Chapter Two: Microeconomics

2.1. Supply and Demand

2.1.1. Perfectly Competitive Markets/Pure Competition

Market structures are classified into: Pure competition, pure monopoly, Monopolistic competition and Oligopoly

This division of market is based on:

1) The number of firms in the industry;

2) Product differentiation/standardization;

3) Ease of entering and exit into the market.

Definitions of the different market structures:

a) <u>Pure competition</u>: it involves large number of small firms producing standardized product. Entry and exit are free

b) <u>Pure monopoly</u>: is where a single seller is the sole supplier of goods and services (G&S). Entry is blocked and there no product differentiation.

c) <u>Monopolistic competition</u>: is characterized by a relatively large number of sellers producing differentiated products. There is large non-price competition via product differentiation. Entry and exit is quite easy.

d) <u>Oligopoly</u>: involves only few sellers of the same or similar product and hence there is interdependence in decision making.

Pure/perfect competition

This type of market structure is further discussed in detail from sections 2.1 to 2.3.

The characteristics of this market include:

1. <u>Very large numbers</u>: The distinguishing feature of this market is that there exists a large number of independently acting sellers- selling at national or international markets. A good example can be retail cigarette sellers in Ethiopia.

2. <u>Standardized product</u>: The firms produce standardized/identical/homogenous products. Consumers will be indifferent to buy from any sellers, as long as the price is the same. The firms don't try to differentiate their products – no non-price competition, only price competition exists. (e.g. Photocopy services, they give more or less the same service)

3. "Price Takers": In pure competition individual firms don't exert any control over price because each firm produces only a small fraction of total supply to the market. Hence, every firm is price taker i.e. it cannot change market price but simply adjust to it. If one of the firms increase price greater than the market, consumers will not buy from it. Conversely, it can sell as much as it wants at market price. Therefore, there is no reason to charge lower than market price.

4. Free entry and exit: new firms can freely enter and incompetent firms can exit freely. No significant legal, technological, financial or other obstacles prohibit new firms from selling their product in the market.

NB: Although pure competition is rare in the real world, this market model is highly relevant because:

- Pure competition is a meaningful starting point for any discussion of price and output determination

- Pure competition is a standard against which efficiency is evaluated.

Table 1 below summarizes the different market structures by comparing them using their important features.

Table 1: Summary of different market structures

Description	Pure/perfectly competitive	Pure monopoly	Monopolistic Competition	Oligopoly
Number of firms/sellers	Many	One	Large	Few
Types of products	Standardized	No differentiation and substitute	Differentiated	Similar
Ease of entry	Free	Blocked	Quite easy	Difficult
Price discrimination	No	Yes	Yes	Yes

2.1.2 Demand and supply functions, schedule and curve.

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 Demand.

Definition: Demand indicates the different quantities of a product that buyers are willing and able to buy at various prices in a given period of time, other things remaining unchanged (Ceteris Paribus). The definition stresses that:

1) The consumer is willing to have that product

2) The consumer should have the ability to buy the product and

3) Demand is <u>time</u> specific

Note that quantity demanded and demand are two different concepts. <u>Quantity demanded</u> refers to a specific quantity that a consumer is willing and able to buy at a specific price. But <u>demand</u> refers to the relationship between various possible prices of a product and the corresponding quantities demanded for the product, other things remain unchanged.

A. Demand schedule, curve and function

The demand schedule is a table, which represents the relationship between the various prices of a product and the corresponding quantities demanded, other factors remaining constant. See Table 2 below.

From the table below, we notice that as price continues to fall, the respective quantity demanded increases, and vice versa. This inverse or negative relationship between price and quantity demanded, holding other things constant, is called the **law of demand.**

Table 2: An individual household's weekly demand of orange.

	Price per Kg	Quantity demanded per week
A	6	2
B	5	3
C	4	4
D	3	5
E	2	6
F	1	7

The law of demand: states that, all other things remain unchanged, as price of a product increases, quantity demanded decreases, and as price decreases quantity demanded increases.

When the data presented in the demand schedule is depicted graphically, it is called a demand curve. It shows how the quantity of a product varies as the price of the product changes.

By agreement, price is on the y-axis and quantity is on the X-axis. The negative slope of the demand curve reflects the law of demand.

Demand Curve
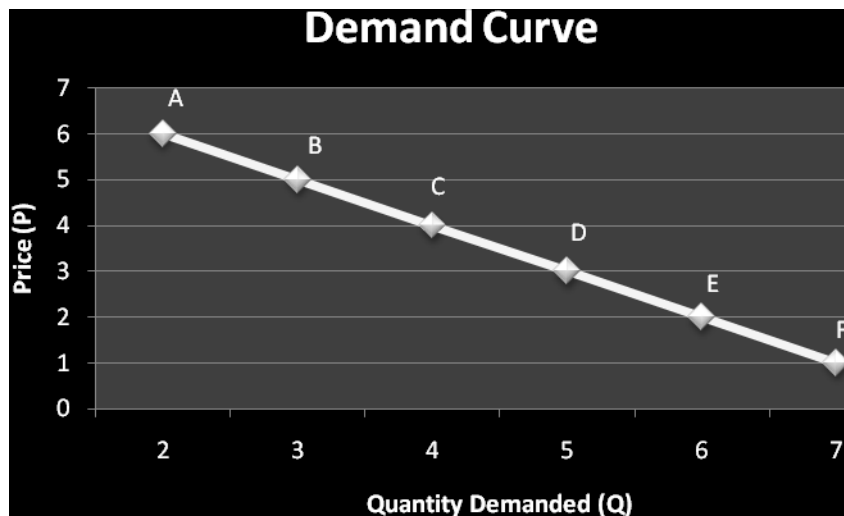
The individual household's demand for orange can also be expressed in the form of mathematical equation, which is called the demand function.

$$Q_d = f(P)$$

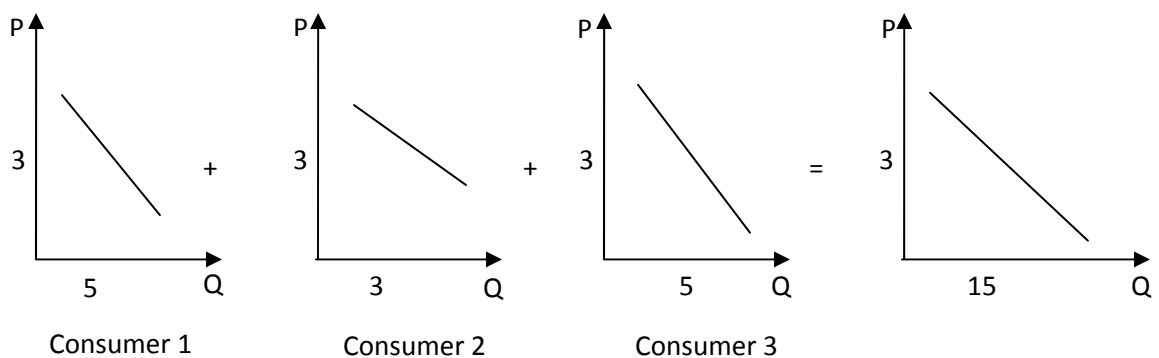Or as $P = f^{-1}(Q_d)$ P, which is known as inverse demand function

For example,

$$Q_d = 8 - P$$

or $P = 8 - Q_d$

B. Individual and market demand

The market demand is the total demand of all buyers for a product. The market demand schedule or curve for a product is derived by horizontally adding the quantity demanded for the product by all buyers at each price.

Consumer 1   Consumer 2   Consumer 3

C. Determinants of Demand

The demand for a product is determined by

i) Price of the product

ii) Taste or preference of consumers

iii) Income of the consumers

iv) Price of related goods (substitutes and complements)

v) Consumer's expectation of income and price

vi) Number of buyers in the market

 The first determinant, price of the product, is known as <u>own-price determinant</u> of demand. The remaining determinants (*ii*) – (*iv*), are known as non-own price determinants or <u>demand shifters</u>.

Change in quantity demanded and change in demand

For each price of a product, there is a corresponding quantity demanded. When the price of the product changes, the corresponding quantity demanded also changes hence a change in quantity demanded as a result of change in the price of the product is represented as a <u>movement along a fixed demand curve</u>.

A <u>change in demand</u>, on the other hand, refers to a change in the demand schedule or a shift of the entire demand curve to a new location. This happens due to changes in one or more of the non-own price determinants of demand like changes in income, taste, etc.

Effects of non-own price determinants of demand

1. **Effects of changes in taste or preference**: a favorable change in consumers' taste causes an increase in demand, which is represented by a right ward shift of the demand curve. The favorable change can be a result of fashion change, or intensive advertisement. Unfavorable changes in taste, such as scientific report about the negative impact of a product on health, on the other hand will reduce the demand for that product and cause the demand curve for the product to shift to the left. (e.g. Queen Burger; lost its market because people got sick after eating the burgers)

2. **Effects of change in income:**

   How changes in income affect demand depends on the nature of the product. For most products, a rise in income causes an increase in demand and vice versa. Products whose demand varies directly with income are called <u>superior goods or normal goods</u>. On the other hand, there are some products whose demand decreases as consumers' income

increases and vice versa. Such goods whose demand varies inversely with income are called <u>inferior goods</u>. For example, cabbage, second hand shoes, etc

3. **Prices of related goods**

A change in the price of a related good may either increase or decrease the demand for a product depending on whether the related good is a substitute or a compliment.

- A <u>substitute good</u> is one that can be used in place of another good. If X and Y are substitutes, an increase in price of X leads to an increase in demand for Y, and vice versa, other things constant (e.g. Coke and Pepsi).

- A <u>complementary good</u> is one that is used together with another good like sugar and tea. If X and Y are complements, then an increase in the price of X leads to a decrease in the demand for Y and vice versa, other things constant. For example, a car and its tire,

- <u>Unrelated goods</u> are goods that are neither substitutes nor complements e.g. automobiles and bananas.

4. **Effects of change in consumers' expectation of price and income**

When consumers expect higher future price of a product, for example due to poor harvest in the past rainy season, they would buy more today to avoid unnecessary expenditure in the future. This causes an increase in current demand for the product and shifts the demand curve to the right.

A change in the expectations concerning future income may also prompt consumers to change their current spending, but its impact would depend on the nature of the product. Expectation of higher income will induce consumers to buy more of a normal good but less of an inferior good.

5. **Effects of change in number of buyers**

When number of buyers increase in a market, then the demand will increases. For example, improvements in communications have increased the demand for stocks and bonds due to an increase in the number of participants internationally. Population growth in a country also increased the demand for food stuffs.

D. Supply schedule, curve and function

Supply indicates the various quantities of a product that sellers (producers) are willing and able to provide at each of a series of possible prices in a given period of time, other things remain unchanged. Like demand, supply can be represented by a schedule, curve or a function.

As opposed to demand, as price rises, the respective quantity supplied also rises and vice versa. This direct (positive) relationship between the price of a product and quantity supplied, ceteris paribus, is called the law of supply.

Supply Curve
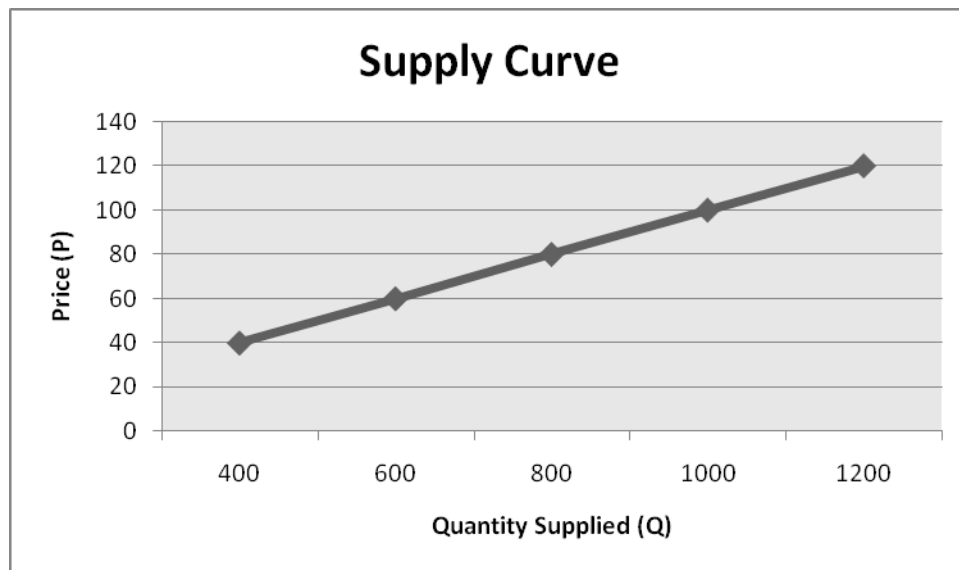
The law of supply: states that, other things constant, as price of a product increase, quantity supplied of the product increase and as price decreases, quantity supplied also decreases. Price is an obstacle from the standpoint of the consumer, who is on the paying end. The higher the price the less the consumer will buy. But the supplier is on the receiving end of the product's price. To a supplier, price represents revenue which serves as an incentive to produce and sell a product. The higher the price, the greater this incentive and the greater the quantity supplied.

E. Individual and market supply

The market supply schedule or curve indicates the total market supply of a product that all sellers in the market are willing and able to provide in a given period of time. It is derived by horizontally adding the quantity supplied of the product by all sellers at each price.

F. Determinants of supply

The supply curve is drawn on the assumption that all factors except own price are fixed and do not change. If one of them does change, a change in supply will occur and so the entire supply curve will shift.

Basic non-own price determinants of supply are or supply shifters are:

1. Prices of inputs (resources)

2. Technology

3. Taxes and subsidies

4. Prices of related goods

5. Price expectations of sellers

6. Number of sellers in the market

7. Weather

1) Resource prices

Higher resource prices will raises production costs, and assuming a fixed product price, high production cost squeeze profits. This reduction in profits reduces the incentive for firms to supply output at each product price so that resource prices and supply are inversely related.

2) Technology

Improvements in technology enable firms to produce more units of output with fewer resources. Because resources are costly, using fewer of them will lowers production costs and increases supply, thus, if there happens to be technological progress, sellers would be willing and able to produce and provide more of their product at each price than before. Therefore, technological advancement shifts the supply curve outwards (to the right).

3) Taxes and subsidies

Businesses treat most taxes as costs. An increase in sales or property taxes will increase production costs, hence will reduce supply. In contrast, subsidies are taxes in reverse. If the government subsidizes the production of a good, it in effect lowers the producers' costs and increases supply.

4) Prices of related goods

Firms that produce a particular product, say, leather jackets, can sometimes use their plant and equipment to produce alternative goods like leather shoes. The higher prices of these alternative goods like leather shoes may induce leather jacket producers to switch production in order to increase profits. This substitution in production results in a decline in the supply of leather jackets.

5) Price expectations of sellers (expected selling price)

Changes in expectations about the future price of a product may affect the producers' current willingness to supply of the product. It is difficult, however, to generalize about how a new expectation of higher prices affects the present supply of a product. Farmers expecting a higher teff price in the future might withhold some of their current teff harvest from the market, thereby "causing a

decrease in the current supply of teff". In contrast, in many types of manufacturing industries, newly formed expectation that price will increase may induce firms to add another shift of workers to expand their production capabilities, "causing current supply to increase".

6) Number of sellers

Other things equal, the larger the number of suppliers, the greater the market supply, as more firms enter an industry, the supply curve shifts to the right and vice versa.

7) Weather conditions

A change in weather condition will have an impact on the supply of a number of products, especially agricultural products. Other things equal, good weather condition will increase the supply of maize and so the curve shifts outward. That is, at each price, sellers are willing and able to provide more maize than before. Bad weather will have the opposite impact.

2.1.3 Market equilibrium

Market brings supply and demand together to decide how the buying decisions of households and the selling decisions of businesses interact to determine the price of a product and the quantity actually bought and sold. We assume a competitive market – neither buyers nor sellers can set the price.

The market demand and supply of maize per week

Market demand (in quintal)	Price (per quintal)	Market supply (in quintal)	Surplus (+), shortage (-)
400	120	1200	(+) 800
600	100	1000	(+) 400
800	80	800	0
1000	60	600	(-) 400
1200	40	400	(-) 800

Surpluses (+) or ($Q^s > Q^d$): Buyers can buy whatever amount they want to buy but sellers cannot sell all they want to. For example, at the price of Birr 120 per quintal, sellers are willing and able to supply 1,200 quintals per week but buyers are willing to purchase only 400 quintals leading to a surplus of 800 quintals. Surplus is the excess of supply over demand. Surplus or unsold output in the hands of the sellers increases the competition among sellers and this pushes the price down.

Shortages (-) or (Q^d^>Q^s^): Buyers cannot buy what they want to buy, but sellers sell all they want to sell. Hence buyers are dissatisfied, but sellers are satisfied. Let's jump to Birr 40 per quintal. This lower price encourages buyers to buy more but discourages sellers of maize. Buyers are willing and able to purchase 1200 quintals while sellers are ready to sale only 400 quintals only. This results in a shortage of 800 quintals. <u>Shortage is the result of excess demand over supply</u>. The existing level of shortage creates competition among buyers and this pushes the price up.

Equilibrium price and quantity (Q^s^=Q^d^): competition between buyers and sellers drive price to equal at birr 80, total quantity demanded is equal to total quantity supplied i.e. the total market demand equals the total market supply. At this price, there is neither shortage nor supply. <u>Economists call this price the market clearing or equilibrium price</u>, "equilibrium" meaning "in balance" or "at rest". At birr 80, quantity supplied and quantity demanded are in balance at the equilibrium quantity of 800. Equilibrium quantity is the quantity which is actually bought and sold at the equilibrium price.

The equilibrium price and equilibrium quantity can also be shown graphically.
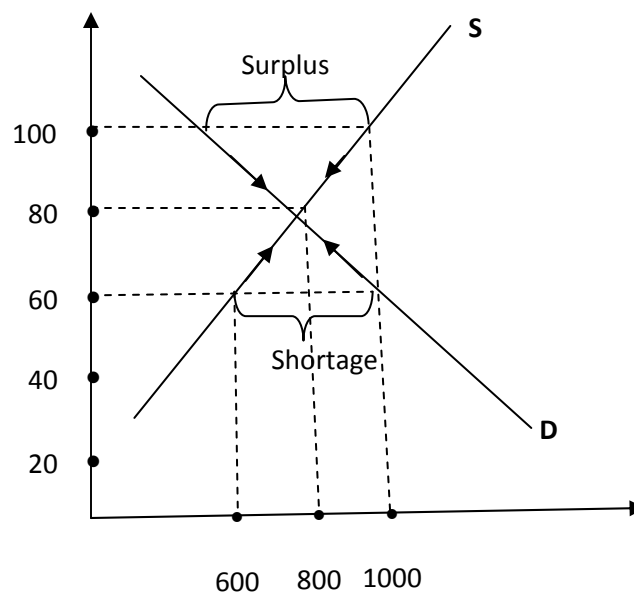
Graphically, the intersection of the supply curve and the demand curve indicates the market equilibrium for that product.

<u>Mathematically</u>:

Consider that there are 200 identical buyers of wheat in a market with an individual demand function of $Q_{dw} = 8 - P_w$, ceteris paribus, where Q_{dw} is quantity demanded for wheat by individual buyer and P_w is price of wheat. There are also 100 identical sellers of wheat with an

individual supply function of $Q_{sw} = 2P_w$, other things constant (Q_{sw} is quantity supplied of wheat by individual seller and P_w is price of wheat).

Question: Formulate the market demand and supply functions and calculate the equilibrium price and quantity.
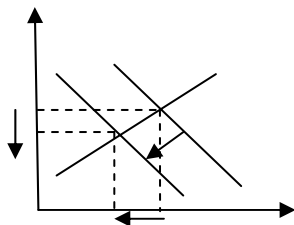
Changes in Supply, Demand and Equilibrium

i.   When demand changes wile supply remaining unchanged
    a.   When demand increases
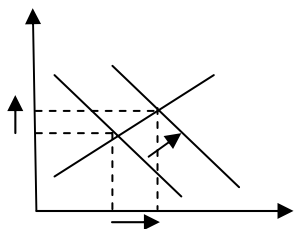
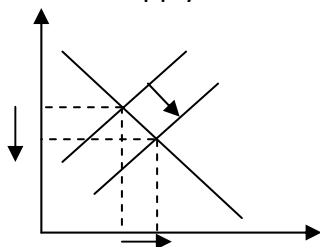- Demand shifts to the right
- Equilibrium price increases
- Equilibrium quantity increases

    b.   When demand decreases

- Demand shifts to the left
- Equilibrium price decreases
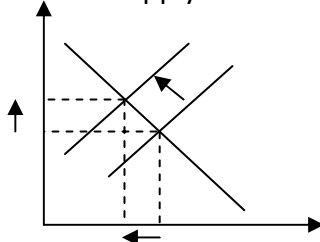- Equilibrium quantity decreases

ii.   When Supply changes while demand remaining constant
    a.   When supply increases

- Supply shifts to the right
- Equilibrium price decrease
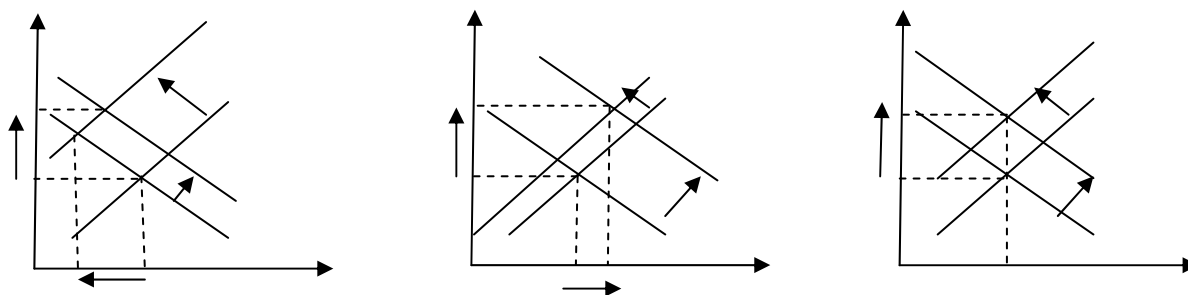- Equilibrium quantity increases

    b.   When supply decreases

- Supply shifts to the left
- Equilibrium price increases
- Equilibrium quantity decrease

iii.   When both demand and supply change
    a.   When Demand increases and supply decreases

In all cases, equilibrium price increases. But the impact on equilibrium quantity is indeterminate. I.e. it is determined by the extent of changes (shifts) in demand and supply.

    b. When demand decreases and supply increases

In this case equilibrium price will decrease and that of quantity remains indeterminate. (Show)

    c. When both supply and demand increase

Equilibrium price will be indeterminate while equilibrium quantity increases. (Show)

    d. When both demand and supply decreases

Equilibrium price will be indeterminate while equilibrium quantity decreases. (Show)

Summary of the analysis:

Supply	Demand		
	Increase	No change	Decrease
Increase	P? Q↑	P↓ Q↑	P↓ Q?
No change	P↑ Q↑	$\overline{P}$ $\overline{Q}$	P↓ Q↓
Decrease	P↑ Q?	P↑ Q↓	P? Q↓

2.1.4. Elasticity of Demand and Supply

Price elasticity of demand (e_d):

The law of demand simply states that quantity demanded decrease (increase) as price of goods and services increases (decreases). It, however, says nothing about the magnitude of change in quantity demanded. Extent of change in quantity demanded is embedded in the concept of elasticity.

Elasticity is a measure of responsiveness of quantity demanded to changes in the price of a good. It is simply the percentage change in quantity demanded for a one percent change in the price of a good.

Mathematically,

$$\varepsilon_d = \frac{percentage\ change\ in\ quantity\ demanded}{percentage\ change\ in\ price} = \frac{\%\Delta Q}{\%\Delta P}$$

$$= \frac{change\ in\ quantity\ demanded}{original\ quantity\ demanded} \div \frac{change\ in\ price\ original}{original\ price}$$

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

Where Q and P are original quantity demanded and price respectively.

When elasticity is computed, changes in quantity and prices are expressed as percentages. Hence, the elasticity number is unit free, i.e., it doesn't depend on unit of measurement.

Example: When price of wheat falls from 4 birr to 2 birr, the quantity demanded raised to 8 from 6 quintals. Find elasticity.

Ans: $\varepsilon_d = -\frac{2}{6}$

N.B. − Price elasticity of demand is negative because of the law of demand.

   - Conventionally, we ignore the sign by taking in absolute terms

$$\varepsilon_d = \left| \frac{\%\Delta Q}{\%\Delta P} \right|$$

Classification of price elasticity of demand

Price elasticity of demand can be classified into elastic, inelastic and unitary elastic.

1. <u>Elastic demand ($\%\Delta Q > \%\Delta P$):</u> demand is said to be price elastic if the price elasticity of demand is greater than unity (one). That is, the percentage change in quantity demanded exceeds the percentage change in prices. In other words, if the price elasticity of a good is greater than one, then demand is termed as price elastic,

$$\varepsilon_d = \left| \frac{\%\Delta Q}{\%\Delta P} \right| > 1 \rightarrow elastic\ demand$$

This implies that change in prices of a good has greater effect on quantity demanded. Quantity is sensitive to changes in prices.

E.g. luxurious goods have elastic demand

The demand for a product may be perfectly elastic. This means that a minute change in price of a good will result in an infinitely large change in quantity demanded. The demand curve for such goods is horizontal implying that a small change in prices will lead to an infinite change in quantity.

A small change in price will lead to larger (infinite) changes in quantity demanded

2. Inelastic demand ($\%\Delta Q < \%\Delta P$): If the price elasticity of demand has been zero and one (zero included), then demand is said to be price inelastic.

Formally,

$$0 \leq \varepsilon_d < 1 \text{ or } 0 \leq \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} < 1 \rightarrow \text{inelastic demand}$$

When demand is inelastic, a change in price has little impact on quantity demanded. That is, demand is weakly responsive to changes in prices.

Price elasticity of demand may be perfectly inelastic. Under such situation, the demand curve would be vertical. Demand is completely non-sensitive to changes in price.

The vertical demand curve indicates that if price changes, there will be no change in quantity demanded. That is no matter what the change in price, demanded remains the same.

Example: demand for insulin

$$e_d = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} \approx 0$$

3. Unitarily elastic demand ($\%\Delta Q = \%\Delta P$): If the price elasticity of demand is equal to one, then demand for a good is said to be unitary elastic.

Formally,

$$e_d = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = 1$$

In other words, the percentage change in quantity demanded equals the percentage change in price.

Example: If 200% increase in price of a good decrease the quantity demanded by 200%, elasticity will be unit elastic.

Summary

Elasticity	Classification	Interpretation
$0 \leq e_d < 1$	Inelastic	($\%\Delta Q < \%\Delta P$)
$e_d = 1$	Unitary elastic	($\%\Delta Q = \%\Delta P$)
$e_d > 1$	Elastic	($\%\Delta Q > \%\Delta P$)

Determinants of Price Elasticity of Demand

What determines the price elasticity of demand for a product?

a) Availability of substitutes:

In general, the more and better substitutes exist for an item, the more elastic its demand will be. A perfectly elastic demand has many perfect substitutes. On the contrary, a perfectly inelastic demand has virtually no substitutes.

Example, demand for taxi service (of one driver).

b) Proportion of income consumers spend on a commodity:

If consumers spend a large proportion of their income on a given item, then that item has price elastic demand.

E.g. Food in large family (with so many children), i-pod, etc.

On the other hand, if consumers spend less of their income on a particular item, then the demand for that item is inelastic.

Example, Matches

c) Adjustment time

Demand tends to be more elastic with longer time over long periods; consumers will have more time to adjust their consumption patterns in response to price changes, that, is, find substitutes.

Example, A permanent increase in price of gasoline leads to development of substitutes (solar, thermal, etc.) energy sources. But in shorter period, it is difficult to develop substitutes.

d) General Vs Specified

The more narrowly defined the product, the greater the number of substitutes and the higher the elasticity of demand. Example, Pepsi Vs soft drinks, Chevrolets Vs automobile, taxi Vs transport service, etc

Calculating Price Elasticity of Demand

Price elasticity of demand can be measured at a point or between two points.

a) Point elasticity: is elasticity measured at a single point or for arbitrarily small changes.

$$point\ elasticity\ of\ demand = \frac{Distance\ of\ the\ point\ from\ Q\ axis}{Distance\ of\ the\ point\ from\ the\ P\ axis}$$

With both distances measured along the demand curve.

Example
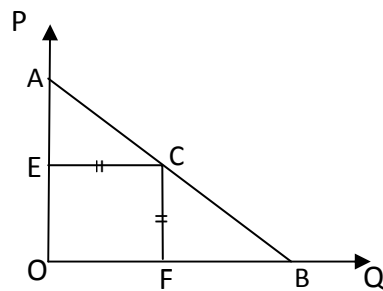
$$\varepsilon_d = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

$$but\ \frac{\Delta Q}{\Delta P} = \frac{EC}{AE} = \frac{OF}{AE}$$

$$\frac{P}{Q} = \frac{OE}{OF}$$

$$\varepsilon_d = \frac{OF}{AE} \cdot \frac{OE}{OF} = \frac{OE}{AE} = \frac{CF}{AE}$$

But the triangles ΔAEC and ΔCFB are similar

$$\Rightarrow \frac{CF}{AE} = \frac{CB}{AC}$$

$\Rightarrow \varepsilon_d = \dfrac{CB}{AC}$ This is applicable if you have the demand function for some good X or

at least the demand curve for some given level of price and quantity, i.e.

$$\varepsilon_d = \frac{1}{Slope} \cdot \left(\frac{P}{Q}\right)$$

b) <u>Arc elasticity</u>: It is an elasticity measured between two points on a demand curve.

Elasticity is defined as:

$$\varepsilon_d = \left| \frac{\Delta Q}{\Delta P} \frac{P}{Q} \right|$$

The quantities ΔQ and ΔP are easy to define (as $\Delta Q = Q_2 - Q_1$ and $\Delta P = P_2 - P_1$). But the question arises as to what values of Q and P we use. Are we supposed to take the beginning or final values or some average?
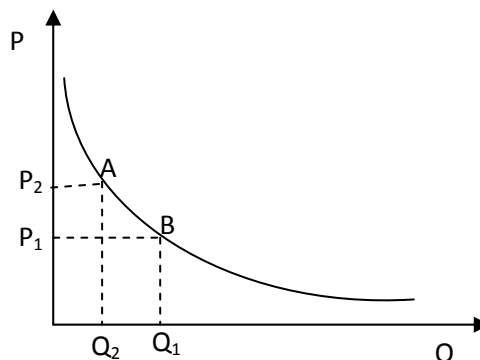
The most convenient way is to use the average of the initial and final values.

Example 1: Let the initial point be (Q_1, P_1) and final point (Q_2, P_2), then

$$\varepsilon_d = \frac{\Delta Q}{\Delta P} \cdot \frac{(P_1 + P_2)/2}{(Q_1 + Q_2)/2} = \frac{Q_2 - Q_1}{P_2 - P_1} \cdot \frac{P_1 + P_2}{Q_1 + Q_2}$$

This is the formula to find arc elasticity of demand between 2 points.

Geometrically:

$$Arc\_\varepsilon_d = \frac{Q_2 - Q_1}{P_2 - P_2} \left(\frac{P_1 + P_2}{Q_1 + Q_2} \right)$$

N.B. As the gap between point A and B approaches zero, arc elasticity becomes closer to point elasticity.

Example 2: Suppose that the price of a quintal of wheat rises from 200 Birr to 300 Birr and as a result the quantity of wheat demanded declined from 100 to 90 quintals.

Given: (Q_1, P_1) = (100, 200) and (Q_2, P_2) = (90, 300)

Arc $\varepsilon_d = \left| \dfrac{\Delta Q}{\Delta P} \times \dfrac{P}{Q} \right| = \left| \dfrac{90-100}{300-200} \right| \times \left| \dfrac{200+300}{100+90} \right| = \dfrac{10}{100} \times \dfrac{500}{190} = \dfrac{5}{9}$ (show for what would be if we use initial or final price and quantity).

Price Elasticity of Demand and Slop

The slop of the linear demand curve is constant from point to point, with $Slop = \dfrac{\Delta P}{\Delta Q}$.

However, since $\dfrac{Q}{P}$ is not constant, the demand elasticity will be different at different points on the non-linear demand curve.

Example: The quantity demanded is related to price by the following equation:

$Q^d = a - bP$ For all b>0

$$Slop = \dfrac{\Delta P}{\Delta Q} = \dfrac{1}{\dfrac{\Delta Q}{\Delta P}} = -\dfrac{1}{b}$$

$$\varepsilon_d = -\dfrac{1}{Slop} \times \dfrac{P}{Q} = -b\left(\dfrac{P}{a-bP} \right) = \dfrac{-bP}{a-bP}$$

Example: $Q^d = 10 - 2P$ Calculate price elasticity of demand at prices of 2 and 4, and show that the above formula holds.

Price Elasticity of Demand along the Demand Curve

Price elasticity of demand varies continuously along a linear demand curve. It will be higher at higher price (lower output), equal to one at the mid point of a demand curve and it will be lower at lower price (higher output) levels.

Graphically:

N.B Elasticity is the ratio of the distance from point F to Q_c (point on the demand curve) to the distance between E and the point on the curve.
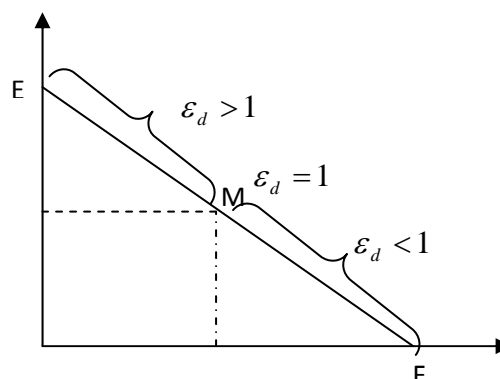
Price Elasticity of Demand and Total Revenue and Expenditure

Total expenditure (TE): is the product of the amount of goods and services purchased and their price during the period. i.e.

$$TE = P \times Q$$

Total revenue (TR): is the amount sold multiplied by the price over a given time period

$$TR = P \times Q$$

Note: Expenditure by buyers represents revenue for sellers.

Example:

	Price	Quantity	TE=TR	Change in TR (=MR)
A	12	1	12	
B	10	2	20	8
C	8	3	24	4
D	6	4	24	0
E	4	5	20	-4

The Effect of Price Change on Total Expenditure and Total Revenue

What will happen to TR/TE when price changes? The increase in price increases total consumer expenditure by increasing the P component of PQ. But the law of demand indicates that as price increase, quantity demanded will decrease, i.e. the Q component of PQ declines as P increases. Hence, we have two opposing forces acting on TR/TE (=PQ) as price increases. The net effect of price increases on PQ depends on price elasticity of demand, which tells us about the relative magnitude of the two effects.

a) <u>Inelastic Demand</u>: When demand is price inelastic, the percentage reduction in quantity demanded lowered by the price increase would be smaller than percentage increase in price (%ΔQ < %ΔP). This shows that the upward influence of price increase on total expenditure is stronger than the downward pressure of the reduction in quantity demanded on revenue/expenditure.

$$\Rightarrow P \uparrow \rightarrow TR/TE \text{ (=PQ) } \uparrow$$

$$\Rightarrow P \downarrow \rightarrow TR/TE \text{ (=PQ) } \downarrow$$

I.e. the net effect of price increase on TR/TE is increase and the net effect of price decrease on TR/TE is a decline.

b) <u>Unit Elasticity of Demand</u>: When demand is unitary elastic, any given percentage income in price will result in exactly an equal percentage reduction in quantity demanded. In other words, the upward force equals the downward force and the net effect would be no change in total revenue/total expenditure (as %ΔQ = %ΔP)

$\Rightarrow$ P$\uparrow$ or P$\downarrow$ $\Rightarrow$ no change/effect on TR/TE

c) <u>Elastic Demand</u>: When demand is price elastic, the percentage reduction in quantity demanded caused by price increase would be greater than the percentage increase in price (%ΔQ > %ΔP). This implies that the upward pressures on total revenue/total expenditure caused by price increase would be more than off-set by the downward pressure on total revenue/total expenditure resulting from the reduction in quantity demanded.

$\Rightarrow$ P$\uparrow$ $\rightarrow$ TR/TE (=PQ) $\downarrow$

$\Rightarrow$ P$\downarrow$ $\rightarrow$ TR/TE (=PQ) $\uparrow$

In summary, the net effect of price increase and decrease is:

Price elasticity of demand	Implication	Effects on TR/TE	
		Price increase	Price Decrease
Elastic	%ΔQ > %ΔP	(–)	(+)
Unitary elastic	%ΔQ = %ΔP	(0)	(0)
Inelastic	%ΔQ < %ΔP	(+)	(-)

Marginal Revenue (MR) is a change in total revenue when the quantity sold change by a small amount. That is:

$$MR = \frac{\Delta TR}{\Delta Q}$$

$$= \frac{dTR}{dQ} = \frac{d(P.Q)}{dQ}$$

$$= \frac{QdP \times PdQ}{dQ}$$

$$= p + Q\frac{dP}{dQ}$$

But we know that $\varepsilon = \dfrac{dQ/Q}{dP/P} \Rightarrow \varepsilon \cdot \dfrac{Q}{P} = \dfrac{dQ}{dP} \Rightarrow \dfrac{dP}{dQ} = \dfrac{P}{\varepsilon \cdot Q}$

Using this result in the above analysis will give us:

$$MR = P + Q\left(\dfrac{P}{\varepsilon \cdot Q}\right)$$

$$MR = P\left(1 + \dfrac{1}{|\varepsilon|}\right)$$

We can establish the relationship total revenue and elasticity of demand as:

1. If $\left|\varepsilon^d\right| > 1$ (elastic), MR>0 and total revenue will be increasing

2. If $\left|\varepsilon^d\right| < 1$ (inelastic), MR<0 and total revenue will be decreasing

3. If $\left|\varepsilon^d\right| = 1$ (unitary elastic), MR=0 and total revenue will not change.

Other Elasticity Concepts

Elasticity can be defined with respect to any two related variables. There are two more important elasticities of demand, namely, income elasticity of demand and cross-price elasticity of demand.

a) <u>Income elasticity of demand</u> (ε_y): It measures the sensitivity of consumer purchases for a given percentage change in income, ceteris paribus. It can be defined as:

$$\varepsilon_y = \dfrac{\Delta Q}{\Delta Y} \times \dfrac{Y}{Q} \text{, where Y=income and Q=quantity demanded.}$$

ε_y Measures the percentage change in the number of units of a good demanded, when income changes by one percent, ceteris paribus.

Example: ε_y =2.3 imply that a 1% increase in income leads to a 2.3% increase in quantity demanded, ceteris paribus.

When computing ε_y, we don't take it in absolute term since its sign is of interest. Income elasticity of demand could be positive or negative.

i. <u>Positive income elasticity</u>: such income elasticity indicates that increases in income are associated with increase in the quantity of goods purchased. Such goods with ε_y >0 are <u>normal/superior goods</u>.

Normal goods are also further classified into necessities and luxuries. A good is said to be necessity if its income elasticity is positive and less than one, i.e.

$0 < \varepsilon_y < 1$

E.g. the demand for *injera*

This means that the quantity demanded for a product increases when income increases, but less than proportionately. People will spend a similar fraction of their additional income on such goods.

If income elasticity of demand exceeds one, then the good is called luxury good, i.e. if $\varepsilon_y > 1$, then this means people will spend a larger fraction of their income on luxury items.

ii. Negative income elasticity: A negative income elasticity of demand implies an inverse relationship between income and the amount of the good purchased. Goods that have negative income elasticity of demand are called inferior goods.

b) Cross-Price Elasticity of Demand ($\varepsilon_{y.P_X}$):

It is used to measure the sensitivity of consumer purchase of one good to changes in the price of another good.

Example: The elasticity of demand for good *Y* with respect to the prices of good *X* measures responsiveness of demand for *Y* to a change in the prices of *X* and is defined as:

$$\varepsilon_{y.P_X} = \frac{\Delta Q_Y}{\Delta P_X} \times \frac{P_X}{Q_y}$$

Example: A cross-price elasticity of $\varepsilon_{y.P_X}$ = -1.4 means that a 1% increase in the price of good *X* leads to a 1.4% reduction in the demand for good *Y*.

Again the sign of the elasticity is important. A positive cross-price elasticity of demand means that an increase in P_X leads to an increase in the demand of good *Y* (or decrease in quantity demanded of good *X*), ceteris paribus. Hence, the two goods are substitutes.

Negative cross-price elasticity on the other hand implies that an increase in P_X causes a reduction in quantity demanded of good *Y*. Hence, the two products are complements. (e.g. tea and sugar, shoe and socks, etc.)

Note: Two goods (X and Y) have two cross-price elasticities;

i) $\varepsilon_{y.P_X}$ - elasticity of demand for Y with respect to P_X

$$\varepsilon_{y.P_X} = \frac{\Delta Q_Y}{\Delta P_X} \times \frac{P_X}{Q_y}$$

ii) $\varepsilon_{x.}P_y$ - elasticity of demand for X with respect to P$_Y$

$$\varepsilon_{x.}P_y = \frac{\Delta Q_X}{\Delta P_Y} \times \frac{P_Y}{Q_X}$$

These two elasticities need not be equal. If cross-price elasticities are zero ($\varepsilon_{y.P_X} = \varepsilon_{x.}P_y = 0$), then the two goods are independent/unrelated.

Price Elasticity of Supply (ε_S)

The law of supply simply tells us that as price increase or decrease, the quantity supplied will increase or decrease, respectively. But the law doesn't tell us anything about how much does quantity supplied increase or decrease as price increase or decrease by a given amount. Supply elasticity tells us about the magnitude change in quantity supplied as price change.

Definition: The price elasticity of supply is a number used to measure the sensitivity of change in quantity supplied to a given percentage change in the price of a good. Alternatively, it can be defined as the percentage change in quantity supplied resulting from a 1% change in price, ceteris paribus. That is:

$$\varepsilon_s = \frac{\%\Delta Q^s}{\%\Delta P} = \frac{\Delta Q^s}{\Delta P} \times \frac{P}{Q^s}$$

ε_s is always positive $\Rightarrow$ no need for absolute value sign.

Classification of Price Elasticity of Supply: it can be classified into elastic, inelastic or unitary elastic.

i) Elastic supply: if ε_s is greater than one, then supply of an item is said to be elastic (i.e. ε_s >1).

Supply of an item may be perfectly elastic. The shape of elastic supply curve is horizontal.

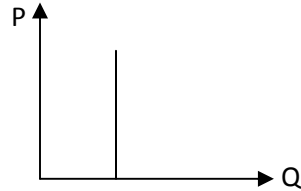ε_s =∞ i.e. a small change in price will lead to an infinite change of quantity supplied by firms.
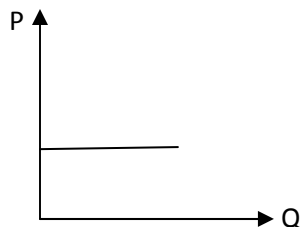
ii) Inelastic supply: if the price elasticity of supply is equal or greater than zero but less than one, then supply is said to be price inelastic.

Mathematically;

$0 \leq \varepsilon_s < 1$

Price elasticity of supply may be perfectly inelastic, i.e. $\varepsilon_s = 0$, which is completely unresponsive to price change.

iii) Unitary Elasticity of Supply: if the price elasticity of supply is equal to one ($\varepsilon_s = 1$), then supply is said to be unitary elastic.

Determinants of Elasticity of Supply:

i.   Time

ii.   Availability of factors of production (resources)

iii.   Possibility of switching production to other products

2.2. Utility and Consumer Equilibrium[*]

2.2.1. Utility and Equilibrium in Consumption

A consumer buys goods and service because it has utility to him/her. Utility is the amount of satisfaction to be obtained from a good or service at a particular time. Utility has nothing to do with usefulness nor does it have any ethical connotation. Moreover, utility of a good varies from person to person.

According to the cardinal approach, utility can be measured and its unit of measurement is 'util'. In the ordinal approach, on the other hand, utility cannot be measured but it can be compared. Following the cardinal approach and assuming that the consumer consumes n different goods and services, then total utiity (U) is the sum of utilities obtained by consuming the various units of good and services. i.e.

$$U = U_1 + U_2 + ... + U_n$$
$$= f_1(q_1) + f_2(q_2) + ... + f_n(q_n)$$

where q is quantity purchased.

[*] Ayele K. (2006), Basic Economics, first edition, Addis Ababa, Ethiopia.

The additional satisfaction received over a given period by consuming one more unit of a good is known as marginal utility (MU).

A rational and utility maximizing consumer consumes goods and services in order of their utilities. Consumer equilibrium is established when the marginal utilities per money spent are equal on each good purchased and his/her money income available for the purchase of the goods has been used up completely. That is:

$$\frac{MU_A}{P_A} = \frac{MU_B}{P_B} = ...$$

Provided that:

$$P_A Q_A + P_B Q_B + ... = Y$$

Where MU_A – marginal utility of good A and MU_B – marginal utility of good B

P_A – price of A and P_B – price of B

Q_A – quantity of A and Q_B – quantity of B

Y – Consumer income.

2.2.2. Law of Diminishing Marginal Utility

The law of diminishing marginal utility states that *the marginal utility of a good declines as more of it is consumed, over any given period*. For example, if a consumer drinks five bottles of cock, the amount of utility obtained from drinking the second bottle is less than that of the first; the 3rd is less than that of the 2nd and so on.
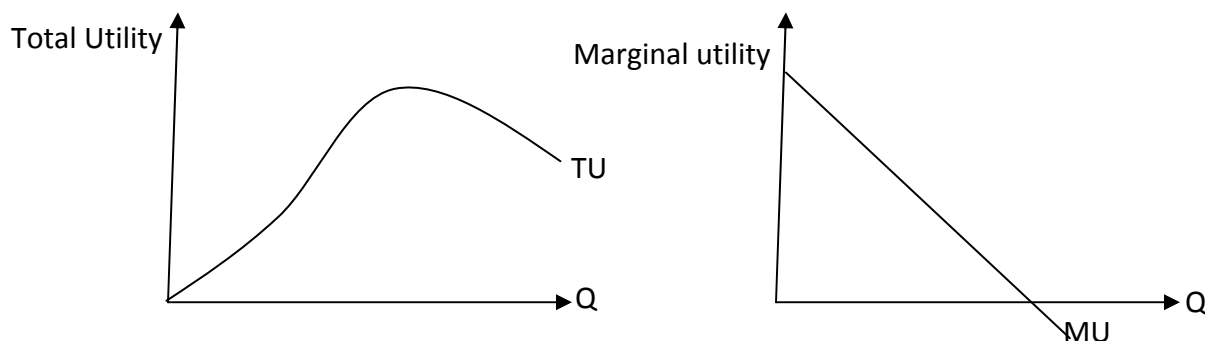
2.2.3. Consumer Surplus

Consumer surplus is the difference between what a consumer pays for some good or service and what s/he would have been willing to pay. The price a consumer pays for a good measures only the MU but not the total utility. Only for the marginal unit which a consumer is just ready to buy price is exactly equal to the satisfaction that s/he expects to get for that unit.

2.2.4. Indifference Curve

In the indifference curve analysis the emphasis is on comparing different utility levels instead of measuring them through cardinal scale. An indifference curve is a locus of points each showing a different combination of two goods which yield the same satisfaction to the consumer. For example the table below shows combination of two goods, good A and good B, between which a consumer is indifferent.

Combination	Units of good A	Units of good B
a	24	4
b	12	8
c	8	12
d	6	16
e	5	20

Moving from one combination to another, the consumer is substituting one good for the other but maintaining a constant level of utility derived from them. The rage at which the consumer substitutes one good for the other so as to remain equally satisfied is the slop of the indifference curve. It is known as the marginal rate of substitution:

$$MRS_{BA} = -\frac{\Delta Q_A}{\Delta Q_B}$$, Marginal rate of substitution of B for A.

Characteristics of indifference curve

    a. An indifference curve slops downward from left to right
    b. An indifference curve is convex to the origin
    c. Indifference curves do not intersect nor they are tangent to one another
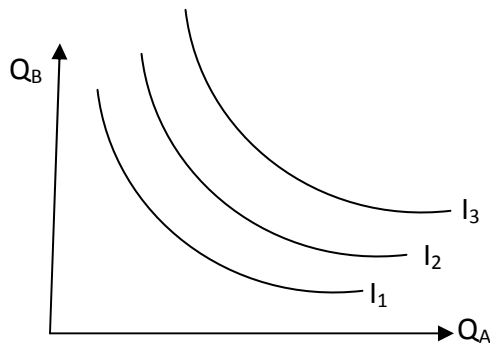
Indifference curves by themselves cannot tell us which combination is to be chosen. In addition to his/her desire, the consumer must have the capacity to pay for the goods. The consumer's

capacity which is indicated by the budget line is determined by his/her income and the prices of the goods.

Budget line: $Y = P_A Q_A + P_B Q_B$. The budget line divides the area between quantity of A and quantity of B axes into feasibility area and non-feasibility area.
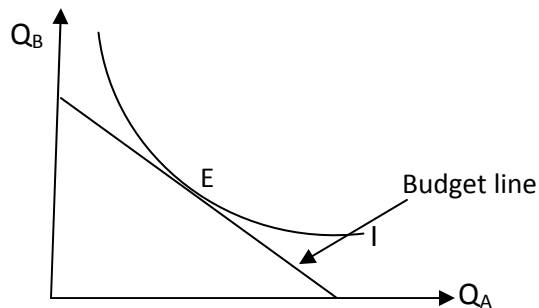
The utility maximization rule

Consumer equilibrium is established on the highest attainable indifference curve. For example, in the figure above consumer utility is at point E. At this point, the slop of the highest attainable indifference curve is equal to the slop of the budget line. This is so because the two ate tangent to each other.

$$\Rightarrow \frac{MU_B}{MU_A} = \frac{P_B}{P_A}$$

2.3. Theory of Production and Costs

2.3.1. Theory of Production

Theory of production shows how economic resources are combined to produce commodities. In economics, the process by which inputs or factors of production (such as labour, equipment, etc.) are combined, transformed and turned into outputs is called <u>Production</u>.

An <u>input</u> is any good or service, such as labour, capital, land and entrepreneurial ability that contribute to the production of a product. The produced product is called <u>output</u>.

Output can be produced in different ways:

   i) Labour intensive technology: a technology that relies heavily on human labor rather than capital. E.g. large number of farmers using small shovels and their hand to cultivate five hectares of land.

   ii) Capital intensive technology: a technology that heavily relies on capital than human labor. E.g. three farmers cultivating five hectares of land using different machines.

In production activity there is a certain kind of relationship between inputs and outputs. And the relationship between any combination of inputs and the maximum output obtainable from

that combination, expressed numerically, is called a <u>Production Function.</u> It is a technical relationship that summarizes the land of technology for producing an output.

Mathematically: $y = f(L, K)$ where y = output, L = labour and K = capital.

Tabular production function:

Labour units	Total product	Average product
0	0	
1	10	10
2	25	12.5
3	35	11.67
4	40	10
5	42	8.4
6	42	7

The Short Run and the Long Run

A firm uses various inputs (factors of production) in a production process. And depending on the duration of the time considered, inputs are categorized as <u>fixed</u> and <u>variable</u> inputs.

- Fixed Inputs: are those factors of production for which the supply can not be changed over a short period. Thus, fixed inputs are inputs which do not change in quantity when output changes in a given short period. (e.g. Buildings, machineries, etc.)

- Variable Inputs: are inputs for which the supply can change in response to the desired change in output in a short time. These inputs change in quantity to effect change in output. (e.g. labour)

The distinction between the two inputs is the time that is under consideration. We have two different periods:

❖ **Short Run**: is a period of time for which the firm is operating under a fixed factor of production. Under this period, at least one input is fixed. In the short run, production can be changed by changing variable inputs, but not fixed inputs. The firm's plant capacity is fixed in the short run, but output can be varied by applying larger or smaller amounts of variable inputs. In the short run, there is a limit to production because there is only limited plant capacity available.

❖ **Long Run**: is a period extensive enough for firms to change the quantities of all resources or inputs employed, including plant capacity. It is a period of time for which there are no fixed factors of production.

Note: the short run and the long run are conceptual rather than specific calendar time periods. The actual period of time encompassing the long run is likely to vary from industry to industry.

E.g. some producers might be able to increase all of their inputs in a month and some might take years to increase the capital inputs required to produce more output.

2.3.2. Production in the Sort Run

Production in the short-run is characterized by the use of some variable inputs and some fixed inputs. Based on the assumption that some inputs, like capital, are fixed in the short run, the relationship between inputs like labour and total output can easily be established.

Total product (TP): is defined as the total quantity of product produced during some period of time by all factors of production employed over that period of time.

Total product curve describes the relationship between the variable input and output, with fixed amount of the other inputs and under current technology.
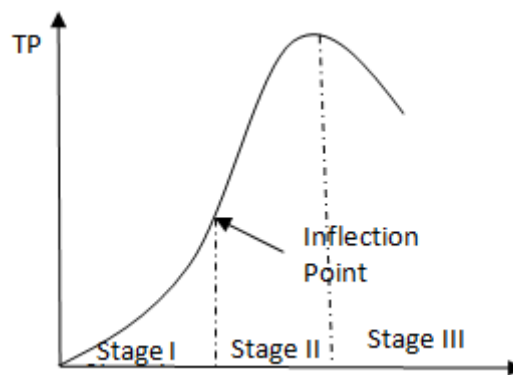
Average Product (AP) is the average amount of output produced by each unit of the variable input.

$$AP_L = \frac{Total\_Product}{Total\_Labor} = \frac{TP}{L}$$

Average product curve shows the relationship between the average product and the variable input.
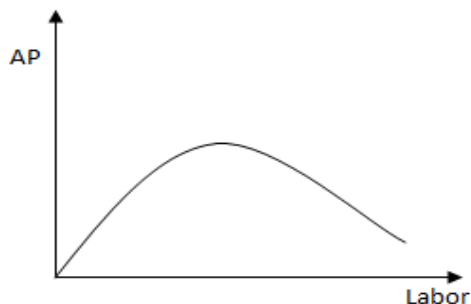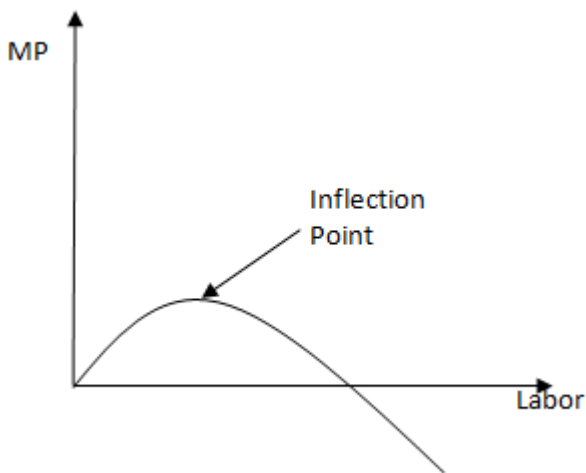

It indicates the productivity of labour (workers). AP_L initially increases, reaches maximum and then decreases but it never reaches zero.

Marginal Product (MP) is the increase in total output resulting from employment of small amount of the variable input.

$$MP_L = \frac{Change\_in\_total\_product}{Change\_in\_amount\_of\_labor} = \frac{\Delta TP}{\Delta L}$$

Marginal product curve:

MP$_L$ initially increasing, reaches a maximum and declines to zero, even to negative values.

Consider the information in the table below.

Total product increases at an increasing rate up to three units of labour (Stage I), in Stage II (i.e. for labor units 4 to 9) total product increases at a decreasing rate and finally output declines in Stage III. When the 9th labor is employed, the rate of increase in output is zero and total product is at its maximum.

Unit of labour	TP$_L$	AP$_L$	MP$_L$	Stages of production
0	0	-	-	
1	8	8	8	Stage I
2	20	10	12	Stage I
3	39	13	19	Stage I
4	52	13	13	
5	60	12	8	Stage II
6	66	11	6	Stage II
7	69	9.9	3	Stage II
8	71	8.9	2	Stage II
9	71	7.9	0	
10	68	6.8	-3	Stage III

Relationship between Total Product and Marginal Product

MP is the change in TP divided by change in labor. This means that MP is the slop of TP curve. The TP first increases, reaches maximum and then declines. This is called the law of <u>diminishing returns</u> or the <u>law of diminishing marginal productivity</u>. (This law starts to effect from the maximum point of MP, i.e. the law applies for the decreasing portion of the MP curve)

This law states that, holding other inputs constant, as variable input is in increased with equal amount, eventually, the addition to total product will decline.

Additional workers will have less of the other inputs, like machines, than earlier workers who had access to ample quantities of the other inputs.

The relationship between TP and MP is:

❖ If MP>0, TP will be rising as labor rises. The additional worker adds something to the total output.

❖ If MP=0, TP will be constant as labor increases. The additional worker does not affect output.

❖ If MP<0, TP will be falling as labor increases. The additional worker actually reduces total output.

The point where MP stops increasing and starts decreasing is called inflection point, because the curvature of the TP curve changes at this point. It is here that diminishing returns start.

AP curve and its relation to MP and TP curve

$$AP_L = \frac{Total\_\Pr oduct}{Total\_Labor} = \frac{TP}{L}$$

Average product of a variable input is represented by the slop of a ray drawn from the origin to a point on the total product curve, corresponding to the given amount of the variable input.
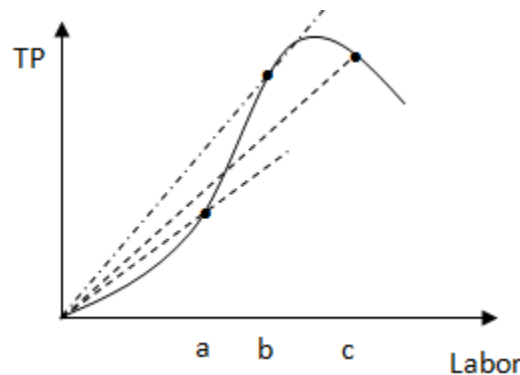
As we increase labor use from 0 units to a, to b and to c units, the lines from the origin to the corresponding points on the TP curve first become steeper, i.e. AP increases, and eventually

flatter, meaning AP will be decreasing. The maximum point on the AP curve corresponds to the slop of the ray from the origin which is tangent to the TP curve.

Remember that marginal product of a variable input is measured by the slop of the tangent line to the total product curve corresponding to the given amount of the variable input. This is because; by definition the marginal product of a given amount of input is the change in output as the variable input changes by a small amount.

So, when AP is maximum, then it is equal to the MP. Then the AP declines as we employ more and more variable inputs beyond this tangency point (MP=AP).

<div align="center">

Stages of Production

</div>

Based on the behaviors of MP and AP, production can be classified into three stages:

Stage I: MP>0, AP is rising. Thus MP > AP

Stage II: MP>0 but AP is falling. MP < AP but still TP is increasing due to MP > 0.

Stage III: MP < 0, TP is falling.

No profit maximizing producer would produce in stages I and III. In stage I, by adding more units of labor, the producer can increase the average productivity of all the units. Thus it would be unwise on the part of the producers to stop production at this stage.
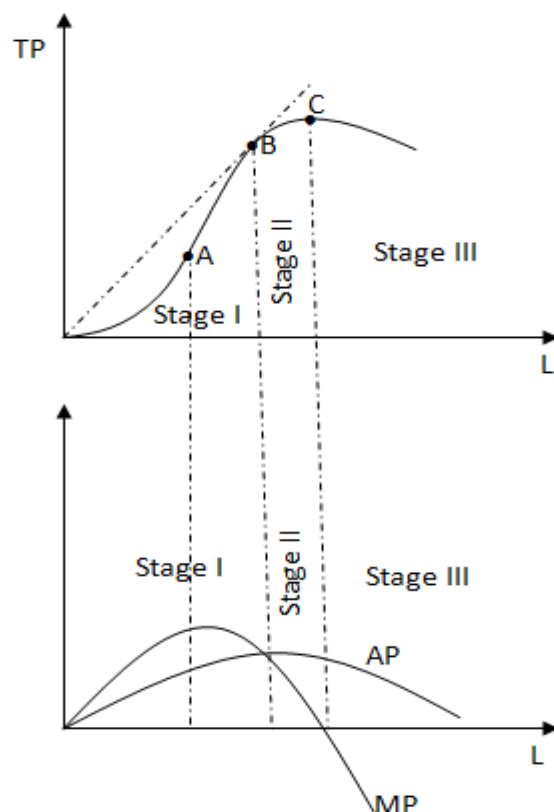
- Point A is inflection point where MP is maximized

- Point B is where AP is maximized, hence AP=MP

- At point C, TP is maximum and MP=0

In stage III, it does not pay for the producers to be in this region because by reducing the labour unit, a producer can increase total output and save the cost of production. Hence, the economically meaningful range is Stage II.

2.2.3 Analysis of Costs in the Short-Run, Fixed, Variable, Total, Average and Marginal Costs

Economic Cost is the monetary value of all inputs used in a particular activity or enterprise over a given period to make goods or services available to users.

The idea behind economic cost of any resource in producing a good is that it must reflect the value of those resources in their best alternative uses i.e. opportunity cost.

Economic cost can be either explicit or implicit.

Economic cost= Explicit cost + Implicit cost

Implicit costs are the values of inputs which are owned by the businessmen.

Explicit costs are the monetary payments or cash expenditures that a firm makes to outsiders who supply inputs.

Accounting Costs are the explicit costs of operating a business (the actual payments that are made).

Due to the different explanation of costs, economists and accountants use the term profit differently.

Accounting profit= Total revenue – explicit cost

= Total revenue – Accounting cost

Economic/pure Profit   = Total revenue – Economic cost

= Total revenue - Opportunity cost of all inputs (implicit and explicit)

Costs in Short-run

In the short-run some resources are fixed and others are variable. This implies that in the short run, costs can be classified as either fixed or variable.

Fixed costs are costs that do not vary with changes in output.

Suppose you are earning 22,000 birr a year as a sale representative for a T-shirt manufacturing. At some point you decided to open a retail store to sell T-shirts on your own. You must invest 20,000 birr of your saving that have been earning an interest of 1000 birr per year. And you decided that to pay 18,000 birr for a clerk.

A year after you open the store, you total up your account and find the following.

Total sell revenue -------------------120000

Cost of T-shirt -------------------- 40000

Clerk's salary -------------------- 18000

Utilities ------------------------- 5000

Total (explicit) cost --------------- <u>63000</u>

Accounting profit ----------------- 57000

Question: calculate the economic profit assuming that your entrepreneurial talent is worth 5,000 birr.

Normal Profit Vs Economic Profit (Pure Profit)

The 5,000 birr is implicit cost of your entrepreneurial talent in the above example, called a normal profit. The payment you could otherwise receive for performing entrepreneurial function is called a normal profit and is an implicit cost. To the accountant, profit is the firm's total revenue less its explicit costs.

To the economist, economic profit is total revenue less economic costs including the normal profit. If a firm's total revenue exceeds all its economic costs, any residual goes to the entrepreneur. The residual is called economic profit or pure profit.

Total fixed cost is the same both at zero level of output and all other level of output.

E.g. building

Fixed costs can not be avoided or changed in the short run.

Firms have no control over fixed costs in the short run and hence they are some times called sunk costs.

<u>**Variable costs**</u> are costs that change with the level of output in the short run.

The total variable cost is the market value of the minimum quantity of the variable inputs consistent with the prevailing technology and factor prices required to produce the various quantities of output.

Various costs can be controlled or altered in the short run by changing production levels.

Therefore, in the short run fixed costs and variable costs together make up total costs.

TC= TFC+TVC

The total cost function: TC=TFC+V (Q)

<u>Cost function</u> expresses the relationship between cost and the corresponding output.

Total Fixed, Total Variable and Total Cost Curves

Total fixed cost curves: is a graph that shows the relationship between total fixed cost and the firm's output.

Since total fixed costs is constant in short run, it is always a horizontal, straight line.

Total variable cost curve: a graph which shows the relationship between total variable cost and the level of a firm's output.

Since more output costs more in total than less output, total variable cost curve has a positive slope.

Total Variable Cost always starts at the origin and rises to the right first at a decreasing rate and then at an increasing rate. This is due to the <u>law of diminishing returns in the short run</u>, as the firm increases production larger and larger amounts of variable input are needed to produce each successive units of output.

Total cost curve: it is a graph that shows the relationship between total cost and the level of a firm's output.

- At zero units of output total cost is equal to the firm's fixed cost. And then for each unit of output total cost varies by the same amount as variable cost. As a result the total cost curve begins from the level of the fixed cost and moves parallel with the total variable cost curve.
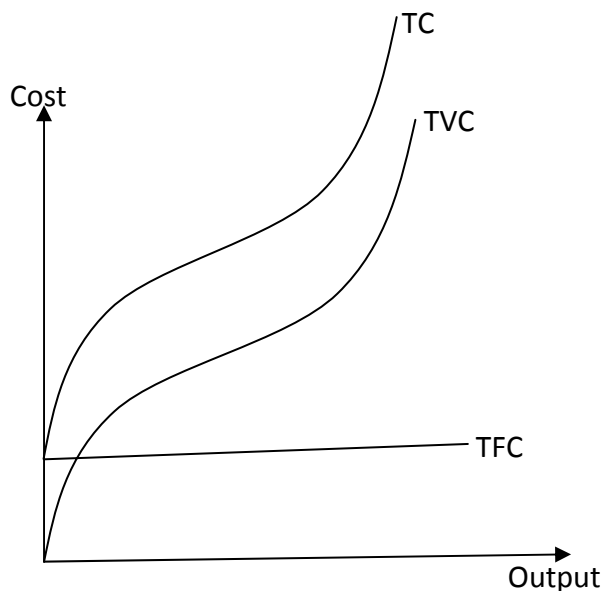
Output	FC	VC	TC
0	200	0	200
1	200	50	250
2	200	90	290
3	200	120	320
4	200	140	340
5	200	150	350
6	200	156	356
7	200	175	375
8	200	208	408

Average costs

Average costs are important as we may make comparisons with product price, which is always stated on per unit basis.

Average fixed costs (AFC): is found by dividing total fixed cost by output.

$$AFC = \frac{TFC}{Q}$$

Since total fixed costs are constant or independent of output, average fixed cost will continuously decline as long as output increases.

Average variable cost (AVC): Is obtained by dividing total variable cost by output.
$$AVC = \frac{TVC}{Q}$$

Since total variable cost reflects the law of diminishing returns, so must the average variable cost because average variable cost is derived from total variable cost.

Due to increasing returns, initially takes fewer and fewer additional variable resources to produce each of the first few units of output.

After AVC hits minimum it will start to rise as diminishing returns require more and more variable resources to produce each additional unit of output.

$\rightarrow$AVC is U-shaped.

Average total cost (ATC): is total cost divided by total output.

$$ATC = \frac{TC}{Q}$$

ATC=AVC+AFC $\Rightarrow \dfrac{TC}{Q} = \dfrac{TVC}{Q} + \dfrac{TFC}{Q}$
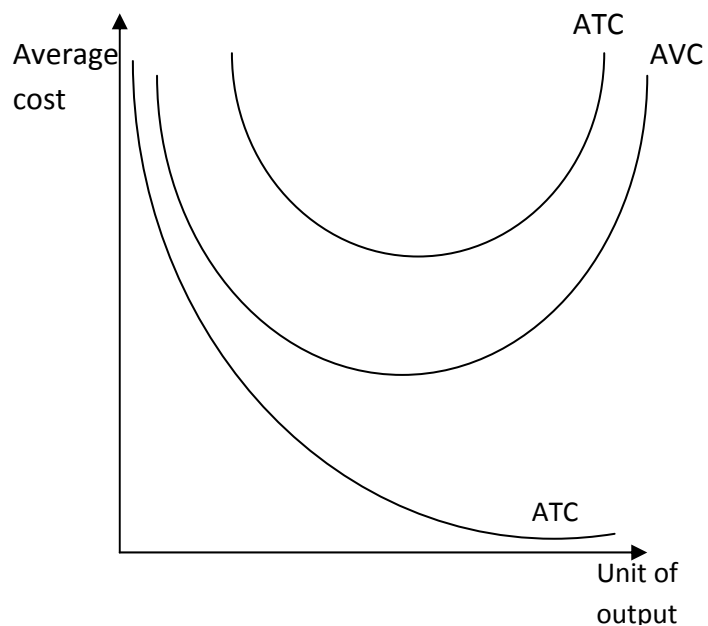
Diminishing returns

The reason behind the shape of AVC and AVC lies in the shape of the marginal product curve. At first, marginal product is increasing, i.e. smaller and smaller increase in the amounts of variable resources is needed to produce successive units of output. Hence, the variable cost of successive units of output decreases.

But when as diminishing returns are encountered, marginal product begins to decline, larger and larger additional amounts of variable resources are needed to produce successive units of output. Total variable cost increases by increasing amounts.

The shape of ATC, AFC and AVC

Output (Q)	AFC	AVC	ATC
1	200	50	250
2	100	45	145
3	66.7	40	106.7
4	50	35	85
5	40	30	70
6	33.3	26	59.5
7	28.6	25	36
8	25	26	51
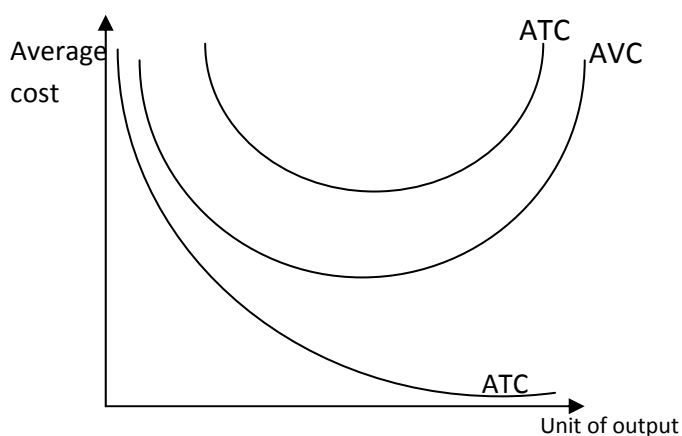
- As AFC=TFC/Q and TFC is fixed, AFC declines continuously as output expands.
- ATC always exceeds AVC due to the fact that ATC=AVC+AFC and AFC is always positive. However, since AFC falls as output increases, AVC and ATC get closer as output rises.
- AVC first declines, reaches a minimum and then starts increasing.

The Relationship of MC, AVC and ATC

MC is the extra cost of producing one more unit of output.

- The marginal cost curve intersects both the AVC and ATC curves at their minimum points.

This relationship is a mathematical necessity. If the marginal cost is below average total cost, average total cost will decline towards marginal cost.

If marginal cost is above average total cost, average total cost will increase, i.e. ATC, always moves towards MC. As a result, marginal cost intersects average total cost at ATC's minimum

point. By the same reasons marginal cost intersects average variable cost at AVC'S minimum point.

No such relationship exists for the MC curves and the AFC curve because the two are not related. MC includes only those costs which change with output, and FC and output are independent.

- The average variable cost reaches its minimum before the average total cost because of the inclusion of average fixed cost.
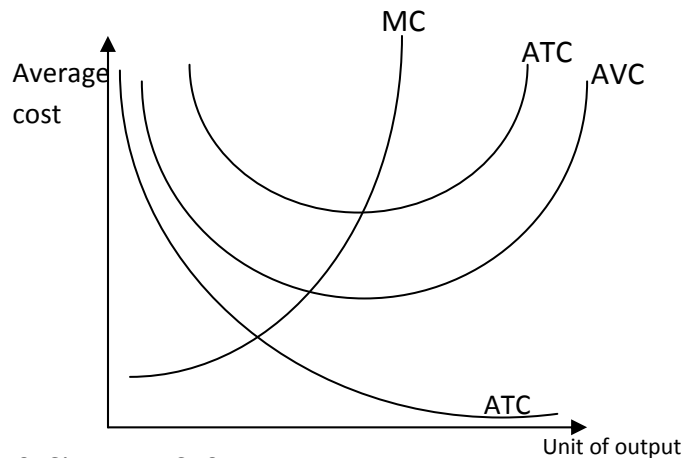
$$MC = \frac{\Delta TC}{\Delta Q}$$

Note that TC=TFC+TVC

Δ TC=ΔTFC+ΔTVC

$$MC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta TFC}{\Delta Q} + \frac{\Delta TVC}{\Delta Q}$$

$MC = \frac{\Delta TVC}{\Delta Q}$ because ΔTFC/ΔQ= 0, Since ΔTFC=0

- If MC<ATC, then ATC is falling
- If MC>ATC, then ATC is rising, i.e. ATC=MC at minimum ATC
→ If MC<AVC, then AVC is falling

→ If MC> AVC, then AVC =MC at minimum AVC

This implies that MC intersects ATC and AVC at their minimum point.

Relationship between cost and production

- Average total cost and marginal cost curves are U-shaped.
- Average product and marginal product curves are inverted U-shape.
- The additional cost of production of a good is lowest at the output level where the additional product of the variable input is maximum, $MP_{max} \Rightarrow MC_{min}$
- Similarly, the average variable cost is minimum when the average product of the variable input is maximum, $AP_{max} \Rightarrow AVC_{min}$
- Thus, MC and AVC curves are mirror images of the MP and AP curves respectively.
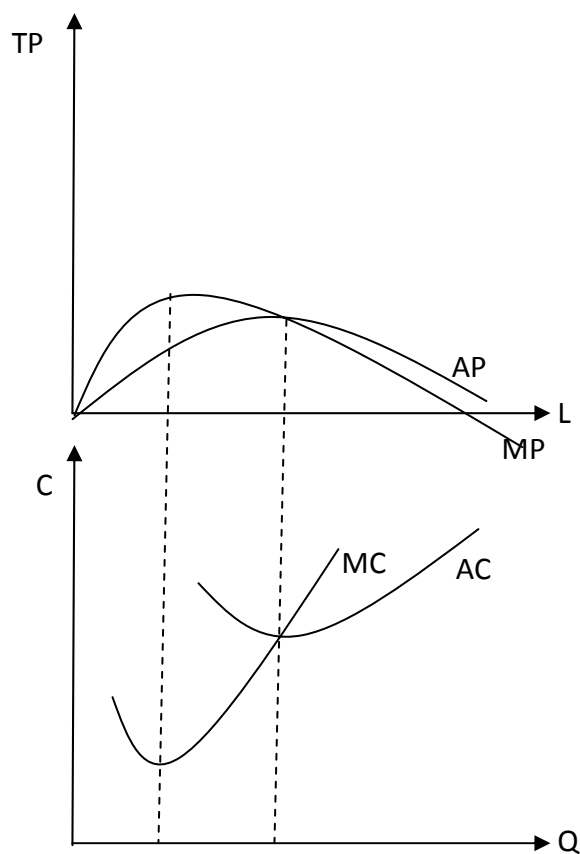
Consider a single variable factor; labor (L) and all other factors are fixed. The wage rate is given by 'w' and it is constant.

$$TVC=w.L$$

$$AVC=TVC/Q \quad \text{but } TVC=w$$

$$=w.L/Q$$

$$AVC= w\,(L/Q)$$

This shows that AVC and AP_L are inversely related. As AP increases (decreases), AVC decreases (increases).

Remember that $AP_L=Q/L$ and $L/Q=1/AP$

$$AVC= w/\,AP_L$$

Again note that; $\Delta TC=\Delta TVC$, since $\Delta TFC=0$

$$\Delta TC=\Delta(w.L)$$

$$\Delta TC=w.\,\Delta L$$

$$MC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta TVC}{\Delta Q} = \frac{w.\Delta L}{\Delta Q}$$

But $\dfrac{\Delta Q}{\Delta L} = MP_L \Rightarrow \dfrac{\Delta L}{\Delta Q} = \dfrac{1}{MP}$

$$\Rightarrow MC = \dfrac{w}{MP_L}$$

This also implies that MC and MP are negatively related. As MP increases (decreases) MC decreases (increases).

2.3 The Profit Maximizing Competitive Firm

A competitive firm is one which sells its products in a perfectly competitive market. The price of a product is uniform through out the market and each seller is small in reaction to the total market sale, and hence can not affect the price of a product.

Thus each seller is a "price taker". Each seller sees the market demand curve for its demand as perfectly elastic, i.e. the demand curve facing a perfectly competitive firm is horizontal.
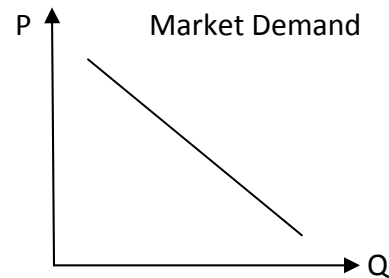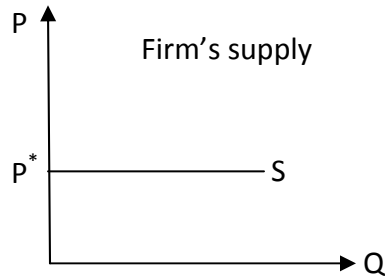
The demand curve facing a perfectly competitive firm is similarly a horizontal line at a market equilibrium price.
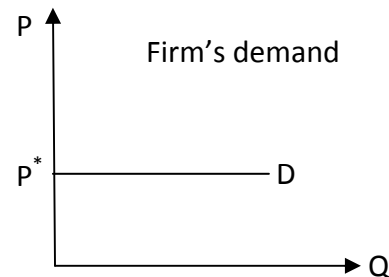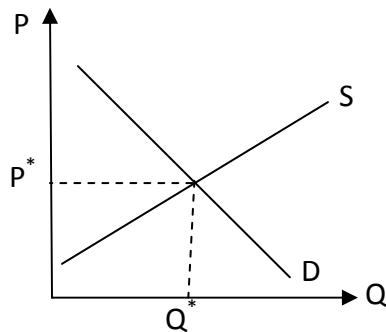
Total, Average and Marginal Revenue

Total Revenue (TR) is the total amount that a firm takes in a form of revenue of its product. Total revenue is then, the price per unit times the quantity of output that the firm sold.
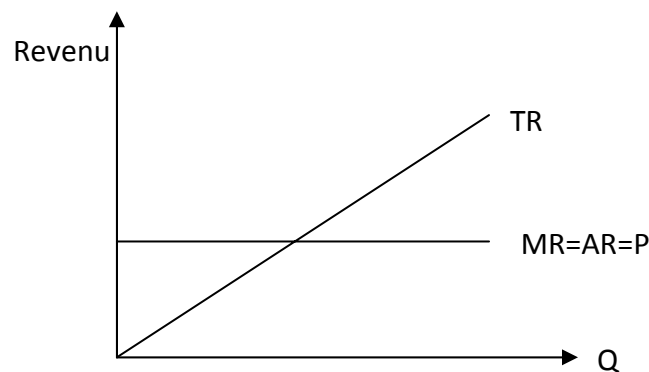
Total Revenue = price X quality

TR = P x Q

Average Revenue (AR) is the quotient of total revenue and quantity that is sold in the market.

$$\text{Average revenue} = \frac{Total.revenue}{Quantity.sold} = \frac{TR}{Q} = \frac{P \times Q}{Q} = P$$

Marginal Revenue (MR) is the additional revenue that a firm takes in, when it increases out put by a small change (by one additional unit for practical purpose)

$$MR = \frac{\Delta TR}{\Delta Q} = \frac{\Delta(P.Q)}{\Delta Q} = \frac{P.\Delta Q}{\Delta Q} = P$$

Thus, MR curve facing a Competitive firm is upward sloping straight line which starts form the origin and rises by a fixed amount for each additional unit of the product sold.

Example

Price	Quality	Total Revenue	AR	MR	TC
15	0	0	-	-	10
15	1	15	15	15	-5
15	2	30	15	15	25
15	3	45	15	15	30
15	4	60	15	15	40
15	5	75	15	15	60
15	6	90	15	15	90

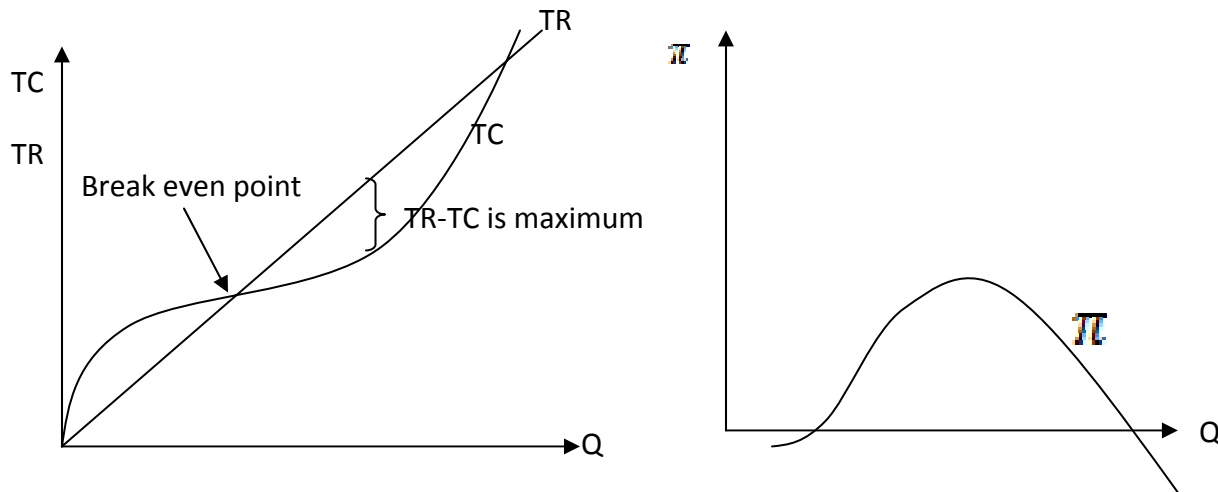**Profit Maximization of a perfectly competitive firm**

There are two ways to determine the level of out put at which a competitive firm will realize maximum profit.

Comparing TR and TC (TC & TR Approach)

Comparing MR and MC (MR & MC Approach)

1. TR and TC Approach

A firm's short run profit is maximized when the difference between total revenue and total cost is the highest
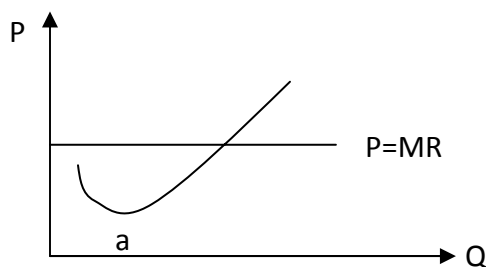

TC>TR>TVC, the firm will produce by covering TVC and part of its total fixed cost, because the fixed cost is the cost that the firm used to pay even at zero level of output.

Case of close down

When TR<TVC, the firm has to stop produce.

2. MR-MC Approach

It seems seasonable to pick output at which MC is at its minimum point.

At 'a' the difference between MR and MC is maximum. But at this point the MR>MC, indicating that profit is not being maximized. That is the additional revenue that the seller has got is greater than the additional cost he has incurred.

- The profit maximizing perfectly competitive firm will produce up to the point where the price, or the marginal revenue, of its output is just equal to the short -run marginal cost.
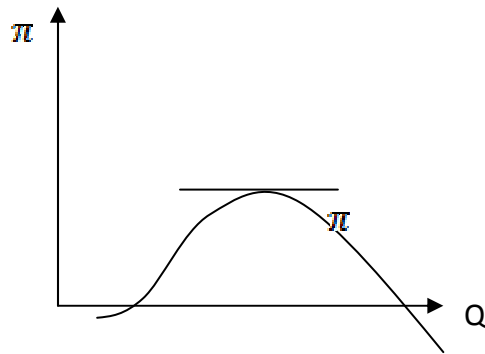
When π is maximized, the slope of π - curve equals zero.

At Maximum profit, slope $=0 = \dfrac{d\pi}{dQ}$

$$\frac{d\pi}{dQ} = \frac{dTR - dTC}{dQ} = 0$$

MR - MC = 0
MR = MC

so at the maximum profit (minimum loss), MR equals MC

<u>Note</u>: Although output level where MC = P* is a profit maximizing level of output for the competitive firm, it may or may not result in a positive economic profit i.e it may take positive, zero, or negative economic profits for a given cost function. The level of profit actually depends upon the market price.

- When P* > AC at an output level where MC = P*, the firm earns positive profit
- The firm provides positive output and continue production at on output level where MC = P* if P* > min AVC because, at this level the firm will cover all its variable and part of its fixed cost.
- When P* = minimum of AC at an out put level where MC = P*, the firm earns zero economic profit (it earns only normal profit). Then, the firm in this case is said to <u>break even</u>.
- In this case the firm will be in different as whether or not to produce at an out put level where P* = MC if P* = min AVC. Because at this level it covers its TVC and faces a loss of TFC, which could have been incurred even at zero output.
- When P<minimum of AC at an output level where MC=P*, the firm incurs loss since TC<TR.
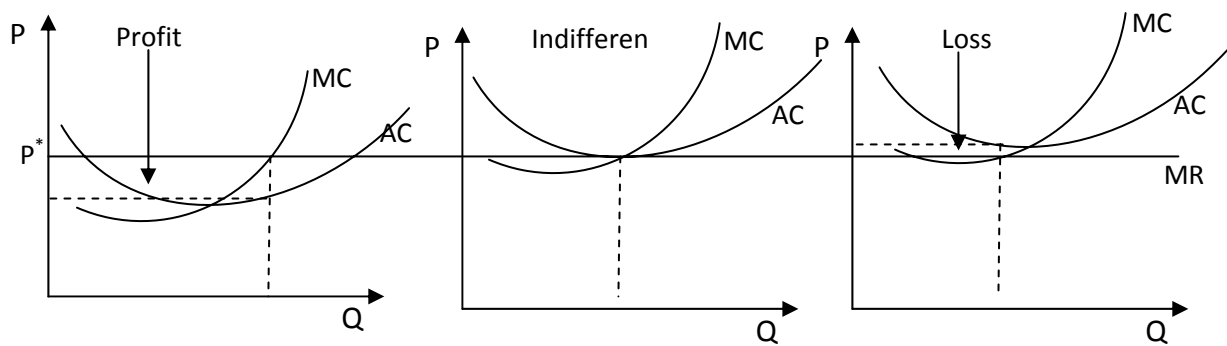
P* < min AVC at the profit maximizing level of output result in a loss of the variable cost, which the firm can avoid by ceasing production.

Hence, the minimum AVC is called the shut down point.

Derivation of the supply curve of a firm

In the figure below at point B, P_2 =MC=ATC which means that the firm will be making only normal profit. Point B is the break-even point. If price decreases below P_2, the firm will be making loss because price will be less than AC. In the short-run, the firm may continue to supply even when price is less than AC provided it is above AVC (at point A). Point A is known as the shut-down point. Therefore, the short-run supply curve of the perfectly competitive fir is that part of the MC cure which lies above AVC.
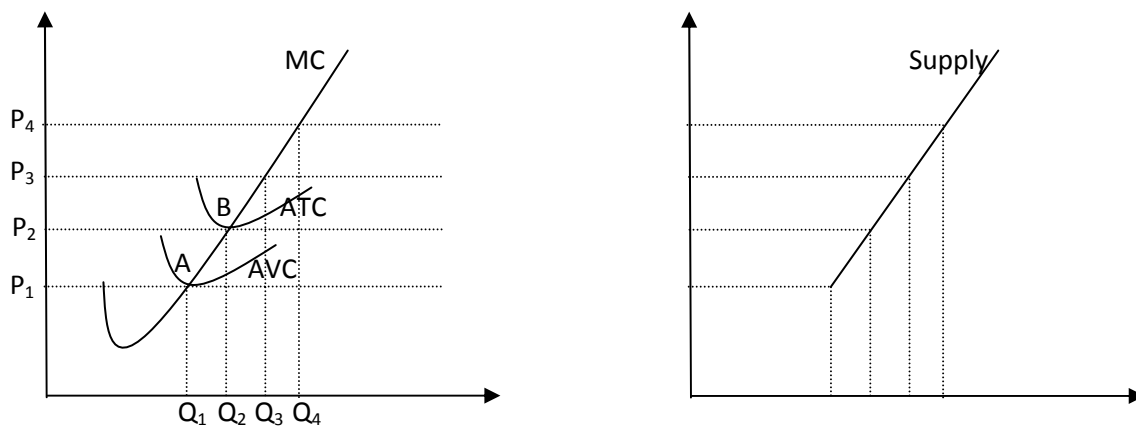
2.4 Review of Market Imperfection

Summery

	Numbers firms	Product differentiation	Firms have price setting power	Free entry	Distinguishers
Perfect Computation	Many	Homogeneous	No	Yes	Price computation
Monopolistic	Many	Differentiated	Yes but limited	Yes	Price & quality

Computation					computation
Oligopoly	Few	Either	Yes	Limited	Strategic behaviour
Monopoly	one	Single product	Yes	No	Still constant market demand

Monopsony

- Is a market with only one buyer called 'monopsonist' facing many sellers,

Market is said to be imperfect when one or more of the assumptions of a perfectly competitive market are not satisfied.

<h2 style="text-align:center">Pure monopoly</h2>

A market is said to be monopoly when there exists only one supplier of a product for which there is no close substitute.

♦ Features of pure monopoly

i. Single seller
ii. The products have no close substitutes e.g. public sector monopoly in water supply
iii. Price maker: A monopolist can set/ control the price at which it sells the output. In essence the monopolist is the price maker. (e.g. ETC's mobile subscription and air-time tariffs)
iv. Huge barrier to entry: Legal, financial and/or technological barriers makes it difficult. The following entry barriers have been associated with the existence of monopoly;

- Control of input: A firm may own the total supply of raw material, which is essential in the production of the product.
- Patent: this is an exclusive right to produce the product granted to the inventor of the product. Monopolist may also have unique access to a technique that is useful in the production of some good or could have the sole right to produce the good (patent).
- Economies of scale: because of the level of technology used by the monopoly, the cost may be lower than the small firms sharing or (trying to share) the market. This blocks entry.
- License: government sometimes blocks entry into a particular market by requiring firms to have governmentally provided license as a condition for operating in such market.
- Entry lag: entry to some market takes time. This gives the firms temporary monopoly time.

o Monopoly market is characterized by absence of competition. Hence, it is the most inefficient market structure.

o Monopolists also practice price discrimination i.e. the same good is sold at different prices to different buyers and/or in different markets.

Monopolists Demand, Marginal Revenue and Total Revenue Curve

Since the monopoly is the only seller of the product, its demand curve is the same as the market (industry) demand curve. As such, the monopolist demand curve is down ward sloping. A monopolist is price maker. Since a monopolist face a negative sloped demand curve, as price increases the quantity demanded decreases.
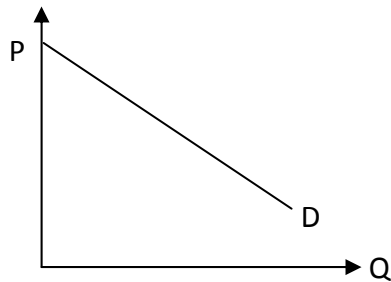
This negatively sloped demand curve shows that the monopolist must decrease price in order to sell more output.

o Monopolist's total revenue (R) is:

R=P.Q   This is no more linear because P is not constant.

o Marginal revenue (MR): is the additional revenue attributed to the sell of one more unit of output.

$$MR = \frac{\Delta TR}{\Delta Q} = \frac{dR}{dQ} = \frac{d(P.Q)}{dQ} = P + Q.\frac{dP}{dQ}$$ because both P and Q are variable

MR is a fixed amount but varied with the quantities sold.

$$MR = P\left(1 + \frac{Q.dP}{P.dQ}\right) = P\left(1 - \frac{1}{|\varepsilon_d|}\right)$$ MR= 0 or TR is maximum at ε_d = 1 and MR< P.

D and MR start at the same point on the vertical axis because the MR of the first unit sold equals the price of the good.

♦ Show this using the inverse demand function: P= a+bQ
♦ Also show that R is maximum at out put where MR=0 or ε_d =1

- At mid point of the demand curve, MR is zero ($|E_d|$ =1), MR is zero; R is maximum

$$MR = P\left(1 - \frac{1}{|\varepsilon_d|}\right) = 0$$ at $|E_d|$=1

- When demand is inelastic ($|E_d|$<1), MR<0; R is decreasing with output increase.
- When demand is elastic ($|E_d|$>1), MR>0; R is increasing with output.
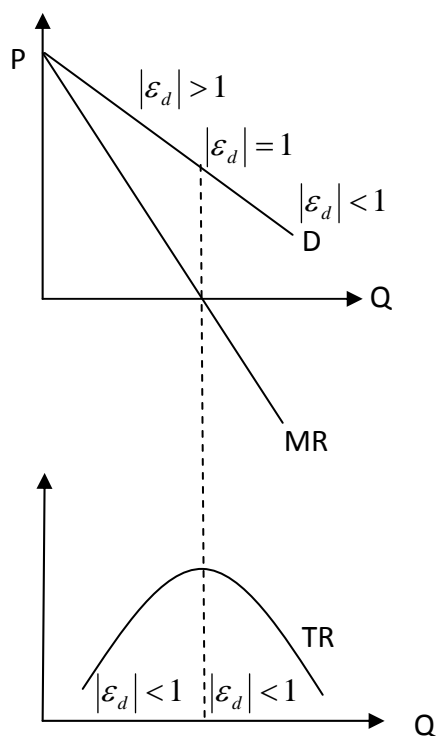
Tabular example:

P	Q	R	MR	AR=P
11	0	0	-	-
10	1	10	10	10
9	2	18	8	9
8	3	24	6	8
7	4	28	4	7
6	5	30	2	6
5	6	30	0	5
4	7	28	-2	4
3	8	24	-4	3

AR= R/Q=P.Q/Q=P

- **NB.** MR =P=10 for the first output, but for all other output sold, MR is less than P (MR<P)
- R is maximum (30) when MR=0

Profit Maximizing under Monopoly

The objective of a monopolist is to maximize profit. There are two approaches to profit maximization under monopoly;
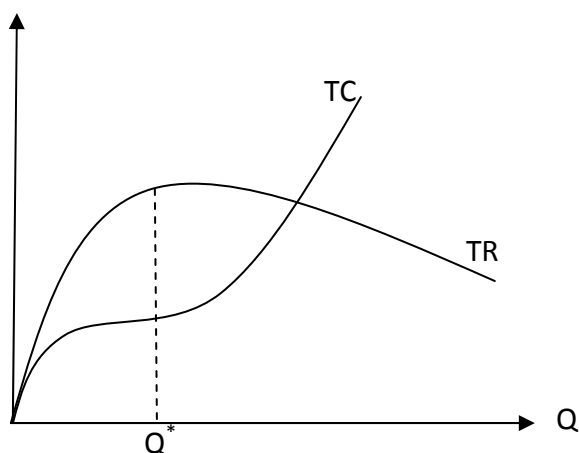
a. <u>TC- TR Approach</u>
In this approach monopolists profit is said to be maximized when the difference between TR and TC is highest

i.e. Π= TR- TC is highest

   =Q (P- ATC)

Graphically, profit is maximized when the vertical distance between R and TC is highest.

Q^* is the monopolist's profit maximizing level of output.

b. Marginal Approach

In this approach, profit is maximized when MR=MC

Remember that $MR = P\left(1 - \dfrac{1}{|\varepsilon_d|}\right)$

Hence profit is maximized when $MR = P\left(1 - \dfrac{1}{|\varepsilon_d|}\right) = MC$

Graphically, the profit maximization level of output occurs when MR intersects MC (while it is rising):

The profit maximizing level of output occurs when MC=MR<P

- Since competitive firms produce when MC=P, a monopolized industry charges higher price and produce smaller output than would competitive industry.
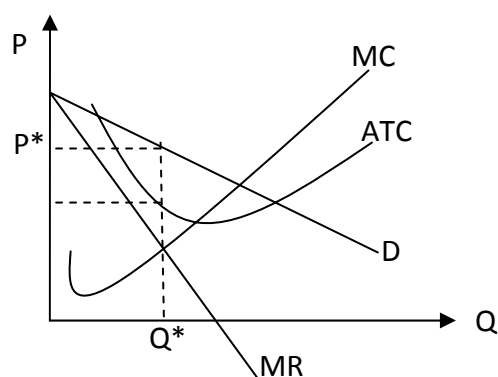
Suppose the demand function for a monopolist is given by: P=10-8Q

And the cost function is $C(Q)=Q^2+Q+3$

Find profit maximizing levels of output and price using: Total approach and Marginal approach

Taxonomy of Imperfect Market Models

In addition to pure monopoly, there are other types of imperfect markets such as; oligopoly and monopolistic competition.

Oligopoly: is a market structure characterized by a few firms selling either uniform or differentiated products. As a result, there is mutual interdependence among the few firms, i.e. the action of one firm will have significant effect on the other. (Read the detail)

Monopolistic Competition: is a market structure where many small firms sell differentiated products. (Read the detail)

Summary of Imperfect market

Description	Pure monopoly	Oligopoly	Monopolistic competition
No. of firms	One	few	Large no. but small seller
Types of product	No substitute	Differentiated or homogenous	differentiated
Price discrimination	✓	✓	✓
Entry in to the industry	Blocked	Difficult	Easy