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Exam Code : MIC1

MICRO ECONOMICS - I

SEMESTER - I

ECONOMICS

BLOCK 1

KRISHNA KANTA HANDIQUI STATE OPEN UNIVERSITY

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COURSE INTRODUCTION

This course introduces a learner to the different aspects of Micro Economic Theory. Microeconomics concerns decision-making by individuals and small groups, such as families, clubs, firms, and governmental agencies. As the famous quote from Lord Robbins says, Microeconomics is the study of how scarce resources are allocated among competing ends. Whether you will buy a new cell phone you like, or should you buy a dapper suit for your job interview? Should you take a trip with some friends this weekend or study at home? Because you have limited income and time and cannot, therefore, buy or do everything that you might want to buy or do, you have to make choices. Microeconomic theory offers a general theory about how people make such decisions.

We divide our study of Microeconomics into 15 units, which are distributed in two blocks.

BLOCK INTRODUCTION

The first block of the paper 'Micro Economics I' has 8 units. *Unit 1* introduces the learner to different concepts of Demand Analysis. The different aspects of elasticities are discussed here along with the Engel's Law. *Unit 2* discusses the Indifference Curve analysis where the price, income and Substitution effects of price changes are discussed. The concept of Revealed Preference Theory is also introduced here. *Unit 3* deals with the Recent Developments of the Theory of Consumer Behaviour where theories given by Hicks, Bernoulli, Newmann and Friedman are discussed. Markowitz hypothesis is also discussed. *Unit 4* explains the recent developments in the theory of market demand along with the Linear Expenditure system. Household time allocation model of Gary Becker is discussed in *Unit 5*. This Unit also discusses the characteristics of Kelvin Lancaster model. The Theories of Costs are discussed in *Unit 6.* The derivation of cost functions is also discussed here. The modern theories of costs, engineering costs and the effect of multiproduct firms and dynamic changes in costs are discussed here. *Unit 7* deals with the Theory of Production. The Production Function, Laws of Variable Proportions, Returns to Scale, Iso Quants, Cobb - Douglars and CES Production Functions are elaborately discussed. *Unit 8* explains the market structure under perfect competition and Monopoly.

While going through a unit, you will notice some along-side boxes, which have been included to help you know some of the difficult, unseen terms. Some "ACTIVITY' (s) have been included to

help you apply your own thoughts. Again, we have included some relevant concepts in "LET US KNOW" along with the text. And, at the end of each section, you will get "CHECK YOUR PROGRESS" questions. These have been designed to self-check your progress of study. It will be better if you solve the problems put in these boxes immediately after you go through the sections of the units and then match your answers with "ANSWERS TO CHECK YOUR PROGRESS" given at the end of each unit.

UNIT 1: INTRODUCTION TO DEMAND ANALYSIS

UNIT STRUCTURE

1.1 Learning Objectives

1.2 Introduction

1.3 Elasticity and its Implications

- 1.3.1 Price Elasticity
- 1.3.2 Income Elasticity
- 1.3.3 Measurement of Income Elasticity
- 1.3.4 Cross Elasticity of Demand

1.4 Consumer's Surplus

1.5 Engel's Law of Demand

1.6 Elementary Theory of Price Formation

- 1.6.1 Demand Price Equilibrium and Demand Function
- 1.6.2 Supply Price Equilibrium and Supply Function
- 1.6.3 Market Equilibrium

1.7 Let Us Sum Up

1.8 Further Reading

1.9 Answers to Cheeck Your Progress

1.10 Model Questions

1.1 LEARNING OBJECTIVES

After going through this unit, you will be able to-

- derive the meaning and discuss different types of elasticity
- describe the concept of consumer's surplus
- discuss the concept of Engel's law of demand and its derivation
- explain the process of price determination and the basic market model.

1.2 INTRODUCTION

One of the basic tools of microeconomics is the theory of demand. Demand is nothing but the quantitative expression of preferences of the consumer. Demand always depends on price, other things remaining

constant. Therefore, in the first section, we are going to describe the relationship between the changes in the quantity demanded of good and its price changes, the concept of elasticity of demand, their types and implications in various aspects. This unit also discusses the concept of consumer surplus and the Engel's Law of demand. Theory of demand and supply equilibrium and determination of price is also discussed in this unit

1.3 ELASTICITY AND ITS IMPLICATIONS

According to the law of demand, when price of good increases, its quantity demanded decreases, assuming other things remain the same. Thus this theory shows the direction of change in quantity demanded, not the changes in amount due to change in its price. Therefore, to know the changes in total amount due to changes in price, economists developed the term 'elasticity of demand'. It is nothing but the responsiveness of demand to changes in the commodity's own price. Actually law of demand is a qualitative statement while the elasticity of demand is a quantitative statement. This concept was first developed by Prof. Marshall in his book 'Principles of Economics'. It describes the degree of responsiveness of quantity demanded of a good to the changes in its price.

Factors/determinants influencing the elasticity of demand:

- **Price level:** the level of price of the commodity determines the price elasticity. An extremely high or low price has less elasticity while moderate price has less elasticity.
- **Income:** High and low income group have less elasticity of demand whereas middle class group has more elasticity of demand.
- **Substitutes and complimentary goods:** Goods having more substitutes have higher elasticity than goods having less substitutes. Similarly demand of the complimentary goods is always highly elastic.
- **Nature of the commodity:** Depending upon the nature of the commodities their elasticities are different. Luxurious commodities have more elasticity whereas necessities have less elastic demand.

- **Wealth distribution:** In case of equal distribution of the wealth in the society, the elasticity of the demand is more and vice versa.
- **Durability:** durable goods are more elastic than perishable.
- **Addiction:** In case of habituated product, the elasticity of demand is low.

Importance: The concept of elasticity is of great practical importance. It plays an important role in business, man, farmers, labours and government policy matters to determine the price of commodities, wage, tax, fare to the transport companies and railways. Similarly electricity charges are also determined on the basis of elasticity of demand. It plays an important role in the field of international economics. It a nation devaluates its currency, it raises the price of imported goods and lowers the prices of its exports. Devaluation would be a successful policy when demand for both exports and imports are elastic.

There are various types of elasticity of demand - price, income and cross elasticity are discussed in the following section.

1.3.1 Price Elasticity

The term elasticity of demand generally termed as price elasticity of demand. According to Prof. Marshall, "the elasticity of demand in a market is great or small according as the amount demanded increases much or little for a given fall in price and diminishes much or little for a given rise in price". Thus, it precisely defined as the proportionate change in quantity demanded due to proportionate change in price.

Let Q be the quantity demanded at price P, ΔQ is the changes in quantity demanded and ΔP is the changes in price. Therefore,

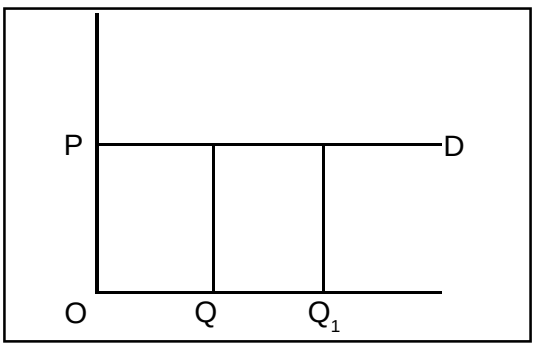
$$\left|e_p\right| = \Delta Q/Q \div \Delta P/P, \qquad \text{where, } e_p \text{ is price elasticity}$$
$$= \Delta Q/\Delta P.P/Q$$

In case of elasticity of demand we use modulus sign and therefore ignore the negative sign although the changes in quantity

demanded due to changes in price is opposite. There are five types of price elasticity.

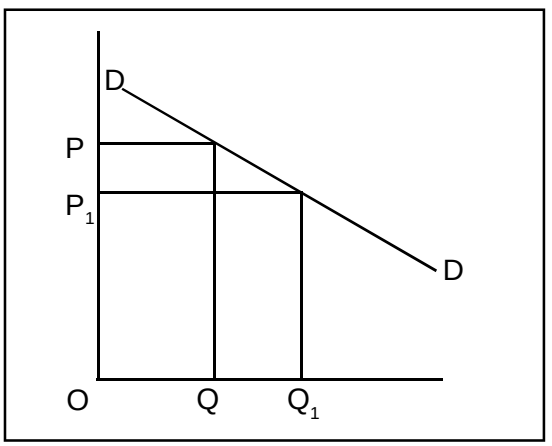
- **Perfectly elastic demand:** The demand of a commodity for which quantity demanded changes infinitely with a very small change in price is known as perfectly elastic demand. The demand curve is horizontal as shown in Figure 1.1. Here, $e_p = \infty = \frac{\Delta Q/Q}{\Delta P/P}$ where, $\Delta P/P$ is equivalent to 0 (zero) i.e. almost no change.

Figure 1.1: Perfectly Elastic Demand Curve



- **Highly elastic demand:-** Highly elastic demand is that percentage change in quantity demanded is more than the % change in price. The slope of this demand curve is shown in the Figure 1.2.

Figure 1.2: Highly Elastic Demand Curve

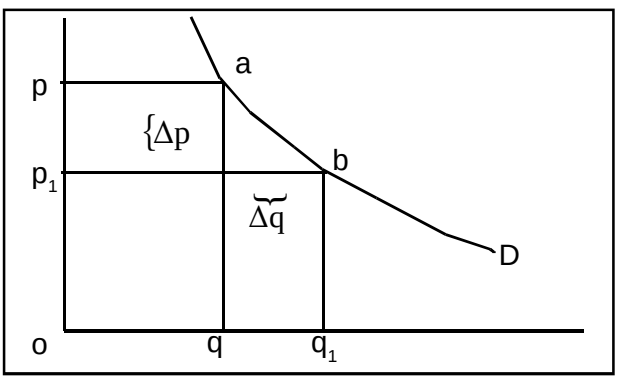


$\text{Here } e_p > \text{one}, e_p > 1 \Rightarrow \frac{\Delta Q/Q}{\Delta P/P} > 1$

$e_p > 1$ when % change in Q > % change in P.

- **Unitary elastic demand:** When percentage change in quantity demanded is exactly equal to the percentage change in price, then it is known as Unitary elastic demand. In this case the slope of the demand curve is rectangular hyperbola and shown in Figure 1.3.

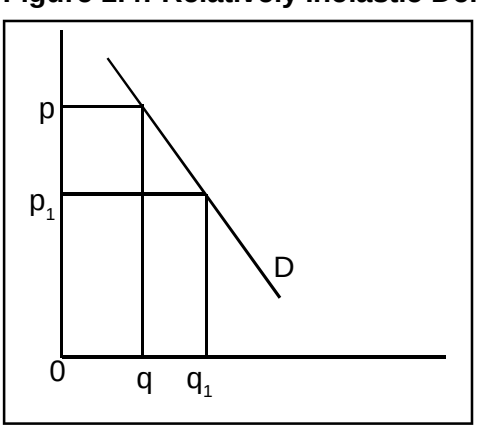
Figure 1.3: Unitary Elastic Demand Curve



$\text{Here } e_p = 1 \Rightarrow \frac{\Delta Q/Q}{\Delta P/P} = 1$ i. e., change is quantity demanded must be equal to change in price.

- **Relatively less elastic or inelastic demand:** Inelastic demand is the demand at which % change in quantity demanded is less than the % change in price. The slope of this demand curve is steeper then the highly elastic or unitary elastic demand curves as shown in the Figure 1.4.

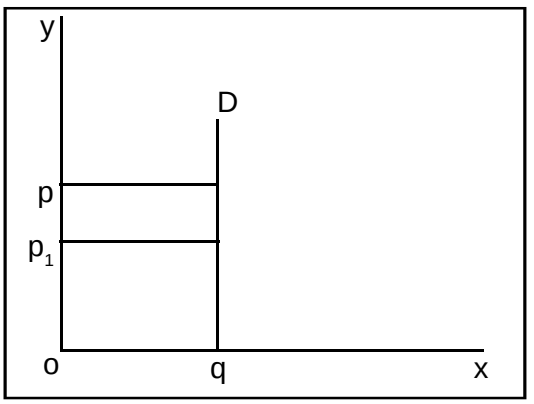
Figure 1.4: Relatively Inelastic Demand Curve



$\text{Here } e_p < 1 \Rightarrow \frac{\Delta Q/Q}{\Delta P/P} < 1$

Ø **Perfectly inelastic demand:** If there is no change in quantity demanded as result of the changes in price, it is known as perfectly inelastic demand. The slope of this demand curve is a vertical line or is parallel to the Y axis and shown in Figure 1.5.

Figure 1.5: Perfectly Inelastic Demand Curve



$$\text{Here } e_p = 0 \Rightarrow \frac{\Delta Q/Q}{\Delta P/P} = 0$$

$$\text{When } \frac{\Delta Q}{Q} = 0 \Rightarrow \text{no change in demand}$$

Therefore, from the above discussion we can come to the conclusion that the ranges of values of the price elasticity of demand is $0 \le e_p \le \infty$

Where, If $e_p = 0$, the demand is perfectly inelastic
If $e_p = 1$, the demand is unitarily elastic
If $e_p = \infty$, the demand is perfectly elastic
If $1 > e_p > \infty$, the demand is elastic
If $0 < e_p < 1$, the demand is inelastic.

Methods for calculating price elasticity: There are various methods for calculating price elasticity of demand. Let us discuss those elaborately -

Ø **Percentage method:** According to this method, price elasticity is calculated by the following formula.

$$E_p = \frac{\%\text{ change in quantity demanded}}{\%\text{ change in price}}$$

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

$$= \frac{\Delta Q/Q}{\Delta P/P} = \Delta Q/P.P/Q$$

Where, ΔQ = change in quantity demanded

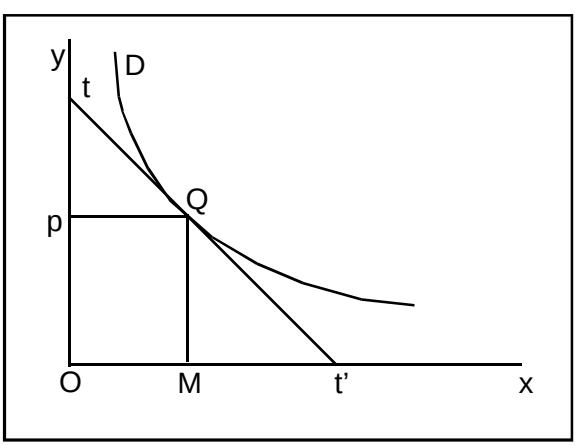
Q = Original price

ΔP = change in price

P = original price

Ø **Point elasticity method or geometric method:** It is another method for estimating elasticity of demand. According to this method, elasticity can be measured at each point on a demand curve. It is used when there is a proportionate change in the quantity demanded as a result from a very small change in price. The change in price is assumed to be so small that the original price and changed price are shown at same point on the demand curve. Let us suppose the DD is the demand curve, tt' is the tangent through point Q in the Figure 1.6. Now we are to find out the elasticity of demand at point Q on demand curve.

Figure 1.6: Point Elasticity of Demand Curve



We know, $e_p = \Delta Q/\Delta P. P.Q$.....(i)

Here $p = MQ$ OP and $Q = OM$

Therefore, $P/Q = MQ/OM$

$\Delta P/\Delta Q = MQ/Mt'$, where $\Delta P/\Delta Q$ is the slope of the line tt'

Therefore, $\Delta Q/\Delta P = Mt'/MQ$

Putting these values in equation (i) we get,

$E_p = Mt'/MQ. MQ/OM = Mt'/OM$

Since PtQ and MQt' are similar triangle, therefore $Mt'/OM = Qt'/Qt$

Therefore, $ep = Qt'/Qt = \frac{\text{Lower portion of the demand curve below Q}}{\text{Upper portion of the demand curve above Q}}$

In the same way we can estimate the elasticity at different points on a straight line demand curve.

From these above analysis it is proved that at the middle point of a linear demand curve, $e_p = 1$ (In the figure below, at point R, $e_p = 1$)

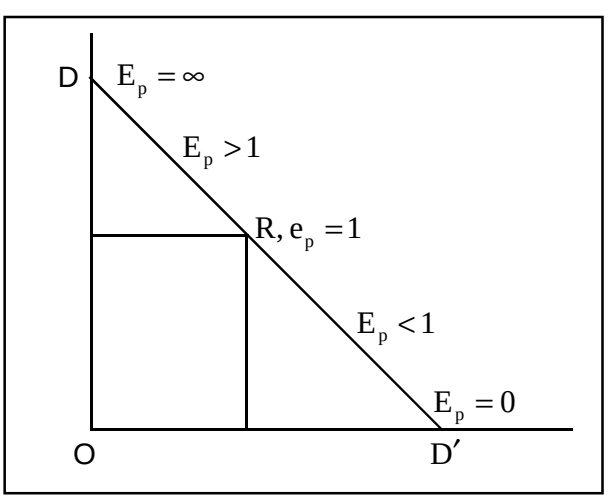
At any point to the right of R, $e_p < 1$

At any point to the left of R, $e_p > 1$

At point D, e_p = infinity

At point D', $e_p = 0$ which is shown in Figure 1.7

Figure 1.7: Different Elasticities along a Linear Demand Curve



- **Arc Method:** The point method for measuring elasticity is an important method and used in those situation where change in quantity demanded are infinitesimally small. Therefore in case of large price change, point elasticity method doesn't provide us the true and reliable results and we use arc method which measures arc elasticity of demand. In this method, both price and quantity are measured by taking an average price and quantity. Thus it is a measure of average elasticity. It connects the two points of demand curve AB as shown in Figure 1.8. It should be clear from the figure that the arc elasticity is an approximation of the true elasticity of the section AB of the demand curve. Another point is clear that more convex to the origin the demand curve is, the poorer the linear approximation attained by the arc elasticity formula. The formula for arc elasticity is

$$Ep = \frac{\Delta Q}{\Delta P} \times \frac{(P1+P2)/2}{(Q1+Q2)/2} = \frac{\Delta Q}{\Delta P} \times \frac{(P1+P2)}{(Q1+Q2)}$$

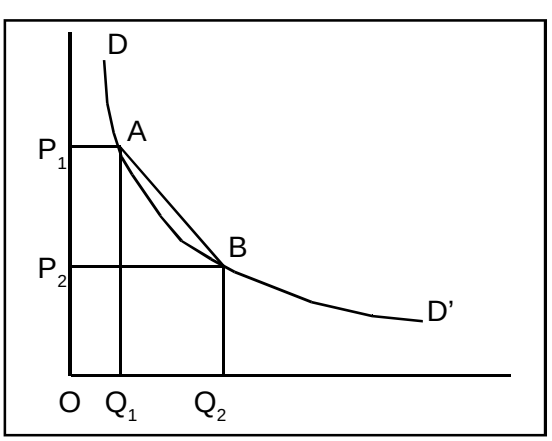
Where, $P_1 = \text{Original price}$

$P_2 = \text{changed price}$

$Q_2 = \text{changed quantity}$

$Q_1 = \text{Original quantity}$

Figure 1.8: Arc Elasticity of Demand



- **Total outlay method or total expenditure method:** Total expenditure is an important determinant of price elasticity of demand. Therefore price elasticity can be measured through total expenditure. According to this method, there are three main propositions-
  - As a result of the change in price (i.e. fall or rise), if the total expenditure remains same then price elasticity is equal to1.
  - As a result of the fall in price, if total expenditure of the consumer rises, and rise in the price if total expenditure falls, then price elasticity of demand is greater than 1, i.e. $e_p>1$
  - As a result of the fall in price if total expenditure decreases and with a rise in the price if total expenditure increases, then $e_p <1$.

    Now we shall prove these one by one

Proof 1: In case $e_p=1$:

When there is a fall in price:

Let us suppose

$Exp_b = PQ$

$Exp_a = (P - \Delta P) (Q + \Delta Q)$

Where, Exp_b = total expenditure before change in price

Exp_a = total expenditure after change in price

P = Initial price

Q = Initial quantity at price P

ΔP = Change in price

ΔQ = Change in quantity demanded.

Since, $Exp_b = Exp_a$

$\Rightarrow PQ = (P - \Delta P) (Q + \Delta Q)$

$\Rightarrow PQ = PQ + P\Delta Q - Q\Delta P - \Delta P\Delta Q$

$\Rightarrow - P\Delta Q + Q\Delta P = 0$ (Since $\Delta P\Delta Q = 0$ because $\Delta P\Delta Q$ will be infinitely small quantity and hence can be ignored)

$\Rightarrow \Delta P/\Delta Q = P/Q$

$\Rightarrow \Delta Q/\Delta P = Q/P$

$\Rightarrow \Delta Q/\Delta P \times P/Q = 1$

$\Rightarrow e_p = 1$ ..... (1)

Similarly, when there is a rise in price:

$Exp_b = Exp_a$

$\Rightarrow PQ = (P + \Delta P)(Q - \Delta Q)$

$\Rightarrow PQ = PQ - P\Delta Q + Q\Delta P - \Delta P\Delta Q$

$\Rightarrow P\Delta Q = Q\Delta P$ (Since $\Delta P\Delta Q = 0$)

$\Rightarrow \Delta P/\Delta Q = P/Q$

$\Rightarrow \Delta Q/\Delta P = Q/P$

$\Rightarrow \Delta Q/\Delta P \times P/Q = 1$

$\Rightarrow e_p = 1$ ..... (2)

Thus, from (1) and (2) we can prove that price elasticity of demand is equal to 1 when total expenditure remains the same with the change in price.

Proof 2: Now we prove when ep > 1, with the fall in the price total expenditure increase and with rise in price total expenditure decreases.

With fall in price:

$Exp_b < Exp_a$

$\Rightarrow PQ < (P - \Delta P)(Q + \Delta Q)$

$\Rightarrow PQ < PQ + P\Delta Q - Q\Delta P - \Delta P\Delta Q$

$\Rightarrow 0 < P\Delta Q - Q\Delta P$ (Since $\Delta P\Delta Q = 0$)

$\Rightarrow P\Delta Q > Q/P$

$\Rightarrow \Delta Q/\Delta P > Q/P$

$\Rightarrow \Delta Q/\Delta P \times P/Q > 1$

$\Rightarrow e_p > 1$ ..... (3)

With rise in price:

$Exp_b > Exp_a$

$\Rightarrow PQ > (P + \Delta P)(Q - ?\Delta Q)$

$\Rightarrow PQ > PQ - P\Delta Q + Q\Delta P - \Delta P\Delta Q$

$\Rightarrow P\Delta Q > Q\Delta P - 0$ (Since $\Delta P\Delta Q = 0$)

$\Rightarrow \Delta P/\Delta Q > P/Q$

$\Rightarrow \Delta Q/\Delta P > Q/P$

$\Rightarrow \Delta Q/\Delta P \times P/Q > 1$

$\Rightarrow e_p > 1$ ..... (4)

From (3) and (4), it can be proved that, price elasticity is greater than 1 when total expenditure increases with the fall in price and decreases with rise in price.

Proof 3: Now we prove $e_p < 1$, when total expenditure rises with increase in price and decrease with fall in price.

With fall in price:

$Exp_b > Exp_a$

$\Rightarrow PQ > (P - \Delta P)(Q + \Delta Q)$

$\Rightarrow PQ > PQ + P\Delta Q - Q\Delta P - \Delta P\Delta Q$

$\Rightarrow 0 > P\Delta Q - Q\Delta P$ (Since $\Delta P\Delta Q = 0$)

$\Rightarrow Q\Delta P > P\Delta Q$

$\Rightarrow P\Delta Q < Q\Delta P$

$\Rightarrow \Delta Q/\Delta P < Q/P$

$\Rightarrow \Delta Q/\Delta P \times P/Q < 1$

$\Rightarrow e_p < 1$ ..... (5)

With rise in price:

$Exp_b < Exp_a$

$\Rightarrow PQ < (P + \Delta P)(Q - \Delta Q)$

$\Rightarrow PQ < PQ - P\Delta Q + Q\Delta P - \Delta P\Delta Q$

$\Rightarrow P\Delta Q < Q\Delta P - 0$ (Since $\Delta P\Delta Q = 0$)

$\Rightarrow \Delta Q/\Delta P < Q/P$

$\Rightarrow \Delta Q/\Delta P \times P/Q < 1$

$\Rightarrow e_p < 1$ ..... (6)

From (5) and (6), once again it is proved that, price elasticity is less than 1 when total expenditure increases with the rise in price and decreases with fall in price.



ACTIVITY: 1.1

Prepare a list of the goods around you. Then notice the nature of the goods which are essential commodities and which are luxurious. Also make comparison for complimentary and substitute goods among your daily usable goods.

.....

.....

.....

.....



CHECK YOUR PROGRESS

Q 1: Demand schedules of good X and Y are as follows:

Px (Rs.)	qx (Units)	py(Rs.)	qy (Units)
8	10	8	10
4	12	6	25

Find the elasticities of demand for both the goods and comment which is more elastic

Q 2: Mention the method for calculating price elasticity.

.....

.....

1.3.2 Income Elasticity

Income elasticity of demand is nothing but the degree of responsiveness of the quantity demanded of a good to changes in the income of the consumer. Income elasticity is always measured in terms of the changes in the income of the individuals

It is defined as

$$Ey = \frac{\text{Proportionate change in quantity demanded}}{\text{Proportionate change in Income}}$$

$$= \frac{\Delta Q/Q}{\Delta Y/Y} = \frac{\Delta Q}{\Delta Y}.\frac{Y}{Q}$$

Where,

ey = Income Elasticity

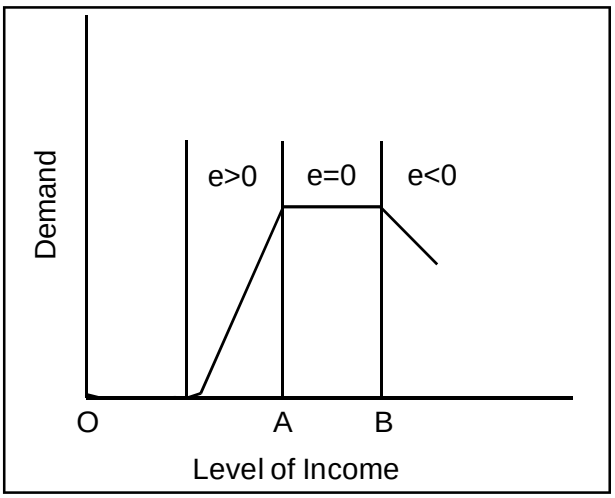
ΔQ = change in the quantity demanded

ΔY = changes in the income of the consumer

Q = quantity demanded of a good

Income elasticity is always positive because generally an increase in income leads an increase in quantity demanded. Like price elasticity, income elasticity also may be equal to one, greater than one or less than one depending upon whether the proportionate change in quantity demanded is equal to, greater than or less than the proportionate change in income respectively. Normal goods have always positive income elasticity and inferior goods negative income elasticity. In between two extreme i.e. normal and inferior, the middle one refers to a good whose quantity demanded remains the same with a change in income and in this case, income elasticity is zero. This has been shown in Figure 1.9.

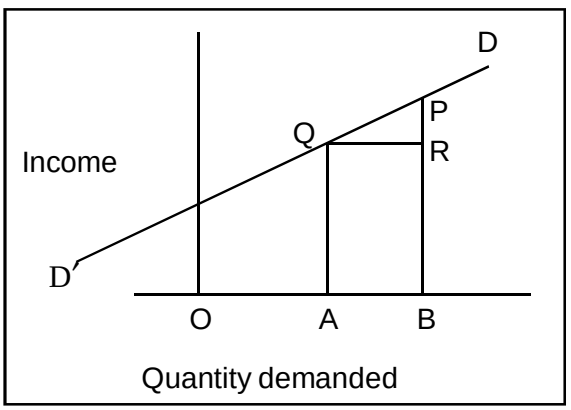
Figure 1.9: Income Elasticy of Demand



1.3.3 Measurement of Income Elasticity

The quantity demanded of a good at different level of income determined from the income demand curve. Figure 1.10 shows how we measure income elasticity of demand at a point Q1 where quantity demanded is OA. As a result of the income increases from AQ to BP, quantity demanded increases from OA to OB.

Figure 1.10: Income Elasticity of Demand



Now, if we expand the demand curve then total demand curve is D D′ which is downward sloping. We know that ey = Δ Q/ Δ Y X Y/Q Here in our case,

Δ Q = QR, Δ Y = PR, Y = AQ, Q = OA

Therefore, e_y = QR/PR. AQ/OA

Since Δ PQR and Δ QD'A are similar triangle, therefore

QR = AD'

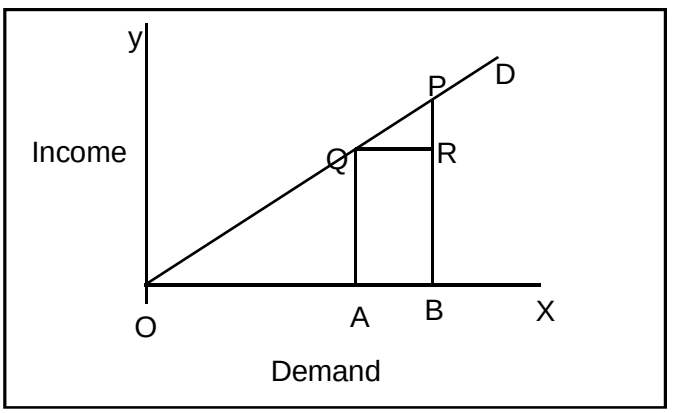
PR = AQ

Therefore, e_y=AD'/ AQ. AQ/OA = AD'/OA

Since, AD'> OA, therefore $e_y > 1$

Similarly, if income elasticity curve is extended downward to Y axis, the X axis at its origin, then e_y =0. It is shown in the Figure 1.11.

Figure 1.11: Change in Income Elasticity of Demand



Here ey at point Q = Δ Q/ Δ Y.Y/Q

Δ Q = AB, Q= OA or D'A

Δ Y = PR, Y = AQ

Therefore, e_y = QR/PR. AQ/D'A

Since Δ D'QA and PGR are similar triangle

Therefore, D'A = QR, PR = AQ

Therefore, QR/PR. PR/D'A = QR/D'A = e_y

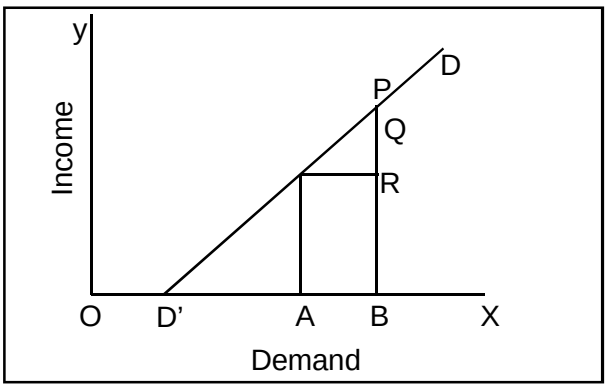
Since, QR and D'A are same

Therefore, e_y = D'A/D'A = 1

Hence e_y = 1.

Again, when income demand curve is extended to X axis towards the right of the origin, the income elasticity of demand is less than one.

Figure 1.12 Measurement of Income Elasticity of Demand



Here, e_y at point Q = Δ Q/Δ Y . Y/Q

Δ Q = AB, Y = QA, Δ Y = PR, Q = D'A

Therefore, e_y = AB/PR. QA/D'A, but PR = QA

E_y = AB/QA. QA/D'A

$\Rightarrow$ E_y = AB/D'A (Since Δ D'AQ and Δ PQR are similar)

Since AB < D'A, therefore, e_y < 1

In this way we can determine income elasticity of demand on a demand curve of a particular point.

Relationship between income elasticity and proportion of a good:

We can establish three relationships between income elasticity and proportion of income spent on a good.

Proposition 1: As a result of increase in income, the proportion of income spent on good increases, then e_y > 1.

Let us suppose,

Q = the income spent on good

Y = the level of income

Q/Y = the proportion of income spent on good

Δ Y = increase in income

Δ Q = increase in good

Now, new proportion of income spent on good as a result of the increase is income and expenditure on good.

$$\frac{Q+\Delta Q}{Y+\Delta Y}$$

Again, when

$$\frac{Q+\Delta Q}{Y+\Delta Y} > \frac{Q}{Y}$$

$$\Rightarrow Y(Q+\Delta Q) > Q(Y+\Delta Y)$$

$$\Rightarrow YQ + Y\Delta\Delta > QY + Q\Delta\Delta$$

$$\Rightarrow \frac{\Delta Q}{\Delta Y} > \frac{Q}{Y}$$

$$\Rightarrow \frac{\Delta Q}{\Delta Y}.\frac{Y}{Q} > 1$$

Therefore, $e_y > 1$ .....(i)

Proposition 2: As a result of the increase in income, the proportion of income spent on goods remains the same, then, $e_y = 1$.

Now,

$$\frac{Q+\Delta Q}{Y+\Delta Y} = \frac{Q}{Y}$$

$$\Rightarrow YQ + Y\Delta\Delta = QY + Q\Delta\Delta$$

$$\Rightarrow \frac{\Delta Q}{\Delta Y}.\frac{Y}{Q} = 1$$

$$\Rightarrow E_y = 1.....(ii)$$

Proposition 3: As a result of the increase in income of the proportion of income spent on goods decreases then $e_y = < 1$.

Now

$$\frac{Q+\Delta Q}{Y+\Delta Y} < \frac{Q}{Y}$$

$$\Rightarrow YQ + Y_{\Delta} Q < QY + Q_{\Delta} Y$$

$$\Rightarrow \frac{\Delta Q}{\Delta Y}.\frac{Y}{Q} < 1$$

$$\Rightarrow E_y < 1.....(iii)$$

Thus from (1), (2) and (3), we may conclude that income elasticity of demand is greater than, equal to or less than one depending upon whether the proportions of income spent on goods increase, remains equal or decreases as a result of increase in income.



CHECK YOUR PROGRESS

Q 3: A consumer was consuming 4 kg of sugar per month when his income was Rs. 1000 per month. When income increases to Rs. 1200 per month, he starts consuming 5 kg of sugar per month. Is the demand for sugar elastic or inelastic with respect to income?

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Q 4: State the relationship between income elasiticity and proportion of income spent on a good. (Answer in about 50 words)

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1.3.4 Cross Elasticity of Demand

It is degree of responsiveness of the quantity demanded of a particular good to change in the price of another good. It is the ratio of the proportionate change in the demand for one commodity by the proportionate change in the price of another good. It is defined as,

$$E_c = \frac{\Delta Qx}{Qx} \div \frac{\Delta Py}{Py} = \frac{\Delta Qx}{\Delta Py} \cdot \frac{Py}{Qx}$$

Where, $e_c = \text{Cross Elasticity}$

$Q_x = \text{Quantity of good X}$

$P_y = \text{Price of good X}$

Thus, from the above definition of cross elasticity, it is seen that cross elasticity always depends on the nature of the commodity and its price changes.

Generally, we see that some commodities are substitutes and some are complementary. In case of substitute goods, the price of one increases say (tea, coffee) tea then demand for coffee increases. Similarly, in case of complementary goods (car, petroleum), if price of petrol increases, the demand for car decreases and vice versa. Therefore value of cross elasticity depends on the type and nature of commodity.

If $e_{XY} < 0$, the goods are complementary

$e_{XY} = 0$, the goods are neither complementary nor substitutes

$e_{XY} > 0$, the goods are substitutes

Thus, cross elasticity has an important role in economic theory. Only on the basis of the value of cross elasticity, goods are classified as substitutes or complementary. Substitutes are those which have positive cross elasticity, again complementary goods are those which have negative cross elasticity. Therefore the degree of substitutability and complementarity depends on the value of cross elasticity.



CHECK YOUR PROGRESS

Q 5: If the price of coffee rises from Rs. 25.00 per hundred grams to Rs. 30.00 per hundred grams and as a result the demand for tea increases from 60 kg to 70 kg, what will be the cross elasticity of demand between tea and coffee. Also comment on the nature of relationship between the two.

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1.4 CONSUMER'S SURPLUS

The concept of consumer's surplus was first introduced by Prof. Alfred Marshall in his book "Principle of Economics" published in 1890. It is a very important issue in economic theory as well as for economic policies such as taxation policy of Government, pricing policy of monopolistic seller, etc. Consumer's surplus is the difference between what a consumer is willing to pay and what he actually pays to buy a certain quantity of a commodity. In practical field, consumer's surplus is to be found especially in the consumption of useful commodities such as salt, fruits, newspapers, etc. of which price is less. For example of such commodities, a consumer is always ready to pay much more than he actually pays thus the additional satisfaction that a consumer derives from purchasing a commodity is called consumer's surplus. In the words of Marshall, the excess of price which a person would be willing to pay rather than go without the thing, over the price which he actually does pay, is the economic measure of this surplus satisfaction. It may be called consumer's surplus"

Consumer's Surplus = what the consumer is prepared to pay - what he actually pays

= $\sum$ Marginal utility - (price X No. Of units purchased)

= $\sum$ MU - PQ

= $\sum$ TU - Total amount spent

The concept of consumer's surplus can be explained with the help of Table 1.1 and Figure 1.13.

Table 1.1: Consumer's Surplus

Units of X	MU	Price	Consumer's surplus
1	100	20	80
2	70	20	50
3	50	20	30
4	35	20	15
5	25	20	5
6	20	20	0

Total unit purchased= 6TU = 300Total Money spent = 120 Total C.S. = Rs 180

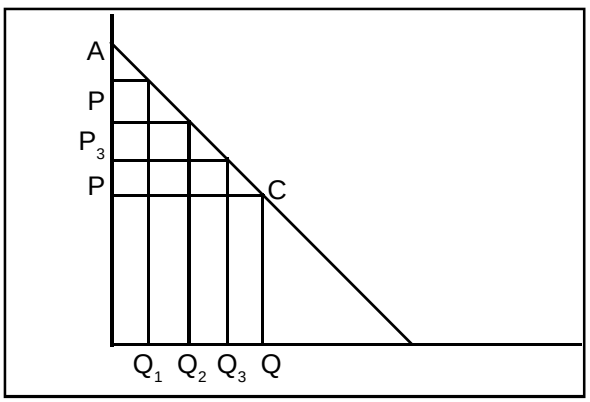
Therefore, total consumer's surplus = Rs 300 - Rs 120 = Rs 180

From this table it is known that the market price of X is Rs 20. The consumer will be going to purchase as many Xs one by one till his MU equals its prices.

Thus consumer purchased 6 units of X and his TU = 300 and price is 120. Therefore his consumer's surplus is equal to 300 - 120 = Rs 180

This concept can also be found from each unit of X. In the first unit, C.S. = 100 - 20 = 80. Similarly in 5th unit C.S. = 25 - 20 = 5 and in the 6th unit, there is no consumer's surplus because market price and consumer's prices are same. Now, if we add all the CS, then it is equal to 180P. Graphically it is shown in Figure 1.13.

Figure 1.13: Consumer's Surplus



In Figure 1.13, AB is the consumer's demand curve for X and market price is OP. At this price, the consumer consumes CQ quantity of X at OP price. However, the consumer is willing to pay OP1 for OQ1, OP2 for OQ2 and OP3 for OQ3 and so on. Thus, it is clear from the above figure that market price of commodity X is lower than the price which the consumer would be willing to spend to acquire the amount Q. In the above figure, it is the area APC which is known as the consumer's surplus.

With the help of indifference curve also the consumer's surplus can be explained which is shown in the following diagram.

In Figure 1.13, X axis measured goods and Y axis measured consumer's money income. The budget line of the consumer is M and it touches indifference curve at E. Therefore the consumer attains the equilibrium at point E. The consumer buys OV quantity of X and pays AM

and the remaining amount of money OA being left to spend on other commodities.

Now to find out the amount of money which the consumer would be willing to pay for the quantity OQ we have drawn another indifference curve passing through the point M and it is vertically parallel to the indifference curve I1 due to Marshallian assumption that the MU of money income is constant. Thus the indifference curves will have the same slope at any given quantity of X. For example at Q the slope of I1 is same as the slope of I0.

Therefore, $[\text{Slope of } I_1 \text{ for Q units of X}]$

$= MRS_{x,m} = MU_x/1 = MU_X$

(Given that $MU_x = 1$

$[\text{Slope of I0 for Q units of X}]$

Given that the quantity of X is the same at E and B, the two slopes are equal.

The indifference curve Io shows that the consumer would be willing to pay the AM for the quantity OQ, because at B, the consumer is indifferent between the consumption of the commodity of OQ of X and OA' of income.

Therefore, the difference between A'M - AM is the difference between what the consumer actually pays (AM at PX) and what he would be ready to pay for OQ of X. This is concept of Consumer's Surplus, all to Marshall.

1.5 ENGEL'S LAW OF DEMAND

Generally the law of demand represents the relationship between demand and price. But in some situation, it is useful to consider the relationship between income and demand. The demand law which explains the relationship between income and demand is known as Engel's Law of demand. According to this law, if income of the consumer increases, quantity demanded also increases provided other things being equal and vice versa. The demand curve which is based on Engel's law is known as Engel's curve. Ernest Engel was a nineteenth century German based statistician who did the basic works related to these curves.

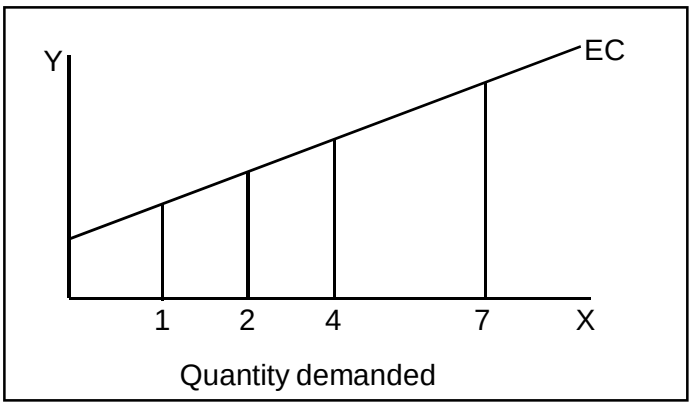
Engels curves can be drawn either for an individual or for the market or aggregate as a whole. Table 1.2 and Figure 1.14 shows the individual as well as Aggregate Engel's curve.

Table 1.2: Engels Law of Demand

Consumer's income (Rs. Per week)	Quantity demanded (Units per week)
50	1
60	2
70	4
80	7

In the above table, we see that consumer's income continuously increases along with quantity demanded of good X on the assumption that the price of X and all other influencing factors remain constant. When we plot this table on the graph, we get the individual's Engel demand curve as shown in the figure below.

Figure 1.14: Engel's Demand Curve



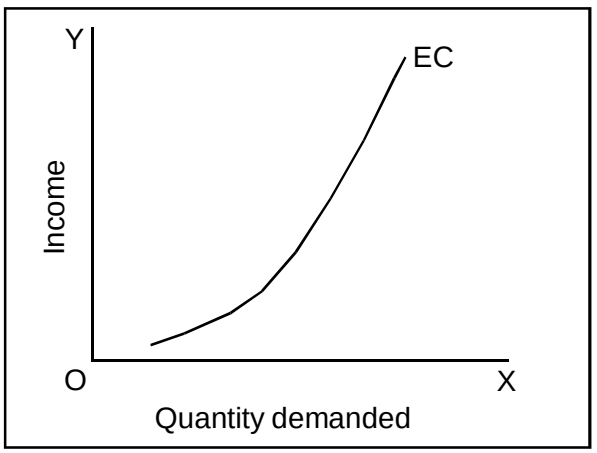
This curve shows the relationship between the level of income and quantity demanded of goods. Again the aggregate demand curve can be shown with the help of Table 1.2.

Table 1.2. shows consumption pattern of different commodities of the various income group. When it is plotted on the graph, we find the aggregate Engel curve of the economy.

Table 1.3: Aggregate Demand

Commodity	Income group			
	Less than Rs. 10000	10000 - 20000	20000 = 30000	Above 30000
House rent	854	1746	3882	
Health care	1642	2053	1843	
Food	1034	1690	1947	
Clothing	2461	3585	5118	
Stationery	864	1081	1098	

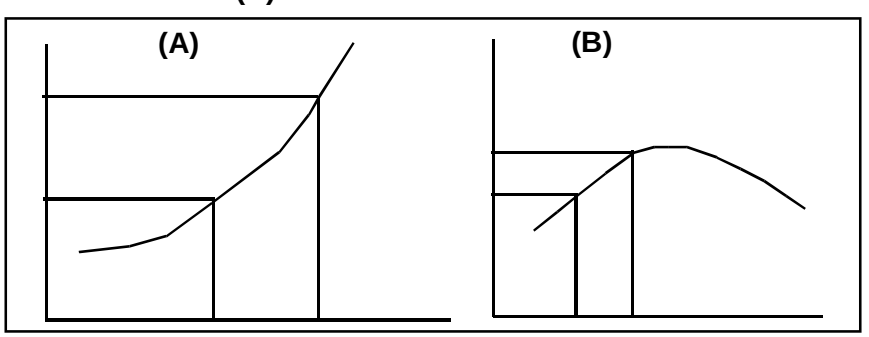
Figure 1.15: Engel's Aggregate Demand Curve X an Economy



In Figure 1.15 x axis represents the quantity consumed on various commodities and Y axis represents the different income level. The curves are the aggregate Engel's demand curves for the economy as a whole.

Shape of the Engel's curve: There are different shapes of Engel's curve depending on the degree of change in income level. Figure 1.16 (A) shows the quantity consumed of the good increases with income at a decreasing rate; and Figure 1.16 (B) shows the quantity consumed of the good increases with income at an increasing rate. So its shape is different.

Figure 1.16: Engel's Demand curve For Normal Goods (A) and Inferior Goods (B)



Thus, Engel curves are very useful for distinguishing between normal and inferior goods. When income increases quantity demanded for normal goods rises on the other hand quantity demanded for an inferior goods falls. For example, when income increases, the demand for colour TV increases, but black & white TV falls.

Engel's demand curve is a very important tool for analysing the inequalities of income and distribution of an economy.

1.6 ELEMENTARY THEORY OF PRICE FORMATION

The pricing system ensures that the individuals or firms who get the goods or services are willing to and are able to pay for them. Price of a good and services indicate how much money individuals are prepared to pay for having them. In other word, prices convey information to the firms about how individuals value different goods and services. Especially in a market economy, the role of price is very important. In a perfectly competitive market, an individual firm is just a price taker; while in imperfect or monopoly market, the supplier can have the control over the price and quantity to be supplied by them. Pricing is not only the fixation of values of product, but also the valuation of the different factors of production though the determination is more or less similar. Price formation may be studied both at micro level and macro level.

In case of micro level price formation, we study the determination of price of particular product or factor by a particular firm or industry or market. On the other hand, at macro level we study the general price level. Here, we will discuss the pricing or price formation at micro level especially for a market economy with less or no interference by the Govt.

In an economy where there is no Government intervention, the price of a commodity is determined by the interaction of demand for and supply of the commodity. In such a free market economy, the price is formed at the equality between the demand for and supply of the commodity. However, this free market formation of price may be influenced by Govt. Intervention when the price is fixed without equality of demand and supply of the

commodity. Here we shall discuss first the equilibrium price and quantity which is determined in a market economy and then we may further proceed to discuss the implications of Government intervention with the price.

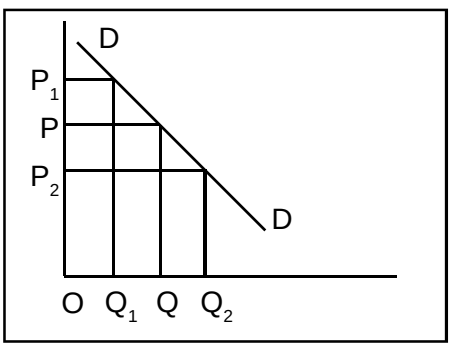
1.6.1 Demand Price Equilibrium and Demand Function

In a free market in absence of any kind of intervention, price of a good is determined where the demand and supply of the good become equal. As we know from the law of demand for a normal commodity has an inverse relationship with its price, the demand curve for normal good is downward sloping. This demand law simply expresses the functional relationship between price and quantity demanded. That is,

$Q_d = f(P)$, ... (1)

Where, Q_d is the quantity demanded and P is the price of the commodity. Here Qd is the dependent variable and the P is the independent variable. Thus there is trade off between values offered or price of the commodity and the quantity demanded. For a higher price, less quantity will be demanded and vice versa. This trade off between price and demand is represented by the demand curve for the commodity. For such functional relationship, the demand curve may be shown with the help of Figure 1.17.

Figure 1.17: A Linear Demand Curve



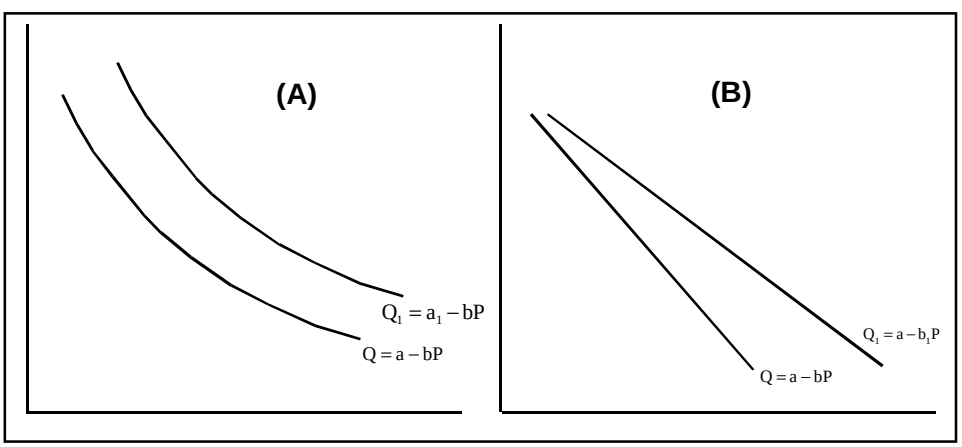
In Figure 1.17, for price OP, OQ quantity will be demanded. If the price is increased to OP1, the quantity demanded will be decreased to OQ1, and vice versa. For the above demand curve,

let us form a linear demand function which can represent the usual shape of the demand curve for a market model as,

$$Q_d = a - bp \qquad (2)$$

Where 'a' and b are constants representing the intercept and the slope of the demand curve. As the slope of the demand curve is negative, the sign before b is negative. Again since at zero price quantity demanded will be maximum, the intercept of the demand curve is positive. Keeping the slope of the demand curve, if we increase the value of a (the intercept), the demand curve will simply shift to the right parallel to the original demand curve and vice versa as shown in Figure 1.18.

Figure 1.18: Change in the Intercept of the Demand Curve (A) and Change in the Stage of the Demand Curve (B)



Similarly an increase in the value of b represents the increase in the slope of the demand curve which is the proportion between the change in quantity demanded and change in price. i.e.

$$b = \Delta Q/\Delta P.$$

Thus increase in the value of b (keeping a unchanged) makes the demand curve steeper than before and vice versa as shown in the figure below.

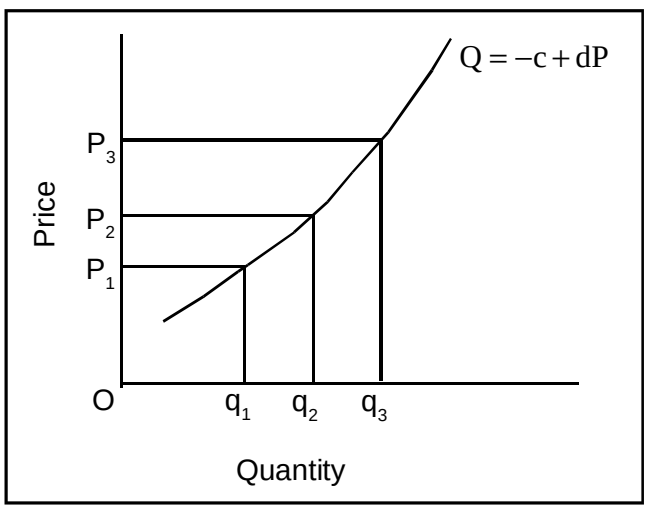
1.6.2 Supply Price Equilibrium and Supply Function

The supply, on the contrary, has a positive relationship with the price of a commodity. If we express this also in functional form, the relationship between quantity supplied and price can be expressed as,

$Q_s = f(P)$ (3)

The relationship has been shown in Figure 1.19.

Figure 1.19: A Supply Curve



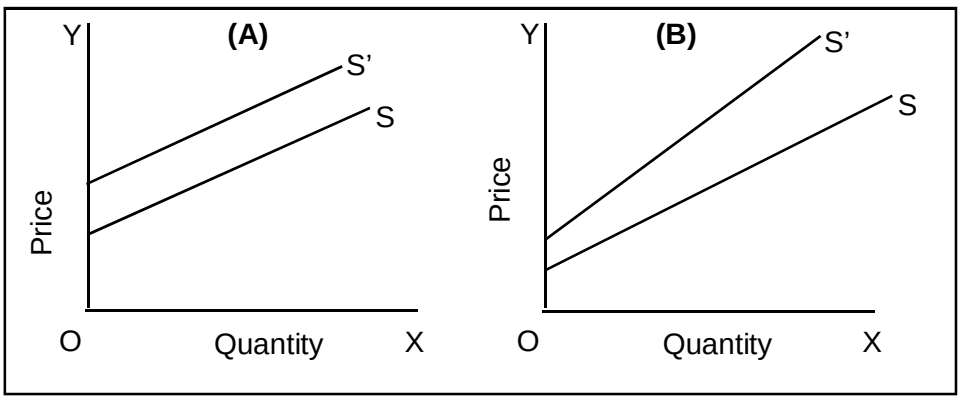
In Figure 1.19, different price and supply trade off has been shown with a upward sloping supply curve depicting a positive relation between price and quantity supplied. For a positively sloped supply curve, the linear supply function can be formed as,

$Q_s = -c + dP,$ (4)

Where, c and d are intercept and slope of supply curve respectively. Here negative sign before c implies that there should be a minimum price for the supplier, that is, he requires a minimum price and according to the slope of the supply curve which is positive, at zero prices, the quantity supply cuts the x- axis at a negative region. Similar to the demand curve, an increase in the absolute value of c leads to shift in the supply curve to the left implying a contraction in supply. Again change in the value of the d changes the steepness of the supply curve. Effect of change in the intercept

and slopes of supply curve on the shape and movement of the supply curve have been shown in the Figures 1.20 (A) and (B) below.

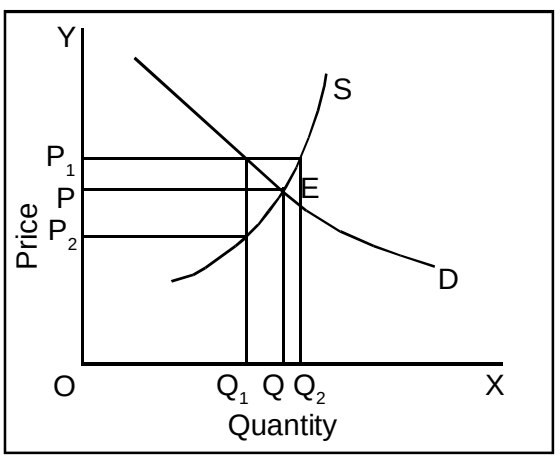
Figure 1.20: Change in the intercept of the supply curve (A) and Change in the slope of supply curve (B)



1.6.3 Market Equilibrium

The price is fixed at the equilibrium, which is attained when the demand and supply are equal. Diagrammatically, it is the intersection point between the demand and supply curves as shown in Figure 1.21.

Figure 1.21: Market Equilibrium



In Figure 1.21, the equilibrium point E determines the equilibrium price OP and equilibrium quantity OQ. At equilibrium, the demand price and the supply price become equal. Here, the quantity supplied and quantity demanded also become equal. Any movement from the equilibrium position makes the demand price

and supply price inequality leading either excess supply or excess demand. For example if the price increases to OP_1, the quantity demanded will be OQ_1 against OQ_2 supply creating an excess supply. Alternatively, For OQ_1 amount quantity, demand price will be OP_2 while supply price will be OP_1. Thus, except equilibrium price and quantity, the demand price and quantity and supply price and quantity are not equal. For equilibrium price and quantity, demand and supply should be equal.

Formation of basic market model: From the demand and supply functions above and the equality of both for equilibrium, we can proceed to a basic market model to find the equilibrium price and quantity as follows. In equilibrium,

$$Q_d = Q_s \qquad (5)$$

Now putting the equations (2) and (4) in (5), we get,

$$\begin{aligned} & a - bP = -c + dp \\ \Rightarrow\ & bP + dP = a + c \\ \Rightarrow\ & P(b + d) = a + c \\ \Rightarrow\ & P = \frac{(a + c)}{b + d} \qquad (6) \end{aligned}$$

Thus, P = (a + c)/(b + d) is the equilibrium price. Now, putting the equilibrium price into the demand function,

$$\begin{aligned} Q &= a - b\left(\frac{a + c}{b + d}\right) \\ &= -\left(\frac{ab + bc}{b + d}\right) \\ &= \frac{ab + ad - ab - bc}{b + d} \\ &= \frac{ad - bc}{b + d} \end{aligned}$$

Thus, the equilibrium quantity demanded will be $Q = \frac{ad - bc}{b + d}$. If we put the equilibrium price at supply function, then

also we shall get the same quantity which simply proves that at equilibrium, quantity demanded and supplied are matched ruling out any excess demand or excess supply in the market.



LET US KNOW

I We can find the elasticity of demand from a linear demand function. For example if the demand function is given as, $Q_d = 100 - 5P$, the elasticity of demand at 50 units of output using the formula, $e_d = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$, here, $\frac{\Delta Q}{\Delta P}$ is the slope of demand curve and hence -5. Putting Q = 50 in the demand function, we get p = 10. Therefore, $e_d = 5 \times \frac{10}{50} = 1$



CHECK YOUR PROGRESS

Q 6: Given the market model in a competitive market

$Q_d = 15 - 2P$

$Q_s = -5 + 2P$

Where, Qd and Qs are quantity demanded and supplied respectively. Find the equilibrium price and output.

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Q 7: What determines the price of a commodity in a free market economy?

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Government intervention and its impact on price and output: Government can intervene on the equilibrium price directly or indirectly. Direct intervention may be practiced in two ways -

- When it is seemed that some commodities are very essential but poor people are not able to buy with the market determined price which is very high, Government can fix a maximum price for such commodities. It is called Price ceiling.
- Sometimes it is seen that producer of certain commodity cannot get the reasonable price as per their cost due to insufficient demand or other reasons. In such cases Govt. can interfere with the market price by fixing a minimum support price which is called price flooring.

In case of price ceiling, the price is fixed at lower level than the market determined equilibrium price. On the contrary, in case of price flooring, the price for a good is fixed at a higher level than the market determined price.

Government also intervenes the market price and quantity indirectly through tax and subsidies which also affect the buying price for the ultimate consumer of particular commodity.



1.7 LETS US SUM UP

- Elasticity is the degree of responsiveness between two variables. Thus Price elasticity of demand explains how demand for a commodity responds when its price changes.
- Goods having high rate of response with price changes are highly elastic and vice versa.
- Generally necessity goods are less elastic or inelastic while luxurious goods are highly elastic.
- Frequently used concepts of elasticity are Price elasticity, income elasticity and Cross elasticity.
- While measuring elasticity of demand, when $e_d = 1$, it is called unitarily elastic demand, when $e_d > 1$, it is elastic and when $e_d < 1$, it is inelastic

demand. Two extreme cases of elasticity of demand are: when $e_d = 0$, the demand for such commodity is perfectly inelastic and when $e_d = \infty$, the commodity's demand is perfectly elastic.

- For perfectly elastic goods, demand curve is horizontal to the x axis and the goods whose demand is perfectly inelastic; demand curve is a vertical line to the x axis.
- With cross elasticity of demand we can also identify the natures of two commodities as complimentary, substitutes or independent commodities. In case of positive cross elasticity of demand, two goods can be said to be substitutes. If cross elasticity of demand is negative, the two commodities are said to be complimentary. On the other hand, if cross elasticity is zero, it can be said that two goods are not related.
- Market price of a commodity is fixed with the interaction of demand and supply of the good in the market. When quantity demanded equals its quantity supplied, market equilibrium is attained where equilibrium price and output is determined.
- Demand price equilibrium or trade off is the different quantity demanded at different prices, which trade off gives the demand curve for the commodity. Since demand moves in opposite direction with movement of price, demand curve is negatively sloped. Conversely, different equilibria between quantities supplied at different prices gives the supply curve which is positively sloped.
- Basic market model is a simple mathematical treatment to find the equilibrium price and output from given demand and supply functions.
- Though equilibrium price and output are determined in a free competitive market, sometimes Government intervenes the market in certain situations either directly through price ceiling and price flooring or indirectly through taxes, subsidies, or imposing restrictions on production level.
- As a result of imposition of tax per unit, price of the good increases while quantity supplied decreases. Conversely, subsidy has opposite impact to tax on price and quantity of a good.

1.8 FURTHER READING

1) Miller, E. & Maddala G.S.: *Microeconomics: Theory and Applications,* Tata McGraw Hills, New Delhi
2) Mandal, R.K: *Microeconomic Theory,* Atlantic, New Delhi
3) Koutsoyiannis, A: *Modern Microeconomics,* Macmillan, London
4) NCERT, *Introduction to Microeconomics:* New Delhi

1.9 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q. No. 1: Do it yourself.

Ans to Q. No. 2: The price elasticity may be calculated using the following formula: $|e_p| = \Delta Q/Q \div \Delta P/P,$ where, e_p is price elasticity

$= \Delta Q/\Delta P.P/Q$

Here, Q is quantity demanded at price $P, \Delta Q$ is the changes in quantity demanded and ΔP is the changes in price.

Ans to Q. No. 3: Do it yourself.

Ans to Q. No. 4: The relationship between income elasticity and proportion of a good can be stated with the help of following three propositions:

Proposition 1: As a result of increase in income, the proportion of income spent on good increases, then $e_y > 1$.

Proposition 2: As a result of the increase in income, the proportion of income spent on goods remains the same, then, $e_y = 1$.

Proposition 3: As a result of the increase in income of the proportion of income spent on goods decreases then $e_y = < 1$.

Ans to Q. No. 5: Do it yourself.

Ans to Q. No. 6: Do it yourself.

Ans to Q. No. 7: In a free market economy the forces of market demand and market supply determines the price of a commodity.

1.10 MODEL QUESTIONS

Q 1: What do you understand by elasticity of demand? What are the factors determining the elasticity of a good?

Q 2: Explain various methods of measuring elasticity of demand.

Q 3: Point out the implications of elasticity of demand and the slopes of demand curve with suitable diagrams.

Q 4: Define income elasticity of demand. Explain the income elasticity of demand and proportion of income spent on that good.

Q 5: How will you find the income elasticity of demand from the proportion of income spent on a good?

Q 6: What is cross elasticity of demand? How can the nature of relation between two goods found with the concept of cross elasticity?

Q 7: Price elasticity of demand for salt is very small. Why?

Q 8: Explain the determination of market price and output with simple basic market model.

Q 9: "Market equilibrium is determined with interaction of market demand curve and supply curve" - Explain with diagram. What happens to the market price and output if the demand curve shifts to right?

Q 10: Explain the implications of tax and subsidies on equilibrium price and output of a good.

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UNIT 2: THEORIES OF CONSUMER BEHAVIOUR

UNIT STRUCTURE

2.1 Learning Objectives

2.2 Introduction

2.3 The Indiference Curve Technique: Basic Concepts

- 2.3.1 Assumptions of the Indifference Curve Technique
- 2.3.2 Indifference Schedule and Indifference Curve
- 2.3.3 Indifference Map
- 2.3.4 Properties of Indifference Curve

2.4 Equilibrium of a Consumer using the Indifference Curve Approach

2.5 Price Effect, Substitution Effect and the Income Effect

2.6 Giffen Goods

2.7 Revealed Preference Theory

2.8 Let Us Sum Up

2.9 Further Reading

2.10 Answers to Check your Progress

2.11 Model Questions

2.1 LEARNING OBJECTIVES

After going through this unit, you will be able to-

- explain the basic concepts of indifference curve and the budget line
- derive the equilibrium of the consumer using the ordinal/indifference curve approach
- explain the price effect and split it up into substitution effect and income effect.
- give the concept of giffen goods

2.2 INTRODUCTION

This unit deliberates on the study of consumer behaviour through ordinal approach. This approach states that utility is not measureable in a cardinal way. A consumer can only give rank to his preferences or order

them. In this unit the attainment of a consumer's equilibrium ordinally through the use of indifference curve approach has been discussed. At first, the basic concepts related to indifference curve approach has been given. Finally, the concept of price effect and its breaking up into the substitution effect and income effect have also been discussed along with the idea of Giffen Goods.

2.3 THE INDIFFERENCE CURVE TECHNIQUE : BASIC CONCEPTS

The indifference curve technique was conceived as an alternative to the cardinal utility approach of the theory of consumer behaviour. A number of economist have contributed to this techique as it has evolved over the years, with the latest reflnements attributed to Slutsky, J.R. Hicks and R.G.D. Allen.

The indifference curve technique rejects the concept of cardinal utility and asserts that utility cannot be measured in quantitative terms. Instead, it adopts the principle of ordinal utility which states that, while the consumer may not be able to indicate exactly the amount of utility that he derives from the consumption of a commodity or a combination of commodities, he is perfectly capable of comparing and ranking the different levels of satisfactions that he derives from them. For example, in case of different varieties of rice, Mrs Saikia may prefer (in terms of satisfaction derived from) to consume a *joha* variety of rice over *aijung* variety of rice, and *aijung* variety of rice over *parimal* variety of rice. Interestingly, this much of information(i.e., information about the order of ranking among the different varieties of rice) is sufficient to derive the demand schedule and hence the demand curve of an individual consumer. Therefore, the questionnable assumption that consumers possess a cardinal measure of satisfaction can be dropped. Thus, the basic distinction between the two schools of thought is that the cardinal approach to the measurement of utility believes that the utility derived from the consumption of commodity can be expressed in quantitative terms. The ordinalist approach, on the other hand, rejects this and states that the

consumer at best can rank the various commodities (or combination of them) in accordance with the satisfaction that he/she expects from their consumption.

Now, let us discuss some of the key concepts used in the indifference curve analysis, viz. indifference curve, indifference map and the budget line. Let us begin with the assumptions on which the theory of indifference curve rests.

2.3.1 Assumptions of the Indifference Curve Technique

The indiference curve technique is based on the following assumptions.

- **Utility can be ordinally measured:** The consumer can rank various commodities or combination of commodities in accordance with the satisfaction that the consumer derives from them.
- **The consumer is rational:** Given the market prices and the money income, a consumer will attempt to maximise his/her satisfaction when he/she undertakes consumption.
- **Additive Utilities:** The quantities of the commodities that is consumed determines the total utility of the consumer.
- **Consistency of choices:** The choice of the consumer is consistent in the sense that if he/she chooses combination A over B in one peried, he/she will not choose B over A in another period. Symbolically : If A>B , then B<A.
- **Transitivity of consumer choice :** If a consumer prefers combination A to B, and prefers B to C, then, it can be concluded that he/she prefers A to C.

  Symbolically : If A>Bs, and B>C, then A>C.

2.3.2 Indifference Schedule and Indifference Curve

An indfference curve is defined as the locus of the various combinations of two commodities that yield the same satisfaction to the consumer, so that the consumer is indifferent to any one

particular combination. In other words, all combinations of the two commodities in the indifference curve are equally desired by the consumer.

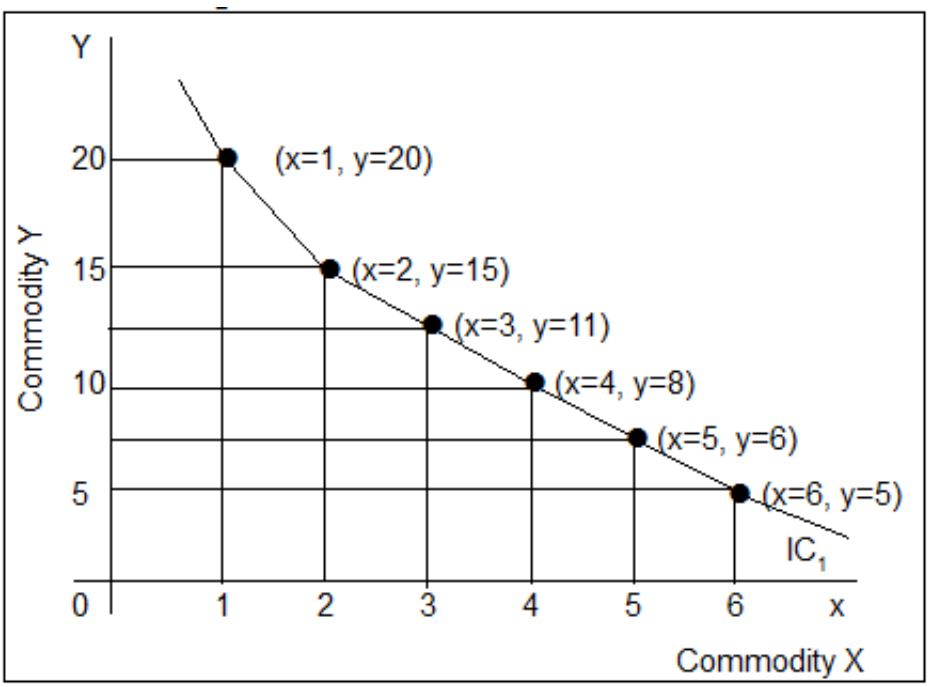
An indifference curve is based on the indifference schedule, which represents the various combinations of two commodities that give the consumer the same level of satisfaction. Given below is an indifference schedule representing various combination of commodity x and y that gives the consumer the same amount of satisfaction.

Table 2.1 : Indifference Curve Schedule

Combination	x	y	MRS_{xy}
1st	1	20	...
2nd	2	15	5
3rd	3	11	4
4th	4	8	3
5th	5	6	2
6th	6	5	1

Putting the various combinations of the indifference schedule from the above Table 2.1, we obtain the IC, indifference curve as shown in Figure 2.1

Figure 2.1 : Indifference Curve



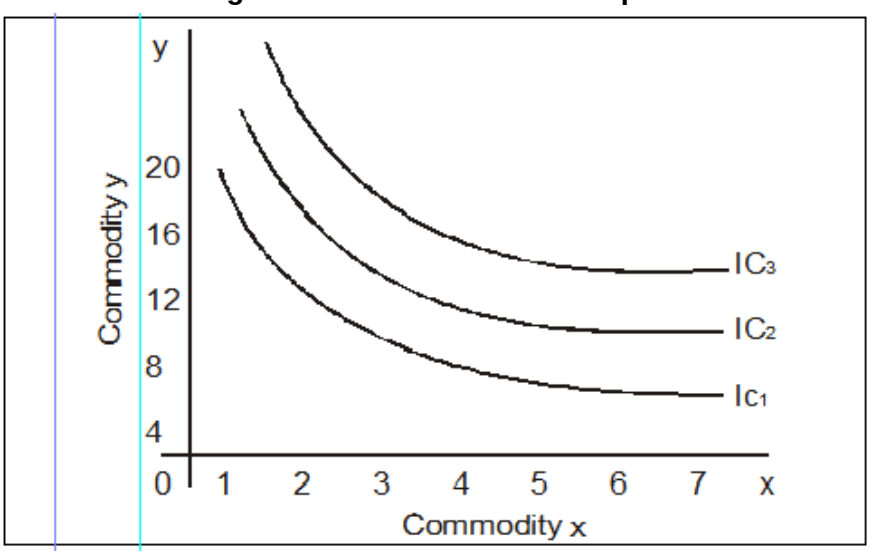
In Figure 2.1, the slope of the indifference curve is indicated by the "marginal rate of substitution'. The marginal rate of substitution of X for Y is defined as the numbers of y that has to be given up by the consumer to get an additional unit of x, so that his/her satisfaction remains unchanged. Thus, [slope of the indifference curve]=MRS_{xy}.

It can be seen from Table 2.1 that as the consumer gets more and more of X, the number of Y he is willing to give up for an additional unit of X successively falls. This is known as the "principle of diminishing marginal rate of substitution" which states that the marginal rate of X for Y falls as more and more of X is substituted for Y. This implies that the indifference curve always slopes downwards to the left and is convex to the origin.

2.3.3 Indifference Map

An indifference map, on the other hand, shows all the indifference curves which rank the preference of the consumer. While the combinations of commodities on the same indifference curve yield the same satisfaction, combinations on a higher indifference curve yield higher levels of satisfaction and combinations on a lower curve yield lower levels of satisfaction. In Figure 2.2, an indifference map has been shown.

Figure 2.2: An Indifference Map



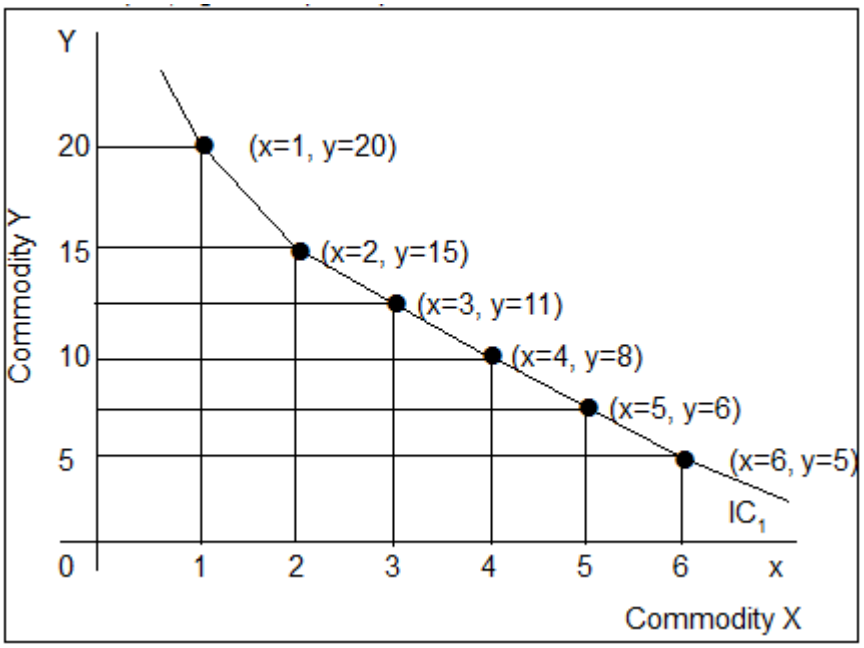
In Figure 2.2, we see an indifference map of a consumer. It is needless to say that the rational consumer would prefer to be on a higher indifference curve (i.e. he would prefer to be on IC_2 than being IC_1 and on IC_3 than on IC_1 and IC_2) rather than on the indifference cure which is positioned lower (IC_2 or IC_1).

2.3.4 Properties of Indifference Curve

Let us now discuss the properties of the indifference curves. The important properties of the indifference curves are as follows :

- **Indifference curves are downward sloping towards the right :** The first important property of an indifference curve is that it slopes downward from left to right. This is also called as indifference curves are negatively sloped towards right. The basic reason for the downward slope is that as the consumer chooses to move along an indifference curve, he/she has to sacrifice some units of one good to obtain an additional unit of the other good. The sacrifices of a few units of one good for obtaining an additional unit of the other good becomes necessary so that the consumer remains in the same level of satisfaction as he/she moves along an indifference curve. Thus, we get the indifference curve of the shape as has been shown in the previous figure 2.1 or 2.2.
- **Indifference curves are convex to the origin :** Another important property of an indifference curve is that an indifference curves is convex to the origin. The convexity of an indifference curve is basically due to the working of the principle of diminishing marginal rate of substitution. While discussing the concept of an indifferene curve, we have mentioned that as the consumer consumes more and more units of X, the number of units of Y he is willing to give up for an additonal unit of X begins to fall. A relook at the table 2.1 as has already been discussed would clarify this point. From the table, it can be

seen that as the consumer increases consumption of X by an additional unit, he tends to give up smaller units of Y for each additional unit of X. The indifference curve representing the table 2.1 (i.e., figure 2.1) is reprodued here

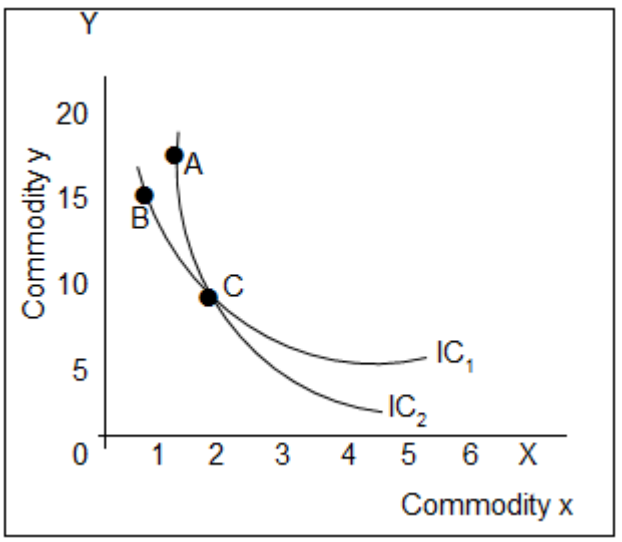


Ø **Indifference curves cannot intersect :** Another important property of an indifference curve is that no two indifference curves can intersect. This means that only one indifference curve can pass through a point in an indifference map. Figure 2.3 will make this point clear.

From the figure shown in the next page it can be seen that the indifference curve IC_2 allows the consumer to choose the combination A. Again IC_1 is another indifference curuve in his indifference map. Now, let us suppose that the consumer chooses combination B in the indifference cuve IC_1. It is obvious from the above figure that combination A would give the consumer higher level of satisfaction as it offers the consumer higher quantities of both the goods X and Y. Now, let us consider point C. This point is common to both the indifference curves.

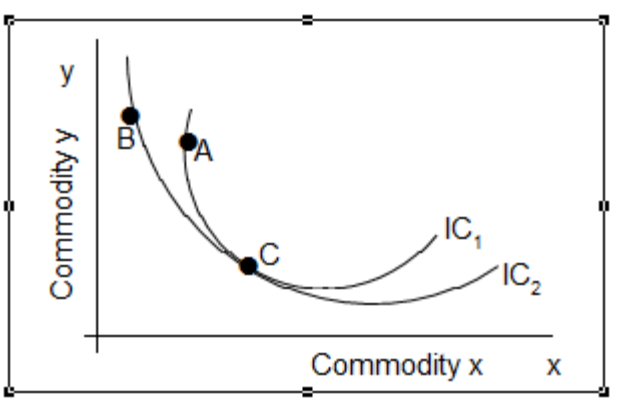
Thus, combinations A and C would give the consumer the same level of satisfaction, as both the points lie on the same indifference curve IC_2. Again for combinations B and C also the consumer will derive the same level of satisfaction as both of them are on the same indifference curve IC_1. What it means is that combinations A and B will derive the same level of satisfaction. This is not at all logical to accept. Thus, two indifference curves can never intersect.

Figure 2.3 : No two Indifference Curves can intersect



The same thing may happen if two indifference cuves touch a single common point in an indifference map as has been shown in the next Figure 2.4.

Figure 2.4 : No two Indifference Curves can touch each other





CHECK YOUR PROGRESS

Q 1: State whether the following statements are True (T) or False (F).

(a) According to the indifference curve analysis, consistency of consumer choices states that if a consumer prefers combination A to B, and prefers B to C, then it implies that the consumer prefers A to C.

(b) According to the indifference curve approach, utility cannot be cardinally measured, they can only be ordinally arranged.

Q 2: Fill in the blanks :

(a) The slope of the indifference curve is indicated by .....

(b) Two ..... cannot intersect.

(c) An indifference curve is defined as the ..... of various combinations of two commodities that yield the ..... level of satisfaction to the consumer.

Q 3: What do you mean by 'consistency of consumer choices' and 'transitivity of consumer choices' as discussed in the indifference curve analysis? (Answer in about 50 words).

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Q 4: What does an indifference schedule exhibit? (Answer in about 30 words)

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Q 5: Can an indifference curve be upward rising? Justify your view in about 60 words.

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2.4 EQUILIBRIUM OF A CONSUMER USING THE INDIFFERENCE CURVE APPROACH

The equilibrium of a consumer under the indifference curve approach can be derived using the budget line and the indifference curve of the consumer. Therefore, before discussing the equilibrium of the consumer, let us first discuss the concept of the budget line.

Concept of the Budget Line : The budget line is an important concept in the indifference curve technique. It is defined as the various combination of the two commodities (X and Y) that a consumer can consume, given his income(M) and the price of the two commodities (P_x and P_y).

The Budget line can be algebraically expressed as : $M=P_xX + P_yY$.

where X and Y indicate the quantities of X and Y respectively.

Now, let us suppose, M=100, P_x=10 and P_y=20, then

(a) If the consumer spends all his income on x, then he can consume

$$X = \frac{M}{Px} = \frac{100}{10} = 10$$

(b) and if he spends all his income on y, then the number of units of y that he can consume is :

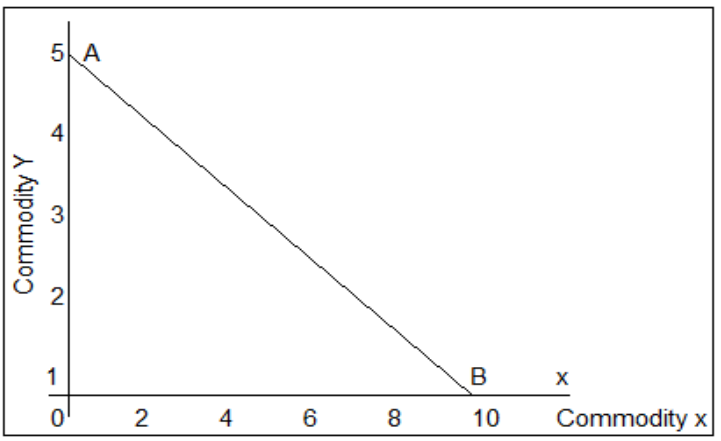
$$Y = \frac{M}{Py} = \frac{100}{20} = 5$$

Thus, 10 X and 5Y are the two extreme limits of the consumer's expenditures. However, he usually prefers a combination of the two commodities within these two limits. In fact, the budget line joins the two extreme consumption limits of the consumer, and the points within those two limits indicate the combinations available to the consumer, given his

income and the prices of the two commodities.

The concept of budget line has been shown with the help of figure 2.5.

Figure 2.5 : Budget Line



In the above figure 2.5, AB indicates the budget line. In this budget line AB, the consumer has the option of consuming 10X (0B) or 5Y (0A) or some combination of the two.

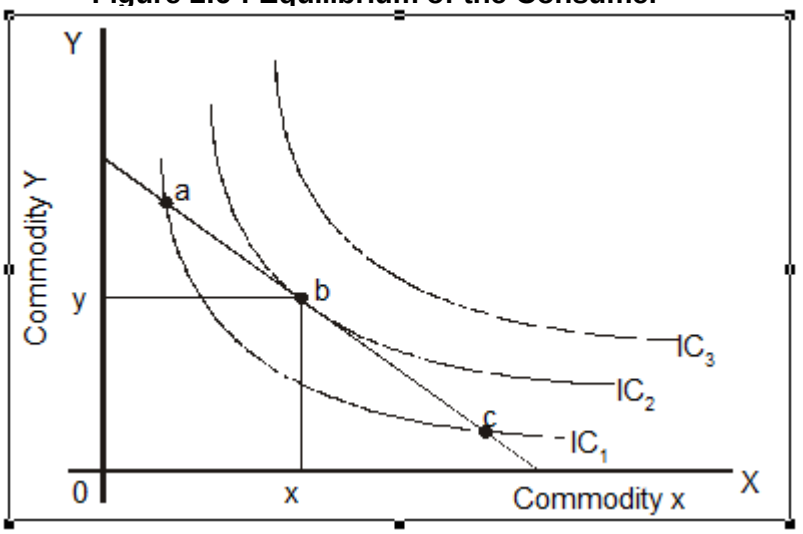
The slope of the budget line is the ratio of the prices of the two commodities. Geometrically,

$$[\text{Slope of the Budget Line}] = \frac{M/P_y}{M/P_x} = \frac{P_x}{P_y}$$

Consumer's Equilibrium: Given his budget line, a consumer would like to maximise his satisfaction by climbing on to the highest indifference curve. This has been shown in the following figure 2.6.

From the above figure 2.6 it can be seen that the consumer is at equilibrium at point b, where his budget line is tangent to the indifference curve IC_2. He has the option of consuming at 'a' and 'c', but those combinations are rejected as they would place him on a lower indifference curve IC_1. The consumer would like to be on the indifference curve IC_3, but his budget line does not allow him to do that. From figure 2.6, it can be seen that at equilibrium the consumer consumes 0x amount of x and 0y amount of y.

Figure 2.6 : Equilibrium of the Consumer



Thus, at equlibrium,

[slope of the indifference curve] = [slope of the budget line]

Symbolically, it can be expressed as :

$$MRS_{xy} = \frac{P_x}{P_y}$$

Indifference Curve Technique vs Cardinal UtilityAnalysis:

The indifference curve technique is considered to be surperior to the cardinal utility approach on the following grounds:

- It avoids the unrealistic assumption of cardinal utility and instead adopts the concept of ordinal utility.
- It can be used to split the price effect into substitution effect and income effect.
- It is not based on the unrealistic assumption of constant marginal utility of money.

Limitations of the Indiference Curve Technique : The indifference curve technique has been crticised on the following grounds :

- The indifference curve technique does not tell us anything new, and it is only “old wine in new bottle”.
- It assumes that the consumer is very familiar with his entire preference schedule, which is not the case in actual life.
- The technique can be efficiently applied only to two commodities. Once more than two commodities are introduced, the analyais become very

complicated to illustrate.



CHECK YOUR PROGRESS

Q 6: State whether the following statements are True (T) or False (F).

(a) The indifference curve approach avoids the unrealistic assumption of constant marginal utility of money.

(b) The budget line of the consumers are the same (T/F)

Q 7: Mention any two superiorities of the ordinal approach over the cardinal aproach. (Answer in about 50 words).

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Q 8: What is a budget line? Derive the algebraic expression of the budget line. (Answer in about 50 words).

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2.5 PRICE EFFECT, SUBSTITUTION EFFECT AND THE INCOME EFFECT

While discussing the law of demand, we have seen that as the price of good changes, quantity demanded for that good also changes in the opposite direction. Thus, if the price of a good rises, quantity demanded of that good falls, and vice versa.

Let us consider this question : why it so happens? Two factors may be held responsible for this. *First,* suppose our hypothetical consumer consumes two commodities, kachori and tea. Now, let us further suppose



Real Income: Income which is available for spending after tax and other contribution have been deducted corrected for inflation.

that the price of kachori increases, while price of tea remains constant. Thus, in such a situation, the ***real income*** of the consumer decreases. Thus, the purchasing power of the consumer decreases, and as such, even when the income of the consumer has not changed, his budget for consumption has decreased. This is similar to the situation, when the income of the consumer decreases. Thus, the response of the consumer to the change in the prices, i.e., his response as a matter of decline in his purchasing powers is referred to as the **income effect**.

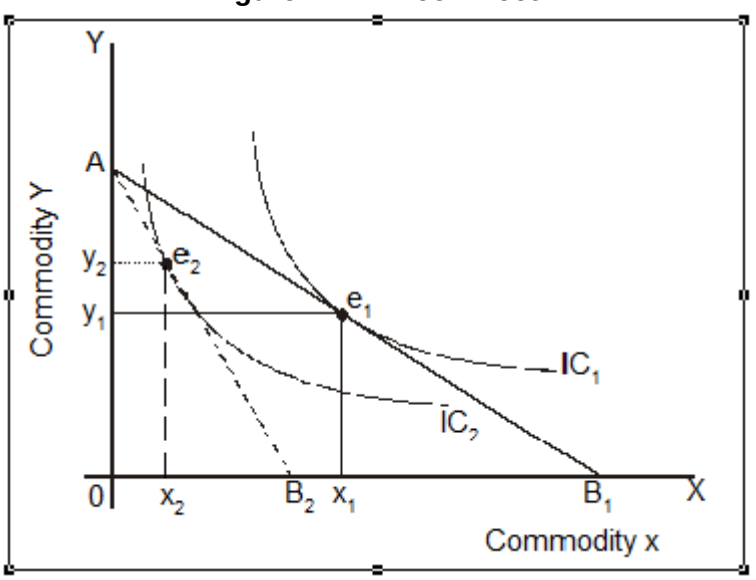
The *second* factor is that, when the price of kachori increases, and purchasing power of the consumer remaining the same, amount of tea that the consumer must give up for obtaining an extra unit of kachori increases. Let us take this example. Suppose, the price of a kachori is Rs. 4/- while the price of a cup of tea is Rs. 2/-. Thus, a cup of tea is relatively cheaper (or less expensive) compared to the other good, i.e., kachori. This means that to obtain a kachori, the consumer has to give up 2 cups of tea. Or, to obtain a cup of tea, the consumer has to give up half of one kachori. Thus, the relatie price of a good shows its cost in terms of the other good in question.

Now, suppose the price of tea increases to Rs. 4/-. The consumer must now give up one kachori for a cup of tea. Thus, compared to the earlier case, tea has become more expensive. Please note that the consumer had to give up only half of a kachori to obtain a cup of tea, but now he needs to give up a full piece of kachori for the same cup of tea. Again, to obtain a kachori, the consumer has to give up one cup of tea. Thus, compared to the earlier case, kachori has become relatively cheaper. Please note that earlier, the consumer had to give up two cups of tea for one kachori, but now, he needs to give up only one cup of tea. Thus, the response of the consumer in making choices between the two goods while taking into consideration the changes in their relative prices is known as the **substitution effect.** These two effects viz., the income effect and the substitution effect can be summed up together, and is termed as the price effect. Thus, the price effect reveals how a consumer reacts to his buying habits as a result of a change in the prices of one of the two commodities.

The price effect and its two components, i.e., the substitution effect and the income effect can be explained with the help of the indifference cuve analysis. Let us first discuss the price effect. Then we shall explain how to decompose the price effect into substitution effect and income effect.

Price Effect : We have already discussed the concept of the indifference curve and the budget line and we have seen how given his/her money income (shown by the budget line), a consumer attains his/her equilibrium in terms of the combination of the two commodities, viz., X and Y. Thus, as the price of X increases (price of Y and income of the consumer remaining the same) the budget constraint rotates clockwise about the Y axis, i.e., on the X axis, the budget line will move towards the origin point (or towards the left). This has been shown with the help of figure 2.7.

Figure 2.7 : Price Effect



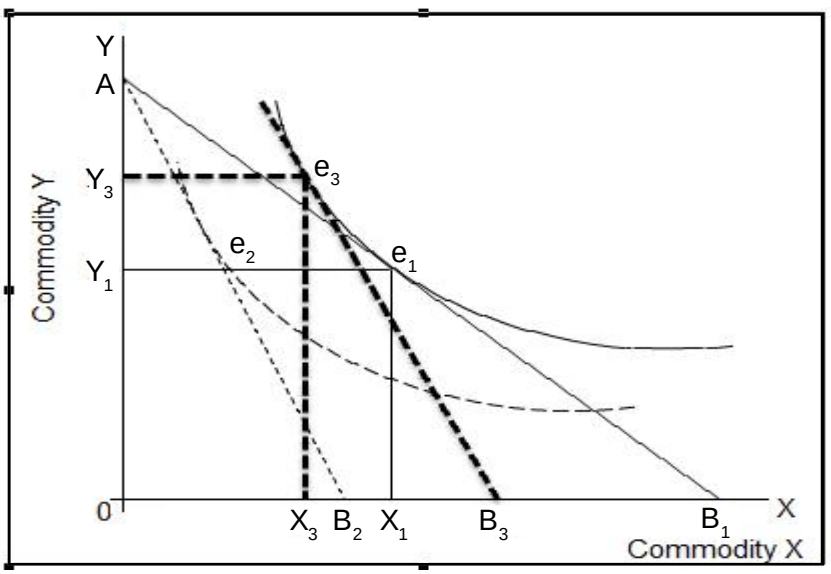
From Figure 2.7 it can be seen that the consumer originally faces the indifference curve IC_1. His/her level of income has been depicted by the budget line AB_1. Thus, given this budget line, the consumer attains equilibrium at point e_1, where the budget ine AB_1 is tangent to the indifference curve IC_1. In this point of equilibrium, the consumer consumes $0X_1$ of commodity X and $0y_1$ of commodity Y. Now let us suppose, the price of X increases. As a result, the real income of the consumer will be adversely affected. As a result, the budget line of the consumer shifts clockwise about Y axis, i.e., it moves towards the left of origin of the axes (towards point 0). The new

budget line of the consumer is AB_2. In this changing situation, the consumer no more remains on the same indifference curve. The new indifference curve of the consumer is IC_2. Thus, given the budget line AB_2, the consumer attains equilibrium at point e_2. The movement from e_1 to e_2 represents the **price effect**.

Now, let us explain how this price effect can be decomposed as the substitution effect and the income effect. We shall first discuss the substitution effect.

Substitution Effect : The substitution effect seeks to reply to the theoretical question. "What will happen if the consumer only faced the new relative price but could still attain the old level of utility. How would the consumer switch between the two goods?" The substitution effect replies to this question. The substitution effect has been explained with the help of figure 2.8.

Figure 2.8 : Substitution Effect



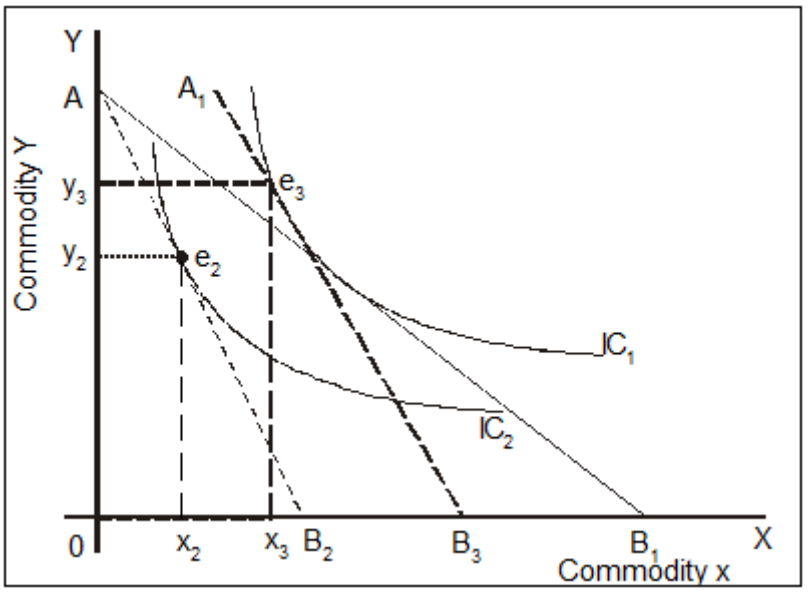
Please note that here we are trying to analyse what will happen if the consumer is allowed to close combinations of commodities in his initial indifference curve IC_1, if we take into consideration the changing budget situation (or the changing relative prices of the two commodities). Thus, we want to analyse given the new budget constraint AB_2, how the consumer will behave if he is allowed to choose combinations of the two commodities in his initial indifference curve IC_1. In such situations, the budget line will

shift in parrellel to the new budget line AB_2. In figure, this has been shown by the budget line $A'B_3$ (the dark dotted line). This budget line $A'B_3$ is tangent to the original indifference curve IC_1 at point e_3. Thus, at this equilibrium point e_3, the consumer buys less of the commodity which is relatively expensive ($0x_3$ instead of $0x_1$) and more of the commodity which is relatively cheaper ($0y_3$ instead of $0y_1$). Thus, this shows that due a change in the price, the consumers tends to sustitute relatively more expensive commodity for the relatively cheaper commodity. This is the **substitution effect**.

I**ncome Effect :** The income effect reveals how the consumer will react to a change in his purchasing power given the new relative prices. For analysing the income effect, we assume that the substitution effect has already taken place. Thus, here we take into consideration the behaviour of the consumer, when given the new relative prices, the consumer faces a lower indiference curve (as his realincome has been adversely affected, he no more remains on the same indifference curve). In such a situation, given the new budget line and the lower indifference curve, the consumer reacts by choosing less of both the commodities, as compared to when he is allowed to remain in the same indifference curve even when taking into consideration the new relative prices (this is what we have considered in case of the substitution effect). This has been explained with the help of figure 2.9.

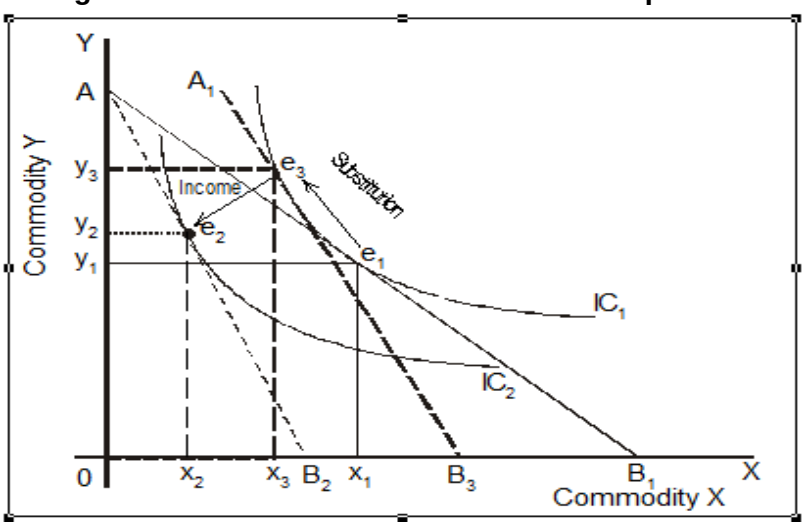
From figure 2.9, it can be seen that with the subsitution effect already in action the consumer buys less of both the commodities X and Y. The income effect has been shown by the movement of the consumer from e_3 to e_2.

Figure 2.9: Income Effect



We can now summarise the whole process in a single figure. This has been shown with the help of figure 2.10.

Figure 2.10 : Price Effect and its Two Components



In figure 2.10, the overall behaviour of the consumer as a response to the change in the price of one commodity has been shown. As the price of the X commodity increases, on overall, the consumer moves from point e_1 to point the point e_2. This is the **price effect**. However, we can break up this overall price effect into two components, viz., the substitution effect and the income effect. The substitution effect is considered first. The substitution effect has been shown by the movement of the consumer from

point e_1 to point e_3. The income effect is allowed, keeping in mind that the substitution effect has already taken place. The income effect has been shown with the help of movement of the consumer from point e_3 to point e_2.

Thus, on the overall, we can summarise that as the price of one good increases, the real income of the consumer is adveresely affected. Or, in other words, the budget line of the consumer is adveresely affected. As a result, the consumer no more remains on the same indifference curve. After the price effect is allowed to happen, and given his new budget line, the consumer attains equilibrium on a lower indiference curve. In attaining this new equilibrium, the consumer consumes less of the commodity which is relatively expensive (in our case, commodity X) and more of the commodity which is relatively cheaper (commodity Y).

2.6 GIFFEN GOODS

Giffen Goods are special categories of inferior goods which do not follow the 'law of demand'. Thus, a fall in the price of such a good will result in a decrease in the quantity demanded whereas a rise in its price would induce an increase in the quantity demanded. Robert Giffen studied this paradox. This happens because the income effect of the price change of a Giffen good is positive and is greater than the negative substitution effect. This results in a price effect which is positive, resulting in the price and quantity demanded changing in the same direction. Thus, the law of demand is violated, and we have an upward sloping demand curve.



CHECK YOUR PROGRESS

Q 9: Fill in the blanks.

a) Price effect has _____components.

b) The increase in the consumption of a commodity due to a fall in its price is called_____

c) To discuss the price effect, the _____was used by Hicks, while the cost-difference method was used by _____

Q 10: What do you mean by the price effect?
(Answer in about 50 words).

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Q 11: What is substitution effect? (Answer in about 50 words).

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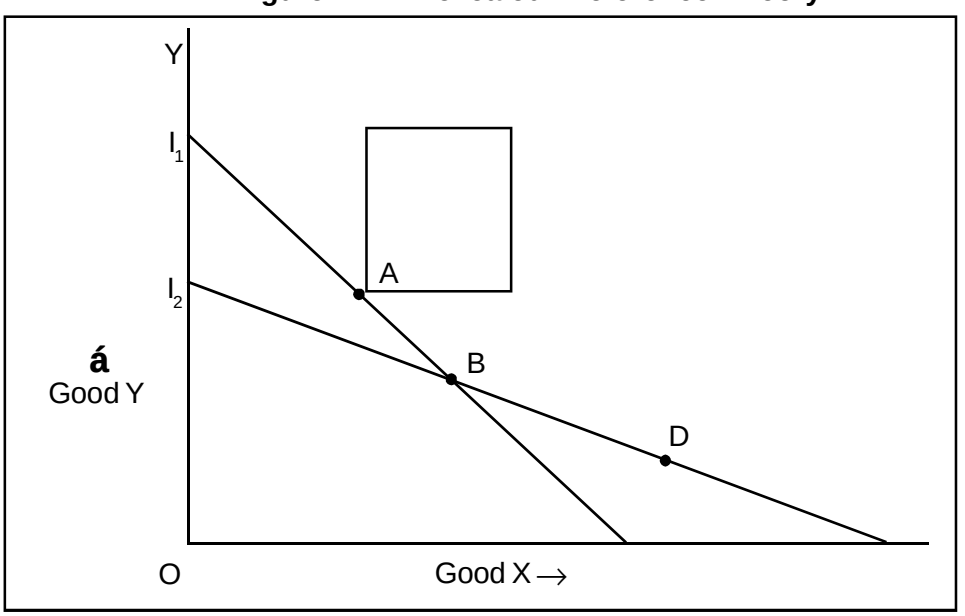
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2.7 REVEALED PREFERENCE THEORY

In the previous sections, we have discussed in details about the indifference curves and how given the budget constraint, an individual can attain equilibrium. Let us assume that an individual facing the budget constraint given by I_1 in the given diagram chooses the combination given by A. Let us now make a comparison between combination A and combination B. Here we can say that both combinations are possible for the consumer, but he prefers A to B. This has been shown with the help of Figure 2.11.

Figure 2.11: Revealed Preference Theory



In the first glance it looks that a direct comparison cannot be made between combination A and combination D because D is not on I_1. But if the relative prices of the two goods changes, and the new budget line is I_2, and the individual chooses combination B. Because D lies on the same budget line I_2 and was not chosen, B is preferred to D. Because A is preferred to B and B is preferred to D, we can conclude that A is preferred to D. Here we assume that both the goods X and Y are normal goods. Then we can say that all combinations that lie in the rectangle above and to the right of A are preferred to A. Thus, the indifference curve passing through A must lie in the unshaded area.

Revealed preference theory suggests that you can determine what consumers' preferences are by observing what they buy under a range of circumstances, particularly under different price and income scenarios. When making a purchase, as consumers, we had considered a set of alternatives beforehand, revealed preference theory suggests. Therefore, given that we chose one option out of a set, whatever we chose has to be the preferred option. Revealed preference theory was pioneered by Paul Anthony Samuelson (1915-2009), an American economist, the first US citizen to be awarded the Nobel Memorial Prize in Economic Sciences.



2.8 LET US SUM UP

- Theory of consumer behaviour studies how a consumer spends his income so as to attain the highest satisfaction or utility.
- An indifference curve is the locus of the various combination of two commodities that yield the same satisfaction to the consumer, so that he is indifferent to any one particular combination.
- An indifference map shows all the indifference curves which rank the preference of the consumer. While combinations of commodities on the same indifference curve yield the same satisfaction, combinations on a higher indifference curve yield greater satisfaction and combinations on a lower curve yield less satisfaction.

- A consumer is in equilibrium at the point where his budget line is tangent to the indifference curve. Symbolically :

$$MRS_{xy} = P_x / P_y$$

- The substitution effect and the income effect are the two components of the price effect.
- These two components can be derived using either the Hicksian compensating variation method or the Slutsky's cost - difference method.



2.9 FURTHER READING

1) Dewett, K.K. (2005). *Modern Economic Theory;* New Delhi: S Chand & Sons.
2) Chopra, P.N. (2008). *Micro Economics;* New Delhi: Kalyani Publishers.
3) Ahuja, H.L. (2006). *Modern Economics;* New Delhi: S. Chand & Sons.
4) Sundharam, K.P.M. & Valish, M.C. (1997). *Microeconomic Theory;* New Delhi: S. Chand & Sons.
5) Koutsoyiannis, A(1979). *Modern Microeconomics*; New Delhi: Macmillan.



2.10 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1: a) False b) True

Ans to Q No 2: a) The slope of the indifference curve is indicated by marginal rate of substitution.

b) Two indifference curves cannot intersect.

c) An indifference curve is defined as the locus of various combinations of two commodities that yield the same level of satisfaction to the consumer.

Ans to Q No 3: Consistency of choices means that the choice of the consumer is consistent in the sense that if he chooses combination A over B in one period, he will not choose B over A in another period.

Again, transitivity of consumer choice means that if a consumer prefers combination A to B, and prefers B to C, then, it can be concluded that he prefers A to C.

Ans to Q No 4: An indifference schedule represents the various combinations of two commodities that give the consumer the same level of satisfaction. An indifference curve is drawn based on an indifference schedule.

Ans to Q No 5: An indifference curve cannot be upward rising, because in such an indifference curve, as the counsumer will move upward the curve, he will be able to choose more quantities of both the goods. As such, he will not remain indifferent among the different bundles of goods available to him. This is clearly a violation of the very definition of an indiffernce curve.

Ans to Q No 6 : a) True b) True

Ans to Q No 7 : Two important superiorities of the indifference curve approach over the cardinal utility approach are :

- Indifference curve approach avoids the unrealistic assumption of cardinal utility and instead adopts the concept of ordinal utility.
- It can be used to split the price effect into substitution effect and income effect.

Ans to Q No 8: A budget line is defined as the various combinations of two commodities (say, x and y) that a consumer can consume, given his income (M) and the price of the two commodities (Px and Py).

Thus, a Budget line can be algebraically expressed as :

$M=P_xX + P_yY.$

where X and Y indicates the quantities of x and y respectively.

Ans to Q No 9: a) Price effect has <u>two</u> components.

b) The increase in the consumption of a commodity due to a fall in its price is called as <u>price effect</u>.

c) To discuss the price effect, the <u>compensating variation method</u> was used by Hicks, while the cost-difference method was used by <u>Slutsky</u>.

Ans to Q No 10: If a consumer consumes two commodities x and y, and given the price of Y, the price of X falls then the real income of the consumer increases. This is because he can now consume more of x with his given income. The increase in the consumption of a commodity due to a fall in its price is referred to as the 'Price Effect.'

Ans to Q No 11: The increase in the consumption of x is brought about by substituting the relatively cheaper X for Y. It is referred to as the substitution effect. Hence, the 'substitution effect' takes place when the relative prices of the two commodities change is such a manner that the consumer concerned is neither better nor worse of than he was before, but is obliged to rearrange his purchases in accordance with the new relative prices.

2.11 MODEL QUESTIONS

A) Very Short Questions (Answer each question in about 75 words)

Q 1: Dislinguish between cardinal and ordinal utility. Which one of these two concepts is more realistic and why?

Q 2: What is cardinal utility?

Q 3: Define the term marginal utility.

Q 4: What do you mean by the term total utility?

Q 5: State any two situations where the law of diminishing marginal utility fails to operate.

B) Short Questions (Answer each question in about 100 -150 words)

Q 1: Write a short note on the concept of diminishing marginal utility. Under what conditions does this law operate?

Q 2: Discuss the assumptions of the cardinalist approach to utility. What criticisms have been raised on the assumptions of this approach?

Q 3: What is an indifference map? Why does an indifference curve take the shape of a downward sloping convex curve?

Q 4: With the help of a suitable figure discuss the concept of a budget line.

C) Essay-type Questions (Answer each question in about 300-500 words)

Q 1: State the law of Equi-marginal utility. How does it explain consumer's equilibrium?

Q 2: What is an indifference curve? Discuss the properties of indifference cuves.

Q 3: Derive the consumer's equilibrium using the indifference map and the budget line as your tools.

Q 4: Derive the "Price Effect" of a price fall. Distintegrate the price effect into substitution effect and income effect.

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UNIT 3: RECENT DEVELOPMENTS OF THE THEORY OF CONSUMER BEHAVIOUR-I

UNIT STRUCTURE

3.1 Learning Objectives

3.2 Introduction

3.3 Hicksian Revision of Demand Theory

3.4 Choice under Uncertainty

- 3.4.1 The Bernoulli Hypothesis
- 3.4.2 The Neumann-Morgenstern Method of Measuring Utility
- 3.4.3 The Friedman- Savage Hypothesis
- 3.4.4 The Markowitz Hypothesis

3.5 Let Us Sum Up

3.6 Further Reading

3.7 Answers to Check Your Progress

3.8 Model Questions

3.1 LEARNING OBJECTIVES

After going through this unit, you will be able to-

- describe how the revised theory is different from old theory
- describe how Samuelson findings is different from Hicks
- know the concept of choice under uncertainty
- know the different views of different economists regarding uncertainty

3.2 INTRODUCTION

Indifference-preference analysis is an alternative way to study consumer behavior. Although indifference curve analysis of consumer behavior has been widely acclaimed, yet it is not without its critics. It is observed that it does not mark a complete break from the utility analysis and it is not only a reformulation of old utility theory but only a theory with new terms used for the old one.

Prof. Samuelson has criticized indifference analysis because he regarded it as highly introspective. He developed a behaviorist's method of deriving the theory of demand and presented his theory as an improvement over this technique. He based his theory on strong ordering hypothesis known as 'choice reveals preference'.

Prof. Hicks revised his demand theory in his earlier work Value and Capital. The revised theory was presented in book 'Revision of Demand theory'. Prof. Hicks was of the view that the earlier theory of demand given by him in Value and Capital contained only potential econometric reference and it was not made explicitly. While in Samuelson's Revealed Preference theory, econometric reference was made explicitly. Hicks in his new theory wanted to make econometric reference more explicit than even that in Samuelson's theory. One thing which is important to note is that Hicks in his new theory of demand once again rejects the concepts of cardinal utility and the hypothesis of independent utilities.

In this unit we will go through in details about the difference in views of the revised theory with the old theory. Along with this we will also learn about the behavior of an individual in risky situations. Many of the choices that people make involve considerable uncertainty. Sometimes we need to choose between risky ventures.

The consumer is certain about his income, tastes and the goods he purchases and maximizes his satisfaction by choosing that combination which gives him the highest total utility. But in reality, many goods and services involve risk or uncertainty, such as investments in shares of stock, insurance and gambling. In this unit we will learn more about the choice of the consumer under uncertain situations.

3.3 HICKSIAN REVISION OF DEMAND THEORY

Hicks was influenced by the revealed preference approach and the logic of strong ordering by Samuelson and his followers (Arrow, little and Hauthakkar). Hicks in his 'A Revision of Demand Theory' again reject the concept of hypothesis of independent utility and cardinal utility. He instead

assumes utility to be purely ordinal. Hicks who popularize the use of indifference curve in demand theory have given them up in his revision of demand theory.

In his book he has explained all the concepts without the uses of indifference curve though there are positions which are equally preferred by the consumers' surplus without using the indifference curve. He explained the disadvantages of the indifference curve technique. First he points out that the graphical method of indifference curve analysis is fully effective and useful for presenting the cases where there are only two goods which are involved. When the indifference curve analysis is extended towards three commodities case then three dimensional diagrams need to be plotted. The situation becomes more difficult when the analysis is extended to more than three commodities. The second advantage of indifference curve is that it focuses us to make assumption in his revision of demand theory.

The behavior according to scale of preferences is known as preference hypothesis.

Preference Hypothesis and Logic of Ordering : Hicks assumes preference hypothesis as a principle which governs behavior of ideal consumer. According to Hicks, an ideal consumer chooses that alternative which he prefers most out of various alternatives open to him. The ideal consumer is affected only by the current market condition.

We have seen in the demand theory that was presented by Hicks under 'Value and Capital' was also based upon the preference hypothesis. But under value and capital scale of preferences was given in form of set of indifference curves. But indifference curve analysis was given up because of its disadvantages in revision of demand theory.

Hicks in his revision of demand theory started from the logic of ordering itself rather than its geometric application. According to him the demand theory which is based on preference hypothesis turns out to be economic application of the logical theory of ordering. Before proceeding for derivation of demand theory using preference hypothesis, Hicks explained the logic of order.

Let us proceed to the logic of order by first explaining the difference between strong and weak ordering and then followed by demand theory based on weak ordering.

Strong Ordering : A set of items is strongly ordered if each item has a place of its own in the order and each item could then be given a number and to each number there would be one item and only one item which would correspond.

Weak ordering : A set of items is weakly ordered if items are clustered into groups but none of the items within a group can be put ahead of others. Thus a weak ordering consists of a division into groups in which sequence of groups is strongly ordered but in which there is no ordering within the groups.

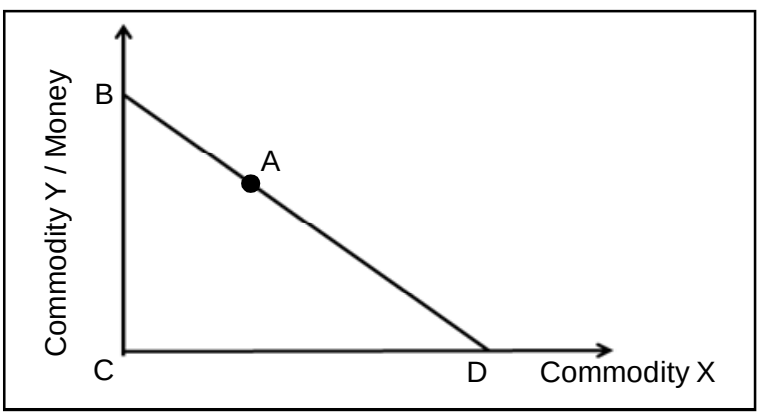
We have seen that the consumer is indifferent on an indifference curve as all the points lying on it give same level of satisfaction. It implies that indifference curve shows weak ordering as all the points lying on it are giving same level of satisfaction and hence occupy same place in the order.

On the other hand, revealed preference approach shows strong ordering as it assumes that any chosen combination reveals its preference for it over all the available alternative combinations.

Weak ordering implies that the consumer chooses a combination and rejects all other alternatives open to him. Then rejected combinations need not be inferior to the position actually chosen but may have been indifferent to it.

The strong and weak ordering have been shown in the Figure 3.1.

Figure 3.1: Strong and Weak Ordering



In the figure 3.1, Commodity X is an individual good and is measured on X-axis and Commodity Y, i.e. money, is a composite good representing all goods and services other than Commodity X. given the income and the price of Commodity X and Commodity Y, the price-income situation of ideal consumer is shown by the line DD. Consumer can choose any combination on line DD or inside the triangle ODD. The actual choice of the consumer is shown by the point A.

Hicks criticizes the logic of strong ordering on the basis of two grounds-

First, the strong ordering form under Samuelson's version of preference hypothesis it cannot be assumed that all geometrical points which lies within or on the price income line represent effective alternatives. A two dimension continuum point cannot be strongly ordered.

Second, the situation is entirely different in the real world because of the use of money. Thus in making a choice between commodities which is available in discrete units and divisible commodity money, the strong ordering has to be given up.

And now we move on to the discussion of logic of weak ordering. Hicks has used weak ordering hypothesis in his demand theory. According to Hicks, if the consumer scale of preferences is weakly ordered, then his choice of a particular position A does not reveal that A is preferred to any rejected combination within and on the triangle ODD. All that is shown is that there is no rejected position preferred to A. It is perfectly possible that some rejected position may be indifferent to A. The choice of A instead of that rejected position is then a matter of chance.

There is a possibility that some rejected combination may be indifferent to chosen bundle. If this weak ordering hypothesis is adopted then with this little information the demand theory cannot be derived.

Hicks introduced an additional hypothesis along with weak ordering hypothesis so as to derive basic proposition of demand theory. Under the additional hypothesis, the consumer will always prefer a large amount of

money preferred to smaller amount of money provided that the amount of good X at his disposal remains unchanged.

Let us now discuss the Direct Consistency Test.

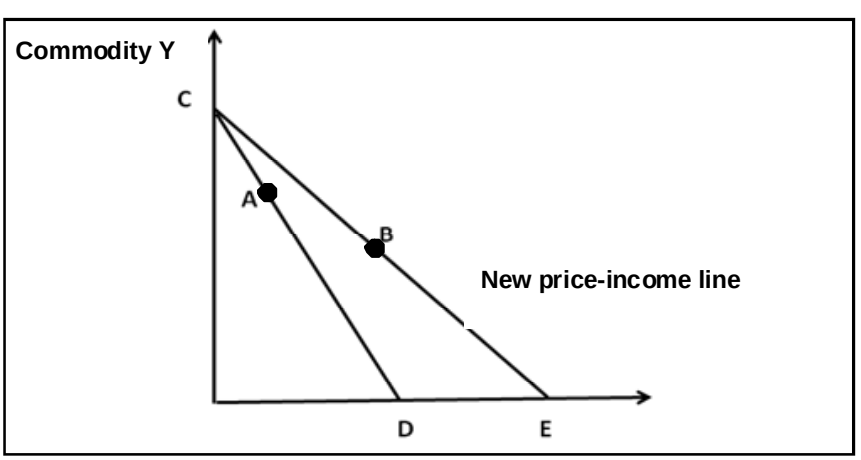
Direct Consistency Test: According to Hicks, the term Direct Consistency is the economic expression of two term consistency condition on the theory of logic of order. Hicks had proved hypothesis not for consistency of consumer choices but for inconsistency as well. This has been explained with the help of Figure 3.2.

As before there are assumed to be two commodities, Commodity X and Commodity Y; the alternative combinations that are available to the consumer are represented by the points on or under the triangle ODD. The point A shows the actually chosen combination. The strong and weakly preferences are same as we have studied in the last section.

Now let us take a new situation, i.e. a new price income line situation. The alternative situation that are available to the consumer are represented by the points on or under the triangle shown by the new price income line DE.

Suppose B is the actually chosen combination in this new price income situation. We have also assumed that the consumer is acting according to the unchanged scale of preferences in both situations new and old. The preferences of the consumer in both the situations must be consistent with each other. The consumer behavior is said to be inconsistent if he reveals his preferences for combination A over combination B in A situation.

Figure 3.2: Direct Consistency Test



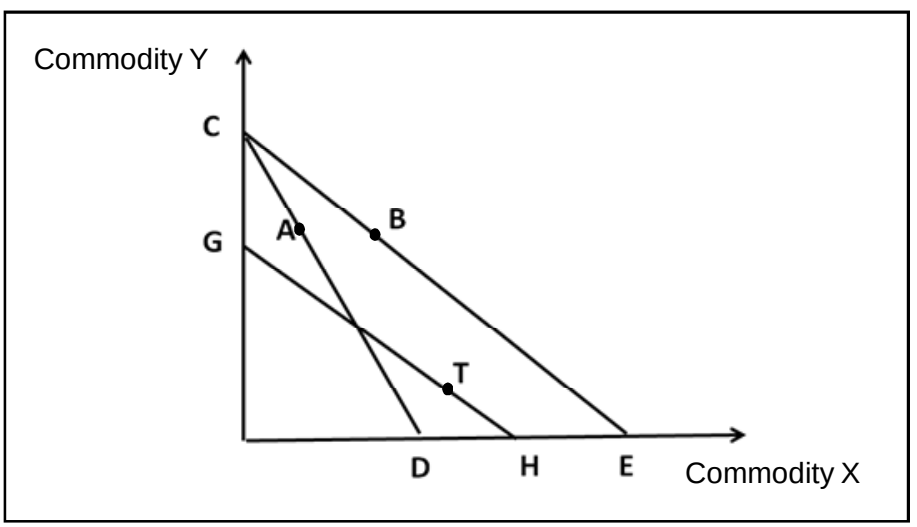
While in situation B he prefers combination B over combination A when both combination A and B are available to the consumer in both situations but under weak preference hypothesis the possibility of indifferences has to be taken into account.

Next we shall discuss the derivation of Law of Demand through Logical Weak Ordering Approach.

Derivation of the Law of Demand throug Logical weak Ordering Hicks developed revised theory of demand on the basis of weak preference ordering along with additional hypothesis and the direct consistency test. He initially derives the theory of demand for a single commodity. In the derivation of a single commodity the consumer is confronted with a market situation where there is a change in the price of one commodity only keeping the prices of other good constant. He derived the law of demand by decomposing the price effect int substitution effect and income effect.

Hicks used two methods to separate the substitution effect from the income effect. First is the method of compensating variation and second is the method of cost difference. Let us proceed with the derivation of law of demand by the method of compensating variation. This has been shown with the help of Figure 3.3. Let us suppose that there are two commodities, commodity X and composite good i.e. commodity Y.

Figure 3.3: Derivation of law of demand through Hicks's Logical Ordering Approach



Commodity X is measured on X- axis and commodity Y on the Y-axis. Given the price of the commodity and income of the consumer, the price income line is shown as CE. The chosen combination by consumer on price income line CE is A. Suppose that there is a reduction in the price of commodity X with no change in the money income. As a result of this reduction in price of commodity Y, the price income line would pivot to right to CD. The vertical intersect would not change as there is no change in commodity Y. Now consumer would chose a combination on this new price income line. The consistency test reveals that as long as quantity of commodity X is consumed any combination on the line CD must be preferred to combination A. In other words, it does not matter whether the new combination B on the line CD lies to the right of A or to the left of A or exactly above A. It would be preferred to A. This happens because the combination A lies within the triangle OCD. When combination B lies to the right of A it means that quantity demanded of good X rises due to the fall in its price.

If the fall in price of commodity X is associated with a reduction in income then with the help of consistency test it can be shown that the quantity demanded of commodity X remains same or must rise but it cannot fall.

The price effect is decomposed into substitution effect and income effect. The residual changes in price effect are explained by the income effect. The income effect of a change in the price of commodity X can also be explained with the help of consistency test. In order to show the influence of substitution effect on the demand for a commodity we have to make a suitable reduction in income along with the fall in price of commodity X.

The movement from A to B represents the price effect. In order to separate the substitution effect, income has to be reduced by the compensating variation. Income of the consumer is reduced such that he chooses combination T at a lower price. At this lower price and lower income this combination is different to combination A. The substitution effect measures the effect of the change in relative prices with the real income

constant. On the other hand, income effect measures the effect of the changes in the real income as it is shown in the figure.

When the income is reduced by compensating variation the new price income line GH intersects the CE line below the combination A. On the new price income line GH, the actual chosen combination is T. The movement from A and T represent the substitution effect and would result in the increase in the quantity demanded of commodity X.

Let us see the income effect now. Let the money that has been taken away from the consumer is restored to him. With this increase in income whether the consumer will buy more of commodity X or less at T cannot be explained with the help of consistency test but empirical evidence shows that in most of the cases the consumption of a commodity increases with the rise in income. Thus when the consumer is at combination A and his income is increased by the amount that had been taken away by him, he will still increase his consumption of good X. That is why the combination lies to the right of T. The movement from combination T and B shows the income effect.

To sum up the demand for a commodity increases with the fall in price due to both substitution effect and income effect. It is proved that law of demand holds that there exist a negative relationship between price and quantity demanded.



CHECK YOUR PROGRESS

Q 1. What is meant by preference hypothesis? Answer in 20 words.

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Q 2. What is meant by strong ordering? Answer in 40 words.

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Q 3. What is meant by weak ordering? Answer in 40 words.

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3.4 CHOICE UNDER UNCERTAINTY

We now study the choice involving risk and uncertainty. Decision or choice theory in economics is concerned with identifying the values, uncertainties and other issues relevant in a given decision, its rationality and the resulting optimal decision. It is closely related to the field of game theory. Decision theory is concerned with choices of individual agents whereas game theory is concerned with interaction of agents whose decisions affect each other.

This area represents the heart of decision theory. The idea of the expected value is that when faced with the number of action each of which could give rise more than one possible outcome with different probabilities the rational procedure is to identify all possible outcomes, determine their values which could be positive or negative and the probabilities that will result from each course of action and multiply the two to give an expected value. The action to be chosen should be the one that gives rise to the highest total expected value.

In 1738 Daniel Bernoulli published an influential paper entitled 'Exposition of a New Theory on the Measurement of Risk' in which he uses St. Petersburg Paradox to show that expected value theory must be normatively wrong.

It was Neumann and Morgenstern who in their theory of expected utility proved that expected utility maximization followed from the basic postulates about rational behavior. Their theory was refined by Friedman and Savage and by Markowitz. We explain these different views on choices involving risk or uncertainty.

3.4.1 The Bernoulli Hypothesis

Bernoulli's Hypothesis states a person accepts risk not only on the basis of possible losses or gains, but also based upon the utility gained from the risky action itself. The hypothesis was proposed by mathematician Daniel Bernoulli in an attempt to solve what was known as the St. Petersburg Paradox. The St. Petersburg Paradox was a question that asked, essentially, why people are reluctant to participate in fair games where the chance of winning is as likely as the chance of losing. Bernoulli's Hypothesis solved the paradox by introducing the concept of utility and stating that the amount of utility from playing a game is a significant decision factor in whether or not to participate. The hypothesis also introduces the concept of diminishing marginal utility gained from having increasing amounts of money. The more money a person has the less utility they gain from getting more money. This will make a person who has won several rounds of a game and gained additional money less likely to participate in the future- the utility factor is no longer present even though the odds have not changed.

Bernoulli's Hypothesis can be applied to the financial world when looking at an investor's risk tolerance. As the amount of money a person has grows, the person may becomes more risk averse (despite their ability to take on risk increasing due to their increase in capital) because they are experiencing diminished marginal utility with every extra dollar earned. Since they no longer feel the sense of utility from their gains, they no longer want to play the risky game.

Daniel Bernoulli provided a convincing explanation of the said behaviour of rational individual. According to him, a rational individual will take decisions under risky and uncertain situations on the basis of expected utility rather than expected monetary value.

He further contended that marginal utility of money to the individual declines as he has more of it. Since the individual behaves on the basis of expected utility from the extra money if he wins a

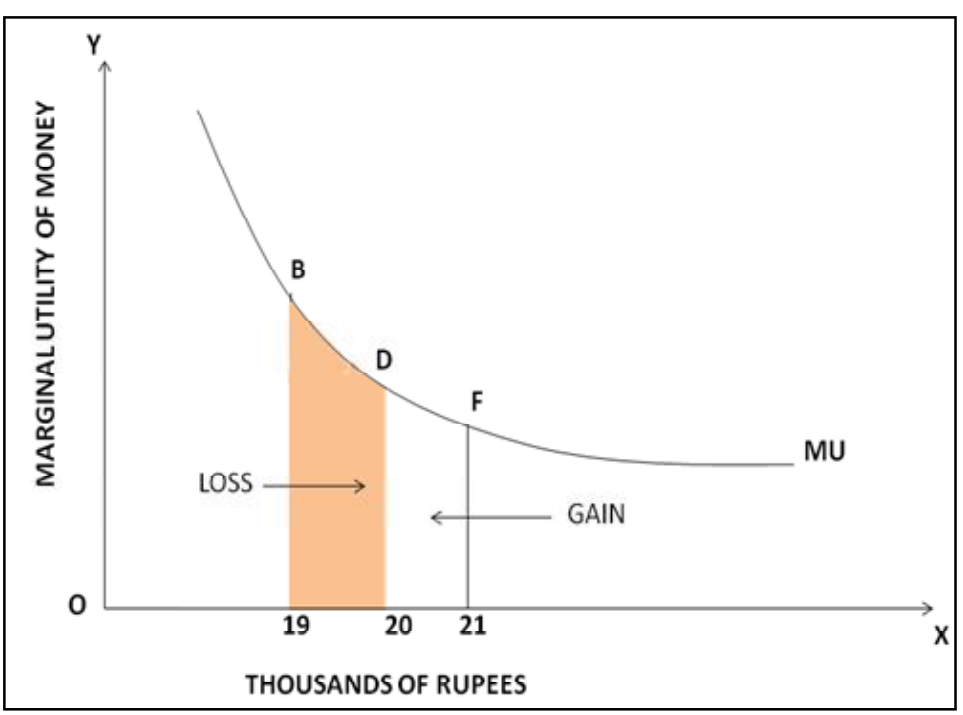
game and the marginal utility of money to him declines as he has extra money, most individuals will not 'play the game', that is, will not make a bet. It is in this way that Bernoulli resolved 'St. Petersburg Paradox'.

A graphic illustration will make clear Bernoulli's solution to the paradox has bees explain with the help of Figure 3.4.

Consider Figure 3.4 in which on the X-axis, the quantity of money (thousands of rupees) and on the Y-axis, marginal utility of money (rupees) to an individual are measured. Suppose an individual has 20 thousands of rupees with him and can make a bet at even odd (i.e., 50-50 chance) of winning or losing rupees one thousand.

If he wins the bet, money with him will rises to 21 thousand (20 + 1) rupees. If as a result of an increase in money with him, his expected marginal utility of money declines, then the expected marginal utility of extra one thousand rupees to him which is depicted

Figure 3.4: Bernoulli's Hypothesis: Unwillingness to Participate in a Fair Game

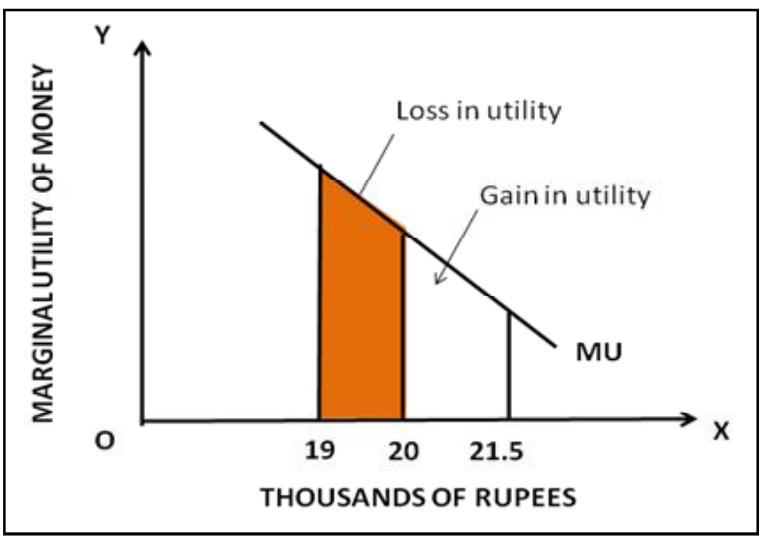


by the rectangle CDFE is less than the extra marginal utility of the previous one thousand (i.e., 20th thousand) rupees which is measured by the rectangle ABDC.

In other words, the gain in utility in case of his winning the bet is less than the loss of utility in case of his losing the bet, though the gain and loss is the same in terms of monetary amount (i.e., Rs. one thousand). Thus, given the diminishing marginal utility of money the expected gain in utility is less than the expected loss of utility from one thousand rupees involved in the bet, a rational individual will therefore not make a bet with 50-50 odds.

It may be further noted that a rational individual would even be unwilling to bet or gamble even at favorable odds if his marginal utility of money declines very rapidly. For example, if a person is offered a bet; if he wins the bet, he will be given Rs. 1500 and if he loses it, he has to pay Rs. 1000, then, as in case of rapid decline in marginal utility of money, he may be unwilling to agree to make the bet. Consider Figure 3.5 where the individual has Rs. 20,000 at present.

Figure 3.5: Unwillingness to Participate at Favorable when Marginal Utility of Money declines rapidly



In case he wins the bet, his monetary gain will be Rs. 1500 which will raise his money income to Rs. 21,500 and gain in his total utility will be given by the black-shaded area and if he loses the bet, his income falls by Rs. 1000 to Rs. 19,000 and as a result he suffers a loss in total utility equal to the red-shaded area.

It will be observed from Figure 3.5 that despite a smaller loss in money terms, the loss in terms of total utility is greater than the gain in total utility despite a greater increase in money in case he wins the bet. This happened due to the rapid decline in marginal utility of money as individual's money increases.

It may be pointed out that in our discussion above about the individual's betting it is assumed that individual derives no pleasure from gambling, that is, he does not enjoy gambling for its own sake. This is another way of saying that the individual behaves rationally in the sense that he will behave on the basis of expected gains and losses of utility from winning and losing money through gambling.

Although Bernoulli's hypothesis that individual decision to participate in a gamble or not, depends on his expected utility rather than expected money value of the game is of crucial significance in any discussion of individual's behaviour under risky and uncertain situations. So long as there is no upper bound on the utility function, the prize in a gamble can be appropriately adjusted so that the paradox is regenerated. Further Bernoulli's main point that an individual considers expected utility from the extra money rather than monetary value of the gain itself has found wide acceptance among economists.

However, a major drawback of Bernoulli's expected utility hypothesis is that it assumes cardinally measurable utility which economists today find it difficult to believe. J. Von Neumann and O. Morgenstern adopted an entirely new approach to assigning numerical values to the utilities obtained from extra money by the individuals behaving in risky or uncertain situations, such as in case of gambling and insurance and they based their method of

constructing utility index (which is envied at in a different way from the cardinal measurement of utility by neoclassical economists) on the expected utility hypothesis of Bernoulli. They showed that we can analyze the choice by an individual under risky and uncertain situation on the basis of N - M utility index.

3.4.2 The Neumann-Morgenstern Method of Measuring Utility

J. Von Neumann and O. Morgenstern in their book Theory of Games and Economic Behaviour evolved the method of cardinal measurement of expected utility from risky choices which are found in gambling, lottery tickets, etc. For this, they constructed a utility index which is called the N-M utility index.

They adopted an entirely new approach to assigning numerical values to the utilities obtained from extra money by the individuals behaving in risky and uncertain situations. They based their method of constructing utility index on the expected utility hypothesis of Bernoulli.

Neumann and Morgenstern gave a method of numerically measuring expected utility from winning prizes. The choices by an individual under risky and uncertain situations depend on N-M utility index, i.e. expected numerical utilities and with changes in money income.

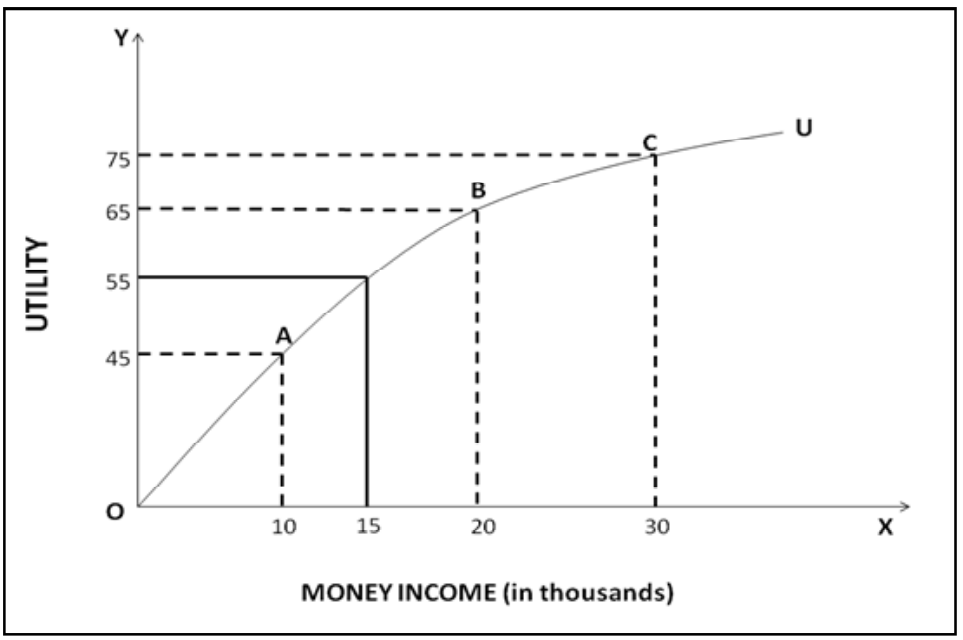
Most individuals generally prefer the less risky situation i.e. they seek to minimize risk are called risk averse. Such person prefers a certain given income to a risky income with the same expected value. Some individuals prefer risk and are therefore called risk seekers or risk lovers. Some other individuals are indifferent towards risk and are called risk neutral.

But different preferences towards risk depend on whether for an individual marginal utility of money diminishes or increases or remain constant. For a risk averse, the marginal utility of money diminishes as he has more money.

Suppose the individual is currently employed on a fixed monthly salary basis of Rs.15000. there is no uncertainty because here he has a fixed salary. Now suppose that he is considering to join new job involves risk because his income in this case not certain. If he proves to be successful salesman his income may increase to Rs.30000 per month but if he does not happen to be a good salesman his income may go down to Rs. 10000 per month. Suppose in this new job there is 50-50 chance of either earning Rs.30000 or Rs.10000 (that is, each has a probability of 0.5). When there is uncertainty, the individual does not know the actual utility from taking a particular action.

But given the probability of alternative outcomes, we can calculate the expected utility. Whether the individual will choose the new risky job or retain the present salaried job with a certain income can be known by comparing the expected utility from the new risky job with the utility of money income of Rs.15000 with certainty is 55. This has been explained with the help of Figure 3.6.

Figure 3.6: Utility Function of a Risk Averse



Further, in case of a new risky job if he is proved to be successful salesmen and his income increases to Rs 30000, his

utility will be 75 and if he fails, his income falls to Rs.10000 which yields utility 45.

$\therefore$ Expected Income, E(X) $= 0.5 \times 10000 + 0.5 \times 30000$

$= 20000$

Expected Utility, E (U) $= 0.5\,U(10000) + 0.5\,U(30000)$

$= 0.5 \times 45 + 0.5 \times 75$

$= 22.5 + 37.5$

$= 60$

Thus with the present job with a fixed salary of Rs.15000 with no uncertainty the Expected Utility is 55 whereas the expected utility of the new job or salesman on commission basis is 60. Though the individuals is risk- averse as revealed by the nature of his utility function of money income, but since the Expected Utility of the risky job is greater than the utility of the present job with a certain income, he will choose the risky job.

Suppose that if the individual in his new job proves to be successful and earns Rs.30000 double the present assured income of Rs. 15000 but he fails in his new risky job of a salesman on commission basis, his income falls to zero, then the expected utility of the risky job is given by,

$E(U) = 0.5\,U(0) + 0.5\,U(30000)$

$= 0 + 0.5 \times 75$

$= 37.5$

Now the expected utility from the new job is less than the utility of 55 from the present job with an assured income of Rs. 15000 [Note that in the risky job also, expected income is Rs. 15000, $E(X) = 0.5 \times 0 + 0.5 \times 30000 = 15000$], we are considering the choice of a risky averse individual for whom marginal utility of money declines as he has more of it.

The N-M utility index provides conceptual measurement of cardinal utility under risky choices. It is meant to be used for making

predictions about two or more alternatives relating to gambling, lottery tickets, etc. and out of them which one a person may prefer.

The N-M index is based on the expected values of utilities. It provides a method to measure cardinally the marginal utility of money. But it does not refer to whether the marginal utility of money diminishes or increases. In this sense, this method of measuring utility is incomplete.

But the N-M cardinal utility is different from the neo-classical cardinal utility. It is not like measures of length or weight. Nor does it measure the intensity of introspective satisfaction or pleasure from goods and services, as is the case with the neo-classical utility'. The N-M method of measuring utility analyses the actions of a person making risky choices.

Despite the fact that there is arbitrariness in computing the N-M utility index, it is measurable up to a linear transformation. It does not involve additively but permits ordinal measurement of relative preferences of risky choices.

3.4.3 The Friedman-Savage Hypothesis

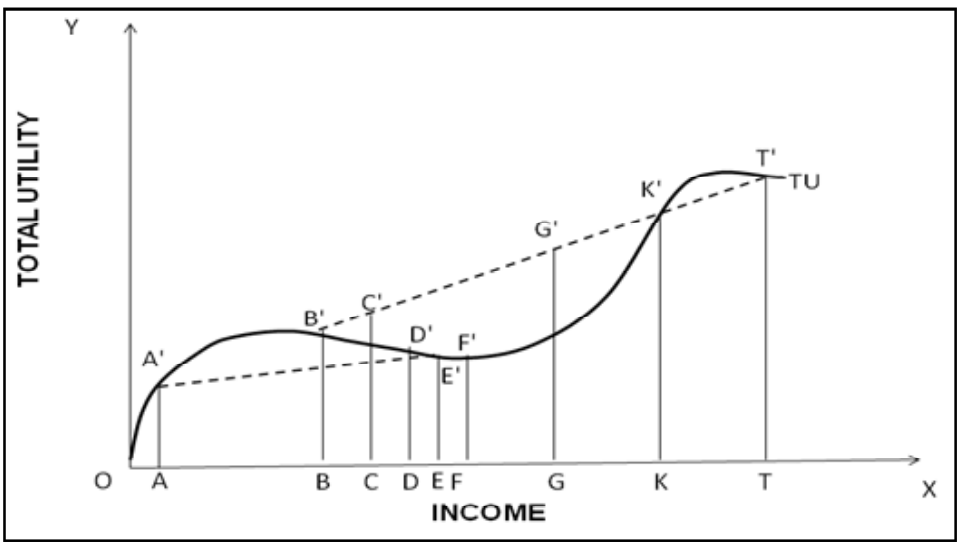
The Neumann-Morgenstern method is based on the expected values of utilities and therefore, does not refer to whether the marginal utility of money diminishes or increases. In this respect, this method of measuring utility is incomplete. When a person gets an insurance policy, he pays to escape or avoid risk. But when he buys a lottery ticket, he gets a small chance of a large gain.

Thus he assumes risk. Some people indulge both in buying insurance and gambling and thus they both avoid and choose risks. The reason behind this has been provided by the Friedman-Savage Hypothesis as an extension of the N-M method.

It states that marginal utility of money diminishes for incomes below some level; it increases for incomes between that level and some higher level of income, and again diminishes for all incomes

above that higher level. This has been illustrated in Figure 3.7 in terms of the total utility curve TU where utility is plotted on the vertical axis and income on the horizontal axis.

Figure 3.7: Friedman-Savage Hypothesis



Suppose a person buys insurance for his house against the small chance of a heavy loss from fire and also buys a lottery ticket which offers a small chance of a large win. Such a conflicting behaviour of a person who buys insurance and also gambles has been shown by Friedman and Savage with a total utility curve. Such a curve first rises at a diminishing rate so that the marginal utility of money declines and then it rises at an increasing rate so that the marginal utility of income increases.

The curve TU in the figure first rises facing downward up to point F' and then facing upward up to point K'. Suppose the person's income from his house is OF with FF' utility without a fire. Now he buys insurance to avoid risk from a fire. If the house is burnt down by fire, his income is reduced to OA with AA' utility. By joining points A' and F', we get utility points between these two uncertain income situations. If the probability of no fire is P, then the expected income of this person on the basis of the N-M utility index is

$$Y = P\,(OF) + (1 - P)\,(OA).$$

Let the expected income (Y) of the person be OE, then its utility is EE' on the dashed line A' F' Now assume that the cost of insurance, (insurance premium) is FD. Thus the person's assured income with insurance is OD (= OF- FD) which gives him greater utility DD' than EE' from expected income OE with probability of no fire. Therefore, the person will buy insurance to avoid risk and have the assured income OD by paying FD premium in case his house is burnt down by fire.

With OD income left with the person after buying insurance of the house against fire, he decides to purchase a lottery ticket which costs DB. If he does not win, his income would fall to OB with utility BB'. If he wins, his income would increase to OK with utility KK'. Thus his expected income with probability P' of not winning the lottery is

Y1 = P'(OB) + (1 - P') (OK)

Let the expected income F, of the person be ??, then its utility is CC' on the dashed line B'K' which gives him greater utility (CC') by purchasing the lottery ticket than DD' if he had not bought it. Thus the person will also buy the ticket along with insurance for the house against fire.

Let us take OG expected income in the rising portion F'K' of the TU curve when the marginal utility of income is increasing. In this case, the utility of buying the lottery ticket is GG' which is greater than DD' if he were not to buy the lottery. Thus he will stake his money on the lottery.

In the last stage when the expected income of the person is more than OK in the region K' T 'of the TU curve, the marginal utility of income is declining and consequently, he is not willing to undertake risks in buying lottery tickets or in other risky investments except at favorable odds. This region explains St. Petersburg Paradox.

Friedman and Savage believe that the TU curve describes the attitudes of people towards risks in different socio-economic groups. However, they recognize many differences between persons

even in the same socio-economic group. Some are habitual gamblers while others avoid risks. Still, Friedman and Savage believe that the curve describes the propensities of the main groups.

According to them, people in the middle income group with increasing marginal utility of income are those who are willing to take risks to improve their lot. If they succeed in their efforts in having more money by taking risks, they lift themselves up into the next higher socio-economic group. They do not want just more consumer goods. Rather, they want to rise in the social scale and to change their patterns of life. That is why, the marginal utility of income increases for them.

3.4.4 The Markowitz Hypothesis

Prof. Markowitz found the Friedman-Savage hypothesis contrary to common observations. According to him, it is not correct to say that the poor and the rich are unwilling to gamble and take risks except at favorable odds. Rather, both purchase lotteries and gamble on horse races. They also play the games at casinos and gamble alike in the stock market.

Thus Friedman and Savage failed to observe the actual behaviour of the poor and the rich because they assume that the marginal utility of income depends on the absolute level of income. Markowitz has modified it by relating the marginal utility of income to changes in the level of present income.

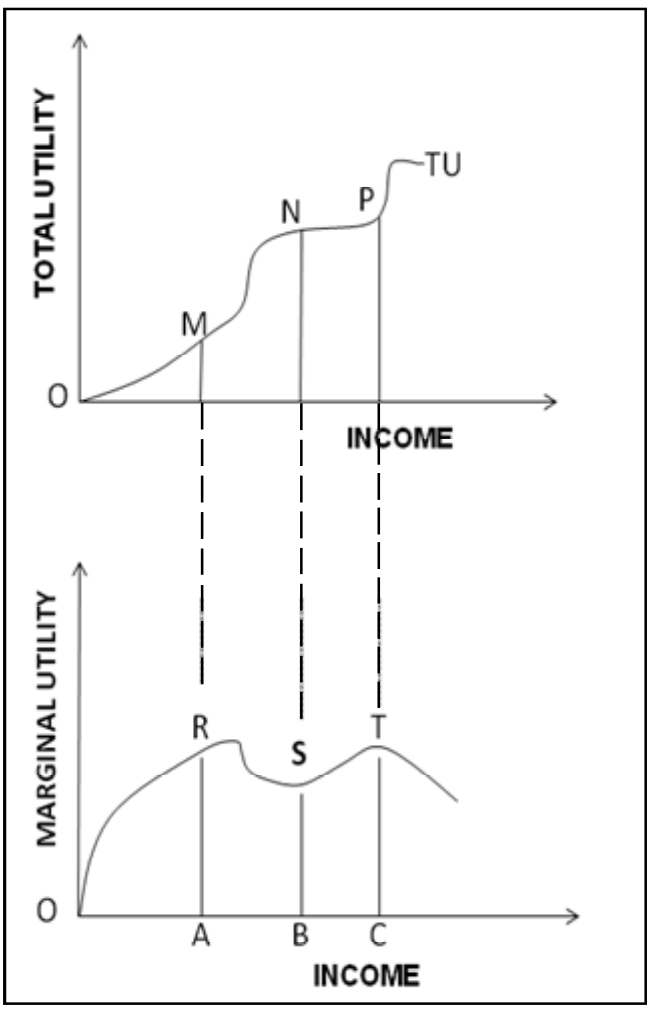
According to Markowitz, when income increases by a small increment, it leads to increasing marginal utility of income. But large increases in income lead to diminishing marginal utility of income. That is why at higher levels of income people are reluctant to indulge in gambling even at fair bets and people in slowly rising income groups indulge in gambling to improve their position.

On the other hand, when there are small decreases in income, the marginal utility of income rises. But large decreases in

income lead to diminishing marginal utility of income. That is why people insure against small losses but indulge in gambling where large losses are involved.

This is called the Markowitz hypothesis which is explained in Figure 3.8 where Markowitz takes three inflexion points M, N and P in the upper portion of the diagram with present income at the middle point N on the TU curve of income.

Figure 3.8: Markowitz Hypothesis



The marginal utility of income curve MU is derived in the lower portion of the diagram where the present income level is OB. With a small increase in the income of a person from OB to OC, the marginal utility of income increases from point S to T on the MU

curve. But large increases in income beyond OC lead to diminishing marginal utility of income from point T onwards along the MU curve.

On the other hand, small decreases in income from OB to OA lead to increasing marginal utility of income from S to R on the MU curve. But large decreases in income to the left of A lead to diminishing marginal utility of income from point R towards O along the MU curve.

The Markowitz hypothesis is an improvement over the Friedman-Savage hypothesis. Instead of the absolute level of income, it takes the present level of income of a person. It suggests that a person's behaviour towards insurance and gambling is the same whether he is poor or rich. The emphasis is on small or large increases or decreases in the present income of a person that determines his behaviour towards insurance and gambling.



CHECK YOUR PROGRESS

Q 4. State the St. Petersburg Paradox? Answer in about 30 words.

.....

.....

.....

Q 5. What is meant by Expected Utility?

.....

.....

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.....

.....

Q 6. Which book did J. Von Neumann and O. Morgenstern evolved the method of cardinal measurement of expected utility from risky choices in their book?

.....



3.5 LET US SUM UP

- Hicks in his revision of demand theory started from the logic of ordering itself rather than its geometric application. According to him the demand theory which is based on preference hypothesis turns out to be economic application of the logical theory of ordering.
- Bernoulli's Hypothesis solved the St. Petersburg Paradox by introducing the concept of utility and stating that the amount of utility from playing a game is a significant decision factor in whether or not to participate. The hypothesis also introduces the concept of diminishing marginal utility gained from having increasing amounts of money.
- Neumann and Morgenstern adopted an entirely new approach to assigning numerical values to the utilities obtained from extra money by the individuals behaving in risky and uncertain situations. They based their method of constructing utility index on the expected utility hypothesis of Bernoulli.
- The N-M index is based on the expected values of utilities. It provides a method to measure cardinally the marginal utility of money.
- The Friedman-Savage Hypothesis states that marginal utility of money diminishes for incomes below some level; it increases for incomes between that level and some higher level of income, and again diminishes for all incomes above that higher level.
- The Markowitz hypothesis is an improvement over the Friedman-Savage hypothesis. Instead of the absolute level of income, it takes the present level of income of a person.



3.6 FURTHER READING

1) Carvan, J.: 'Introduction to Economics : An Integrated Approach to Fundamental Principles'.
2) Henderson, J. M & Quandt and R.E, Micro Economic Theory, Mc Graw Hill.
3) Kaur, U.: 'The Development of the Theory of Demand from Bernoulli to Marshall'.

4) Koutsoyiannis, A.: Modern Microeconomics', ELBS with Macmillan Publication.
5) Pindyck R.S & Rubinfeld D.L & Mehta, 'Micro Economics ', Pearson Education.
6) Salvatore, D.: Micro Economics, Theory and Applications, Oxford University Press.
7) Singh, H.K.M.:' Demand Theory and Economic Calculations in a Mixed Economy.'

3.7 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1: The behavior according to scale of preferences is known as preference hypothesis.

Ans to Q No 2: A set of items is strongly ordered if each item has a place of its own in the order and each item could then be given a number and to each number there would be one item and only one item which would correspond.

Ans to Q No 3: A set of items is weakly ordered if items are clustered into groups but none of the items within a group can be put ahead of others. Thus a weak ordering consists of a division into groups in which sequence of groups is strongly ordered but in which there is no ordering within the groups.

Ans to Q No 4: The St. Petersburg paradox is a situation where a naive decision criterion which takes only the expected value into account predicts a course of action that presumably no actual person would be willing to take.

Ans to Q No 5: Expected utility is an economic term summarizing the utility that an entity or aggregate economy is expected to reach under any number of circumstances. The expected utility is calculated by taking the weighted average of all possible outcomes under certain circumstances, with the weights being assigned by the likelihood, or probability, that any particular event will occur.

Ans to Q No 6: Theory of Games and Economic Behavior

3.8 MODEL QUESTIONS

A) Short Questions (Answer each question in about 150 words)

Q 1: Explain the St. Petersburg Paradox.

Q 2: Why does the Markowitz hypothesis known as improvement over the Friedman-Savage hypothesis?

Q 3: Why do the N-M Index is significant?

Q 4: What is Direct Consistency Test?

B) Essay-type Questions (Answer each question in about 300-500 words)

Q 1: Explain how the Samuelson demand theory is different from Hicksian revision theory of demand.

Q 2: Explain Derivation of law of demand through Hicks's Logical Ordering Approach.

Q 3: State Bernoulli's solution to the St. Petersburg Paradox.

Q 4: Explain the Neumann and Morgenstern's expected utility theory.

Q 5: Explain how Markowitz hypothesis is an improvement of Friedman-Savage hypothesis.

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UNIT 4: RECENT DEVELOPMENTS OF THE THEORY OF CONSUMER BEHAVIOUR-II

UNIT STRUCTURE

4.1 Learning objectives

4.2 Introduction

4.3 The Constant Elasticity Demand Function

4.4 The Dynamic Version of Demand Function

4.5 Linear Expenditure System

4.6 Let Us Sum Up

4.7 Further Reading

4.7 Answers to Check Your Progress

4.9 Model Questions

4.1 LEARNING OBJECTIVES

After going through this unit, you will be able to-

- illustrate the idea of recent developments in the theory of market demand
- discuss about constant elasticity of demand function, dynamic versions of demand and linear expenditure system.

4.2 INTRODUCTION

In the earlier unit of consumer behaviour analysis, we have already discussed various approaches of consumer behaviour analysis. Although these approaches are theoretically impressive, but there are many writers who have questioned about the usefulness of these theories. They understand that the approaches to utility are very little in use to explain the complexity of the real world. Various economists use the law of demand to formulate the demand functions directly on the basis of market data, without considering utility theory and the behaviour of the individual consumer. But such kind of statistical estimation of market demand function suffers various difficulties. Among other difficulties of estimation of market demand function, the most important difficulties arise when all the determinants of demand

(i.e., prices of the goods, prices of the related goods, income of the consumers etc.) changes simultaneously, which makes it extremely difficult to assess the influence of each factor separately. However, there has been a continuous improvement in the econometric technique and currently the demand functions are fairly easy to estimate statistically.

4.3 THE CONSTANT ELASTICITY OF DEMAND FUNCTION

In applied research, the most commonly used form of demand function is the constant elasticity type. A very important characteristics of such kind of demand function is that the quantity demanded remains constant for all changes in price and has an elasticity of (-1) everywhere. The functional form of the constant elasticity type demand function can be expressed as-

$$Q_x = aP_x^b P_r^c Y^d e^{ft}$$

where Q_x = quantity demanded of commodity x

P_x = price of commodity x

P_r = price of other related commodity

Y = aggregate consumer income

e^{ft} = trend variable for taste where e is the natural logarithm

b, c and d = price elasticity, cross elasticity and income elasticity of demand respectively.

The above function is known as a constant elasticity of demand function because the co-efficient b (price elasticity), c (cross elasticity) and d (income elasticity) of demand function are assumed to remain as constant. It can be proved that the price elasticity of demand remains unchanged under constant elasticity of demand function. In order to prove this first we have to take logarithm form of the above non-linear demand function and then partially differentiate it with respect to price.

$$Q_x = aP_x^b P_r^c Y^d e^{ft}$$

$$\log Q_x = \log a + b \log P_x + c \log P_y + d \log Y$$

(the term for the trend is ignored for simplicity)

Now, the partial derivative of the function with respect to P_x

$$\frac{\partial \log Q_x}{\partial \log P_x} = b \text{.....(A)}$$

From a basic property of logarithms it is known that the change of the logarithms of a variable is equal to the proportionate change of the variable. By applying these property to the above partial derivative we obtain-

$$\partial \log Q_x = \frac{\partial Q_x}{Q_x} \text{ and } \partial \log P_x = \frac{\partial P_x}{P_x} \text{.....(B)}$$

Putting the value of (B) in (A), we get...

$$\frac{\partial Q_x / Q_x}{\partial P_x / P_x} = b$$

$$\Rightarrow \frac{\partial Q_x}{\partial P_x} \frac{P_x}{Q_x} = b$$

Since b the price elasticity of demand is constant.

Or, it can be written in other form as-

$$Q_x = a\left[\frac{Px}{P}\right]^b \left[\frac{Pr}{P}\right]^c \left[\frac{Y}{P}\right]^d$$

Here, P is the general price level. It is obvious that if prices and income change by the same proportion, say k%, the quantity demanded of X will not change. Because k will appear in both the numerator and the denominator of the relative prices and real income, thus, it will cancel out. The new quantity demanded will be the same as the initial one-there is no money illusion in the behaviour of the consumer.

4.4 THE DYNAMIC VERSION OF DEMAND FUNCTION

The dynamic version of demand function includes the lagged variables. The main reason behind the inclusion of the lagged variable is that in economics a cause often produces its effect only after a lapse of

time e.g., the current purchasing behaviour or decisions are influenced by past behaviour of individuals.

Now, to express the dynamic versions of demand functions, we have to assume a particular relationship between past and present. One of the most vital is that current purchasing behaviour depends upon past level of demand and past level of income.

In case of durable commodity, the past purchases represent the stock of this commodity which affects the current and future purchases of the product. And, in case of non-durable or consumables, the past purchases represent the habit of the consumer, which is acquired by buying and consuming the commodity in the past. Incorporating the influence of past decisions and experiences in the demand function is a way for rendering it dynamic.

In this dynamic version of demand function, it is also assumed that the more recent past levels of income or demand have a greater influence on present consumption patterns than the more remote ones (e.g., the impact of last year's income is more than the income of the ten years ago).

The general form of dynamic version of demand function including lag values of demand, income or other variables may be expressed as-

$$Q_{x(t)} = f\{P_{x(t)}, P_{x(t-1)} \ldots\ldots Q_{x(t-1)}, Q_{x(t-2)} \ldots\ldots Y_{(t)}, Y_{(t-1)} \ldots\ldots\}$$

The necessity of a dynamic approach has long been recognised for the study of the demand of certain commodities (consumer durables). The applicability of dynamic formulations has extended by Richard Stone in "the Durability of consumers durable goods (1960)". Nerlov have developed the stock or partial adjustment model where the demand as well as the investment functions is used extensively. The Nerlov's model is used in applied econometrics in the area of agricultural economics.

Under this model, a desired level of demand (Q_t^*) is determined by the current level of income (Y_t).

$$Q_t^* = \beta (Y_t) \ldots\ldots\ldots\ldots\ldots (1)$$

But the desired level of demand is a gradual process; it cannot be immediately acquire due to limited income, credit limitations etc. So, in each period the consumer get the closer value of Q_t*. Suppose, the consumer purchase a certain quantity at period 't' is $Q_{(t)}$ and at period (t-1) is $Q_{(t-1)}$. Then, the actual change is the difference between Q_t and $Q_{(t-1)}$ that is $\{Q_{t-}Q_{(t-1)}\}$. This change in actual purchases is only a fraction k of the desired change, $\{Q_t^* - Q_{(t-1)}\}$. Thus,

Actual change = k (desired change)

$Q_t - Q_{t-1} = k\{Q_t^* - Q_{(t-1)}\}$ .....(2)

;where k = coefficient of stock adjustment which value lies between 0 and1.

Putting equation (1) in (2), we get

$$\Rightarrow Q_{(t)} - Q_{(t-1)} = k\{\beta\{_{(t)} - Q_{(t-1)}\}$$
$$\Rightarrow Q_{(t)} = k\beta\beta_{(t)} - kQ_{(t-1)} + Q_{(t-1)}$$
$$\Rightarrow Q_{(t)} = (k\beta k\beta_{(t)} + (1-k)Q_{(t-1)}$$
$$\Rightarrow Q_{(t)} = a * Y_{(t)} + \beta * Q_{(t-1)} \text{.....(3)}$$

; where $\alpha^* = k\beta$ and $\beta^* = (1-k)$

Equation (3) is the final form of the stock adjustment principle.

The above partial adjustment model has been used by Houthakker and Taylor to explain the demand for non-durable commodities in their well-quoted book "Consumer demand in the United states, 1929-1970, Analysis and Projections". They argue that the current quantity demanded for non-durable in any one period depends upon the demand of the same commodity in the previous period. This is so because of habit formation process which is a basic to human behaviour. They described the demand function for non-durables goods as-

$$Q_t = \beta_0 + \beta_1 P_t + \beta_2 \Delta P_t + \beta_3 Y_t + \beta_4 \Delta Y_t + \beta 5\ Q_{t-1} \text{.....(4)}$$

Here, Qt = quantity demanded in period t.

P_t = Price in period t.

ΔP_t = change in price between t and (t-1)

Y_t = income in period t

ΔY_t = change in income between t and (t-1)

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4$ and β_5 are the coefficients.

Demand for particular goods in a particular period depends mainly on price of a product, stock of the commodity and on the current level of income of the consumer. Symbolically,

$$Q_t = \alpha_0 + \alpha_1 P_t + \alpha_2 S_t + \alpha_3 Y_t \ldots\ldots\ldots\ldots\ldots (5)$$

;where S_t = stocks of durables, if the demand function refers to durable goods.

S_t = stocks of habits, if the function refers to non-durables

Q_t = quantity demand in period t

P_t = Price in period t

Y_t = income in period t

$\alpha_0, \alpha_1, \alpha_2$ and α_3 are the co-efficient.

The sign of the co-efficient S will be positive or negative. In case of durables, it will be negative. This is so because the more the quantity of durable the consumer has, the lesser is the demand for such commodities. i.e., it possesses a negative relationship. But, in case of non-durables, the sign of S is positive; this is because of habits. i.e., the higher is our purchases of non-durable goods, the stronger our habit becomes. It possesses a positive relationship.

It is also noted that the stock (S_t) cannot be measured. The reasons are - 1st, the stock of durable goods is composed of various heterogeneous items of various ages-the electrical equipment we have is not of the same age, some items may be very old and need scrapping and replacing, some others are new. Their heterogeneity also makes direct measurement difficult. We want to have stocks which are the sum of depreciated inventories of durable goods. But the appropriate depreciation rates are not known. Second, the stock of habits is a psychological variable and so it cannot be quantified.

As stocks cannot be measured from the demand function, we can eliminate it by assuming some other measureable variable in place of it. The process of elimination for durable commodities are explained below--

Let, $(S_t - S_{t-1}) = Q_t - d\ S_t$ .....(6)

Here, $d\ S_t$ indicates depreciation where d is constant depreciation rate (e.g., if the life of durable commodity is 10 years, we assume that the yearly depreciation is 10% of the value of the durable).

From equation (5)---

$$Q_t = \alpha_0 + \alpha_1 P_t + \alpha_2 S_t + \alpha_3 Y_t$$

$$\Rightarrow S_t = \frac{1}{\alpha_2}(Q_t - \alpha_0 - \alpha_1 P_t - \alpha_3 Y_t) \text{.....(7)}$$

Putting the value of equation (7) in (6), we get

$$(S_t - S_{t-1}) = Q_t - \delta\left\{\frac{1}{\alpha_2}(Q_t - \alpha_0 - \alpha_1 P_t - \alpha_3 Y_t)\right\} \text{.....(8)}$$

Since, the demand function for period t is-

$$Q_t = \alpha_0 + \alpha_1 P_t + \alpha_2 S_t + \alpha_3 Y_t$$

Now, deducting Q_{t-1} from Q_t

$$Q_1 - Q_{t-1} = \{\alpha_0 + \alpha_1 P_t + \alpha_2 S_t + \alpha_3 Y_t\} - \{\alpha_0 + \alpha_1 P_{t-1} + \alpha_2 A_{t-1} + \alpha_3 Y_{t-1}\}$$
$$= \alpha_1(P_t - P_{t-1}) + \alpha_2(S_t - S_{t-1}) + \alpha_3(Y_t - Y_{t-1}) \text{.....(9)}$$

Again, substituting the value of (8) in equation (9).....

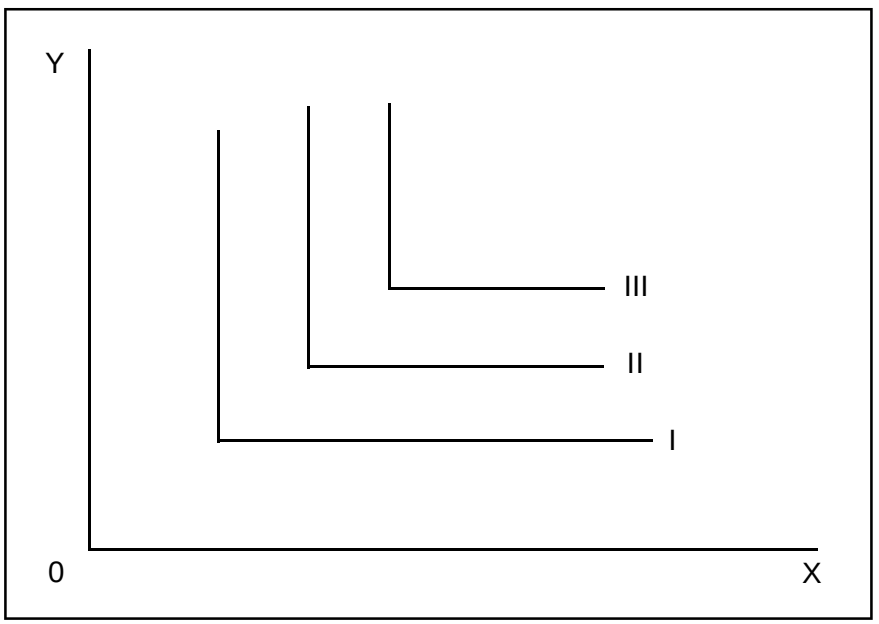
$$Q_t - Q_{t-1} = \alpha_1(P_t - P_{t-1}) + \alpha_2\left[Q_1 - \delta\left\{\frac{1}{\alpha_2}(Q_t - \alpha_0 - \alpha_1 P_t - \alpha_3 Y_t) + \alpha_3(Y_t - Y_{t-1})\right\}\right]$$
$$\Rightarrow Q_1 = Q_{t-1} + \alpha_1(P_t - P_{t-1}) + \alpha_2 Q_1 - \delta(Q_t - \alpha_0 - \alpha_1 P_t - \alpha_3 Y_t) + \alpha_3(Y_t - Y_{t-1})$$
$$\Rightarrow Q_t = Q_{t-1} + \alpha_1 P_t - \alpha_1 P_{t-1} + \alpha_2 Q_t - \delta Q_t + \delta\alpha_0 + \delta\alpha_1 P_t + \delta\alpha_3 Y_t + \alpha_3 Y_t - \alpha_3 Y_{t-1}$$
$$\Rightarrow Q_t(1 - \alpha_2 + \delta) = \delta\alpha_0 + (\delta\alpha_1)P_t + \alpha_1(P_t - P_{t-1}) + \alpha_3(Y_t - Y_{t-1}) + \delta\alpha_3 Y_t + Q_{t-1}$$
$$\Rightarrow Q_t(1 - \alpha_2 + \delta) = (\delta\alpha_0) + (\delta\alpha_1)P_t + \alpha_1(\Delta P_t) + (\delta\alpha_3)Y_t + \alpha_3(\Delta Y_t) + Q_{t-1}$$
$$\Rightarrow Q_t = \frac{\delta\alpha_0}{1 - \alpha_2 + \delta} + \frac{\delta\alpha_1(P_t)}{1 - \alpha_2 + \delta} + \frac{\alpha_1(\Delta P_t)}{1 - \alpha_2 + \delta} + \frac{\delta\alpha_3(Y_t)}{1 - \alpha_2 + \delta} + \frac{\alpha_3(\Delta Y_t)}{1 - \alpha_2 + \delta} + \frac{(Q_{t-1})}{1 - \alpha_2 + \delta} \text{.....(10}$$

By setting $\beta_0, \beta_1, \beta_3, \beta_4$ and β_5 for the coefficients of this equation (10), we arrive at the final form of Houthokker's and Taylor's formulation as shown in equation (4).

4.5 LINEAR EXPENDITURE SYSTEM

Linear expenditure system is a model that deals with groups of commodities rather than individual commodities which yields total consumer expenditure. In aggregate econometric models the linear expenditure system is widely used where they provide desirable disaggregation of the consumption function. One of the earliest linear expenditure models was suggested by R. Stone in 1954. On the basis of utility function, the linear expenditure system was formulated. Under this model, the demand function is derived by maximising the utility function subject to budget constraint. In this respect, the linear expenditure approach is as same as indifference curve approach. Basically, the indifference curve approach is designed for handling substitute commodities. But, in case of linear expenditure system, it is designed to group of commodities between which substitution is not possible. If we plot the indifference map of linear expenditure system in X-Y plane then we get the Figure 4.1.

Figure 4.1: Indifference Map of Complementary Goods



In the above diagram, I, II and III shows that it is not possible to substitute between X and Y.

Suppose, total utility (U) $= U_A+U_B+U_C+U_D+U_E$

$= \sum_A^E Ut$

; which indicate that the sum of the utilities derived from the various groups of commodities. The additives of the above function implies that the utilities of the various groups are independent i.e., there is no possibility of substitution between groups A,B,C,D and E. Each groups must include all substitutes and complements. So, the substitution is possible within each group, but it is not possible between the two groups. Here, it is needed to noted that Stones utility function is additive in the logarithms of the group of utilities.

$$U = \sum_{i=1}^{n} b_i \log(q_i - y_i)$$

$$U^* = (q_1 - y_1)^{b_1}(q_2 - y_2)^{b_2} \ldots\ldots\ldots\ldots (q_n - y_n)^{b_n}$$

$$U = b_1 \log(q_1 - y_1) + b_2 \log(q_2 - y_2) \ldots\ldots + b_n \log(q_n - y_n)$$

;where

q_i = quantity demanded of group i

y_i = minimum quantity of group i

b_i = marginal budget share (0< b < 1)

U = total utility and $(q_i - y_i) > 0$

Now, to derive the demand function we have to maximise the log linear utility function.

Maximise, $U = b_1 \log(q_1 - y_1) + b_2 \log(q_2 - y_2) \ldots\ldots + b_n \log(q_n - y_n)$

Subject to $Y = \sum p_i q_i$

Then we get the following demand function $q_i = y_i = \frac{b_i}{p_i}(Y - \sum p_i y_i)$

This demand function may be written in slightly different form

$$p_i q_i = y_i p_i + b_i (Y - \sum p_i y_i)$$

(Expenditure on group i) = (subsistence expenditure) + (supernumerary expenditure)

It is clear that b_1 is the partial derivative of the expenditure on i with respect to the supernumerary income.

$$b_1 = \frac{\partial(q_1 p_1)}{\partial(Y - \sum p_i y_i)}$$

It should be mentioned here that there are various versions of linear expenditure model depending on the form of the utility function.



CHECK YOUR PROGRESS

Q 1: Mention the determinants of demand function.

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Q 2: Write down the functional form of the constant elasticity type demand function.

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Q 3: The dynamic version of demand believed that the more recent past levels of income or demand have a greater influence on present consumption patterns than the more remote ones. (True or False)

Q 4: The linear expenditure system approach is designed to group of commodities between which substitution is not possible. (True or False)



4.6 LET US SUM UP

- The statistical estimation of market demand function is difficult when all the determinants of demand changes simultaneously.

- The constant elasticity type demand function indicates that the quantity demanded remains constant for all changes in prices. In other words, the elasticity of demand remains unchanged under constant elasticity of demand function.
- The dynamic version of demand function includes lagged variables. The reason behind inclusion of lagged variable is that current purchasing decisions are influenced by past behaviour of individuals.
- Nerlov have developed the stock adjustment principle which is also known as partial adjustment model. This model is used extensively in demand functions as well as in investment functions.
- Houthakker and Taylor used the partial adjustment model to explain the demand functions for non-durable commodities.
- Linear expenditure system model deals with groups of commodities rather than individual commodities which yields total consumer expenditure. One of the earliest linear expenditure model was suggested by R. Stone. Although the linear expenditure system is as same as indifference curve approach but one distinction is possible between these two. The indifference curve approach is designed for handling substitute commodities. But, in case of linear expenditure system, it is designed to group of commodities between which substitution is not possible



4.7 FURTHER READING

1) Pindyck R.S & Rubinfeld D.L & Mehta, 'Micro Economics', ,Pearson Education.
2) Henderson, J. M & Quandt and R.E, Micro Economic Theory, McGraw Hill.
3) Koutsoyiannis, A, Modern Microeconomics, ELBS with Macmillan Publication.
4) Madnani, G.M.K (2008) 'Introduction to Econometrics: Principles and Applications', Oxford & IBH Publishing Co. Pvt. Ltd.
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4.8 ANSWERS TO CHECK YOUR PROGRSS

Ans to Q No.1: The demand function of a product is determined or influenced by number of factors. The following five are the main determinants of demand---(i) the price of the commodity (ii) the price of the related goods (i.e.,complementary and substitute goods.) (iii) the income of the buyer (iv) Tastes and preferences of the buyer and (v) other factors like environmental, government action etc.

Ans to Q No.2: The functional form of the constant elasticity type demand function can be expressed as-

$$Q_x = \alpha P_x^b P_r^c Y^d e^{ft}$$

;where Q_x = quantity demanded of commodity , P_x = price of commodity x,

P_r = price of other related commodity, Y = aggregate consumer income, e^{ft} = trend variable for taste where e is the natural logarithm and b, c and d = price elasticity, cross elasticity and income elasticity of demand respectively.

Ans to Q No.3: True

Ans to Q No.4: True

4.8 MODEL QUESTIONS

A) **Short Questions** (Answer each question in about 150 words)

Q 1: Mention the important characteristics of constant elasticity type demand function.

Q 2: What is the meaning of dynamic versions of demand functions?

Q 3: What do you mean by linear expenditure system?

B) **Long Questions** (Answer each question in about 300-500 words)

Q 1: Discuss briefly about the dynamic versions of demand functions.

Q 2: Explain briefly about linear expenditure system approach.

Q 3: Explain about the stock adjustment model.

Q 4: Discuss how Houthakker and Taylor used the partial adjustment concept to explain the demand function?

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UNIT 5: RECENT DEVELOPMENTS OF THE THEORY OF CONSUMER BEHAVIOUR-III

UNIT STRUCTURE

5.1 Learning Objectives

5.2 Introduction

5.3 Household Time Allocation Model of Garry S. Becker

5.4 Characteristics Model of Kelvin Lancaster

5.5 Positive and Negative Network Externalities (Bandwagon, Snob and Veblen Effects)

5.6 Let Us Sum Up

5.7 Further Reading

5.8 Answers to Check Your Progress

5.9 Model Questions

5.1 LEARNING OBJECTIVES

After going through this unit, you will be able to-

- to acquire knowledge about some new ideas over traditional ideas concerned with the theory of consumer behaviour.
- to discuss Becker's Household time allocation model and Kelvin Lancaster's Characteristics model.
- analyse the positive as well as the negative effects of network externalities i.e., Bandwagon effect, Snob effect and Veblen effect.

5.2 INTRODUCTION

The famous economist Garry S. Becker's Household Time Allocation model and Lancaster's Characteristics model provide a new idea or content matter in the consumer behaviour analysis. This new ideas create a new base for the theory of household behaviour. It is different from the traditional theory of consumer behaviour as it studies about the nonmarket commodities and the associated allocation of household time. Further, this new approach gives importance on the role of household's technology and also its taste as a determinant of behaviour.

Along with Becker and Lancaster model, the positive as well as negative network externality is also discussed here. The network externality shows a very important drawback of traditional assumption of demand. So, the above mention models and ideas are explained below briefly.

5.3 HOUSEHOLD TIME ALLOCATION MODEL OF GARRY S. BECKER

Nobel laureate Garry S Becker in his article *'A theory of the allocation of time'* (1965) laid the analytical foundations for the study of household production and the allocation of time within the household. Becker created the foundational modelling framework for household level analysis of consumption and time use. Becker's theory assumes that individuals within a family make informed and rational decisions resulting in the attainment of maximum utility satisfaction through combining time and market goods to produce more basic commodities. It also assumes that individuals decide whether or not to participate in the labour market by comparing the value of their time to the value they place on the time spent at home.

The household is assumed to produce and consume a vector of commodities

$Z = (Z_i)$ ---------- (1)

where i =1, 2, 3.....I.

These commodities are associated with different levels of activities performed by the household (e.g., consumption of food, child rearing, leisure activities). Each commodity Z_i is produced by using the below mention production function.

$$Z_i = f_i (x_i, T_i) \quad \text{---------- (2)}$$

where, x_i = vector of market goods and T_i = vector of time input used in producing the ith input.

To produce the basic commodities Z_i the households combine time and market goods through the production function f_i. The best combination of these two commodities is choose by maximising a utility function----

$$U = U (Z_i,.....Z_m) \equiv U (f_1,.....f_m) \equiv U (x_1,.....x_m; T_1,.....T_m) \text{ ------ (3)}$$

Subject to: g (Z_i,.....Z_m) = Z ---------- (4)

where g is the expenditure function of Z_i and Z is bound on resources.

The most direct way of maximisation of the utility function (3) requires separate constraints on the expenditure of market goods and time and to the production function. These are

(a) Goods constraints---

$$\sum_{1}^{m} p_i x_i = 1 = V + T_w \overline{W}$$

(b) Time constraints---

$$\sum_{1}^{m} T_i = T_c = T - T_w$$

where

p_i = vector giving the unit prices of x_i

T_w = vector giving the hours spent at work

$\overline{W}$ = vector giving the earning per unit of T_w

T_c = vector giving the total time spent at consumption

T = vector giving the total time available

(c) The equivalent form of the production function (1), that is

$$\left.\begin{aligned} T_i &= t_i Z_i \\ X_i &= b_i Z_i \end{aligned}\right\} \rightarrow (5)$$

;where ti indicates vector giving the input of time per unit of Zi and bi is similar vector for the market goods.

But, Becker maximised the utility function subject to only single budget constraint i.e.,

$$\sum p_i x_i + \sum T_i \overline{W} = V + T\overline{W}$$

Now, putting the value of Ti and xi from equation (5) .....

$$\Rightarrow \sum p_i b_i Z_i + \sum t_i Z_i \overline{W} = V + T\overline{W}$$

$$\Rightarrow \sum \left(p_i b_i + \sum t_i \overline{W}\right) Z_i = V + T\overline{W} \text{.....(6)}$$

With,

$$n_i = p_i b_i + t_i \overline{W} \text{ and } S = V + T\overline{W}$$

The full price of consumption of a unit of Z_i (n_i) is the sum of the prices of the goods and of the time used per unit of Z_t . Becker called 'S' as a full income and the full income constrained is meaningful resource constraint because time can be converted into goods through money income.

It is easy to interpret S_0 if $\overline{W}$ were constant and independent of the Z_t, and it gives the money income. This money income is spent on Z_t either directly through expenditures on goods, $\sum p_i b_i Z_i$ or indirectly through the forgoing income, $\sum t_i Z_i$ and if $\overline{W}$ were not constant, then $S_0 = V = T\overline{W}$ overstate the money income achievable and it complicated the equilibrium conditions.

In order to maximise this money income, the household have to spend the time also on the activities like sleep, food, leisure along with job. Due to this reason, the households in richer countries forfeit money income in order to obtain additional utility. Simply, this is the time allocation model of Becker.

5.4 CHARACTERISTICS MODEL OF KELVIN LANCASTER

The new economic theory of consumer behaviour is an important development made by Kelvin Lancaster in his working paper *A New Approach to Consumer Theory* (1966) and also called as characteristics model. This model is different from traditional approach on believing that it is the properties or characteristics of the goods from which utility is derived. Here, in general, in this model the simplest consumption activity will be characterised by joint output. As it is assumed that the single goods or the combination of goods are inputs of consumption activity in which the output is a collection of characteristics. Also, it is assumed that utility or preference orderings are rank collections of characteristics. A good (e.g., meal) possess nutritional as well as aesthetic characteristics and different meals will possess these characteristics in different relative proportions. the possesses characteristics of a good or a combination of a good for all the consumers

are the same and are in the same quantities. Thus, the relationship between goods and characteristics plays a crucial role in Lancaster's characteristics model. The essence of this approach based on the following:

- The good does not give utility to the consumer; it possesses characteristics and these characteristics give rise to utility.
- A good will possess more than one characteristic and many characteristics will be shared by more than one good.
- Goods in combination may possess characteristics different from those pertaining to the goods separately.

Lancaster replaces the traditional model by setting out a special model which is a special solution to a special problem. This model has some important assumptions---

- The individual good or a collection of goods are regards as a consumption activity which is associated with a scalar (the level of the activity, k). The level of activity k, y_k and the goods consumed in that activity to be both linear and objective, so that

$$X_i = \sum_k a_{j_k} y_k \ldots\ldots\ldots\ldots(1)$$

(if xj is the jth commodity)

$$\Rightarrow x = Ay \text{ (in matrix form)}\ldots\ldots\ldots\ldots\ldots(2)$$

(i.e., the vector of total goods required for a given activity)

- A fixed vector of characteristics is produces after each consumption activity and there is a linear relationship exists. If zi is the amount of the ith characteristic then

$$z_i = \sum_k b_{ik} y_k \ldots\ldots\ldots\ldots(3)$$

$$x = By\ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

- The individual have an ordinal utility function on characteristics U(z) which is choose to maximised and it possesses the ordinary convexity properties of a standard utility function.

Here, the linearity assumption is made to simplify the problem.

The production relation in this model is shown as----

$$F_k(z,\ x) = 0, \quad k = 1,\ldots\ldots m\ldots\ldots\ldots\ldots(5)$$

The vector z represents the direct ingredients of his preferences and his welfare and the collections of goods available to him. The vector x shows the indirect relationship with the rest of the economy through vector y.

The vector z and x are linked with each other through the equation (2) (i.e., x = Ay) and equation (4) (i.e., z = By). Now, suppose there are r characteristics, m activities and n goods. Only if r = m = n, there will be a relationship between z and x. And both the matrixes (i.e., B and A) are square and it can be solve for y in terms of x (i.e., $y = A^{-1} x$, giving $z = BA^{-1}x$). The utility function U(z) can be written as a function of u(x). Otherwise, the relations between z and x in spaces of different dimensions. Let us consider some x* in the case in which m > n, then equation (2) places only n restrictions on the m vector y, and y can still be chosen with (m-n) degrees of freedom. If r < m, then there will be (m-r) degrees of freedom in choosing y, given some z, but whether the ultimate relationship gives several choices of z for a given x, or several x for a given z, and whether all vectors z are attainable, depends on the relationships between r, m and n, and the structures of the matrices A and B. In general, the consumer may face a choice among many paths linking goods collections with characteristics collections.

If it takes the standard choice situations facing the consumer in a free market, with a linear budget constrained, then the situation in this model becomes ----

Maximise, U(z)

Subject to $px \leq k$

With $z = By$, $x = Ay$; $x, y, z \geq 0$

This is a non linear program of an intractable kind and this model mainly interested only in the properties of the solution. This model can be written in simpler form as----

Maximise U(z)

Subject to $px \leq k$

With $z = Bx$; $z, x \geq 0$

This simpler form contains four parts-one is the utility function U(z) maximised operating on characteristics. The $px \leq k$ is the budget constraints. The $z = Bx$ represent a transformation between goods and characteristics. And, the $z, x \geq 0$ is the non-negativity constraints. The new approach of Lancaster thus becomes an interesting and important case of consumer choice rather than a general model of consumer demand.



CHECK YOUR PROGRESS

Q 1: State the assumptions of Lancaster's model of consumer theory. (Answer within 60 words)

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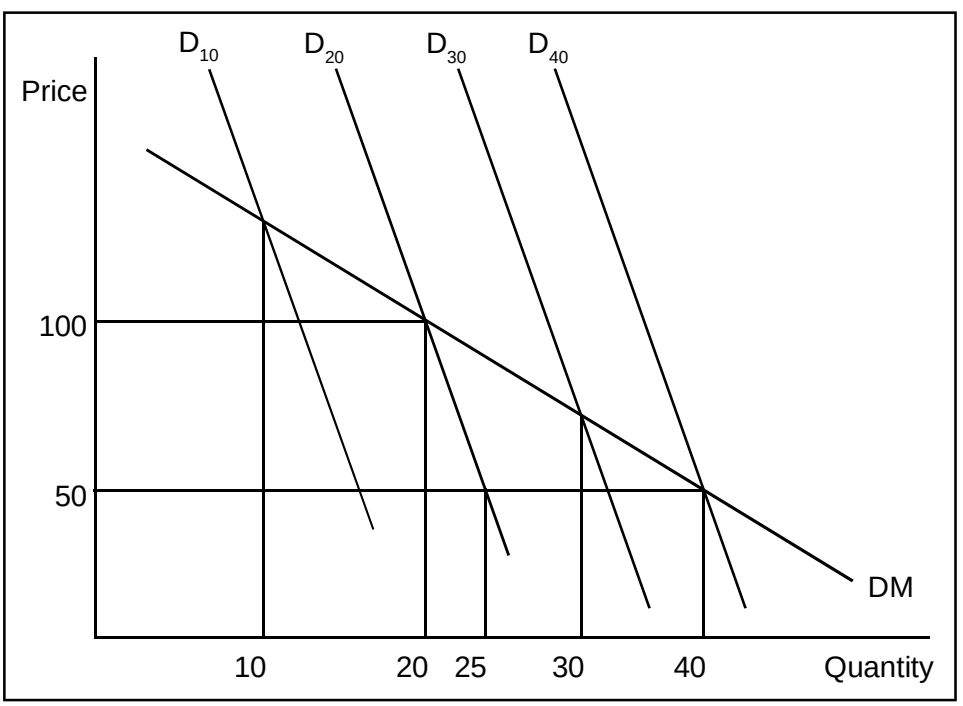
5.5 POSITIVE AND NEGATIVE NETWORK EXTERNALITIES (BANDWAGON, SNOB AND VEBLEN EFFECTS)

In our demand analysis, we have assumed that demand for goods of different individuals are independent of one another i.e., demand for tea by Joy depends on his own income, his taste, price of tea etc and does not depend on other person Priya's demand for tea. But, in our real worlds, it is seen that for some goods one persons demand also depends on the demands of other people. If this is the case, then it may be called as a network externality. Broadly, the network externality can be divided into two types-Positive network externalities and negative network externalities. If the quantity of a good demanded by a typical consumer increases in response to the growth in purchases of other consumers then it is regarded

as a positive network externality and on the other hand, if the quantity demanded decreases in response to the growth in purchases of other consumers, then there is a negative network externality work. The existence of positive and negative network externality gives rise to Bandwagon, Snob and Veblen effects.

- **Bandwagon effect:** It refers to the demand or desire for a good by a person who wants to be in style because possession of a good is in fashion and therefore, many others has it. The Bandwagon effect often arises with video games, children's toys etc. It is important to note that the Bandwagon effect is the important objective of marketing and advertising strategies of several manufacturing companies who appeal to go in for a good as people of style are buying it. The positive network externality or the Bandwagon effects are illustrated in Figure 5.1.

Figure 5.1: Bandwagon Effect



Let us assume that only 10 thousand people (in Assam) have purchased the good which is relatively small number compared to the total population of Assam. Due to this, consumers will have little incentives to buy the product. In this case the demand curve is given by D10. Now, suppose that the consumers think that 20 thousand people

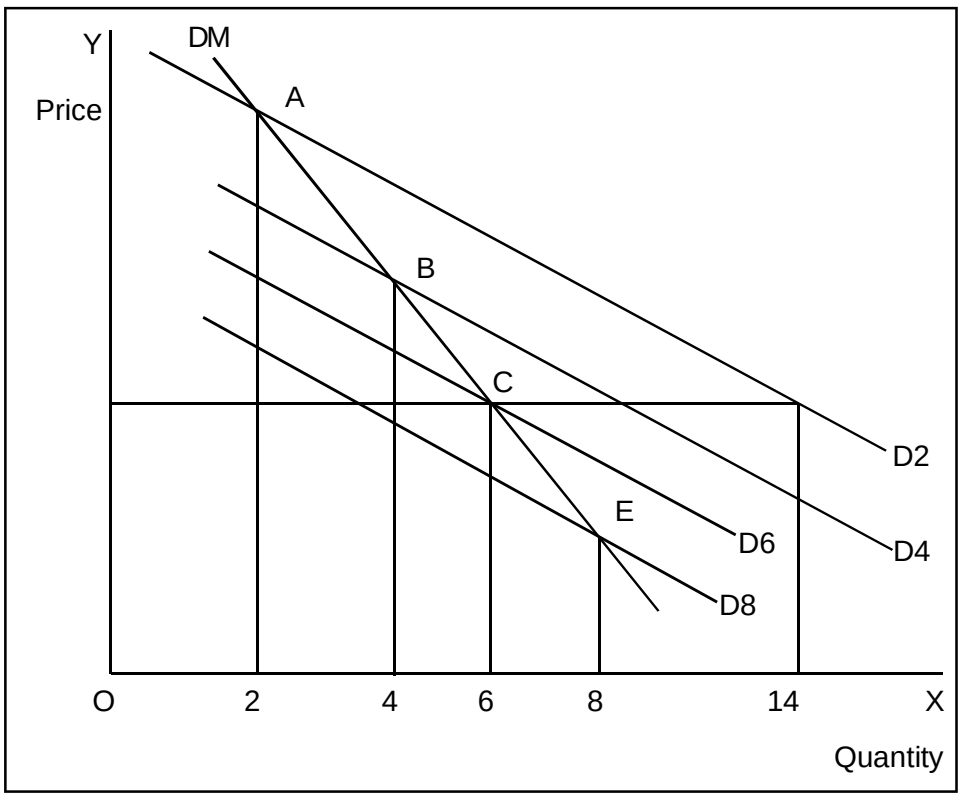
have bought the product. Then they find it more attractive and want to buy more and as a result the demand curve becomes D20 as shown in the diagram. Similarly, the demand curve becomes D30, if the consumer thinks that thirty thousand people purchased the good and so on. Thus, the more people consumers believe to have purchased the product, the further to the right the demand curve shifts. This is a bandwagon effect. Thus, Bandwagon effect is an example of a positive network externality in which the quantity demanded of a product that an individual buys increases in response to the increase in the quantity purchased by other individuals.

In the figure 5.1, it is seen that when the price were 100, then 20 thousand people would buy the product and the relevant demand curve would be D_{20}. If the price were 50 then forty thousand people would buy the good and D_{40} was the relevant demand curve. Therefore, the market demand curve is found by joining the points on the demand curves D_{10}, D_{20}, D_{30} and D_{40} that corresponds to the quantities ten thousand, twenty thousand, thirty thousand and forty thousand. Comparatively, the market demand curve is relatively elastic than the curves D_{10}, D_{20}, D_{30} and D_{40}. This is happen due to positive network externality.

If there were no network externality, then price drop from 100 to 50 increase the quantity demand from 20 to 25. But, in case of having externality the quantity demand increases to forty thousand. Thus, the positive network externality makes the demand curve more elastic.

- **Snob effect:** The snob effect arises when the network externalities are negative. The snob effects works quite contrary to the bandwagon effect. The snob effect refers to the desire to own an exclusive or unique good having a prestige value. The quantity demanded of a snob good is higher the fewer people who own it. Rare works of art, specially designed sports cars and specially designed made to order clothing, very expensive cars are some example of snob goods. The value or utility one gets from a very expensive luxury car is mainly due to the prestige and status value of it which results from the fact that only few others own it. The snob effect can be illustrated with the help of Figure 5.2.

Figure 5.2: Snob Effect

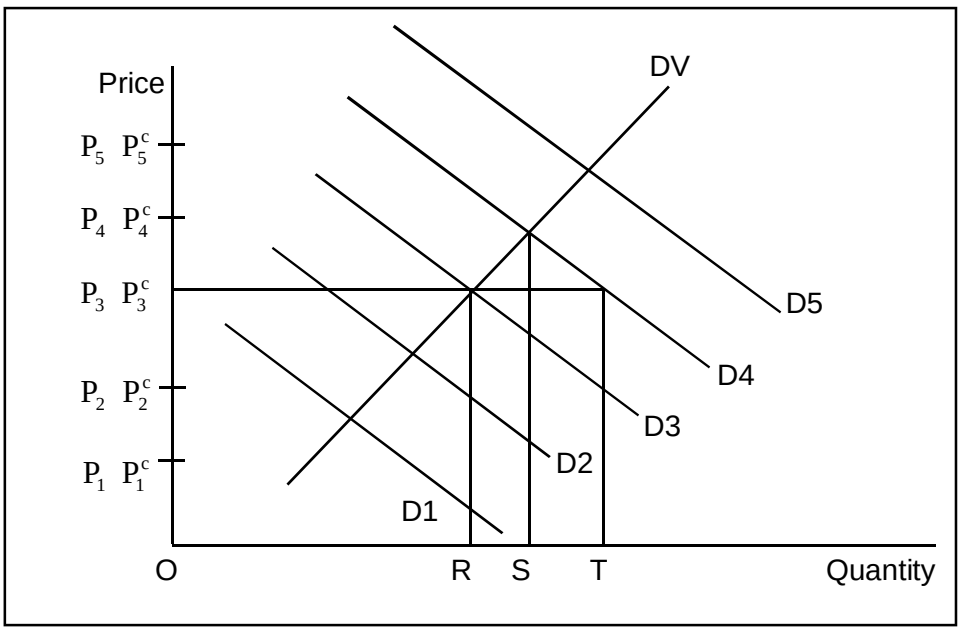


In Figure 5.2, D2 is the demand curve when people think that two thousand people used the good. If they think that four thousand people used the good, its value decreases and then D4 becomes the new demand curve. Similarly, if it is think that six thousand people use the good, then the snob value or prestige value is further reduced and then D6 becomes the new demand curve. The people come to know how many people actually own the good. If we join A, B, C and E which represent quantity demanded at different numbers of people owning the commodity and thus incorporating snob effect we have the market demand curve. The snob effect makes the demand curve less elastic.

- **Veblen effect:** To discuss about the Veblen effects it is helpful to categorised the price of a commodity into real price and the conspicuous price as the utilities derived from a commodity used for conspicuous consumptions depends not only on the inherent qualities of that unit but also on the price paid for it. The probability of these two prices in which to be identical in highly organised markets where price information is common knowledge. In other markets, where bargains and special

discounts are prevails, the real or conspicuous price need not be identical. In any case, the quantity demanded will be a function of both the real price and the conspicuous price.

Figure 5.3: Veblen Effect



In Figure 5.3, P_1, P_2, P_3, P_4 and P_5 are the real prices. $P_1^c, P_2^c, P_3^c, P_4^c$ and P_5^c are the price of conspicuous consumption. D_1 is the demand curve which indicate that the quantity demanded at alternate prices if all consumers expected a conspicuous price of P_1^c. Similarly, D_2, D_3, D_4 and D_5 can be obtained. If it is assume that the consumer possess accurate market information then the virtual equilibrium point exists i.e., the point where the real price is equal to the conspicuous price. In the diagram, $P_1 = P_1^c, P_2 = P_2^c, P_3 = P_3^c, P_4 = P_4^c$ and $P_5 = P_5^c$ indicates the virtual equilibrium. The locus of this virtual equilibrium points gives us the demand curve (DV). It is seen that a change in price from P_4 to P_3 will reduce the quantity demanded by RS. The price effect is to increase the quantity demanded if there were no change in the expected conspicuous price would be OT. However, at lower price a number of buyers would leave the market because of the reduced utility derived from the commodity at that lower conspicuous price. Therefore, RT is the Veblen effects.



CHECK YOUR PROGRESS

Q 2: State the Bandwagon Effect. (Answer within 20 words)

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Q 3: State the Snob Effect. (Answer within 20 words)

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Q 4: When does the Snob Effect arise? (Answer within 30 words)

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5.6 LET US SUM UP

- Garry S Becker created the foundational modelling framework for household level analysis of consumption and time use.
- Becker maximised the utility function subject to only single budget constraint instead of different constraints like time constraints, goods constraints and production constrained. And, he asserts that in order to maximise the money income, the household have to spend the time also on the activities like sleep, food, leisure along with job.
- According to the Characteristics model of Lancaster, the utility is derived from the properties or characteristics of the goods.
- Consumer can buy any commodity combination lays within the feasible region. However, since a rational consumer spends his total income on the commodities, he will buy a commodity combination lays on the frontier.
- Lancaster's efficiency frontier shows the maximum attribute combinations the consumer can obtain from his income.
- Network externalities are a special kind of externalities which may be positive or negative. Due to existence of network externality one individuals utility for a good depends on the number of other people who

consume the commodity that is there is a interdependence of demand among different individuals.

- The existence of network externality gives rise to Bandwagon, Snob and Veblen effects.

5.7 FURTHER READING

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3) Leibenstein, H (1950) 'Bandwagon, Snob, and Veblen Effects in the Theory of Consumers' Demand', The Quarterly Journal of Economics, Vol. 64, No. 2. (May, 1950), pp. 183-207.
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5.8 ANSWERS TO CHECK YOUR PROGRESS

Ans. to Q. No. 1: The assumptions of Lancaster's consumer theory are: (a) The good does not give utility to the consumer; it possesses characteristics and these characteristics give rise to utility. (b) A good will possess more than one characteristic and many characteristics will be shared by more than one good. (c) Goods in combination may possess characteristics different from those pertaining to the goods separately.

Ans. to Q. No. 2: Bandwagon effect refers to the demand or desire for a good by a person who wants to be in style because possession of a good is in fashion and therefore, many others has it. The Bandwagon effect often arises with video games, children's toys etc.

Ans. to Q. No. 3: Snob effect refers to the desire to own an exclusive or unique good having a prestige value. The quantity demanded of a snob good is higher the fewer people who own it.

Ans. to Q. No. 4: The snob effect arises when the network externalities are negative. The snob effects works quite contrary to the bandwagon effect. Similarly, rare works of art, specially designed sports cars and specially designed made to order clothing, very expensive cars are some example of snob goods.

5.9 MODEL QUESTIONS

Q 1: Explain briefly the household model of time allocation.

Q 2: Describe briefly the Characteristics model of Lancaster.

Q 3: What do you mean by network externality? What kind of effects arises due to network externality? Explain any two with the help of diagram.

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UNIT 6: THEORY OF COST

UNIT STRUCTURE

6.1 Learning Objectives

6.2 Introduction

6.3 Cost Function

6.4 Short Run Cost Functions

6.5 Derivation of the Cost Function from the Production Function

6.6 Long Run Cost Functions

6.7 Derived Demand

6.8 Modern Theory of Costs

- 6.8.1 Engineering Cost
- 6.8.2 Economics of Scope
- 6.8.3 Learning Curve

6.9 Let Us Sum Up

6.10 Further Reading

6.11 Check Your Progress

6.12 Answers to Check Your Progress

6.13 Model Questions

6.1 LEARNING OBJECTIVES

After going through this unit, you will be able to-

- Distinguish fixed cost from variable cost
- The short run period from the long run period
- The various types of costs that exist in the short run
- Derive the long run average and marginal costs
- Derive the cost function from the production function
- Explain what derived demand is.

6.2 INTRODUCTION

When a producer decides to undertake the production of a particular good, his or her business decision will depend not only on the physical quantities of the goods produced but also on the money value of the inputs

used and the output produced. The money value of the inputs used is referred to as the cost of production. For example, when a piece of furniture is produced, the total expenses incurred on the raw materials (like wood, nails, adhesive, paint, etc.), labour, space, tools and machinery constitute the cost of production. Clearly, when the total output increases, the costs of production are bound to increase. Thus, cost is related to production and this is why cost functions are known as derived function - they being derived from the production function.

6.3 COST FUNCTION

Cost function refers to the functional relationship between total cost and inputs. Generally, total cost is a multivariable function, that is total cost is determined by many factors. However, for pedagogical convenience, the total cost is considered as a function of output only, other things remaining constant. Graphically, costs are represented on two dimensional diagrams, suggesting that C= f(X), ceteris paribus, where C refers to the cost and X refers to the output produced. Any change in the factors other than output results in a shift in the cost curve graphically.

Economic theory distinguishes between the short run and the long run. The short run is a time period where the supply of certain factors of production or inputs is inelastic. i.e. their supply cannot be increased at a short notice. On the other hand, the long run is a time period where the supply of all factors of production is elastic. Thus, in the short run, some factors of production are fixed and some are variable, whereas in the long run, all factors of production are variable. Accordingly, it is instructive to distinguish between the short run and the long run cost function.

6.4 SHORT RUN COST FUNCTIONS

In the short run, the inputs used in the production process are divided into two categories - fixed inputs and variable inputs. Accordingly, the costs incurred on them are classified as fixed cost and variable cost respectively. Fixed cost includes salaries of administrative staff, depreciation of machinery, expenses for building depreciation, repairs, land maintenance

etc. Variable cost on the other hand includes expenses on raw materials, cost of direct labour, running expenses of fixed capital (like fuel), etc.

Thus, in the short run, total cost of production has two components - fixed costs and variable costs, i.e.

TC = TFC + TVC, where TC represents total cost, TFC is total fixed cost and TVC is total variable cost,

Accordingly, the average cost which is defined as total cost divided by output produced, also has two components , i.e.

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

$$\text{or } AC = \frac{TFC + TVC}{Q}$$

$$\text{or } AC = AFC + AVC$$

The marginal cost is defined as the change in total cost as a result of a small change in the output, i.e.

MC = d (TC) / dQ

The shape of the short run cost curves are shown in Figure 6.1 and 6.2

Figure 6.1: TC, TVC and TFC

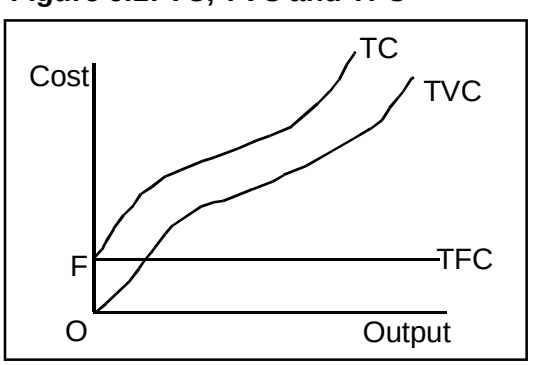


Figure 6.2: AFC

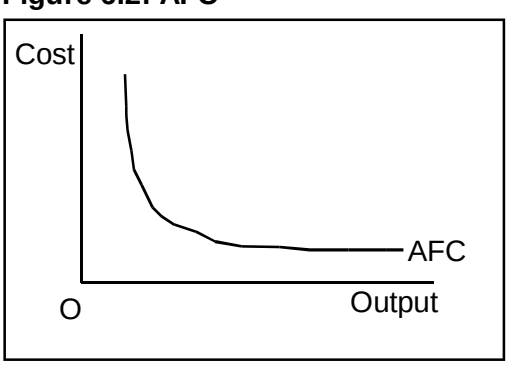


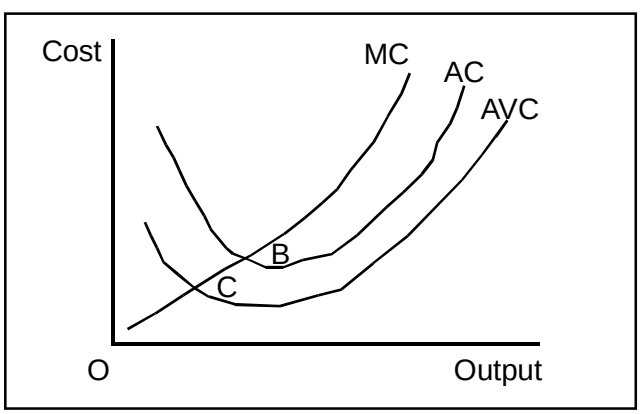
Figure 6.1 shows the total cost, total fixed cost and total variable cost curves. The total fixed cost curve (TFC) is a horizontal straight line, implying that as the quantity of output increases, total fixed cost remains the same.The total variable cost (TVC) is an upward rising curve starting from the origin, which means that TVC will be zero if no output is produced. The TVC initially increases at a decreasing rate, and then increases at an increasing rate, thereby making it take the shape of an inverted S. This shape arises due to the operation of the law of diminishing returns in the

production function.The total cost (TC) is the sum of the total fixed and variable costs. Clearly, total cost increases in the same way as TVC, but starts from the point F, signifying that if no output is produced the total cost equals total fixed cost.

Like the total cost, the average cost (AC) also has two components- the average fixed cost (AFC) and the average variable cost (AVC). The AFC is a downward sloping curve, which is shaped like a rectangular hyperbola, as represented in Figure 6.1. The AFC is relatively high at low levels of output, and keeps falling continuously as output increases. The average variable cost (AVC) curve starts declining as output initially increases. It reaches a minimum point, and after that as output increases, the AVC starts increasing. Similar to the AVC, the AC curve in the short run also declines initially as the output level increases. It then reaches a minimum point after which the AC curve starts increasing. Though similar in shape, the minimum point of the AC curve occurs at an output level beyond that level of AVC attaining it minimum. Or in other words, the minimum point of the AC curve occurs to the right of the minimum point of the AVC.

The marginal cost (MC) is the change in the total cost, attributable to a unit change in the output. As output increases, the MC starts falling, and reaches a minimum point. This minimum is attained before the minimum of the AVC curve. After attaining a minimum, the MC curve starts rising with the increase in output. The MC curve intersects the AVC and AC curves at their minimum points, as shown by the points B and C respectively in Figure 6.3

Figure 6.3: MC, AC and AVC



The relationship between the average and marginal costs of production can be expressed mathematically as below:

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

Differentiating the above equation with respect to Q gives

$$\frac{d(AC)}{dQ} = \frac{Q.\frac{d(TC)}{dQ} - TC.\frac{dQ}{dQ}}{Q2}$$

$$\text{or,} \quad \frac{d(AC)}{dQ} = \frac{MC}{Q} - \frac{AC}{Q}$$

$$\text{or,} \quad \frac{d(AC)}{dQ} = \frac{MC - AC}{Q}$$

$$\text{When AC is falling, we get } \frac{d(AC)}{dQ} = \frac{MC - AC}{Q} < 0 \quad \text{i.e.} MC < AC$$

$$\text{When AC is minimum, we get } \frac{d(AC)}{dQ} = \frac{MC - AC}{Q} = 0 \quad \text{i.e.} MC = AC$$

$$\text{When AC is increasing, we get } \frac{d(AC)}{dQ} = \frac{MC - AC}{Q} > 0, \text{i.e.} MC > AC$$

Graphically, this relationship between AC and MC is reflected in the MC curve lying below the AC curve when AC is falling, MC intersecting the AC at its minimum point, and MC lying above the AC when AC is rising.

To sum up, the short run costs of production involve both fixed and variable costs, and these two components define the nature and shape of the cost curves in the short run.



CHECK YOUR PROGRESS

Q 1: Choose the correct answer:

(a) The average fixed cost curvetakes the shape of a _____ (horizontal straight line/rectangular hyperbola).

(b) When AC is falling, MC is _____ (below/ above) the AC curve.

(c) When average product is increasing, average cost is _____ (increasing/ decreasing).

Q 2: What is a cost function?

.....

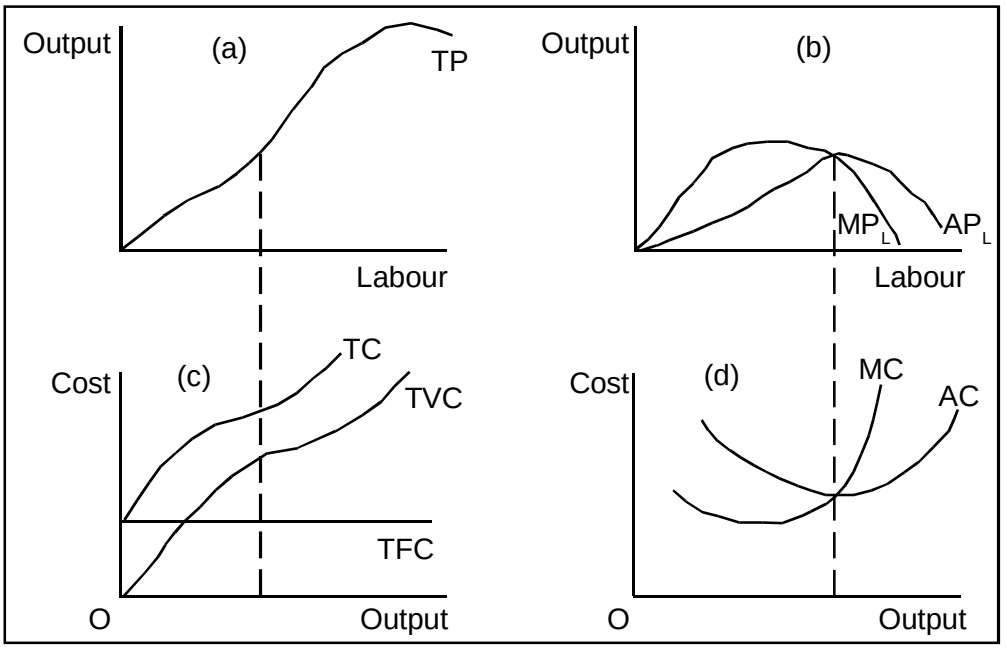
Q 3: Derive the relation between average and marginal cost.

.....

6.5 DERIVATION OF THE COST FUNCTION FROM THE PRODUCTION FUNCTION

The shape of the short run cost curve is dependent on the shape of the short run production function. In the short run, when there is one variable factor and one fixed factor, the behaviour of output to changes in the variable input is governed by the law of variable proportions, or the law of diminishing returns. When there is one fixed factor (say capital K), then as the variable factor input (say labour L) increases, total output initially increase at an increasing rate. This results in the total cost increasing at a decreasing rate because the increase in input is adding more to the output than to the cost. After a certain point, output increases at a decreasing rate because the fixed factor becomes scarce relative to the variable factor. Hence, addition of the input adds more to total cost as compared to output, which results in the total cost increasing at an increasing. This behaviour of the total product or output curve in the short run results in the total cost function increasing at decreasing rate and then at an increasing rate, and gives it an inverted S shape. This may be seen shown in Figure 6.4 (a) and (c).

Figure: 6.4 Derivation of Cost Function from Production Function



In the short run production function, the marginal and average product initially keeps increasing, reaches a maximum and then starts declining. When the average product increases, the average cost declines, and vice-versa.The average cost reaches a minimum point when the average product attains it maximum. Similar is the relation between the marginal cost and marginal product. Thus, the average and marginal cost curves initially slope downwards, reaches a minimum point and then starts increasing. Figure 6.4 (b) and (d) show these relationship.

From Figure 6.4 (b) we see that the marginal product reaches its highest value before the average product attains its maximum. Accordingly, the marginal cost curve attains its minimum value before the average cost reaches its minimum. The marginal product curve intersects the average product curve at its maximum. Corresponding to this, the marginal cost curve intersects the average cost curve at its minimum (as shown in 6.4(d))

Thus, this is how the cost function and cost curves are derived from the production function and product curves.



LET US KNOW

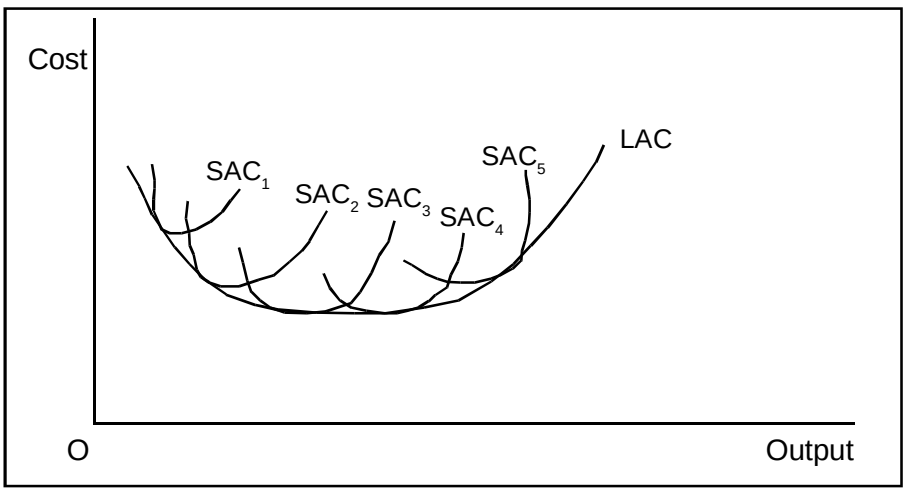
- The average product of labour is defined as APL=Q/L and the marginal product of labour is defined as MPL=dQ/dL, where Q is the total output or total product and L refers to the labour input.

6.6 LONG RUN COST FUNCTION

The long run is a period where the producer has sufficient time to expand his increase his inputs in order to increase his output. Thus, all factors become variable in the long run, since their supply can be increased as required, and the distinction between long run and short run no longer holds.

The derivation of the long run average cost curve and the marginal cost curve is explained below.

Figure: 6.5: Derivation of LAC



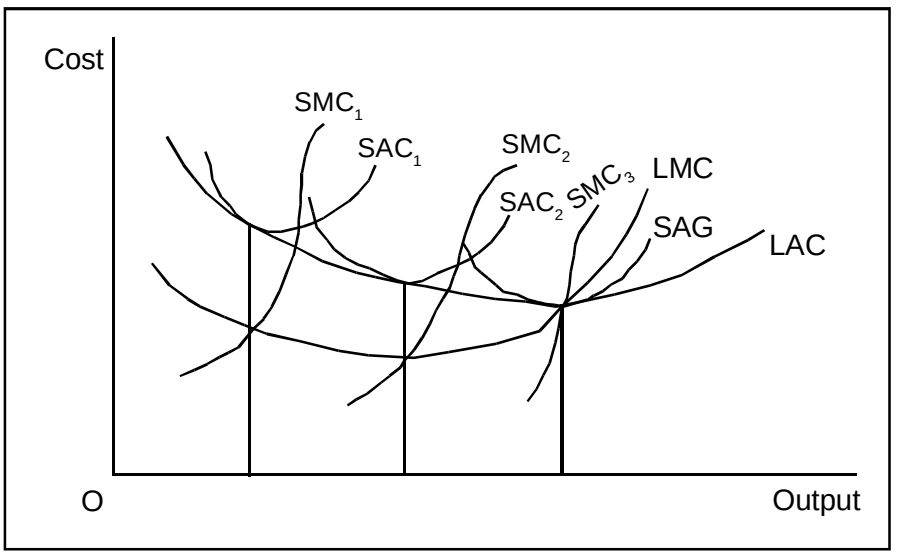
The long run average cost (LAC) curve is derived from the short run average cost (SAC) curves. Each point on the LAC corresponds to a point on the SAC which is tangent to the LAC at that point. Suppose there are three methods of production available to a firm, each with different plant sizes, say a small, medium and large plant size. The corresponding costs associated with each plant are given by the short run average cost

curves SAC_1, SAC_2 and SAC_3 respectively. If the firm wishes to start with a small level of output, say X_1, it will choose the first plant SAC_1. If the demand for the product increases up to X_2, the firm has the option to either keep producing with the small size plant, or to install the medium sized plant (whose average cost conditions are given by SAC_2. If the firm foresees its demand to increase in future, (say to X_2') it would be wise on the part of the producer to install the medium size plant. This is because if the producer continues with the existing plant, then he would be producing his output at higher average cost (as shown by the rising part of the SAC_1 curve), whereas the average cost would be lower at BX_2' (than AX_2') when he is producing the same output using the medium-size plant. Similarly, if the producer foresees a further increase in demand to X_3 and more, he will install the large size plant and will operate on the SAC_3 curve.

Now, in the long run, it is possible to have a number of plant sizes, each being suitable to produce a certain level of output. In such a case, the number of points of intersection of different SAC curves (which are crucial for the producer to decide whether to continue with the same plant, or switch to a new one) will be numerous. In the limit, if we assume that there is infinite number of plants, we obtain a continuous curve which is the long run average cost curve LAC. From figure 3.6, it can be seen that each point on the LAC is a point of tangency with the corresponding SAC curves, and thus envelopes the short run AC curves. Therefore, the LAC is also known as the 'envelope curve'. Under traditional economic theory, the LAC curve is U shaped, just like the SAC curve. This means that in the long run, as output increases, average cost initially decreases, reaches a minimum, and after that increases.

The long run marginal cost curve (LMC) too is derived from the short run marginal cost (SMC) curves. The LMC is derived from the SMCs in the following manner.

Figure 6.6: Derivation of LMC



From the points of tangency of the SAC and the LAC along the LAC curve, we draw vertical lines to the X axis. The points where these vertical lines intersect the different SMC curves are joined, and this gives us the LMC. Thus the LMC is formed from the points of intersection of the vertical lines drawn from the points of tangency of the SAC and LAC.



CHECK YOUR PROGRESS

Q 4: Define the terms average fixed cost (AFC) and average variable cost (AVC). Is the shape of the curves representing AFC and AVC similar?

.....

.....

Q 5: Why is the long run average cost curve known as the envelope curve?

.....

Q 6: Why is the demand for factors of production known as derived demand?

.....

.....

6.7 DERIVED DEMAND

The concept of derived demand arises in the case of demand for factor inputs. In the context of the cost function, it is clear that the role of factor inputs and their price is crucial. The price of a factor input is determined by its demand and supply conditions. However, demand and supply of factors of production have certain peculiarities as compare to the demand for and supply of goods. Infact, it is this peculiarities that necessitate the need for having a separate theory of factor pricing.

The supply of factor inputs is peculiar because factor inputs are not homogeneous. Each factor of production, be it land, labour or capital, differ in their character in respect of supply. Land is a gift of nature, labour is a partially natural and partially man-made factor of production while capital is a man-made factor of production. Even within land and labour, there exist a lot of heterogeneity.

The demand for a factor is determined by its productivity and the good that it produces. A factor which is not productive is not demanded. For example, infertile land will not be demanded for cultivation and an outdated machinery is not demanded for production purpose. However, productivity of a factor alone is not sufficient for its demand. A factor is demanded for the type of good or service that it produces. For example, a labourer having skills in the production of shirts is not suitable for producing furniture. Thus, the demand for labour capable of producing shirts will arise only when the demand for shirts increase. In other words, the demand for labour arises out of the demand for the goods and services it can produce. This is why demand for a factor of production is known as derived demand, unlike the demand for goods and services which is an autonomous demand arising due to the specific characteristics of the good or service.

6.8 MODERN THEORY OF COSTS

In this section we shall discuss a few important modern theory of costs, viz., Engineering cost and Learning Curve.

6.8.1 Engineering Cost

As we know, theories and principles of Economics today is applied in many other branches of study. Management and Engineering are among those. Just like we derive cost from the production function, in the same way, engineering costs are derived from engineering production functions. Here, each productive method is divided into sub-activities corresponding to the various physical-technical phases of production for the particular commodity.For each phase the quantities of factors of production are estimated and finally the cost of each phase is calculated on the basis of the prevailing factor prices.

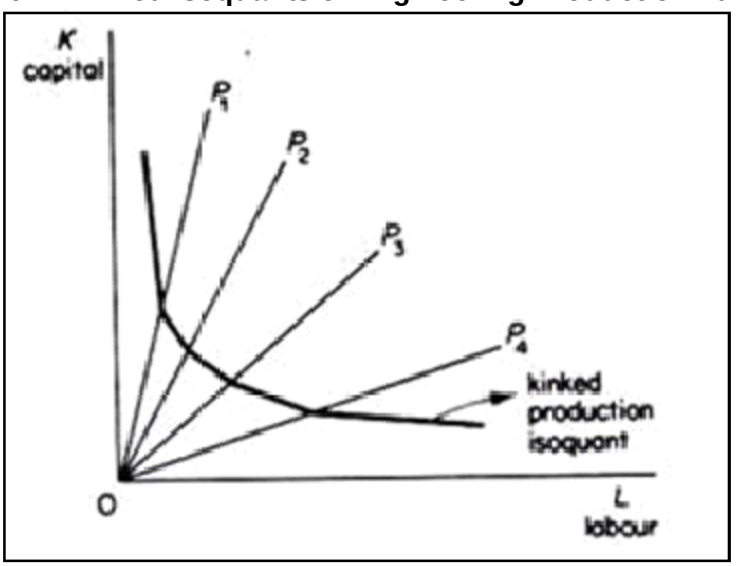
The total cost of the particular method of production is the sum of the costs of its different phases.Such calculations are done for all available plant sizes. Production isoquants are subsequently estimated, and from them, given the factor prices, the short-run and the long-run cost functions may be derived. It should be noted that engineering production functions and the cost functions derived from them refer usually to the production costs and do not include the administrative costs for the operation of any given plant.

Engineering production functions are characterized by a limited number of methods of production. The production isoquants are kinked, reflecting the fact that factor substitutability is not continuous, but limited. Substitution of factors occurs directly at the kinks of the isoquants, where one production technique is substituted for another (Figure 6.7).

On the straight segments of the production isoquant a combination of the adjacent methods of production is employed. What happens in engineering production functions along the segments of the isoquants is an indirect substitution of factors via substitution of processes.Along a engineering production isoquant, factors cannot be substituted for each other except by changing the levels at which entire technical processes are used, because each

process uses factors in fixed characteristic ratios. Engineering production functions are the basis of linear programming. In this approach, process substitution plays a role analogous to that of factor substitution in conventional analysis.

Figure 6.7: Kinked Isoquants of Engineering Production Function



6.8.2 Economics of Scope

The theory of economy of scope states that the average total cost of a company's production decreases when there is an increasing variety of goods produced. Economy of scope gives a cost advantage to a company when it produces a complementary range of products while focusing on its core competencies. Economy of scope is an easily misunderstood concept, especially since it appears to run counter to the concepts of specialization and scale economies. One simple way to think about economy of scope is to imagine that it's cheaper for two products to share the same resource inputs (if possible) than for each of them to have separate inputs.

An easy way to illustrate economy of scope is with rail transportation. A single train can carry both passengers and freight more cheaply than having separate trains, one for passengers and another for freight. In this case, joint production reduces total input costs. (In

economic terminology, this means that one input factor's net marginal benefit increases after product diversification.)

Similarly, suppose, company ABC is the leading desktop computer producer in the industry. Company ABC wants to increase its product line and remodels its manufacturing building to produce a variety of electronic devices, such as laptops, tablets and phones. Since the cost of operating the manufacturing building is spread out across a variety of products, the average total cost of production decreases. The costs of producing each electronic device in another building would be greater than just using a single manufacturing building to produce multiple products.

Real-world examples of the economy of scope can be seen in mergers and acquisitions (M&A), newly discovered uses of resource byproducts (such as crude petroleum) and when two producers agree to share the same factors of production.

Economies of scope can arise from the sharing or joint utilization of inputs and lead to reductions in unit costs. Scope economies are frequently documented in the business literature and have been found to exist in electronic-based B2B (business-to-business) providers, home healthcare, banking, publishing, distribution, and telecommunications.

Methods of Achieving Economies of Scope:

Flexible Manufacturing

The use of flexible processes and flexible manufacturing systems has resulted in economies of scope because these systems allow quick, low-cost switching of one product line to another. If a producer can manufacture multiple products with the same equipment and if the equipment allows the flexibility to change as market demands change, the manufacturer can add a variety of new products to their current line. The scope of products increases, offering a barrier to entry for new firms and a competitive synergy for the firm itself.

Related Diversification

Economies of scope often result from a related diversification strategy and may even be termed "economies of diversification." This strategy is made operational when a firm builds upon or extends existing capabilities, resources, or areas of expertise for greater competitiveness. According to Hill, Ireland, and Hoskisson, "firms select related diversification as their corporate-level strategy in an attempt to exploit economies of scope between their various business units." Cost-savings result when a business transfers expertise in one business to a new business. The businesses can share operational skills and know-how in manufacturing or even share plant facilities, equipment, or other existing assets. They may also share intangible assets like expertise or a corporate core competence. Such sharing of activities is common and is a way to maximize limited constraints.

Mergers

Mergers may be undertaken for any number of reasons. "As a rule of thumb," as explained Rob Preston, in an article about the trouble with mergers, "'scope' acquisitions-moves that enhance or extend a vendor's product portfolio-succeed more often than those undertaken to increase size and consolidate costs." Pharmaceutical companies, for example, frequently combine forces to share research and development expenses and bring new products to market. Research has shown that firms involved in drug discovery realize economies of scope by sustaining diverse portfolios of research projects that capture both internal and external knowledge spill overs.

Linked Supply Chains

Today's linked supply chains among raw material suppliers, other vendors, manufacturers, wholesalers, distributors, retailers, and consumers often bring about economies of scope. Integrating a vertical supply chain results in productivity gains, waste reduction,

and cost improvements. These improvements, which arise from the ability to eliminate costs by operating two or more businesses under the same corporate umbrella, exist whenever it is less costly for two or more businesses to operate under centralized management than to function independently.

6.8.3 Learning Curve

The learning curve is an important modern concept according to which cumulative experience in the production of a product over time increases efficiency in the use of inputs such as labour and raw materials and thereby lowers cost per unit of output. K.J. Arrow, one of the pioneers in putting forward this concept calls it "Learning by doing".

According to Arrow, as a firm or its manager produces successive lots of output over various periods of time, it learns to pro-duce more with a given quantity of re-sources or it is capable of producing a given output by using lesser quantities of inputs or resources than before.

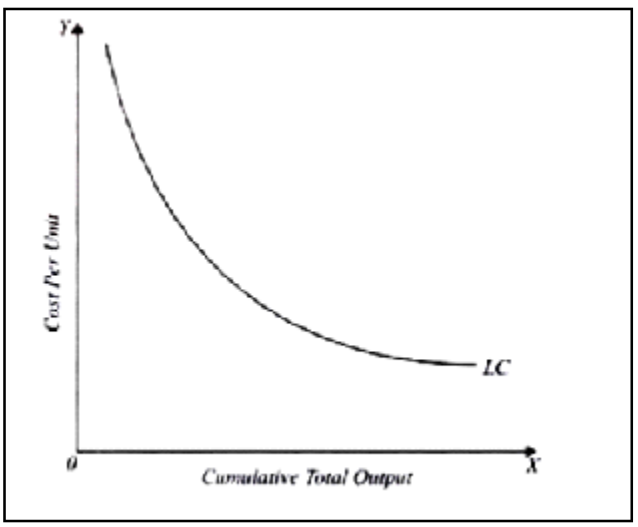
Thus, either with the increase in efficiency of resources or with saving in resources such as labour and raw materials, cost per unit of output declines. This learning curve effect mostly occurs in the reduc-tion of labour requirements per unit of output.

A number of factors bring this learn-ing curve effect. As cumulative volume of output over successive periods of time increases, labour and supervisors become more familiar with the work methods or the production process, which leads to the reduction in the amount of scrap and other types of wastes.

Besides, raw materials cost per unit of output may also decline as cumulative volume of output in successive periods over time increases and as a result a firm gains more experi-ence in doing a production process repeatedly over successive time periods.

The learning curve is graphically shown in Figure 6.8 where on the X-axis cumulative total output over successive periods of time and on the F-axis cost per unit of output are measured. It will be seen from that the learning curve shows downward which shows declining cost per unit of output as cumulative output increases over time and the firm learns from its work experience.

Figure 6.8: Learning Curve



The learning curve effect is usually expressed as a constant percentage. This percentage represents the proportion by which cost per unit of output declines with the increase in cumulative output in each successive time period.



6.9 LET US SUM UP

- Cost function refers to the functional relationship between the cost of production and output produced.
- In the short run, total cost has two components -fixed cost and variable cost.
- The short run cost function is derived from the production function.
- The shape of the cost curves in the short run is determined by the shape of the short run product curves.
- In the long run, the distinction between fixed and variable costs does not exist and all costs become variable.

- The long run average cost curve is derived from the short run average cost curve.
- The long run average cost curve envelopes the short run average cost curves and hence is also known as the 'envelope curve'.
- The long run marginal cost curve too is derived from the short run marginal cost curve, but does not envelope the short run curves as the average cost curve.
- Derived demand refers to the demand for factors of production being dependent on the demand for the goods that they produce.



6.10 FURTHER READING

1) Pindyck, R. & Rubinfield, D.L., " Microeconomics", Prentice Hall of India.
2) Koutsoyiannis, A., "Modern Microeconomics", Macmillan.
3) Sen Anindya, "Microeconomic Theory", OxfordUniversity Press.
4) Madalla and Miller, "Microeconomics", McGraw Hill.



6.11 ANSWERS TO CHECK YOUR PROGRESS

Ans. to Q No.1: (a) Rectangular hyperbola (b) Below (c) Decreasing

Ans. to Q No.2: It shows the functional relationship between total cost and factor inputs used in the process of production.

Ans. to Q No.3: Refer to the mathematical derivation in the text.

Ans. to Q No.4: AFC=TFC/Q and AVC=TVC/Q. The AFC takes a rectangular hyperbola shape while the AVC is U shaped.

Ans. to Q No.5: Because it envelopes the short run AC curves.

Ans. to Q No.6: Because the demand for factor inputs arise from the demand for the products that they produce.



6.12 MODEL QUESTIONS

A) Short questions (Answer each question in about 150 words)

Q 1: Distinguish between fixed and variable cost with suitable examples.

Q 2: Why does the total cost initially increases at a decreasing rate and then at an increasing rate?

Q 3: Why does the total variable cost curve start from the origin while the total cost curve starts from a point on the Y axis?

B) Essay-type Questions (Answer each question in about 300-500 words)

Q 1: Derive the cost function from the production function.

Q 2: How is the long run AC curve derived from the short run AC curves? Explain with the help of a diagram.

Q 3: Explain diagrammatically the derivation of the long run marginal cost curve.

*** **** ***

UNIT 7: THEORY OF PRODUCTION

UNIT STRUCTURE

7.1 Learning Objectives

7.2 Introduction

7.3 Production Function

7.4 Production Function in the Short Run and the Law of Variable Proportions

7.5 Production Function in the Long Run

- 7.5.1 Isoquant
- 7.5.2 Characteristics of Isoquant
- 7.5.3 Marginal rate of Technical Substitution
- 7.5.4 Elasticity of Substitution

7.6 Returns to Scale

7.7 Cobb-Douglas Production Function

7.8 Constant Elasticity of Substitution (CES) Production Function

7.9 Least Cost Combination of Inputs

7.10 Let Us Sum Up

7.11 Further Reading

7.12 Answers to Check Your Progress

7.13 Model Questions

7.1 LEARNING OBJECTIVES

After going through this unit, you will be able to-

- define the production function
- explain the different stages of production in the short run production function
- distinguish the long run production function from the short run production function
- explain the terms isoquant, MRTS and elasticity of substitution
- define a homogeneous production function
- discuss the different types of returns to scale

- work out the different properties of the Cobb-Douglas and CES production functions
- explain the least cost combination of inputs.

7.2 INTRODUCTION

The previous chapter looked at cost side of a firm involved in the production process. In this chapter, we shall discuss in detail the production function and its characteristic behaviour in the short run and long run. A few concepts concerning the substitutability among factors, such as the marginal rate of technical substitution and the elasticity of substitution are also described. Two commonly used production functions, viz. the Cobb-Douglas production function and the CES production function and their properties are discussed too. Finally, we shall be discussing about the optimizing behaviour of the firm and how it selects that input combination which gives it the maximum profit.

7.3 PRODUCTION FUNCTION

Production is the process in which economic resources or inputs are combined to create economic goods and services or outputs. For example, in the production of a table (which is an output), several inputs are required, such as labour, raw-material (wood), tools and equipment. These inputs are combined in a particular manner, as defined by the technology, to produce the given output, which is the table.

Production function describes the relation between physical quantities of inputs and physical quantity of output. Given a state of technology, the production function shows the maximum amount of output attainable with a given level of inputs. It thus shows the functional relationship between inputs and output. Symbolically, if X_1, X_2…. X_n are the quantities of inputs, and Q is the maximum attainable output, then the production function is written as

$$Q = f(X_1, X_2, \ldots X_n)$$

The general mathematical form of the production function is

$Q = f(L, K, R, S, n, A)$,

Where Q = output,

L = labour input,

K = capital input,

R = raw materials,

S = land input,

n = returns to scale parameter,

A = efficiency parameter.

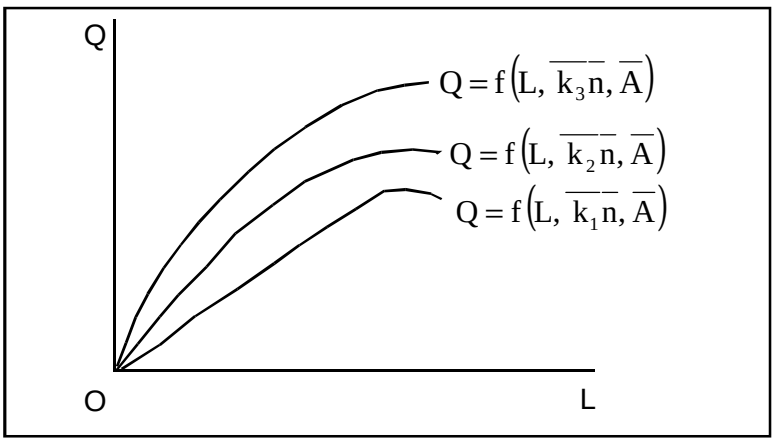
All variables in the production function are flow variables and are measured per unit of time. Since raw materials bear a constant relation to output at all levels of production, hence if output is measured in terms of value added (where the value of raw materials can be deducted from the value of output) and the variable R can be excluded from the production function mentioned above. Likewise, land input S is constant for an economy as a whole, and hence may not enter the aggregate production function.

Thus, the production function in traditional economic theory assumes the form

$Q = f(L, K, n, A)$.

The 'returns to scale' parameter n refers to the long run analysis of the laws of production and the efficiency parameter refers to the entrepreneurial or organisational aspect of production. Graphically, the production function is presented on a curve on a two dimensional graphs. Changes in the relevant variable are shown either by movements along the curve that depicts the production function, or by shifts of this curve. The Figure 7.1 depicts the production function which shows the relation between output and labour, for given K, n and A.

Figure 7.1: Production Function for Different Levels of K $\left(\overline{k_1} < \overline{k_2}, < \overline{k_3}\right)$



Other things remaining same, as labour increases, output also increases, and this is shown by movements along the curve. Changes in K, n and/or A leading to a change in output results in a shift in the production function from Q_1 to Q_2.

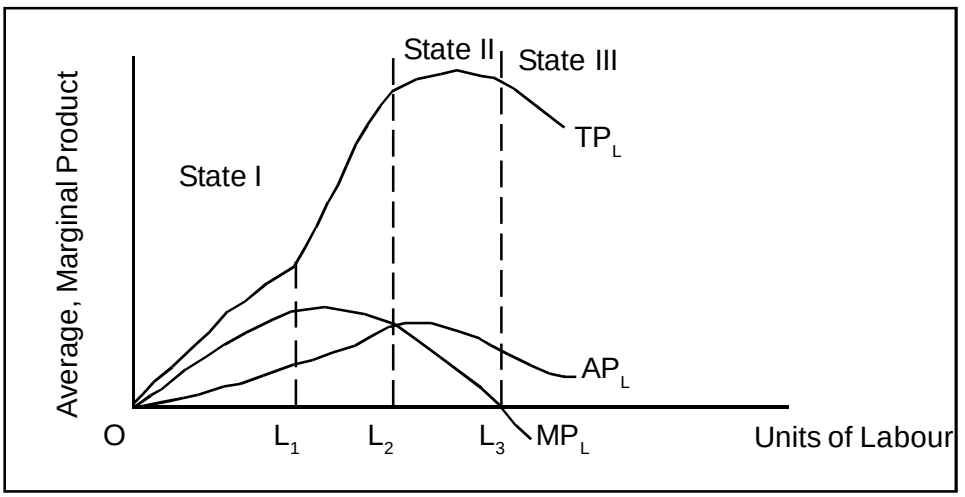
7.4 PRODUCTION FUNCTION IN THE SHORT RUN AND THE LAW OF VARIABLE PROPORTIONS

In economic theory, a distinction is made between the short run and long run. The short run is a time period when it is not possible to increase the supply of certain factors, especially the fixed factors. Accordingly, changes in output can come about only through changes in the supply of the variable factor. The behaviour of the production function in the short run is governed by the law of diminishing returns, and is also known as law of variable proportions, or returns to a factor. The supply of the fixed factor remaining constant in the short run results in the production function taking the form as Q= f(L, K).

In the short run, the total product (TP) is an increasing function of labour input, i.e. as labour increases, total output also increases. TP initially increases at an increasing rate. This is because, for a given amount of capital, as labour input increases, the productivity of both the factors increase and this leads to total product increasing at an increasing rate initially. However, for the given amount of capital input, as labour input increases

further it results in a fall in the productivity of the inputs, and as a result, the total product increases at a decreasing rate, as is shown in the diagram. Further increases in the variable factor lead to the total output reaching a maximum level OL_3 level of employment and beyond that the total output starts declining. This has been shown in Figure 7.2.

Figure 7.2: Production Function in the Short Run



The behaviour of the total output results in the marginal product of labour (MP_L) which is defined as the change in output as a result of the change in labour input. As labour input increases, MP_L also increases upto the point OL_1 and attains its maximum. After that increases in labour results in a fall in the MP_L. This continues till OL_3 at which MP_L becomes zero. This point corresponds to the point of the TP curve attaining it maximum. Beyond OL_3 increase in labour result in the MP_L becoming negative.

The behaviour of the average product of labour curve (AP_L) is similar to the MP_L. Initially AP_L increases as the labour input increase and reaches a maximum at OL_2 level of employment. After that the AP_L starts declining for increases in the labour input. Till OL_2 AP_L is lower than the MP_L. AP_L and MP_L are equal at the point where AP_L attains its maximum. As AP_L starts declining, the MP_L lies below the AP_L.

The behaviour of the short run production function is governed by the law of diminishing returns. The entire path of the production function, as traced out in the above diagram, can be divided into three phases. The first phase is till OL_2, and is depicted as the phase of increasing returns.

The second phase is from OL_2 to OL_3 and is referred to as the phase of diminishing returns, where the MP_L is falling. The third phase is from OL_3 onwards and is termed as the phase of negative returns. In the short run, a producer would produce in the second phase where the marginal returns are falling. The first phase would see an increase in the marginal returns as output increases, and hence the producer will have every incentive to keep increasing the level of output. The last phase is automatically ruled out because the returns are negative. Thus, the economic region of production would be the phase of diminishing returns.



CHECK YOUR PROGRESS

Q 1: State whether the following statements are true or false (T/F)

a) In the short run production function, all the inputs are variable factors. (T/F)

b) Diminishing returns occur when the marginal product is decreasing but positive.

Q 2: Why does a producer choose to operate in the second stage in the law of diminishing returns? (Answer within 30 words)

.....

.....

.....

7.5 PRODUCTION FUNCTION IN THE LONG RUN

The long run is a period where it is possible to increase the supply of all factors as and when required. Thus all factors of production become variable in the long run. So, in our production function given by Q=f(L,K), both L an K are now variable inputs. Accordingly, increase in output can come about through an increase in all the factors.

7.5.1 Isoquant

To represent the long run production function graphically, we use the technique of isoquants. The isoquant is a curve which shows different combinations of capital and labour producing the same level of output. To show different levels of output, we draw different isoquants, and this is represented by an isoquant map. Figure 7.3 and 7.4 represent an isoquant and an isoquant map respectively.

Figure 7.3 Isoquant

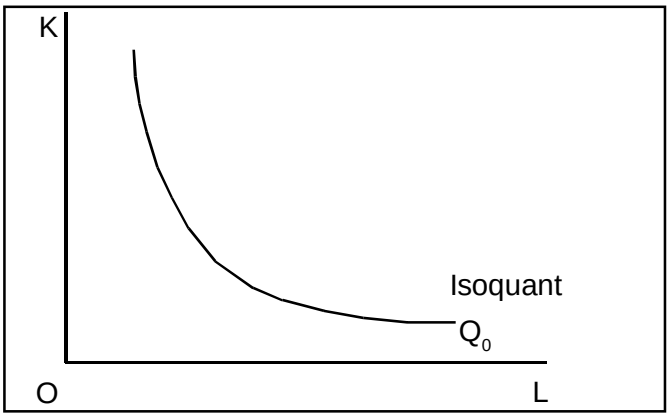
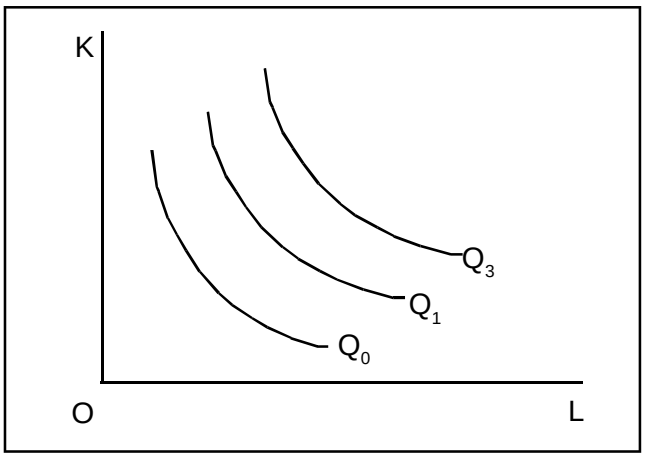


Figure 7.4 Isoquant map



7.5.2 Characteristics of Isoquant

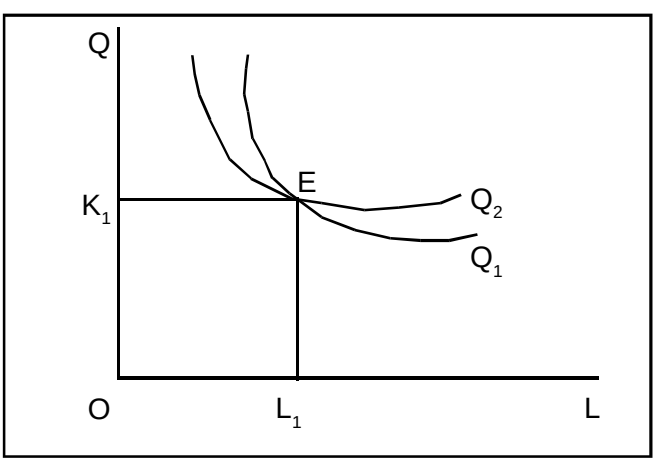
Isoquants possess the following characteristics:

- Isoquants are downward sloping from the left to the right. This is because as one input increases, the other must be reduced so as to get the same level of output. Ifboth the inputs increase, or

if one input increases, and the other remains constant, then the output is bound to increase.

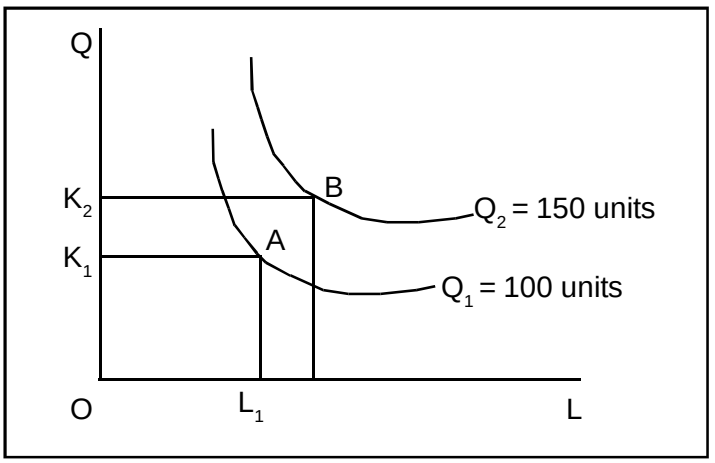
- Ø Isoquants are convex to the origin. The convexity of isoquant arises on account of diminishing marginal rate of technical substitution (MRTS). The MRTS is rate at which one input is substituted for the other, keeping the output constant.The concept MRTS will be discussed in detail in the following section. If the MRTS was increasing, the isoquant would have been concave to the origin, and if the MRTS would have been constant, the isoquant would take the shape of a downward sloping straight line.
- Ø No two isoquants can intersect each other. If two isoquants intersect each other, say at E, as shown in Figure 7.5 below, it would mean that at point E, OL_1 amount of labour and OK_1 amount of capital is producing two different levels of output, viz., Q_1 and Q_2, which is not possible.

Figure 7.5: Intersection of Isoquants



- Ø Higher levels of output are represented by higher isoquants. In fig 4.6point A represents the output level Q_1 (=100 units, say) which is produced by OL_1 and OK_1 amount of inputs. Increase in the inputs to OL_2 and OK_2 produce a higher level of output Q_2 (=150 units, say). The higher output level Q_2 is thus represented by a higher isoquant.

Figure 7.6: Higher isoquants represent higher levels of output





LET US KNOW

I Though isoquants are normally convex to the origin, yet there are other possibilities too. These include a linear isoquant, whose MRTS is constant and inputs are assumed to be perfect substitutesand an L shaped isoquant, where the inputs are used in a fixed proportion.

Having discussed about the meaning and properties of isoquants, let us now take a detailed look at what the marginal rate of transformation represents.

7.5.3 Marginal Rate of Technical Substitution

The marginal rate of technical substitution (MRTS) represents the degree of substitutability in a production function. Along a particular isoquant, if one input is increased, the other input must be decreased so that the level of output remains constant. MRTS is defined as the rate at which one input is substituted for the other, keeping the output constant. It is expressed as

MRTS = -(dK/dL)

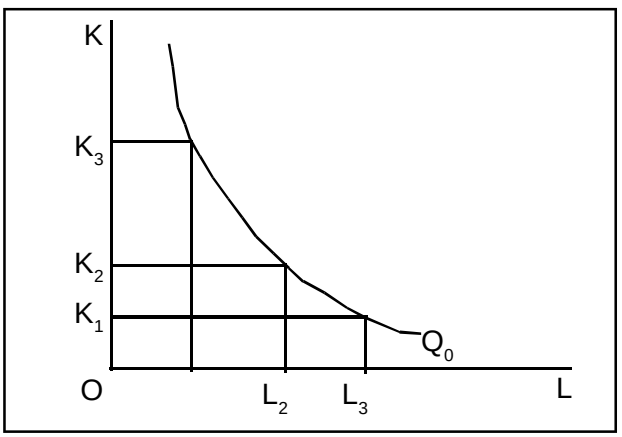
MRTS represents the slope of the isoquant.

It can be shown that the MRTS is equal to the ratio of the marginal products of labour and capital, i.e.

$$MRTS = \frac{MPL}{MPK}$$

Over the relevant region of production, the MRTS diminishes, i.e. as more and more labour is substituted for capital, keeping output constant, the absolute value of the MRTS falls. If we look at figure 7.7, we find that along an isoquant, for equal increases in labour input ($OL_1=L_1L_2=L_2L_3$), less and less of capital (K3K2>K2K1) is given up , thereby resulting in diminishing MRTS. It is this feature of diminishing MRTS that results in the isoquant being convex to the origin.

Figure 7.7: Diminishing MRTS



7.5.4 Elasticity of Substitution

The MRTS as a measure of substitutability of factors suffers from a serious limitation of being dependent on the units of measurement of the factors. A measure of substitutability which removes this drawback is the elasticity of substitution. The elasticity of substitution is defined as the percentage change in the capital-labour ratio to the percentage change in the MRTS. That is,

$$\sigma = \frac{\text{percentage change in } \frac{K}{L}}{\{\text{percentage change in MRTS}\}}$$

$$\text{Or}, \sigma = \frac{\left\{d\left(\frac{K}{L}\right)\right\}}{\left\{\frac{K}{L}\right\}} \Big/ \left\{\frac{d(MRTS}{MRTS}\right\}$$

The elasticity of substitution is independent of the units of measurement as both the numerator and denominator are measuredin the same units.

7.6 RETURNS TO SCALE

In the long run, output may be increased by changing all the factors of production. For the production function Q= f(L,K), output may be increased by increasing L and K in the same proportion or in different proportions. Under returns to scale, we consider the case where the factor inputs change in the same proportion. Thus, production behaviour in the long run is governed by returns to scale where we see how output responds to changes in factor inputs which increase in the same proportion. Suppose the inputs in a production function increase by k times. Then, if the output increases by more than k times, we get increasing returns to scale, if it increases by k times, we get constant returns to scale and if it increases by less than k times, we get decreasing returns to scale.

Mathematically, returns to scale is explained with the help of a homogeneous production function. For the production function given by Q= f(L,K), let Q_0 denote the initial level of output, i.e.

$Q_0 = f(L,K)$.

If we increase both the inputs by k times, we get the new output Q* as

$Q^* = f(kL, kK)$ and

If k can be factored out, and the new level of output can be expressed as

$Q^* = k^m f(L,K)$

Or, $Q^* = k^m Q_0$,

then the production function is said to be homogeneous of degree m. Here, the power of k (i.e. m) is called the degree of homogeneity of the function. If m cannot be factored out, then the production function is said to be non-homogenous.

For a homogeneous production function,

If m >1, we get increasing returns to scale,

If m =1, we get constant returns to scale, and

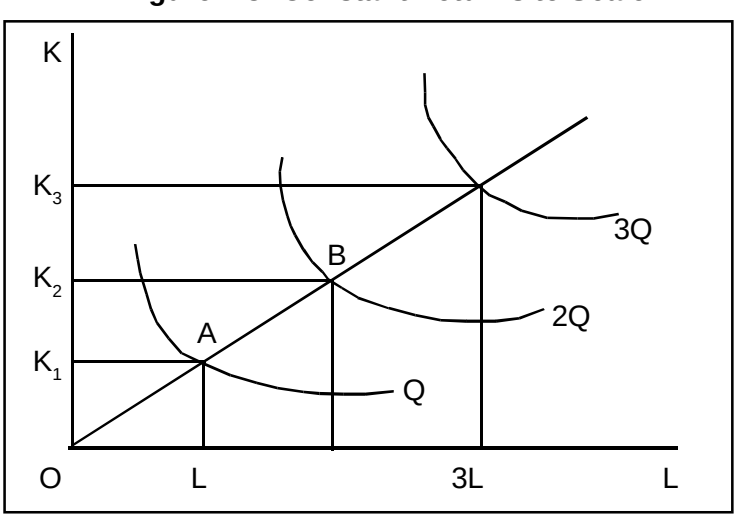
If m <1, we get decreasing returns to scale.

To represent returns to scale graphically, we shall use the concept of product lines. A product line shows the physical movement from one isoquant to another as we change both the factors. The product line passes through the origin if all factors are variable. Among all possible product lines, one particular type is theisocline. An isocline is the locus of points of different isoquants at which the MRTS of factors is constant. For a homogeneous production function, isoclines are straight line through the origin.

The returns to scale may be shown graphicallyby the distance between multiple level isoquants, on an isocline. Multiple level isoquants are isoquants that show levels of output which are multiples of some base level of output, say Q, 2Q, 3Q, etc.

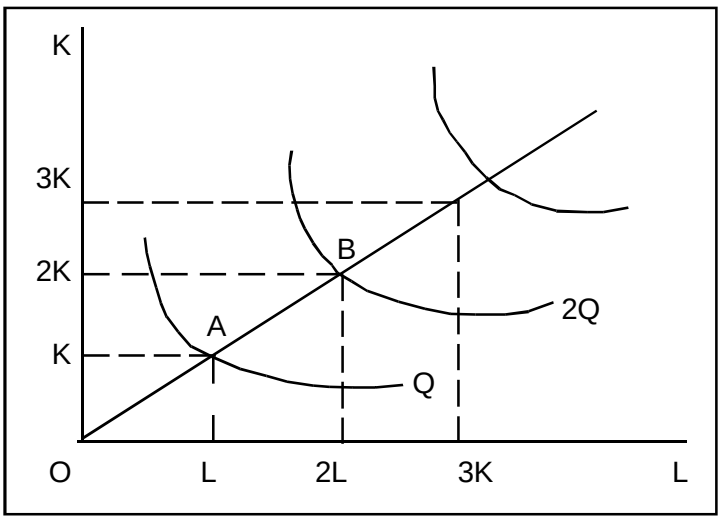
Under constant returns to scale, along an isocline, the distance between successive multiple level isoquants is constant. This is shown in Figure 7.8 where doubling of both the inputs increases output from Q to 2Q, and a three times increase in inputs (from L to 3L and K to 3K) increases output from Q to 3Q. Thus, the distance between successive multiple level isoquants remains same, i.e. OA=AB =BC.

Figure 7.8: Constant Returns to Scale



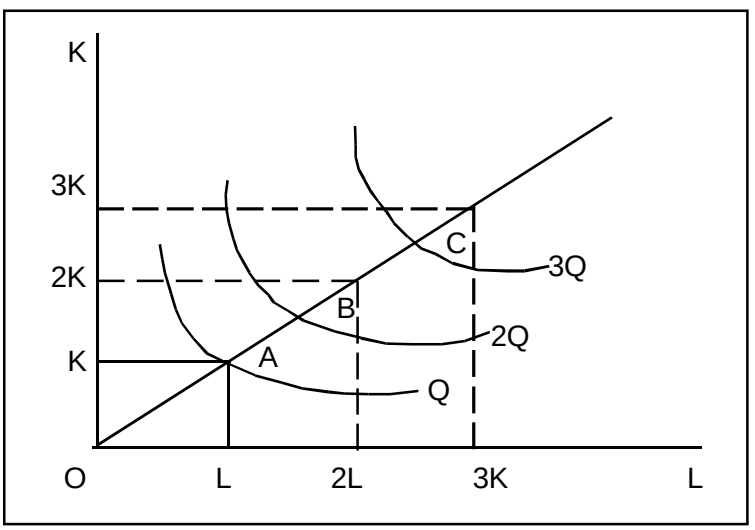
Under decreasing returns to scale, the distance between consecutive multiple level isoquants increases along an isocline. This is shown in figure 7.9. Here increase in inputs by two times (from L to 2L and K to 2K) results in output increasing by less than two times. Thus, the distance between successive multiple level isoquants keeps increasing, i.e. OA<AB<BC.

Figure 7.9: Decreasing Returns to Scale



Under increasing returns to scale, the distance between consecutive multiple level isoquants decreases along an isocline. This is shown in Figure 7.10 Here increase in inputs by two times (from L to 2L and K to 2K) results in output increasing by more than two times. Thus, the distance between successive multiple level isoquants keeps on decreasing, i.OA>AB>BC.

Figure 7.10: Increasing Returns to Scale



All production processes are assumed to show the same returns to scale over all ranges of output. However, the technological conditions may be such that returns to scale may vary over different ranges of output. Over some range of output, we may have constant returns to scale, while over another range, we may have increasing or decreasing returns to scale. With a non-homogeneous production function, returns to scale may be increasing, decreasing or constant, but their graphical representation is not as straightforward as in the case of a homogeneous production function.



CHECK YOUR PROGRESS

Q 3: The convexity of isoquants arise due to _____ MRTS. (Fill in the blank)

Q 4: Why is the elasticity of substitution a better measure of factor substitutability than MRTS?

.....

7.7 COBB-DOUGLAS PRODUCTION FUNCTION

A particular form of the production function which is widely used is the Cobb-Douglas production function. Developed by C.W.Cobb and D.H. Douglas, the functional form of this production function is as follows:

$$Q = AL_{\lambda}\ K^{\beta}$$

The Cobb-Douglas production function is given as

$$Q = AL^{\lambda}\ K^{\beta} \text{.....(i)}$$

Where, Q denotes output

L denotes labour input

K denotes capital input

A is the efficiency parameter

Property 1:

The Cabb-Douglas production function is homogeneous of degree $\lambda + \beta$.

Proof:

For the Cobb-Douglas production function

$$Q = AL^{\lambda} K^{\beta}$$

Let all the inputs increase by l times, and Q* be the resulting output is

$$\begin{aligned} Q^* &= A(\lambda L)^{\lambda} (\lambda K)^{\beta} \\ &= A\lambda^{\propto+\beta}.L^{\lambda}K^{\beta} \\ &= \lambda^{\propto+\beta}.Q \end{aligned}$$

$\Rightarrow$ The Cobb - Doughlas production function is homogeneous if degree $\propto +\beta$

If $\propto +\beta = 1$, we get constant return to scale,

$\propto +\beta > 1$, we get increasing return to scale

$\propto +\beta < 1$, we get decreasing returns to scale

Property 2:

$\propto$ and b represent the relation share of labour and capital input respectively in the total product. They also represent the partial elasticity of output with respect to that input.

Proof: We have the Cobb-Douglas production function

$$Q = AL^{\propto} K^{\beta}$$

Partially Differentiating (i) w.r. to L gives

$$\begin{aligned} \frac{\partial Q}{\partial L} &= A.\propto L^{\propto-1}.K^{\beta} \\ &= \frac{\propto AL^{\propto}K^{\beta}}{L} \\ &= \frac{\propto Q}{L} \text{.....(ii)} \\ \Rightarrow \propto &= \frac{L.{}^{\partial Q}\!/_{\partial L}}{Q} = \end{aligned}$$

Property 3:

The MRTS in a Cobb-Douglas production function is a function of $\left(\frac{K}{L}\right)$.

Proof:

By definition,

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

For the Cobb-Douglas production function $Q = AL^{\propto} K^{\beta}$

$$MP_L = \frac{\partial Q}{\partial L} = \frac{\propto Q}{L} [\text{From (ii)}] \text{ and}$$

$$MP_K = \frac{\partial Q}{\partial K} = \frac{\beta Q}{K} [\text{From (ii)}]$$

$$\therefore MRTS_{LK} = \frac{MP_L}{MP_K} = \frac{\propto Q}{L} \Big/ \frac{\beta Q}{K}$$

$$= \frac{\propto}{\beta}\left(\frac{K}{L}\right) \text{.....(iv)}$$

Which is a function of $\left(\frac{K}{L}\right)$

Property 5:

The elasticity of substitution is unity for a Cobb-Douglas production function

Proof: The elasticity of substitution is defined as

$$es = \frac{d\left(\frac{K}{L}\right) \Big/ \frac{K}{L}}{\frac{d(MRTS)}{MRTS}}$$

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

For the Cobb-Douglas production function.

$$MRTS = \left(\frac{\propto}{\beta}\right)\left(\frac{K}{L}\right) [\text{From (iv)}]$$

$$\text{or} \left(\frac{K}{L}\right)\left(\frac{\propto}{\beta}\right) = MRTS \text{.....(v)}$$

Differentiating the above w.n. to MRTS gives

$$\left(\frac{\propto}{\beta}\right)\frac{d\left(k/L\right)}{d(MRTS)}=\frac{d(MRTS)}{d(MRTS)}$$

$$\Rightarrow \frac{d\left(k/L\right)}{d(MRTS)}=\frac{1}{\left(\propto/\beta\right)}.....(vi)$$

7.8 CONSTANT ELASTICITY OF SUBSTITUTION (CES) PRODUCTION FUNCTION

One limitation of the Cobb-Douglas production function is that the elasticity of substitution is always equal to one. This drawback is sought to be removed by the CES production function, which is given as-

Property 1:

The CES production function is homogeneous of degree one.

Proof: For the CES production function,

$$Q=A\left[SK^{-f}+(1-\delta)L^{-f}\right]^{-1/f}.....(iii)$$

if L and K are increased by l times so that Q* is the new level of output, we get

$$\begin{aligned} Q^* &= A\left[\delta(\lambda K)^{-f}+(1-\delta)^{-f}\right]^{-1/f} \\ &= A\left[\lambda^{-f}\left\{\delta K^{-f}+(1-\delta)L^{-f}\right\}\right]^{-1/f} \\ &= \lambda^{-f}.(-1/f).A\left[\delta K^{-f}+(1-\delta)L^{-f}\right]^{-1/f} \\ &= \lambda.Q \end{aligned}$$

Thus, (vii) represents a linearly homogeneous production function.

Property 2:

In the CES production function, the MRTS is a function of $\frac{k}{L}$ ratio

Proof: For the CES production function

$$Q = A\left[\delta K^{-f} + (1-\delta)L^{-f}\right]^{-1/f}$$

$$MP_L = \frac{\partial Q}{\partial L}$$

$$= \left(\frac{-1}{f}\right) A\left[\delta k^{-f} + (1-\delta)L^{-f}\right]^{\frac{-1}{f}-1}.(1-\delta)(-f)L^{-f-1}$$

$$= \left(\frac{-1}{f}\right)(1-\delta)(-f).\frac{A\left[\delta k^{-f} + (1-\delta)L^{-f}\right]^{-1/f}}{\left[\delta k^{-f} + (1-\delta)L^{-f}\right]}.\frac{L^{-f}}{L}$$

$$= \frac{1-\delta}{L}.\frac{Q^{f}.L^{-f}}{\left[\delta k^{-f} + (1-\delta)L^{-f}\right]} \text{.....(viii)}$$

Similarly,

$$\mu P_k = \frac{\partial Q}{\partial K}$$

$$= \left(\frac{-1}{f}\right) A.\left[\delta k^{-f} + (1-\delta)L^{-f}\right]^{\frac{-1}{f}-1}.(-f)K^{-f-1}$$

$$= \left(\frac{-1}{f}\right)\delta \frac{A\left[\delta K^{-f} + (1-\delta)L^{-f}\right]^{-1/f}}{\left[\delta K^{-f} + (1-\delta)L^{-f}\right]}.(-f).\frac{K^{-f}}{K}$$

$$= \frac{\delta}{K}.\frac{QK^{-f}}{\left[\delta K^{-f} + (1-\delta)L^{-f}\right]} \text{.....(ix)}$$

Now, elasticity of substitution is defined as

$$e_s = \frac{d\left[K/L\right]}{d(MRTS)}.\frac{MRTS}{K/L}$$

$$= \left[\left(\frac{\delta}{1-\delta}\right)\left(\frac{1}{1+\delta}\right)\left(\frac{K}{L}\right)^{-f}\right].\left[\left(\frac{K}{L}\right)^{-1}\right] \text{ (using (x) and (xi)}$$

$$e_s = \frac{1}{1+\delta}$$

7.9 LEAST COST COMBINATION OF INPUTS

If a firm has unlimited resources at its disposal, it is free to choose any technique of production, and decide on any labour-capital input combination to carry out its production process. However, firms have limited resources at hand and the inputs used in the process of production have a cost. Thus, there are expenses involved in the production process, and the total cost of production varies from technology to technology. We shall now take a look at how a firm selects the optimum combination of inputs, given their resources and the input prices.

In economics, we assume that the producer is a rational being whose objective is profit maximisation. To maximise the total profit, the firm has two options. The first is, given the cost of production, it will choose that input combination which will produce the highest possible output. The second option is, given a particular level of output to produce, it will choose that input combination which will have the least cost (i.e. the least cost combination of inputs).

Before explaining both the methods, we have to first introduce the concept of the 'isocost' line. Let C denote the total resources available to the firm which it can spend on the total cost of production. Let PK and PL denote the price of capital and price of labour respectively. It is assumed that PK and PL are given to the firm. The firm's cost function can be written as

$C=K.P_K+L.P_L$, where K and L represent the quantities of capital and labour respectively.

Given the values of C, P_L and P_K, the above equation represents a line which shows different combinations of L and K which gives the same amount of total cost.

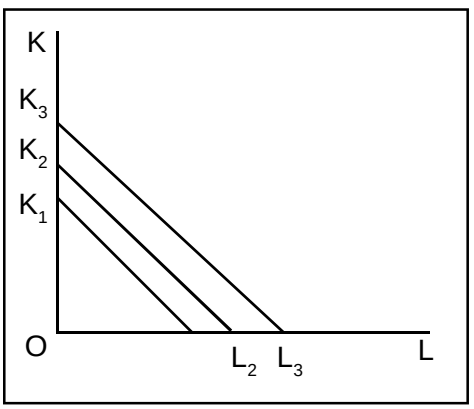
Rewriting the above equation, we get

$$K = \left(\frac{C}{PK}\right) - \left(\frac{PL}{PK}\right)L$$

The above equation, when represented graphically, is the isocost line, which is a straight line with a slope equal to P_L/P_K, which is the factor

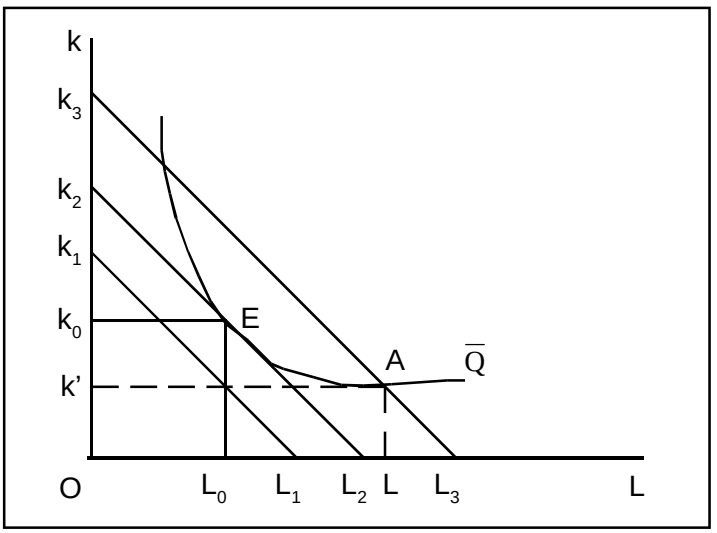
price ratio. An isocost line K_1L_1 is shown in Figure 7.11. If the firm decides to use all its resources in buying only capital, it will buy OK_1 of capital and zero amount of labour. Likewise, if it decides to buy only labour, it will buy OL_1 amount of labour, and zero amount of capital. If the total cost (C) increases, P_L and P_K remaining unchanged, the isocost line shifts upwards to K_2L_2 and K_3L_3.

Figure 7.11: Isocost Lines



The least cost combination of inputs requires that the producer chooses that combination of L and K which maximises profit, given a particular level of output, say Q (bar) to produce. A likely example could be to minimise the cost of building a bridge. In such a case, profit maximisation will take place when the firm is on the lowest possible isocost line. The figure below shows different isocost lines, K_1L_1 being the lowest of them. However, the total cost as depicted by K_1L_1 is not enough to produce the given level of output. At point A where the isocost line K_3L_3 intersects the isoquant, the input combination OK'and OL' can be purchased with the outlay given by K_3L_3. However K_3L_3 does not represent lowest possible cost because the input combination OK_0 and OL_0 produces the same level of output Q(bar) and the total cost is lower, as depicted by the isocost line, K_2L_2. Thus, the least cost combination of inputs is attained at point E where the isoquant Q(bar) is tangent to the isocost line. This has been shown in Figure 7.12.

Figure 7.12: Least cost combination of inputs

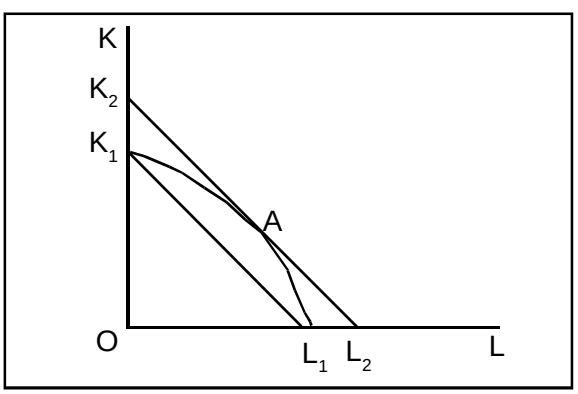


For the least cost combination, the condition for equilibrium requires that the isocost line is tangent to the isoquant. In other words, the slope of the isocost and the isoquant are equal at the point of equilibrium, which implies that

$$\frac{PL}{PK} = \frac{MPL}{MPK}$$

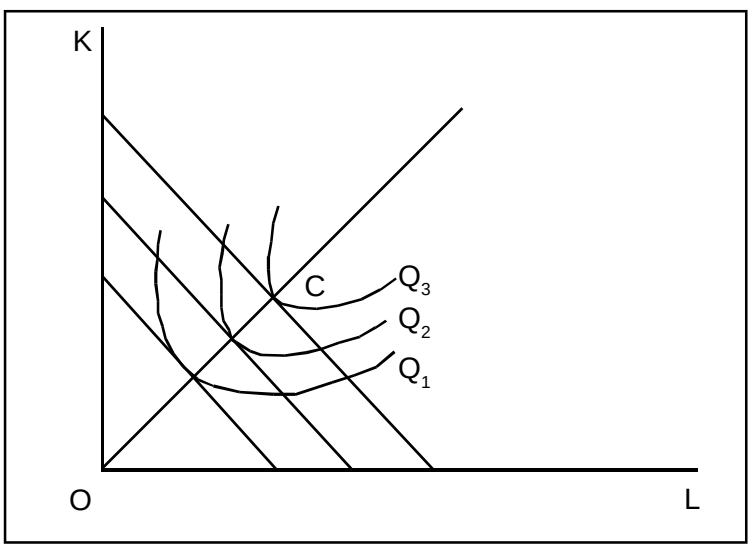
This constitutes the first order condition of equilibrium. The second order condition of equilibrium requires that the isoquant is convex to the origin at the point of equilibrium. If the isoquant is concave at the point of equilibrium, as shown in Figure 7.13, we see that the point of tangency at A does not yield the least cost combination of inputs, because at point K1, the producer is able to produce the same level of output but with a lower cost.

Figure 7.13: For concave isoquant



Thus, the least cost combination of inputs occurs at the point where the isocost is tangent to the isoquant, and the isoquant is convex to the origin. In the long run when all the factors become variable, the firm may go in for expansion of output. In such a case, its objective is to make a choice of the optimal way of expanding its output so as to maximise its profit. With given factor prices and the production function, the optimal expansion path is shown by tangency of successive isoquants and successive isocost lines as shown in Figure 7.14.

Figure 7.14: Optimal expansion path





CHECK YOUR PROGRESS

Q 5: State the elasticity of substitution for the Cobb-Douglas production function.

Q 6: Choose the correct answer:

(a) For the CES production function, the elasticity of substitution is _____ (one/greater than one/constant).

Q 7: What is an isocost line?

.....

.....

Q 8: What conditions need to be satisfied for a firm to be in equilibrium?

.....

.....

Q 9: What does an optimal expansion path depict?

.....

.....



7.10 LET US SUM UP

- Production function describes the relation between physical quantities of inputs and physical quantity of output. Given a state of technology, the production function shows the maximum amount of output attainable with a given level of inputs.
- The behaviour of the production function in the short run is governed by the law of diminishing returns.
- According to the law of diminishing returns, in the short run as the quantity of the variable factor increases, the fixed factor remaining the same, total output initially increases at an increasing rate, then at a diminishing rate, reaches a maximum, after which it starts declining.
- The long run production function is graphically described by the isoquant. The isoquant is a curve which shows different combinations of capital and labour producing the same level of output.
- Isoquants are downward sloping curves, convex to the origin. Isoquants cannot intersect each other, and higher isoquants represent higher levels of output.
- The marginal rate of transformation (MRTS) is defined as the rate at which one input is substituted for the other, keeping the output constant.
- The elasticity of substitution is defined as the percentage change in the capital-labour ratio to the percentage change in the MRTS. Being free from the units of measurement, the elasticity of substitution is a better measure of substitutability than the MRTS.
- In the long run, the production function is governed by returns to scale. Depending on whether output increases in proportion, more than proportionately and less than proportion to the input, we get three types

of returns to scale, viz, constant, increasing and decreasing returns to scale respectively.

- Two types of production function which are of special interest are the Cobb-Douglas production function and the CES production function.

- The isocost line shows different combinations of L and K which gives the same amount of total cost.
- The least cost combination of inputs occurs at the point where the isocost is tangent to the isoquant, and the isoquant is convex to the origin.
- In the long run when all the factors become variable, the firm has to make a choice of the optimal way of expanding its output so as to maximise its profit. With given factor prices and the production function, the optimal expansion path is shown by tangency of successive isoquants and successive isocost lines.



7.11 FURTHER READING

1) Pindyck, R. &Rubinfield, D.L., " Microeconomics", Prentice Hall of India.
2) Koutsoyiannis, A., "Modern Microeconomics", Macmillan.
3) AnindyaSen, "Microeconomic Theory", OxfordUniversity Press.
4) Madalla and Miller, "Microeconomics", McGraw Hill.



7.12 ANSWERS TO CHECK YOUR PROGRESS

Ans. to Q No. 1: (a) False (b) True

Ans. to Q No. 2: Because the marginal product is positive. In the first stage when the marginal product is increasing, the producer earns more by producing an extra unit of output, and hence will not stop production in the first stage. The third stage is ruled out due to negative returns.

Ans. to Q No. 3: Diminishing

Ans. to Q No. 4: Refer text.

Ans. to Q No. 5: The Cobb-Douglas production function is given as

$$Q = AL^{\lambda} K^{\beta} \text{.....(i)}$$

Where, Q denotes output

L denotes labour input

K denotes capital input

A is the efficiency parameter

Ans. to Q No. 6: Constant

Ans. to Q No. 7: The isocost line shows different combinations of L and K which gives the same amount of total cost.

Ans. to Q No. 8: The isocost line must be tangent to the isoquant, and the isoquant must be convex to the origin at the point of tangency.

Ans. to Q No. 9: Traces the different optimal least cost combination points when output expands in the long run.

7.13 MODEL QUESTIONS

A) Short questions (Answer each question in about 150 words)

Q 1: Distinguish the short run production function from the long run production function.

Q 2: State the properties of isoquants.

Q 3: Show that (?+?) represents the returns to scale in the production function given by Q=AL?+K? .

Q 4: How does output respond to changes in input under increasing and constant returns to scale?

B) Essay-type Questions (Answer each question in about 300-500 words)

Q 1: Explain the law of diminishing returns in production.

Q 2: Explain the long run behaviour of the production function.

Q 3: Explain how a producer attains equilibrium using the least cost combination of inputs.

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UNIT 8: MARKET AND MARKET STRUCTURES

UNIT STRUCTURE

8.1 Learning Objectives

8.2 Introduction

8.3 Concept of Market and Revenue Curves

- 8.3.1 Classification of Market Structure
- 8.3.2 AR and MR Curves of a Firm under Perfect Competition and Monopoly

8.4 Perfect Competition

- 8.4.1 Pure Competition and Perfect Competition
- 8.4.2 Demand Curve or Average Revenue (AR) Curve and Marginal Revenue (MR) Curve under Perfect Competition

8.5 Monopoly

8.6 Oligopoly

- 8.6.1 Oligopoly with Product Differentiation
- 8.6.2 Oligopoly without Product Differentiation

8.7 Let Us Sum Up

8.8 Further Reading

8.9 Answers to Check Your Progress

8.10 Model Questions

8.1 LEARNING OBJECTIVES

After going through this unit, you will be able to-

- define market
- classify market into different forms
- discuss perfect competition and equilibrium of a firm and industry both in the short-run and in the long-run
- define monopoly
- discuss various issues relating to monopoly
- explain price discrimination and the concept of monopoly power

8.2 INTRODUCTION

We all buy and sell various kinds of ***products*** in a market. In general, whenever we talk of a market, we have a place in mind, where buyers interact with sellers and buy goods and services in exchange of money. In this unit, we shall try to get a deeper insight into this concept 'market'. We shall try to define the term market in business and economics sense, and shall discuss the evolution of this concept. We shall also try to explain the classification of markets on the basis of different parameters.Again, we shall make an attempt to explain the equilibrium of a firm / industry under the major market structures: viz, perfect competition and monopoly. This unit will be helpful for us in relating the theoretical principles of market with the day-to-day maket envirionment.



Products include Goods, Services and Ideas.

Goods: Those, which are tangible; like – books, foods, torch light, batteries etc.

Services: Those, which are intangible; like- the services of a barber, cobbler, lawyer, nurse etc.

Ideas: Ideas refer to innovative thinking that can lead to successful business concepts and by obtaining copyright, patents etc.

8.3 CONCEPT OF MARKET AND REVENUE CURVES

As we have said, by the term market, we in general understand a particular place or locality where goods are sold and purchased. However, in economics, the term 'market' does not mean a particular geographical place or locality. Thus, to define market in economics, the concept of a particular place or locality is not much important. What is important is the contact between the buyers and the sellers so that transaction (i.e., sale and purchase of commodities) can take place at an agreed price.

Thus, the essentials of a market are: a) commodity which is to be dealt with; b) the existence of buyers and sellers; c) a place, be it a certain region, a country or the entire world; and d) a communication between buyers and sellers, which ensures only one price for a commodity at a time.

8.3.1 Classification of Market Structure

Market structure refers to the type of market in which firms operate. Market structure may be classified:

- Ø On the basis of area as local, national and world markets;
- Ø On the basis of time, as market price on any particular day

or moment; short-period price, long-period price, or ***secular*** maket price covering a generation; and

- Ø On the basis of nature of competition – perfect competition and imperfect competition.

Here, we shall basically discuss market structure on the basis of nature of competition. Nature of competition can be distinguished based on the following three criteria:

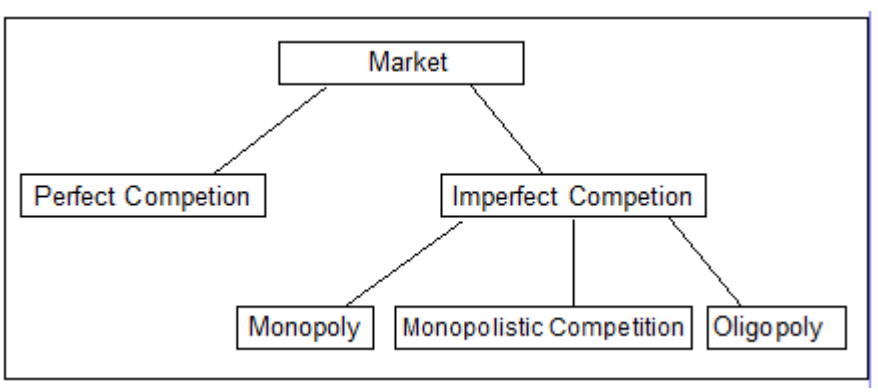
a) Number of Sellers in the industry,

b) Entry barriers into the industry, and

c) Nature of the product.

Thus, based on these above criteria, classification of market structure has been shown in the following tree diagram 8.1.

Figure 8.1: Classification of Market Structure



Thus, we have discussed that the market structure can broadly be classified into two major categories – perfect competition, imperfect competition. Market structure under imperfect competition can be further classified as monopoly, monopolistic competition and oligopoly. In the following table 8.1, we shall try to look at the individual characteristics of these market structure with regard to the above three criteria.

Table 8.1: Individual Characteristcs of Different Types of Market

Market Type	*Number of Sellers*	*Entry Barrier*	*Nature of Product*
Perfect Competiton	Many, small, Independent	None	Homogenous
Monopoly	One	Very high	Homogenous
Monopolistic Competition	Many, small, virtually independent	None	Differentiated
Oligopoly	Few, interdependent	Substantial	Homogenous or Differentiated

8.3.2 AR and MR Curves of a Firm under Perfect Competition and Monopoly

AR and MR Curves of a Firm under Perfect Competition:

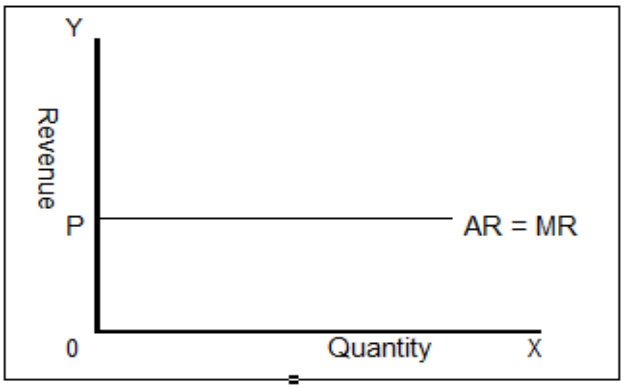
A firm under perfect competition has to accept the prevailing market price and can sell any amount of output in the market at that price. Thus, a firm under perfect competition will earn AR, TR and MR similar to the following table 8.2

Table 8.2: Total, Average and Marginal Revenue Schedules

Number of units sold (Q)	*Price or Average Revenue*	*Total Revenue (AR x Q)*	*Marginal Revenue*
(1)	(2)	(3)	(4)
1	14	14	14
2	14	28	14
3	14	42	14
4	14	56	14
5	14	70	14

Based on the above schedule, the shapes of AR and MR curves of a perfect competitive firm has been shown in the following figure 8.2:

Figure 8.2: AR and MR Curves of a Firm under Perfect Competition



It can be seen from figure 8.2 that the firm's AR and MR curves are the same. The slope of the curves is horizontal.

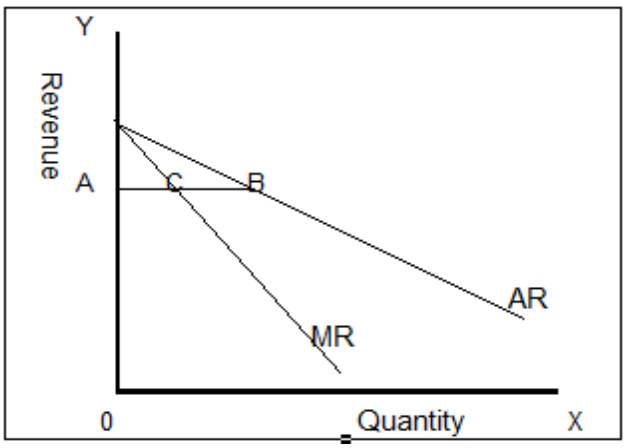
AR and MR Curves of a Firm under Imperfect Competition: Unlike perfect competition, a firm under imperfect competition does not have to sell all its amount at a fixed market price. This means that the firm can sell more units of the product as its price falls. We have shown a hypothetical schedule of AR, TR and MR in table 8.3 in the next page.

Table 8.3: Total, Average and Marginal Revenue Schedules

Number of units sold (Q)	*Price or Average Revenue*	*Total Revenue (AR x Q)*	*Marginal Revenue*
(1)	*(2)*	*(3)*	*(4)*
1	20	20	20
2	19	38	18
3	18	54	16
4	17	68	14
5	16	80	12

Based on the above schedule, the shapes of AR and MR curves of a firm under imperfect competition has been shown in the following figure:

Figure 8.3: AR and MR Curves of a Firm under Monopoly



It can be seen from figure 8.3 that unlike perfect competition, the firm's AR and MR curves under imperfect competition are not the same. It is to be noted that both the curves are downward sloping. Again, the slope of the marginal revenue curve is twice as much steeper as that of the average revenue curve. This is because it can be seen from the above table 8.3 that as sale increases by one unit, average revenue falls by one unit of price (as its number of units sold increases by one unit), marginal revenue falls by two units of price. Thus if we draw a perpendicular line on the y-axis from any point of the AR curve, say AB as in figure 8.3, the MR curve will cut it in the middle. Thus, AC = half of AB.



CHECK YOUR PROGRESS

Q 1: Define market. (Answer within 50 words)

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Q 2: What are the different categories of a product? Give examples of each of the categories. (Answer within 50 words)

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8.4 PERFECT COMPETITION

Perfect competition is described as the market structure having no rivalry among the individual firms. Thus, the concept of perfect competition is totally opposite to our general idea, where we mean by competition 'rivalry' among the individual firms. In the subsequent sections, we shall discuss equilibrium of firm and industry both in the short run and in the long run under this market structure.

Again, under perfect competition firms face two cost conditions: ***identical cost conditions*** and ***differential cost conditions***. We shall be confining our discussion only to identical cost conditions. Identical cost conditions will help us generalize our discussion from an individual firm to all other firms and thereby to industry as a whole. We shall now look at the assumptions on which this market structure rests.



Identical Cost Condition assumes that the firms in the industry face similar cost conditions. Thus, it becomes possible to generalise from a firm's analysis to the analysis of the whole industry.

The reverse is the case with ***differential cost condition***.

Assumptions of Perfect Competition: The assumptions of perfect competition are as follows:

- **Large number of sellers and buyers:** Presence of large number of buyers and sellers implies that it is not possible either for the individual firms or the individual buyers to affect the price or output in the market. That means, in perfect competition, individual firms have zero market power. Thus, an individual firm under perfect competition is a price taker.
- **Product homogeneity:** This assumption of perfect competition ensures that neither the buyers nor the sellers have any ground to differentiate among the products and, hence, ask for a different price. *(For the concept of product homogeneity, please refer to 'Let us know' in the next page).*
- **Free entry and exit of firms:** This assumption is supplementary to the assumption of large number of sellers in the industry.
- **Profit maximisation:** The only goal of a firm in perfect competition is

profit maximization.

- **No government intervention:** There is no government intervention in the market in any form like: tariffs, subsidies, rationing of production or demand, etc.

The fulfilment of these above five conditions forms a market structure known as '**pure competition**'. This market form is different from perfect competition, which requires the fulfilment of the following additional assumptions:

- **Perfect mobility of factors of production:** The factors of production including labour are fully mobile. Thus, labourers are fully mobile between different jobs and there is no labour union.
- **Perfect knowledge:** All sellers and buyers possess complete knowledge of the conditions of the market. Information is free and costless.



LET US KNOW

Product Homogenity: It is the quality of goods, services or factors which ensures that they cannot be differentiated in the minds of suppliers and consumers. A range of commodities is said to be homogeneous if all of them in that range are perfect substitutes for each other. The commodities may be physically distinct but economically homogeneous. The more the degree of homogeneity of products, the more will be the substitutability among them.

Short-run: It is that period of time which is too short for all economic agents (firm, industry or a buyer) to fully respond to a change. In our present analysis of market, short-run is the period in which a) no firm can enter into or exit from the industry, and b) the individual firms cannot make any adjustments to its *fixed factor of production*.

Long-run: It is that period of time which is sufficient for all economic agents to fully adjust to a change. The firms and industry can change both the variable and the fixed factors of production during this period.

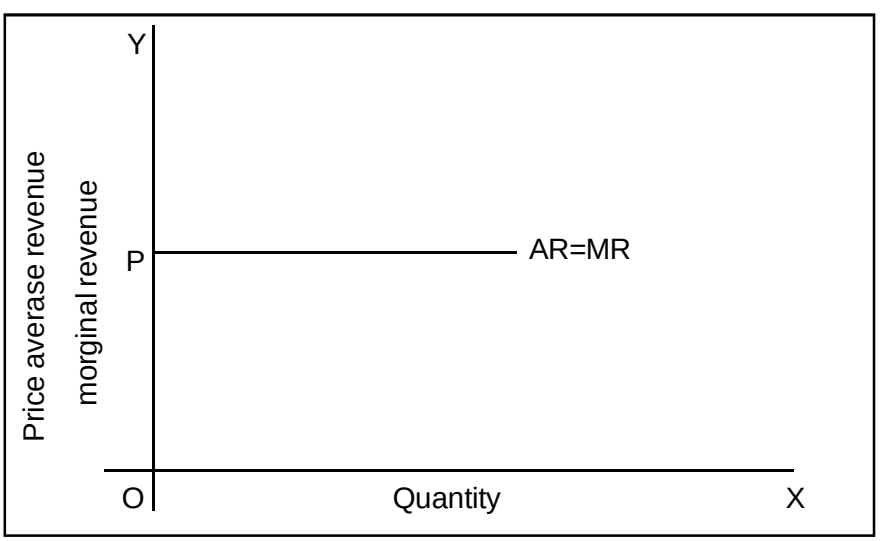
8.4.1 Pure Competition and Perfect Competition

If in a market the first three characteristics of perfect competition namely homogeneity of products, large number of buyers and sellers and freedom of entry and exit of firms prevail, the remaining three characteristics namely perfect knowledge, full mobility and no transport cost are not found, then the market is called not as perfect competition. Rather, the market is called as pure completion. Thus the perfect competition is a wider concept than pure competition.

8.4.2 Demand Curve or Average Revenue (AR) Curve and Marginal Revenue (MR) Curve under Perfect Competition

Since in perfect competition the price of the product is fixed, so the average revenue $AR = \frac{TR}{Q} = \frac{P.Q}{Q} = P$ is the same for all units of output sold. Thus the marginal revenue and average revenue coincide in perfect competition.

Figure 8.4: AR and MR Curves under Perfect Competition





CHECK YOUR PROGRESS

Q 3: State whether the following statements are True or False.(T/F)

(a) Absence of government intervention under perfect competition implies that fiscal instruments like subsidies, tax etc are not utilised by government to regulate the market.(T/F)

(b) Perfect mobility of factors of production is a feature of pure competition. (T/F)

Q 4: What is the basic difference between short-run and long-run. (Answer in about 50 words).....

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8.5 MONOPOLY

In the earlier section, we have basically discussed perfect competition. We have, thus, seen that perfect competition is the market structure where there exists a large number of buyers and sellers and in which the individual power of any seller is nil. The monopoly is just the opposite of perfect competition. The word 'monopoly' has come from the Greek words *monos polein,* which means 'alone to sell'. This single seller is called a *monopolist*. The term is also sometimes used for a single group of sellers that acts as a price setter, although often a group is called cartel. Thus, in simple terms, monopoly can be described as the market structure where there is only one supplier of the product, which has no close substitute in the market.

As there is only one seller of the product, therefore, the concept of firm and industry is the same in monopoly. In reality, the existence of a monopoly firm is as much rare as perfect competition. However, in some of our remote villages, where there is only one doctor, he may be seen as a monopoly supplier of medical services in the locality.

8.6 OLIGOPOLY

Oligopoly is a form of imperfect competition and is usually described as the competition among a few. Hence, Oligopoly exists when there are two to ten sellers in a market selling homogeneous or differentiated products. A good example of an Oligopoly is the cold drinks industry. In India, there are a handful of firms who manufacture cold drinks. These firms sell homogeneous as well as differentiated products in the market. Among different types of Oligopoly, we shall discuss briefly two types here: (a) Oligopoly without product differentiation, and (b) One of the types of oligopoly is the perfect oligopoly. This types of Oligopoly occurs when the product is homogeneous in nature (e.g. Aluminum industry).

8.6.1 Oligopoly with Product Differentiation

Another of the types of oligopoly is an imperfect oligopoly. This occurs when product differentiation exists (e.g. Talcum powder industry).

In case of oligopolistic markets with product differentiation, the market shares are determined not just by prices, but also by durability, design and performance of each firm's product. It is quite natural for firms to compete by choosing prices rather than quantities. To see how price competition can work with differentiated products, we will go through the following example.

Suppose, each duopolist has a fixed cost of £20 but zero variable cost and that they face the same demand curves.

Firm 1's Demand Curve : $Q1 = 12 - 2P1 + P2$…….. (1)

Firm 2's Demand Curve: $Q2 = 12 - 2P2 + P$……. (2)

where P1 and P2 are the prices charged by Firms 1 and 2 respectively, and Q1 and Q2 are the quantities they sell. It may be noted that the quantity each firm can sell increases when its competitor charges higher price and decreases when the firm raises its own price.

If both firms set their prices at the same time, we can use the Cournot model to determine equilibrium. Each firm will choose

its own price, taking the competitor's price as fixed. We shall discuss the Cournot model later in Unit 13 of this course.

8.6.2 Oligopoly without Product Differentiation

We shall discuss a few models of Oligopoly without Product Differentiation in unit no 14 and 15 of this block.



8.7 LET US SUM UP

- The essentials of a market are:
  - a commodity which is to be dealt with;
  - the existence of buyers and sellers;
  - a place, be it a certain region, a country or the entire world; and
  - a communication between buyers and sellers, which ensures only one price for a commodity at a time.
- The market structure can broadly be classified into two categories – perfect competition and imperfect competition.
- Market structure under imperfect competition can be further classified into – monopoly, monopolistic competition and oligopoly.
- Market structure can be distinguished based on the three criteria:
  - number of sellers in the industry;
  - entry barriers into the industry;
  - nature of the product
- Monopoly can be described as the market structure where there is only one supplier of the product, which has no close substitute in the market.



8.8 FURTHER READING

1) Ahuja, H. L. (2006). *Modern Economics.* New Delhi: S. Chand & Co.
2) Chopra, P.N. (2008). *Micro Economics*. Ludhiana: Kalyani Publishers.
3) Dewett, K.K. (2005). *Modern Economic Theory*. New Delhi: S.Chand & Co.
4) Koutsoyiannis, A. (1979). *Modern Microeconomics*. New Delhi: Macmillan India.

5) Sundharam, K.P. M. & Vaish, M.C. (1997). *Microeconomic Theory.* New Delhi: S. Chand & Co.

8.9 ANSWERS TO CHECK YOUR PROGRESS

Ans to Q No 1: A market can be defined as a place or a common platform, where buyers and sellers interact to exchange goods and services at an agreed price.

Ans to Q No 2: Products include:

Goods : Those, which are tangible; like – books, foods, torch light, batteries etc.

Services : Those, which are intangible; like- the services of a barber, cobbler, lawyer, nurse etc.

Ans to Q No 3: (a) True (b) False

Ans to Q No 4: The basic difference between short-run and long-run is that during short-run an economic agent (a firm or an industry) can change only the variable factor of production. But in the long-run an economic agent can change both the variable and the fixed factors of production.

8.10 MODEL QUESTIONS

A) Short Type Questions (Answer each question in about 150 words)

Q 1: What are the basic three criteria of market classification?

Q 2: What is the difference between pure competition and perfect competition?

Q 3: What is meant by product homegenity?

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