THEORY OF PRODUCTION

What is Production:

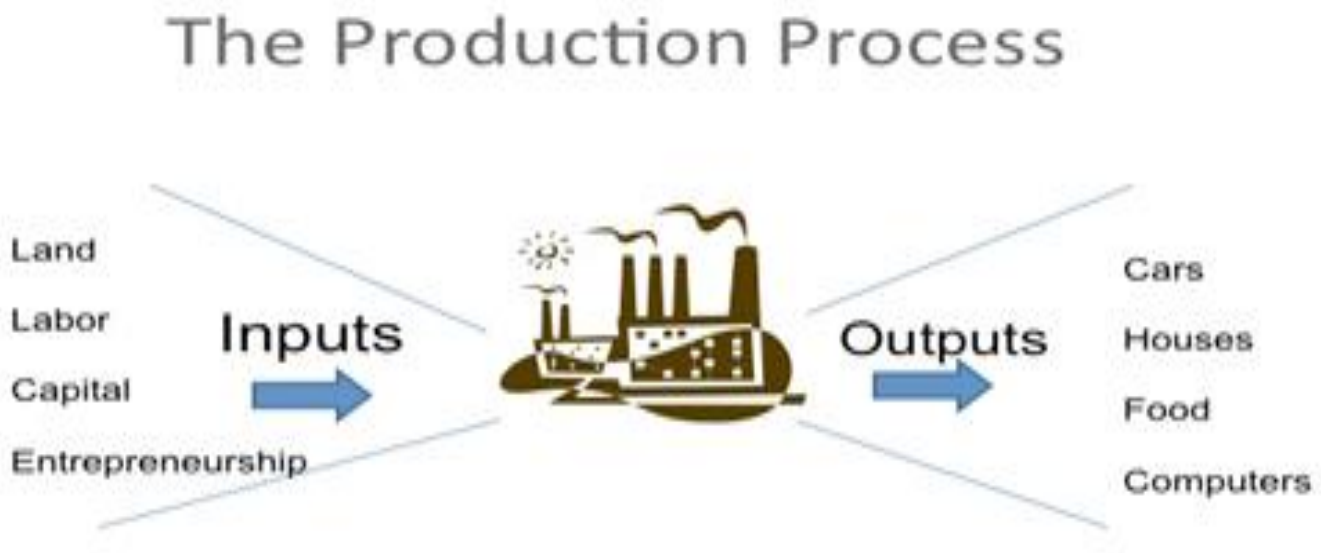
- Production in day to day life is understood as creating something or a making good.
- But in economics it has separate meaning.
- In simple terms production is conversion of inputs (resources) in to output (goods).

Ex: the input of land, labour, seeds, irrigation, fertilizers and machines and equipment's result in the production of wheat.

Definition:

- according to James bates J. Parkinson "production is organised activity of transforming resources in to finished products in the form of goods and services; and the objective of products is to satisfy the demand of such transformed resources".

PRODUCTION PROCESS



Production function:

- The production function expresses a functional relationship between physical inputs and physical outputs of a firm at any particular time period. The output is thus a function of inputs. Mathematically production function can be written as

$$Q = f(A, B, C, D)$$

- Where "Q" stands for the quantity of output and
- A, B, C, D are various input factors such as land, labour, capital and organization.
- Here output is the function of inputs. Hence output becomes the dependent variable and inputs are the independent variables.

Assumptions of production function:

a. The production function is related to a particular period of time.
b. There is no change in technology.
c. The producer is using the best techniques available.
d. The factors of production are divisible.
e. Production function can be fitted to a short run or to long run

The following table explain production function:

production	Labour in hours	Land in Acres	Output (in units)
A	0	0	0
B	1	2	10
C	2	4	22
D	3	6	36
E	4	8	48

- The table shows certain factor combinations and their corresponding output levels.
- 1 hour of labour and 2 acres of land produce 10 units and so on.
- The technical relationship between input (labour in hours and land in acres) and output in units is termed as production function.

COBB-DOUGLASS PRODUCTION FUNCTION

- Production function of the linear homogenous type is invented by Junt wicksell and first tested by C. W. Cobb and P. H. Douglass in 1928.
- This famous statistical production function is known as Cobb-Douglas production function.
- Originally the function is applied on the empirical study of the American manufacturing industry from 1899 to 1922.
- Cobb – Douglas production function takes the following mathematical form.

$$Y = (AK^X L^{1-X})$$

Where Y=output

K=Capital

L=Labour

A= positive constant

'X' and '1-X' indicates elasticity's of production

- That is 'X' and '1-X' is measure the percentage of response of output to percentage change in labour and capital respectively.

- The function estimated for the USA by Cobb and Douglass is

$$\mathbf{Y = (1.01K^{0.75}\ L^{0.25})}$$

- The production function shows that one percent change in labour input, capital remaining constant is associated with 0.75 percentage change in output.
- Similarly one percentage change in capital, labour remaining constant is associated with a 0.25 percent change in output.

Assumptions:

1. The function assumes that output is the function of two factors viz. capital and labour.
2. It is a linear homogenous production function of the first degree
3. The function assumes that the logarithm of the total output of the economy is a linear function of the logarithms of the labour force and capital stock.
4. There are constant returns to scale
5. All inputs are homogenous
6. There is perfect competition
7. There is no change in technology.

ISOQUANTS

- The term Isoquants is derived from the words 'ISO' and 'quant' – 'ISO' means equal and 'quant' implies quantity. Isoquant therefore, means equal quantity.
- A family of ISO-product curves or isoquants or production difference curves can represent a production function with two variable inputs, which are substitutable for one another within limits.
- ISO quants are the curves, which represent the different combinations of inputs producing a particular quantity of output. Any combination on the isoquant represents the same level of output.

For a given output level firm's production become,

Q= f (L, K)

Where 'Q' is the units of output is a function of the quantity of two inputs 'L' and 'K'.

Assumptions:

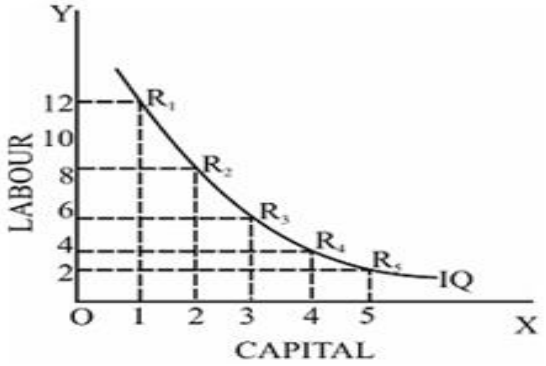
- There are only two factors of production, viz. labour and capital.
- The two factors can substitute each other up to certain limit
- The shape of the isoquant depends upon the extent of substitutability of the two inputs.
- The technology is given over a period.

An isoquant may be explained with the help of an arithmetical example.

Combinations	Labour (units)	Capital (units)	Output (quintals
A	1	10	50
B	2	7	50
C	3	4	50
D	4	4	50
E	5	1	50

Combination ‘A’ represent 1 unit of labour and 10 units of capital and produces ‘50’ quintals of a product all other combinations in the table are assumed to yield the same given output of a product say ‘50’ quintals by employing any one of the alternative combinations of the two factors labour and capital.

If we plot all these combinations on a paper and join them, we will get continues and smooth curve called ISO-product curve as shown below.

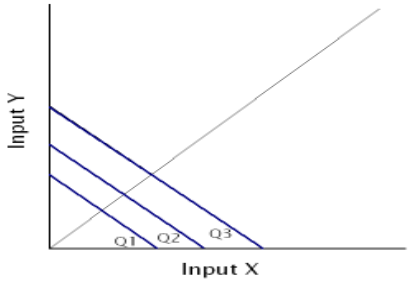


From the table diagram, it can be observed that the producer sacrifices less quantity of labour for additional unit of capital.

Types of Iso quants:

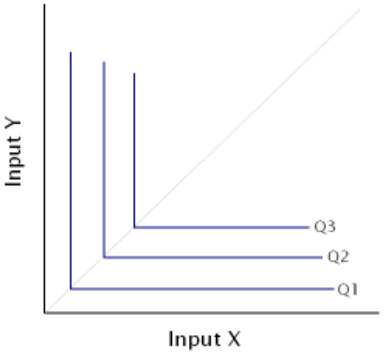
Linear Isoquant:

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



Input-Output Isoquant:

This assumes strict complementarity [that is, zero substitutability] of the factors of production. The isoquant take the shape of a right angle. This type of isoquant is also called 'Leontief isoquant' after Leontief, who invented the input-output analysis.



Kinked Isoquant:

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

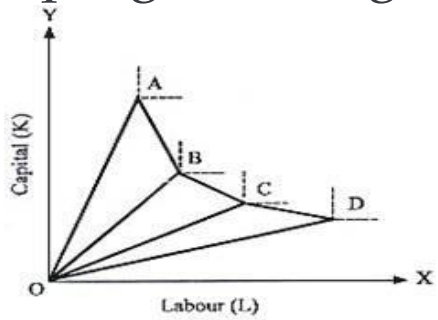
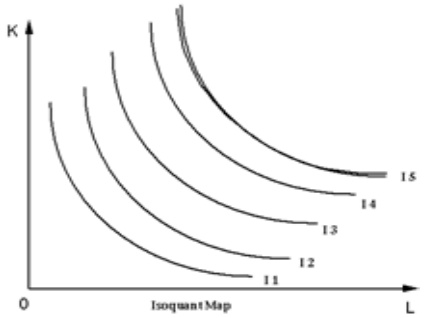


Fig. 7.7: Kinked Isoquant

Smooth Convex Isoquant:

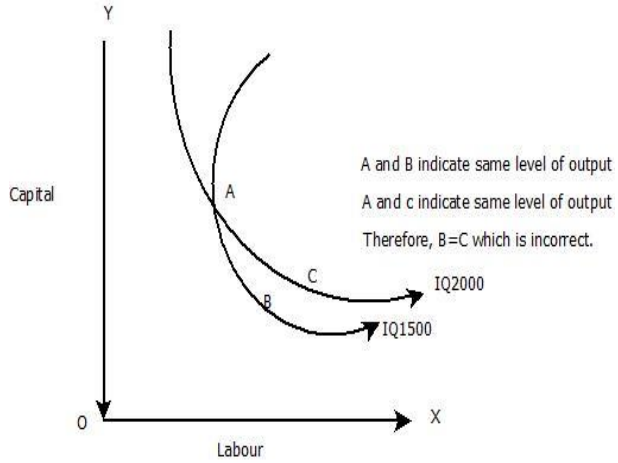
This form assumes continuous substitutability of K and L only over a certain range, beyond which factors cannot substitute each other. The isoquant appears as a smooth curve convex to the origin.



PROPERTIES OF ISO-QUANTITIES

Two isoquants do not intersect each other:

Two isoquants do not intersect each other because if producer wants to operate at a higher level of output, he has to switch over to another isoquant with a higher level of output and vice versa.

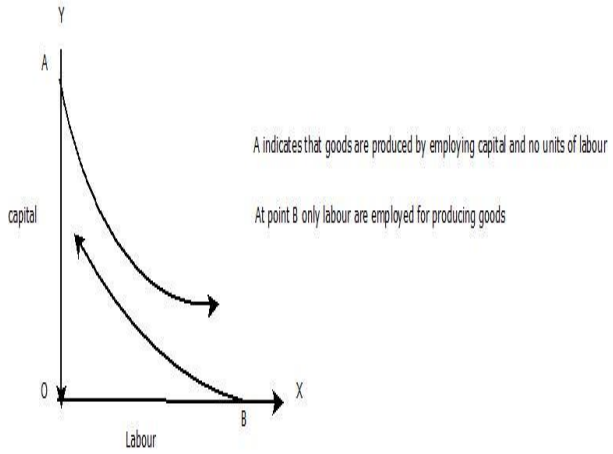


No isoquant can touch either axis:

If an isoquant touches the X-axis it would mean that the commodity can be produced with OB units of labour and without any unit of capital.

Point A on the Y-axis implies that the commodity can be produced with OA units of capital and without any unit of labour.

However, this is wrong because the firm cannot produce a commodity with one factor alone.



A higher IQ implies a higher level of output: i.e., with the same quantity of one input and larger quantity of other input, the larger output will be produced.

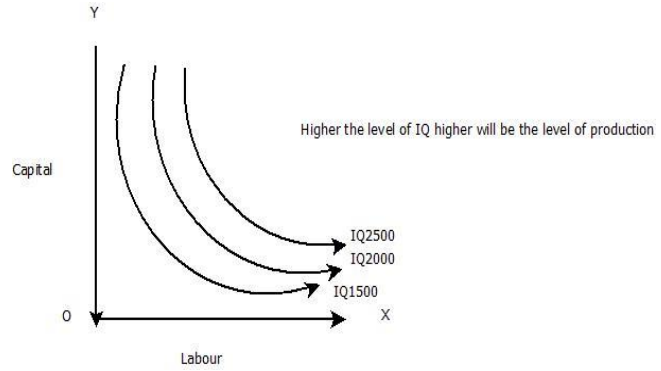
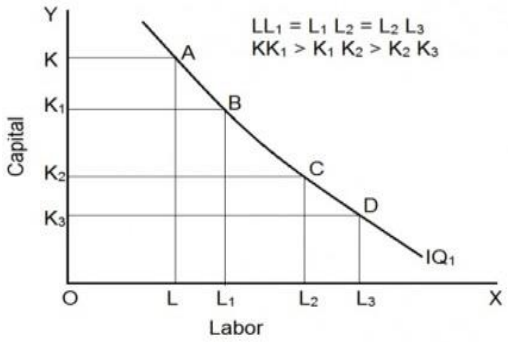


Figure 5



Isoquants are convex to the origin: An isoquant must always be convex to the origin. This is because of the operation of the principle of diminishing marginal rate of technical substitution.

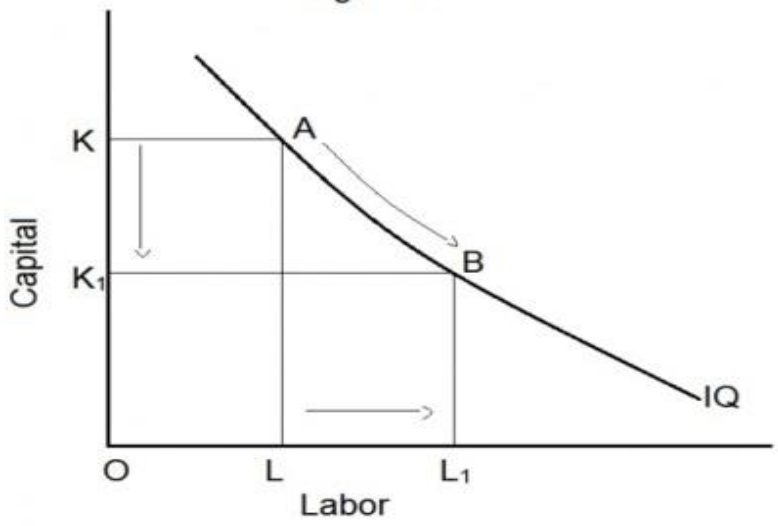
MRTS is the rate at which marginal unit of an input can be substituted for another input making the level of output remain the same.

Isoquants are negatively sloped:

An isoquant slopes downwards from left to right. The logic behind this is the principle of diminishing marginal rate of technical substitution.

In order to maintain a given output, a reduction in the use of one input must be offset by an increase in the use of another input.

Figure 8

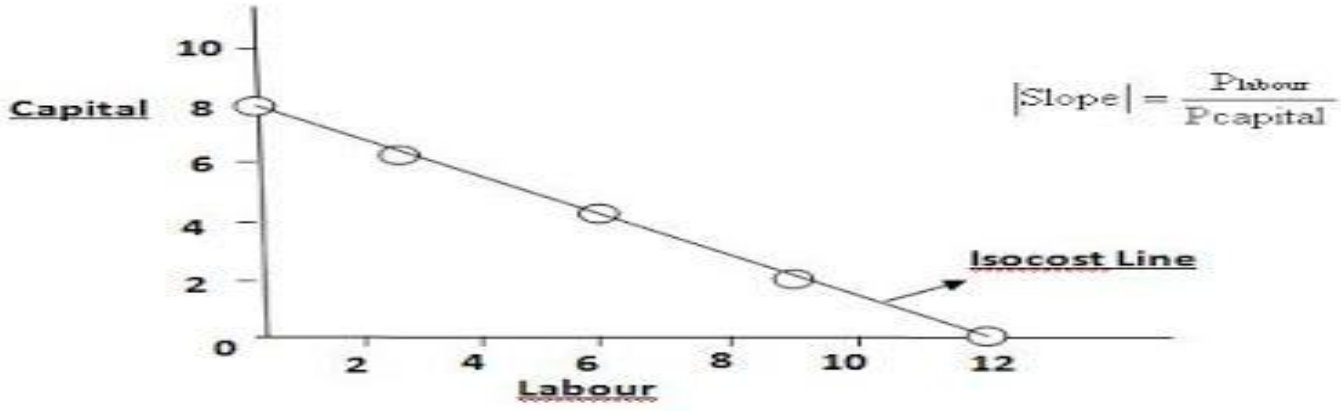


The Isocost Line:

- The isocost line is an important component when analysing producer's behaviour.
- The isocost line illustrates all the possible combinations of two factors that can be used at given costs and for a given producer's budget.
- In simple words, an isocost line represents a combination of inputs which all cost the same amount.

- Now suppose that a producer has a total budget of Rs 120 and and for producing a certain level of output, he has to spend this amount on 2 factors A and B. Price of factors A and B are Rs 15 and Rs. 10 respectively.

Combinations	Units of Capital	Units of Labour	Total expenditure
	Price = 15 Rs	Price = 10 Rs	(in Rupees)
A	8	0	120
B	6	3	120
C	4	6	120
D	2	9	120
E	0	12	120



The isocost line shows all the possible combinations of two factors Labour and capital.

LAW OF PRODUCTION:

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Law of Production

Production analysis in economics theory considers two types of input and output relationships.

1. When quantities of certain inputs, are fixed and others are variable and
2. When all inputs are variable

These two types of relationships have been explained in the form of laws.

i. Law of variable proportions

ii. Law of returns to scale

Law of variable proportions

- The law of variable proportions states that as the quantity of one factor is increased, keeping the other factors fixed, the marginal product of that factor will eventually decline.
- This means that up to the use of a certain amount of variable factor, marginal product of the factor may increase and after a certain stage it starts diminishing.
- When the variable factor becomes relatively abundant, the marginal product may become negative.

LAW OF VARIABLE PROPORTIONS

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Assumptions:

The law of variable proportions holds well under the following conditions:

- ***Constant State of Technology:*** First, the state of technology is assumed to be given and unchanged. If there is improvement in the technology, then the marginal product may rise instead of diminishing.
- ***Fixed Amount of Other Factors:*** Secondly, there must be some inputs whose quantity is kept fixed. It is only in this way that we can alter the factor proportions and know its effects on output. The law does not apply if all factors are proportionately varied.
- ***Possibility of Varying the Factor proportions:*** Thirdly, the law is based upon the possibility of varying the proportions in which the various factors can be combined to produce a product. The law does not apply if the factors must be used in fixed proportions to yield a product.

LAW OF VARIABLE PROPORTIONS

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Illustration of the Law: The law of variable proportion is illustrated in the following table and figure. Suppose there is a given amount of land in which more and more labour (variable factor) is used to produce wheat.

Units of Labour	Total Product	Marginal Product	Average Product
1	2	2	2
2	6	4	3
3	12	6	4
4	16	4	4
5	18	2	3.6
6	18	0	3
7	14	-4	2
8	8	-6	1

LAW OF VARIABLE PROPORTIONS

- It can be seen from the table that up to the use of 3 units of labour, total product increases at an increasing rate and beyond the third unit total product increases at a diminishing rate.
- This fact is shown by the marginal product which the addition is made to Total Product as a result of increasing the variable factor i.e. labour.
- It can be seen from the table that the marginal product of labour initially rises and beyond the use of three units of labour, it starts diminishing.
- The use of six units of labour does not add anything to the total production of wheat.
- Hence, the marginal product of labour has fallen to zero.
- Beyond the use of six units of labour, total product diminishes and therefore marginal product of labour becomes negative.
- Regarding the average product of labour, it rises up to the use of third unit of labour and beyond that it is falling throughout.

LAW OF VARIABLE PROPORTIONS

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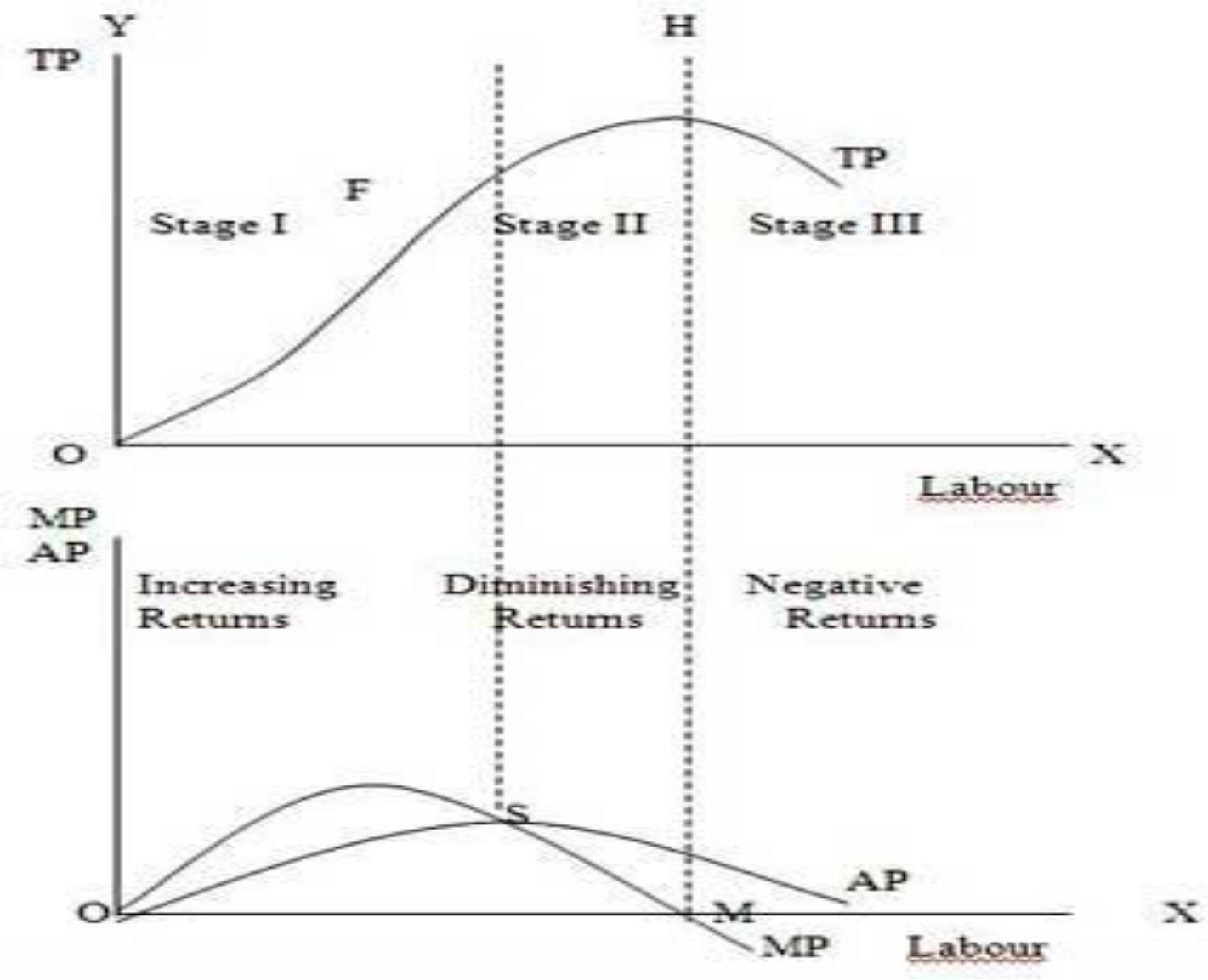
Three Stages of the Law of Variable Proportions:

These stages are illustrated in the following figure where labour is measured on the X-axis and output on the Y-axis.

Stage 1. Stage of Increasing Returns:

- In this stage, total product increases at an increasing rate up to a point.
- This is because the efficiency of the fixed factors increases as additional units of the variable factors are added to it.
- In the figure, from the origin to the point F, slope of the total product curve TP is increasing i.e. the curve TP is concave upwards up to the point F, which means that the marginal product MP of labour rises.
- The point F where the total product stops increasing at an increasing rate and starts increasing at a diminishing rate is called the point of inflection.
- Corresponding vertically to this point of inflection marginal product of labour is maximum, after which it diminishes.
- This stage is called the stage of increasing returns because the average product of the variable factor increases throughout this stage.
- This stage ends at the point where the average product curve reaches its highest point.

LAW OF VARIABLE PROPORTIONS



LAW OF VARIABLE PROPORTIONS

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Stage 2. Stage of Diminishing Returns:

- In this stage, total product continues to increase but at a diminishing rate until it reaches its maximum point H where the second stage ends.
- In this stage both the marginal product and average product of labour are diminishing but are positive.
- This is because the fixed factor becomes inadequate relative to the quantity of the variable factor.
- At the end of the second stage, i.e., at point M marginal product of labour is zero which corresponds to the maximum point H of the total product curve TP.
- This stage is important because the firm will seek to produce in this range.

Stage 3. Stage of Negative Returns:

- In stage 3, total product declines and therefore the TP curve slopes downward.
- As a result, marginal product of labour is negative and the MP curve falls below the X-axis.
- In this stage the variable factor (labour) is too much relative to the fixed factor.

LAW OF RETURN TO SCALE

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- The law of returns to scale describes the relationship between outputs and scale of inputs in the long-run when all the inputs are increased in the same proportion.
- In the words of Prof. Roger Miller, "Returns to scale refer to the relationship between changes in output and proportionate changes in all factors of production.
- To meet a long-run change in demand, the firm increases its scale of production by using more space, more machines and labourers in the factory.

Assumptions:

(1) All factors (inputs) are variable but enterprise is fixed.

(2) A worker works with given tools and implements.

(3) Technological changes are absent.

(4) There is perfect competition.

(5) The product is measured in quantities.

LAW OF RETURN TO SCALE

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When all inputs are changed in the same proportion (or scale of production is changed),the total product may respond in three possible ways:

1) Increasing returns to scale
2) Constant returns to scale, and
3) Diminishing returns to scale

Table 2 : Returns to Scale in Physical Units

Unit	*Scale of Production*	*Total Returns*	*Marginal Returns*	
1.	1 Workers + 2 Acres Land	8	8	Increasing Returns
2.	2 Workers + 4 Acres Land	17	9	
3.	3 Workers + 6 Acres Land	27	10	
4.	4 Workers + 8 Acres Land	38	11	Constant Returns
5.	5 Workers + 10 Acres Land	49	11	
6.	6 Workers + 12 Acres Land	59	10	Diminishing Returns
7.	7 Workers + 14 Acres Land	68	9	
8.	8 Workers + 16 Acres Land	76	8	

LAW OF RETURN TO SCALE

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Increasing return to scale:

- The law of increasing returns to scale operates when the percentage increase in the total product is more than the percentage increase in all the factor inputs employed in the same proportion.
- The table reveals that in the beginning with the scale of production of (1 worker + 2 acres of land), total output is 8.
- To increase output when the scale of production is doubled (2 workers + 4 acres of land), total returns are more than doubled. They become 17.
- Now if the scale is trebled (3 workers + 6 acres of land), returns become more than three-fold, i.e., 27. It shows increasing returns to scale.
- In the figure RS is the returns to scale curve where R to C portion indicates increasing returns.
- Many economies set in and increase in return is more than increase in factors.

LAW OF RETURN TO SCALE

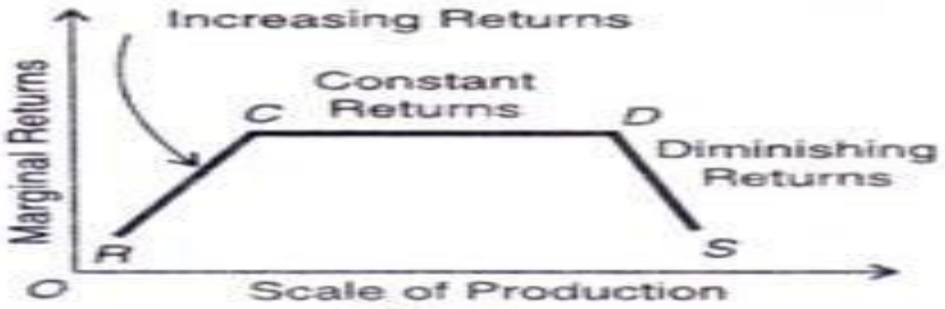

Fig. 5

Constant return to scale:

- Law of constant returns to scale operates when a given percentage increase in the factor inputs in the same proportion causes equal percentage increase in total output.
- If the scale of production in increased further, total returns will increase in such a way that the marginal returns become constant.
- In the table, for the 4th and 5th units of the scale of production, marginal returns are 11, i.e., returns to scale are constant.
- In the figure, the portion from C to D of the RS curve is horizontal which depicts constant returns to scale. It means that increments of each input are constant at all levels of output.
- Economies of scale are counter balanced by diseconomies of scale.

LAW OF RETURN TO SCALE

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Diminishing return to scale:

- The law of diminishing returns to scale occurs when a given percentage increase in all factor inputs in equal proportion causes less than percentage increase in output.
- The table shows that when output is increased from the 6th, 7th and 8th units, the total returns increase at a lower rate than before so that the marginal returns start diminishing successively to 10, 9 and 8.
- In the figure, the portion from D to S of the RS curve shows diminishing returns.
- Output increases in a smaller proportion.
- Diseconomies outweigh economies of scale.

ECONOMIES OF SCALE:

- Production may be carried on a small scale or a large scale by a firm.
- When a firm expands its size of production by increasing all the factors, it secures certain advantages known as economies of production.
- Marshall has classified these economies of large-scale production into internal economies and external economies.
- Internal economies refers to the economies in production costs which accurate to the firm alone when it expands its output.
- The internal economies occur as a result of increase in the scale of production

ECONOMIES OF SCALE:

- External economies are those benefits, which are shared in by a number of firms or industries when the scale of production in an industry or groups of industries increases.
- Hence external economies benefit all the firms in the industry as the size of the industry expands.

Internal Economies:

A). Technical Economies.

- Technical economies arise to a firm from the use of better machines and superior techniques of production.
- As a result, production increases and per unit cost of production falls.
- A large firm, which employs costly and superior plant and equipment, enjoys a technical superiority over a small firm.
- Another technical economy lies in the mechanical advantage of using large machines.

ECONOMIES OF SCALE:

- The cost of operating large machines is less than that of operating mall machine.
- More over a larger firm is able to reduce it's per unit cost of production by linking the various processes of production.
- Technical economies may also be associated when the large firm is able to utilize all its waste materials for the development of by-products industry.
- Scope for specialization is also available in a large firm.
- This increases the productive capacity of the firm and reduces the unit cost of production.

B). Managerial Economies:

- These economies arise due to better and more elaborate management, which only the large size firms can afford.
- There may be a separate head for manufacturing, assembling, packing, marketing, general administration etc.
- Each department is under the charge of an expert.
- Hence the appointment of experts, division of administration into several departments, functional specialization and scientific co-ordination of various works make the management of the firm most efficient.

ECONOMIES OF SCALE:

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C). Marketing Economies:

- The large firm reaps marketing or commercial economies in buying its requirements and in selling its final products.
- The large firm generally has a separate marketing department.
- It can buy and sell on behalf of the firm, when the market trends are more favourable.
- In the matter of buying they could enjoy advantages like preferential treatment, transport concessions, cheap credit, prompt delivery and fine relation with dealers. Similarly it sells its products more effectively for a higher margin of profit.

D). Financial Economies:

- The large firm is able to secure the necessary finances either for block capital purposes or for working capital needs more easily and cheaply.
- It can barrow from the public, banks and other financial institutions at relatively cheaper rates. It is in this way that a large firm reaps financial economies.

ECONOMIES OF SCALE:

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E). Risk bearing Economies:

- The large firm produces many commodities and serves wider areas.
- It is, therefore, able to absorb any shock for its existence.
- For example, during business depression, the prices fall for every firm. There is also a possibility for market fluctuations in a particular product of the firm.
- Under such circumstances the risk-bearing economies or survival economies help the bigger firm to survive business crisis.

F). Economies of Research:

- A large firm possesses larger resources and can establish its own research laboratory and employ trained research workers.
- The firm may even invent new production techniques for increasing its output and reducing cost.

G). Economies of welfare:

- A large firm can provide better working conditions in-and out-side the factory.
- Facilities like subsidized canteens, crèches for the infants, recreation room, cheap houses, educational and medical facilities tend to increase the productive efficiency of the workers, which helps in raising production and reducing costs.

ECONOMIES OF SCALE:

External Economies:

Business firm enjoys a number of external economies, which are discussed below:

A). Economies of Concentration:

- When an industry is concentrated in a particular area, all the member firms reap some common economies like skilled labour, improved means of transport and communications, banking and financial services, supply of power and benefits from subsidiaries.
- All these facilities tend to lower the unit cost of production of all the firms in the industry.

B). Economies of Information

- The industry can set up an information centre which may publish a journal and pass on information regarding the availability of raw materials, modern machines, export potentialities and provide other information needed by the firms.
- It will benefit all firms and reduction in their costs.

ECONOMIES OF SCALE:

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C). Economies of Welfare:

- An industry is in a better position to provide welfare facilities to the workers.
- It may get land at concessional rates and procure special facilities from the local bodies for setting up housing colonies for the workers.
- It may also establish public health care units, educational institutions both general and technical so that a continuous supply of skilled labour is available to the industry.
- This will help the efficiency of the workers.

DISECONOMIES OF SCALE:

DISECONOMIES OF LARGE SCALE PRODUCTION

- Internal and external diseconomies are the limits to large-scale production.
- It is possible that expansion of a firm's output may lead to rise in costs and thus result diseconomies instead of economies.
- When a firm expands beyond proper limits, it is beyond the capacity of the manager to manage it efficiently.
- This is an example of an internal diseconomy.
- In the same manner, the expansion of an industry may result in diseconomies, which may be called external diseconomies.
- Employment of additional factors of production becomes less efficient and they are obtained at a higher cost.
- It is in this way that external diseconomies result as an industry expands.
- So The major diseconomies of large-scale production are discussed below slide:

DISECONOMIES OF SCALE:

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Internal Diseconomies:

A). Financial Diseconomies:

- For expanding business, the entrepreneur needs finance.
- But finance may not be easily available in the required amount at the appropriate time.
- Lack of finance retards the production plans thereby increasing costs of the firm.

B). Managerial diseconomies:

- There are difficulties of large-scale management.
- Supervision becomes a difficult job.
- Workers do not work efficiently, wastages arise, decision-making becomes difficult, coordination between workers and management disappears and production costs increase.

C). Marketing Diseconomies:

- As business is expanded, prices of the factors of production will rise.
- The cost will therefore rise. Raw materials may not be available in sufficient quantities due to their scarcities.
- Additional output may depress the price in the market.
- The demand for the products may fall as a result of changes in tastes and preferences of the people. Hence cost will exceed the revenue.

DISECONOMIES OF SCALE:

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D). Technical Diseconomies:

- There is a limit to the division of labour and splitting down of production processes.
- The firm may fail to operate its plant to its maximum capacity. As a result cost per unit increases. Internal diseconomies follow.

E). Diseconomies of Risk-taking:

- As the scale of production of a firm expands risks also increase with it.
- Wrong decision by the management may adversely affect production.
- In large firms are affected by any disaster, natural or human, the economy will be put to strains.

External Diseconomies:

- When many firm get located at a particular place, the costs of transportation increases due to congestion.
- The firms have to face considerable delays in getting raw materials and sending finished products to the marketing centres.
- The localization of industries may lead to scarcity of raw material, shortage of various factors of production like labour and capital, shortage of power, finance and equipment's. All such external diseconomies tend to raise cost per unit.

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