Chapter

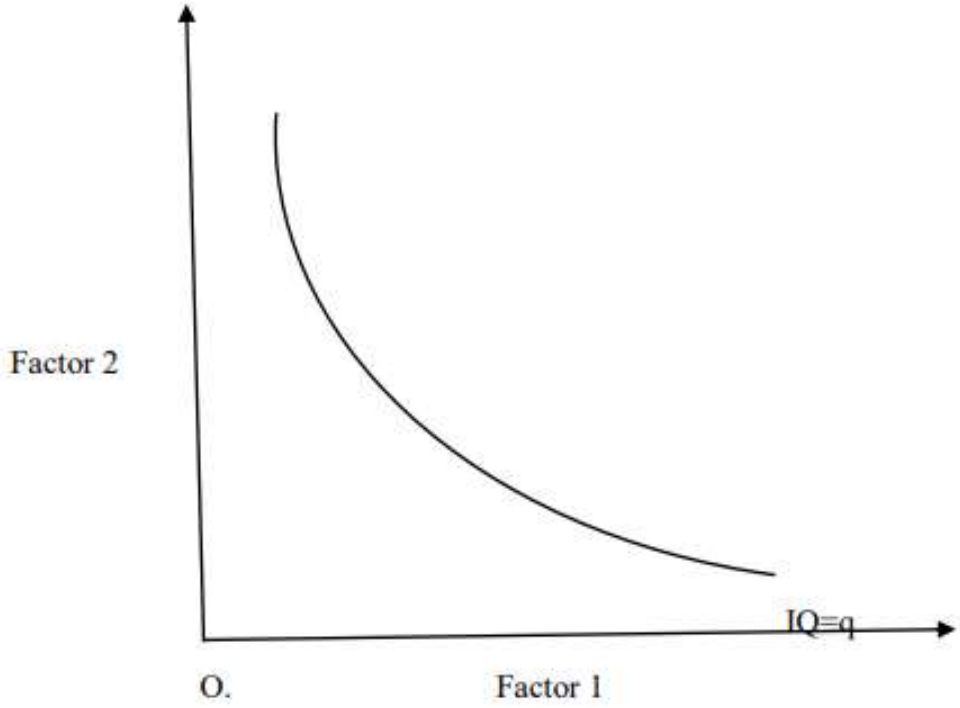
Production and Cost

PRODUCTION: Production means the physical transformation of inputs into output

PRODUCTION FUNCTION: The relationship between inputs used and the output produced by a firm is called the production function. If there are only factors of production, the production function can be written as follows.

$$q = f\ (X1, X2)$$

ISOQUANTS: Isoquants can be defined as 1 the locus of points of combinations of two inputs, which give the same maximum possible level of output. The following is an isoquant.



PROPERTIES OF ISOQUANTS:

1. Isoquants are convex to the origin.
2. Isoquants slope downwards from left to right.
3. Isoquants never intersect each other.
4. Higher Isoquants represent a higher level of output.
5. A group of Isoquants is called Isoquant Map.

SHORT-RUN AND LONG RUN

SHORT RUN	LONG RUN
Short period of time	Long period of time
Factors of production are fixed	Factors of production are variable
Production function is called Law of variable proportion	Production function is called Law of Fixed proportion

TOTAL PRODUCT (TP) OR TOTAL PHYSICAL PRODUCT (TPP):

Total output produced with the given quantity of inputs.

AVERAGE PRODUCT (AP) OR AVERAGE PHYSICAL PRODUCT(APP)

AP is the output per unit of the variable input. By dividing Total output with Variable factors we get AP. $AP\ OR\ APP = TP\ Q$ here Q= quantity of inputs.

MARGINAL PRODUCT (MP) OR MARGINAL PHYSICAL PRODUCT (MPP)

It is the additional product produced with the employment of an additional unit of input.

$^{2}MP\ OR\ MPP = \Delta TP/\Delta Q$

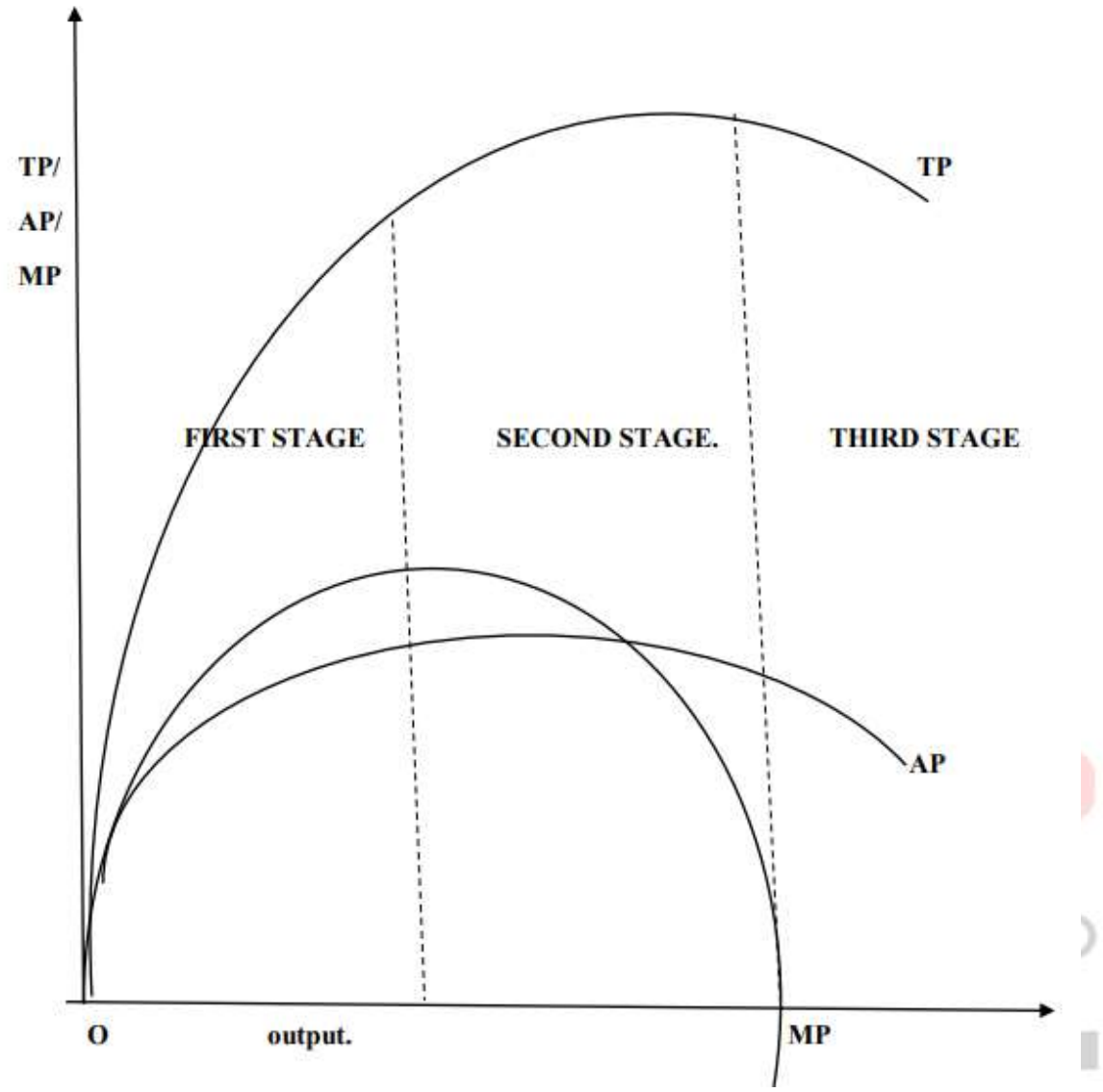
THE LAW OF VARIABLE PROPORTION OR LAW OF DIMINISHING MARGINAL PRODUCT

The short-run production is called The law of variable proportion or law of diminishing marginal product. In the short run, the producer can change the quantity of output only by changing the quantity of only one variable factor i.e., labour. 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 a 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 a 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 is therefore known as the Law of variable proportions. The variation in inputs lead to a disproportionate increase in output more and more units of a 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 remains 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.

No. of Workers	Total product	Average product	Marginal product
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	9.05	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 several workers Marginal product is the additional product resulting term additional labour. It is found out by dividing the change in the total product by the change in the number of workers. The total output increases at an increasing rate until the employment of the 4th worker. The rate of increase in the marginal product reveals this. Any additional labour employed beyond the 4thlabour faces3 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



In the above diagram TP, AP and MP are Total product curve, Average product curve and MP is the Marginal product curve. The three stages of the law are illustrated. In the first stage, TP increases at an increasing rate. AP and MP also increase. It is called Increasing returns to a factor. In the second stage TP increases at a decreasing rate, and AP and MP decline. It is called Diminishing returns to a factor. In the third stage, TP starts to decline and MP becomes negative and AP declines. It is called Negative returns to a factor.

Relationship between TP and MP.

1. When TP increases at an increasing rate, MP also increases.
2. When TP increases at a decreasing rate of MP Decreases.
3. When TP becomes maximum, MP becomes Zero.

4. When TP Decreases MP becomes negative.

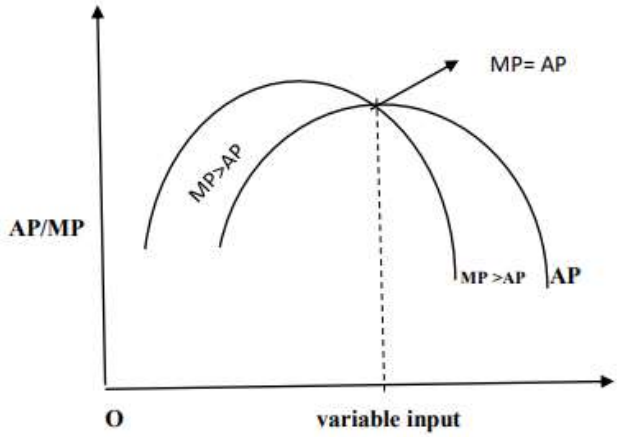
Relationship between MP and AP

1. As AP increases, MP is greater than AP.

2. When AP reaches a maximum, AP and MP will be equal.

3. When AP Decreases, MP less than AP.

This is shown by the following diagram



LONG RUN PRODUCTION FUNCTION (LAW OF RETURNS TO SCALE)

Returns to scale refer to change in output caused by the proportionate change in all inputs. When all inputs are changed in the same proportion, TP responds in three different ways. They are the following.

1. Increasing returns to scale (IRS)

   When the proportionate change in all inputs leads more than proportionate change in output

2. Constant returns to scale (CRS)

   When the proportionate change in all inputs leads to proportionate change in output.

3. Diminishing returns to scale (DRS)

   When the proportionate change in all inputs leads to less than proportionate change in output.

COBB DOUGLAS PRODUCTION FUNCTION.

One of the important tools of statistical analysis in the production function that measures the relationship between change in physical input is Cob-Douglas production function. The

concept was4 originated in the USA. This is more peculiar to manufacturing concerns. The Cob-Douglas production function was developed by C.W. Cobb and Paul. H. Douglas. It is written as follows. $q = X\ aX\ '^{B}$

α + β<1 Increasing returns to scale

α + β= 1 Constant returns to scale

α + β>1 Decreasing returns to scale

COST: It refers to the expenses incurred by the producer to produce goods and services.

TOTAL COST: Total Cost refers to the total of all costs incurred by the producer to produce goods and services. It is the sum of the Total Variable Cost and Total Fixed Cost.

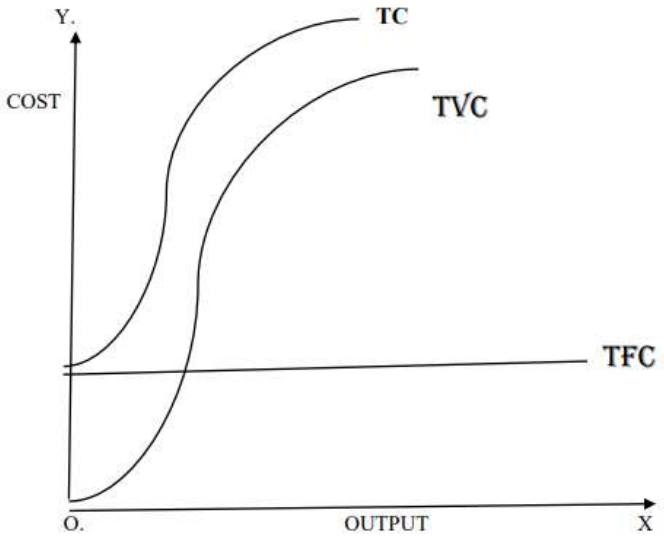
$$\boldsymbol{TC = TFC + TVC}$$

TOTAL FIXED COST: The total cost incurred by the producer to buy fixed inputs is called Total Fixed cost. It includes Rent, salary for permanent employees, interest on loans, insurance premium etc. It is the difference between the Total Cost and Total Variable Cost.

TFC = TC - TVC

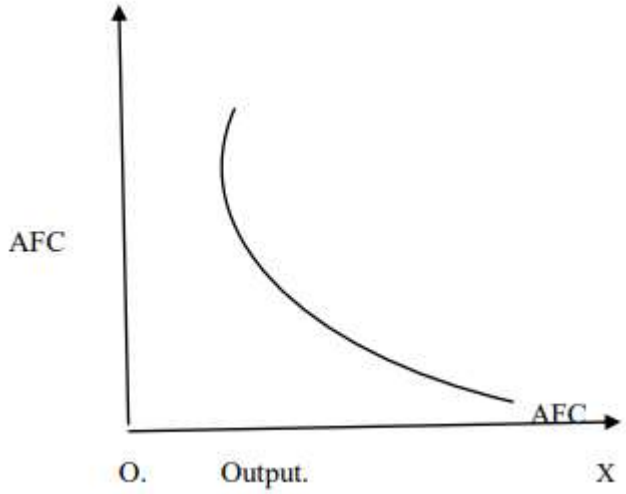
TOTAL VARIABLE COST: The total cost incurred by the producer on variable factors is called Total Variable Cost. It includes the cost of raw materials, energy cost, salary of temporary employees etc. When there is no production TVC become zero. It is the difference between TC and TFC. The following diagram shows the shape of TC, TFC and TVC.

$$\boldsymbol{TVC = TC - TFC}$$



AVERAGE FIXED COST: Fixed cost per unit of output is called[5] Average Fixed cost. AFC Curve is a rectangular hyperbola. AFC = $\boldsymbol{TFC\ Q\ here\ Q = Quantity\ of\ output}$.

$$\boldsymbol{TFC \times Q = AFC}$$

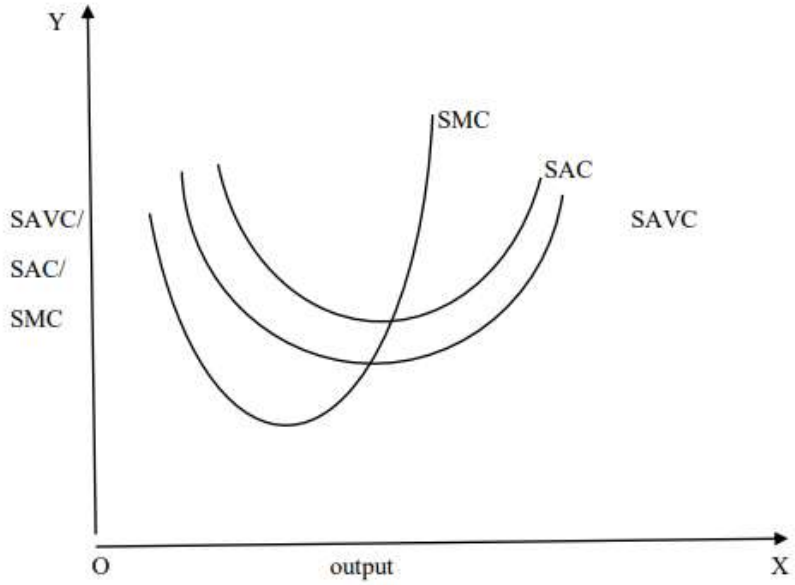


SHORT AVERAGE VARIABLE COST [SAVC]: SAVC is the variable cost per unit of output. AVC curve[6] is a 'U' shape curve. $AVC = TVC/Q \quad ;TVC = AVC \times Q$

SHORT-RUN AVERAGE COST [SAC]; Cost per unit of output is called SAC. It is a 'U' shaped curve.

$\boldsymbol{SAC = TC\ Q \quad TC = SAC \times Q}$

SHORT-RUN MARGINAL COST[SMC]: SMC is the additional cost incurred for producing an additional unit of output. $\boldsymbol{SMC = \Delta TC/\Delta Q\ OR \quad TCn - TCn - 1}$ SMC curve is a 'U' shaped curve.



RELATIONSHIP BETWEEN AVC AND MC OR SAC AND SMC.

1. AVC and MC initially falls and later rise.
2. When AVC falls, MC will be less than AVC.
3. When AVC rises, MC will be more than AVC.
4. MC cuts the minimum point of AVC from below.

RELATIONSHIP BETWEEN SAC AND SAVC.

1. The difference between SAC and AVC indicates AFC.
2. The difference between SAC and AVC Decreases as the output increases.
3. The minimum point of AVC is on the left of the minimum point of SAC.

LONG RUN COSTS: In the long run, all inputs are variable. So there is no distinction between Fixed cost and Variable cost. The important long-run costs are Long-run Average Cost and Long Run Marginal Cost. LRAC and LRMC are 'U' shaped curve flatter than SAC.

$\boldsymbol{LRAC = TC/Q}$ $\quad$ $\boldsymbol{LRMC = \Delta TC / \Delta Q}$

RELATIONSHIP BETWEEN LRAC AND LRMC.

1. When LRAC falls LRMC is less than LRAC.
2. When LRAC rises LRMC is more than LRAC.
3. LRMC cuts LRAC at the minimum point from below.
4. The minimum point of LRMC will be on the left of LRAC.
5. Both are 'U' shaped curves.

$$TC = TFC + TVC \; OR \; TC = AC \times Q$$

$$TFC = TC - TVC \; OR \; TFC = AFC \times Q$$

$TVC = TC - TFC \; OR \; AVC \times Q$