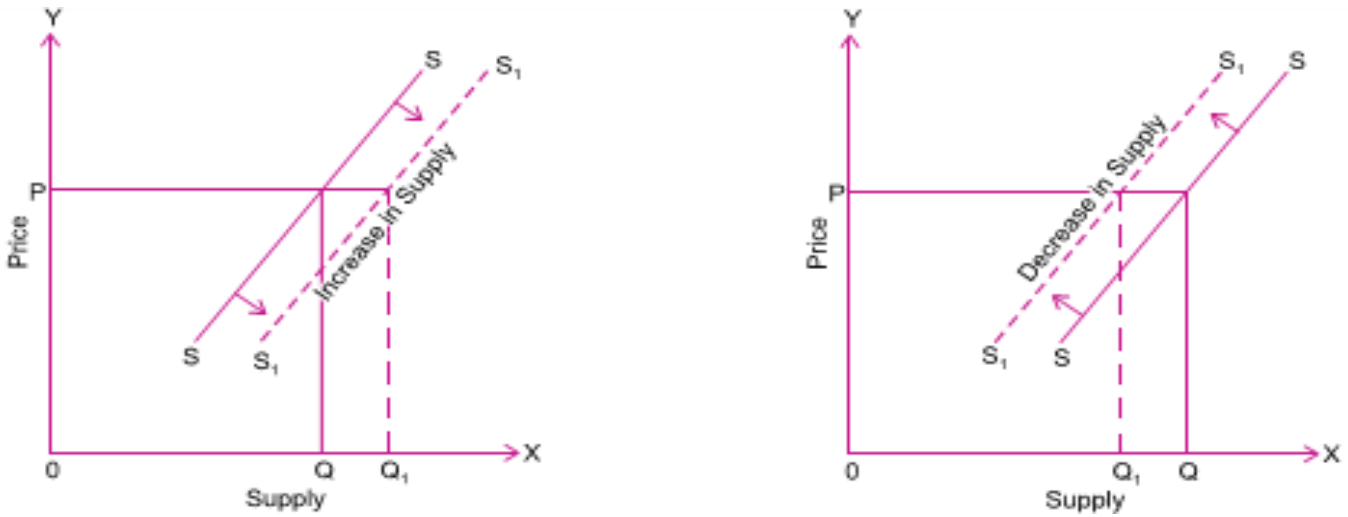


Figure 2.10 Shift in the Supply Curve

- **Generally**, movement along the supply curve is caused by a **change in the commodity's own price**. In this situation, supply curve remains the same. On the other hand, a shift in the supply curve is caused by a **change in something other than the commodity's own price.**

Determinants of Supply

- Supply of a commodity is determined by a number of factors.
- Some of these important factors are the following:
  - **Own Price of the Commodity**
  - Price of inputs (cost of production)
  - Technology
  - Prices of related goods
  - Sellers expectation of price of the product
  - Taxes & Subsidies
  - Number of sellers in the market
  - Weather, etc.

Effects of Non-Own Price Determinants of Supply

- The first determinant, **own price of the product**, is known as **own-price determinant of supply**. The remaining determinants i.e., those factors listed above other than price are called **supply-shifters** or **non-own price determinants of supply**.

i. Effect of Change in Input Price:

- An increase in the prices of factors of production leads to **an increase in the cost of production.** This causes a decrease in the supply of the product which is represented by a leftward shift of the supply curve.
- Likewise, a decrease in input price causes an increase in supply.

ii. Effect of Change in Technology:

- Technological advancement leads to **fall in the cost of production**, enables a firm to produce and supply more in the market. This shifts the supply curve outward. On the other hand, supply of those commodities will be less whose production depends on **old technology**.

iii. Effects of Change in Price of Related Goods:

- An increase in the price of other related goods induces the firms to produce **more of those other goods**, leading to a **reduction in the supply** of the goods whose price has remained unchanged. For example: an increase in price of leather shoe may reduce the supply of leather jacket.

iv. Expected Price of the Product

- A change in sellers expectation of a price of a product will have an impact on the current willingness of sellers to supply the product. For example if **expected price of a given commodity increase** in the near future, then its **current supply will decrease**. This shifts supply curve to the left.

v. Effect of Change in Weather Condition

- A change in weather condition will have an impact on the supply of a number of products, especially agricultural products.

- For example, other things remain unchanged, **good weather condition boosts the supply** of agricultural products. This shifts the supply curve of a given agricultural product **outward.** On the other hand, bad weather condition will have the opposite impact.

vi. Effects of Change in Number of Sellers

- A change in the number of suppliers similarly will have a predictable effect on supply. An increase in the number of sellers will cause increase in total supply of commodities, and hence, the supply curve to shift to the right.
- Supply curve shifts inward if the number of sellers decreased.

vii. Effects of Change in Taxes and Subsidies

- **Taxes** may have an effect of increasing cost of production. An increase in certain types of taxes increase the cost of production. As a result **supply decreases.** A decrease in tax, on the other hand, increases supply.
- If government provide financial support(**Subsidy**) to producers then subsidy causes supply to rise, and the supply curve to **shift outward.**

MARKET EQUILIBRIUM

- The word "**equilibrium**" means a **state of balance**.
- In a free market system, output price as well as the level of output in a market are determined by the **forces of demand and supply**.

In the context of price determination, **Equilibrium** refers to a situation in which the market demand for a commodity **equal** to its market supply. In short, the balance between opposite forces of market demand and market supply is termed as **Market Equilibrium.**

- **Equilibrium Price**: is the price at which the market demand for a given commodity equals market supply. At this price level, there is neither **shortage** **nor** **surplus**.

- Since there is neither shortage nor surplus at this price level, the equilibrium price is also known as **Market Clearing Price**.

2. Equilibrium Quantity

- The quantity or amount that is actually bought and sold at equilibrium price is called the '**equilibrium quantity'.** The table below shows the imaginary market's demand and supply schedule of oranges at different prices.

Table 2.5: Market Demand and Supply Schedule of Oranges

Price (Birr per kg)	Demand (kg)	Supply (kg)	Trend
25	200	1000	Excess supply
20	400	800	Excess supply
15	600	600	Equilibrium
10	800	400	Excess demand
5	1000	200	Excess demand

- In the above schedule there is one price at which market demand is equal to market supply. This price is Birr **15 per kg** and equilibrium quantity is **600.**

Graphical Presentation of Market Equilibrium

- Determination of equilibrium price and equilibrium quantity can also be illustrated graphically with the help of a market demand curve and market supply curve.

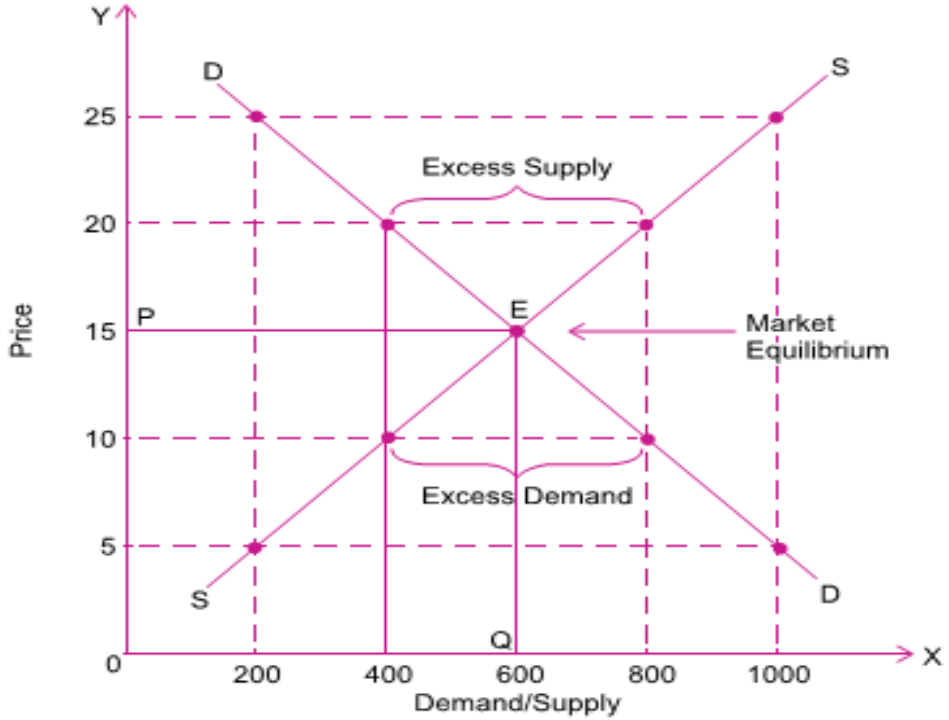


Figure 2.11 Market equilibrium

Note: The excess of supply over demand is called **Surplus.**

The excess of demand over supply is called **Shortage.**

Note the following:

1. Any price above the equilibrium price causes **surplus.**
2. Any price below the equilibrium price causes **shortage.**
3. Whenever market demand is greater than market supply, there will be **shortage,** and whenever market supply is greater than market demand, there will be **surplus** in the market.

Mathematical Analysis of Market Equilibrium

- The equilibrium price and equilibrium quantity of a product can also be determined mathematically.

Example 1: Let there be 5000 identical buyers of a commodity X in a market with an individual demand function of $D_X = 8 - P_X$, and 1000 identical sellers of commodity X with an individual supply function of $S_X = 20\ P_X$, where D_X is quantity demanded, S_X is quantity supplied and P_X is price of the commodity X. For calculating the equilibrium price and equilibrium quantity, we formulate the market demand and market supply functions for the commodity X.

Solution:

Market demand function = Number of buyers × Individual demand function

$$= 5{,}000 \times (8 - P_X) = 40{,}000 - 5{,}000\ P_X$$

Market supply function = Number of sellers × Individual supply function

$$= 1000 \times 20\ P_X = 20{,}000\ P_X$$

On equating the two market functions, we get:

$$40{,}000 - 5{,}000\ P_X = 20{,}000\ P_X \text{ or } 25{,}000\ P_X = 40{,}000$$

$$\therefore\ P_X = \frac{40{,}000}{25{,}000} = 1.6$$

Hence, equilibrium price of commodity X is Birr 1.6. On substituting the value of P_X in either of the two functions, say market demand function, we get:

Equilibrium quantity $= 40{,}000 - 5{,}000\ P_X$

$$= 40{,}000 - 5{,}000 \times 1.6 = 40{,}000 - 8{,}000 = 32{,}000 \text{ units}$$

Note:

We will get the same value for the of equilibrium quantity if we substitute the value of P_X in market supply function.

Numerical example: Given market demand: $Q_d = 100-2P$, and market supply: $P = (Q_s/2) + 10$

a) Calculate the market equilibrium price and quantity

b) Determine, whether there is surplus or shortage at P= 25 and P= 35.

Solution:

a) At equilibrium, $Q_d = Q_s$

$$100 - 2P = 2P - 20$$

$$4P = 120$$

$$\overline{P} = 30, \text{ and } \overline{Q} = 40$$

b) $Q_d(\text{at } P = 25) = 100\text{-}2(25) = 50$ and $Q_s(\text{at } P = 25) = 2(25) - 20 = 30$

Therefore, there is a shortage of: 50 -30 = **20 units**

Q_d(at P=35) = 100-2(35) = 30 and Q_s (at p = 35) = 2(35)-20 = 50, a surplus of **20 units**

Effects of Change in Demand and Supply on Equilibrium

- Given demand and supply the equilibrium price and quantity are **stable.** However, when one or more determinants of demand and supply changes what will happen to the equilibrium price and quantity?

- **Changes in demand and supply bring about changes in the equilibrium price level and equilibrium quantity.**

- Now let`s see the effect of change in demand, supply or both on equilibrium price and quantity for the following conditions.

  A. When demand changes while supply remains constant

  B. When supply changes while demand remain constant

  C. When both demand and supply changes

A. When Demand Changes while Supply remains Constant

There can be two situations of change in demand.

i. Effect of Increase in Demand:

- Under the conditions of stable supply curve, if there is **increase in demand** (that is, a rightward shift of the demand curve), **both equilibrium price and equilibrium quantity increase.**

- When demand curve shifts to the right **(DD to D_1D_1)**, the equilibrium price (**OP to OP_1**) and equilibrium quantity **(OM to OM_1)** both increase. That means, consumers are now demanding larger quantities of the good at every price than before (See the figure 2.12 below).

ii. Effect of Decrease in Demand:

- Under the conditions of stable supply curve, if there is **decrease in demand** (i.e., a leftward shift of the demand curve), both the **equilibrium price and equilibrium quantity decreases.** When demand curve shifts to the left **(DD to D_1D_1),** both the equilibrium price **(OP to OP_1)** and equilibrium quantity **(OM to OM_1)** decrease.

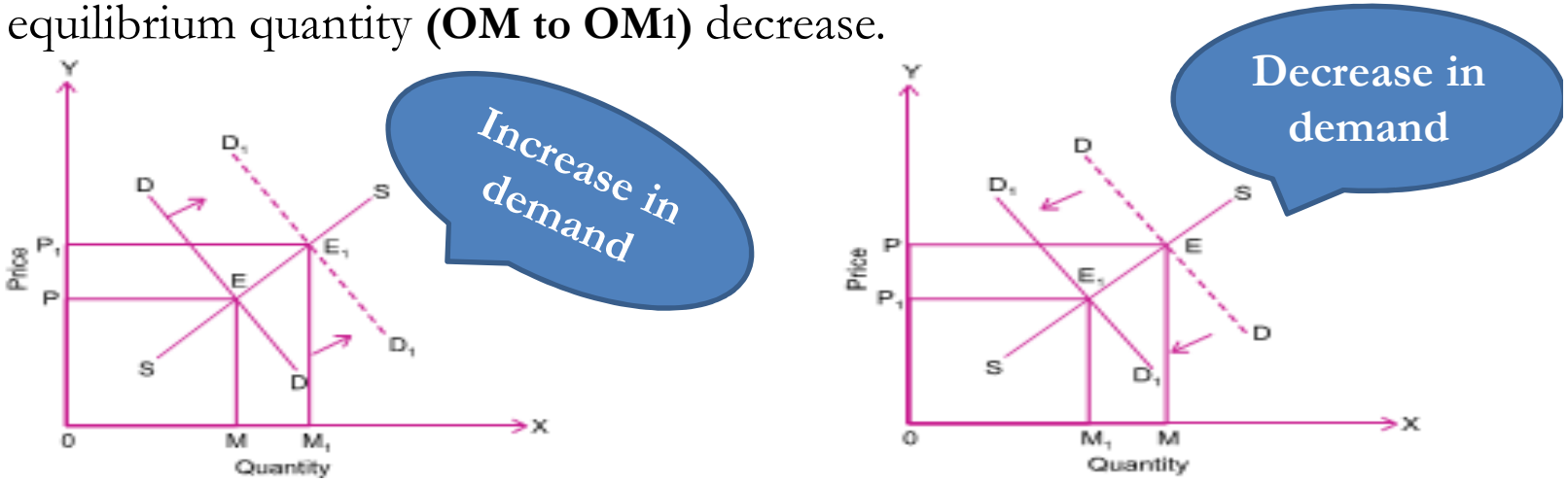


Figure 2.12: Effect of change in demand

In short, the relationship between the change in demand and the resulting change in equilibrium price and quantity is direct.

B. When Supply Changes while Demand remains Constant

i. Effect of Increase in Supply:

- Under the conditions of stable demand curve, if there is **increase in supply** (that is, a rightward shift of the supply curve), **equilibrium price decreases and equilibrium quantity increases.**
- When supply curve shifts to the right, price falls **(OP to OP1)** but equilibrium quantity increases **(OM to OM1)**, as shown in Figure 2.13.

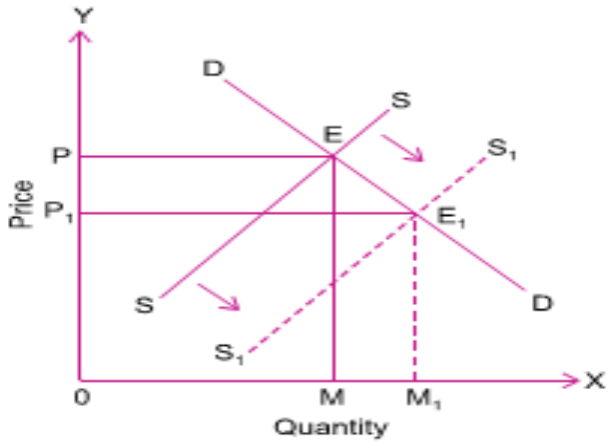


Figure 2.13: Effect of increase in supply

ii. Effect of Decrease in Supply:

- Under the conditions of stable demand curve, if there is a decrease in supply (that is, a leftward shift to the supply curve), **equilibrium price increases and equilibrium quantity decreases.**
- When supply curve shifts to the left price rises **(OP to OP1)** but equilibrium quantity decreases **(OM to OM1),** as shown in Figure 2.14.

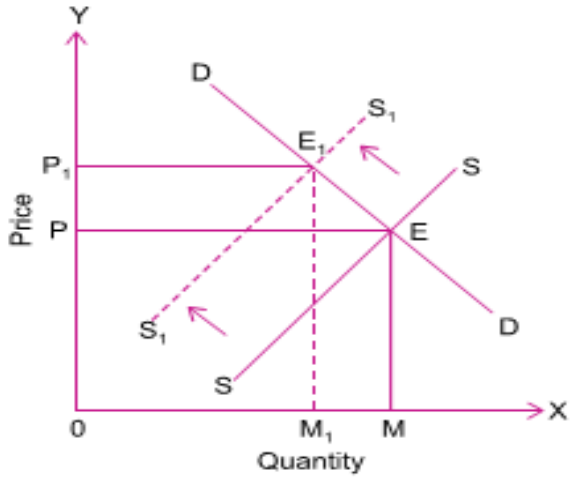


Figure 2.14: Effect of increase in supply

In short, the relationship between the change in supply and the resulting change in equilibrium quantity is direct, but it has inverse relationship with equilibrium price.

C. When Both Demand and Supply Change

- So far we have seen how equilibrium price and quantity change as demand shifts and supply shifts **separately**, under the ceteris paribus assumption. Under normal conditions, however, both may change **simultaneously**.

- Here in this section we will see effect of 'simultaneous change in demand and supply on equilibrium'. In this case, we have four different situations.

A. When both Demand and Supply Increases

B. When both Demand and Supply Decreases

C. When Demand Increase and Supply Decrease

D. When Demand Decrease and Supply Increase

i. When both Demand and Supply Increase:

- When both demand and supply increase (that is, both demand curve and supply curve shift to the right), the **equilibrium quantity would certainly rise**. But the equilibrium price may **rise, fall or remain unchanged**. It depends on the comparative increase in demand and supply.

A. If the increase in demand is **greater than** the increase in supply, the **equilibrium price rises**. In brief, when the rise in demand is greater than the rise in supply, the **net effect will be rise in both price and quantity**.

(See Figure 2.15A)

B. If the increase in demand is **smaller than** the increase in supply, the **equilibrium price falls**. In brief, when the rise in supply is greater than the rise in demand, the net effect will be **decrease in equilibrium price and increases in equilibrium quantity. (See Figure 2.15B)**

C. If the increase in demand and increase in supply are **equal**, the **equilibrium price remains unchanged. (See Figure 2.15C)**

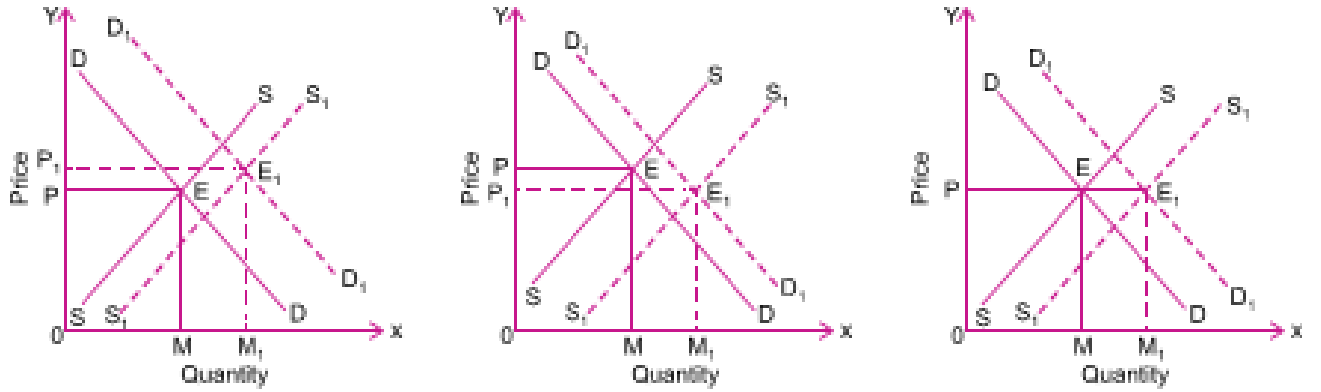


Figure 2.15: When supply and demand increase at various ratios

ii. When both Demand and Supply Decrease:

- If both demand and supply decrease (that is, both demand curve and supply curve shift to the left), the **equilibrium quantity would certainly fall**. But the equilibrium price may **rise, fall or remain unchanged**. It depends on the comparative decrease in demand and supply.

A. If the decrease in demand is **greater than** the decrease in supply, the **equilibrium price fall**. In brief, when the fall in demand is greater than the fall in supply, the **net effect will be fall in both price and quantity**.

(See Figure 2.16A)

B. If the decrease in demand is **smaller than** the decrease in supply, the **equilibrium price rise**. **(See Figure 2.16B)**

C. If the decrease in demand and decrease in supply are **equal**, the **equilibrium price remains unchanged**. **(See Figure 2.16C)**

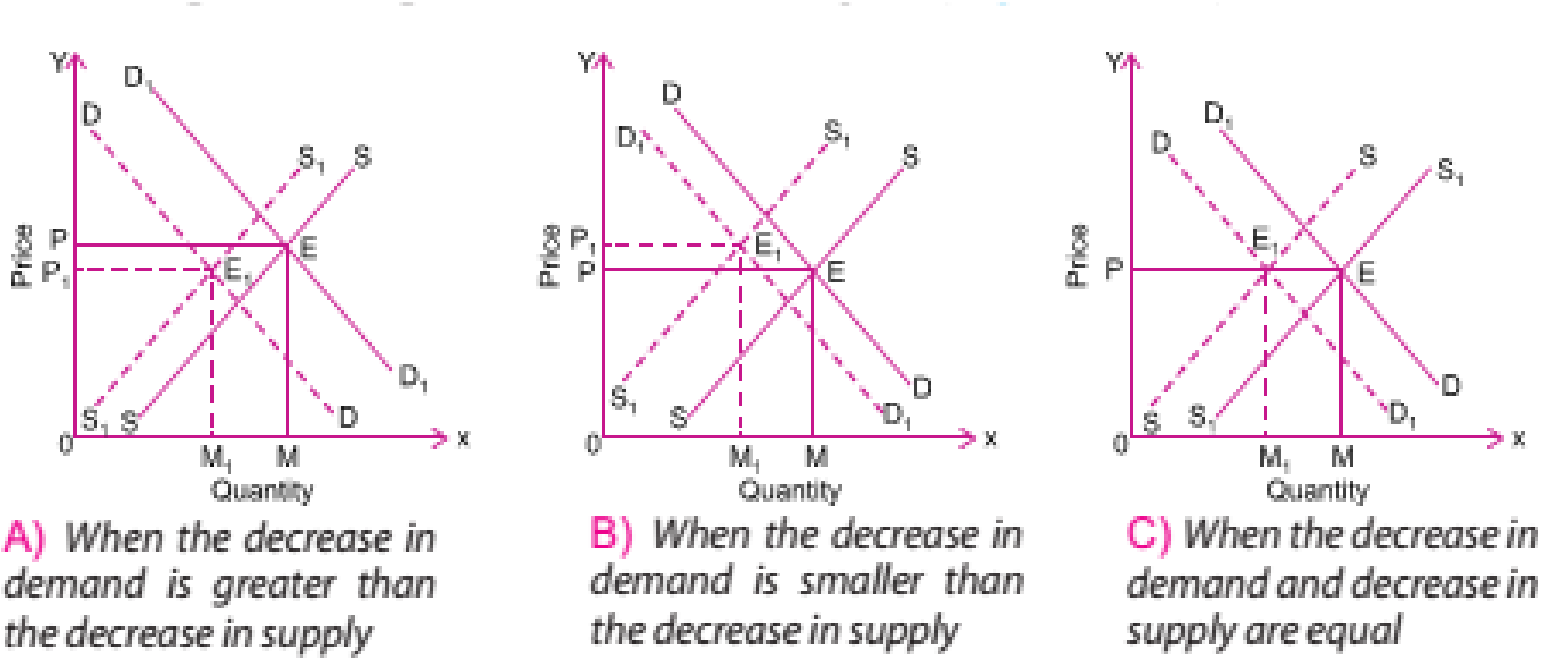


Figure 2.16: When demand and supply decrease at different ratios

The above two discussion makes it clear that the effect of changes in both demand and supply on the **equilibrium price** depends on the **strength of the relative changes in demand and supply**. The only **certain** thing is that the **equilibrium quantity** in all circumstances is determined at a point where demand curve intersects the supply curve.

iii. Demand Increases while Supply Decreases

- The rise in demand shifts the demand curve to the right and the fall in supply shifts the supply curve to the left (See the Figure below).

- As a result **equilibrium price increases** by a higher magnitude than when either demand or supply alone would have changed. The effect on **equilibrium quantity is not definite** i.e., it may increase, decrease or remain constant.

- The effect on quantity, however, depends on the **magnitude of the change in demand and supply curves**. In panel (a) the rise in demand is **less than** the fall in supply, therefore, **quantity decreases**.

- In panel (b) the rise in demand is **greater than** the fall in supply, therefore, **quantity increases**. If the rise in demand is **equal** to the fall in supply quantity will **remain unchanged.**

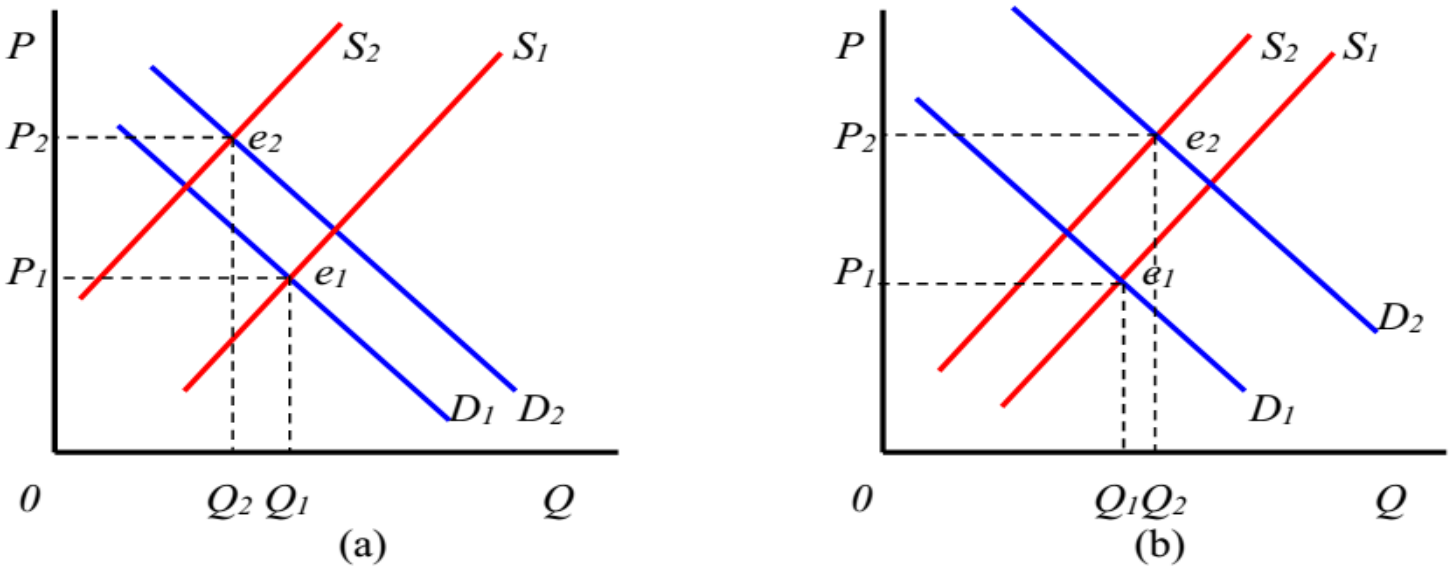


Figure 2.17: Increase in Demand and Decrease in Supply

Table 2.6: Summary on "Effects of Change in Demand and Supply"

Change in Demand and Supply	Effects on Equilibrium Price	Effects on Equilibrium Quantity
When Demand Increase	Price* Rises	Quantity* Increases
When Demand Decrease	Price* Falls	Quantity* Decreases
When Supply Increase	Price* Falls	Quantity* Increases
When Supply Decrease	Price* Rises	Quantity* Decreases
When Both DD and SS Increase	Price Indeterminate	Quantity* Increases
When Both DD and SS Decrease	Price Indeterminate	Quantity* Decreases
When DD Increase and SS Decrease	Price* Rises	Quantity* Indeterminate
When DD Decrease and SS Increase	Price* Falls	Quantity* Indeterminate

ELASTICITY

- **Elasticity** is a measure of responsiveness of the dependent variable to changes in independent variables. The formula to determine the responsiveness of Y to changes in the X_i can be expressed as

$$\varepsilon_1 = \frac{\%\Delta Y}{\%\Delta X_1}, \qquad \varepsilon_2 = \frac{\%\Delta Y}{\%\Delta X_2}, \qquad \varepsilon_n = \frac{\%\Delta Y}{\%\Delta X_n}$$

- This formula states that **elasticity** is the percentage change in the dependent variable divided by the percentage change in the particular independent variable whose effect is being examined.

- Accordingly, we have the concepts of elasticity of demand and elasticity of supply. Now, let us look at the elasticity of demand and supply separately.

1. ELASTICITY OF DEMAND

- In economics, **elasticity** is a measure of the sensitivity or responsiveness of quantity demanded or quantity supplied to changes in price (or other factors).

- **Elasticity of Demand:** refers to the degree of responsiveness of quantity demanded of a good to a change in its price, or change in income, or change in prices of related goods.

- Commonly, there are three kinds of demand elasticity: **price elasticity, income elasticity, and cross price elasticity of demand.**

I. Price Elasticity of Demand

- **Price elasticity of demand** refers to the responsiveness of the quantity demanded of a good to **a change in its price**.
- 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.
- The price elasticity of demand (ε) is defined to be the percentage change in quantity demanded divided by the percentage change in price.

$$\varepsilon = \frac{\text{Percentage change in quantity demanded for a product}}{\text{Percentage change in price of the same product}}$$

$$= \frac{\%\Delta Q_d}{\%\Delta P}$$

- In short, it indicates how consumers react to changes in price.

- The greater the reaction the greater will be the elasticity, and the lesser the reaction, the smaller will be the elasticity.

Note:

- Elasticity is **unit free** because it is a ratio of percentage changes.
- The sign of price elasticity of demand is usually **negative**.

This is because of **the law of demand**. In elasticity, we consider the absolute value of the coefficients. The negative sign in front of an elasticity coefficient indicates only the relationship between price and quantity demanded.

- The value of price elasticity of demand varies between **zero and negative infinity**. However, if the price elasticity of demand is **positive** the product is '**Giffen good**'.

Measurement of Price Elasticity of Demand

- Price elasticity demand can be measured in two ways. These are:

1. Point Elasticity Approach

2. Arc Elasticity Approach

1. Point Elasticity Approach

- It is the most common and widely used approach for measuring elasticity.
- It is used to measure elasticity **at a point** on a demand curve.

2. Arc Elasticity Approach

- This approach is used to measure elasticity between **two points**.
- Since arc elasticity takes the average, sometimes this approach is also known **as average or mid point elasticity approach**.

- **The formula for 'Point price elasticity of demand' is given by:**

$$e_p = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$= \frac{\dfrac{\%\text{ change in quantity demanded}}{\text{Initial quantity}} \times 100}{\dfrac{\%\text{ change in price}}{\text{Initial price}} \times 100}$$

$$= \frac{\dfrac{\Delta Q}{Q} \times 100}{\dfrac{\Delta P}{P} \times 100} = \frac{\Delta Q}{Q} \div \frac{\Delta P}{P}$$

$$= \frac{\Delta Q}{Q} \times \frac{P}{\Delta P} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

$$\varepsilon = slope \times \frac{P}{Q}$$

- **The formula for 'arc price elasticity of demand' is given by:**

$$\text{Arc price elasticity of demand} = \bar{e}_p = \frac{\%\Delta Q}{\%\Delta P}$$

$$\text{where: } \%\Delta Q = \frac{\frac{Q_2 - Q_1}{Q_1 + Q_2}}{2}, \quad \%\Delta P = \frac{\frac{P_2 - P_1}{P_1 + P_2}}{2}$$

$$\text{Thus, } \bar{e}_p = \frac{\frac{\frac{Q_2 - Q_1}{Q_1 + Q_2} \times 100}{2}}{\frac{\frac{P_2 - P_1}{P_1 + P_2} \times 100}{2}} = \frac{\frac{Q_2 - Q_1}{Q_1 + Q_2}}{\frac{P_2 - P_1}{P_1 + P_2}} = \frac{Q_2 - Q_1}{Q_1 + Q_2} \times \frac{P_1 + P_2}{P_2 - P_1}$$

$$\text{by rearranging, it becomes, } \bar{e}_p = \frac{Q_2 - Q_1}{P_2 - P_1} \times \frac{P_1 + P_2}{Q_1 + Q_2}$$

Note:

- The arc elasticity formula is used if the change in price is relatively large. That is if the change in price is very small, the reference point does not matter. But if the change in price is large, it does matter.

- Thus, to measure elasticity between two points **arc elasticity** is a more accurate measure of elasticity than point elasticity method.

- The range of values of the price elasticity of demand is $O \leq ep \leq \infty$.

1. More than unit elastic demand (Elastic Demand)

- If **$1 < ep < \infty$**, then the demand is said to be **'elastic'**.
- When percentage change in quantity demand of a commodity is **more than** the percentage change in its price, it is called **more than unit elastic demand**.
- Here the product is said to be **luxury product**.

2. Less than unit elastic demand (Inelastic Demand)

- If **$O < ep < 1$**, then the demand is said to be **'inelastic'**.
- When percentage change in quantity demand of a commodity is **less than** the percentage change in its price, it is said to be **less elastic** or less than unit elastic demand. Here the product is said to be **necessity product**.

3. Unit Elastic Demand

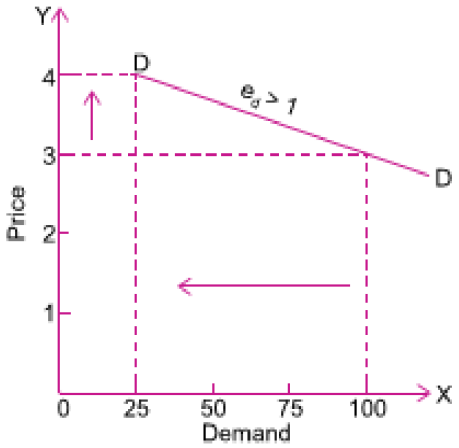
- **If ep = 1**, then the demand is said to be **'unitary elastic'.**
- When percentage change in quantity demand of a commodity and percentage change in price are **equal**, it is said to be **unit elastic demand**.

4. Perfectly Inelastic Demand

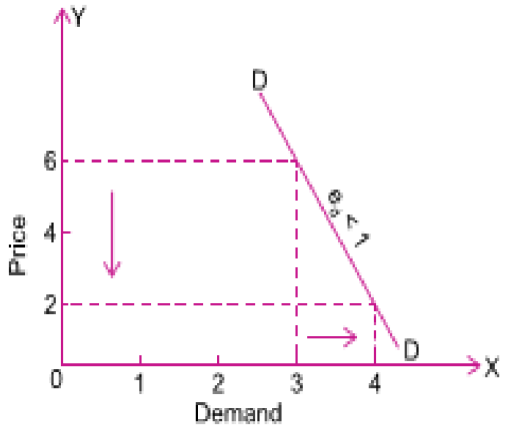
- **If ep = O**, then the demand is said to be **'perfectly inelastic'.**
- When quantity demand of a commodity **does not change at all**, irrespective of any change in its price, it is said to be **perfectly inelastic demand**.
- Here the demand curve is **vertical to the x-axis**.
- A demand curve given by a **vertical line** indicates a case in which the quantity demanded of a good is **totally unresponsive** to changes in price.

5. Perfectly Elastic Demand

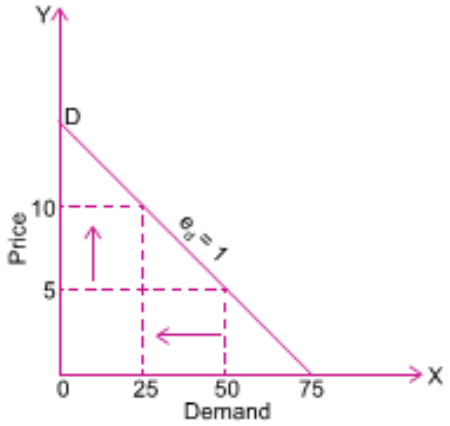
- **If ep = ∞**, then the demand is said to be **'perfectly elastic'.**
- When quantity demand of a commodity rises or falls to any extent without or with very little change in price, the demand for the commodity is said to be **perfectly elastic or infinitely elastic demand.**
- Demand curve is **horizontal** when elasticity of demand is perfectly elastic.
- A demand curve is given by a **horizontal line**, indicates a very small decrease in price would cause an infinite quantity of the good to be demanded. If price rises, in contrary, the quantity of the good falls to zero. Such a curve is referred to as a **perfectly elastic demand curve.**



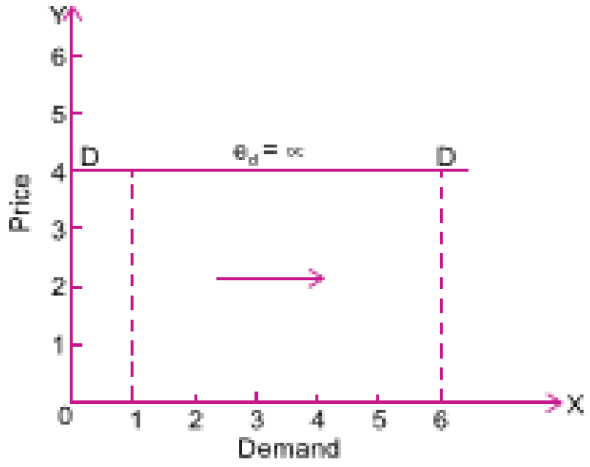
Elastic Demand



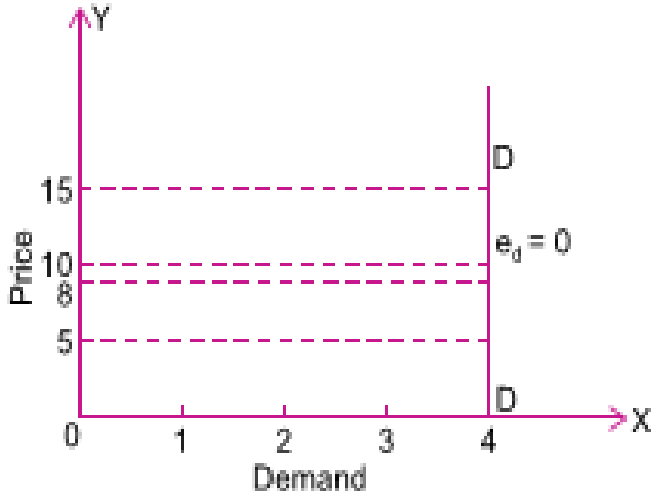
Inelastic Demand



Unitary Elastic



Perfectly Elastic Demand



Perfectly Inelastic Demand

Figure 2.18: Demand curve showing different types of price elasticity

- As we have discussed earlier price elasticity of demand ranges between **0 and ∞.** This can be summarized graphically as follows.

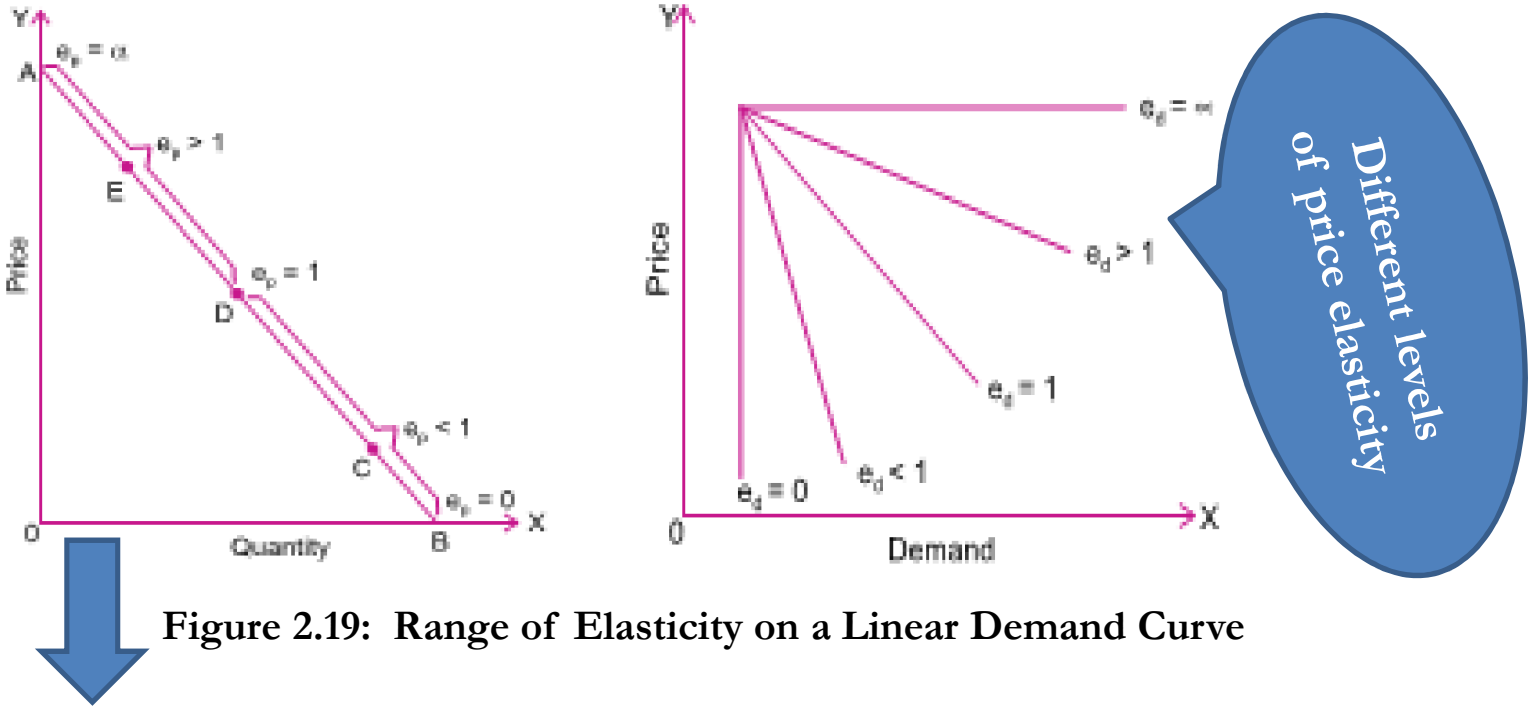


Figure 2.19: Range of Elasticity on a Linear Demand Curve

Given this graphical measurement of elasticity it is obvious that at the mid-point of a linear demand curve $e_p = 1$ (point D). At any point to the right of D the elasticity is less than unity ($e_p < 1$). At any point to the left of D, $e_p > 1$. Finally at point A, the $e_p \rightarrow \infty$, while at point B' the $e_p = 0$.

Example:

Assume that a consumer purchases 10 units of a good when price is Birr 4 and 18 units when price falls to Birr 2. Compute **price elasticity of demand**.

Solution:

- Percentage change in quantity demanded is: $\frac{18-10}{10}\times 100 = 80\%$
- Percentage change in price is: $\frac{2-4}{4}\times 100 = -50\%$
- **Elasticity**, therefore, is given as

$$\varepsilon = \frac{80\%}{-50\%} = -1.6$$

- Here, since E is greater than one, demand is said to be **elastic**.
- **Interpretation:** one percent fall in price leads quantity demanded to rise by 1.6 percent, showing that the consumer is **more sensitive**.

Example:

Again, assume that a consumer purchases 10 units of a good when price is Birr 4 and 14 units when price falls to Birr 2. Compute price elasticity of demand.

Solution:

- Percentage change in quantity demanded is:

$$\frac{14-10}{10}\times 100 = 40\%$$

- Percentage change in price is

$$\frac{2-4}{4}\times 100 = -50\%$$

Price elasticity of demand is

$$\varepsilon = \frac{40\%}{-50\%} = -0.8$$

Interpretation:

- A one percent fall in price causes a 0.8 percent rise in quantity demanded. Since elasticity is less than one, therefore, demand is said to be **inelastic.**

Example:

Assume now a consumer purchases 10 units of a good when price is Birr 4 and 15 units when price falls to Birr 2. Compute price elasticity of demand.

Solution:

- Percentage change in quantity demanded is: $\frac{15-10}{10}\times 100 = 50\%$
- Percentage change in price is: $\frac{2-4}{4}\times 100 = -50\%$
- Price elasticity of demand is, therefore

$$\varepsilon = \frac{50\%}{50\%} = -1$$

Interpretation:

- A given percentage change in price of this commodity causes the same proportionate percentage change in quantity demanded.; and hence demand is referred to as **unitary elastic**.

Example:

Demand for a commodity increased from 100 units to 120 units as a result of 10% fall in its price. Calculate **price elasticity of demand**.

Solution:

Given: $Q_{x_1} = 100, Q_{x_2} = 30, Q_{x_2} = 120$, fall in price = 10%

$$\varepsilon = \frac{\text{Percentage change in quantity demanded for a product}}{\text{Percentage change in price of the same product}}$$

$$\text{Percentage change in quantity demanded} = \frac{\text{Change in quantity demanded}}{\text{Change in quantity}} * 100$$

$$= \frac{120-100}{100} \times 100 = 20\%$$

% change in price = **10%**

$$\varepsilon = \frac{20}{10} = 2$$

- **Interpretation:** ∴ Demand for the commodity is **more than unit-elastic**, that is, 1% fall in price causes 2% rise in quantity demanded.

Example:

At birr 5 per unit, a consumer buys 40 units of a commodity and the price elasticity of his demand is 2. How much will he buy if the price reduces to birr 4 per unit?

Solution: *Given:* $P_1 = 5,\ Q_1 = 40,\ e_p = 2,\ P_2 = 4$ and $Q_2 = ?$

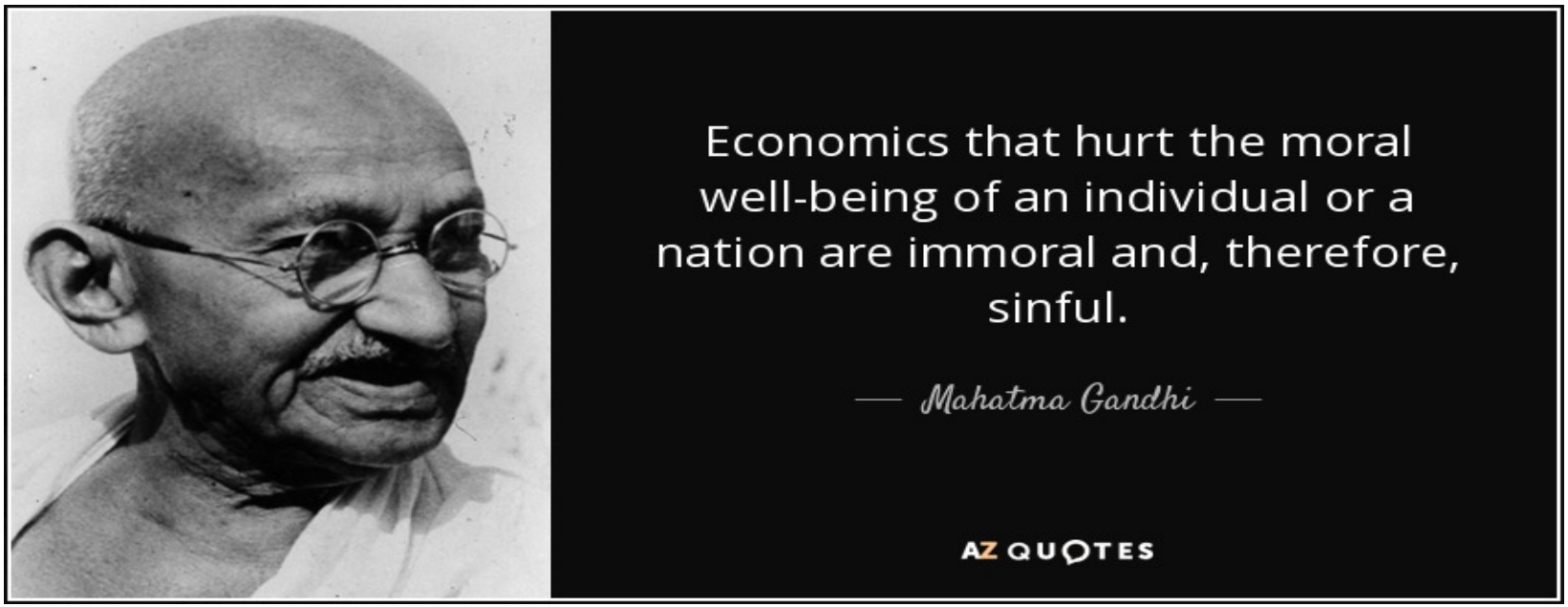
$$e_p = \frac{\Delta Q}{\Delta P} \times \frac{P_1}{Q_1} = \left|\frac{Q_2 - Q_1}{4-5}\right| \times \frac{5}{40} = 2 = \frac{Q_2 - 40}{1} = 2 \times \frac{40}{5}$$

$$\Rightarrow Q_2 - 40 = 16$$

- ∴ New quantity (Q2) = 16 + 40 = 56 units
- **Interpretation:** The consumer will buy 56 units of the commodity, when its price reduce to Birr 4 per unit.

Puzzle

♣ How do you write "18th March 2022" in 5 letters without using numbers?



Price Elasticity of Demand and Total Revenue

- Total revenue by definition is equal to price times quantity **(TR = P × Q).**
- When the price of a commodity increases, it is **not necessary** that the total revenue of the seller will also increase. Rather, the change in total revenue (if any) depends upon the **responsiveness of buyers to a change in price.**
- We may say, the effect of a change in price on the total revenue, depends upon the **price elasticity of demand for the commodity**.
- We discuss the relationship between price elasticity of demand and total revenue under the following three heads:

- If the demand for a commodity is **Price-Inelastic**, an **increase in price** leads to an **increase in total revenue**. Similarly, a price decrease reduces the total revenue **(TR).**
- If the demand for a commodity is **Price-Elastic**, an **increase in price** leads to a **decrease in total revenue** and a price decrease increases the **TR**.
- When Demand is **Unit-Elastic** an increase or decrease in price leads to **no change in the total revenue.**

Table 2.7: Relationship between Elasticity and Total Revenue

Change in Price	Effect on Total Revenue (TR)		
	When |ep| <1	When |ep| >1	When |ep| =1
Increase	Increase	Decrease	No Change
Decrease	Decrease	Increase	No Change

Determinants of Price Elasticity of Demand

- There are many factors which determine the price elasticity of demand.
- The following factors make price elasticity of demand **elastic or inelastic** other than changes in the price of the product.

i. The Availability of Substitutes:

- If a commodity has many close substitutes, its demand is likely to be **elastic.** Even a small fall in price will induce more people to buy this commodity rather than its substitutes. On the other hand, if a good has **no or weak substitutes**, the demand for it would be **inelastic**.
- In general, a commodity with **close substitutes** tends to have **an elastic demand**, and one with **weak substitutes** has an **inelastic demand.**

ii. Time:

- The elasticity of demand depends on the size of the time period- **short period or long period.** Price elasticity is generally **low for short periods** as compared to long periods. In the **long- run**, price elasticity of demand tends to be **elastic**. Because:
  - More substitute goods could be produced
  - People tend to adjust their consumption pattern as price increase.

iii. The Proportion of Income Consumers Spend for a Product:

- The **smaller the proportion of income** spent for a good, the **less price elastic** will be, and the **higher the proportion of income** to be spend on a product, the **more will be the elasticity**.

iv. Nature of the Commodity:

- That is, whether it is a **'necessary' or a 'luxury'** or a commodity of 'comfort'.
- **Demand for necessities**, such as food items, is generally **inelastic** since these goods are essential for existence.
- On the other hand, **'luxuries' and 'comforts'** are not essential for existence and their consumption can be dispensed with or postponed. Thus, their demand changes by large amounts due to small changes in price.
- **Generally, the demand for necessities is inelastic and the demand for luxuries and comforts is elastic.**

II. Income Elasticity of Demand

- **Income elasticity of demand** is a measure of the responsiveness of quantity demanded to **changes in income** assuming all other things, including price, constant.

- It is defined by percentage change in quantity demand due to percentage change in consumer`s income.

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

$$\varepsilon_I = \frac{\Delta Q}{\Delta I} \cdot \frac{I}{Q}$$

- Like price elasticity of demand, we use two approach to calculate income elasticity of demand i.e., point and arc income elasticity approach.

- Unlike price elasticity of demand, income elasticity of demand can be **positive.** The sign of the coefficient indicates the nature of the products; whether the products are normal or inferior.

Normal Goods are goods whose quantity demand increases with rise in consumers' income, while Inferior Goods are those goods whose quantity demand decreases with rise in income.

- The income elasticity for **normal goods** is **positive** reflecting the positive relationship between income and quantity demanded. For **inferior goods**, however, **income elasticity is negative.**

- Goods with **high positive income elasticity** are considered as **luxury goods**. In contrast, **Necessities** have **low positive income elasticity**.

If the coefficient is greater than one, $\varepsilon_I > 1$, the good is income elastic, whereas if $\varepsilon_I < 1$, the good is said to be income inelastic.

- Here it is important to note that there is no clear cut range of the ε_I coefficient for distinguishing between necessities and luxury goods.

Example:

When the income of the consumer is Birr 1000, the consumer buys 100 units of a good. If income increases to Birr 1200, the resulting quantity demanded would be 130 units. **Compute income elasticity demand.**

Solution:

The income elasticity demand of the consumer is given as:

$$\varepsilon_I = \frac{\Delta Q}{\Delta I} \cdot \frac{I}{Q}$$

$$\varepsilon_I = \frac{30}{200} \cdot \frac{1000}{100} = 1.5$$

- Since ε_I is positive and greater than one the consumer's demand is income elastic and the product is **luxurious good.**

Example:

Suppose a consumer started consuming 12 kg of butter when his income increased to Birr 2000 - which he used to consume only 8 kg when his income was Birr 1600. The consumer's income elasticity of demand can be found using arc method as follows.

Solution:

Given: $Q_1 = 8$ kg, $I_1 = 1600$ Birr 1600, $Q_2 = 12$ kg, $I_2 = 2000$ Birr, $\varepsilon_I = ?$

$$\bar{e}_I = \left(\frac{Q_2 - Q_1}{I_2 - I_1}\right)\left(\frac{I_1 + I_2}{Q_1 + Q_2}\right)$$

$$= \left(\frac{12-8}{2000-1600}\right)\left(\frac{1600+2000}{8+12}\right)$$

$$= \frac{4}{400} \times \frac{3600}{20} = 1.8$$

C. Cross Price Elasticity of Demand

- One of the determinants of demand is the **price of related goods.**
- The responsiveness of quantity demanded for **one commodity** due to the changes in the **prices of other commodities**, ceteris paribus, is called **Cross Price Elasticity of Demand.**
- In other words, **Cross Price Elasticity of Demand** may be defined as the ratio of proportionate change in the demand of one commodity (say x) to the proportionate change in the price of another commodity (say y).
- It can be measured as follows:

$$\varepsilon_{XY} = \frac{\text{Percentage change in quantity demanded of one commodity (X)}}{\text{Percentage change in the price of another commodity (Y)}}$$

$$\varepsilon_{XY} = \frac{\Delta Q_X}{\Delta P_Y} \cdot \frac{P_Y}{Q_X} \quad \textbf{(Point cross price of elasticity of demand)}$$

- To measure **cross price elasticity of demand** between two points, we use arc cross price elasticity of demand formula:

$$\varepsilon_{XY} = \frac{Q_{X2} - Q_{X1}}{P_{Y2} - P_{Y1}} \cdot \frac{P_{Y1} + P_{Y2}}{Q_{X1} + Q_{X2}}$$

$$\varepsilon_{XY} = \frac{\Delta Q_X}{\Delta P_Y} \cdot \frac{P_{Y1} + P_{Y2}}{Q_{X1} + Q_{X2}}$$

- The cross price elasticity of demand coefficient may take different values depending on the type of relationship between the two goods.

- The cross- price elasticity of demand for **Substitute** goods is **Positive**.
- The cross- price elasticity of demand for **Complementary** goods is **Negative**.
- The cross- price elasticity of demand for **Unrelated** goods is **Zero**.

Illustration:

- If the cross elasticity of demand coefficient has a **positive sign** it indicates that a rise in the price of one of the two goods results in rise in the quantity demanded of the other good. As a result the two goods are **substitutes**.

- If the cross price elasticity of demand coefficient has a **negative sign**, it reflects that a rise in the price of one of the goods results in decline in the quantity demand for the other indicating that the goods are **complements.**

- However, if it is **zero**, it mean that any increase or decrease in price of one good has **no effect** on the quantity demanded of the other good.

✹ **Note:** The size (magnitude) of the cross price elasticity of demand coefficient shows **strength of the substitution or complementary** relationship between the goods under consideration. i.e., the **higher the value** of cross elasticity, the **stronger will be the degree of substitutability or complementarity, depending on the sign**.

Example: The quantity demanded of good *X* before change in the price of good *Y* was 25 units. As good *Y*'s price changes from Birr 5 to Birr 10, the quantity demanded of good *X* has increased to 75 units. Compute its elasticity.

Solution:

$$\varepsilon_{XY} = \frac{\Delta Q_X}{\Delta P_Y} \times \frac{P_Y}{Q_X}$$

$$\varepsilon_{XY} = \frac{50}{5} \times \frac{5}{25} = 2$$

Interpretation: the two goods, therefore, are substitute products.

Example: Suppose the price of coffee rises from Birr 100 per kg to Birr 120 per kg. As a result, consumer demand for tea (being a good substitute for coffee) rises from 20 kg to 30 kg. Compute Cross elasticity of demand for tea.

Solution:

$$\varepsilon_{XY} = \frac{\Delta Q_X}{\Delta P_Y} \times \frac{P_Y}{Q_X}$$

$$= \frac{10}{20} \times \frac{100}{20}$$

$$= \frac{5}{2} = 2.5$$

- Thus, cross price elasticity of demand tea for coffee is **2.5.** That is, if price of coffee increases by 1% demand for tea increases by **2.5%.**

2. ELASTICITY OF SUPPLY

- **Price Elasticity of Supply:** measures the responsiveness of the quantity supplied to a **change in the commodity's price**, ceteris paribus. In other words, it measures the percentage change in quantity supplied of a product due to a percentage change in the price of the same product, ceteris paribus.

- **Price Elasticity of Supply:** indicates how sellers react to change in price. The greater the reaction, the **greater will be the elasticity**, lesser the reaction, the **smaller will be the elasticity**.

- Thus, the formula for measuring price elasticity of supply is defined as:

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

- As the case with price elasticity of demand, we can measure the price elasticity of supply using **point and arc elasticity methods**. However, a simple and most commonly used method is **point method**.

- To measure price elasticity of supply **at a point** we use **point price elasticity of supply** formula which is defined as:

$$e_s = \frac{\frac{\Delta Q}{Q} \times 100}{\frac{\Delta P}{P} \times 100}$$

$$= \frac{\Delta Q}{Q} \times \frac{P}{\Delta P} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

- To measure price elasticity of supply **between two points**(prices) we use **arc(mid point) price elasticity of supply** formula which is defined as:

$$\varepsilon_s = \frac{Q_2 - Q_1}{P_2 - P_1} \cdot \frac{P_1 + P_2}{Q_1 + Q_2} \qquad \varepsilon_s = \frac{\Delta Q}{\Delta P} \cdot \frac{P_1 + P_2}{Q_1 + Q_2}$$

Note that:

- Elasticity is a **unit free** measure.
- The range of values of the price elasticity of supply is **O ≤ es ≤ ∞.**
- Like price elasticity of demand, price elasticity of supply can be **elastic, inelastic, unitary elastic, perfectly elastic or perfectly inelastic.**
- The coefficients of price elasticity of supply are **often positive** because normally supply curves are **positively sloped**. But there are exceptions in which the supply curve is either **vertical or horizontal.**

1. More than Unit Elastic Supply:

- **If $e_s > 1$**, then the supply is said to be **'Elastic'.**
- When percentage change in quantity supplied is **more than** percentage change in price, it is said to be **more than unit elastic supply**.

2. Less than Unit Elastic Supply:

- **If $e_s < 1$**, then the supply is said to be **'Inelastic'.**
- When percentage change in quantity supplied is **less than** the percentage change in price, it is said to be **less than unit elastic supply**.

3. Unit Elastic Supply:

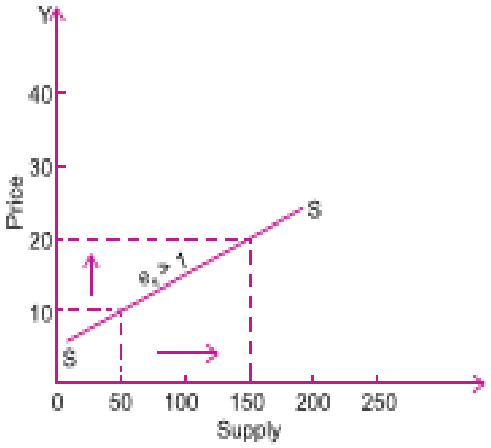
- **If $e_s = 1$**, then the supply is said to be **'Unitary Elastic'.**
- When percentage change in quantity supplied and percentage change in price are equal, it is said to be **unit elastic supply**.

4. Perfectly Inelastic Supply:

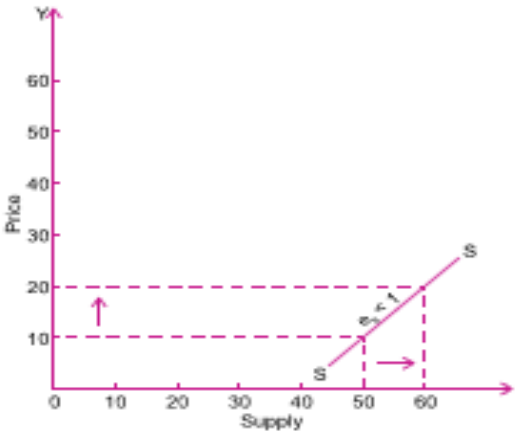
- **If es = O**, then the supply is said to be **'Perfectly Inelastic'.**
- When quantity supplied **does not change** at all irrespective of any change in price of the commodity, it is said to be **perfectly inelastic supply**.
- If the supply is perfectly inelastic, it will be represented by a **vertical line**. This is the case in the very short run where it is difficult to produce more of a good regardless of what happens to price.

5. Perfectly Elastic Supply

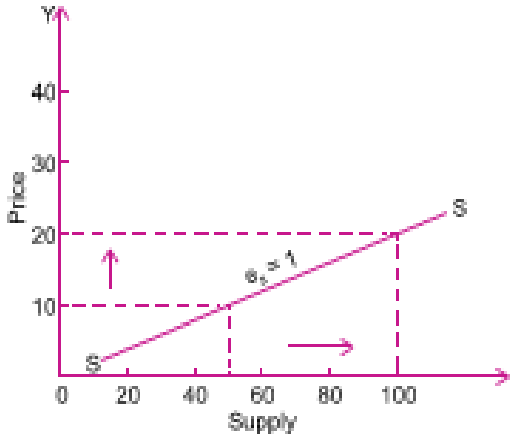
- **If es = ∞**, then the supply is said to be **'Perfectly Elastic'.**
- When quantity supply of a commodity rises or falls to any extent without or with very little change in price, the supply of the commodity is said to be perfectly elastic or **infinitely elastic supply**. If supply is perfectly elastic it will be represented by a **horizontal straight line**.



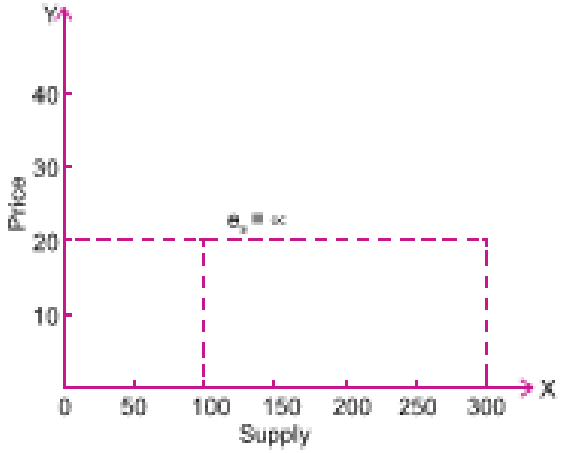
Elastic Supply



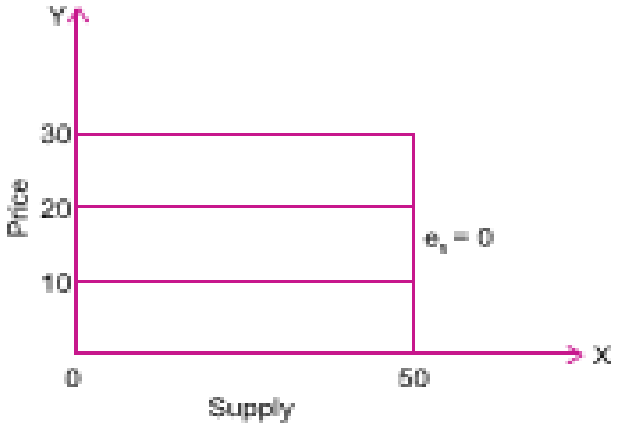
Inelastic Supply



Unitary Supply



Perfectly Elastic Supply



Perfectly Inelastic Supply

Figure 2.19: Supply curve showing different types of price elasticity

Example: A firm produces 100 units of output and sells each unit for Birr 20 at equilibrium. Suppose the demand for the firm's product has increased and caused a rise in price to Birr 25 a unit. After the rise in price the quantity that the firm sells has increased to 120 units. Compute elasticity of supply.

$$\varepsilon_s = \frac{\Delta Q_s}{\Delta P} \cdot \frac{P}{Q_s} \qquad \varepsilon_s = \frac{20}{5} \cdot \frac{20}{100} = 0.8$$

This implies that the supply of the firm is price inelastic.

Example: A local producer of oil reduced its quantity supplied from 10,000 liters to 8,000 liters per month in response to price fall of oil from Birr 25 to Birr 20. Then find price elasticity of supply using the Arc method.

$$e_s = \left(\frac{Q_2 - Q_1}{P_2 - P_1}\right)\left(\frac{P_2 + P_1}{Q_1 + Q_2}\right)$$
$$= \left(\frac{8,000 - 10,000}{20 - 25}\right)\left(\frac{25 + 20}{10,000 + 8,000}\right) = \left(\frac{-2,000}{-5}\right)\left(\frac{45}{18,000}\right)$$
$$= 1$$

Example: The coefficient of elasticity of supply of a commodity is 3. A seller supplies 20 units of this commodity at a price of Birr 8 per unit. How much of this commodity will the seller supply when price rises by Birr 2 per unit?

Solution: *Given:* $e_s = 3, P_1 = 8, \Delta P = 2, Q_1 = 20, Q_2 = ?$

We know that, $e_s = \frac{\Delta Q}{\Delta P} \times \frac{P_1}{Q_1}$

$$\Rightarrow e_s = \frac{Q_2 - Q_1}{2} \times \frac{8}{20} = 3$$

$$\Rightarrow Q_2 - 20 = 3 \times \frac{20}{4} \Rightarrow Q_2 - 20 = 15 \Rightarrow Q_2 = 35$$

- Thus, the supplier will supply 35 units at the commodity at 10 Birr per unit.

Example: The quantity supplied of a commodity at a price of Birr 8 per unit is 400 units. Its price elasticity of supply is 2. Calculate the price at which its quantity supplied is 600 units.

Solution: *Given:* $e_s = 2, P_1 = 8, Q_1 = 400, Q_2 = 600,$

$\Delta Q = 600 - 400 = 200, P_2 = ?$

We know that, $e_s = \frac{\Delta Q}{\Delta P} \times \frac{P_1}{Q_1}$

$$\Rightarrow 2 = \frac{200}{P_2 - P_1} \times \frac{8}{400} = \frac{4}{P_2 - 8}$$

$$\Rightarrow 2P_2 - 16 = 4 \Rightarrow 2P_2 = 20 \Rightarrow P_2 = 10$$

$\therefore$ The quantity supplied will be 600 units at a price of 10 Birr per unit.

Example:

Calculate price elasticity of supply from the following data:

Price (Birr)	Total Revenue (Birr)
8	224
12	504

Solution: We know that

Total revenue = Price × Quantity

$$\therefore \quad \text{Quantity} = \frac{\text{Total Revenue}}{\text{Price}}$$

We calculate the units of quantity supplied for the given data, as follows:

Price (Birr)	Total Revenue (Birr)	Quantity (Units)
8	224	28
12	504	42

Given: $P_1 = 8,\ P_2 = 12,\ \Delta P = 12 - 8 = 4$

$$Qs_1 = 28,\ Qs_2 = 42$$

$$e_s = \frac{\Delta S}{\Delta P} \times \frac{P}{S}$$

$$= \frac{42-28}{12-8} \times \frac{8}{28} = 1$$

Example:

- When the price of a commodity falls from Birr 10 per unit to Birr 9 per unit, its quantity supplied falls by 20%. Calculate its price elasticity of supply.

Solution: *Given:* $P_1 = 10,\ P_2 = 9,\ \%\Delta Q_s = 20\%$

$$e_s = \frac{\text{change in quantity supplied}}{\text{change in price}} \times 100$$

$$\%\ \text{change in quantity supplied} = 20\%$$

$$\%\ \text{change in price} = \frac{\text{change in Price}}{\text{original Price}} \times 100$$

$$= \frac{(10-9)}{10} \times 100 = 10\% \Rightarrow e_s = \frac{20\%}{10\%} = 2$$

Exercise:

- Suppose the price elasticity of supply of a firm is 0.5. A rise in price to Birr 6 has induced a 10 percent rise in quantity supplied by the firm. Find the initial level of price.

Determinants of Price Elasticity of Supply

- There are many factors that's makes the price elasticity of supply to be more or less elastic. The main factors are the following:

i. Behavior of Cost of Production:

- If an increase in supply leads to a large increase in cost of production, the supply would be **relatively inelastic**, and supply tends to be **more elastic** if cost of production does not change much.

ii. Time Element:

- In the **short run**, supply tends to be **relatively inelastic**. However, in the long-run, new plants can be set up and production capacity can be expanded. Therefore, in the **long-run supply tends to be elastic.**

iii. Nature of the Commodity:

- Since **supply of durable goods** can be increased or decreased quickly in response to change in price, the supply of such products is **relatively elastic.** On the other hand, **supply of perishable goods** like milk and vegetables is **relatively less elastic**.

iv. Availability of Facilities for Expanding Output:

- If producers have sufficient production facilities, such as availability of raw materials, power, etc. they would be able to increase their supply in response to rises in prices of the commodities. Thus, supply, therefore, will be **elastic.**

- But if, on the other hand, there is **shortage** of power, fuel and essential raw materials, the output would expand slowly in response to rises in prices of the commodities. Thus, supply, therefore, will be **inelastic.**

v. Nature of Inputs:

- Elasticity of supply depends on the nature of inputs used for the production of a commodity. If the production of a product requires inputs that are **easily available**, its supply would be **more elastic**.

- On the other hand, if the production of a product **uses specialized inputs**, its supply will be **relatively inelastic**.

vi. Risk-taking Behavior of Entrepreneurs:

- The elasticity of supply is also determined by the willingness of the entrepreneurs to take risk. If entrepreneurs are **willing to take risk**, the supply will be **more elastic**. On the other hand, if entrepreneurs **hesitate to take risks**, the supply will be **inelastic.**

vii. Expectation of Future Prices:

- If the producers expect a **rise in the price** of a commodity in future, producers will like to hoard the commodity to take advantage of rise in future price. The supply will, therefore, be **less elastic**.
- On the other hand, if they expect a **fall in future price**, they will release the goods from their stocks. The **supply will be more elastic**.

viii. Status of Stock

If there is a **large stock of unsold goods**, supply can easily and quickly increase. Thus, supply tends to be **more elastic**.

SUMMARY

Value of Ep	Types of Ep	Description
|Ep| = 0	**Perfectly Inelastic Demand**	Change in price does not affect quantity demand at all
|Ep| < 1	**Inelastic**	% change in quantity demand is less than % change in price
|Ep| = 1	**Unit Elastic**	% change in quantity demand is equal to % change in price
|Ep| >1	**Elastic**	% change in quantity demand is more than % change in price
|Ep| = ∞	**Perfectly Elastic Demand**	Quantity demand changes infinitely

Value of Es	Types of Es	Description
Es = 0	**Perfectly Inelastic**	Change in price does not affect quantity supply at all
Es < 1	**Inelastic**	% change in quantity supply is less than % change in price
Es = 1	**Unit Elastic**	% change in quantity supply is equal to % change in price
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Es = ∞	**Perfectly Elastic Supply**	Quantity supply changes infinitely

The End