

MICRO ECONOMICS

UGMBCC03

What is Production?

- **Production** is a process of combining various material inputs and immaterial inputs (plans, know-how) in order to make something for consumption (output). It is the act of creating an output, a good or service which has value and contributes to the utility of individuals.
- The process of transforming inputs into outputs can be any of the following kinds:
 - Change in the Form(Raw material transformed to finished goods)
 - Change in Place(Supply chain, Factory to Retailer)
 - With these three kinds of transformations, usability of the good or materials increases.

CLASSIFICATION OF INPUTS

- Factors of production are resources a company uses to generate a profit by producing goods and services.
- Land, labor, capital and entrepreneurship are the four categories of factors of production.
- These variables are measured per unit of time and hence referred to as flow variables.

Entrepreneurship combines these factors of production to earn a profit. For example, an [entrepreneur](#) brings together gold, labor and machinery to produce jewelry. The entrepreneur takes on all the risks and rewards that come with producing a good or service.

- An input is a good or service that goes into the production process. As economists refer to it, an input is simply anything which a firm buys for use in its production process.
- An output, on the other hand, is any good or service that comes out of a production process.
- Inputs are considered variable or fixed depending on how readily their usage can be changed

- Fixed input
 - An input for which the level of usage cannot readily be changed
 - In economic sense, a fixed input is one whose supply is inelastic in the short run.
 - In technical sense, a fixed input is one that remains fixed (or constant) for certain level of output.

Variable input

- A variable input is one whose supply in the short run is elastic, example, labour, raw materials, and the like. Users of such inputs can employ a larger quantity in the short run.
- Technically, a variable input is one that changes with changes in output. In the long run, all inputs are variable.

- Short run
 - At least one input is fixed
 - All changes in output achieved by changing usage of variable inputs

Long run

- All inputs are variable
- Output changed by varying usage of all inputs

PRODUCTION FUNCTION

- In simple words, production function refers to the functional relationship between the quantity of a good produced (output) and factors of production (inputs).
- “The production function is purely a technical relation which connects factor inputs and output.” Prof. Koutsoyiannis
- Defined production function as “the relation between a firm’s physical production (output) and the material factors of production (inputs).” Prof. Watson

- A tool of analysis used in explaining the input-output relationship.
 - It describes the technical relationship between inputs and output in physical terms.
 - In its general form, it holds that production of a given commodity depends on certain specific inputs.
 - In its specific form, it presents the quantitative relationships between inputs and outputs.
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- A production function may take the form of a schedule, a graph line or a curve, an algebraic equation or a mathematical model.
 - The production function represents the technology of a firm.

PRODUCTION FUNCTION

- • **Production function**
 - Maximum amount of output that can be produced from any specified set of inputs, given existing technology
- **Technical efficiency**
 - Achieved when maximum amount of output is produced with a given combination of inputs
- **Economic efficiency**
 - Achieved when firm is producing a given output at the lowest possible total cost

PRODUCTION FUNCTION

- • Process 1 Process 2 Process 3

15	20	10
20	20	20

A process of production is technically efficient if it uses less of one factor and no more from the other factor, compare to any other process of production.

PRODUCTION FUNCTION

- Production Function Prof. Koutsoyiannis: “The production function is purely its inputs and output technical relation which connects factor” Prof. Watson “The relation between a firm’s production and material factors of production”
- An empirical production function is generally so complex to include a wide range of inputs: land, labour, capital, raw materials, time, and technology.
 - These variables consists and forms of the independent variables in a firm’s actual production function.
 - A firm’s long-run production function is of the form:
 - $Q = f(L_d, L, K, M, T, t)$
 - where L_d = land and building; L = labour; K = capital; M = materials; T = technology; and, t = time.

PRODUCTION FUNCTION

- For sake of convenience, economists have reduced the number of variables used in a
 - production function to only two: capital (K) and labour (L). Therefore, in the analysis of
 - input-output relations, the production function is expressed as:
 - $Q = f(K, L)$
 - Increasing production, Q, will require K and L, and whether the firm can increase both K and L or only L will depend on the time period it takes into account for increasing production, that is, whether the firm is thinking in terms of the *short run or in terms of the long run*.
 - Economists believe that the supply of capital (K) is *inelastic in the short run and elastic* in the long run.
 - Thus, in the short run firms can increase production only by increasing labour, since the supply of capital is fixed in the short run. In the long run, the firm can employ more of both capital and labour, as the supply of capital becomes elastic over time.

Short Run Production

- • In the short run, capital is fixed
 - Only changes in the variable labor input can change the level of output
- $Q = f(L, K)$ • Short run production function
- Total Product: It gives maximum of output that can be produced at different levels of one input, assuming that the other input is fixed at a particular level.
- Marginal Product: Change in the output resulting from a very small change in one factor input, keeping the other factor inputs constant.
- Average Product: Total production for per unit of output.

Short Run Production

- **Average & Marginal Products**
 - Average product of labor
 - $AP = Q/L$
 - Marginal product of labor
 - $MP = Q/L$
 - Average product of Capital
 - $AP = Q/K$
 - Marginal product of Capital
 - $MP = Q/K$

Law of Diminishing Returns or the Law of Variable Proportion

- “As the proportion of the factor in a combination of factors is increased after a point, first the marginal and then the average product of that factor will diminish.” Benham
- “An increase in some inputs relative to other fixed inputs will in a given state of technology cause output to increase, but after a point the extra output resulting from the same additions of extra inputs will become less and less.” Samuelson

- **Assumptions:**
- **Law of variable proportions is based on following assumptions:**
- **(i) Constant Technology:**

The state of technology is assumed to be given and constant. If there is an improvement in technology the production function will move upward.
- **(ii) Factor Proportions are Variable:**

The law assumes that factor proportions are variable. If factors of production are to be combined in a fixed proportion, the law has no validity.
- **(iii) Homogeneous Factor Units:** The units of variable factor are homogeneous. Each unit is identical in quality and amount with every other unit.
- **(iv) Short-Run:** The law operates in the short-run when it is not possible to vary all factor inputs.

- **Explanation of the Law:**

- In order to understand the law of variable proportions we take the example of agriculture. Suppose land and labour are the only two factors of production.

- **By keeping land as a fixed factor, the production of variable factor i.e., labour can be shown with the help of the following table:**

From the table 1 it is clear that there are three stages of the law of variable proportion. In the first stage average production increases as there are more and more doses of labour and capital employed with fixed factors (land). We see that total product, average product, and marginal product increases but average product and marginal product increases up to 40 units. Later on, both start decreasing because proportion of workers to land was sufficient and land is not properly used. This is the end of the first stage.

The second stage starts from where the first stage ends or where $AP=MP$. In this stage, average product and marginal product start falling. We should note that marginal product falls at a faster rate than the average product. Here, total product increases at a diminishing rate. It is also maximum at 70 units of labour where marginal product becomes zero while average product is never zero or negative.

The third stage begins where second stage ends. This starts from 8th unit. Here, marginal product is negative and total product falls but average product is still positive. At this stage, any additional dose leads to positive nuisance because additional dose leads to negative marginal product.

Table 1.

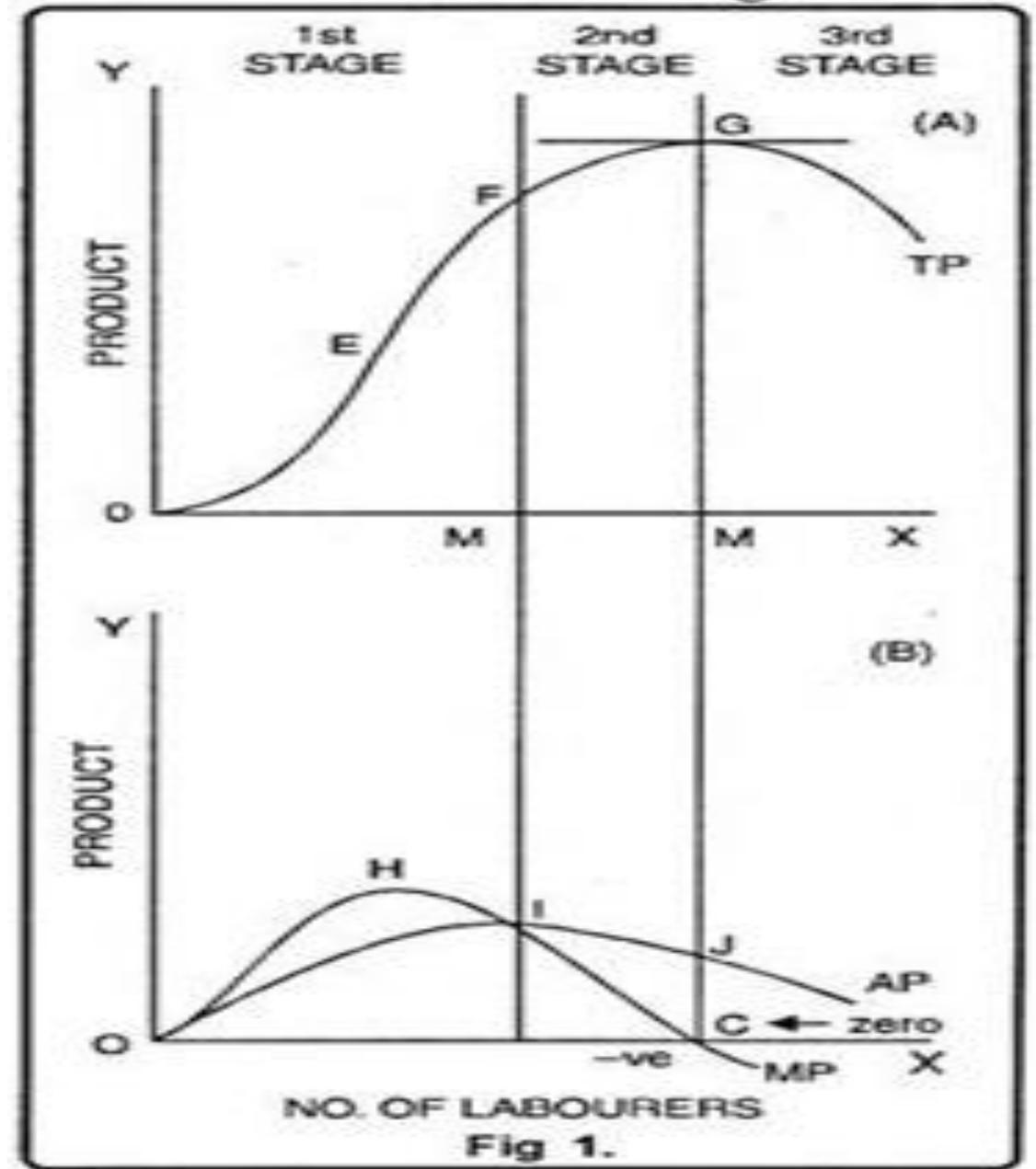
Units of Land	Units of Labour	Total Production	Average Production	Marginal Production
10 Acres	0	-	-	-
"	1	20	20	20
"	2	50	25	30
"	3	90	30	40
"	4	120	30	30
"	5	140	28	20
"	6	150	25	10
"	7	150	21.3	0
"	8	140	17.5	-10

1st stage }
 MP > AP }
 AP = MP }
 2nd stage }
 MP = 0 and TP Maximum }
 3rd stage MP < 0 }

Graphic Presentation:

In fig. 1, on OX axis, we have measured number of labourers while quantity of product is shown on OY axis. TP is total product curve. Up to point 'E', total product is increasing at increasing rate. Between points E and G it is increasing at the decreasing rate. Here marginal product has started falling. At point 'G' i.e., when 7 units of labourers are employed, total product is maximum while, marginal product is zero. Thereafter, it begins to diminish corresponding to negative marginal product. In the lower part of the figure MP is marginal product curve.

Up to point 'H' marginal product increases. At point 'H', i.e., when 3 units of labourers are employed, it is maximum. After that, marginal product begins to decrease. Before point 'I' marginal product becomes zero at point C and it turns negative. AP curve represents average product. Before point 'I', average product is less than marginal product. At point 'I' average product is maximum. Up to point T, average product increases but after that it starts to diminish.



Three Stages of the Law:

- **1. First Stage:**
 - First stage starts from point 'O' and ends up to point F. At point F average product is maximum and is equal to marginal product. In this stage, total product increases initially at increasing rate up to point E. between 'E' and 'F' it increases at diminishing rate. Similarly marginal product also increases initially and reaches its maximum at point 'H'. Later on, it begins to diminish and becomes equal to average product at point T. In this stage, marginal product exceeds average product ($MP > AP$).
- **2. Second Stage:**
 - It begins from the point F. In this stage, total product increases at diminishing rate and is at its maximum at point 'G' correspondingly marginal product diminishes rapidly and becomes 'zero' at point 'C'. Average product is maximum at point 'I' and thereafter it begins to decrease. In this stage, marginal product is less than average product ($MP < AP$).
- **3. Third Stage:**
 - This stage begins beyond point 'G'. Here total product starts diminishing. Average product also declines. Marginal product turns negative. Law of diminishing returns firmly manifests itself. In this stage, no firm will produce anything. This happens because marginal product of the labour becomes negative. The employer will suffer losses by employing more units of labourers. However, of the three stages, a firm will like to produce up to any given point in the second stage only.

Total Product	Marginal Product	Average Product
<p>Stage I First increases at increasing rate then at diminishing rate.</p>	<p>Increases in the beginning then reaches a maximum and begins to decrease.</p>	<p>First increases, continues to increase and becomes maximum.</p>
<p>Stage II Continues to increase at diminishing rate and becomes maximum.</p>	<p>Continues to diminish and becomes equal to zero.</p>	<p>Becomes equal to MP and then begins to diminish.</p>
<p>Stage III Diminishes</p>	<p>Becomes negative.</p>	<p>Continues to diminish but will always be greater than zero.</p>

In Which Stage Rational Decision is Possible:

- To make the things simple, let us suppose that, a is variable factor and b is the fixed factor. And a_1, a_2, a_3, \dots are units of a and b_1, b_2, b_3, \dots are unit of b.
- Stage I is characterized by increasing AP, so that the total product must also be increasing. This means that the efficiency of the variable factor of production is increasing i.e., output per unit of a is increasing. The efficiency of b, the fixed factor, is also increasing, since the total product with b_1 is increasing.
- The stage II is characterized by decreasing AP and a decreasing MP, but with MP not negative. Thus, the efficiency of the variable factor is falling, while the efficiency of b, the fixed factor, is increasing, since the TP with b_1 continues to increase.
- Finally, stage III is characterized by falling AP and MP, and further by negative MP. Thus, the efficiency of both the fixed and variable factor is decreasing.

Rational Decision:

- Stage II becomes the relevant and important stage of production. Production will not take place in either of the other two stages. It means production will not take place in stage III and stage I. Thus, a rational producer will operate in stage II.
- Suppose b were a free resource; i.e., it commanded no price. An entrepreneur would want to achieve the greatest efficiency possible from the factor for which he is paying, i.e., from factor a . Thus, he would want to produce where AP is maximum or at the boundary between stage I and II.
- If on the other hand, a were the free resource, then he would want to employ b to its most efficient point; this is the boundary between stage II and III.
- Obviously, if both resources commanded a price, he would produce somewhere in stage II. At what place in this stage production takes place would depend upon the relative prices of a and b .

Condition or Causes of Applicability:

- There are many causes which are responsible for the application of the law of variable proportions.
- **They are as follows:**
 - **1. Under Utilization of Fixed Factor:**In initial stage of production, fixed factors of production like land or machine, is under-utilized. More units of variable factor, like labour, are needed for its proper utilization. As a result of employment of additional units of variable factors there is proper utilization of fixed factor. In short, increasing returns to a factor begins to manifest itself in the first stage.
 - **2. Fixed Factors of Production.** The foremost cause of the operation of this law is that some of the factors of production are fixed during the short period. When the fixed factor is used with variable factor, then its ratio compared to variable factor falls. Production is the result of the co-operation of all factors. When an additional unit of a variable factor has to produce with the help of relatively fixed factor, then the marginal return of variable factor begins to decline.

- **3. Optimum Production:**After making the optimum use of a fixed factor, then the marginal return of such variable factor begins to diminish. The simple reason is that after the optimum use, the ratio of fixed and variable factors become defective. Let us suppose a machine is a fixed factor of production. It is put to optimum use when 4 labourers are employed on it. If 5 labourers are put on it, then total production increases very little and the marginal product diminishes.
- **4. Imperfect Substitutes:**Mrs. Joan Robinson has put the argument that imperfect substitution of factors is mainly responsible for the operation of the law of diminishing returns. One factor cannot be used in place of the other factor. After optimum use of fixed factors, variable factors are increased and the amount of fixed factor could be increased by its substitutes.

Such a substitution would increase the production in the same proportion as earlier. But in real practice factors are imperfect substitutes. However, after the optimum use of a fixed factor, it cannot be substituted by another factor.

Applicability of the Law of Variable Proportions:

- The law of variable proportions is universal as it applies to all fields of production. This law applies to any field of production where some factors are fixed and others are variable. That is why it is called the law of universal application.

The main cause of application of this law is the fixity of any one factor. Land, mines, fisheries, and house building etc. are not the only examples of fixed factors. Machines, raw materials may also become fixed in the short period. Therefore, this law holds good in all activities of production etc. agriculture, mining, manufacturing industries.

- **1. Application to Agriculture:**With a view of raising agricultural production, labour and capital can be increased to any extent but not the land, being fixed factor. Thus when more and more units of variable factors like labour and capital are applied to a fixed factor then their marginal product starts to diminish and this law becomes operative.
- **2. Application to Industries:**In order to increase production of manufactured goods, factors of production has to be increased. It can be increased as desired for a long period, being variable factors. Thus, law of increasing returns operates in industries for a long period. But, this situation arises when additional units of labour, capital and enterprise are of inferior quality or are available at higher cost.

As a result, after a point, marginal product increases less proportionately than increase in the units of labour and capital. In this way, the law is equally valid in industries.

Postponement of the Law:

- **The postponement of the law of variable proportions is possible under following conditions:**
- **(i) Improvement in Technique of Production:** The operation of the law can be postponed in case variable factors techniques of production are improved.
- **(ii) Perfect Substitute:** The law of variable proportion can also be postponed in case factors of production are made perfect substitutes i.e., when one factor can be substituted for the other.