MANAGERIAL ECONOMICS

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Lecture No -   17 : Theory of Production

Session Outline

Defining Input, Output, Production
Production function
Short Run Production Function
Law of Diminishing Return

What is Production?

Production is basically an activity of transformation , which connects factor inputs and outputs

What is Production?

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)

What is Production?

• With these three kinds of transformations, usability of the good or materials increases.

• Production is an activity that increases consumer usability of goods and services.

Basic Concepts of Production Theory: Classifications of Inputs

(i) labour (ii) capital

(iii) land (iv) raw materials

(v) time.

These variables are measured per unit of time and hence referred to as flow variables.

Entrepreneurship has been added as part of the production inputs, though this can be measured by the managerial expertise and the ability to make things happen.

Basic Concepts of Production Theory

- 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.

Basic Concepts of Production Theory

- 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.

Basic concepts of Production Theory

- 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.

Basic Concepts of Production Theory

- 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

- 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.

Production Function

- In its specific form, it presents the quantitative relationships between inputs and outputs.

- 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.

Basic Concepts of Production Theory

- **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

       10   15   05

       15   15   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

- 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 form the independent variables in a firm's actual production function.

- A firm's long-run production function is of the form:

- Q = f(Ld, L, K, M, T, t)

- where Ld = 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)

Production Function

- 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.*

Production Function

- 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
- Short run production function $Q = f(L, \bar{K}) = f(L)$

Short Run Production

- 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.

Average & Marginal Products

- Average product of labor
    - $AP = Q/L$

- Marginal product of labor
    - $MP = \Delta Q/\Delta L$

- Average product of Capital
    - $AP = Q/K$

- Marginal product of Capital
    - $MP = \Delta Q/\Delta K$

Total, Average, & Marginal Products of Labor, K = 2

Number of workers (L)	Total product (Q)	Average product (AP=Q/L)	Marginal product (MP=ΔQ/ΔL)
0	0	--	--
1	52	52	52
2	112	56	60
3	170	56.7	58
4	220	55	50
5	258	51.6	38
6	286	47.7	28
7	304	43.4	18
8	314	39.3	10
9	318	35.3	4
10	314	31.4	-4

Law of Diminishing Returns or the Law of Variable Proportion

➢ The Shape of total product curve is determined by law of diminishing return.

➢ The law of diminishing returns, states that with a given state of technology if the quantity of one factor input is increased , by equal increment , the quantities of other factor inputs remaining fixed , the resulting increment of total product will first increase but decreases after a particular point.

**Law of Diminishing Returns or the Law of Variable Proportion**

➢ It states that as we go on employing more of one factor of production, other factor remaining same, the marginal productivity will diminish after some point.

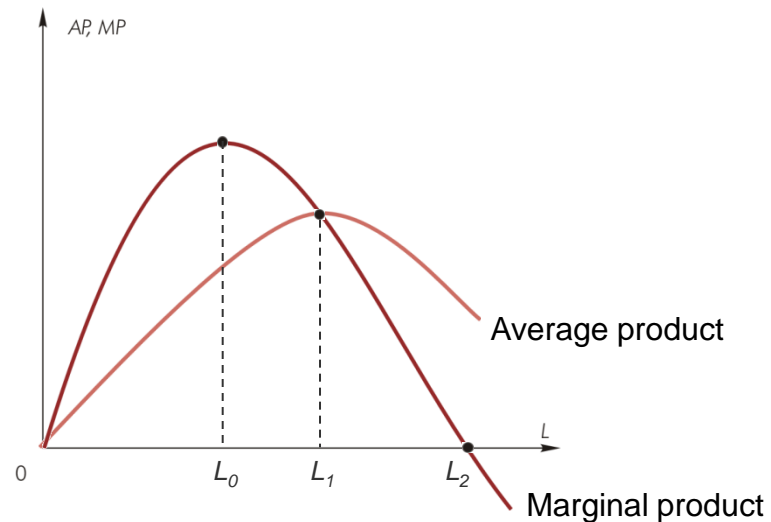➢ The shape of marginal product curve is therefore Inverted U Shaped.

Assumptions

- State of technology is given.

- One factor of production must always be kept constant at a given level.

- The law is not applicable when two inputs are used in a fixed proportion.

Total, Average & Marginal Product Curves

Panel A
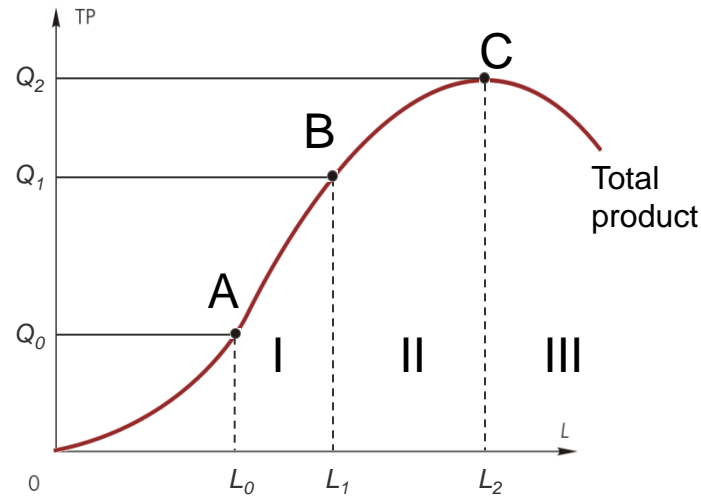
Panel B

Total, Average & Marginal Products

- At the point O, the factor input labor is equal to zero, the value of total product will also be zero. Obviously the value of MP and AP will be zero. So all the three curves , TP, AP and MP starts from the origin.

- TP curve is first convex from below and then concave.

Total, Average & Marginal Products

- As long as TP curve is convex, MP is increasing. When TP curve is Concave , MP is decreasing.

- The point A on TP curve is called as point of inflexion. MP will be maximum corresponding to this point of the TP curve.

- AP is maximum at the point B, and also AP = MP.

Total, Average & Marginal Products

- Corresponding to the maximum point of the TP curve, point C, MP is equal to Zero.

- To the left of Point C, total product is increasing and marginal product is positive. To the right of point C, TP curve is decreasing and marginal product is negative.

Total, Average & Marginal Products

- Since the MP curve is must be decreasing when the average product is maximum, the MP curve reaches maximum before the AP curve.

Marginal and Average Product

- When AP is rising, MP is greater than AP

- When AP is falling, MP is less than AP

- When AP reaches it maximum, AP = MP

The Three Stages of Production

Stage I: Stage of Increasing Returns:

- AP is increasing and the MP is greater than the AP. Up to point B on the TP curve Stage I exist.

- AP is increasing, but MP is increasing first up to point A then decreasing.

The Three Stages of Production

Stage II: Stage of Decreasing Returns

- Both AP and MP is decreasing. But MP is positive.
- The portion of TP curve between B and C represents this stage.

The Three Stages of Production

Stage III: Stage of Negative Returns

- TP is diminishing and the MP is negative.

- The portion of TP curve which lies to the right of point C represents this stage.

The Three Stages of Production

In which stage would the rational producer like to operate?

The Three Stages of Production

In Stage I, MP and AP both are rising, and the MP is more than AP.

- A given increase in variable factor leads to a more than proportionate increase in the output.

- The producer is not making the best possible use of the fixed factor. A particular portion of fixed factor remains unutilized.

The Three Stages of Production

In Stage III, MP of variable factor is negative and the TP is also decreasing.

The Three Stages of Production

In Stage II, MP and AP both are falling and MP through positive, is less than AP.

- There is less than proportionate change in output due to change in labor force .

- Hence at this stage the producer will employ the variable factor in such a manner that the utilization of fixed factor is most efficient.

The Three Stages of Production

A good example of Diminishing Returns includes the use of chemical fertilizers- a small quantity leads to a big increase in output. However, increasing its use further may lead to declining Marginal Product (MP) as the efficacy of the chemical declines.

Law of Diminishing Return -Example

Number of Workers	Unit of product produced	Marginal Product
1	10	10
2	25	15
3	45	20
4	60	15
5	70	10
6	60	-10

Law of Diminishing Return -Example

It is with three workers that the farm production is most efficient because the marginal product is at its highest.

Beyond this point, the farm begins to experience diminishing returns and, at the level of 6 workers, the farm actually begins to see decreasing returns as production levels decline, even though costs continue to increase.

Law of Diminishing Return -Example

In this example, the number of workers changed, while the land used, seeds planted, water consumed, and all other inputs remained the same.

If more than one input were to change, the production results would vary and the law of diminishing returns may not apply if all inputs could be increased.

Session References

    Managerial Economics; D N Dwivedi, 7ᵗʰ Edition

    Managerial Economics – Christopher R Thomas, S Charles Maurice and Sumit Sarkar

    Micro Economics : ICFAI University Press