MANAGERIAL ECONOMICS

Supply Side Economics: Theory of Production and Cost

Topic 10

ITM BUSINESS SCHOOL
PGDM 2021 - 2023 - SEM I
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Definition of Production

'Production means the process of **using the factors of production** to produce goods and service'.

In other words, **'production means the transformation of inputs into outputs'.**

The term **'inputs'** refers to things that a **firm buys and uses** in production, i.e. land, labor, capital and entrepreneur.

'**Outputs**' refers to what we get at the end of the production process, i.e. **finished products**.

'Factors of production' refers to the goods and services which assist the production process.

According to **L. M. Fraser,** "Factors of production is a group or class of productive resources".

Some economists use the term 'inputs' in place of 'factors', where various inputs are used to produce outputs.

Conventionally, the inputs bought and used in the production of a given product, classified into four factors of production, namely land, labor, capital and entrepreneur.

Land

- All **natural resources** which are available for free.
- Example - land surfaces, air, water, lakes, seas, minerals, forests, mountains, and so on.

Labor

- All **physical or mental activities** by man for **monetary reward.**
- Example - lecturers, educational book editors, doctors, electricians, farmers, lawyers, florists, graphic designers and engineers.

Capital

- **Man-made wealth** which is used to produce more wealth.
- Example - buildings, factories, machinery, tools, equipment, inventories of goods, trucks, railroads, raw materials and money.

Entrepreneurship

- **Human ability to combine the factors of production,** and initiate the process of production
- An entrepreneur bears the risks involved.

Production Function

Production function refers to a statement of the functional **relationship** between **inputs (factors of production)** and **outputs (goods and services)**. This shows the maximum output that can be produced with a given amount of inputs.

Production functions can be represented by the following mathematical equation:

Q = f (K, L, M, etc.)

Where,

Q = the amount of output per unit of time (depends on the quantity of inputs)

K, L, M, etc = the various factors of production, like capital, labour, raw materials, etc

The above formula explains that the quantity of output (Q) depends on the factors of production.

The more inputs used in production, the more the amount of output produced.

Production functions can also be represented by a table, graph or equation.

Key assumptions

1. Some given "state of the art" in the production technology.
2. Whatever input or input combinations are included in a particular function, the output resulting from their utilization is at the maximum level.
3. We assume that the quality of inputs is homogeneous (to ensure that only quantity differs, not quality).

For simplicity we will often consider a production function of two inputs:

Q=f(L, K)

Q: Output

L: Labor

K: Capital

Short Run and Long Run Production Functions

What is the difference between the two. Does short run refer to a short period of time, e.g. one year, whereas long run to a long period of time, e.g. 10 years?

Answer: No.

Both short run and long run actually depends on the inputs (factors of production), which can vary in production. There are two types of inputs:

Short run The time period during which at least one input, such as plant size, cannot be changed.

Plant size The physical size of the factories that a firm owns and operates to produce its output. Plant size can be defined by square footage, maximum physical capacity, and other physical measures.

In the theory of the firm, the short run is defined as any time period that is so short that there is at least one input, such as current plant size, that the firm cannot alter.

- In other words, during the short run, a firm makes do with whatever big machines and factory size it already has, no matter how much more it wants to produce because of increased demand for its product.
- We consider the plant and heavy equipment, the size or amount of which cannot be varied in the short run, as fixed resources.

In agriculture and in some other businesses, **land may be a fixed resource.**

There are, of course, variable resources that the firm can alter when it wants to change its rate of production. These are called **variable inputs or variable factors of production.**

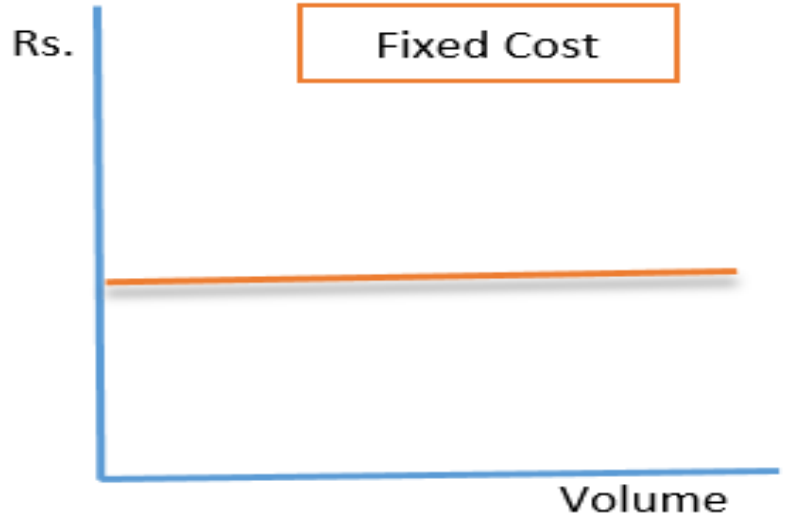
Typically, the variable inputs of a firm are its **labor and its purchases of raw materials.**

In the short run, in response to changes in demand, the firm can, by definition, **change only the amounts of its variable inputs.**

Short Run and Long Run Production Functions

A fixed input is an input where the **quantity does not change according to output**, e.g. machinery, land, buildings, tools, equipment, etc.

A **variable input** is an input where the **quantity changes according to output,** e.g. raw materials, electricity, fuel, transportation, communication, etc.



Total Variable Cost *(TVC)*

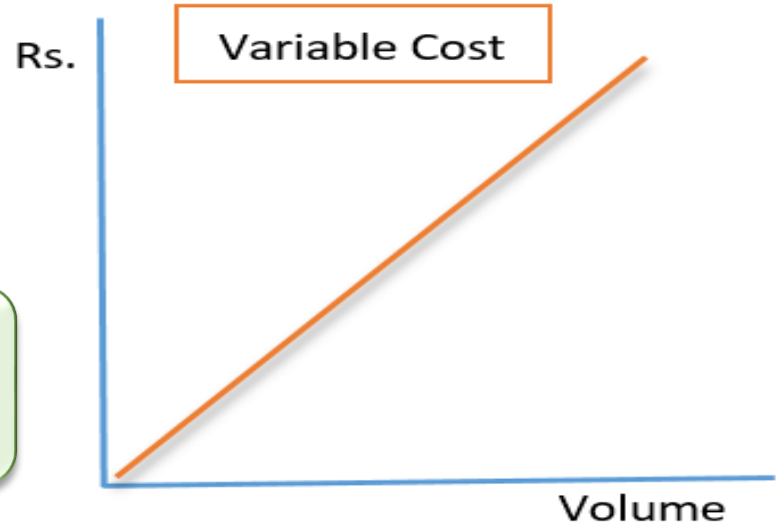
- Total amount paid for variable inputs
- Increases as output increases

Total Fixed Cost *(TFC)*

- Total amount paid for fixed inputs
- Does not vary with output

Total Cost *(TC)*

TC = TVC + TFC



Short Run and Long Run Production Functions

COST SHEET ANALYSIS:
DABUR INDIA LIMITED

FIXED COSTS	Rs.in crore
Depreciation on Building	727
Depreciation Plant & Machinery	2118
Depreciation lease on land	10
Rates And Taxes	348
Depreciation Vehicle	196
Depreciation furniture & fixtures	170
Depreciation computer	275
R&D	368
Auditor's Remuneration	76
General Expenses	9201
Security	446
Insurance	286
Director's Fee	2192
Telephone and Fax	355
Legal and Professional	2159
Repair and Maintenance Building	281
Processing charges	2098
Other Repairs	678
Rent	2132
Advertisement	39019
Total Fixed costs	63135

VARIABLE COST	
Repairs To Machinery	423
Direct Labour	18000
Raw Material	77335
Primary Packing Material	50071
Power and Fuel	4239
Stores and Spares	1172
Excise Duty	3099
Sales tax	289
Freight and forwarding	6287
Travel and Conveyance	3007
Commission and Discount	3166
Total Variable costs	167088

Total Cost	230223

Short Run and Long Run Production Functions

Long run The time period during which all factors of production can be varied.

How long is the long run?

- That depends on each individual industry.

The long run can now be considered the period of time in which all inputs can be varied. Specifically, in the long run, the firm can alter its plant size.

For Wendy's or McDonald's, the long run may be four or five months, because that is the time it takes to add new franchises.

For a steel company, the long run may be several years, because that's how long it takes to plan and build a new plant.

An electric utility might need more than a decade to build a new plant.

Short run and long run in our discussion are terms that apply to planning decisions made by managers.

Managers routinely take account of both the short-run and the long-run consequences of their behavior.

While always making decisions about what to do today, tomorrow, and next week—the short run as it were—they keep an eye on the long-run net benefits of all short-run actions.

As an individual, you have long-run plans, such as going to graduate school or having a successful career, and you make a series of short-run decisions with these long-run plans in mind.

Short Run and Long Run Production Functions

Short Run

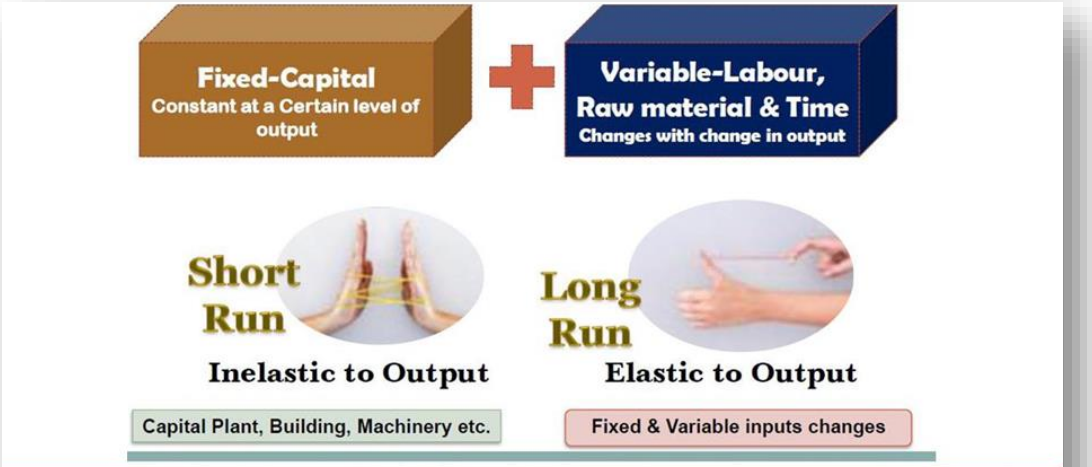
The **short run** time frame has at **least one input** which is **fixed**, but other inputs vary.

- The output can be varied by changing the quantities of one or a few inputs.
- In most firms. for example, capital (buildings, equipment, tools, etc) is a fixed resource. Output can be increased by varying labour.

Long Run

The **long run** time frame, on the other hand, has **inputs which are all variable**.

- In the long run, firms can alter the inputs to increase the output.



The short-run production function shows the maximum quantity of good or service that can be produced by a set of inputs, assuming the amount of at least one of the inputs used remains unchanged.
The long-run production function shows the maximum quantity of good or service that can be produced by a set of inputs, assuming the firm is free to vary the amount of all the inputs being used.

Short-run Production Function One Fixed Input and One Variable

We assume that at least one input is fixed (capital is the fixed input). Suppose that on two inputs are used in production: capital and labour. Thus, the production function can be written as follows:

$$Q = f(L, \bar{K}) = f(L) \quad \bar{K} \rightarrow \text{Quantity of capital is fixed}$$

OR

$$Q = f(K, \bar{L}) = f(K) \quad \bar{L} \rightarrow \text{Quantity of labour is fixed}$$

Alternative terms in reference to inputs

- ✓ Inputs
- ✓ Factors
- ✓ Factors of production
- ✓ Resources

Alternative terms in reference to outputs

- ✓ Output
- ✓ Quantity (Q)
- ✓ Total product (TP)
- ✓ Product

Short-Run Total Cost Schedules

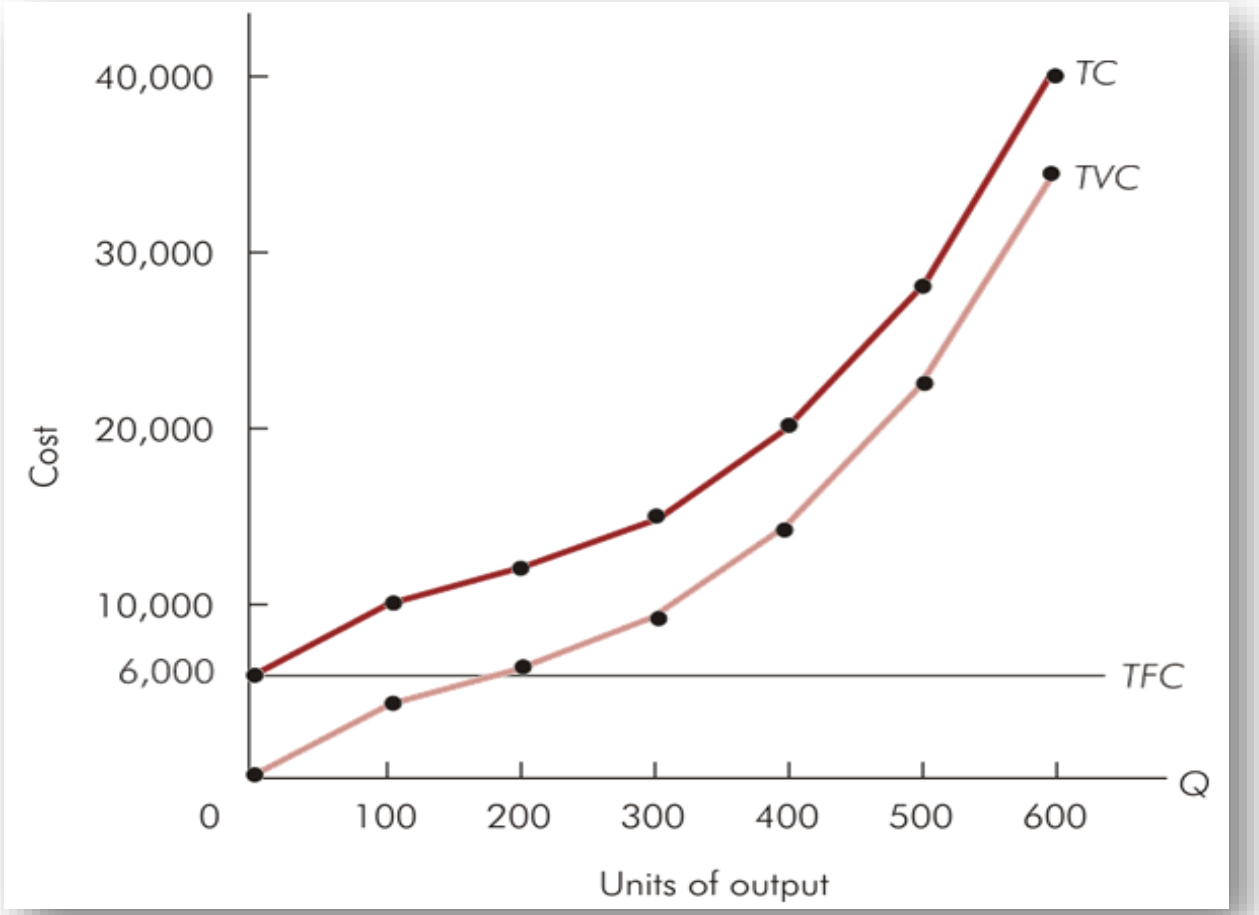
Output (Q)	Total fixed cost (TFC)	Total variable cost (TVC)	Total Cost (TC=TFC+TVC)
0	6,000	0	6,000
100	6,000	4,000	10,000
200	6,000	6,000	12,000
300	6,000	9,000	15,000
400	6,000	14,000	20,000
500	6,000	22,000	28,000
600	6,000	34,000	40,000

Calculate the following costs from the above table;

Output (Q)	Average fixed cost (AFC=TFC/Q)	Average variable cost (AVC=TVC/Q)	Average total cost (ATC=TC/Q= AFC+AVC)	Short-run marginal cost (SMC=ΔTC/ΔQ)

Short-Run Total Cost Schedules

Output (Q)	Average fixed cost (AFC=TFC/Q)	Average variable cost (AVC=TVC/Q)	Average total cost (ATC=TC/Q= AFC+AVC)	Short-run marginal cost (SMC=ΔTC/ΔQ)
0				
100	60	40	100	40
200	30	30	60	20
300	20	30	50	30
400	15	35	50	50
500	12	44	56	80
600	10	56.7	66.7	120



Short-Run Costs: Problem 1

Q	*TC*	*TFC*	*TVC*	*ATC*	*AFC*	*AVC*	*MC*
0	**120**			X	X	X	X
1				**265**			
2			**264**				
3				**161**			
4							**85**

Average variable cost *(AVC)*

$$AVC = \frac{TVC}{Q}$$

Average fixed cost *(AFC)*

$$AFC = \frac{TFC}{Q}$$

Average total cost *(ATC)*

$$ATC = \frac{TC}{Q} = AVC + AFC$$

Short run marginal cost (SMC) measures rate of change in total cost (TC) as output varies

$$SMC = \frac{\Delta TC}{\Delta Q} = \frac{\Delta TVC}{\Delta Q}$$

Short-Run Costs: Solution 1

Q	*TC*	*TFC*	*TVC*	*AC*	*AFC*	*AVC*	*MC*
0	**120**	120	0	X	X	X	X
1	265	120	145	**265**	120	145	145
2	384	120	**264**	192	60	132	119
3	483	120	363	**161**	40	121	99
4	568	120	448	142	30	112	**85**

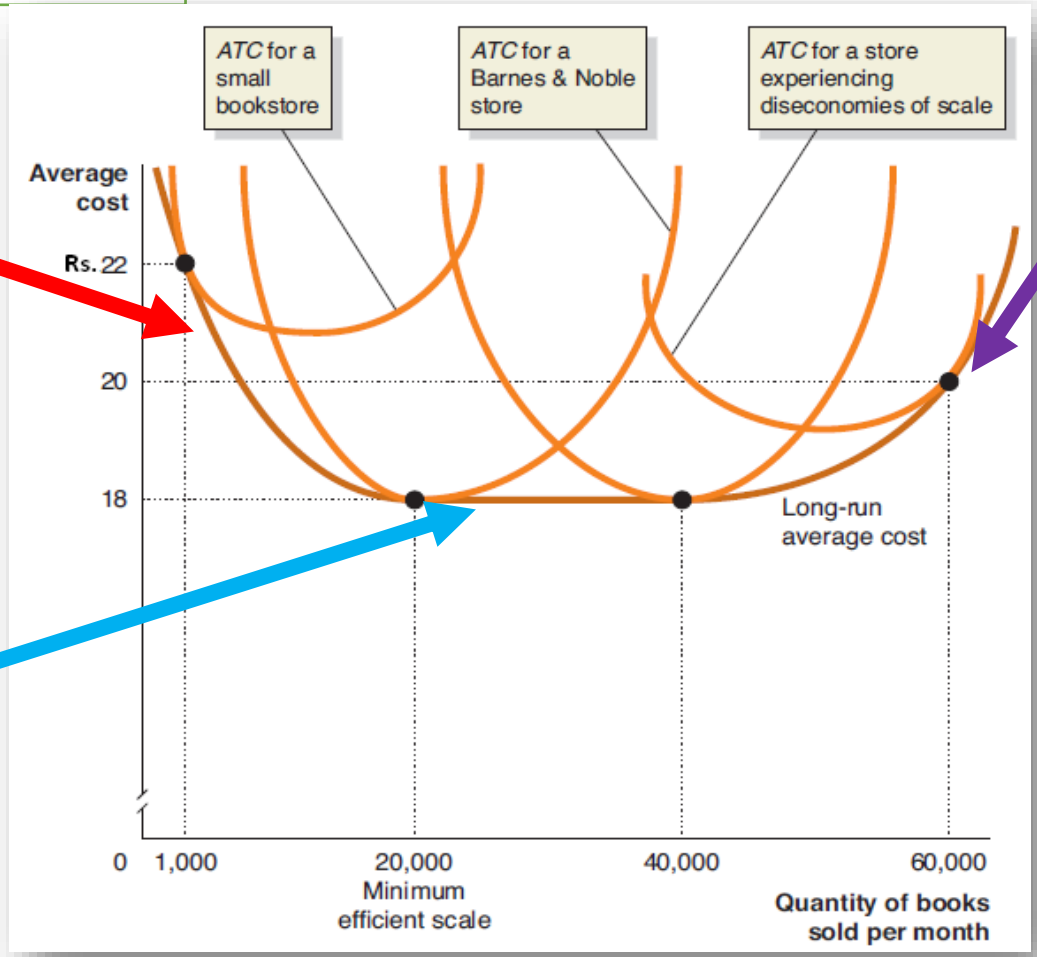
Costs in the Long Run

- When no inputs are fixed. A firm may experience **economies of scale,** which means the firm's long-run average costs fall as it increases the quantity of output it produces.
- We can see the effects of economies of scale in Figure which shows the relationship between short-run and long-run average cost curves.
- Managers can use long-run average cost curves for planning because they show the effect on cost of expanding output by, for example, building a larger factory or store.

Diseconomies of scale The situation in which a firm's long-run average costs rise as the firm increases output.

Economies of scale The situation when a firm's long-run average costs fall as it increases the quantity of output it produces.

Constant returns to scale The situation in which a firm's long-run average costs remain unchanged as it increases output.



Break Even Analysis

Break Even Analysis

❖**Break Even Point =** Volume in units or in Rupees at which **profit=0 ALSO Loss=0**.

Profit Volume(PV) ratio = $\frac{S - AVC}{S}$

S=Selling Price, and AVC=Average Variable Cost

Q1. Example:

❖Selling Price(S)=Rs.5 , and

❖Average Variable Cost(AVC)=Rs.4 per unit

Solution:

❖Profit Volume(PV) ratio = $\frac{5-4}{5}$ x 100 = 20 %.

Break Even(Sales Value or Rs.) = $\frac{FC}{PV\ ratio}$

Where,

❖FC = Fixed Cost

❖Profit Volume(PV) ratio = $\frac{S - AVC}{S}$

Q2. Example:

❖Selling Price = Rs.5 Per Unit

❖AVC = Rs.3 Per Unit

❖FC = Rs.4,000 per month

Solution:

Break Even(Sales Value or Rs.) = $\frac{FC}{PV\ ratio}$

$= \frac{4000}{\frac{(5-3)}{5}}$ = Rs.10,000

Break Even Analysis

❖**Contribution per unit = S – AVC**

❖Think Contribution as the amount available to cover Fixed Cost and earn a Profit.

Break Even(Sales Value or Units or Volume) = $\frac{\text{FC}}{\text{Contribution per unit}}$

Q3. Example:

❖FC = Rs.4000

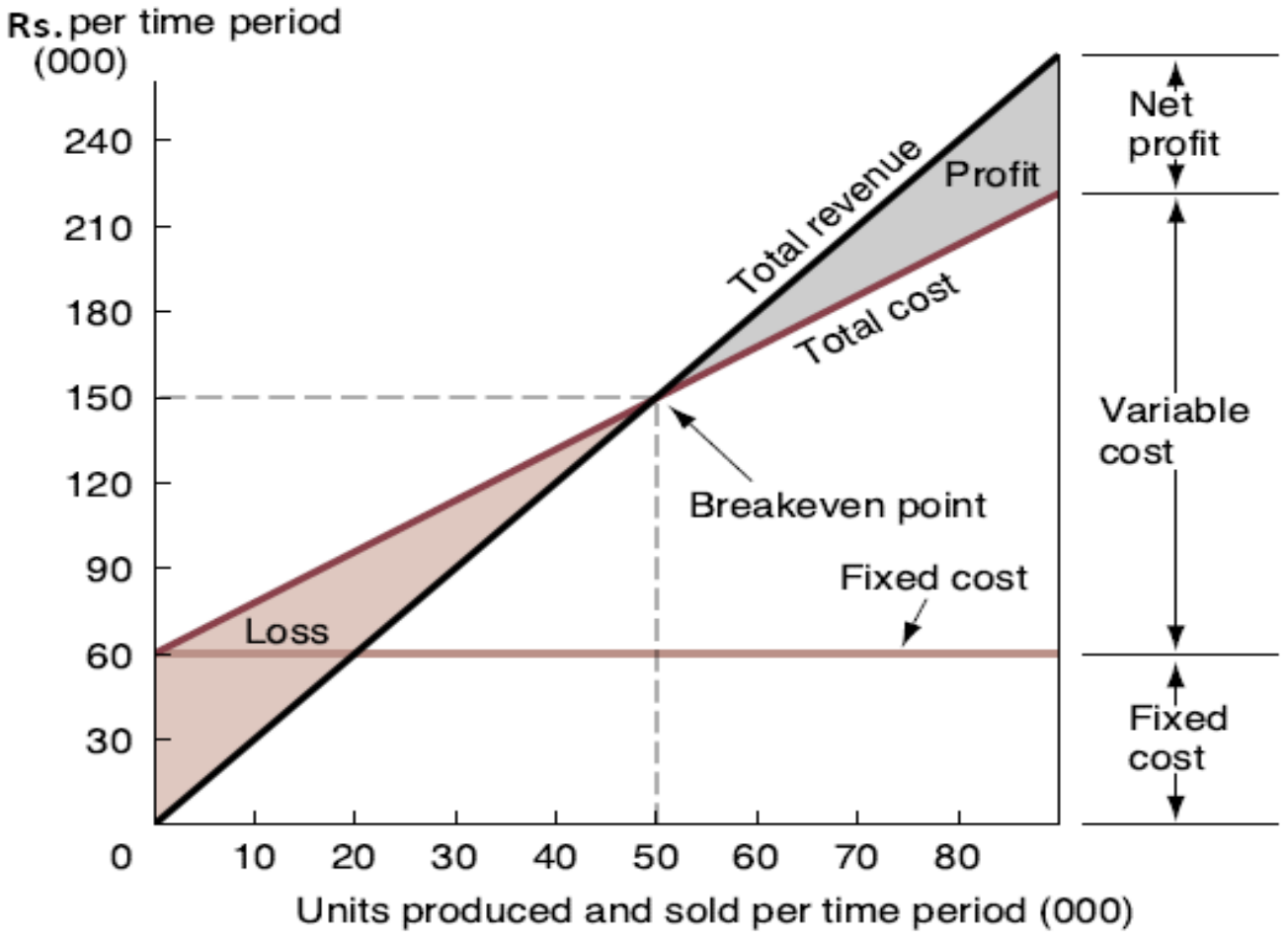
❖Selling price =5

❖Average Variable Price =Rs.3

Solution:

Break Even(Sales Value or Units or Volume)

$= \frac{4000}{5-3}$ = 2000 Units



Margin of Safety

Margin of Safety = Sales – Break Even (in unit)

= 8000 – 6250 = 1,750

Extra Reading

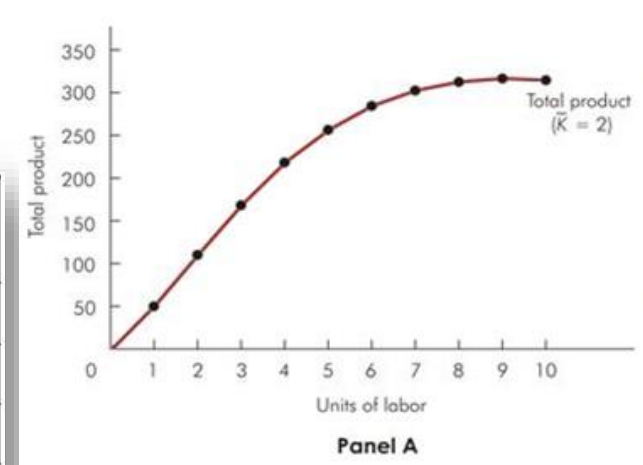
The Three Stages of Production in the Short Run

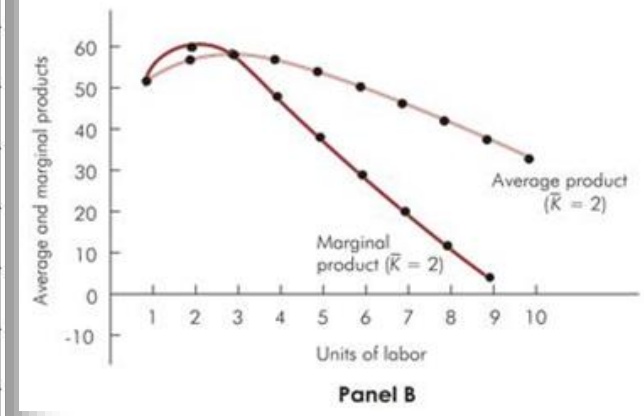
Number of workers (L)	Total product (Q)	Average product (AP=Q/L)	Marginal product (MP=ΔQ/ΔL)
0	0		
1	52		
2	112		
3	170		
4	220		
5	258		
6	286		
7	304		
8	314		
9	318		
10	314		

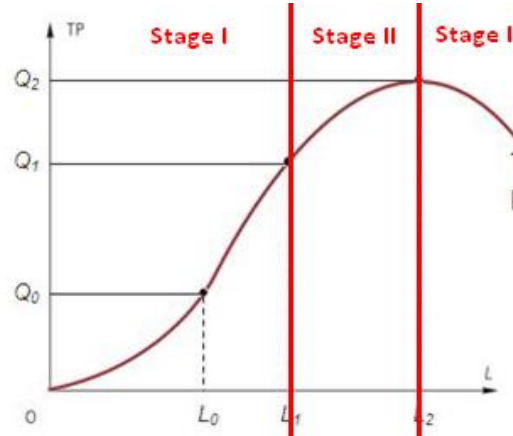
The Three Stages of Production in the Short Run

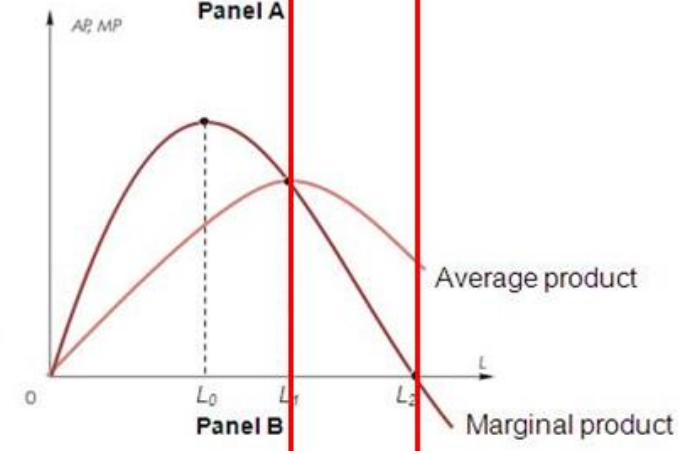
Law of Diminishing Returns
Or
Law of Variable Proportions

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









Why not Stage III?

- Firm uses more variable inputs to produce less output

What level of input usage within Stage II is best for the firm?

- The answer depends upon;
- how many units of output the firm can sell,
- the price of the product, and
- the monetary costs of employing the variable input.

Why not Stage I?

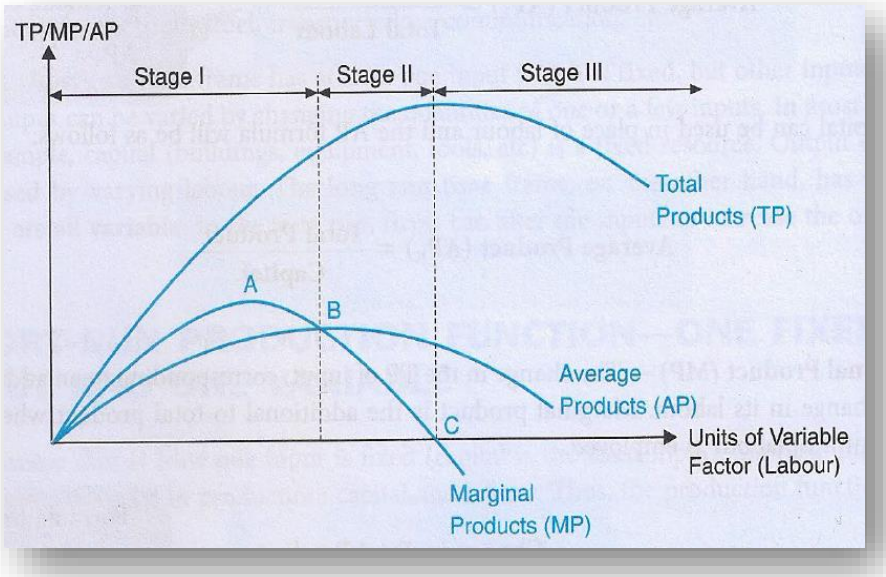
- Underutilizing fixed capacity
- Can increase output per unit by increasing the amount of the variable input

Example 2: Stages of Production

Capital (fixed input)	Labour (variable input)	Total Product	Marginal Product	Average Product	Stages of Production
10	0	0	0	0	Stage I
10	1	8	8	8	
10	2	20	12	10	
10	3	33	13	11	
10	4	44	11	11	
10	5	50	6	10	Stage II
10	6	54	4	9	
10	7	56	2	8	
10	8	56	0	7	Stage III
10	9	54	-2	6	
10		50	-4		

MP = $\frac{54 - 56}{9 - 8}$ = -2

AP = $\frac{56}{8}$ = 7



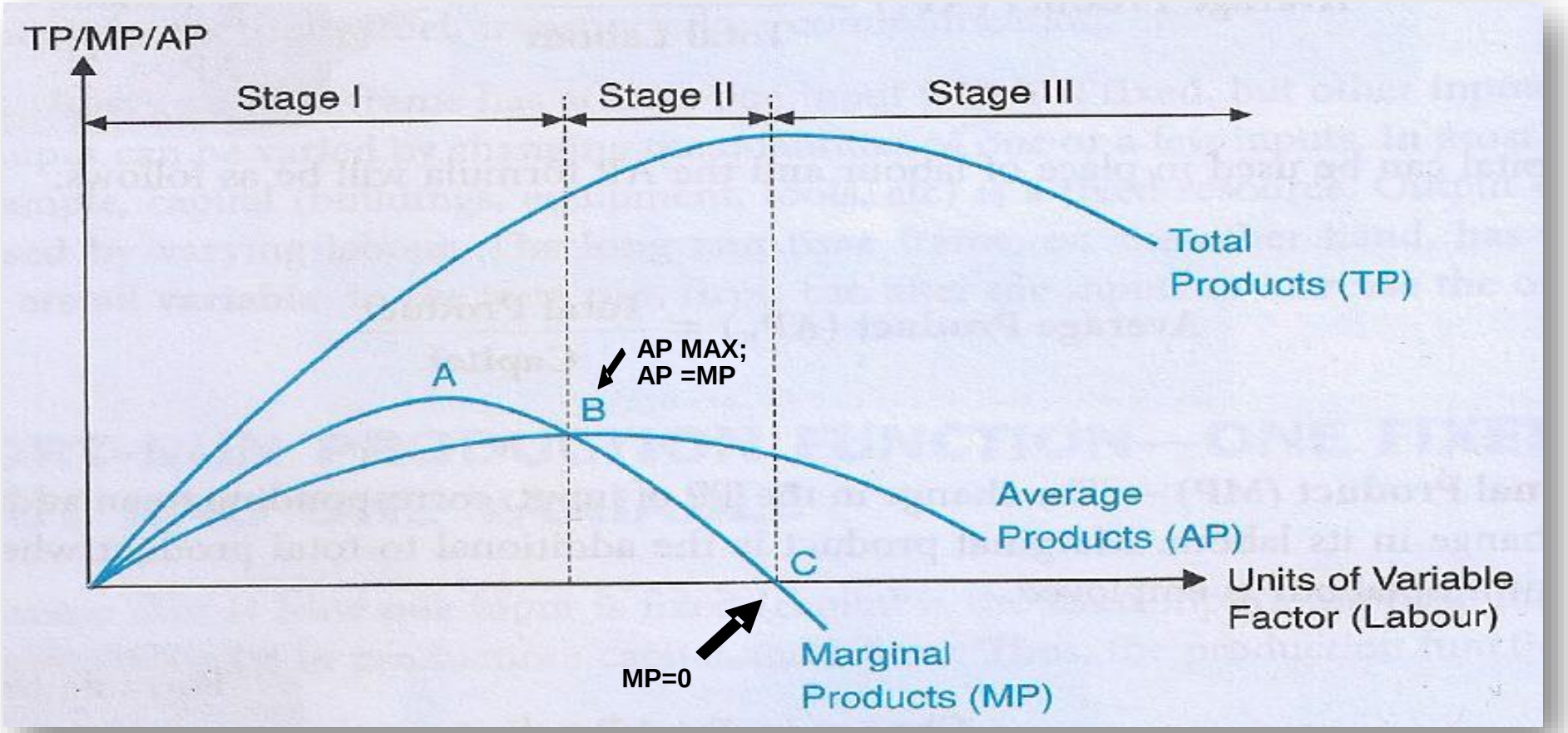
Example 2: Stages of Production

RELATIONSHIP BETWEEN TP AND MP

When ***MP*** is *increasing*, ***TP*** increase at an *increasing rate*.
When ***MP*** *is decreasing*, ***TP*** increase at a *decreasing rate*.
When ***MP*** *is zero*, ***TP*** at its *maximum*.
When ***MP*** *is negative*, ***TP*** *declines*.

RELATIONSHIP BETWEEN AP AND MP

When ***MP*** is above ***AP*** , ***AP*** is *increasing*
When ***MP*** is below ***AP***, ***AP*** is *decreasing.*
When ***MP*** equals to ***AP***, ***AP*** is at *maximum*



The Three Stages of Production in the Short Run

Law of Diminishing Returns:

- This law basically explains the behaviour of production functions in the short run. (Recap: In the short run, at least one input must be fixed. The output can be varied by changing the quantities of one or a few inputs.)
- As **additional units of a variable input** are **combined** with a **fixed input**, at **some point the additional output** (i.e., marginal product) **starts to diminish**.

Or

- The law of diminishing marginal returns states that if the quantities of certain factors are increased while the quantities of one or more factors are held constant, beyond a certain level of production, the rate of increase in output will decrease (total production will increase in a decreasing rate) and eventually the marginal product declines:

Or

- The law of diminishing marginal returns states that as more of a variable input is used while other inputs and technology are fixed, the marginal product of the variable input will eventually decline:
- This law is also called the **law of variable proportions** because it shows how output varies (when the proportion of a variable input to fixed inputs used in production varies).