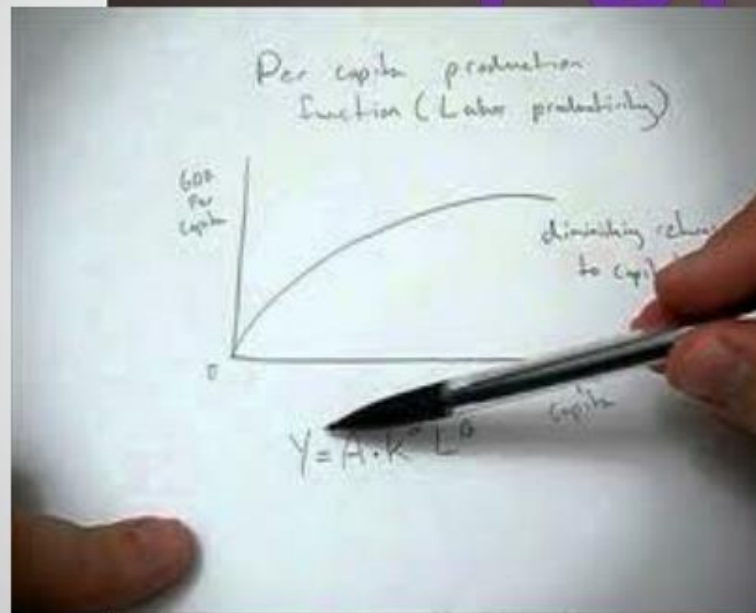


# PRODUCTION FUNCTION



# TABLE OF CONTENTS

- ⦿ Definition and example of Production Function.
- ⦿ Types of Production Function.
- ⦿ Law Of Production Function.
- ⦿ Law of Variable Proportions.
- ⦿ Production Function with one Variable Input.
- ⦿ Production Function with two Variable Inputs.
- ⦿ Assumption.
- ⦿ Summary.
- ⦿ FURTHER READINGS

# PRODUCTION FUNCTION

- Production refers to the transformation of inputs or resources into outputs of goods and services. In other words, production refers to all of the activities involved in the production of goods and services, from borrowing to set up or expand production facilities, to hiring workers, purchasing raw materials, running quality control, cost accounting, and so on, rather than referring merely to the physical transformation of inputs into outputs of goods and services.

# FOR EXAMPLE

- ⦿ A computer company hires workers to use machinery, parts, and raw materials in factories to produce personal computers.
- ⦿ The output of a firm can either be a final commodity or an intermediate product such as computer and semiconductor respectively.
- ⦿ The output can also be a service rather than a good such as education, medicine, banking etc.

# PRODUCTION FUNCTION

- ⦿ Mathematical representation of the relationship:
- ⦿  $Q = f(K, L, La)$
- ⦿ Output (Q) is dependent upon the amount of capital (K), Land(L) and Labour (La) used



# PRODUCTION FUNCTION

- ◉ There are two distinct types of production function that show possible range of substitution inputs in the production process.
- ◉ 1. Fixed proportion Production function
- ◉ 2. Variable proportions production function

# PRODUCTION FUNCTION

**Short term** : Time when one input (say, capital) remains constant and an addition to output can be obtained only by using more labour.

**Long run**: Both inputs become variable.

**Production process is subject to various phases-**

**Laws of production state the relationship between output and input.**

# LAWS OF PRODUCTION

## Short run :

Relationship between input and output are studied by varying one input , others being held constant.

**Law of Variable Proportions** brings out relationship between *varying proportions of factor inputs* and output

## Long run:

Production function is subject to different phases described under the **Law of Returns to Scale**

- Studied assuming that all factor inputs are variable.



# LAW OF VARIABLE PROPORTIONS

Law of Variable Proportions (Short run Law of Production)

Assumptions:

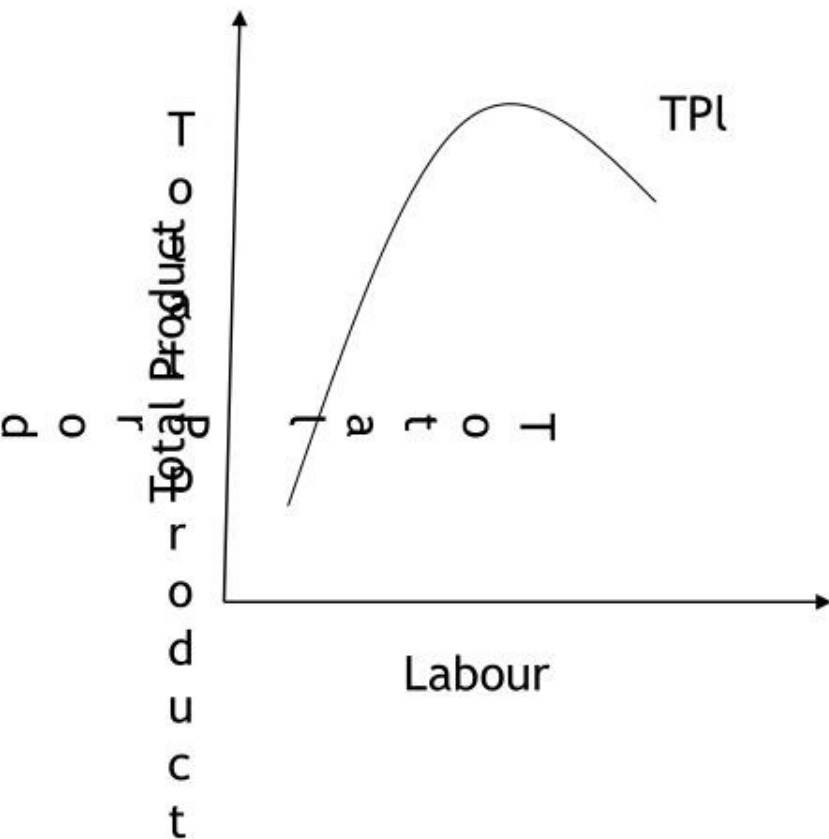
- ⦿ One factor (say, L) is variable and the other factor (say, K) is constant
- ⦿ Labour is homogeneous
- ⦿ Technology remains constant
- ⦿ Input prices are given

# LAW OF VARIABLE PROPORTIONS

No of Workers L	Total Product ( $TP_l$ )	Marginal Product ( $MP_l$ )	Average Product ( $AP_l$ )	Stages of Returns
1	24	24	24	I) <b>Increasing Returns</b>
2	72	48	36	
3	138	66	46	
4	216	78	54	
<b>5</b>	300	<b>84</b>	60	
6	384	<b>84</b>	64	
7	462	78	66	II) <b>Diminishing Returns</b>
8	528	66	66	
9	576	48	64	
<b>10</b>	<b>600</b>	<b>24</b>	60	
11	594	<b>-6</b>	54	III) <b>Negative Returns</b>
12	552	-42	46	

# LAW OF VARIABLE PROPORTIONS

## Panel A



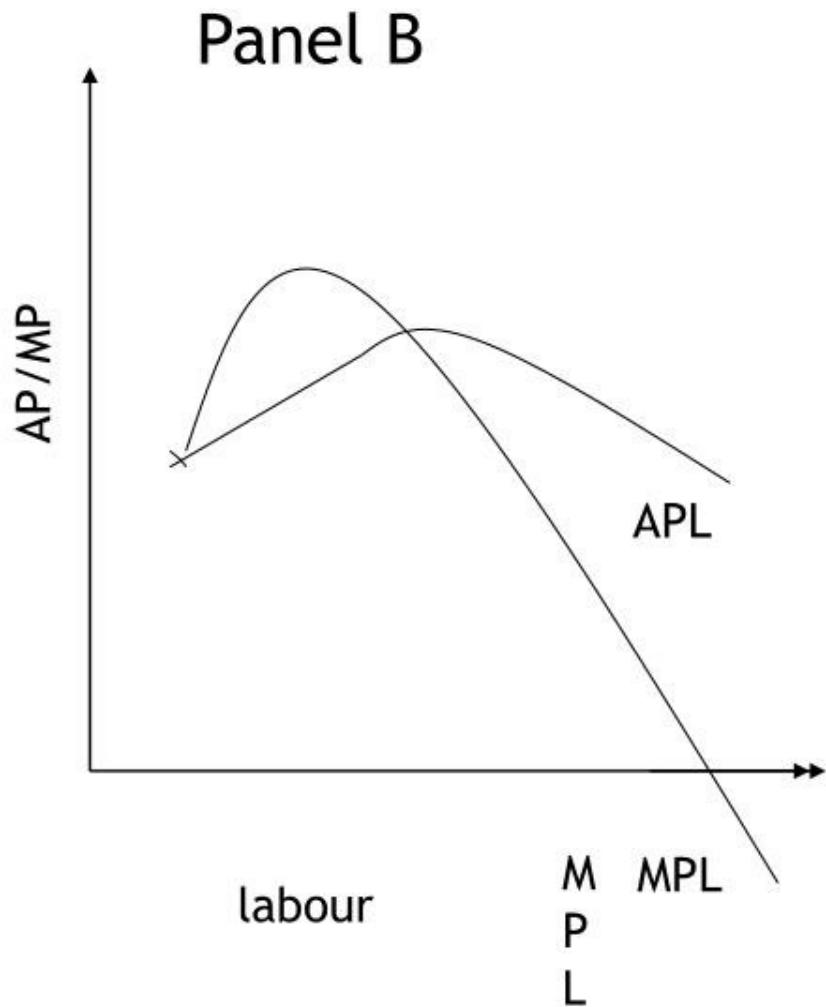
TP rises at an increasing rate till the employment of the 5<sup>th</sup> worker.

Beyond the 6<sup>th</sup> worker until 10<sup>th</sup> worker TP increases but *rate of increase* begins to fall

TP turns negative from 11<sup>th</sup> worker onwards.

This shows Law of Diminishing Marginal returns

# LAW OF VARIABLE PROPORTIONS



Panel B represents  
Marginal and average  
productivity curves of  
labour

# LAW OF VARIABLE PROPORTIONS

Increasing Returns- Stage I:

*TP<sub>l</sub> increases at an increasing rate.*

Fixed factor (K) is abundant and variable factor is inadequate. Hence *K gets utilized better with every additional unit of labour*

Stage II- TP<sub>l</sub> continues to increase but at a diminishing rate.

stage III- TP<sub>l</sub> begins to decline -*Capital becomes scarce as compared to variable factor.* Hence *over utilization of capital* and setting in of diminishing returns

**Causes of 3 stages:** *Indivisibility and inelasticity of fixed factor and imperfect substitutability between K and L*



# LAW OF VARIABLE PROPORTIONS

Significance of Law of Diminishing Marginal Returns:

- *Empirical* law, frequently observed in various production activities
- Particularly in *agriculture* where natural factors (say land), which play an important role, are limited.
- Helps manager in identifying *rational and irrational stages of operation*

# LAW OF VARIABLE PROPORTIONS

- It provides answers to questions such as:
  - a) How much to produce?
  - b) What number of workers (and other variable factors) to employ in order to maximize output

In our example, firm should employ a minimum of 7 workers and maximum of 10 workers (where TP is still rising)

# LAW OF VARIABLE PROPORTIONS

- Stage III has very high L-K ratio- as a result, additional workers not only prove unproductive but also cause a decline in TPL.
- In Stage I capital is presumably under-utilised.
- So a firm operating in Stage I has to increase L and that in Stage III has to decrease labour.

# VARIABLE PROPORTIONS PRODUCTION FUNCTION

- ◉ There are two Variable Proportions  
Production  
Function\_

**1- Production Function With One Variable  
Input.**

**2- Production With Two Variable Inputs**

# PRODUCTION FUNCTION WITH ONE VARIABLE INPUT

- When discussing production in the short run, three definitions are important:
  - Total product
  - Marginal product
  - Average product



## PRODUCTION FUNCTION WITH ONE VARIABLE INPUT

Total Product

$$TP = Q = f(L)$$

Marginal Product

$$MP_L = \frac{\Delta TP}{\Delta L}$$

Average Product

$$AP_L = \frac{TP}{L}$$

Production or  
Output Elasticity

$$E_L = \frac{MP_L}{AP_L}$$

# Total Product

- Total product (TP) is another name for output in the short run.

$$TP = Q = f(L)$$

# MARGINAL PRODUCT

- The marginal product (MP) of a variable input is the change in output (or TP) resulting from a one unit change in the input.
- MP tells us how output changes as we change the level of the input by one unit.
- Consider the two input production function  $Q=f(L,K)$  in which input L is variable and input K is fixed at some level.
- The marginal product of input L is defined as holding input K constant.

$$MP_L = \frac{\Delta TP}{\Delta L}$$

## AVERAGE PRODUCT

- The average product (AP) of an input is the total product divided by the level of the input.
- AP tells us, on average, how many units of output are produced per unit of input used.
- The average product of input L is defined as holding input K constant.

$$AP_L = \frac{TP}{L}$$

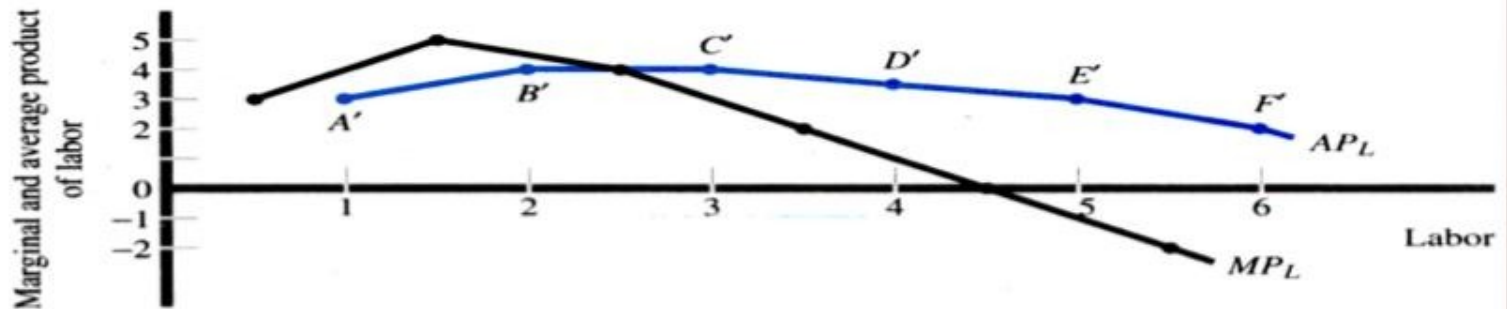
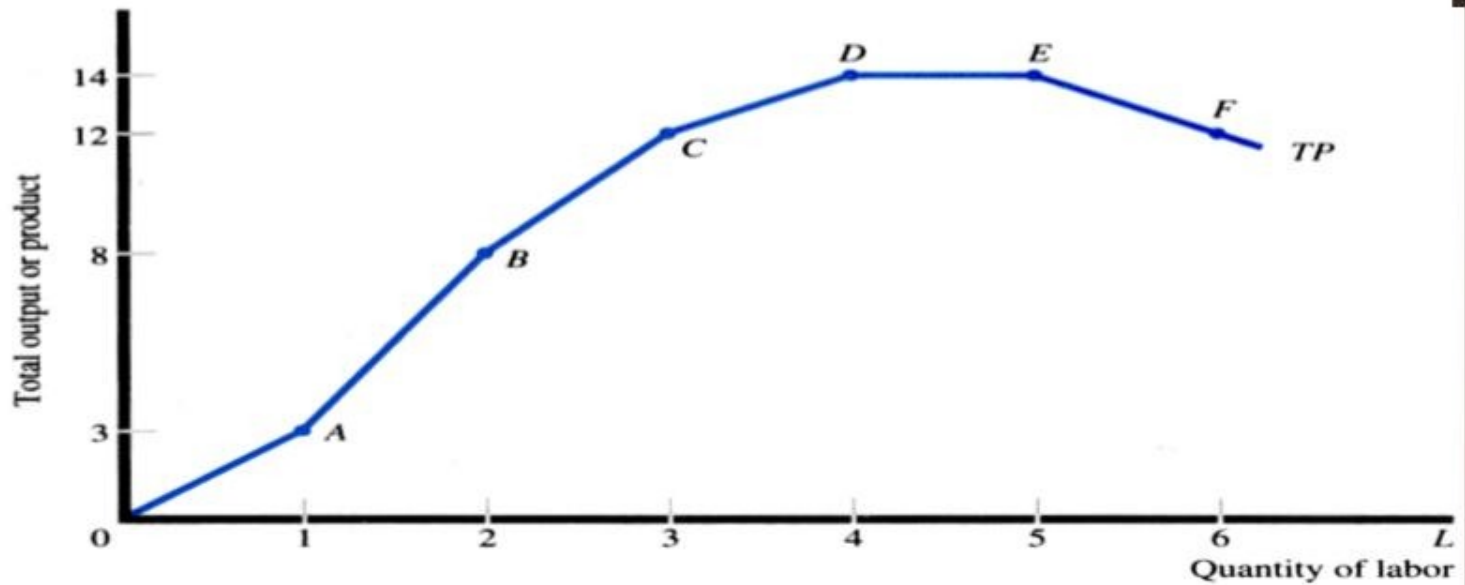
## PRODUCTION FUNCTION WITH ONE VARIABLE INPUT-EXAMPLE

Total, Marginal, and Average Product of Labor, and Output Elasticity

L	Q	$MP_L$	$AP_L$	$E_L$
0	0	-	-	-
1	3	3	3	1
2	8	5	4	1.25
3	12	4	4	1
4	14	2	3.5	0.57
5	14	0	2.8	0
6	12	-2	2	-1



# PRODUCTION FUNCTION WITH ONE VARIABLE INPUT



## PRODUCTION WITH TWO VARIABLE INPUTS

-In the long run, all inputs are variable.

Isoquants show combinations of two inputs that can produce the same level of output.

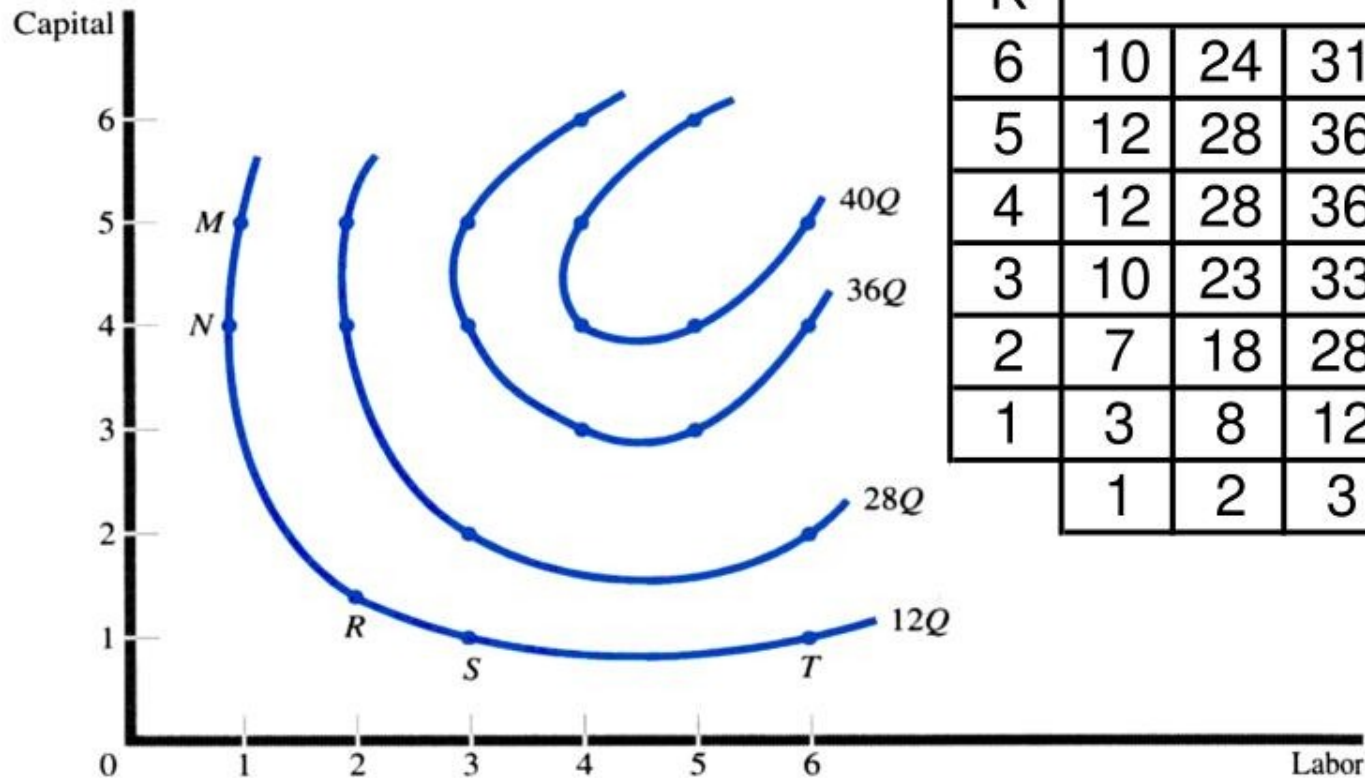
-In other words, Production isoquant shows the various combination of two inputs that the firm can use to produce a specific level of output.

-Firms will only use combinations of two inputs that are in the economic region of production, which is defined by the portion of each isoquant that is negatively sloped.

-A higher isoquant refers to a larger output, while a lower isoquant refers to a smaller output.

# PRODUCTION WITH TWO VARIABLE INPUTS

## Isoquants



K	Q						
6	10	24	31	36	40	39	
5	12	28	36	40	42	40	
4	12	28	36	40	40	36	
3	10	23	33	36	36	33	
2	7	18	28	30	30	28	
1	3	8	12	14	14	12	
	1	2	3	4	5	6	L

# *ASSUMPTIONS*

- ⦿ THE PRODUCTION FUNCTIONS ARE BASED ON CERTAIN ASSUMPTIONS.
- ⦿ 1 Perfect divisibility of both inputs and outputs
- ⦿ 2 Limited substitution of one factor for another
- ⦿ 3 Constant technology
- ⦿ 4 Inelastic supply of fixed factors in the short run

# SUMMARY

- ⦿ A production function specifies the maximum output that can be produced with
- ⦿ a given set of inputs. In order to achieve maximum profits the production
- ⦿ manager has to use optimum input-output combination for a given cost. In this
- ⦿ unit, we have shown how a production manager minimizes the cost for a given
- ⦿ output in order to maximize the profit. Also, we have shown how to maximize
- ⦿ the output at a given level of cost.

# FURTHER READINGS

- ◉ Adhikary, M (1987), Managerial Economics (Chapter V), Khosla, Publishing House, Delhi.
- ◉ Google.



*THANK YOU*

*AND HAVE A NICE DAY.....*

