# UNIT II
# Theory of Production

# Theory of Production

- Production is a process that create/adds value or utility
- It is the process in which the inputs are converted in to outputs.

| | |
|---|---|
| Inputs | • The factors of production such as Land, Labour, Capital, Technology ,etc |
| Outputs | • The goods and service produced such as Soap, Omni Car ,etc |

# Production Function

- Production function means the functional relationship between inputs and outputs in the process of production.

- It is a technical relation which connects factors inputs used in the production function and the level of outputs

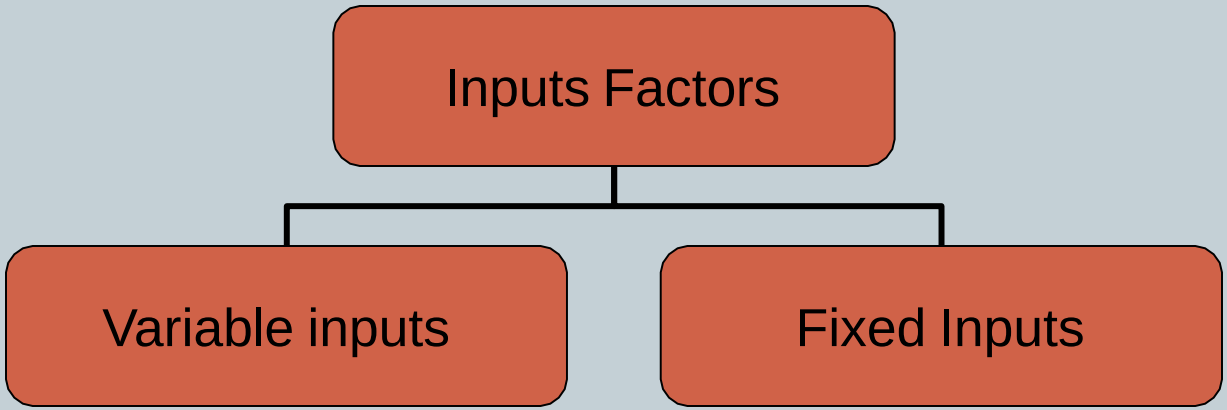
Q = f (Land, Labour, Capital, Organization, Technology, etc)

# Factors of Production

| | |
|---|---|
| Land | • Natural resources such as surface, mineral , air, rivers, sea, etc<br>• Free gift of nature, fixed |
| Labour | • Mental or physical effort done by a man with the view of |
| Capital | • Man made goods used in the production process<br>• Most mobile factor |
| Organization | • Entrepreneur or coordinator of all other factors of production |

# Inputs : Fixed inputs and Variable inputs

- The factors of production that is used to carry out the production is called inputs.
- Land, Labour, Capital, Organizer, Technology, are the example of inputs



# Inputs : Fixed inputs and Variable inputs

## Fixed inputs

- Remain the same in the short period .
- At any level of out put, the amount is remain the same.
- The cost of these inputs are called Fixed Cost
- Examples:- Building, Land etc
- ( In the long run fixed inputs are become varies)

## Variable inputs

- In the long run all factors of production are varies according to the volume of outputs.
- The cost of variable inputs is called Variable Cost
- Example:- Raw materials, labour, etc

# Various concepts of production

**Total Product –** **Total quantity of output produced**

**Average Product-** **Ratio of Total Product and one variable inputs**

Average Product = Total Product/ Units of Variable Factor Input

**Marginal Product –** **The rate of change of out put as a result changes in one variable input**

Marginal Product = Change in Output/ Change in Input

## Short run Production Function with Labour as Variable factor

| Labour (L) | Capital (K) | Total Output (TP) | Average Product (AP) | Marginal Product (MP) |
|---|---|---|---|---|
| 0 | 10 | 0 | | |
| 1 | 10 | 10 | | |
| 2 | 10 | 30 | | |
| 3 | 10 | 60 | | |
| 4 | 10 | 80 | | |
| 5 | 10 | 95 | | |
| 6 | 10 | 108 | | |
| 7 | 10 | 112 | | |
| 8 | 10 | 112 | | |
| 9 | 10 | 108 | | |
| 10 | 10 | 100 | | |

# Law of Production Function

- **Laws of Variable proportion**- Law of Diminishing Return ( Short run production function with at least one input is variable)

- **Laws of Return scales** – Long run production function with all inputs factors are variable.

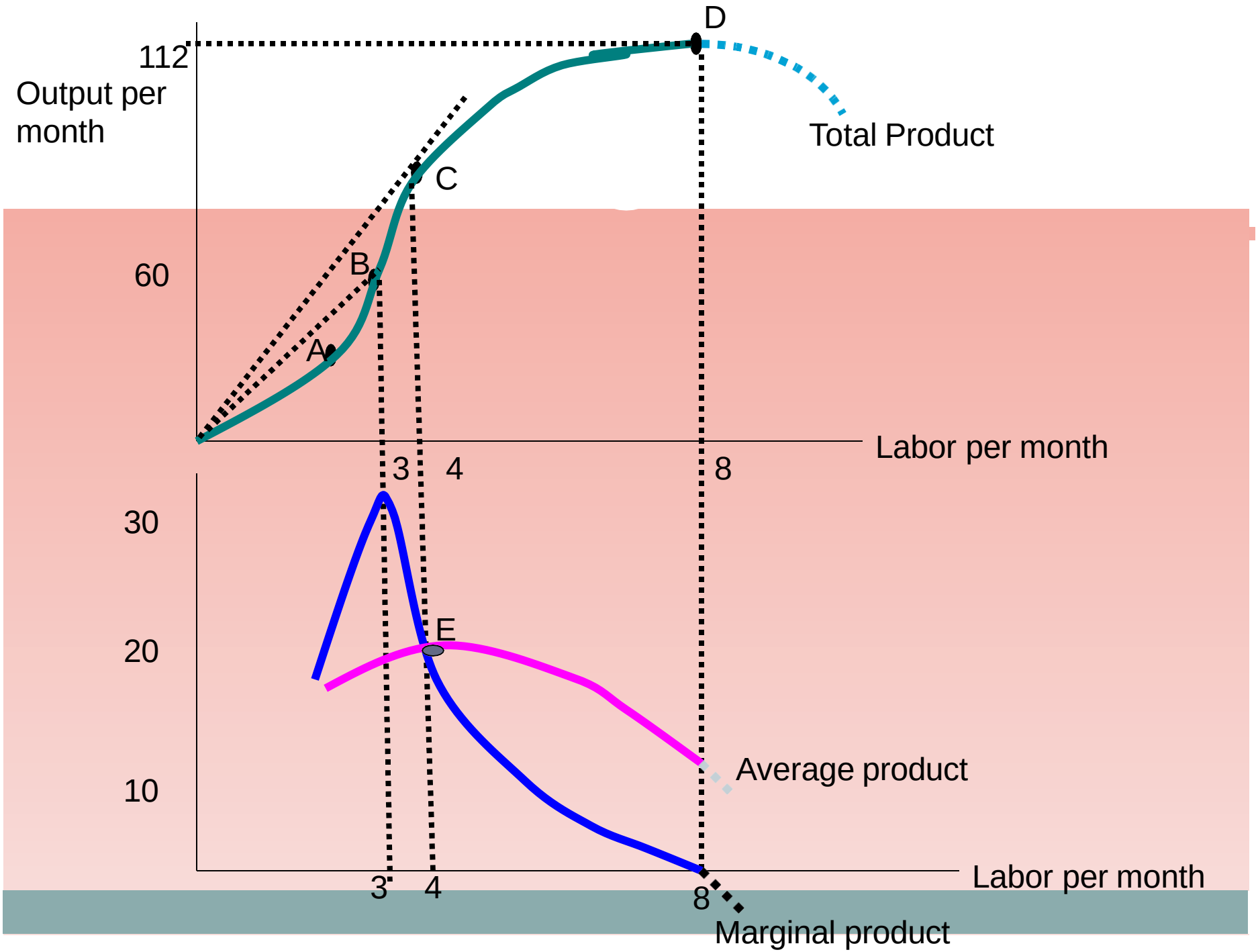
# • Law of variable proportion: Short run Production Function

- Explain short run production function
- Production function with at least one variable factor keeping the quantities of others inputs as a Fixed.
- Show the input-out put relation when one inputs is variable

**"If one of the variable factor of production is used more and more unit,keeping other inputs fixed, the total product(TP) will increase at an increasing rate in the first stage, and in the second stage TP continue to increase but at diminishing rate and eventually TP decrease."**

## Short run Production Function with Labour as Variable factor

| Labour (L) | Capital (K) | Total Output (TP) | Average Product (AP) | Marginal Product (MP) | |
|---|---|---|---|---|---|
| 0 | 10 | 0 | - | | |
| 1 | 10 | 10 | 10 | 10 | |
| 2 | 10 | 30 | 15 | 20 | First |
| 3 | 10 | 60 | 20 | 30 | Stage |
| 4 | 10 | 80 | 20 | 20 | |
| 5 | 10 | 95 | 19 | 15 | Second |
| 6 | 10 | 108 | 18 | 13 | stage |
| 7 | 10 | 112 | 16 | 4 | |
| 8 | 10 | 112 | 14 | 0 | |
| 9 | 10 | 108 | 12 | -4 | Third |
| 10 | 10 | 100 | 10 | -8 | stage |


D
112
Output per month
Total Product
C
B
60
A
Labor per month
3
4
8
30
20
E
Average product
10
Labor per month
3
4
8
Marginal product

# Stages in Law of variable proportion

## First Stage: Increasing return

- TP increase at increasing rate till the end of the stage.
- AP also increase and reaches at highest point at the end of the stage.
- MP also increase at it become equal to AP at the end of the stage.
- MP>AP

## Second Stage: Diminishing return

- TP increase but at diminishing rate and it reach at highest at the end of the stage.
- AP and MP are decreasing but both are positive.
- MP become zero when TP is at Maximum, at the end of the stage
- MP<AP.

## Third Stage: Negative return

- TP decrease and TP Curve slopes downward
- As TP is decrease MP is negative. AP is decreasing but positive.

# The Three Stages of Production

**In the short run, rational firms should only be operating in Stage II.**

**Why Stage II?**

- Why not Stage III?
  - Firm uses more variable inputs to produce less output!
- Why not Stage I?
  - Underutilizing fixed capacity.
  - Can increase output per unit by increasing the amount of the variable input.

Where should rational firm produce?

## Where should rational firm produce?

- **Stage I:** MP is above AP implies an increase in input increases output in greater proportion.
- The firm is not making the best possible use of the fixed factor.
- So, the firm has an incentive to increase input until it crosses over to stage II.
- **Stage III:** MP is negative implies contribution of additional labor is negative so the total output decreases .
- In this case it will be unwise to employ an additional labor.

- **Stage II:** MP is below AP implies increase in input increases output in lesser proportion.
- ***A rational producer/firm should produce in stage II.***
- But where exactly the firm will operate within stage II cannot be determined only on the basis of the product curves.
- We need information about input costs and price of output.

# 2. Law of return to scales: Long run Production Function

- Explains long run production function when the inputs are changed in the same proportion.
- Production function with all factors of production variable.
- Shows the input-out put relation in the long run with all inputs are variable.

**"Return to scale refers to the relationship between change in output and proportionate changes in all factors of production "**

# Law of return to scales: Long run Production Function

| Labour | Capital | TP | MP |
|---|---|---|---|
| 2 | 1 | 8 | 8 |
| 4 | 2 | 18 | 10 |
| 6 | 3 | 30 | 12 |
| 8 | 4 | 40 | 10 |
| 10 | 5 | 50 | 10 |
| 12 | 6 | 60 | 10 |
| 14 | 7 | 68 | 8 |
| 16 | 8 | 74 | 6 |
| 18 | 9 | 78 | 4 |

Increasing returns to scale

Constant returns to scale

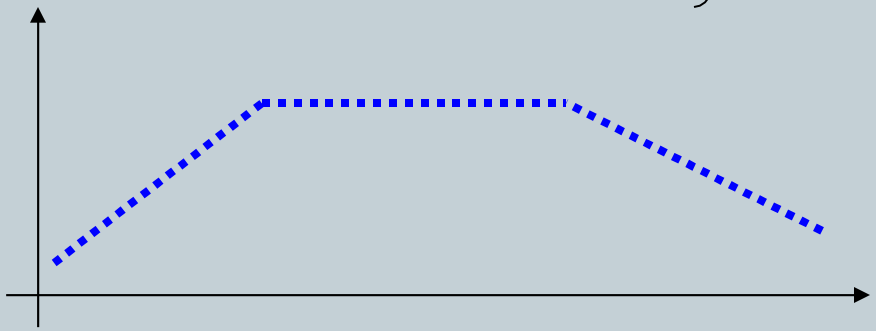
Decreasing returns to scale

# • Law of return to scales: Long run Production Function

**Inputs 10% increase – Outputs 15% increase** } **Increasing returns to scale**

**Inputs 10% increase – Outputs 10% increase** } **Constant returns to scale**

**Inputs 10% increase – Outputs 5% increase** } **Decreasing returns to scale**



# Homogeneous production function

**In the long run all inputs are variable. The production function is homogeneous if all inputs factors are increased in the same proportions in order to change the outputs.**

***A Production function Q = f (L, K )***
***An increase in Q>  Q^ = f (L+L.10%, K+K.10% )-***
**Inputs increased same proportion**

**Increasing returns to scale** **Inputs increased 10% => output increased 15%**

**Constant returns to scale** **Inputs increased 10% => output increased 10%**

**Decreasing returns to scale** **Inputs increased 10% => output increased 8%**

# Homogeneous production function

**In the long run all inputs are variable. The production function is homogeneous if all inputs factors are increased in the same proportions in order to change the outputs.**

***A Production function Q = f (L, K )***

***Q1 = f (L+L.10%, K+K.10% )-***

**Inputs increased same proportion**

**Increasing returns to scale** **Inputs increased 10% => output increased 15%**

**Constant returns to scale** **Inputs increased 10% => output increased 10%**

**Decreasing returns to scale** **Inputs increased 10% => output increased 8%**