

UNIT – III

Production and Cost Analysis

3.1 Introduction

Production implies provision of goods and services, often described as ‘commodities.’ In technical sense, production is the transformation of resources into commodities overtime and/or space. To put it simply, production is the act of converting or transforming input into output. The act of production is technically carried out by a firm. A firm is a business unit which undertakes the activity of transforming inputs into outputs of goods and services. In the production process, a firm combines various inputs in different quantities and proportions to produce different levels of outputs. Production is a flow concept. It is measured as a rate of output per unit of time.

Meaning of Production

Production is another important economic activity. It directly or indirectly satisfies the wants and needs of the people. Satisfaction of human wants is the objective of production. Production is the conversion of input into output. The factors of production and all other things which the producer buys to carry out production are called inputs. The final goods and services produced are known as output. In economics, the term production is not the same as in common language where it is usually taken to mean ‘creation’ of something. In economics, the term production carries a wider connotation. It stands for creation of ‘value’, which can be of two varieties, namely ‘use value’ and ‘exchange value’. Thus, production is the activity which creates or adds utility and value.

According to Edwood Buffa, “Production is a process by which goods and services are created”.

3.2 Factors of Production

The resources needed to produce a given product are called factors of production. Production of goods and services needs various inputs which are known as ‘Factors of Production’, ‘Agents of Production’, ‘Productive Resources’ or sometimes even ‘Productive Services’. According to Marshall, the four major factors of production are:

- i) Land
- ii) Labour
- iii) Capital
- iv) Entrepreneurship

The level of production depends upon both the quantity of inputs and the efficiency with which they are employed in the process of production. It is also noteworthy that

economic growth of a country, in a way, represents its productive capacity which, in turn, depends upon the technology and amounts of productive resources.

i) Land

Land is not created by mankind but it is a gift of nature available to us free of cost. So, it is called as natural factor of production. It is also called as original or primary factor of production. Normally, land means surface of earth. But in economics, land has a wider meaning.

Land includes earth's surface and resources above and below the surface of the earth. It includes following natural resources :-

- ✓ On the surface (e.g. soil, agricultural land, etc.)
- ✓ Below the surface (e.g. mineral resources, rocks, ground water, etc.)
- ✓ Above the surface (e.g. climate, rain, etc.)

Land is the sum total of those productive resources which are provided 'free of cost' by nature to us that is to say those resources on which no human effort has been expended to make them actually usable in a productive process

The salient features of land are highlighted below.

- ✓ Land is a free gift of nature to mankind. It is not a man-made factor but is a natural factor.
- ✓ Land is primary factor of production.
- ✓ Supply of land is perfectly inelastic i.e. fixed in quantity. Neither it can be increased nor decreased.
- ✓ Land is a passive factor in the sense that it cannot produce anything of its own. It needs help of Labour, Capital, Entrepreneur, etc.
- ✓ There is no social cost of land since; it is a gift of nature to society. It is not created by society by putting any efforts and paying any price. So its supply price for society is zero. At the same time, the supply price for individual is not zero.
- ✓ Land is a perfectly immobile factor.
- ✓ Economic reward for the use of land is rent.

ii) Labour

The term labour is used to mean several things and can be a source of great deal of vagueness and imprecise statements. The term labour refers to only human effort (or activity) which can be physical, mental or a mixture of the two. It does not include the work performed by animals or machines or nature.

Labour lately is known as human resource. All companies need labor in order to carry out production. Everyone from the manual workers, to the owner of the company falls under

the classification of human resources. Without this factor, there would be no production because nobody would be working. The salient features of labour are highlighted below.

- ✓ Labour cannot be separated from laborers. Worker sells their service and doesn't sell themselves.
- ✓ Labour cannot be stored. Once the labour is lost, it cannot be made up. Unemployed workers cannot store their labour for future employment.
- ✓ Labour is an active factor of production unlike land.
- ✓ Labour is heterogeneous. No two persons possess the same quality of labour. Skills and efficiency differs from person to person. So, some workers are more efficient and productive than others in the same job.
- ✓ Labour is an imperfectly mobile factor.
- ✓ Labour supply is inelastic in general. Supply of labour depends upon many factors like size of population, age and sex composition, desire to work, quality of education, attitude towards work, etc. Thus, supply cannot be changed easily according to changes in demand.
- ✓ The amount of labour is the product of (i) duration of time over which it is performed and (ii) the intensity with which it is performed.

Supply of labour in a country refers to

- ✓ the total number of workers available for labour
- ✓ the intensity with which they can work
- ✓ the duration for which they work
- ✓ their efficiency (or productivity)

iii) Capital

Capital is another important factor which plays a huge role in the production. Capital includes things like tools, machines, and other things that a business uses in order to produce their goods or services. At some level, all companies rely on their capital in order to run successfully. Without these things, the company would be unable to carry out production.

The term capital may mean different in different disciplines; in economics, capital is that part of wealth which is used for production. It is one of the factors of production/ input.

The word capital in economics may mean either of the three;

- ✓ assets
- ✓ money/ wealth
- ✓ income

The salient features of capital are highlighted below.

- ✓ Capital is not a gift of nature. It is manmade, secondary as well as an artificial factor of

production.

- ✓ Capital helps in increasing level of productivity and speed of production.
- ✓ Supply of capital is relatively elastic.
- ✓ Capital is not perishable like labour. It has a long life subject to periodical depreciation.
- ✓ Capital is a perfectly mobile factor.
- ✓ Capital has a social cost. Capital as a resource has alternative uses. It can be put to either of the uses. The society in order to have one of them sacrifices another; accounting it as social cost.

iv) Entrepreneurship

Factors of production viz. land, labour and capital are scattered at different places. These cannot produce economic goods and services by themselves. They have to be brought together and, in a coordinated way, made to pass through a productive process to create output. According to Kaldor, entrepreneurship consists of three major functions, viz, coordination, management and supervision. All these factors have to be assembled together. This work is done by enterprise through entrepreneur. This is the function of an entrepreneur; to bring the required factors together and making them work harmoniously.

This final factor of production of entrepreneurship involves the activity right from start of the business to assembling of other factors in order to carry out production smoothly. It is not possible for an entrepreneur to start production process without other factors of production viz. land, labour, capital. Entrepreneurship is an independent factor of production. The salient features of an entrepreneur as a factor of production are highlighted below.

- ✓ Entrepreneur should be able to plan, organize, manage and allocate other primary factors of production efficiently.
- ✓ Entrepreneur should be able to define objective precisely.
- ✓ Entrepreneur should be able to deal with numerous risks involved in entrepreneurship.
- ✓ Entrepreneur should be able to incorporate innovation and adopt modern techniques of production.
- ✓ Entrepreneur should be able to take decisions promptly. Quick decisions are expected but hasty decisions may be avoided.

3.3 Production Function

The rate of output of a commodity functionally depends on the quantity of inputs used per unit of time. The technological-physical relationship between inputs and outputs is

referred to as the production function. Basically, production function is an engineering concept, but it is widely used in business economics for studying production behaviour. “The production function is the name given to the relationship between rates of input of productive services and the rate of output of product. It is the economist’s summary of technical knowledge”

Definitions

According to **Prof. L.R. Klein** “The production function is a technical or engineering relation between input and output. As long as the natural laws of technology remain unchanged, the production function remains unchanged.”

In the words of **Prof. Koutsoyiannis** “The production function is purely a technical relation which connects factor inputs and output.”

Prof. Watson says, “The relation between a firm’s physical production (output) and the material factors of production (inputs).”

In the words of **Prof. G. J. Stigler**, “Production function is the relationship between inputs of productive services per unit of time and outputs of product per unit of time.”

Attributes of Production Function

i) Flow Concept

A production function is a flow concept. It relates to the flow of inputs and the resulting flows of output of a commodity during a period of time. Here, time is taken to be functional or operational time period.

ii) Physical Concept

A production function is a technical relationship between inputs and outputs expressed in physical terms and not in terms of a monetary unit, such as rupee or dollar.

iii) State of Technology and Inputs

It implies that the production of a firm depends on the state of technology and inputs. Technology refers to the sum total of knowledge of the means and methods of producing goods and services. It is the society’s knowledge concerning the industrial and agricultural arts. It includes methods of organisation and techniques of production. Input refers to anything that is used by the firm in the process of production. Thus, inputs include every type of productive resource — land, labour, capital, etc., also time and human energy as well as

knowledge which are employed by the firm for producing a commodity. The set of factor inputs in a production function has the following important characteristics.

iv) Inputs (a, b, c, d...n) are complementary in nature as their combined productive services are transformed into production of a specific commodity.

v) Some inputs are substitutes to one another

Thus, for example, if a and b are substitutable factors, a may be increased instead of b. The a is fixed while b is variable at a time. In practice, however, factors like labour and capital, are not perfectly substitutable, but there may be sufficiently high degree of substitutability.

vi) Some inputs may be specific

Particularly, highly specialised factors are of specific use, as they have least degree of substitutability.

vii) Factors Combination for the Maximum Output

The concept of a production function in economic analysis is viewed to indicate something more than just a technical relationship. It is taken to be the technical relationship showing the maximum output that can be produced by a specific set of combination of factor inputs. From the economic point of view, the rational firm is interested not in all the numerous possible levels of output corresponding to the different combinations of factor inputs, but only that combination which yields maximum output.

viii) Short-run and Long-run Production Function

Fixity or variability of factors depends on the functional time period under consideration. On functional criteria, there are short period and long period. Correspondingly, we have a short-run and long-run production functions. Short-run production function pertains to the given scale of production. Long-run production function pertains to the changing scale of production.

Time Element and Production Functions

The functional relationship between changes in input and consequent changes in output depends on the time element short-run and long-run time periods. This time element considered here is the functional or operational time period.

i) The Short-run

The term “short-run” is defined as a period of time over which the inputs of some factors of production cannot be varied. Factors which cannot be altered in the short-run are

called fixed factors. Thus, by definition, in the short period, some factors are fixed and some are variable. Elements of capital such as plant, machinery and equipment are generally fixed in the short-run. But a fixed factor can also be land or the manager or administrative staff. In the short period, thus, the output is produced with a given scale of production, *i.e.*, the size of plant or firm remaining unchanged.

Again, short-run production implies a restricted set of choices open to the firm on account of inelasticity of fixed factors. Hence, in the short-run period, output can be varied only by varying the variable factors combined with the given set of fixed factor inputs.

Short-run Production Function

By definition, in the short period, the production function includes fixed and variable components of inputs. At least one significant factor is fixed over the short period. Algebraically, thus, short-run production function may be stated as under:

$$Q_t = f(a/p_0, c_0, \dots, n_0, T)$$

where, stroke (/) divides between variable and fixed components. Subscript 0 at the top is used to denote fixed factors. Thus, a , b , c are quantities of fixed factors. Technology (T) is, obviously, held constant.

ii) The Long-run

The term “long-run” is defined as a period of time long enough to permit variations in the inputs of all factors of production employed by a firm. In other words, the long period is such a time period over which all factors become variable. Thus, there is no distinction between fixed and variable factors in the long-run, as all factors become variable factors. Adjustment between factors can be easily brought about in the long-run. The size of plant which is usually fixed in the short period can be varied in the long-run; hence, the scale of production can be varied only in the long-run. Thus, in the long-run, there is a full scope for adjustment between factors in the production process.

Long-run (normal period) is associated with the change in the scale of production, assuming the basic technology of production to be constant. Again, the long-run being related to operational time involved in altering the fixed factors (of short period), does not correspond to a specific period of time.

Long-run Production Function

In the long-run, the firm operates with the changing scale of output and its size as a whole is varied. Thus, long-run production can be stated as under:

$$Q = f(a, b, c, \dots, n, T)$$

It is evident that there is no dichotomy of inputs in the long-run, as all factors are denoted as variable components in production. However, for analytical convenience, T , the state of technology, is held constant.

Cobb-Douglas Production Function

One of the important tool of statistical analysis in production function that measures the relation between changes in physical input is Cobb-Douglas production function. The concept was originated in USA. This is more peculiar to manufacturing concerns. The Cobb-Douglas formula says that labour contributes about 75% increases in manufacturing production while capital contributes only 25%. The formula is as follows:-

$$O = K^a L^{1-a} C$$

Where O is output. L is the quantity of labour “ C ” is the quantity of capital employed K and a ($a < 1$) are positive constants. a and $1-a$ measure percentage response of output to percentage change in labour and capital respectively.

The production function shows at One (1%) percentage change in labour, capital remaining constant, is associated with 0.75% change in output. Similarly One percentage change in capital, labour remaining constant, is associated with a 20% change in output.

Returns to scale are constant. That is if factors of production are increased, each by 10 percentage then the output also increases by 10 percentage.

The laws of Production

Production function shows the relationship between a given quantity of input and its maximum possible output. Given the production function, the relationship between additional quantities of input and the additional output can be easily obtained. This kind of relationship yields the law of production. The traditional theory of production studies the marginal input- output relationship under (I) Short run; and (II) long run. In the short run, input-output relations are studied with one variable input, while other inputs are held constant. The Law of production under these assumptions are called “the Laws of variable production”. In the long run input output relations are studied assuming all the input to be variable. The long-run input output relations are studied under `Laws of Returns to Scale.

3.4 Law of Diminishing Returns (Law of Variable Proportions)

The Laws of returns states the relationship between the variable input and the output in the short term. By definition certain factors of production (e.g.-Land, plant,

machinery etc.,) are available in short supply during the short run. Such factors which are available in unlimited supply even during the short periods are known as variable factor. In short-run therefore, the firms can employ a limited or fixed quantity of fixed factors and an unlimited quantity of the variable factor. In other words, firms can employ in the short run varying quantities of variable inputs against given quantity of fixed factors. This kind of change in input combination leads to variation in factor proportions. The Law which brings out the relationship between varying factor properties and output are therefore known as the Law of variable proportions.

The variation in inputs lead to a disproportionate increase in output more and more units of variable factor when applied cause an increase in output but after a point the extra output will grow less and less. The law which brings out this tendency in production is known as “Law of Diminishing Returns”.

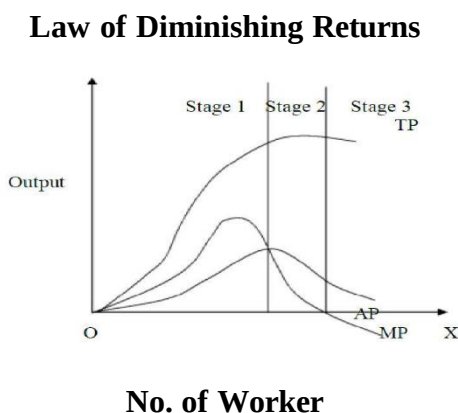
The Law of Diminishing returns levels that any attempt to increase output by increasing only one factor finally faces diminishing returns. The Law states that when some factor remain constant, more and more units of a variable factor are introduced the production may increase initially at an increasing rate; but after a point it increases only at diminishing rate. Land and capital remain fixed in the short-term whereas labour shows a variable nature. The following table explains the operation of the Law of Diminishing Returns.

Table 3.1
Law of Diminishing Returns

No. of Wor kers	Tot al Pro duc t	Avera ge Produ ct	Margin al Produc t
1	10	10	10
2	22	11	12
3	36	12	14
4	52	13	16
5	66	13.2	14
6	76	12.7	10
7	82	11.7	6
8	85	10.5	3
9	85	9.4	0
10	83	8.3	(-2)

The above table illustrates several important features of a typical production function. With one variable input - here both **Average Product (AP)** and **Marginal Product (MP)** first rise, reach a maximum – then decline. Average product is the product for one unit of labour. It is arrived at by dividing the **Total Product (TP)** by number of workers. Marginal product is the additional product resulting from additional labour. It is found out by dividing the change in total product by the change in the number of workers. The total output increases at an increasing rate till the employment of the 4th worker. The rate of increase in the marginal product reveals this. Any additional labour employed beyond the 4th labour clearly faces the operation of the Law of Diminishing Returns. The maximum marginal product is 16 after which it continues to fall, ultimately becoming negative. Thus when more and more units of labour are combined with other fixed factors the total output increase first at an increasing rate then at a diminishing rate finally it becomes negative. The graphical representation of the above table is shown below:

Figure 3.1



OX axis represents the units of labour and OY axis represents the unit of output. The total output (TP) curve has a steep rise till the employment of the 4th worker. This shows that the output increases at an increasing rate till the employment of the 4th labour. TP curve still goes on increasing but only at a diminishing rate. Finally TP curve shows a downward trend.

The Law of Diminishing Returns operates at three stages. At the first stage, total product increases at an increasing rate. The marginal product at this stage increases at an increasing rate resulting in a greater increase in total product. The average product also increases. This stage continues up to the point where average product is equal to marginal product. The law of increasing returns is in operation at this stage. The Law of increasing Returns operates from the second stage onwards. At the second stage, the total product

continues to increase but at a diminishing rate. As the marginal product at this stage starts falling, the average product also declines. The second stage comes to an end where total product becomes maximum and marginal product becomes zero. The marginal product becomes negative in the third stage. So the total product also declines. The average product continues to decline in the third stage.

Assumptions of Law Diminishing Returns

The Law of Diminishing Returns is based on the following assumptions;-

- ✓ The production technology remains unchanged.
- ✓ The variable factor is homogeneous.
- ✓ Any one factor is constant.
- ✓ The fixed factor remains constant.

Law of Returns to scale

In the long-run all the factors of production are variable and an increase in output is possible by increasing all the inputs. The Law of Returns to scale explains the technological relationship between changing scale of input and output. The law of returns to scale explains how a simultaneous and proportionate increase in all the inputs affects the total output. The increase in output may be proportionate, more than proportionate or less than proportionate. If the increase in output is proportionate to the increase in input, it is constant Returns to scale. If it is less than proportionate it is diminishing returns to scale. The increasing returns to the scale comes first, then constant and finally diminishing returns to scale happens.

Increasing Returns to scale

When proportionate increase in all factors of production results in a more than proportionate increase in output and this results in the first stage of production which is known as increasing returns to scale. Marginal output increases at this stage. Higher degree of specialization, falling cost etc., will lead to higher efficiency which results in increased returns in the very first stage of production.

Causes of Increasing Returns

- ✓ The main reason for increasing returns in the first stage is that in the beginning the fixed factors are larger in quantity than the variable factor. When more units of the variable factor are applied to a fixed factor, the fixed factor is used more intensively and production increases rapidly.
- ✓ In the beginning, the fixed factor cannot be put to the maximum use due to the non-applicability of sufficient units of the variable factor. But when units of the variable factor are applied in sufficient quantities, division of labour and specialization lead to per unit increase

in production and the law of increasing returns operates.

- ✓ Another reason for increasing returns is that the fixed factors are indivisible which means that they must be used in a fixed minimum size. When more units of the variable factor are applied on such a fixed factor, production increases more than proportionately. This points towards the law of increasing returns.

Constant Returns to scale

Firms cannot maintain increasing returns to scale indefinitely after the first stage, firm enters a stage when total output tends to increase at a rate which is equal to the rate of increase in inputs. This stage comes in to operation when the economies of large scale production are neutralized by the diseconomies of large scale operation.

Diminishing Returns to Scale

In this stage, a proportionate increase in all the input result only less than proportionate increase in output. This is because of the diseconomies of large scale production. When the firm grows further, the problem of management arise which result inefficiency and it will affect the position of output.

Isoquant Curve

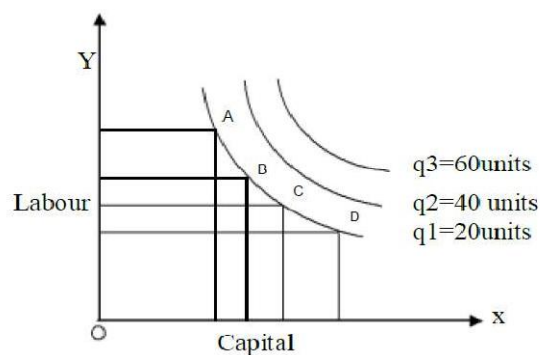
The terms “Iso-quant” has been derived from the Greek word ‘iso’ means ‘equal’ and Latin word ‘quantus’ means ‘quantity’. The iso-quant curve is therefore also known as ‘equal product curve’ or production indifference curve. An iso-quant curve is locus of point representing the various combination of two inputs–capital and labour–yielding the same output. It shows all possible combination of two inputs, namely - capital and labour which can produce a particular quantity of output or different combination of the two inputs that can give in the same output. An isoquant curve all along its length represents a fixed quantity of output. The following table illustrates combination of capital (K) and labour (L) which give the same output say – 20 units. The combinations of A uses one unit of “K” and 12 units of “L” to produce is 20 units. Likewise, the combinations B, C, D and E give the same output - 20 units.

Table 3.2

C o m b i n a t i o n	C a p i t a l	L a b o u r	O u t p u t
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	1		
A	1	1 2	2 0
B	2	8	2 0
C	3	5	2 0
D	4	3	2 0
E	5	2	2 0

Figure 3.2



The above curve shows the four different combinations of inputs. (Capital and Labour) which give the same output namely 20 units, 40 units, 60 units respectively. Thus it provides fixed level of output. Further the shape of isoquants reveal the degree of substitutability of one factor for another to yield the same level of output. It also implies the diminishing marginal rate of technical substitution. Marginal rate of technical substitution refers to the rate at which one output can be substituted for another in order to keep the output constant. The slope of an isoquant indicates the marginal rate of technical substitution at the point.

Properties of Isoquants

- ✓ Isoquants have a negative slope: An isoquant has a negative slope in the economic region or in the relevant range. Economic region means where substitution between input is technically possible that keeps same output.
- ✓ Isoquants are convex to origin: Convex nature of Isoquant shows the substitutability of one factor for another and the diminishing marginal rate of technical substitution.
- ✓ Isoquant cannot Intersect or be tangent to each other.

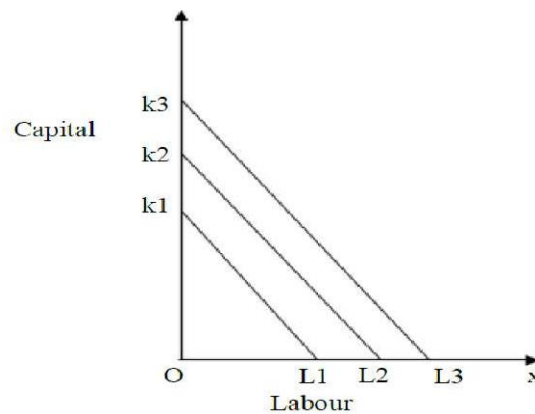
Marginal Rate of Technical substitution (MRTS)

MRTS is the rate at which marginal unit of an input can be substituted for the marginal units of the other input so that the level of output remains the same. In other words it is the ratio of marginal unit of labour substituted for the marginal units of capital without affecting the total output. This ratio indicates the slope of Isoquants.

Isocost Curve

Isocost curve shows the different combination that a firm can buy with a certain unit of money.

Figure 3.3



Usually, the management has to incur expenditure in buying inputs namely - labour, raw materials, machinery etc., Further, management is expected to know price of inputs what it costs to produce a given output. Therefore, it is required to minimize the cost of output that it produces. Here management is more helpful to draw isocost curve that represents the equal cost. An iso-cost line is so called because it shows the all combinations of inputs having equal total cost. The isocost lines are straight lines which represents the same cost with different input combinations. Suppose a firm decides to spend Rs.100 on output. If one unit of labour costs Rs. 10 the firm can purchase 10 units of labour. Similarly, if a unit of capital cost Rs.25, the firm can spend the whole amount on buying 4 units of capital likewise the firm can spend partly on capital, say 2 units and partly on labour, say 5 units for this Rs.100.

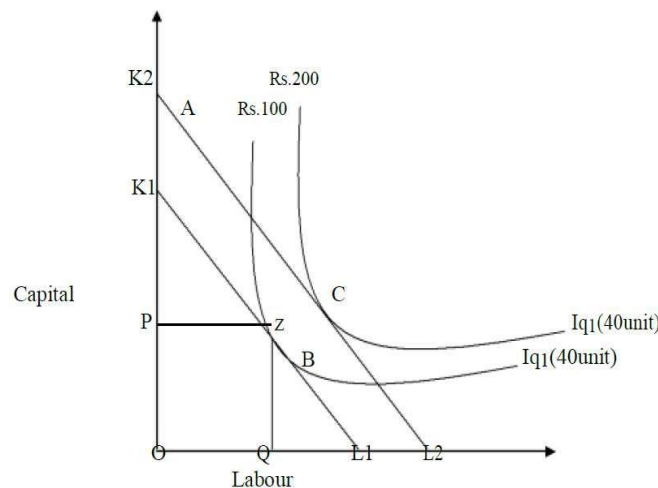
The figure shows that the firm has the option to spend the total money either on capital or labour or on both, from this Rs. 100, the firm can buy either OL, units of labour or OK, units of capital or any combination of those two between the extremes “K1” and L1. An isocost curve represents the same cost for all the different combination of inputs. The upward

isocost curve as represented by K2, L2 and K3, L3 shows higher amounts spent on larger quantities of both K and L.

Optimum Combination of inputs

A profit maximizing firm seeks to minimize its cost for a given output or to maximize the output for a given total cost. A certain quantity of output can be produced with different Input combinations. Optimum input combination is that which bears least cost. Thus the input combination that results in the minimum cost of production is to be found out. This is known as least - cost input combination. This can be found out by combining Isoquant curves and Isocost curves. The production function is represented by Isoquant curve and the cost function is represented by Isocost curve. The least cost combination exists at a point where Isoquant is tangent to Isocost.

Figure 3.4



The figure shows the least – cost combination of capital and labour. The Isoquant Iq_1 , is tangent to the Isocost curve K_1, L_1 at point 'z'. At this point the combination is OP of capital and OQ of labour. The point 'z' gives the ideal combination which minimizes cost of production per unit, it is the point at which the firm is in equilibrium. At the point 'z' the isocost line K_1, L_1 , representing Rs.100 is tangent to the isoquant curve Iq_1 , representing 20 units of output. Any other point on Iq_1 , would mean the same output, but at high cost. The point A or B or Iq_1 , gives the same output but with a higher cost combination of inputs K_2, L_2 representing Rs. 200. The point 'C' is the least cost point of producing 40 units formed by the intersection of Iq_2 (40 units) and K_2, L_2 (Rs.200).

3.5 Economies of Scale

Economies of scale means a fall in average cost of production due to growth in the size of the industry within which a firm operates. The factors which cause the operation of the laws of returns to scale are grouped under economies and diseconomies of scale. Increasing returns to scale operates because of economies of scale and decreasing returns to scale operates because of diseconomies of scale where economies and diseconomies arise simultaneously. Increasing returns to scale operates when economies of scale are greater than the diseconomies of scale and returns to scale decreases when diseconomies outweigh the economies of scale. Similarly when economies and diseconomies are in balance, returns to scale becomes constant. Economies of scale exist when long run average costs decline as output is increased. Diseconomies of scale exist when long run average cost rises as output is increased.

The economies of scale occur because of (i) Technical economies: the change in production process due to technology adoption. (ii) Managerial economies (iii) Purchasing economies, (iv) Marketing economies and (v) Financial economies.

Diseconomies of Scale

Arises due to managerial problems. If the size of the business becomes too large, then it becomes difficult for management to control the organizational activities therefore diseconomies of scale arise.

Factors Causing Economies of Scale

There are various factors influencing the economies of scale of an organization. They are generally classified into two categories as internal factors and external factors.

Internal Factors

- i) **Labour economies:** if the labour force of a firm is specialized in a specific skill then the organization can achieve economies of scale due to higher labour productivity.
- ii) **Technical economies:** with the use of advanced technology they can produce large quantities with quality which reduces their cost of production.
- iii) **Managerial economies:** the managerial skills of an organization will be advantageous to achieve economies of scale in various business activities.
- iv) **Marketing economies:** use of various marketing strategies will help in achieving economies of scale.
- v) **Vertical integration:** if there is vertical integration then there will be efficient use of raw

material due to internal factor flow.

vi) Financial economies: the firm's financial soundness and past record of financial transactions will help them to get financial facilities easily.

vii) Economies of risk spreading: having variety of products and diversification will help them to spread their risk and reduce losses.

viii) Economies of scale in purchase: when the organization purchases raw material in bulk reduces the transportation cost and maintains uniform quality.

External Factors

i) Better repair and maintenance facilities: When the machinery and equipments are repaired and maintained, then the production process never gets affected.

ii) Research and Development: research facilities will provide opportunities to introduce new products and process methods.

iii) Training and Development: continuous training and development of skills in the managerial,

iv) production level will achieve economies of scale.

v) Economies of location: the plant location plays a major role in cutting down the cost of materials, transport and other expenses.

vi) Economies of Information Technology: advanced Information technology provides timely accurate information for better decision making and for better services.

vii) Economies of by-products: Organizations can increase the economies of scale by minimizing waste and can be environmental responsible by using the by-products of the organization.

Factors Causing Diseconomies of Scale

i) Labour union: Continuous labour problem and dissatisfaction can lead to diseconomies of scale.

ii) Poor team work: Poor performance of the team leads to diseconomies of scale.

iii) Lack of co-ordination: Lack of coordination among the work force has a major role to play in causing diseconomies of scale.

iv) Difficulty in fund raising: Difficulties in fund raising reduce the scale of operation.

v) Difficulty in decision making: The managerial inability, delay in decision making is also a factor that determines the economies of scale.

vi) Scarcity of Resources: Raw material availability determines the purchase and price. Therefore there is a possibility of facing diseconomies in firms.

- vii) Increased risk:** Growing risk factors can cause diseconomies of scale in an organization. It is essential to reduce the same.

3.6 Cost Concepts

The term cost simply means cost of production. It is the expenses incurred in the production of goods. It is the sum of all money-expenses incurred by a firm in order to produce a commodity. Thus it includes all expenses from the time the raw material are bought till the finished products reach the wholesaler. A managerial economist must have a proper understanding of the different cost concept which are essential for clear business thinking. The cost concept which are relevant to business operation and decision can be grouped on the basis of their purpose under two overlapping categories:

1. Concept used for accounting purpose
2. Concept used in economics analysis of the business

Types of Cost (or Cost Concepts)

There are several types of costs (or cost concepts). Following are the important items:-

- i) Money Cost:** money cost means the total money expenses incurred by a business firm on the various items entered into the production of a particular product. For example, money payments made on wages and salaries to workers and managerial staff, payments for raw materials purchased, expenses on power and light, insurance, transportation, advertisement and also payments made on the purchase of machinery and equipments etc., constitute money cost of production. Money cost is also called nominal cost.
- ii) Real Cost:** Real cost means the real cost of production of a particular product. It is the next best alternative sacrificed in order to obtain that product. It also denotes the “efforts” of workers and sacrifices of owners undergone in the production of a particular product.
- iii) Opportunity Cost:** Opportunity cost refers to the cost of foregoing or giving up an opportunity. It is the cost of the next best alternative. It implies the income of benefit foregone because a certain course of action has been taken. As Adam Smith observed, if a hunter can bag a deer or a beaver in the single day, the cost of deer is a beaver and the cost of beaver is a deer. A man who marries a girl is foregoing the opportunity of marrying another girl. A film actress can either act in films or do modelling work. She cannot do both the jobs at the same time. Her acting in the film results in the loss of an opportunity of doing modelling work. Likewise, if an old building is proposed to be used for a business, where rent of the building is the opportunity cost. The opportunity cost concept was first developed by an Austrian economist, Wieser. The opportunity cost concept plays an important role in managerial

decisions. It is useful in determination of relative prices of different goods. It is also useful in fixing the price of an output factor. Above all, it helps in the best allocation of available resources.

- iv) Sunk Cost:** Sunk costs are those which have already been incurred and which cannot be changed by any decision made now or in the future. These are past or historical costs.
- v) Incremental cost:** These are additional costs incurred due to a change in the level or nature of activity.
- vi) Differential Cost:** It refers to the change in cost due to change in the level of activity or pattern of production or method of production.
- vii) Explicit Cost:** Explicit costs are those costs, which are actually paid (or paid in cash.). They are paid out costs.
- viii) Implicit Cost:** Implicit costs are those costs, which are not paid in cash to anyone. These are not actually incurred, but are computed for decision-making purpose. These are the costs, which the entrepreneur pays to himself. For example, rent charged on owned premises, wages of entrepreneur, interest on owned capital etc., Implicit costs are also known as imputed costs or hypothetical costs.
- ix) Accounting cost:** Accounting costs represent all such expenditures, which are incurred by a firm on factors of production. Thus, accounting costs are explicit costs. In short, all items of expenses appearing on the debit side of trading, profit and loss account of a firm represent the accounting cost. Since all the expenses on production are in money terms, the accounting costs are money costs or nominal costs.
- x) Economic Cost:** Economic cost refers total of explicit cost and implicit cost. Thus it includes the payment for factors of production (that is rent, wages etc.,) and the payments for the self-owned factors (interest on owned capital, rent on owned premises, salary to entrepreneur etc.,)

3.7 Cost Function

The concept of cost function refers to mathematical relation between cost of a product and the various determinants of cost. In cost function the dependent variable is unit cost or total cost and the independent variable are the price of factor, the size of the output or nay other relevant phenomenon.

$$C = f(O, S, T, P \dots)$$

C = Cost O = Level of Output S = Size of Plant T = Time under Consideration P = Price of the factor of production

Determinants of Cost Function

i) Level of Output

There is positive relationship between total output and total cost. As the output increases the total cost also increases. The cost may rise or fall by different rates in different periods of time.

ii) Size of Plant

Size of plant or scale of operation is inversely related to cost. As the scale of operation increases the cost declines but only up to a certain point.

iii) Price of Inputs

The cost also depends on the price of factors of production. Any increase in prices of input will also increase the cost.

iv) Managerial Efficiency

Managerial efficiency has direct bearing on cost function. With the increase inefficiency the cost declines and productivity increases, and economies the cost.

v) State of Technology

State of technology also influences the cost. Better the technology better is the technological efficiency. How best we can produce with the available technology determines the level of costs.

vi) Time under Consideration

The time period under consideration significantly affects demand elasticity, with longer periods typically leading to higher elasticity. Demand elasticity refers to how sensitive the demand for a good or service is to changes in its price.

3.8 Cost Output Relationship

The theory of cost deals with the behaviour of cost in relation to change in output. In other words, the cost theory deals with the cost output relationship.

The basic principle of the cost behaviour is that the total cost increases with the increase in output. But the specific form of cost function depends on whether the time framework chosen for cost analysis is short – run or long – run. It is important to know that some costs remain constant in the short run while all costs are variable in the long run.

Cost Output Relationship in the Short - Run

Short run is the period wherein only some of the factors are held constant and some are

variable. Therefore, the costs associated with both fixed and variable inputs form part of the short period costs.

Short – Run Total Cost:- $TC = TFC + TVC$

The costs which are found in the short period:

- i) Total Fixed Cost
- ii) Total Variable Cost
- iii) Total Cost
- iv) Average Cost: - a) Average Variable Cost b) Average Fixed Cost c) Average Total Cost
- v) Marginal Cost
- i) Total Fixed Cost (TFC)

Total fixed cost is the sum of fixed cost which remains same irrespective of the level of output. This is the expenditure incurred by the firm on the fixed factors of production.

For example, the money incurred on land, building, machinery, etc. remains the same whatever is the amount of output.

They are also called Overhead Costs.

Figure 3.5
Total Fixed Cost (TFC)

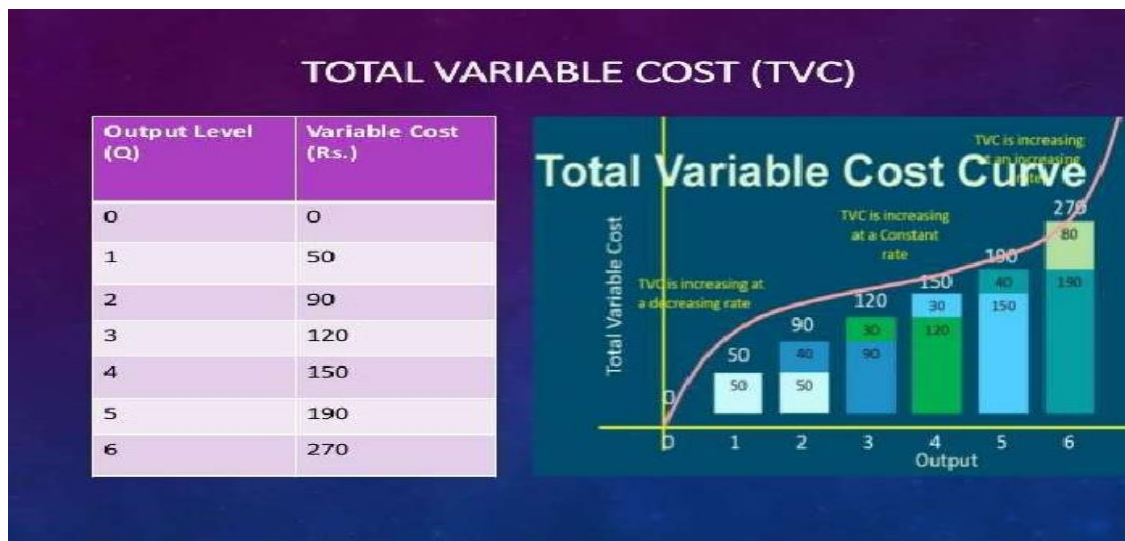


ii) Total Variable Cost (TVC)

Total variable costs are those costs of production that change directly with output. They rise when output increases, and fall when output declines. If there is no output the total variable cost will be zero. They include expenses on raw materials, power, taxes, advertising, etc.

Marshall has called variable cost as 'Prime Cost' or 'Avoidable Cost'.

Figure 3.6
Total Variable Cost (TVC)



In the short run cost diagram shows that total variable cost varies directly with the volume of output. TVC curve starts from the origin, up to a certain range it remains concave from below and then it becomes convex. If taken from a different angle we can say that initially the variable cost rises but with diminished rate and later the variable cost rises with increased rate. This makes the TVS curve inversely S-shaped.

iii) Total Cost (TC)

Total costs are the total expenses incurred by a firm in producing a given quantity of a commodity. When we add TFC and TVC it becomes total cost (TC).

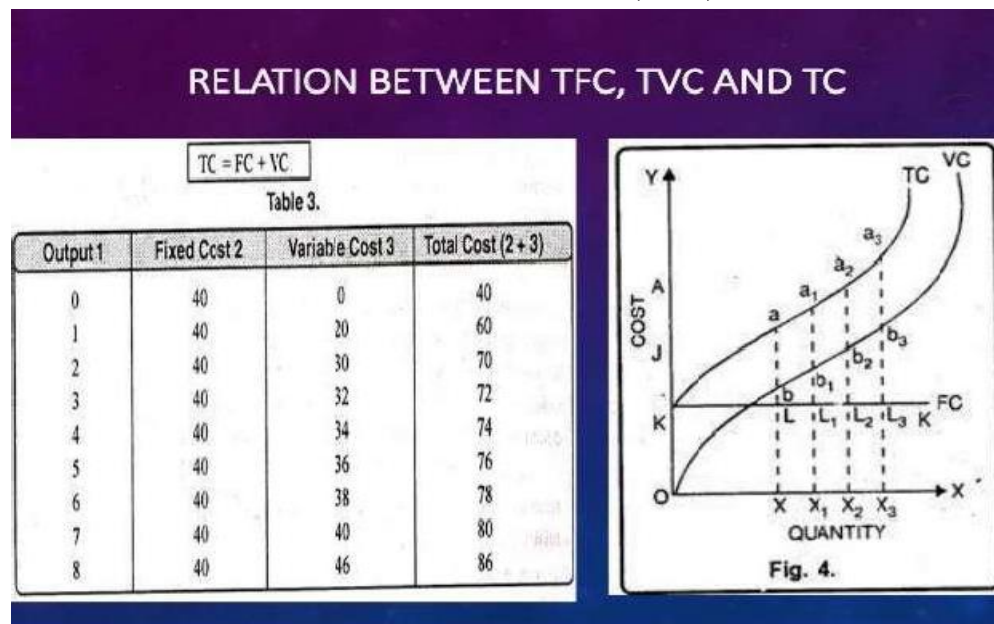
They include payment for rent, interest, wages, and expenses on raw materials, electricity, water, etc.

Relation between TFC, TVC and TC

In order to determine the total costs of a firm, we aggregate fixed as well as variable costs at different levels of output i.e.

- ✓ $TC = TFC + TVC$
- ✓ $TFC = TC - TVC$
- ✓ $TVC = TC - TFC$

Figure 3.7
Total Variable Cost (TVC)



In the figure TFC is parallel to X-axis. This curve starts from the point on the Y-axis meaning thereby that fixed cost will be incurred even if the output is zero.

On the other hand, total variable cost curve rises upward showing thereby that as output increases, total variable cost also increases. This curve starts from the origin which shows that when the output is zero, variable costs are also nil.

The total cost curve has been obtained by adding vertically total fixed cost curve and total variable cost.

iv) Average Cost

The concept of average cost is more relevant from the point of view of a firm because per unit cost helps in explaining the pricing of a product in a better way rather than the total cost.

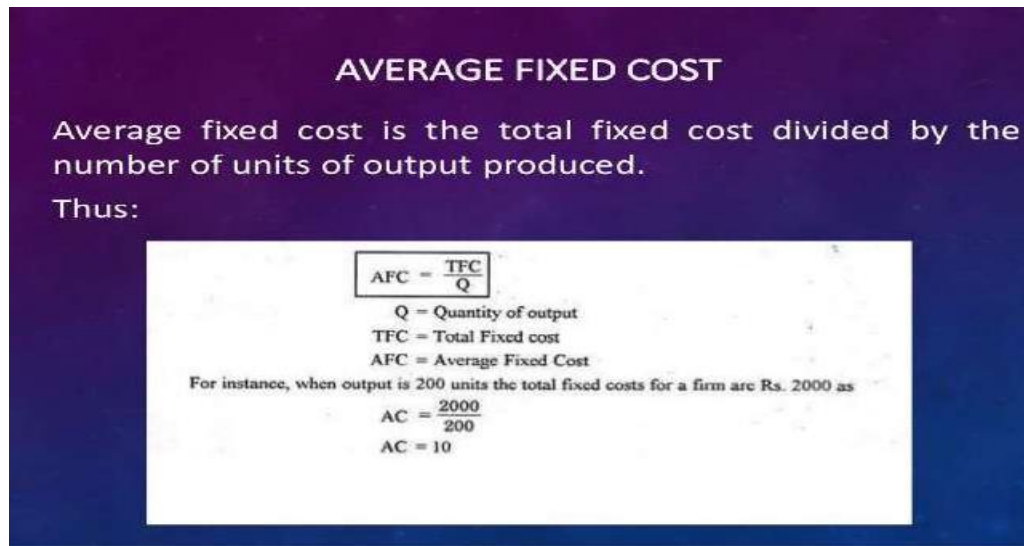
The concept of average cost is divided in to two”

- a) Average Fixed Cost
- b) Average Variable Cost
- c) Average Total Cost

a)Average Fixed Cost

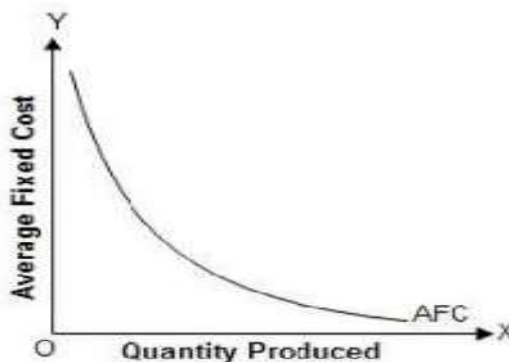
Average fixed cost is the total fixed cost divided by the number of units of output produced. Thus:-

Figure 3.8 Average Fixed Cost



Since, total fixed cost is a constant quantity, average fixed cost will steadily fall as output increases, thus, the average fixed cost curve slopes downward throughout the length.

Figure 3.9 Average Fixed Cost



In Figure the average fixed cost curve slopes downward with a view to touch the horizontal axis. But it will not be so because AFC can never be zero. Thus, it is clear that as output increases, average fixed costs go on diminishing.

b) Average Variable Cost

Average variable cost is the total variable cost divided by the number of units of output produced.

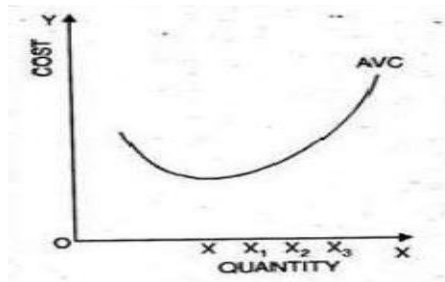
$$AVC = TVC / Q$$

AVC = Average variable costs. TVC = Total variable costs

Q = Output

Generally, the AVC falls as output increases from zero to the normal capacity output due to the law of increasing returns. But beyond the normal capacity output, the AVC will rise steeply because of the operation of the law of diminishing returns.

Figure 3.10 Average Variable Cost

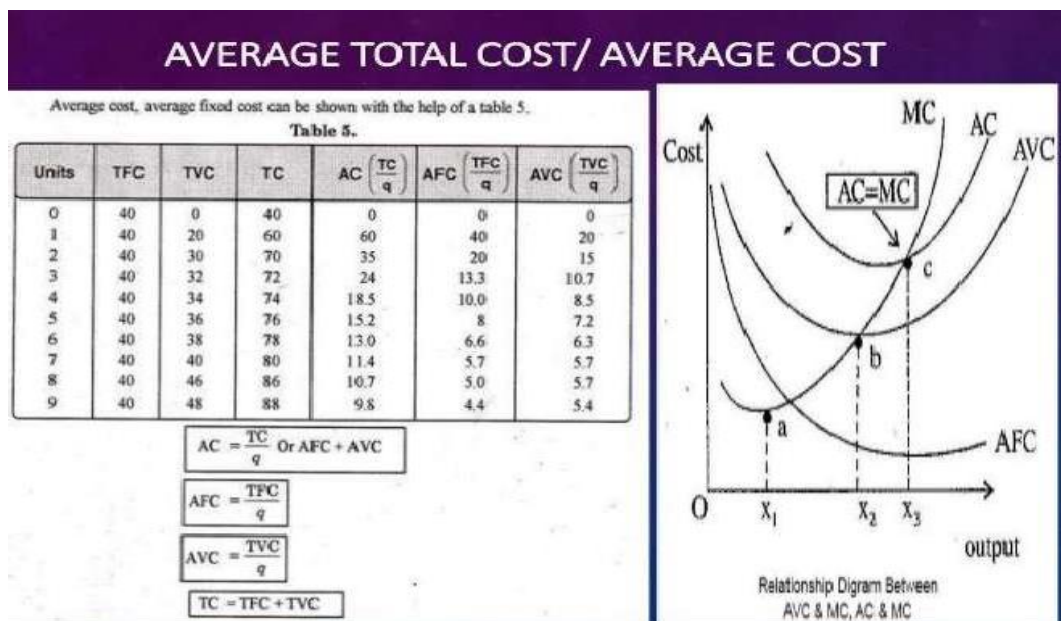


c) Average Total Cost

Average Total Cost/ Average Cost “The average cost of production is the total cost per unit of output.” In other words average cost of production is the total cost of production divided by the total number of units produced.

Suppose, the total cost of producing 500 units is Rs. 1000, the average cost will be: $AC = TC/Q$
 $AC = 1000/500 = 2$

Figure 3.11 Average Total Cost

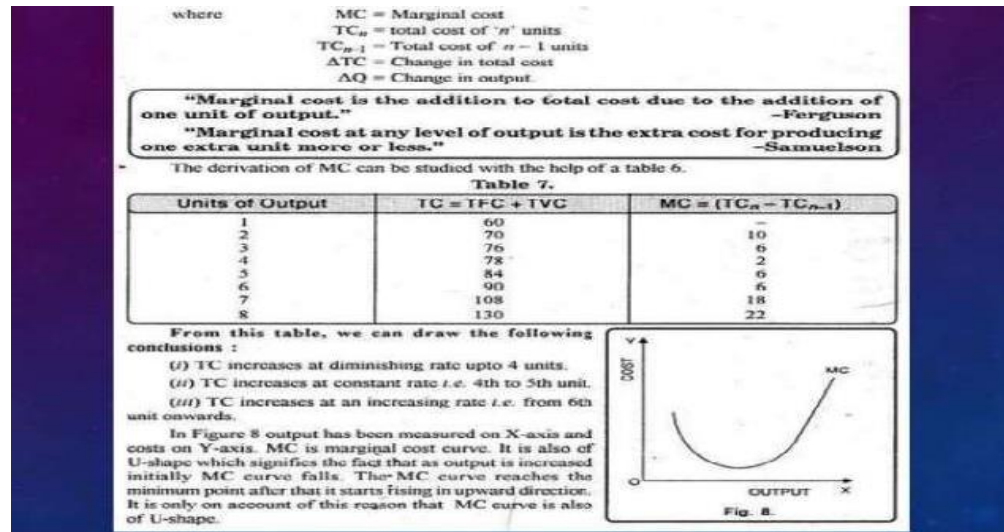


i) Marginal Cost

Marginal cost is an addition to the total cost caused by producing one more unit of

output. For instance, the total cost for the production of 100 units is Rs. 5000. Suppose the production of one more unit costs Rs. 5000. It will be called the marginal cost.

Figure 3.12 Marginal Cost



Cost Output Relationship in the Long - Run

Long run means time period long enough to make the entire productive factors variable. In the long run all factors of production become variable. The entrepreneur has number of choices to change the plant size and level of output. The long run cost curve is also known as planning curve. The long run average cost curve is derived from short run average cost curves.

Long run average cost is also known as:

i) Envelope Cost

It is also known as "envelope cost" because it encloses all short run average cost curves. The curve is created as an envelope of an infinite number of short-run average total cost curves.

ii) Planning Curve

With the help of this curve a firm can plan as to which plant it should use to produce different quantities, so that production is obtained at the minimum cost.

The LRAC curve is U-shaped, reflecting economies of scale when it is negatively-sloped and diseconomies of scale when it is positively sloped.

In some industries, the LRAC is L-shaped, and economies of scale increase indefinitely. Initially the long-run average cost rapidly falls but after a point it remains flat throughout or at its right-hand end it may even slope gently downward.

Figure 3.13
Long Run Average Cost Curve

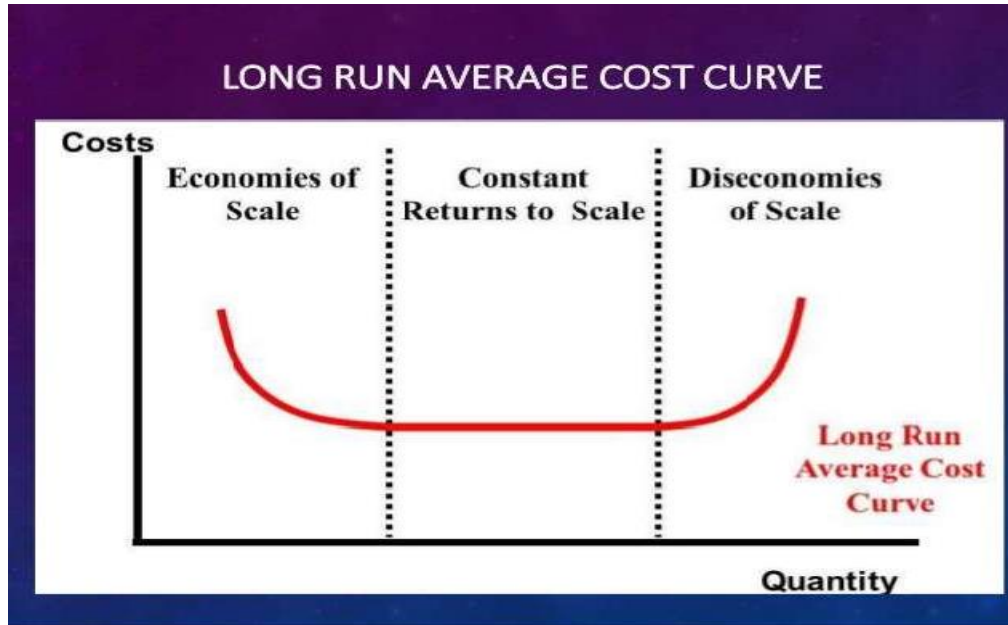
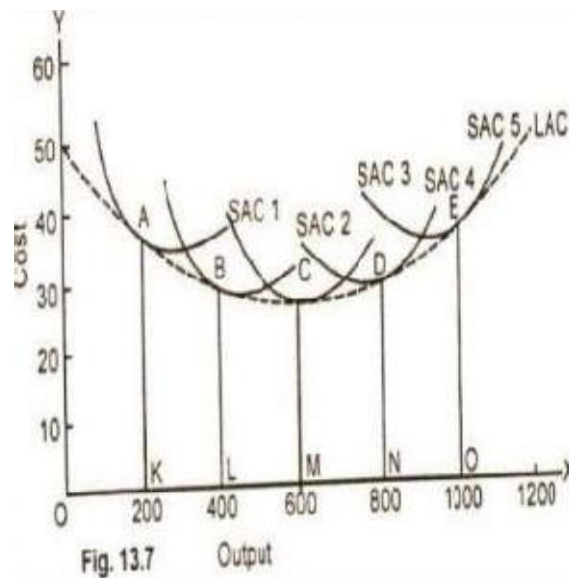


Figure 3.14
Long Run Average Cost Curve



if the anticipated rate of output is 200 units per unit of time, the firm will choose the smallest plant. It will build the scale of plant given by SAC1 and operate it at point A. This is because of the fact that at the output of 200 units, the cost per unit is lowest with the plant size 1 which is the smallest of all the four plants.

In case, the volume of sales expands to 400, units, the size of the plant will be

increased and the desired output will be attained by the scale of plant represented by SAC2 at point B.

If the anticipated output rate is 600 units, the firm will build the size of plant given by SAC3 and operate it at point C where the average cost is \$26 and also the lowest. The optimum output of the firm is obtained at point C on the medium size plant SAC3.

If the anticipated output rate is 1000 per unit of time the firm would build the scale of plant given by SAC5 and operate it at point E.

If we draw a tangent to each of the short run cost curves, we get the long average cost (LAC) curve. The LAC is U-shaped but is flatter than the short run cost curves. Mathematically expressed, the long-run average cost curve is the envelope of the SAC curves.

In this figure, the long-run average cost curve of the firm is lowest at point C. CM is the minimum cost at which optimum output OM can be obtained.

3.9 Revenue

The amount of money that a producer receives in exchange for the sale proceeds is known as revenue.

For example, if a firm gets Rs. 16,000 from sale of 100 chairs, then the amount of Rs. 16,000 is known as revenue. Revenue refers to the amount received by a firm from the sale of a given quantity of a commodity in the market. Revenue is a very important concept in economic analysis. It is directly influenced by sales level, i.e., as sales increases, revenue also increases.

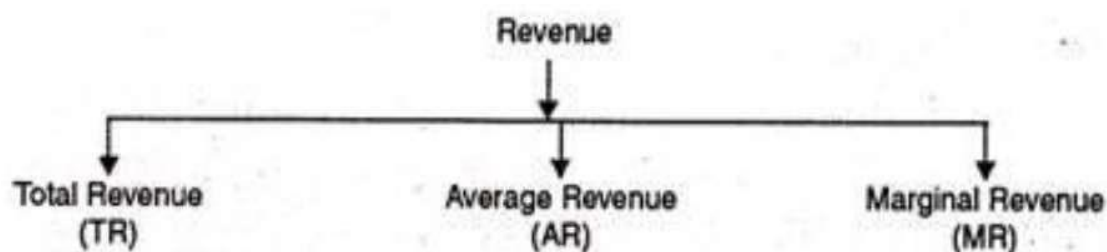
Features of Revenue

- ✓ Revenue arises from the normal trading activities of a business.
- ✓ Revenue eventually creates an inflow of funds into the business.
- ✓ Revenue is measured in monetary terms.
- ✓ Revenue must be allocated to a particular accounting period.
- ✓ Revenue is earned as a result of revenue generating activities typically expressed as expenses.

Concept of Revenue

The concept of revenue consists of three important terms; Total Revenue, Average Revenue and Marginal Revenue.

Figure 3.15 Revenue



i) Total Revenue (TR)

Total Revenue refers to total receipts from the sale of a given quantity of a commodity. It is the total income of a firm. Total revenue is obtained by multiplying the quantity of the commodity sold with the price of the commodity.

Total Revenue = Quantity $\times$ Price

For example, if a firm sells 10 chairs at a price of Rs. 160 per chair, then the total revenue will be: 10 Chairs $\times$ Rs. 160 = Rs 1,600

ii) Average Revenue (AR)

Average revenue refers to revenue per unit of output sold. It is obtained by dividing the total revenue by the number of units sold.

Average Revenue = Total Revenue/Quantity

For example, if total revenue from the sale of 10 chairs @ Rs. 160 per chair is Rs. 1,600, then:

Average Revenue = Total Revenue/Quantity

AR = 1,600/10 = Rs 160

AR and Price are the Same

We know, AR is equal to per unit sale receipts and price is always per unit. Since sellers receive revenue according to price, price and AR are one and the same thing. This can be explained as under:

TR = Quantity $\times$ Price ... (1) AR = TR/Quantity (2)

Putting the value of TR from equation (1) in equation (2), we get

AR = Quantity $\times$ Price / Quantity AR = Price

AR Curve and Demand Curve are the Same

A buyer's demand curve graphically represents the quantities demanded by a buyer at various prices. In other words, it shows the various levels of average revenue at which different quantities of the good are sold by the seller. Therefore, in economics, it is

customary to refer AR curve as the Demand Curve of a firm.

iii) Marginal Revenue (MR)

Marginal revenue is the additional revenue generated from the sale of an additional unit of output. It is the change in TR from sale of one more unit of a commodity.

$$MR_n = TR_n - TR_{n-1}$$

Where:

MR_n = Marginal revenue of nth unit; TR_n = Total revenue from n units;

TR_{n-1} = Total revenue from (n – 1) units; n = number of units sold

For example, if the total revenue realized from sale of 10 chairs is Rs. 1,600 and that from sale of 11 chairs is Rs. 1,780, then MR of the 11th chair will be:

$$MR_{11} = TR_{11} - TR_{(11-1=10)} \quad MR_{11} = TR_{11} - TR_{10} \quad MR_{11} = Rs. 1,780 - Rs. 1,600 = Rs. 180$$

One More way to Calculate MR:

We know, MR is the change in TR when one more unit is sold. However, when change in units sold is more than one, then MR can also be calculated as:

$$MR = \text{Change in Total Revenue} / \text{Change in number of units} = \Delta TR / \Delta Q$$

Let us understand this with the help of an example:

If the total revenue realised from sale of 10 chairs is Rs. 1,600 and that from sale of 14 chairs is Rs. 2,200, then the marginal revenue will be:

$$MR = TR \text{ of 14 chairs} - TR \text{ of 10 chairs} / 14 \text{ chairs} - 10 \text{ chairs} = 600/4 = Rs. 150$$

TR is summation of MR:

Total Revenue can also be calculated as the sum of marginal revenues of all the units sold.

It means, $TR_n = MR_1 + MR_2 + MR_3 + \dots + MR_n$

or, $TR = \Sigma MR$

The concepts of TR, AR and MR can be better explained through Table 7.1.

Table 3.3 TR, AR and MR

Units Sold (Q)	Price (P)	Total Revenue (Rs.) $TR = Q \times P$	Average Revenue (Rs.) AR $= TR/Q = P$	Marginal Revenue (Rs.) $MR_n = TR_n - TR_{n-1}$
----------------	-----------	--	--	---

1	1 0	10=1x1 0	10 =10+1	10 =10-0
2	9	18 =2x9	9 =18 + 2	8 =18-10
3	8	24 =3x8	8 =24 + 3	6 =24-18
4	7	28 = 4x7	7 =28 + 4	4 =28-24
5	6	30 = 5x6	6 =30 + 5	2 =30-28
6	5	30 = 6x5	5 =30 + 6	0 =30-30
7	4	28 = 7x4	4 =28 + 7	-2 =28-30

Shapes of Revenue Curve

i) Total Revenue curve

TR is obtained by multiplying amount of output sold by the given price determined in the market by intersection of market demand and market supply curve.

i.e. $TR = Q \times P$

Where, Q= amount of product sale P= Market Price which is constant.

TR increases at the same rate because, every additional unit of the commodity is sold at the same price. In this type of market firms are price taker not price maker.

It can be explained with the help of following table and graph.

Table 3.4

Total Revenue Under Perfect Competition

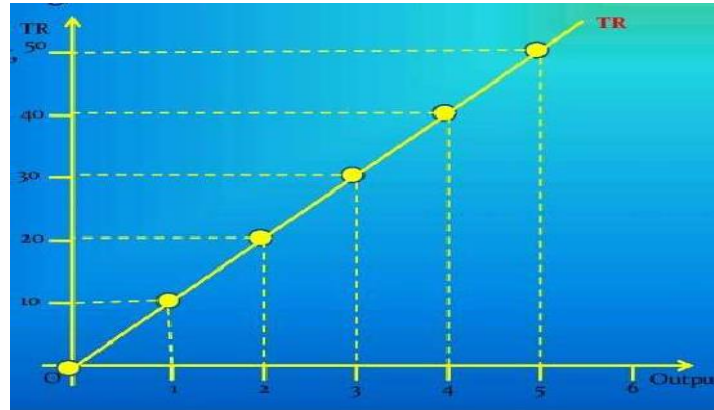
Units of Output (Q)	Per Unit Price (P)	Total Revenue (TR)
0	10	0
1	10	10
2	10	20
3	10	30
4	10	40
5	10	50

In above table total revenue (TR) is obtained by multiplying output (Q) and Price (P). When output is zero TR also zero. TR is Rs. 10, 20, 30, 40 and 50 for the 1, 2, 3, 4 and 5 units of sale respectively, where price is constant at Rs. 10.

In the above table as increase in sell of output total revenue also increasing, but

the rate of increase in total revenue is constant.

Figure 3.16
Total Revenue Under Perfect Competition



i) Average Revenue curve

Average Revenue (AR): Per unit revenue obtained by a seller by selling product at market price in the market in certain time period is known as AR for that time period of that seller or producer.

It is calculated by dividing total revenue (TR) by corresponding quantity sold (Q) in the market at market price (P).

i.e. $AR = TR/Q$

i.e. $AR = (P \times Q)/Q$

i.e. $AR = P$

Therefore, another name of AR is the average market price of the product. Since, price is constant in perfect competition market and hence, AR is also constant.

It can be explained with the help of following table;

Table 3.5
Average Revenue Under Perfect Competition

Units of Output (Q)	Per Unit Price (P)	Total Revenue TR	Average Revenue AR- TR/Q
0	10	0	-
1	10	10	10
2	10	20	10
3	10	30	10
4	10	40	10
5	10	50	10

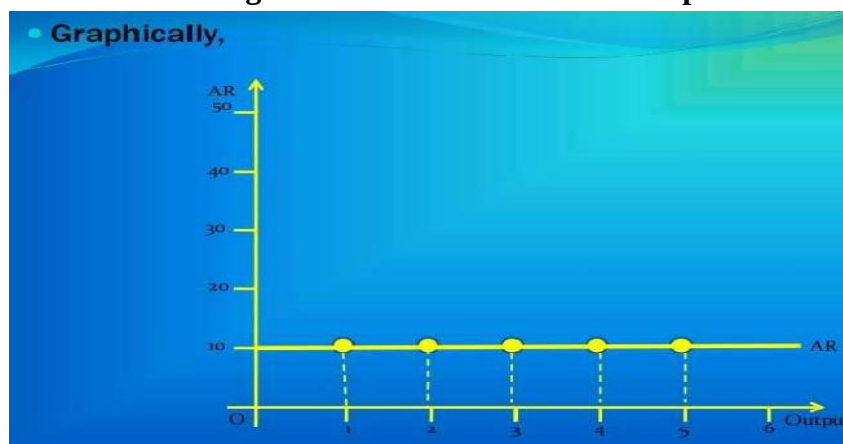
In the above table as increase in sells of output of the product Average Revenue (AR) remains constant i.e. Rs. 10 for first unit to fifth unit of output.

Above information shows that AR is constant and equal to the price for all level of output.

In the following figure average revenue curve is found by plotting the combination of points of the quantity sold on the horizontal axis and corresponding AR on the vertical axis.

AR curve is a horizontal straight line at the different level of output sold at given price. It shows that AR is constant and equal to the price for all level of output, i.e. $AR = P$.

Figure 3.17
Average Revenue Under Perfect Competition



i) Marginal Revenue curve

Marginal revenue is the change in total revenue in response to the change in quantity sold. It is calculated by dividing the change in total revenue (ΔTR) by the change in quantity sold (ΔQ).

In case of perfectly competitive market marginal revenue (MR) remains constant and equal to the market price for all level of output sold, i.e. $MR = P$.

It can be explained with the help of following table and graph.

Table 3.6
Marginal Revenue in Perfect Competition

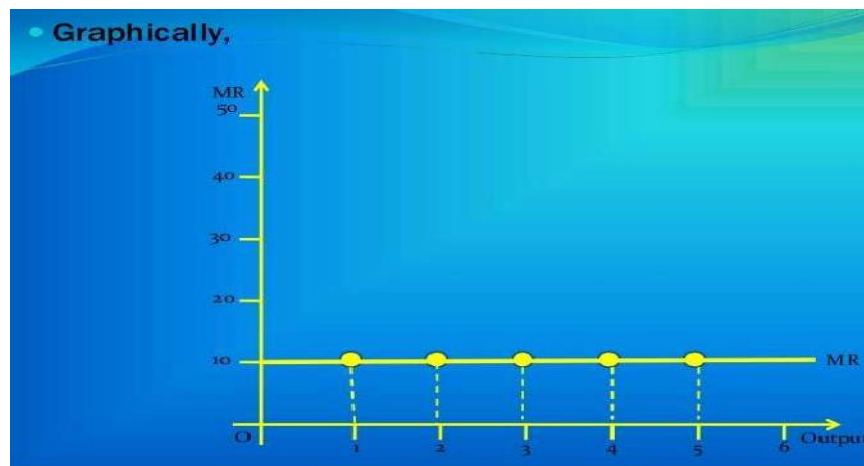
Unit s of O	P e r U n	Total Reven ue (TR) - $P \times Q$	Average Reven ue AR- TR/Q	Marginal Revenue (MR) – $\Delta TR/\Delta R$
----------------------	-----------------------	--	--------------------------------------	---

ut pu t (Q)	i t P r i c e (P)			
0	10	0	-	-
1	10	10	10	10
2	10	20	10	10
3	10	30	10	10
4	10	40	10	10
5	10	50	10	10

In the above table as increase in output sold at market price TR increases at constant rate. But MR remains constant i.e. Rs. 10. which is equal to price.

Form above table we conclude that Price, AR and MR are same i.e. Rs. 10. that means $P = AR = MR$.

Figure 3.18
Marginal Revenue in Perfect Competition



In the above figure MR is the slope of the TR. The MR curve is found by plotting the MR on y-axis and quantity sold on x-axis.

The MR curve is also horizontal to the x-axis as of the AR. It shows that AR and MR are overlapped and equal to the price in perfectly competitive market.

Significance of Revenue Curve

The main points of significance of revenue curves are as under:

i) Estimation of Profits and Losses

A producer aims at maximizing his profits. His profits will be maximum where he finds $AR > AC$.

The maximum difference between AR and AC will show maximum profits. A producer finds out whether he is making supernormal profits, normal profits or sustaining losses.

ii) Equilibrium

The second point of the importance of AR and MR curves is to know how much a producer should produce. In this case, the concept of MR is very important. The firm will be in equilibrium at that point where $MR = MC$. This is a general condition for the firm under all market situations. $MR = MC$ determines output, price, profits or loss.

iii) Capacity Utilization

It is through revenue curves that we come to know whether a firm is producing at its full capacity or not. In other words, the firm will be producing at its full capacity, if AR curve is tangent to AC curve at its minimum point. It is possible only under perfect competition but not under imperfect competition like monopoly, monopolistic competition etc.

iv) Price Changes

The concepts of AR and MR are also useful to the factor services in determining their price. In factor pricing like rent, wages, interest and profits, they become inverted U-shaped. The AR and MR curves become ARP and MRP (Average Revenue productivity and Marginal Revenue Productivity). It is an important tool in explaining the equilibrium of the firm under different market conditions.

Relationship of Total Revenue, Average Revenue and Marginal Revenue

The relation of total revenue, average revenue and marginal revenue can be explained with the help of table and figure.

Table Representation

The relationship between TR, AR and MR can be expressed with the help of a table 3.5.

Table 3.7

Relationship between TR, AR and MR

U n	TR/q AR or	(P	(TR _n – TR _n – 1)
--------	---------------	--------	--

i t (q)	Price	q) T R	MR
1	10	10	10
2	9	18	8
3	8	24	6
4	7	28	4
5	6	30	2
6	5	30	0
7	4	28	-2
8	3	24	-4
9	2	18	-6
10	1	10	-8

From the table 3.5 we can draw the idea that as the price falls from Rs. 10 to Re. 1, the output sold increases from 1 to 10. Total revenue increases from 10 to 30, at 5 units. However, at 6th unit it becomes constant and ultimately starts falling at next unit i.e. 7th. In the same way, when AR falls, MR falls more and becomes zero at 6th unit and then negative. Therefore, it is clear that when AR falls, MR also falls more than that of AR: TR increases initially at a diminishing rate, it reaches maximum and then starts falling.

The formula to calculate TR, AR and MR is as under:

$$TR = P \times q$$

$$\text{Or } TR = MR_1 + MR_2 + MR_3 + MR_4 + \dots + MR_n, \text{ TR}$$

$$AR = TR/q \quad MR = TR_n - TR_{n-1}$$

In fig. 1 three concepts of revenue have been explained. The units of output have been shown on horizontal axis while revenue on vertical axis. Here TR, AR, MR are total revenue, average revenue and marginal revenue curves respectively.

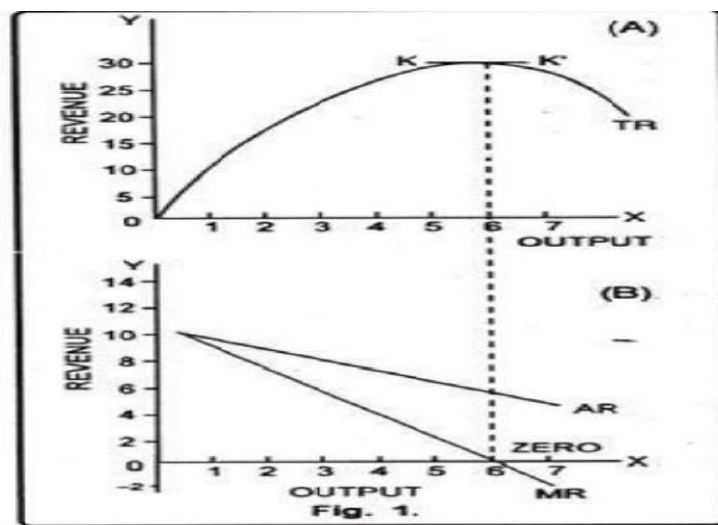
In figure 1 (A), a total revenue curve is sloping upward from the origin to point K. From point K to K' total revenue is constant. But at point K' total revenue is maximum and begins to fall. It means even by selling more units total revenue is falling. In such a situation,

marginal revenue becomes negative.

Similarly, in the figure 1 (B) average revenue curves are sloping downward. It means average revenue falls as more and more units are sold.

In fig. 1 (B) MR is the marginal revenue curve which slopes downward. It signifies the fact that MR with the sale of every additional unit tends to diminish. Moreover, it is also clear from the fig. that when both AR and MR are falling, MR is less than AR. MR can be zero, positive or negative but AR is always positive.

Figure 3.19
The relationship between TR, AR and MR



The relationship between TR, AR, and MR

In order to understand the basic concepts of revenue, it is also important to pay attention to the relationship between TR, AR, and MR. When the first unit is sold, TR, AR, and MR are equal.

Therefore, all three curves start from the same point. Further, as long as MR is positive, the TR curve slopes upwards.

However, if MR is falling with the increase in the quantity of sale, then the TR curve will gain height at a decreasing rate. When the MR curve touches the X-axis, the TR curve reaches its maximum height.

Further, if the MR curve goes below the X-axis, the TR curve starts sloping downwards.

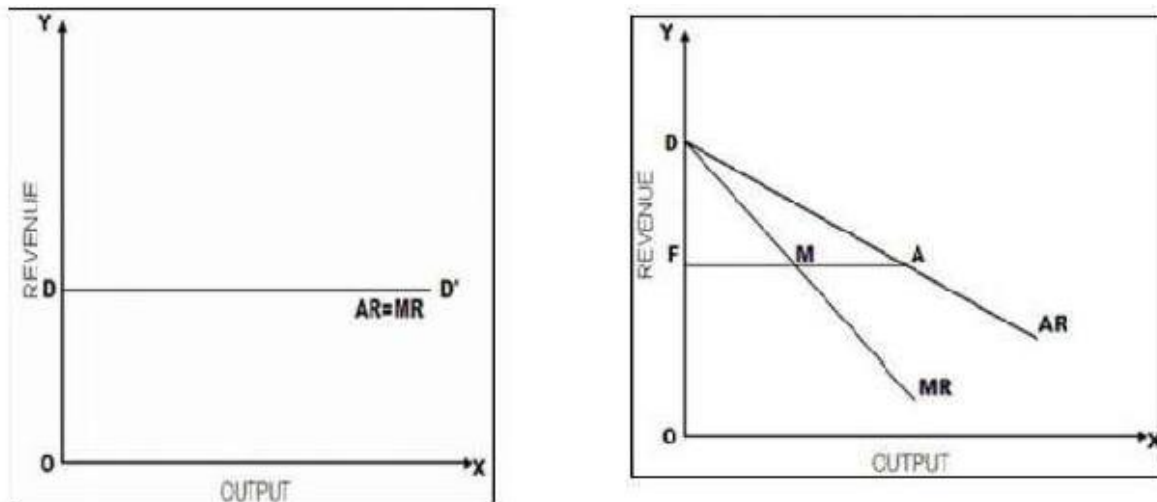
Any change in AR causes a much bigger change in MR. Therefore, if the AR curve has a

negative slope, then the MR curve has a greater slope and lies below it.

Similarly, if the AR curve has a positive slope, then the MR curve again has a greater slope and lies above it. If the AR curve is parallel to the X-axis, then the MR curve coincides with it.

Here is a graphical representation of the relationship between AR and MR:

Figure 3.20 Relationship between AR and MR



In the left half, you can see that AR has a constant value (DD'). Therefore, the AR curve starts from point D and runs parallel to the X-axis. Also, since AR is constant, MR is equal to AR and the two curves coincide with each other.

In the right half, you can see that the AR curve starts from point D on the Y-axis and is a straight line with a negative slope. This basically means that as the number of goods sold increases, the price per unit falls at a steady rate.

Similarly, the MR curve also starts from point D and is a straight line as well. However, it is a locus of all the points which bisect the perpendicular distance between the AR curve and the Y-axis. In the figure above, $FM=MA$.

3.10 Supply Analysis

Supply and demand are the dual forces which determine the price of a good in the market. As Alfred Marshall argued, only when both an object's scarcity, namely supply and the intensity of wanting it, viz. demand are known, it will be possible to understand how its price is determined. The concept of supply which is one of the two "blades of the scissors" that determines price is similar in many ways to the other blade, viz. demand.

Meaning of Supply

The meaning of supply is symmetrical with that of demand. It can be defined as the quantity of a good or service that a seller wishes to sell on the market at a particular price at a particular time. Supply of a good is different from its stock. The quantity of a good that a seller can bring out to sell immediately on demand is his stock. But it should be noted that the seller is not always ready to sell the whole of his stock. As the market conditions change, he varies the quantity of the good he is prepared to sell from time to time. Therefore, generally a seller offers only a portion or part of his stock for sale as supply. In short, supply is that part of the stock which a seller offers for sale at a particular price at a particular time. While stock refers to potential supply, supply means the quantity which is actually brought in the market. **Law of Supply**

More of a commodity will be offered for sale when price rises and less will be offered for sale when price falls, *ceteris paribus*. The relationship between price and supply is direct and that between price and demand is inverse. To put it otherwise, "other things remaining the same, the supply of a good extends with a rise in its price and contracts with a fall in its price".

Factors determining supply

A variety of factors determine the supply of a commodity.

- ✓ Price of the commodity is the most important. As the price rises, sellers like to sell more and vice versa.
- ✓ A rise in the prices of factors of production raises its cost of production which, in turn, lowers profits and thereby the supply. Thus a rise in the cost of production of a good lessens the supply of that good. Similarly a fall in cost of production of a good increases supply.
- ✓ Any change in the prices of other products would influence the supply of a good by causing substitution of one product for another.
- ✓ A change in technology as a result of innovations or inventions affects the supply by altering the cost of production. With an improvement in production technology used by the firm, the cost of production declines and as a result the firm would supply more than before at the given price. Thus supply would increase.
- ✓ The objective of the production unit also determines the supply. If the firm aims at maximisation of revenue or sales rather than of profits, supply would be larger.
- ✓ If the number of firms producing a good increases, the market supply would increase.
- ✓ Sellers' expectations of future prices also determine supply. During inflation, sellers anticipate

further rise in prices in future and would reduce supply.

- ✓ The imposition of a sales tax or an excise duty causes a downward shift in supply and the grant of subsidy by the government increases supply.
- ✓ Supply depends on many other factors like, changes in government policy, fear of war or depression, climatic conditions, inequalities of income, means of transport and communications, agreements among producers, etc.

The Supply Function

It is a short hand formula of the various factors determining supply of a good.

Symbolically, $S = (P_1, P_2, \dots, P_n, F_1, \dots, F_n, T, O, O_d)$

Where S stands for the supply of a good, P; for price of the good P_2 to P_n for prices of all other goods, F_1 to F_n for prices of all factors of production, T for technology, O for objective of the firm and O_d for other determinants.

The supply schedule and supply curve: Supply schedule shows the various quantities of the good offered for sale at different prices. Corresponding to the demand schedule, it is possible to construct an individual's supply schedule as follows:

Table 3.8

Pro price of the good (in Rs.)	Quo quality of supply (in units)
3	40
4	50
5	60
6	70
7	80

If the data are drawn into a diagram graphically, it gives a supply curve.

Figure 3.21 Supply Curve

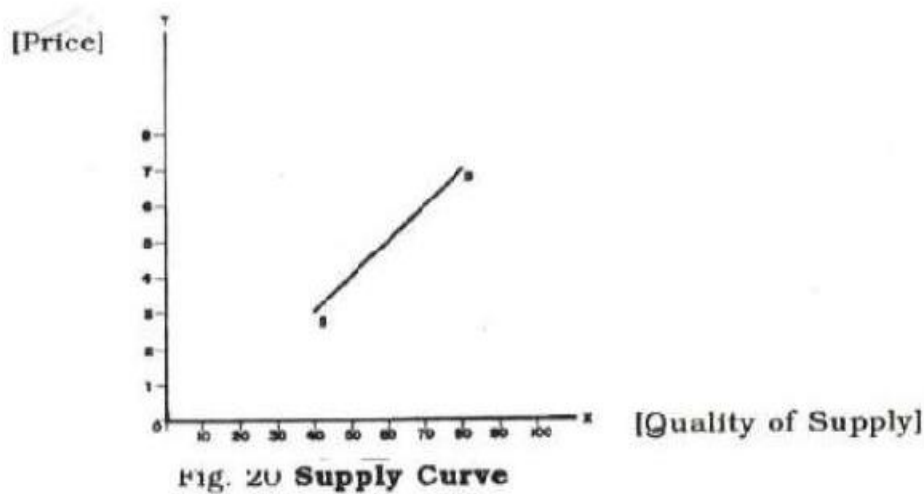
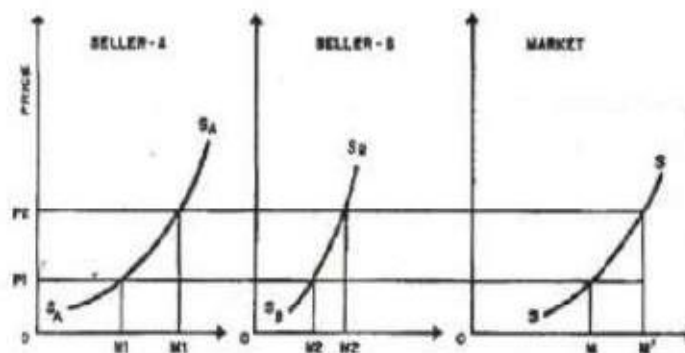


Figure 3.18 is the supply curve sloping upwards from left to right. Suppose the price of pen is Rs.3 per unit, 40 units are offered for sale by an individual at this price. Increase in price will bring out increase in supply, as shown in the Table and in the Curve. SS curve shows the direct relation between price and supply. If we add up horizontally through the lateral summation process the supply curves of all individual sellers of the good in a market, we derive a Market Supply Curve as shown in Figure 3.19.

Figure 3.22

Deviation of Market Supply Curve from Individual Supply Curve



At price OP_1 , seller A is prepared to sell amount OMI while seller B offers for sale the amount OM_2 . If there are only two sellers, A and B at price OP_1 , market supply is the amount $OM(OMI + OM_2)$. At a higher price OP_2 both sellers offer more for sale and market supply is $OM_1 (OMI + OM_2)$. Similarly we find the amounts of market supply at different prices and draw the market supply curve SS . This market supply curve is a lateral summation

of the individual supply curves, SA and SB.

As compared to the individual supply curves, the market supply curve is quite elastic for reasons, as follows:

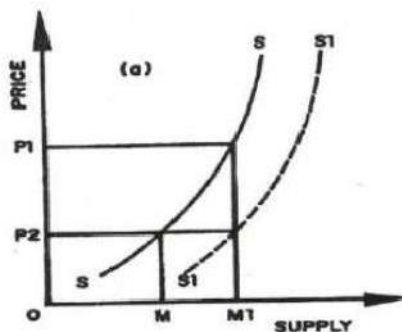
- ✓ The sellers already present in the market sell more and more as price rises.
- ✓ With a rise in price, more sellers are attracted to the market to sell. Since profit is the goal for sale, which depends upon the cost of production and price, ultimately the elasticity of supply curves of producers in a market rests on the way costs change with increased production.

Shifts in Supply Curve

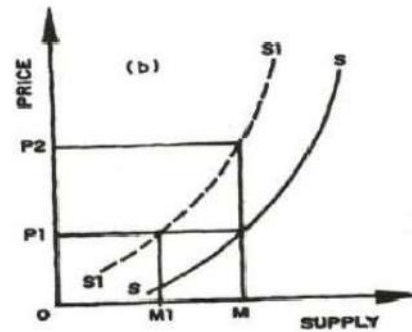
The most important factor bringing about changes in supply is the change in price. Sellers plan their production and supply taking into consideration the price of the product in the market. With a rise in price, the amount supplied extends and with a fall in price, the amount of supply contracts. Thus changes in price induce extension and contraction in supply.

Figure 3.20

3.23 (a) Increase in Supply



3.23 (b) Decrease in Supply



If the amount offered for sale rises without any change in price, or when the same amount is supplied even at a lower price, it is called increase in supply. In Figure 3.23 (a) market supply is the same (OM) even at a lower price OP_1 . Looked at another way, at the same price OP_2 , the amount supplied increases from OM to OMI as the supply curve shifts from its position SS to S_1S_1 . This is the case of an increase in supply.

Now we can take the opposite case, the case of a decrease in supply. If the same amount is supplied at a higher price or at the same price a lower amount is offered for sale, supply is said to have decreased. In Figure 3.23 (b) the same amount OM is supplied at higher price OP_2 or lesser quantity (OMI) is being offered for sale at the same price OP_1 .

Increase in supply means a shift of the supply curve to the right and a decrease in supply involves a shift of the supply

curve to the left.

Elasticity of Supply

The responsiveness of supply to changes in price is called elasticity of supply. Elasticity of supply is a measure of the rate at which supply changes as a result of change in price. It is the percentage change in amount supplied with a given percentage change in price.

$$\text{Elasticity of supply} = \frac{\text{Proportionate change in supply}}{\text{Proportionate change in price}}$$

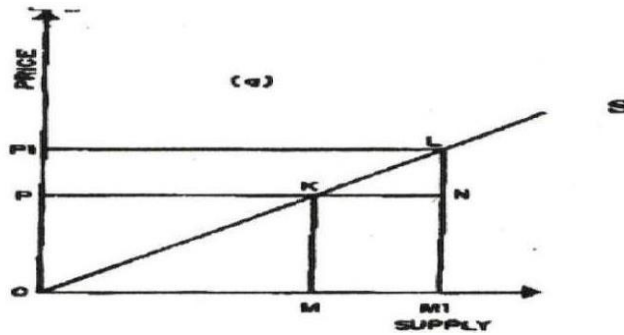
Ordinarily when price increases amount supplied rises. Likewise, with a fall in price amount supplied falls. Price and amount supplied move in the same direction. Therefore, elasticity of supply will be always positive. In the limiting case of completely inelastic supply curve, when the supply curve is a vertical straight line the elasticity of supply is zero. It means that the amount supplied remains the same, however much price rises. In the other limiting case, when supply curve is a straight line parallel to the X axis elasticity of supply is infinite: a small rise in price evokes a large rise in the amount supplied. We use the formula given above to find out the magnitude of elasticity of supply. If the proportionate increase in the amount supplied is double the proportionate rise in price, elasticity of supply is 2. If the proportionate change in amount supplied is only one-half of the proportionate change in price, elasticity of supply is 0.5. On the same line supply has unitary elasticity if the amount supplied changes in the same proportion as price has changed.

It is helpful to know whether one supply curve is more or less elastic than another over a range, or at a point. We should therefore know the geometrical estimation of elasticity at a particular point of a supply curve. Exact measurement of elasticity of supply is possible through the use of the formula given above. Geometrically, we can say that

- a) if supply curve is a straight line passing through the origin, it has unitary elasticity throughout.
- b) If the supply curve is a straight line cutting the Y-axis, it has an elasticity more than unity.
- c) if supply curve is a straight line intersecting the X-axis it has an elasticity of less than unity.

Elasticity of supply is Unitary

Figure 3.24
Elasticity of Supply Equals One



In Figure 3.21 the straight line supply OS curve passes through the origin O. When price rises from OP to OP₁, amount supplied goes up from OM to OM₁.

Now, elasticity of supply

$$\begin{aligned}
 &= \frac{\text{Change in supply}}{\text{Amount supplied}} \div \frac{\text{Change in price}}{\text{Price}} \\
 &= \frac{KN}{OM} \div \frac{PP_1}{OP} \\
 &= \frac{KN}{OM} \times \frac{OP}{PP_1} \\
 &= \frac{KN}{OM} \times \frac{KM}{LN} \\
 &= \frac{KN}{LN} \times \frac{KM}{OM} \text{ (Since } OP = KM \text{ and } PP_1 = LN \text{)} \dots \dots \dots (1)
 \end{aligned}$$

Triangles OKM and KLN are similar, therefore,

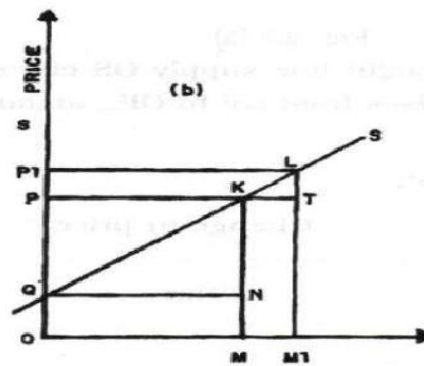
$$\frac{KN}{LN} = \frac{OM}{KM}$$

$$= \frac{OM}{KM} \times \frac{KM}{OM} = \frac{KM}{KM} = 1$$

Putting this value in equation (1) derived above, we have. Elasticity of Supply
Thus a straight line supply curve passing through the origin has unitary elasticity.

Elasticity of Supply Greater than One

Figure 3.25 Supply



$$ES = \frac{\text{Change in supply}}{\text{Amount supplied}} \div \frac{\text{Change in price}}{\text{Price}}$$

$$= \frac{MM1}{OM} \div \frac{PP1}{OP}$$

As $MM1 = KT$, $PP1 = LT$ and $OP = KM$;it can be rewritten as

$$ES = \frac{KT}{OM} \div \frac{LT}{KM}$$

$$= \frac{KT}{OM} \times \frac{KM}{LT}$$

$$= \frac{KT}{OM} \times \frac{KM}{LT}$$

$$= \frac{KT}{QN} \times \frac{KM}{LT} \text{ (since } OM = QN \text{)}$$

$$\text{or } = \frac{KT}{LT} \times \frac{KM}{QN} \quad \dots \dots \dots (2)$$

Triangles KLT and QKN are similar, therefore,

$$\frac{KT}{LT} = \frac{QN}{KN}$$

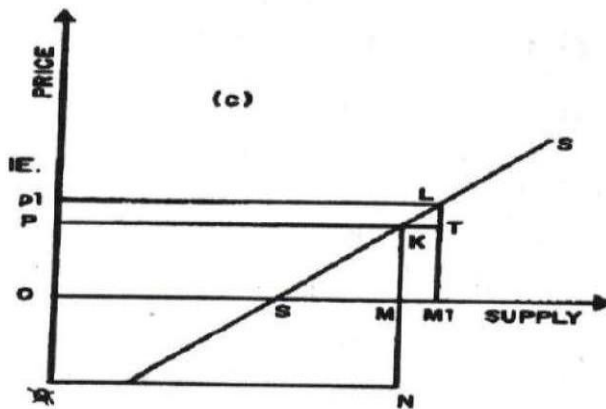
Putting this in our equation (2) above we get Elasticity of supply

$$= \frac{QN}{KN} \times \frac{KM}{QN} = \frac{KM}{KN}$$

which is obviously less than one. This shows that when a straight line supply curve (or its projection) cuts the X-axis it has an elasticity of less than unity.

Elasticity of Supply Less than One

Figure 3.26 Supply



In the same way, we can find out the elasticity of supply. In figure 3.23 (c) where the supply function SS cuts the X axis at Q. In the range Ks, elasticity of supply is

$$\frac{\text{Change in supply}}{\text{Amount supplied}} \div \frac{\text{Change in price}}{\text{Price}}$$

$$\frac{MM_1}{OM} \div \frac{LT}{KM} = \frac{KT}{OM} \div \frac{LT}{KM} = \frac{KT}{OM} \times \frac{KM}{LT} \quad (MM_1 = KT)$$

$$= \frac{KT}{LT} \times \frac{KM}{OM} = \frac{KT}{LT} \times \frac{KM}{QN} \quad (MM_1 = KT \text{ and } OM = QN) \quad \dots \dots \dots (3)$$

Since triangles KTL and QNK are similar

$$\frac{KT}{LT} = \frac{QN}{KN}$$

Putting this value in equation (3) derived above, we get

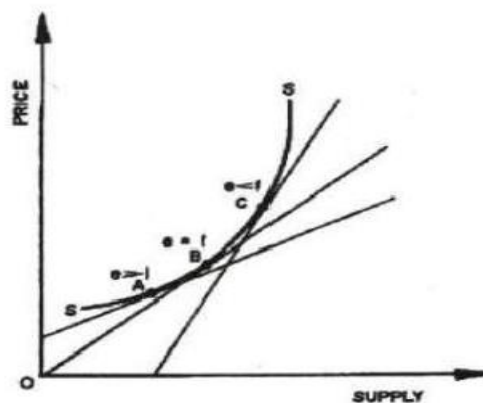
$$\text{Elasticity of supply} = \frac{QN}{KN} \times \frac{KM}{QN} = \frac{KM}{KN}$$

which is obviously less than one. This shows that when a straight line supply curve (or its projection) cuts the X-axis it has an elasticity of less than unity.

Elasticity of supply in a Supply Curve

When the supply function in question is a curve, we use the method of finding elasticity at a point by drawing a tangent to the supply curve at that point. If the tangent passes through the origin, elasticity of supply at the point of tangency is one; if the tangent intersect the Y-axis, it is more than unity, and if the tangent cuts the X axis the elasticity of supply at the point is less than unity. This is shown in Figure 3.24.

Figure 3.27
Elasticity of supply in a Supply Curve



Elasticity of supply varies with the period under consideration. Given a small change in price the quantity offered for sale in a given period will be smaller in the short run than in the long run. The longer the period to which supply curve is related, the greater will be the elasticity.

Supply may be inelastic in the short period and quite elastic in the long period. Thus, elasticity of supply has a time dimension while elasticity of demand has none.

Uses of the Concept of Elasticity of Supply

The concept of elasticity of supply has many uses:

- ✓ It helps us in knowing the effect on the price of a commodity when its demand rises. It will depend, among other things, on the elasticity of supply. The more elastic is supply the smaller the rise in price needs to be in order to induce sellers to offer more of the commodity for sale.

The difference between short-run inelasticity of supply and long-run elasticity of supply of capital assets, technical and entrepreneurial talent helps us in an understanding of the _quasi-rent, they enjoy. The greater the elasticity of supply of a factor or production the higher is the share of rent in the total earning. If the supply of a factor is perfectly elastic (supply curve is a straight line parallel to the horizontal axis) then there is no rent element in the factor earning. On the extreme opposite, if the supply of a factor is altogether inelastic, as in the case of land for a country, then the whole of its earnings are rent. Thus the elasticity of supply of a factor determines what part of its earning **is** in the nature of rent.

- ✓ The elasticity of supply concept is also useful in economic planning. In less developed countries knowledge of supply elasticities of at least the key industries is essential for the formulation of production programmes and for avoiding unnecessary shortage induced inflationary pressures.

