University Grant Commission

Subject: Economics Code: 01

Unit – 1: Micro Economics

Sub Unit 1: Theory of Consumer Behaviour

Sub Unit – 2: Theory of Production and Cost

Topic
1.2.1. Production **1.2.1.1. Production Function**
1.2.2. Types of Production Function
1.2.3. Total, Average and Marginal Products
1.2.4. Relation between TP, AP and MP
1.2.5. Equal product curve or Iso-quant
1.2.6. Different types of Iso-quants
1.2.6.1. Properties of Isoquants
1.2.7. Marginal Rate of Technical Substitution
1.2.8. Ridge Lines
1.2.9. Lows of Production
1.2.10. Returns to scale and Homogeneity of the Production Function
1.2.11. Homothetic Production Function
1.2.12. Stages of production
1.2.13. Some Important Production Functions **1.2.13.1. Cobb-Douglas Production Function** **1.2.13.3. Production Function with elasticity of Substitution** **1.2.13.4. Fixed Proportion production Function**
1.2.14. Technological Progress and the production Function **1.2.14.1. Capital-Deepening Technical Progress** **1.2.14.2. Labour-Deepening Technical Progress** **1.2.14.3. Neutral Technical Progress** **1.2.14.4. Economic and Non-Economic Region**
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1.2.16. Cost
1.2.17. Different Cost concepts
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1.4.5. SR supply curve of an Industry / Industry supply Curve
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1.4.22. Static Stability of Equilibrium (both Walrasian and Marshallian case) 1.4.22.1. Walrasian Case 1.4.22.2. Marshallian Case 1.4.22.3. Dynamic Stability
1.4.23. Measurement of the degree of Monopoly Power 1.4.23.1. Lerner's Measure 1.4.23.2. Triffin Measure 1.4.23.3. Bain's Measure 1.4.23.4. Rothschild's Measure
1.4.24. Price Discrimination 1.4.24.1. Degrees of price Discrimination 1.4.24.1a. When is price discrimination possible? 1.4.24.1b. Price Discrimination and the Price Elasticity of Demand
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Sub Unit-5: Factor Pricing

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1.5.5. Factor Pricing Under Imperfect Competition **1.5.5.1. Factor Market Perfectly Competitive and Product Market and product Market Imperfectly Competitive or Monopolistic** **1.5.5.2. Monopsony in the Factor Market and Perfect Competition in the Product Market** **1.5.5.3. Monopsony in the Factor Market and Monopoly in the Product Market**
1.5.6. The 'ADDING-UP' Problem: Product Exhaustion Theorem
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Topics
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1.6.2. Neo-Classical Welfare Economics **1.6.2.1. Pigovian Welfare Economics** **1.6.2.2. Pigou's Dual Criterion of Welfare** **1.6.2.3. A Critique of Neo-Classical Welfare Economics**
1.6.3. Analysis of Externalities or Divergences Between Private and Social Costs and Returns **1.6.3.1. External Economies of Production** **1.6.3.2. External Diseconomies of Production** **1.6.3.3. External Economies of Consumption** **1.6.3.4. External Diseconomies of Consumption**
1.6.4. The Case of Public Goods
1.6.5. Conditions of Pareto Optimality

Sub Unit-1

Theory of Consumer Behaviour

1.1.1. Demand Analysis:

Demand: - In economic analysis, the term 'demand' is not just the term to mean "need". It also means, a rational consumer must have the money to purchase that commodity to meet the need i.e., the ability to purchase. So, by the definition, demand of a product is the mutual coexistence of the "purchasing power" and "desired purchase", where the basic objective of a consumer is utility maximisation, obtained from the consumption of that product. So, 'demand', the term is used to represent the relationship between price of a commodity and the amount of that commodity, the consumer is Willing to purchase at that time period.

According to prof. Beinham, **"the demand for anything at a given price is the amount of it which will be bought per unit of time at that price".**

- The 'planned demand' of one consumer or family at a "given" or 'expected price' of a product is the 'individual demand' or 'family demand' where as the demand of all the consumers is a market in aggregate sense will be the 'market demand'.

1.1.2. Determinants of Demand: -

Individual Demand

- **Primary Factors:**

1. **Price of the product,** $say\ \times (p_{\times}) \Rightarrow\ Q_d^{\times} \infty\ \frac{1}{p_{\times}}$
2. **Price of the related products,** $say\ Y\ and\ Z\ (p_y\ , p_z)$

$\Rightarrow$ Substitutes and complements

Substitute: Let $X\ and\ Y\ are\ substitute\ goods$

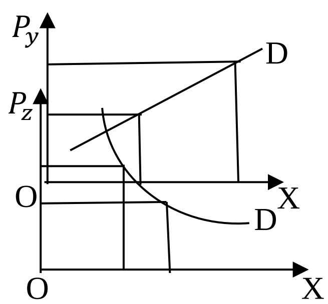
$\longrightarrow\ p_y \downarrow \longrightarrow Q_d^y\ \uparrow \longrightarrow\ Q_d^{\times}\ \downarrow \Rightarrow p_y\ and\ Q_d^{\times}\ are\ directly\ related\ \Rightarrow$

$Demand\ curve\ is\ positively\ sloped.$

Complement: Let $\times\ and\ Z\ are\ complementary\ good.$

$\longrightarrow\ p_z \uparrow \longrightarrow\ Q_d^z\ \downarrow \longrightarrow\ Q_d^{\times}\ \downarrow \Rightarrow\ p_z\ and\ Q_d^{\times}\ are\ inversely\ related\ \Rightarrow$

$Demand\ curve\ is\ negatively\ sloped.$



3. Income of the consumer (M)

↳ Normal good and Inferior good.

Normal good: A good is 'normal' good if demand for it increases with the increase in income. So, for a normal product, income and the demand for a product both are directly $(+vely)$ related ⇒ $Q_d^{\times} \infty\, M$

Inferior good: A good will be 'inferior' good if demand for it decreases with the increase in income. So, for an inferior product, income and the demand for a product both are inversely related ⇒ $Q_d^{\times} \infty\, \frac{1}{M}$.

4. **Taste and Preference** ⇒ $Q_d^{\times} \infty\, T$

- **Secondary Factors: ⟶**

1. Time (t)
2. Demonstration effect (d)

Market Demand

1. Population of the nation (p)
2. Rate of interest (r)
3. Distribution of Income (D)
4. Increase in money supply
5. Advertisement
6. Govt. policies through tax or subsidies etc.

1.1.3. Demand Function: -

The 'demand function' will represent the relation between quantity demanded or demand for a product and its determinants.

Thus, the aggregate demand function can be written as, from the previous discussion,

$Q_d^{\times} = f\left(p_{\times}, p_y, p_z, M, T, t, d, P, r, D\right)$————(i)

The 'reduced' from of the demand function can be developed considering 'other factors' remain constant, i.e., "ceteris peribus". Here, the other factors are:

$p_y, p_z, M, T, t, d, P, r, D.$

Hence the reduced form of the demand function can be written as:

$Q_d^{\times} = f\ (p_{\times})$————(ii)

So, the other factor in equation (ii) is called 'PARAMETER'.

1.1.4. Demand Law: -

The ‘demand law’ states the relationship between price of a product and quality demanded for that product. According to the demand law,

“Other factors remain constant, price and quantity demanded both are inversely related”.

$$Q_d^{\times} \infty \frac{1}{p_{\times}}$$

$$\Rightarrow\ Q_d^{\times} = K.\frac{1}{p_{\times}}\ [\,K\ is\ a\ variation\ constant]$$

$$\Rightarrow p_d^{\times} \uparrow\downarrow \Rightarrow\ p_{\times}\ \downarrow\uparrow$$

Assumptions: -

i) No change in consumer’s “taste and preference”.

ii) Consumer’s income remains constant According to Marshall ‘money income’ in constant whereas according to Friedman, ‘real income is constant’.

iii) The prices of the related products like substitutes and complements are constant.

1.1.5. Demand Curve: -

i) If the demand function is ‘linear’, i.e. it follows the structure $y = mx + c$ than it can be depicted by a demand line.

ii) If the demand function is ‘non-linear’, i.e. it follows the structure y = $ax^2 + bx + c,$ than it can be depicted by a demand curve.

Whatever may be the shape, we do not have any confusion that the ‘usual’ slope of a demand line or demand curve will be negatively sloped and for the ‘exception’, it will be positively sloped.

1.1.6. Why the demand curve be negatively sloped?

According to R. G. Lipsey, “The curve, which shows the relation between the price of a commodity and the amount of that commodity the consumer wishes to purchase, is called the demand curve”.

The following reasons are responsible for negatively sloped of a demand cure:

1. Law of Diminishing Marginal Utility:

$$\times \uparrow\downarrow \Rightarrow\ MU_{\times}\ \downarrow\uparrow$$

According to the Marshalling approach, the consumer's equilibrium condition for a single product, $\times$, can be written as $MU_{\times} = \lambda\, p_{\times}$; $p_{\times} \rightarrow price\ per\ unit$

$$\lambda \rightarrow MU\ of\ money\ (constant)$$

Since λ is constant therefore a fall in $p_{\times}$ means fall in

$MU_{\times}\ and\ fall\ in\ MU_{\times}\ is\ possible\ omly\ by\ increase\ in\ \times$

$$\therefore\ p_{\times} \downarrow\uparrow\rightarrow\ MU_{\times} \downarrow\uparrow\rightarrow \times\uparrow\downarrow$$

$$\Rightarrow\ P_{\times}\ and\ \times\ are\ inversly\ related$$

$$\Rightarrow Demand\ cure\ is\ (-)vely\ sloped$$

2. Price Effect:

The concept is based on the 'ordinal utility approach'. It measures the effects on quantity demanded of a product due to a change in price of that product.

Price effect can be decomposed of a product due to a change in price of that product.

Price effect can be decomposed in two major components:

(a) Substitution effect

$$P_{\times} \downarrow\uparrow\rightarrow Y \downarrow\uparrow \times \downarrow\uparrow$$

$$\Rightarrow\ P_{\times}\ f\ \times\ are\ inversely\ related$$

$$\Rightarrow Demand\ curve\ is\ (-)sloped.$$

(b) Income effect

$$P_{\times}\ \downarrow\uparrow R.I.\uparrow\downarrow\rightarrow \times\uparrow\downarrow$$

$$\Rightarrow\ P_{\times}\ \&\ \times\ are\ inversely\ related$$

$$\Rightarrow Demand\ curve\ is\ (-)vely\ sloped.$$

[One should note that following the substation effect, $P_{\times}\ \downarrow\uparrow\rightarrow Y \downarrow\uparrow\rightarrow \times\uparrow\downarrow$, wich is satisfied for both the cases normal as well as inferior. Due to this inverse relation between $P_{\times}\ and\ \times, the$ substation effect is always negative (-).

But the income effect may be positive or even negative.

for NORMAL: $P_{\times}\ \downarrow\rightarrow RI\ \uparrow\rightarrow \times\uparrow$

and for INFERLOR: $P_{\times}\ \downarrow\rightarrow RI\uparrow\rightarrow \times\downarrow$

3. Bandwagon Effect:

↳ This concept is developed by Prof. Samuelson. Following this approach, it there is a fall in price of a product then there will be two types of impacts simultaneously.

(a) Creation of new customer at a lower price.

(b) Increase in demand by the old customer.

⇒ So again, we have the inverse relationship and the demand curve is negatively sloped.

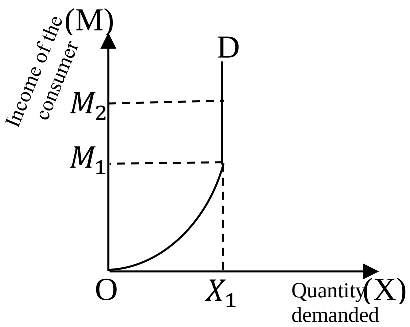
4. Alternative Use:

One product for example, 'STEEL' can be used for different purposes, So, a fall in price will lead to a rise in demand by all the sectors. Hence, we have the inverse relationship.

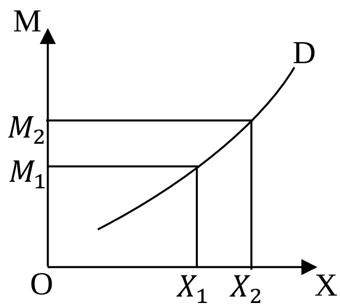
1.1.7. Relation between Demand and Income: -

$D_\times = f(M), i.e.$ Other things being equal, demand for one commodity depends upon the level of income. Generally, with an increase in income demand for goods increase. But this may not always be true. We can distinguish between three types of commodities:

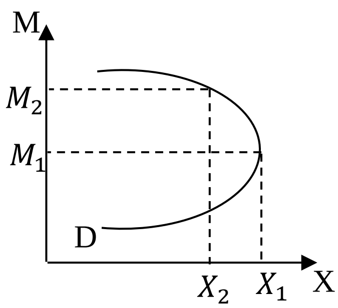
(a) Necessary Goods: -



(b) Comforts & Luxury Goods: -



(c) Inferior Goods: -



1.1.8. Kinds of Demand: -

Demand may be classified into four types

Kinds of Demand

1. Direct Demand
2. Indirect Demand
3. Joint Demand
4. Composite Demand

Price demand

Income demand

Cross demand

1. **Direct demand:** Refers to demand for a commodity that is directly consumed to satisfy human wants, for example demand for bread, butter, fruits etc.

(a) Price demand ⇒ It refers to the demand for a commodity at a particular price.

$D_{\times} = f(P_{\times})$; Ceteris paribus.

(b) Income demand ⇒ It refers to the demand for a commodity at various levels of consumer's income.

$D_{\times} = f(M)$; Ceteris Paribus.

(c) Cross demand ⇒ It refers to quantity demanded of a commodity due to change in the price of other commodities

$D_{\times} = f\left(P_y\right)$; Ceteris paribus.

2. **Indirect demand:** Demand for factors of production is indirect because they help in the production of a commodity which is directly demanded by the consumer in the market. (Derived demand)

3. **Joint demand:** It refers to the demand for those goods which are always demanded jointly as for example car and petrol.

4. **Composite demand:** It refers to the total demand for a commodity which can be used for various purposes.

1.1.9. Exceptions to the Demand Law: -

If price of a product goes down (up) then the demand for that product also goes down (up), other factors remain constant.

Following are the examples relating to the exception:

1. **Veblen Effect:** There are some products, like diamond and jewellery represent the social status. So, the consumption of such products is the 'CONS PICUOUS CONSUMPTION', is explained by the American Economist Veblen. So increase in price of such product will tend to a further increase in demand for this product. Now price and quantity demand both are directly related rather than inverse relation.

2. **Speculative market:** $\begin{matrix} Pshare\ of \\ a\ company \end{matrix} \uparrow \rightarrow \begin{matrix} Dshare\ of \\ that\ company \end{matrix} \uparrow$

Since consumer prefers to invest assuming it profitable

⇒ Price & quality demanded both are $+\,vely$ related

⇒ Demand curve is upward sloping.

3. **Ignorance:** According to Prof. Benham, a lower priced commodity may be considered as inferior or a higher priced commodity as superior.

↳ Price & quantity demanded are $+\,vely$ related.

↳ Demand curve is upward sloping.

4. **Future Expectation:** If consumer expects a rise in price in near future due to the shortage in stock natural calamities, then they will rush to purchase more, at the present price.

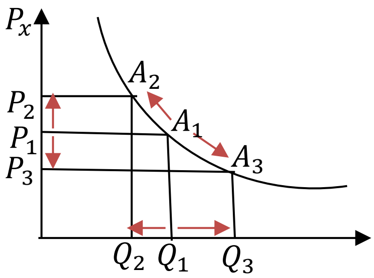
↳ We have the direct relation.

5. **Giffen Good**: These goods are special type of interior, occupy the lowest place in the consumer's budget. Fall in price of such goods means reduction in demand for that product.

1.1.10. Change in demand vs change in quantity demanded: -

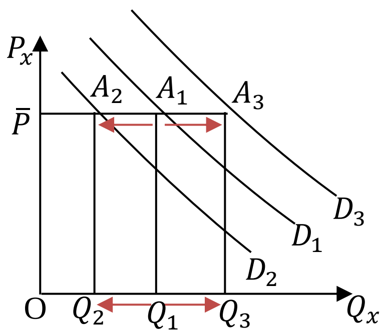
1. Change in quality demand: -

The concept directly follows from the law of demand. 'Other factors remain constant', increase (decrease) in price means decrease (increase) in quality demanded. Thus, change in quantity demanded represents the movement of the consumer along the demand curve from one point to another.



2. Change in demand: -

If now price of the product remains constant and other factors are variable; then shifting of the demand curve is possible in rightward or leftward direction.



It represents the change in demand, therefore,
the movement is not restricted along the
single demand curve – the movement is
possible to higher and lower demand curve.

↳ (M, $p_{subst.,}$ t) ↑↓ and (p_{comple}) ↓↑→ $DD\ rightwar\ shift.$

1.1.11. Market Demand: -

The market demand means the demand for a product at a given price by aggregate sense. So the market demand line or curve can be derived by the horizontal summation of all the individual consumer's demand curves.

Let we have 'in' numbers of consumers then

$Q_{MD} = Q_{D1} + Q_{D2} + Q_{D3} + \ldots\ldots. + Q_{Dn}$

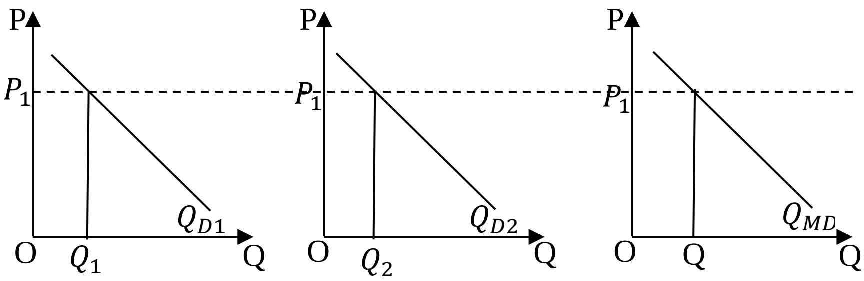
$= \sum_{i=1}^{n} Q_{Di}$

Assumption:

i) Existence of at least two consumers

ii) All demand lines are negatively sloped

iii) The demand line is 'independent' not 'interdependent'.



1.1.12. Elasticity of Demand: -

Elasticity of any function can be measured with the help of the following formula.

Elasticity = $\frac{\text{Percentage change in the dependent variable}}{\text{Percentage change in the independent variable}}$

Symbolically,

$E = \frac{\Delta Y}{Y} \div \frac{\Delta \times}{\times} = \frac{\Delta Y}{Y} \cdot \frac{\times}{\Delta \times} = \frac{\Delta Y}{\Delta \times} \cdot \frac{\times}{Y}$; $[Y = f(\times)]$

1.1.12.1. Price Elasticity of Demand: -

Price elasticity of demand measures the responsiveness of quantity demanded of a commodity to a change in its price.

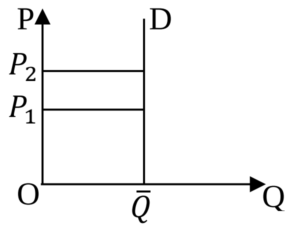
$$E_p = \frac{\%\ change\ in\ quantity\ demanded\ of\ a\ commodity}{\%\ change\ in\ the\ price\ of\ the\ commodity}$$

Symbolically,

$$E_p = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

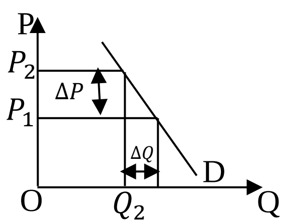
Elasticity	**Type of Elastic**	**Implications**
1. $E_p = o$	Perfectly Inelastic	Change in price leaves quantity demanded unchanged.
2. $E_p < 1$	Less than Unit Elastic	Change in quantity demand falls short of % change in price.
3. $E_p = 1$	Unit Elastic	% Change in quantity demanded equals the percentage change in price.
4. $E_p > 1$	More than Unit Elastic	% Change in quantity demanded exceeds the % change in price.
5. $E_p = \infty$	Perfectly Elastic	Any change in price however small, causes an infinite change in quantity demanded.

1. $E_p = 0 \Rightarrow \frac{\Delta Qp}{\Delta pQ} = 0 \Rightarrow \Delta Q = 0$

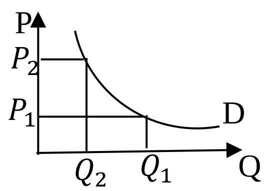


[Perfectly price inelastic demand] ⇒ *Demand curve is vertically Parallel.*

2. $E_p < 1 \Rightarrow \frac{\Delta Q}{\Delta p} \cdot \frac{p}{Q} < 1 \Rightarrow \frac{\Delta Q}{Q} < \frac{\Delta p}{p}$



[Relatively price inelastic demand] ⇒ *Demand* curve is steeper.



3. $E_p = 1 \Rightarrow \frac{\Delta Q}{\Delta p} . \frac{p}{Q} = 1 \Rightarrow \frac{\Delta Q}{Q} = \frac{\Delta p}{p}$

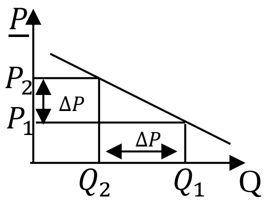
[Unitary price

elastic demand] ⇒ Demand curve is rectangular hyperbole.

4. $E_p > 1 \Rightarrow \frac{\Delta Q}{\Delta p} . \frac{p}{Q} > 1 \Rightarrow \frac{\Delta Q}{Q} > \frac{\Delta p}{p}$

[Relatively price

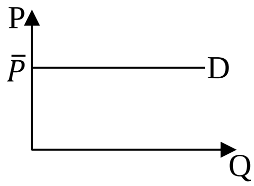
elastic demand] ⇒ Demand curve is less steep or flat.



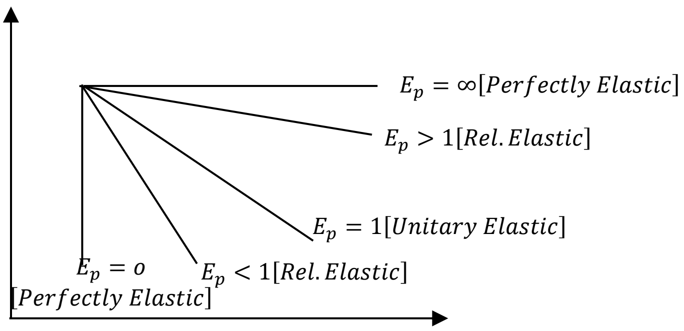
5. $E_p = \infty \Rightarrow \frac{\Delta Q}{\Delta p} . \frac{p}{Q} = \infty \Rightarrow \substack{\Delta Q = \infty \\ \Delta p = 0}$

[Perfectly price

elastic demand] ⇒ Demand curve is horizontally parallel.



Combined diagram of different type of price elasticity of demand: -



1.1.12.2. Nature of Product and Elasticity of Demand: -

i) **Normal product**: Where the usual demand law is satisfied, the demand curve is negatively sloped, so due to the inverse relationship, the fraction is usually negative. To make it positive we put the minus sigh before the ratio.

$E_p^{\times} = (-)\frac{\Delta Q_x}{\Delta P_x} . \frac{p_\times}{Q_\times}$ $or\ E_p$ = (-) $\frac{\Delta Q}{\Delta p} . \frac{p}{Q}$

ii) **Giffen Product:** The exception of the law of demand, the demand curve is positively sloped. So due to the direct relationship.

$$E_p^{\times} = \frac{\Delta Q_\times}{\Delta p_\times} . \frac{p_\times}{Q_\times}\ or\ E_p = \frac{\Delta Q}{\Delta p} . \frac{p}{Q}$$

1.1.12.3. Determinants of Own Price Elasticity of Demand: -

2. **Natural of the product**: Necessary good → Elasticity is low.

   Luxury good → Elasticity is high.

2. Availability of Substitutes: If close substitutes of a good are available in the market ⇒ Demand for the commodity will be quite price elastic.

3. Number of Uses: Large number of alternatives uses ⇒ highly elastic.

4. Product durability: More the product is durable; higher will be the price elasticity.

5. Consumption Postponement: If consumption of a product can be postponed for a specific period of time, price elasticity will be high.

6. Habit: Those commodities, whose consumption is a habit like cigarettes, have a low-price elasticity.

7. Income distribution: ●High quality product in high income class

   ↳ Price elasticity is low

   ● For the poorer class it is very high

8. Income & Expenditure: Lesser (larger) is the proposition of expenditure on the commodity elasticity will be less (relatively elastic).

9. Price level: Highly priced product such as diamonds and law priced product like salt have low price elasticity because a change in their price has very little effect on demand.

10. Time period: In the short period price elasticity is low and for the long period it is high.

11. Joint demand: If the demand for car is relatively in elastic then the demand for petrol will also be inelastic.

12. Marginal utility: If diminishing rate of MU is high them a further fall in price will lead to a small rise in demand, i.e. relatively elastic.

1.1.12.4. Arc Elasticity:

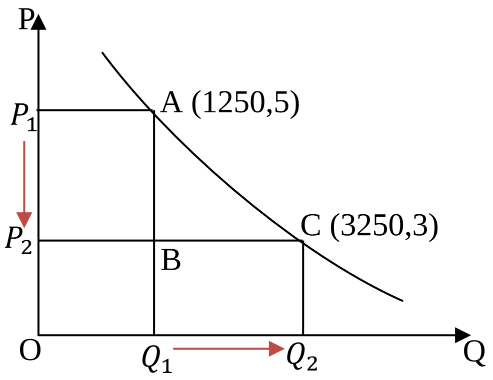
Elasticity of demand as measured above is relevant in a situation in which there is a small change in the price of a commodity. But often, business firms contemplate significant changes in the price of their products. They would be interested to estimate the possible response of the demand to significant price change.

In the type of situation, we need to calculate what is known as the are elasticity.

Let us consider one demand curve. Then one segment on this curve or range between two points is called as ‘Arc’. It is to be noted that the arc elasticity is the ‘AVERAGE MEASURE’ of elasticity on the Arc of one demanded curve. Since Arc means the range between two points on a demand curve therefore as the gap between two points increases (decreases) the Arc will be large (small).

Now we have to measure the 'Arc elasticity' over the range Ac. By the Definition or formula of price elasticity.

$$E_p = \frac{change\ in\ quantity\ demanded}{change\ in\ price} \times \frac{Initial\ price}{Initial\ quantity}.$$



So, price elasticity is the product of two fractions. Now the basic problem is relating to the second fraction, i.e. what should be the value of the fraction. If the movement is restricted along the demand curve from A to C, then we have one fraction i.e. $\frac{0p_1}{0Q_1}$, but it the movement is from C to A, then the fraction differs, i.e. $\frac{0p_2}{0Q_2}$.

To overcome this problem one overage price and overage quantity can be considered as the initial price and initial quality.

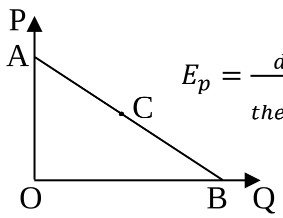
Hence, initial price = $\frac{p_1+p_2}{2}$ and initial quality = $\frac{Q_1+Q_2}{2}$ Therefore, the arc elasticity can be defined as,

$$E_p = (-)\frac{\Delta Q}{\Delta p} \cdot \frac{p}{Q}$$

$$= (-)\frac{Q_2 - Q_1}{p_2 - p_1} \cdot \frac{\frac{p_1 + p_2}{2}}{\frac{Q_1 + Q_2}{2}} = (-)\frac{Q_2 - Q_1}{p_2 - p_1} \cdot \frac{p_1 + p_2}{Q_1 + Q_2}$$

$$= (-)\left(-\frac{p_1 + p_2}{p_1 - p_2}\right) \cdot \left(-\frac{Q_1 - Q_2}{Q_2 + Q_1}\right) = (-)\frac{p_1 + p_2}{p_1 - p_2} \cdot \frac{Q_1 - Q_2}{Q_1 + Q_2}$$

1.1.12.5. Different type of elasticities on different points of a demand curve:



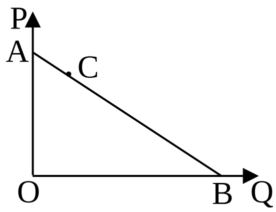
$$E_p = \frac{Lower\ segment\ of\ the\ demand\ curve\ from\ point\ C}{Upper\ segment\ of\ the\ demand\ curve\ from\ point\ C}$$

i). If C is the mid-point:

$\Rightarrow CB = Ac$

$\Rightarrow \frac{CB}{AC} = 1$

$\Rightarrow\ E_p = 1$ [Unitary price elastic]



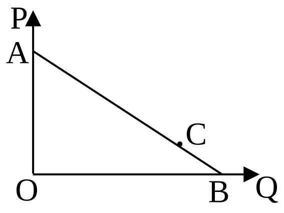
ii) If C is close to vertical axis:

$\Rightarrow CB > AC$

$\Rightarrow \frac{CB}{AC} > 1$

$\Rightarrow E_p > 1$ [Relatively price elastic]

iii) If C is close to horizontal axis:

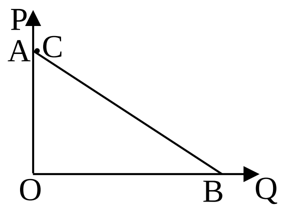


$\Rightarrow CB < AC$

$$\Rightarrow \frac{CB}{AC} < 1$$

$\Rightarrow E_p < 1$[Relatively price in elastic]

iv) If C is one point on the vertical axis:

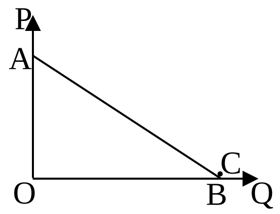


$\Rightarrow AC = 0$

$$\Rightarrow \frac{CB}{AC} = \infty$$

$\Rightarrow E_p = \infty$ [Perfectly price elastic]

v) If C is on point on the horizontal axis:

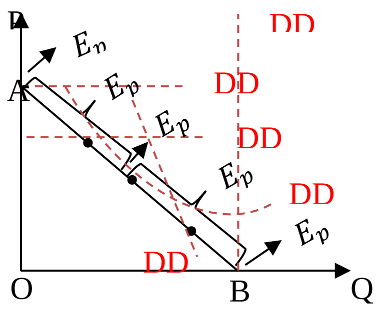


$\Rightarrow CB = 0$

$$\Rightarrow \frac{CB}{AC} = 0$$

$\Rightarrow E_p = 0$ [Perfectly price in elastic]

Combined



1.1.13. Total Outlay Method: -

One alternative method to calculate the own price elasticity of demand is the total outlay or total expenditure method. Total expenditure (TE) represents money spent by the consumer to purchase some unit of a product, i.e. product of price per unit and quantity demand.

$\therefore TE = PQ$

Marshall distinguished between three separate cases relating to the change in total expenditure resulting from a change in price.

Price per unit (Ro)	Quantity demanded	TE(Rs)
5	20	100
i) ↓ 4	25	100 (Constant)
ii) ↓ 4	30	120 (Increasing)
iii) ↓ 4	22	88 (Decreasing)

Case 1: - If price falls then quantity demanded will increase in such a way by which Total Expenditure will be constant.

↳ Price & quantity demanded will move in opposite direction but at a same rate.

↳ TE line will be vertical.

Case 2: - Now if price falls but demand increases in such a way that by which total expenditure finally increases.

↳ % change in quantity demanded > % change in price.

↳ The product must be relatively elastic.

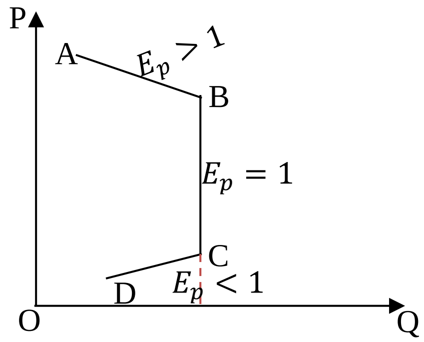
↳ TE line will be negatively sloped.

Case 3: - Now if price falls, demand increases in such a way that by which total expenditure falls.

↳ % change in quantity demanded < % change in price.

↳ The product must be relatively in elastic.

↳ TE line will be positively sloped.



1.1.14. Slope of the Demand curve and Price Elasticity: -

We know the usual function in a reduced form in Q = t (p), but in a diagram to draw the demand curve, P is measured in the vertical axis and Q in the horizontal axis.

So, let as consider one inverse function P = f (Q)

Where $\frac{dp}{dQ}$ represents the slope of the demand curve.

$$E_p = -\frac{dQ}{dp} \cdot \frac{p}{Q}$$

$= -\frac{p}{Q} / \frac{dp}{dQ}$

$$= \frac{p/_{Q}}{Slope\ of\ the\ demand\ curve}$$

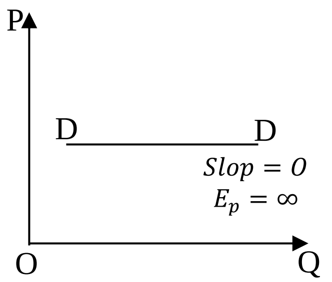
i) If the slope of the demand curve = 0

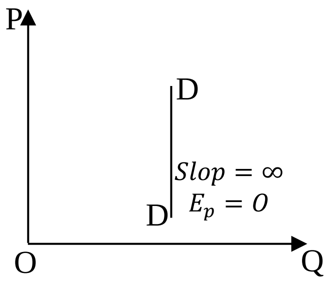
$\Longrightarrow E_p = \infty \Rightarrow demand\ curve\ is\ horizontal$

ii) If the slope of the demand curve = ∞

$\Rightarrow E_p = 0 \Rightarrow demand\ curve\ is\ vertical$

iii) As the slope increases (decreases) the value of the price elasticity decreases (increases).





Corollary 1: - At a given price with content or equal slope, the price elasticity may be different.

Corollary 2: - At a given price, with dissent slope, the price elastic may be same, if the intercept of two demand lines are same.

Corollary 3: - At a given price, given point, the price elasticities are different.

1.1.15. Income Elasticity of Demand: -

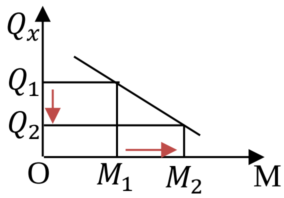
According to Watson, "Income elasticity of demand means the ratio of percentage of change in demand to the percentage change in income i.e.

$$E_M^{\times} = \frac{\left(\frac{\Delta D_\times}{D_\times}\right).100}{\frac{\Delta M}{M}.100} \Rightarrow E_M^{\times} = \frac{\Delta D_\times}{\Delta M}.\frac{M}{D_\times} \Longrightarrow E_M = \frac{\Delta D}{\Delta M}.\frac{M}{D}$$

i) When $E_M^{\times} < 0$

$$\Rightarrow \frac{\Delta D_\times}{\Delta M}.\frac{M}{D_\times} < 0 \Rightarrow \frac{\Delta D_\times}{\Delta M} < 0\ [\because M > 0, D_\times > 0]$$

$\Rightarrow M \uparrow\downarrow D_\times \downarrow\uparrow$

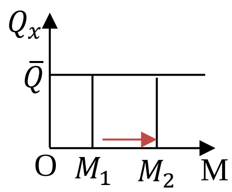


⇒ Income of the consumer and demand for × both are inversely related.

⇒ The product must be INFERIOR.

⇒ Income demand line is $(-)vely$ sloped.

ii) When $E_M^{\times} = 0$



$\Rightarrow \frac{\Delta D_\times}{\Delta M} \cdot \frac{M}{D_\times} = 0 \ \Rightarrow \ \frac{\Delta D_\times}{\Delta M} = 0 \ [\because M > 0, D_\times > 0]$

$\Rightarrow M \uparrow\downarrow \ D_\times$ Constant

⇒ Consumption of the consumer will be constant whatever may be the change in income.

⇒ Income demande line must be horizontal.

iii) When $E_M^\times > 0$

$\Rightarrow \frac{\Delta D_\times}{\Delta M} \cdot \frac{M}{D_\times} > 0 \ \Rightarrow \ \frac{\Delta D_\times}{\Delta M} > 0 \ [\because M > 0, D_\times > 0]$

$\Rightarrow M \uparrow\downarrow \ D_\times \ \uparrow\downarrow$

⇒ Income and demand both are directly related.

⇒ The product must be NORMAL.

⇒ Income demand line is positively sloped.

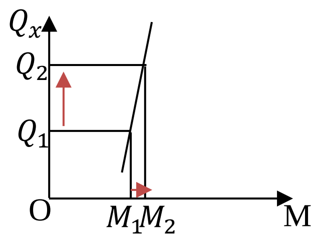
Now it again can be classified in three categories –

a) If $E_M^\times > 1$ [Relative income elastic demand]

⇒ % change in demand > % change in income.

⇒ The product must be a LUXURY.

⇒ The income demand line must be steeper than a 45^0 line.

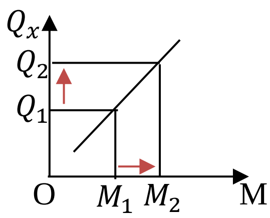


b) If $E_M^\times = 1$ [Unitary income elastic demand]

⇒ % change in demand - % change in income.

⇒ The product must be a COMFORT.

⇒ The income demand line must be flatter than before and a 45^0 $line$.

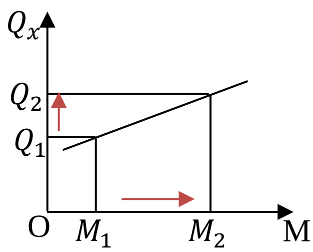


c) If $E_M^\times < 1$ [Relative income inelastic demand]

⇒ % change in demand < % change in income.

⇒ The product must be a NECESSARY.

⇒ The income demand line must be flatter than 45^0 $line$.



❖ One alternative explanation can be developed from the formula of income elasticity, i.e.

$E_M = \frac{d\times}{dM} \cdot \frac{M}{\times}$ Where dx = change in consumption ×

dM = change in income

$\text{APC} = \frac{\times}{M}$

$\text{MPC} = \frac{d\times}{dM}$ $\qquad \because\ E_M = \frac{d\times}{dM} \cdot \frac{M}{\times} = \frac{\frac{d\times}{dM}}{\frac{\times}{M}} = \frac{MPC}{APC}$

i) If MPC > APC ⇒ $\frac{MPC}{APC} > 1 \Rightarrow E_M > 1$ ⇒ Relative income elastic demand.

ii) If MPC = APC ⇒ $\frac{MPC}{APC} = 1 \Rightarrow E_M = 1$ ⇒ Unitary income elastic demand.

iii) If MPC < APC ⇒ $\frac{MPC}{APC} < 1 \Rightarrow E_M < 1$ ⇒ Relative income inelastic demand.

1.1.16. Cross Elasticity of Demand: -

If measures the degree of responsiveness, i.e. change in demand for a product due to a change in price of other product. According to Prof. Liebhafsky, **"The cross elasticity of demand is a measure of the responsiveness of purchase of Y due to a change in price of ×."**

Hence, $E_{y\times} = \frac{(\Delta d_y/D_y)\,100}{(\Delta P_\times/P_\times)\,100} \Rightarrow E_{y\times} = \frac{\Delta D_y}{\Delta p_\times} \cdot \frac{P_\times}{D_y}$

1. If $E_{y\times} > 0 \Rightarrow \frac{\Delta D_y}{\Delta p_\times} \cdot \frac{P_\times}{D_y} > 0$

⇒ $\frac{\Delta D_y}{P} > 0$ [$\because P_\times > 0, D_y > 0$]

⇒ $P_\times$ and consumption of Y both are directly related.

⇒ $P_\times \downarrow\uparrow \times \downarrow\uparrow Y \downarrow\uparrow$

⇒ $\times$ *and* Y *both are* 'Substitutes' to each other.

⇒ Demand curve is $(+)vely$ sloped.

2. $E_{y\times} = 0$ $\frac{\Delta D_y}{\Delta p_\times} = 0$

⇒ Consumption of Y must be courtant whatever may be the change in $p_\times$.

⇒ $P_\times \downarrow\uparrow \times \uparrow\downarrow Y$ is constant.

⇒ $\times$ *and* Y both the products are 'independent' to each other.

⇒ Demand curve is vertical.

3. $E_{y\times} < 0 \Rightarrow \frac{\Delta D_y}{\Delta P_\times} < 0$

⇒ $P_\times$ *and* Consumption of Y both are inversely related.

⇒ $P_\times \downarrow\uparrow \times \uparrow\downarrow Y \uparrow\downarrow$

⇒ $\times$ *and* Y both are 'complementary' to each other.

⇒ Demand curve is $(-)vely$ sloped.

1.1.17. Supply Analysis:

According to Lipsey, "stock refers to the quantity of a product at a specific period of time whereas supply represents the portion of the stock offered for sale at a given price during a given period of time".

1.1.17.1. Determinates Supply:

i) Price of the product × $(P_\times) \Rightarrow Q_s^\times \propto P_\times$

ii) Price of the related product, say Y and Z $(P_{y,} P_2)$

↳ Let × $and\ Y\ are$ substitutes and × and Z are complements

$$S_\times \propto \frac{1}{P_y}$$

and $S_\times \propto P_z$

iii) Price of input $P_i \Rightarrow S_\times \propto \frac{1}{P_i}$

iv) State of technology (T) ⇒ $S_\times \propto T$

v) Goal of the producer (G) ⇒ $S_\times \propto G$

↳ Basic objective is profit maximization.

↳ But if the target is 'sales maximization' then supply will be increased.

1.1.17.2. Supply Function:

From the above-mentioned determinants, the 'aggregate' supply function can be written as,

$Q_s^\times = f\ (P_{\times,} P_{y,}\ P_{z,}\ P_{i,}\ T\ , G) - - - - -$ (i)

The 'reduced' form of the supply function can be developed considering other factors remain constant. The other factors are $P_y\ , P_z\ , P_i\ , T\ , G.$ Thus the 'reduced' form can be written as.

$Q_s^\times = f(P_\times) - - - - -$ (ii)

1.1.17.3. Supply Law:

The 'supply law' represents the relationship between price of a product and quantity supplied of the product, other factors remain constant 'According to the law of supply'.

"Other factors remain constant, price and quantity supplied both are directly related.

$Q_s^\times \propto P_x$

$\Rightarrow\ Q_s^\times =\ kP_\times$ ...... (iii) [Where k is a variation constant]

$\Rightarrow P_\times\ \downarrow\uparrow \Rightarrow Q_s^\times\ \downarrow\uparrow$

⇒ Supply curve is $(+)vely$ sloped.

1.1.17.4. Why price of a product and quantity supplied of that product both are directly related?

It can be answered by two ways:

i) Increase in price means increase in revenue or profit which will lead to an increase in supply by a single firm.

ii) Increase in the magnitude of profit by a single firm means entry of new firm to the industry which will lead to the rise in supply.

1.1.17.5. Supply curve under perfect competition:

We know that the supply curve is the locus of different ‘unique’ combination between price and quantity supplied. The unique combination means one-to-one correspondence, i.e. for one given price there will be one and only one amount is ready for supply. Under perfect competition, we can determine these unique combinations. So, supply curve is the feature of perfect competition.

1.1.17.6. Supply curve under monopoly:

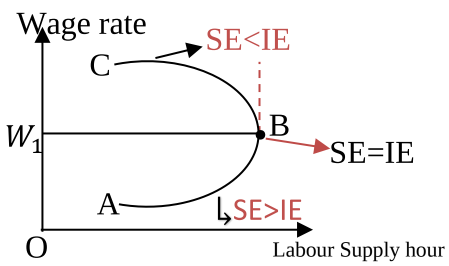
No such unique combination can be determined under monopoly. Since monopolist is the ‘price – maker’ or ‘quantity adjuster’ therefore two cases may be possible.

i) Different prices can be charged for the same quantity, i.e. no one–to–one correspondence or absence of the unique combination.

ii) Different quantities can be offered for the same price, i.e. no one–to–one correspondence or absence of the unique combination.

1.1.17.6. Exception to supply law:

1. Backward bending labour supply curve: Let 24 hours of a day is decomposed in two components, i.e. working hours (H) and leisure (L). Now individual labour supply curve is backward bending other a point, or at a higher and higher wage rate above ow_1, the individual will work fewer and fewer hours.



a) Up to ow_1, the labour supply curve is positively sloped because more wage rate means more working hours than

leisure. Since working hours is substituted for leisure
hour, therefore substitution for leisure hour, therefore
substitution effect is greater than income effect.

b) At ow_1, both effects are equal. So labour supply curve may be a print or vertical.

c) Above ow_1 leisure will be one normal product because 24 hours is constant and working hours is high therefore now substitution effect will be lower than income effect. So, for this case, labour supply curve will be backward bending.

3. Inelastic Supply: If 'reproduction' is not possible then labour supply line will be vertical or perfectly inelastic, i.e. whatever may be the change in price, supply is constant. For example, one panting by one famous dead painter.

4. Perishable Goods: If cannot be stored, perish after a period of time, such as fish, vegetables etc. If the goods are not sold, they will decay. So whatsoever has been produced is to be sold at the prevailing price. Thus, the supply line for perishable goods will be vertical or perfectly in elastic.

5. Expected Price: Let price of a product is falling and producer expects a further fall in price in near future then he will be ready to supply more at a falling price. So, price and quantity supplied both are inversely related.

6. Auction or distress Sales: In an auction, goods are sold whatever may be the price. Similarly, a needy person if he wants to dispose of anything will sell at any price. The supply law cannot operate in such cases.

1.1.18. Equilibrium:

By the definition, equilibrium refers to the market condition which once achieved tends to persist. So, it is a 'Stage of no Change'. Equilibrium represents the interaction between two opposite forces, determined by the social behaviour.

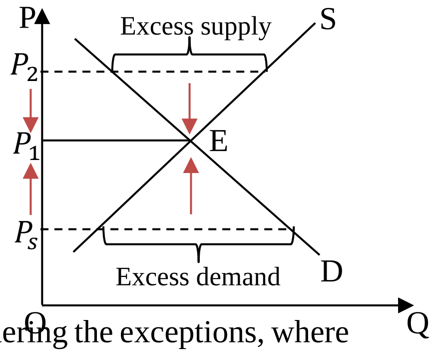
Equilibrium will be occurred when the quantity of a commodity demanded in the market is equal to the commodity supplied to the marked at a given period of time.

i.e. D = S.

1.1.18.1. Stable Equilibrium:

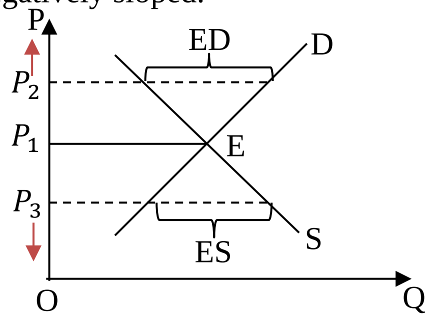
A stable equilibrium means, "any divergence from the market determined equilibrium value will create the operation of market forces in such a way by which the previously determined market value will be restored".

Slope of SS > slope of DD



1.1.18.2. Unstable Equilibrium:

It means movement away from the market determined value, considering the exceptions, where the demand curve is positively sloped and the supply curve is negatively sloped.



1.1.18.3. Metastable:

In one unlikely case, that the market demand curve and market supply curve 'coincide' to each other, we have a situation like neutral or metastable equilibrium.

We have two conditions at equilibrium.

i) D = S (necessary)

ii) At intersection, supply line cuts the Demand line from below (sufficient).

Through some economists are f the view that these two conditions are simultaneously is the sufficient condition. These two only can be noted as 'first order condition' and 'second order condition'.

1.1.19. Cardinalism and Ordinalism:

A new framework, for the analysis of consumer behaviour – a framework which is different from the Cardinal Utility Approach of the Theory of Demand, developed by the Neoclassical Scholars. The most detective and unrealistic assumption of the theory is 'utility can be cardinally measured in principle as well as practice'. But utility cannot be measured exactly in terms of any unit because it is 'subjective'.

Cardinalism ⟶ developed by Prof. Marshall

Ordinalism ⟶ developed by Edgeworth, Pareto, Slutch Johnson, Hicks and Allen.

'Ordinal Utility' ⟶ first developed by one Russian Scholar Slutsky, in 1915 and in 1928, a detailed discussion about Indifference curve Approach was done by Prof. Hicks and Allen in a paper.

According to the neoclassical thoughts, headed by Prof. Marshall to a consumer utility obtained from a commodity at a given point of time is the amount he is ready to spend for obtaining that unit of commodity. This is the main theme of the cardinal approach.

Ex: price of a bottle of 'coke' is Rs. 10.

A thirsty consumer is ready to pay Rs. 15.

Hence, following the cardinalist, utility obtained from the bottle of cold drinks to the man is Rs. 15. So utility can be measured quantitatively in terms of money.

According to the alternative thoughts, when a given quantity is present in different things in such a way, they may be arranged in an order of preference by saying that they possess it to greater or less degrees, it is said to possess ordinal quantity.

Ex: Let a consumer has two options, R cup of 'Quality walls' or a bottle of 'coke'. Now he cannot express the degree of utility he is enjoying in quantity but he may prefer ice-cream which will after more satisfaction. Hence following the ordinalist, ranking or order is possible according to the preference. So, ice-cream can be ranked as first, cold-drinks as second.

1.1.20. Marshallian Theory of Demand: Cardinal Utility Approach

The theory of demand mainly deals with two basis problems:

(i) Determination of consumers equilibrium condition.

(ii) To establish the law of demand.

1.1.20.1. Assumptions:

(i) cardinally measurable.

(ii) Independent functions.

$U = f(X),\ U = f(Y)$

* Utility obtained from X depends on only the consumption of X not on Y.

* similarly obtained from Y depends on only the consumption of Y not on X.

(iii) Additive

For different products $TU = f(X) + f(Y)$

↳ For different units of same product $TU = f(X_1) + f(X_2) + \ldots\ldots\ldots\ldots + f(X_n)$

(iv) Non related → two products are not related / two products are not substitutes or complements.

(v) Constant marginal utility of money.

(vi) Diminishing marginal utility.

If $U = f(X)$ than $\frac{dU}{dX} > 0$ but $\frac{d^2U}{dX^2} < 0$; $\frac{dU}{dX} = MU_X$

(vii) Divisibility → product is perfectly and finitely divisible is small units.

(viii) Non-Satiety → Marginal utility may diminish but total utility is still increasing. This is possible when one consumer is 'undersaturated' i.e. MU_X must be positive.

(a) Perfect saturation (TU is max) ⇒ $MU_X = 0$

(b) Over saturation (TU is falling) ⇒ $MU_X < 0$

(c) Under saturation (TU is rising) ⇒ $MU_X > 0$ (non-satiety)

(ix) Rational → basic objective is the maximisation of net utility.

(x) Price & Income (Price of a product and income of the consumer is constant).

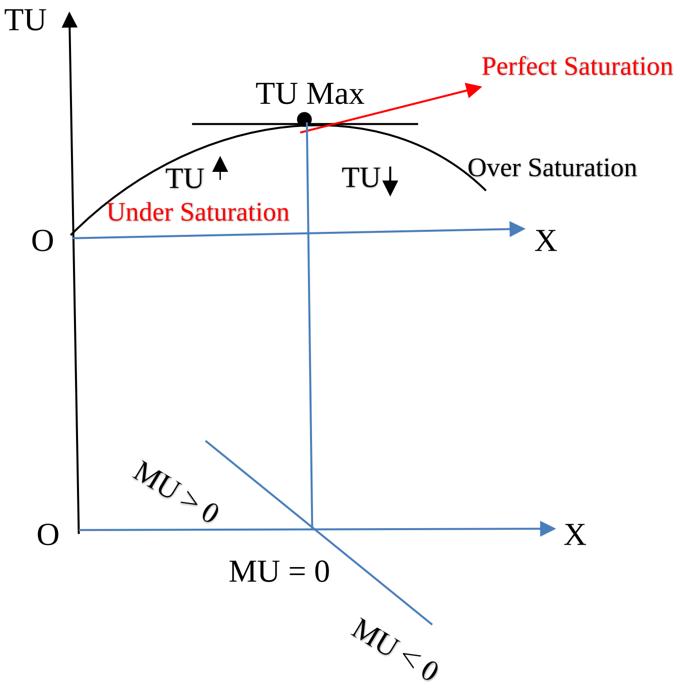
1.1.20.2. The law of diminishing marginal utility:

$MU_X = \frac{\Delta(TU)}{\Delta X} = \frac{TU_2 - TU_1}{X_2 - X_1}$ [X_1, X_2 are two units of X]

(i) if TU is increasing ⇒ $TU_2 > TU_1$ ⇒ $MU_X > 0$ ⇒ Under saturation

(ii) if TU is constant ⇒ $TU_2 = TU_1$ ⇒ $MU_X = 0$ ⇒ Perfect saturation

(iii) if TU is decreasing $TU_2 < TU_1$ $MU_X < 0$ over saturation.



1.1.20.3. Consumer's Equilibrium:

Net utility (NU) = Utility obtained – Utility sacrificed.

(i) For single product (X):

$NU = U(X) - \alpha\, P_X . X$ $X \rightarrow$ Product available in the market

α & P_X are cont. $\Rightarrow NU = U(x) - \bar{\alpha}.\, \bar{P}_x.x$ Max NU $x \rightarrow$ the amount or quantity demanded of X

(i) $\frac{d(NU)}{dX} = 0 \Rightarrow \frac{d}{dX}[U(x)] - \bar{\alpha}\, \bar{P}_x \frac{d}{dX}(x) = 0$ $U(x) \rightarrow$ utility obtained.

$\Rightarrow MU_x - \bar{\alpha}\, \bar{P}_x = 0$ P_x = Price of the product X per unit

$\Rightarrow \boxed{MU_x = \bar{\alpha}\, \bar{P}_x}$ (necessary) $P_x.\, x$ = Expenditure to purchase the quantity of X

(ii) $\frac{d^2(NU)}{dx^2} < 0 \Rightarrow \frac{d}{dX}[\frac{d}{dX}(NU)] < 0$ $\alpha \rightarrow$ MUM

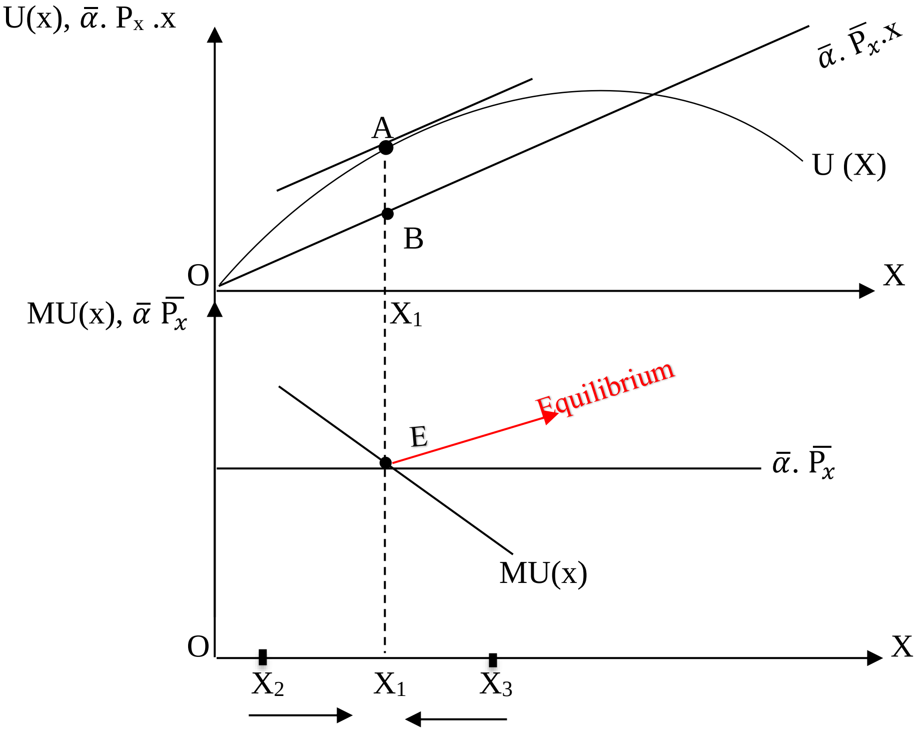
$\alpha.\, P_x.\, x \rightarrow$ utility sacrificed

$\Rightarrow \frac{d}{dX}[MU_x - \bar{\alpha}\, \bar{P}_x] < 0$

$\Rightarrow \frac{d(MU_x)}{dX} < 0 \; [\therefore \frac{d}{dX}(\bar{\alpha}\, \bar{P}_x) = 0]$

$\Rightarrow$ Slope of $MU_x < 0$

$\Rightarrow$ $\boxed{MU_x \text{ must be falling}}$ (sufficient)



NU is maximum Where the vertical gap between U(x) and $\bar{\alpha}.\ \bar{P}_x$ x is Maximum (AB) Equilibrium quantity Is OX_1

(ii) For two products (X, Y):

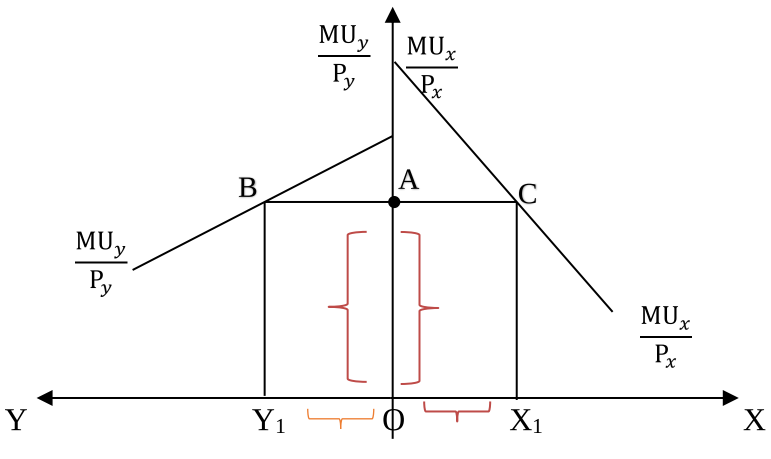
For X, equilibrium is, $MU_X = \alpha.P_x \Rightarrow \frac{MU_x}{P_x} = \alpha$

For Y, equilibrium is, $MU_Y = \alpha.P_y \Rightarrow \frac{MU_y}{P_y} = \alpha$

Hence for two products the condition will be

$$\boxed{\frac{MU_x}{P_x} = \frac{MU_y}{P_y} = \alpha = MUM}$$ (marginal utility of money)

This is popularly known as Law of Equi-Marginal Principle



At pt. C, $X = OX_1$; $\frac{MU_x}{P_x} = OA$

At pt. B, Y = OY_1 ; $\frac{MU_y}{P_y}$ = OA

Therefore, A represents the equilibrium point where $\frac{MU_x}{P_x} = \frac{MU_y}{P_y}$

Equilibrium consumption of two products are OX_1 & OY_1

The principle of substitution will be helpful to explain the law of equi-marginal principle.

(i) if $\frac{MU_x}{P_x} > \frac{MU_y}{P_y}$

⇨ X will offer higher satisfaction than Y.

⇨ Consumption of X$\uparrow \rightarrow MU_x \downarrow \rightarrow \frac{MU_x}{P_x} \downarrow$ [as P_x is constant]

⇨ Y$\downarrow \rightarrow MU_y \uparrow \rightarrow \frac{MU_y}{P_y} \uparrow$ [as P_y is constant]

⇨ The adjustment will continue until the equality holds.

(ii) if $\frac{MU_x}{P_x} < \frac{MU_y}{P_y}$

⇨ Y will offer higher satisfaction than X.

⇨ Consumption of Y$\uparrow \rightarrow MU_y \downarrow \rightarrow \frac{MU_y}{P_y} \downarrow$

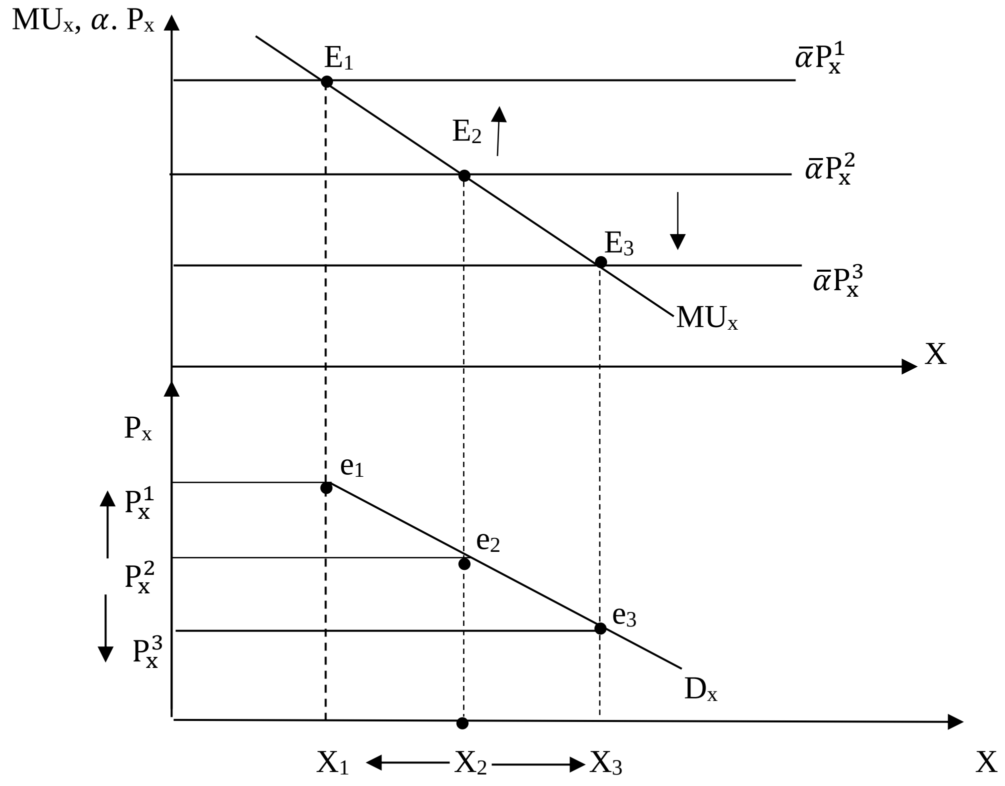
⇨ Consumption X$\downarrow \rightarrow MU_x \uparrow \rightarrow \frac{MU_x}{P_x} \uparrow$

⇨ The adjustment will continue until the equality holds.

(iii) For large no. of products (n no. of products)

$$\boxed{\frac{MU_1}{P_1} = \frac{MU_2}{P_2} = \ldots\ldots\ldots\ldots\ldots = \frac{MU_n}{P_n} = \alpha = \text{(MUM)}}$$

1.1.20.4. Demand curve:



Let E_2 be the initial equilibrium point where both the necessary ($MU_x = \alpha P_x$) and sufficient (MU_x is fulling) condition are satisfied. The points represent one combination e_2 (X_2, P_x^2) in the lower panel.

Now increase (decrease) in P_x from P_x^2 to P_x^1 (P_x^3) mean parallelly upward (downward) shifting of the horizontal line (as ∞ is constant). Therefore, the new equilibrium will be E_1 (E_3). The combination will be e_1 (X_1, P_x^1) and e_3 (X_3, P_x^3). Joining these unique combination e_1, e_2, e_3 in the lower panel a negatively sloped demand line can be derived.

1.1.20.5. Price Elasticity:

Let the budget eq^n for two products (X, Y) is, $M = P_x.X + P_y.Y$.

M is income, $P_x . X \rightarrow$ Exp. For X, $P_y.Y \rightarrow$ Exp. For Y.

$\therefore dM = P_x d_x + XdP_x + P_y dy + ydP_y$

$\Rightarrow O = P_x d_x + XdP_x$ [M is constant, price of other product (P_y) is constant,

two products are non-related (dy = O)]

$\Rightarrow P_x d_x = - XdP_x$

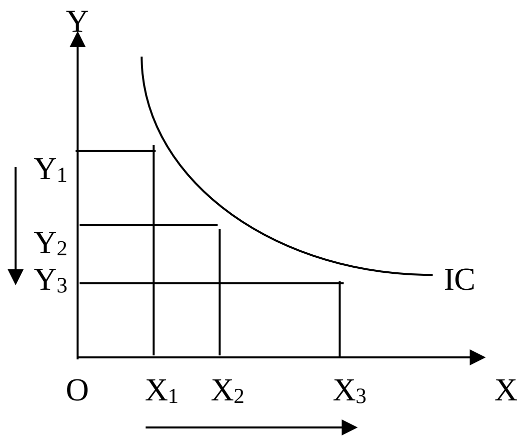
$\Rightarrow -\frac{P_x}{X} \cdot \frac{dX}{dP_x} = 1 \Rightarrow e_p^x = 1 \Rightarrow$ Under Marshallian approach $e_p = 1$ i.e. unitary elastic and the dd curve is 'RECTANGULAR HYPERBOLA'

1.1.21. Indifference Curve: [Hicks and Allen, 1928]

1.1.21.1. Ordinal Utility Approach [Slutsky, 1915]

The tern indifferent means, a consumer is indifferent to different product combination.

Indifference curve is the locus of various 'indifferent' combinations of two products X & Y, which yield equal level of satisfaction to the consumer.



1.1.21.2. Assumption:

(i) Scale of preference

(ii) Ordinally measurable

(iii) Product combination

↳ existence of X & Y, / the combination like (X, O), (O, Y) are unrealistic.

(iv) Dependent function

↳ The utility 'dependent' in nature, i.e. U = f (X, Y). It means utility derived from the product

X depends on the consumption of X and Y, not from X alone.

(v) Nature of product ⟶ both products are normal.

(vi) Related product ⟶ substitute & complementary.

(vii) Non-satiety ⟶ A consumer is always 'under saturated' which means MU obtained from both

products are positive.

$U = f(X, Y)$, $MU_x > O$, $MU_y > O$

if $MU_x = O$, $MU_y = O \Rightarrow$ Perfect saturation if $MU_x < O$, $MU_y < O \Rightarrow$ Over saturation.

(viii) Diminishing marginal rate of substitution (DMRS)

(ix) Consistent behaviour $\longrightarrow$ AIB, BIC $\Rightarrow$ AIC

Alternatively, C does not prefer to A.

(x) Transitive behaviour $\longrightarrow$ APB, BPC, CPD $\Rightarrow$ APD.

if APB & BPA $\Rightarrow$ AIB

if AIB & BIC $\Rightarrow$ AIC

if APB & BPC $\Rightarrow$ APC

if AIB & BPC $\Rightarrow$ APC

if APB & BIC $\Rightarrow$ APC

1.1.21.3. Properties of Indifference Curve:

By definition, movement along the IC means different consumption amounts of two products but constant utility. Therefore, the equation of IC can be written as,

$\bar{U} = f(X, Y)$................ (i)

P-1:- The IC is negatively sloped:

$\Rightarrow$ From equation (i) it can say that increase in X definitely means decrease in Y, to maintain constant

utility.

$\Rightarrow$ By the assumption of Non-satiety, a consumer is always ‘undersaturated’.

$\Rightarrow MU_x > O$, $MU_y > O \Rightarrow$ Slope of IC $= \frac{\Delta y}{\Delta x}$

$= -\frac{MU_x}{MU_y} < O.$

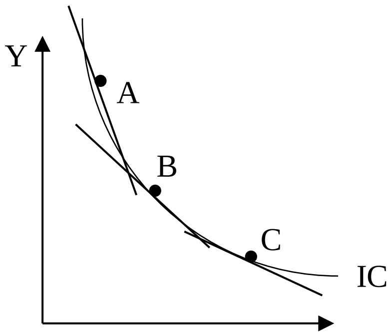
P-2:- IC is convex to the origin:

$\Rightarrow$ The convexity of IC is based on the assumption of diminishing marginal rate of substitution.

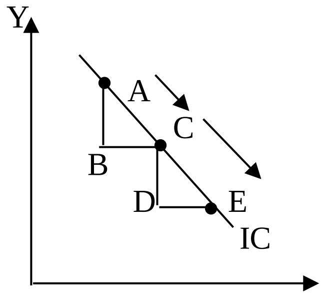
$\Rightarrow$ Slope of IC $= \left(-\frac{\Delta y}{\Delta x}\right) = \frac{MU_x}{MU_Y} = MRS_{XY}$

$\Rightarrow$ The absolute value of the slope of IC, $\left|\frac{\Delta y}{\Delta x}\right|$ = MRS. Now due to the assumption, MRS is diminishing

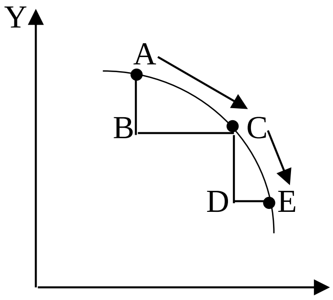
$\Rightarrow$ slope of IC is diminishing $\Rightarrow$ IC must be convex to the origin.



(F – 1)

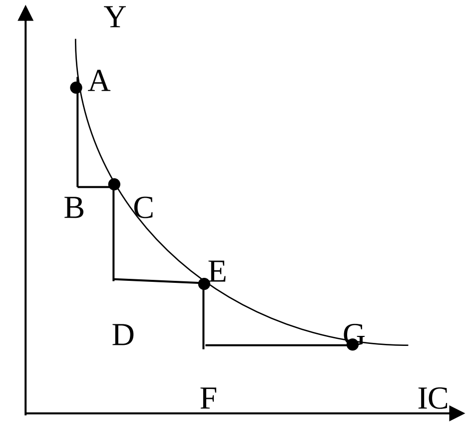


(F – 3)



(F – 4)

X



(F – 2)

⇨ In fig – 3, AB = CD and BC = DE

$\Rightarrow \left(\frac{AB}{BC}\right) = \left(\frac{CD}{DE}\right)$

⇨ MRS or slope of IC is constant

⇨ IC is straight line.

In fig – 4, AB = CD but BC > DE

$\Rightarrow \left(\frac{AB}{BC}\right) < \frac{CD}{DE}$

⇨ MRS or slope of IC is increasing

⇨ IC must be concave to the origin.

⇨ In fig – 2, from point A to C means increase in X where ΔX = BC but corresponding loss of Y where

ΔY – AB. Therefore MRS = $\frac{AB}{BC}$.

Now loss of Y is given, i.e. AB = CD = EF then a rational consumer is prepared to accept more of X

i.e. BC < DE < FG

$\Rightarrow \frac{AB}{BC} > \frac{CD}{DE} > \frac{EF}{FG}$

⇨ MRS is diminishing ⇨ IC is convex to the origin.

Hence the assumption of diminishing MRS only means the convexity of an IC.

P-3:- Higher IC represents higher satisfaction.

P-4:- Two ICs cannot intersect each other.

P-5:- IC does not touch the axes.

1.1.21.4. Exception to the Indifference Curve:

Normally IC is always negatively sloped assuming both products are normal, close substitutes and a consumer is always under saturated.

Hence some exceptional conclusions can be done, when these assumptions are relaxed.

Nature of the product:

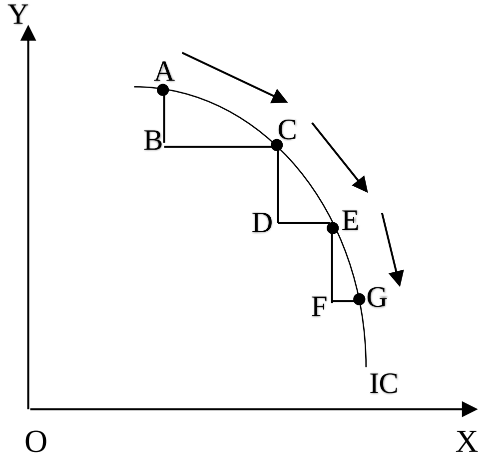
a) let one of the product, say 'Y' is inferior.

⇨The consumer is ready to sacrifice equal Amounts of Y i.e. AB = CD = EF, though Getting lower amount of X, i.e, BC > DE > FG.

⇨ $\frac{AB}{BC} < \frac{CD}{DE} < \frac{EF}{FG}$

⇨ MRS or slope of IC increasing

⇨ IC must be "concave to the origin".



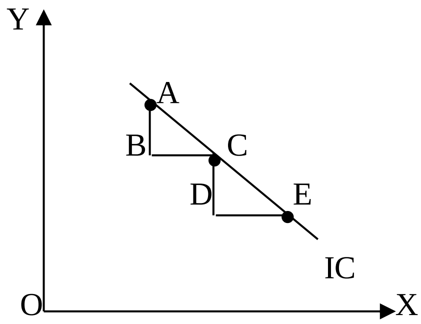
b) when both products are "perfect substitutes"

⇨ Exchange rates are equal because AB = CD and BC = DE

⇨ $\frac{AB}{BC} = \frac{CD}{DE}$

⇨ MRS or slope of IC is constant.

⇨ IC must be a "straight line".



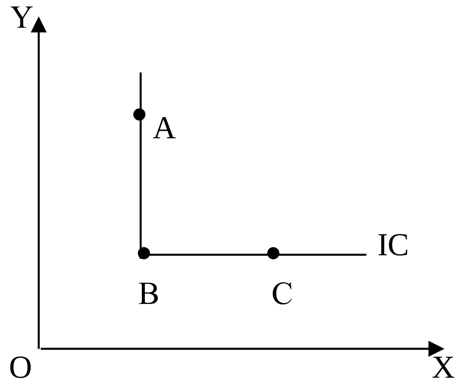
c) when both products are 'complementary' to each other

⇨ substitution is not possible, e.g. petrol and automobile.

⇨ for A to B, MRS = $\frac{AB}{O}$ = α

and for B to C, MRS = $\frac{O}{BC}$ = O

⇨ IC will be 'L – shaped'



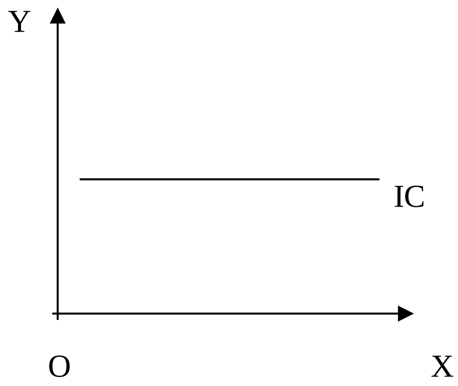
1.1.21.5. Nature of Saturation:

a) consumer is ‘perfectly saturated’ with respected to X but ‘under saturated’ w.r.t. Y.

⇨ $MU_x = O, MU_y > O$

⇨ Slope of IC = $-\frac{MU_x}{MU_Y} = O$

⇨ IC will be horizontal

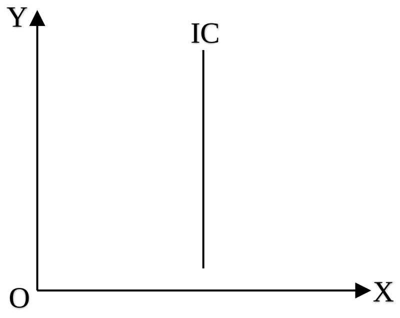


b) consumer is ‘perfectly saturated’ w.r.t Y but ‘under saturated’ w.r.t. X.

⇨ $MU_x > O, MU_y = O$

⇨ Slope of IC = $-\frac{MU_x}{MU_Y} = \alpha$

⇨ IC is vertical



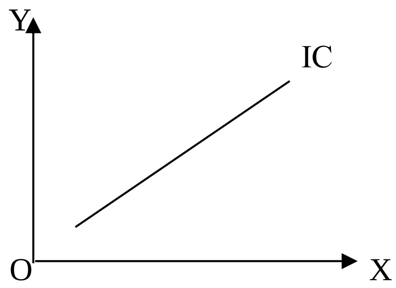
c) consumer is ‘over saturated’ w.r.t. X but ‘under saturated’ w.r.t. Y

⇨ $MU_x < O, MU_y > O$

⇨ Slope of IC = $-\left(\frac{MU_x}{MU_Y}\right) > O$

⇨ IC will be positively sloped.

And the same conclusion can be when consumer is ‘over saturated’ w.r.t Y but ‘under saturated’ w.r.t. X.



⇨ $MU_x > O, MU_y < O$

⇨ Slope of IC = $-\left(\frac{MU_x}{MU_Y}\right) > O$ ⇨ IC is positively sloped.

1.1.21.6. Budget Line:

Budget line represents the locus of different combinations of two products (say X and Y) for constant expenditure (E). Therefore, movement along the BL represents constant or equal level of income (M).

$$\bar{E} = f(X, Y)$$

1.1.21.6.1. Assumptions:

(i) Both products are close substitutes and divisible in small units.

(ii) At a given period of time, the level of income is constant.

(iii) The price of the products (P_X, P_Y) are market determined and constant.

(iv) The consumer spends his entire income for the consumption of two products i.e. M = E

(v) Nonexistence of savings and demand for loan.

Since, M = E

$$\overline{M} = \overline{P}_x.X + \overline{P}_y.Y \Rightarrow \text{Equation of BL}$$

$$M = P_x.X + P_y.Y$$

$$\text{or, } P_y.Y = M - P_x.X$$

$$\text{or, } Y = \frac{M}{P_y} - \left(\frac{P_x}{P_Y}\right).X$$

$$\text{or, } \frac{\Delta y}{\Delta x} = -\frac{P_x}{P_Y} \Rightarrow \text{Slope of BL.}$$

1.1.21.6.2. Characteristics of BL:

(i) Since the equ of BL is linear ⇒ BL must be a straight line.

(ii) Slope of BL = $-\frac{P_x}{P_Y} < O$ ⇒ BL must be falling or negatively sloped.

(iii) since, $Y = \frac{M}{P_y} - \left(\frac{P_x}{P_Y}\right).X$

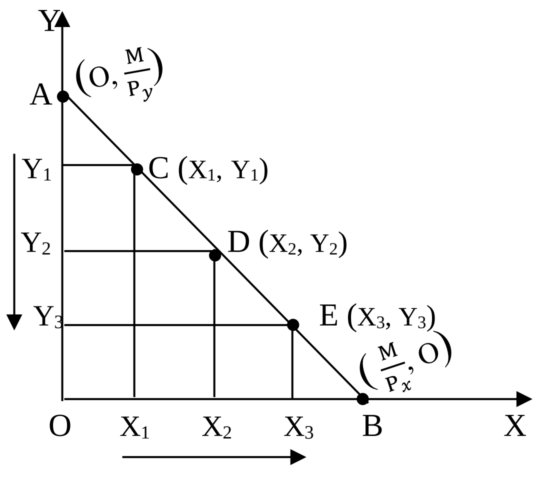
⇒ The intercept of BL = $\frac{M}{P_y} > O$

⇒ Therefore, BL starts from positive vertical intercept.

(iv) Since M = E
Movement of the consumer is restricted
Along the BL.

(v) Change in income means shifting of BL, in upward or downward direction, when prices are constant. (shift)

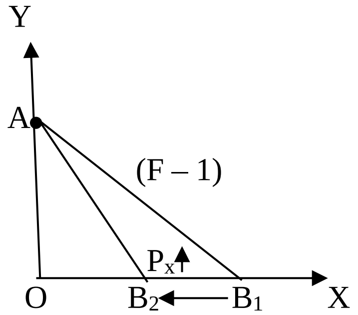
(vi) Change in price of a single product means change in slope of BL, either steeper or flatter, where income and price of other product remain constant (pivot).



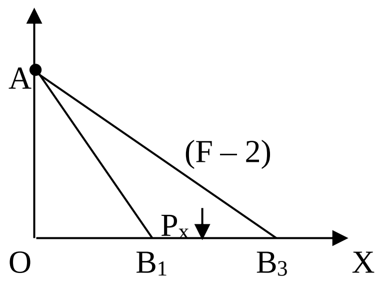
1.1.21.6.3. Change in the Slope of BL:

1) change in P_x ; M & P_y are constant

*$P_x\uparrow \Rightarrow \left(\frac{P_x}{P_Y}\right)\uparrow \Rightarrow$ Steeper BL (F – 1)

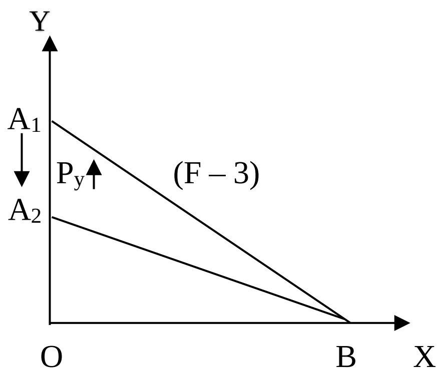


* $P_x\downarrow \Rightarrow \left(\frac{P_x}{P_Y}\right)\downarrow \Rightarrow$ flatter BL (F – 2)

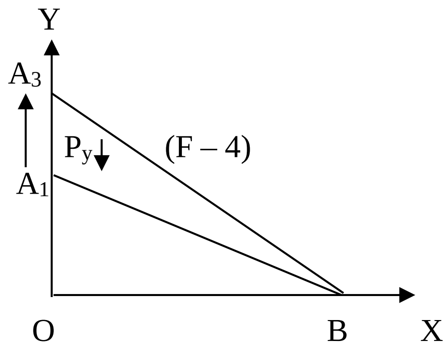


2. change in P_y ; M and P_x are constant

* $P_y\uparrow \Rightarrow \left(\frac{P_x}{P_Y}\right)\downarrow \Rightarrow$ flatter BL (F – 3)



* $P_y\downarrow \Rightarrow \left(\frac{P_x}{P_Y}\right)\uparrow \Rightarrow$ steeper BL (F – 4)

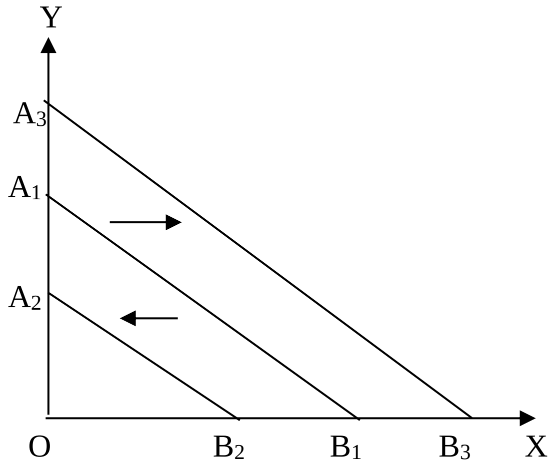


1.1.21.6.4. Shifting of BL:

1. change in M ; P_x & P_y are constant
   * M↑⇒ Parallelly rightward shifting of BL from A_1 B_1 to A_3 B_3 (F – 5)

   * M↓ ⇒ Parallelly leftward shifting of BL from A_1 B_1 to A_2 B_2 (F – 5)

2. change in prices of the products P_x and P_y at a same rate with same direction
   - If prices are doubled then BL will shift Parallely in downward direction



   - If prices are halved than BL will shift parallel in upward direction.

1.1.21.7. Equilibrium Condition:

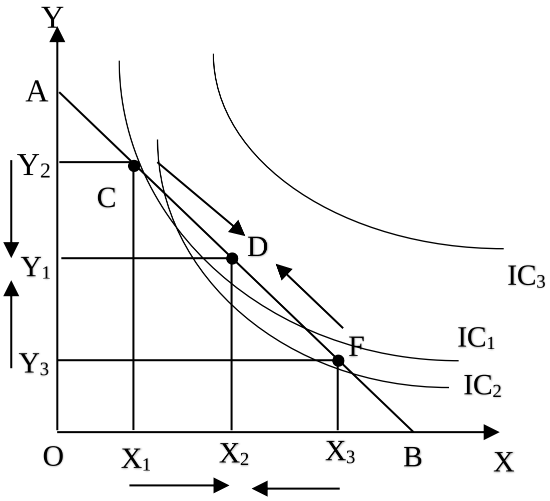
Given prices of two products and income of the consumer, the problem can be written as,
Maximization of satisfaction, U = U (X, Y)
s, t, budget constraint $M = P_x.X + P_y.Y$
Fitting Lagrange multiplier
$L = U(X, Y) – \lambda [M - P_x.X - P_y.Y]$
taking partial derivative w.r.t. X & Y

$$\frac{\partial L}{\partial X} = O \Rightarrow \frac{\partial U}{\partial X} - \lambda P_x = O \Rightarrow MU_x = \lambda P_x$$

$$\lambda = \frac{MU_x}{P_x}$$

and $\frac{\partial L}{\partial Y} = O \Rightarrow \frac{\partial U}{\partial Y} - \lambda P_y = O \Rightarrow MU_y = \lambda P_y$

$$\Rightarrow \lambda = \frac{MU_y}{P_y}$$



$$\therefore \frac{MU_x}{P_x} = \frac{MU_y}{P_y}$$

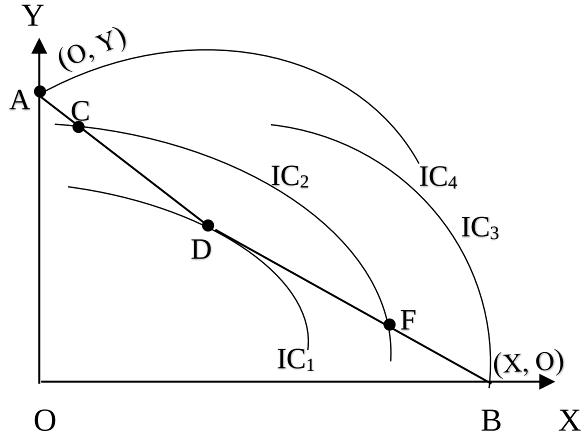
or, $\frac{MU_x}{U_y} = \frac{P_x}{P_y}$ ⇒ Slope of IC = slope of BL

⇒ MRS equal to the price ratio.

Therefore, equilibrium conditions are
(i) Slope of IC = slope of BL
(ii) at equilibrium, the IC must be convex to the origin.

Equilibrium conditions and the corner solution:

- Let IC and BL both are tangent but at the tangential point, IC is not convex to the origin.
  - ⇨ IC is convex to the origin due to the Diminishing marginal rate of substitution.
  - ⇨ But if MRS is increasing, then IC will be concave to the origin.
  - ⇨ So, if the convexity of IC is violated, then Consumer may attain higher satisfaction by consuming single product, either X or Y. This situation is called 'MONOMANIA'. Therefore, one corner Point A (O, Y) another corner point B (X, O) can offer higher satisfaction.



⇨ Hence if tangential point is maintained, violating the convexity, the equilibrium point cannot be derived.

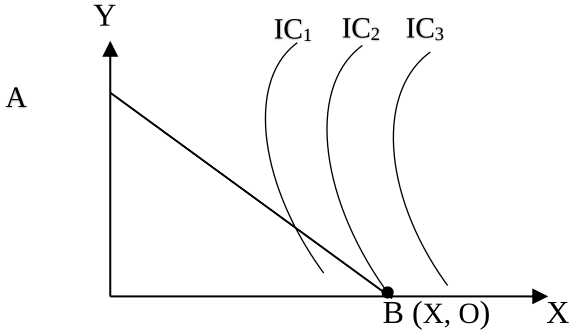
- Let IC is convex to the origin, but IC and BL both are tangent, either steeper or flatter.

  (i) Ic is steeper than BL

  ⇨ $\frac{MU_x}{MU_y} > \frac{P_x}{P_y}$

  ⇨ $\frac{MU_x}{P_x} > \frac{MU_y}{P_y}$

  ⇨ The consumer will consume a single product X at point B (X, O)

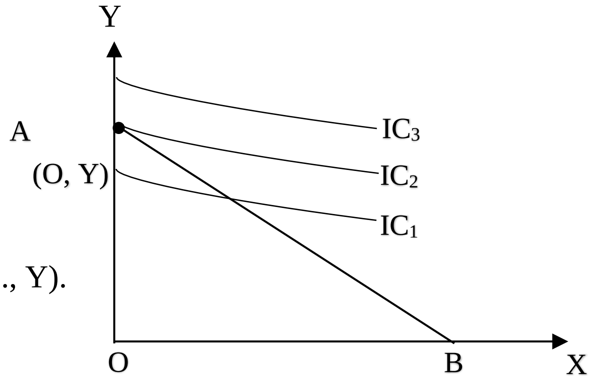


  (ii) IC is flatter than BL

  ⇨ $\frac{MU_x}{MU_y} < \frac{P_x}{P_y}$

  ⇨ $\frac{MU_x}{P_x} < \frac{MU_y}{P_y}$

  ⇨ Consumer will consume a single product Y at point A (O., Y).



Hence if convexity is maintained, violating the restriction of tangent than equilibrium solution cannot be derived.

1.1.21.8. Price Consumption Curve:

PCC_x is the locus of successive consumer's equilibrium points occurred due to a change in P_x where P_y and M remain constant.

↳ movement along PCC_x means variable price ratio $\left({}^{P_x}/_{P_y}\right)$ with constant money income.

↳ Since price ratio in absolute sense represents the slope of the budget line, thus PCC_x always indicates a change in slope of budget line.

The budget equation is $M = P_x.X + P_y.Y$

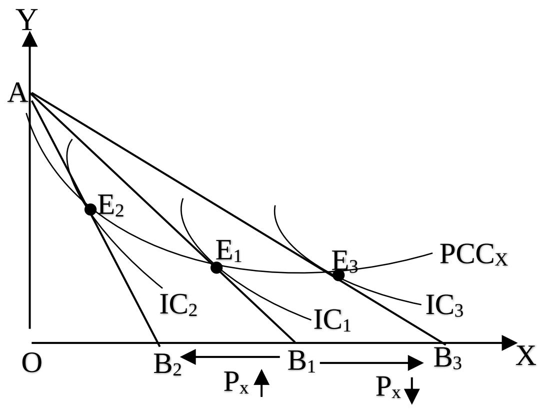
$$\text{or, } 1 = \frac{X}{\frac{M}{P_x}} + \frac{Y}{\frac{M}{P_y}} \qquad \frac{M}{P_x} \Rightarrow \text{horizontal intercept.}$$

$$\frac{M}{P_y} \Rightarrow \text{vertical intercept.}$$

To derive PCC_x, it is assumed that M and P_y are two constants. Therefore, the vertical intercept is constant in the diagram where entire change lines in horizontal axis.

The shape of the PCC_x depends on the Nature of the product X:

(a) If 'X' is normal than PCC_x may be Negatively sloped, horizontal or even positively sloped.
(b) If X is Giffen good ⇨ PCC_x is backward bending.
(c) If demand for X is constant, ⇨ PCC_x will be Vertical or parallel to the Y-axis.



1.1.21.8.1. Relationship between PCC_x and Price-elasticity of demand:

1) when PCC_x is horizontal or parallel to X-axis:
Movement from point E_1 to E_2 to E_3 means Continuous fall in P_x.

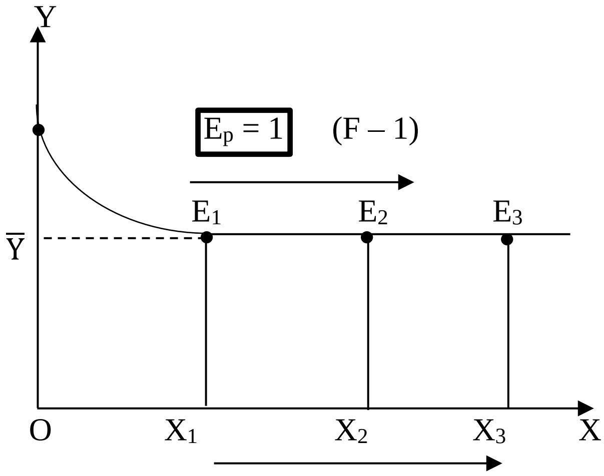
⇨ $\bar{M} = P_x.X + \bar{P_y}.\bar{Y}$

⇨ $\bar{M} = \downarrow P_x.X\uparrow + \bar{P_y}.\bar{Y}$

⇨ To maintain the equality or constant income (LHS is const) the other component of expenditure $P_x.X$ has to be constant, which means % change in X = % change in P_x

⇨ $\dfrac{\%\text{ rise in X}}{\%\text{ fall in } P_x} = 1$

⇨ $E_p = 1$ ⇨ Product is 'unitary elastic'.



2) when PCC_x is negatively sloped:

Movement from E_1 to E_2 to E_3 means fall in P_x, increase in X and decrease in Y.

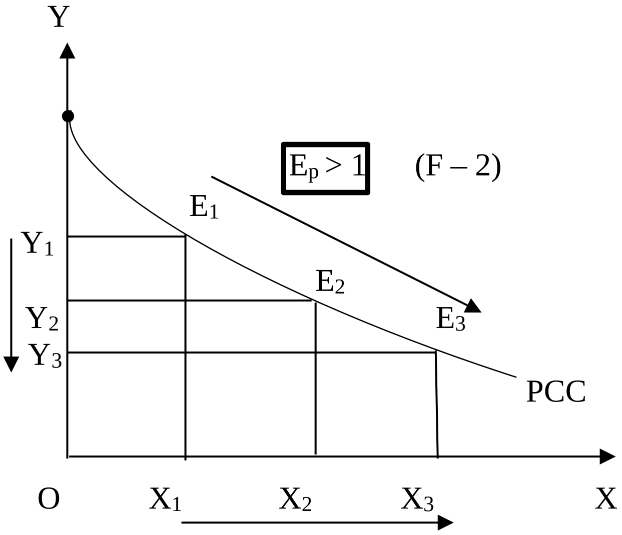
⇨ $\bar{M} = \downarrow P_x . X \uparrow + \bar{P}_y \; Y \downarrow$

⇨ As y is diminishing and P_y is fixed than expenditure for y becomes less.

⇨ to maintain constant income ($\bar{M}$) expenditure for X must be more which is possible only when % change in X > % change in P_x

⇨ $\dfrac{\text{\% rise in X}}{\text{\% fall in } P_x} > 1$

⇨ $E_p > 1$ ⇨ Product is relatively price elastic



3) when PCC_x is positively sloped:

⇨ Movement from E_1 to E_2 to E_3 means fall in P_x and increase in consumption of both products X and Y.

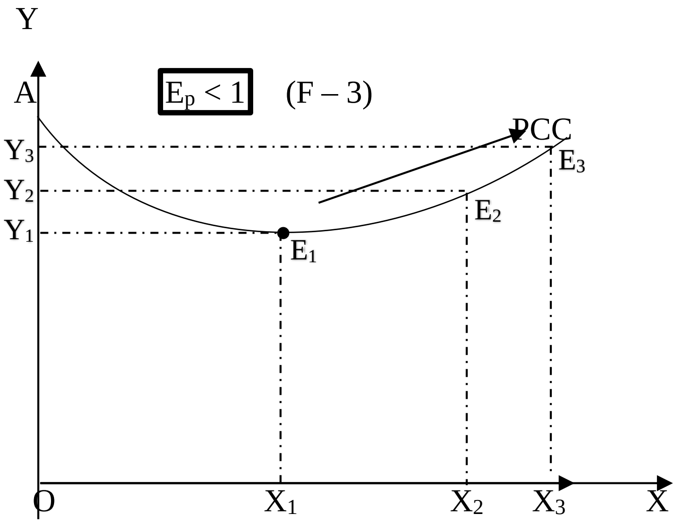
⇨ $\bar{M} = \downarrow P_x . X \uparrow + \bar{P}_y \; Y \uparrow$

⇨ As Y is rising and P_y is fixed than expenditure for y is rising.

⇨ to maintain $\bar{M}$, expenditure for X must be less which is possible only when % change in X < % change in P_x

⇨ $\dfrac{\text{\% rise in X}}{\text{\% fall in } P_x} < 1$

⇨ $E_p < 1$ ⇨ Product is relatively price in elastic



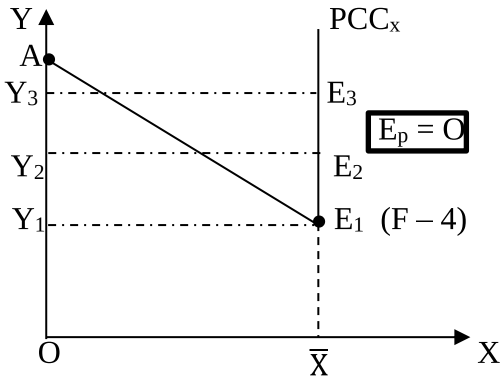
4) when PCC_x is vertical:

⇨ Movement from E_1 to E_2 to E_3 means continuous fall in P_x but constant consumption in X.

⇨ % change in X = O

⇨ $\dfrac{\text{\% rise in X}}{\text{\% fall in } P_x} = O$

⇨ $E_p = O$ ⇨ Perfectly price inelastic

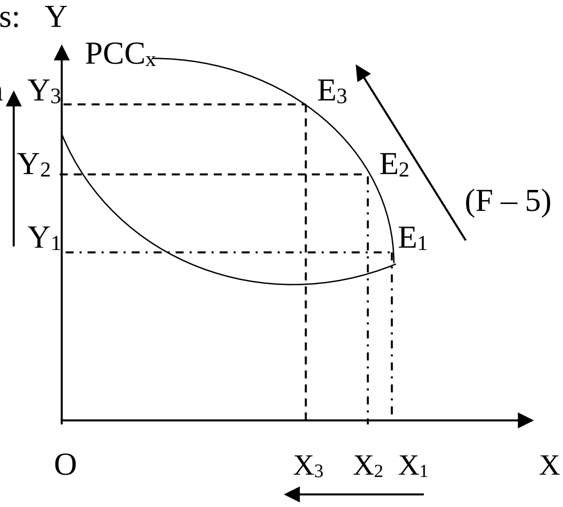


5) when PCC_x is backward bending to Y-axis:

⇒ Movement from E_1 to E_2 to E_3 means again, a fall in P_x, but fall in consumption of X.

⇒ we have the direct relationship between price and quantity demanded.

⇒ The product must be a "Giffen good" For such a shape.



1.1.21.8.2. Relationship between PCC_x and Cross-Elasticity:

$E_{yx} = \dfrac{\%\text{ rise in X}}{\%\text{ fall in }P_x}$; P_y and M constant.

(i) If $E_{yx} > O \Rightarrow P_x\downarrow\ Y\downarrow\ X\uparrow \Rightarrow$ two products are substitutes

(ii) If $E_{yx} < O \Rightarrow P_x\downarrow\ Y\uparrow\ X\uparrow \Rightarrow$ two products are complementary

(iii) If $E_{yx} = O \Rightarrow P_x\downarrow\ \overline{Y}\ X\uparrow \Rightarrow$ they are non-related.

The same diagrams can develop the relationship

(a) In fig – 1, when PCC_x is horizontal, the fall in P_x ⇒ increase in X but constant consumption of Y,

⇒ $E_{yx} = O$ ⇒ Non – related.

(b) In fig – 2, when PCC_x is negatively sloped ⇒ fall in P_x ⇒ increase in X but decrease in consumption Y

⇒ $E_{yx} > O$ ⇒ substitutes.

(d) In fig – 3, when PCC_x is positively sloped ⇒ fall in P_x ⇒ increase in the consumption of X as well as Y ⇒ $E_{yx} < O$ ⇒ complementary.

1.1.21.9. Income Consumption Curve:

ICC is the locus of successive consumer's equilibrium points occurred due to a change in income (M), where prices of the products (P_x, P_y) are constant.

The budget equation is $M = P_x.X + P_y.Y$

$$\Rightarrow 1 = \frac{X}{\frac{M}{P_x}} + \frac{Y}{\frac{M}{P_y}}\ ;\ \frac{M}{P_x} = \text{horizontal intercept.}$$

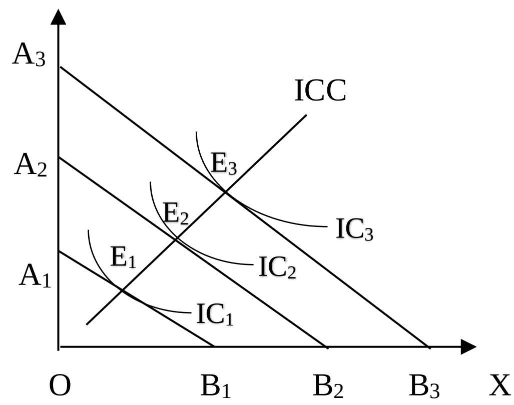
$$\frac{M}{P_y} = \text{vertical intercept.}$$

⇨ Change in income (M), keeping P_x and P_y are two constant components means change in both the intercepts by equal magnitude. Hence, the derivation of ICC is based on the concept of "shifting of budget line", parallelly in upward or downward direction.

⇨ It is noted that, any point lies on ICC means One equilibrium. Therefore, necessary Condition, itself represents the equation of ICC.

i.e. $\frac{MU_x}{MU_y} = \frac{P_x}{P_y}$ ⇨ $MRS = \frac{P_x}{P_y}$

⇨ Marginal rate of substitution = price ratio



- If ICC is positively sloped ⇨ both products are 'NORMAL'
- If ICC is backward bending ⇨ at least one product is 'INFERIOR'
- ICC is parallel to any axis, considering constant consumption of at least one product.

1.1.21.9.1. Relationship between ICC and Income Elasticity of demand:

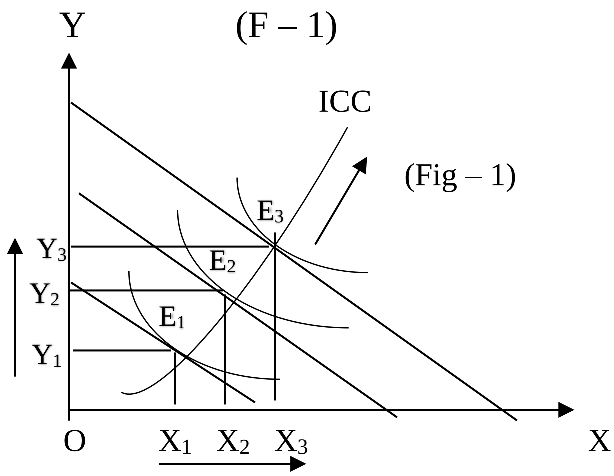
$$E_M^x = \frac{\%\text{ change in X}}{\%\text{ change in M}} = \frac{\Delta X}{\Delta M} \cdot \frac{M}{X}$$

(1) ICC is positively sloped

Movement from point E_1 to E_2 to E_3 means continuous rise in income (M) with rise in consumption of X and Y. The direction relation represents,

⇨ $\frac{\Delta X}{\Delta M} > O$ ⇨ $E_M^x > O$ & $\frac{\Delta Y}{\Delta M} > O$ ⇨ $E_M^Y > O$

⇨ Both products are "NORMAL"



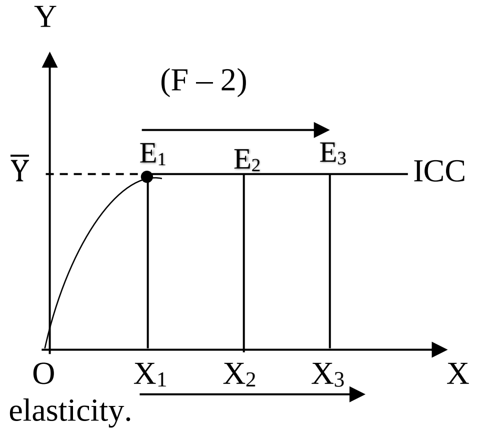
(2) ICC is parallel

(a) In (fig – 2), movement from point E_1 to E_3 means continuous rise in M with the rise in consumption of X but constant consumption of Y.

$\Rightarrow \frac{\Delta X}{\Delta M} > O \Rightarrow E_M^x > O$ and $\frac{\Delta Y}{\Delta M} = O \Rightarrow E_M^Y = O$

⇨ ICC is parallel to X axis

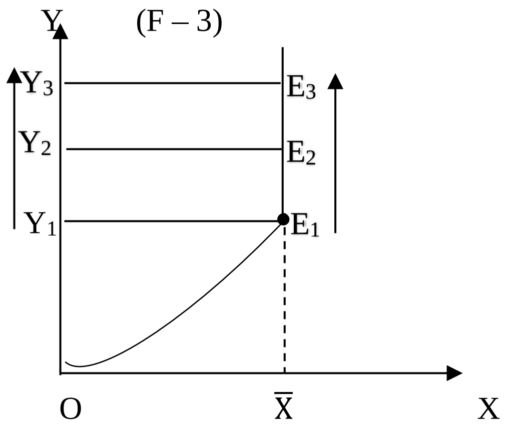
⇨ X is normal product with positive elasticity and Y is an constant consumption with zero income elasticity.



(b) In fig – 3, movement from point E_1 to E_3 means continuous rise in M with the rise in consumption of Y but constant consumption of X.

$\Rightarrow \frac{\Delta Y}{\Delta M} > O \Rightarrow E_M^Y > O$ and $\frac{\Delta X}{\Delta M} = O \Rightarrow E_M^x = O$

⇨ Product Y is normal with positive income elasticity and X is an constant consumption with zero income elasticity.

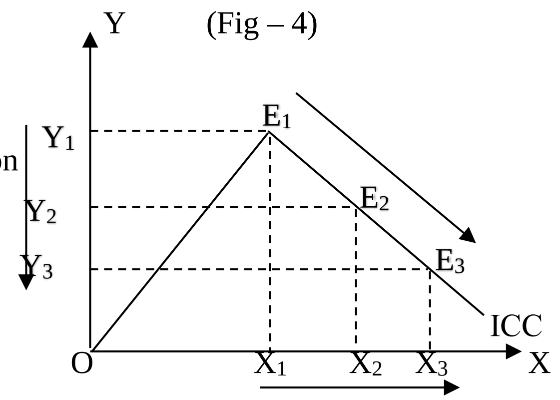


(3) ICC is backward bending

In fig – 4, movement E_1 to E_3 means Continuous rise in M with rise in Consumption of X but fall in consumption of Y.

$\Rightarrow \frac{\Delta X}{\Delta M} > O \Rightarrow E_M^x > O$ and $\frac{\Delta Y}{\Delta M} < O \Rightarrow E_M^Y < O$

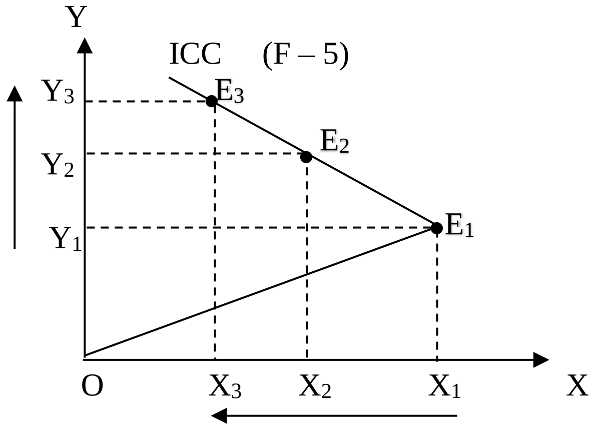
⇨ X is 'NORMAL' and Y is 'INFERIOR'



In fig – 4, movement from E_1 to E_3 means continuous rise in M with rise in consumption of Y but fall in consumption of X.

$\Rightarrow \frac{\Delta Y}{\Delta M} > O \Rightarrow E_M^Y > O$ and $\frac{\Delta X}{\Delta M} < O \Rightarrow E_M^x < O$

$\Rightarrow$ Y is 'NORMAL' and X is 'INFERIOR'



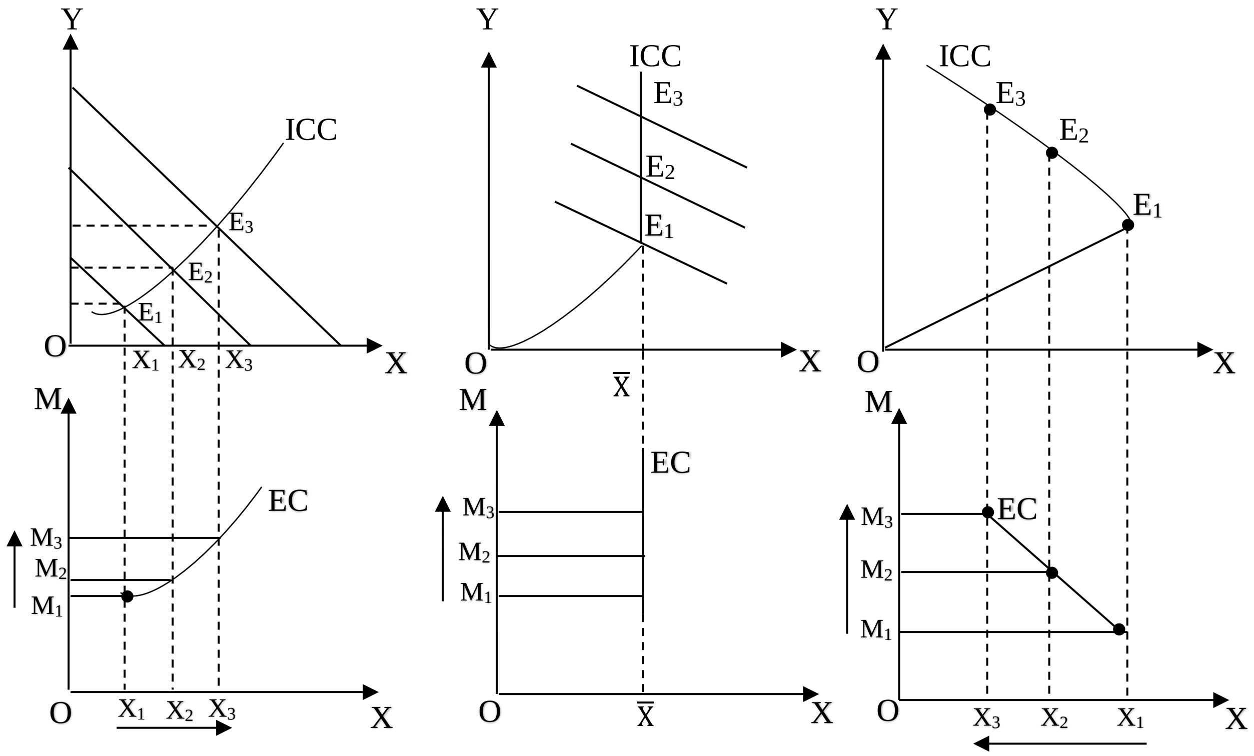
1.1.21.10. Engel curve from ICC:

Engel curve (EC) represents the relation between income of the consumer and consumption of a single product (say X) where prices (P_x, P_y) are constant.

$\Rightarrow$ As the demand curve can be derived from PCC, the Engel curve can be derived from ICC.

$\Rightarrow$ Therefore, following the Engel's Law, two points can be written:

1. As money income increases, demand for the consumption item also increases
2. It increases at a lower rate.



(F – 1) (F – 2) (F – 3)

- In fig-1, let product X is a the consumption item.
- as

⇒ Movement from point E_1 to E_3 means increase in income (M) but increase in consumption of X at a lower rate.

⇒ EC is concave to the M-axis.

$$\begin{pmatrix} M_1 < M_2 < M_3 \\ X_1 < X_2 < X_3 \\ \Delta M > \Delta X \end{pmatrix}$$

- ICC is vertical represents constant consumption of X for a change in M.

⇒ EC will be vertical.

$$\begin{pmatrix} M_1 < M_2 < M_3 \\ X_1 = X_2 = X_3 \\ \Delta X = 0 \end{pmatrix}$$

- If ICC is backward bending to Y-axis, where X can be treated inferior.

⇒ EC will be negatively sloped

$$\begin{pmatrix} M_1 < M_2 < M_3 \\ X_1 > X_2 > X_3 \end{pmatrix}$$

1.1.21.11. Decomposition of price Effect into Substitution Effect and Income Effect:

Price Effect (PE) represents or measures the effects on quantity demanded for a single product, say X, due to change in price of that product, say P_x, where price of the related product like P_y and money income of the consumer M remain constant.

Therefore, it can be represented by a fraction, PE = $\frac{\Delta X}{\Delta P_x}$

⇒ The sign of the PE depends on the nature of the product or the direction i.e. relationship between P_x and X

- For a normal product, increase (decrease) in P_x means decrease (increase) in quantity demanded for X. Due to this increase relationship the demanded curve for a normal product must be negatively sloped.

$$\Rightarrow \quad PE = \frac{\Delta X}{\Delta P_x} < O$$

- If quantity demanded for a product, say X remains constant for any change in P_x then demanded line will be vertical or perfectly inelastic.

$$\Rightarrow PE = \frac{\Delta X}{\Delta P_x} = O$$

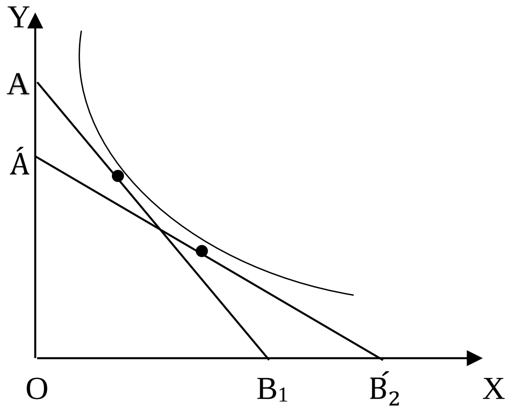
- For 'Giffen good', increase (decrease) in P_x means increase (decrease) in quantity demanded for X. Due to this direct relationship, the demanded curve for a Giffen product must be positively sloped.

$$\Rightarrow PE = \frac{\Delta X}{\Delta P_x} > O$$

1.1.21.11.1. Substitution Effect (SE):

A fall in price of a single product, say P_x, other factors remain constant means a fall in relative price ($\frac{P_x}{P_y}$) of that commodity. Due to this change, there will be a change in the composition of demand, which can be stated as SE. It can be calculated by keeping the consumer's 'real income' constant.

⇨ A fall in P_x, other factors remain constant means the consumer is better off. Now if the consumer is to be kept as well off as before and simultaneously is allowed to purchase at a new price than the money income has to be reduced and can be possible by the introduction of tax. This is called compensated demand curve.



$\boxed{E_1 E_2 = SE}$

1.1.21.11.2. Income Effect (IE):

Income effect of a change in price of one good is the change in quantity demanded resulting exclusively from a change in real income

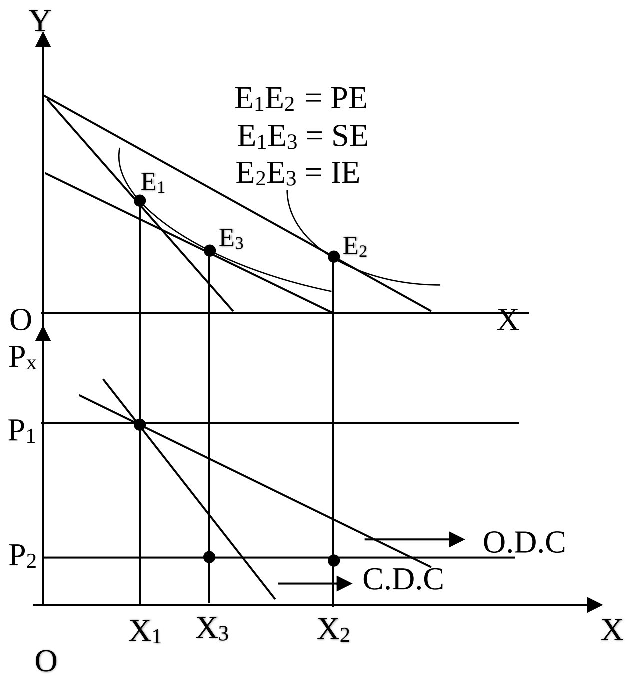
- For normal, IE > O ; $P_x\downarrow$ R.I.$\uparrow$ X$\uparrow$
- For inferior good, IE < O ; $P_x\downarrow$ R.I.$\uparrow$

Compensated demand curve:

A demand curve which considers only Substitution effect is called a compensated Demand curve because here the price change is compensated by a change in income to keep utility constant.

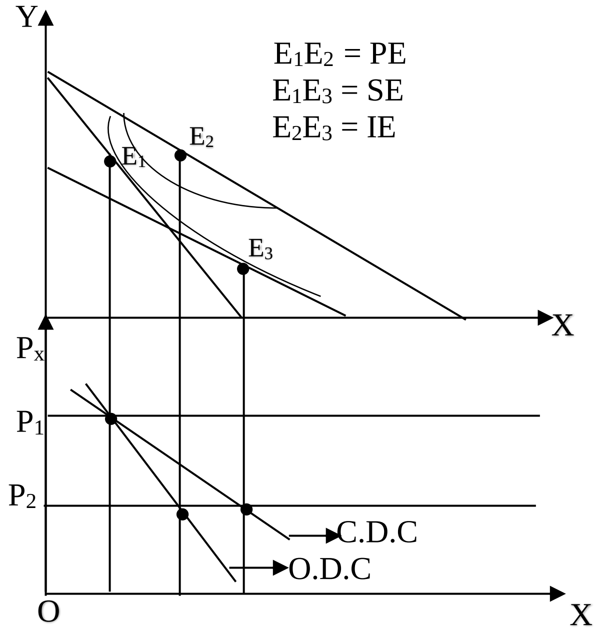
Ordinary demand curve considers total PE Whereas compensated demand curve considers only SE.

As PE $\lesseqgtr$ O, the O.D.C may either be (- ve)ly sloped or vertical or (+ve)ly sloped, whereas SE is always negative, the C.D.C must always be O.D.C (- ve)ly sloped.



■Ordinary demand curve is more elastic than compensated demand curve for a normal good

■Ordinary demand curve is less elastic than compensated demand curve for an inferior good.



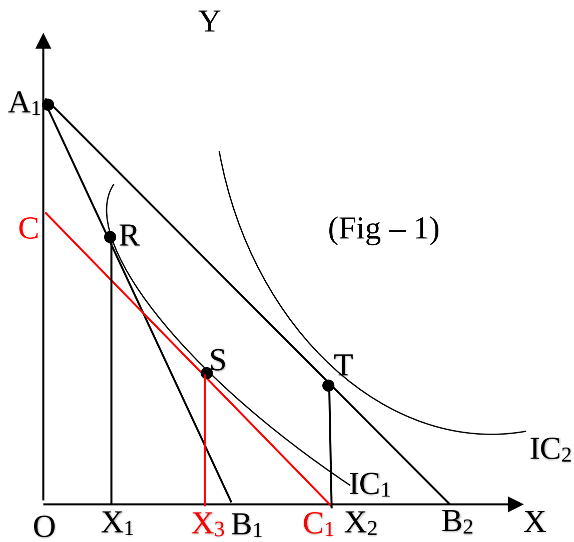
1.1.21.11.3. PE = SE + IE:

1.1.21.11.3a. Hick's Approach:

Let us illustrate it diagrammatically with the help of IC_s as in fig 1.

⇨ We begin with the budget line marked A_1B_1 and equilibrium point as R on IC_1. With fall in P_x the budget line pivots to A_1B_2 and the new equilibrium is at T on a higher indifference curve IC_2.

⇨ The total change in quantity demanded is from OX_1 (at R) to OX_2 (at T) i.e. $(OX_2 - OX_1)$ $= X_1 X_2$ = PE.



⇨'Compensating the consumer for the change in real income': by this expression what we mean is (a) the consumer has experienced a gain in real income due to a fall in P_x, (b) we take away this gain from him by reducing his money income to a level so that he remains on the original indifference curve IC_1.

⇨ Graphically, we show it by drawing an imaginary budget line, CC_1 , which is placed to the left and of and is parallel to the new budget line A_1B_2 (the budget line after the fall in P_x)

The CC_1 line shows as follows:

- As the consumer's real income not changed, consumer's equilibrium point would have shifted to S because of a relative fall in P_x in relation to P_y.

- At equilibrium point S, the consumer would have increased his purchase of X from OX_1 to OX_3
- X_1 X_3 can be regarded as substitution effected.

In short, a fall in the price of X results in:

1. A change in relative price ratio, and hence an increase in the quantity purchased of X, from OX_1 to OX_3, OX_1 to OX_3 is the measure of the SE.

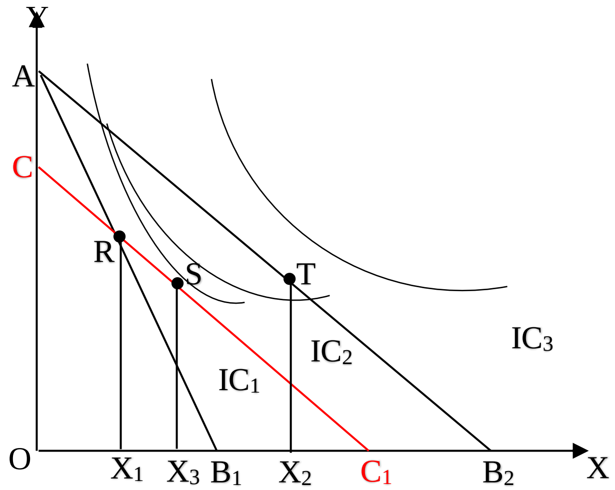
2. An increase in the real income of the consumer, and hence an increase in the quantity purchased of X from OX_3 to OX_2, OX_3 to OX_2 is the measure of IE.

Therefore, $X_1X_3 + X_3X_2 = X_1X_2$

SE + IE = PE

1.1.21.11.3b. Slutsky's Approach:

Slutsky also decomposes the price effect into substitution effect and income effect, by holding real income constant, but in a slightly different way, as would be clear from fig-2.



⇨ To begin with, the original budget line is A_1B_1 with the fall in P_x, the budget line changes into A_1B_2

⇨ The eq^m points shifts from R on IC_1 to T on IC_3.

⇨ Slutsky assumes that we take away some nominal income from the consumer, so that the consumer will have to go back to point R. This is shown by drawing an imaginary income line passing through the point R (and parallel to A_1B_2). This line is CC_1. But at CC_1 also we find the consumer does not like to go back to R, instead he prefers S which is on a higher IC. He likes to purchase OX_3 quantity of X.

⇨ This increased purchase of X, i.e. X_1X_3, consequent on a fall in the relative price of X may be considered as the SE.

⇨ Likewise, an increase in the quantity purchased from OX_3 to OX_2 i.e. X_3X_2, may be considered as the real income effect.

- In short, the only difference between the Hicksian and the Slutsky approach relates to the fact that the real income is held to be constant in different ways. Broadly the results are same.

1.1.22. Advanced theory of Consumer Behaviour: Revealed Preference Theory: [Samuelson]

Revealed preference theory has been given by Paul. A. Samuelson after criticising utility analysis given by Alfred Marshall and indifference curve analysis by J.R. Hicks. According to Samuelson, Marshallian utility analysis and Hicksian indifference curve analysis are based on unrealistic assumption.

⇨ He says that utility cannot be measured and preferences of an individual cannot be obtained. He has also criticised the assumption of convexity of IC.

⇨ To overcome their shortcomings of Marshallian and Hickson analysis, Samelson has given revealed preference theory to study consumer's behaviour.

⇨ The main merit of the revealed preference theory is that 'law of demand' can be directly derived from the revealed preference axioms without using indifference curve and most of the restrictive assumption. What is needed is simply to record consumer's observed behaviour in the market, i.e. what bundle of goods a consumer buys at different prices.

1.1.22.1. Assumptions:

1. **Rationality:** A consumer behaves rationally, i.e. he aims at maximum satisfaction with his limited income and prefers a bigger bundle to the smaller bundle of goods.

2. **Consistency:** If a consumer prefers bundle A to bundle B, then he cannot prefer bundle B to bundle A, i.e. if A > B then B > A under the same condition is not possible.

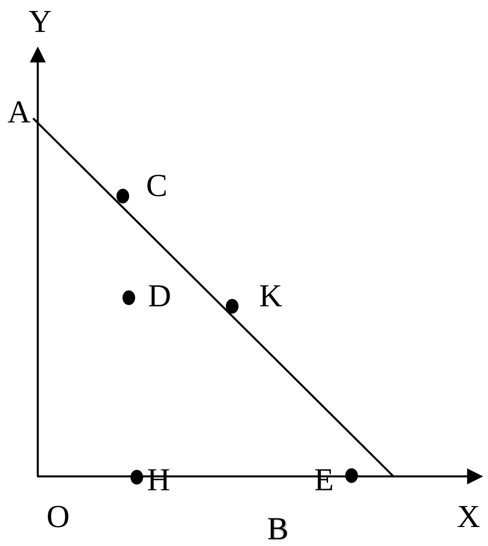
3. **Transitivity:** If a consumer prefers bundle A to bundle B and he also prefers bundle B to bundle C then if follows that the consumers prefers bundle A to bundle C.

i.e. if A > B and B > C ⇨ A > C

4. **Tastes and preferences of consumer** are given and remain unchanged during the period of analysis.

1.1.22.2. Revealed Preference Axiom:

The basic idea of revealed preference theory can be stated as follows. Given the income of the consumer and prices of two goods, X and Y, AB is the income price line (budget line) and trangle AOB is the area of consumer's selection (budget space).



The consumer can select any of the combinations, Like C, K, E, D, H with the help of his given Constraint under the price line AB. Consumer will buy a particular combination of two goods, X and Y according to his preference. If the consumer chooses to buy combination K, then K is revealed preferred to C, E, D and H. Once a consumer reveals his preference for a particular combination K, then all other combinations like C, E, D, H are inferior. It means that the consumer prefers the position K to any other position within or on the trangle AOB. In Samuelson's words, he reveals his preference for K over all other positions available to the consumer. This is strong axiom of revealed preference theory / strong ordering hypothesis.

According to Hicks, if a consumer makes his choice for a particular position K, it does not mean that K is preferred to all other positions within or on the trangle AOB. It simply means that no other position within or on the trangle AOB is preferred to position K. It is quite possible that some 'rejected' positions may be as good as position K and consumer may be indifferent between K and some other position like C and E. In this case the positions which are inferior are D and H. This is known as weak axiom of revealed preference theory / weak ordering hypothesis.

The main difference between strong ordering and weak ordering is that, under strong ordering a position chosen on AB is preferred to all other positions on and within the trangle AOB, whereas under weak ordering a chosen position on AB is preferred to all positions within the trangle AOB but there may be position of indifference with other positions on the budget line AB.

1.1.23. Consumer's Surplus:

This concept was developed by Prof. Marshall consumer surplus (C.S) represents the different between total utility obtained from one product and the actual payment for that product. One alternative version to explain the consumer surplus is the difference between the expected price and actual price.

1.1.23.1. Assumptions:

(i) Marginal utility is diminishing

(ii) Price of the product is constant

(iii) Utility can be measured in terms of money

1.1.23.2. Explanation:

Let us consider one table, where it is shown that different marginal utilities obtained from the successive consumption of one product are Rs. 10, Rs. 8, Rs. 6, Rs. 4 and Rs. 2. Hence marginal utility is diminishing and calculated in term of money from the given information from the table two points should be noted.

Units	Marginal Utilities (Rs.)	Price
1	10	2
2	8	2
3	6	2
4	4	2
5	2	2
Total Utility	TU = 30	Total Expenditure = 10

(i) price remains same for each unit, i.e. Rs.2.

(ii) the MU obtained from the last unit is same to its price.

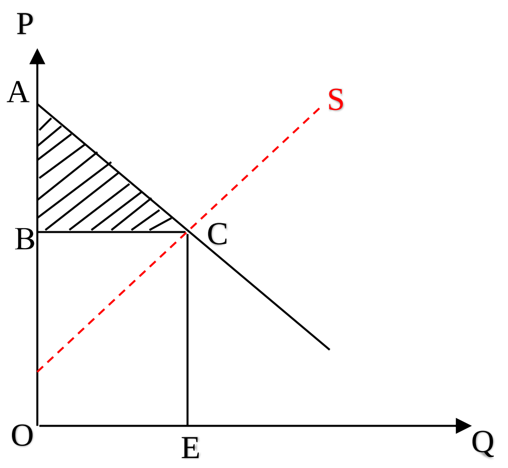
∴ C.S. = 30 – (5 × 2) = 30 – 10 = 20.

In Marshallian theory, the equilibrium Condition is MU = λP

where λ represents constant MU of money.

The MU line/curve represents the demand Line/curve.

At a price OB per unit, the quantity demanded is OE.



Therefore, Total expenditure = Price X Quantity

= OB × OE = area OBCE

It is to be noted that total utility can be derived from demand line, at OE units,

TU = area OACE

Hence C>S = area OACE – area OBCE = area ABC

1.124. Indirect Utility Function and Roy's Identity:

All utility functions discussed till now are "direct", utility is a function of the quantities of commodities consumed. These have X's as arguments. We can obtain the utility function X with prices and income as arguments using the first order conditions of optimisation, we know that the constrained optimisation leads to a system of demand equation of the type

$$X_1^* = f\,(P_1, P_2, \ldots\ldots, P_n, M)$$

The expenditure relation is

$$M = P_1X_1 + P_2\,X_2 + \ldots\ldots + P_nX_n = g\,(P_1, P_2 \ldots\ldots, P_n, U^O)$$

Which gives minimum necessary expenditure for achieving the given levels of satisfaction and a given set of prices. This function can be written as,

$$U^* = h\,(P_1, P_2, \ldots\ldots, P_n, M)$$

This is defined as the indirect utility function.

Roy's Identity:

Since both the direct and indirect utility function represent the same preference ordering the maximisation of U w.r.t. quantities Xi's leads to the same demand equations as the minimisation of U^* w.r.t. prices and income with given quantities. Thus, the relation between U and U^* is dual.

Differentiating U^* w.r.t. prices and income, keeping $dU^* = 0$.

$$\frac{\partial U^*}{\partial P_1}.dP_1 + \frac{\partial U^*}{\partial P_2}\,dP_2 + \ldots\ldots + \frac{\partial U^*}{\partial P_n}\,dP_n + \frac{\partial U^*}{\partial M}.dM = O \;\ldots\ldots\ldots\ldots(i)$$

And total differential of $\sum X_1^*.Pi = M$, gives

$$X_1^*\,dP_1 + X_2^*\,dP_2 + \ldots\ldots + X_n^* dP_n = dM \;\ldots\ldots\ldots\ldots\ldots\ldots..(ii)$$

Where X_i^*'s are the equilibrium quantities. Comparing the terms dP_1, $dP_2 \ldots\ldots, dP_n$ and dM in eqs. (i) and (ii) we have.

$$\frac{\partial U^*/\partial P_1}{X_1^*} = \frac{\partial U^*/\partial P_2}{X_2^*} = \ldots\ldots\ldots\ldots\ldots = \frac{\partial U^*/\partial P_n}{X_n^*} = \frac{-\,\partial U^*/\partial M}{1}$$

$$\text{or, } X_i^* = -\,\frac{\partial U^*/\partial P_i}{\partial U^*/\partial M}$$

This gives demand function for the specified indirect utility f^n. This the equilibrium demand for ith commodity is (-) of the ratio of the partial derivatives of the I.U.F. (U^*) w.r.t. P_i and M. This is defined as Roy's identity.

Sub Unit – 2: Theory of Production and Cost

1.2.1. Production:

Production means the creation of utilities, Therefore, in economic terms, it is an activity which can create or add some value.

According to FRASER, Production will mean putting utility into goods.

Following Hicks, 'Production is an activity directed to the satisfaction of others peoples' wants through exchange.

1.2.1.1. Production Function:

The production function expresses a functional relationship between quantities of inputs and output. It shows how and to what extent output changes with variations in inputs during a specified period of time

$$Y = f(L, K, R, S) \; ; Y = \text{output}$$

L = labour input

K = capital input

R = raw materials

S = land input

Different types of production functions are used in the economic analysis:

(i) According to the classical economists, production mainly depends on the employment of labour.

$$Q = f(L)$$

(ii) According to the Neoclassical economists, production depends on labour as well as capital.

$$Q = f(L.K)$$

(iii) Cobb-Douglas to the production function: $Q = A.\, K^{\alpha}.\, L^{\beta}$

where, A, α , β are three positive constants and (α + β) = 1

Q = output
K = Capital
L = Labour
α = elasticity of output w.r.t. capital/capital elasticity of output.
β = elasticity of output w.r.t. labour/labour elasticity of output.
A = technological constant.

(iv) One another production function is used which is Leontif production function or Fixed coefficient production function where both the inputs are employed in a fixed proportion.

Let 3 units of labour and 4 units of capital are used to produce 50 units of a product. Then the proportion is 3:4 which is maintained i.e. fixed proportion.

$$Q = \min\left(\frac{K}{\alpha}, \frac{L}{\beta}\right).$$

1.2.2. Types of Production Function:

There are types of production function (i) short-run production function and (ii) long run production function.

(i) Short run production function:

It refers to productions in the short run where there are some fixed factors and some variable factors. In the short run production will increase when more units of variable factors are used with the fixed factor. Law of variable proportion comes under short-run production.

(ii) Long run production function:

It refers to production become variable. In the long run production can be increased by increasing units of all the factors simultaneously and in the same proportion. Law of returns to scale comes under long run production.

1.2.3. Total, Average and Marginal Products:

1. Total product: Total product refers to the aggregate output resulting from the use of a given amount of fixed input and a certain quantity of the variable input.

2. Average product: Average product of an input is defined as the total product divided by the amount of input used to produce it.

$$AP_L = Q/L \ \& \ AP_K = Q/K$$

3. Marginal product: The marginal product of an input is to the change in the amount of an input.

$$MP_L = \frac{\Delta Q}{\Delta L} \text{ and } MP_K = \Delta Q/\Delta L$$

1.2.4. Relation between TP, AP and MP:

(a) Ap curve is the slope of the straight line from the origin to each point on the TP curve. MP curve is

the slope of the TP curve at each point.

(b) When AP is maximum, MP = AP

(c) When TP is maximum, MP = 0

(d) When TP is falling, MP is negative.

(e) As long as TP is positive, AP is positive

(f) Both AP and MP curves are invested U-shaped

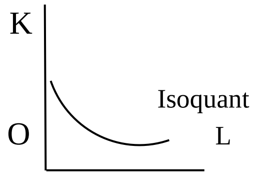
(g) When MP > AP ⇨ AP is rising

(h) When MP = AP ⇨ AP is constant

(i) When MP < AP ⇨ AP is falling

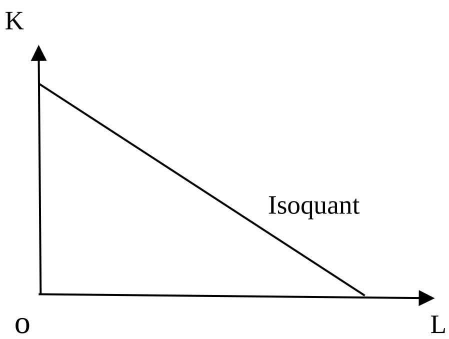
1.2.5. Equal product curve or Iso-quant:

Equal product curves are similar to the indifference curves of the theory of consumer behaviour. An equal product curve represents all those input combinations which are capable of producing the same level of output. These equal product curves are also known as isoquants or is a product curve or product indifference curve.

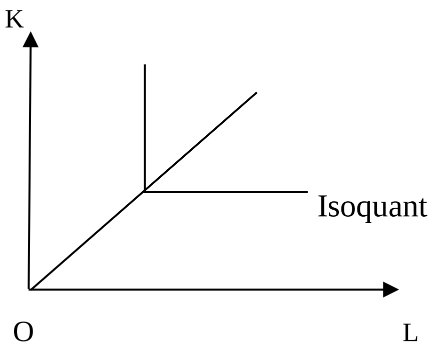


1.2.6. Different types of Iso-quants:

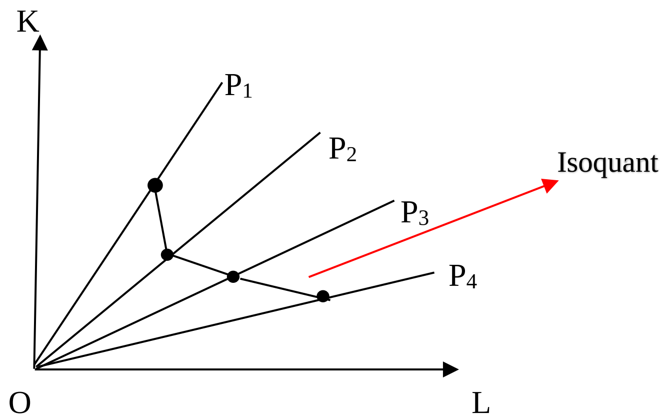
Linear Isoquant: This type assumes perfect substitutability of factors of production. A given commodity may be produced by using only capital or only labour or by an infinite combination of K and L.



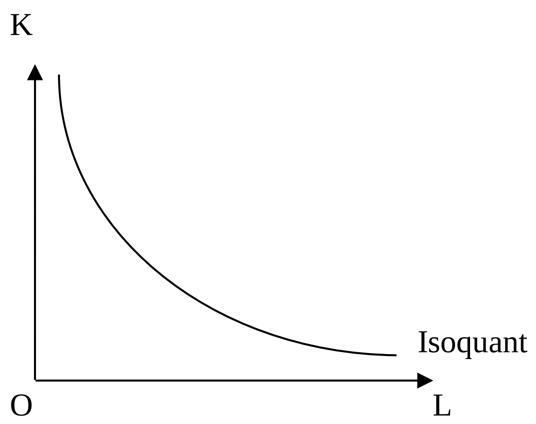
Input-Output Isoquant: This assumes strict complementarity production. There is only one method of production for any one commodity. The isoquant takes the shape of a "right angle'. This type of isoquant is also called "Leontief isoquant".



Kinked Isoquant: This assumes limited substitutability of k and L. There are only a few process for producing any one commodity. Substitutability of the factors is possible only at the kinks. This form is also called "activity analysis isoquant" or "linear-programming isoquant" because it is basically used in linear programming.



Smooth Convex Isoquant: This assumes continuous substitutability of k and L only over a certain range, beyond which factors cannot substitute each other.



1.2.6.1. Properties of Isoquants:

i) Isoquants are negatively sloped.
ii) An isoquant lying above and to the right of another represents a higher output level.
iii) No two isoquants can intersect each other.
iv) No isoquant can touch either axis.
v) Isoquant are convex to the origin.

1.2.7. Marginal Rate of Technical Substitution:

The marginal rate of technical substitution (MRTS) is based on the production function where two inputs can be produce constant level of output.

MRTS indicates the rate at which factors can be substituted at the margin without altering the level of output. More precisely, MRTS of X for Y may be defined as amount of factor Y which can be replaced by one unit of factor X, the level of output remaining unchanged.

$$MRTS_{LK} = -\frac{dK}{dL} \Rightarrow \frac{MP_L}{MP_K}$$

The marginal rate of technical substitution as a measure of the degree of substitutability of factors has a serious defect. It depends on the units of measurement of the factors. A better measure of the case of factor substitution is provided by the elasticity of substitution.

The elasticity of substitution is defined as the percentage change in the capital-labour ratio, divided by the percentage change in MRTS.

$$\sigma = \frac{d\left(\frac{K}{L}\right) \big/ \left(\frac{K}{L}\right)}{d(MRTS) \big/ (MRTS)}$$

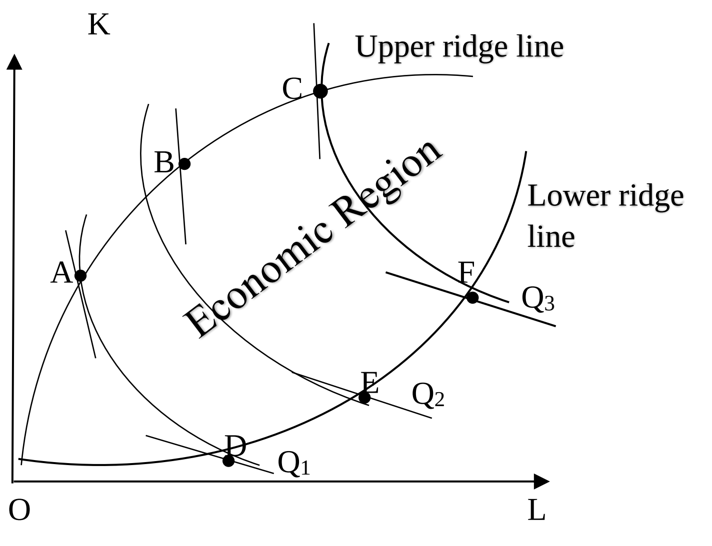
σ = elasticity of substitution

K = Capital

L = labour

1.2.8. Ridge Lines:

The locus of prints of isoquants where the marginal products of the factors are zero from the ridge lines/ridge line is of locus of such points along which marginal product of any factor is zero.
The lower ridge line implies that the MP_L is Zero and the upper ridge line implies that the $MP_K = 0$



1.2.9. Lows of Production:

Lows of Production describe the technically possible ways of increasing the level of production output may increase in various ways.

In the short run output may be increased by using more of the variable factor, while capital are kept constant. The expansion of output with one factor constant is described by the law of diminishing returns of the variable factor, which is often referred to as the law of variable proportion.

In the long run output may be increased by changing all factors by the same proportion. This is called law of returns to scale.

$$X_O = f(L, K)$$

We increase all the factors by the same proportion 'm'

$$X^* = f(mL, mK)$$

(i) If X^* increases by the same proportion 'm' as input $\Rightarrow$ CRS

(ii) If X^* increases less than proportionally with increase in the factors $\Rightarrow$ DRS

(iii) If X^* increases more than proportionally with increase in the factors $\Rightarrow$ IRS

1.2.10. Returns to scale and Homogeneity of the Production Function:

Let $X_O = f(L, K)$

We increase both factors by the same proportion 'm'

$$X^* = f(mL, mK)$$

If 'm' can be factored out, than the new level of output X^* can be expressed as a function of m(to any power a) and initial level of output

$$X^* = m^a f(L, K) \Rightarrow X^* = m^a X_O$$

(i) if $a = 1 \Rightarrow$ CRS $\Rightarrow$ linear homogeneous

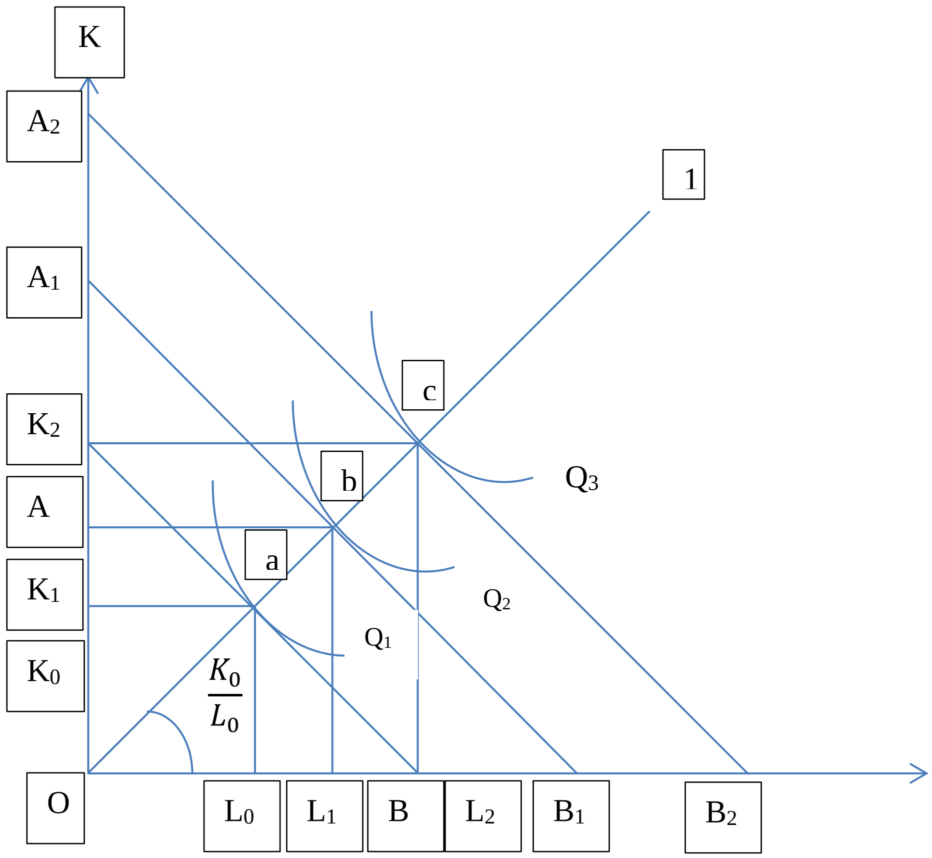
(ii) if $a < 1 \Rightarrow$ DRS

(iii) if $a > 1 \Rightarrow$ IRS

1.2.11. Homothetic Production Function:

The neo-classical production function is homothetic. Because neo-classical production function is homogeneous, hence $MRTS_{KL}$ would depend on $\frac{K}{L}$ ratio. Homotheticity implies that along a ray (product line) from the origin $MRTS_{KL}$ remains constant since $\frac{K}{L}$ is constant on a product line. $MRTS_{KL}$ at any points a, b, c are given by the slope of AB, A_1B_1 and A_2B_2.

The slopes are all equal. Hence $MRTS_{KL}$ are same at points a, b, c. This is the meaning of homotheticity.



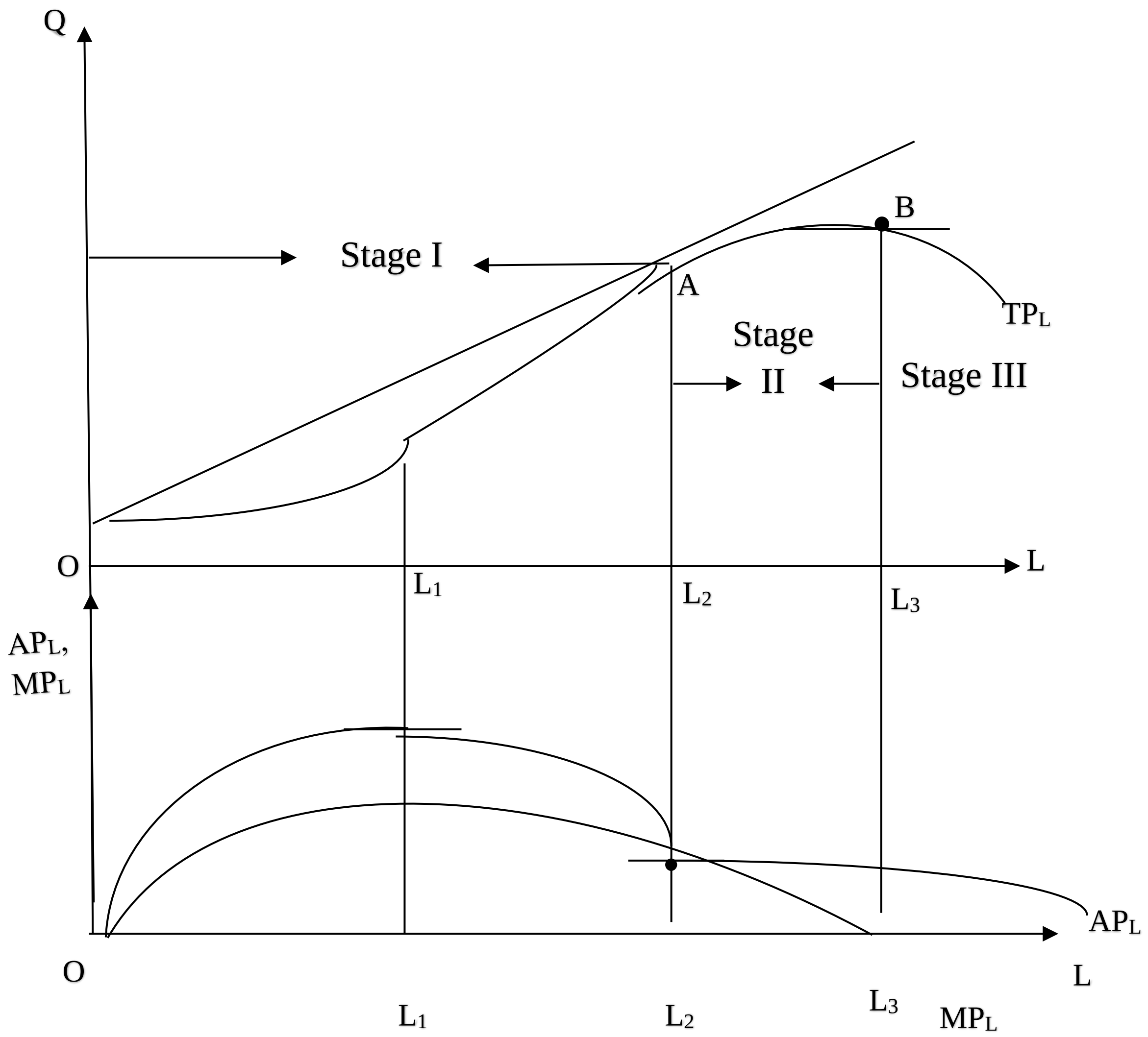
All homogeneous production function are homothetic but the converse is not true. In other words all homothetic functions need not be homogeneous.

1.2.12. Stages of production:

(i) In stage I, AP_L is rising but MP_L may rise or fall. So movement from O to A on the total product curve represents stage I, i.e. up to the employment of OL_2.

(ii) In stage II, MP_L is diminishing.

(iii) In stage III, TP is diminishing or MP_L becomes negative.



We have, $E_L = \frac{\Delta Q}{\Delta L} \cdot \frac{L}{Q} \cdot = \frac{\Delta Q/\Delta L}{Q/L} = \frac{MP_L}{AP_L}$

Therefore

(i) In stage I, $MP_L > AP_L \Rightarrow \frac{MP_L}{AP_L} > 1 \Rightarrow E_L > 1$ [relatively elastic]

(ii) In stage II, $MP_L = AP_L \Rightarrow \frac{MP_L}{AP_L} = 1 \Rightarrow E_L = 1$ [Unitary elastic]

$MP_L < AP_L \Rightarrow \frac{MP_L}{AP_L} < 1 \Rightarrow E_L < 1$ [relatively inelastic]

(iii) In stage III, $MP_2 = 0 \Rightarrow E_L = 0$ [Perfectly inelastic]

$MP_L < 0 \Rightarrow E_L < 0$ [negative elasticity]

Hence stage II, is the stage where a rational entrepreneur will operate.

1.2.13. Some Important Production Functions:

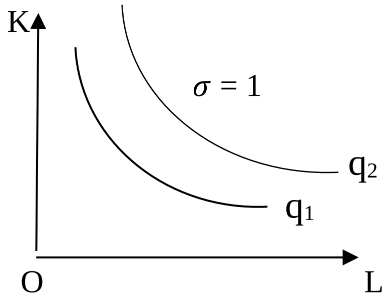
There are four types of production function (i) Cobb-Douglas production function (ii) Constant elasticity of substitution (CES) production function (iii) production function with elasticity of substitution (δ) = ∞
And (iv) production function with elasticity of substitution being equal to zero.

1.2.13.1. Cobb-Douglas Production Function:

$Q = A.\, K^{\alpha}\, L^{\beta}$; $\alpha + \beta = 1 \Rightarrow$ CRS
$\alpha + \beta > 1 \Rightarrow$ IRS
$\alpha + \beta > 1 \Rightarrow$ DRS

The isoquants of C-D production function are convex to the origin and are of rectangular hyperbola.

Main Features:



(i) The marginal product of capital and labour depends only on the quantities of capital and labour used in the production process.

$$MP_K = \frac{\partial Q}{\partial K} = \alpha\,.\,A\,.\,K^{\alpha-1}\,L^{\beta} = \alpha\,{}^{(A.K^{\alpha}L^{\beta})}/_{K} = \alpha.{}^{Q}/_{K} = \alpha.AP_K$$

$$MP_L = \frac{\partial Q}{\partial L} = \beta.A.K^{\alpha}L^{\beta-1} = \alpha\,{}^{(A.K^{\alpha}L^{\beta})}/_{L} = \beta.{}^{Q}/_{L} = \alpha.AP_L$$

(ii) The marginal rate of substitution

$$MRTS_{LK} = \frac{\partial Q/\partial L}{\partial Q/\partial K} = \frac{\beta(Q/L)}{\alpha(Q/K)} = \frac{\beta K}{\alpha L}$$

(iii) Factor Intensity

In C-D function factor intensity is measured by the ratio ${}^{\beta}/_{\alpha}$. The higher this ratio the more labour intensive the technique and vice-versa.

(iv) α and β the exponents of K and L respectively, show the output elasticities of capital and labour.

$$E_K = \frac{dQ}{dK}\,.\,{}^{K}/_{Q} = \alpha\,.\,{}^{Q}/_{K}\,.\,{}^{K}/_{Q} = \alpha$$
$$E_L = \frac{dQ}{dL}\,.\,\frac{L}{Q} = \beta\,.\,{}^{Q}/_{L}\,.\,\frac{L}{Q} = \beta$$

(v) C-D production function is homogeneous of degree (α+β). In special case of (α+β) = 1, the function tums into linearly homogeneous function.
(vi) Elasticity of Substitution:

$$\sigma = \frac{(d(K/L))/K/L}{\partial(MRTS)/MRTS} = \frac{\partial(K/L)/K/L}{d(\frac{\beta}{\alpha}.\frac{K}{L})/(\frac{\beta}{\alpha}.\frac{K}{L})}$$

$$= \frac{\partial(K/L))/K/L}{\left(\frac{\beta}{\alpha}\right).d(\frac{K}{L})/(\frac{\beta}{\alpha}.\frac{K}{L})} = \frac{\partial(\cancel{\frac{K}{L}})}{\cancel{\frac{K}{L}}} \cdot \frac{\cancel{\frac{\beta}{\alpha}}.\cancel{\frac{K}{L}}}{\cancel{\frac{\beta}{\alpha}}.\ d(\cancel{\frac{K}{L}})} = 1$$

Hence such a production function elasticity of factor substitution is equal to one.

1.2.13.2. CES production function:

CES production function has been developed jointly by Arrow, Chenery, Minhas and Solow. Minhas is the only Indian who developed CES production function.

$Q = \gamma[\delta K.^{-\rho} + (1 - \delta)\ L^{-\rho}]^{-1/\rho}$; Q = output.
γ = efficiency parameter.
δ = distribution parameter.
ρ = substitution parameter.

Main Features:

(i) A change in the efficiency parameter (γ) causes a shift in production function that can occur as a result of technological or organizational changes.

(ii) The distribution parameter (δ) indicates the relative importance of capital (K) and labour (L).

(iii) Elasticity of Substitution

$\sigma = \frac{1}{1+\rho}$ when $\rho = 0$, $\sigma = 1$

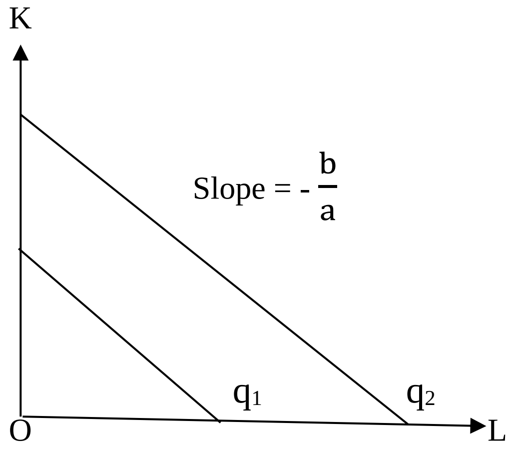
when $\rho = \infty$, $\sigma = 0$

when $\rho = -1$, $\sigma = \infty$

(iv) Iso quants are of normal convex shape.

1.2.13.3. Production Function with elasticity of Substitution (σ) = ∞:

This production function is of the following form Q = aK + bL where a & b are constants. The graph of this production function yields downward sloping parallel straight lines with slope equal to ($^b/_a$). This is the case of perfect substitutes with elasticity of substitution being equal to infinity.

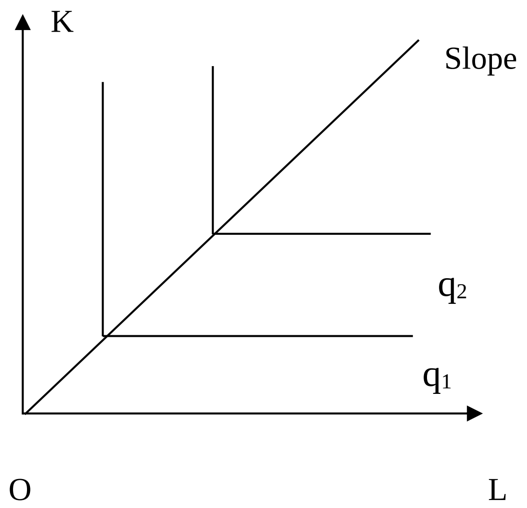


1.2.13.4. Fixed Proportion production Function:

In this production function factors are used $= \frac{b}{a}$

In a fixed ratio. The isoquants for this type of production function are right-angled or L-shaped.

In this production function, the firms will Always operate along the ray from the Origin where capital-labour ratio $(\frac{K}{L})$ is fixed at $(\frac{b}{a})$. As in this factor ratio $(\frac{K}{L})$ remains constant and therefore, the value of elasticity of substitution is equal to zero.



1.2.14. Technological Progress and the production Function:

1.2.14.1. Capital-Deepening Technical Progress:

The technical progress is capital-depending (or capital using) it, along a line on which the $^K/_L$ ratio is constant, the $MRTS_{LK}$ increases. This implies that technical progress increases the marginal product of capital by more than marginal product of labour. The ratio of marginal products (which is $MRTS_{LK}$) decreases in absolute value, but taking into account that the slope of the isoquant is negative, this sort of technical progress increases the $MRTS_{LK}$.

1.2.14.2. Labour-Deepening Technical Progress:

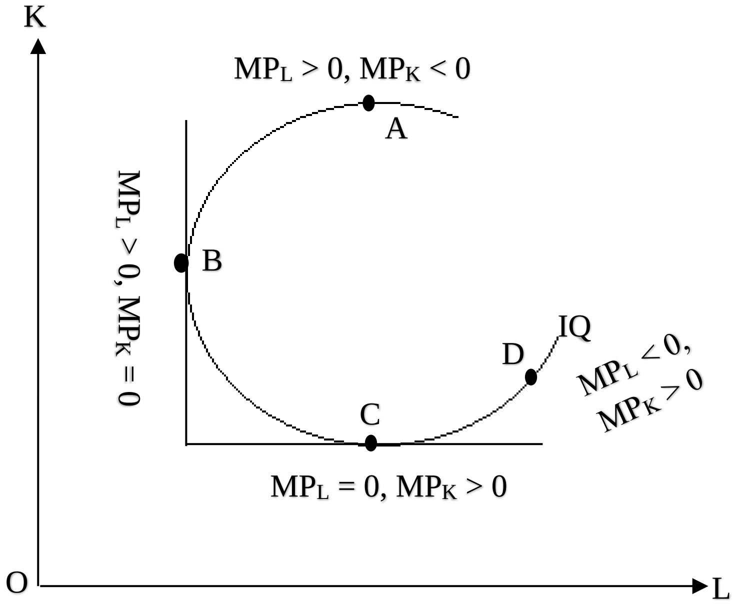
Technical progress is labour-deepening, it along a radius through the origin (with constant $^K/_L$ratio), the $MRTS_{LK}$ increases. This implies that the technical progress increases the MP_L faster than MP_K. thus the $MRTS_{LK}$ being the ratio of the marginal products, increases in absolute value (but decreases it the minus sign is taken into account).

1.2.14.3. Neutral Technical Progress:

Technical progress is neutral if it increases the marginal product of both factors by the same percentage, so that the $MRTS_{LK}$ remains constant.

1.2.14.4. Economic and Non-Economic Region:

One alternative explanation of the isoquant curve can Be developed with the help of Economic and Non-Economic region of production. For this discussion, the technical shape of IQ is necessary. Now the equation of IQ is, Q = f (L, K), so different combinations Of L and K can be obtained, which are Technically possible. Joining these combinations the technical shape of IQ can be derived. It is to be noted that this technical shape is the summation of economic shape and non-economic shape. In this figure, the technical shape (ABCD) of isoquant curve is drawn which is the locus of all technically possible input combinations.



(i) At the range BC : IQ is negatively sloped

$\Rightarrow \frac{\Delta K}{\Delta L} = -\frac{MP_L}{MP_K} < 0 \Rightarrow MP_L > 0 , MP_K > 0$

(ii) At point B : The tangent is vertical

$\Rightarrow$ Slope of IQ = $\infty \Rightarrow -\frac{MP_L}{MP_K} = \infty \Rightarrow MP_L > 0$

(iii) At point C : The tangent is horizontal

$\Rightarrow$ Slope of IQ = 0 $\Rightarrow -\frac{MP_L}{MP_K} = 0 \Rightarrow MP_L = 0 , MP_K > 0$

(iv) At the range CD : IQ is positively sloped

$\Rightarrow$ Slope of IQ > 0 $\Rightarrow -\frac{MP_L}{MP_K} > 0 \Rightarrow MP_L < 0 , MP_K > 0$

Hence from the technical ABCD of IQ, the range ‘BC’ represents the economic shape where marginal productivities of both the factors are positive. The other two ranges like ‘AB’ and ‘CD’ are non-economic because their marginal productivity of one factor is positive but the other is negative. Similarly at prints B and C, marginal productivity of one factor is put the other factor is zero. Therefore the economic shape ‘BC’ actually the stage-II production of the law of variable proportion.

1.2.15. Iso-Cost Line:

Iso-Cost line is the locus of different combinations of two inputs in the input space by which the cost of production of the producer must be constant. Therefore, movement along the iso-cost line means different combinations of two inputs with equal cost.

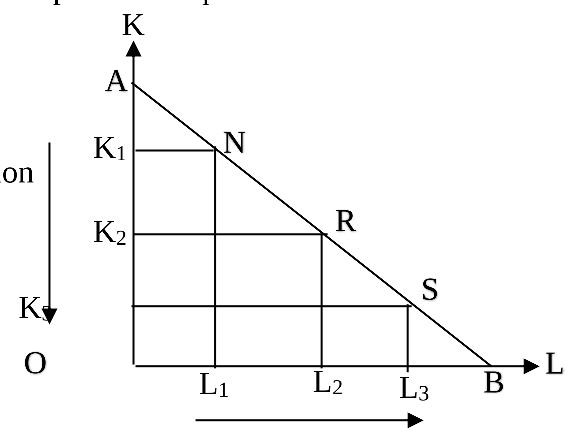
$Q = f(L,K)$

$C = wL + rK$; w = wage rate

R = rate of interest

$rK = -wL + C$ C = cost of production

$K = -\left(\frac{w}{r}\right) L + \left(\frac{C}{r}\right)$



Characteristics of Iso-Cost Line:
(i) The line follows a linear form i.e. $y = mx + c$, so the Iso-Cost line must be a straight line.
(ii) The slope of the Iso-Cost line = $(-\frac{w}{r}) < 0$
(iii) The intercept of Iso-Cost line = $(\frac{c}{r}) > 0$
(iv) Change in price of one input means change in slope of iso-cost line – getting steeper or flatter.
(v) Change in C means shifting of the iso-cost line parallel in upward or downward direction.

Expansion Path:
Expansion path is the locus of successive producer's equilibrium points occurred due to a change in outlay or cost of production where input prices, i.e. wage rate and rate of interest are constant.

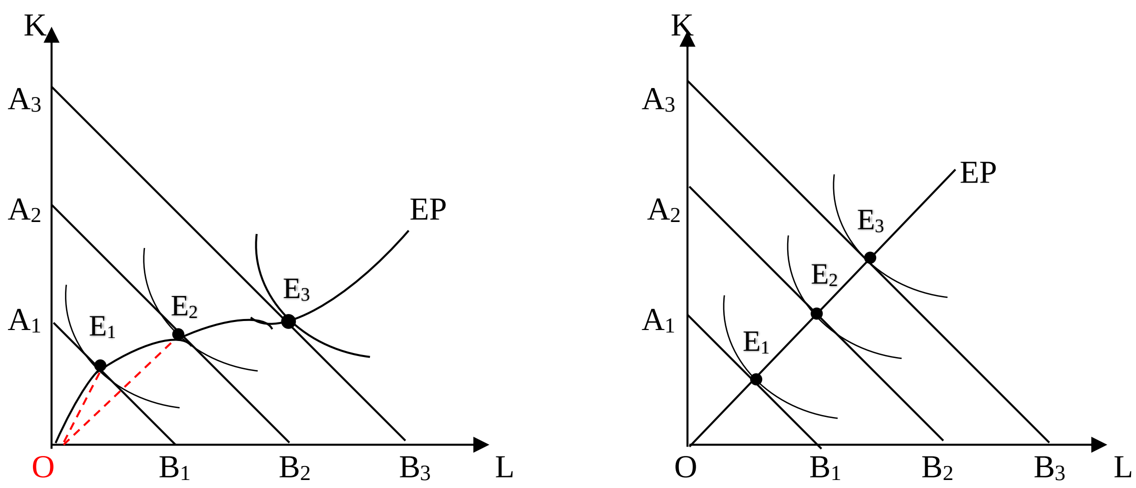
Features of EP:
(i) It is a long run concept where labour and capital both the factors are variable.

(ii) It always starts from origin.

(iii) If the production function is 'Homogeneous Function' of any degree, i.e. degree one, degree greater than one or degree less than one, for all these cases input ratio or factor proportion $(\frac{K}{L})$ is constant.
Than the expansion path will be a positively sloped straight line.

(iv) If the production function is 'Non-Homogeneous', than EP will be curvature. For this movement from
E_1 to E_2 means diminishing input ratio or factor proportion.

(v) When both inputs are 'normal' then the EP will be positively sloped but if one of the inputs is 'interior',
than the EP will be backward bending.



1.2.16. Cost:

Economic theory distinguishes between short run costs and long run costs. Short run costs are the cost over a period during which some factors of production are fixed. The long run costs are the costs over a period long enough to permit the change of all factors of production. In the long run all factors become variable.

Cost Function:

Both in the short run and in the long run, total cost is a multivariate function, that is, total cost is determined by many factors. Symbolically, $C = f(Q, T, P_f) \Rightarrow$ long run cost function

$$C = f(Q, T, P_f, \overline{K}) \Rightarrow \text{short run cost function}$$

C = total cost
Q = output
T = technology
P_f = price of factors
$\overline{K}$ = Fixed factors

1.2.17. Different Cost concepts:

Explicit cost: Cost which are actually in curved by the firms and provisions have to be made for such expanses are called explicit cost.

Implicit cost: Such costs for which company does not pay any cash, e.g., owner's service are computed through the method of opportunity cost.

Incremental cost: Change in total cost resulting from the implementation of a decision regarding change in production mix, marketing or any other business activity.

Sunk cost: Sunk cost refers to expenses incurred by the firm during some previous time. These costs are fixed in nature and exist for the firm regardless of whether the facility is used or not.

Historic cost: Historic cost valuation states cost of plant and materials at the price originally paid for them.

Replacement cost: Replacement cost valuation states the costs at prices that would have to be paid currently if same machinery has to be purchased.

Economic cost: This is the cost of accomplishing that activity in the most efficient way possible, given technological, geographical and other real world constraints.

Opportunity cost: It is the cost related to the next. Best choice available to someone who has picked between several mutually exclusive choices.

Private cost: Cost that the buyer of a good or service pays the seller. This can also be described as the costs internal to the firm's production function.

External cost: The costs that people other than the buyer are forced to pay as a result of the transaction.

Social cost: Private costs + External costs = Social costs.

Psychic cost: It is a subset of social costs that specifically represent the costs of added stress or losses to quality of life.

1.2.18. Short Run Costs of the Traditional Theory:

In the traditional theory of the firm total costs are split into two groups : total fixed costs and total variable cost.

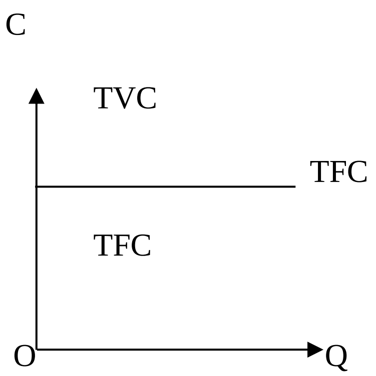
$$TC = TFC + TVC$$

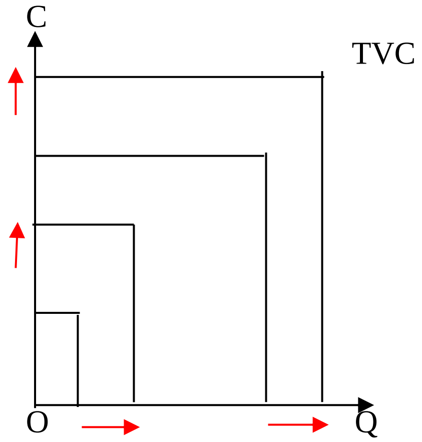
The fixed cost includes:

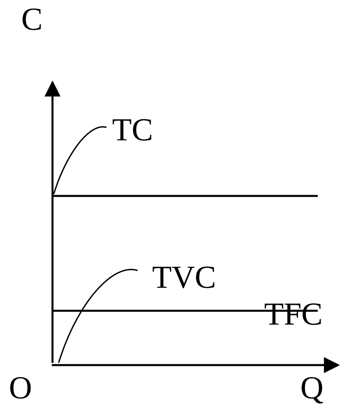
(i) salaries of administrative staff
(ii) depreciation of machinery
(iii) expenses for building depreciation and repairs.
(iv) expenses for land maintenance

The variable cost includes:

(i) the raw materials
(ii) the cost of direct labour
(iii) the running expenses of fixed capital, such as fuel, as ordinary repairs and routine maintenance.



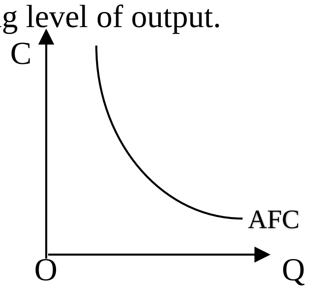


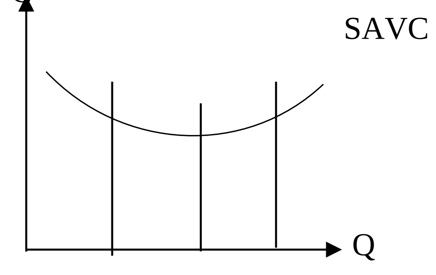


$$AFC = \frac{TFC}{Q}$$

Graphically the AFC is a rectangular hyperbola, showing at all its points the same magnitude, that is, the level of TFC. The average variable cost is similarly obtained by dividing the TVC with corresponding level of output.

$$AVC = \frac{TVC}{Q}$$





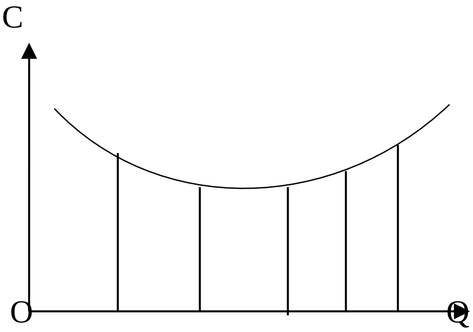
The ATC is obtained by dividing the TC by the corresponding level of output.

$$AC = \frac{TC}{Q} = \frac{TFC+TVC}{Q} = AFC + AVC$$

The shape of the AC is similar to that of the AVC (both being U-shaped).

The U-shape of both the AVC and AC reflects the law of variable proportions or law eventually decreasing returns to the variable factors of production.

SAC



Marginal cost:

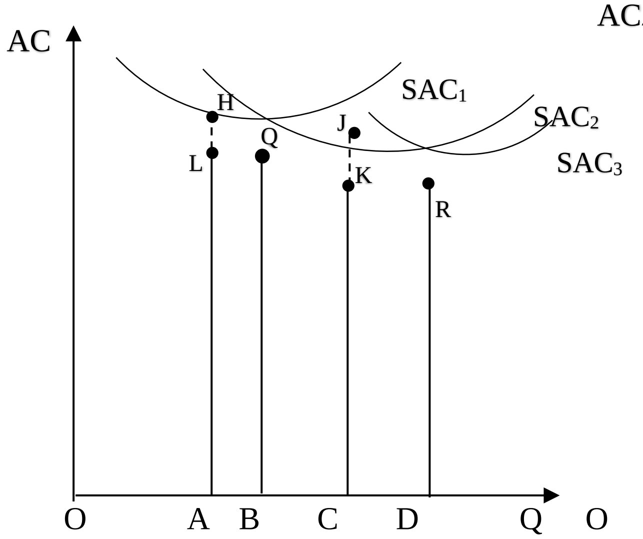
$$MC = \frac{dTC}{dQ}$$

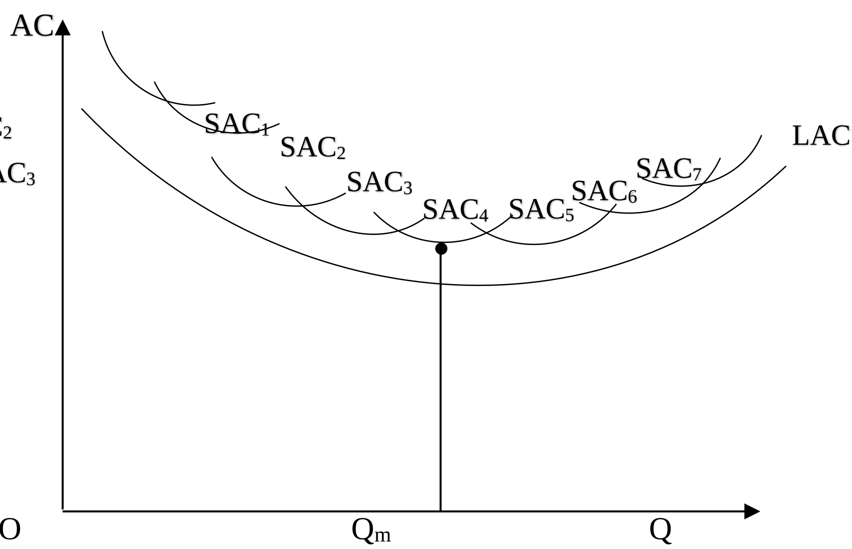
$$MC_n = TC_n - TC_n - 1$$
$$= (TFC_n + TVC_n) - (TFC_{n-1} + TVC_{n-1})$$
$$= TVC_n - TVC_{n-1}$$

Hence marginal cost is the addition to the total variable costs when output is increased from (n-1) units of output.

1.2.19. Long Run cost of the Traditional Theory:

In the long run all factor are assumed to become variable. We said that the long run cost curve is a planning curve, in the sense that it is a guide to the entrepreneur in his decision to plan the future expansion of his output. The long run average cost is derived from short run cost curves. Each point on the LAC corresponds to a point on a short run cost curve, which is tangent to the LAC at that point. Long run average cost curve depicts the least possible average cost for producing all possible levels of output.





In the traditional theory of the firm the LAC curve is U-shaped and it is often called the 'Envelope curve' because it 'envelopes' the short run curves.

1.2.20. Modern Theory of cost:

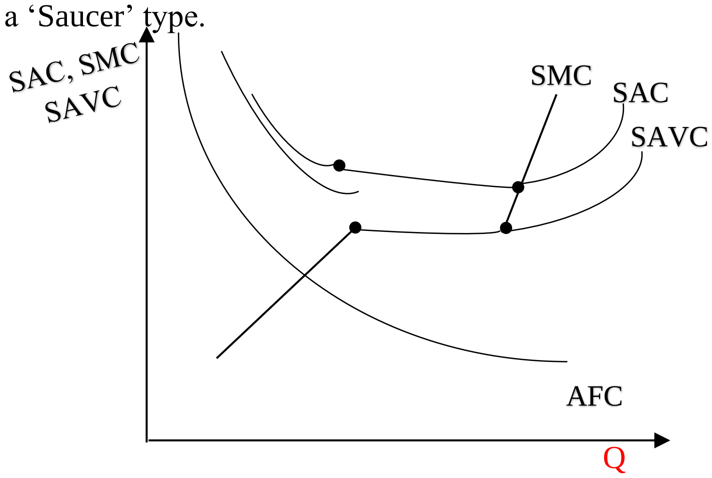
Following the modern theory of cost, we have a little bit change in the shape of SRAC and LRAC.

(i) Short Run: The AVC curve is not a smooth ‘U’ shaped curve. It is falling due to economics of a large scale production, rising due to the diseconomies with a horizontal stretch over a large range of output. It means the SAVC curve is a ‘Saucer’ type.

(a) when AFC and AVC both are falling
The AC is falling at a higher rate. So AC is steeper.

(b) when AFC is falling but AVC is
Horizontal due to the maintenance of ‘reserve capacity’ then AC is falling but a lower rate them before. So AC is negatively sloped but flatter.

(c) when AFC is falling but AVC is
Rising then AC is rising but a lower rate. So flatter than the rising portion of AVC.

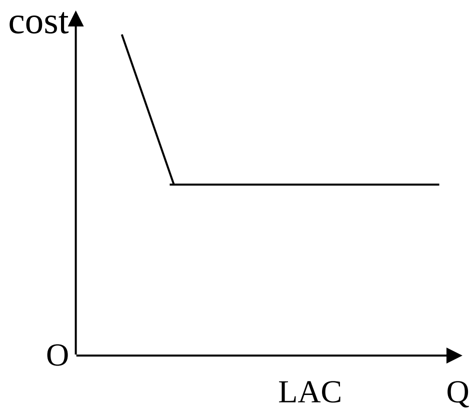


(d) The rising portion of SMC passes through the minimum point of SAC but coincides with the entire
horizontal stretch of SAVC.

(ii) Long Run: Some economists argue on the basis of empirical evidence that the long run average cost curve is L-shaped, rather than U-shaped. The L-shaped curve shows a rapid fall in the beginning but after a point “the curve remains flat, or may slope gently downwards, at it right hand end.”

The following two explanations have been provided for the existence of L-shaped long-run average cost curve.

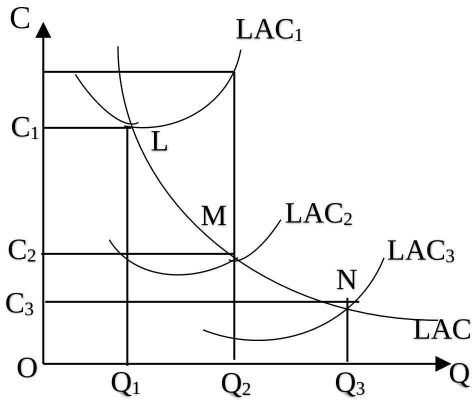
(a) Technological Progress: One reason why empirical
Studies do not fixed U-shaped long run AC curve is that whereas economic theory assumes that technology remains unchanged or there is no technological progress, but



in the real-world technological progress does take place over time.

As a result of technological progress in the real World, LAC curve will shift downward over time. Thus in a given state of technology LAC curve are U-shaped but when there is technological progress, The LAC curve is L-shaped.

(b) Learning by doing: Learning by doing is another Factor which causes the long run AC to slope Downward throughout. It is common knowledge that a person learns while doing some previous work with the experience he learns to do thing in a better why than before. This tends to reduce the costs.



1.2.21. Elasticity of cost:

If output (Q) is produced at a total cost (c), the cost function is C = f (Q)

The elasticity of total cost is the ratio of the proportional change in total cost to the proportional change in total output.

$$\text{Cost of Elasticity (K)} = \frac{dC/c}{dQ/Q} = \frac{dC}{C}\cdot\frac{Q}{dQ} = \frac{dC}{dQ}\cdot\frac{Q}{C}$$

$$= \frac{dC}{dQ} \div \frac{C}{Q} = \frac{MC}{AC} \Rightarrow \text{Ratio of MC to AC}$$

(a) If MC > AC ⇨ K > 1 ⇨ decreasing returns.

(b) If MC = AC ⇨ K = 1 ⇨ constant returns.

(c) If MC < AC ⇨ K < 1 ⇨ increasing returns.

Elasticity of AC:

The elasticity of total cost is given by

$E(C) = \frac{dC}{dQ}\cdot\frac{Q}{C}$; where $AC = \frac{C}{Q}$

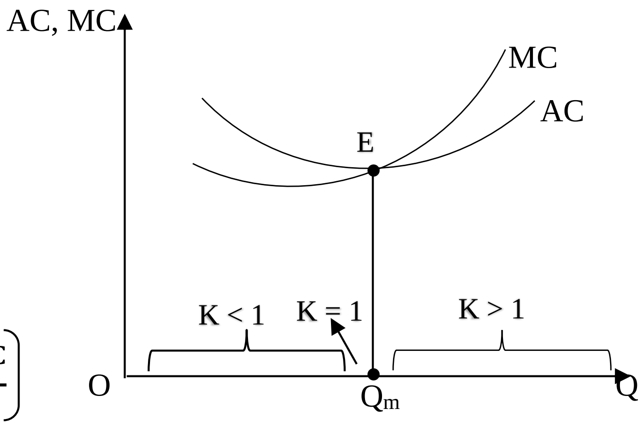
Therefore, replacing total cost (C) by Average cost (C/Q)

$$\text{Thus } E(C/Q) = \frac{d(C/Q)}{dQ}\cdot\frac{Q}{C/Q} = \frac{d(C/Q)}{dQ}\cdot\frac{Q^2}{C}$$

$$= \frac{Q^2}{C}\left[\frac{d}{dQ}(C/Q)\right] = \frac{Q^2}{C}\left(\frac{Q.\frac{dC}{dQ} - C}{Q^2}\right)$$

$$= \frac{\cancel{Q^2}}{C}\cdot\frac{1}{\cancel{Q^2}}\left(Q.\frac{dC}{dQ} - C\right)$$

$$= \frac{1}{C}\left(Q.\frac{dC}{dQ} - C\right) = Q.\frac{dC}{dQ} - \frac{C}{C} = K - 1$$



(a) If $K \ {}^{>}/_{<}\ 1 \Rightarrow E(C/Q)\ {}^{>}/_{<}\ 0$

(b) The elasticity of total cost exceed the elasticity of average cost by unity i.e. $E(C/Q) = K - 1$

Or $K - E(C/Q) = 1$

Or E (C) - E ($^{C}/_{Q}$) = 1

Elasticity of MC:

$K = \frac{dC}{dQ} \cdot \frac{Q}{C}$; $MC = \frac{dC}{dQ}$

Thus elasticity of MC $= \frac{d(\frac{dC}{dQ})}{dQ} \cdot \frac{Q}{\frac{dC}{dQ}}$ ——— (i)

Since K is given by

$K = \frac{Q}{C} \cdot \frac{dC}{dQ}$

or $\frac{dC}{dQ} = \frac{K.C}{Q}$ —— (ii)

Substituting the value of (iii) in (i) we get

$E(MC) = \frac{d}{dQ} (\frac{K.C}{Q}). \frac{Q}{\frac{K.C}{Q}}$

$= \frac{d}{dQ} (\frac{K.C}{Q}). \frac{Q^2}{KC}$

Sub Unit – 3: Theory of Games

1.3.1. Player and Game:

In many problem decisions making requires some conflict and interest between two or more opponent engaging them-selves in same field of business. In mathematical terminology the business man is called player and the business is called game.

1.3.2. Strategy, Pure Strategy, Mix Strategy:

In a game each player takes some executives to control their business. We make a assumption that each player utilises the services of their executives only once at a time. The selection of a particular executive by a player to control the business is called strategy. When a player takes a strategy ignoring the strategy takes by his opponents, is called pure strategy. On the other hand a strategy-taken by a player depending upon the strategy taken by his opponents is called mix-strategy.

Let, A and B are the two players in same filed of busi9ness. Let player A has “m” executives A_1, A_2, A_3.......A_m and player B has n executives B_1, B_2, B_3.......B_n. Now if player A using the services if A_2 depending upon the condition that B’s pure move is B_n (n-1,2,3…..n) is called mix-strategy of player A.

1.3.3. Maximising and Minimising Player:

The player who is in the better position than his opponent is called maximising player on the other hand the player who is in worse position is called the minimising player.

1.3.4. Two Person Zero-Sum Game:

Games are classified on the basic of two criterions: a) Number of participants, b) Net outcome.

Considering the first criterion there may be one person, two persons, three persons and n persons is a game. According to the second criterion the games are classified in two party-

a) Zero Sum Game

b) Non-Zero-Sum Game

a two persons zero sum game is one in which the algebraic sum of net outcome will be zero for two players.

1.3.5. Pay-Off Matrices:

The pay-off metrics is a real matrix (a_{ij}). Where i=1,2……m and j-1,2…….n, whose elements a_{ij} indicates the gain of row players for taking I th and j th strategy for row and column player respectively.

Let, A and B are the two players playing the game in same filed of business. Let player A, the maximising player has m pure strategy and the minimizing player B has n pure strategies the pay of matrix is given as.

Player B

Player A

$$\begin{array}{cc} & \begin{array}{cccc} B_1 & B_2 & \cdots & B_n \end{array} \\ \begin{array}{c} A_1 \\ A_2 \\ \vdots \\ A_m \end{array} & \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{pmatrix} \end{array}$$

a_{ij} indicates the gain of player A for I th and j th strategies for A and B players respective.

1.3.6. Saddle Point. Value of The Game and Optimum Strategy:

The saddle point of a game is that point when the maximum of row minima coincides with the minimum of column maxima. Let A and B are the two players. The pay-off matrix of player A and B for their pure moves A_i and B_j respectively is given as

Player B

Player A

$$\begin{array}{cc} & \begin{array}{cccc} B_1 & B_2 & \cdots & B_n \end{array} \\ \begin{array}{c} A_1 \\ A_2 \\ \vdots \\ A_m \end{array} & \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{pmatrix} \end{array}$$

Where i=1,2…..m and j=1,2…..n. the elements of the pay-off matrix indicates the maximum of minimum gain of player A and minimum of maximum loss of player B. here A's problem is to maximise the minimum gain and B's problem is to minimise the maximum loss. The equilibrium exist where maximum of minimum gain coincide minimum of maximum loss. Let a_{KL} is that value where equilibrium exists (where K=1,2…m and L=1,2,,,n). thus the point (K,L) is called saddle point and the value of a_{KL} is called the value of the game. The strategies of A_L and A_K and of B. say B_c is called optimum strategies of A and B respectively.

1.3.7. Fair Game and Strictly Determinate Game:

If the value of the game is zero. Then it is called fair game. On the other hand if the value of the game is non-zero quantity then we call it strictly determinate game. If the non-zero quantity is positive the game is in favour of maximising player and if the non-zero quantity is negative then the game is in favour of minimising player.

1.3.8. Solution Of 2×2 Games Using Mixed Strategy [Problem with Out the A Saddle Point in Case of Pure Strategy]:

Let the pay-off matrix of two players A and B with their pure moves A_i and B_j (i=1,2 and j=1,2) is given as

Player B

$$\text{Player A}\quad \begin{array}{c} \\ A_1 \\ A_2 \end{array} \begin{array}{c} \begin{array}{cc} B_1 & B_2 \end{array} \\ \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \end{array}$$

Let, the mix strategies taken by player A and B are p= (p_1, p_2) and q= (q_1, q_2) respectively such that $p_1+p_2=1$ and $q_1+q_2=1$ and p_1, p_2, q_1, q_2 lies on the open interval (0,1).

If A play his mix strategies p= (p_1, p_2)

Then expected gain of A is

$E_1(p)= a_{11}p_1+ a_{21}p_2$

$= a_{11}p_1+ (1- p_1)\, a_{21}$ for B's pure more B_1.

Similarly, for B's pure more B_2, the expected gain of A is

$E_2(p)= a_{12}p_1+(1- p_1)\, a_{22}$

When B play his mix strategy for A's pure move A_1. The expected loss of B is

$E_1(q)= a_{11}q_1+(1- q_1)\, a_{12}$

Similarly, for A's pure more A_2. The expected loss of B is

$E_2(q)= a_{21}q_1+(1- q_1)\, a_{22}$

Now if v is the value of the game then $E_1(p) \geq v$, $E_2(p)$)$\geq v$ and $E_1(q) \leq v$, $E_2(q)$)$\leq v$

Assuming the existence of the value if the game and as both o<pm p_2<1 and o<q_1, q_2<1. Then by using complementary slackers' theorem, we can say that all the equation strictly reduces to equality form and we have therefore,

$E_1(p)$=v= $E_2(p)$.......(i)

$E_1(q)$=v= $E_2(q)$.......(ii)

From, (i) we get $a_{11}p_1+ a_{21}(1- p_1)= a_{12}p_1+a_{22}+(1- p_1)$

$$p_1^* = \frac{a_{22} - a_{21}}{a_{11} + a_{22} - (a_{11} + a_{22})}$$

Since, $p_1^* + p_2^{=1*}$

$$p_2^* = \frac{a_{11} - a_{12}}{a_{11} + a_{22} - (a_{21} + a_{12})}$$

Similarly form (ii) we get

$$q_1^* = \frac{a_{22} - a_{12}}{a_{11} + a_{22} - (a_{21} + a_{12})}$$

$$q_2^* = \frac{a_{11} - a_{21}}{a_{11} + a_{22} - (a_{12} + a_{21})}$$

Where (p_1^*, p_2^*) are the optimum strategies of player A and (q_1^*, q_2^*) are the optimum strategies of player B.

The value of the game v= $\frac{a_{11}a_{22} - a_{21}a_{12}}{a_{11} + a_{22} - (a_{12} + a_{21})}$

1.3.9. Dominance Property

In this method the pay-off matrix can be reduced by more observations and in many causes it may be solved only by adopting this method and in other cases it may be reduced to 2×2 or 2×n or m×2 game so that it can be solved by mixed strategies or graphical method.

The dominance property is obtained by following two rules.

i) if all the elements of k th row are less than or equal to the corresponding elements of r th row of the pay-off matrix then we can say that k th row is dominated by r th row and we reject k th row.

ii) If all the elements of l th column are greater than or equal to the corresponding elements of s th column. Then we shall say that l th column is dominated by s th column and we reject the l th column.

Example:

Consider the particular pay-off matrix

Player B

Player A

	B_1	B_2	B_3	B_4
A_1	-5	3	1	20
A_2	5	5	4	6
A_3	-4	-2	0	-5

We have seen that for A's pure more A_3, all the elements of third row are less than that of second row, so we reject third row. Thus, the pay-off matrix reduced to

	B_1	B_2	B_3	B_4
A_1	-5	3	1	20
A_2	5	5	4	6

Now for B's pure move B_4 all the elements of u*th* column are greater than the corresponding element of the 3rd column so we shall reject 4th column and the pay-off matrix reduces to.

Player B

Player A

	B_1	B_2	B_3
A_1	-5	3	1
A_2	5	5	4

Now all the elements of 2nd column are greater than or equal to the corresponding elements to the 1st column. So shall reject 2nd column and our pay-off matrix reduces to

Player B

Player A

	B_1	B_3
A_1	-5	1
A_2	5	4

Now all the elements of 1st row are less than or equal to the corresponding elements of 2nd row and over pay-off matrix reduces to

Player B

Player A

	B_1	B_2
A_2	5	4

Now form the pay-off matrix it is evident that B will select his pure more B_3 and the value of the game is 4 and optimal strategies are A_2 and B_3 for player A and B respectively.

Sub Unit – 4: Perfect Competition

1.4.1. Perfect Competition:

Perfect Competition (pc) is a market structure characterised by a complete absence of rivalry among the individual firms. Thus, perfect competition in economic theory has a meaning diametrically opposite to the everyday use of this term. In practice businessmen use the word competition as synonymous to rivalry. In theory PC implies no rivalry among firms.

1.4.2. Assumptions:

The model of PC is based on the following assumptions:⇒

a) **Large number of sellers and buyers:-**
The industry or market includes large number of sellers (firms) and buyers so that no individual firm or no individual buyer can not affect the price.

b) **Product homogeneity: -**
The industry is defined as a group of firms producing a homogeneous product.
The assumptions of large number of sellers and of product homogeneity imply that the individual firm in pure competition is a price taker i.e. its demand curve is infinitely elastic.

$TR = PQ$

$AR = \frac{PQ}{Q} = P$

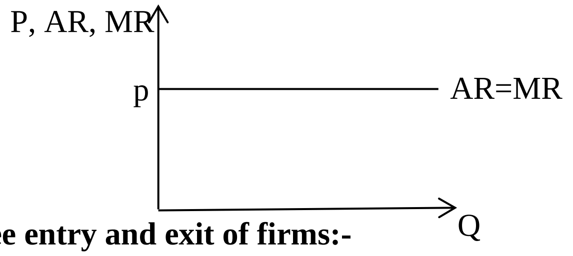
$\therefore Slope\ of\ AR = \frac{\partial(AR)}{\partial Q} = 0$

$\therefore Slope\ of\ demand\ curve = 0$

$Similarly\ MR = \frac{\partial(+R)}{\partial Q} = P$

Slope of MR curve $= 0$

AR Curve (dd curve) and MR curve are identical and horizontal.



c) **Free entry and exit of firms:-**
There is no barrier to entry or exit from the industry. Any new firm is free to set up production if it so wishes and any existing firm can stop production and leave the industry if it so wishes.

d) **Profit maximization:-**
The goal of all firms is profit maximisation.

e) **No govt. regulation:-**
There is no govt. intervention in the market.

The market structure with above assumption is called pure competition. It is different from PC, which requires the fulfilment of the following additional assumptions.

f) Perfect mobility of factors of production:-

The factors of production are free to move from one firm to another throughout the economy.

g) Perfect knowledge:-

It is assumed that all sellers and buyers have complete knowledge of the condition of the market of both present and future. Information is free and costless.

Hence it can be concluded that PC is an economic model of a market possessing the following characteristics: each economic agent acts as if prices are given, that is, each acts as a price taker; the product is homogeneous; there is free entry; and all economic agents in the market possess complete and perfect knowledge about the relevant price.

Under the above assumptions we shall examine the equilibrium condition of the firm and the industry in the short Run and in the long Run.

1.4.3. SR equilibrium of the firm:⇒

The firm is equilibrium when it maximises its profit (π), defined as the difference between total cost and total revenele i.e. $\pi = TR - Tc$

Conditions of π Maximization: -

The firm aims at the maximisation of its profit $\pi \ = R - C \ where, \ \pi \ = profit$

Clearly $R = f_1(x) and \ C = f_2(x),$ $\qquad R = total \ revenue$

given the price P $\qquad C = totyal \ cost.$

a) The first order condition for the maximization of a function is that its first derivative be equal to zero. Differentiating the total profit function and equating to zero we obtain.

$$\frac{\partial \pi}{\partial x} = \frac{\partial R}{\partial x} - \frac{\partial C}{\partial x} = 0$$
$$\Rightarrow \frac{\partial R}{\partial x} = \frac{\partial C}{\partial x}$$

The term $\partial R/_{\partial x}$ is the slope of the total revenue curve, that is, the marginal revenue. The term $\frac{\partial C}{\partial x}$ is the slope of the total cost curve or the marginal cost. Thus, the first order condition for profit maximisation is

$$MR = MC$$

Given that $MC > 0$ MR must also be positive at equilibrium.

Since $MR = P \ the \ first \ order$ condition may written as

$$MC = P$$

b) The second order condition for a maximum requires that the second derivative of the function be negative. The second derivative of the total profit function is

$$\frac{\partial^2 \pi}{\partial x^2} = \frac{\partial^2 R}{Dx^2} - \frac{\partial^2 C}{\partial x^2}$$

This must be negative if the function has maximized that is, $\frac{\partial^2 R}{\partial x^2} - \frac{\partial^2 C}{\partial x^2} < 0$

Which yield the condition $\frac{\partial^2 R}{\partial x^2} < \frac{\partial^2 C}{\partial x^2}$

But $\frac{\partial^2 R}{\partial x^2}$ is the slope of MR curve and $\frac{\partial^2 C}{\partial x^2}$ is the slope of MC curve. Hence the second order condition may verbally be written as follows $(Slop\ of\ MR) < (slop\ of\ MC)$.

Thus the MC must have a steeper slope than the MR curve or the MC must cut the MR curve from below. In pure competition the slope of the MR curve is zero, hance the second order condition is simplified as follows $0 < \frac{\partial^2 C}{\partial x^2}$.

Following the conditions, a perfectly competitive firm can either excess profit or normal profit or loss depending on the values of P and AC.

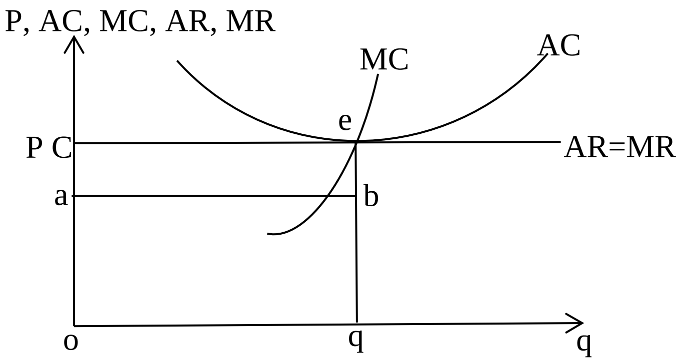
The firm earns excess profit when $P > AC$

The firm earns normal profit $P = AC$

The firm earns loss profit $P < AC$

All the cases are represented in the following figures: -

Excess profit: -



p>Ac

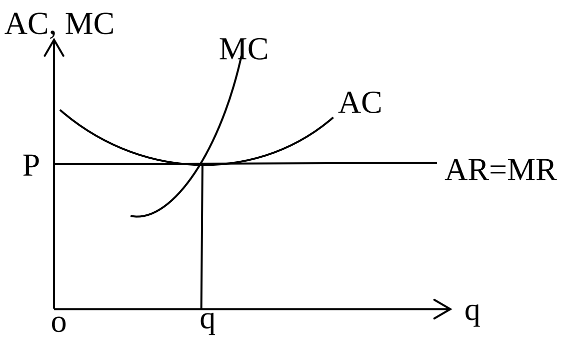
Which reads: the MC Curve must have a positive slope, or the MC must be rising.

$$\begin{aligned} Here\ TR &= Pq \\ TR &= op \times oq \\ &= oceq \\ TC &= AC \times q \\ &= bq \times oq \\ &= oabq \end{aligned}$$

As here $TR > TC,$ an excess profit is earned.

Hence the excess profit $= TR - TC = aced$

Normal profit:-



p=Ac

Here $TR = pq$ $\qquad$ $Tc = Ac.q$

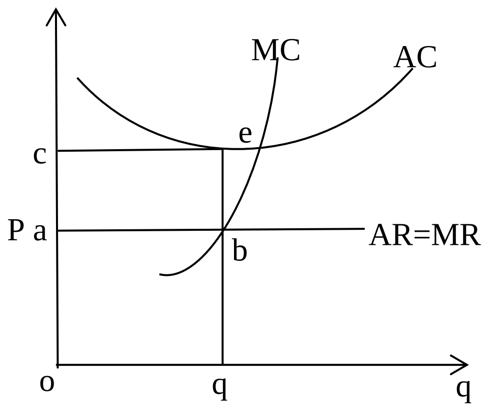
$= op \times oq$ $\qquad$ $= bq \times oq$

$= oabq$ $\qquad$ $= oabq$

$\therefore TR = TC$

As here $TR = TC,$ there is no excess profit only normal profit is earned.

Loss:-



P<AC

Here, $TR = pq$ $\qquad$ $TC = AC \times q$

$= op \times oq$ $\qquad$ $= eq \times oq$

$= oabq$ $\qquad$ $= oceq$

As here $TR < TC,$ a loss is earned.

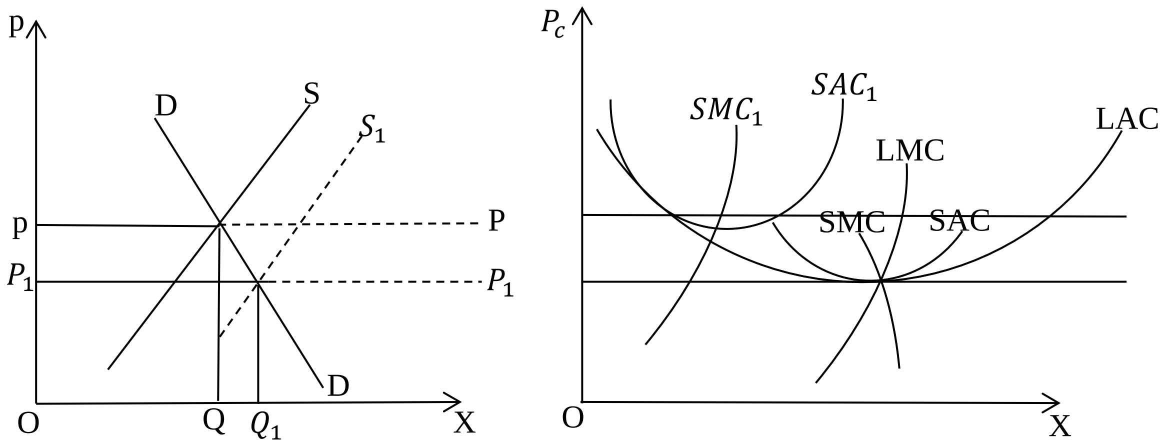
Hence the loss is $= TC - TR \; = aced$

1.4.4. Long run equilibrium: - (of the firm)

Long run equilibrium for a firm in PC occurs at the point where the price equals minimum long run average cost. At this point minimum short run average total cost equal minimum long run average total cost and the short run and long run $MC_{(s)}$ are equal. The position of long run equilibrium is characterised by a no profit situation.

In the long run firms are equilibrium when they have adjusted their plant so as to produce at the minimum point of their long run AC curve, which is tangent (at this point) to the demand curve defined by the market price. In the long run the firms will be earning just normal profit, which are included in the LAC. If they are making excess profits new firms will be attracted in the industry, this will lead to a fall in price (a down ward shift in the individual demand curves) and an upward shift of the cost curves due to the increase of the prices of the cost curves due to the increase of the prices of factors as the industry expands. These changes will continue until the LAC is tangent to the demand curve defined by the market price. If the firms make losses in the long run they will leave the industry, price will rise and costs may fall as the industry contracts, until the remaining firms in the industry cover their total costs inclusive of the normal rate of profit.

In figure – 2 we show how firms adjust to their long run equilibrium position. If the price is P, the firm is making excess profit working with the plant whose cost is denoted by SAC_1. It will therefore have an incentive to build new capacity and it will move along its LAC. At the same time new firms will be entering the industry attracted by the excess profit. As the quantity supplied in the market increases (by the increased production of expanding old firms and by the newly established ones) the supply curve in the market will shift to the right and price will fall until it reaches the level of P_1 (in figure – 1) at which the firms and the industry are in long run equilibrium. The LAC in figure – 2 is the final cost curve including any increase in the prices of factors that may have taken place as the industry expanded.



(Fig – 1) (Fig – 2)

The condition for the long run equilibrium of the firm is that the marginal cost be equal to the price and to the long run average cost.

$$LMC = LAC = P$$

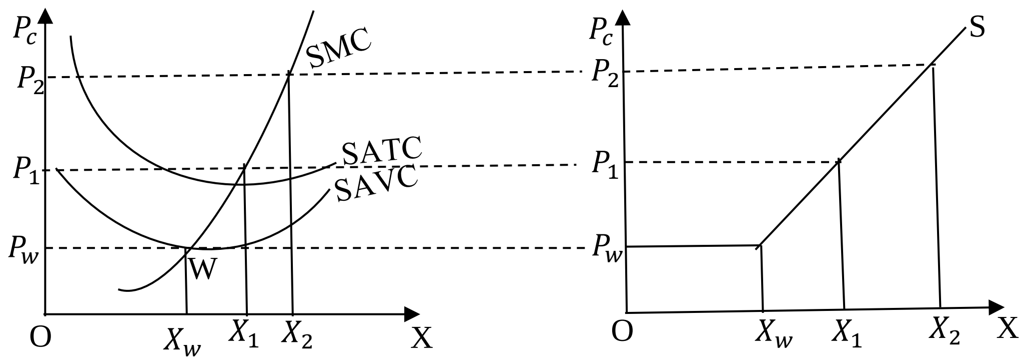
The firms adjust its plant size so as to produce that level of output at which the LAC is the minimum possible, given the technology and the prices of factors of production. At equilibrium the SMC is equal to LMC and the SAC is equal to LAC. Thus, given the above equilibrium condition, we have,

$$SMC = LMC = LAC = LMC = P = MR$$

This implies that at the minimum point of LAC the corresponding (short-run) plant is worked at its optimal capacity, so that the minimum of the LAC and SAC coincide on the other hand, the LMC cuts the LAC at its minimum point and the SMC cuts the SAC at its minimum point. Thus the minimum point of the LAC the above equality between short run and long run costs is satisfied.

1.4.4. SR Supply curve of a perfectly competitive Firm: -

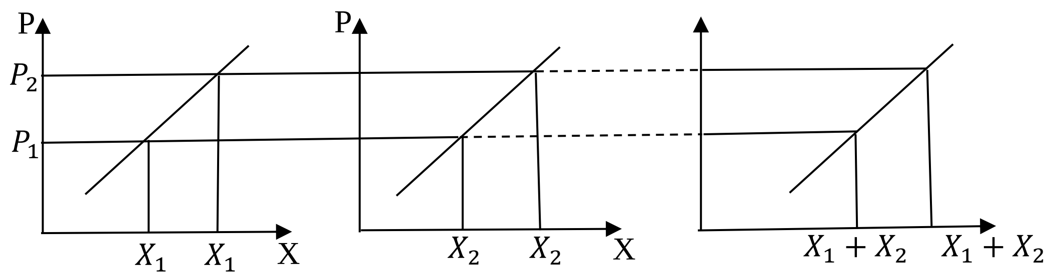
The supply curve of the firm may be derived by the points of intersection of its MC curve with successive demand curves. Assume that the market price increases gradually. This causes an upward shift of demand curve of the firm. Given the positive slope of the MC curve, each higher demand curve cuts the MC curve to point which lies to the right of the previous intersection. This implies that the quantity supplied by the firm increases as price rise. The firm, given its cost structure, will not supply any quantity (will closedown) is price falls below P_w, because at a lower price the firm does not cover its variable costs (fig – 1). If we plot the successive point of intersection of MC and the demand curves on a separate graph we observe that the supply curve of the individual firm is identical to its MC curve to the right to the closing-down point w. Below P_w the quantity supplied by the firm is zero. As price rises above P_w the quantity supplied increases. The supply curve of the firm is shown in figure – 2.



1.4.5. SR supply curve of an Industry / Industry supply Curve: -

The industry supply curve is the horizontal summation of the supply curves of the individual firms.

This is explained in the following figure where the industry consists of two firms A and B.



Supply curve of A Supply curve of B Industry supply curve

1.4.6. Industry LR Equilibrium: ⇒

The industry is in LR equilibrium when a price is reached at which all firms are in equilibrium at minimum point of LAC. Under these condition there is no farther entry or exit of firms in the industry, given the technology and factor prices. The LR equilibrium of the industry is shown in figure – 1

At the market price P, the firms produce at their minimum cost, earning just normal profits, following the condition $LMC = SMC = P = MR$. At P the industry is in equilibrium because profits are normal and all costs are covered so that there is no incentive for entry or exit.

1.4.7. Industry LR supply Curve: ⇒

To obtain the LR industry supply curve we must make use of the fact that in LR equilibrium all firms will be operating at the minimum point of their LR , AC curves and this minimum value is equal to the market price for every firm. Thus, to obtain the long run industry supply curves we have to ask what happens to the individual firms AC curves when the industry output expands. The answer depends on whether the industry is a constant cost industry (An industry is a constant cost industry if the prices of factors of production employed by it remain constant as industry, an increasing cost industry output expands).

(An industry is an increasing cost industry is the prices of factors of production increase as the market expands), or a decreasing cost industry (An industry is a decreasing cost industry is the prices of factors of production decline as the market expands).

a) **Constant cost industry: -**
b) **Increasing cost industry: -**
c) **Decreasing cost industry: -**

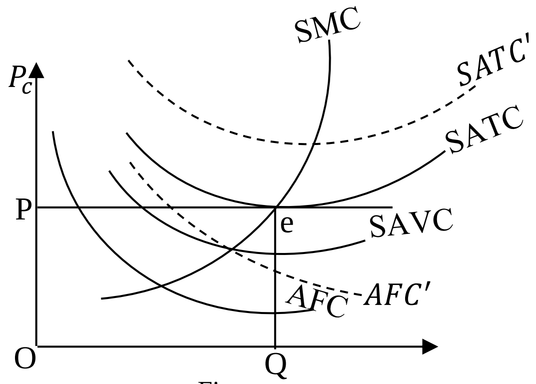
1.4.8. Impact of increase in cost on equilibrium price and quantity of a perfectly competitive firm under SR and LR.

i. An Increase in Fixed Cost: -

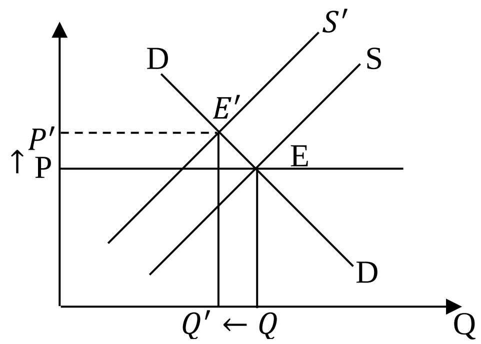
Fixed cost is that amount of cost borne by the firm even when production is stop with increase in fixed cost both $AFC \text{ and } AC$ curves shift upward. However AVC and MC curves remains unaffected.

As MC curve is the supply curve of the firm, the equilibrium position of the firm is not affected in the SR. The same output will be produced with constant price.

However, assuming that the firm before the change in costs was in long run equilibrium earning just normal profits, it will not cover its higher (shifted) total average costs and will go out of business in the long run consequently in the long run the market supply curve will shifts upwards to the left; in the new equilibrium the output will be lower the price higher, and there will be fewer firms in the industry (if the higher price does not cover the increased costs)



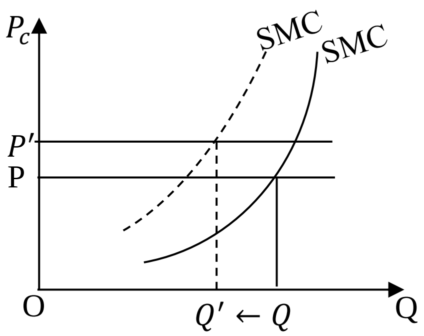
Firm
With increase in FC, VC and MC are Unaffected, consequently equilibrium P and Q are unaffected.



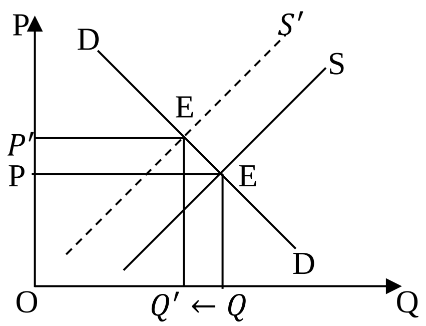
With increase in FC, TC of all firms increases, they start to earn loss, there is a tendency to exit industry. Total industrial output will fall and price will rise.

ii. Increase Invariable Cost: -

Variable cost is that amount of cost which is a function of output of a firm. With the increase in variable cost, $AVC, AC\ and\ MC$ curves shift left ward. As MC is the supply curve, its left ward movement leads to higher price and lower quantity. Thus, even in the SR the market supply curve will shift upward to the left and, given the market demand price will rise. In the new market equilibrium, the number of firms will be the same but the quantity will be lower and the price higher as compared with the initial equilibrium.



With increase in VC, MC will shift upwards, Consequently, P will increase and Q will fall.



With increase in VC, TC of all firms increases, they start to earn loss, there is a tendency to exit industry. Total industrial output will fall and price will rise.

1.4.9. Impact of Taxation on Equilibrium Price and Output of a Perfectly Competitive Industry.

(i) Impact of lump-sum tax: -

Lump-sum tax is that amount of tax which is paid regardless of the physical quantity or value of sales or the amount of profit. Hence its nature is like a fixed cost to the firm. Thus in the SR

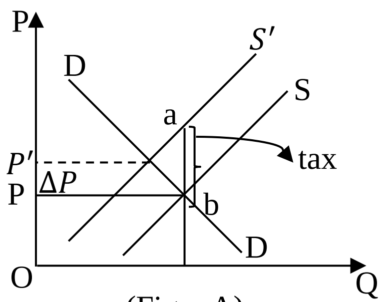
the lump-sum tax does not affect the MC curves and the firm will continue to produce the same output as before the imposition of tax.

However in the LR the result is different. The imposition of lump-sum tax leads to an increase in TC, which forces the firms to earn lower amount of profit or even loss. Consequently, there is a tendency to exit the industry. Thus, in the long run the market supply curve will shift to the left as firms leaves the industry. The output will be lower and price higher as compared with pre-tax equilibrium.

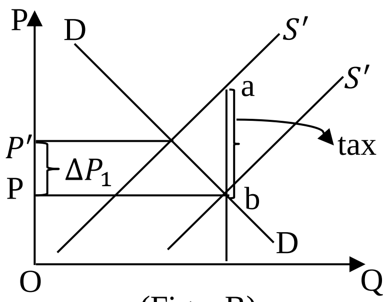
(ii) Impact of unit tax: -

A unit tax is that amount of tax which is imposed per unit of output. Such a tax, Consequently, affect the MC of the firm. The MC will shift upward to the left with the imposition of unit tax, by how much price will increase that depends on the elasticity of supply curve. All the cases are discussed below:-

Case – 1: - Supply curve is positively sloped,



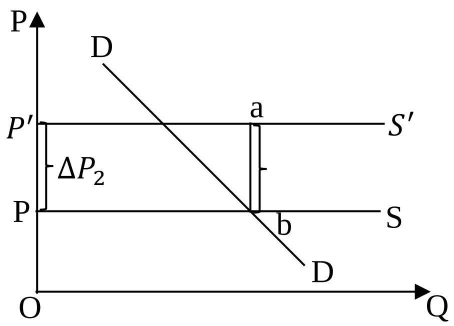
(Fig – A)



(Fig – B)

For same amount of tax (say, ab) burden of taxation is more for consumer and less for producer in fig – B relatively to figure – A. Higher the elasticity of ss, more will be burden on consumer and vice versa.

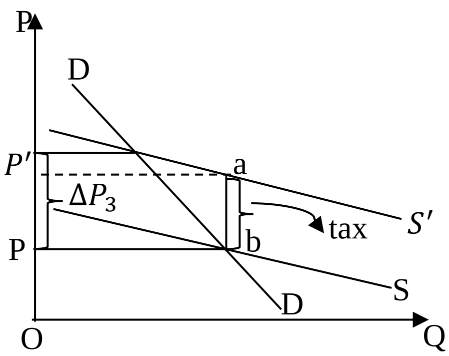
Case – 2: - Supply curve is horizontal;



Total tax burden is borne by the consumer (ab) = price increase

Producer’s burden = 0

Case – 3: - Supply curve is negatively sloped;



Total tax burden < consumer's burden.

1.4.10. Monopoly

1) A monopoly is said to exit when there is only one producer in a market. This is a sharp departure from perfect competition (PC) where there are a long number of sellers. Three conditions must be satisfied in a monopoly market. They are:
   a) There is single seller
   b) The product sold has no close substitutes and
   c) There are strong barriers to entry.

1.4.11. SR Equilibrium Monopolist: -

The firm aims at the maximization of its profit

$$\pi = R - C \qquad\qquad Where, \pi = profit$$
$$R = totasl\ revenue$$
$$C = total\ cost.$$

a) The first order condition for the maximization of a function is that its first derivative be equal to zero, differentiating the total profit function and equating to zero we obtain.

$$\frac{\partial \pi}{\partial Q} = \frac{\partial R}{\partial Q} - \frac{\partial C}{\partial Q} = 0$$
$$\Rightarrow \frac{\partial R}{\partial Q} = \frac{\partial C}{\partial Q}$$

The term $\frac{\partial R}{\partial Q}$ is the slope of the total revenue curve that is, the marginal revenue. The term $\frac{\partial C}{\partial Q}$ is the slope of the total cost curve, that is the marginal cost curve. Thus the first order $cond^n$ for profit maximization is $MR = MC$.

Given that $MC > 0$ MR must also be positive at equilibrium. Since $MR = p$ the first order condition may write as $MC = p$.

b) The second order condition for a maximum requires that the second derivative of the function be $(-ve)$. The second derivative of the total profit function is

$$\frac{\partial^2 \pi}{\partial Q^2} = \frac{\partial^2 R}{\partial Q^2} - \frac{\partial^2 C}{\partial Q^2}$$

This must be negative if the function has been maximized so that, $\frac{\partial^2 R}{\partial Q^2} - \frac{\partial^2 C}{\partial Q^2} < 0$

Which yields the condition $\frac{\partial^2 R}{\partial Q^2} < \frac{\partial^2 C}{\partial Q^2}$

But $\frac{\partial^2 R}{\partial Q^2}$ is the slope of MR curve and $\frac{\partial^2 C}{\partial Q^2}$ is the slope of MC curve. Hence the second order condition may verbally be written as

Slope of $MR < slope\ of\ MC$.

1.4.12. Shape of AR (Demand) Curve and MR Curve: -

Suppose demand curve is given by $p = a - bq$

P = price

a = constant intercept

q = quantity

b = slope of the DD curve

(-) implies $(-ve)ly$ sloped DD curve

$\therefore TR = pq$ $\qquad MR = \frac{\partial(TR)}{\partial q} = a - 2bq$

$TR = aq - bq^2$ $\qquad \frac{\partial(MR)}{\partial q} = -2b$

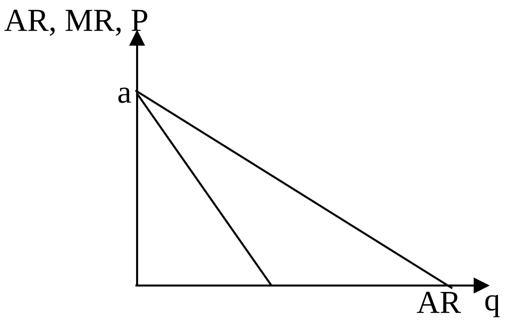
$AR = a - bq$

$\frac{\partial(AR)}{\partial q} = -b$

Further $q = 0$, $AR = MR = a$

Hence, both $AR\ and\ MR$ curves are $(-ve)ly$ sloped and MR is twice steeper than AR.

Now we can derive $AR\ and\ MR$ curves on the basis of above discussion,

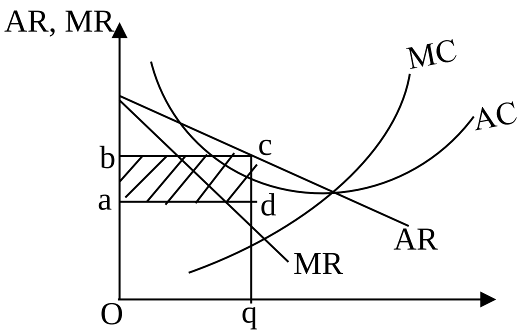


Following the above conditions, a monopolist can earn either excess profit or normal profit or loss depending on the values of $P\ and\ AC\ in\ the\ SR$.

The firm earns excess profit when $P > AC$.

The firm earns normal profit when $P = AC$.

The firm earns loss profit when $P < AC$.



All the cases are represented in the following figure,

Case – I: -

$TR = p \times q$

$= ob \times oq$

$= obcq$

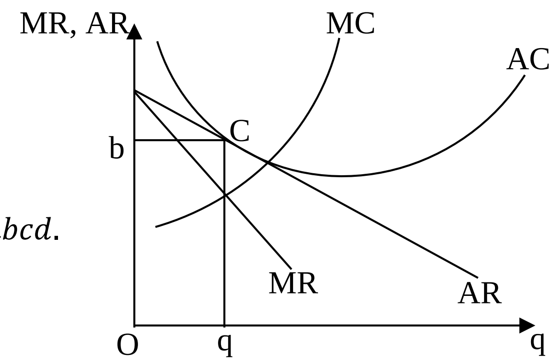
As $TR > TC$, the monopolist $TC = AC \times q$

earns excess profit $= oa \times oq$

$= oadq$

The amount of excess profit = $TR - TC$

$= abcq - oadq = abcd.$



Case – II: -

Here, $TR = p \times q$

$= ob \times oq$

$= obcq$

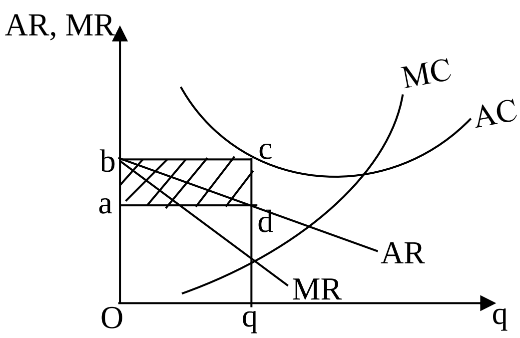
$TC = AC \times q$

$= ob \times oq$

$= obcq$

As here, $TR = TC$, the monopolist earns only normal profit

Case – III: -



Here, $TR = p \times q$

$= oa \times oq$

$= oadq$

$TC = AC \times q$

$= ob \times oq$

$= obcq$

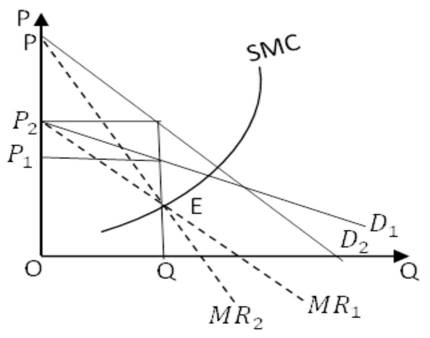
As here $Tc > TR$, the monopolist earns loss, the amount of loss is $TC - TR$

$$= obcq - oabq$$

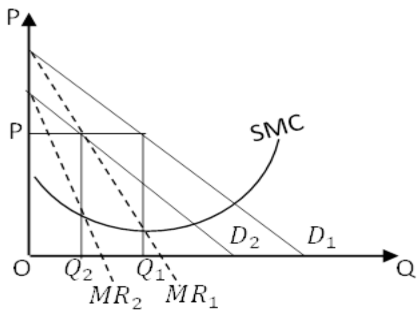
$$= abcd.$$

1.4.13. Absence of SS Curve Under Monopoly in the SR:-

There is the unique supply curve for the monopolist derived from his MC. Given his MC, the same quantity may be offered at different prices depending on the price elasticity of demand. Graphically this is shown in figure – I. The quantity Q will be sold at price P_1 if demand is D_1, while the same quantity Q will be sold at price P_2 if demand is D_2. Thus, there is no unique relationship between price and quantity. Similarly, given the MC of the monopolist, various quantities may be supplied at any one price, depending on the market demand and the corresponding MR curve. In figure – 2 we depict such a situation. The cost conditions are



(Fig – 1)



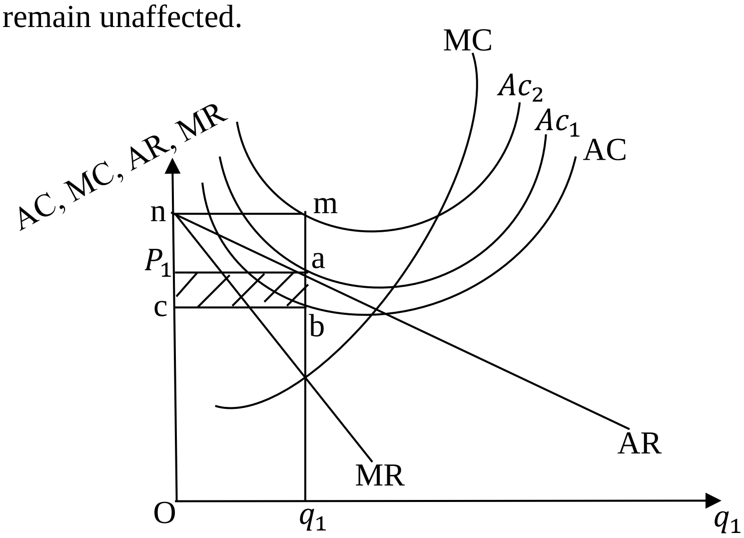
(Fig – 2)

Represented be MC curve. Given the costs of the monopolist, he would supply OQ_1, if the market demand is D_1, while at the same price, P_1 he would supply only OQ_2 if the market demand is P_2.

3. Impact of change in FC and VC is same as perfect competition: -
4. Impact of imposition of lump-sum tax and unit tax is same as perfect competition: -

1.4.14. Impact of change in Fixed Cost (FC): -

a) Fixed cost is that amount of cost borne by the firm even when production is stop with increase in fixed cost both AFC and AC curve shift upward. However, AVC and MC curves remain unaffected.



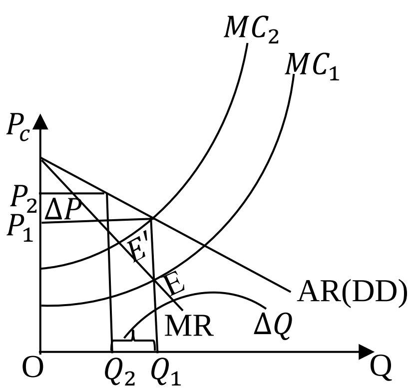
Initially the monopolist earns an excess profit of the amount P_1abc.

As FC increases AC will increase. The monopolist earns just normal profit. Further suppose FC increases more consequently AC increases to AC_2. The firm starts to earn a loss. Amount of loss is P_1amn.

All happens in the SR. Because in LR a monopolist can never earn a loss. It earns either normal profit or excess profit.

1.4.15. Impact of Change in Variable Cost: -

A variable cost is that amount of cost which is a function of output of a firm. With the increase in variable cost, AVC, AC and MC curves shifts leftward. As MC is the supply curve, its leftward movement leads to higher price and lower quantity. Thus, even in the SR the market ss curve will shift upwards to the left and given the market demand, price will rise. In the new market equilibrium, the number of firms will be the same but the quantity will be lower and price higher as compared with the initial equilibrium.



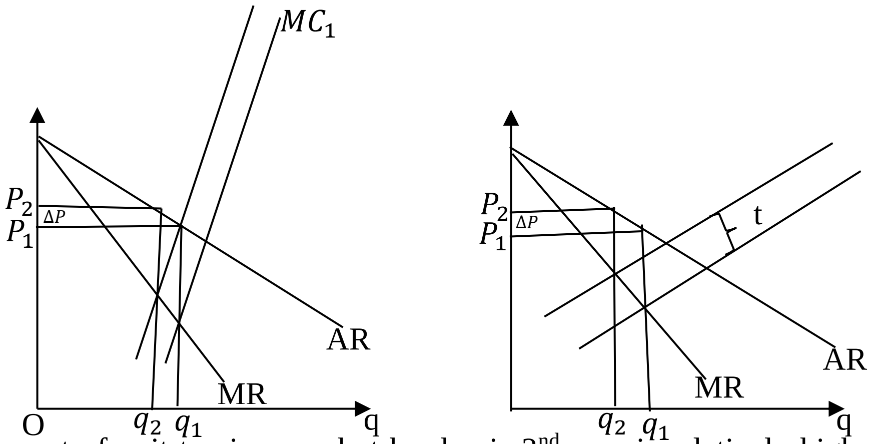
1.4.16. Impact of Imposition of Lump-Sum Tax: -

Lump-sum tax is that amount of tax which is paid regardless of the physical quantity or value of sales or the amount of profit. Hence its nature is like a fixed cost to the firm. Thus, in the SR the lump-sum tax does not affects the MC curves and the firm will continue produce the same output as before the imposition of tax.

However, in the long run the result is different. The imposition of lump-sum tax leads to an increase in total cost which forces the firms to earn lower amount of profit or even loss. Consequently, there is a tendency to exit the industry. Thus, in the long run the market supply curve will shift to the left as firms leaves the industry. The output will be lower and price higher as compared with pre-tax equilibrium.

Impact of unit tax: -

A unit tax is that amount of tax which is imposed per unit of output. Such a tax, consequently affect the marginal cost of the firm. The MC will shift upward to the left. With the imposition of unit tax, by how much price will increase that depends on the elasticity of supply curve.

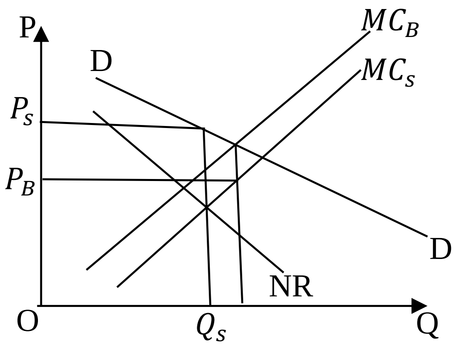


In both cases amount of unit tax is same but burden is 2nd case is relatively higher. As MC curve more and more flatter, the burden of consumer becomes more and more. But unlike perfect competition, when MC is horizontal, burden of taxation can't be equal to amount of taxation.

1.4.17. Bilateral Monopoly: -

A bilateral monopoly is said to exist when one producer produces output and there is only one buyer for the product.

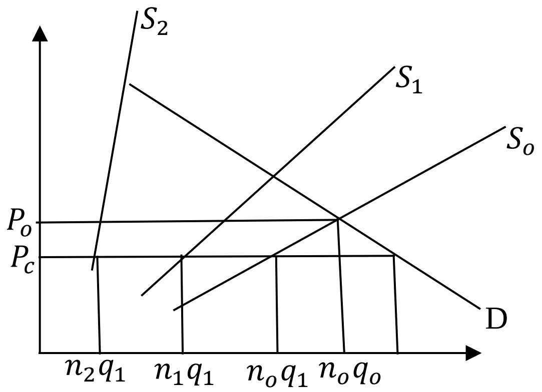
Since there is only one buyer and one seller, the price and quantity will be determined by negotiation. However, we can find the upper and lower limits for prices and quantities by considering alternatively the single seller as all-powerful and the single buyer is all-powerful. This is explained in the following figure. Here DD is the demand curve MR is the marginal revenue curve and MC_s is the marginal cost curve of the seller. If the seller is all-powerful, equilibrium price – quantity is P_s and Q_s.



However, if the single buyer is all-powerful, he can make the monopolist behave like a perfect competitor. Thus Mc_S is the monopolist supply curve. Corresponding to MC_S, we construct the MC_B curve, which shows the marginal cost of buying an additional unit. MC_B exceeds price because in order to purchase an additional unit, the buyer must pay a higher price. The buyer equals his marginal cost of buying an additional unit with the marginal value of an additional unit (as given by the demand curve) and purchases Q_B units. Since the seller is behave in like a competitor with supply curve MC_S, he will sell the Q_B units at price P_B.
The actual solution for the bilateral monopoly problem is indeterminate, depending on the respective bargaining powers of the buyer and the seller.

1.4.18. Impact of Price Control Under Perfect Competition and Monopoly: -

Efforts by Govt. to put ceiling on prices are very common. Here we shall discuss the impact of price ceilings under both $PC\ and\ d$ monopoly. This is explained in following figure.



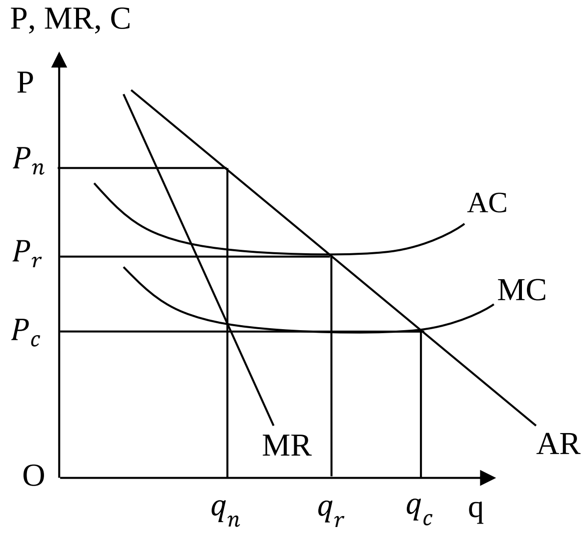
Before controls are imposed the market clears at a price of P_o and an industry output of n_oq_o. (There are no firms each producing q_o). Now suppose the govt. imposes a price ceiling of P_c (where $P_c < P_o$). At this lower price consumers demand Q_1 units but firms each cut back their output to n_oq_1. The storage created by the ceiling price is thus $Q_1 - n_oq_1$ initially. Because P_c is below the minimum $ATC(= P_o)$ of firms, there is an exodus of firms from the industry. This causes a shift of the supply curve say to S_1. The shortage grows to $Q_1 - n_1q_1$ because there are fewer firms in the industry. The reduction in the newer of firms does not affect the controlled price, so the exodus continues. As time goes on and more firms have, the supply curve shifts to S_2 and the shortage grows to $Q_1 - n_2q_1$ ultimately all firms will leave the industry.
Two points should always be kept in mind regarding price control under perfect competition.

(a) Shortages appear to become greater the longer the controls are in effect.
(b) The longer the controls are in effect the greater will be the rise in price and needed to clear the market in the short run.

1.4.19. Natural Monopoly: -

There are many cases where monopoly arises naturally because of economics scale. These monopolies are called natural monopolies. In these cases, average cost of production declines over the entire range of market demand. This implies that one firm can produce the entire output more cheaply than multiple firms could. Examples of natural monopolies are telephone companies, gas pipelines etc. The monopolistic firm, if left alone does not produce a society optimal level of output. But regulation can bring about the optimal output if the regulators are able and willing to make the necessary calculations.

The mechanism of natural monopoly is explained in terms of the following figure below.



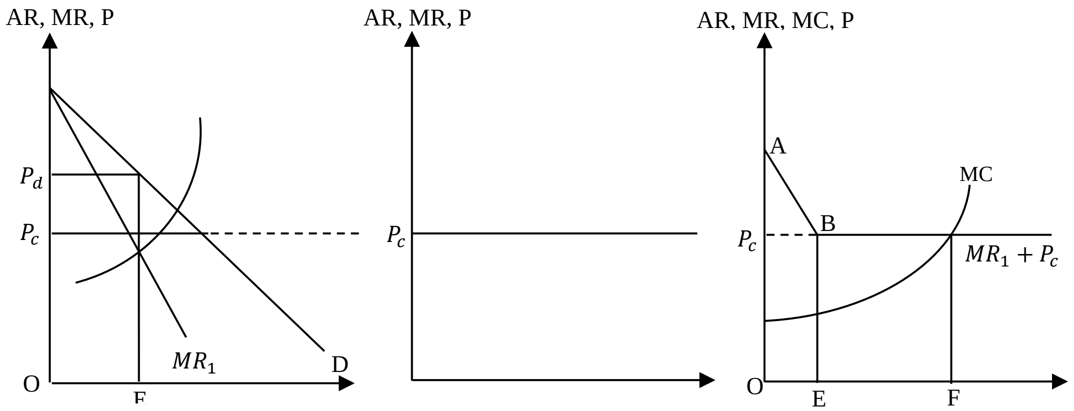
In the figure as AC is declining everywhere, MC is always below AC. If the firm were unregulated, it would produce q_n and sell at the price P_n. Ideally the regulatory agency would like to puss the firm's price down to the competitive level P_c. But at $P_c (P_c < AC)$ the firm earns a loss. So, the best alternative is to set the price at P_r where $AR = AC$. At P_r the firm earns monopoly profit and output is set at that level that the firm can no go out of business.

1.4.20. Dumping: -

When a monopolist produces in its way in home country and sells its product in the world market where there is a perfectly competitive market for the good in question, the situation is called dumping. It is an example of price discrimination. This situation is explained in the following figure,

The domestic monopoly firm is represented by the downward sloping demand and marginal revenue curve MR_1(Panel -A). The world market (Panel -B) is shown with competitive price P_c. Here the MR curve is horizontal and identical with P_c line. The firm will allocate any given level of total output between the domestic and world market by maintaining the equality MC with each MR curves. The horizontal sum of $MR_1$and P_c is shown in (Panel-C). If output is OE or less, the firm does not enter into the world market. For output larger than OE the foreign corresponding marginal revenue is the price P_c this is shown by the horizontal line $MR_1 + P_c$.

Profit maximizing level of output is determined at that point where MC intersects the horizontal sum of MR curves. From (Panel C) it is clear that OE units will be sold in home market at price P_d and foreign sells (EF) are made at the competitive world price P_c.



(Panel - A) (Panel - B) (Panel – C)

1.4.21. Cob – web model: -

The demand in any period depends on the price of that period but the supply depends on the price of the previous period. Such a situation is generally found in case of agricultural production. If the price of any agriculture product increases in any period, it will not be possible to increase the production of the commodity in same period. Rather production will increase in the next period in response to the increase in price. Under such a situation equilibrium price is determined in the following way:

Suppose demand and supply function are,

$$Q_{dt} = c + bP_t \; --- (1)$$

$$Q_{st} = g + hP_{t-1} --- (2)$$

Where, b, c, g and h are constant.

Let us assume that the price level adjusts to bring about the equality of demand and supply in all period. This means that $Q_{dt} = Q_{st} --- (3)$

Substituting the value of (1) and (2) into equation (3)

$$c + bP_t = g + hP_{t-1} --- (4)$$

$$or, \qquad bP_t = hP_{t-1} + (g - c)$$

$$or, \qquad P_t = {}^{h}/_{b}\,(P_{t-1}) + \left(\frac{g-c}{b}\right)$$

This is a first order non homogeneous difference equation. Its solution will give us the time path of price level.

If the equation be,

$$y_t = by_{t-1} + a$$

The solution will be $y_t = \left(y_0 - \frac{a}{1-b}\right) b^t + \frac{a}{1-b}$

When, $b \neq 1$.

$y_t = y_0 + at$ when $b = 1$

Since $b < 0$ and $h > 0$ under normal demand and supply condition, $\frac{h}{b} \neq 1$

$$P_t = \left[P_0 - \frac{(g-c)_b}{\frac{(b-h)}{b}}\right]\left(\frac{h}{b}\right)^t + \frac{\frac{g-c}{b}}{\frac{b-h}{b}}$$

$$P_t = \left(P_0 - \frac{g-c}{b-h}\right)\left(\frac{h}{b}\right)^t + \frac{g-c}{b-h} \; ----(5)$$

When the model is in equilibrium $P_t = P_{t-1}$ substituting P_e for P_t and P_{t-1} in equation (4)

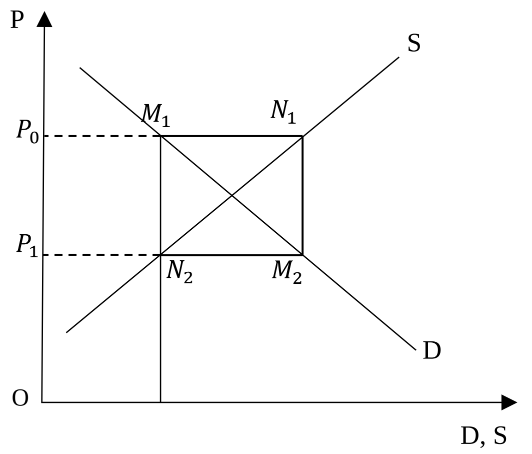
$P_e = \frac{g-c}{b-h}$ Substituting in equation (5)

$$P_t = (P_0 + P_e)\left(\frac{h}{b}\right)^t + P_e$$

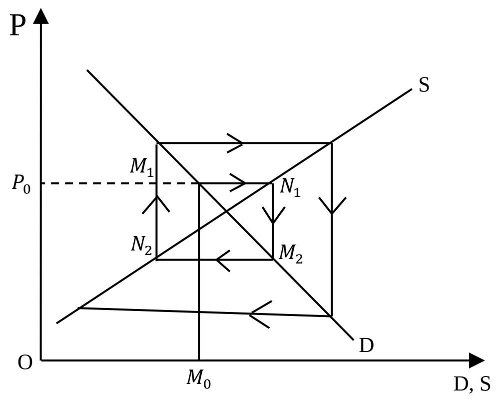
With an ordinary negative demand function and positive supply function, $b < 0$ and $h > 0$. There fore $h/_b < 0$ and the time path will oscillate.

Above discussion we shall get three cases in the following:

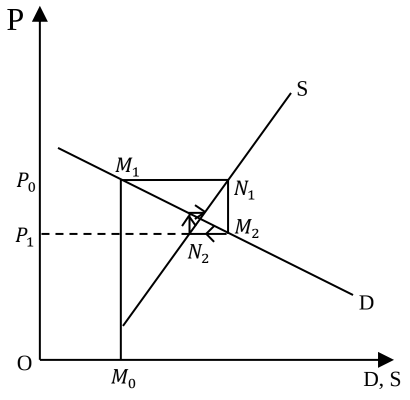
(b) If $|h| = |b|, \left|h/_b\right|$ =and time path oscillates uniformly.



(a) If $|h| > |b|, \left|\frac{h}{b}\right| > 1$ and the time path P_t explodes.



(c) If $|h| < |b|, \left|h/_b\right| < 1$, the time path converges and P_t approaches P_e



In short, for stability the supply curve must be flatter the demand curve.

1.4.22. Static Stability of Equilibrium (both Walrasian and Marshallian case):

1.4.22.1. Walrasian Case: -

If at any price it is seen that the demand for any commodity is greater than the supply of any commodity, the buyers will bid up the price and if supply is greater than demand, the seller will reduce the price.

Let us defined the excess demand for any commodity as being equal to the difference between demand and supply. If E stands for excess demand then by definition

$E = D(P) - S(P)$. Here E is also a function of price. A market is said to be stable in Walrasian sense if excess demand varies inversely with price, i.e.

If $\frac{dE}{dP} < 0 \;\; i.e, \frac{dE}{dP} = D'(P) - S'(P) < 0 \; or, D'(P) < S'(P)$

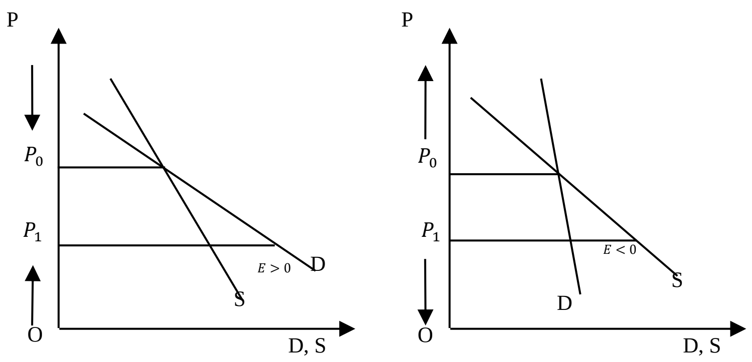
$$or, \qquad \frac{dD}{dP} < \frac{dS}{dP}$$

Let P_0 be the equilibrium price and D_0, S_0 be the equilibrium demand and supply respectively,

$$\therefore \; \frac{P_0}{D_0} \cdot \frac{dD}{dP} < \frac{P_0}{S_0} \cdot \frac{dS}{dP} [\because \; D_0 = S_0 \; in \; epuilibrium]$$

Therefore, the market will be stable in Walrasian sense if the elasticity of demand at the equilibrium point is less than the elasticity of supply at the equilibrium point. In the normal case where the demand curve is downward sloping and the supply curve is upward rising, the elasticity of demand is negative and the elasticity of supply is positive. Hence the market will always be stable. In the normal case $D'(P) < 0$ and $S'(P) > 0$. Hence obviously.

$D'(P) < S'(P)$ and the stability condition is always fulfilled.



STABLE (a) UNSTABLE (b)

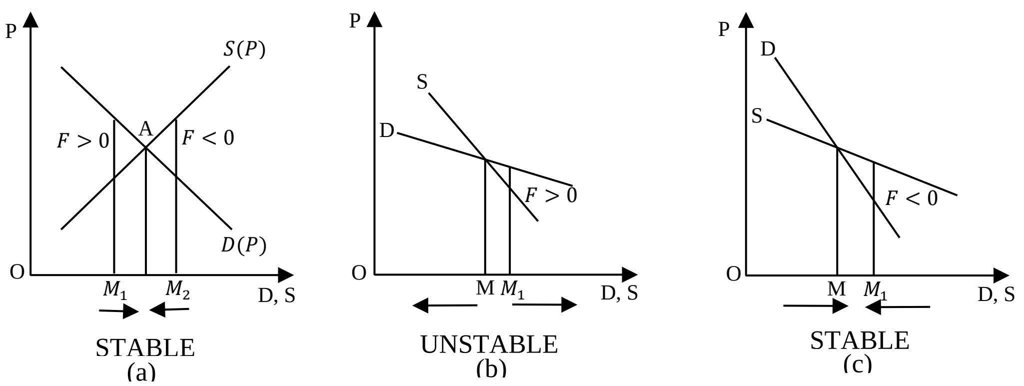
When the supply curve is also downward sloping $D'(P) < 0 \; and \; S'(P) < 0$. Now for stability we require $D'(P) < S'(P)$. It is satisfied when $\left|\frac{dD}{dP}\right| > \left|\frac{dS}{dP}\right| \; i.e$, when $\left|\frac{dP}{dD}\right| < \left|\frac{dP}{dS}\right|$. But $\left|\frac{dP}{dD}\right|$ is the absolute value of the slope of the demand curve and $\left|\frac{dP}{dS}\right|$is the absolute value of the slope of the supply curve. This means that the absolute value of the slope of the demand curve is less than the absolute value of the slope of the supply curve. That is the supply curve is steeper than the demand curve. In figures (a) and (b) as the price falls from P_0 to P_1, excess demand increases from zero to positive in the stable situation but decreases from zero to negative in the unstable situation. Thus in the stable case excess demand varies inversely with price while in the unstable case excess demand varies directly with price.

1.4.22.2. Marshallian Case: -

The sellers will increase the quantity of output if excess demand price is positive and will decrease the quantity of output if excess demand price is negative.

The market will be stable in Marshallian sense if the excess demand price varies inversely with the quantity of output $i.e,$ if $\frac{dp}{dq} < 0$. Consider the normal case where the demand curve is downward sloping and the supply curve is upward rising. In figure (a) as the quantity of output increases from OM_1 to OM, the excess demand price decreases from positive to zero. As the quantity of output increases further to OM_2 the excess demand price decreases further and becomes negative. Hence the equilibrium price A is stable in Marshallian case.

But consider the case where both the demand and supply curves are downward sloping. Here the market will be stable if the demand curve is steeper than the supply curve. In this case (Fig-c) as the quantity of output increases OM to OM_1, the excess demand price decreases from zero to negative. In the unstable case (Fig - b) where the supply curve is steeper than the demand curve, as the quantity of output increases from OM to OM_1 the excess demand price also increases from zero to positive.



Stated mathematically, stability in Marshallian sense requires $\frac{dF}{dq} < 0$ $i.e, \frac{dP^d}{dq} - \frac{dP^s}{dq} <$ 0 $i.e, \frac{dP^d}{dq} < \frac{dP^s}{dq}$

In the normal case when the demand curve is downward sloping and the supply curve is upward rising $\frac{dP^d}{dq} < 0$ and $\frac{dP^s}{dq} > 0$ and the stability condition is always fulfilled.

But when the demand and the supply curve is downward sloping $\frac{dP^d}{dq} < 0$ and $\frac{dP^s}{dq} < 0$. Hence the stability condition will be fulfilled if, $\left|\frac{dP^d}{dq}\right| > \left|\frac{dP^s}{dq}\right|$. But $\frac{dP^d}{dq} = \frac{dP}{dD}$ and $\frac{dP^s}{dq} = \frac{dP}{dS}$.

Hence $\left|\frac{dP}{dD}\right| > \left|\frac{dP}{dS}\right|$ $i.e,$ the absolute value of the slope of the demand curve is greater than the absolute value of the slope of the supply curve. This means that the demand curve is steeper than the supply curve.

Thus, we see that in the normal case where the demand curve is downward sloping and the supply curve is upward rising there is no conflict between the Walrasian and the Marshallian approaches. The market is stable according to both the approaches. But if the supply curve is also downward sloping the two conditions become conflicting. The market cannot be stable according to both the definitions. For stability in the Walrasian sense it is required that the supply curve should be more steep than the demand curve. But stability in the Marshallian sense it is required that the demand curve should be more steep than the supply curve. When both the demand and supply curves are downward sloping Walrasian stability condition requires $\left|\frac{dP}{dD}\right| < \left|\frac{dP}{dS}\right|$ while Marshallian stability condition requires $\left|\frac{dP}{dD}\right| > \left|\frac{dP}{dS}\right|$. Evidently, both these conditions cannot be fulfilled at the same time. Thus if both the demand and the supply curves are downward sloping, then if the market is stable in the Walrasian sense it must be unstable in the Marshallian sense and vice versa.

1.4.22.3. Dynamic Stability: -

Let us consider the condition of dynamic stability in a market where the Walrasian mechanism operates. This means that the price responds to excess demand and supply in the market. It is assumed that the demand and the supply functions are linear. Assumed that the demand function is given by

$$D_i = ap_t + b - - - (1)$$

And the supply function is given by

$$S_i = Ap_t + B - - - (2)$$

Where, a, b, A and B are constants. Let us also assume that if there is an excess demand in the market in any period then in the next period the price rises and the rise in price is proportional to the amount of excess demand. Thus, the change in price in period t over the price in period $(t-1)$ is equal to K times the excess demand in period $(t-1)$ where K is the factor of proportionality. $i.e, P_t - P_{t-1} = KE(P_{t-1}) - - - (3)$ where $E(P_{t-1})$ is excess demand in period $(t-1)$. Now from (1) and (2)we get,

$$D_{t-1} = ap_{t-1} + b \; and \; S_{t-1} = AP_{t-1} + B$$

$$or, \qquad E(P_{t-1}) = D_{t-1} - S_{t-1} = (a-A)P_{t-1} + b - B$$

Now, putting the value of $E(P_{t-1})$ in (3) we get,

$$P_t - P_{t-1} = K[(a-A)P_{t-1} + (b-B)] - - - (4)$$

Equation (4) can be written as follows:

$$P_t - P_{t-1} = K[(a-A)P_{t-1} + (b-B)]$$

$$or, \qquad P_t = P_{t-1} + K[(a-A)P_{t-1} + (b-B)]$$

$$or, \qquad P_t = [P_{t-1}\{1 + K(a-A)\} + K(b-B)]$$

This equation is a first order non homogeneous difference equation in P. the solution of the difference equation gives us the time path of price.

If the equation can be,

$$y_t = by_{t-1} + a$$

The solution will be

$$y_t = \left[y_0 - \frac{a}{1-b}\right] b^t + \frac{a}{1-b} \; when \; b \neq 1$$

$$\therefore \; P_t = \left[P_0 - \frac{a}{1-b}\right] b^t + \frac{a}{1-b} \qquad a = k(b-B), \; b = [1 + k(a-A)]$$

$$P_t = P_0 - \left[\frac{k(b-B)}{1-1-k(a-A)}\right]\{1 + k(a-A)\}^t + \frac{k(b-B)}{1-1-k(a-A)}$$

$$P_t = \left[P_0 - \frac{b-B}{A-a}\right]\{1 + k(a-A)\}^t + \frac{b-B}{A-a} \; --- \; (5)$$

When the model is in equilibrium $P_t = P_{t-1}$ substituting P_e for P_t and P_{t-1}

$$\therefore \; P_t = P_{t-1} = P_e$$

$$P_t = (P_0 - P_e)\{1 - k(a-A)\}^t + P_e$$

$$or, \qquad P_e = P_e[1 + k(a-A)] + k(b-B)$$

$or, \; \cancel{P_e} = \cancel{P_e} + P_e[k(a-A)] + k(b-B)$

$or, \; P_e = -\frac{\cancel{k}(b-B)}{\cancel{k}(a-A)} = \frac{b-B}{A-a}$

If the demand curve is downward sloping and the supply curve is upward rising

$a < 0$ and $A > 0$ so that $(a - A) < 0$. Now if k is sufficiently large then it may happen that $[1 + k(a-A)]$ is negative. If $[1 + k(a-A)]$ is negative the time path of price will be oscillatory.

The time path will be oscillatory but converging if the absolute value of $[1 + k(a-A)]$ is less than unity. But it will be oscillatory and divergent if the absolute value of $[1 + k(a-A)]$ is greater than unity.

It should be noted that static stability depends on the slopes of the demand and supply functions. It depends on the value of a and A only. But dynamic stability depends, in addition on the constant; which may be called the speed of adjustment.

In the same way we can also carry on our dynamic analysis terms of Marshallian stability condition. The same static condition of Marshallian stability can also be obtained from dynamic analysis.

1.4.23. Measurement of the degree of Monopoly Power: -

By monopoly power we mean the amount of discretion (experience) which a producer or seller possesses in regard to the farming of his price and output policy.

Monopoly power indicates the degree of control which a producer or seller possess the price and output to his product. Various measures of monopoly power have been suggested by different economists.

1.4.23.1. Lerner's Measure:

One of the earliest methods to measure monopoly power is expressed by Prof. A. P. Lerner in terms of the bargaining strength. The difference between price and marginal cost is the measure of the degree of monopoly power.

$$D.M.P. = \frac{P - MC}{P}$$

⇒ for pure or perfect competition $P = MC \ \Rightarrow \ D.M.P. = 0$

⇒ when the monopolized product entails no cost of production that is, when the product is a free good where supply is controlled by one person, the marginal cost will be equal to zero.

⇒ Lerner's index of monopoly power $= \frac{P-MC}{P} = \frac{P-0}{P} = 1$

⇒ Lerner's index of monopoly power varies from $0 \ to \ 1$.

Lerner's index of monopoly power is nothing but the inverse of the price elasticity of demand.

$$D.M.P. = \frac{P - MC}{P}$$

For profit maximization, $MC = MR \ \Rightarrow \ D.M.P. = \frac{P-MR}{P}$

$$\left[MR = P\left(1 - \frac{1}{e}\right)\right]\frac{P - MR}{P} = \frac{P - P\left(1 - \frac{1}{e}\right)}{P} = \frac{P\left[1 - \left(1 - \frac{1}{e}\right)\right]}{P}$$

$= 1 - 1 + \frac{1}{e} = \frac{1}{e}$ = inverse of the elasticity of demand.

⇒ More the price elasticity of demand less will be the Lerner's index of monopoly power.

1.4.23.2. Triffin Measure:

Pro. Robert Triffin has improved upon Lerner's measure by suggesting price cross – elasticity instead of price elasticity of demand.

⇒ the smaller the extent of cross elasticity of demand for the product of a firm, the greater the degree of monopoly enjoyed by the firm and vice versa. ⇒ $D.M.P. = \frac{1}{e_c}$

⇒ According to Triffin, the cross elasticity of demand between products of various firms under perfect competition is infinite and therefore firms under perfect competition enjoy no monopoly power at all.

⇒ Pure monopoly having zero cross elasticity of demand enjoys absolute monopoly power.

1.4.23.3. Bain's Measure:
Prof. J. S. Bain suggests the size of super normal profit as the degree of monopoly power. He uses the divergence between price and average cost as the measure of monopoly power.

⇒ Under perfect competition super normal profits are competed away with entry of new firms in the industry. So, the degree of monopoly power is zero when competition is pure.

⇒ It is therefore, under monopoly with no threat of entry of new firms that monopoly profits are the largest and degree of monopoly power is absolute.

⇒ The degree of monopoly power will, however, be small where the treat of new entrants exists.

⇒ Thus, the degree of monopoly power is measured by the size of super normal profit.

1.4.23.4. Rothschild's Measure:
Rothschild's measure the degree of monopoly power as the ratio of the slope of a firm's demand curve to the slope of the industry demand curve.

$$D.M.P = \frac{slope\ of\ firms\ demand\ curve}{slope\ of\ industry\ demand\ curve}$$

⇒ Since under perfect competition the demand curve of a firm is horizontal, the Rothschild index equal to zero.

⇒ Under pure monopoly there being no difference between firm and industry, this index equals unity.

$D.M.P$ exists between zero and unity.

1.4.24. Price Discrimination:
Price discrimination refers to the practice of a seller of selling the same good at different prices to different buyers.

1.4.24.1. Degrees of price Discrimination:
Prof. A. C Pigou has distinguished between the following three types of price discrimination on another ground:

1. Price discrimination of the first degree

2. Price discrimination of the second degree

3. Price discrimination of the third degree

First degree:
Price discrimination of the first degree is said to occur when the monopolist is able to sell each separate unit of the output at a different price. It is also known as 'take it or leave it' price discrimination.

Second degree:
In the price discrimination of the second-degree buyers are divided into different groups and from each group a different price is charged which is the lowest demand price of that group.

Third degree:
Price discrimination of the third degree is said to occur when the seller divides his buyers into two sub-markets or groups and charges a different price in each sub-market. In this case monopolist will receive the entire consumer's surplus.

1.4.24.1a. When is price discrimination possible?
1. The market must be divided into sub-markets with different price elasticities.

2. There must be effective separation of the sub-markets, so that no reselling can take place from a low-price market to a high price market.

1.4.24.1b. Price Discrimination and the Price Elasticity of Demand:
We have, $MR = P\left(1 - \frac{1}{e}\right)$

Is case of price discrimination we have,

$$MR_1 = P_1\left(1 - \frac{1}{e_1}\right)$$

and $MR_2 = P_2\left(1 - \frac{1}{e_2}\right)$; $MR_1 = MR_2$

$$\Rightarrow P_1\left(1 - \frac{1}{e_1}\right) = P_2\left(1 - \frac{1}{e_2}\right)$$

$$or, \quad \frac{P_1}{P_2} = \frac{\left(1 - \frac{1}{e_2}\right)}{\left(1 - \frac{1}{e_1}\right)}$$

$$(i)\ If\ e_1 = e_2 \Rightarrow \frac{P_1}{P_2} = 1 \Rightarrow P_1 = P_2$$

⇒ This means that when elasticities are the same price discrimination is not profitable. The monopolist will charge a uniform price for his product.

(ii) If price elasticities differ price will be higher in the market whose demand is less elastic.

$$P_1\left(1 - \frac{1}{e_1}\right) = P_2\left(1 - \frac{1}{e_2}\right)$$

If $|e_1| > |e_2|$

Then $\left(1 - \frac{1}{e_1}\right) > \left(1 - \frac{1}{e_2}\right)$

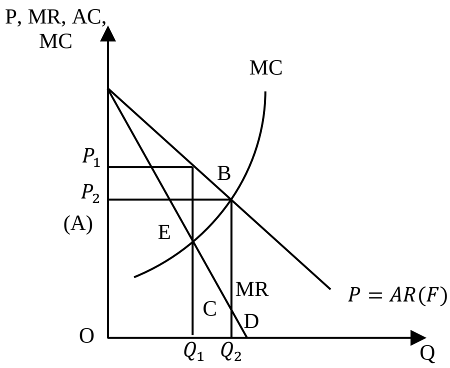
$$\Rightarrow \quad \frac{P_1}{P_2} = \frac{\left(1 - \frac{1}{e_2}\right)}{\left(1 - \frac{1}{e_1}\right)} < 1 \quad \Rightarrow \quad P_1 < P_2$$

⇒ The market with the higher elasticity will have the lower price.

1.4.25. Regulation of Monopoly: -

1) Price Control: -

We know that monopoly equilibrium price-quantity combination can be determined by the necessary condition, $MR = MC$. But government can induce the monopolist to increase the level of output by setting a maximum price at the level where the short run MC curve cuts the $P = AR$ line. This will result a reduction in monopolist profit, lower price with higher output.



Let for the unregulated monopolist, the $P = AR \text{ and } MR$ lines are negatively sloped as usual. Point E represents the equilibrium point where both the necessary $(MC = MR)$ and sufficient (MC cuts MR from below) conditions are fulfilled. Therefore, OP_1 represents the equilibrium price and OQ_1, the equilibrium output level.

Now for a regulated monopolist, the government imposed a maximum price of P_2 which is determined by the point B, the intersection of the price line and MC curve. Therefore, point B is the competitive solution where $P = MC$. For the price control the new demand line of the monopolist will be ABF and ABCD will be the corresponding MR (The thick line). So, the common portion is AB, The perfectly elastic range. A regulated monopolist will behave like a perfectly competitive firm and will operate at the point B.

So, price control means lower price from $P_1 \text{ to } P_2$, higher output from $Q_1 \text{ to } Q_2$ and regulation in total profit. Consumers will be a gainer from the imposition of price control.

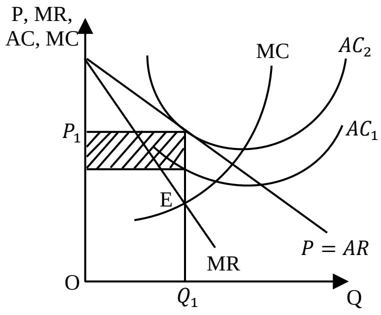
1.4.26. Lump – Sum Tax: -

The government can regulate the monopolist by reducing or by eliminating profit with the help of imposition of lump-sum tax (LST), e.g. license fee or a profit tax.

Since, $LST = T_0 = constant > 0$

So, LST behaves like a fixed cost. Now marginal cost (MC) depends on the variable cost, which means imposition of LST will affect the average cost (AC) only.

From the first order condition of equilibrium:



No change in equilibrium condition means, no change in the equilibrium point or the price quantity combination(Q_1, P_1). MC being unaffected, change in the position of AC from AC_1 *to* AC_2 will represent the reduction in super normal profit. Monopolist will be in break-even finally. Therefore, shifting of the tax-burden is not possible by the producer to the consumer.

1.4.27. Per-Unit Tax:

The government can reduce the monopoly profit by imposing per unit tax (PUT).

Since, $PUT = f(Q)$

Therefore, let $T = t \cdot Q$ where 't' represents the 'tax rate'.

So, PUT behaves like a variable cost.

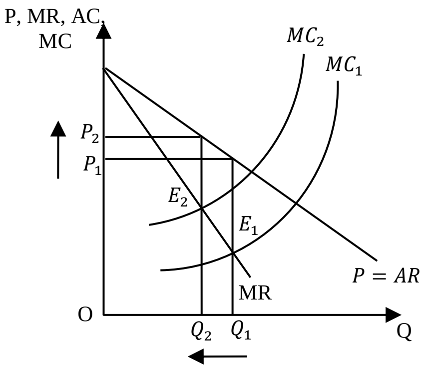
⇒ MC and AC, both the curves will be affected.

Now $\pi = R(Q) - \{C(Q) - t \cdot Q\}$

$\pi = R(Q) - C(Q) - t \cdot Q$

⇒ From the first order condition of equilibrium

⇒ $MR = MC + t$.



So, we have a change in the equilibrium condition. The MC curve will shift in upward direction, price will be higher for lower quantity. Shifting of the tax burden will be possible from producer to consumers, i.e. the consumer will be worse-off.

But in all three cases; the monopolist's per unit and total profit will decline.

1.4.28. Monopolistic Competition:

The concept of monopolistic competition put forth by Chamberlin was a true revolutionary as well as more realistic than either pure competition or pure monopoly. The distinguishing feature of monopolistic competition which makes it as a blending of competition and monopoly is the differentiation of this product. This means that the products of various firms are not homogeneous but different though they are closely related to each other's.

Product differentiation does not mean that the products of various firms are altogether different. They are only slightly different so that they are quite similar and serve as close substitutes of each other.

Assumptions:

The basic assumptions of Chamberlin's large-group model are the same as there of pure competition with the exception of the homogeneous product.

i) There is a large number of sellers and buyers in the 'group'.

ii) The products of the sellers are differentiated, yet they are close substitutes of one another.

iii) There is free entry and exit of firms in the group.

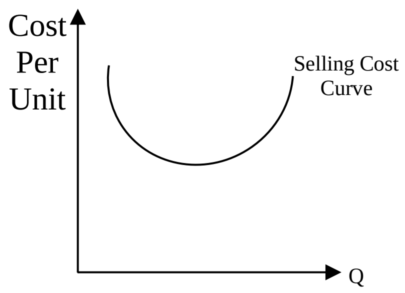
iv) The goal of the firm is profit maximization both in the short-run and the long-run.

v) Prices of factors and technology are given.

vi) The firm is assumed to behave as if it knew its demand and cost curves with certainty.

1.4.29. Cost Curves and Selling Cost: -

Chamberlin, in his model of monopolistic competition has assumed the traditional U-shaped cost curves AC, AVC and MC. In addition he has introduced a new cost, i.e. selling cost. Selling costs are defined as cost incurred in order to alter the position or the shape of the demand curve for a product.



Selling cost include all the expenses that are intended to promote the sales, including cost of advertisement, salesman's salaries, expenses of sales department, margins granted to dealers, wholesalers and retailers, window display and demonstration of new goods.

Chamberlin argues that the selling cost curve is U-shaped.

1.4.30. Oligopoly: -

It is an important form of imperfect competition, where the number of sellers is very few, no less than two and not more than twenty. The simplest form of oligopoly with two sellers is called duopoly. The product, produced and sold in market may be homogeneous or may be differentiated. Therefore,

(i) If the product is 'homogeneous' or perfect substitutes, then it will be called a 'pure oligopoly', e.g., steel, cement, copper etc.

1.4.31. Characteristics of oligopoly:-

(i) Strong interdependence.

(ii) Group behaviour:

In monopoly or monopsony, we have the concept of ‘individual behaviour’.

In perfect competition or monopolistic competition, we have the ‘mass behaviour’.

Theory of oligopoly is a theory of group behaviour, not of individual or mass.

(iii) Selling cost:

Advertisement plays an important role in the oligopoly market.

(iv) Non-price competition:

The firms avoid price-cutting because it will lead to price- war. Customers then will try to buy from that seller, selling at the cheapest price. Such a price war will drive few firms out of the market. Therefore, the firms try to compete on non-price basis.

(v) Indeterminateness of demand line:

Quantity of one firm depends on the rival’s reaction. Since rival’s reaction is indeterminate. Therefore, the demand line is also indeterminate.

(vi) Indeterminate solution:

The demand line represents $P = AR$ line. Since the demand line is indeterminate therefore the MR line is also indeterminate. Therefore equilibrium solution or price-output combination cannot be determinate by the equality of MR and MC.

(vii)Objective of the firm:

Under oligopoly, it has been establishes through empirical surveys that entrepreneurs have many other motives than profit maximization. The non-profit motives are:

(a) Maximization of sales or total revenue

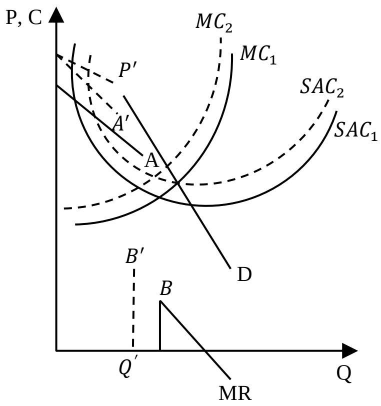
(b) Firms try to maximize their own utility function.

(c) Maintenance of a stable profit over a long period.

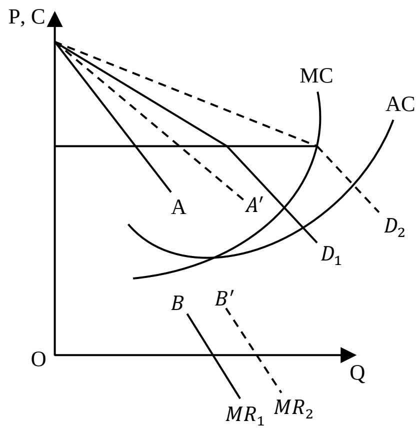
(d) Maintenance of a satisfactory level of performance.

1.4.32. Sweezy Model (Special case)

There is only one case in which a rise in cost will most certainly induce the firm to increase its price when costs rise, despite the fact that the higher costs pass through the discontinuity of the MR curve. This occurs when the rise in costs is general (for example imposition of a sales tax) and affect all firms equally. Under these circumstances the firm will increase its price with the certainty that the others in the industry will follow, since, their costs are similarly affected. The point of the kink shifts upwards to the left, and equilibrium is established at a higher price and a lower output (Fig-1). The firms, via independent action, move closer to the point of joint profit maximization. Furthermore, there is a range through which demand may shift without a change in price although quantity will change. If the demand curve is kinked, a shift in the market demand upwards or downwards will affect the volume of output, but not the level of price, so long as cost passes within the range of the discontinuity of the new MR.



(Fig-1)



(Fig-2)

In this case the shift occurs along the same price line (Fig 2). As the market expands, the firm will not rise its price, because its (given) lost continues to pass through the discontinuity of the new MR curve and hence there is no incentive to change *P,* although output will increase.

Sub Unit-5: Factor Pricing

1.5.1. Factor Pricing Analysis: -

To develop the concept of factor pricing, we need a separate theory due to peculiarity of demand for and supply of the factors. Following points are to be mentioned which are responsible for a separate theory. They are as follows:

1.5.1.1. Derived demand:

The demand for a product is “direct demand” which is directly consumed by the consumer, where as demand for factor are “derived demand”, depends on the demand for the final product. So, they are the intermediate product. If demand for a product gets up, then demand for factor which is responsible for the production of that final product will also go up.

1.5.1.2. Joint demand:

One particular factor cannot produce anything. Therefore the demand for factor is “joint demand” because production is possible by the assistance of all the factors.

1.5.1.3. Factor supply:

Increase in price of a product means some incentive to the producer for more production. But we have some factor, e.g. land where the supply is perfectly inelastic. Hence constant supply for any price

1.5.1.4. Nature of the factor:

The different unit of a product may be homogeneous. But different units of factor are not generally homogeneous, e.g. one important factor like labour can be classified in “skilled” and “unskilled” categories.

1.5.2. Some Key Concepts:

Before presenting the marginal productivity theory of distribution, let us go for terms used in the theory.

1.5.2.1. Marginal Physical Product (MPP):

It represents the change in total production due to a change or an increase in the employment of one factor, say labor (L) by extra one unit, other factor remain constant.

$MPP_L = \frac{\delta Q}{\delta L}$ If, $Q = 3L + L^2$

$$MPP_L = \frac{\delta Q}{\delta L} = 3 + 2\text{L}$$

1.5.2.2. Value of Marginal Physical Product (VMP):

When marginal physical product is expressed in monetary term then we have VMP. If MPP of one factor, say L, is multiplied by price of a product per unit (P_X), then we obtained the monetary value of MPP_L.

$$VMP_L = P_X \cdot MP_L$$

1.5.2.3. Marginal Revenue Product (MRP):
It represents the change in total revenue earned by the producer due to an increase in employment of labour extra one unit. Therefore MRP of labour can be obtained by the multiplication of MR and MPP of labour.

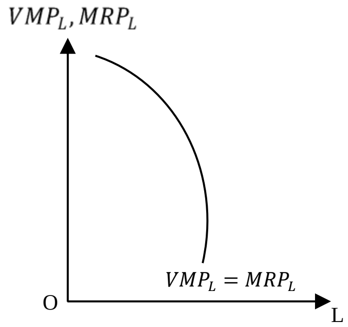
$$MRP_L = MR \cdot MPP_L$$

Two major conclusions can be drawn in this respect:

1. If product market is perfectly competitive:

$\Rightarrow \; P_X = MR_X$

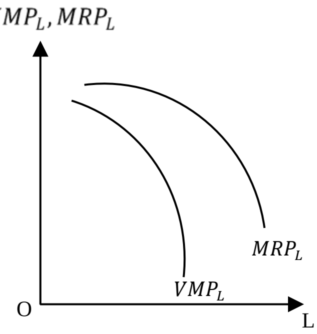
$\Rightarrow P_X \cdot MP_L = MR_X \cdot MP_L \;\; \Rightarrow \; VMP_L = MRP_L$



2. If product market is imperfectly competitive:

$\Rightarrow \; P_X > MR_X$

$\Rightarrow \; P_X \cdot MP_L > MR_X \cdot MP_L \; \Rightarrow \; VMP_L > MRP_L$



1.5.3. Marginal Productivity Theory of Distribution:

Propositions:

(i) Each input is paid according to its marginal productivity

$$[MP_L = w, MP_K = r \;\; etc]$$

(ii) Total product is exhausted when each factor is paid according to its marginal productivity.

$$[Q = MP_L \cdot L + MP_K \cdot K]$$

Assumptions:
(i) Perfect competition prevails in the factor market, i.e. $W = AW = MW$. Thus the wage line is parallel to the labour axis.

(ii) The factor (say labour) is homogeneous and divisible.

(iii) The factor is perfectly mobile and substitution between L and K is possible.

(iv) The basic objective is profit maximization.

(v) Full employment prevails in the factor market.

(vi) The 'Law of Variable Proportion' is an operation, by which substitution is possible.

(vii) The operation of the law of diminishing marginal returns which means consequent fall in the MP_L with the increase in the employment of labour.

(viii) The product market is perfectly competitive, i.e. $P = AR = MR$ is a horizontal line.

1.5.4. Factor Pricing under Perfect Competition: [Product market is perfectly competitive and factor market is perfectly competitive]

The profit equation can be written as: $\pi = TR - TC = \bar{P}Q - WL$

1. Necessary Condition: $VMP_L = W$

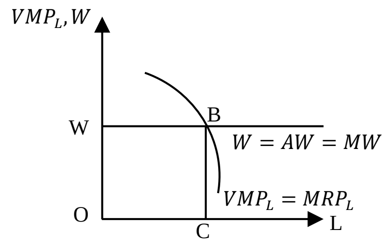
The firm employs each factor up to that number where its price is equal to VMP_L. It is to be noted that, when product market is perfectly competitive, then,

$$P_X = MR_X$$

$$\Rightarrow P_X \cdot MP_L = MR_X \cdot MP_L$$

$$\Rightarrow VMP_L = MRP_L$$

Hence, a single curve will represent the VMP_L as well as MRP_L curve. By assumption (i) wage line is horizontal, $W = AW = MW$. Therefore, the interaction between W line and VMP_L or MRP_L curve will represent the equilibrium point.



2. Sufficient Condition:

Slope of $VMP_L < 0$

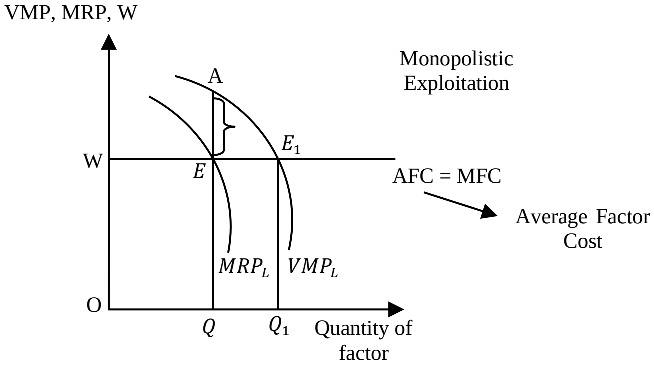
⇒ At equilibrium the VMP_L curve must be negatively sloped. So, by diagram point B will be equilibrium point, where, $W = AW = MW = VMP_L = MRP_L$.

⇒ OW will be the going wage rate and producer will employ OC unit of labour at that rate. It is to be noted that, if the MP theory is applied, then each unit of labour of production receives just what its marginal unit contributes to the total product. Hence, there is no 'exploitation' of any factor. It is therefore claimed that this theory always represents the 'social justice'.

1.5.5. Factor Pricing Under Imperfect Competition:

1.5.5.1. Factor Market Perfectly Competitive and Product Market and product Market Imperfectly Competitive or Monopolistic:

In a perfectly competitive factor market, the price of the factor service is given for the firm and does not affect the volume of its purchases. The supply curve or the cost curve is horizontal to the x-axis ($AFC = MFC$). But because of there is imperfect or monopoly in the product market, the MRP curve will lie below the VMP curve. Since we know that under imperfect competition or monopoly in the product market marginal revenue is less than the price (AR) of the product, therefore the MRP will be less than the value of marginal product (VMP).



Symbolically,

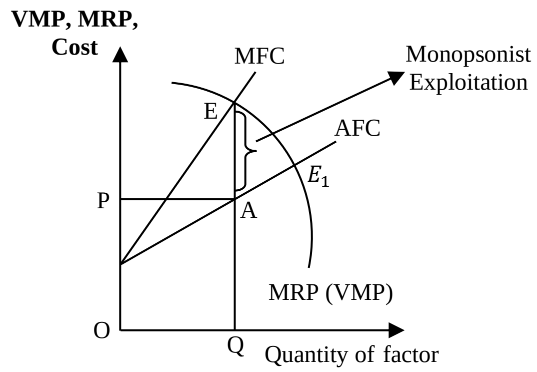
$MRP < VMP$

$\because MR < P$ (Under imperfect competition both AR and MR curves slopes downward)

The firm will be equilibrium where MRP equals MFC, the price of the factor under perfect competition. This is shown in figure by point E where the firm employs OQ units of factors service at OW wage. Hence the MRP of employing OQ units is QE which is less than QA the value of its marginal product. Thus the factor service gets less that the value of its marginal product by EA amount. This means that when the firms have monopolistic power the factor is said its MRP which is smaller than the VMP. This effect has been called 'monopolistic exploitation' by Joan Robinson.

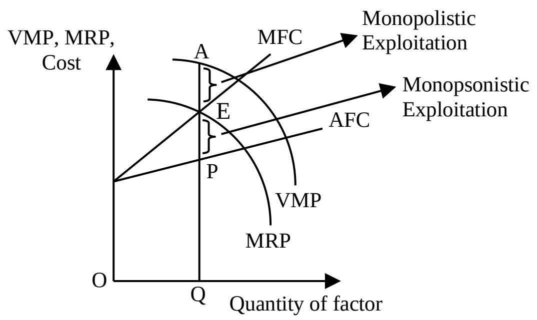
1.5.5.2. Monopsony in the Factor Market and Perfect Competition in the Product Market:

A monopsonist firm is a single buyer of a particular factor in the market. Since the firm is the market for the factor in this case, the supply of factor service to the monopsonist is identical to its supply to the market. Thus the supply curve to the firm (AFC) is positively sloping from left to right upward. The firm can employ more units of the factor service by offering a higher price per unit. The MFC curve to this AFC curve will also be sloping upward and will be above the AFC curve throughout its length.



The firm is in equilibrium at point E in figure where the MRP curve cuts and the MFC curve from above and equals it at that point. The firm employs OQ units of the factor services by paying OP (QA) price for them. In this case, there is monopsonistic exploitation of the factor because the factor service is being paid less than its marginal revenue product. For OQ units the factor is being paid QA (=OP) price whereas its marginal revenue product is QE. The difference between the MRP and the price paid to the factor is $AE(QE - QA)$ which measures monopsonistic exploitation per unit of the factor employed.

1.5.5.3. Monopsony in the Factor Market and Monopoly in the Product Market:
When there is monopsony in the factor market and monopoly in the product market, $MRP < VMP \text{ and } MFC > AFC$. This implies that the MRP curve will lie below the VMP curve and MFC curve will lie above the AFC curve as shown in figure.



As usual the firm is in equilibrium at point E where the MRP curve cuts MFC curve from above and equals it. The firm employs OQ units of the factor service at QP price which is less than QE the marginal revenue product of the factor. Thus due to its monopsonistic position in the factor market, the firm exploits the factor units used to the extent of $PE(QE - Qp)$.OW the other hand, due to its monopolistic position in the product market, the MRP of the factor is less than its VMP and the firm exploits the factor units employed further to the extent of EA amount.

We may conclude that in the case of monopsony in the factor market and monopoly in the product market, the factor used in production by the firm is doubly exploited: first, due to the excess of MRP over the price of the factor, and second, due to the excess of the VMP over the MRP of the factor.

1.5.6. The 'ADDING-UP' Problem: Product Exhaustion Theorem:
As soon as it was propounded that the factor of production are paid equal to their marginal products, a perplexing problem cropped up over which there was a serious debate, among the famous economists at that time. The perplexing problem which was posed was that if all factors were paid rewards equal to their marginal products, would the total product be just exactly exhausted? In other words, if each factor is rewarded equal to its marginal product, the total product should be disposed of without any surplus or deficit. The problem of providing that the total product will be just exhausted if all factors are paid rewards equal to their marginal product Exhaustion problem.

1.5.7. Wicksteed's Solution of Product Exhaustion Problem:
Philip Wicksteed was one of the first economists who posed this problem and provided a solution for it. Wicksteed applied a mathematical proposition called 'Euler's Theorem' to prove

that the total product will be just exhausted if all the factors are paid equal to their marginal products.

It follows therefore that if production function is homogeneous of the first degree (i.e. where there are constant returns to scale) then, according 'Euler's Theorem', if the various factors, L and K are paid rewards equal to their marginal products, the total products will be just exhausted, with no surplus or deficit.

1.5.8. Wicksell, Walras and Barone's Solution of Product Exhaustion Theorem:

After Wicksteed, Wicksell, Walras, Barone, each independently, advanced more satisfactory solution to the problem that marginally determined factor rewards would just exhaust the total product. These authors assumed that the typical production function was not homogenous of the first degree, but was such that yielded U-shaped long-run average cost curve. They pointed out that in the long run under perfect competition; the firm was in equilibrium at the minimum point of the LAC curve. At the minimum point of the LAC curve, the returns to scale are monetarily constant, that is returns to scale are constant within the range of small variations of output. Thus the condition required for the marginally determined rewards to exhaust the product, that is, the operation of constant returns to scale, was fulfilled at the minimum point of the LAC curve, where a perfectly competitive firm is in long-run equilibrium. Thus in the case of perfectly long-run equilibrium if the factors are paid rewards equal to their marginal products, the total product would be just exactly exhausted.

Sub Unit – 6: Welfare Economics

The literature on welfare economics has grown rapidly in recent years. Vilfredo Pareto considered the question of maximising social welfare on the basis of general optimum conditions. Marshall and Pigou, the neo-classical economists, concentrated on particular sectors of the economic system in their postulates of welfare economics. It was Prof. Robbin's ethical neutrality view about economics that led to the development of welfare economics as an important field of economic studies. Kaldor, Hicks and Scitovsky have laid the foundations of the New welfare Economics with the help of the "compensations principle' avoiding all value judgements. On the other hand, Bargson, Samuelson and others have developed the concept of the Social Welfare Function without sacrificing value judgements.

Welfare economics has been defined by Scitovsky as "welfare economics is that branch of economic analysis which is concerned primarily with establishment of criteria that can provide a positive basis for adopting policies which are likely to maximise social welfare." In short, welfare economics is to prescribe criteria or norms with which to judge the desirability of certain economic re-organizations and prescribe policies on that basis.

1.6.1. Positive Economics and Welfare Economics

Welfare economics is a normative study. Hence it is important to know the difference between positive economics and normative economics. Positive economics is concerned with explaining what is, that is, it describes theories and laws to explain observed economic phenomena, whereas normative economics is concerned with what should be or what ought to be the things.

In positive macro-economics, we are broadly concerned with explaining the determination of relative prices and the allocation of resources between different commodities. In positive macro-economics we are broadly concerned with how the level of national income and employment, aggregate consumption and investment and the general level of prices are determined. In these parts of positive economics, what should be the prices, what should be the saving rate, what should be the allocation of resources, and what should be the distribution of income are not discussed. These questions of, what should be and what ought to be, fall within the purview of normative economics. Thus, given the profit maximisation assumption, positive economics states that monopolist will fix a price which will equate marginal cost with marginal revenue. The question what price should or ought to be fixed so that maximum social welfare is achieved lies outside the purview of positive economics. Similarly, given the monopsony in the labour market, positive economics explains what actual wage rate is determined. It does not go into the question how wage rate should be paid to the labourer so that they should not be exploited. Likewise, how national income between different individuals is distributed falls within the domain of positive economics. But positive economics is not concerned with the question of how income should be distributed. On the other hand, normative economics is concerned with describing what should be the things. It is therefore, also called prescriptive economics. What price for a product should be fixed, what wage rate should be paid, how income should be distributed, etc., fall within the purview of normative economics.

It should be noted that normative economics involves value judgements or what are simply known as values. By value judgements or values, is meant the conceptions of the people about what is good or bad. These conceptions regarding values of the people are based on the ethical, political, philosophical and religious beliefs of the people and are not based upon any scientific logic or law. Because normative economics involves value judgements, eminent economist Prof. Robbins contended that economics should not become normative in character.

Value judgements of various individuals differ and their Tightness or wrongness cannot be decided on the basis of scientific logic or laws. Therefore, in our view, positive economics should be kept separate and distinct from normative economics. However, because normative economics involves value judgements, it does not mean that it should be considered as useless or not meaningful and should not be the concern of economics. As a matter of fact, many vital issues concerning economic welfare of the society necessarily involve some value judgements.

From the above it seems that difference between positive and welfare economics is quite clear, in one case what a man does without considering the favourable or unfavourable effects on others while in the other it is what he should do and must consider the favourable or unfavourable effects on others.

1.6.2. Neo-Classical Welfare Economics

Neo-Classical economists Marshall, Pigou, Cannon and his followers considered economics as a normative science. Marshall formulated the concepts of 'Consumer's Surplus' and 'National Dividend' in his 'Principles of Economics' published in 1890. These concepts became the basis of old welfare economics.

1.6.2.1. Pigovian Welfare Economics

A.C. Pigou is another important neo-classical economist who laid the scientific foundation of welfare economics through the publication of 'Economics of Welfare' in 1932. Welfare is a mental phenomenon and 'the elements of welfare are the states of consciousness' which is made of utilities or satisfaction of human wants. Pigou also differentiated economic welfare from general (social) welfare. The former is a part of the latter. General welfare depends on a large number of economic and non-economic variables. Economics welfare alone is the subject matter of economics. Pigou limited the scope of welfare economics to economic welfare because general (or social) welfare is a very and complex term.

Pigovian welfare economics is related to the satisfaction derived from the use of exchangeable goods and services. Pigovian welfare economics is based on the following assumption:

A. Every individual attempt to maximise his satisfaction from the use of limited monetary resources.

B. Satisfaction derived from the consumption of goods and services can be compared interpersonally and intrapersonally.
C. Marginal utility of money income decreases with every increase in it which implies that the marginal utility of a unit of money to the poor is greater than that of the rich.

1.6.2.2. Pigou's Dual Criterion of Welfare

Pigou formulated dual criterian to maximise welfare on the basis of the above assumptions. They are:

1. An increase in national income brought about either by increasing some goods without reducing the others or by transferring factors from less productive to more productive activities increase economic welfare.

2. Any reorganization of the economy, which increases the purchasing power of the poor without reducing the national income increases social welfare.

In this way Pigou explicity brought the conditions of maximization of welfare. The first condition states that given the tastes and income distribution, the level of social welfare increases with any increase in national income. Second condition states that given the constant level of national income, the transfer of purchasing power from the rich to the poor will also increase economic welfare.

1.6.2.3. A Critique of Neo-Classical Welfare Economics

Neo-Classical economists particularly Marshall and Pigou made significant contribution to the development of welfare economics by giving the concept of consumer's surplus and economic surplus. Pigou also discussed the various types of externalities, which are great obstacles in the achievement of maximum welfare, in his 'Economics of Welfare'. But neo-classical welfare economics is bases on the unrealistic assumption of cardinal utilities which can be compared interpersonally and intrapersonally.

Secondly, national income is not an appropriate measure of social welfare because it is the product of real outputs and their prices. Therefore, it is possible, that national income increases only due to rise in price level without any increase in the quantity and quality of goods and services. Thirdly, Dr. Graff is of the opinion that money is not an appropriate and satisfactory measure of economic welfare because the value of money changes with variation in price level and welfare does not depend only on exchangeable goods and services. Fourthly, Pigou's 'man's equal capacity for satisfaction' assumption is based on an ethical rather than a scientific principle.

1.6.3. Analysis of Externalities or Divergences Between Private and Social Costs and Returns

Divergences between private and social costs and returns (benefits) are known as externalities. Externalities are, in fact, market imperfections where the market offers no price for service or disservice. These externalities lead to misallocation of resources and cause production or consumption to fall short of an optimum level. Thus they do not lead to maximum social welfare, Pigou's major contribution lies in studying the main causes leading to divergences between private and social costs and returns and in suggesting measures for removing these divergences.

1.6.3.1. External Economies of Production

When some firm renders a benefit or cost of a service to other firms without appropriating to itself all the benefit or cost of the service, it is an external economy. External economies (or diseconomies) therefore reflect non-market interdependence. The act of producing a good on the part of one firm may either benefit or impose costs on other firms without passing through the market process. In other words, the benefit or cost is not market process. Hence external economies involve non-market interdependence.

External economies of production may also arise when the expansion of a firm makes it possible for other firms in the industry to obtain their inputs at low cost. In all such cases, social marginal benefits exceed the private marginal benefits and the private costs exceed the social costs. For the expanding firms does not receive any remuneration for the costs incurred by it and the benefits which it has conferred on others.

1.6.3.2. External Diseconomies of Production

External diseconomies of production also lead to divergence between private and social costs and returns when the production of a commodity or service by a firm affects adversely other firms in the industry. Professor Pigou's example of air pollution explains these divergences. Suppose a factory is situated in a residential or populated area and emits smoke. The smoke from the factory soils clothes, household articles, buildings and damages the health of the inhabitants of the area. As a result, the maintenance costs of the inhabitants increase in the form of increased expenses on washing clothes, cleaning of household articles and rooms, and cleaning and painting of building and enhanced medical expenses. These are social costs for which the factory does not compensate inhabitants of the area and in a sense benefits itself. The private costs are thus less than the social costs, and the private benefits to the factory are higher than the social benefits because the factory-owner escapes costs incurred by the inhabitants of the area and thereby gets private benefits.

1.6.3.3. External Economies of Consumption

External economies of consumption arise from non-market interdependences of the satisfactions enjoyed by different consumers. An increase in the consumption of a good or service which affects favourably the consumption patterns and desires of other consumers is an external economy of consumption. When an individual installs a TV set, the satisfaction of his neighbours increases when they and their children view the various programmes. This is a case of external economy in consumption in which social benefit and cost, because the TV-owners does not receive any money in return as the neighbours are not asked to pay anything for seeing TV programmes.

1.6.3.4. External Diseconomies of Consumption

When the consumption of a good or service by one consumer confers a disadvantage or effects adversely the consumption patterns and desires of other consumers, it is an external diseconomy of consumption. Diseconomies of consumption especially arise in the case of dress fashions and articles of conspicuous consumption. When a rich lady in a particular locality adopts a new style of dress, it leads to the discarding of clothes already in use not only by her but by other women who emulate her. This results in higher social costs and lower social benefits than private costs and benefits. Individuals who are not in a position to emulate the consumption patterns of their rich neighbours feel dissatisfied and jealous. As a result, their productive efficiency falls and serious divergences emerge between social and private costs and returns. Other instances are of noise nuisance from loud-speakers.

Conclusion, we may conclude the discussion in the words of Prof. Baumol, "External economies and diseconomies can lead to a misallocation of resources even in the world of perfect competition. Too much may be produced by in industries in which external diseconomies prevail, while there may be a less than optional output of commodities whose production involves external economies. In principle it is even possible that, where there are external diseconomies, the presence of monopolies can lead to output smaller and therefore more nearly optimal than those which would result from competition."

1.6.4. The Case of Public Goods

Another cause of divergences between private and social costs, and private and social benefits is the case of public goods which Pigou completely ignored. According to Samuelson, 'each individual's consumption of such a good (public good) leads to no subtractions from any other individual's consumption of that good, every individual benefit from public goods. But divergences arise when one individual arrange for a public good he confers a benefit on some other individuals and thereby creates a social benefit that is higher than his own private benefit. When a person manages a municipal street light in from of his house through his personal efforts all the residents of the locality benefit from it. The social benefit far exceeds his own benefit.

Remedial Measures

To bring about the equality of private and social costs and benefits, Pigou favoured state, interference rather than self-interest. He, therefore, suggested the use of taxes, subsidies and other social control measures to close the gap between private and social costs and benefits arising from externalities in production and consumption.

1.6.5. Conditions of Pareto Optimality

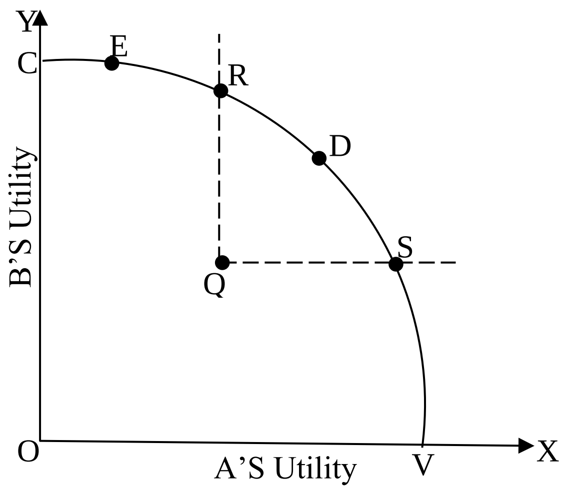
Neo-classicals and earlier economists defined social welfare as a sum total of cardinally measurable utilities of different members of the society. An optimum allocation of resources was one which maximized the social welfare in this sense. Pareto was the first to part with this traditional approach to social welfare in two important respects. First, he rejected the notion of cardinal utility and its additive nature and, second, he detached welfare economies from the interpersonal comparisons of utilities. Pareto's concept of maximum social welfare which is based upon ordinal utility and is also free from value judgements occupies a significant place in modern welfare economists. Pareto optimum may not be sufficient condition for attaining maximum social welfare but it is a necessary condition for it. Pareto optimum (often called Economic Efficiency) is a position from which it is impossible to make anyone better off without making someone worse off by any reallocation of resources of inputs and outputs. Thus, in the Pareto optimum position the welfare of an individual of the society cannot be increased without decreasing the welfare of another member.

1.6.5.1. Pareto Criterion

This criterion refers to economic efficiency which can be objectively measured. It is called pareto criterion after famous Italian economist Vilfredo Pareto. According to this criterion any change that makes at least one individual better-off and on one worse-off is an improvement in social welfare. Conversely, a change that makes no one better-off and at least one worse-off is a decrease in social welfare.

The criterion can be stated in a somewhat different way: a situation which it is impossible to make anyone better-off without making someone worse-off is said to be Pareto-optimal or Pareto efficient.

Pareto criterion can be explained with the help of Samuelson's utility possibility curve. Utility possibility curve is the locus of the various combinations of utilities obtained by two persons from the consumption of a particular bundle of goods.



In above figure, CV is a utility possibility curve which shows the various levels of utilities obtained by two individuals A and B of the society resulting from the redistribution of a fixed bundle of goods and its consumption by them. According to Pareto criterion, a movement from Q to R, or Q to D, or Q to S represents the increase in social welfare because in such movements the utility of either A or B or both increases. A movement form Q to R implies that the utility or welfare of B increases, while that of A remains the same. On the other hand, a movement from Q to S implies that while A has become better off, B is no worse off. And a movement from Q to D or any other point on the segment between R and S will, mean increase in welfare or utility of both the individuals. Thus points R, D and S are preferable to Q from point of view of social welfare. But unfortunately, Pareto criterion does not help us in evaluating the changes in welfare if the movement as a result of redistribution is from the point Q to a point outside the segment RS, such as point E on the utility possibility curve CV. As a result of the movement from point Q to E, the utility of A decreases while that of B increases. In such circumstances, Pareto criterion cannot tell us as to whether social welfare increases or decreases.

1.6.5.2. Marginal Conditions of Pareto Optimum

Pareto concluded from his criterion that competition leads the society to an optimum position but he had not given any mathematical proof, of it, nor he had derived the marginal conditions to be fulfilled to achieve the optimum position. Later on, Lerner and Hicks derived the marginal conditions which must be fulfilled for the attainment of Pareto optimum. These marginal conditions are based on the following important assumptions:

1. Each individual has his own ordinal utility function and possesses a definite amount of each product and factor.
2. Production function of every firm and the state of technology is given and remains constant.
3. Goods are perfectly divisible.
4. A producer tries to produce a given output with the least cost combination of factors.
5. Every individual wants to maximise his satisfaction.
6. Every individual purchases some quantity of all goods.
7. All factors of production are perfectly mobile. Given the above assumptions various marginal conditions (first order conditions) required for the achievements of Pareto optimum or maximum social welfare are explained below:

1. The Optimum Distribution of Products amount the Consumers: Efficiency in Exchange.

The first condition relates to the optimum distribution of the goods among the different consumer composing a society at -a particular point of time. The condition says, "The marginal rate of substitution between any two goods must be the same for every individual who consumes them both."

Thus,

$$MRS_{x,y}^{A} = MRS_{x,y}^{B}$$

2. The Optimum Allocation of Factors

The second condition for Pareto optimum requires that the available factors of production should be utilized in the production of different goods in such manner that it is impossible to increase the output of one good without a decrease in the output of another or to increases the output of both the goods by any reallocation of factors of production. This situation would be achieved if "The marginal technical rate of substitution (MRTS) between any pair of factors must be the same for any two firms using both to produce the same product."

Thus,

$$MRTS_{L,K}^{x} = MRTS_{L,K}^{y}$$

3. The Optimum Direction of Production
The third condition relates to the technical conditions of production and the state of consumer's preferences. The fulfilment of this condition determines the optimum quantities of different commodities to be produced with given factor endowments. This condition states that "the marginal rate of substitution between any pair of products for any person consuming both must be the same as the marginal rate of transformation (for the community) between them."
Thus,
$MRPT_{x,y} = MRS^A_{x,y} = MRS^B_{x,y}$
According to the condition, for the attainment of maximum social welfare goods should be produced in accordance with consumer's preferences.

In summary. A pareto-optional state in the economy can be attained if the following three marginal conditions are fulfilled:
1. The $MRS_{x,y}$ between any two goods be equal for all consumers.
2. The $MRTS_{L,K}$ between any two inputs be equal in the production of all commodities.
3. The $MRPT_{x,y}$ be equal to the $MRS_{x,y}$ for any two goods.

A situation may be Pareto-optional without maximizing social welfare. However, welfare maximization is attained only at a situation that is Pareto-optimal. In other words, Pareto optimality is a necessary but not sufficient condition for welfare maximization. All points on the PPC are Pareto-optimal.

The Second-Order and Total Conditions
The marginal or the first order conditions explained above are 'necessary' but not sufficient for the attainment of maximum social welfare because the marginal conditions by themselves do not guarantee maximum welfare, for the marginal conditions can be fulfilled even at the level of minimum welfare. To attain the maximum welfare position second-order conditions together with the marginal conditions must be satisfied. The second order conditions require that all indifference curves are convex to the original and all transformation curves concave to it in the neighbourhood of any portion where marginal conditions are satisfied.

But even the satisfaction of both (first and second order conditions) does not ensure the largest maximum welfare because even marginal conditions are fulfilled, it may still be possible to move to a position where social welfare is greater. To attain the maximum social welfare, another set of conditions which are called by Hicks as the 'total conditions' must also be satisfied. The total conditions state, "that if welfare is to be a maximum, it must be impossible to increase welfare by producing product not otherwise produced or by using a factor not otherwise used." If it is possible to increase welfare by such activities the optimum position is not determined by marginal conditions alone.

Therefore, welfare will be really maximum if the marginal as well as total conditions are satisfied. But such a social optimum too is not a unique one. It is one of a large number of optima. The whole analysis of conditions of Pareto optimality assumes a given distribution of income. With a change in the distribution of income Pareto optimality will be achieved with different output-mix of various products and different allocation of various factors among products. Thus, a new optimum will emerge due to redistribution of income and there are no criteria to judge whether the new optimum is better or worse than the previous social optimum. For this can be known with the help of some value Judgements regarding income distribution which has been ruled out by the Pareto criterian.

Its Criticism Pareto Criterion and the concept of Pareto optimality or maximum social welfare based on a occupies a significant place in welfare economics. To Judge the efficiency of an economic system, the notion of Pareto optimality has been used to bring out the gains of trading or exchange of goods between individuals. But even Pareto criterion which rules out comparing those changes in policies which make some worse off has been a subject of controversy and has been criticized on several grounds.

1. There can be an infinite number of Paretian optima, each with a different level of welfare.
2. The Pareto criterion is not completely free from value Judgements.
3. An important limitation of Pareto criterion is that it cannot be applied to Judge the social desirability of those policy proposals which benefit some and harm others.
4. A chief drawback of Pareto-optimality analysis is that it accepts the prevailing income distribution and no attempt is made to find an optimal distribution of income, since it is thought that there does not exist any objective, value-free and scientific way of finding optimal distribution of income. Thus, Pareto optimality analysis remains either silent or biased in favour of status quo on the issue of income distribution.

1.6.6. Perfect Competition and Pareto Optimality

All the marginal conditions of attaining Pareto optimality are fully satisfied under perfect competition. Now we shall show how perfect competition satisfies all the marginal conditions required for the achievement of Pareto optimum. Perfect Competition And Optimal Distribution of Goods or Efficiency in Exchange.

The condition for Pareto optimality with regard to the distribution of goods among consumers requires that the marginal rate of substitution (MRS) between any two goods, say X and Y, must be the same for any pair of consumers. Let A and B be the two consumers between whom two goods X and Y are to be distributed. Under perfect competition prices of all goods are given and same for every consumer. It is also assumed that, consumers try to maximize their satisfaction subject to their budget constraint. Now, given the price of two goods, consumer A will maximize his satisfaction when he is buying the two goods X and Y in such amounts that:

$MRS^{A}_{x,y} = \frac{P_x}{P_y}$ ----------------- (i)

Likewise, the consumer B will also be in equilibrium when is he is purchasing and consuming the two goods X and Y in such amounts that:

$MRS^{B}_{x,y} = \frac{P_x}{P_y}$ ----------------- (ii)

Since this is essential condition of perfect competition that price of good are the same or uniform for all consumers, the price ratio of the two goods $\left(\frac{P_x}{P_y}\right)$ in equations (i) and (ii) above will be the same for consumers A and B. Thus, under perfect competition,

$MRS^{A}_{x,y} = MRS^{B}_{x,y}$

Perfect Competition and Optimal Allocation of Factors

The second marginal condition for Pareto optimality relates to the optimal allocation of factors in the production of various goods. This condition requires that for the optimal allocation of factors marginal rate of technical substitution (MRTS) between any two factors must be the same for all producers. This condition is also satisfied by perfect competition. For a producer working under perfect competition prices of factors he employs are given and constant and he is in equilibrium at the combination of factors where the given isoquant is tangent to an iso-cost line. As is well known, the slope of the isoquant represents marginal rate of technical substitution between the two factors and the slope of the iso-cost line measures the ratio of the prices of two factors. Thus, under perfect competition, a cost minimizing producer A will equate MRTS between labour and capital with the price ratio of these two factors. Thus, under perfect competition:

$MRST^{A}_{L,K} = \frac{P_L}{P_K}$ ----------------- (i)

Where P_L *and* P_K are the prices of labour and capital respectively and $MRTS^{A}_{L,K}$ is the marginal rate of technical substitution between labour and capital of producer A. Similarly, producer B working under perfect competition will also equate his marginal rate of technical substitution between the two factors with their preice ratio. Thus,

$MRTS^{B}_{L,K} = \frac{P_L}{P_K}$ --------------------- (ii)

Since under perfect competition $\frac{P_L}{P_K}$ will be the same for all the producers. Therefore

$MRST^{A}_{L,K} = MRTS^{B}_{L,K}$

Perfect Competition and Optimum Direction (i.e., Composition) of Production: General Economic Efficiency

This condition states that marginal rate of substitution between any two commodities for any consumer should be the same as the marginal rate of transformation for the community between these two commodities.

Under conditions of perfect competition, each firm to be in equilibrium produces so much output of a commodity that its marginal cost is equal to the price of the commodity. Thus, for firm in perfect competition.

$MC_x = P_x \text{ } and \text{ } MC_y = P_y$

Where MC_x *and* MC_y are marginal costs of productions of commodities X and Y respectively and P_x *and* P_y are prices of commodities X and Y. Therefor, it follows that firms in perfect competition will be in equilibrium when they are producing commodities in such quantities that

$\frac{MC_x}{MC_y} = \frac{P_x}{P_y}$

The ration of marginal costs of two commodities represents the marginal rate of transformation between them. Therefore, for each producing firm in perfect competition:

$MRT_{xy} = \frac{MC_x}{MC_y} = \frac{P_x}{P_y}$ ------------------ (i)

Where there prevails perfect competition on the buying side, each consumer maximises his satisfaction and is in equilibrium at the point where the given price line is tangent to his indifference curve. In other words, each consumer is in equilibrium where;

$MRS_{xy} = \frac{P_x}{P_y}$ ------------------- (ii)

Since, under perfect competition, the ratio of prices of two commodities $\left(\frac{P_x}{P_y}\right)$ is the same for a consumer and a producer it follows from (i) and (ii) above that

$MRS_{xy} = MRT_{xy}$

We thus see that all first order marginal conditions required for the attainment of Pareto-optimality or maximum social welfare are fulfilled under perfect competition. It is in this sense that perfect competition represents economic optimum from the viewpoint of social welfare.

Perfect Competition does not always ensure Pareto Optimality
Perfect competition does not guarantee that second order conditions required for the achievement of Pareto optimality will also be fulfilled. Besides, when externalities, that is, external economies and diseconomies in production and consumption are present, perfect competition will not lead to Pareto optimality.

Further, even if the above two factors, namely, non-fulfilment of the second order conditions and the existence of externalities are not actually found, the perfect competition will not lead to economic efficiency or Pareto optimality if the given distribution of income is not optimal from the viewpoint of social welfare.

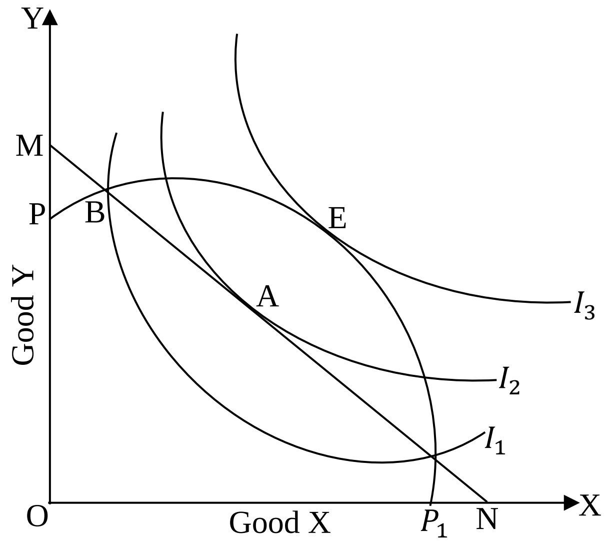
Finally, there is another factor which prevents the achievement of Pareto-optimality or maximum social welfare even when perfect competition prevails in the economy. This factor relates to the employment or utilization of available resources. Pareto optimality will not be attained if the available resources are not fully employed or utilized.

It follows from above that perfect competition though a necessary condition is not a sufficient condition for Pareto-optimality. Therefore, that a free enterprise economy characterized by perfect competition ensures efficient allocation of resources or maximum social welfare cannot be accepted without some qualifications. And these qualifications are:
1. the second order conditions are satisfied,
2. the externalities in production and consumption are absent,
3. prevailing distribution of income is optimal from the social point of view, and
4. available resources are fully employed.

1.6.7. Obstacles to the Attainment of Pareto Optimality or Maximum Social Welfare
We have explained above the conditions for the attainment of Pareto optimality or maximum social welfare. We have also briefly discussed above that with some qualification perfect competition ensures the achievement of Pareto optimality or maximum social welfare. Now the pertinent question is what are the factors which hinder the attainment of Pareto-optimality and maximum social welfare. The main obstacles are:
1. the existence of monopoly or imperfect competition,
2. the presence of externalities, i.e. external economies and diseconomies in production and consumption:
3. the consumption of Public Goods, and
4. the lack of perfect knowledge.

1.6.8. The Theory of Second Best
If all the Pareto optimality conditions are met, it represents the first best solution. But, as we have discussed above, there are certain obstacles like monopoly, externalities and indivisibilities that lead to Pareto non optimality. In searching for the second-best solution, Lipsey and Lancaster showed that the second-best solution does not involve competitive behaviour in the rest of the economy. “The theory of the second-best states that if one or more of the first-order conditions for Pareto optimality cannot be satisfied because of institutional constraints, in general it is neither necessary nor desirable to satisfy the remaining Pareto conditions,”

The theory of the second-best is explained diagrammatically in figure where PP_1 is the production possibility frontier of the society for two goods X and Y. $I_1.I_2$ and I_3 are the community indifference curves. The Pareto-optimality point is E. But there is some constraint (say, in the form of externalities or indivisibilities) which makes this optimal point unattainable. Such a constraint is represented by the line MN. Given this constraint, the optimal point need not be on the product possibility frontier PP_1 such as B because it is on a lower community indifference curve I_1.



But point A is definitely preferable to point B even if it not on the PP_1 frontier. This is because point A is on a higher indifference curve I_2. Thus the attainment of the second-best optimum position at point A does not require the usual first best Pareto optimality condition as at point E.

There is, however, no general theory of the second best. "This theory has been used to question the desirability of policies to obtain the Pareto conditions on a piecemeal basis."

1.6.9. The Compensation Criteria or New Welfare Economics

The compensation criteria also known as the New Welfare Economics, have been formulated by Hicks, Kaldor and Scitovsky. Accepting Pareto's ordinal measurement of utility and the impossibility of its interpersonal comparisons, they tried to show that social welfare could be increased without making value judgements.

Assumptions. The various compensation criteria are based on the following assumptions:

(a) Each individual's satisfactions are independent from the other so that he is the best Judge of his welfare.

(b) There is the absence of external effects in production and consumption.

(c) The tastes of the individuals remain constant.

(d) The problems of production and exchange can be separated from the problems of distribution. Compensation principle accepts the level of social welfare to be a function of the level of production. Thus, it ignores the effects of a change in distribution on social welfare.

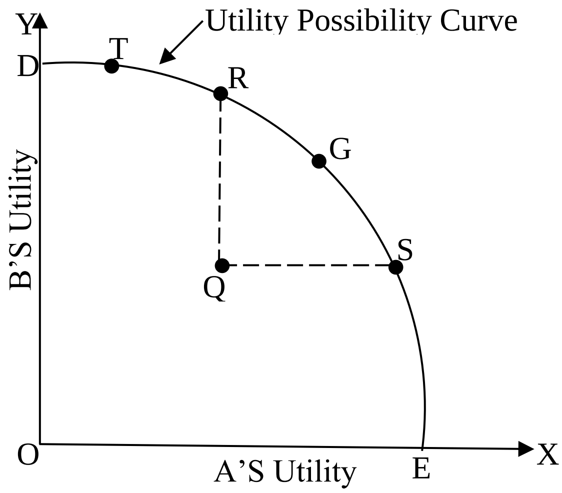
(e) Utility can be measured ordinally and interpersonal comparisons of utilities are not possible.

Kaldor-Hicks Welfare Criterion

Nicholas Kaldor was the first economist to give a welfare criterion based on compensating payments. Kaldor's criterion helps us to measure the welfare implications of a movement in either direction on the contract curve in terms of Edgeworth box diagram. According to Kaldor's welfare criterion, if a certain change in economic organisation or policy makes some people better off and other worse off, then that change will increase social welfare if those who gain could compensate the losers and still be better off than before. Thus, if any policy change benefits any one section of the society to such an extent that he is better off even after the payment of compensation to the other section of the society out of the benefits received, then that change leads to increase in social welfare. Prof. J.R. Hicks supported kaldor for employing compensation principle to evaluate the change in social welfare resulting from any economic reorganization that benefits some people and harms the others. This criterion states that, "if A is made so much better by the change that he could compensate B for his loss and still have something left over, than the reorganization is unequivocal improvement." In other words, a change is an improvement if the losers in the changed situation cannot profitably bribe the gainers not to change from the original situation.

Hicks has given his criterion from the loser's point of view, while Kaldor had formulated his criterion from gainer's point of view. Thus, the two criteria are really the same thought they are clothed in different words.

Kaldor-Hicks criterion can be explained with the help of the utility possibility curve. In figure ordinal utility of two individuals A and B is shown on X and Y axes respectively. DE is the utility possibility curve which represents the various combinations of utilities obtained by individuals A and B



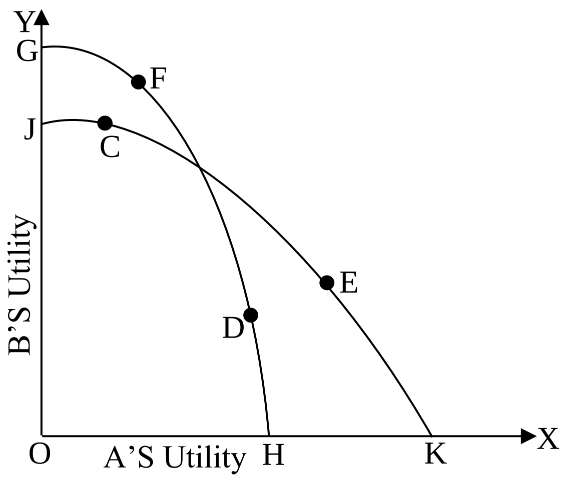
Kaldor-Hicks criterion Explained with Utility Possibility Curve

As we move downward on the curve DE, utility of A increases while that of B falls. On the other hand, if we move up on the utility curve ED, utility of B increases while that of A falls.

Suppose the utilities obtained by A and B from the distribution of income or output between then are represented by point Q inside the utility possibility curve DE. Let us assume that as a result of some change in economic policy, the two individuals move from point Q to point T on the utility possibility curve DE. As a result of this movement, utility of individual B has increased while the utility of A has declined, that is, B has become better off and A has become worse off than before. Therefore, this movement from point Q to point T cannot be evaluated by means of Pareto criterion of course points such as R, G, S or any other point on the segment RS of the utility possibility curve DE are socially preferable to point Q on the basis of Pareto criterion. But since the movement from Q to T involves interpersonal comparison of utility it cannot be said whether or not social welfare increases on the basis of Pareto criterion. However, the compensation principle propounded by Kaldor-Hicks enables us to say whether or not social welfare has increased as a result of movement from Q to T. According to Kaldor-Hicks criterion, we have to see whether the individual B who gains with the movement from position Q to position T could compensate the individual A who is loser and still be better off than before. Now, it will be seen from figure that utility possibility curve DE passes through points $R, G\ and\ S$. This means that by mere redistribution of income between the two individuals, that, is individual B gives some compensation to individual A for the loss suffered, they can move to the position R. It is evident from the figure that at position R individual A is as well off as compared to position Q. It means due to a policy change and consequent movement from position Q to position R gainer (individual B) could compensate the loser (individual A) and still is better off than at Q. Therefore, according to Kaldor-Hicks criterion, social welfare increases with the movement from position Q to position T, for from T they could move to the position R through mere redistribution of income.

1.6.10. Scitovsky Paradox

Scitovsky pointed out an important limitation of Kaldor-Hicks criterion that it might lead to contradictory results. He showed that if in some situation position A on Kaldor-Hicks criterion, it may be possible that position A is also shown to be an improvement over B on the basis of some criterion. For getting consistent results when position B has been revealed to be preferred to position A on the basis of a welfare criterion, then position A must not be preferred to position B on the same criterion. According to Scitovsky, Kaldor-Hicks criterion involves such contradictory and inconsistent results. Since Scitovsky was the first to point out this paradoxical result in Kaldor-Hicks criterion, it is known as ‘Scitovsky-Paradox’. How Kaldor-Hicks criterion may lead to contradictory results in some situations is depicted in figure. In this figure JK and GH are two utility possibility curves which intersect each other. Now suppose that the initial position is at point C on JK. Further suppose that due to a certain policy change, utility possibility curve changes and takes the position GH and the two individuals find themselves at position D. Position D is superior to position C on Kaldor-Hicks criterion because from position D movement can be made through mere redistribution to position F at which both individuals are better off as compared to the original position C. Thus, movement from position C to position D satisfies Kaldor-Hicks criterion. But, as has been pointed out by Scitovsky, reverse movement from position D on the new utility possibility curve GH to the position C on the old utility possibility curve JK also represents an improvement on Kaldor-Hicks criterion, that is, C is socially better than D on Kaldor-Hicks criterion. This is because from position C movement can be made by mere redistribution of income to position E as the utility possibility curve JK on which position C lies also passes through the position E.



Scitovsky Paradox

And, as will be observed from figure, at position E both the individuals are better off than at D. We thus see that the movement from position C to the position D due to a policy change is passed by the Kaldor-Hicks criterion and also the movement back from position D to position C is also passed by the Kaldor-Hicks criterion. This implies that D is socially better than C on this criterion and C is also socially better than D on the same criterion. So Kaldor-Hicks criterion leads us to contradictory and inconsistent results. It is mention worthy that these contradictory results are obtained by Kaldor-Hicks criterion when following a policy change new utility possibility curve intersects the former utility possibility curve. After bringing out the possibility of contradictory results in Kaldor-Hicks criterion which is generally known as Scitovsky's Double Criterion.

Its Criticism

The compensation principle has been bitterly criticised by the various welfare economists.

1. The Kaldor-Hicks compensation principle, according to Dr. Little, is merely a definition and not a test of increase in welfare because it ignores income distribution.

2. Compensation principle is not free from value Judgements as is claimed by its propounders. It involves implicit value Judgements.

3. Kaldor-Hicks think that the level of production is the main determinant of social welfare and the distribution a secondary one. But this is quite untenable. This is because welfare has dual aspect: absolute and relative. People are dissatisfied not only because they are poor but more because other peoples are very rich. If all the people would have been poor, they would not have been dissatisfied very much. Thus, a lower total output equitably distributed is preferred to larger output, inequitably distributed, from the point of view of social welfare.

4. This criterion does not take into consideration the payment of actual compensation. It recognises only potential compensation with which actual increase in welfare cannot be measured.

5. Compensation principle does not take into account the external effects on consumption and production. The exponents of compensation principle are of the opinion that an individual's welfare depends solely upon his own level of production and consumption and is not affected by the production and consumption activities of the others. But this is not a realistic assumption because a person's level of satisfaction (or dissatisfaction) depends to a larger extent upon the consumption of goods and services by other persons.

1.6.11. The Social Welfare Function

The concept of social welfare function was first introduced by Prof. Bergson and later on developed by Samuelson, Tintner and Arrow. They are of the view that no meaningful propositions can be made in welfare economics without introducing value Judgements. The concept of social welfare is an attempt at providing a scientifically normative study of welfare economics.

A social welfare function shows the factors on which the welfare of a society is supposed to depend.

Bergson defines it "as a function either of the welfare of each member of the community or of the quantities of products consumed and services rendered by each member of the community."

In its original form the Bergson social welfare function is formulated in a completely general manner. It is a function which establishes a relation between social welfare and all possible variables which effect each individual's welfare. Such as a services and consumption of each individual. It can be regarded as a function of each individual's welfare, which in turn depends both on his personal well-being and on his appraisal of the community. Thus, the social welfare function is an ordinal index of society's welfare and is a function of individual utilities. It is expressed as

$$W = F(U_1 U_2 \dots \dots U_n)$$

Where W is the social economic welfare, F is for function and $U_1, U_2 \dots \dots U_n$ are the levels of utilities of 1, 2,….n, individuals. W is an increasing function of these utilities.

Assumptions

The Bergson social welfare function is based on certain assumptions:

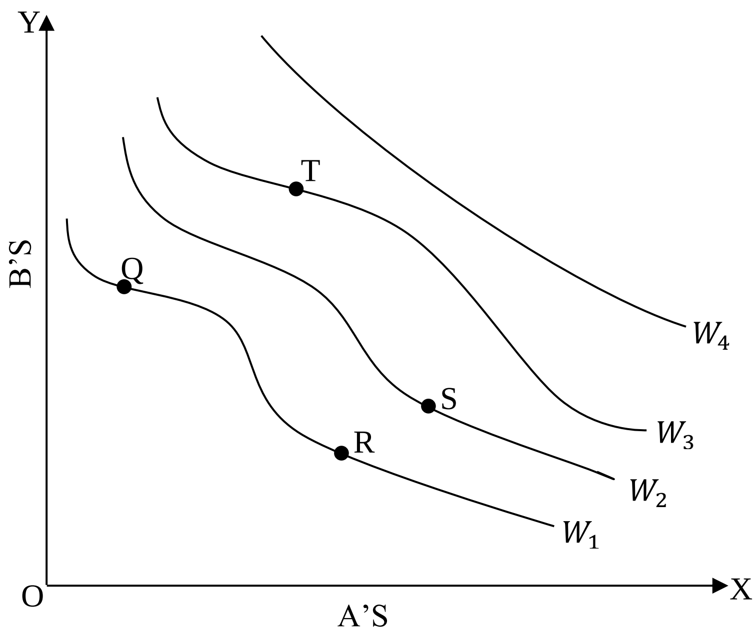
(a) It assumes that social welfare depends on each individual's wealth and income and each individual's welfare depends in turn on his wealth and income and on the distribution of welfare among the members of the society.

(b) It assumes the presence of external economies and diseconomies with their consequent effects.

(c) Interpersonal comparisons of utility involving value Judgements are freely permissible.

We can explain the social welfare function with the help of social indifference curves or welfare frontiers. Let us assumes a society of two persons. In such a case social welfare function can be represented with the help of social indifference curves.

In figure the utility of individuals A and B has been represented on the horizontal and vertical axes respectively. W_1 W_2 and W_3 are the social indifference curves representing successively higher levels of social welfare. A social indifference curve is a locus of the various combinations of utilities of A and B which results in an equal level of social welfare.

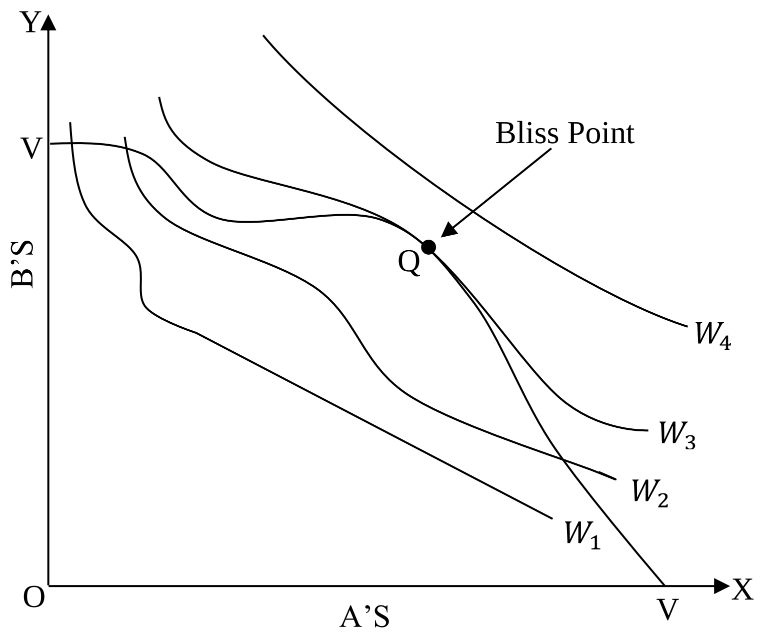


Social Indifference Curves depicting Social Welfare Function

The properties of social indifference curve are just like that of individual consumer's indifference curves. Given a family of social indifference curves, the effects of a proposed change in policy on social welfare can be evaluated. In terms of figure 192 any policy change that moves the economy from Q to T is an improvement. Similarly, a movement from Q to S or from R to S also represents an improvement in social welfare and a movement from T to Q or T to S represents a decrease in social welfare. A movement along the same social indifference curve represents no change in the level of social welfare. The significance of social welfare function is that it enables us to obtain a unique optimum position regarding social welfare. This unique optimum position is best of all the Pareto optima and therefore ensures the maximum social welfare. Now let us include the concept of grand utility possibility frontier in our attempt to obtain a unique optimum position with the aid of social welfare function.

Grand utility possibility frontier is a locus of various physically attainable utility combinations of two persons when the factor endowment, state of technology and preference orders of the individuals are given. In other words, every point on the grand utility possibility curve represents the optimum position with regard to the allocation of the products among the consumers, allocation of factors among different products and the direction of production. Thus, every point on the grand utility possibility curve represents a Pareto optimum and as we move from one point to another on it the utility of one individual increases while that of the other falls.

Now let us superimpose grand utility possibility curve on the social indifference curves representing social welfare function to find a unique optimum position of social welfare. In below figure social indifference curves $W_1, W_2\ W_3\ and\ W_4$ representing the social welfare function have been drawn along with the grand utility possibility curve VV. Social indifference curve VV at point Q. Thus, point Q represents the maximum possible social welfare given the factor endowments, state of technology and preference scales of the individuals. Point Q is known as the point of constrained bliss since, given the constraints regarding factor endowments and the current technology, Q is the highest possible state of social welfare which the society can attain.



Maximisation of Social Welfare

Social welfare represented by the social indifference curve W_4 is higher than at Q but it is not possible to attain it, given the technology and factor endowment. Thus, from among a larger number of Pareto optimum points on the grand utility possibility curve, we have a unique optimum point Q at which the social welfare is the maximum. The point of production of goods, unique pattern of production of goods, unique distribution of goods between the individuals and the unique combination of factors employed to produce the goods.

1.6.12. Arrow's Social Choice and Individual Values

Bergson and Samuelson made significant contribution to welfare economics by introducing explicit value Judgement in the form of social welfare function. However, Bergson and Samuelson did not deal with the question as to how to get these value Judgement or what these value Judgements could be for constructing a social welfare function. It was this problem left untouched by Samuelson and Bergson, which was explored by Arrow in his path breaking work "Social Choice and Individual Values". K.J. Arrow in his social choice and Individual values has demonstrated the impossibility of obtaining the social welfare function even if individual preferences are consistent. He suggests five minimum conditions or criteria which social choices must satisfy in order to reflect which social choices must satisfy in order to reflect preferences of individuals. They are as follows:

1. Collective Rationality
2. Responsiveness to Individual Preferences
3. Non-imposition
4. Non dictatorship
5. Independence of Irrelevant Alternatives Arrow demonstrates that it is not possible to satisfy all these five conditions and obtain a transitive social choice for each set of individual preferences without violating at least one condition. In other words, social choice is inconsistent or undemocratic because no voting system allows these five conditions to satisfied. This has come to be known as the Arrow Impossibility Theorem.

Its Criticism Arrow's general impossibility theorem has been criticized by Samuelson, Little and other welfare economists.

According to Little, Arrow's negative conclusions have no relevance in welfare economics. His impossibility theorem relates to a decision-making process and not to a social welfare function.

Baumol shows that "Arrow's requirements are stricter than they seem at first view and that inconsistent or "undemocratic" social choice making is not really the only alternative.

Moreover, the Arrow theorem is based on the assumption of a majority voting pattern which does not take into consideration the possibility of a voting system that requires unanimity and permits buying and selling of votes.