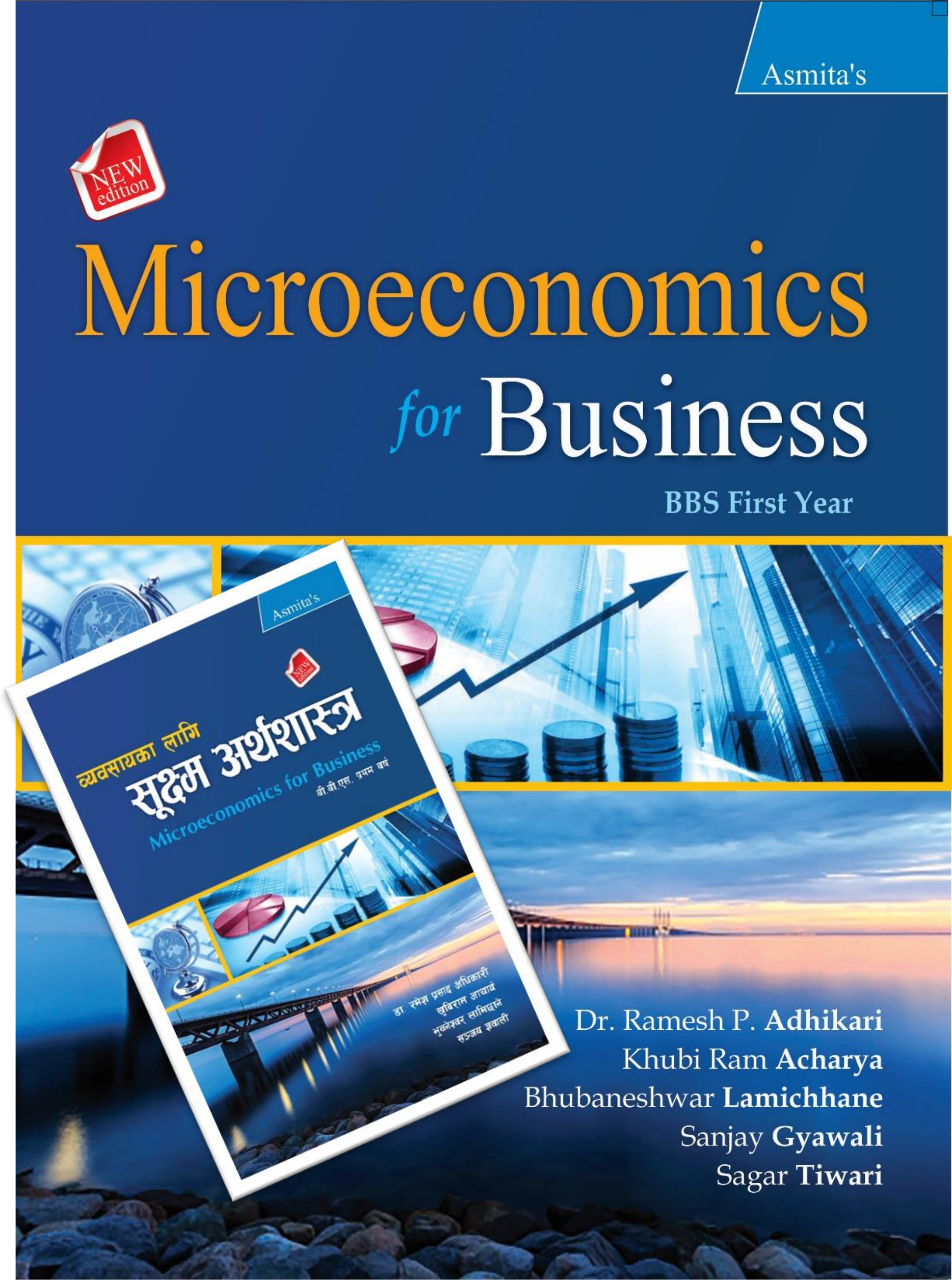
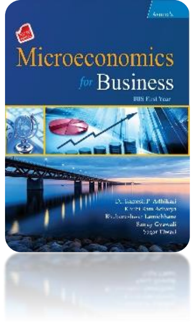
Theory of Production

Unit 5

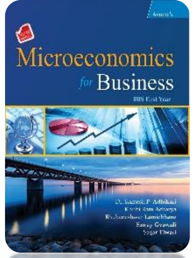




Learning Objectives

On completion of this unit, students will be able to:

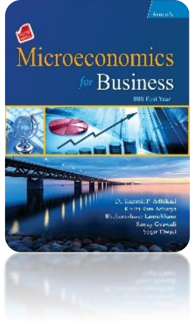
- define TP, AP and MP
- define the production function and describe its types
- explain the concept of Cobb-Douglas production function
- explain the law of variable proportions
- describe the concept of isoquant and its properties
- explain the marginal rate of technical substitution and iso-cost line
- explain the optimal combination of inputs
- describe the laws of returns to scale.



Introduction

- Production is the process of transforming inputs into outputs or goods and services.
- Traditionally, production is also defined as the process of creating utility.
- Production is regarded as the mother of all economic activities because there will be no other economic activities, i.e. consumption, exchange and distribution in absence of production.
- The aim of all the firm is to maximize profit or sales revenue.
- The profit maximization or sales revenue maximization is possible only through efficient production of goods and services.
- The efficient production of goods and services is possible only through optimum combination of inputs or factors of production.

Concept of Total Product (TP), Average Product (AP), and Marginal Product (MP)



Total Product (TP)

- Total product is defined as the total quantity of output produced by the producer employing all the available units of inputs in the given period of time.
- TP is the sum of marginal product, i.e.

$$TP = MP_1 + MP_2 + \ldots + MP_n = SMP$$

where

TP = Total product

MP = Marginal product

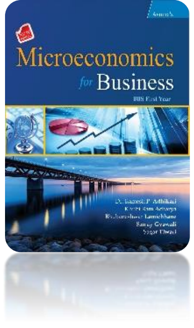
TP can also be obtained by multiplying average product (AP) by units of labour or any variable factor used in production process, i.e.

$$TP = AP \times L$$

where

L = Labour or variable input

Concept of Total Product (TP), Average Product (AP), and Marginal Product (MP) Contd…



Average Product (AP)

- Average product is obtained by dividing total product by number of variable input or factor used in production process.
- In other words, it is the output per unit variable factor. Thus,

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

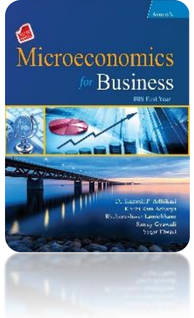
where

AP = Average product

TP = Total product

L = Units of labour or variable input or factor

Concept of Total Product (TP), Average Product (AP), and Marginal Product (MP) Contd…



Marginal Product (MP)

- Marginal product is defined as the addition in total product as a result of an additional unit of available factor, i.e. labour.
- In other words, it is the ratio of change in total product and change in units of labour or any variable input. Thus,

$$MP = TP_n - TP_{n-1}$$

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

where

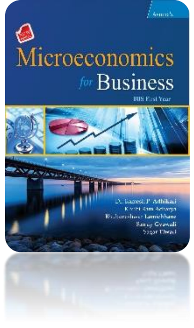
MP = Marginal product

ΔTP = Change in total product

ΔL = Change in variable input or labour

TP_n = Total product of 'n' units of labour

TP_{n-1} = Total product of 'n – 1' units of labour



Production Function

- Production function is defined as functional relationship between physical inputs and physical output of a firm.
- In other words, production function shows the maximum possible output which can be produced by the given quantities of inputs.

$$Q = f(L_d, L, K, O, T) \quad \ldots \text{(i)}$$

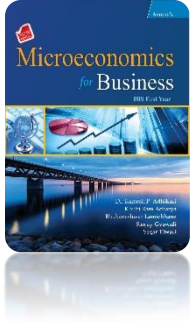
where

Q	= Output	L_d	= Land
L	= Labour	K	= Capital
O	= Organization	T	= Technology

the general equation of this simple production function is expressed symbolically as

$$Q = f(L, K) \quad \ldots \text{(ii)}$$

Types of Production Function



1. Short Run Production Function

- Short run production function is the technical or functional relationship between inputs and output where quantities of some inputs are kept constant and quantities of some inputs are varied.
- The input and output relationship in the short run is studied under the law of variable proportions.

$$Q = f(L, \overline{K}) \quad \ldots \text{(iii)}$$

where

f = Function   Q = Output

L = Labour which is variable factor $\overline{K}$ = Capital, which is fixed factor

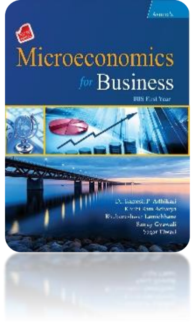
- The short-run production function is also expressed as

$$Q = f(N_{Vt}, \overline{K})$$

where

N_{Vt} = Units of variable input

Types of Production Function Contd…



2. Long Run Production Function

- Long run production function is defined as the production function in which all inputs are variable.
- In other words, long run production function is the technical or functional relationship between inputs and output when quantities of all inputs are variable.

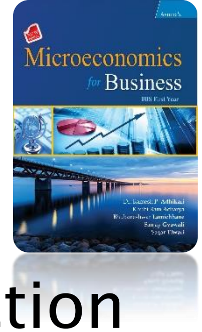
$$Q = f(L, K) \quad \ldots \text{(iv)}$$

where

Q = Quantity of output

L = Units of labour

K = Units of capital



Cobb-Douglas Production Function

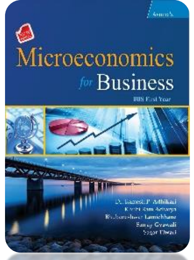
- Cobb-Douglas production function is a specific production function which is most widely used in economic analysis.
- The **Cobb-Douglas** production function was first proposed by **Kunt Wicksell** (1851-1926), a leading Swedish economist. Later, it was tested empirically by two American originators, **C.W. Cobb** (a mathematician) and **P.H. Douglas** (an economist) in 1928 AD. Therefore, it is known as the Cobb-Douglas production function.
- Cobb-Douglas production function:

$$\mathbf{Q = A K^{\alpha} L^{\beta}} \qquad \ldots \text{(i)}$$

where

Q	= Output	A	= Efficiency parameter, positive constant
K	= Capital	L	= Labour
α	= Elasticity of output with respect to capital	α and β	= Positive constants
β	= Elasticity of output with respect of labour = $1 - \alpha$		

Properties/ Features of Cobb-Douglas Production Function



1. **Returns to scale:** The Cobb-Douglas production function can be used to calculate nature of returns to scale from the value of $(\alpha + \beta)$.

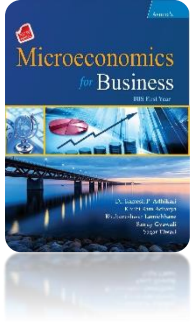
   If $\alpha + \beta = 1$, it shows constant returns to scale.

   If $\alpha + \beta > 1$, it shows increasing returns to scale.

   If $\alpha + \beta < 1$, it shows decreasing returns to scale.

2. **Marginal product of an input can be expressed in terms of its average product:** Cobb-Douglas production function shows that marginal product of a factor can be expressed in terms of its average product. It is given as follows:

Properties/ Features of Cobb-Douglas Production Function Contd.



Marginal product of labour

$$MP_L = \frac{\partial Q}{\partial L}$$

$$= \frac{\partial (A\,K^{\alpha} L^{\beta})}{\partial L}$$

$$= A\,K^{\alpha}.\ \frac{\partial (L^{\beta})}{\partial L}$$

$$= A\,K^{\alpha}.\ \beta.\ L^{\beta-1}$$

$$= A\,K^{\alpha}\ .\ \beta\ .\ \frac{L^{\beta}}{L}$$

$$= \beta\ \frac{(A\,K^{\alpha} L^{\beta})}{L}$$

$$= \beta\ .\ \frac{Q}{L}$$

$$= \beta\ .\ AP_L \left[\because\ \ AP_L = \frac{Q}{L}\right]$$

Marginal product of capital

$$MP_K = \frac{\partial Q}{\partial K}$$

$$= \frac{\partial (A\,K^{\alpha} L^{\beta})}{\partial K}$$

$$= A\,L^{\beta}.\ \frac{\partial (K^{\alpha})}{\partial K}$$

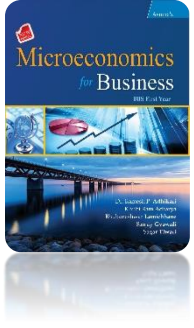
$$= A\,L^{\beta}.\ \alpha.\ K^{\alpha-1}$$

$$= A\,L^{\beta}.\ \alpha.\ \frac{K^{\alpha}}{K}$$

$$= \alpha\ \frac{(A\,L^{\beta} K^{\alpha})}{K}$$

$$= \alpha\ .\ \frac{Q}{K}$$

$$= \alpha\ .\ AP_K \left[\because\ \ AP_K = \frac{Q}{K}\right]$$

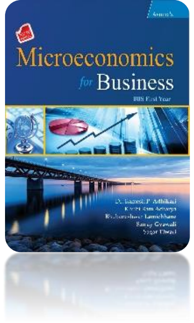


Properties/ Features of Cobb-Douglas Production Function Contd.

3. **Marginal rate of technical substitution:** The marginal rate of technical substitution can be expressed in terms of ratio between labour and capital.

$$MRTS_{L,K} = \frac{dK}{dL} = \frac{MP_L}{MP_K} = \frac{\beta\left(\frac{Q}{L}\right)}{\alpha\left(\frac{Q}{K}\right)} = \frac{\beta}{\alpha}\left(\frac{K}{L}\right)$$

$$MRTS_{K,L} = \frac{dL}{dK} = \frac{MP_K}{MP_L} = \frac{\alpha\left(\frac{Q}{K}\right)}{\beta\left(\frac{Q}{L}\right)} = \frac{\alpha}{\beta}\left(\frac{L}{K}\right)$$

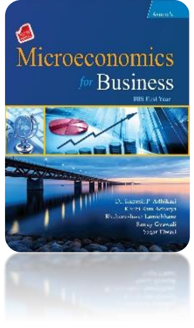


Properties/ Features of Cobb-Douglas Production Function Contd.

4. **Measurement of elasticity of factor substitution is equal to unity:** The elasticity of substitution (σ) of Cobb–Douglas production function is equal to unity. The elasticity of substitution is defined as the percentage change in capital–labour ratio divided by percentage change in marginal rate of technical substitution.

$$\sigma = \frac{\text{Percentage change in } \frac{K}{L}}{\text{Percentage change in } MRTS_{L,K}}$$

$$= \frac{\frac{d(K/L)}{(K/L)}}{\frac{d(MRTS_{L,K})}{(MRTS_{L,K})}} = \frac{\frac{d(K/L)}{(K/L)}}{\frac{d\left(\frac{\beta\,.\,K}{\alpha\,.\,L}\right)}{\left(\frac{\beta\,.\,K}{\alpha\,.\,L}\right)}} = \frac{\frac{d(K/L)}{(K/L)}}{\frac{\frac{\beta}{\alpha}\,d\left(\frac{K}{L}\right)}{\frac{\beta}{\alpha}\left(\frac{K}{L}\right)}} = \frac{\frac{\beta}{\alpha}\,d\left(\frac{K}{L}\right)\,.\left(\frac{K}{L}\right)}{\frac{\beta}{\alpha}\,d\left(\frac{K}{L}\right)\,.\left(\frac{K}{L}\right)} = 1$$



Properties/ Features of Cobb-Douglas Production Function Contd.

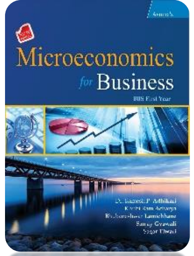
5. **Factor intensity:** In the Cobb-Douglas production function, factor intensity is measured by the ratio between α and β.

If $\frac{\alpha}{\beta} > 1$, there is use of capital intensive technique in production.

If $\frac{\alpha}{\beta} < 1$, there is use of labour intensive technique in production.

If $\frac{\alpha}{\beta} = 1$, there is equal factor intensive technique of production, i.e. equal proportion of labour and capital is used in production.

6. **The efficiency of production:** The efficiency in the organization of the factors of production is measured by the coefficient A. Higher the value of A, higher will be degree of efficiency of production and vice-versa.

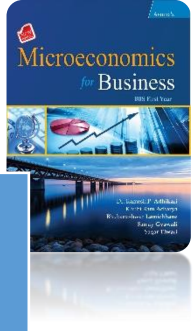


Law of Variable Proportions

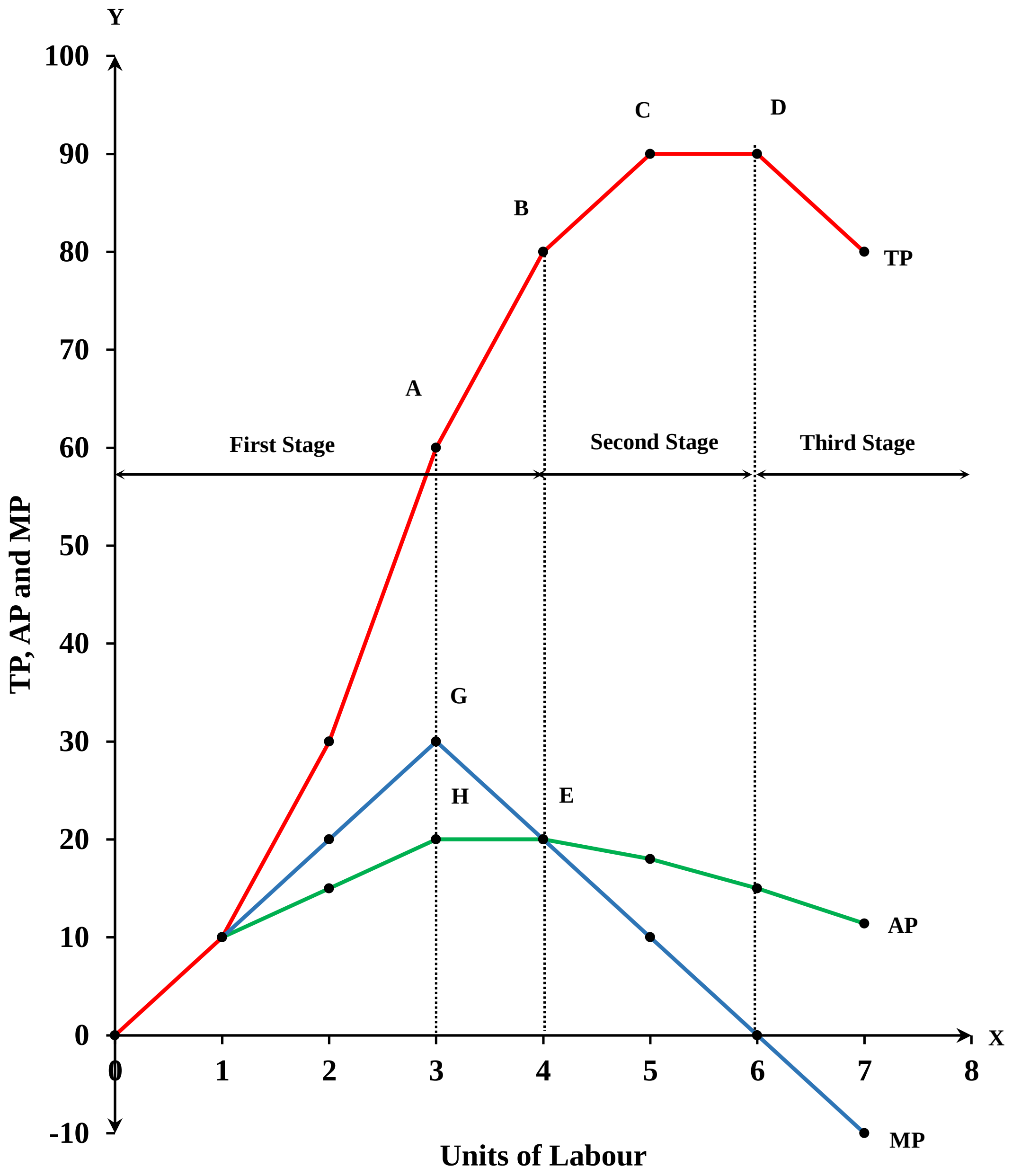
The law of variable proportions is concerned with the short run production function. It examines production with single variable factor keeping quantities of other factors constant. This law was propounded by the economists like **Joan Robinson, Alfred Marshall**, **P.A. Samuelson,** etc. This law is also known as the law of diminishing returns.

Assumptions

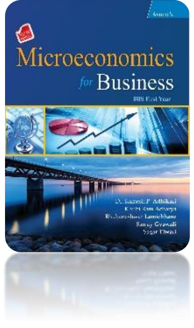
- There is no change in technology.
- At least, one factor of production is fixed.
- There must be possibility of varying the proportion of factors of production.
- Labour is only a variable factor.
- All units of labour are homogeneous.



Land (in Ropanies)	Units of Labour	TP	AP	MP	Stage of Production
10	0	0	0	0	First stage
10	1	10	10	10	
10	2	30	15	20	
10	3	60	20	30	
10	4	80	20	20	
10	5	90	18	10	Second Stage
10	6	90	15	0	
10	7	80	11.4	–10	Third Stage



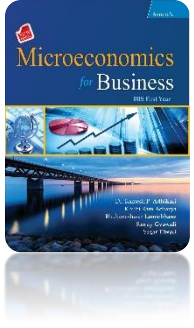
Y
TP, AP and MP
100
90
80
70
60
50
40
30
20
10
0
-10
A
B
C
D
G
H
E
TP
AP
MP
First Stage
Second Stage
Third Stage
0
1
2
3
4
5
6
7
8
X
Units of Labour



Law of Variable Proportions Contd.

Causes of Operation of Stages

1. First Stage (Stage of Increasing Returns)
   1. Increase in efficiency of fixed factor
   2. Increase in the efficiency of variable factor
2. Second Stage (Stage of Decreasing Returns)
   1. Scarcity of fixed factor
   2. Indivisibility of fixed factor
   3. Imperfect substitutability of the factor
3. Third Stage (Stage of Negative Returns)
   1. Inefficient utilization of variable factor
   2. Over utilization of fixed inputs
   3. Complexity of management
   4. Over utilization of fixed inputs

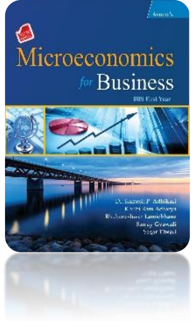


Law of Variable Proportions Contd.

Stage of Operation

(Which stage of production does a rational producer choose?)

- ❖ A rational producer does not choose first and third stage.
- ❖ In the first stage, TP increases at the increasing rate and MP of the variable factor also increases; and there is no full utilization of fixed factors of production. Thus, there is opportunity of increasing production by increasing quantity of variable factor.
- ❖ In the third stage, TP declines, AP also declines and MP becomes negative.
- ❖ Thus, the rational producer will choose second stage where both AP and MP of variable factors are diminishing; and there is full utilization of fixed factor.
- ❖ At which particular point of this stage, the producer will choose to produce depends upon the prices of factors.

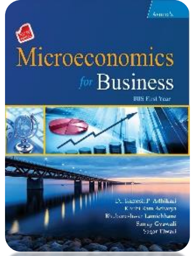


Law of Variable Proportions Contd.

Application of the Law of Variable Proportions

The law of variable proportions specially applies to the agriculture. There are some reasons why agriculture is subject to this law, which are as follows:

- The agricultural operations spread out over a wide area. Therefore, it cannot be effectively supervised.
- Scope for the use of specialized machinery is also very limited in the agricultural sector.
- Agricultural operations are affected by rain fall and climate change.

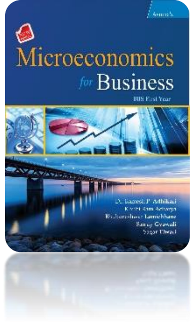


Isoquant

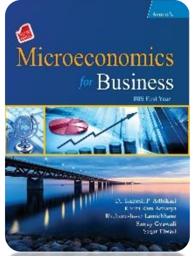
- Isoquant is defined as the locus of different combinations of any two inputs (labour and capital) which yield same level of output.
- This term 'isoquant' has been derived from a Greek word *'iso'* meaning equal and a Latin word *'quant'* meaning quantity.
- Therefore, the isoquant curve is also known as the *equal product curve* or *production indifference curve*.

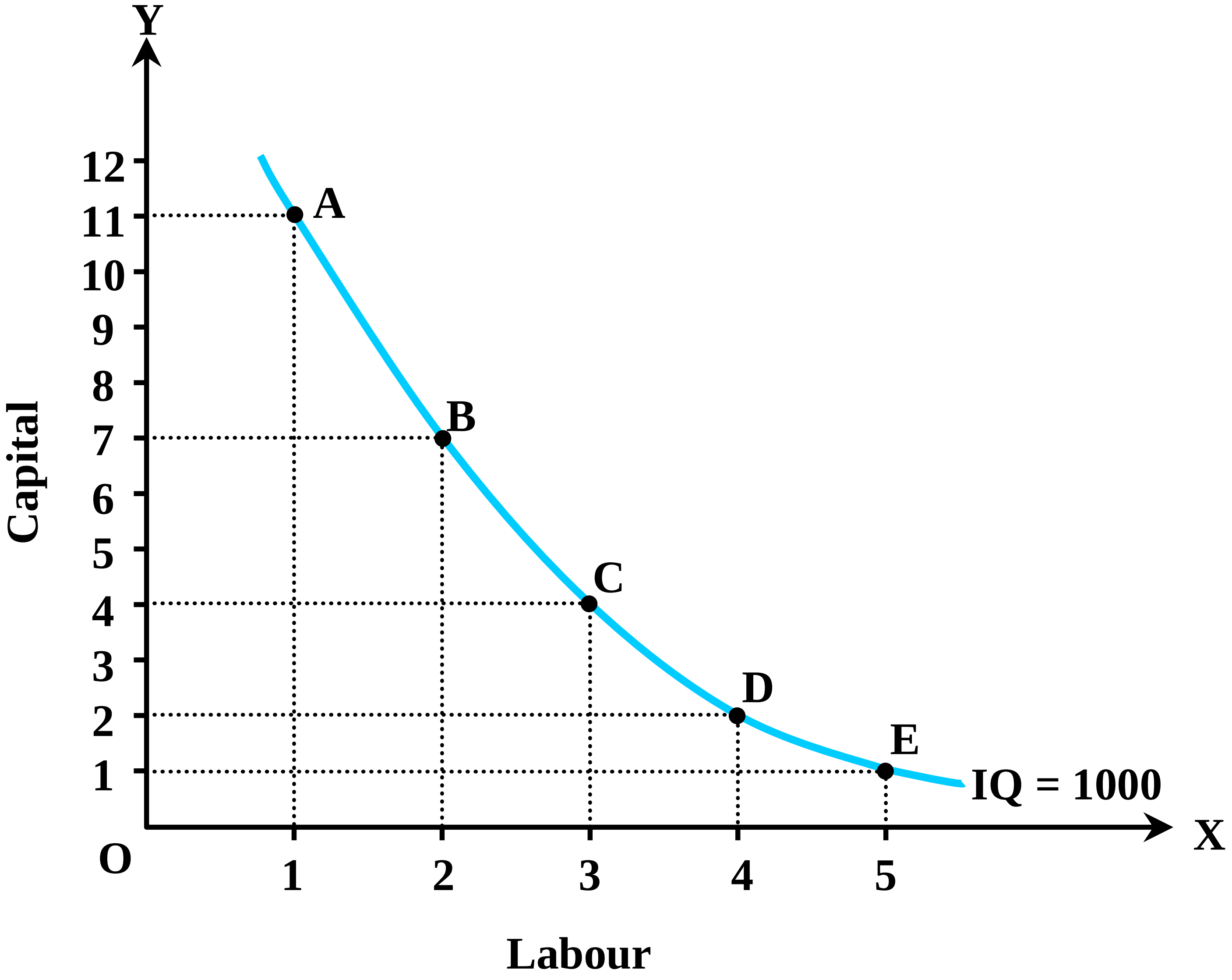
Assumptions

- The two inputs are imperfect substitute.
- Labour and capital can be substituted for one another only up to a certain limit.
- Production function is continuous, i.e. labour and capital are perfectly divisible and can be substituted in any small quantity.



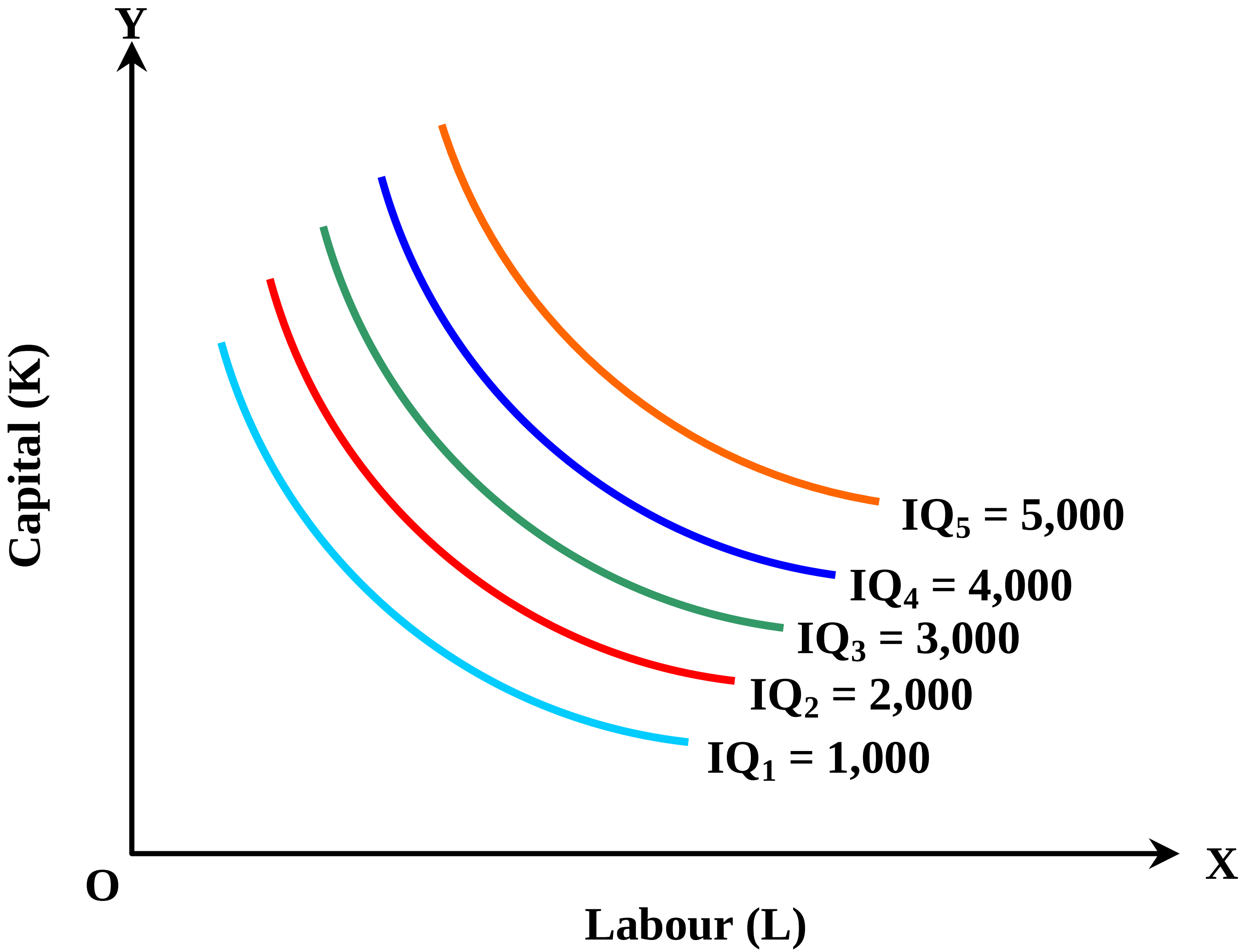
Combinations	Labours	Capital	Output
A	1	11	1,000
B	2	7	1,000
C	3	4	1,000
D	4	2	1,000
E	5	1	1,000

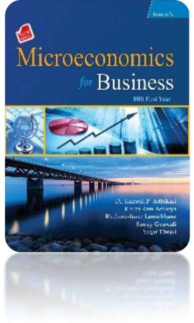

Microeconomics
for Business

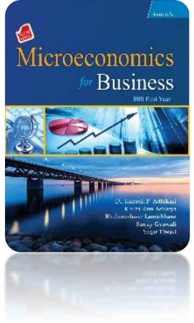

Y
12
11
10
9
8
7
6
5
4
3
2
1
O
Capital
A
B
C
D
E
IQ = 1000
X
1
2
3
4
5
Labour

Isoquant Map

The set of isoquants is called isoquant map. A higher isoquant represents higher level of output and lower isoquant represents a lower level of output.

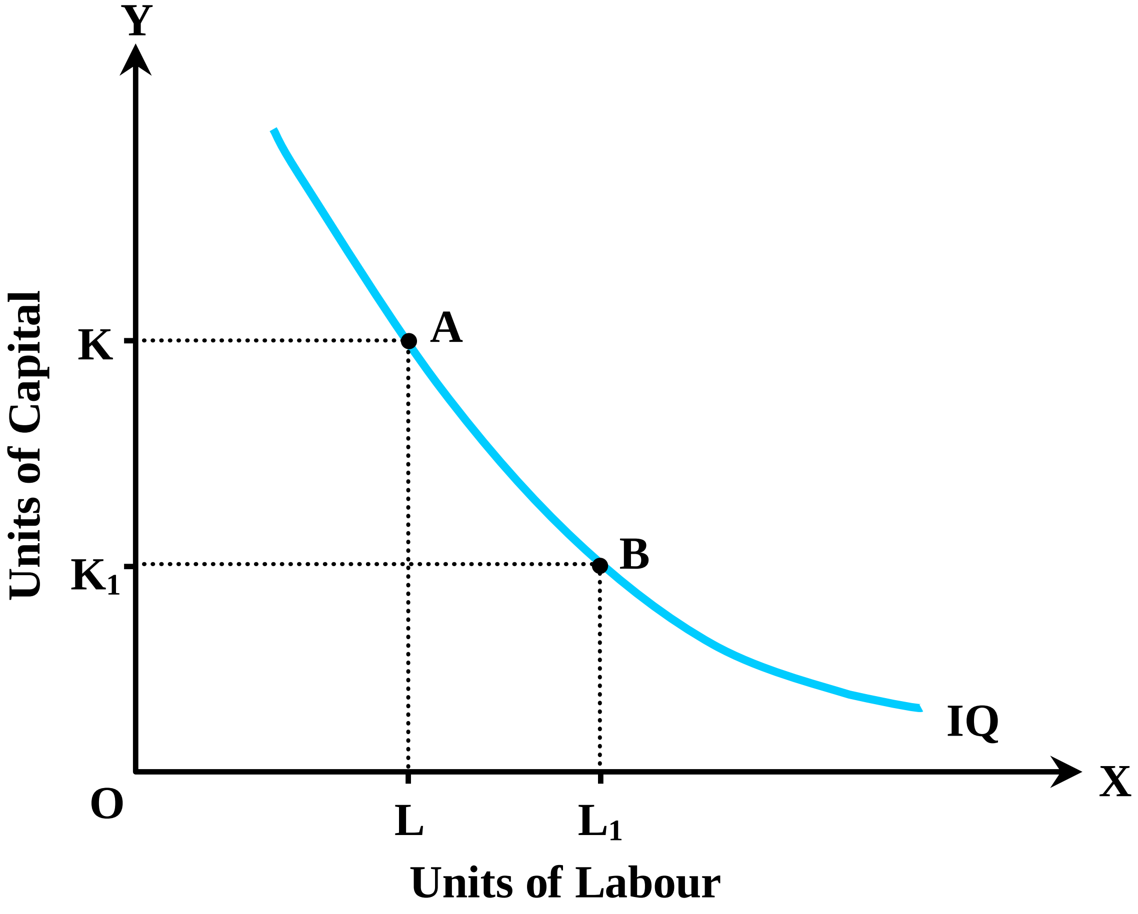






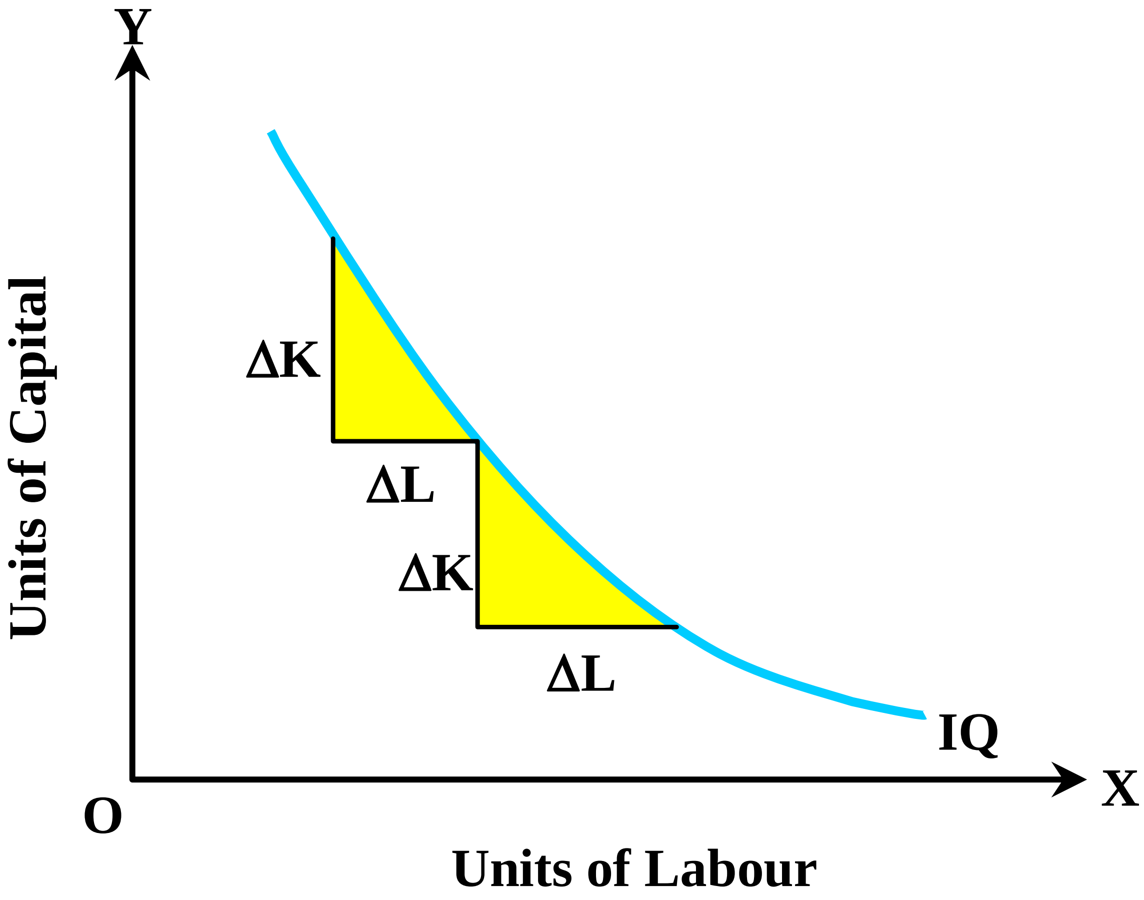
Properties of Isoquant

1. Isoquant has negative slope.



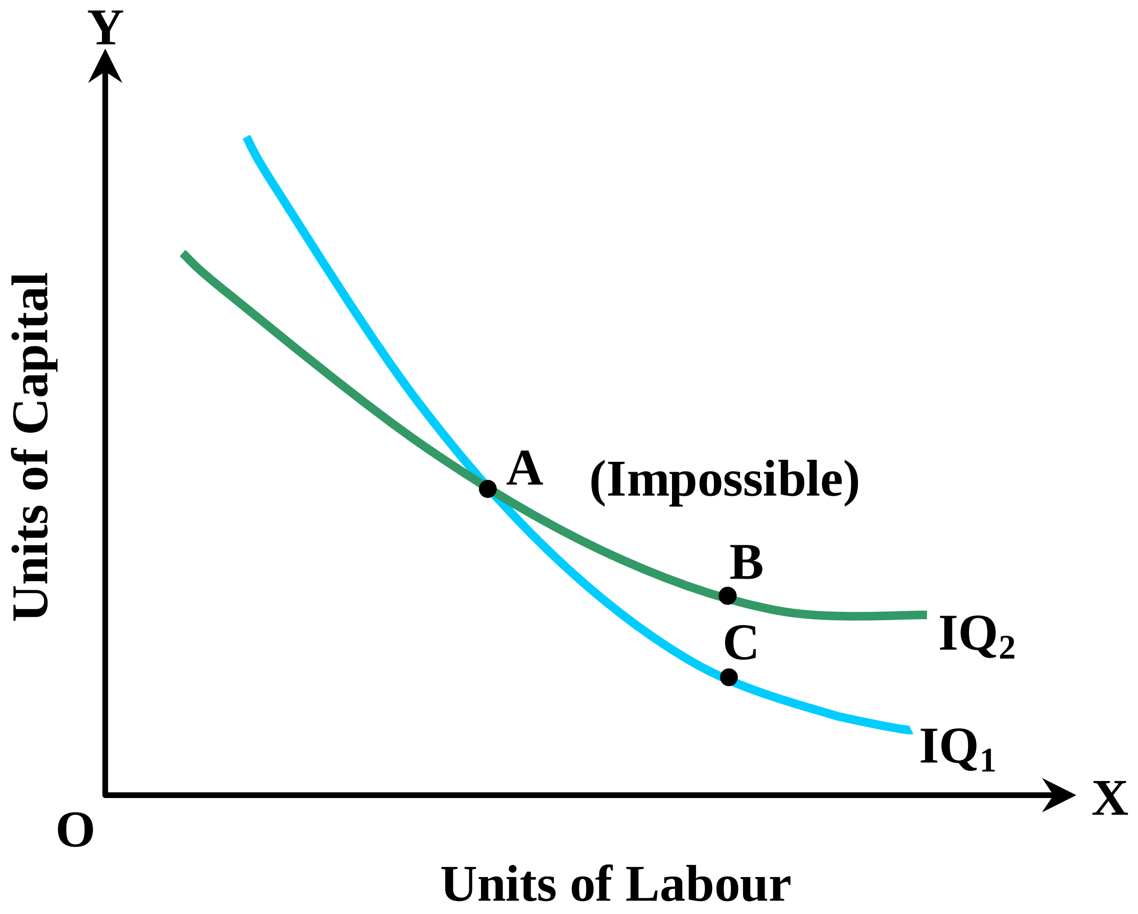
Properties of Isoquant Contd.

2. Isoquant is convex to the origin.

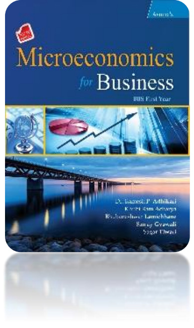


Properties of Isoquant Contd.

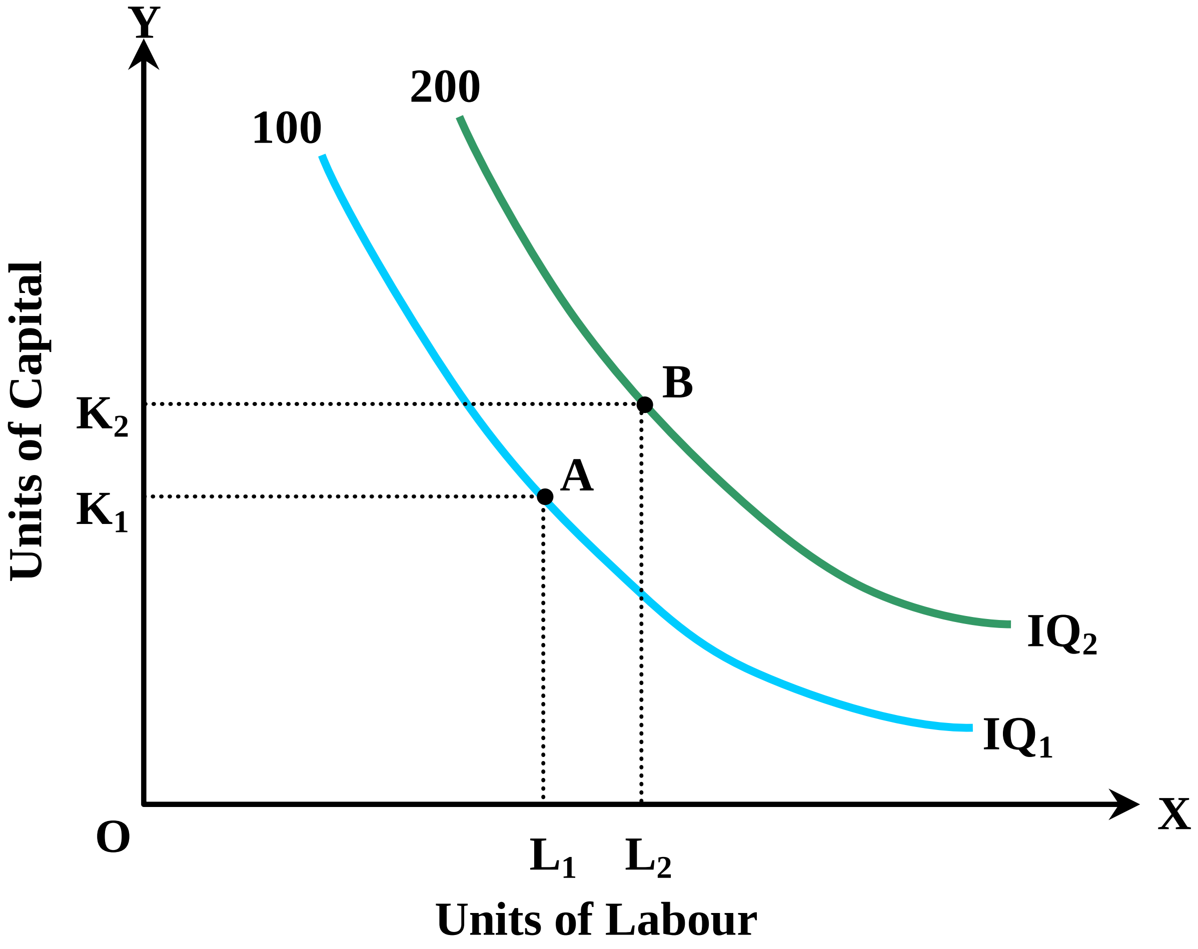
3. Isoquants never intersect with each other.

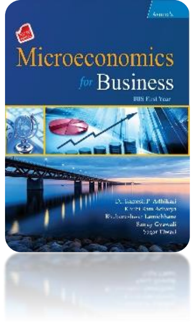


Properties of Isoquant Contd.



4. Higher the isoquant, higher will be output.





Marginal Rate of Technical Substitution (MRTS)

The marginal rate of technical substitution is defined as the rate at which one input can be substituted for another output remaining constant. In other words, marginal rate of technical substitution of labour for capital can be defined as the number of units of capital which can be replaced by one unit of labour keeping the level of output constant. Marginal rate of technical substitution is slope of the isoquant.

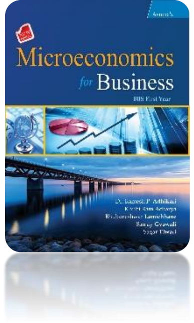
$$\mathbf{MRTS_{L,\,K} = -\frac{dK}{dL} = \frac{MP_L}{MP_K}}$$

where

$MRTS_{L,\,K}$ = Marginal rate of technical substitution of labour for capital

MP_L = Marginal productivity of labour

MP_K = Marginal productivity of capital



Factor Combinations	Units of labor	Units of Capital	$MRTS_{L,K} = -\frac{\Delta K}{\Delta L}$
A	1	11	-
B	2	7	**4**
C	3	4	**3**
D	4	2	**2**
E	**5**	**1**	**1**

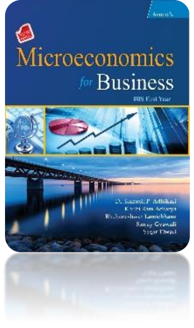
$$\text{Slope of the Isoquant} = MRTS_{L,K} = -\frac{dK}{dL} = -\frac{MP_L}{MP_K}$$

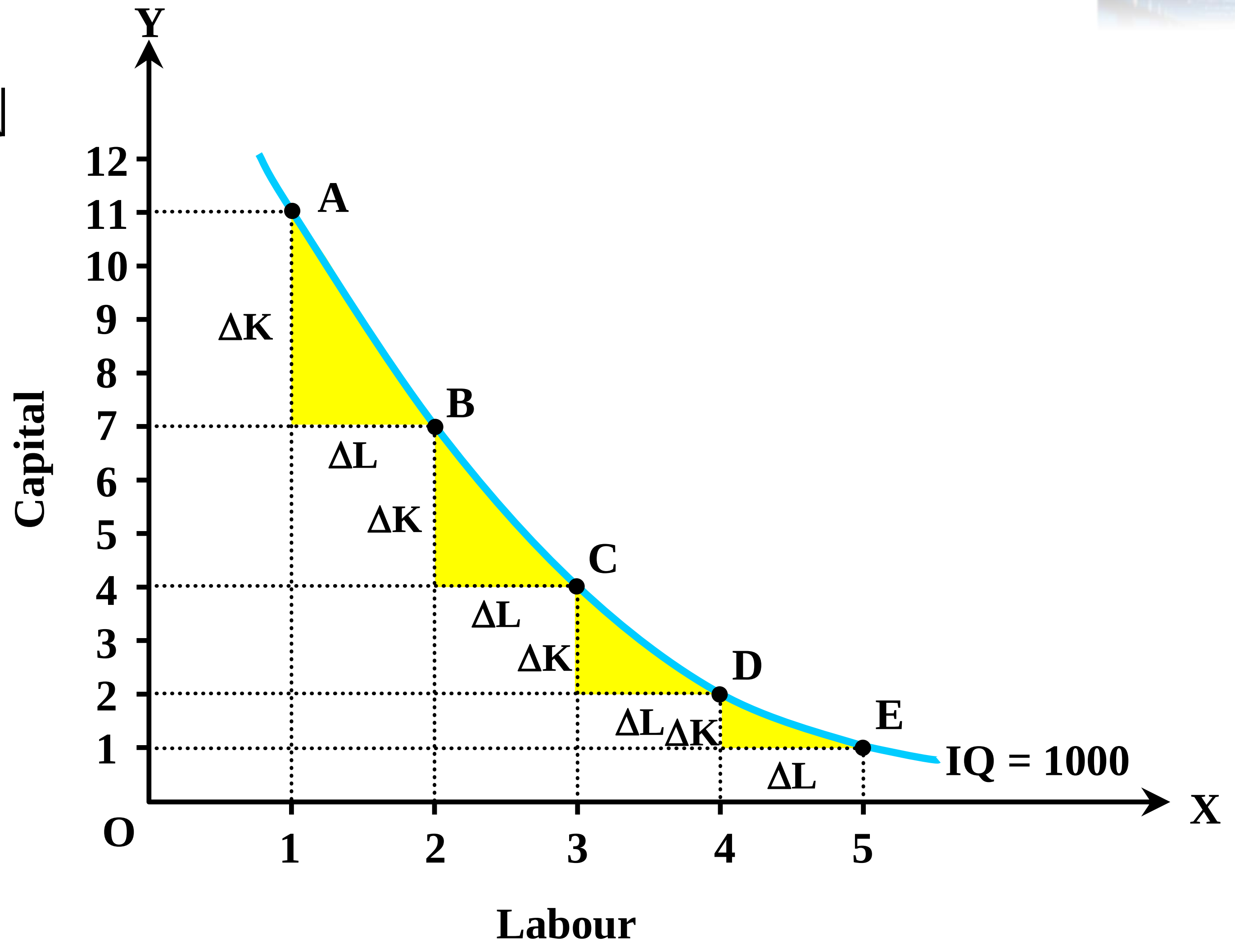
where

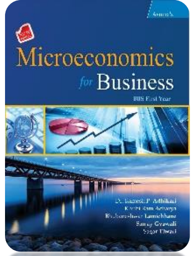
$MRTS_{L,K}$ = Marginal rate of technical substitution labour of capital

MP_L = Marginal productivity of labour

MP_K = Marginal productivity of capital







Isocost Line

Isocost line is defined as the locus of various combinations of any two inputs which the producer can get for a certain amount of money at a given prices of the factors of production or inputs. The concept of isocost line is based on the assumptions of two inputs, i.e. labour and capital; and given total cost or money outlay. Total cost or outlay is the sum of total expenditure made to purchase labour and capital. Thus,

Total outlay (C) = Total expenditure on labour + Total expenditure on capital

or, $C = P_L \cdot L + P_K \cdot K$

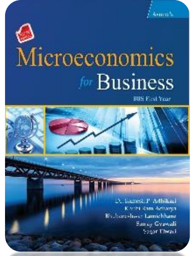
$\therefore$ $C = w \cdot L + r \cdot K$ ... (i)

where

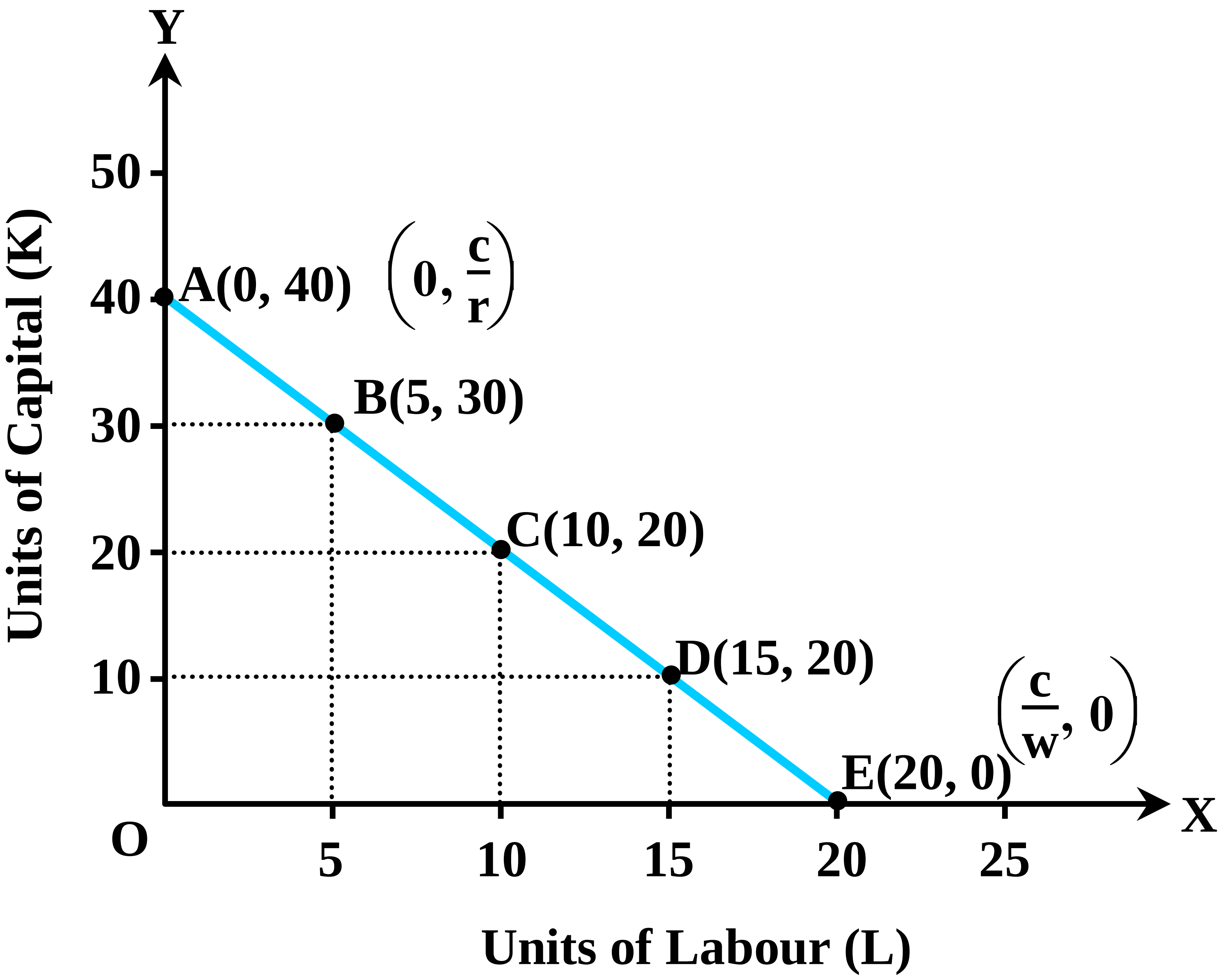
C = Total cost or outlay

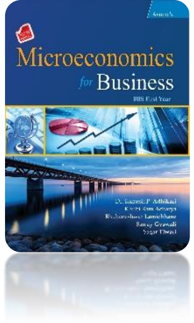
w = Wage rage (Price of labour) r = Rate of interest (Price of capital)

L = Units of labour K = Units of capital



Combinations	Price of Labour (w)	Units of Labour (L)	Price of Capital (r)	Units of Capital (K)	Cost Outlay ($C = wL + rK$)
A	Rs. 100	0	Rs. 50	40	$100 \times 0 + 50 \times 40 =$ Rs. 2,000
B	Rs. 100	5	Rs. 50	30	$100 \times 5 + 50 \times 30 =$ Rs. 2,000
C	Rs. 100	10	Rs. 50	20	$100 \times 10 + 50 \times 20 =$ Rs. 2,000
D	Rs. 100	15	Rs. 50	10	$100 \times 15 + 50 \times 10 =$ Rs. 2,000
E	Rs. 100	20	Rs. 50	0	$100 \times 20 + 50 \times 0 =$ Rs. 2,000


Y
X
O
Units of Capital (K)
Units of Labour (L)
50
40
30
20
10
5
10
15
20
25
A(0, 40)
$\left(0, \frac{c}{r}\right)$
B(5, 30)
C(10, 20)
D(15, 20)
E(20, 0)
$\left(\frac{c}{w}, 0\right)$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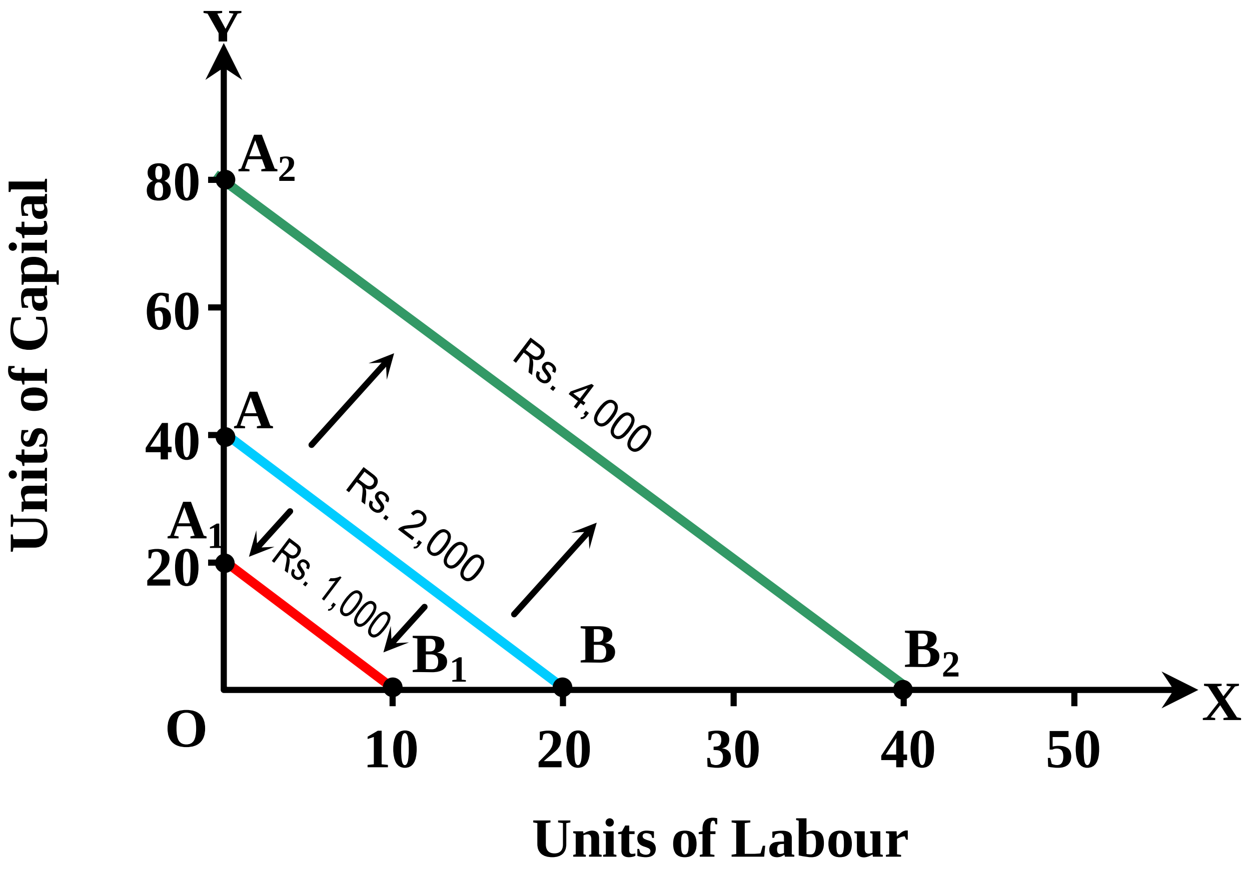
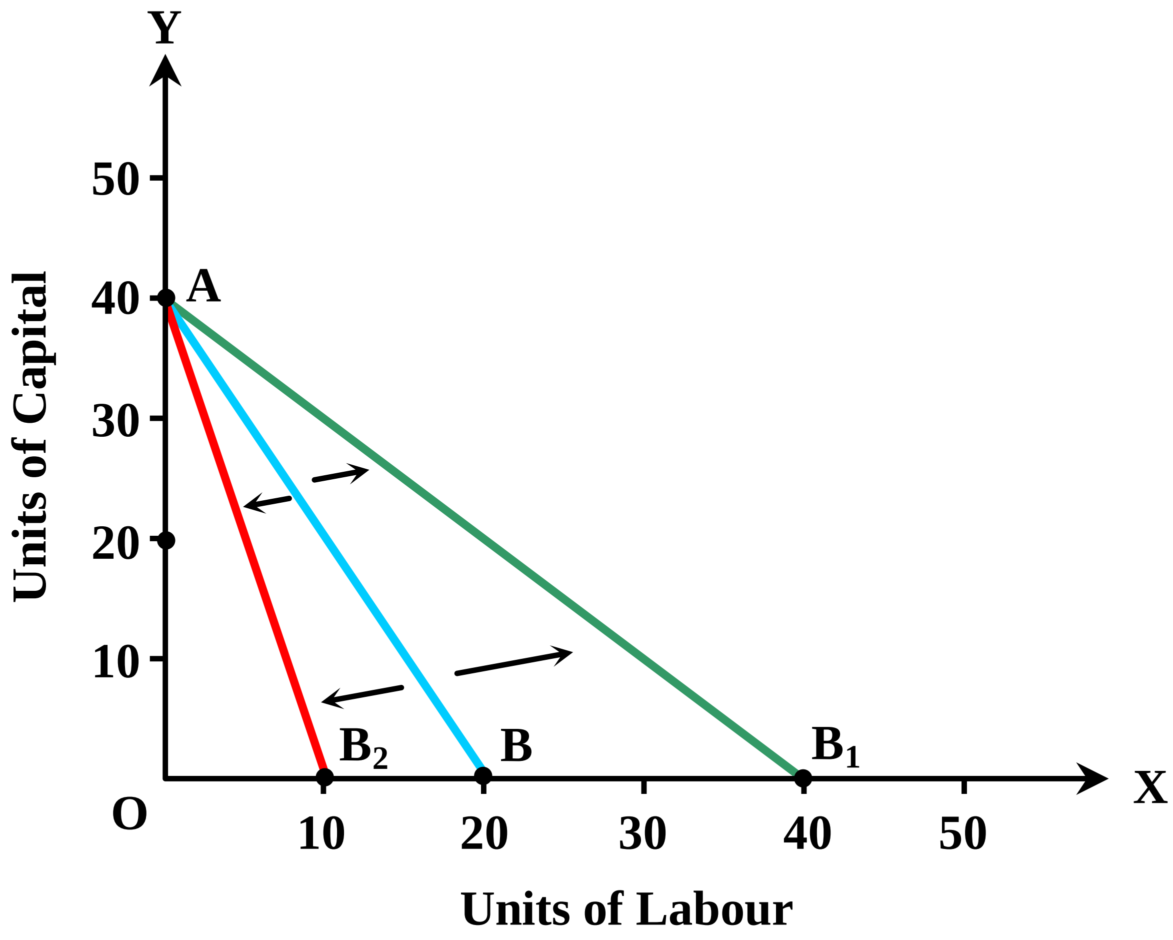
Change in Isocost Line

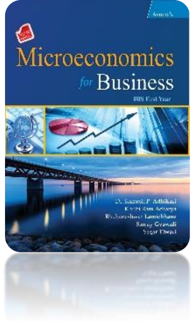
1. Effect of change in total outlay/ shift in isocost line

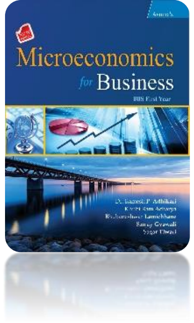


Change in Isocost Line Contd.

2. Effect of change in price of factors of production or inputs/ swing in isocost line

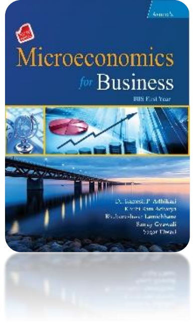






Optimum Employment of Inputs (Least Cost Combination of Two Inputs)

- Optimum employment of two inputs is also known as the least cost combination of two inputs or producer's equilibrium.
- It is assumed that a rational firm or producer always seeks to maximize profit.
- For profit maximization, the firm seeks to minimize cost of production for producing a given quantity of output or maximize output for the given level of cost outlay.
- The choice of particular combination of factors or inputs depends upon the technical possibilities of production and prices of factors of production or inputs used for the production of the particular product.
- The technical possibilities of production are represented by the isoquant map and prices of inputs used for the production of the particular products is represented by the isocost line.

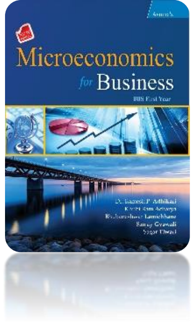


Optimum Employment of Inputs (Least Cost Combination of Two Inputs) Contd.

Assumptions

- The producer is rational, i.e. he/she seeks to maximize profit.
- The producer uses two inputs: labour and capital.
- The price of both inputs (labour and capital) is fixed or constant.
- All units of inputs are homogeneous.
- The total cost or money outlay is given.
- There is existence of perfect competition in the factor market.
- Marginal rate of technical substitution must diminish.
- There exists isoquant map in case of output maximization and family of isocost line in case of cost minimization.

Optimum Employment of Inputs (Least Cost Combination of Two Inputs) Contd.



Conditions for Equilibrium

1. **First order condition (Necessary condition):** Isoquant must be tangent to the isocost line. In other words, the slope of isoquant should be equal to slope of isocost line.

Slope of isoquant = Slope of isocost line

$$\text{or,} \quad MRTS_{L,K} = \left(-\frac{w}{r}\right)$$

$$\text{or,} \quad \left(-\frac{MP_L}{MP_K}\right) = \left(-\frac{w}{r}\right)$$

$$\text{or,} \quad \frac{MP_L}{MP_K} = \frac{w}{r}$$

$$\therefore \quad \mathbf{\frac{MP_L}{w} = \frac{MP_K}{r}}$$

where

$MRTS_{L,K}$ = Marginal rate of technical substitution of labour for capital

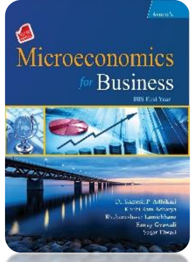
w = Wage rate or price of labour

r = Interest rate or price of capital

MP_L = Marginal productivity of labour

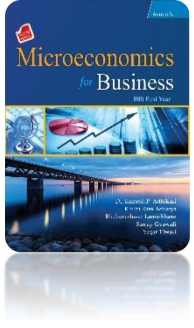
MP_K = Marginal productivity of capital

Optimum Employment of Inputs (Least Cost Combination of Two Inputs) Contd.

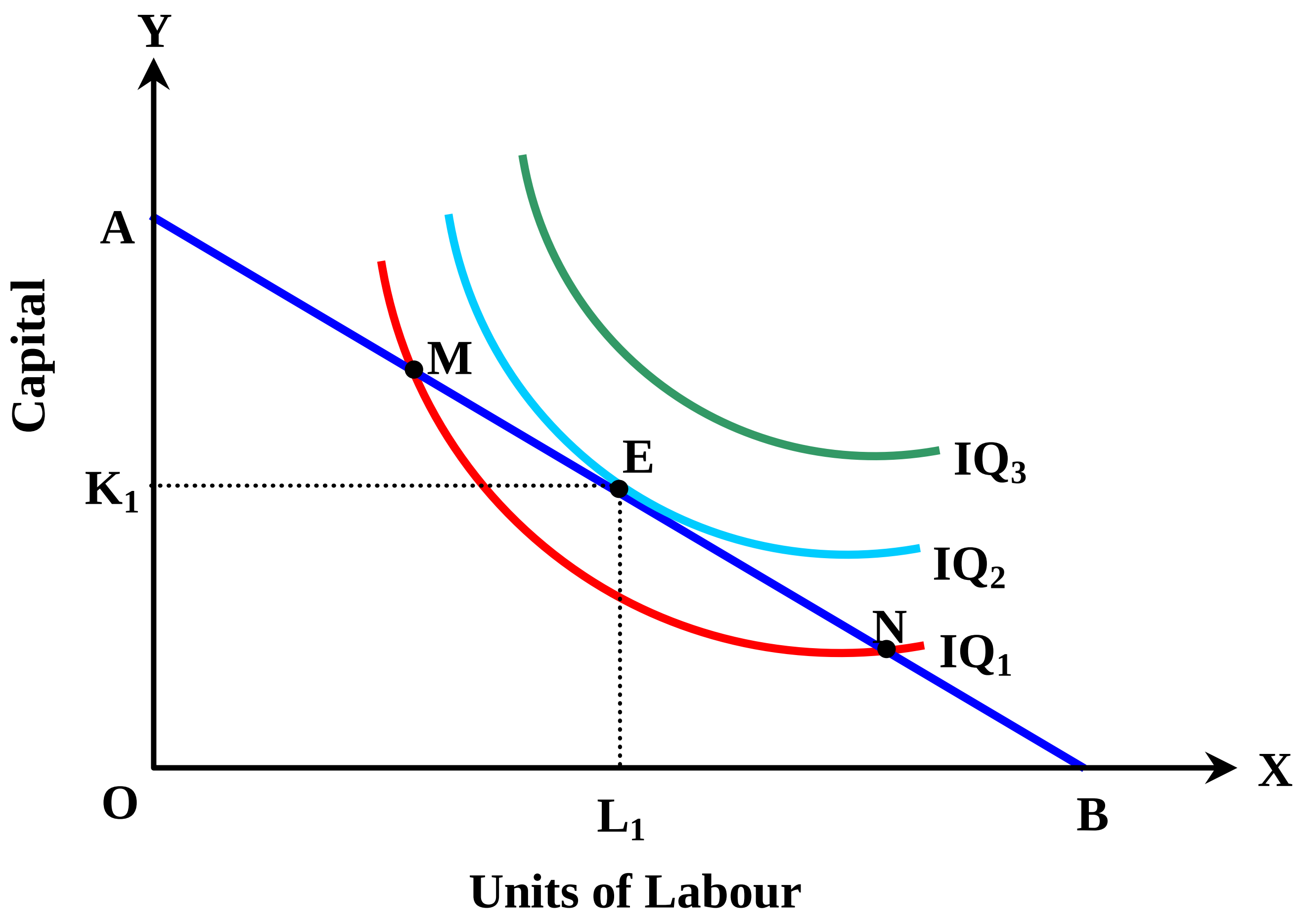


2. **Second order condition (Sufficient condition):** Isoquant must be convex to the origin at the point of tangency.

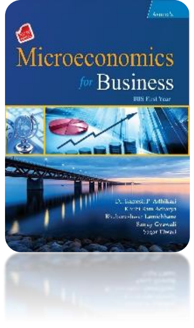
Approaches of Optimum Employment of Inputs



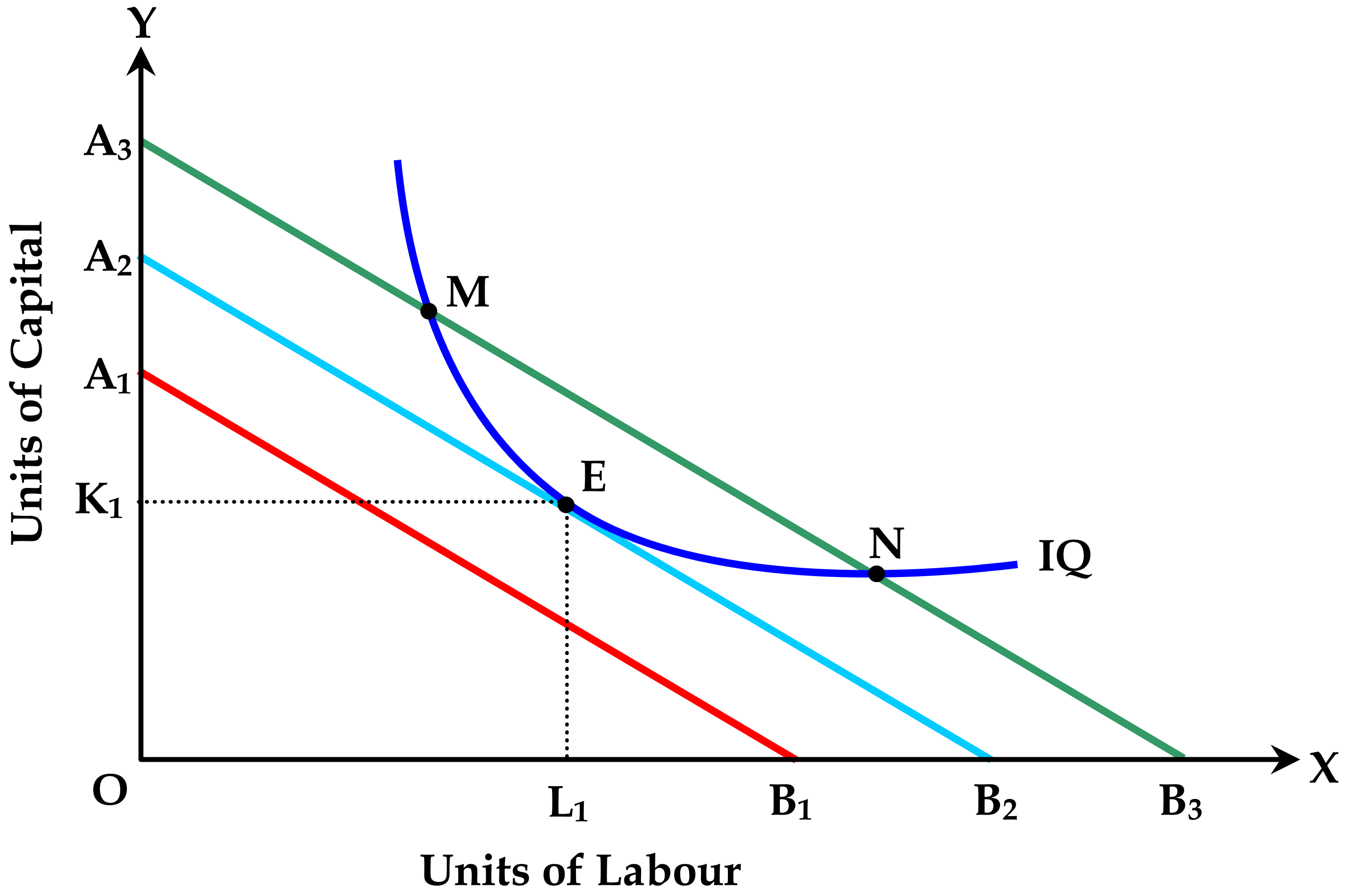
1. **Maximization of output for the given cost outlay (Output maximization subject to cost constraint or financial constraint):** A rational firm or producer seeks to maximize output at the given cost outlay. This is the situation in which the firm or producer is fixed with the resource constraint and seeks to maximize the output.



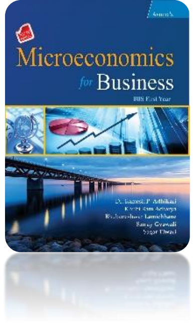
Optimum Employment of Inputs (Least Cost Combination of Two Inputs) Contd.



2. **Minimization of cost for the given level of output (Cost minimization subject to output constraint):** A rational firm or producer seeks to minimize cost at the given level of output. This is the situation in which producer or firm is faced with output constraint.



Laws of Returns to Scale

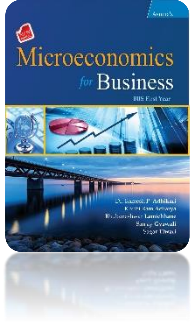


- Laws of returns to scale refers to long run input output relationship which explains how output changes when all inputs are varied in the equal proportions.
- In the returns to scale all factors of production are varied simultaneously at the same proportion.

Types of Laws of Returns to Scale

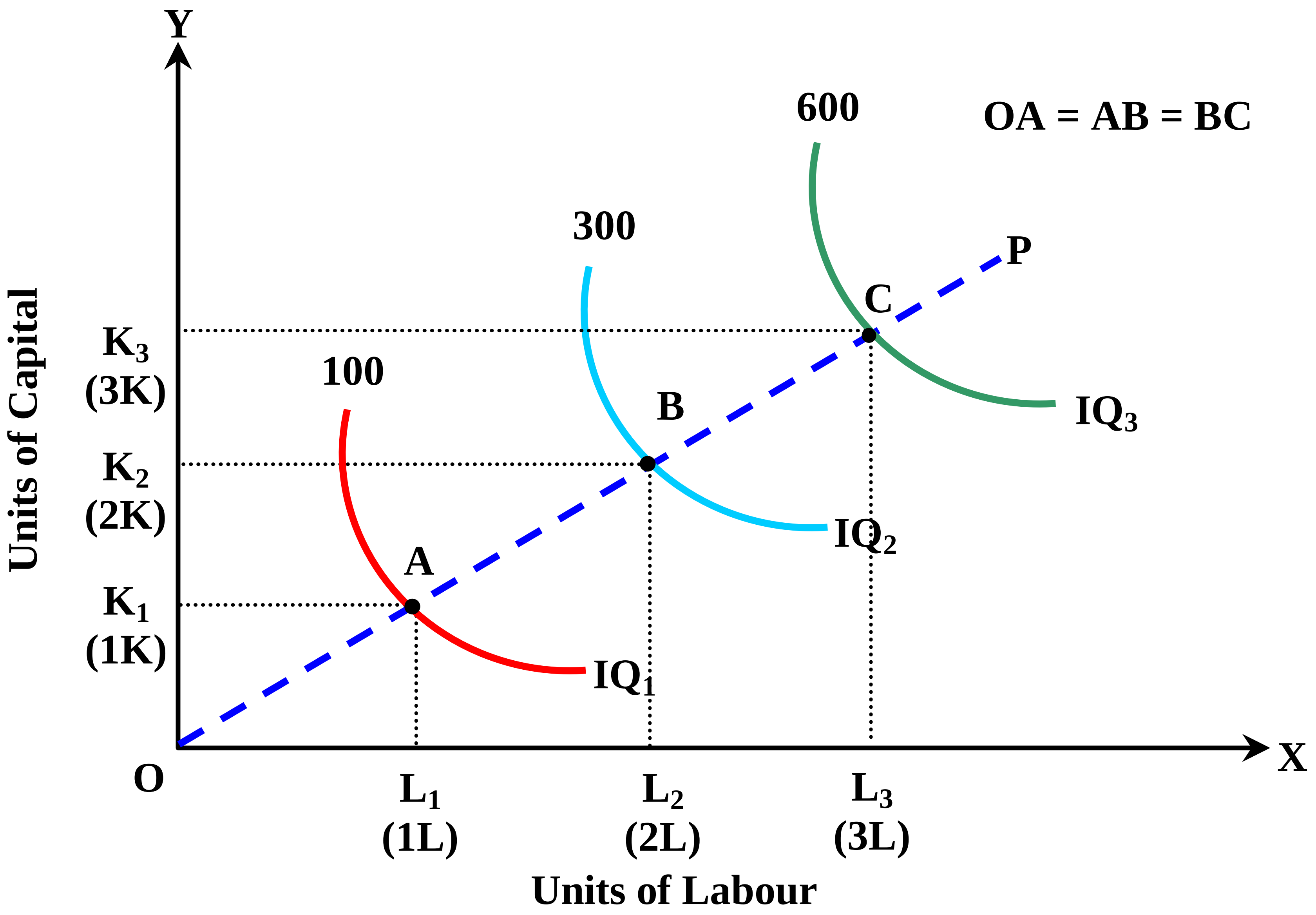
1. Increasing Returns to Scale
2. Constant Returns to Scale
3. Decreasing Returns to Scale

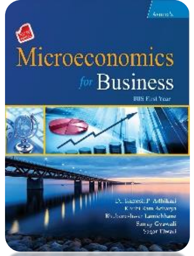
Increasing Returns to Scale



- Increasing returns to scale refers to the increase in output at a greater proportion (percentage) than the proportionate or percentage increase in inputs.
- It means that if inputs are doubled, output will be more than double and if inputs are tripled, output will be more than triple.

Combinations	Labors (L)	Capital (K)	Total Product (TP)
A	1	1	100
B	2	2	300
C	3	3	600


Y
600
OA = AB = BC
300
P
C
K3
(3K)
100
B
IQ3
K2
(2K)
IQ2
A
K1
(1K)
IQ1
Units of Capital
O
X
L1
(1L)
L2
(2L)
L3
(3L)
Units of Labour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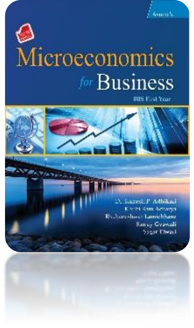
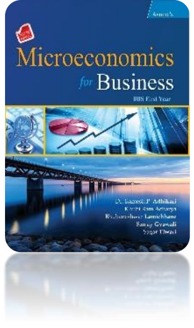
Increasing Returns to Scale Contd.



Causes of Increasing Returns to Scale

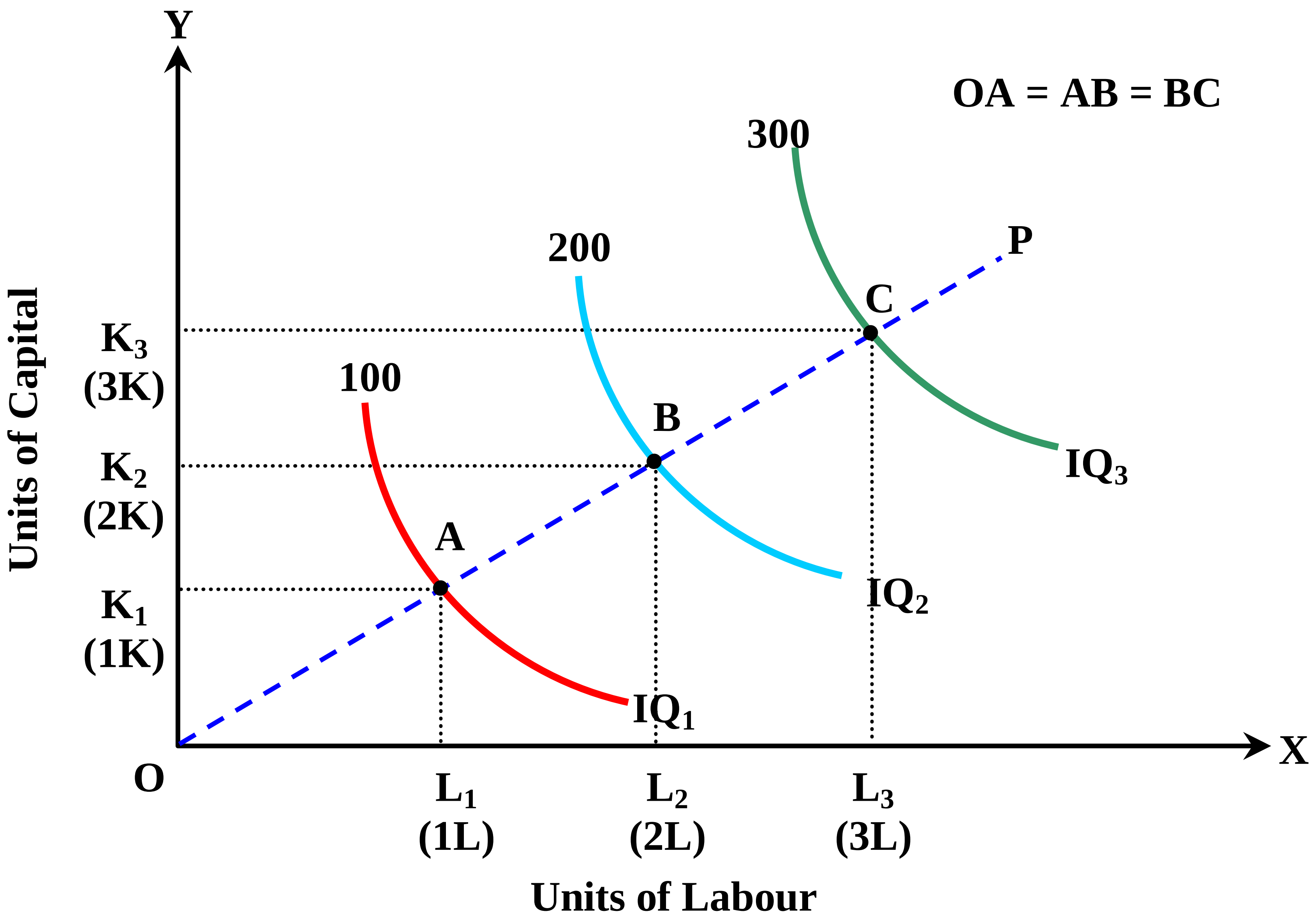
1. Technical and managerial indivisibilities
2. Higher degree of specialization
3. Dimensional relations

Constant Returns to Scale

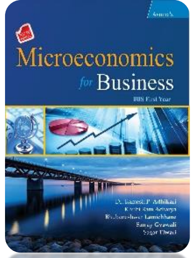


- Constant returns to scale refers to the equal proportionate or percentage change in output and inputs.
- It means that if inputs are doubled, output will be also double and if inputs are tripled, output will be also triple and so on.

Combinations	Labors (L)	Capital (K)	Total Product (TP)
A	1	1	100
B	2	2	200
C	3	3	300

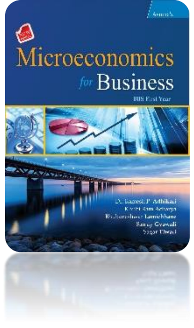

Y
OA = AB = BC
300
200
P
C
K3
(3K)
100
B
K2
(2K)
A
IQ3
IQ2
K1
(1K)
IQ1
Units of Capital
O
X
L1
(1L)
L2
(2L)
L3
(3L)
Units of Labour

Constant Returns to Scale Contd.



Causes of Constant Returns to Scale

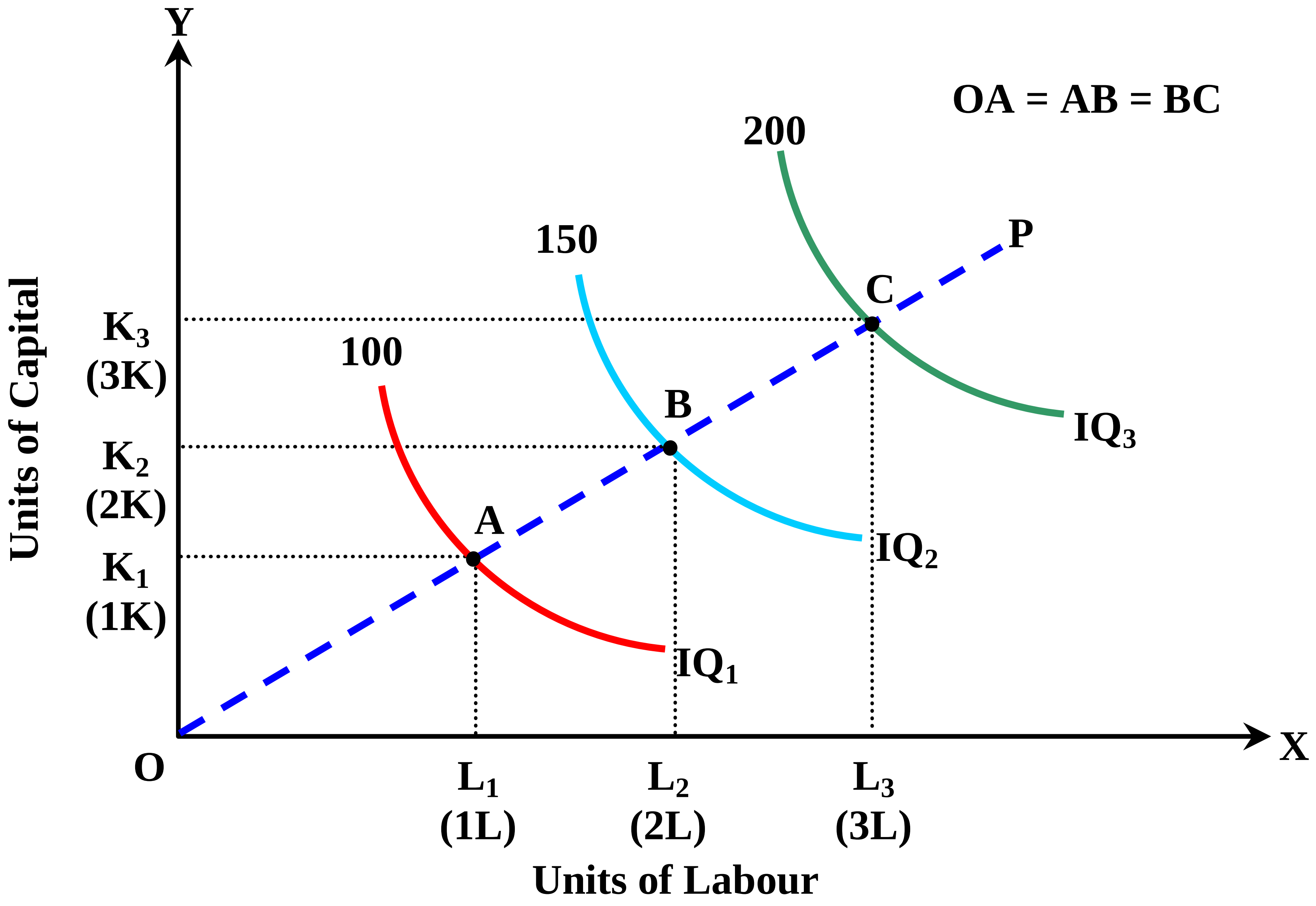
1. Limitations of economies of scale
2. Divisibility of inputs

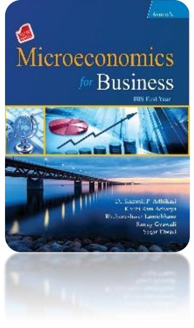


Decreasing Returns to Scale

- Decreasing returns to scale refers to increase in output at a smaller proportion or percentage than the proportionate or percentage increase in inputs.
- It means that if inputs are doubled, output will be less than double and if inputs are tripled, output will be less than triple and so on.

Combinations	Labors (L)	Capital (K)	Total Product (TP)
A	1	1	100
B	2	2	150
C	3	3	200


OA = AB = BC
Y
X
O
Units of Capital
Units of Labour
K_3 (3K)
K_2 (2K)
K_1 (1K)
L_1 (1L)
L_2 (2L)
L_3 (3L)
100
150
200
A
B
C
P
IQ_1
IQ_2
IQ_3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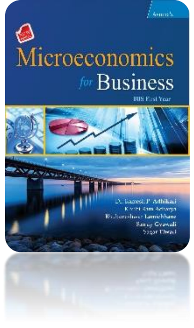
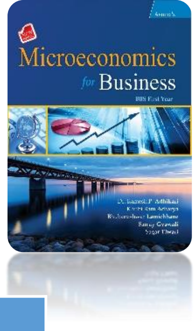
Decreasing Returns to Scale Contd.



Causes of Decreasing Returns to Scale

1. Managerial diseconomies
2. Limitedness of the natural resources
3. Labour diseconomies
4. Entrepreneurship as a fixed factor



Numerical Examples 1

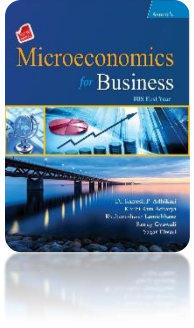
Consider the following data

No. of Labour (L)	1	2	3	4	5	6	7	8
Total Output	40	100	180	240	280	300	310	300

a. Compute AP and MP.

b. Graph TP, AP and MP and explain their relationship in reference to law of variable proportions.

c. Using schedule, explain the relationship between (i) TP and MP and (ii) AP and MP.

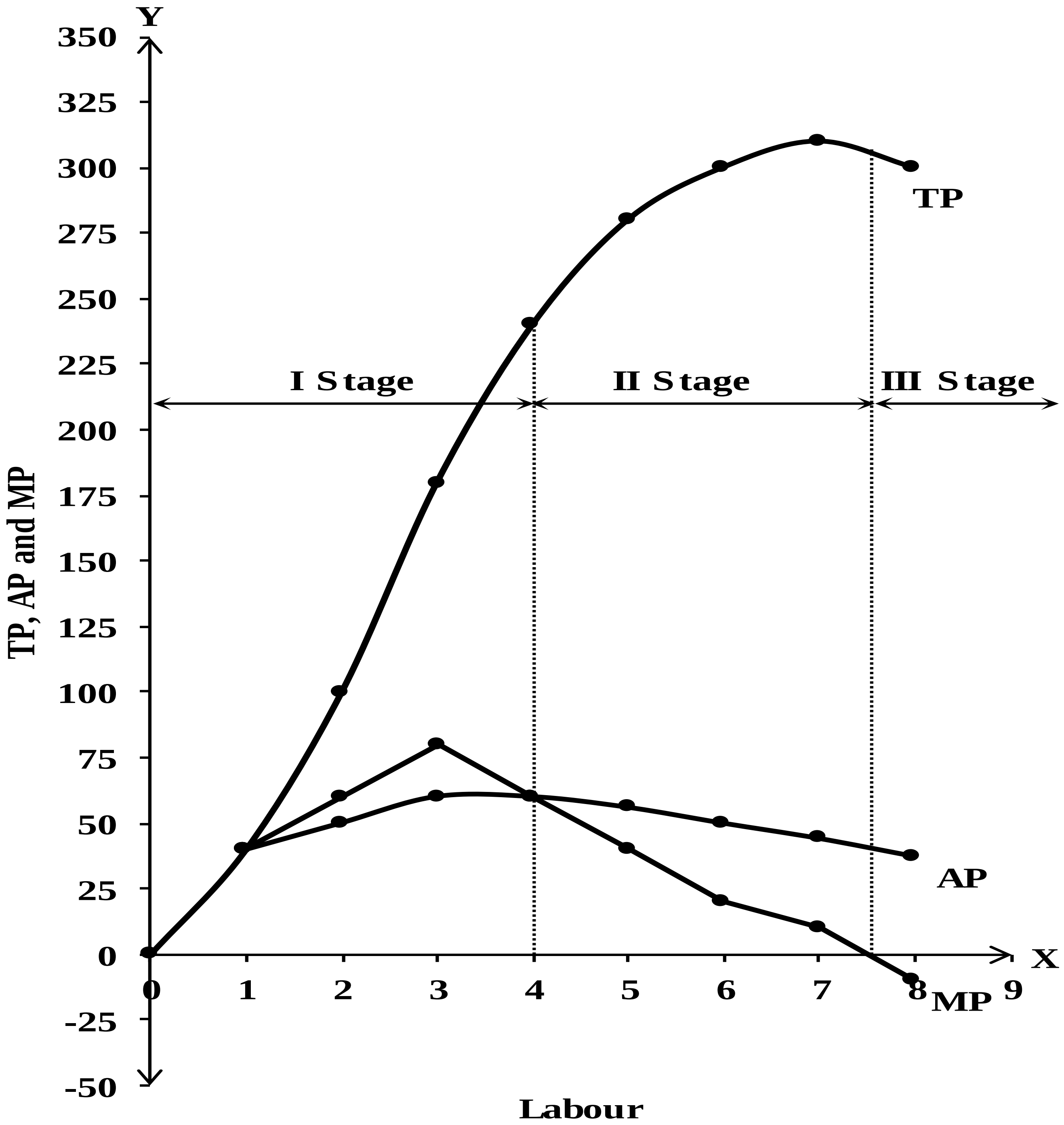


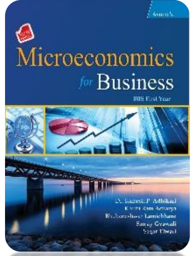
SOLUTION

a. Computation of AP and MP

Labour (Units)	TP	AP	MP
0	0	-	-
1	40	40.0	40
2	100	50.0	60
3	180	60.0	80
4	240	60.0	60
5	280	56.0	40
6	300	50.0	20
7	310	44.3	10
8	300	37.5	-10

b. Graphical Representation of TP, AP and MP.



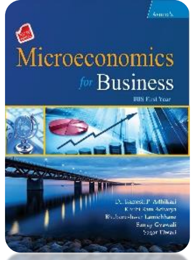


There are three stages of the law of variable proportions which are explained below:

Stage I: In this stage, TP first increases at an increasing rate up to the 3^{rd} unit of labour and increases at a diminishing rate up to the 4^{th} unit of labour. AP is increasing throughout the stage. MP first increases and after reaching its maximum starts, falling. This stage ends at the point where AP = MP. AP and MP are equal at 4^{th} unit of output.

Stage II: In this stage, TP increases at a diminishing rate. AP and MP both are decreasing. This stage ends at the point where MP = 0 or TP is the maximum.

Stage III: In this stage, TP is decreasing. Both AP and MP are decreasing. AP remains positive but MP is negative.



c. i. The relationship between AP and MP are as follows:

When AP $<$ MP, AP increases

When AP $=$ MP, AP is the maximum

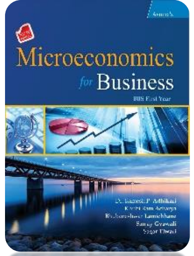
When AP $>$ MP, AP is decreasing.

ii. The relationship between TP and MP are as follows:

When MP > 0, TP is increasing.

When MP $= 0$, TP is at its maximum.

When MP < 0, TP is decreasing.



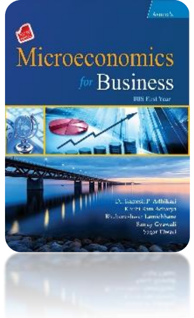
Numerical Examples 2

Using the production function, $Q = 16L + 8L^2 - L^3$, answer the following:

a. Compute TP, AP and MP schedules.

b. Draw TP, AP and MP and explain the three stages of production or law of variable properties.

c. Using production schedule, explain the relationship between AP and MP.

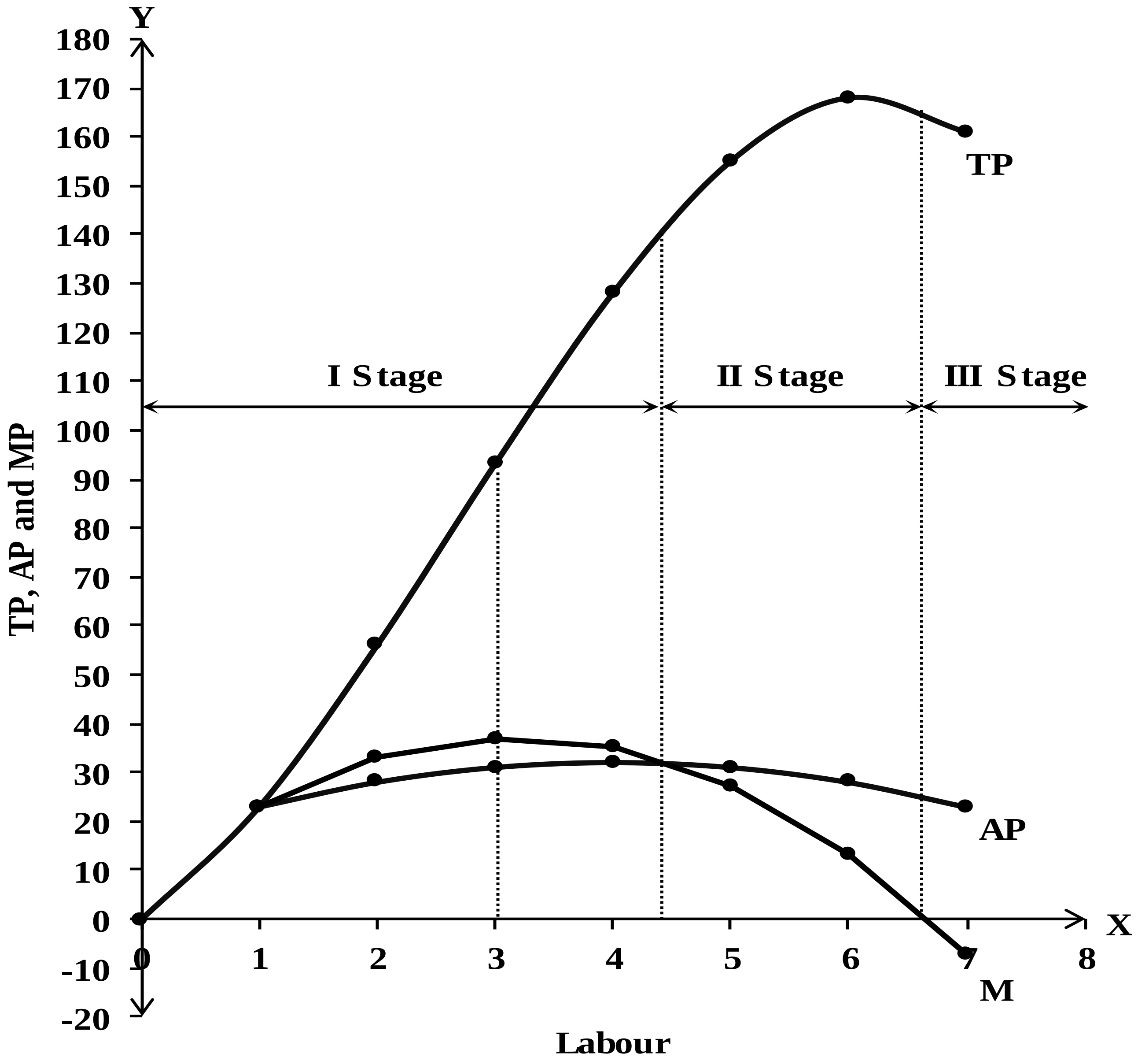


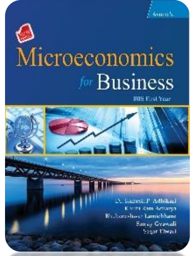
SOLUTION

a. TP, AP and MP schedules has been computed as follows:

Labour (Units)	$TP = Q = 16L + 8L^2 - L^3$	AP	MP	Stages of Production
0	$16 \times 0 + 8 \times 0^2 - 0^3 = 0$	-	-	I Stage
1	$16 \times 1 + 8 \times 1^2 - 1^3 = 23$	23	23	
2	$16 \times 2 + 8 \times 2^2 - 2^3 = 56$	28	33	
3	$16 \times 3 + 8 \times 3^2 - 3^3 = 93$	31	37	
4	$16 \times 4 + 8 \times 4^2 - 4^3 = 128$	32	35	II Stage
5	$16 \times 5 + 8 \times 5^2 - 5^3 = 155$	31	27	
6	$16 \times 6 + 8 \times 6^2 - 6^3 = 168$	28	13	
7	$16 \times 7 + 8 \times 7^2 - 7^3 = 161$	23	-7	III Stage

b. Based on the above schedule, TP, AP and MP curves can be drawn as follows:



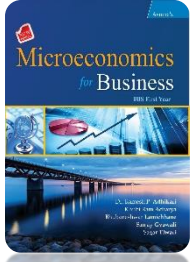


Based on the above table and schedule, three stages of production can be explained as follows:

i. **First stage (Stage of increasing returns):** In this stage, TP increases at an increasing rate up to 3rd unit of labour and increases at the decreasing rate with increase in units of labour. AP increases throughout the stage. MP increases up to 3rd unit of labour and thereafter, it declines. This stage ends when AP = MP.

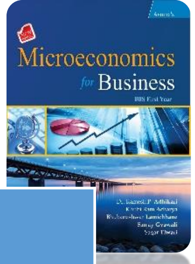
ii. **Second stage (Stage of diminishing returns):** In this stage, TP increases at the diminishing rate. At 6th unit of labour, TP is maximum. Both AP and MP are decreasing. At the end of the stage, when TP is maximum, MP = 0.

iii. **Third stage (Stage of negative returns):** In this stage, TP is continuously decreasing. AP is also continuously decreasing but never becomes zero and negative. MP is negative.



c. The relationship between AP and MP is as follows:

- When AP > MP up to 3rd unit of output, AP is increasing.
- At the labour range of 3rd unit to 4th unit, AP increasing but MP is decreasing.
- At the labour range of 4th unit to 7th unit, both AP and MP are declining. MP is negative at 7th unit of labour.



Numerical Examples 3

Consider the following three production preference schedules:

Schedule I				Schedule II				Schedule III			
Combina-tions	K	L	Out-put	Combina-tions	K	L	Out-put	Combina-tions	K	L	Out-put
A	1	20	1000	E	1	22	1200	M	1	27	1500
B	2	16	1000	F	2	17	1200	N	2	22	1500
C	3	13	1000	G	3	14	1200	O	3	18	1500
D	4	12	1000	H	4	13	1200	P	4	17	1500

Suppose, a producer has fixed total cost outlay equal to Rs. 2000. Prices of labour per units and capital per unit are Rs. 100 and Rs. 200 respectively.

a. Compute total cost for each combinations containing in each production preference schedule and identify least cost combination which maximize output at given total cost outlay.

b. Sketch an iso-cost line and IQ map and identify that which combination of capital and labour will put the producer at an optimum point.

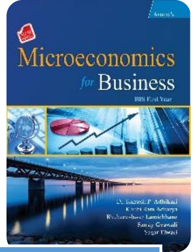
SOLUTION

Given

Total cost outlay (C) = 2000

Price of labour (P_L or w) = Rs. 100

Price of capital (P_K or r) = Rs. 200



a. Calculation of Total Cost

Schedule	Combination	K	P_K	L	P_L	Total Outlay ($P_K . K + P_L . L = C$)
i	A	1	200	20	100	200 × 1 + 100 × 20 = 2200
	B	2	200	16	100	200 × 2 + 100 × 16 = 2000
	C	3	200	13	100	200 × 3 + 100 × 13 = 1900
	D	4	200	12	100	200 × 4 + 100 × 12 = 2000
ii.	E	1	200	22	100	200 × 1 + 100 × 22 = 2400
	F	2	200	17	100	200 × 2 + 100 × 17 = 2100
	G	3	200	14	100	200 × 3 + 100 × 14 = 2000
	H	4	200	13	100	200 × 4 + 100 × 13 = 2100
iii.	M	1	200	27	100	200 × 1 + 100 × 27 = 2900
	N	2	200	22	100	200 × 2 + 100 × 22 = 2600
	O	3	200	18	100	200 × 3 + 100 × 18 = 2400
	P	4	200	17	100	200 × 4 + 100 × 17 = 2500

As shown in the above schedule least cost combinations of two inputs are C, G and O respectively. However, given the total outlay combinations G is the optimal combination. It is the highest possible combinations producing 1200 units at the given prices of two inputs that is P_K = Rs. 200 and P_L =Rs. 100.

b. If $L = 0$, $K = \frac{C}{P_K} = \frac{2,000}{200} = 10$ units

Hence, A(0, 10)

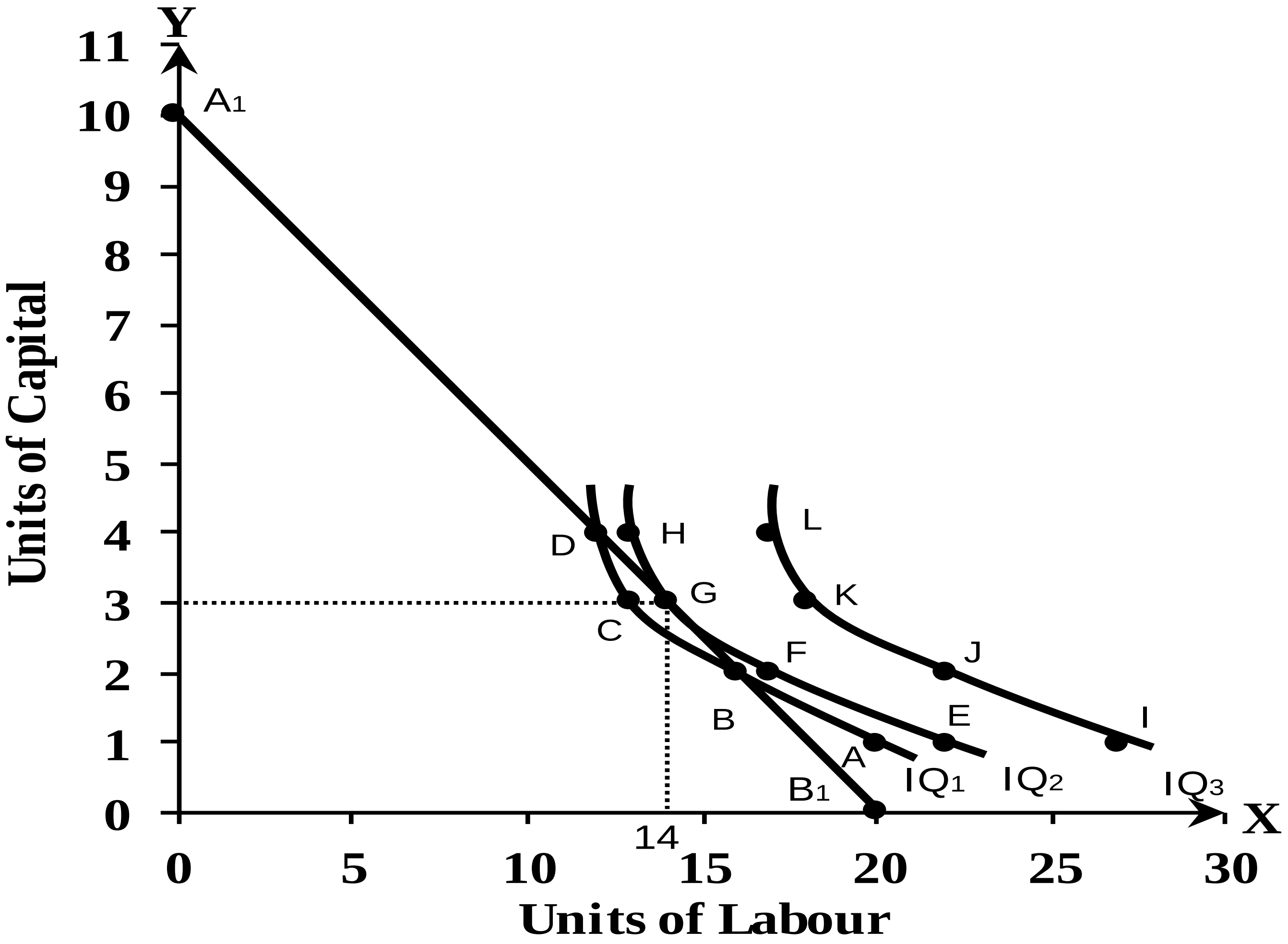
If $K = 0$, $L = \frac{C}{P_L} = \frac{2,000}{100} = 20$ units

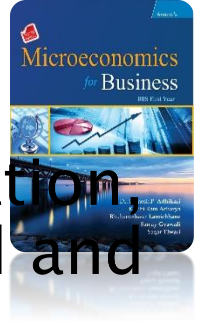
Hence, B (20, 0)

This gives isocost cost line A_1B_1, which is shown in the following figure.:

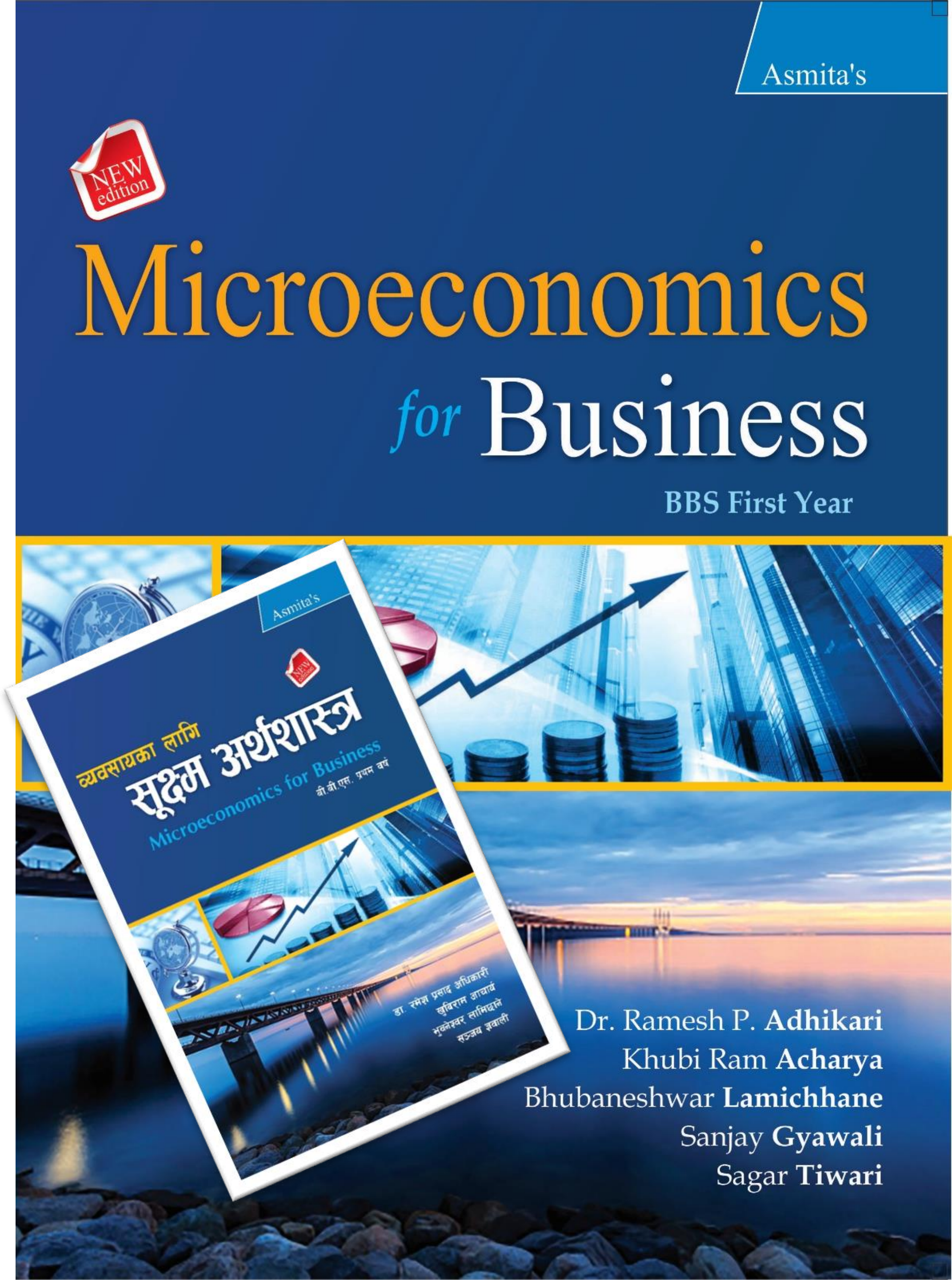
Now, plotting these points and the given production schedules, we get equilibrium point as show in the following figure.

In the figure, a producer is in equilibrium at point F. In this situation, he produces 1200 units of output by employing 3 units of capital and 14 units of labour.





Thank You



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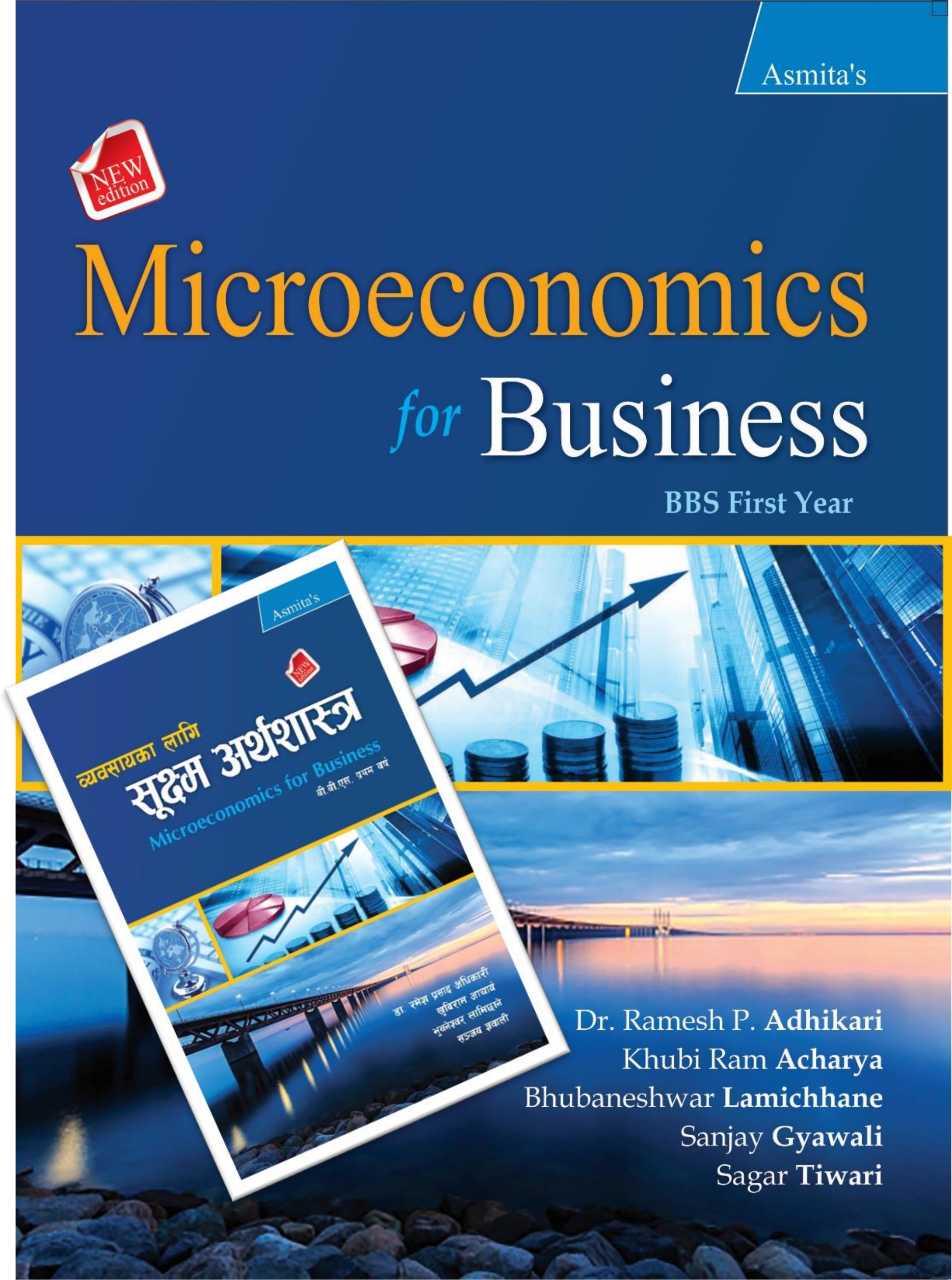
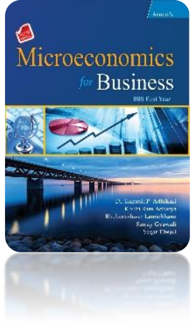
Cost and Revenue Curves

Unit 6

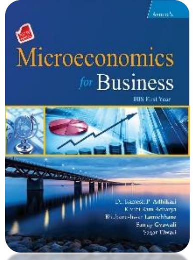




Learning Objectives

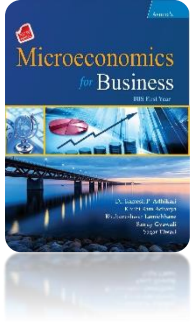
On completion of this unit, students will be able to:

- describe the cost function
- define cost and its various concepts
- derive short run and long run cost curves
- explain the relationship between AC and MC
- describe economies and diseconomies of scale
- describe the economies of scope
- explain the various concepts of revenue
- derive revenue curves under the different market conditions
- explain the relationship between price elasticity of demand, marginal, average and total revenue.



Introduction

- A firm has to play dual role of a producer and a seller.
- As a producer, it attempts to minimise cost of production and as a seller, it attempts to maximize the revenue.
- The ultimate goal of the producer is to maximise the profit.
- It is possible only through maximization of revenue or minimization of cost or both.
- In the modern competitive world, the producer maximizes the profit by the minimization of cost.
- The maximization of profit by the revenue maximization is the traditional approach. In this unit, we study cost and revenue.



Theory of Cost

Cost Function

- Cost function shows the relationship between cost of production and the level of production.
- Cost of production is influenced by various variables like level of output, price of inputs, technology, etc.
- The cost function is expressed as

$$C = f(Q, P_f, T)$$

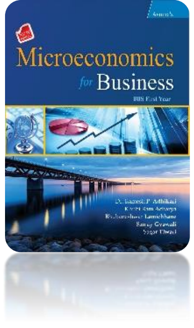
where

C = Cost of production T = Technology

P_f = Price of inputs or factors of production Q = Quantity of output

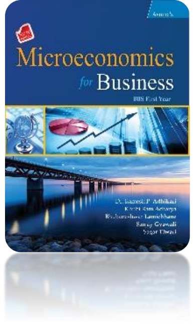
- Although, cost of production is influenced by various factors, for simplicity we assume that cost of production is the function of level of output. It is expressed as

$$C = f(Q)$$



Concept of Cost

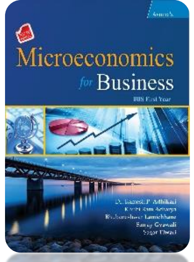
- Cost is defined as the money expenditure incurred on factors of production while producing a commodity.
- In order to produce goods and services, a firm uses raw materials and various factors of production, which are called inputs.
- The expenditure incurred on these inputs is called cost.
- In other words, cost refers to all sorts of monetary expenditures incurred in the production of a commodity.



Different Concepts of Cost

1. Implicit and Explicit Cost
   a. **Implicit cost:** Implicit cost is defined as the value of factor inputs owned and used by the firm or the entrepreneur in its own production process.
   b. **Explicit cost:** Explicit cost is defined as the payment made by a firm for the use of inputs purchased or hired from outside or others.
2. Accounting and Economic Cost
   a. **Accounting cost:** Accounting cost is defined as the cost that involves direct payment of money by entrepreneur to the various factors of production.
   b. **Economic cost:** The accountants consider those costs, which involve cash payment by the entrepreneur or the firm to others.

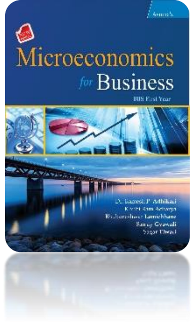
Different Concepts of Cost Contd.



3. Historical and Replacement Cost
   a. **Historical cost:** Historical cost is defined as the actual monetary value of inputs like raw materials, machineries, etc. at the time they were purchased or produced rather than their current value.
   b. **Replacement Cost:** Replacement cost is defined as the expenditure that would have incurred if that asset was purchased now.
4. Separable and Common Cost
   a. **Separable cost:** Separable cost is defined as the cost that can be easily known to a product, a division or a process.
   b. **Common cost:** Common cost is defined as the cost that cannot be known to any one unit of operation.
5. Opportunity Cost

   Opportunity cost is defined as the loss of income due to opportunity foregone

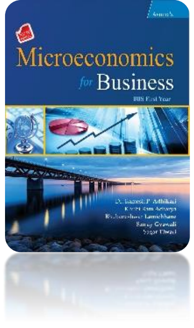
Short Run Costs



- Short run is a period of time in which the firm can vary its output by varying only the amount of variable factors, such as labour and raw materials.
- In the short-run, fixed factors, such as capital, equipment, top management, etc. cannot be changed to change the level of output.
- The Short-run costs are those costs, which are incurred by the firm during a period in which some factors, especially capital equipment, land and management are held constant.
- The short-run costs are incurred on the purchases of labour, raw materials, fuel, etc. which vary with the change in the level of output.

Cost-Output Relationship

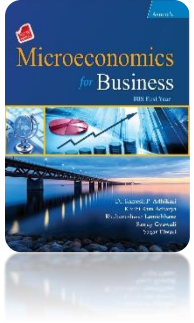
- The cost theory explains with how cost of production changes with



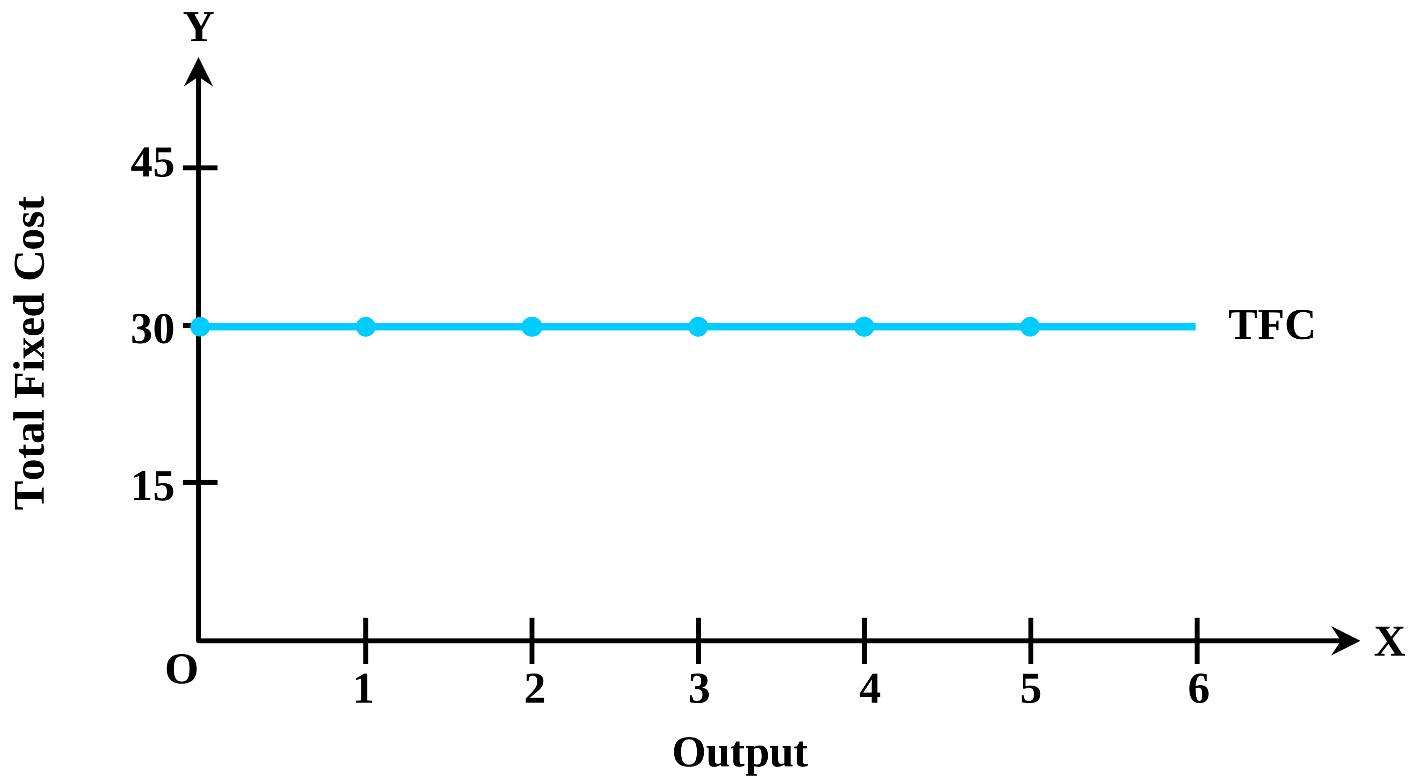
Derivation of Short-Run Total Cost Curves

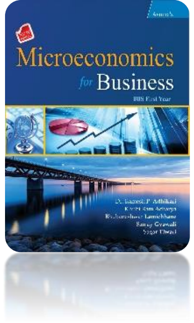
1. Total Fixed Cost (TFC)

- Total fixed cost is defined as the total expenses incurred by fixed factors of production.
- Fixed factors are those factors, which cannot be changed in short run.
- The fixed cost remains unchanged, whatever be the level of output.
- Even if there is no output at a time, this cost will have to be incurred.
- Fixed cost includes rent of factory, salaries payment of permanent employees, interest on capital, insurance premium, license fee, etc.



Output (in units)	TFC (in Rs.)
0	30
1	30
2	30
3	30
4	30
5	30


Y
45
30
15
Total Fixed Cost
TFC
O
1
2
3
4
5
6
X
Output

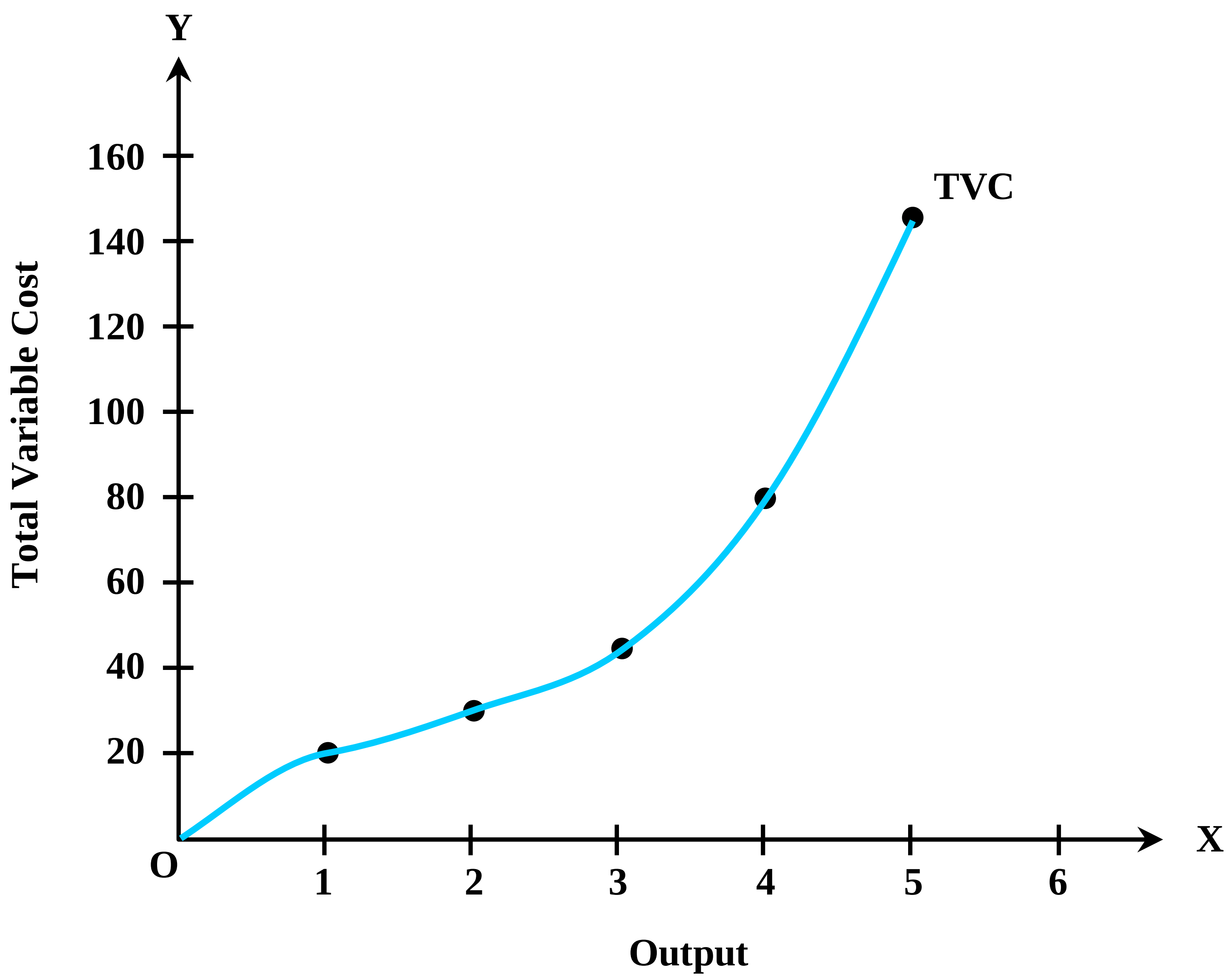


Derivation of Short-Run Total Cost Curves Contd.

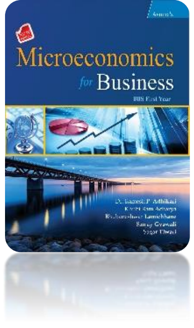
2. Total Variable Cost (TVC)

- Total variable cost is defined as the total expenses incurred on variable factors of production.
- Variable factors are the factors, which change with the change in output.
- Thus, variable cost is that cost which changes with the change in output.
- Variable cost includes the cost of raw materials, wages of labour, cost of fuel, etc.
- If the output increases, the total variable cost will increase.
- If the output decreases, the total variable cost will decrease.
- If the output is zero, the total variable cost will also be zero.

Output (in units)	TVC (in Rs.)
0	0
1	20
2	30
3	45
4	80
5	145


Y
160
140
120
100
80
60
40
20
Total Variable Cost
TVC
O
1
2
3
4
5
6
X
Output

Derivation of Short-Run Total Cost Curves Contd.

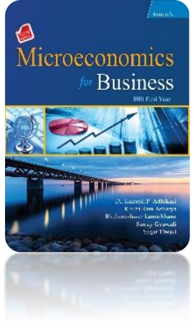


3. Total Cost (TC)

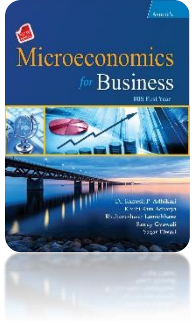
- Total cost is defined as the total monetary expenditures incurred in the production of a commodity.
- In other word, it is the sum of total fixed cost and total variable cost.
- When quantity of output is zero, total cost will be equal to total fixed cost because total variable cost will be zero.

$$TC = TFC + TVC$$

- Initially, total cost increases at a decreasing rate and then increase at an increasing rate.
- Like variable cost total cost also changes with the change in output.



Output (in units)	TFC (in Rs.)	TVC (in Rs.)	TC
0	30	0	30
1	30	20	50
2	30	30	60
3	30	45	75
4	30	80	110
5	30	145	175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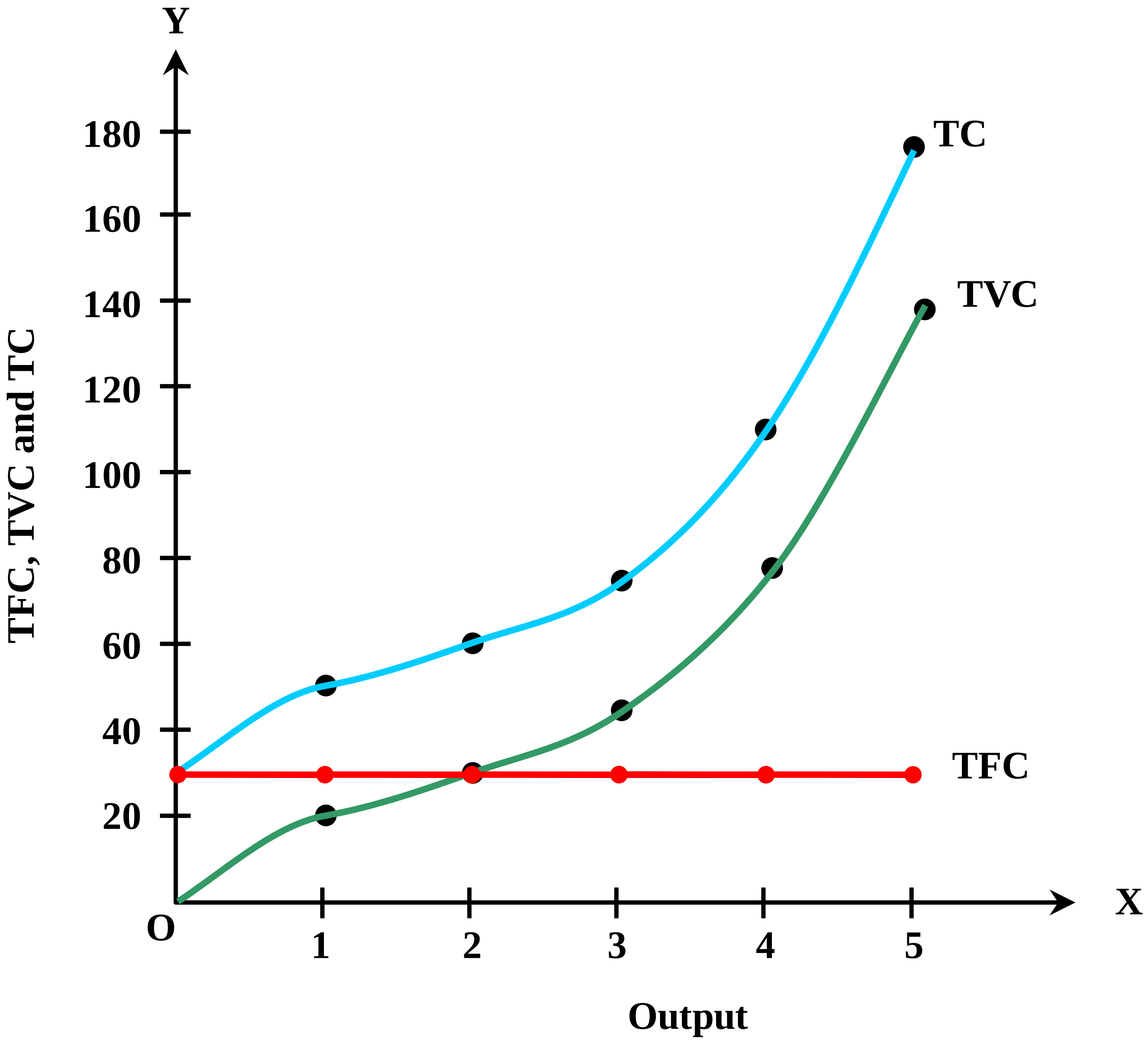
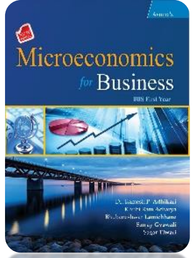

Y
180
160
140
120
100
80
60
40
20
O
1
2
3
4
5
X
TC
TVC
TFC
TFC, TVC and TC
Output



Derivation of Short-Run Average Cost Curves

1. Average Fixed Cost (AFC)

The average fixed cost is defined as the total fixed cost divided by the total quantity of output produced.

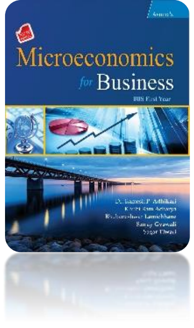
$$AFC = \frac{TFC}{Q}$$

where

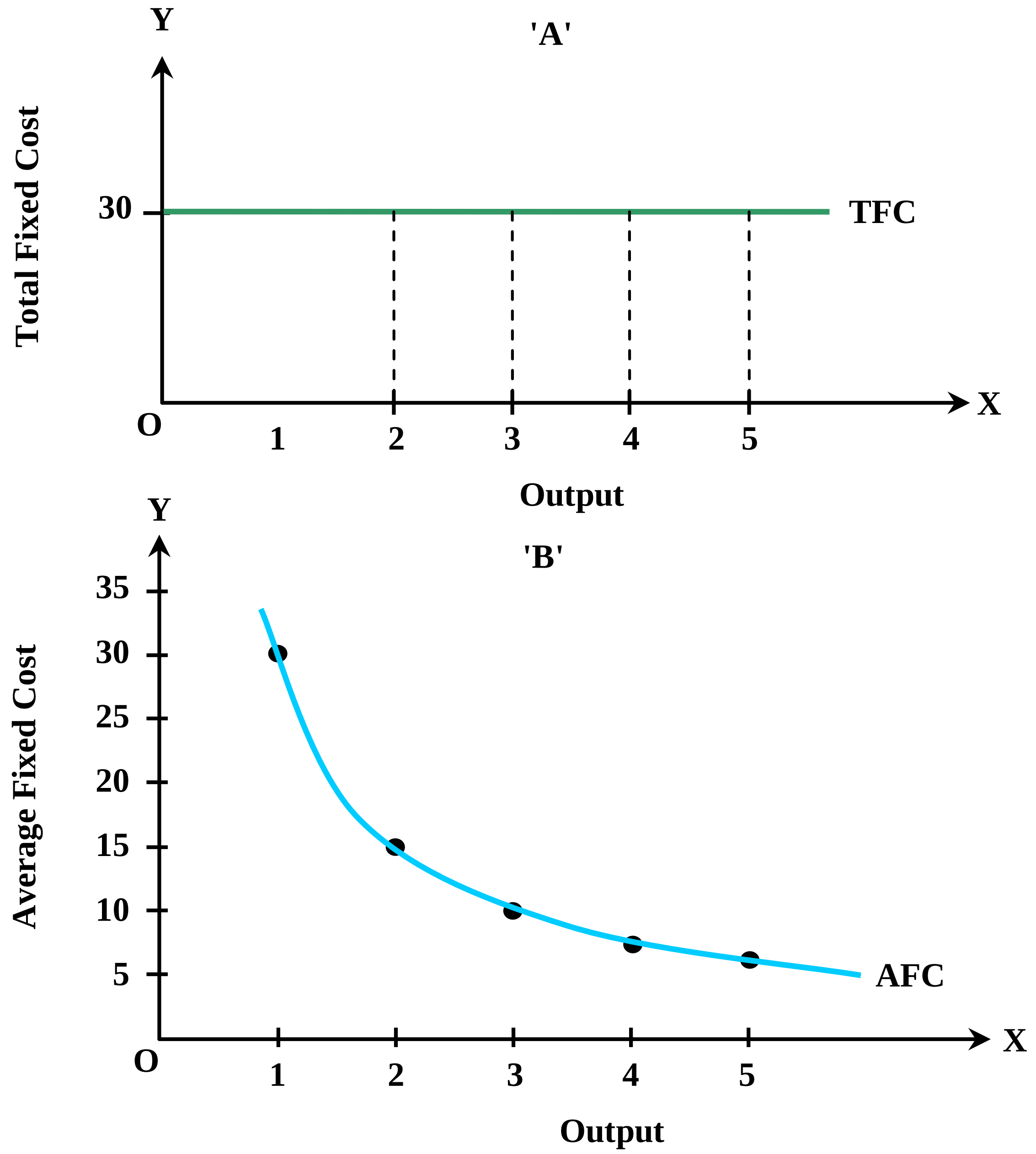
AFC = Average fixed cost

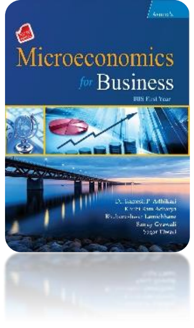
TFC = Total fixed cost

Q = Total quantity of output produced



Output	Total Fixed Cost	Average Fixed Cost
0	30	-
1	30	30
2	30	15
3	30	10
4	30	7.5
5	30	6


'A'
Y
Total Fixed Cost
30
TFC
O
1
2
3
4
5
X
Output
'B'
Y
Average Fixed Cost
35
30
25
20
15
10
5
AFC
O
1
2
3
4
5
X
Output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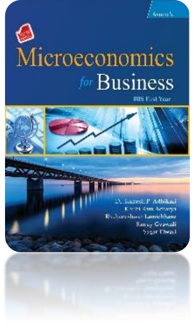
Derivation of Short-Run Average Cost Curves Contd.



2. Average Variable Cost (AVC)

Average variable cost is defined as the total variable cost divided by total quantity of output produced.

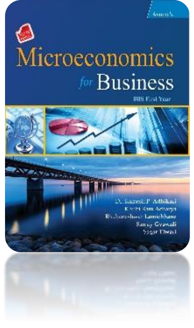
$$AVC = \frac{TVC}{Q}$$

where

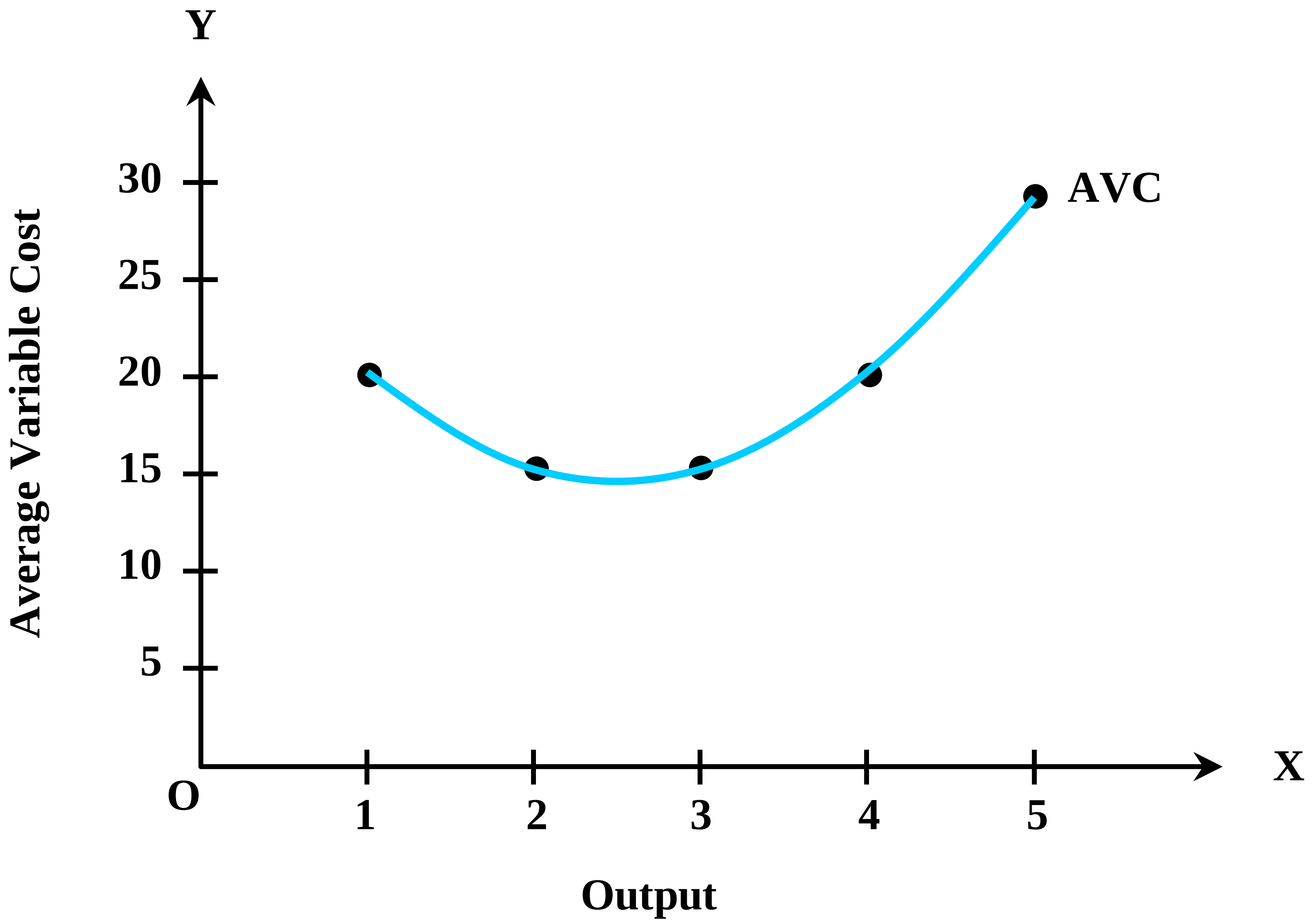
AVC = Average variable cost

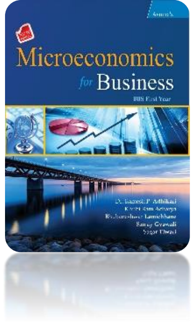
TVC = Total variable cost

Q = Total quantity of output produced



Output	Total Variable Cost	Average Variable Cost
0	0	0
1	20	20
2	30	15
3	45	15
4	80	20
5	145	29


Y
30
25
20
15
10
5
Average Variable Cost
AVC
O
1
2
3
4
5
X
Output



Derivation of Short-Run Average Cost Curves Contd.

3. Average Total Cost/ Average Cost (ATC/ AC)

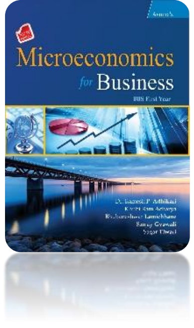
- Average total cost is defined as the total cost divided by total quantity of output.
- In other words, it is the sum of AFC and AVC.

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

where

ATC	= Average total cost	Q	= Output
TFC	= Total fixed cost	TVC	= Total variable cost
AFC	= Average fixed cost	AVC	= Average variable cost

Output	Total Cost	Average Cost
0	30	-
1	50	50
2	60	30
3	75	25
4	110	27.5
5	175	35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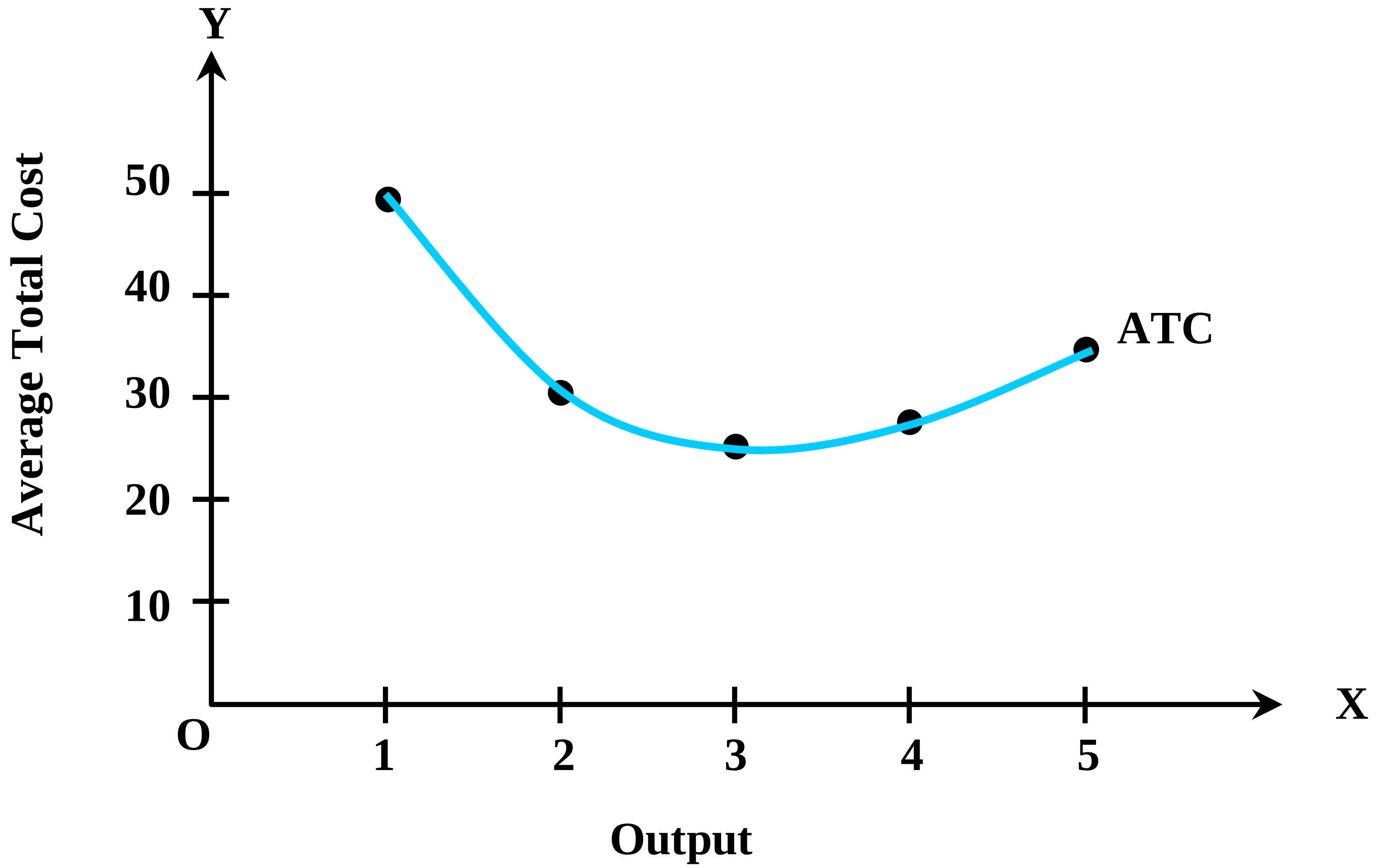
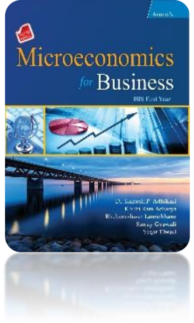

Y
50
40
30
20
10
Average Total Cost
ATC
O
1
2
3
4
5
X
Output

Derivation of Short-Run Marginal Cost (MC)



- Marginal cost is defined as the change in total cost due to one unit change in output.
- In other words, marginal cost is the ratio of change in total cost to the change in total output.
- Symbolically, it can be expressed as follows:

$$MC = \frac{\Delta TC}{\Delta Q}$$

$$\text{or,} \quad MC = TC_n - TC_{n-1}$$

where

MC = Short run marginal cost

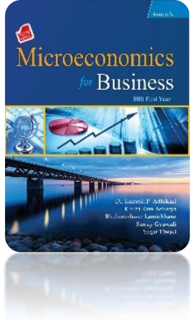
ΔTC = Change in total cost

ΔQ = Change in quantity of output produced

TC_n = Total cost of n^{th} unit

TC_{n-1} = Total cost of $(n - 1)^{th}$ unit

Output	Total Cost	Marginal Cost
0	30	-
1	50	20
2	60	10
3	75	15
4	110	35
5	175	65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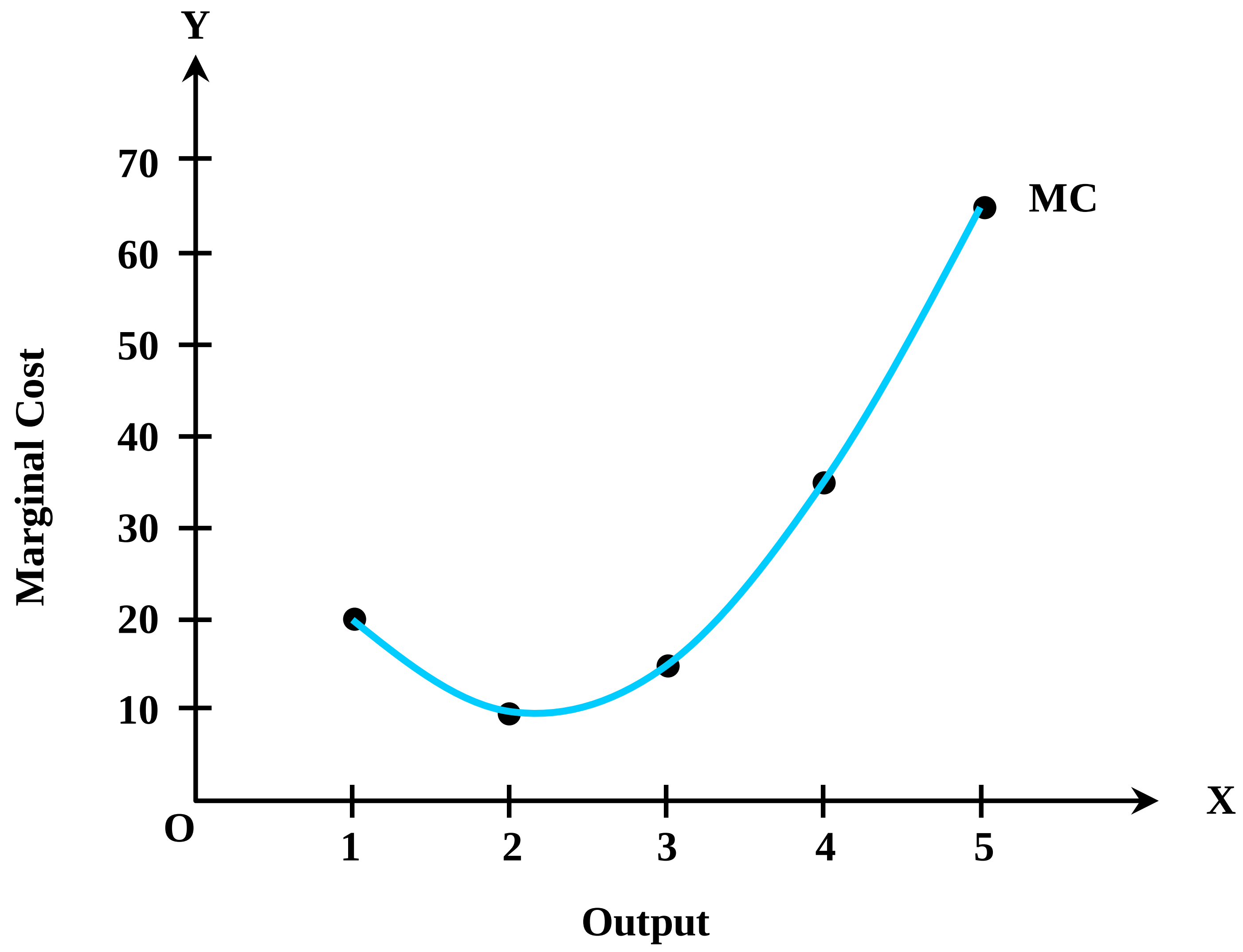
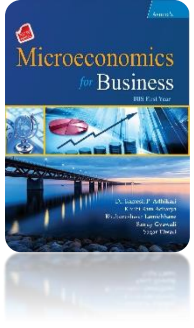
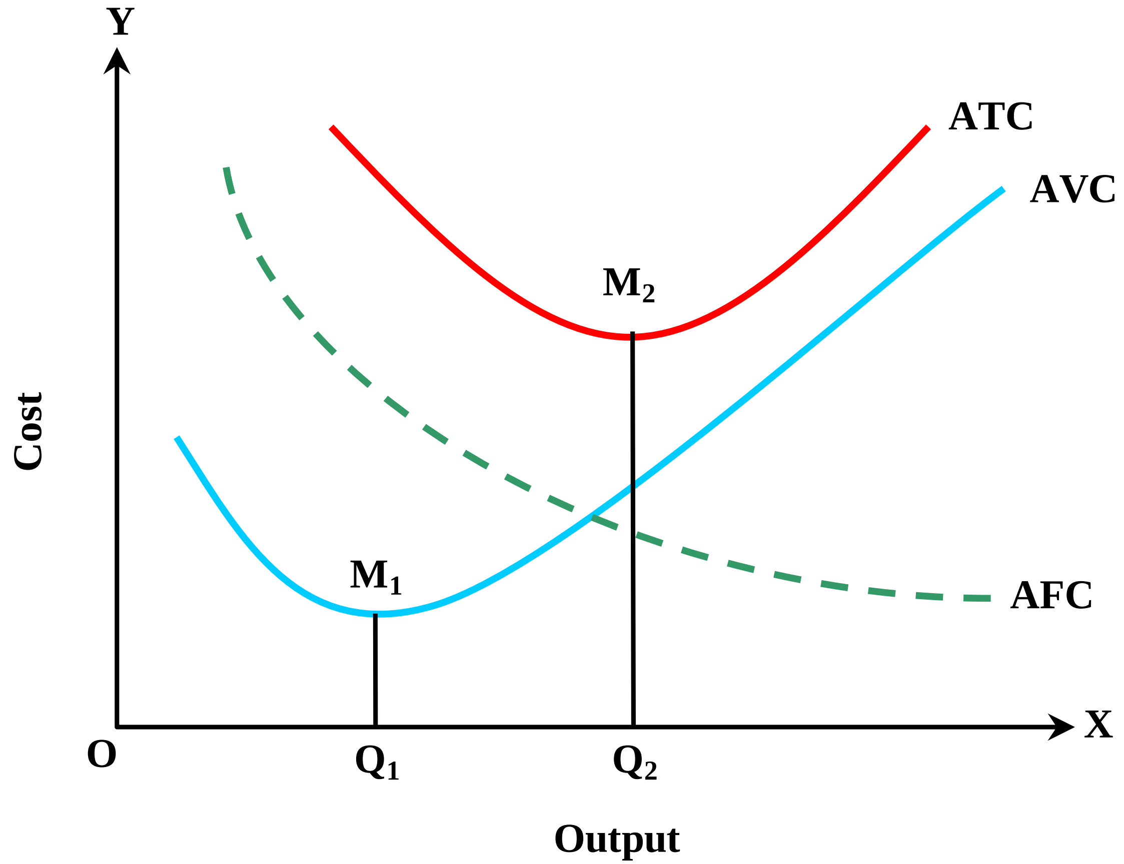

Y
70
60
50
40
30
20
10
Marginal Cost
MC
O
1
2
3
4
5
X
Output

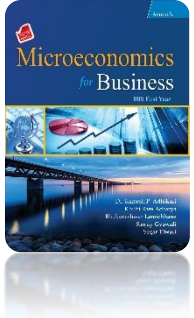
Why ATC Curve is 'U' shaped?



- Average total cost curve (ATC) is 'U' shaped.
- It means that in the beginning, it falls and after reaching the minimum point, it starts to rise upward.
- It gets U shaped due to the following reasons:
  - 1. Basis of AFC and AVC
  - 2. Basics of the law of variable proportions
  - 3. Indivisibility of the factors



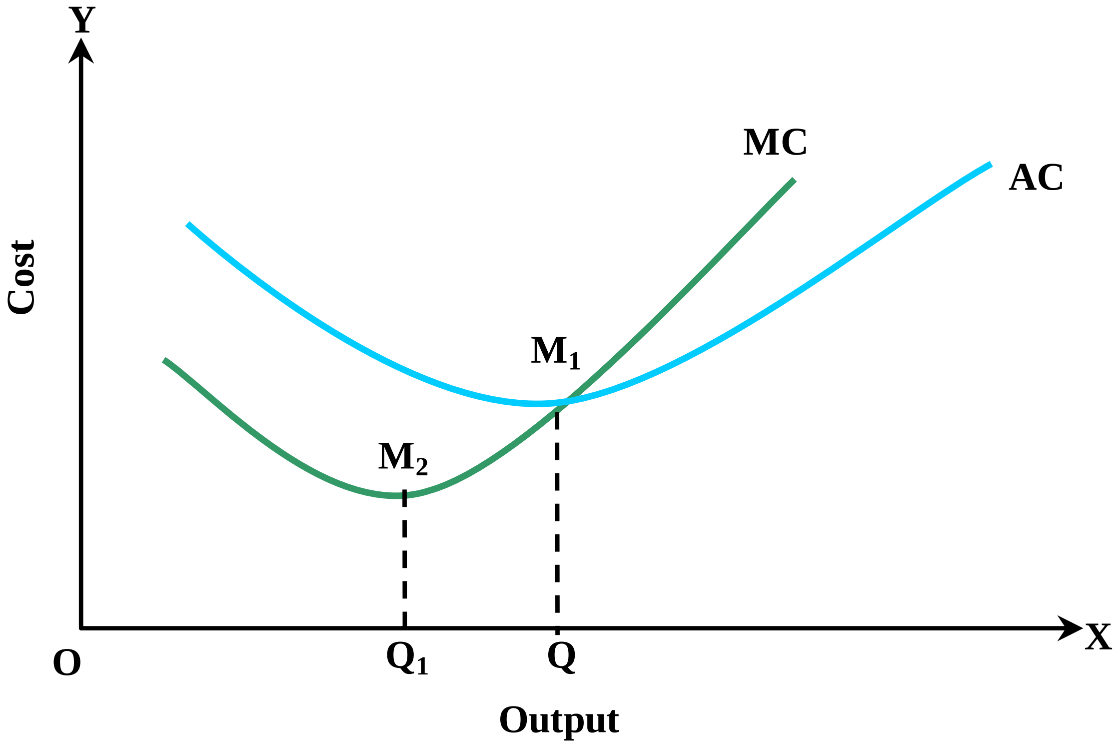
Relationship between AC and MC in the Short-Run



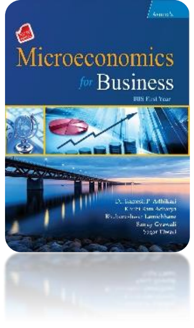
- There is close relationship between AC and MC.
- MC is the change in TC resulted from the change in production of one unit of output where as AC is total cost divided by the output.
- It means that both AC and MC are derived from TC. Thus,

$$MC = \frac{\Delta TC}{\Delta Q}, \qquad AC = \frac{TC}{Q}$$

- In general, both AC and MC are U-shaped and MC = AC when AC is minimum.



Relationship between AC and MC in the Short-Run Contd.



The relationship between AC and MC can be summarized as below:

i. Both AC and MC are calculated from total cost.

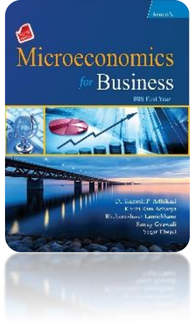
ii. Both AC and MC are U shaped.

iii. When AC is falling, the MC curve is always below the AC curve and the MC falls faster than AC.

iv. When the AC is rising, the MC curve lies above the AC curve and the MC rises faster than the AC.

v. When the AC is minimum, the MC equals to AC.

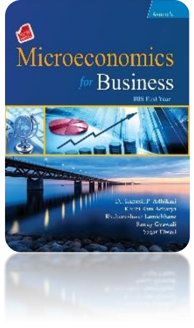
vi. MC intersects at the minimum point of AC.



Long Run Cost

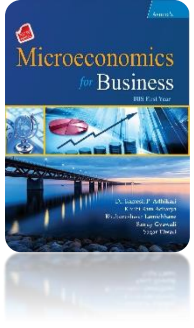
- Long-run is a period of time during which the quantities of all factors of production are variable.
- Thus, in the long-run, output can be increased by increasing capital equipment or by increasing the size of existing plant or by building a new plant.
- The long-run costs are the costs incurred during a period, which is sufficiently large to allow the variation in all factors of production including capital equipment, land and managerial staff to produce a level of output.

Derivation of Long-Run Cost Curves



Long-Run Cost of the Traditional Theory

- In the long- run, all factors of production are assumed to be variable.
- There are no any fixed factors in the long-run.
- Long-run cost curve is a planning curve in the sense that it is a guide to the entrepreneur in his decision to plan the future expansion of his output.



Long-Run Average Cost Curve (LAC)

- Long-run average cost is obtained by dividing the long-run total cost by the level of output.
- A long-run cost curve depicts the functional relationship between output and the long-run cost of production.

$$\text{LAC} = \frac{\text{LTC}}{\text{Q}}$$

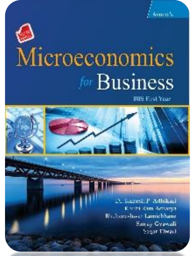
where

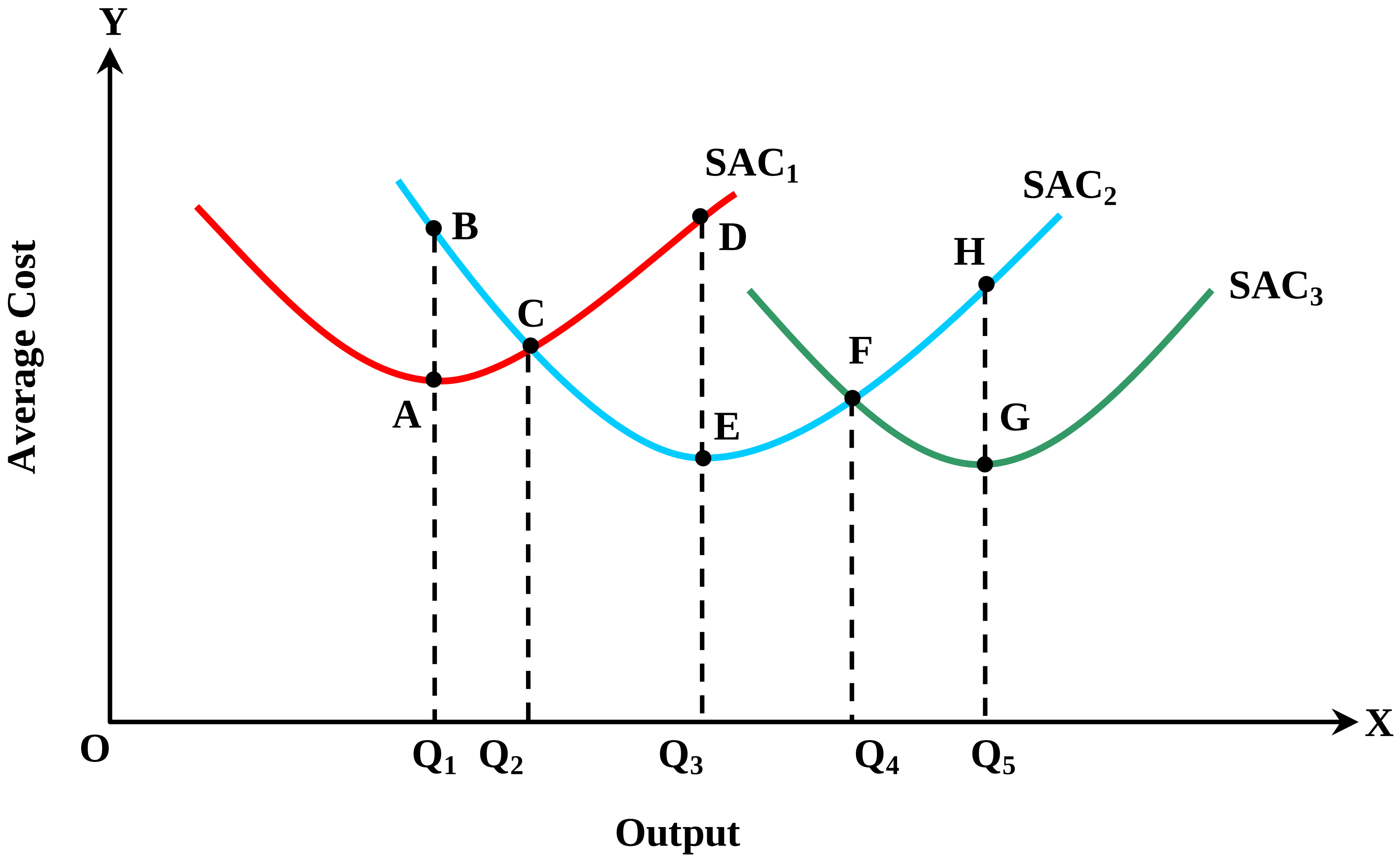
Q = Output

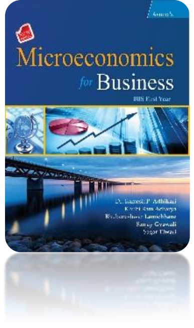
LAC = Long-run average cost

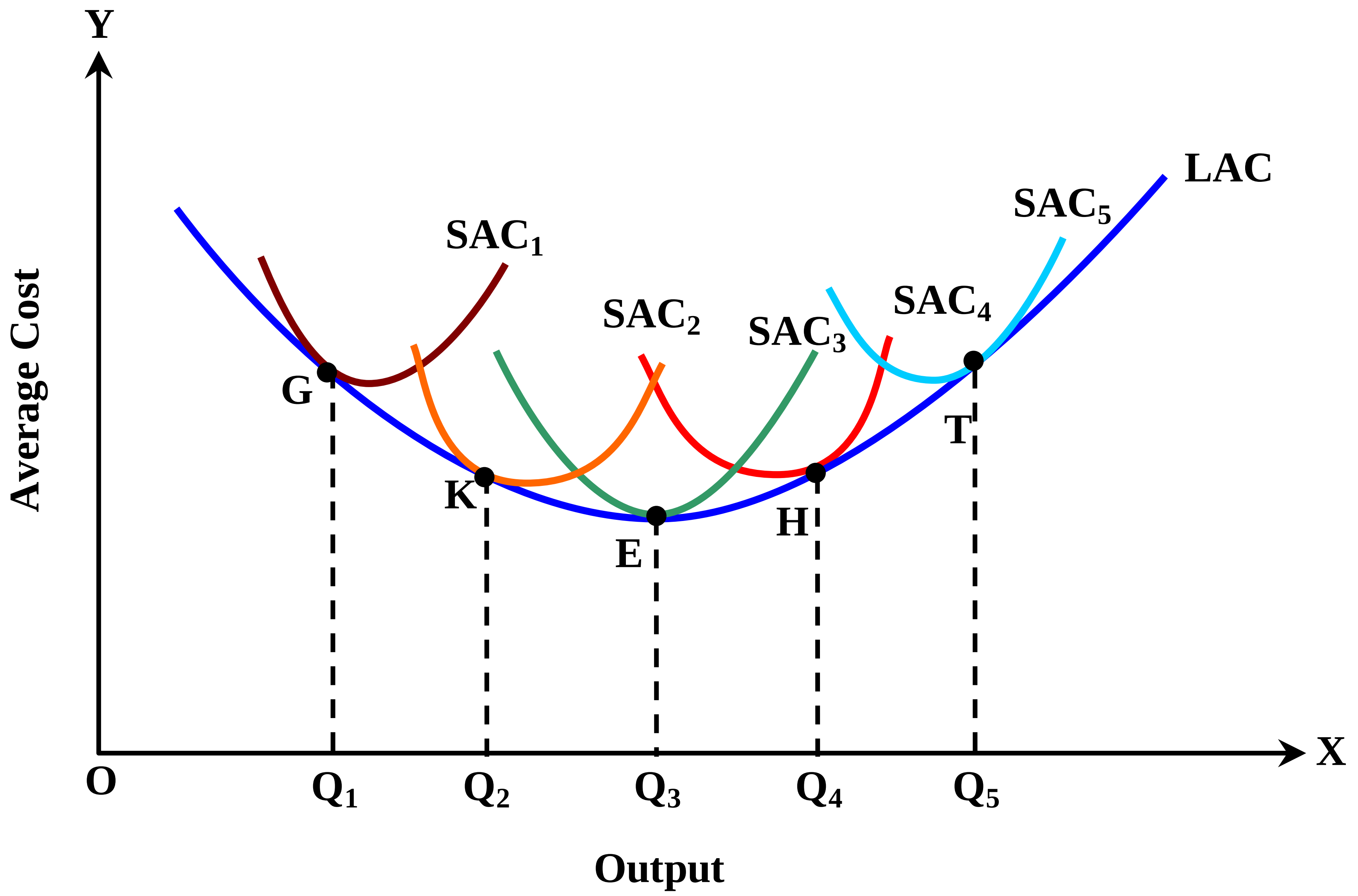
LTC = Long-run total cost

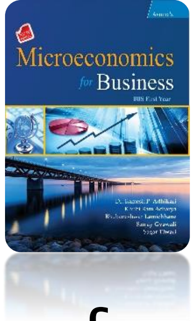
- Long-run average cost curve is obtained from the short-run average cost curves (SACs).




Y
Average Cost
SAC_1
SAC_2
SAC_3
B
D
H
C
F
A
E
G
O
Q_1
Q_2
Q_3
Q_4
Q_5
X
Output


Microeconomics
for Business

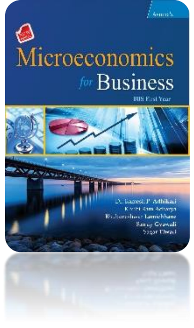

Y
Average Cost
LAC
SAC1
SAC2
SAC3
SAC4
SAC5
G
K
E
H
T
O
Q1
Q2
Q3
Q4
Q5
X
Output



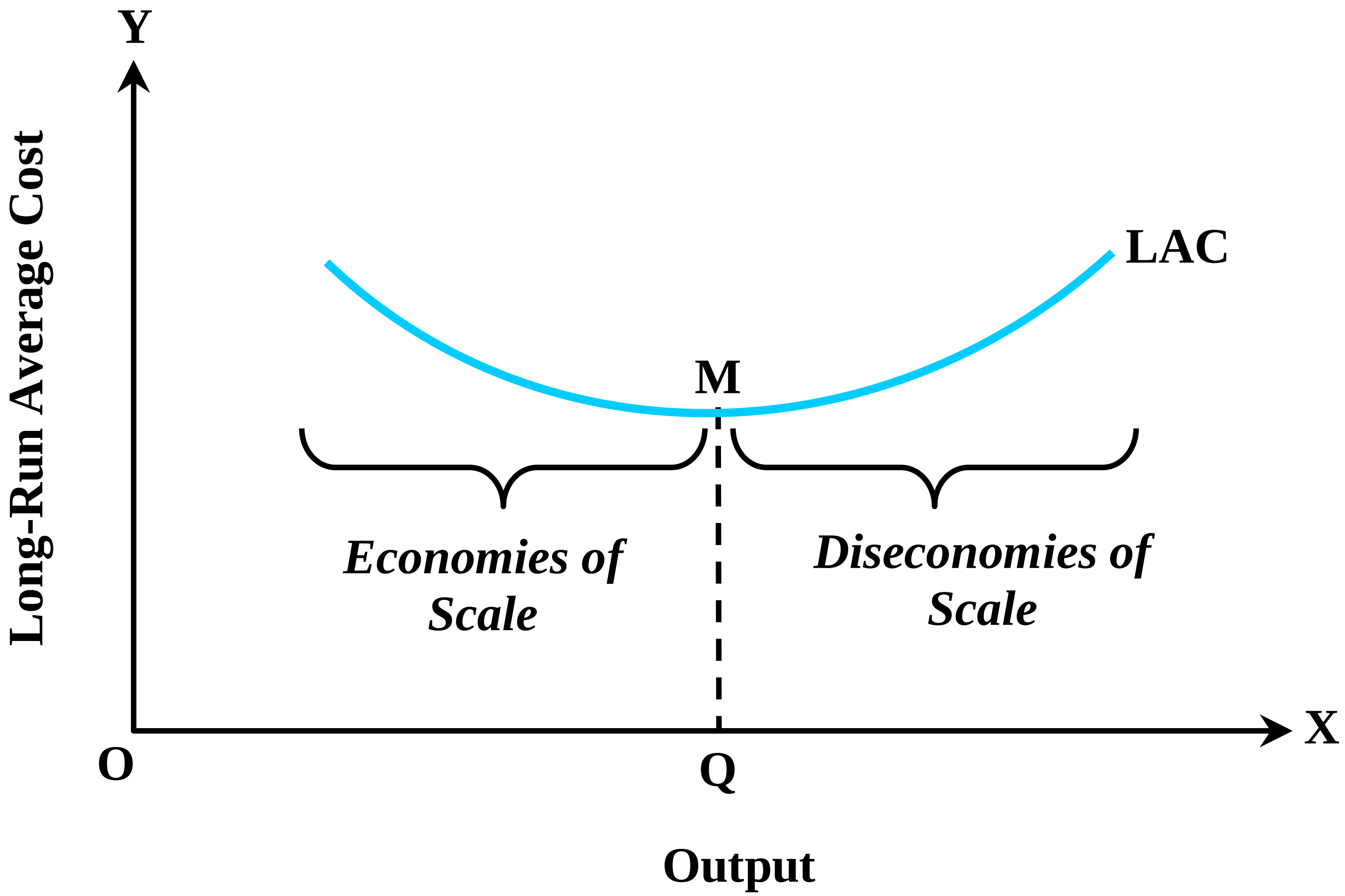
Why is SAC_3 Optimum Size Plant?

- The plant SAC_3 is optimum plant because its minimum cost of production is the lowest.
- If the size of plants is increased beyond SAC_3, it results in higher average cost of production.
- Similarly, if the size of the plant is smaller than SAC_3, average cost of production is higher.
- Thus, the optimum output (least cost output) of the plant SAC_3 is OQ_3.
- Now if the firm produces output OQ_3 with the optimum plant SAC_3, it is said to have achieved the optimum size.
- Thus, an optimum firm is that firm which is producing optimum output with the optimum plant.
- The firm is of optimum size if it employs plant SAC_3 and uses it to produce OQ_3 output.
- The output OQ_3 is also regarded as the socially optimum output.

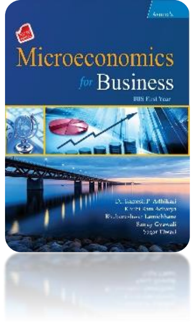
Why is LAC Less Pronounced (Flatter) than SAC?



- Though the LAC curve is ‘U’ shaped, it is less pronounced (flatter) than SAC curves.
- It means that the LAC curve first falls slowly and then rises gradually after a minimum point is reached.

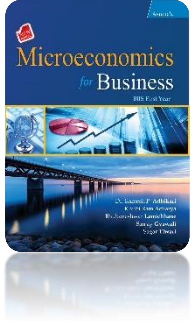


Why is LAC Curve called Planning Curve?



- Long-run average cost curve is often called the planning curve of the firm by some economists because firm plans to produce any output in the long-run by choosing a plant on the long-run average cost curve corresponding to the given output.
- The long-run average cost curve reveals to the firm that how large should be the plant for producing a certain output at the least possible cost.

Derivation of Long-run Marginal Cost Curve (LMC)



- Long-run marginal cost (LMC) is the change in long-run total cost as a result of one unit change in output.

$$LMC = \frac{\Delta LTC}{\Delta Q}$$

where

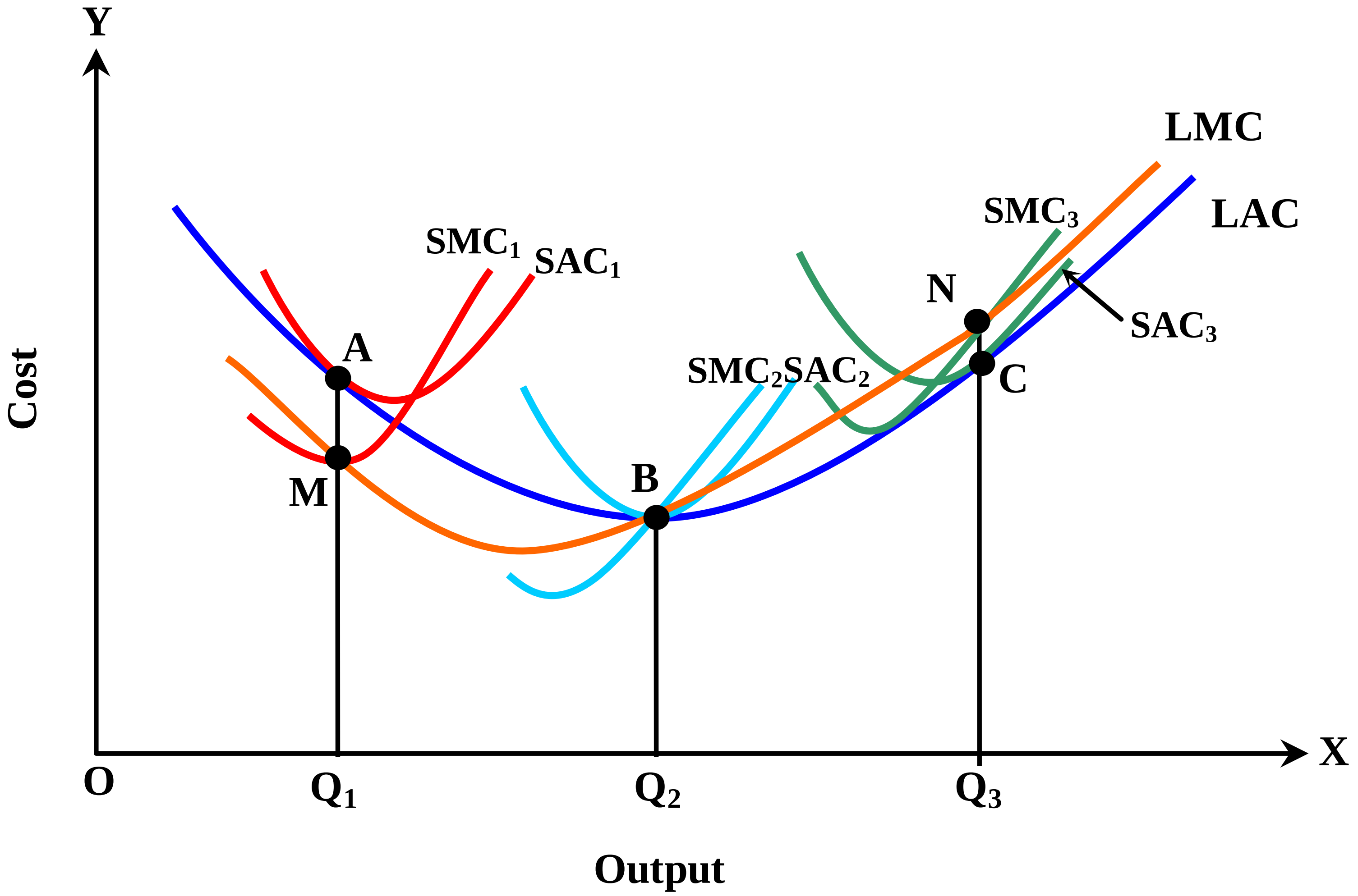
LMC = Long-run marginal cost

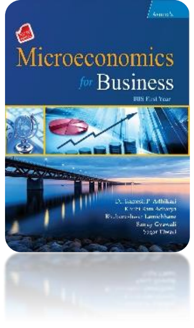
Δ Q = Change in total output

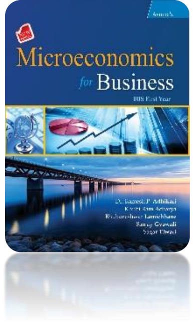
Δ LTC = Change in long-run total cost

- Long-run marginal cost curve is derived from short-run marginal cost curves.

Derivation of Long-run Marginal Cost Curve (LMC)



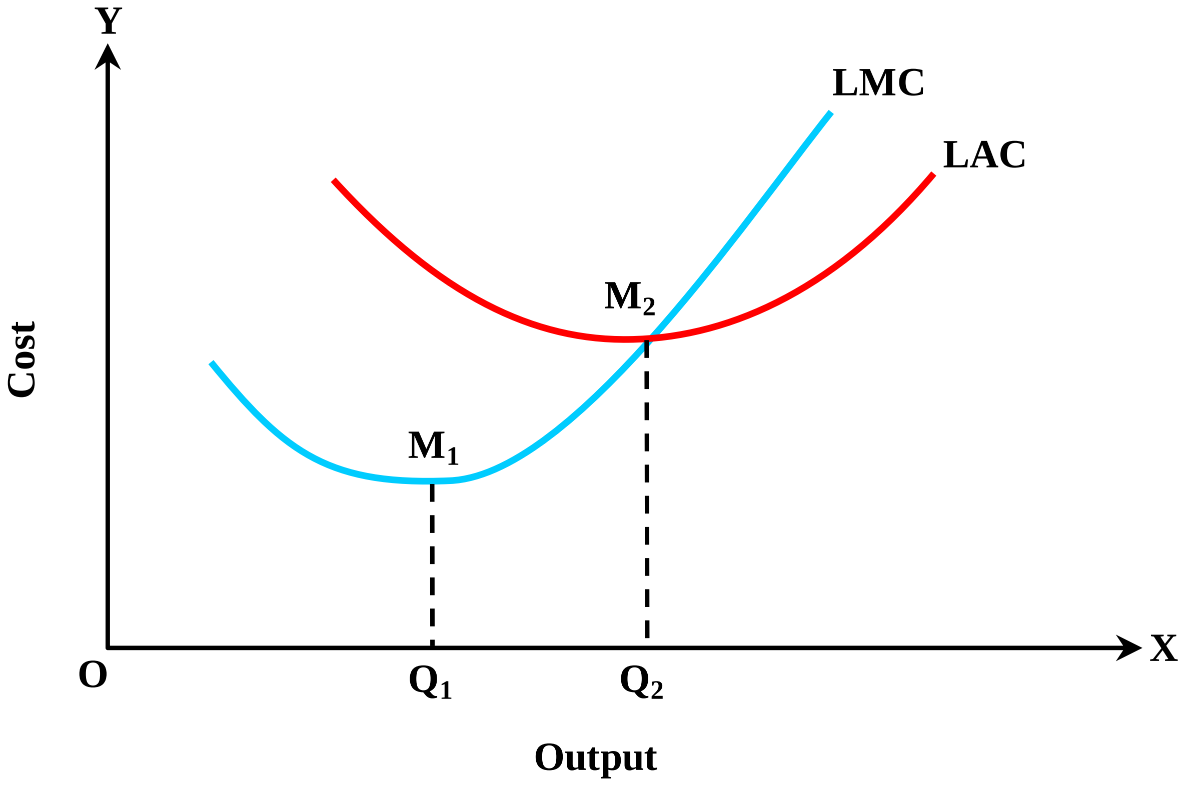




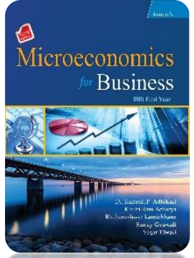
Relationship between LAC and LMC

Both LAC and LMC are derived from long-run total cost (LTC)

$$LAC = \frac{LTC}{Q}\ ;\ LMC = \frac{\Delta LTC}{\Delta Q}$$



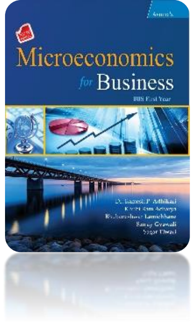
Relationship between LAC and LMC Contd.



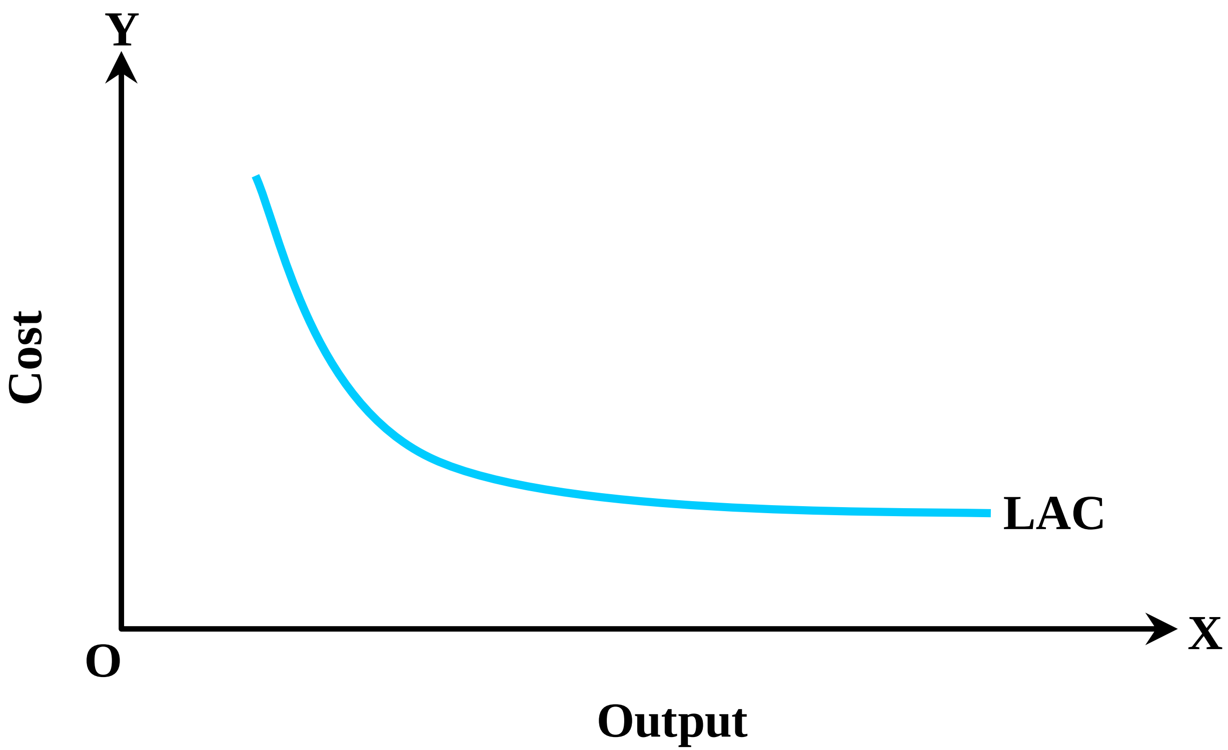
The relationship between LAC and LMC can be pointed out as follows:

- When LAC is minimum at point M_1, LAC = LMC.
- When LAC is decreasing, LAC > LMC.
- When LAC is increasing, LMC > LAC.
- LMC becomes minimum earlier than LAC. It means that minimum point of LMC is left of minimum of LAC, and
- When LMC is decreasing, it decreases faster than LAC and when LMC is increasing, it increases faster than LAC.

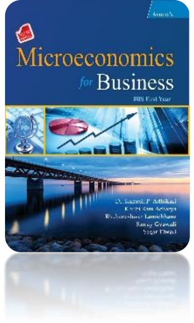
L-Shaped and Continuously Falling Long-run Average Cost Curve (L-Shaped LAC: Modern Theory of Cost)



- The U-shaped cost curves of the traditional theory have been questioned by various economists both on theoretical and empirical grounds. The empirical studies on cost have proved U-shaped cost curves to be wrong.
- In 1939 A.D. **George Stigler** said that firms also look into flexibility while producing. According to him, long run average cost curve is 'L' shaped rather than 'U' shaped.
- This is also known as the



L-Shaped and Continuously Falling Long-run Average Cost Curve (L-Shaped LAC: Modern Theory of Cost) Contd.

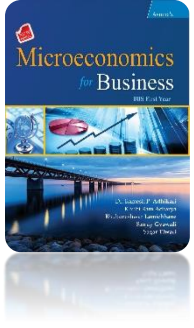


- In respect of LAC behavior, the modern theory of cost distinguishes between production costs and managerial costs. Both these costs are variable in the long-run. The behaviour of these costs determines the slope of long-run average cost curve (LAC).

1. **Production cost behaviour**: Production cost decreases steeply in the beginning with the increase in scale of production but the rate of decreases in cost slows down as the scale increase beyond a certain level of production.
2. **Managerial cost behaviour**: According to modern theory of cost, managerial cost first decreases but begins to increase as the scale of production is expanded beyond a certain level.

What makes LAC L-Shaped?

- The net effect of decreasing production cost and increasing managerial cost determines the shape of long-run average cost.
- In the initial stage of production, LAC decreases very steeply because of continuous decrease in cost of production.
- Beyond a certain scale, managerial cost begins to rise.
- According to modern theory of cost, rise in managerial cost is more than offset by the decrease in production costs.
- Therefore, LAC is continuous to fall but very slowly.
- In case the decrease in production cost is just sufficient to offset rise in managerial cost, the LAC becomes constant.
- This makes LAC an L-shaped curve.



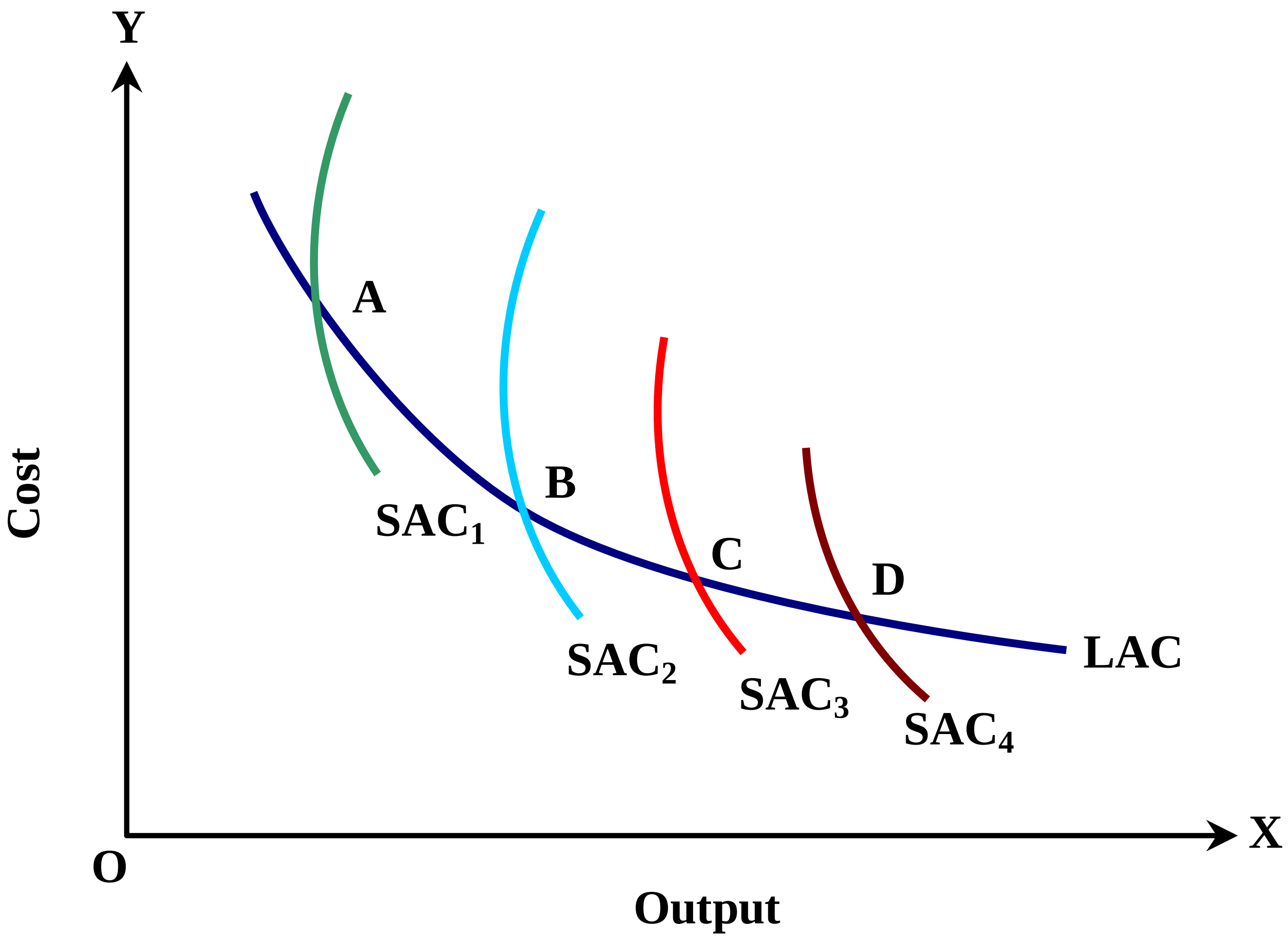
Derivation of LAC Curve

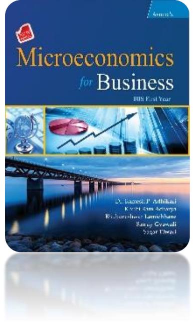
- Long-run average cost is obtained by dividing the long-run total cost by the level of output.
- The figure shows the decreasing or downward sloping LAC curve.
- In the modern theory of cost, LAC curve is also derived from the SAC curves.
- In the figure, there are four plants with short-run average cost curves SAC_1, SAC_2, SAC_3 and SAC_4.
- The empirical studies have found that firms use normally 2/3 to 3/4 of the plant size.
- This is called reserve capacity.

Derivation of LAC Curve Contd…

According to the modern theory of cost and theoretical as well as empirical evidence of the cost curve, we can draw following conclusions:

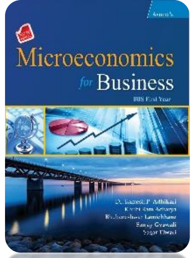
- LAC is roughly L-shaped.
- LAC does not envelop short-run cost curves.
- It interests certain points of SAC.
- It never turns up with the increase in output.





Economies and Diseconomies of Scale

- A firm experiences economies and diseconomies of scale when it increases its level of production.
- The LAC curve is ‘U’ shaped due to economies and diseconomies of scale.

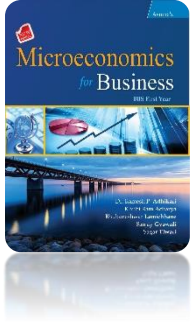


Economies of Scale

- Economies of scale are defined as the decrease in long run average cost of production due to increase in size of the firm.
- In other words, it refers to the property whereby long-run average total cost falls as the quantity of output increases.
- In the initial stage of production, when output increases by increasing variable factors of production, the different types of economies of scale accrue in production.
- The economies of scale are classified as under:

Types of Economics of Scale

1. Internal Economies
   i. Economies in production
   ii. Marketing Economies
   iii. Managerial Economies
   iv. Economies in Transportation and storage cost
2. External Economies



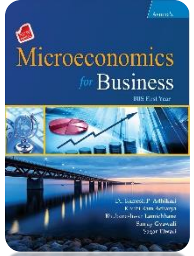
Diseconomies of Scale

- Diseconomies of scale refer to the property whereby long-run average total cost rises as the quantity of output increases.
- With the expansion of output, the different types of difficulties appear which increases average cost of production.
- As a result, LAC starts to increase.
- Diseconomies of scale are classified as under.

Types of Diseconomies of Scale

1. Internal Diseconomies
   i. Managerial inefficiency
   ii. Labour inefficiency
2. External Economies

Economies of Scope



- Economies of scope is the situation in which it is cheaper to produce various products jointly by a firm than by the separate firms independently.
- In other words, production is said to exhibit economies of scope if the cost of a single firm producing two or more different products is less than the costs of the outputs produced separately by two or more firms independently.

Symbolically,

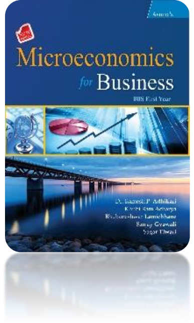
$$\mathbf{TC\ (Q_{A},\ Q_{B}) < TC\ (Q_{A}) + TC\ (Q_{B})}$$

where

$TC\ (Q_{A},\ Q_{B})$ = Total cost of producing good– A and B by a single firm

$TC(Q_A) + TC(Q_B)$ = Total cost of producing good– A and B by two firms

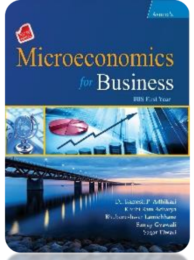
- Economies of scope exist if the total cost of jointly producing two commodities A and B by a firm is smaller than by two firms



Economies of Scope Contd.

Causes of Economies of Scope

1. Common production facilities
2. Use of by-products
3. Common marketing and administration



Economies of Scope Contd.

Measurement of Economies of Scope

- The degree of economies of scope measures the extent to which the cost of production decreases by producing products together by a firm rather than by different firms separately.
- The economies of scope as calculated using following formula:

$$S = \frac{TC(Q_A) + TC(Q_B) - TC(Q_A, Q_B)}{TC(Q_A, Q_B)} \times 100$$

where

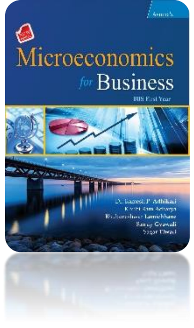
S = Degree of economies of scope

$TC(Q_A)$ = Total cost of producing only product A

$TC(Q_B)$ = Total cost of producing only product B

$TC(Q_A, Q_B)$ = Total cost of producing both products A and B

If $S > 0$, there is economies of scope and $S < 0$, there is diseconomies of scope.



Theory of Revenue

Revenue Function

- Revenue function shows the relationship between revenue and its determinants like price per unit, quantity sold, etc. Symbolically, it can be expressed as

$$R = f(P, Q)$$

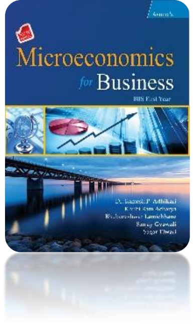
where

R = Revenue

P = Price per unit

Q = Quantity of output

- It implies that revenue is influenced by per unit price and quantity sold in the market. Therefore, revenue changes with the change in price per unit and quantity sold.



Concept of Revenue

Money receipt of a firm from the sale of its product is called revenue.

Types of Revenue

1. Total Revenue (TR)

Total revenue is the total amount of money received by a firm from the sales of its own product at the given period of time. In other words, total revenue is the sum of marginal revenue. Total revenue is also the product of price and quantity sold.

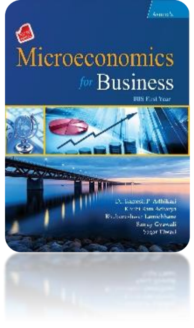
$$TR = P \times Q$$

where

P = Price

Q = Quantity sold

TR = Total revenue

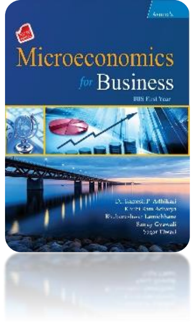


Concept of Revenue

2. Average Revenue (AR)

- Average revenue is the price per unit.
- It is obtained dividing total revenue by the number of units sold. Symbolically,

$$AR = \frac{TR}{Q} = \frac{P \times Q}{Q} = P$$



Concept of Revenue

3. Marginal Revenue

- Marginal revenue is the addition to total revenue from the sales of an additional unit of the commodity.
- Marginal revenue is obtained by dividing the change in total revenue by the change in quantity sold.

$$\mathbf{MR = TR_n - TR_{n-1}}$$

$$\text{or,}\quad \mathbf{MR = \frac{Change\ in\ total\ revenue}{Change\ in\ quantity\ sold} = \frac{\Delta TR}{\Delta Q}}$$

where

MR = Marginal revenue

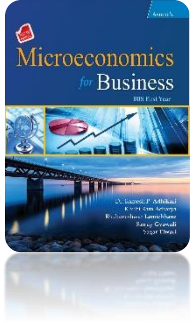
TR_n = Total revenue of 'nth' product

Q = Quantity sold

TR_{n-1} = Total revenue of $(n-1)^{th}$ product

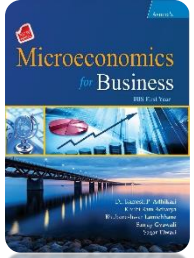
ΔQ = Change in quantity sold

ΔTR = Change in total revenue

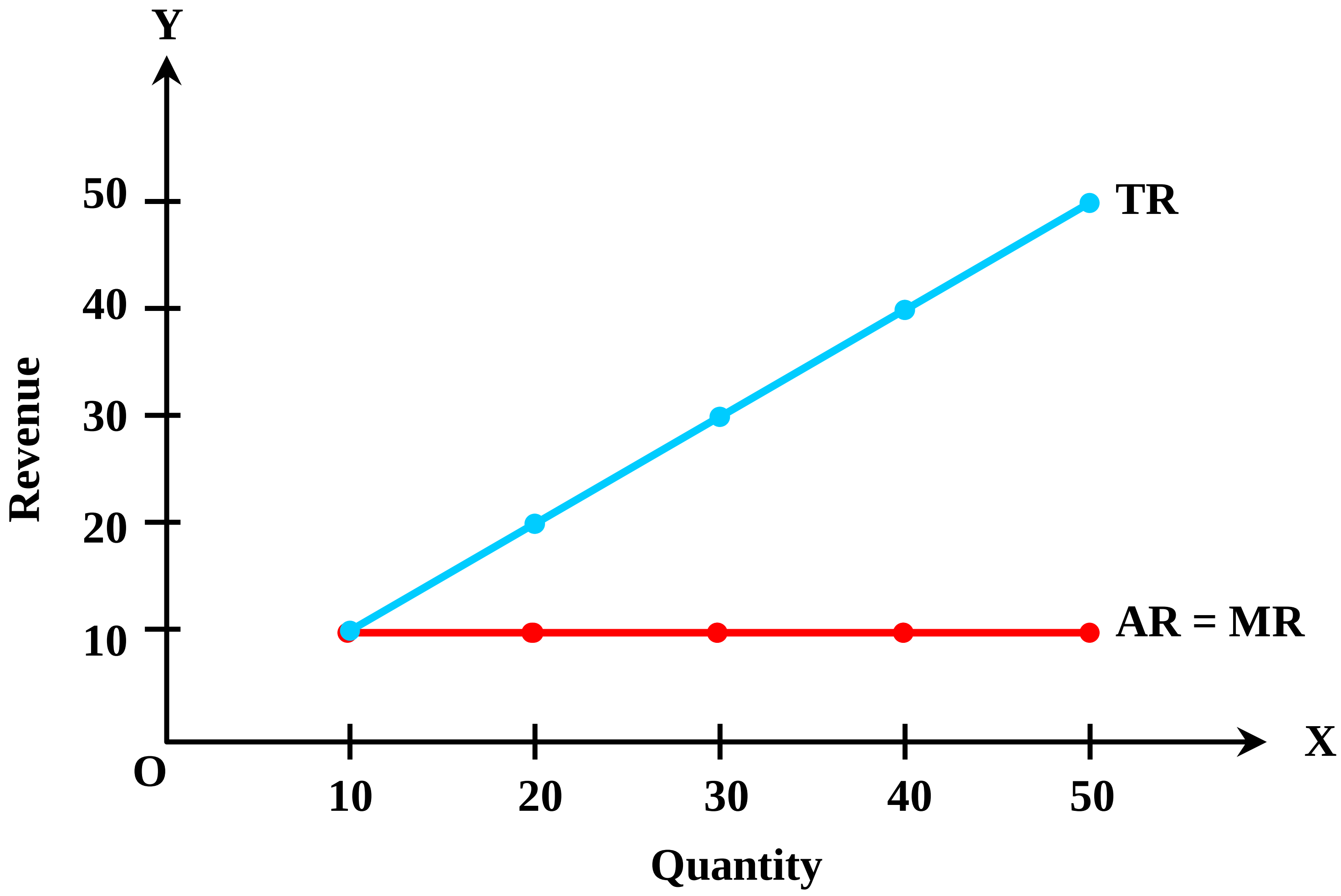


Derivation of Revenue Curves under Perfect Competition

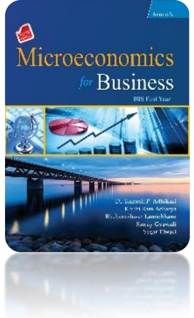
- Perfect competition is the market structure where there are a large number of buyers and sellers producing a homogeneous product with uniform price.
- In the perfect competition, firm is a 'price-taker'.
- A firm can sell whatever output it produces at the given price.
- Therefore, price remains constant at any level of output.
- The price is determined by the intersection of market demand and supply curves.
- From price and quantity values, TR, AR and MR can be obtained.



No. of Units Sold (Q)	Price (P)	TR = (P × Q)	AR	MR
1	10	10	10	10
2	10	20	10	10
3	10	30	10	10
4	10	40	10	10
5	10	50	10	10

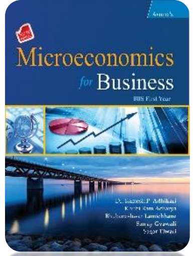

Y
50
40
30
20
10
Revenue
TR
AR = MR
O
10
20
30
40
50
X
Quantity

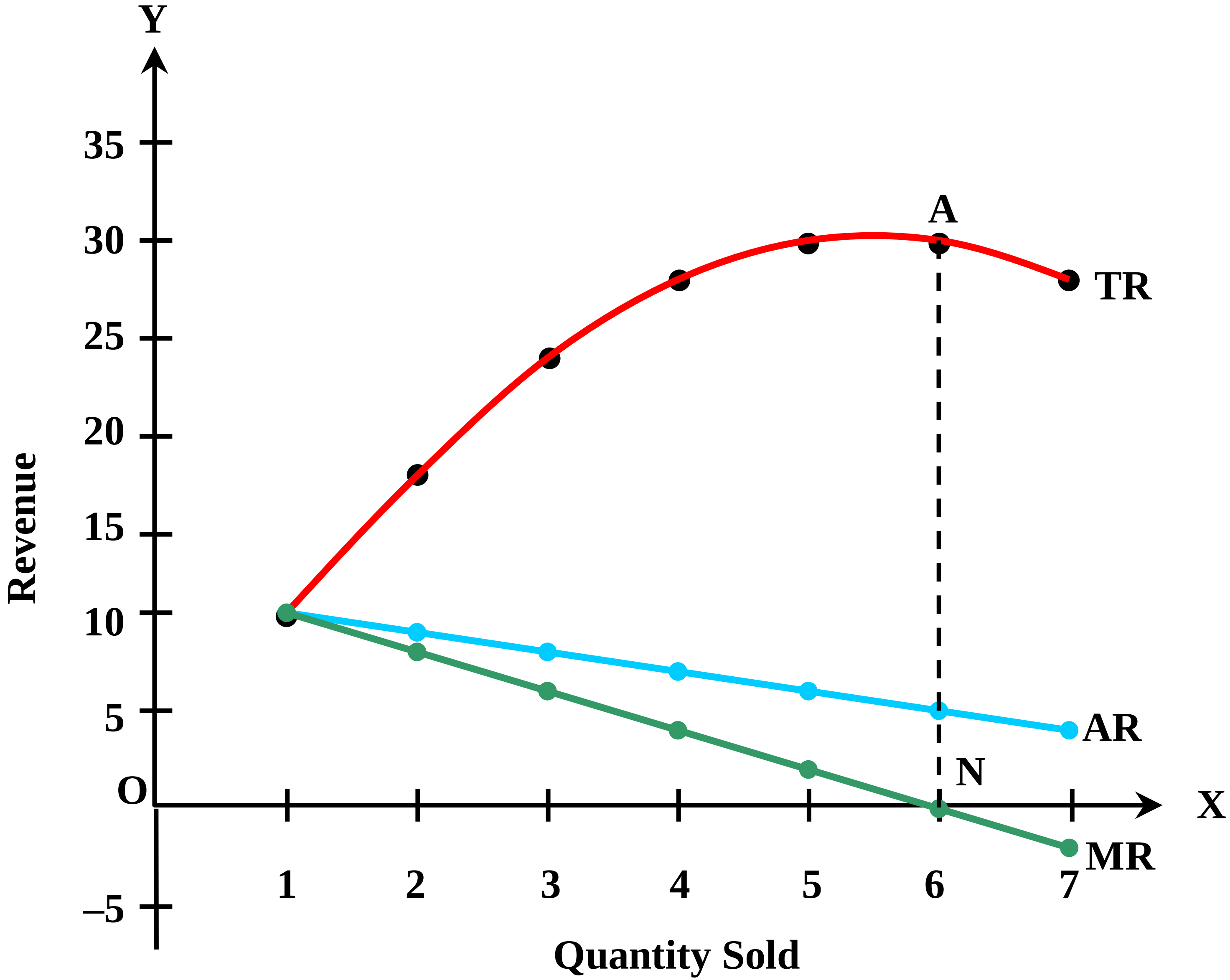
Derivation of Revenue Curves under Imperfect Competition or Monopoly



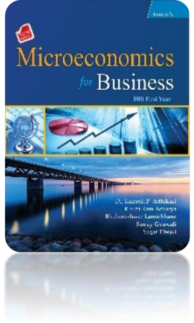
- Monopoly is a market structure in which there is a single seller or producer of a commodity, there are no close substitutes for the commodity it produces and there are barriers to entry of new firm in the market.
- In imperfect competition or monopoly, the firm is itself a 'price maker’.
- Therefore, it reduces prices in order to increase the sales.
- Consequently, both the average and marginal revenue curves slope downward from left to right.
- It means that if a monopolist desires to sell more units of the output, he will have to reduce the price.
- On the other hand, if the monopolist desires to charge high price, he will have to sell less units of output.

Quantity Sold (Q)	Price (P)	TR = (P × Q)	AR	MR
1	10	10	10	10
2	9	18	9	8
3	8	24	8	6
4	7	28	7	4
5	6	30	6	2
6	5	30	5	0
7	4	28	4	– 2


Microeconomics
for Business


Y
35
30
25
20
15
10
5
O
–5
Revenue
A
TR
AR
N
MR
X
1
2
3
4
5
6
7
Quantity Sold

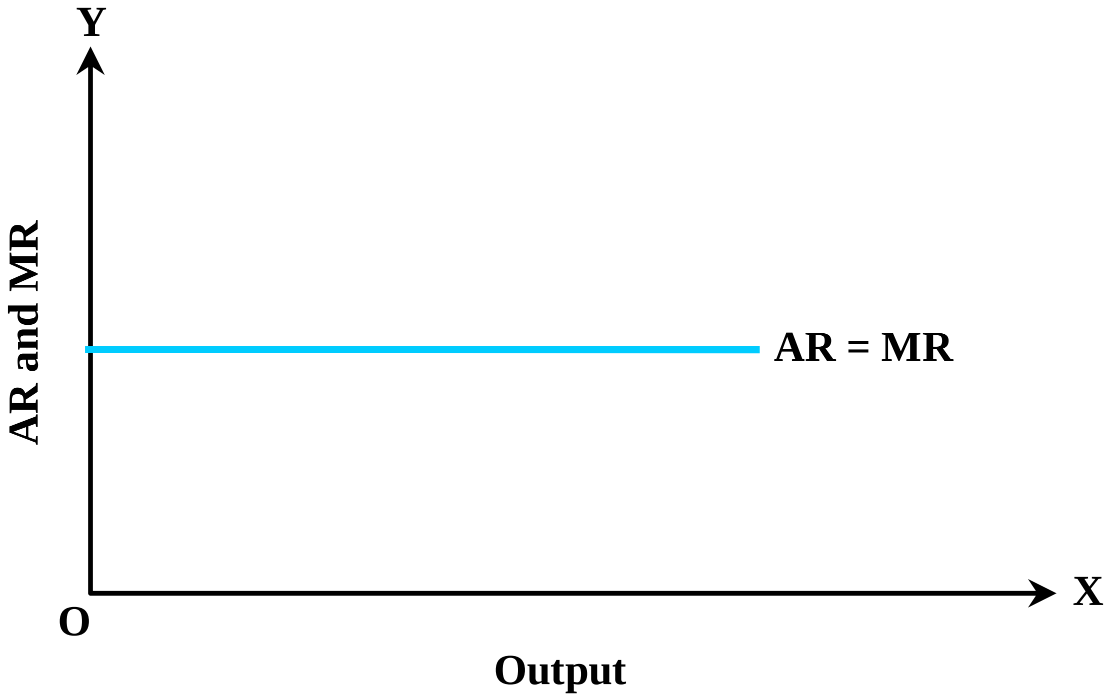
Relationship between Average Revenue and Marginal Revenue Curves



- The relationship between AR and MR depends upon the nature of market.
- Therefore, the relationship between AR and MR is explained under perfect competition and imperfect competition respectively.

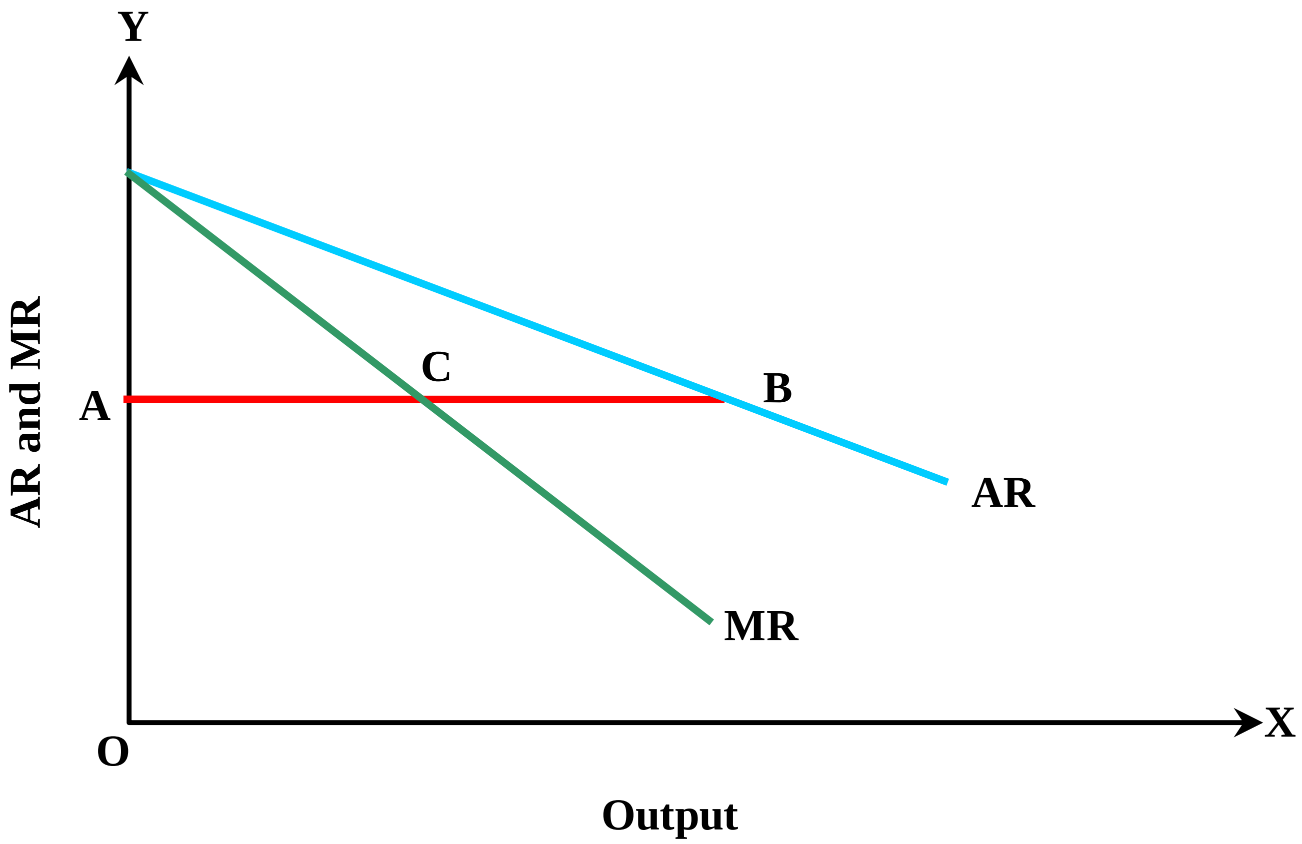
Relationship between AR and MR Curves under Perfect Competition

- Under perfect competition, seller cannot influence price of the product.
- He has to sell at the ruling price prevailing in the market.
- Thus, average revenue or price is same throughout.
- Marginal revenue curve coincides with the average revenue curve because additional units are sold at the same price as before.



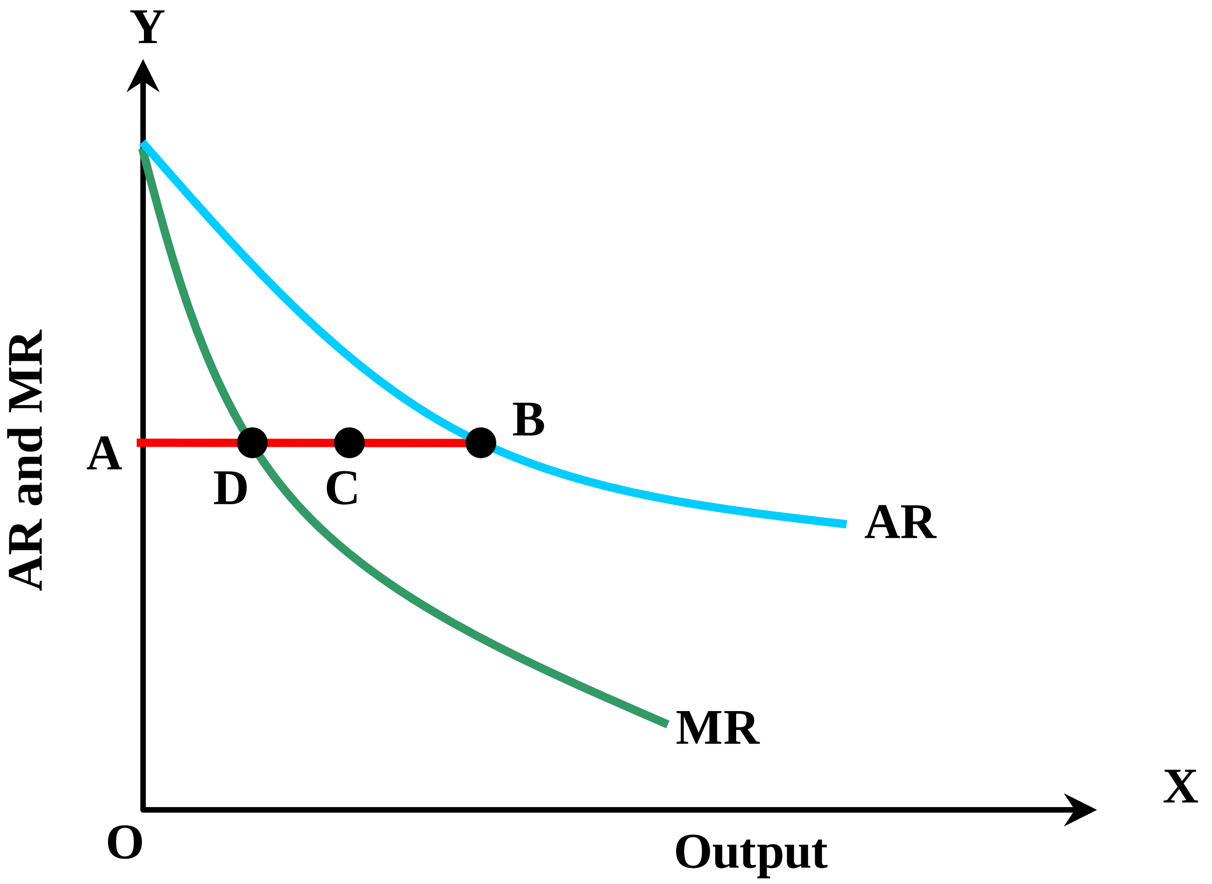
Relationship between AR and MR Curves under the Monopoly/ Imperfect Competition

1. When both AR and MR Curves are Straight Line

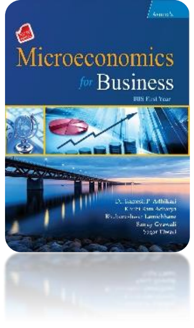


Relationship between AR and MR Curves under the Monopoly/ Imperfect Competition Contd.

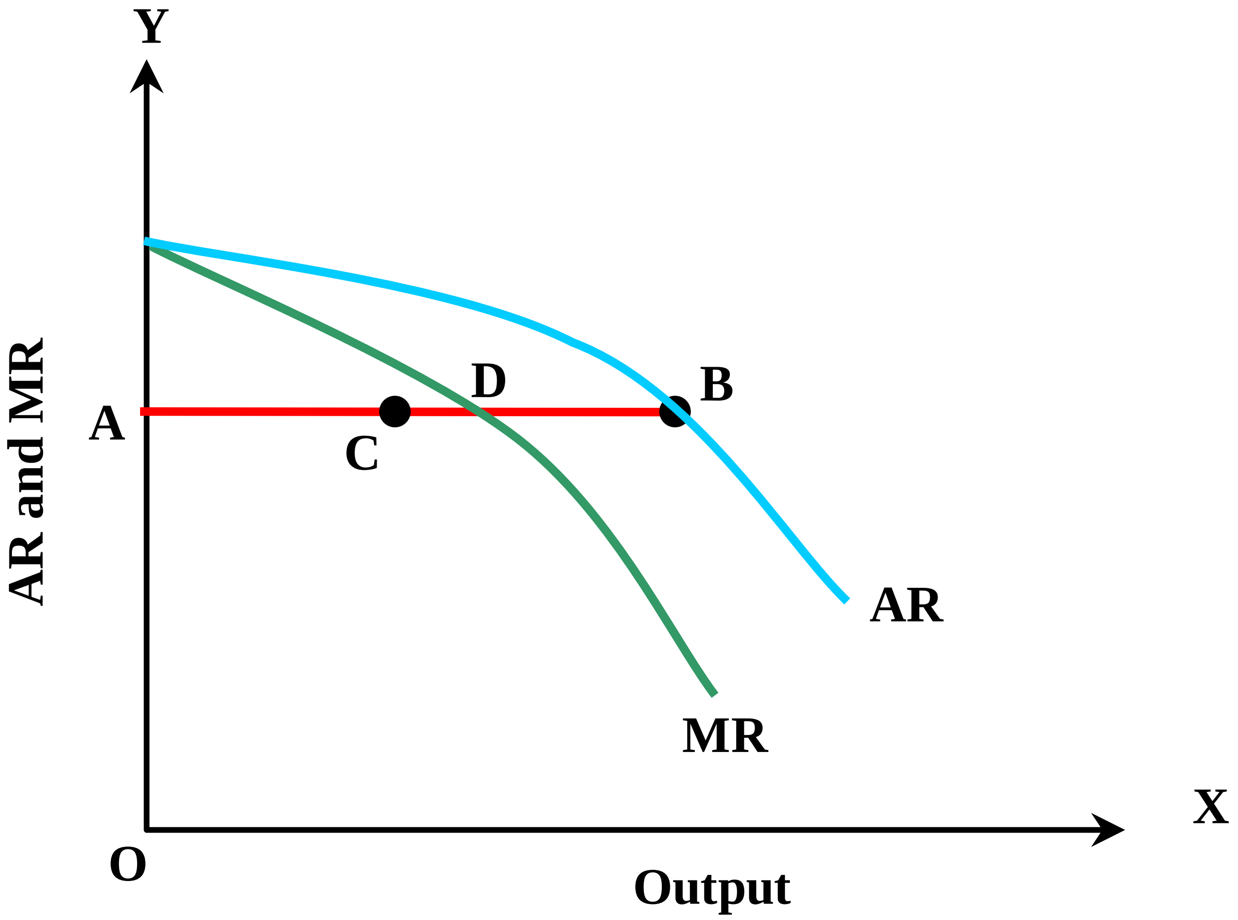
2. When both AR and MR Curves are Convex to the Origin



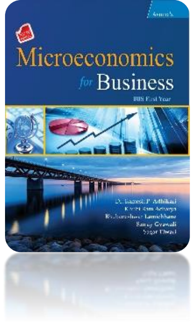
Relationship between AR and MR Curves under the Monopoly/ Imperfect Competition Contd.



3. When both AR and MR Curves are Concave to the Origin



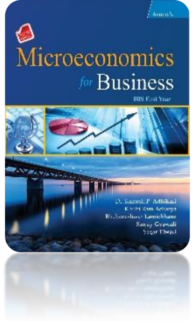
Relationship between Price Elasticity of Demand and Revenue



There is very useful relationship between price elasticity of demand and concept of revenue. This relationship can be studied as follows:

- Relationship between Price Elasticity of Demand and Marginal Revenue
- Relation between Price Elasticity of Demand and Average Revenue
- Relationship between Price Elasticity of Demand and Total Revenue

Relationship between Price Elasticity of Demand and Marginal Revenue



Marginal revenue is the addition in total revenue as a results of increase in sales by one additional unit. Then,

$$\mathbf{MR = \frac{d(TR)}{dQ}}$$

$$\text{or,}\quad MR = \frac{d(P \times Q)}{dQ} \qquad (\because TR = P \times Q)$$

$$\text{or,}\quad MR = P.\frac{dQ}{dQ} + Q.\frac{dP}{dQ}$$

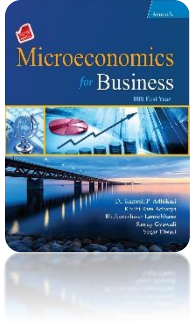
$$\text{or,}\quad MR = P.1 + Q.\frac{dP}{dQ}$$

$$\therefore\quad \mathbf{MR = P + Q.\frac{dP}{dQ}}$$

Taking P common, we get,

$$\mathbf{MR = P\left(1 + \frac{Q}{P}.\frac{dP}{dQ}\right)} \qquad \textbf{... (i)}$$

Relationship between Price Elasticity of Demand and Marginal Revenue Contd.



In the above equation $\frac{dP}{dQ} \cdot \frac{Q}{P}$ is the reciprocal of coefficient of price elasticity of demand. It means that,

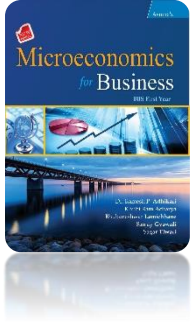
$$\frac{dP}{dQ} \cdot \frac{Q}{P} = \frac{-1}{E_P}$$

By substituting $\left(\frac{-1}{E_P}\right)$ in the above equation (I), we get,

$$MR = P\left(1 - \frac{1}{E_P}\right)$$

$$\text{or,} \quad MR = P\left(\frac{E_P - 1}{E_P}\right) \qquad \text{... (ii)}$$

Relationship between Price Elasticity of Demand and Marginal Revenue Contd.



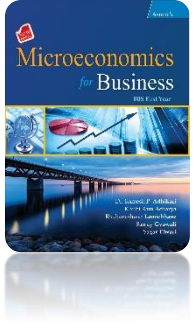
- The above equation (ii), gives the relationship between price elasticity of demand and marginal revenue.
- Given the relationship between marginal revenue (MR) and price elasticity of demand E_P, we can draw following conclusions:

i. When $E_P = 1$, $MR = 0$. It means that total revenue remains constant for both rise and fall in price.

ii. If $E_P > 1$, $MR > 0$. It means that increase in price results decrease in total revenue and vice-versa.

iii. If $E_P < 1$, $MR < 0$. It means that increase in price results increase in total revenue and vice-versa.

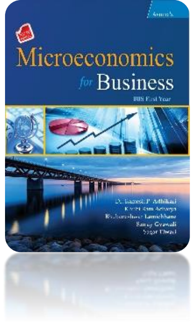
Relation between Price Elasticity of Demand and Average Revenue



- We know that price is same as average revenue in all market conditions.
- Therefore, substituting P = AR in the above equation, (ii) we get,

$$\mathbf{MR = AR\left(\frac{E_P - 1}{E_P}\right)}$$

$$\text{or,} \quad AR = MR\left(\frac{E_P}{E_P - 1}\right)$$



Relation between Price Elasticity of Demand and Average Revenue Contd.

$$AR.E_P - AR = MR.E_P$$

or, $$MR.E_P = AR.E_P - AR$$

or, $$MR.E_P - E_P.AR = -AR$$

or, $$E_P\,(MR - AR) = (-AR)$$

or, $$E_P = \frac{(-AR)}{MR - AR}$$

or, $$E_P = \frac{-AR}{-(AR - MR)}$$

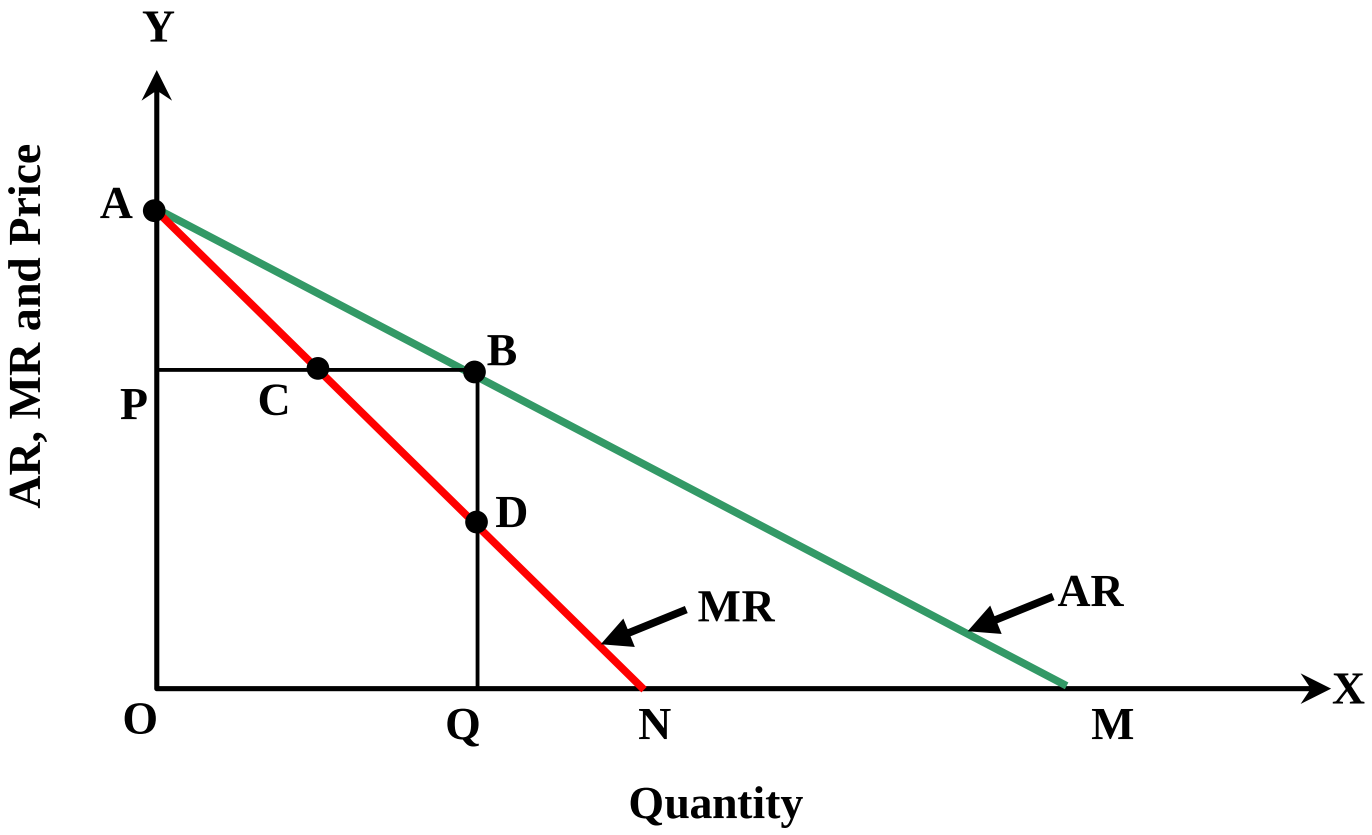
$$\therefore \quad E_P = \left(\frac{AR}{AR - MR}\right) \qquad \text{...(iii)}$$

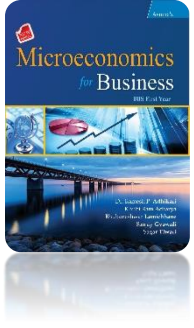
Above equation (iii), gives the relationship between average revenue (AR) and price elasticity of demand (E_P).

Relation between Price Elasticity of Demand and Average Revenue Contd.

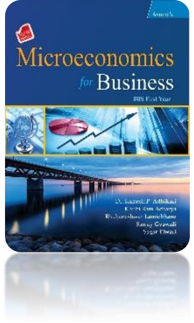
Alternatives Method (Graphical/ Geometrical Proof)

- The above equation (iii) gives the relationship between AP and MR and between AR and E_P.





Relation between Price Elasticity of Demand and Average Revenue Contd.



- X-axis represents quantity and Y-axis represents average revenue, marginal revenue and price.
- The downward sloping curve AM represents average revenue curve (AR) and AN represents marginal revenue curve (MR).
- Lets us suppose that price is given at OP (= QB).
- According to point elasticity of demand, price elasticity of demand at point B is the lower segment of the demand curve (AR curve) divided by upper segment of the demand curve (AR curve).

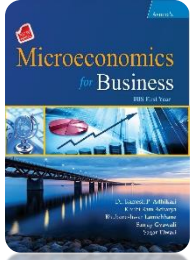
$$E_P \text{ at } B = \frac{\text{Lower segment}}{\text{Upper segment}}$$

$$= \frac{BM}{AB} \qquad \text{... (i)}$$

Since, ΔAPB and ΔQBM are equiangular,

$$E_P \text{ at } B = \frac{BM}{AB} = \frac{BQ}{AP} \qquad \text{... (ii)}$$

Relation between Price Elasticity of Demand and Average Revenue Contd.



Again, in congruent triangles, APC and DBC,

$$AP = BD \qquad \text{... (iii)}$$

From equation (i), (ii) and (iii), we get,

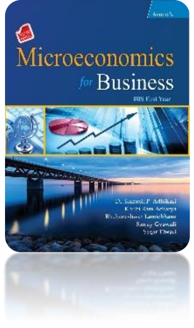
$$E_P \text{ at } B = \frac{BM}{AB} = \frac{BQ}{AP} = \frac{BQ}{BD} \qquad [\because AP = BD]$$

$$= \frac{BQ}{(BQ - DQ)} \qquad [\because BD = BQ - BD]$$

$$E_P \text{ at } B = \left(\frac{AR}{AR - MR}\right) \qquad [\because BQ = AR \text{ and } DQ = MR]$$

Hence, by graphical or geometrical method also we can establish the relationship between. E_P, AR and MR

Relationship between Price Elasticity of Demand and Total Revenue

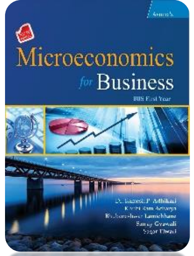


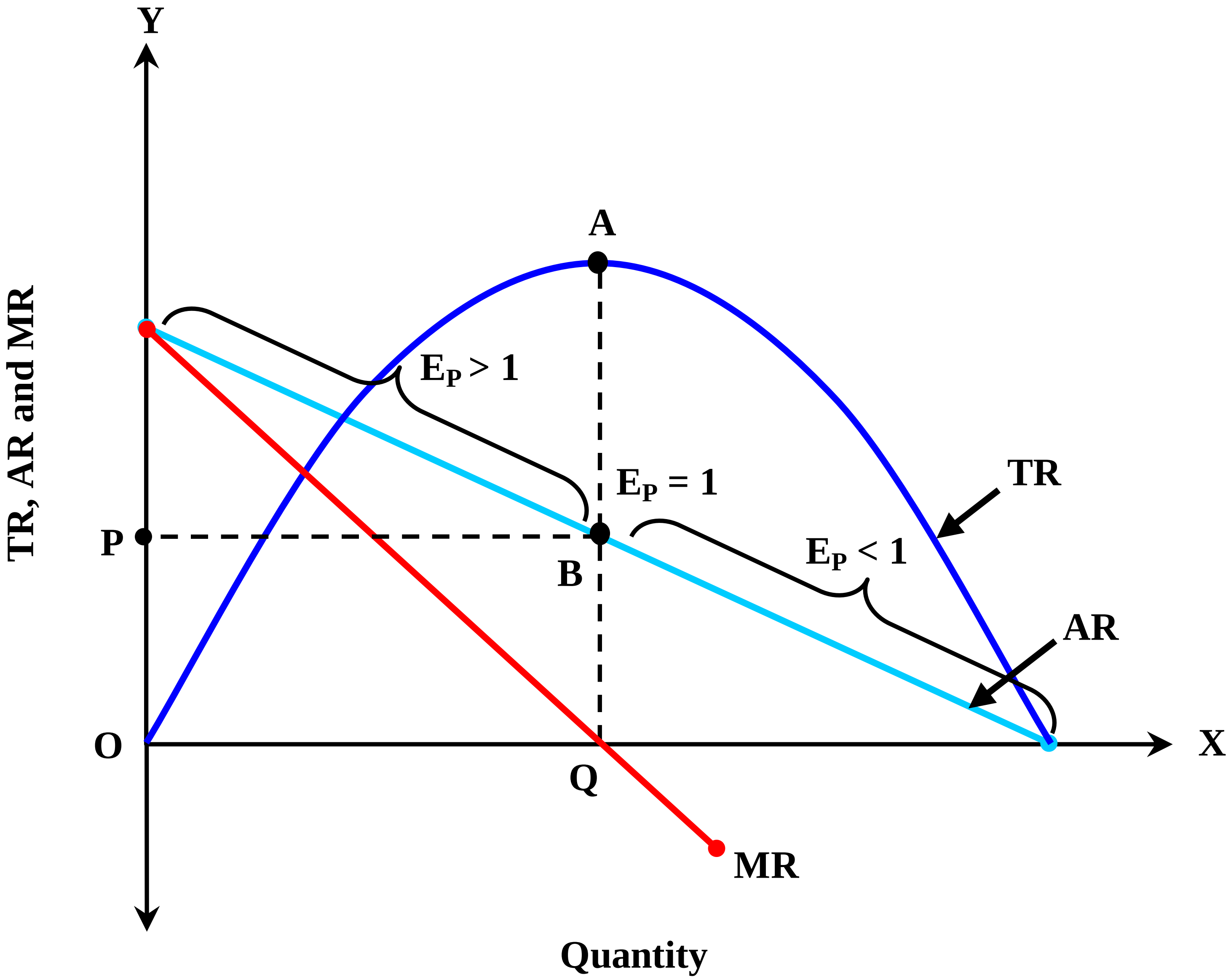
- Since, the total revenue (TR), marginal revenue (MR) and price elasticity of demand (E_P) are interrelated, the relationship between TR and E_P can be traced through the relationship between MR and E_P.
- Given the relationship between MR and E_P in the equation, $MR = P\left(1 - \frac{1}{E_P}\right)$, the relationship between TR and E_P can be summed up as follows:

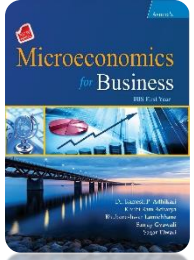
i. If $E_P = 1$, $MR = 0$; TR does not change with change in price.

ii. If $E_P < 1$, $MR < 0$; TR decreases with decrease in price and increase with increase in price.

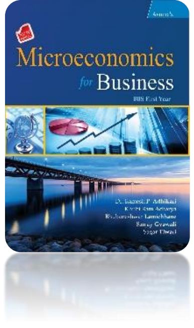
iii. If $E_P > 1$, $MR > 0$; TR decreases with increase in price and increases with decrease in price.


Microeconomics
for Business


Y
TR, AR and MR
A
$E_P > 1$
$E_P = 1$
TR
P
B
$E_P < 1$
AR
O
X
Q
MR
Quantity



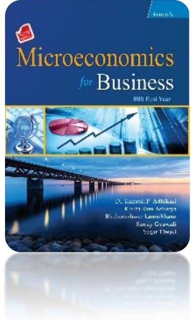
S.No.	Coefficient of Price Elasticity of Demand	Change in Price	Change in Total Revenue
1.	$E_P = 1$ (Unity Elastic Demand)	Increase Decrease	No Change No Change
2.	$E_P < 1$ (Inelastic Demand)	Increase Decrease	Increase Decrease
3.	$E_P > 1$ (Elastic Demand)	Increase Decrease	Decrease Increase
4.	$E_P = 0$ (Perfectly Inelastic)	Increase Decrease	Increase Decrease
5.	$E_P = \infty$ (Perfectly Elastic)	Increase Decrease	Decrease Increase



Numerical Examples 1

Complete the following table, draw TC, TVC and TFC and briefly explain the relationship between TC, TVC and TFC.

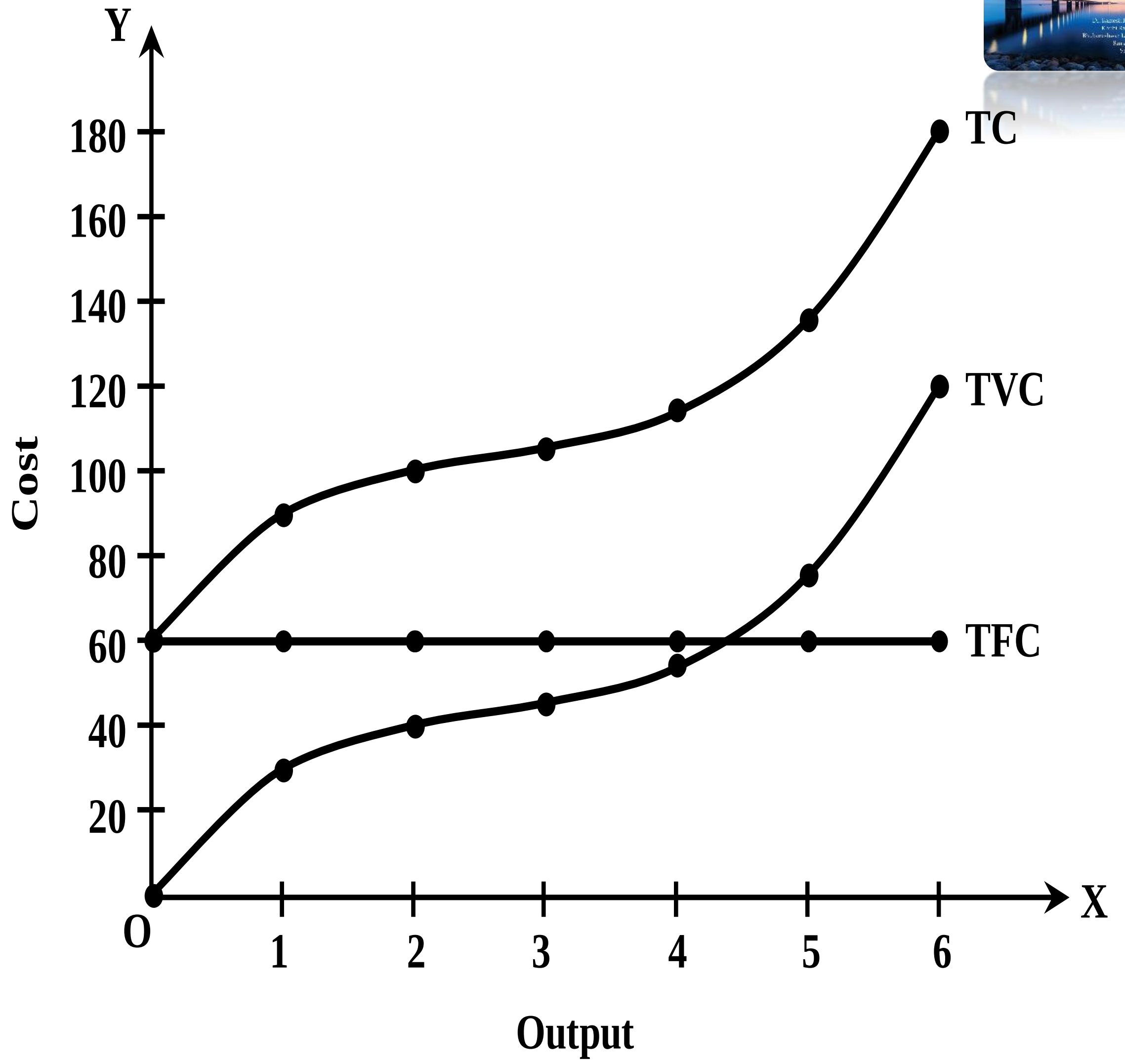
Quantity	TFC	TVC	TC
0	60	0	–
1	-	30	–
2	-	40	–
3	-	45	–
4	-	55	–
5	-	75	–
6	-	120	–

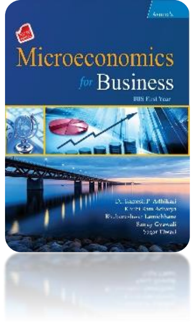


SOLUTION

Quantity	TFC	TVC	TC
0	60	0	60
1	60	30	90
2	60	40	100
3	60	45	105
4	60	55	115
5	60	75	135
6	60	120	180

- In the above diagram, TFC curve is horizontal because it is Rs. 60 regardless of level of output.
- TVC is zero when output is zero.
- It increases with increase in output.
- It is roughly U-shaped because of operation of law of variable proportion.
- TC begins from Rs. 60 because it is the sum of TVC and TFC.
- It is also roughly U-shaped because of operations of law of variable proportion.
- At every level of output the difference between TC and TVC is Rs. 60.
- Therefore, distance between them is constant at each and





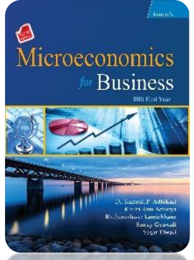
Numerical Examples 2

Complete the following table and explain the relationship between AC and MC with diagram.

Output	TFC	TVC	TC	AFC	AVC	AC	MC
0	200	0					
1	-	50					
2	-	90					
3	-	120					
4	-	140					
5	-	175					
6	-	230					
7	-	310					
8	-	400					

SOLUTION

Output (Q)	TFC	TVC	TC = TFC + TVC	AFC $= \frac{TFC}{Q}$	AVC $= \frac{TVC}{Q}$	AC $= \frac{TC}{Q}$	MC $= \frac{\Delta TC}{\Delta Q}$
0	200	0	200	-	-	0	-
1	200	50	250	200	50	250	50
2	200	90	290	100	45	145	40
3	200	120	320	66.6	40	106.6	30
4	200	140	340	50	35	85	20
5	200	175	375	40	35	80	35
6	200	230	430	33.3	38.3	71.6	55
7	200	310	510	28.5	44.2	72.7	80
8	200	400	600	25	50	75	90



The relationship between AC and MC can be pointed as follows:

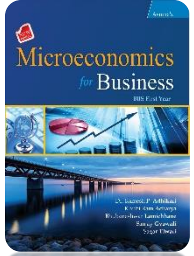
i. At the beginning both AC and MC are declining.

ii. When MC is decreasing, it declines faster than AC.

iii. MC is minimum at fifth unit of output and AC is minimum at sixth unit of output.

iv. AC = MC at sixth unit of output and at this output AC is minimum.

v. Beyond minimum point of AC, MC > AC.



Numerical Examples 3

Total cost function of a producer is given by $TC = 1000 + 10Q - 0.9Q^2 + 0.004Q^3$. Find TFC, TVC, TC, AFC, AVC and MC to produce 5 units of output.

SOLUTION

Given, $TC = 100 + 10Q - 0.9Q^2 + 0.004Q^3$

Total fixed cost (TFC) is the total cost at zero level of output and it remains the same whatever be the level of output. It remains the same regard less of change in output.

When $Q = 0$, $TC = 1000$. Hence, at $Q = 5$, $TFC = 1000$

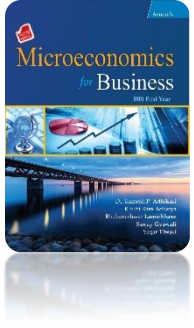
When $Q = 5$, $AFC = \frac{TFC}{Q} = \frac{1000}{5} = 200$

We know that $TC = TFC + TVC$

$TVC = TC - TFC$

$TVC = 1000 + 10Q - 0.9Q^2 + 0.004Q^3 - 1000$

$TVC = 10Q - 0.9Q^2 + 0.004Q^3$



At, $Q = 5$

$$TVC = 10 \times 5 - 0.9\,(5)^2 + 0.004(5)^3 = 50 - 22.5 + 0.5 = 28$$

Now, $TC = TFC + TVC = 1000 + 28 = 1028$

Now,

$$AVC = \frac{TVC}{Q} = \frac{28}{5} = 5.6$$

$$MC = \frac{d(TC)}{dQ} = \frac{d}{dQ}(1{,}000 + 10Q - 0.9Q^2 + 0.004Q^3)$$

$$= \frac{d(1000)}{dQ} + 10\frac{dQ}{dQ} - 0.9\left(\frac{dQ^2}{dQ}\right) + 0.004\left(\frac{dQ^3}{dQ}\right)$$

$$= 0 + 10 \times 1 - 2 \times 0.9 \times Q + 3 \times 0.004 \times Q^2$$

$$= 10 - 1.8\,Q + 0.012Q^2$$

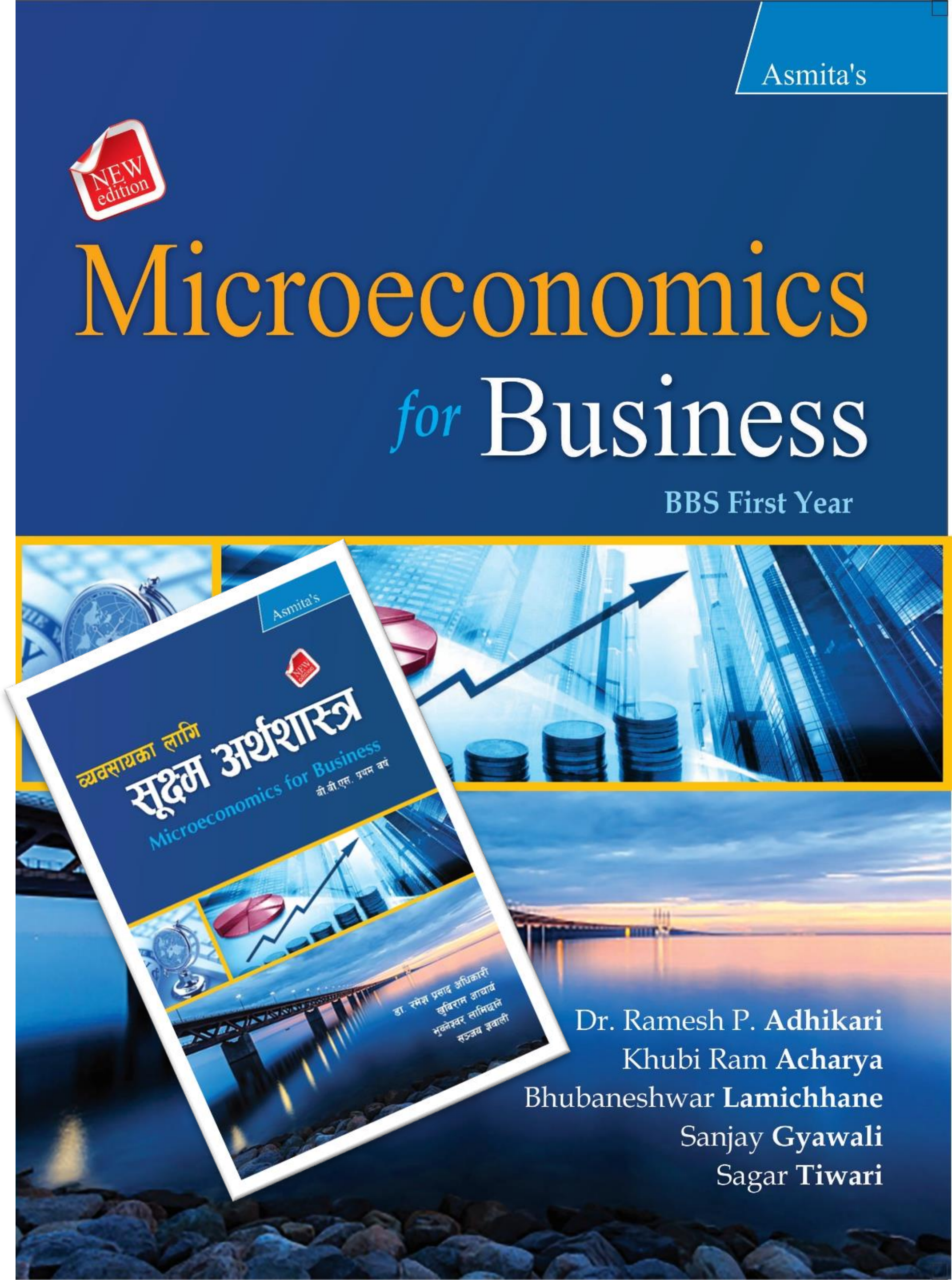
Putting $Q = 5$, we get

$$MC = 10 - 1.8(5) + 0.012 \times 5^2$$

$$= 10 - 9 + 0.3$$

$$= \text{Rs. } 1.3$$

Thank You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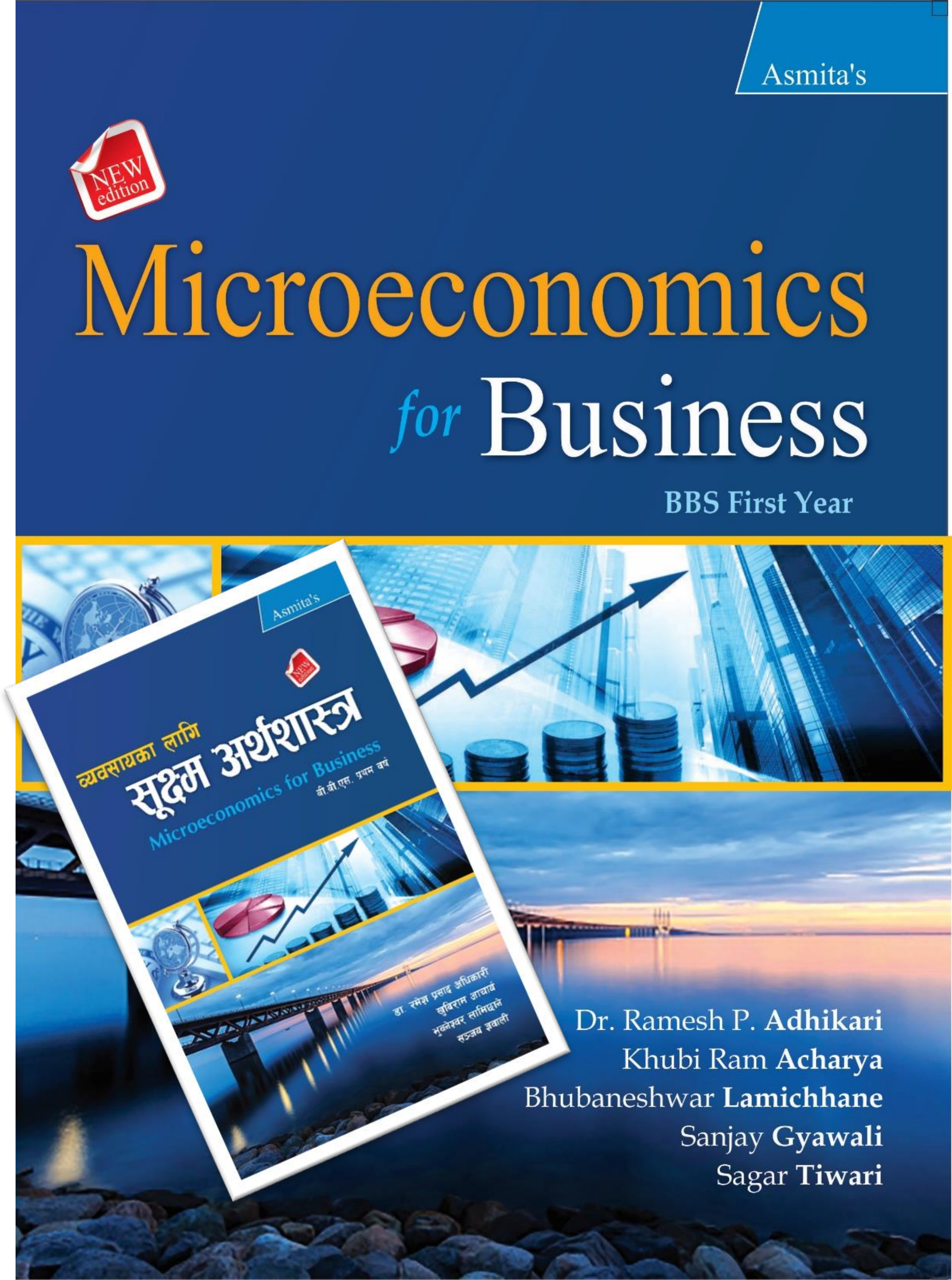
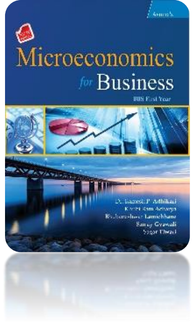
Theory of Factor Pricing

Unit 8



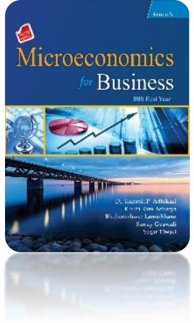
A S M I T A



Learning Objectives

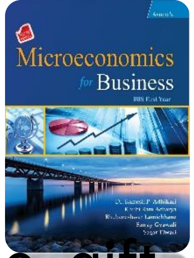
On completion of this unit, students will be able to:

- explain the concept of rent and its types
- explain the modern theory of rent
- explain the concept of wages and its types
- describe the marginal productivity theory of wages, concept of collective bargaining and minimum wages fixation
- explain the concept of interest and its types
- explain the loanable fund theory and liquidity preference theory of interest
- describe the concept of profit and its types
- distinguish between economic and business profit
- explain the dynamic theory of profit and innovation theory of profit.



Introduction

- Factor pricing deals with the theory of factor price determination. The term factor refers to factors of production.
- Traditionally, there are four factors of production. They are land, labour, capital and organization.
- These factors of production are to be employed for the production of goods and services.
- These factors of production get reward in the form of wage, rent, interest and profit receptively for their contribution in the production of goods and services.
- Economists have developed various theories for the determination of price of each factor of production. These theories are called theories of factor pricing.



Rent

Rent is defined as the payment made to the landlord by a tenant for the use of land, i.e. gift of nature. In other words, it is the reward or price paid for the use of land.

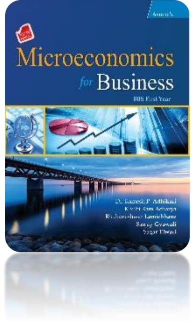
Types of Rent

1. Contract Rent
2. Economic Rent

Contract Rent

- Contract rent is the total payment made by the tenant to the landlord.
- In other words, it is the commercial rent which refers to price paid per unit of time for the services of durable goods, such as land, computer, machineries, house, vehicle, etc. when hired rather than purchased.
- It is also gross rent, which includes economic rent, service charges, depreciation charges, net profit and interest.

Contract Rent = Economic Rent + Service Charges + Depreciation Charges + Profits + Interest

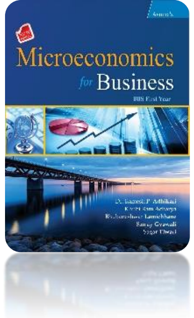


Rent Contd.

Economic Rent

- Economic rent is that part of the payment which is made only for the use of land, i.e. gift of nature. In economics, rent means economic rent. Economic rent is the pure rent.
- In the views of **David Ricardo**, economic rent is the amount paid for the use of original and indestructible power of the soil. But modern economists have extended the concept of economic rent to other factors of production. According to them, economic rent is the earning of any factor of production which exceeds its opportunity cost or minimum supply price in its use.
- The minimum supply price is the transfer earning of the factor, i.e. what the factor could earn in its next best alternative use.

Economic Rent = Actual Earning – Transfer Earning

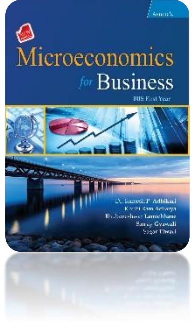


Modern Theory of Rent

- The modern theory of rent is based on the ideas of economists like **Alfred Marshall, Mrs. Joan Robinson** and **K.E. Boulding**. This theory of rent believes that rent is a surplus payment in excess of transfer earnings of the factors of production.

  Rent (Economic Rent) = Actual Earning – Transfer Earning

- Transfer earning is the earning or price of a factor of production from its next best or alternative use. In other words, transfer earning is the minimum earning which a unit of factor of production must be paid in order to induce it to stay in the present use or industry or occupation.
- If a factor is getting less than this minimum, it will give up the present employment and shift to its next best alternative employment.
- But, if a factor in its present employment is earning more than the minimum necessary to keep it in the employment, the excess is called economic rent.



Modern Theory of Rent Contd.

According to modern theory of rent, rent depends upon the elasticity of supply. There are three possible situations given by the modern economists, which are follows:

1. When supply of factors of production is perfectly elastic, the actual earning of the factors equals to its transfer earning and hence there will be no economic rent.
2. When supply of factors of production is perfectly inelastic, the transfer earning of the factors will be zero, and all of its earning is a surplus and all is economic rent.
3. When supply of factor of production is less than perfectly elastic, the transfer earning of the factors will differ and they all will earn surplus of varying quantity and economic rent varies.

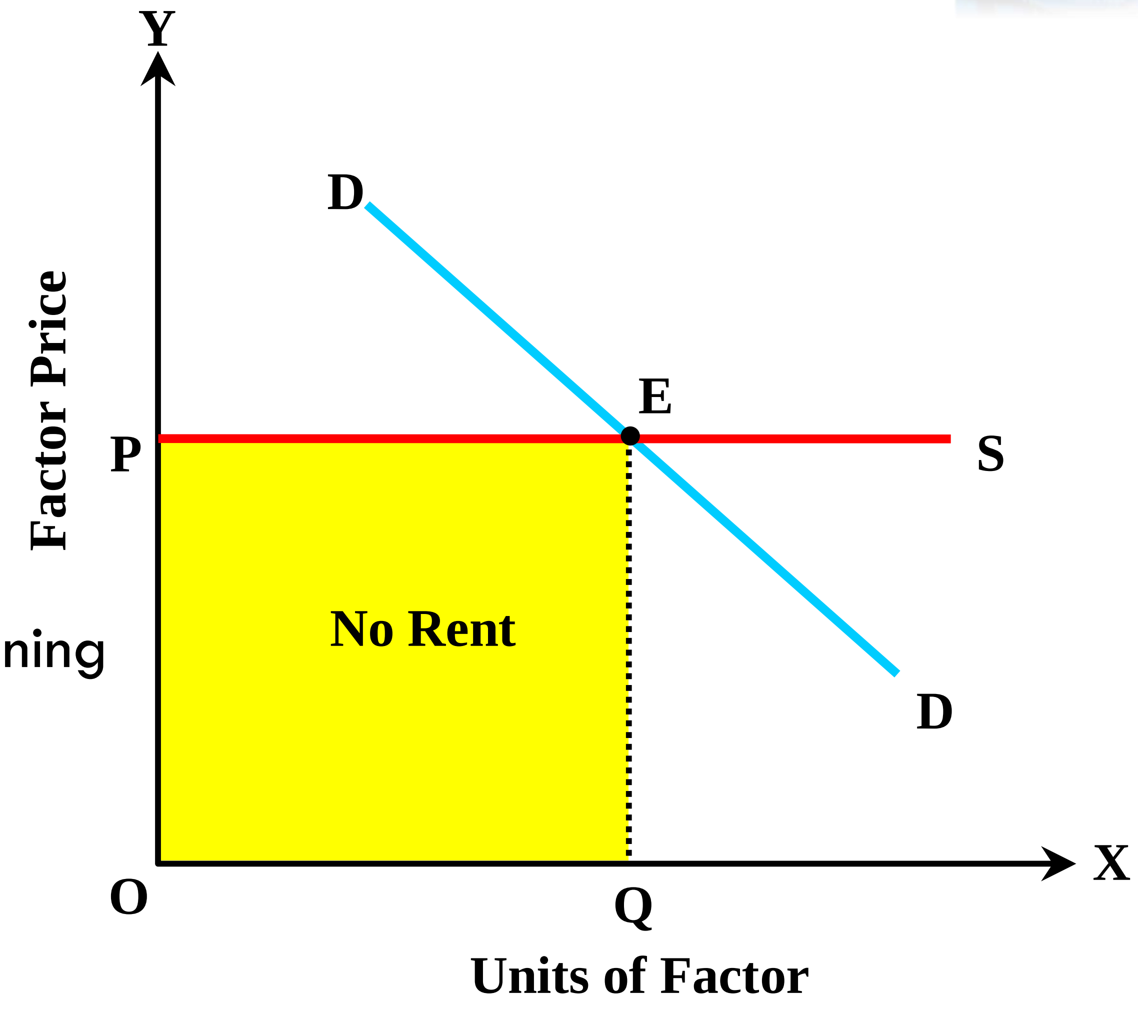
Modern Theory of Rent Contd.

Types of Supply of the Factors and the Rents Earned by Them

1. **Perfectly elastic supply ($E_S = \infty$):** The supply of a factor for some particular use can be perfectly elastic. In this situation, transfer earning is equal to the actual earning. So, the factor will earn no rent.

Economic Rent = Actual Earning – Transfer Earning

= OQEP – OQEP = 0



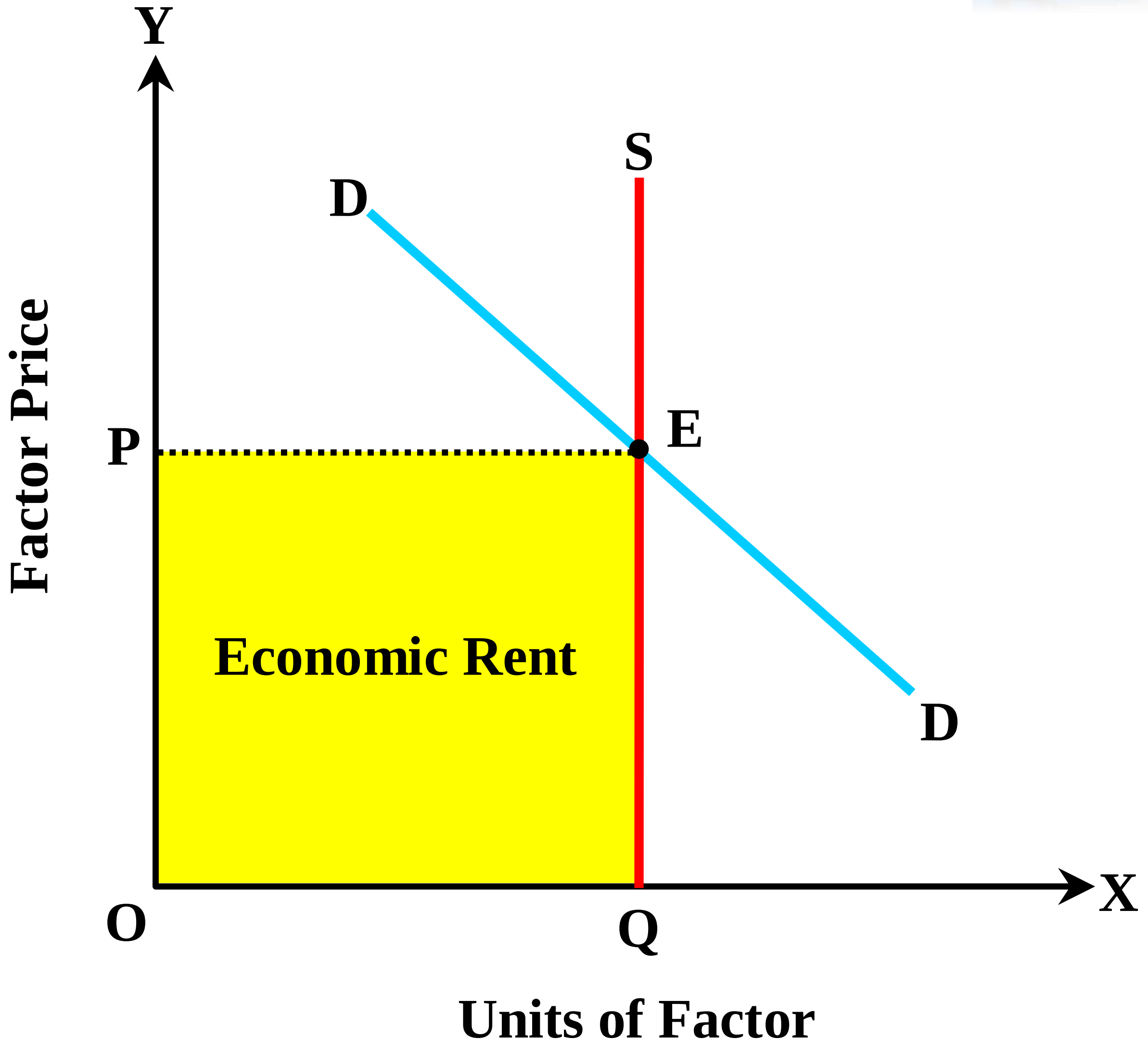
Modern Theory of Rent Contd.

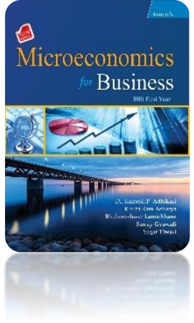
2. **Perfectly inelasticity supply:** The supply of a factor like land is perfectly inelastic. So, it has no transfer earning. The whole of its actual earning is rent.

Economic Rent = Actual Earning – Transfer Earning

= OQEP – 0

= OQEP





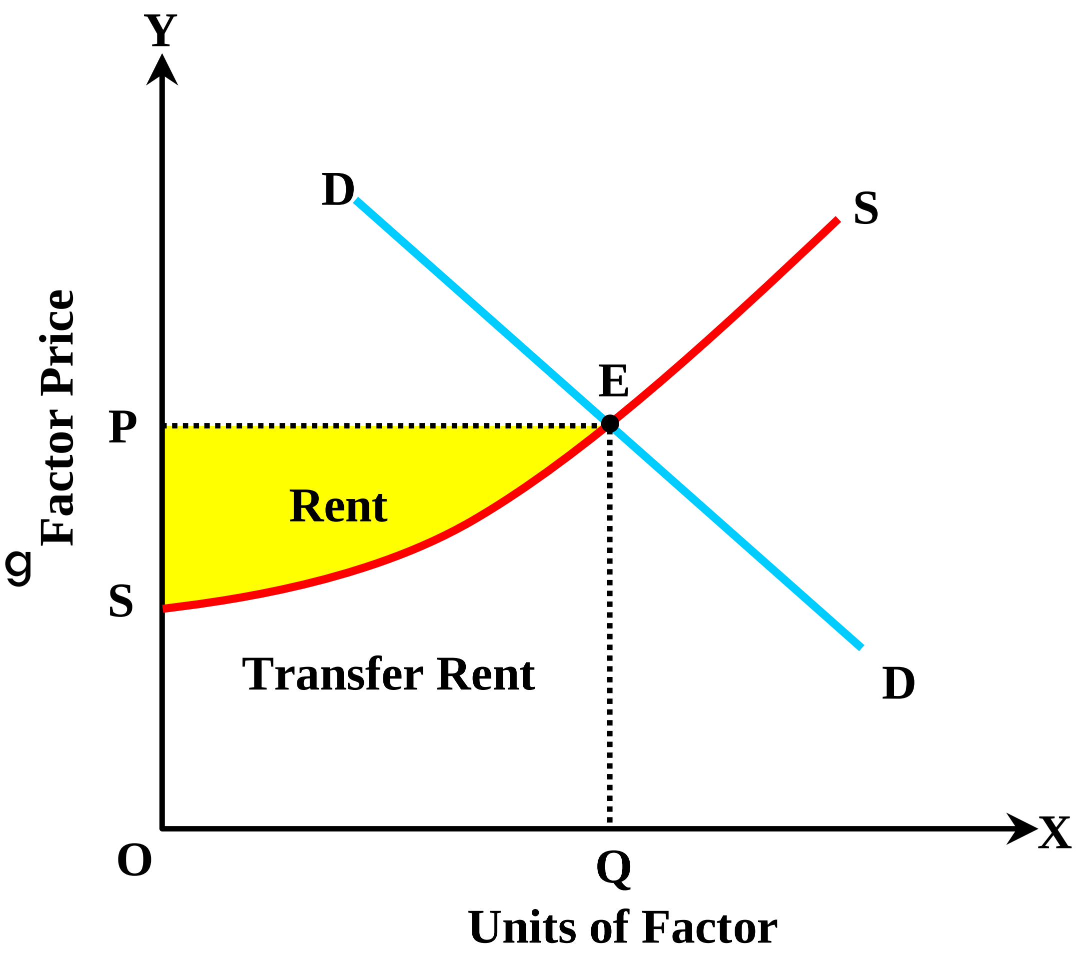
Modern Theory of Rent Contd.

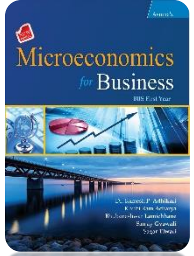
3. **Elastic supply:** The supply of the factor is neither perfectly elastic or nor perfectly inelastic. It is always between these two. In this situation, actual earning will be more than transfer earning. So, rent or economic rent will be occurred.

Economic Rent = Actual Earning – Transfer Earning

= OQEP – OQES

= PES





Wages

In economics, wages means payment made to the labour for his or her contribution in the production of goods and services. It is also defined as the reward given to the labour, whether it is mental or physical.

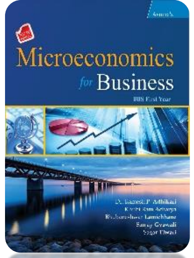
Money Wages (Nominal Wages)

- Money wage is defined as the price or reward paid in monetary terms to a worker for his or her services. Money wage is also called nominal wage.

Real Wages

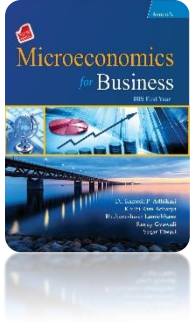
- Real wages is defined as the purchasing power of money wages. In other words, it is the sum of goods and services that money wage can purchase and extra benefits provided to the labour.
- Extra benefits includes accommodation facilities, health care, transportation facilities, cloth allowances, insurance facilities, etc. The real wage determines the living standard of the labour of a particular country.

Marginal Productivity Theory of Wages



- Marginal productivity of labour means productive capacity of labour.
- The marginal productivity theory of wages was first stated by a German economist, **Von Thunen** in his book 'The Isolated State'. Later, it was developed and popularised by the economists like **J.B. Clark, Alfred Marshall, A.C. Pigou, Leon Walras**, etc.
- According to this theory, wages are determined at a point where value of marginal productivity of labour (VMP_L) equals to the marginal cost of labour (MC_L).

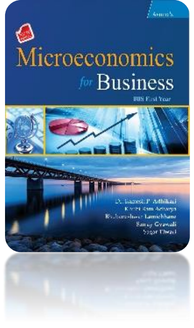
Marginal Productivity Theory of Wages Contd.



Assumptions

- There is perfect competition in both product and factor market.
- There is no change in technique of production.
- The objective of the firm is to maximize profit.
- There is operation of the law of diminishing marginal returns in the productivity of labour.
- There is full employment in the long-run.
- There is perfect mobility of factors of production.
- The labour is homogeneous and perfectly mobile.
- Price of the product remains constant.

Marginal Productivity Theory of Wages Contd.



Condition for Equilibrium

On the basis of above given assumptions, we can express equilibrium condition as follows:

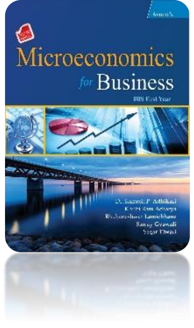
$$\mathbf{VMP_L = MC_L \quad \ldots \text{ (i)}}$$

where

VMP_L = Value of marginal productivity of labour

MC_L = Marginal cost of labour

Marginal Productivity Theory of Wages Contd.



Value of Marginal Productivity of Labour (VMP_L)

Value of marginal productivity of labour is defined as the additional revenue in total revenue due to employed an additional unit of labour by the firm. It is also obtained by multiplying the price of a commodity say X and marginal productivity of labour. The value of marginal productivity of labour curve is the demand curve for labour, which slopes downward because of constant price of the product and diminishing marginal productivity of labour. Symbolically,

$$\begin{aligned} VMP_L &= P_X \cdot MP_L \\ &= MR_X \cdot MP_L \qquad [\because \text{In the perfect competition, } P_X = MR_X] \end{aligned}$$

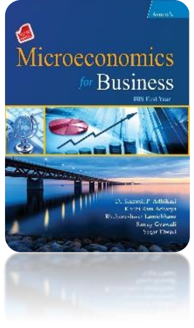
where

VMP_L = Value of the marginal productivity of labour

P_X = Price of the product X, which is constant

MP_L = Marginal productivity of labours

MR_X = Marginal revenue derived from good-X



Marginal Productivity Theory of Wages Contd.

Marginal Cost of Labour (MC_L)

Marginal cost of labour is defined as the wage paid to the each additional unit of labour. In other words, marginal cost of labour is the marginal wages, which is constant in the perfect competition. The marginal cost of labour is equal to the wage rate. It is also a supply curve of labour. It is horizontal straight line parallel to X-axis. Symbolically,

$$\mathbf{MC_L = w}$$

where

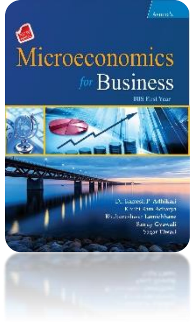
w = Wage rate

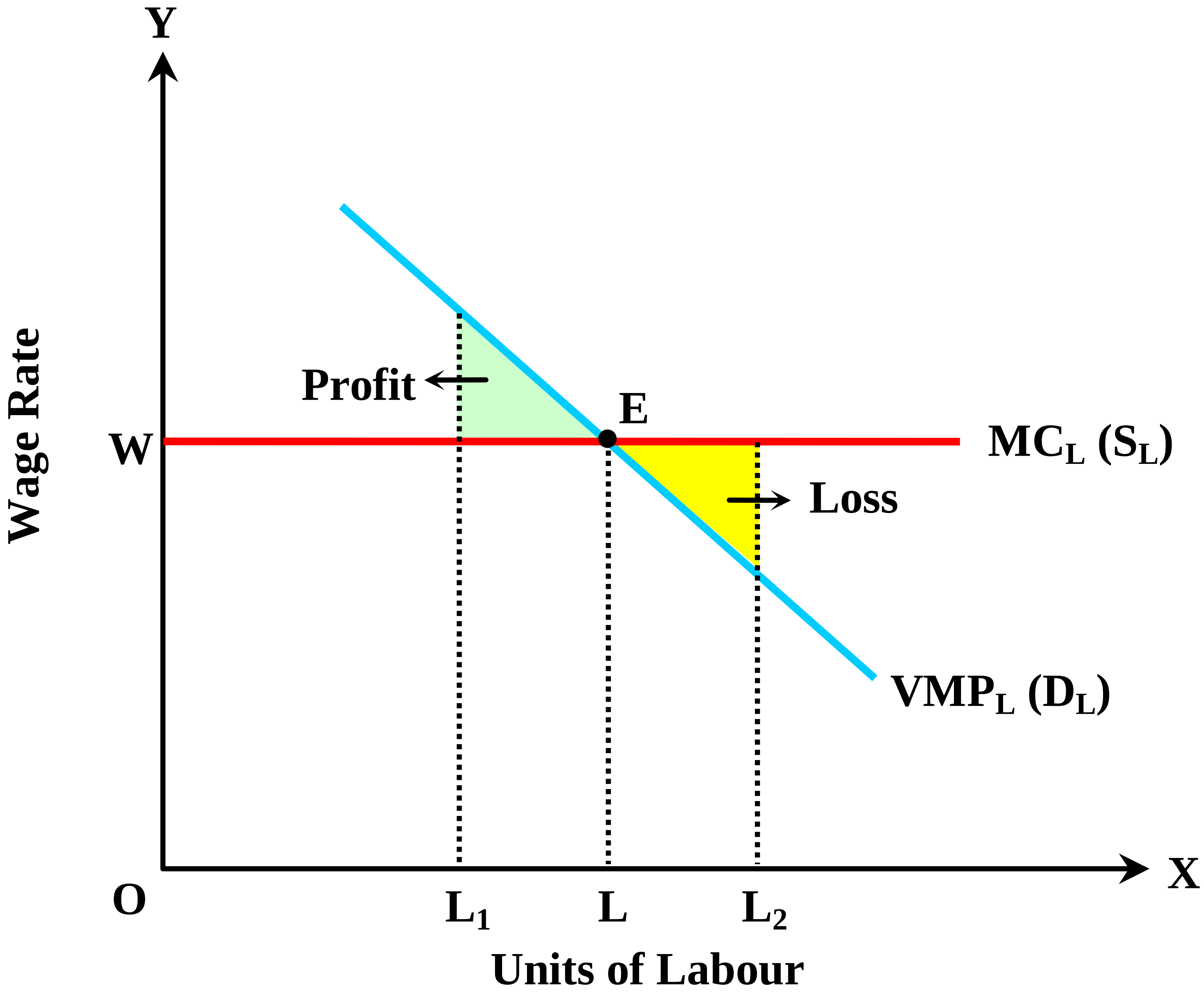
MC_L = Marginal cost of labour

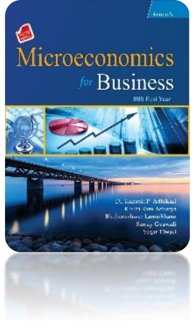
The profit maximizing firm will hire labour where MC_L equals to VMP_L. It can be expressed as

$$\mathbf{VMP_L = MC_L}$$

or, $\mathbf{VMP_L = w}$, which is the equilibrium condition.


Microeconomics
for Business


Y
Wage Rate
Profit
E
W
MC$_L$ (S$_L$)
Loss
VMP$_L$ (D$_L$)
O
L$_1$
L
L$_2$
X
Units of Labour

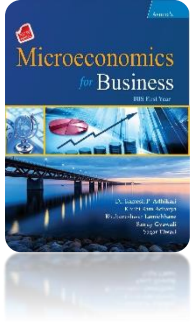


Marginal Productivity Theory of Wages Contd.

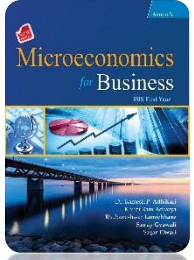
Criticisms

1. Based on perfect competition
2. One sided
3. Based on full employment
4. Static theory
5. Difficult to measure marginal productivity
6. Wage differentials
7. Ignored role of labour unions

Concept of Collective Bargaining



- The term Collective bargaining was first used by **Sidney** and **Beatrice Webb** in 1891 A.D. Collective bargaining is technique used by the trade union (organization of workers) and employers collectively to resolve their differences without assistance of a third party.
- The phrase Collective Bargaining is made up of two words. Collective means united or a group action and bargaining means negotiating. On the one side, the people involved in the negotiation are the representatives of management and on the other hand, the representatives of employees are trade unions.
- It plays very important role in setting and preventing industrial disputes. It is also an important tool for maintaining industrial peace.
- The responsibility of its proper implementation should be of both the employers and the employees.

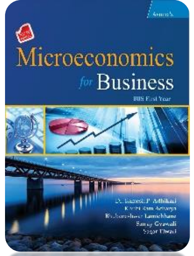


Determination of Wages under Collective Bargaining

Collective bargaining is a process of negotiation between employers and trade union (a group of employees) to achieve higher salaries, improving working conditions, non-wage benefits, such as medical facility, provident fund, pension, social security, reduction in working hour, over time, etc. Under collective bargaining, wage determination can be explained in two ways.

1. When there is Perfect Competition in both Labour and Product Market

In the perfectly competitive labour market, wage rate in a particular industry is fixed by the forces of demand for labour and supply of labour. The labour market is in equilibrium when marginal revenue productivity of labour (MRP_L) and its marginal wage rate are equal. Since in the perfect competition, MR = P, the value of marginal productivity of labour (VMP_L) is equal to the marginal revenue productivity of labour (MRP_L). MRP_L is product of MR and MP_L. Thus, $MRP_L = MR \times MP_L$. In the perfectly competitive market, marginal wage (MW) is constant and equal to the marginal cost of labour (MC_L). It is also a supply curve of labour. It is horizontal straight line parallel to X-axis. At the intersection point of demand for and supply of labour curves, MRP_L and marginal wage (MW) are equal. Both average wage (AW) and marginal wage (MW) are also equal in the perfect competition market. It can be shown by the help of **Figure**.



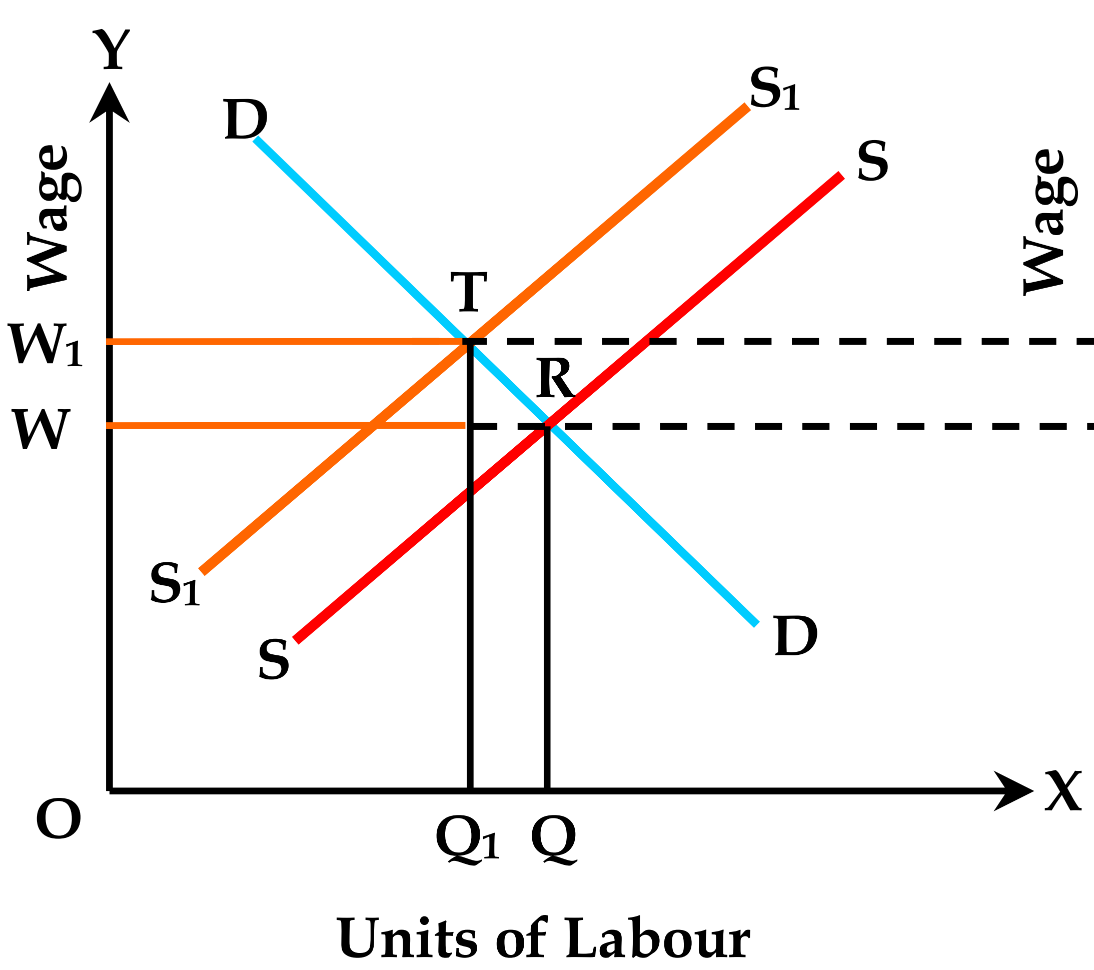


Fig. A
'Industry'

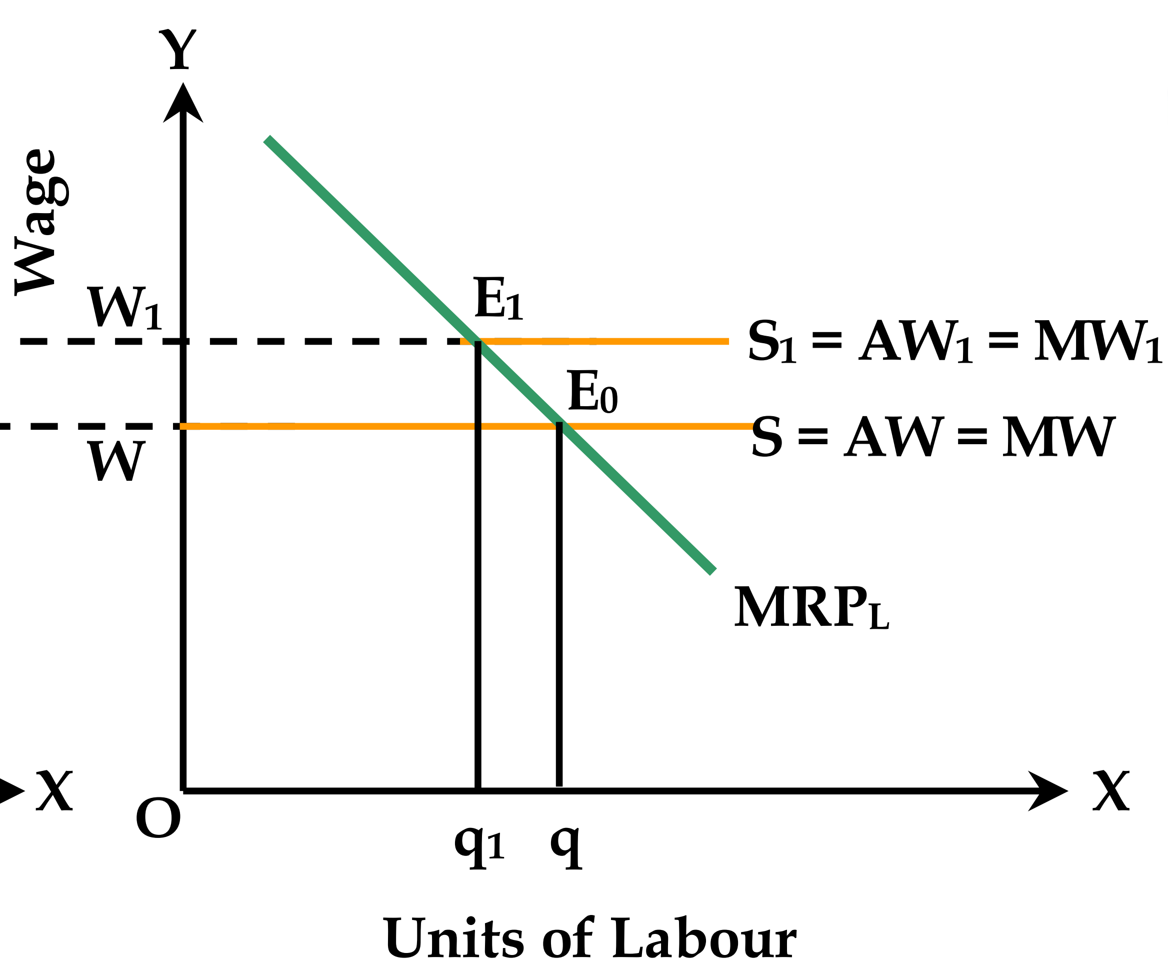
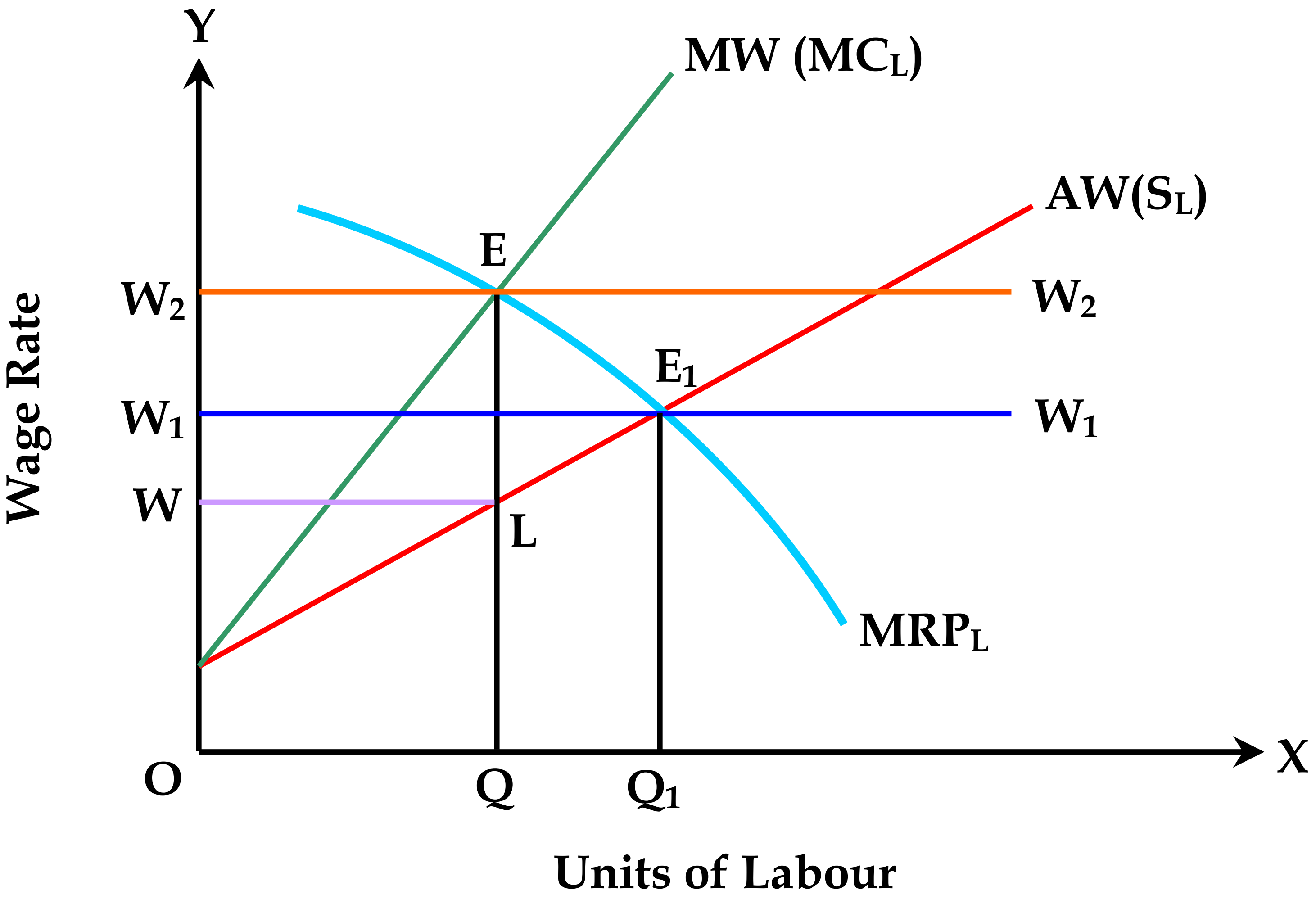


Fig. B
'Firm'

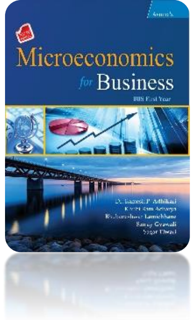
Determination of Wages under Collective Bargaining Contd.

2. When there is Monopsony in Labour Market and Perfect Competition in Product Market

A monopsonist firm is a single buyer of a factor, i.e. labour in the market. Therefore, the monopsonist firm can buy more units of the factors, i.e. labour by offering higher price per-unit and vice-versa. Thus, the supply curve of firm is positively sloping from left to right upward. Both average wage curve and marginal wage curve are also upward sloping. But MW curve will be above the AW curve. It can be shown by the **Figure**.



Minimum Wages Fixation



Minimum wages is defined as the minimum amount of remuneration that an employer is required to pay to the workers for the work performed during a given period of time. It is fixed by the government of a country in coordination with business organization and trade unions. The basic purpose of the minimum wage law is to protect interest of labour in the following conditions:

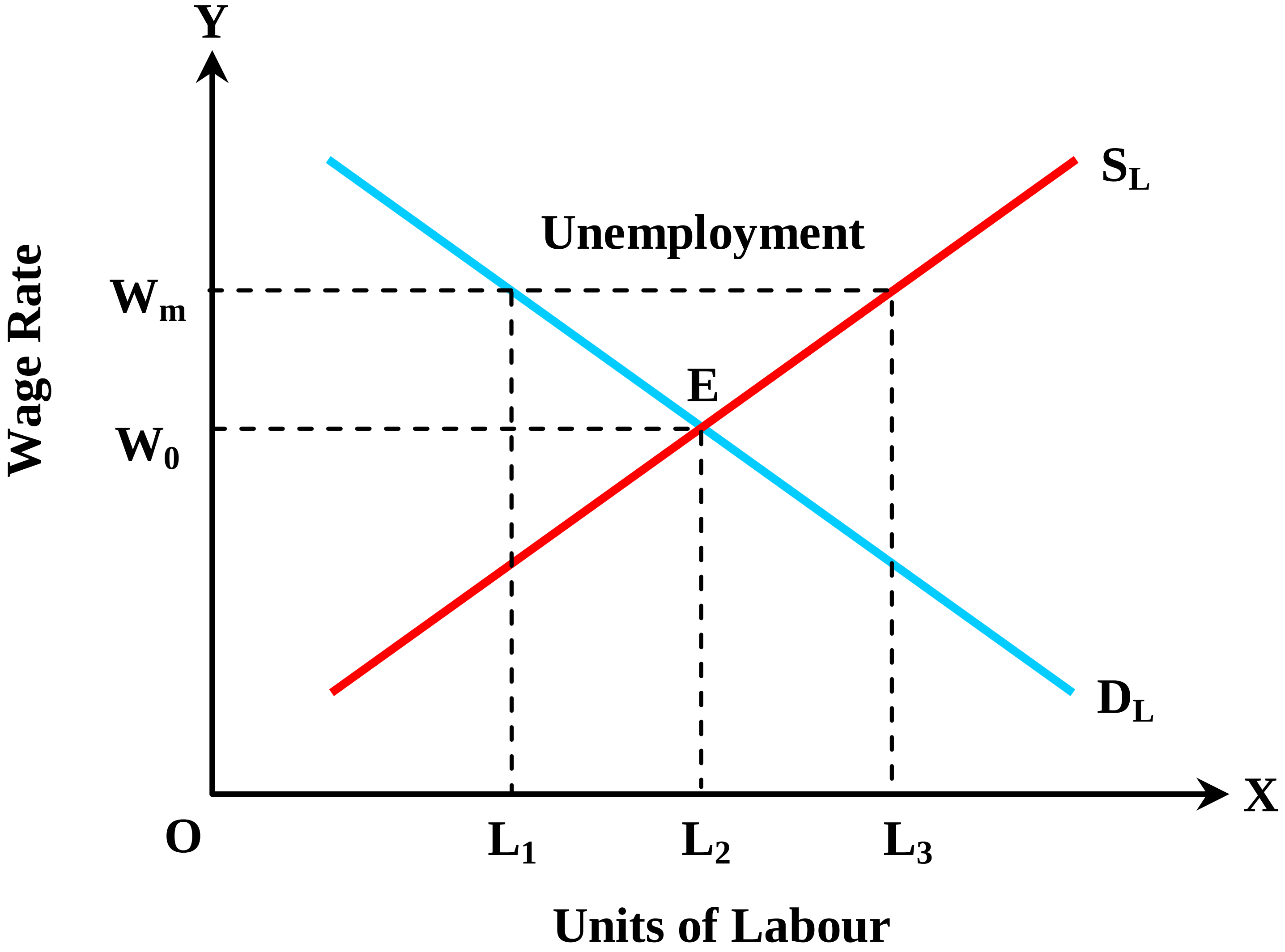
- Market determined wage rate is found to be much lower than required to meet the basic needs of labour.
- Market conditions open the possibility of exploitation of unorganized, unskilled and unemployed labour, and
- Government intends to improve economic condition of labour living in object poverty.

Minimum Wages Fixation Contd.

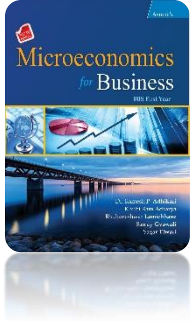
Here, we examines the effects of minimum wage law on the wage rate and labour employment in the following market conditions.

1. Effect of Minimum Wage Law in Perfectly Competitive Market

Under the perfectly competitive market, minimum wage law increases the wage rate and decreases the employment. It also checks the wage rate falling from minimum level and also checks the possibility of increase in employment. It can be shown by the help of **Figure.**

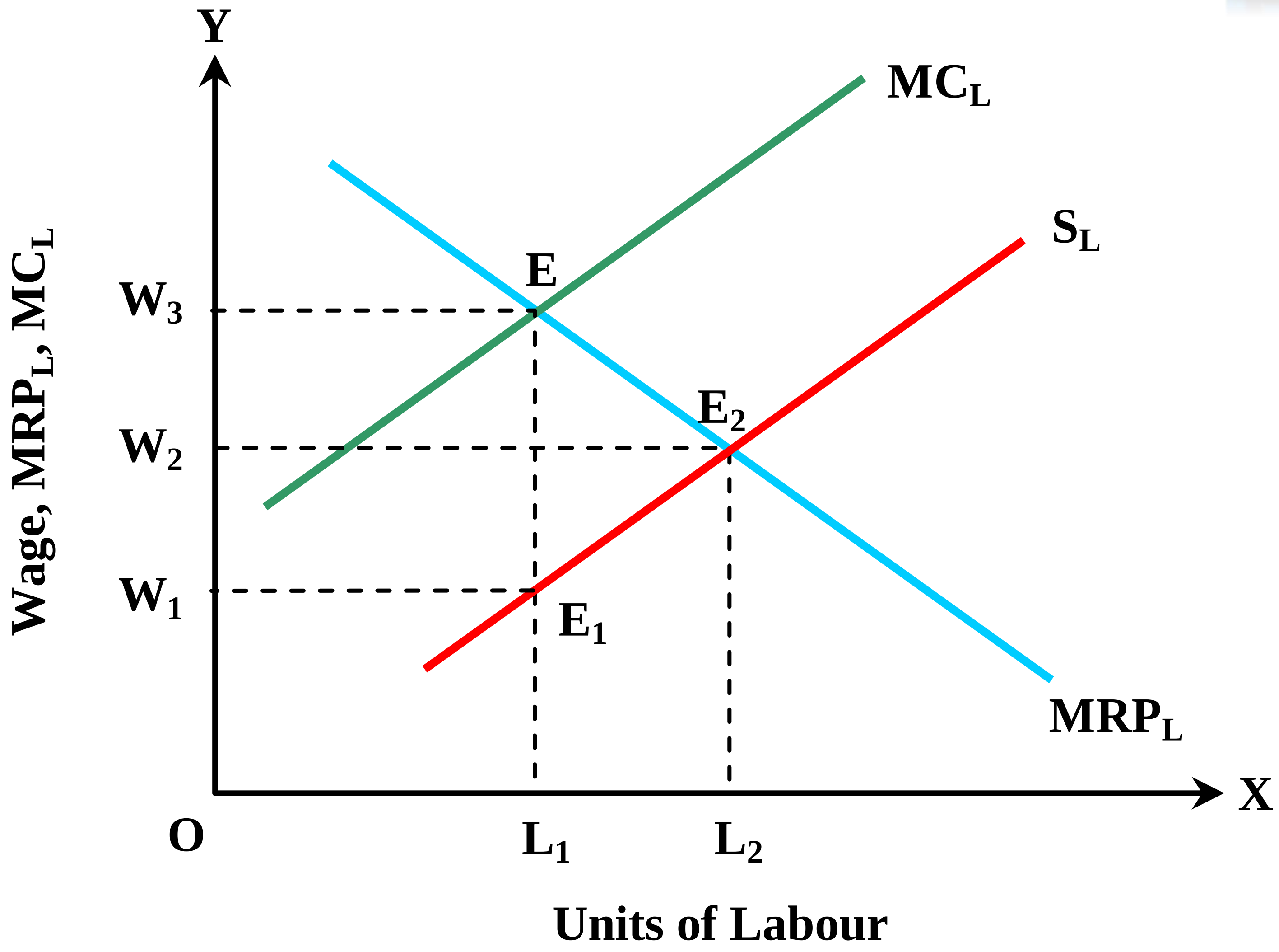


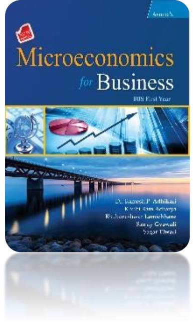
Minimum Wages Fixation Contd.



2. Effect of Minimum Wage Law in Monopsony

Under the monospony in labour market, minimum wage can be fixed by increasing wage rate without affecting the employment and by increasing both wages and employment. It can be shown by the help of the following **Figure.**





Wage Differentials

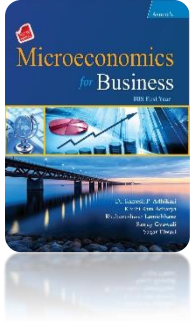
The theory of wage determination is based on the assumption of homogeneous units of labour. The wage of labour is the same in the perfectly competitions market if labour is homogeneous and non-monetary advantages are the same in all jobs. But in real world labour is not homogeneous and the different kinds of labour are not paid the same wages. It arises wage differentials.

A wage differential is defined as the difference in wages between workers with different skills in the same industry for same work or the difference in wages between the workers with similar skills within the different industries.

Types of Wage Differentials

- Dynamic wage differentials
- Static wage differentials.

Wage Differentials Contd.



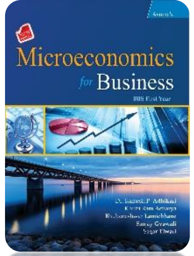
Dynamic Wage Differentials

Dynamic wage differentials occur due to the disequilibrium in commodity and factor market time to time. It depends on the demand for and supply of labour. The wage differential removes as the equilibrium is restored. The equilibrium is restored due to the forces of demand for and supply of labour. Therefore, wage differential is a temporary.

Static Wage Differentials

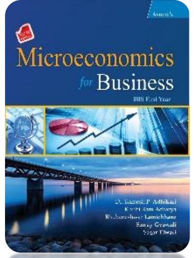
When wage differentials exist in state of equilibrium of industry, it is called static wage differentials. Such wage differentials cannot be removed by the competitive forces of the market. It arises due to the following reasons:

Wage Differentials Contd.



- Heterogeneity of labour, i.e. qualitative differences in labour
- Difference in the nature of occupations
- Differences in the prices of product which various kinds of labour produce
- Market imperfections
- Difference in risk of performing job
- Difference in cost of living
- Difference in cost of education and training
- Difference in hours of leisure.

Interest

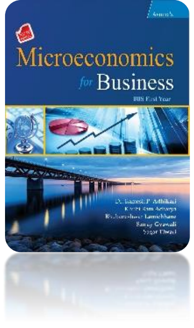


- Generally, interest refers to the payment made by a borrower of the fund to the lender for the use of the fund in a specific period of time.
- In other words, interest is defined as the reward received by the capital for its contribution in the production of goods and services.

Types of Interest

1. Gross Interest
2. Net Interest

Types of Interest Contd...



Gross Interest

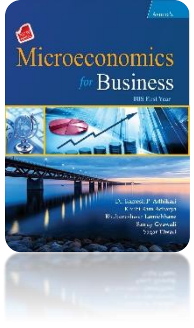
Gross interest is defined as the total amount paid by the borrower to a lender in return of the capital borrowed for a period of time. In other words, what we commonly talk about interest is the gross interest. Besides price for the use of capital, gross interest also includes reward for risk, reward for inconvenience, and reward for management of loan.

Gross Interest = Net interest + Reward for risk + Reward for inconvenience + Reward for management of loan

Net Interest

Net interest is defined as a part of gross interest or total interest which is exclusively paid for the use of the capital. It is also known as the pure interest. In order to calculate net or pure interest, the reward for risk, the reward for management of loan and the reward for inconveniences should be deducted from the gross interest.

Net Interest = Gross interest – Reward for risk – Reward for inconvenience – Reward for management of loan



Nominal and Real Interest Rate

- **Nominal interest rate** is defined as the interest rate before taking inflation into account. In other words, nominal interest rate is the percentage yield of a loan without considering the rate of inflation. Nominal rate of interest is also known as the money rate of interest.
- **Real interest rate** is defined as the interest rate that takes inflation rate into accountThe nominal rate of interest is influenced by the inflation rate but real rate of interest is not influenced by the rate of inflation. Thus, nominal rate of interest is the sum of real rate of interest and rate of inflation.

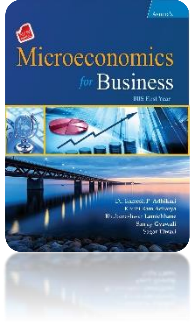
$$R' = R + i$$

where

R' = Nominal rate of interest

R = Real rate of interest

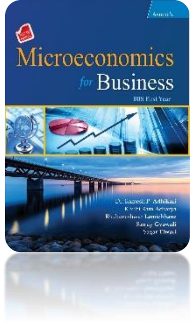
i = Rate of price inflation



Interest Rate Differentials

- Interest rate differential refers to the difference in interest rate between two similar interest bearing assets or securities. For example, if a bond yields 9 percent interest rate and next bond yields 6 percent interest rate, then 3 percent would be the interest rate differentials.
- It is mostly used in carry trade. Under carry trade, investors borrow at a low interest rate and invest it in an asset yielding a higher rate of return.
- Interest rate differentials can also be used to calculate the difference between the interest rate and a bank's posted interest rate on the prepayment date for mortgages.

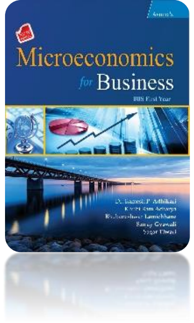
Theories of Interest



There are various theories of interest. Here, we study following two theories of interest:

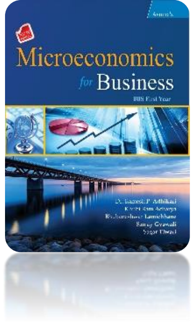
1. Loanable Fund Theory of Interest
2. Liquidity Preference Theory of Interest

Loanable Funds Theory of Interest (Neo-Classical Theory of Interest)



- The loanable funds theory of interest was propounded by the economists like **Kunt Wicksell**, **Gunar Myrdal**, **Bertin Ohlin**, **Dennis Robertson**, etc.
- According to this theory, rate of interest is determined from the demand for and supply of loanable funds.
- The demand for loanable funds is inversely related to the rate of interest and supply of loanable funds is positively related to the rate of interest.
- This theory is based on assumptions like existence of full employment of resources in the long-run, perfect competition, flexible rate of interest, no change in level of income, etc.

Loanable Funds Theory of Interest (Neo-Classical Theory of Interest) Contd.



Demand for Loanable Funds (D_L)

1. Investment demand (I)
2. Consumption demand (C)
3. Demand for hoarding (H)

$$D_L = I + C + H$$

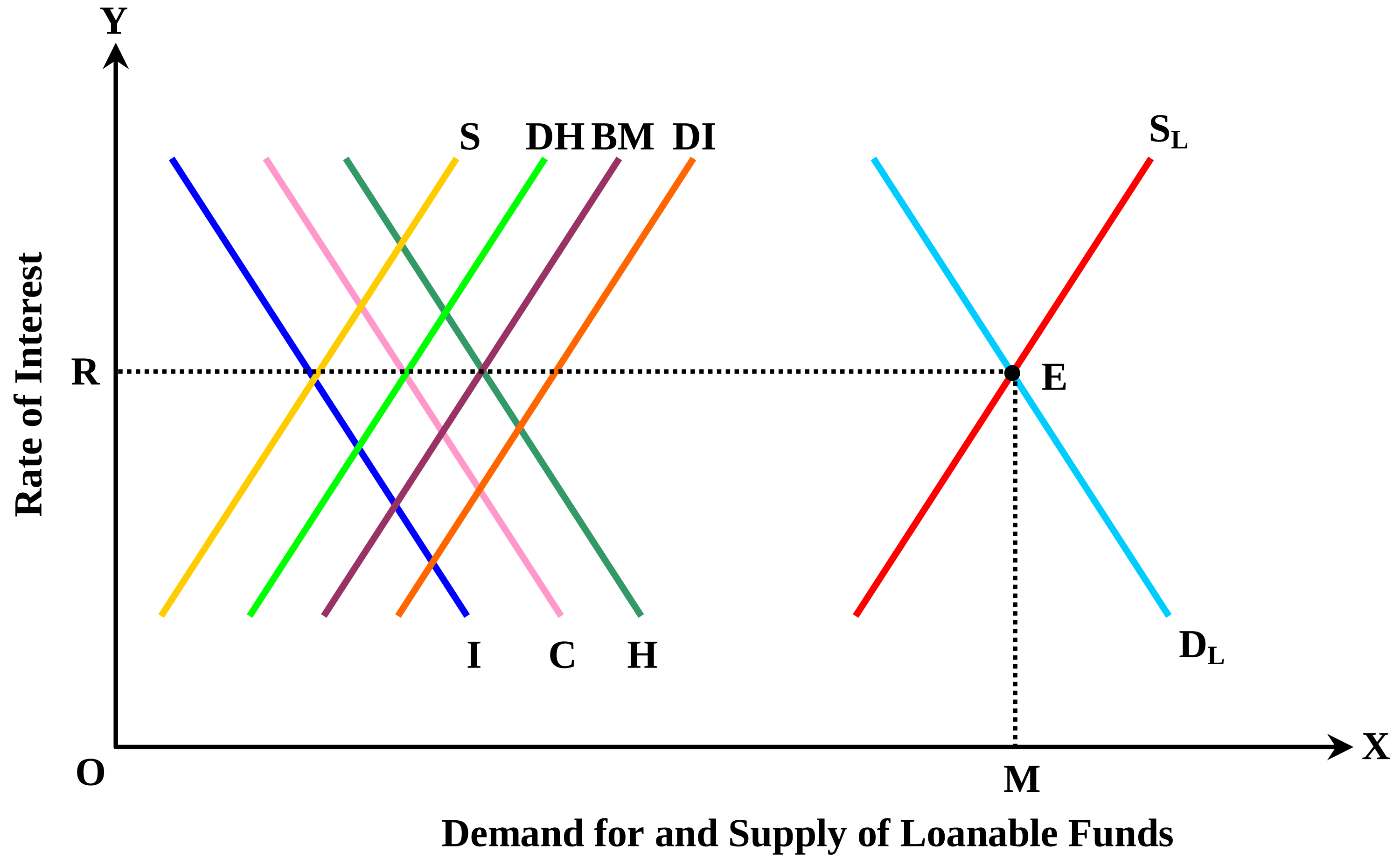
Supply of Lonable Funds (S_L)

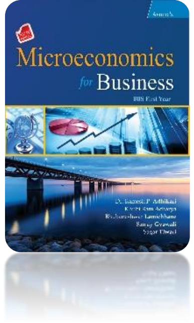
1. Saving (S)
2. Dishoarding (DH)
3. Bank money (BM)
4. Disinvestment (DI)

$$S_L = S + DH + BM + DI$$

Determination of Rate of Interest

The equilibrium rate of interest is determined by the interaction of the forces of demand for and the supply of loanable funds.

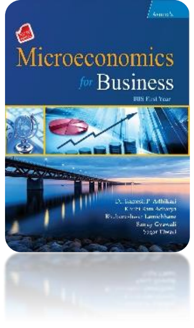




Loanable Funds Theory of Interest (Neo-Classical Theory of Interest) Contd.

Criticisms

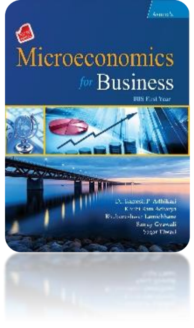
1. Unrealistic assumptions
2. Unrealistic integration of monetary and real factors
3. Indeterminate theory
4. Not a practicable theory
5. Wrong concept of hoarding



Liquidity Preference Theory of Interest (Keynesian Theory of Interest)

- The liquidity preference theory of interest was propounded by the famous British economist **J.M. Keynes** in his book 'General Theory of Employment Interest and Money' published in 1936. Therefore, this theory is also known as the Keynesian theory of interest. Keynes criticised the classical and neo-classical theories of interests and developed his own theory of interest.
- According to him, people desire to hold the assets in the form of cash because they can buy any thing they need or desire with the cash money. This cash money is the liquidity and desire of people to hold cash money is the liquidity preference.

Liquidity Preference Theory of Interest (Keynesian Theory of Interest) Contd.



1. Demand for Money

i. **Transaction motive (L_t):** Transaction motive is the demand for money or desire to hold cash by individuals or business firms to fulfil daily needs.

ii. **Precautionary motive (L_P):** Precautionary motive for holding money refers to the desire of people to hold cash balances for unforeseen contingencies.

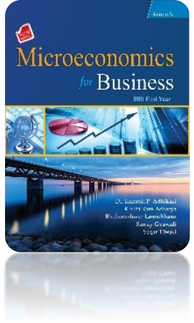
$$L_T = f(Y)$$

$$L_P = f(Y)$$

$$L_1 = L_T + L_P = f(Y)$$

iii. **Speculative motive:** Speculative motive is the desire of people or business firms to keep cash or liquid money with them to take advantage of future change in rate of interest and bond prices.

Liquidity Preference Theory of Interest (Keynesian Theory of Interest) Contd.



Total Demand for Money (L)

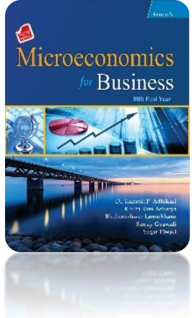
The total demand for money is the sum of active cash balances (sum of transaction and precautionary motive) and speculative motive of demand for money.

$$L = L_1 + L_2 = L_T + L_P + L_2$$

2. Supply of Money (M_S)

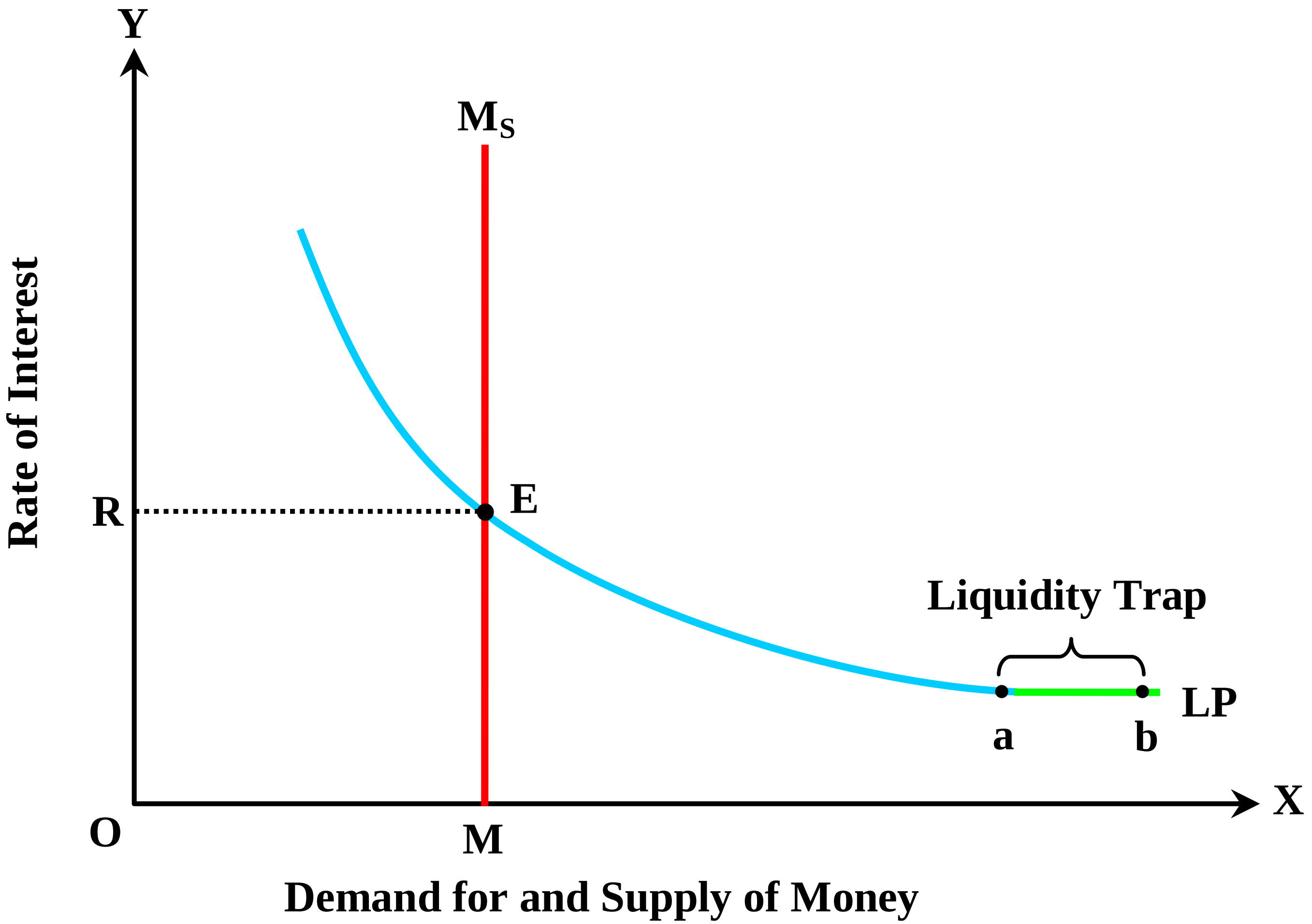
- Supply of money is defined as the total quantity of money in an economy which consists of coins, notes and bank deposits.
- It is exogenously determined by the central bank and assumed to be constant in the short-run. It is not influenced by the rate of interest.
- Therefore, supply curve of money is vertical straight line parallel to Y-axis, i.e. perfectly inelastic.

Liquidity Preference Theory of Interest (Keynesian Theory of Interest) Contd.

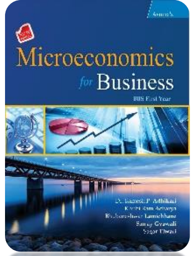


3. Determination of Interest Rate

- According to Keynes, the equilibrium rate of interest is determined at the point where demand for money curve, i.e. liquidity preference curve and money supply curve intersect each other.
- It means that the forces of demand for and supply of money determine the rate of interest.

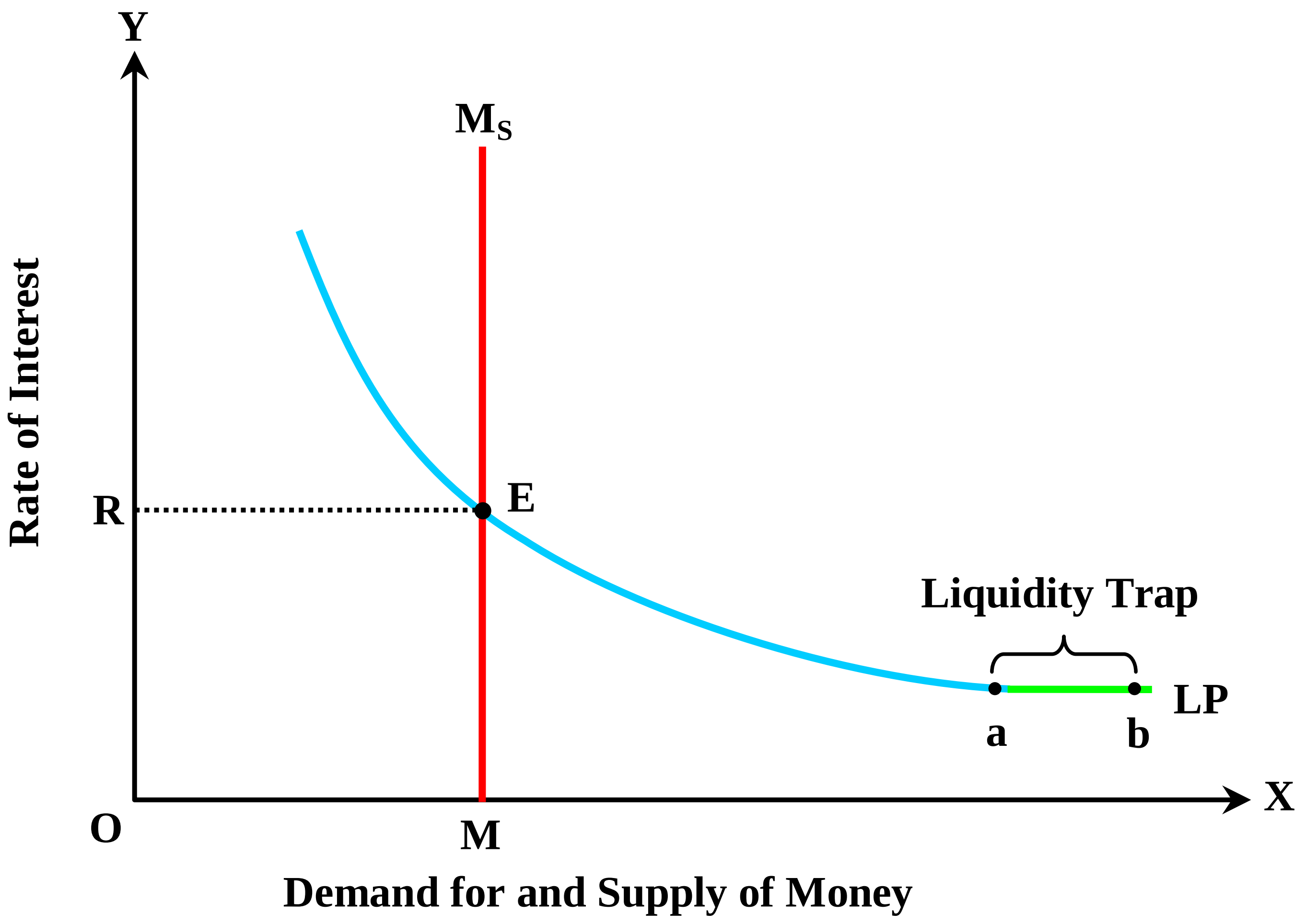


Liquidity Preference Theory of Interest (Keynesian Theory of Interest) Contd.

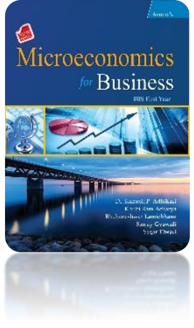


4. Liquidity Trap

- Liquidity trap is defined as the situation in which rate of interest falls to such a low level that it becomes unattractive to lend money and people will keep whole money with them.
- It further implies that rate of interest can not be lower any more.
- In this situation, demand for money curve become perfectly elastic, i.e. horizontal straight line parallel to X-axis.
- In **Figure**, *'ab'* part of the LP curve is horizontal, which represents liquidity trap.



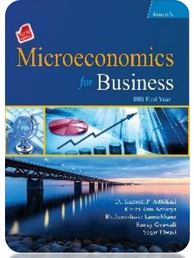
Liquidity Preference Theory of Interest (Keynesian Theory of Interest) Contd.



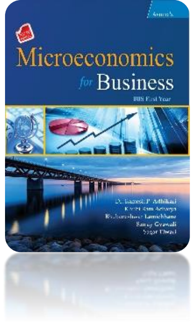
Criticisms

1. Real factors ignored
2. No liquidity without saving
3. Long period ignored
4. Liquidity preference arises not for three motives only
5. Indeterminate

Profit



- Profit is defined as the excess of total revenue over the cost of production.
- In other words, profit is the reward for the entrepreneur for his or her efforts, skill, risks and innovations.
- Profit is the residual income of an entrepreneur left after payments to the other inputs, i.e. rent to the land, wages to labour and interest to the capital.
- The definition of profit is quite different for the economists than for accountants.
- Accountants are concerned with business profit whereas economists are concerned with economic profit.



Business Profit and Economic Profit

Business Profit

Business profit is defined as the excess of total revenue over the explicit cost or accounting cost. It is also known as the accounting profit or gross profit. In the business sense, business profit is the excess of total revenue over the total cost of production.

Business Profit (Accounting Profit) = Total Revenue – Explicit Cost

= Total Revenue – Accounting Cost

Economic profit

Economic profit is defined as the excess of total revenue over the economic cost. Economic cost is the sum of implicit cost and explicit cost.

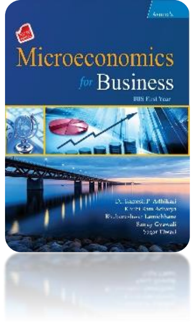
Economic Profit = Business Profit – Implicit Cost

Economic profit is also calculated deducting economic cost from total revenue. Thus,

Economic Profit = Total Revenue – Economic Cost

= Total Revenue – (Implicit Cost + Explicit Cost)

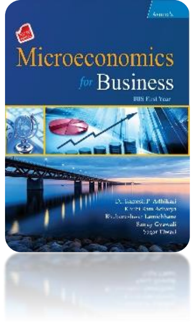
= Total Revenue – Implicit Cost – Explicit Cost



Theories of Profit

There are various theories of profit. Here, we study only following two theories:

1. Dynamic Theory of Profit
2. Innovation Theory of Profit



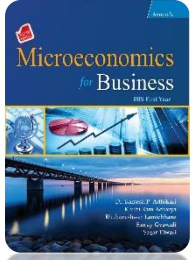
Dynamic Theory of Profit

The dynamic theory of profit was introduced by an American economist, **J.B. Clark** in 1891 AD. According to him, profit arises only in the dynamic economy. There is no profit in a static economy.

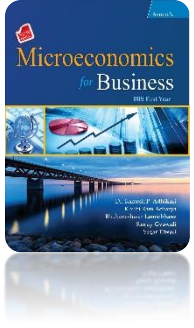
Types of Economies

1. Static Economy
2. Dynamic Economy

Dynamic Theory of Profit Contd.



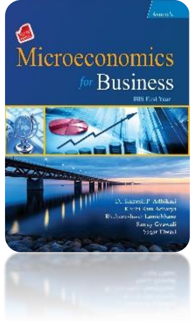
1. **Static economy:** According to this theory, profit cannot emerge in the static economy. In the static economy, demand and supply remain same. The factors which determine demand and supply, such as technology of production, size of the population, human wants, supply of capital, forms of business organization, habit and nature of people, fashion, consumption pattern, etc. remain same.
2. **Dynamic economy:** According to dynamic theory of profit, profits arise only in the dynamic economy. The following five changes occur in the dynamics economy:
   - Changes in size of population
   - Changes in supply of capital
   - Changes in production technique
   - Changes in human wants
   - Changes in the forms of business organization



Dynamic Theory of Profit Contd.

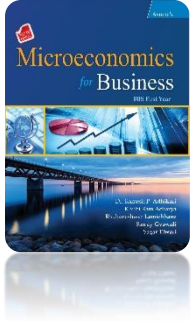
Criticisms

1. Origin of profit
2. Incomplete explanation
3. No difference between profit and wages
4. Failed to determined the size of profits
5. Profit not only due to changes occurring in the society
6. Important determinants of profit ignored



Innovation Theory of Profit

- The innovation theory of profit was introduced by an eminent American economists **Joseph A. Schumpeter.**
- According to him, the principle function of an entrepreneur is to make innovation and profits are the reward for performing this important function.
- In the words of Schumpeter, *"Profit is the reward for innovation."*
- Thus, the main sources of profit are innovations.
- Here, the word innovation means all changes that occur in the production process.
- The objective of innovation is to reduce cost of production and increase demand for goods and services.
- This theory assumes existence of perfect competition, free market and closed economy.

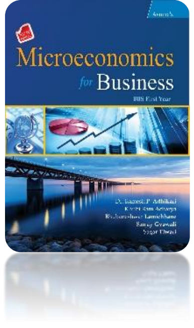


Innovation Theory of Profit Contd.

Types of Innovations

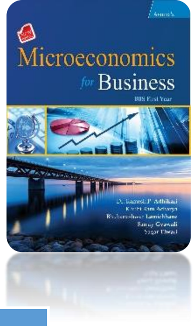
1. **Cost reducing innovation:**
   - Introduction of new production technique
   - Introduction of new machine
   - Exploration of new raw materials
   - Change in organization of production
   - Introduction of new production process
2. **Demand expanding innovations:**
   - Introduction of new product
   - Improvement in quality of product
   - Introduction of superior methods of advertisement
   - Discovery of new markets

Innovation Theory of Profit Contd.



Criticisms

1. Narrowly defined activities of an entrepreneur
2. Windfall or monopoly profits ignored
3. Other determinants of profit ignored
4. Unsatisfactory and incomplete theory
5. Unable to determine the size of profit



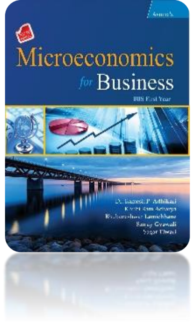
Numerical Examples 1

Consider the following schedule

No. of Labour (L)	Total Productivity of Labour (TP/ Q)	Marginal Productivity of Labour (MP_L)	Value of Marginal Productivity of Labour (VMP_L)
1	20	……	……
2	36	……	……
3	48	……	……
4	56	……	……
5	60	……	……

a. Complete the above schedule assuming price of product $5.

b. Compute profit maximizing number of labour at wage rate $60.



SOLUTION

a. Given

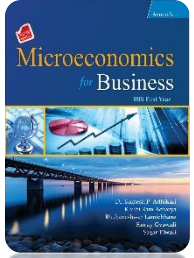
$P_X = \$5$

We know that

$$VMP_L = P_X \cdot MP_L$$

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

L	TP_L	MP_L	P_X	$VMP_L = P_X \cdot MP_L$
1	20	20	5	100
2	36	16	5	80
3	48	12	5	60
4	56	8	5	40
5	60	4	5	20

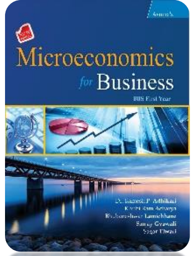


SOLUTION

b. We know that a firm maximizes profit when value of marginal product of labour is equal wage rate, i.e.

$$VMP_L = w$$

In the above table, value of marginal product of labour (VMP_L) is equal to wage rate (w) at 3rd unit of labour, i.e. both are \$60 at 3rd unit of labour. Therefore, profit maximizing unit of the labour is 3 units or L = 3 units.



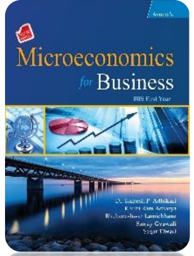
Numerical Examples 2

Tejaswini, a fashion designer, working as a manager of a Boutique for Rs. 120,000 per year wants to start her own business by investing her own money of Rs. 400,000 on which she could earn 10 percent interest if deposited in a bank. Her estimated revenue during the first year of operation is Rs. 300,000 and costs are - salaries to employee Rs. 90,000; supplies Rs. 30,000; rent Rs. 20,000 and utilities Rs. 2,000.

a. Calculate is the business profit.

b. Calculate is the economic profit.

c. If she seeks your advice on whether to stay in the business or not what will be your advice and why?



SOLUTION

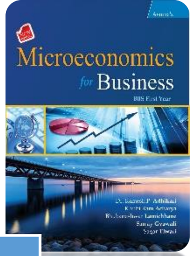
a. Business profit (Accounting profit) = TR – Total explicit costs

= TR – (Salaries to employee + Supplies + Rent + Utilities)

= 300,000 – (90,000 + 30,000 + 20,000 + 2,000)

= 300,000 – 142,000

= Rs. 158,000



Alternatively,

Particulars	Amount (Rs.)	Amount (Rs.)
Revenue		300,000
Less: Explicit costs		
Salaries to employees	90,000	
Supplies	30,000	
Rent	20,000	
Utilities	2,000	142,000
Business Profit/ Accounting Profit		158,000

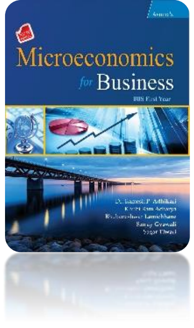
b. Economic profit = Business profit – Implicit costs

= Business profit – (Salary of previous job + Interest of her own money invested)

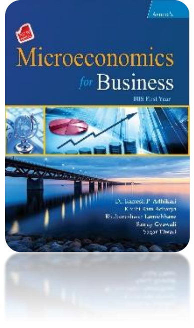
= 158,000 – (120,000 + 10% of 400,000)

= 158,000 – (120,000 + 40,000)

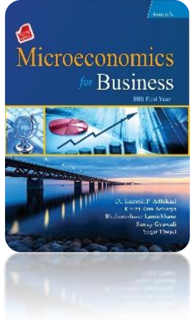
= – Rs. 2,000 (Loss)



Alternatively,

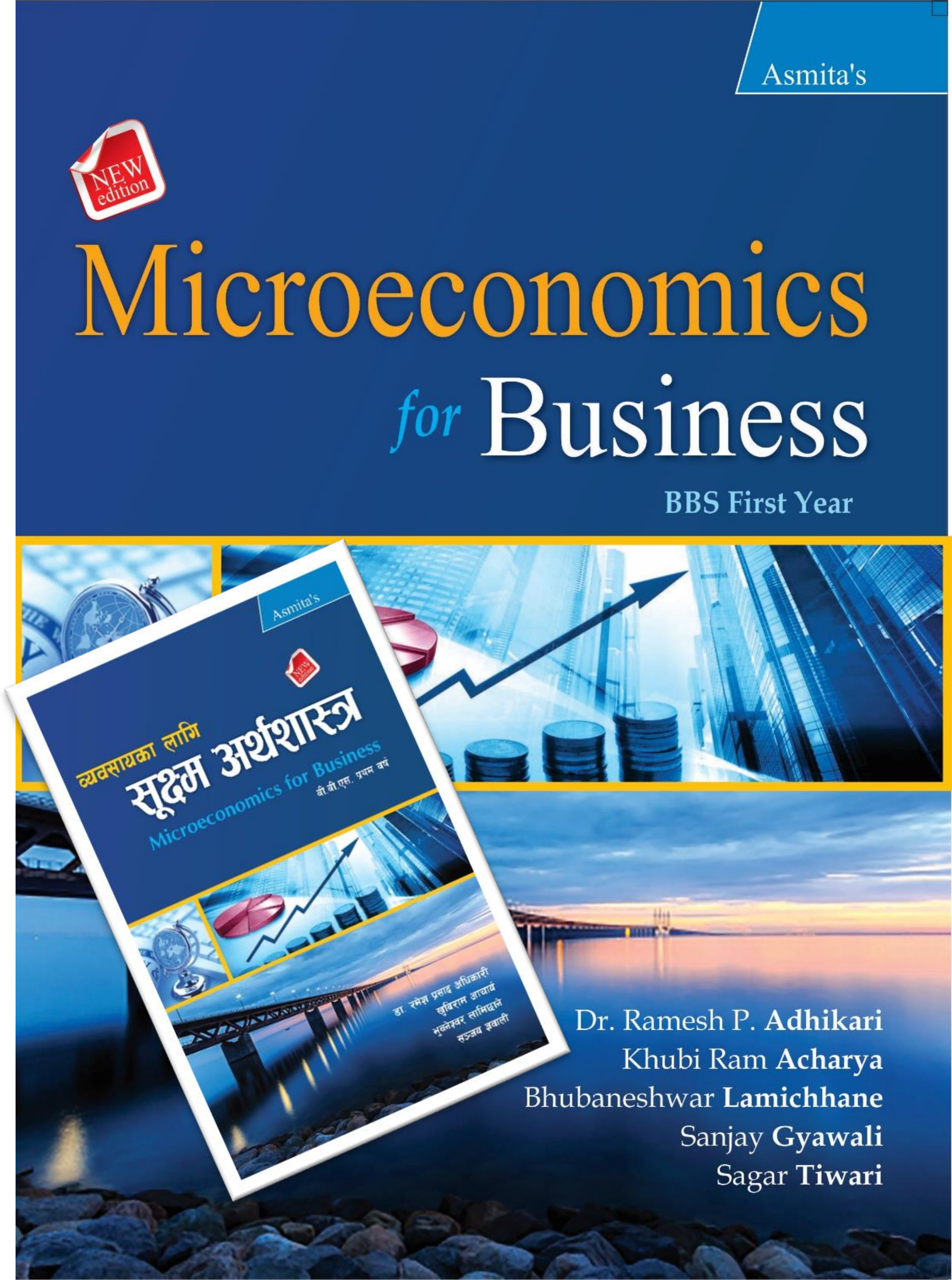


Particulars	Amount (Rs.)	Amount (Rs.)
Business profit/ Accounting profit		158,000
Less: Implicit costs Salary of previous job Interest on Rs. 400,000 @ 10%	120,000 40,000	160,000
Economic profit		(2,000) or –2,000



c. Here, she has loss of Rs. 2,000 because economic profit is negative economic profit is lower than total revenue. Therefore, I advice her not to start new business. If economic profit was positive, I would suggest to start new business.

Thank You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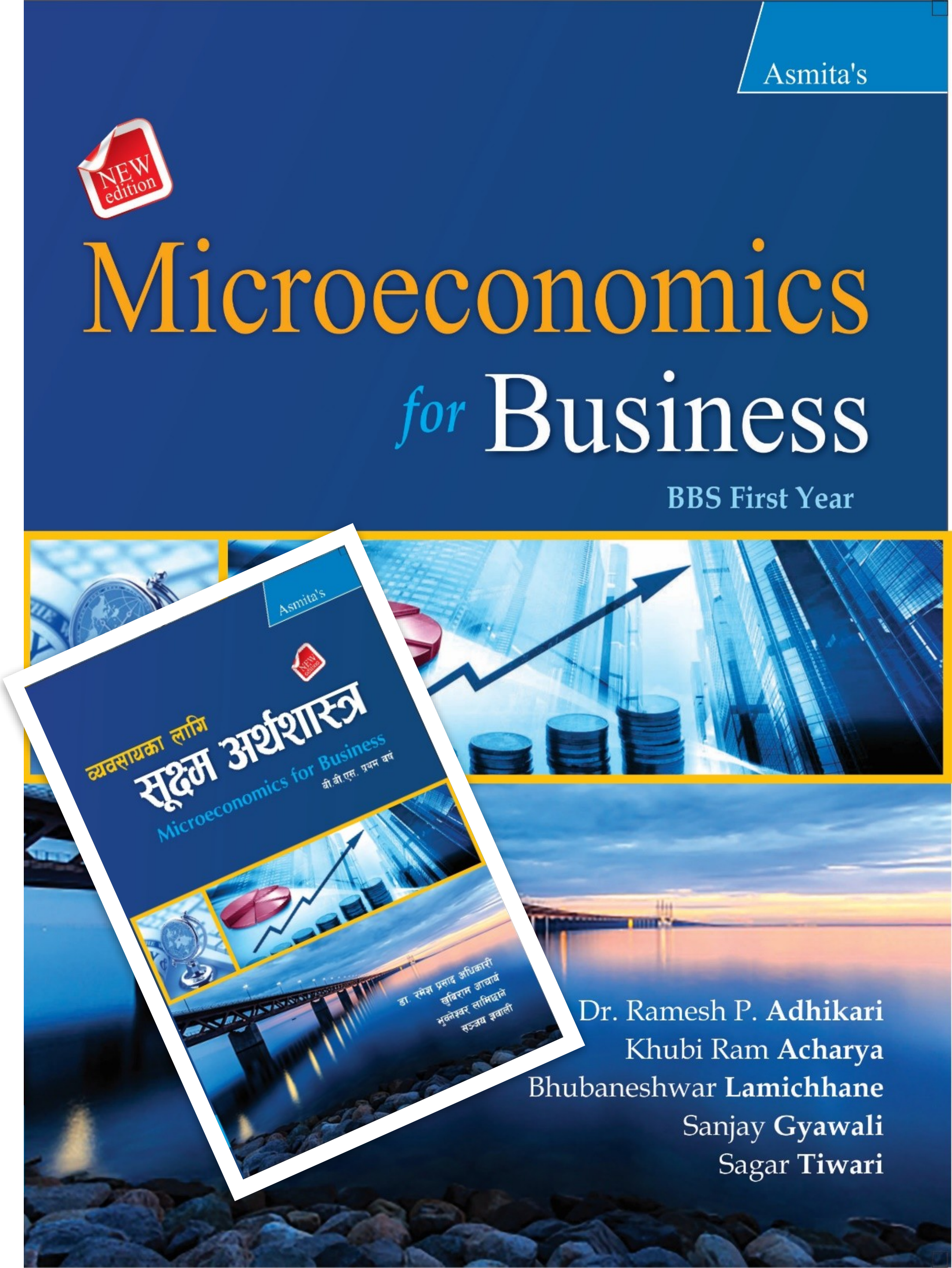
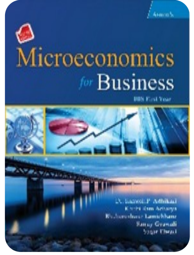
Elasticity of Demand and Supply

Unit 3

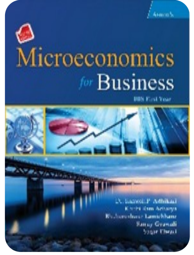


Learning Objectives



On completion of this unit, students will be able to:

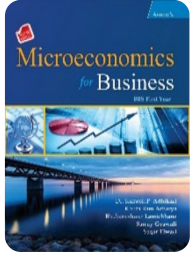
- explain the concept and degrees of price elasticity of demand
- calculate price elasticity of demand by percentage and average method
- explain the point elasticity of demand
- describe price elasticity of demand and total expenditure
- explain the concept and degrees of income elasticity of demand
- calculate income elasticity of demand by using percentage and average method
- explain the concept of advertisement elasticity of demand
- describe the uses of price, income, cross and advertisement elasticity of demand
- describe the concept and degrees of price elasticity of supply
- calculate price elasticity of supply using percentage and average method.



Introduction

- The law of demand states that there is inverse relationship between price of a commodity and its quantity demanded, all other factors remaining the same.
- This law does not explain the degree of relationship between the change in price of the commodity and its quantity demanded. It is silent on the amount of change in demand at the given change in price.
- The explanation on how much or to what extent quantity demanded for a commodity changes as a result of change in price, we study in the elasticity of demand.
- Similarly, the explanation on how much or to what extent quantity supplied for a commodity changes as a result of change in price, we study in the elasticity of supply.

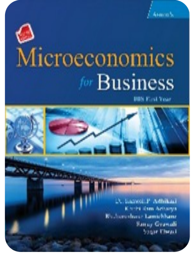
Elasticity of Demand and Its Types



- The concept of elasticity of demand was first introduced by the classical economists **A.A. Cournot and J. S. Mill.** Latter on neo-classical economist **Alfred Marshall** developed it in the scientific way in his book **Principles of Economics**.
- The elasticity of demand is the measure of responsiveness of demand for a commodity to the change in any of its determinants.

Types of Elasticity of Demand

1. Price elasticity of demand
2. Income elasticity of demand
3. Cross elasticity of demand
4. Advertisement elasticity of demand



Price Elasticity of Demand (E_P)

Price elasticity of demand is defined as the responsiveness of change in quantity demanded of a commodity to the change in its price. In other words, the price elasticity of demand is defined as the ratio of percentage change in quantity demanded to the percentage change in price.

$$E_P = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$= \frac{\dfrac{\text{Change in quantity demanded}}{\text{Initial Quantity demanded}} \times 100}{\dfrac{\text{Change in price}}{\text{Initial Price}} \times 100} = \frac{\dfrac{DQ}{Q} \times 100}{\dfrac{DP}{P} \times 100} = \frac{DQ}{DP} \cdot \frac{P}{Q}$$

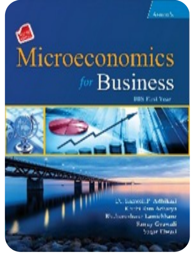
\ $$E_P = \frac{DQ}{DP} \cdot \frac{P}{Q}$$

where

E_P = Coefficient of price elasticity of demand

Q = Initial quantity demanded P = Initial price

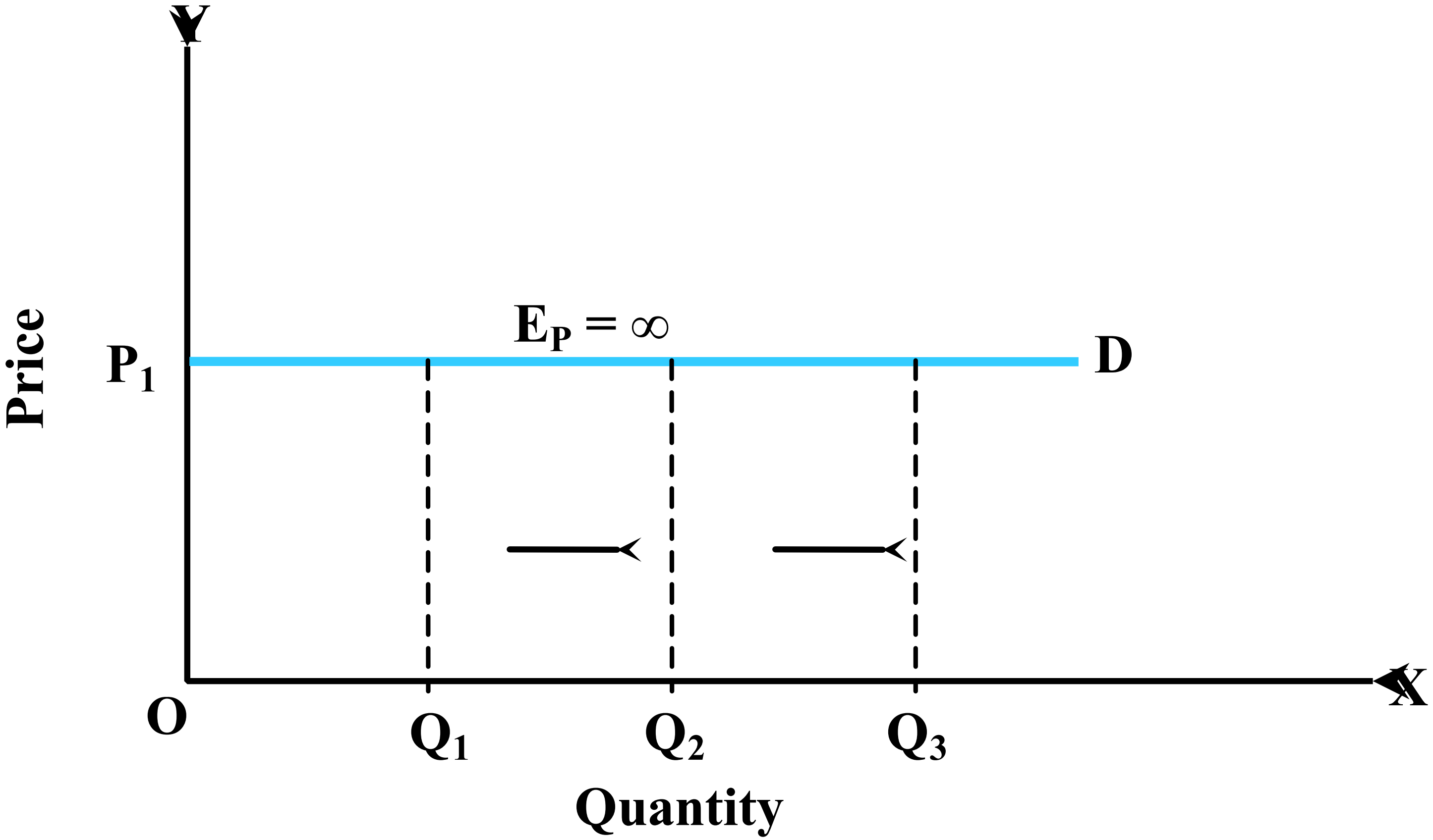
DQ = Change in quantity demanded **D**P = Change in price



Types (Degrees) of Price Elasticity of Demand

1. Perfectly Elastic Demand ($E_P = \infty$)

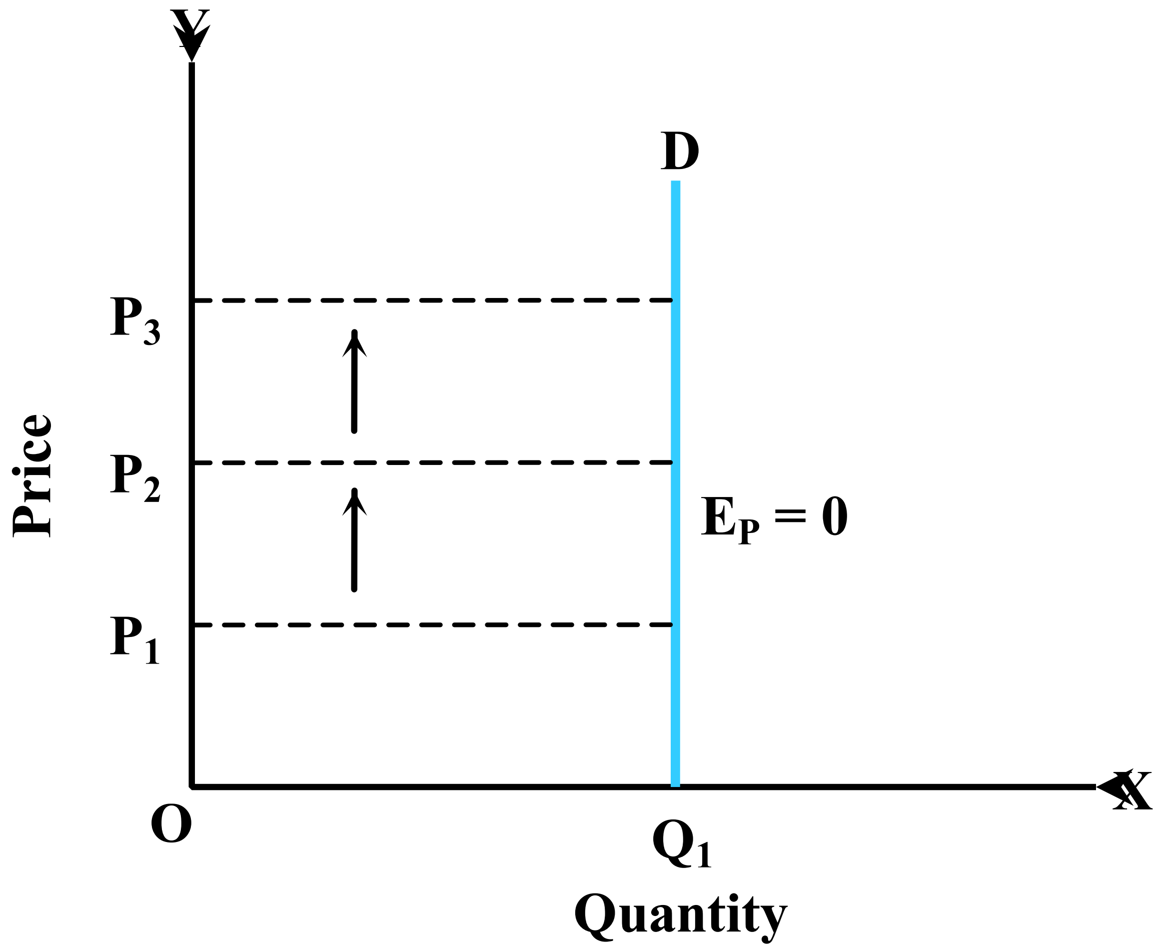
Demand is said to be perfectly elastic if negligible change in price leads to infinite change in the quantity demanded. Perfectly elastic demand is theoretical concept. It is hardly found in practice or real life.



Types (Degrees) of Price Elasticity of Demand Contd.

2. Perfectly Inelastic Demand ($E_P = 0$)

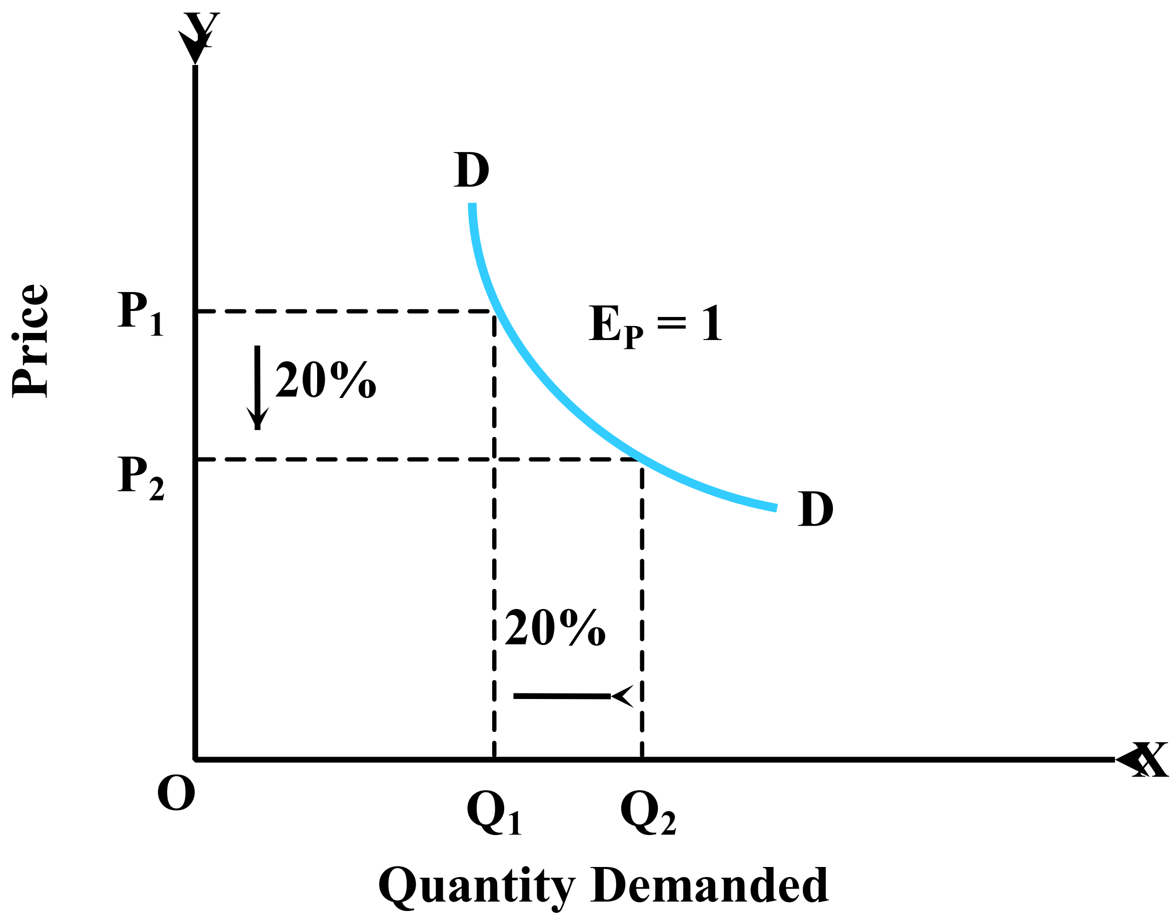
When the demand for a commodity does not change with the change in its price, the demand is said to be perfectly inelastic demand. For example, medicine and salt have perfectly inelastic demand.



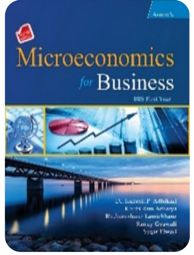
Types (Degrees) of Price Elasticity of Demand Contd.

3. Unitary Elastic Demand (E_P = 1)

When the percentage change in the quantity demanded is equal to the percentage change in price, the demand for a commodity is said to be unitary elastic demand.

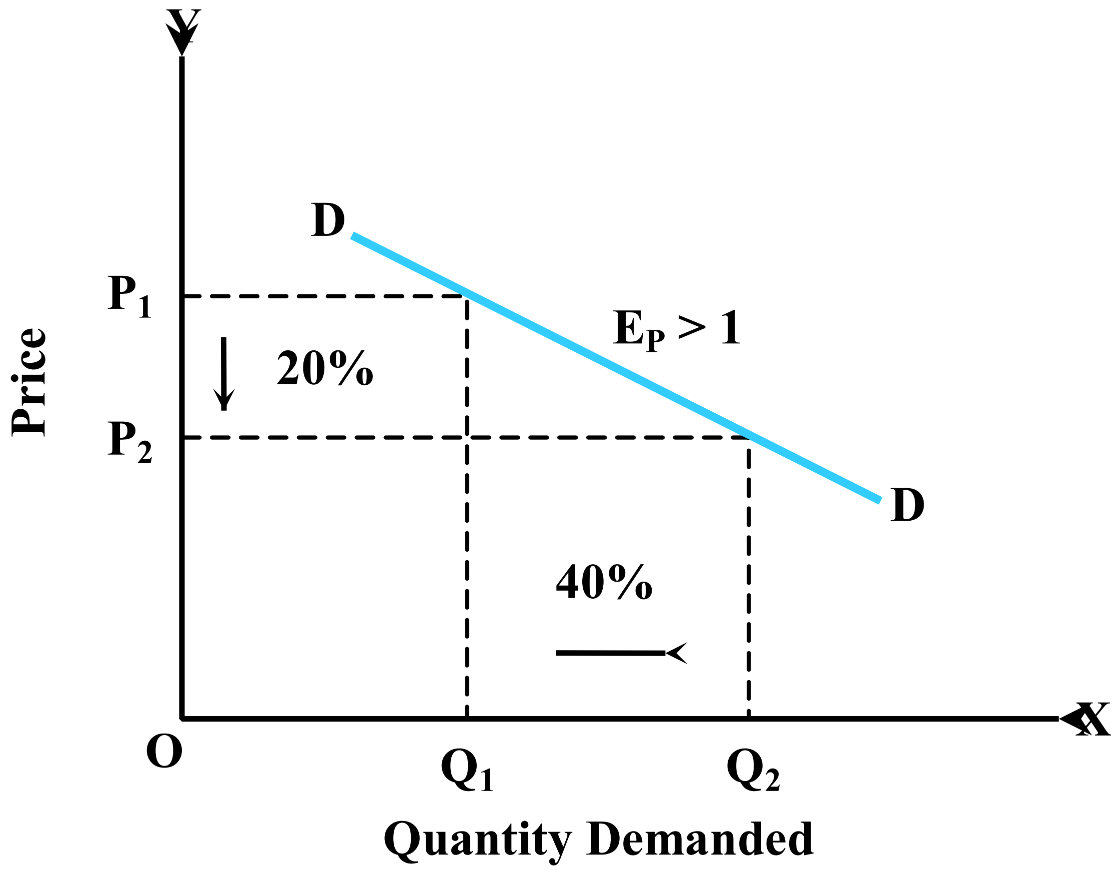


Types (Degrees) of Price Elasticity of Demand Contd.

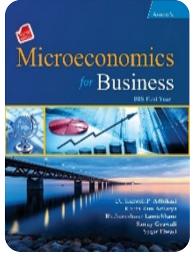


4. Relatively Elastic Demand ($E_P > 1$)

When the percentage change in the quantity demanded for a commodity is more than percentage change in its price, it is called relatively elastic demand. Such kind of elasticity of demand is found in case of luxury goods like LED television, refrigerator, car, etc.

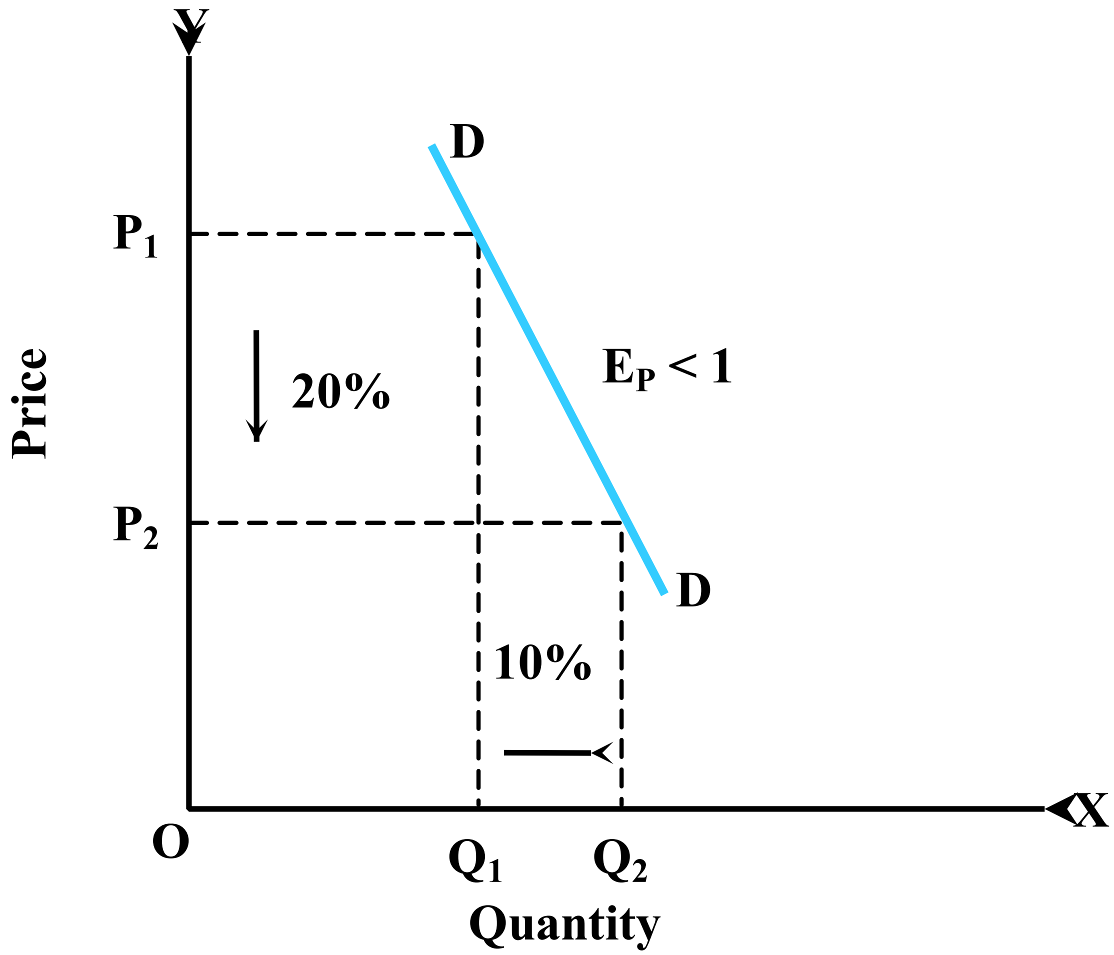


Types (Degrees) of Price Elasticity of Demand Contd.

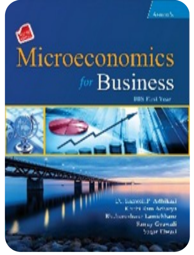


5. Relatively Inelastic Demand (E_P< 1)

If the percentage change in the quantity demanded of a commodity is less than the percentage change in its price, it is called relatively inelastic demand. It is found in case of necessity or basic good like rice, vegetable, clothes, etc.



Calculation of Price Elasticity of Demand



1. Percentage/ Proportionate Method

Percentage method was developed by **Prof. Flux** as an improvement over the outlay method. The price elasticity of demand is measured by its coefficient. The coefficient (E_P) measures the percentage change in the quantity demanded of a commodity resulting from a given percentage change in its price.

$$E_P = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

$$= \frac{\frac{\Delta Q}{Q} \times 100}{\frac{\Delta P}{P} \times 100} = \frac{\left(\frac{\Delta Q}{Q}\right)}{\left(\frac{\Delta P}{P}\right)} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

where

Q = Initial quantity demanded

ΔQ = Change in quantity demanded

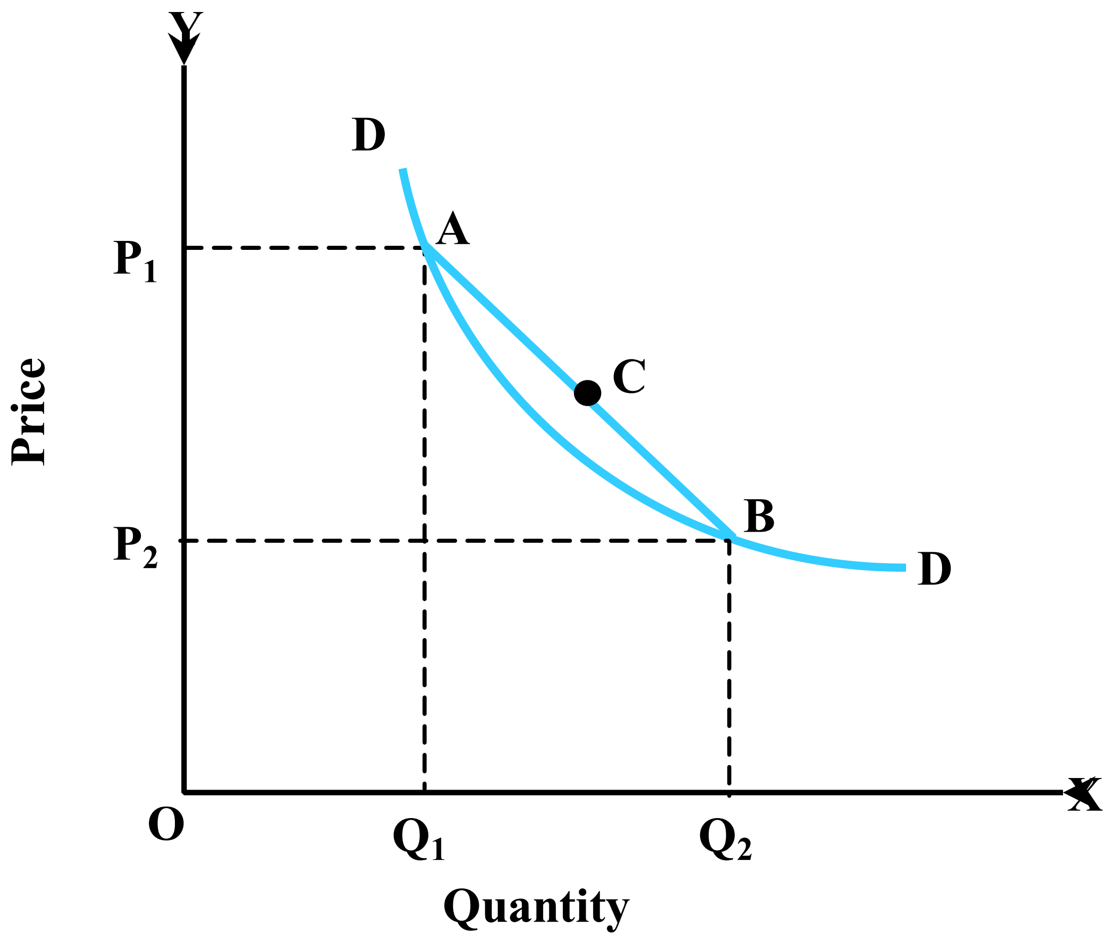
P = Initial price

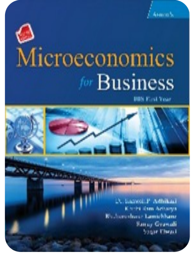
ΔP = Change in price

Calculation of Price Elasticity of Demand Contd.

2. Average Method (Arc Method)

The coefficient of price elasticity of demand between two points on a demand curve is called average or arc elasticity of demand. This method is used when there is large change in price and quantity demanded. Any two points on a demand curve make an arc as in figure.





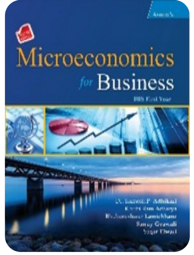
Calculation of Price Elasticity of Demand Contd.

$$E_P = \frac{\left(\dfrac{\text{Change in quantity demanded}}{\text{Average quantity demanded}}\right)}{\left(\dfrac{\text{Change in Price}}{\text{Average Price}}\right)}$$

$$= \frac{\dfrac{\Delta Q}{\dfrac{Q_1 + Q_2}{2}}}{\dfrac{\Delta P}{\dfrac{P_1 + P_2}{2}}} = \frac{\Delta Q}{\Delta P} \times \frac{P_1 + P_2}{Q_1 + Q_2} = \left(\frac{Q_2 - Q_1}{P_2 - P_1}\right) \times \frac{P_1 + P_2}{Q_1 + Q_2}$$

where

Q_1	= Initial quantity demanded	P_1	= Initial Price
Q_2	= New quantity demanded	P_2	= New Price
ΔQ	= Change in quantity demanded	ΔP	= Change in Price



Point Elasticity of Demand

Prof. Marshall developed point method for measuring price elasticity of demand at a point on a demand curve. Point elasticity is the measure of price elasticity at a particular point on a demand curve. In other words, point elasticity is the measure of the percentage change in quantity demanded in response to a very small percentage change in price. It may be symbolically expressed as

$$E_P = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

where

Q = Initial quantity

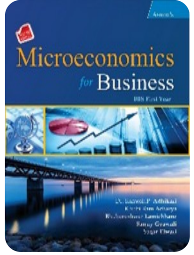
P = Initial price

ΔQ = Change in quantity demanded

ΔP = Change in price

The method of measuring price elasticity on linear and non-linear demand curve is explained below:

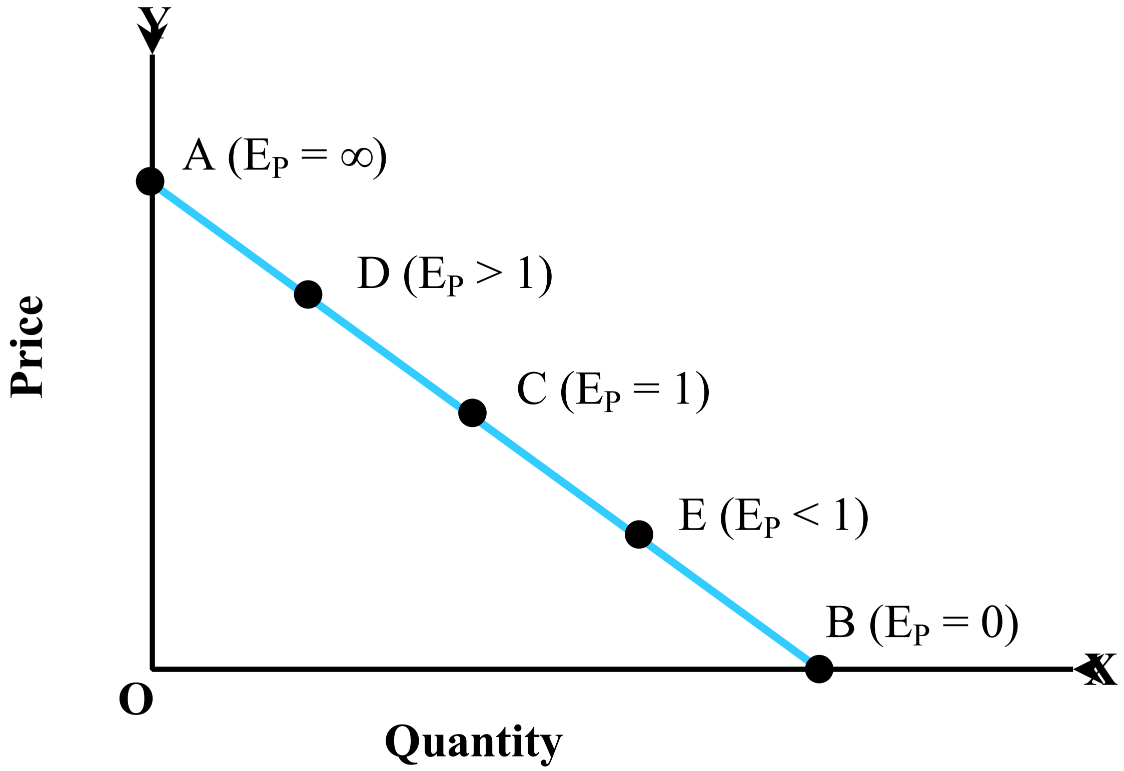
Point Elasticity of Demand Contd.

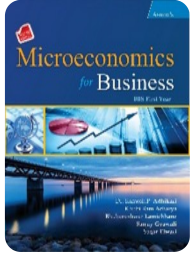


i. Point Elasticity on a Linear Demand Curve

In Figure, AB represents a linear demand curve. Let us suppose, C is the middle point of the demand curve. Using the formula of point elasticity of demand, we can find out coefficient of price elasticity as follows:

$$E_P = \frac{RB}{RA} = \frac{\text{Lower segment}}{\text{Upper segment}}$$





Point Elasticity of Demand Contd.

$$E_p \text{ at point C} = \frac{\text{Lower segment}}{\text{Upper segment}} = \frac{CB}{AC} = 1 \; (\because AC = CB)$$

It is the case of unity elastic demand.

$$E_p \text{ at point A} = \frac{\text{Lower segment}}{\text{Upper segment}} = \frac{AB}{0} = \infty$$

It is the case of perfectly elastic demand.

$$E_p \text{ at point D} = \frac{\text{Lower segment}}{\text{Upper segment}} = \frac{DB}{AD} > 1 \quad (\because DB > AD)$$

It is the case of relatively elastic demand.

$$E_p \text{ at point E} = \frac{\text{Lower segment}}{\text{Upper segment}} = \frac{EB}{AE} < 1 \quad (\because EB > AE)$$

It is the case of relatively inelastic demand.

$$E_p \text{ at point B} = \frac{\text{Lower segment}}{\text{Upper segment}} = \frac{0}{AB} = 0$$

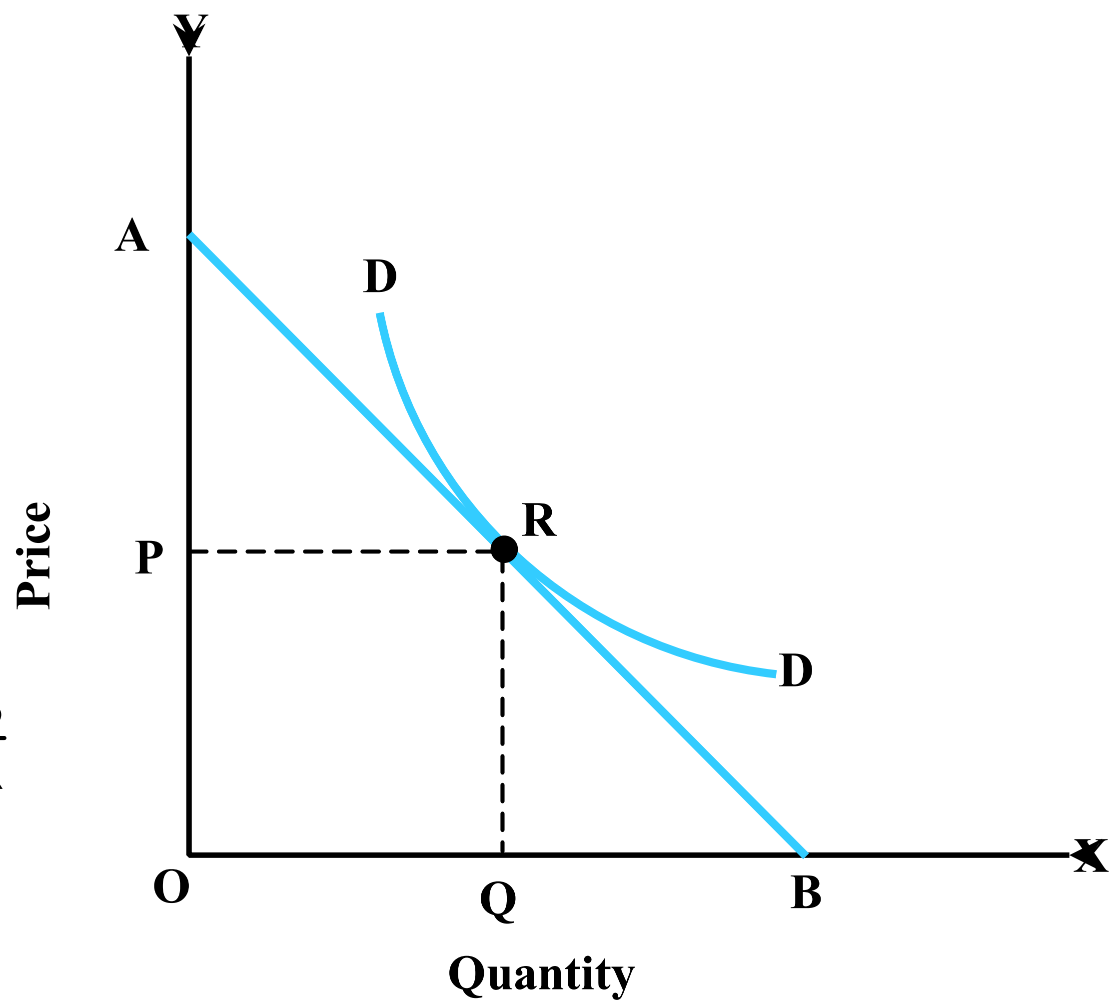
It is the case of perfectly inelastic demand.

Point Elasticity of Demand Contd.

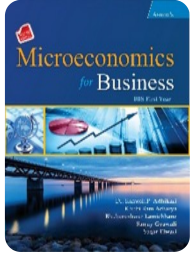
ii. Point Elasticity on a Non-linear Demand Curve

Point elasticity on a non-liner demand cure is measured by drawing a tangent to the demand curve at the chosen point and measuring the elasticity of the tangent at this point. This gives the elasticity of the demand curve at the chosen point.

$$E_P = \frac{\text{Lower segment of the tangent line}}{\text{Upper segment of the tangent line}} = \frac{RB}{AR}$$



Price Elasticity of Demand and Total Expenditure



Total outlay method is also known as the total expenditure method of measuring price elasticity of demand. Marshall developed this method to measure price elasticity of demand. According to this method, we compare total outlay of a consumer before and after the variations in price. Total outlay is the price multiplied by the quantity of a good purchased.

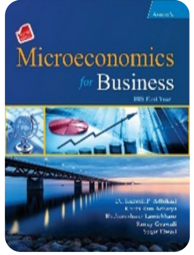
Total outlay (Total Expenditure) = Price × Quantity Purchased

i. **Elasticity greater than unity ($E_P > 1$):** When total expenditure increases with the fall in price and decreases with the rise in price, the demand is said to be elastic demand.

ii. **Elasticity less than unity ($E_P < 1$):** If with the fall in price, the total expenditure decreases and with the rise in price, the total expenditure increases, demand is said to be less than unity.

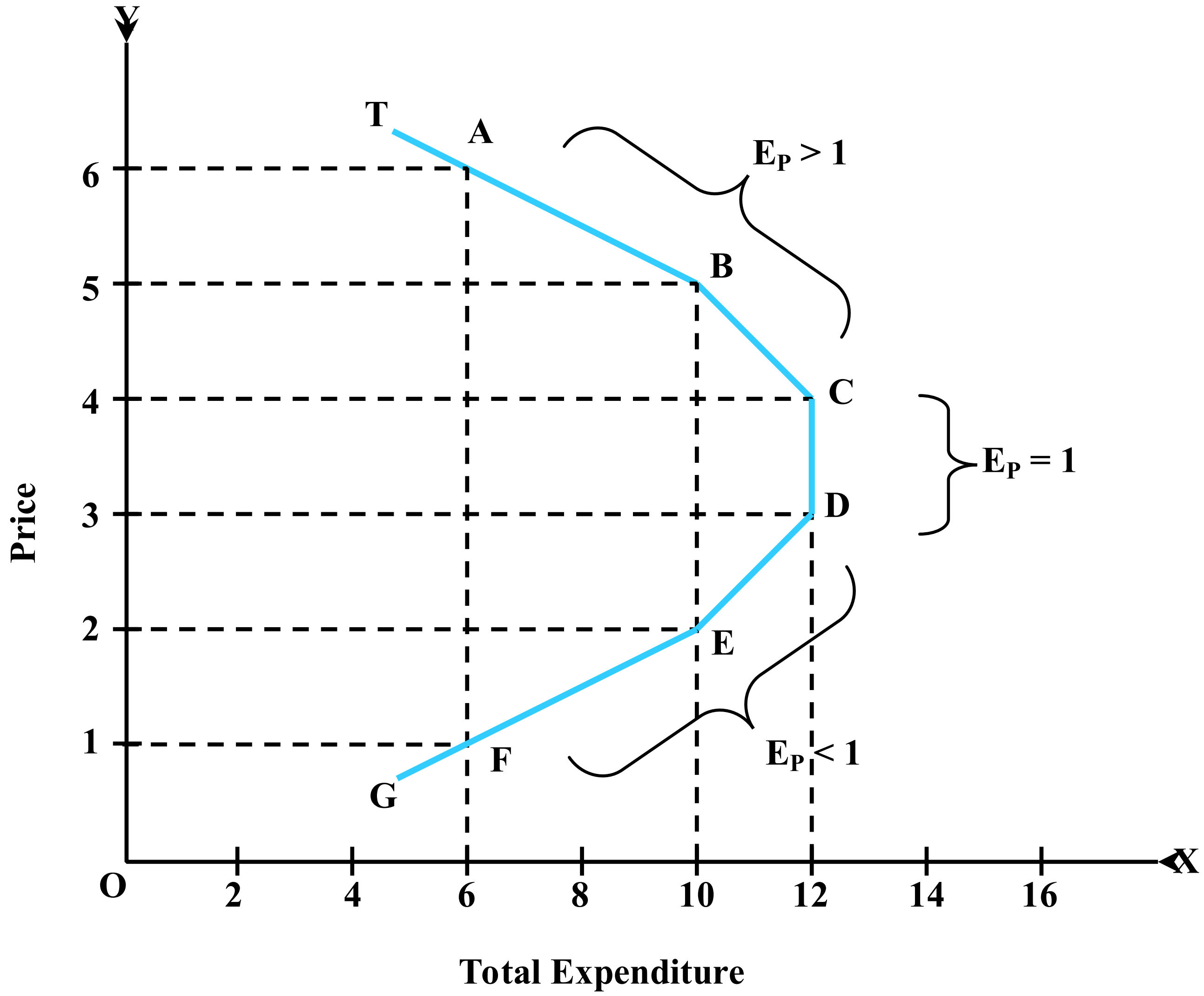
iii. **Elasticity equal to unity ($E_P = 1$):** When the total expenditure remains unchanged with a fall or rise in price, the price elasticity of demand is said to be equal to unity.

Price Elasticity of Demand and Total Expenditure Contd.

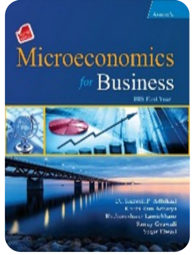


Situation	Price (P) (in Rs.)	Quantity (Q) (in unit)	Total Expenditure $TE = P \cdot Q$	EP
I	6	1	6	EP > 1
	5	2	10	
II	4	3	12	EP = 1
	3	4	12	
III	2	5	10	EP < 1

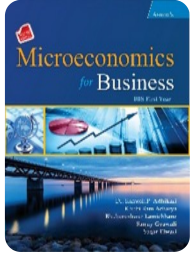
Price Elasticity of Demand and Total Expenditure Contd.



Uses or Importance of Price Elasticity of Demand



1. Monopoly price determination
2. Price determination under discriminating monopoly
3. Price determination of public utilities
4. Price determination of joint products
5. Wage determination
6. International trade
7. Importance to finance minister



Income Elasticity of Demand (E_Y)

Income elasticity of demand is defined as the degree of responsiveness of demand for a commodity to the change in the income of the consumer. In other words, income elasticity of demand is the ratio of the percentage change in demand for a commodity to the percentage change in income.

$$E_Y = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in income}}$$

$$= \frac{\dfrac{\text{Change in quantity demanded}}{\text{Initial quantity demanded}} \times 100}{\dfrac{\text{Change in income}}{\text{Initial income}} \times 100} = \frac{\dfrac{\Delta Q}{Q} \times 100}{\dfrac{\Delta Y}{Y} \times 100} = \frac{\Delta Q}{\Delta Y} \times \frac{Y}{Q}$$

where

E_Y = Coefficient of income elasticity of demand

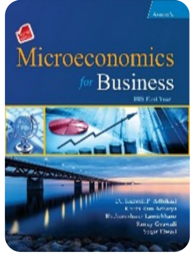
Q = Initial quantity demanded

ΔQ = Change in quantity demanded

Y = Initial income

ΔY = Change in income

Types (Degrees) of Income Elasticity of Demand



1. Positive Income Elasticity of Demand ($E_Y > 0$)

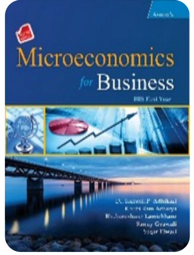
If increase in income leads to increase in demand for a commodity and decrease in income leads to decrease in demand for a commodity, it is called positive income elasticity of demand. The commodity, which has positive income elasticity is called normal good. Positive income elasticity can be divided into three types:

a. Income elasticity greater than unity ($E_Y > 1$)

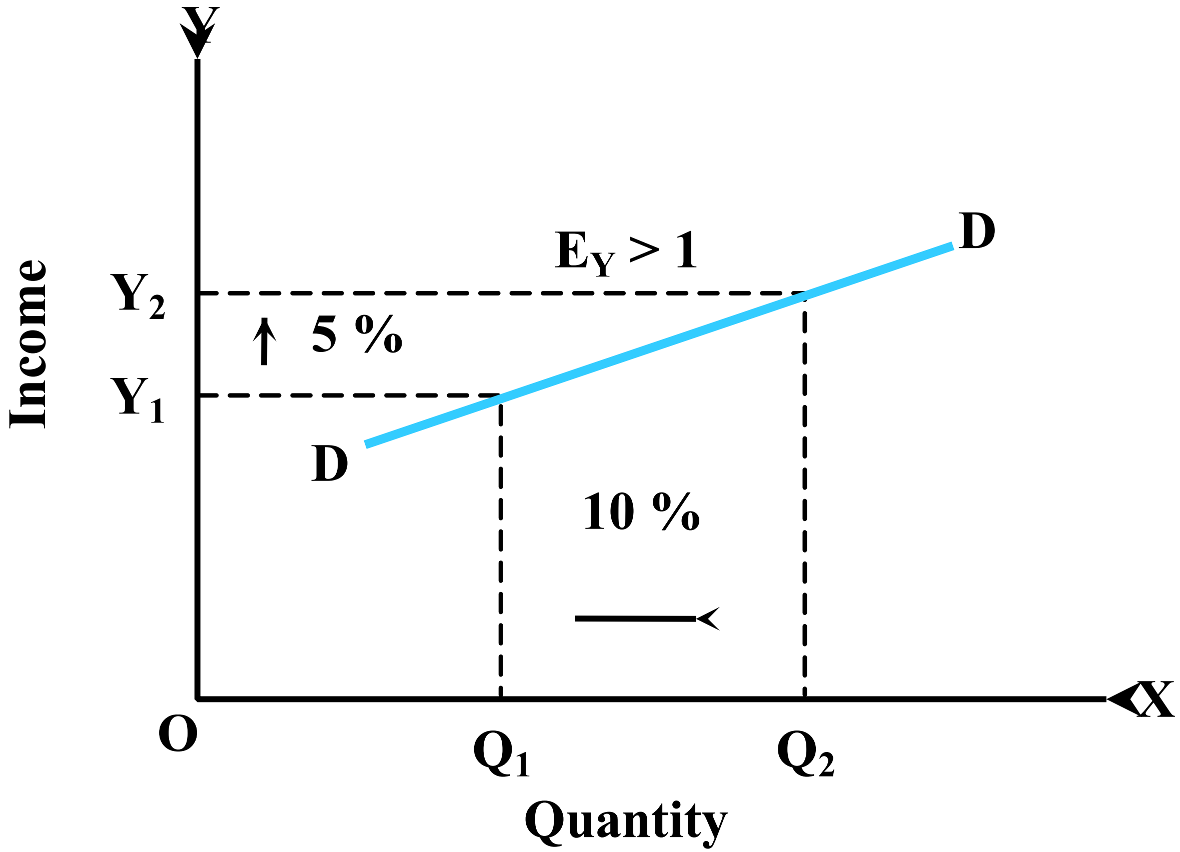
b. Income elasticity less than unity ($E_Y < 1$)

c. Income elasticity equal to unity ($E_Y = 1$)

Types (Degrees) of Income Elasticity of Demand Contd.

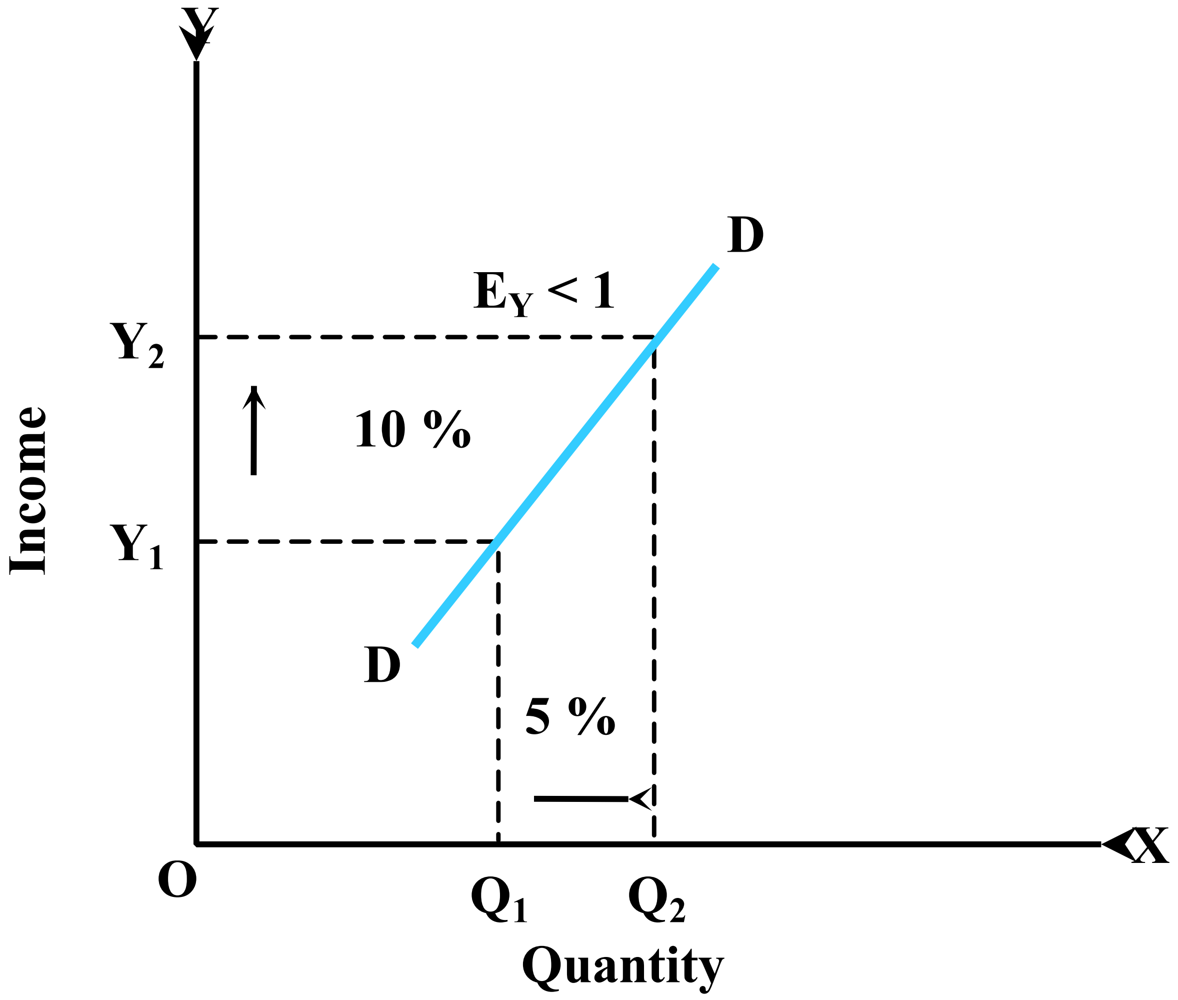


a. **Income elasticity greater than unity ($E_Y > 1$):** The income elasticity of demand is greater than unity when the demand for a commodity increases more than percentage to rise in income. In case of luxury goods, income elasticity of demand is more than unity.



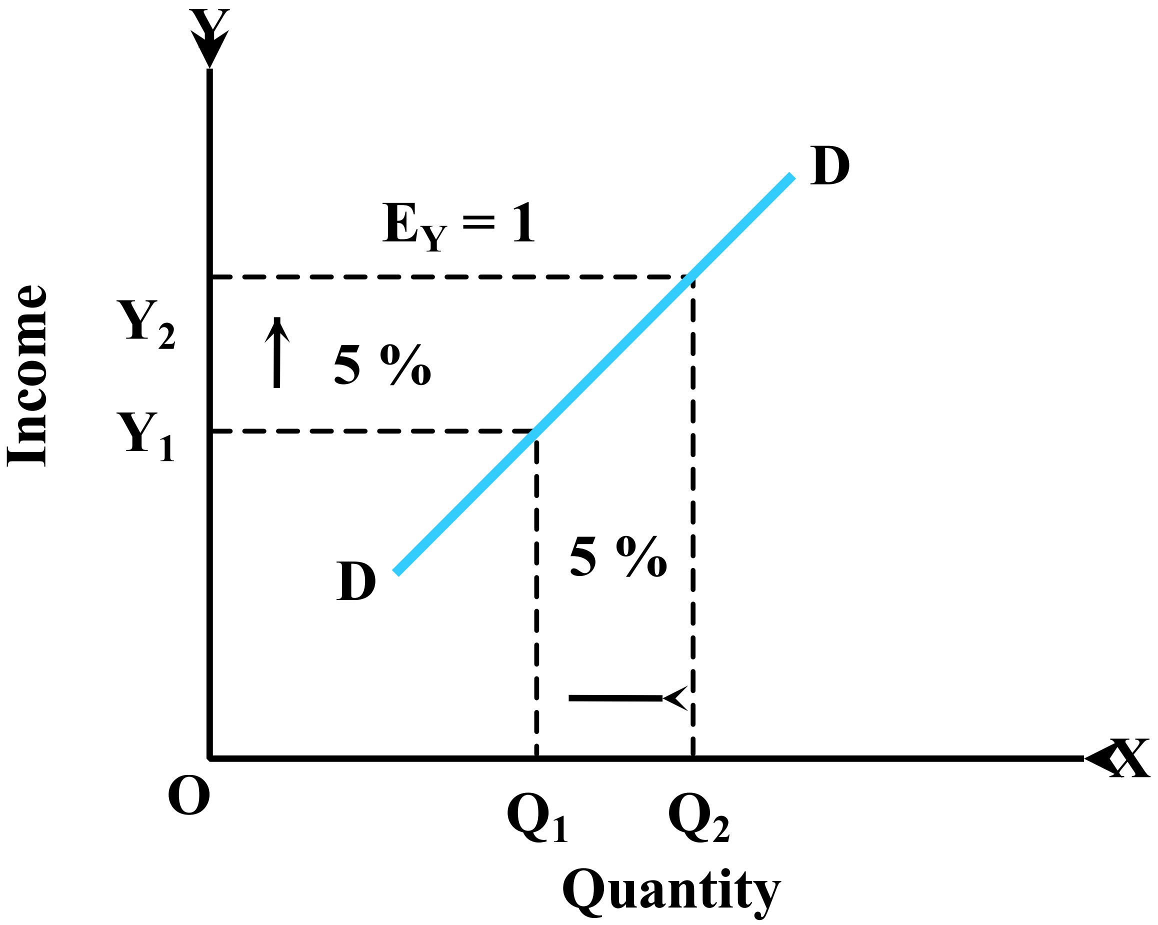
Types (Degrees) of Income Elasticity of Demand Contd.

b. **Income elasticity less than unity ($E_Y < 1$):** Income elasticity of demand is less than unity when the demand for a commodity increases less than percentage to the rise in income. In case of normal necessities, income elasticity of demand is less than unity.



Types (Degrees) of Income Elasticity of Demand Contd.

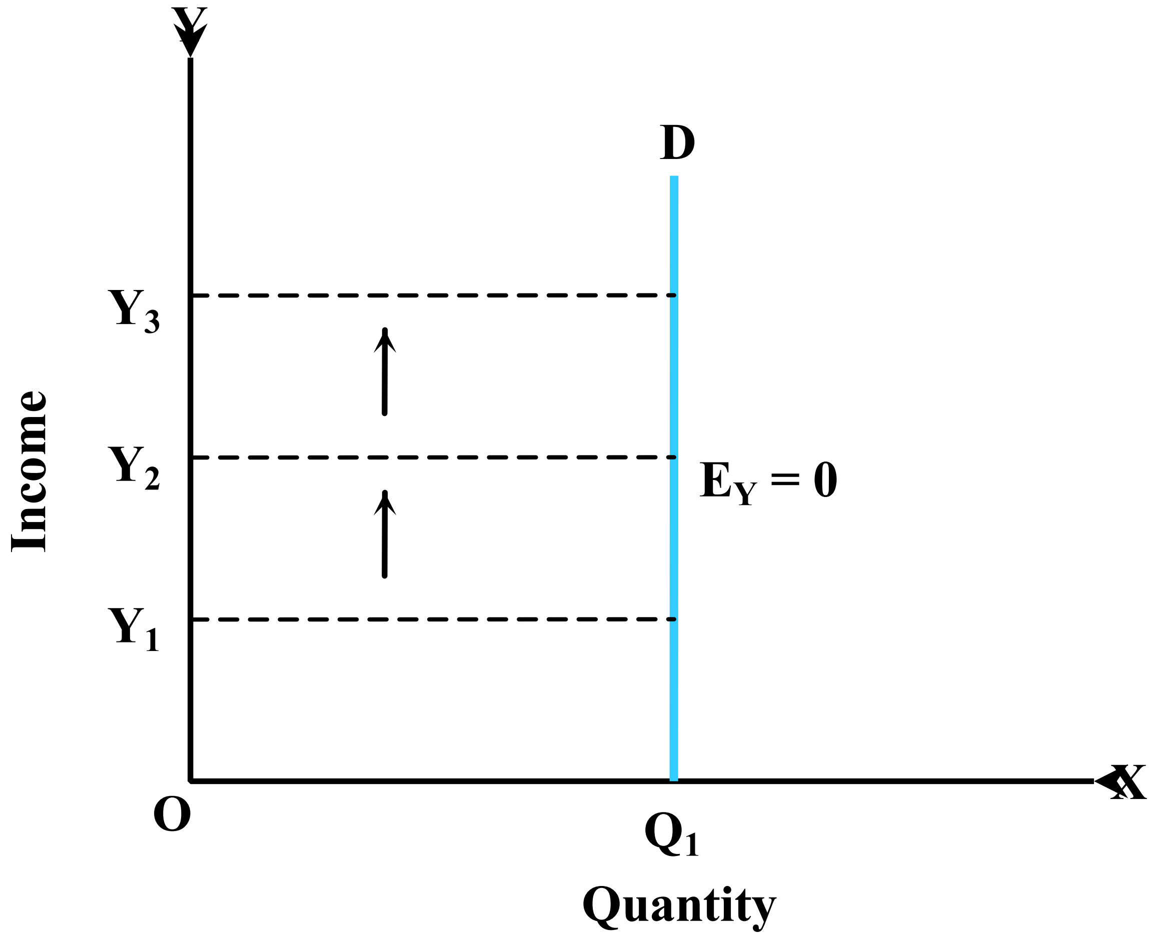
c. **Income elasticity equal to unity (E_Y = 1):** Income elasticity is unity when the demand for a commodity increases in the same proportion as the rise in income. In case of comfortable goods, income elasticity of demand is equal to unity.



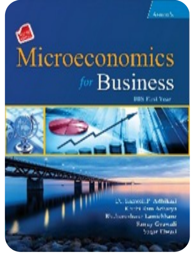
Types (Degrees) of Income Elasticity of Demand Contd.

2. Zero Income Elasticity of Demand ($E_Y = 0$)

If quantity demanded remains unchanged despite change in income and vice-versa, the income elasticity is said to be zero. In case of neutral goods like salt, income elasticity of demand is zero.

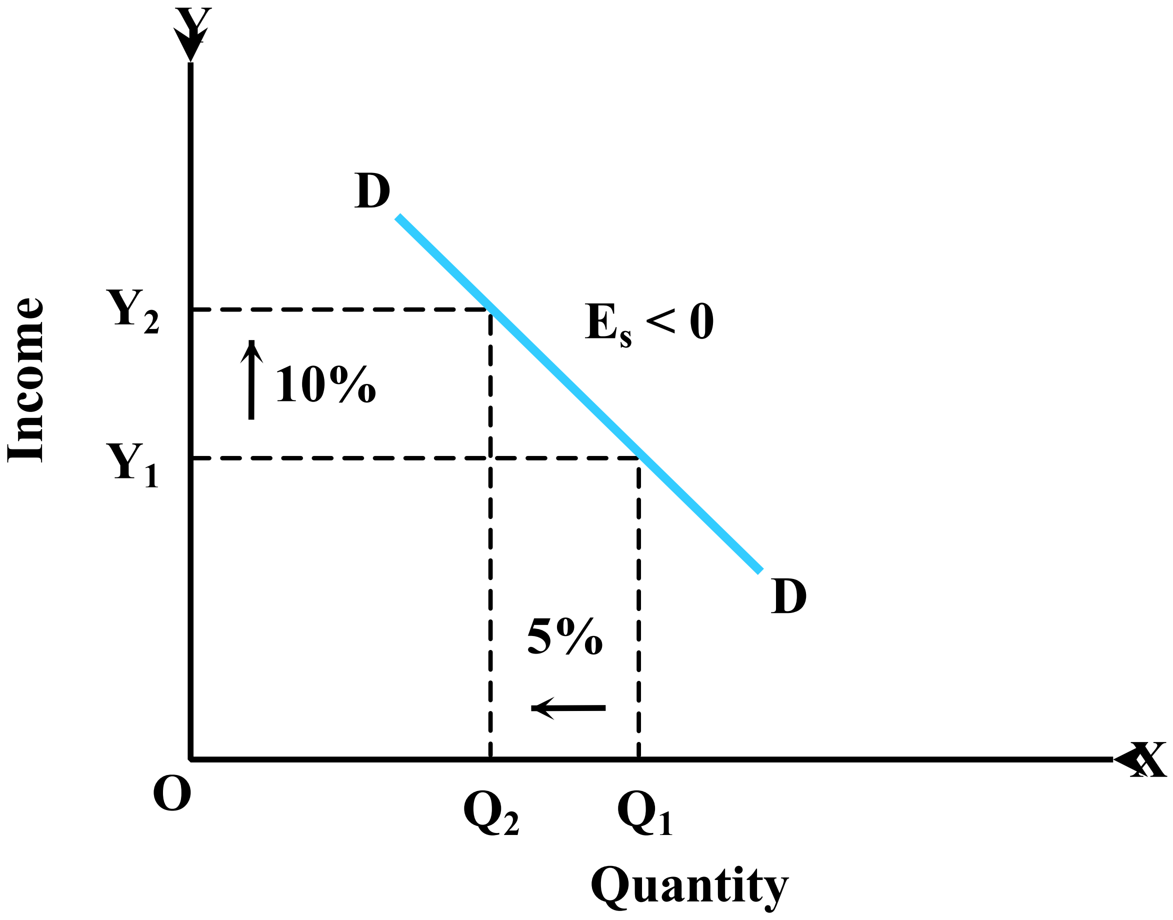


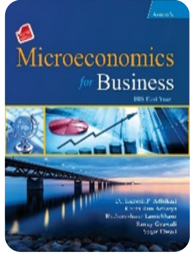
Types (Degrees) of Income Elasticity of Demand Contd.



3. Negative Income Elasticity of Demand ($E_Y < 0$)

In the case of inferior goods, the income elasticity of demand is negative. When the consumer reduces his demand with the rise in income and vice versa, the income elasticity of demand is said to be negative. It is found in case of inferior or low quality goods.





Calculation of Income Elasticity of Demand

1. Percentage/ Proportionate Method

According to the percentage method, income elasticity of demand is measured dividing percentage change in demand by percentage change in income.

$$E_Y = \frac{\text{Percentage change in demand}}{\text{Percentage change in income}} = \frac{\frac{\Delta Q}{Q} \times 100}{\frac{\Delta Y}{Y} \times 100} = \frac{\Delta Q}{\Delta Y} \times \frac{Y}{Q}$$

where

E_Y = Income elasticity

Q = Initial quantity

ΔQ = Change in quantity

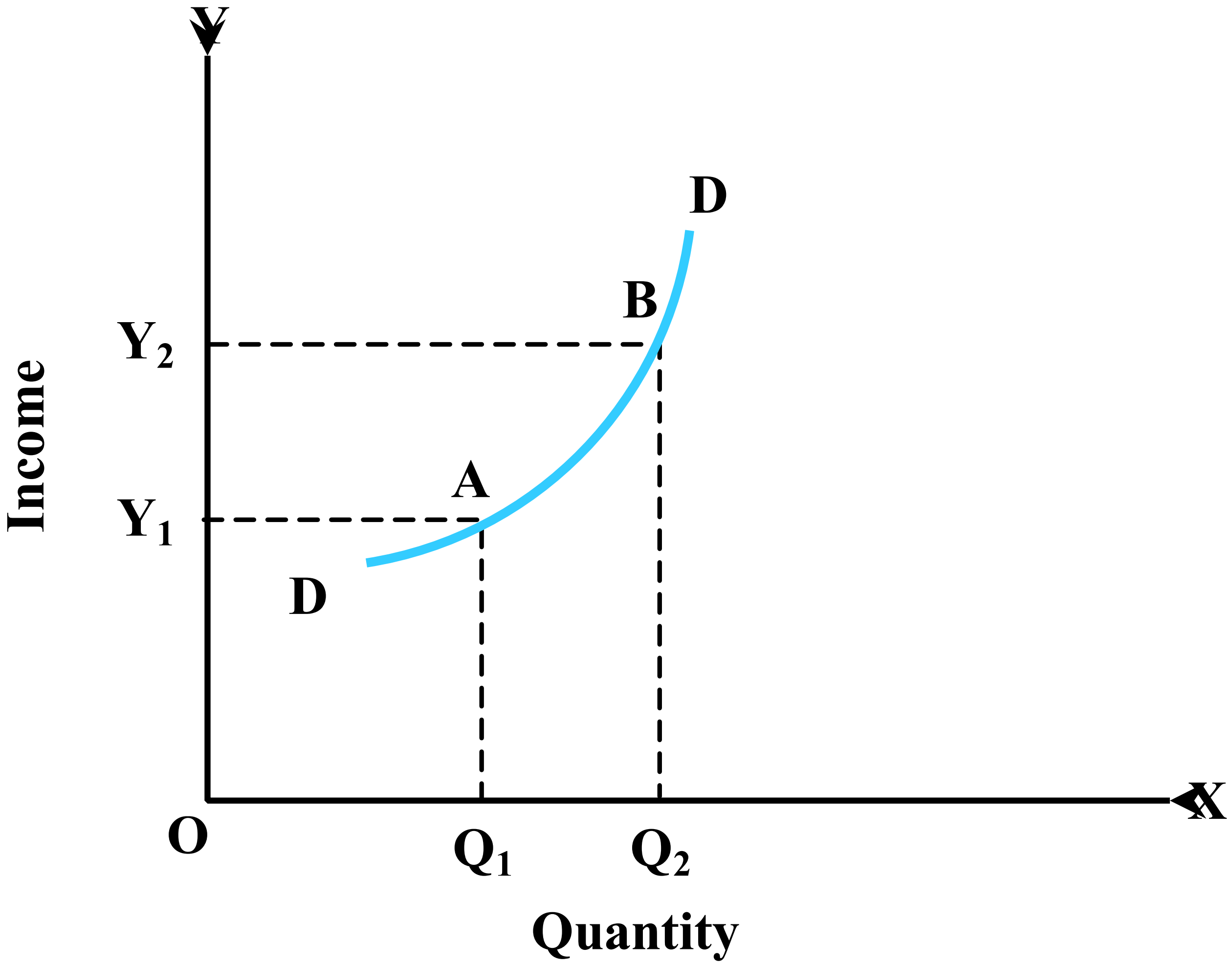
Y = Initial income

ΔY = Change in income

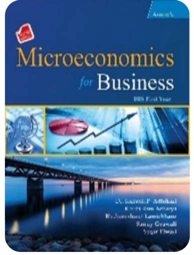
Calculation of Income Elasticity of Demand Contd.

2. Average/ Arc Method

The coefficient of income elasticity of demand between two points on an income demand curve is called average or arc elasticity of income demand. This method is used when there is big change in income and demand.



Calculation of Income Elasticity of Demand Contd.



Average or arc elasticity between point A and B income demand curve DD (E_Y),

$$E_Y = \frac{\left(\dfrac{\text{Change in demand}}{\text{Average demand}}\right)}{\left(\dfrac{\text{Change in Income}}{\text{Average Income}}\right)} = \frac{\dfrac{\Delta Q}{\dfrac{Q_1 + Q_2}{2}}}{\dfrac{\Delta Y}{\dfrac{Y_1 + Y_2}{2}}}$$

$$= \frac{\Delta Q}{\Delta Y} \times \left(\frac{Y_1 + Y_2}{Q_1 + Q_2}\right) \qquad = \left(\frac{Q_2 - Q_1}{Y_2 - Y_1}\right)\left(\frac{Y_1 + Y_2}{Q_1 + Q_2}\right)$$

where

E_Y = Coefficient of income elasticity of demand

Q_1 = Initial demand

Q_2 = New demand

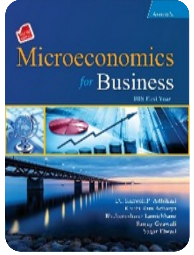
ΔQ = Change in demand

Y_1 = Initial income of the consumer

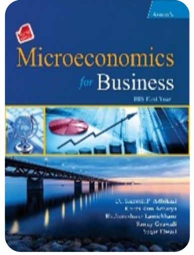
Y_2 = New income of the consumer

ΔY = Change in income

Uses or Importance of Income Elasticity of Demand



1. Useful to know about stage of trade cycle
2. Useful for forecasting demand
3. Useful for classification of normal and inferior goods
4. Useful for making marketing strategy



Cross Elasticity of Demand (E_{XY})

The cross elasticity of demand is defined as the percentage change in the quantity demanded of good-X resulting from a percentage change in the price of Y. In other words, the ratio of percentage change in the quantity demanded of good–X to a given percentage changes in the price of good-Y.

$$E_{XY} = \frac{\text{Percentage change in demand for good–X}}{\text{Percentage change in price of good–Y}}$$

$$= \frac{\dfrac{\text{Change in demand for good–X}}{\text{Initaial demand for good–X}} \times 100}{\dfrac{\text{Change in price of good–Y}}{\text{Initial price of good–Y}} \times 100} = \frac{\dfrac{\Delta Q_X}{Q_X} \times 100}{\dfrac{\Delta P_Y}{P_Y} \times 100} = \frac{\Delta Q_X}{\Delta P_Y} \times \frac{P_Y}{Q_X}$$

where

E_{XY} = Coefficient of cross elasticity of demand

Q_X = Quantity of good-X

ΔQ_X = Change in the demand for good-X

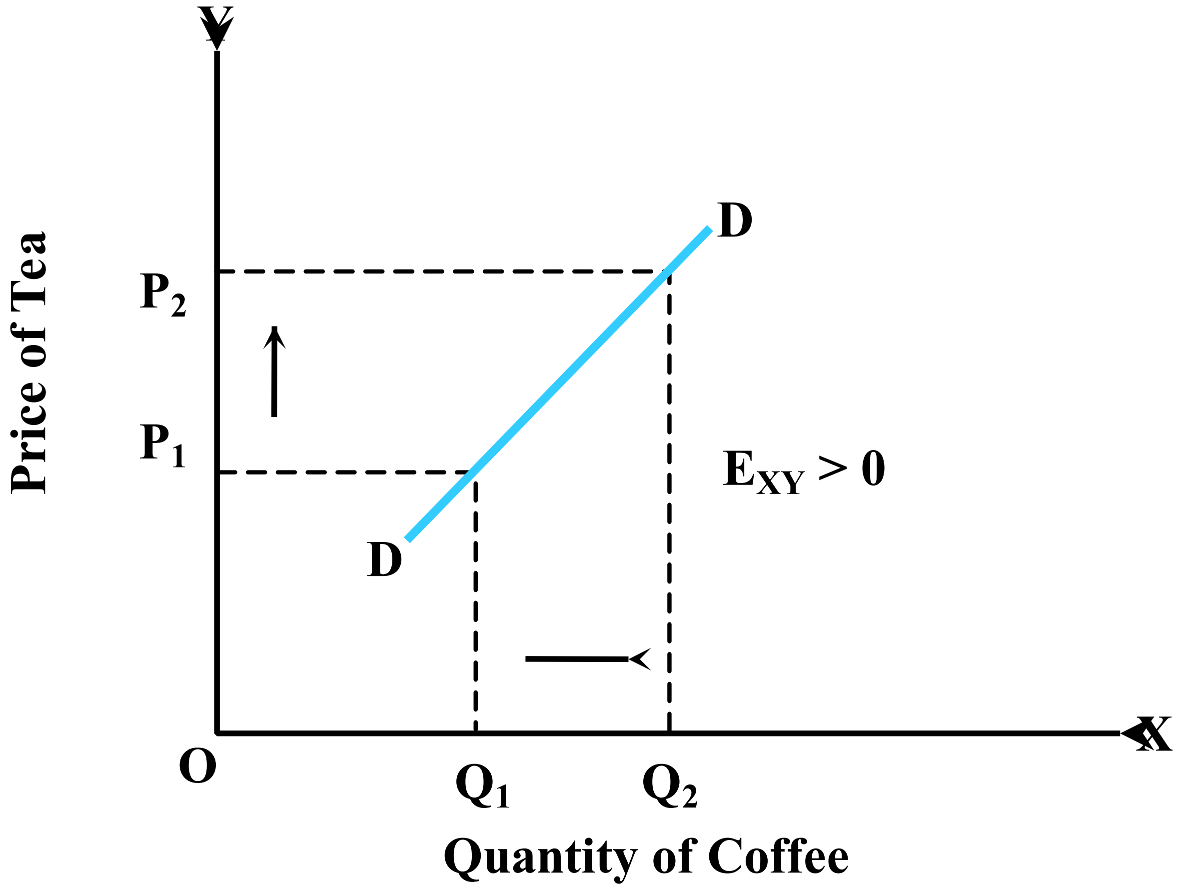
P_Y = Price of good-Y,

ΔP_Y = Change in the price of good-Y

Types (Degrees) of Cross Elasticity of Demand

1. Positive Cross Elasticity of Demand ($E_{XY} > 0$)

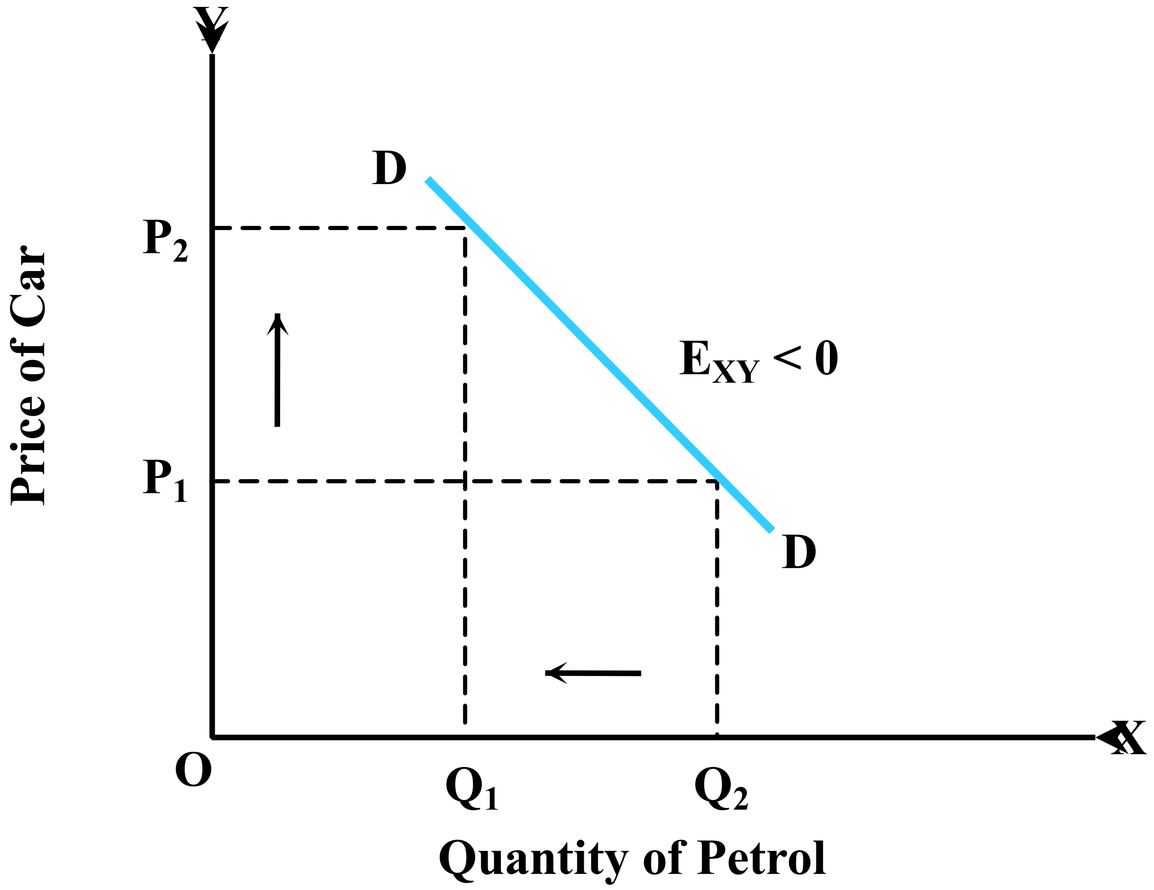
When the quantity demand of a commodity and price of related commodity change into same direction, the cross elasticity of demand is positive. In the case of substitute goods, the cross elasticity of demand is positive



Types (Degrees) of Cross Elasticity of Demand Contd.

2. Negative Cross Elasticity of Demand ($E_{XY} < 0$)

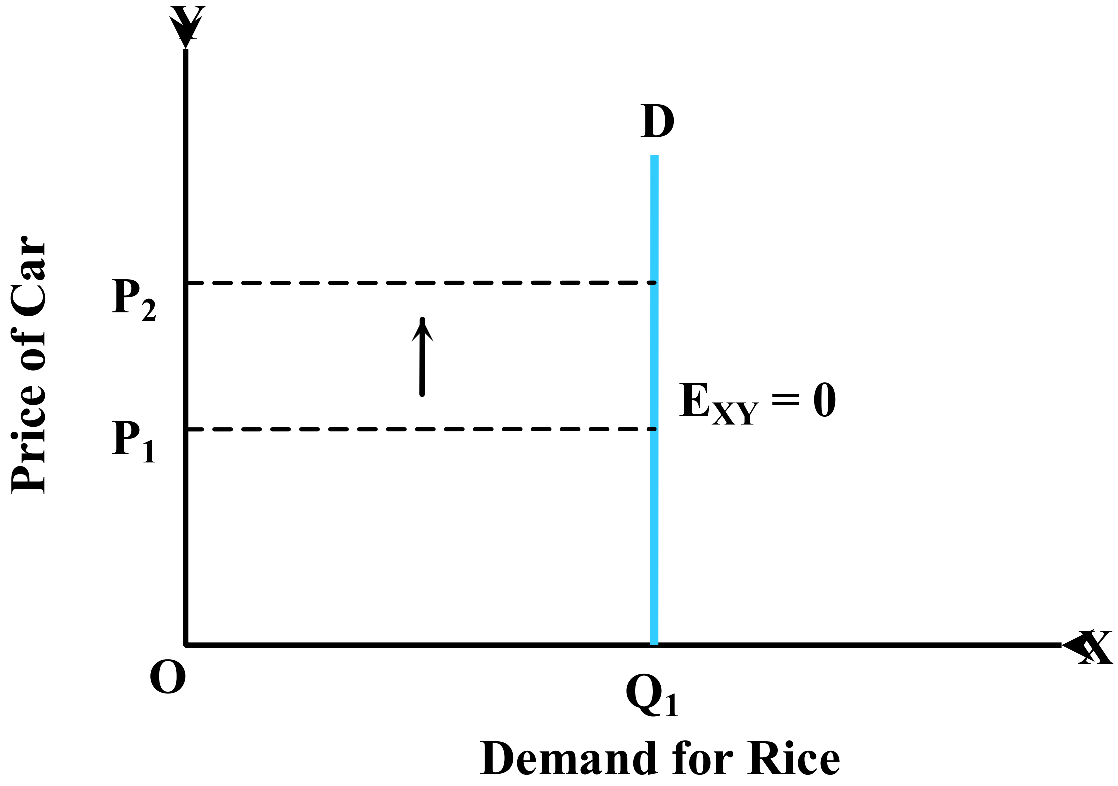
When demand for a commodity and price of related commodity change into opposite direction, the cross elasticity of demand is negative. In the case of complementary goods, cross elasticity of demand is negative.

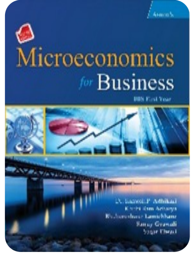


Types (Degrees) of Cross Elasticity of Demand Contd.

3. Zero Cross Elasticity of Demand ($E_{XY} = 0$)

When the change in price of one good has no effect on the demand for another good, the cross elasticity of demand is zero.





Calculation of Cross Elasticity of Demand

1. Percentage/ Proportionate Method

According to percentage method, cross elasticity of demand is measured dividing percentage change in demand for a good –X divided by percentage change in price of good-Y. Let us suppose, two related goods X and Y.

$$E_{XY} = \frac{\text{Percentage change in demand for good X}}{\text{Percentage change in price of good Y}}$$

$$= \frac{\frac{\Delta Q_X}{Q_X} \times 100}{\frac{\Delta P_Y}{P_Y} \times 100} = \frac{\Delta Q_X}{\Delta P_Y} \times \frac{P_Y}{Q_X}$$

where

E_Y = Cross elasticity of demand between good –X and good Y

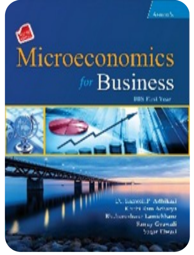
Q_X = Initial quantity of good X

ΔQ_X = change in demand for good X

P_Y = Initial price of good Y

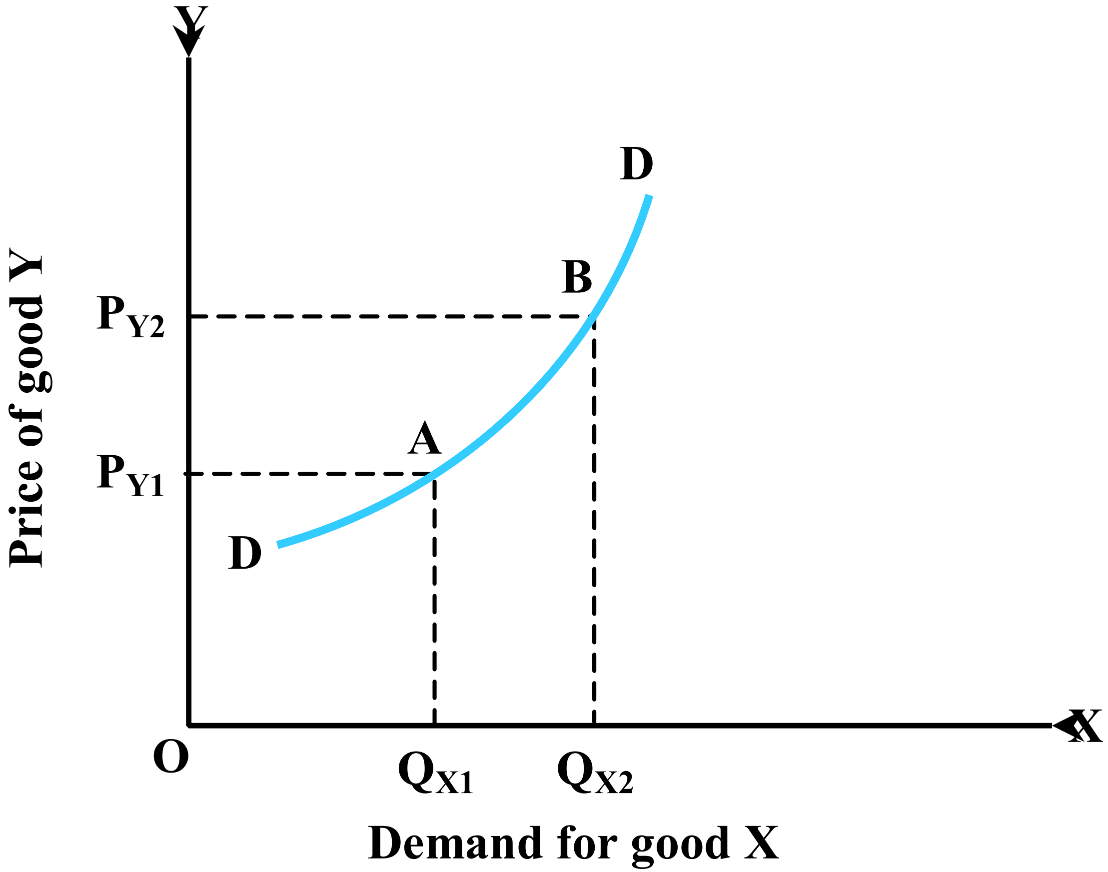
ΔP_Y = Change in price of good Y

Calculation of Cross Elasticity of Demand Contd.

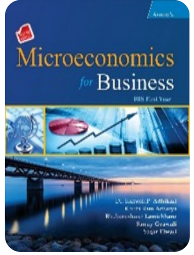


2. Average/ Arc Method

The coefficient of cross elasticity of demand between two points on a cross demand curve is called arc elasticity of demand. This method is used to measure the cross elasticity of demand when there is greater change in price and quantity demanded.



Calculation of Cross Elasticity of Demand Contd.



In **Figure**, DD represents cross demand curve of substitute goods X and Y. The cross elasticity between two points A and B is measured by using following formula:

$$E_{XY} = \frac{\left(\dfrac{\text{Change in demand for good X}}{\text{Average demand for good X}}\right)}{\left(\dfrac{\text{Change in Price of good Y}}{\text{Average Price of good Y}}\right)}$$

$$= \frac{\dfrac{\Delta Q}{\dfrac{Q_{X1} + Q_{X2}}{2}}}{\dfrac{\Delta P_Y}{\dfrac{P_{Y1} + P_{Y2}}{2}}} = \frac{\Delta Q_X}{\Delta P_Y} \times \left(\frac{P_{Y1} + P_{Y2}}{Q_{X1} + Q_{X2}}\right) = \left(\frac{Q_{X2} - Q_{X1}}{P_{Y2} - P_{Y1}}\right) \times \left(\frac{P_{Y1} + P_{Y2}}{Q_{X1} + Q_{X2}}\right)$$

where

E_{XY} = Coefficient of cross elasticity of demand

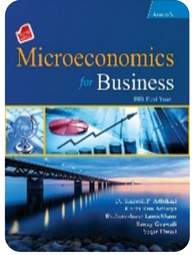
Q_{X1} = Initial demand for good X

Q_{X2} = New demand for good X

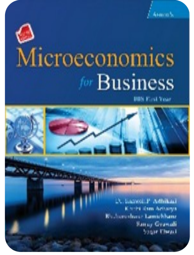
P_{Y1} = Initial price of good Y

P_{Y2} = New price of good Y

Uses or Importance of Cross Elasticity of Demand



1. Classification of goods
2. Classification of market
3. Pricing policy
4. Determination of boundaries between industries



Advertising Elasticity of Demand (E_A)

The ratio of percentage change in quantity demanded and percentage change in advertisement expenditure is called advertising elasticity of demand. In other words, it is responsiveness of change in demand to the change in advertisement expenditure.

$$E_A = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in advertisement expenditure}}$$

$$= \frac{\frac{\Delta Q}{Q} \times 100}{\frac{\Delta A}{A} \times 100} = \frac{\Delta Q}{\Delta A} \times \frac{A}{Q}$$

where

E_A = Coefficient of advertisement elasticity of demand

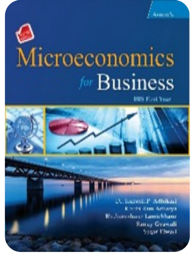
Q = Initial demand

A = Advertisement expenditure

ΔQ = Change in quantity demanded

ΔA = Change in advertisement expenditure

Advertising Elasticity of Demand (E_A) Contd.



The arc or average advertising elasticity of demand between any two advertising expenditure is as

$$E_A = \frac{\Delta Q}{\Delta A} \times \frac{A_1 + A_2}{Q_1 + Q_2} = \frac{Q_2 - Q_1}{A_2 - A_1} \times \frac{A_1 + A_2}{Q_1 + Q_2}$$

where

Q_1 = Initial demand

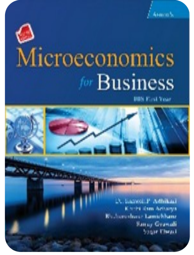
Q_2 = New demand

A_1 = Initial advertisement expenditure

A_2 = New advertisement expenditure

Since, there is always positive relationship between quantity demanded and advertisement expenditure, the coefficient of advertising elasticity of demand is positive

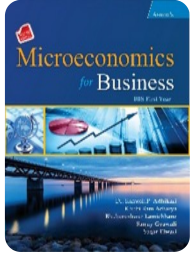
Types (Degrees) of Advertisement Elasticity of Demand



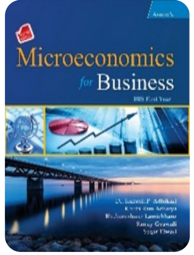
There are three types of advertisement elasticity of demand which are as follows:

1. **Advertisement elasticity of demand equal to 1 ($E_A = 1$):** If percentage change in demand is equal to percentage change in advertisement expenditure, it is called advertisement elasticity of demand equal to 1.
2. **Advertisement elasticity of demand more than 1 ($E_A > 1$):** If percent change in demand is more than percentage change in advertisement expenditure, it is called advertisement elasticity more than 1.
3. **Advertisement elasticity of demand less than 1 ($E_A < 1$):** If percentage change in quantity demanded is less than the percentage change in advertisement expenditure, it is called advertisement elasticity of demand less than 1.

Uses or Importance of Advertising Elasticity of Demand in Decision Making

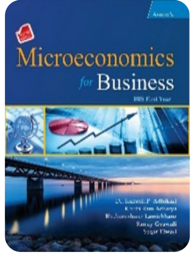


- An important advantage of the study of advertising elasticity of demand is that it helps the management in deciding whether the expenditure on advertisement should be increased or decreased or maintained at present level
- Study of this concept helps the management to know the effect of advertisement on the sales revenue. If the management finds saturation point has been arrived, expenditure on advertising should be stopped.
- Study of this concept helps in evaluating the effectiveness of various media of advertisement.



Determinants of Elasticity of Demand

1. Nature of the commodity
2. Substitute
3. Goods having several uses
4. Joint demand
5. Income of the consumer
6. Postpone of the consumption
7. Habits
8. Price level
9. Time factor



Price Elasticity of Supply

The price elasticity of supply is defined as the responsiveness of quantity supplied of a commodity to the change in its price. The price elasticity of supply is also defined as the ratio between percentage change in quantity supplied and percentage change in price of a commodity.

$$E_s = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

$$= \frac{\dfrac{\text{Change in quantity supplied}}{\text{Initial quantity supplied}} \times 100}{\dfrac{\text{Change in price}}{\text{Initial price}} \times 100} = \frac{\dfrac{\Delta Q}{Q} \times 100}{\dfrac{\Delta P}{P} \times 100} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

where

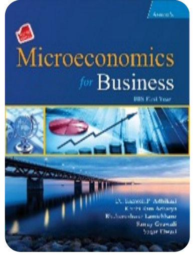
E_S = Coefficient of price elasticity of supply

Q = Initial quantity supplied

P = Initial price

ΔQ = Change in quantity supplied

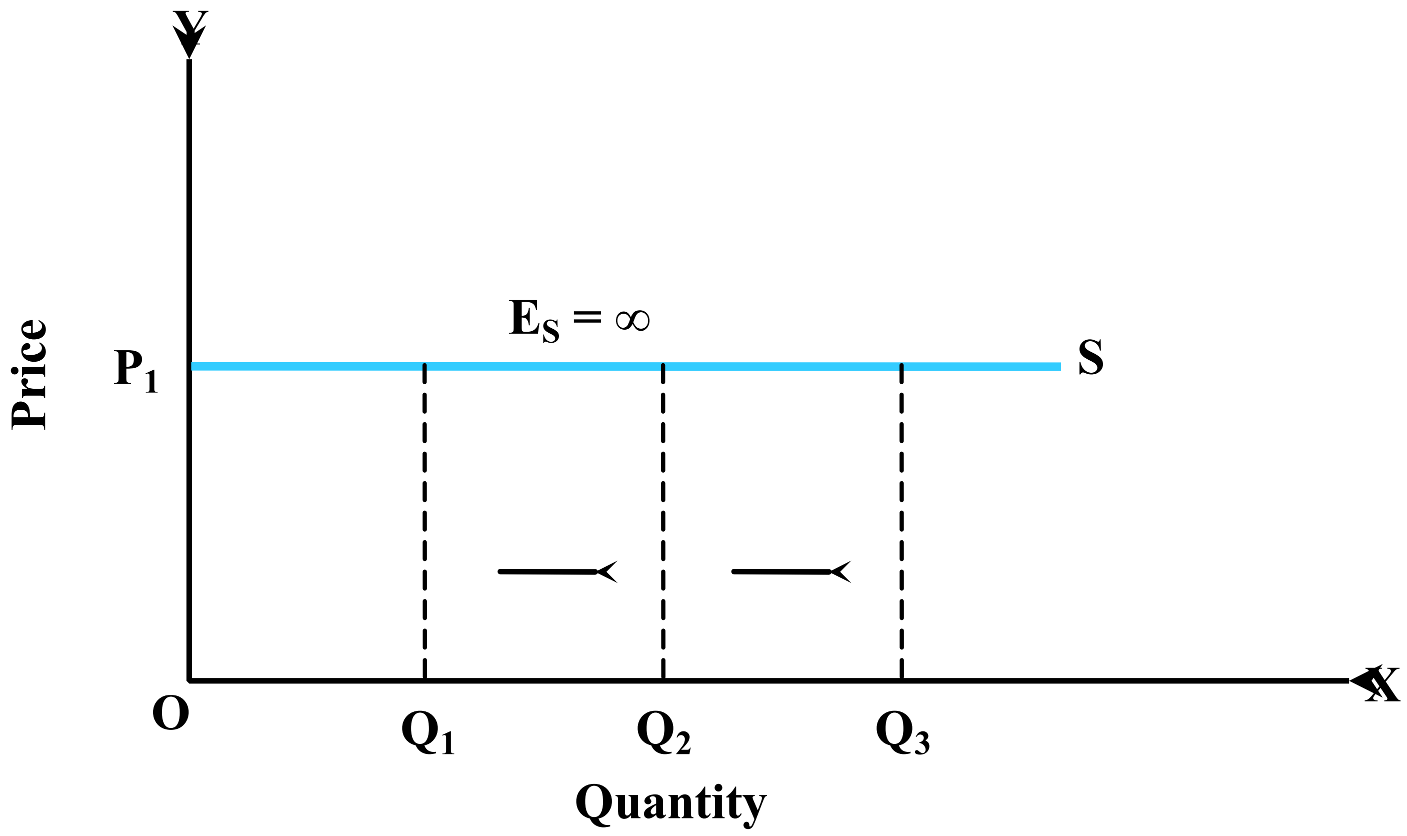
ΔP = Change in price



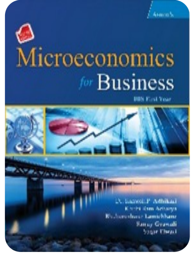
Types (Degrees) Price of Elasticity of Supply

1. Perfectly Elastic Supply ($E_s = \infty$)

Supply is said to be perfectly elastic supply if negligible change in price leads to infinite change in the quantity supplied. Visibly, no change in price causes infinite change in supply..

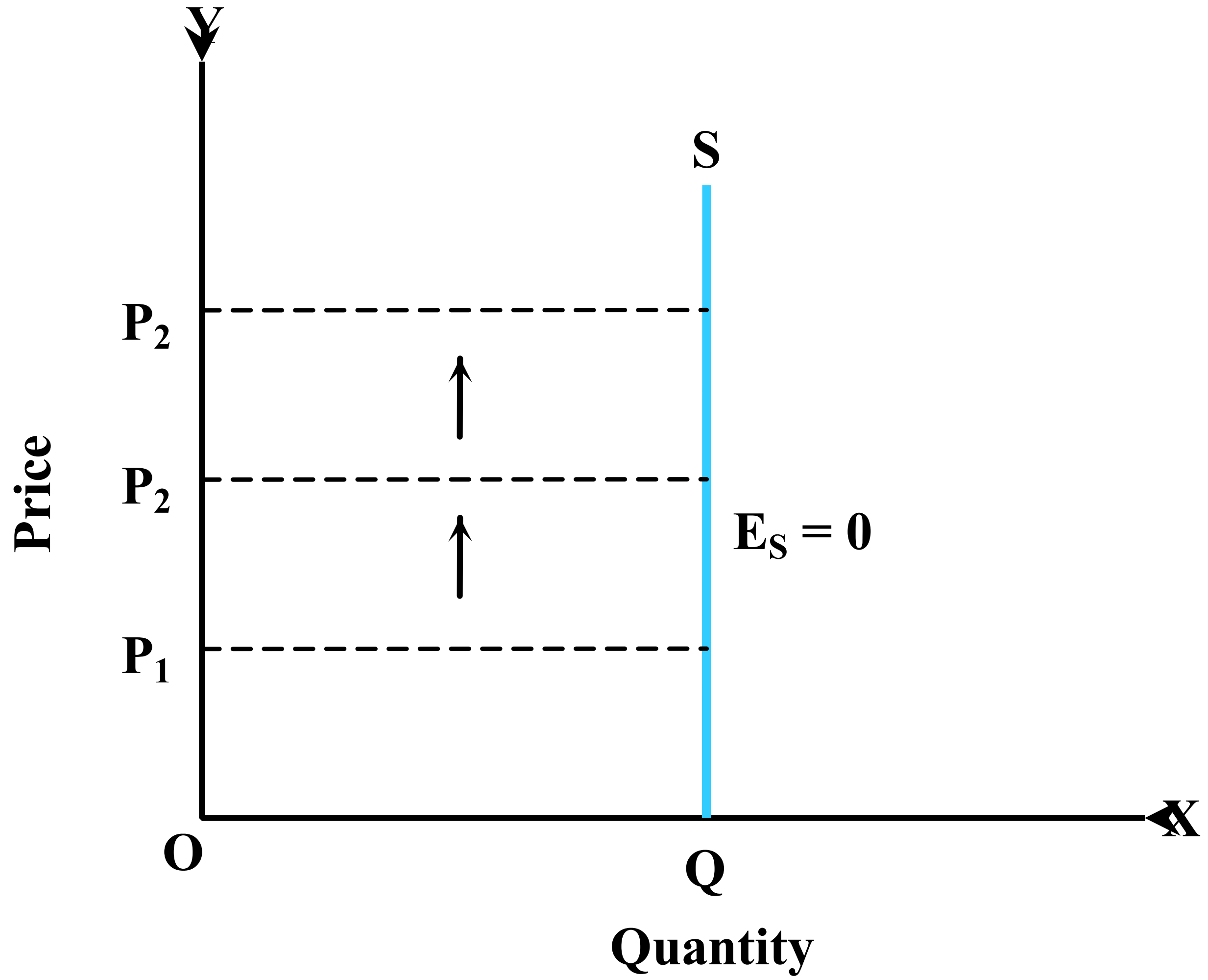


Types (Degrees) Price of Elasticity of Supply Contd.



2. Perfectly Inelastic Supply ($E_s = 0$)

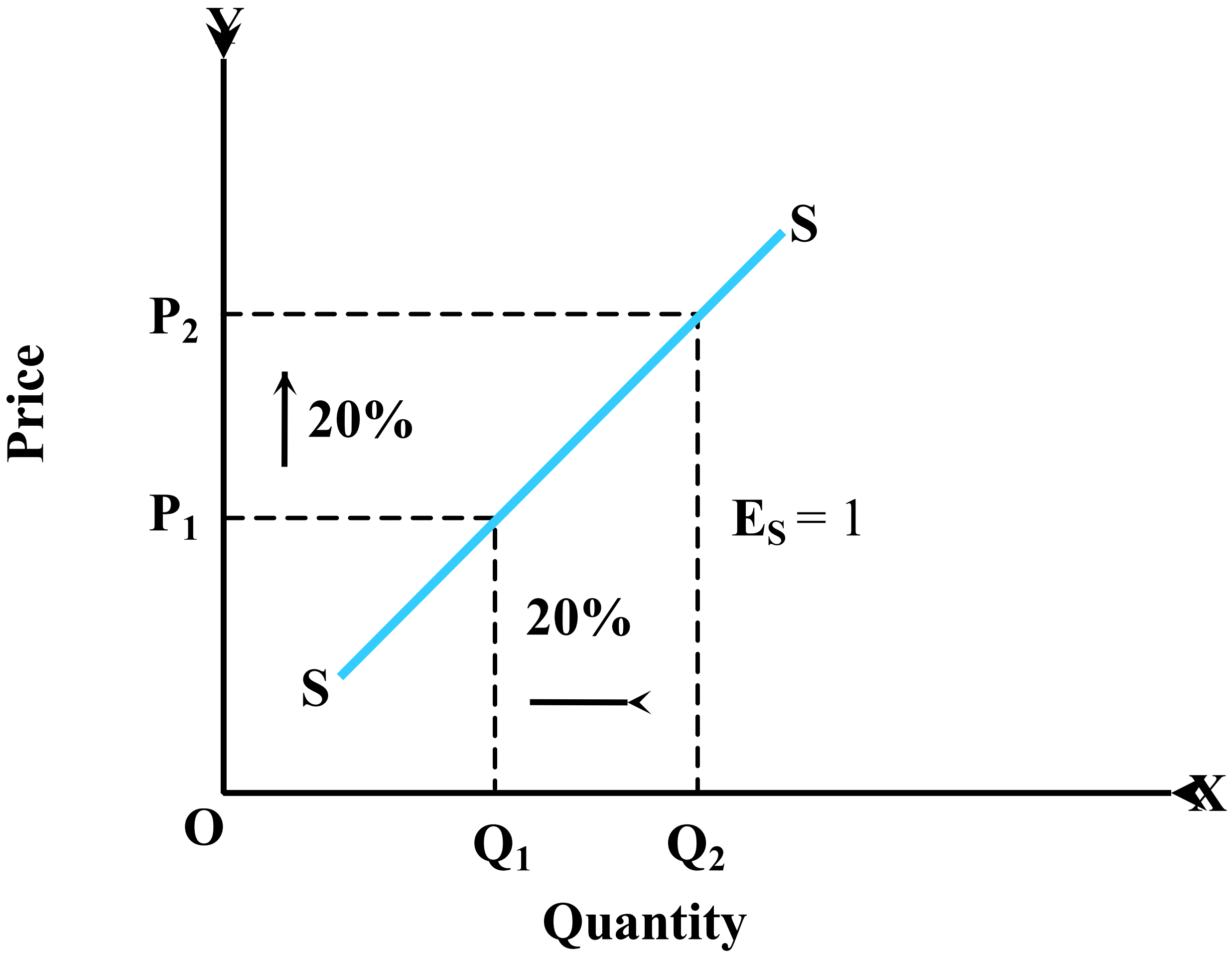
When the supply of a commodity does not change despite the change price, the supply is said to perfectly inelastic supply.



Types (Degrees) Price of Elasticity of Supply Contd.

3. Unitary Elastic Supply ($E_S = 1$)

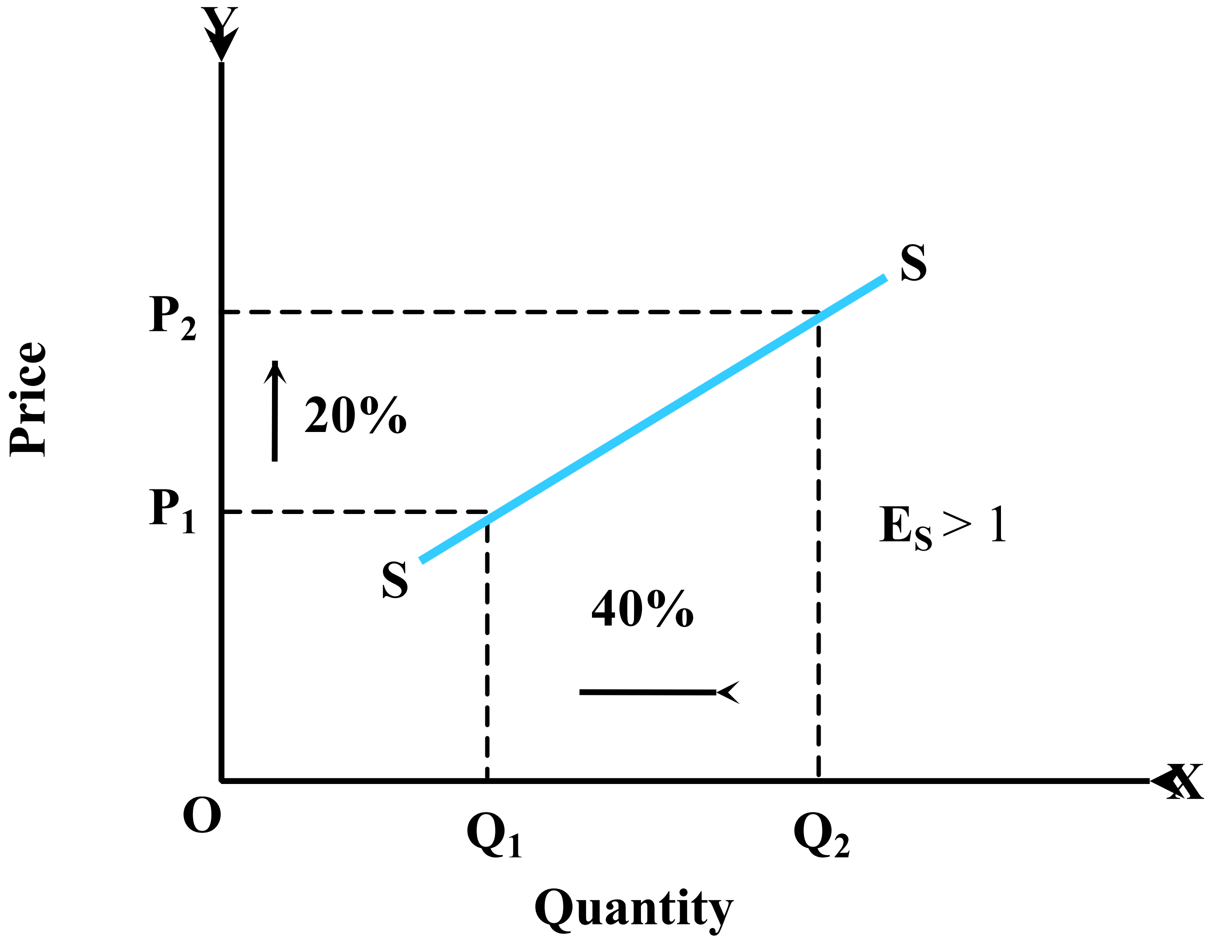
When the percentage change in the quantity supplied is equal to the percentage change in price, the supply of a commodity is said to be unitary elastic.



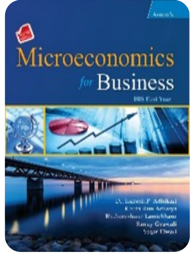
Types (Degrees) Price of Elasticity of Supply Contd.

4. Relatively Elastic Supply ($E_s > 1$)

When the percentage change in the quantity supplied of a commodity is more than the percentage change in price, it is called relatively elastic supply..

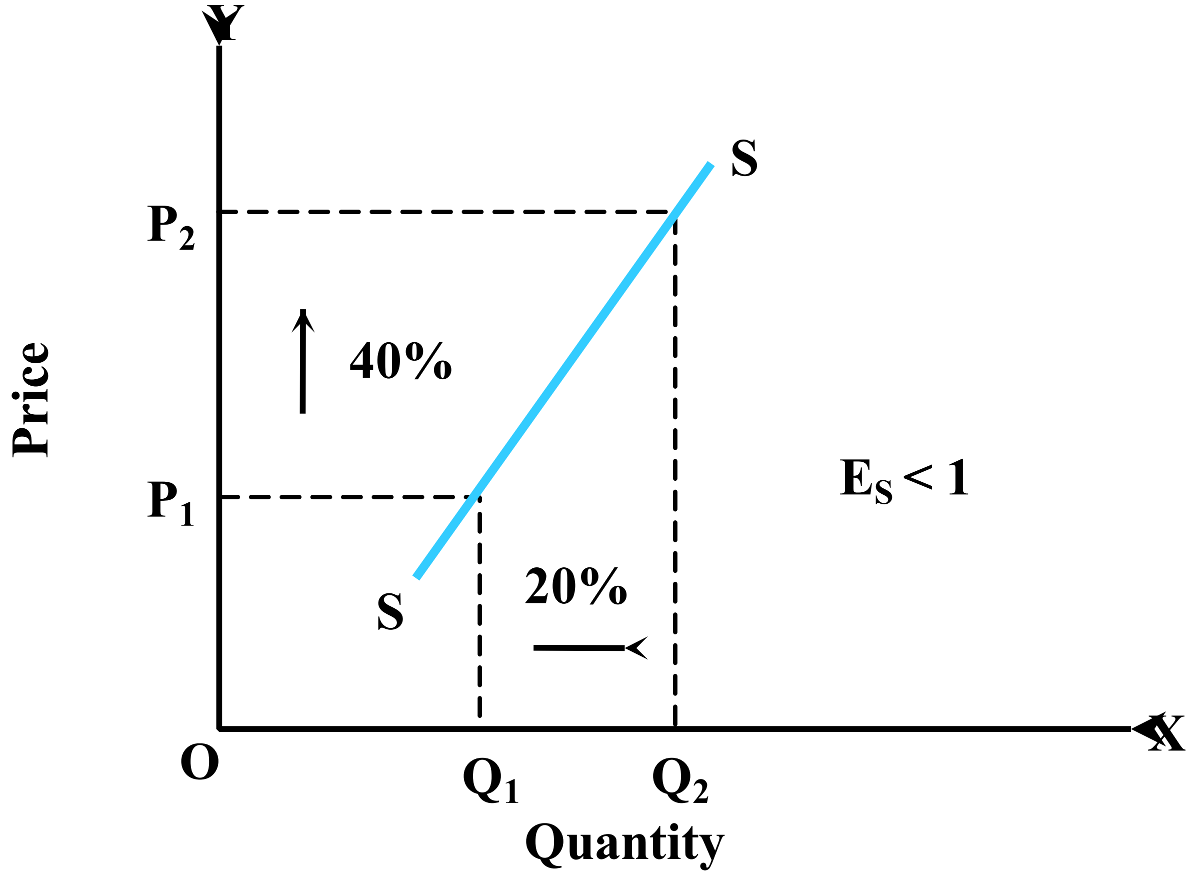


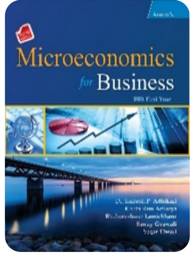
Types (Degrees) Price of Elasticity of Supply Contd.



5. Relatively Inelastic Supply ($E_s < 1$)

When the percentage change in the quantity supplied of a commodity is less than percentage change in price, it is called relatively inelastic supply.





Calculation of Price Elasticity of Supply

1. Percentage/ Proportionate Method

According to this method, price elasticity of supply is calculated dividing percentage change in quantity supplied divided by percentage change in price.

$$E_S = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

$$= \frac{\left(\dfrac{\text{Change in quantity supplied}}{\text{Initial quantity supplied}} \times 100\right)}{\left(\dfrac{\text{Change in Price}}{\text{Initial Price}} \times 100\right)} = \frac{\dfrac{\Delta Q}{Q} \times 100}{\dfrac{\Delta P}{P} \times 100} = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q}$$

where

E_S = Coefficient of price elasticity of supply

Q = Initial quantity supplied

P = Initial Price

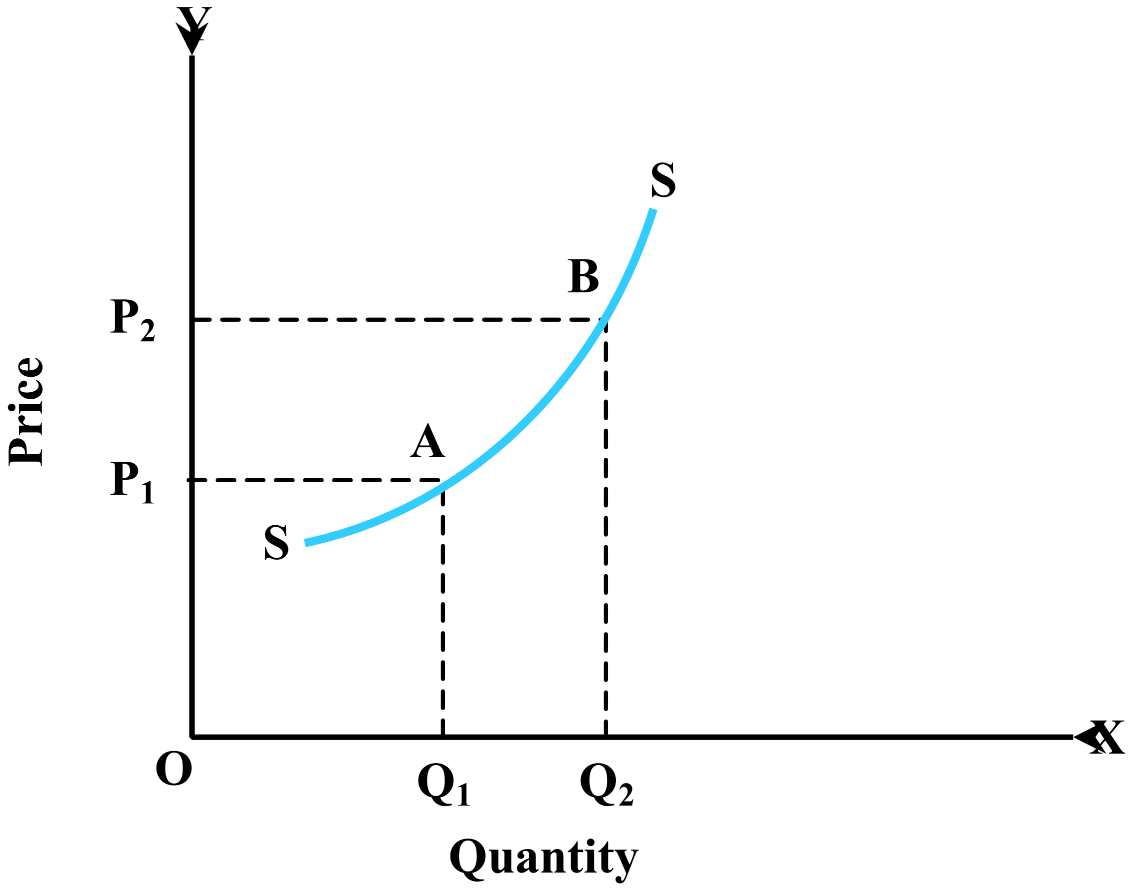
ΔQ = Change in quantity supplied

ΔP = Change in price

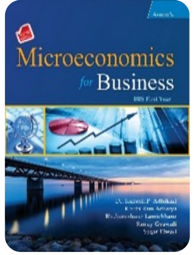
Calculation of Price Elasticity of Supply Contd.

2. Average/ Arc Method

The coefficient of elasticity of supply between two points on a supply curve is called average or arc elasticity of supply. This method is used to measure elasticity of supply when there is greater change in price and quantity supplied.



Calculation of Price Elasticity of Supply Contd.



$$E_S = \frac{\left(\dfrac{\text{Change in quantity supplied}}{\text{Average quantity supplied}}\right)}{\left(\dfrac{\text{Change in Price}}{\text{Average Price}}\right)}$$

$$= \frac{\left(\dfrac{\Delta Q}{\dfrac{Q_1 + Q_2}{2}}\right)}{\left(\dfrac{\Delta P}{\dfrac{P_1 + P_2}{2}}\right)} = \frac{\Delta Q}{\Delta P} \times \left(\frac{P_1 + P_2}{Q_1 + Q_2}\right) = \left(\frac{Q_2 - Q_1}{P_2 - P_1}\right)\left(\frac{P_1 + P_2}{Q_1 + Q_2}\right)$$

where

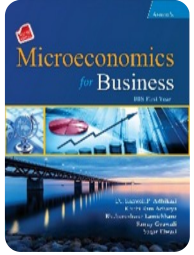
E_S = Coefficient of price elasticity of supply

Q_1 = Initial quantity supplied

Q_2 = New quantity supplied

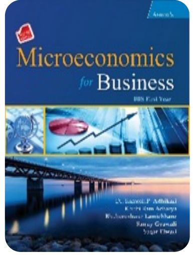
P_1 = Initial Price

P_2 = New Price



Factors Influencing Price Elasticity of Supply

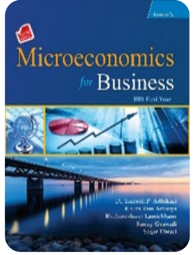
1. Nature of the commodity
2. Cost of production
3. Time element
4. Producers expectation
5. Technical condition of production



Numerical Examples 1

Calculate the price elasticity of demand by percentage and average method, when price decrease from Rs. 20 to Rs. 10 in the following example:

Price (Rs.)	20	10
Demand	40	80



SOLUTION

Proportionate Method

Initial price (P) = Rs. 20 Initial quantity (Q) = 40

New price (P_1) = Rs. 10 New quantity (Q_1) = 80

$\Delta P = -10$ $\Delta Q = 40$

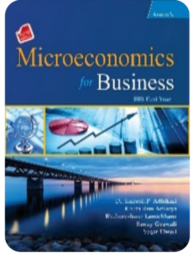
$$E_P = \frac{\Delta Q}{\Delta P} \times \frac{P}{Q} = \left(\frac{40}{-10} \times \frac{20}{40}\right) = -2$$

Since, E_P - 2, the demand is relatively elastic.

Arc Method/ Mid Point Method/ Average Method

$$E_P = \left(\frac{Q_2 - Q_1}{P_2 - P_1}\right) \times \frac{P_1 + P_2}{Q_1 + Q_2} = \frac{80 - 40}{10 - 20} \times \frac{20 + 10}{40 + 80} = -1$$

Since, E_P -1, the demand is unitary price elastic.



Numerical Examples 2

From the following table calculate income elasticity of demand for commodity X when income rises from Rs. 10,000 to Rs. 15,000 and determine what type of goods is commodity X:

Q_X	100	250
Y	Rs. 10,000	Rs. 15,000

Here,

Initial demand (Q_X) = 100

New demand (Q_{X1}) = 250

Change in demand (ΔQ_X) = $Q_{X1} - Q_x$ = 250 – 100 = 150 units

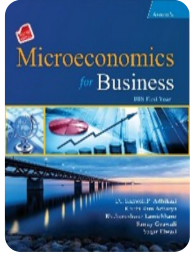
Initial income (Y) = Rs. 10,000

New income (Y_1) = Rs. 15,000

Change in income (ΔY) = $Y_1 - Y$ = 15,000 – 10,000 = Rs. 5,000

$$E_Y = \frac{\Delta Q_X}{\Delta Y} \times \frac{Y}{Q} = \frac{150}{5,000} \times \frac{10,000}{100} = 3$$

Since, $E_Y = 3$ is positive and greater than 1, the commodity is luxury.



SOLUTION

Here,

Initial demand (Q_X) = 100

New demand (Q_{X1}) = 250

Change in demand (ΔQ_X) = $Q_{X1} - Q_x$ = 250 – 100 = 150 units

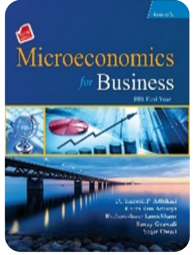
Initial income (Y) = Rs. 10,000

New income (Y_1) = Rs. 15,000

Change in income (ΔY) = $Y_1 - Y$ = 15,000 – 10,000 = Rs. 5,000

$$E_Y = \frac{\Delta Q_X}{\Delta Y} \times \frac{Y}{Q} = \frac{150}{5{,}000} \times \frac{10{,}000}{100} = 3$$

Since, $E_Y = 3$ is positive and greater than 1, the commodity is luxury.



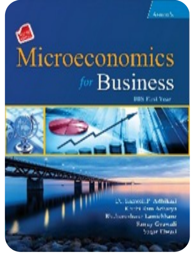
Numerical Examples 3

Consider the following supply schedule:

Points	A	B	C	D
Price (P_X)	0	5	10	15
Supply (Q_X)	10	20	30	40

a. Compute the price elasticity of supply at the movement from B to C by percentage method.

b. Compute the price elasticity of supply by average method between C and D.



SOLUTION

a. Initial quantity supplied (Q_X) = 20

New quantity supplied (Q_{X1}) = 30

Change in quantity supplied (ΔQ_X) = $Q_{X1} - Q_X$ = 30 – 20 = 10

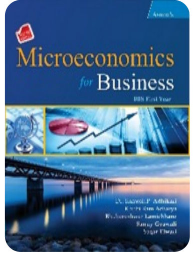
Initial price of good X (P_X) = Rs. 5

New price of good X (P_{X1}) = Rs. 10

Change in price of good X (ΔP_X) = 10 – 5 = 5

$$E_S = \frac{\Delta Q_X}{\Delta P_Y} \times \frac{P_Y}{Q_X} = \frac{10}{5} \times \frac{5}{20} = \frac{1}{2} = 0.5 < 1$$

Interpretation: Since, E_S = 0.5 < 1, the supply is relatively inelastic. One percentage increase in price results 0.5 percentage increase in quantity supplied and vice-versa.



b. Initial quantity supplied (Q_{X1}) = 30

New quantity supplied (Q_{X2}) = 40

Initial Price (P_{X1}) = Rs. 10

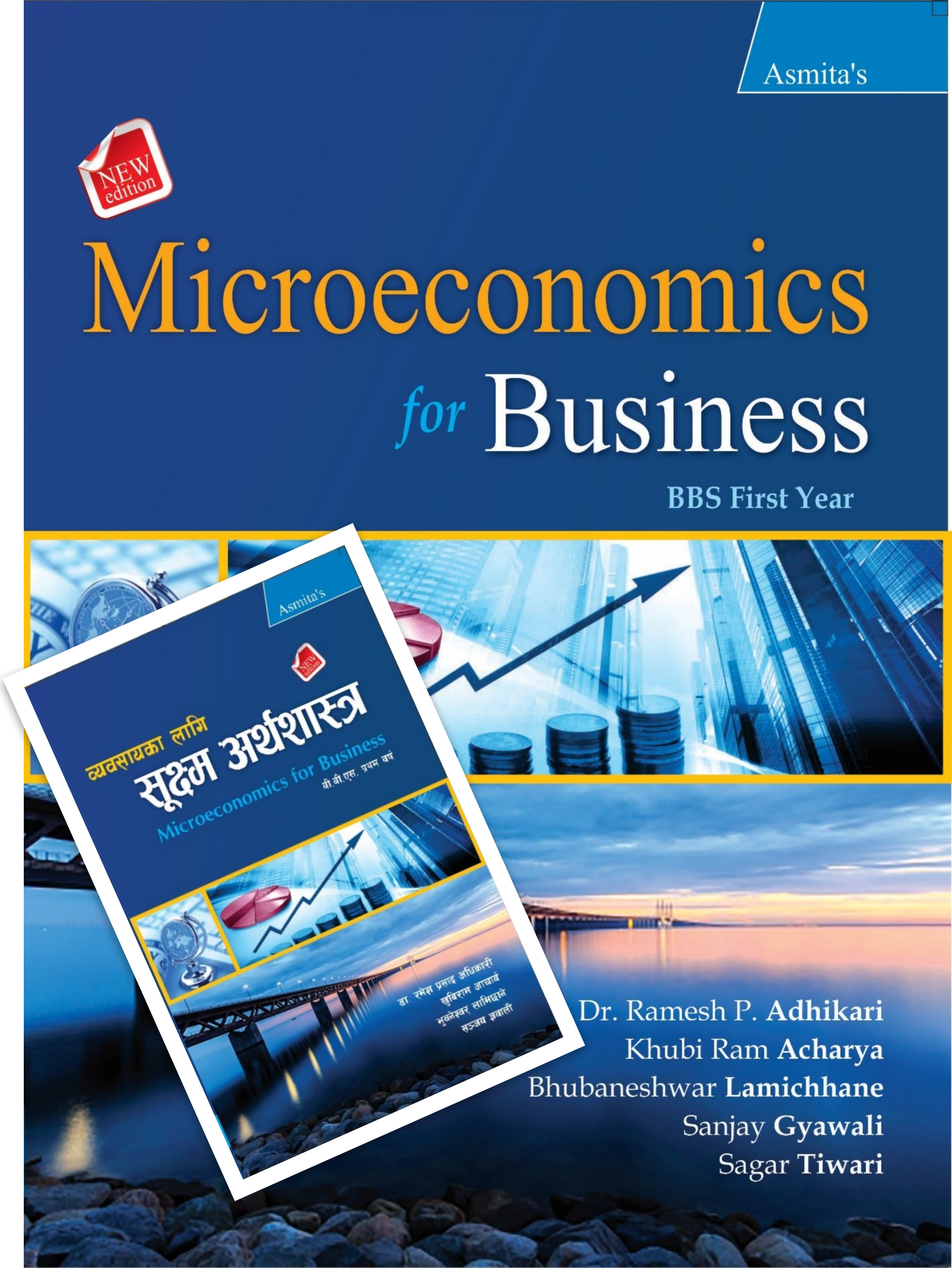
New Price (P_{X2}) = Rs. 15

$$E_S = \frac{(Q_{X2} - Q_{X1})}{(P_{X2} - P_{X1})} \times \frac{(P_{X1} + P_{X2})}{(Q_{x1} + Q_{X2})}$$

$$= \frac{(40 - 30)}{(15 - 10)} \times \frac{(10 + 15)}{(30 + 40)} = \left(\frac{10}{5}\right) \times \left(\frac{25}{70}\right) = 0.71$$

Interpretation: Since, $E_S = 0.71 < 1$, the supply is relatively inelastic. One percentage increase in price results 0.71 percentage increase in quantity supplied and vice-versa.

Thank You



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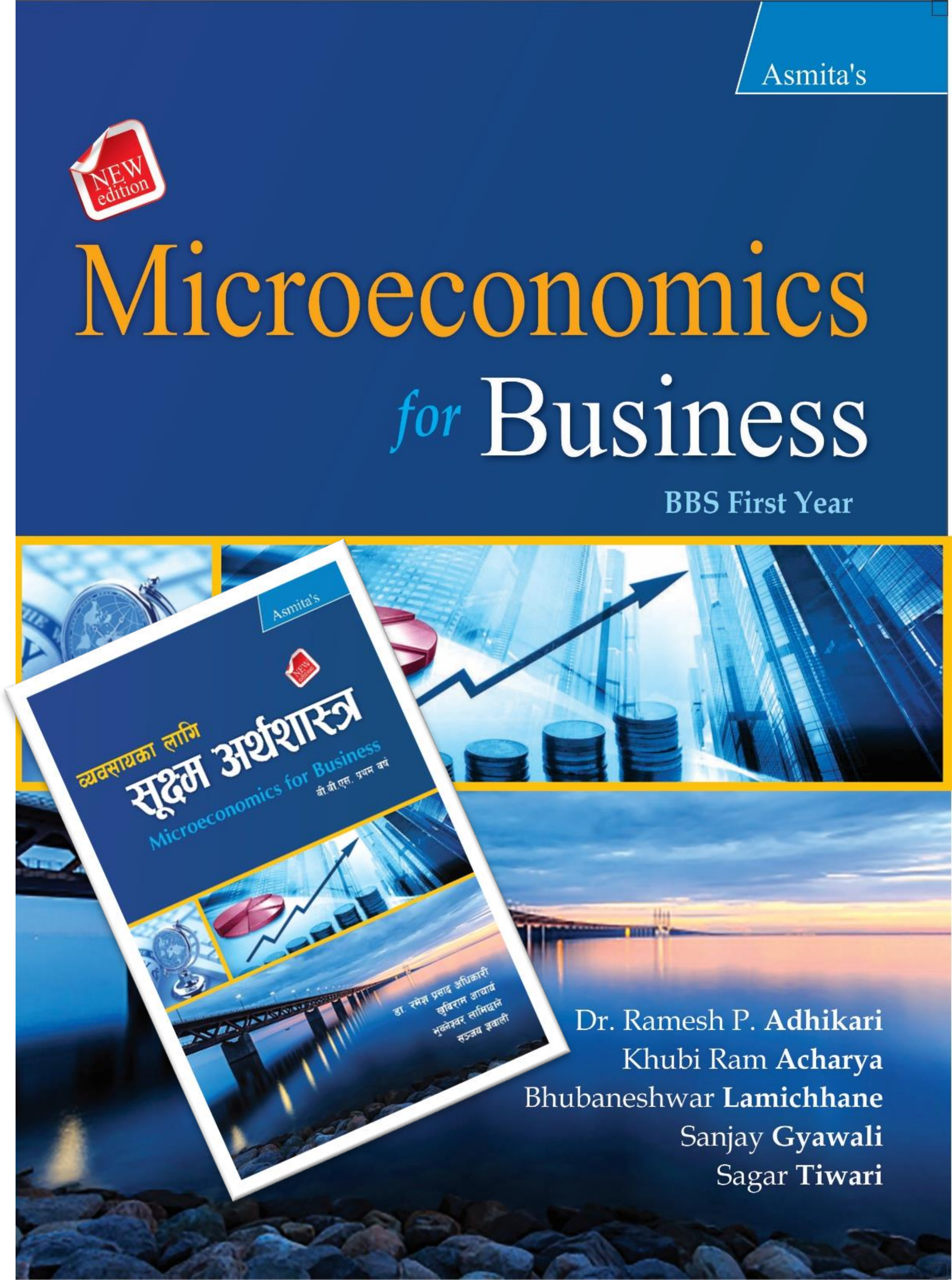
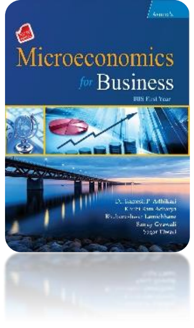
Product Pricing: Theories and Practices

Unit 7

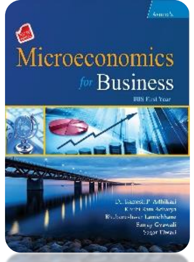




Learning Objectives

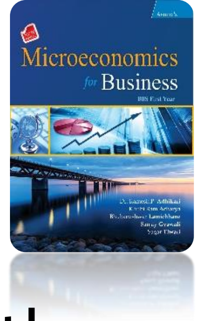
On completion of this unit, students will be able to:

- define different market structures and explain their characteristics
- illustrate the profit maximizing goal of firm
- describe the process of price and output determination under different market structures
- derive short-run supply curve of a firm and industry under perfect competition
- point out the economic effects of monopoly
- explain how a monopolistically competitive firm attains equilibrium under product variation and selling expenses
- define cartel and explain its types
- explain about pricing under joint profit maximization cartel
- give an introduction of various pricing practices in the real world.



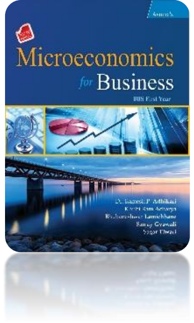
Introduction

- The theories of product pricing are concerned with the determination of equilibrium price and quantity of the output in the different market structures.
- The way in which price and quantity of output are determined depends on the market structure.
- The determination of price and quantity of output under different market structures is very crucial for business decision making.
- The success of the business also depends on the determined price and quantity of the output.



Market Structure: Concept and Characteristics

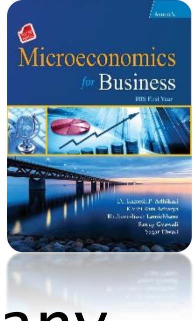
- The forces behind the demand and supply play a vital role in the determination of price of output.
- But the way in which these two factors determine the price of output depends on market structure i.e., how the firms are organized.
- Thus, the pricing of output depends on how product markets are organized, that is whether there are one, two or many firms or producers, whether the product is homogeneous, and so on.
- The market structure refers to the characteristics or structural variables of the market that affect managerial decisions.
- These characteristics are: the number of firms competing in a market, the relative size of firms, technological and cost conditions, demand conditions and the ease with which firms can enter or exit the industry.



Characteristics Market Structure

1. Number of firms in the industry
2. Size of the firm
3. Industry concentration
4. Technology used to produce goods and services
5. Demand and market conditions
6. Potential for entry

Perfect Competition



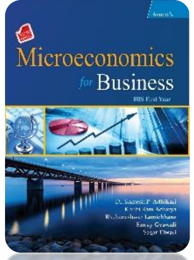
Definition

Perfect competition is the market structure in which there are many buyers and sellers of a homogeneous product. Under this market structure, the price of a product is determined in the industry and the sellers and buyers accept that price, so the price is fixed.

Characteristics of Perfect Competition

1. Large number of sellers and buyers
2. Homogenous products
3. Free entry and exit
4. Perfect mobility of factors of production
5. No government intervention
6. Perfect knowledge about the market
7. Profit maximization objective

Monopoly

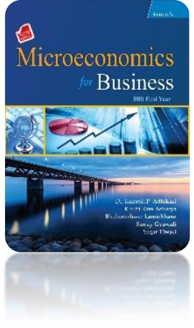


Definition

Monopoly is defined as the market structure where there is a single seller of a product having no close substitutes. The word 'monopoly' has been derived from the Greek words 'monos polein', which means 'alone to sell'.

Characteristics of Monopoly

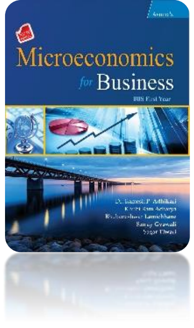
1. Single seller
2. No close substitutes
3. Barriers to entry
4. Firm and industry
5. Independent price policy
6. Price discrimination
7. Profit maximization



Monopoly Contd.

Factors that give rise to Monopoly (Sources of Monopoly)

1. Patent over new innovations
2. Control over the raw materials
3. Cost of establishing an efficient plant
4. Market franchises



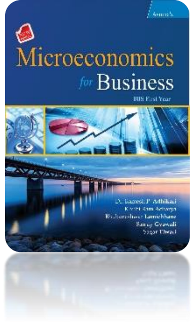
Monopolistic Competition

Definition

Monopolistic competition is defined as the market structure where there are many sellers and buyers of differentiated or heterogeneous product. Differentiated products are products that are similar but not identical.

Characteristics of Monopolistic Competition

1. Large number of sellers and buyers
2. Differentiated Product
3. Free entry and exit of firms
4. High selling cost
5. Relatively elastic demand curve
6. Heroic assumption
7. Profit maximizing objective



Oligopoly

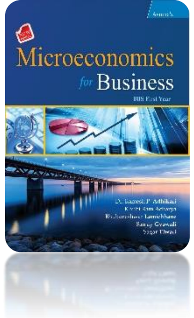
Definition

Oligopoly is a form of market structure where there are a few sellers of homogeneous or differentiated products. If the products are homogeneous, it is called homogeneous or perfect or pure oligopoly and if products are differentiated, it is called heterogeneous or differentiated or imperfect oligopoly.

Characteristics of Oligopoly

1. A few sellers
2. Interdependence of decision making
3. Barriers to entry
4. Indeterminate price and output
5. Advertising and selling cost
6. Nature of the product
7. Price rigidity

Non-collusive oligopoly and Collusive oligopoly

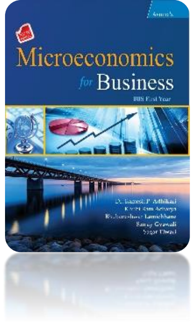


- **Non-collusive oligopoly** is one of the two types of oligopoly market in which oligopoly firms act independently, they is competition with one another and there is no-collusion between the firms.
- **Collusive oligopoly** is another type of oligopoly market where firms have been found to be in some kind of collusion or agreement. There are mainly two models of collusive oligopoly which are:

  1.Cartel: It is a type of collusive oligopoly market, where firms or sellers of a commodity are formally organized with the aim of restricting competition and maximizing profits.

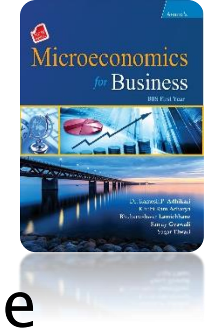
  2.Price Leadership: The form of market collusion in oligopolistic markets whereby the firm that serves as the price leader initiates a price change and other firms in the industry soon match it.

Profit Maximizing Goal of the Firm



- The main objective of a firm is to maximize profit. The firm will maximize profit, when it attains equilibrium. The firm's equilibrium is the condition that, once achieved, tends to persist means that the firm has no tendency to change its behaviour. Thus, a firm is maximizing its profit when it is in equilibrium.
- There are two approaches to analyze firm's equilibrium or profit maximization. They are:
  1. Total revenue and total cost approach (TR-TC Approach)
  2. Marginal revenue and marginal cost approach (MR-MC Approach)

Total Revenue and Total Cost Approach (TR-TC Approach)



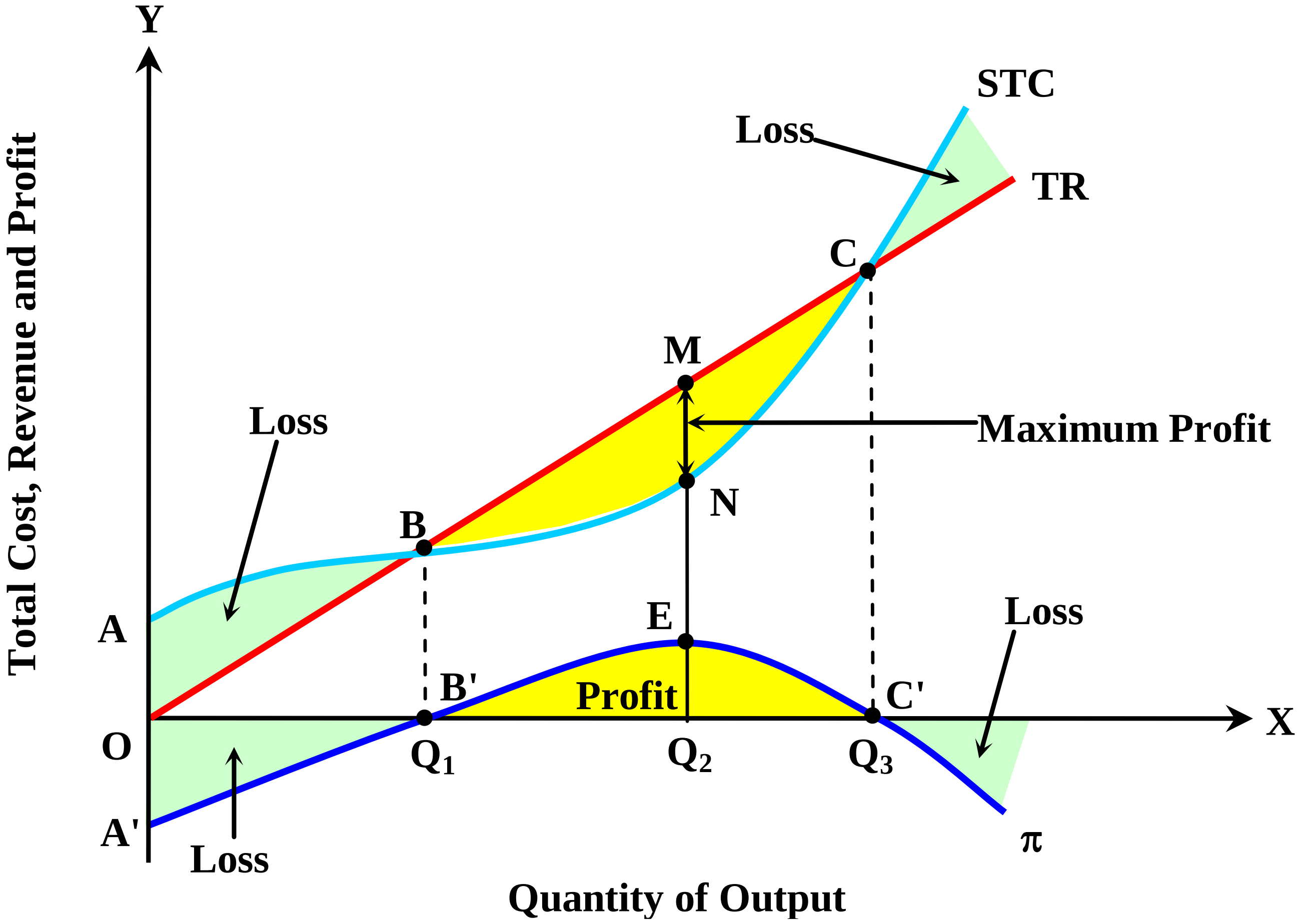
- In terms of total revenues and costs, the total profit (π) is the difference between total revenue (TR) and total cost (TC), i.e. $\pi = TR - TC$.
- As total revenue (TR) = P $\times$ Q, and the total cost (TC) = AC $\times$ Q, given the per unit revenue (AR or P) and per unit cost (AC) in the short-run, the total profit depends on the quantity produced and sold (Q).
- Here, we assume all quantity produced by the firm is sold in the market. So, to achieve the goal of profit maximization, the firm has to seek a production or sales level that makes the largest positive difference between TR and TC.
- In other words, the total profit is maximized at the level of production or sale (Q) where the positive difference between TR and TC is maximum.

Maximum Profit (π) = TR – TC

Total Revenue and Total Cost Approach (TR-TC Approach) Contd.

1. Short-run Equilibrium of a Firm under Perfect Competition Market by Using TR–TC Approach

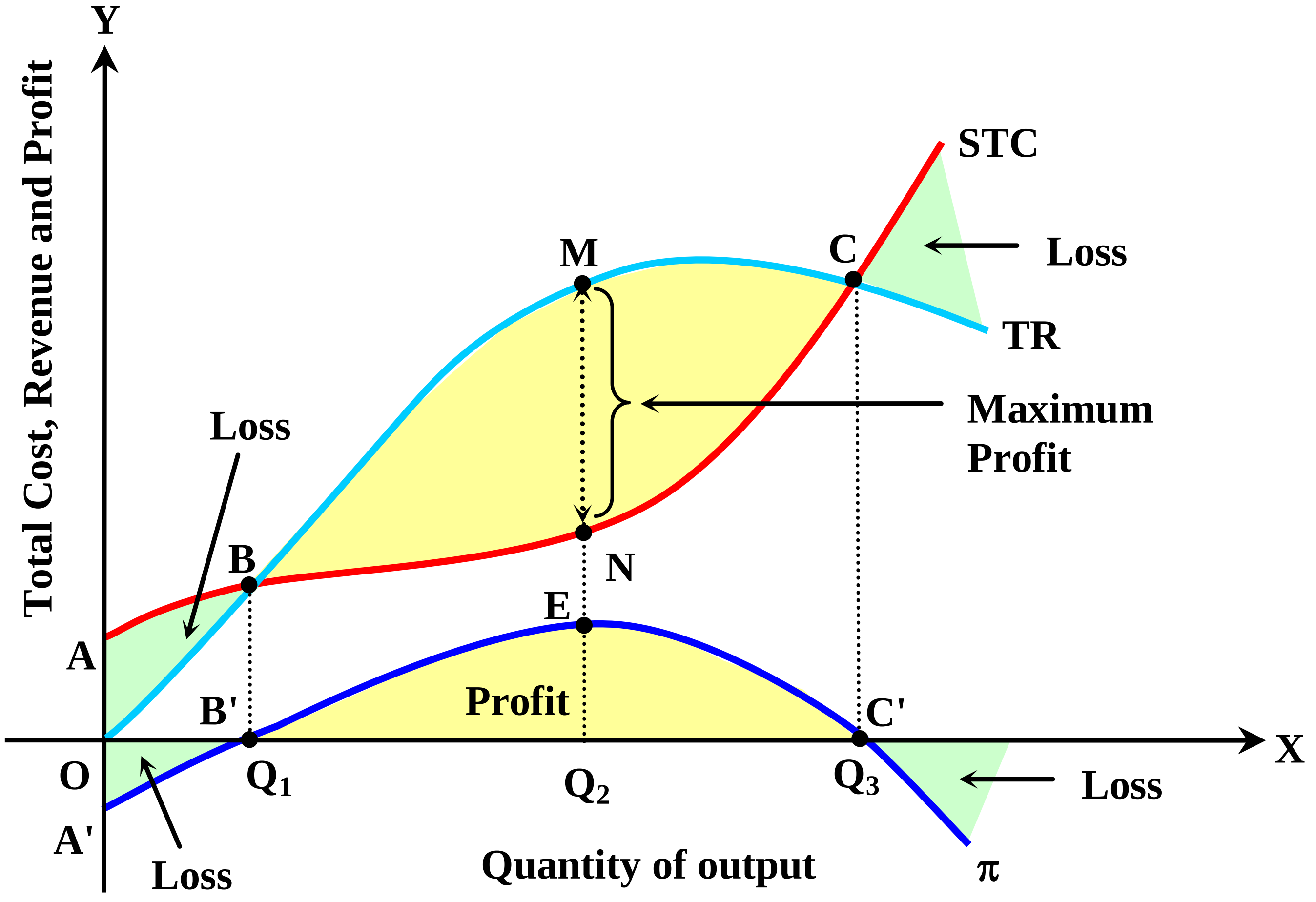
- A perfectly competitive firm attains equilibrium or maximizes profit in the short-run at that level of output at which the positive difference between TR and TC, is maximum.



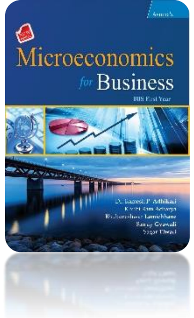
Total Revenue and Total Cost Approach (TR-TC Approach) Contd.

2. Short-run Equilibrium of Firm under Monopoly Market by Using TR-TC Approach

- According to the TR -TC approach, a monopoly firm attains equilibrium or maximizes its profit in the short-run at the level of output and price at which the positive total difference between TR and TC is maximum.



Marginal Revenue and Marginal Cost Approach (MR-MC Approach)



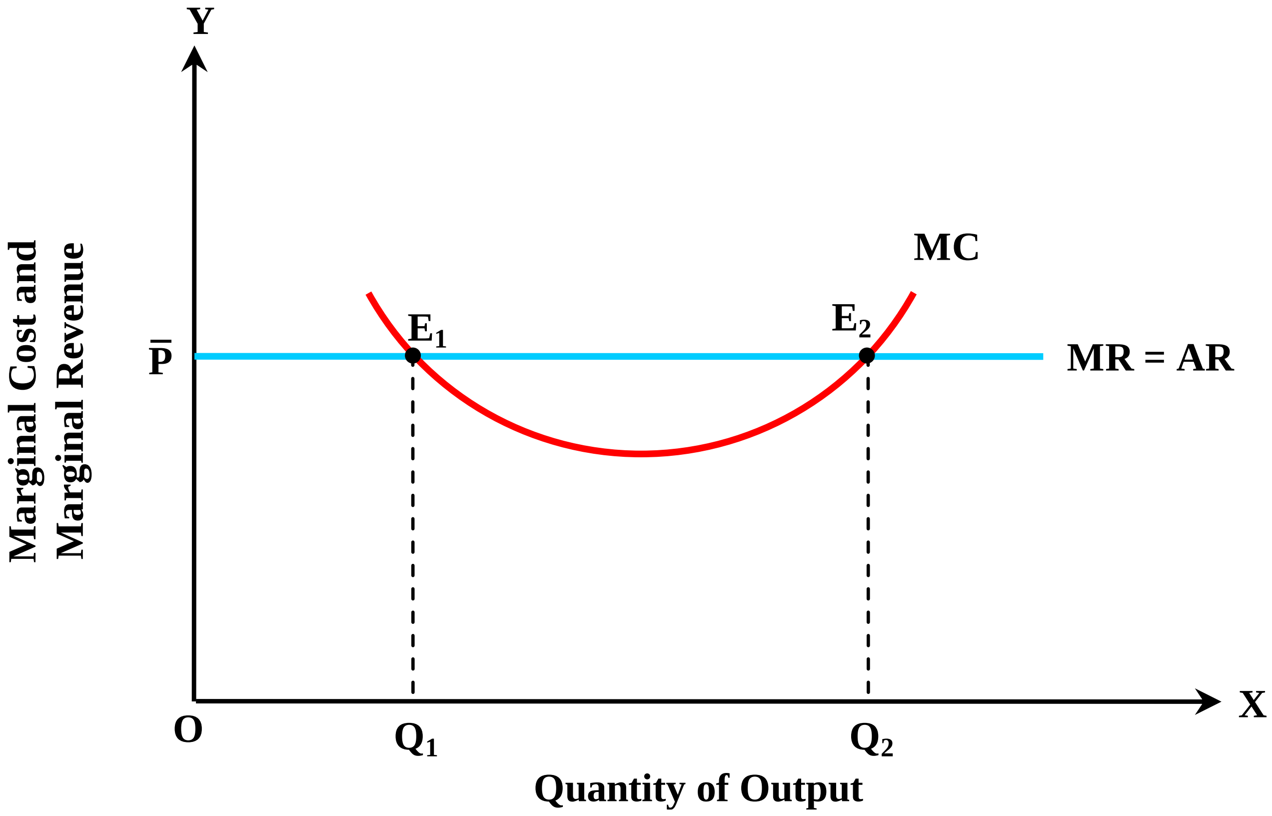
- The marginal revenue and marginal cost approach(MR–MC approach) is even more widely used to determine the equilibrium level of output or the profit maximizing level of output of the firm.
- A profit maximizing firm will be in equilibrium when the following two conditions are fulfilled:

1. **Marginal revenue should be equal to marginal cost (MR = MC).** This condition is also known as necessary condition or first order condition.
2. **Marginal cost (MC) curve must intersect marginal revenue (MR) curve from below.** In other words, slope of MC curve should be greater than slope of MR curve .This condition is also known as sufficiency condition or second order condition.

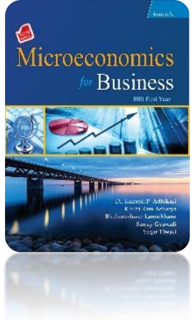
Marginal Revenue and Marginal Cost Approach (MR-MC Approach) Contd.

1. Short-run Equilibrium of a Firm under Perfect Competition by Using MR-MC Approach

- Under perfect competition, marginal revenue and price (average revenue) are equal i.e. P = AR = MR, therefore marginal revenue curve coincides with AR curve.

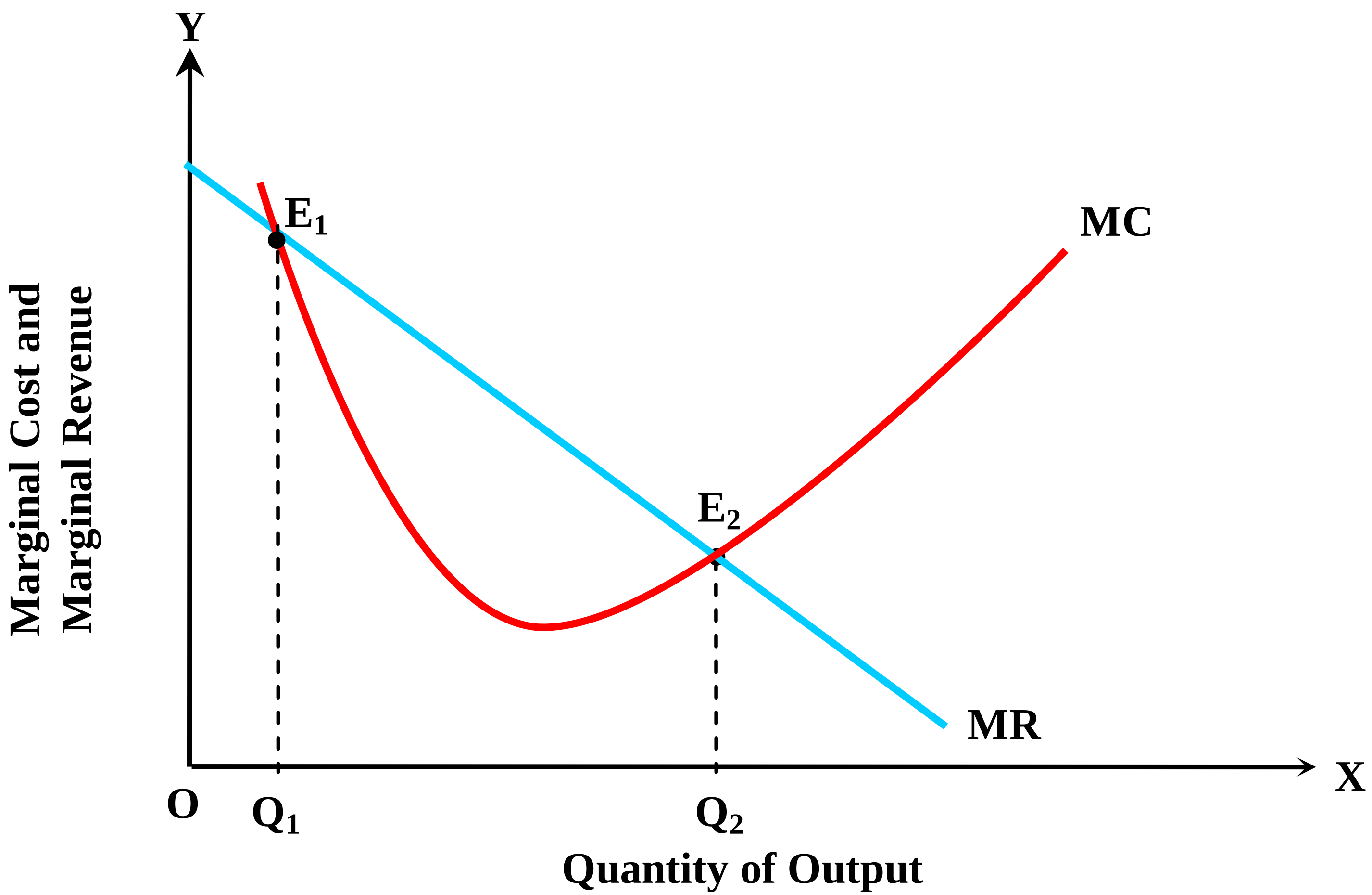


Marginal Revenue and Marginal Cost Approach (MR-MC Approach) Contd.

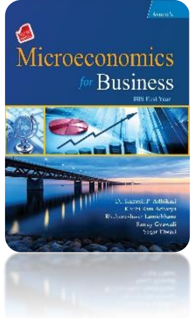


2. Short-run Equilibrium of Firm under Monopoly Market by Using MR-MC Approach

- The marginal revenue (MR) curve of the monopoly firm also slopes downward but it passes from the below of the average revenue curve.
- The marginal cost curve of the firm is roughly U-shaped.

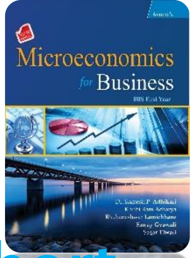


Price and Output Determination under Perfect Competition



- Under perfect competition, the industry or market determines the price of the product by the interaction of market demand and market supply curves and the firms under the industry accept the price determined by the industry.
- The firms determine only the level of output and they have to sell their products at the price determined by the industry.
- So the price for the firms is constant or fixed.
- Therefore, the firm under perfect competition faces horizontal straight lined demand curve (AR curve) which coincides with MR curve.
- Hence, under perfect competition, P = AR = MR, but the cost conditions of the firms under an industry may be different.
- Price and output determination or equilibrium of firm under perfect competition in the short-run and long-run is explained below.

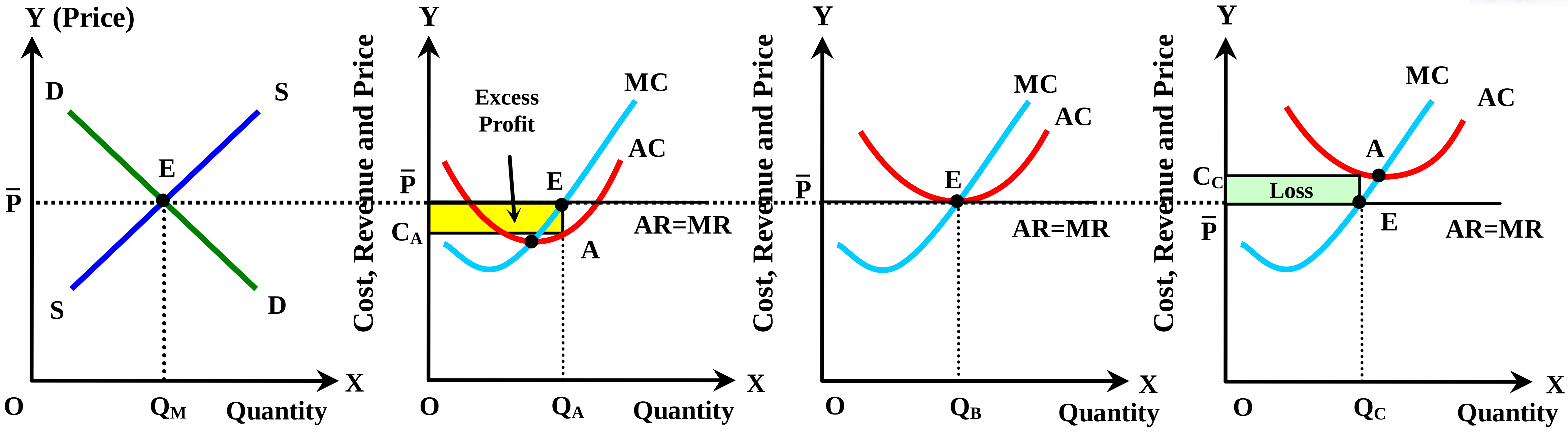
Price and Output Determination under Perfect Competition Contd.



1. Price and output determination under perfect competition in the Short-run (Short-run equilibrium)

- Under perfect competition, marginal revenue and price (average revenue) are equal i.e. P=AR=MR, therefore marginal revenue curve coincides with average curve. The average and marginal cost curves of the firm are roughly U-shaped.
- The short-run equilibrium of a firm under perfect competition requires:

  1. Market supply should be equal to market demand
  2. Marginal revenue must be equal to marginal cost, i.e. MR = MC.
  3. MC curve must intersect MR curve from below. At equilibrium, the perfectly competitive firm may earn excess profit, normal profit or even bear loss in the short-run.
- As the price and the number of firms in the industry is fixed, the competitive firm's profit and loss depends on the short-run average cost.



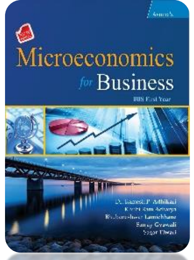
Panel (a):
Industry's Equilibrium

Panel (b): Short-run Equilibrium of a firm with Excess Profit

Panel (c): Short-run Equilibrium of a firm with Normal Profit

Panel (d): Short-run Equilibrium of a firm with Loss

Price and Output Determination under Perfect Competition Contd.



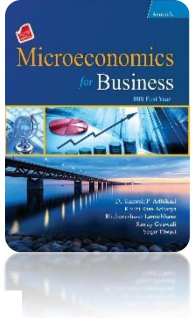
2. Price and output determination under perfect competition in the long-run (Long-run equilibrium)

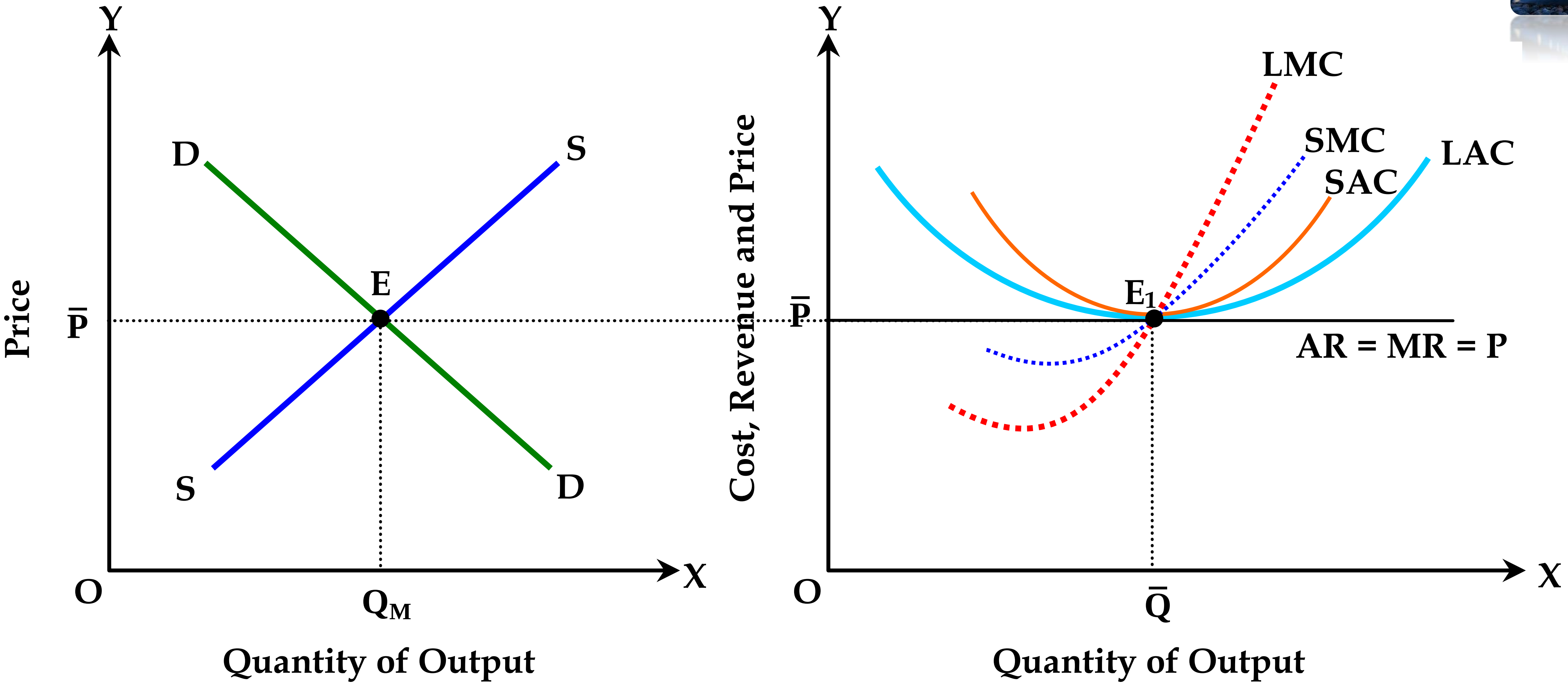
- Under perfect competition, firms can easily enter into and exit out of the industry only in the long-run. And also existing firms have the option of adjusting the quantities of their fixed inputs in the long-run. Thus in the long-run, existing firms can make adjustments in their output and costs.
- Under perfect competition, the following conditions must be fulfilled for a firm in order to attain equilibrium in the long run:

  1. Price (P) or average revenue (AR) or marginal revenue (MR) = long-run average cost (LAC) = long marginal cost (LMC) = short-run average cost (SAC) = short marginal cost (SMC)

     i.e. P = LAC = LMC = SAC = SMC

  2. LMC curve must intersect MR curve from below.
- Thus, under perfect competition market, whatever may be the profit loss situations (excess profit or normal profit or loss)in the short-run equilibrium, the firm earns just normal profit in the long-run



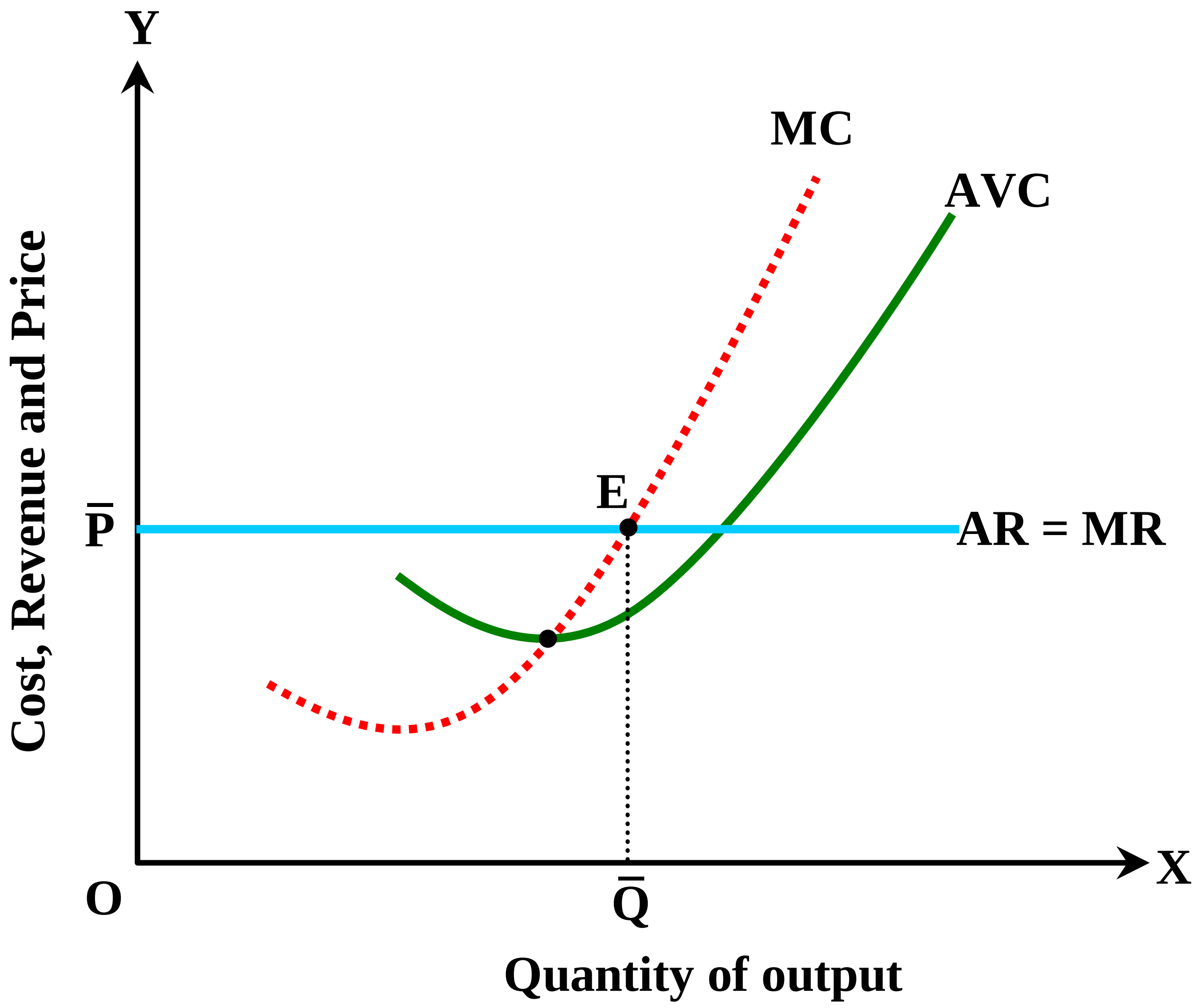


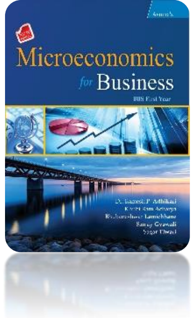
Panel (a): Industry's Equilibrium

Panel (b): Long-run Equilibrium of the firm with Normal Profit

Derivation of Short-run Supply Curve of a Firm and an Industry under Perfect Competition

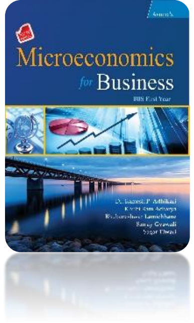
- The demand curve that a competitive firm faces for its output is almost horizontal line.
- Similarly, we know that the competitive firm in the short run will be in equilibrium or will maximize profit at the point where MR = MC and MC curve is rising.
- But for the firm the price is constant and, hence marginal revenue (MR) and average revenue(AR) are constant and equal to price(P).



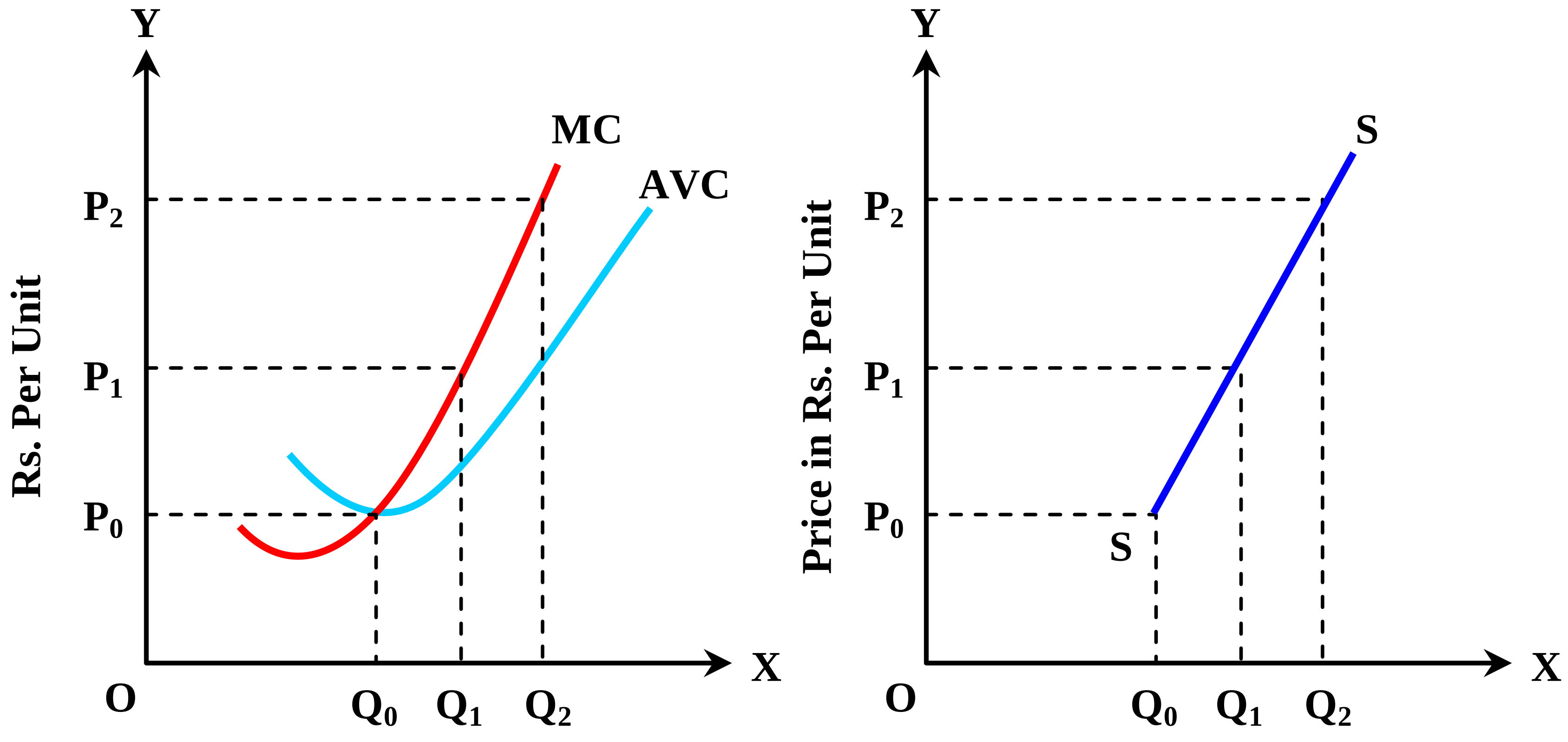


Thus the short run

Derivation of Short-run Supply Curve of a Firm and an Industry under Perfect Competition Contd.



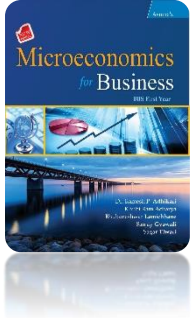
- If we vary the price (but, P > AVC), we get different level of output.
- The rising portion of firm's MC curve above the AVC curve gives the short run supply curve of the competitive firm.



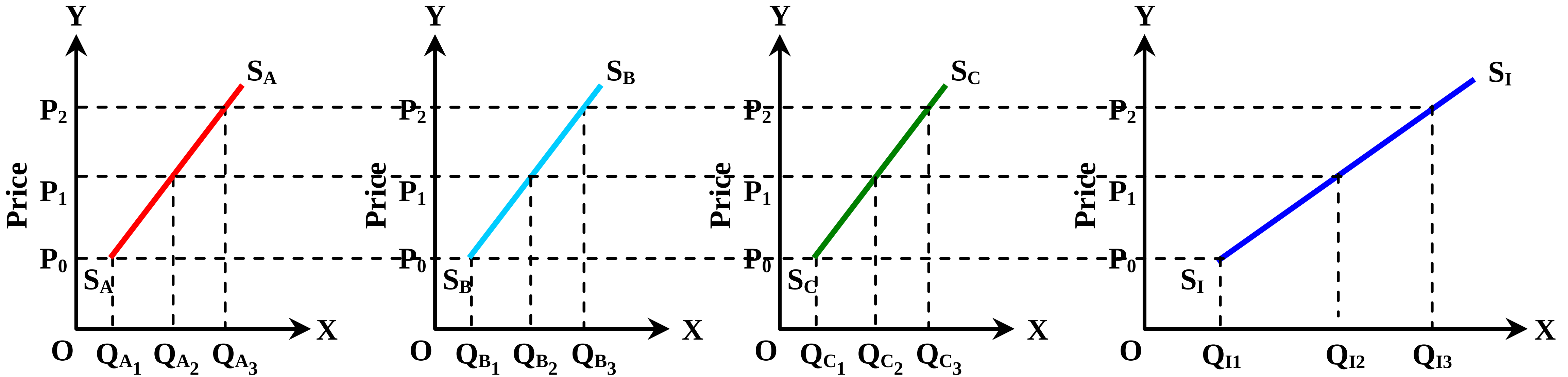
Panel (a): MC and AVC Curves

Panel (b): Supply Curve

Derivation of Short Run Supply Curve of an Industry



- An industry, under perfect competition, can be defined as the group of firms producing homogeneous product.
- The short run supply curve of an industry is normally upward sloping and shows the positive relationship between price and quantity supplied by the industry.



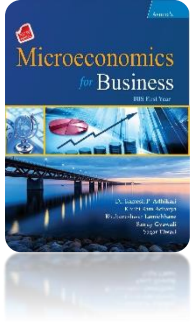
Panel (a): Supply curve of firm A

Panel (b): Supply curve of firm B

Panel (c): Supply curve of firm C

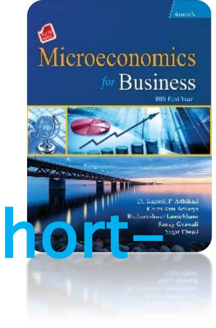
Panel (d): Supply curve of Industry

Price and Output Determination under Monopoly



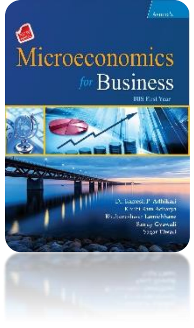
- The demand curve facing the monopolist is the market demand curve which is downward sloping.
- The average revenue curve coincides with the demand curve.
- Because the average revenue curve slopes downward, the MR curve also slopes downward and passes from the below of average revenue curve because the monopolist charges a single price on all the units sold, MR is less than price.

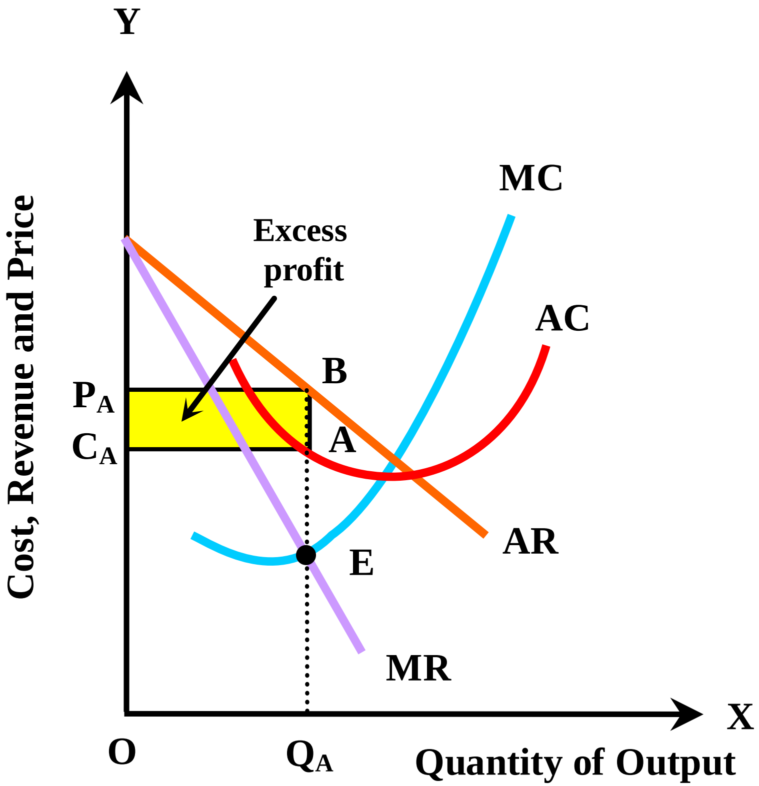
Price and Output Determination under Monopoly Contd.



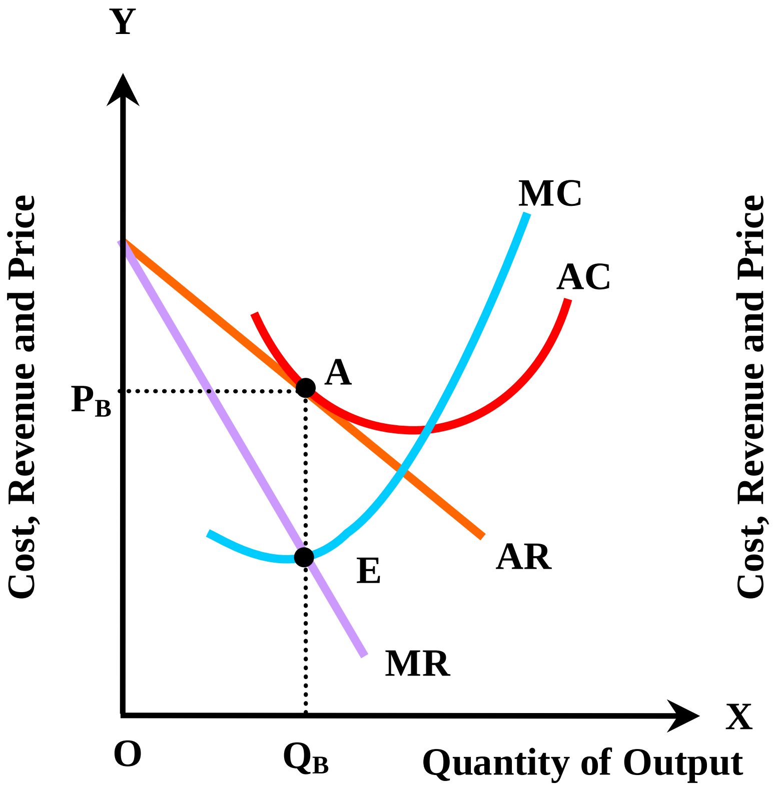
1. Price and output determination under monopoly in the short-run (Short-run equilibrium)

- Short-run refers to that period of time in which the monopolist cannot change the fixed factors like plant and machinery.
- However, the monopolist is free in making price decision due to the entry of new firms blocked and having no close substitutes of its products.
- It means that the monopolist sets the price of the product.
- The monopolist maximizes profit or attains equilibrium by selecting the output at the point where, MR = MC and MC curve is rising.
- The monopolist can charge the highest price that s/he can get for this output, according to the demand curve. But the equilibrium output does not imply that the monopolist can earn profit.
- The profit or loss situation depends on the cost structure of the firm.
- Thus, the short-run equilibrium of monopolist requires:
  1. Marginal revenue must be equal to marginal cost, i.e. MR = MC.
  2. MC curve must intersect MR curve from below.

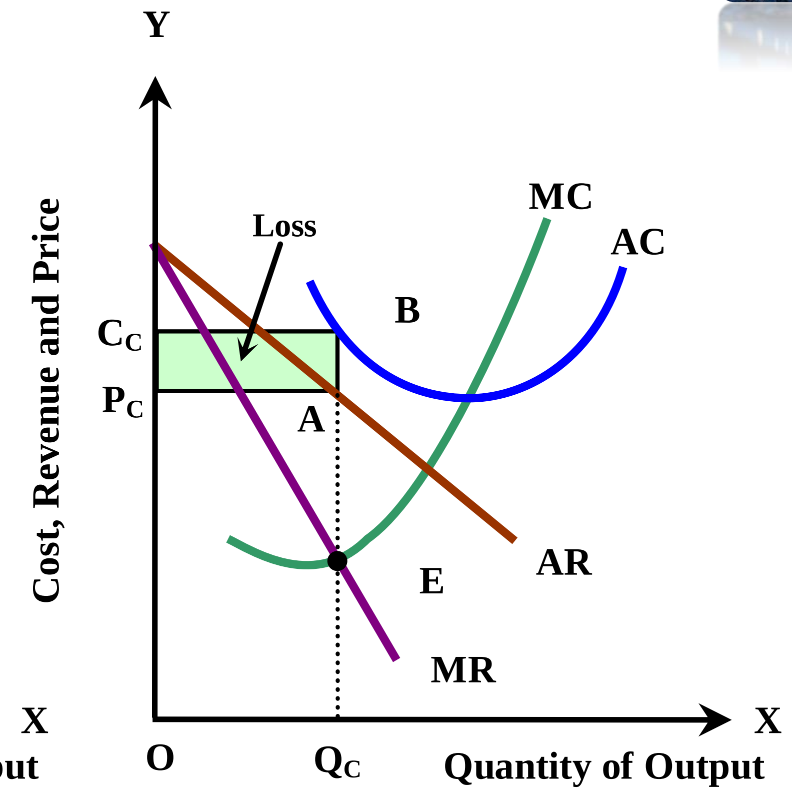




Panel (a): Short-run Equilibrium of a firm with Excess Profit

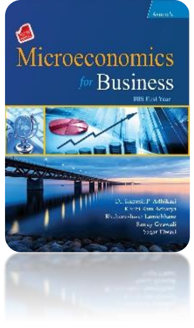


Panel (b Short-run Equilibrium of a firm with Normal Profit



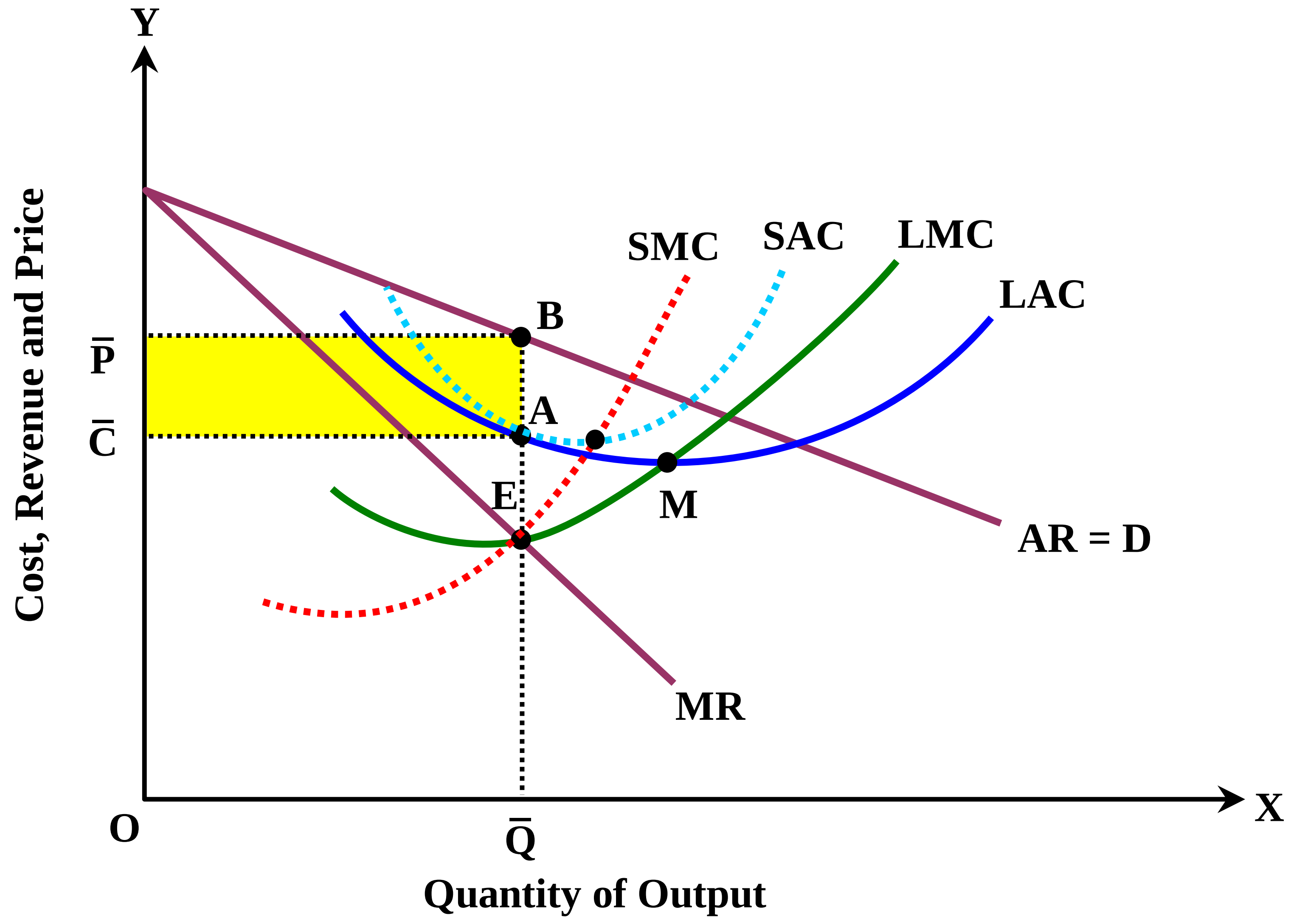
Panel (c): Short-run Equilibrium of a firm with Loss

Price and Output Determination under Monopoly Contd.



2. Price and output determination under monopoly in the long-run (Long-run Equilibrium)

- Long-run is a period of time in which a monopoly firm can rearrange its production techniques and size of production plant.
- Under the monopoly, as the entry of new firms blocked and there are no any close substitutes of the product, the firm will remain in the business if there is no loss in the long-run.
- The long-run equilibrium requires the following conditions:
  1. MR = LMC
  2. LMC curve must intersect MR curve from below.


Y
Cost, Revenue and Price
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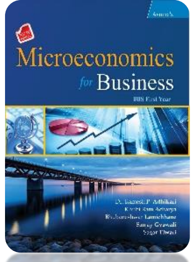
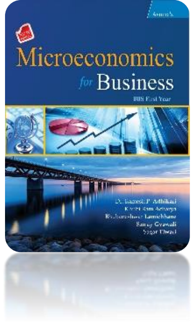
Quantity of Output


Microeconomics
for Business



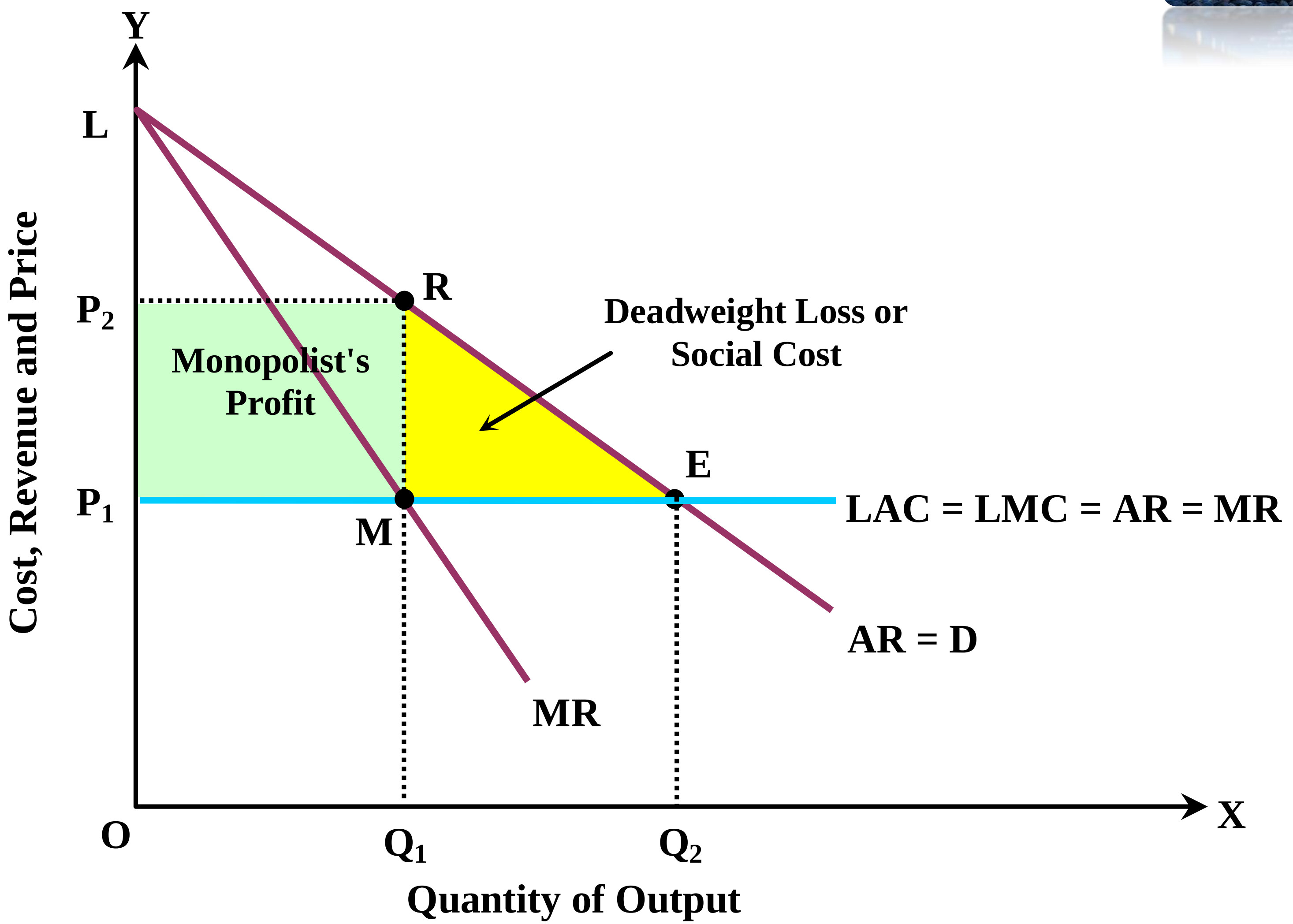
Economic Effects of Monopoly

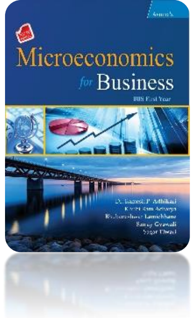
1. Adverse or negative economic effects of monopoly
    a. Allocative inefficiency
    b. Productive inefficiency
    c. Loss of social welfare and dead-weight loss
    d. Contributes income inequality
    e. Lacks to improve product/Reduce innovation
    f. Cost inefficiencies
2. Positive economic effect of monopoly
    a. Promotes innovation
    b. Benefit from the economies of scale

Economic Effects of Monopoly

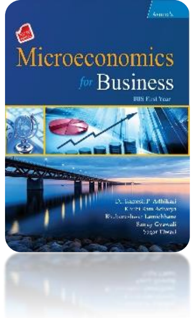
c. **Loss of social welfare and dead-weight loss**

For the illustration of the loss of social welfare and dead-weight loss we assume a constant cost industry. The long run cost conditions of the both perfectly competitive firm and monopolist are same and shown by LAC = LMC curves. The revenue conditions of both the firms are different and shown by AR and MR curves. Here, illustration is made based on the long-run because long-run equilibrium is stable





Price and Output Determination under Monopolistic Competition

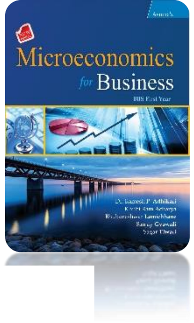


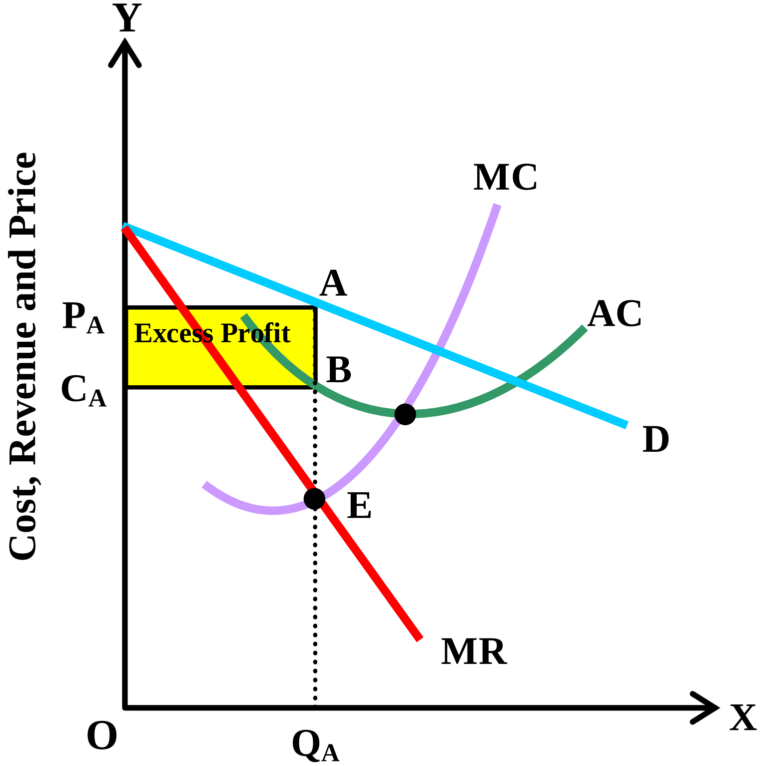
1. Price and output determination under monopolistic competition in the short-run (Short-run equilibrium)

- The demand curve of the firm under the monopolistic competition is negatively sloped and highly price elastic as compared to that of the monopoly firm.
- As the demand curve of the firm is negatively sloped, the corresponding marginal cost curve is also negatively sloped.
- The short-run equilibrium of monopolistically competitive firm requires:

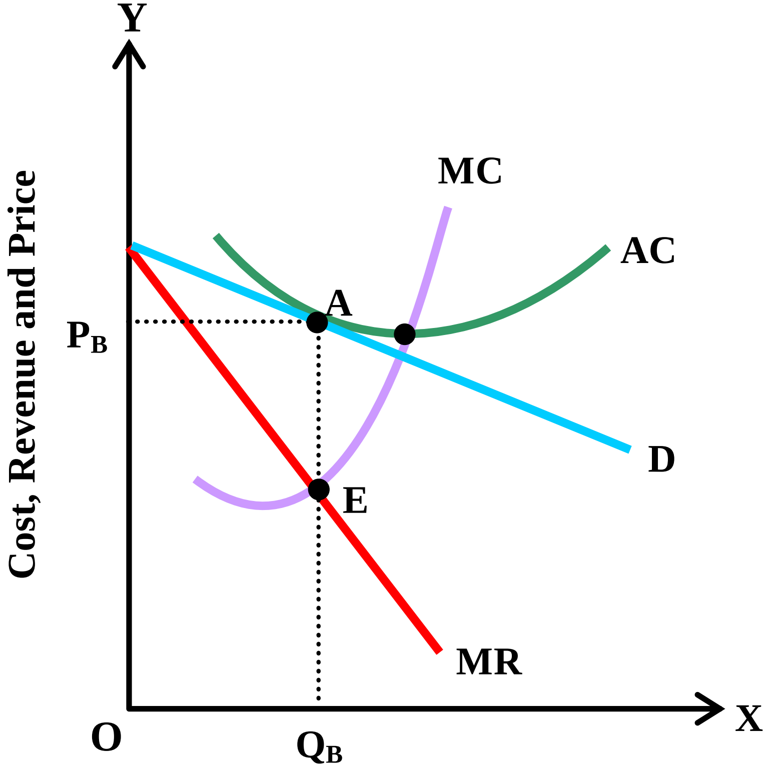
1. Marginal revenue must be equal to marginal cost, i.e. MR = MC.
2. MC curve must intersect MR curve from below.

- At equilibrium, the monopolistically competitive firm may earn excess profit or normal profit or even bear loss (as long as P ≥

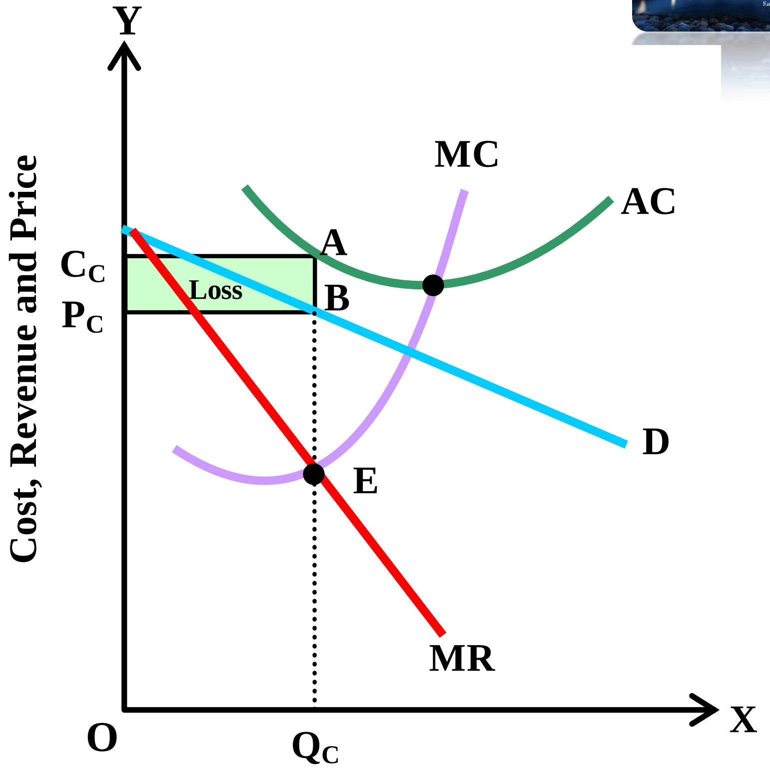




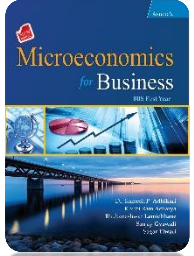
Quantity of Output
Panel (a): Short-run Equilibrium
of a firm with Excess Profit



Quantity of Output
Panel (b): Short-run Equilibrium
of a firm with Normal Profit



Quantity of Output
Panel (c): Short-run Equilibrium
of a firm with Loss

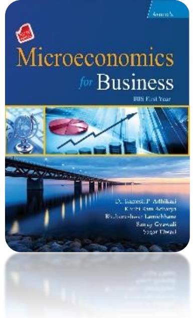


Price and Output Determination under Monopolistic Competition Contd.

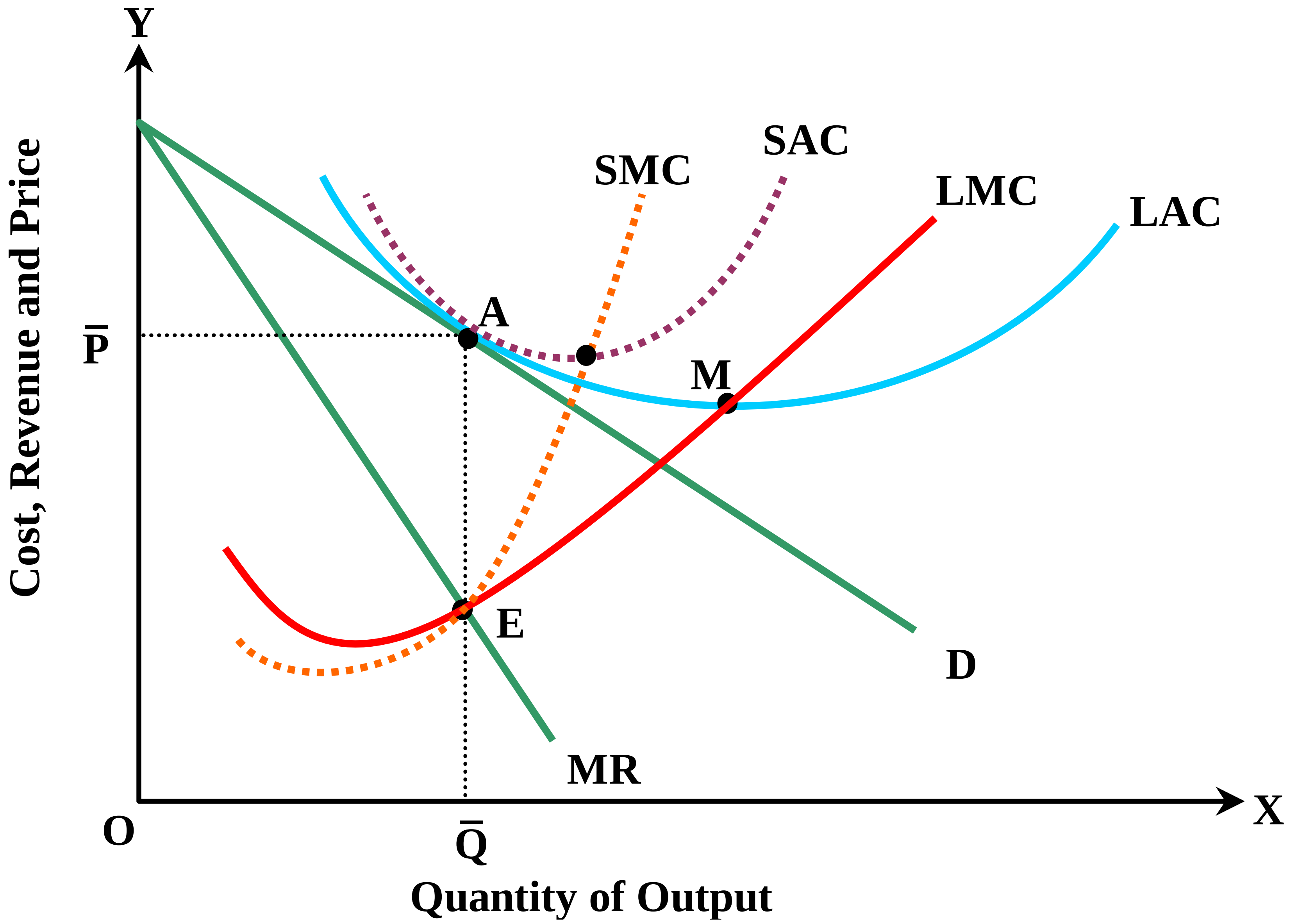
2. Price and output determination under monopolistic competition in the long-run (Long-run equilibrium)

- In the monopolistic competition market, group of firms producing differentiated but closely substitutable goods is called 'production group' or simply 'group' but not 'industry' as in the perfect competition.
- In the monopolistic competition market, there is free entry into and exit from the 'production group’.
- So, if the existing firms in the production group are earning excess profit in short-run, other new firms will enter into the 'production group' in the long-run.
- As new firms enter into the 'production group', the price of the product falls due to the increase in supply.
- The average cost of production also increases due to increase in price of factors of production.

Price and Output Determination under Monopolistic Competition Contd.



- The cause of increase in prices of factors of production is the increased demand of factors of production due to the increase in number of firms.
- The fall in price of the product and increase in average cost of production reduces profit margin. Consequently, excess profit disappears.
- Similarly, if the existing firms are bearing losses in the short-run, they will leave the 'production group' in the long-run.
- Exit of the firms from the group will increase the price of the product as well as decrease the average cost of production.
- Hence, the existing firms will earn just normal profit in the long-run.
- The long-run equilibrium of monopolistically competitive firm requires: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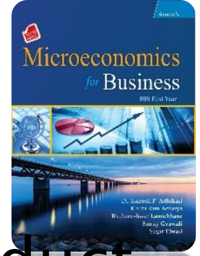
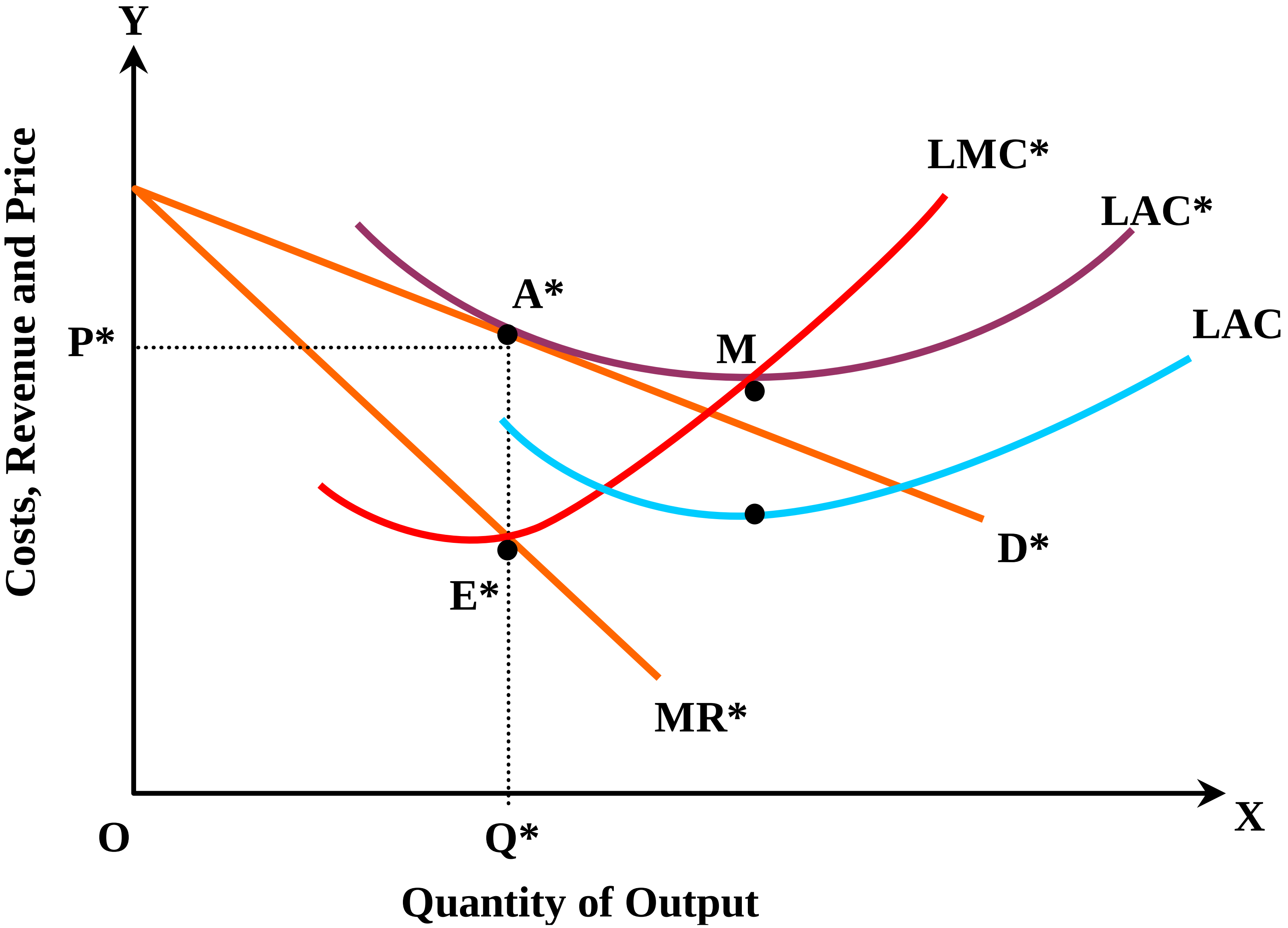
Quantity of Output

Monopolistic Firm's Equilibrium under Product Variation and Selling Expenses



- A monopolistically competitive firm can spend more on product variation and selling efforts to increase the demand for its product and make it less price elastic.
- The competition based on the advertising and product differentiation rather than on price is known as non-price competition.
- Product variation refers to changes in some of the characteristics of product that a monopolistically competitive firm undertakes in order to make its product more attractive to the consumers.
- Selling expenses refers to all those expenses that the firm incurs to advertise the product, increase its sales force, provide better service for its product and so on.
- Product variation and selling expenses can increase the firm's sales and profits, but they also lead to additional costs.
- A firm should spend more on product variation and selling effort as long as the MR from these efforts exceeds the LMC and until MR = LMC.
- A monopolistically competitive firm can increase profit in the short-run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Costs, Revenue and Price
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MR*
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Q*
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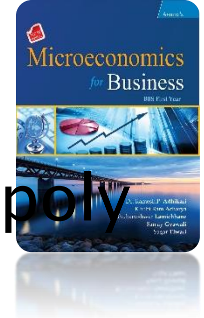
Quantity of Output

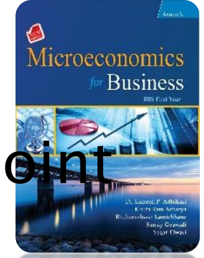
Cartels



- Cartel is defined as the formal organization of the collusive oligopoly firms in an industry with a purpose.
- Under cartels, the firms make agreement relating to price, market area and output levels.
- The main aim of the cartel is to reduce uncertainty arising from the mutual interdependence.
- In other words, a general purpose of cartels is to centralize certain managerial decisions and functions of individual firms in the industry with a view to promote common benefits.
- The cartel may be in the form of open or secret collusion.
- Whether the open or secret collusion, cartel agreements are explicit and formal.
- Therefore, cartels are regarded as the perfect form of collusion.
- There are mainly two types of cartels based on performing functions for its members, which are as follows:

   1. Cartels fixing price for Joint Profit Maximization (Joint Profit Maximization cartel or perfect cartel)

Pricing under Joint Profit Maximization Cartel



- The main objective of the joint profit maximizing cartel is to maximize joint profit of the firms under the industry.
- This model is analyzed under the pure oligopoly.
- Pure oligopoly means the market situation where firms produce homogeneous products.
- To maximize the joint profit, firms appoint a central agency which has authority to determine common price, industry output, production level of each member firms, distribute total profit of the industry among the member firms, etc.
- The joint profit maximization is possible when each individual firm can maximize profit.
- Thus, the conditions for joint profit maximization of a cartel (with two member firms A and B) can be expressed as

i. $MC_A = MC_B = MR$

where

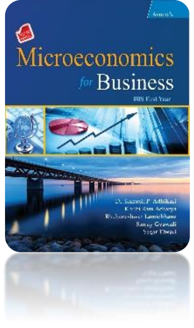
MC_A = Marginal cost of firm A

MC_B = Marginal cost of firm B

MR = Marginal revenue of industry

ii. ΣMC curve must cut MR curve from below.

where

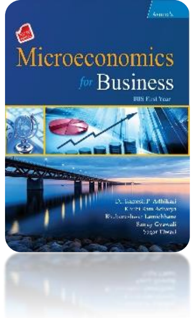


Pricing under Joint Profit Maximization Cartel Contd.

Assumptions

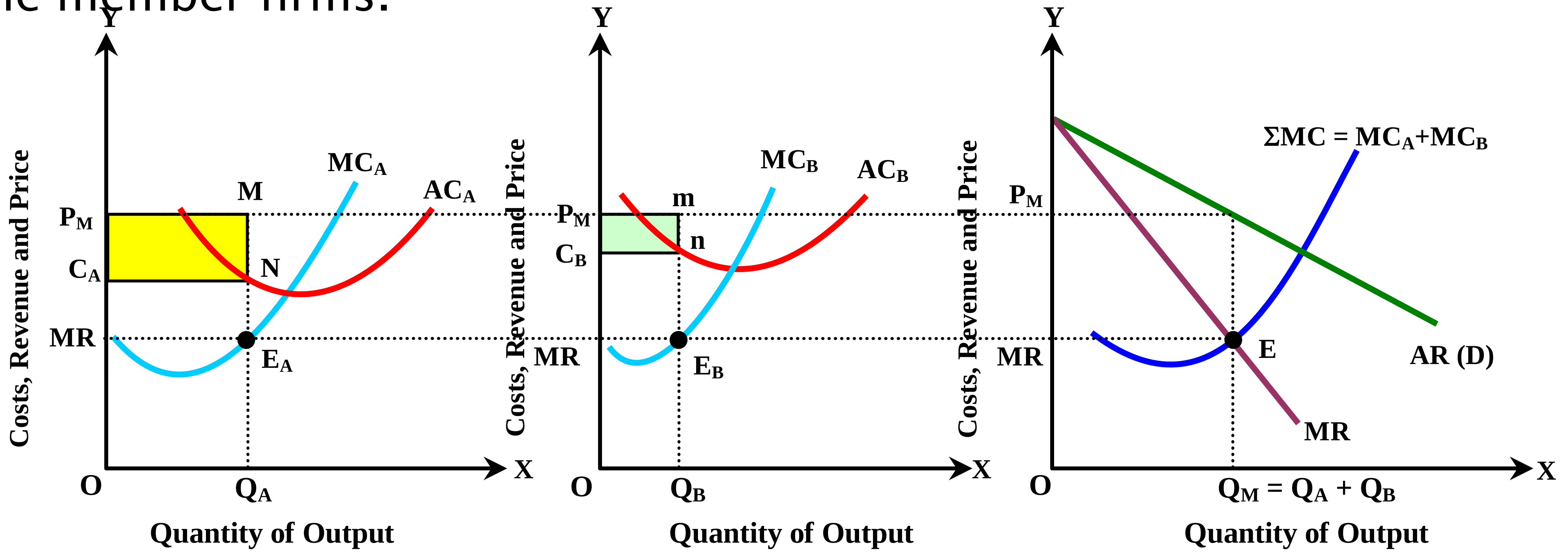
The analysis of joint profit maximization model of a cartel is based on the following assumptions:

- There are only two firms (A and B) in the oligopolistic industry and that form cartel.
- Both firms produce homogeneous products.
- The cost curves of each firm are different and known to the central agency (cartel). The firm A produces at lower cost than the firm B.
- The market demand curve of the product is given and known to the cartel.
- The number of buyers of the product is large.
- The cartel aims at joint profit maximization



Pricing under Joint Profit Maximization Cartel Contd.

The member firms appoint a central agency (cartel) and delegate different authorities such as determination of common prices, total industry output and distribution of total profit of the industry among the member firms.

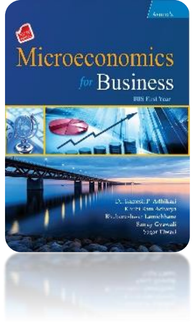


Panel (a): Equilibrium of Firm A

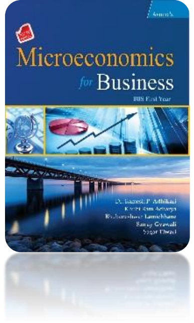
Panel (b): Equilibrium of Firm B

Panel (c): Equilibrium of Industry

Market Sharing Cartels



- This is another type of cartel in collusive oligopoly market.
- In a market sharing cartel, the member firms agree only how to share the market.
- In other words, the firms agree to share the market but keep a considerable degree of freedom concerning the style of their products, selling activities and other decisions.
- There are mainly two method of market sharing which are also called the types of market sharing cartel. They are:
  1. Non-price competition agreements
  2. Sharing of market agreements on Quota System



Market Sharing Cartels Contd.

1. **Non-Price Competition Agreements**

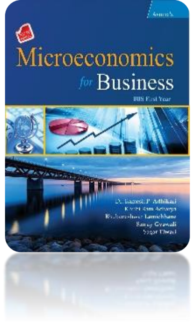
   Non-price competition is a type of market sharing cartel, in which member firms agree on common price and each firm is allowed to sell as much as it can sell at the cartel price.

2. **Sharing of Market Agreements on Quota System**

   Sharing of Market Agreements on Quota System is another method of market sharing cartel.

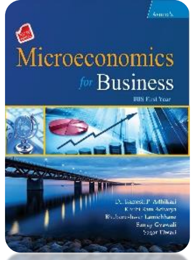
   Under this system, the cartel fixes quota of market share for each firm.

Pricing Practices



- In a complex business world, business firms follow a variety of pricing rules and methods depending on the conditions faced.
- It also depends upon objective of the firm.
- In this part of the unit, we will discuss some important pricing strategies and practices such as price discrimination, cost plus pricing, incremental cost pricing, administered pricing, export pricing, predatory pricing, skimming pricing and penetration pricing.

Price Discrimination

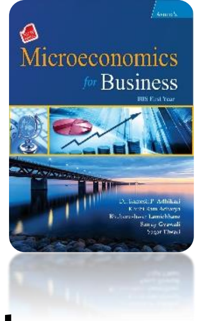


- Price discrimination refers to selling same product at different prices to different customers or in different markets.
- Price discrimination is possible only in the monopoly because even though different buyers would know that they are differently charged, they have no alternative source of buying the product.
- The monopoly firm which adopts the policy of price discrimination is called discriminating monopoly.
- The main objective price discrimination is to maximize profit.

Condition for Price Discrimination

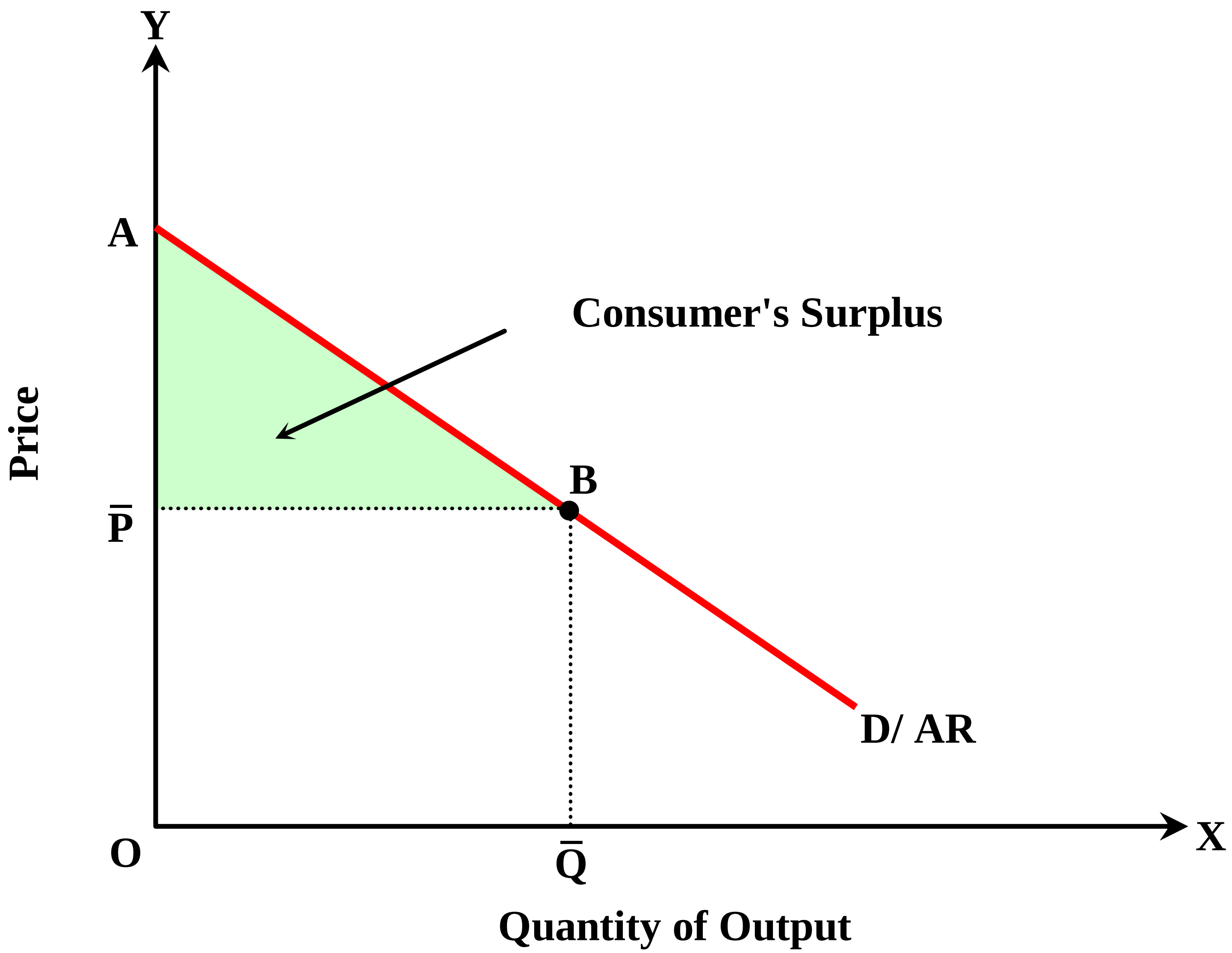
1. Monopoly power
2. Market must be divided into difference sub-markets
3. Different price elasticity of demand in different sub-markets
4. Reselling of the product must not be possible

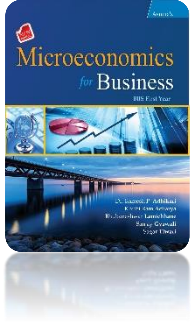
Types/ Degrees of Price Discrimination



1. First Degree Price Discrimination

- In the first degree price discrimination, seller or monopolist charges highest price for each unit of a product that each consumer willing to pay rather than go without it.
- In other words, the monopolist charges each individual consumer the maximum price that the consumer is willing to pay, i.e. reservation price.
- Thus, first degree price discrimination can be defined as the situation in which monopolist sells each unit of output at different prices.
- In this case of price discrimination, consumer's surplus is totally taken away by monopolist or the monopolist obtains maximum possible revenue from each consumer.
- Therefore, this type of price discrimination is also known as the perfect price discrimination.
- In this case, market demand curve coincides with marginal revenue curve.


Y
A
Consumer's Surplus
Price
B
P̄
D/ AR
O
Q̄
X
Quantity of Output



Types/ Degrees of Price Discrimination Contd.

2. Second Degree Price Discrimination

In the second degree price discrimination, different prices are charged for different quantity purchased.

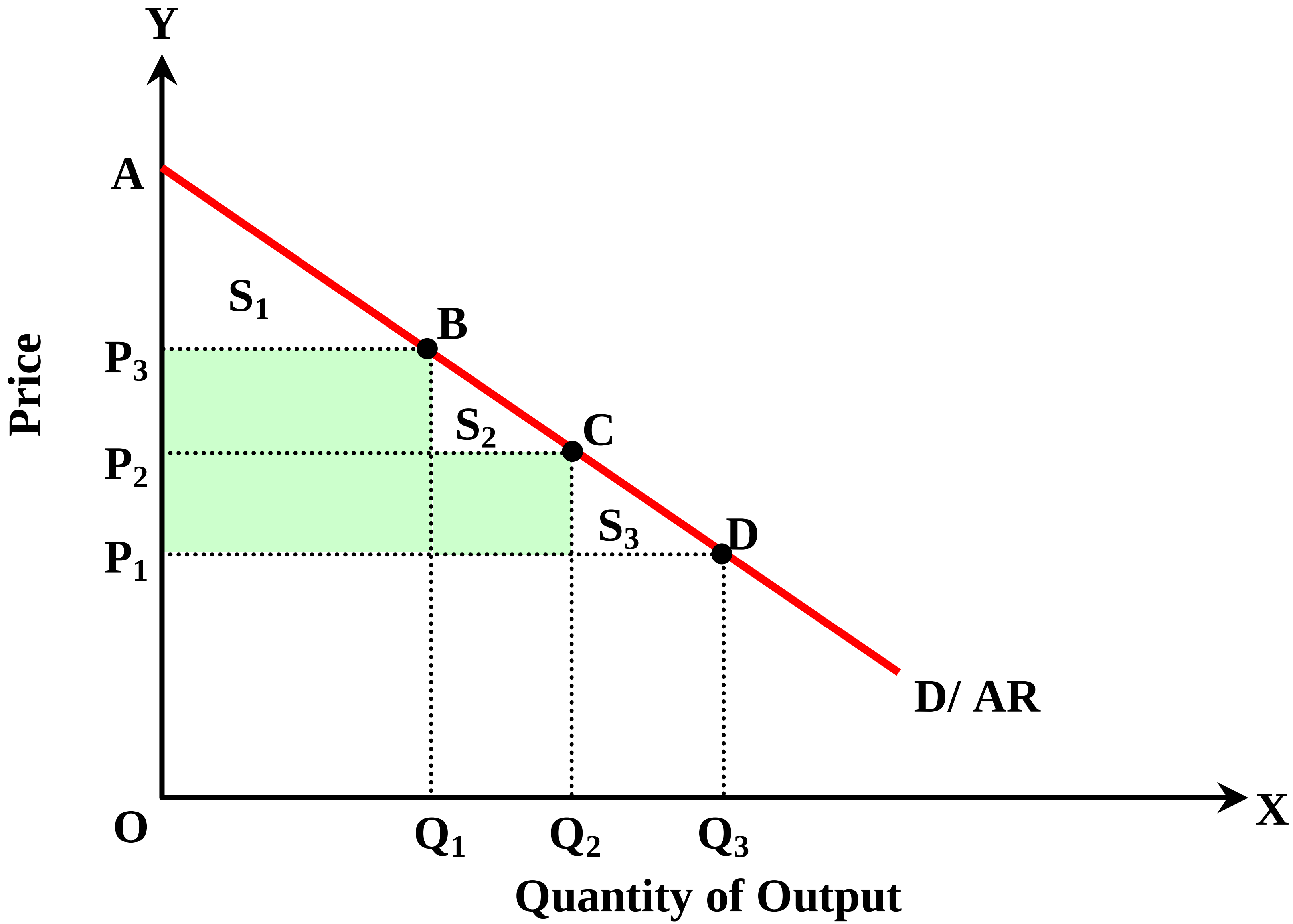
In other words, the second degree price discrimination is defined as the situation in which the monopolist charges different prices based on how much one buys.

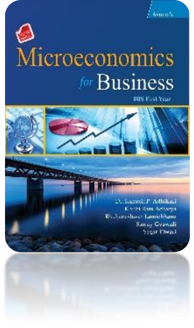
Thus, in the case of second degree price discrimination, the monopolist charges a lower price for each additional batch or block of the commodity.

Such type of price discrimination is common in case of public utilities like telephone and electricity.

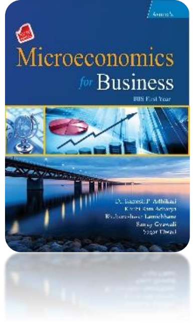
In these public utilities, the price for the first hundred units may differ from the price of second hundred units and so on.

By doing so, the monopolist captures some part of consumer's surplus but not as in the case of first degree price discrimination.


Y
A
S1
B
P3
Price
S2
C
P2
S3
D
P1
D/ AR
O
Q1
Q2
Q3
X
Quantity of Output

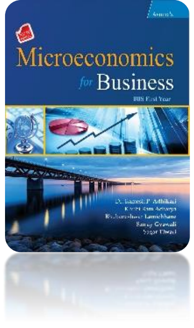

Microeconomics
for Business

Types/ Degrees of Price Discrimination Contd.



3. Third Degree Price Discrimination

- The profit maximizing monopoly firm sets different prices in different markets each having different elasticity of demand of the product. In this case, monopolist charges different prices for the same commodity in the different sub-markets.
- The examples of third degree price discrimination are: different prices for students and common people in bus, aeroplanes, and train tickets; Coca-Cola company charging different prices to the consumers of Kathmandu valley and out of the Kathmandu valley in Nepal, etc.
- The aim of the third degree price discrimination is to increase total revenue and profit.
- Under third degree price discrimination, the monopolist charges a higher price for a product in the market with less elastic demand in such a way as to equalize the MR of the last unit of the product sold in the two markets.



Types/ Degrees of Price Discrimination Contd.

In order to maximize profit by the price discriminating monopolist with two sub-markets, the following conditions must be fulfilled:

i. The marginal revenues in two submarkets should be equal, i.e.

$\mathbf{MR_A = MR_B}$

where

MR_A = Marginal revenue of the market A

MR_B = Marginal revenue of the market B

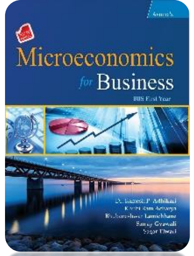
ii. The marginal revenue received from each market should be equal to marginal cost (MC) of the monopolist, i.e.

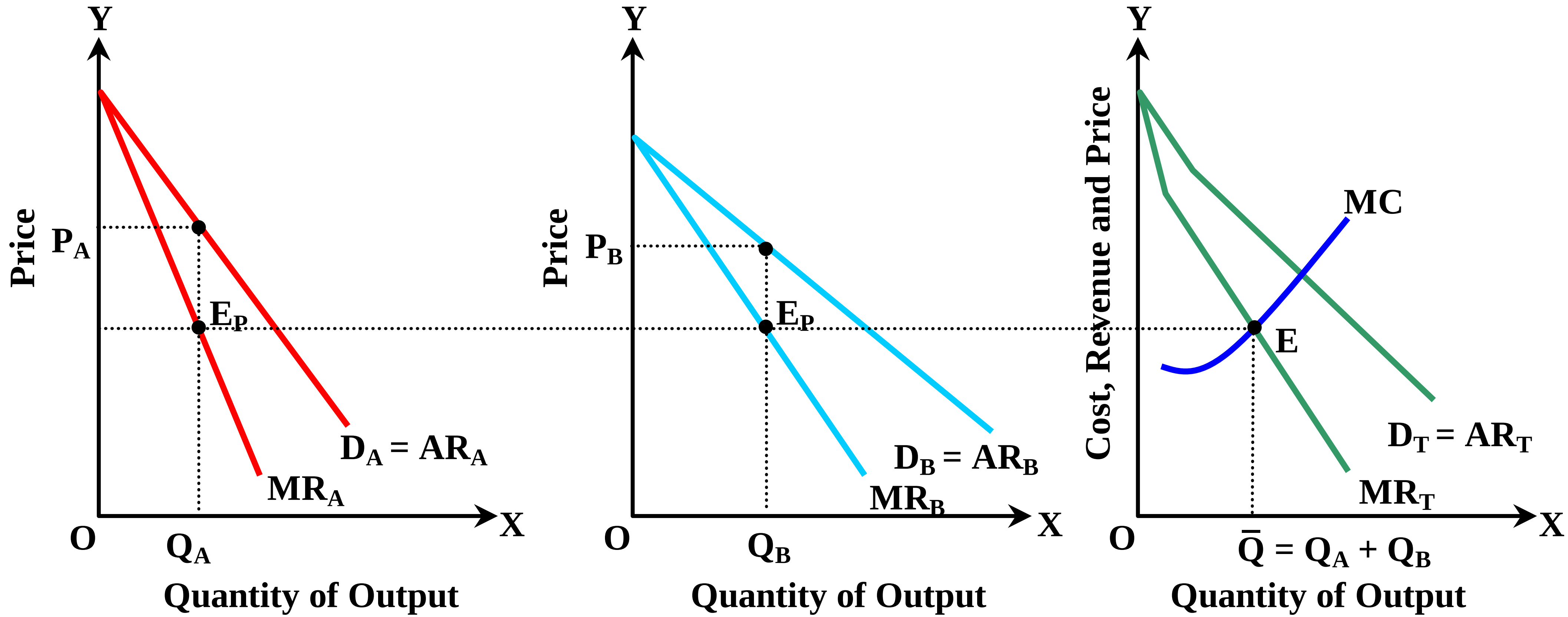
$\mathbf{MR_A = MR_B = MC}$

or, $\mathbf{MR_A = MC}$

or, $\mathbf{MR_B = MC}$

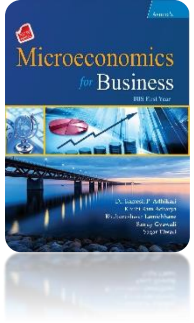
iii. The monopolist's MC curve must cut the MR_T curve from below.





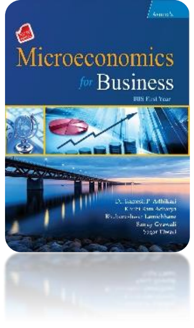
Panel (a):	Panel (b):	Panel (c):
Sub-market A	Sub-market B	Whole Market

Cost Plus Pricing



- According to traditional theory, the price of a product is determined with the help of the MR-MC approach.
- But this approach is not practical because it is very difficult to find out data on marginal cost and marginal revenue.
- Therefore, most of the firms fix prices without considering MR and MC concepts.
- The most popular and short cut method of pricing is the cost-plus pricing method.
- This method is also called **mark-up pricing** or **full cost pricing** or **average cost pricing**.
- In this method, the price of the product is determined by adding a fixed mark-up on average variable cost.
- The mark-up is set sufficiently high to cover average variable and fixed costs and also provide a profit margin for the firm.
- The mark-up varies depending on the industry and demand conditions. Mark-up means the percentage of profit based on cost.
- The general practice under this method is to add a fair percentage

Cost Plus Pricing Contd.



The formula for setting the price is given by

$$P = AVC + AVC(m) \quad \ldots(i)$$

where

AVC = Average variable cost

m = Mark-up percentage

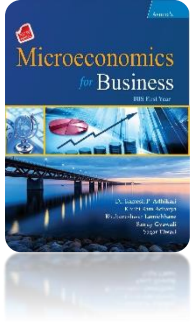
AVC(m) = Gross profit margin(GPM)

P = Price

The mark-up percentage (m) is fixed to cover the average fixed cost (AFC) and a net profit margin(NPV). Thus,

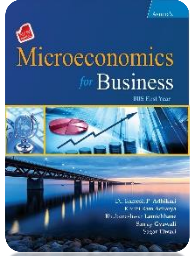
$$AVC\,(m) = AFC + NP \quad \ldots(ii)$$

Incremental Cost Pricing

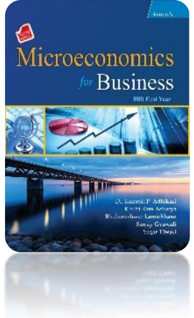


- It is a method of pricing a product based on incremental cost.
- Incremental cost refers to the total additional cost associated with the decisions to expand the output or add a new plant to the existing capacity, add a new variety of products to the product line, etc.
- In this method, the price of all additional units produced after all direct and indirect fixed costs of production have been met, are based on variable costs rather than the total cost incurred in production.
- This method is different from the regular pricing method.
- In the regular pricing method, the selling price of each product includes per-unit fixed cost, per unit variable cost and profit margin.
- But in the incremental cost pricing method, the selling price of the product is based on the per-unit variable cost and profit margin only.

Administered Pricing



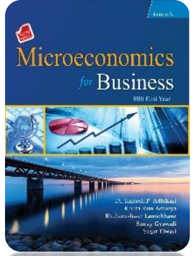
- The pricing strategy in which the price of a product is established by the conscious decision of some individual or agency rather than by the market forces of demand and supply is called administered pricing.
- The independent agency may be the government or the management of a firm having considerable market share or monopoly in the market.
- Administered pricing is generally possible where good is sold by a monopoly firm or public body.
- Administered prices are generally above or below the equilibrium prices.
- These prices are also called controlled prices i.e price ceiling or price floor often set by the government.
- A price ceiling is a maximum price that can be charged for a product, e.g. setting a price ceiling for house rent.
- Similarly, the price floor is the minimum price that can be charged for a product, e.g. setting a price floor as minimum wages of labour



Export Pricing

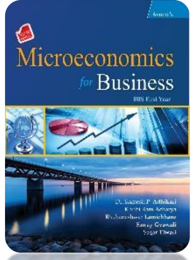
- Export pricing is a method of fixing the price of products which the exporter intends to export and sell in the international markets.
- Export pricing is a much more difficult task than domestic pricing.
- The exporter must take into account the cost of production as well as the conditions prevailing in the international market that influences the price of the product.
- Hence, export pricing is not only a calculation of the cost of production but also a practical exercise based on the international market situation.
- There are additional costs that are incurred and need to be incorporated when setting export prices.
- These costs are given below:
  1. Costs before Exporting
  2. Costs at Country of Destination
  3. Costs related to the Marketing or Selling Structure in Target Country
- The marginal cost pricing of export goods is determined as

Predatory Pricing

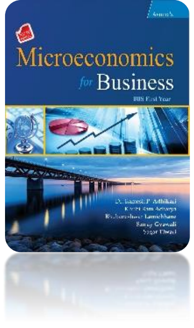


- It is the deliberate pricing strategy of a business firm in which the price of a product or service is charged at very low (or $P<AC$ or even $P< AVC$).
- The predator (dominant seller) sets a very low price with the aim of attracting new customers or driving competitors out of the market or create barriers to entry for potential new competitors so that the predator can charge considerably higher price later.
- The predator is willing to sell at a loss for a period in the hope that its rivals either go bust or decide to stop selling that product.
- The predatory pricing strategy kicks out competitors and increases the monopoly power and profits of the firm.
- But it will be bad for the consumers because it will lead to abnormally high prices in the long term as well as a lack of choice.
- Dumping (exporting goods at a lower price than the domestic price or cost of production) is an example of predatory pricing.

Skim Pricing



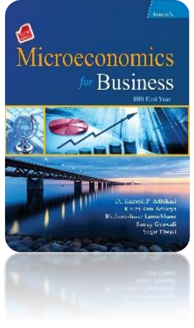
- The skim pricing, also known as price skimming is a product pricing strategy by which a firm charges the highest initial price for a product or service that customers will pay.
- As the demand of the first customers is satisfied, the firm lowers the price to attract another, more price-sensitive segment or layer of the consumers.
- The objective of a price skimming strategy is to capture the consumer surplus and earn maximum revenue or profit in the shortest time possible rather than maximum sales.
- This model encourages the entry of competitors.
- When other firms see the high margin available in the industry, they will quickly enter.
- Price skimming can be considered as a form of price discrimination.



Penetration Pricing

- In contrast, to skim pricing, penetration pricing involves reverse strategy.
- It is a pricing strategy used by new entrants to enter into the market with new products for which substitutes are available, usually by setting a very low price.
- Pricing is one of the easiest ways to differentiate new entrants among existing producers or sellers in the market.
- An extreme form of penetration pricing is called predatory pricing.
- Penetration pricing strategy is used to capture the market share, create brand trustworthiness, switch customers from competitors, generate significant demand and utilize economies of scale and drive competitors out of the market.
- This pricing strategy effectively works in situations when there is little product differentiation, the demand for the product is price-

Numerical Examples 1



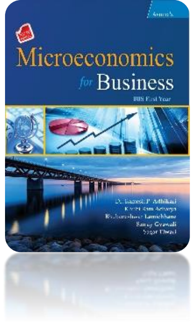
Consider the following table:

Price (Rs.) (P)	Quantity (Q)	Total Cost (TC)	Marginal Cost (MC)	Total Revenue (TR)	Marginal Revenue (MR)	Profit (π)
11	0	10				
10	1	12				
9	2	17				
8	3	21				
7	4	26				
6	5	33				
5	6	43				
4	7	60				
3	8	80				

a. Complete the above table.

b. Derive the TR curve, TC curve and profit (π) curve based on the completed table.

c. Identify the profit maximizing level of output and total profit at that level of output.



SOLUTION

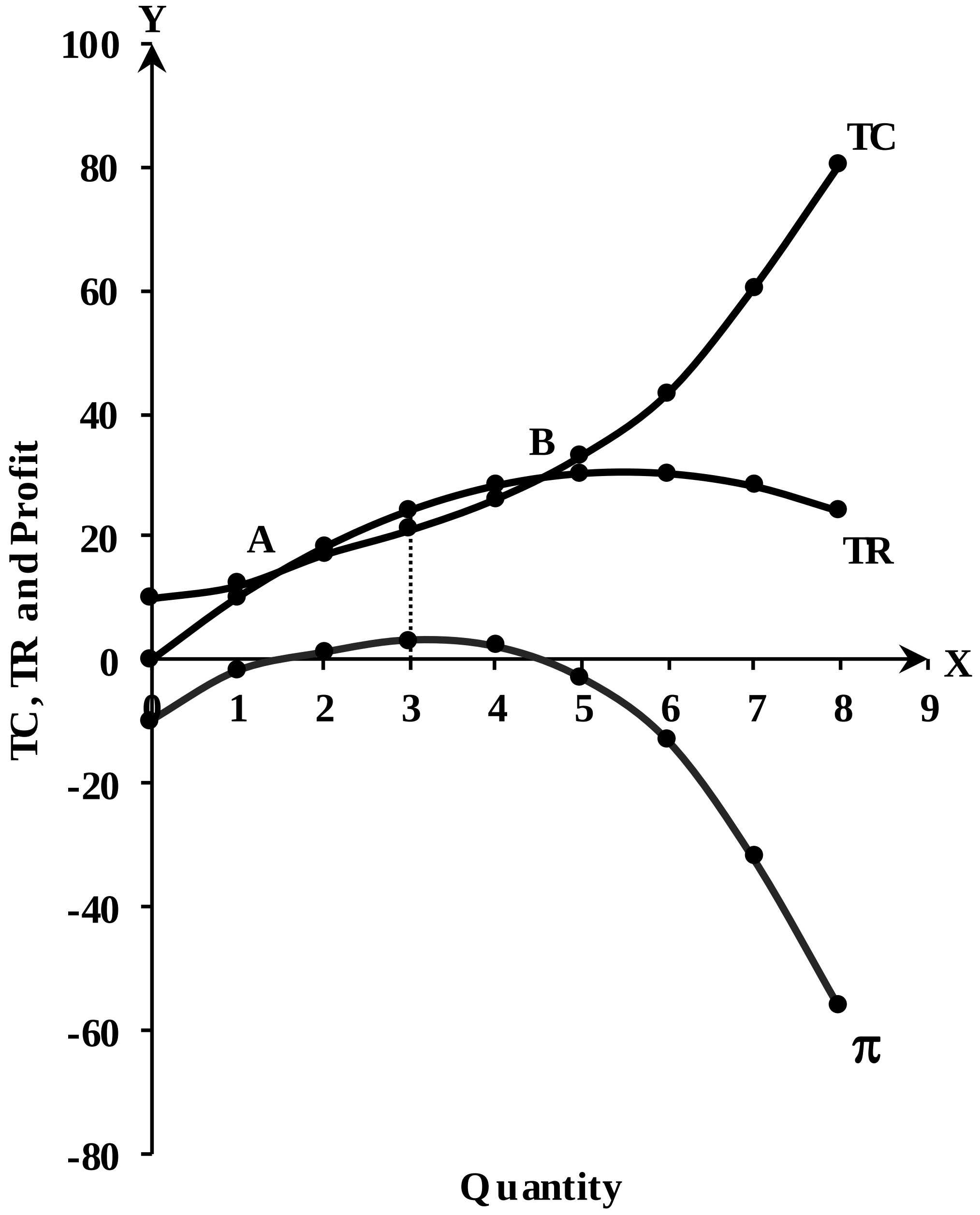
a.

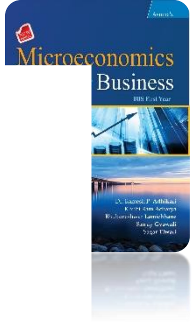
Price (Rs.)	Quantity	Total Cost	Marginal Cost	Total Revenue	Marginal Revenue	Profit = TR – TC
11	0	10	-	0	-	–10
10	1	12	2	10	10	– 2
9	2	17	5	18	8	1
8	3	21	4	24	6	3
7	4	26	5	28	4	2
6	5	33	7	30	2	– 3
5	6	43	10	30	0	– 13
4	7	60	17	28	-2	– 32
3	8	80	20	24	-4	– 56

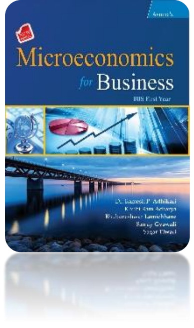
b.

c. Total profit = Rs. 3 and profit maximizing output level is 3 units.

d. This indicates imperfect competition (monopoly or monopolistic competition) because there is inverse relationship between price and quantity of output sold or both price and MR are falling.







Numerical Examples 2

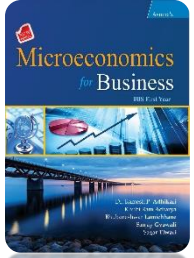
Consider the following table and solve the questions given below.

Output (Q)	0	1	2	3	4	5	6	7	8
Total Revenue (TR)	0	110	200	270	320	350	360	350	320
Total Cost (TC)	200	220	236	248	264	300	360	448	560
Profit (π)									

a. Complete the above table.

b. Graph TR, TC and profit (π) curves and explain the equilibrium condition using TR–TC approach.

c. Which market does it indicate and why?

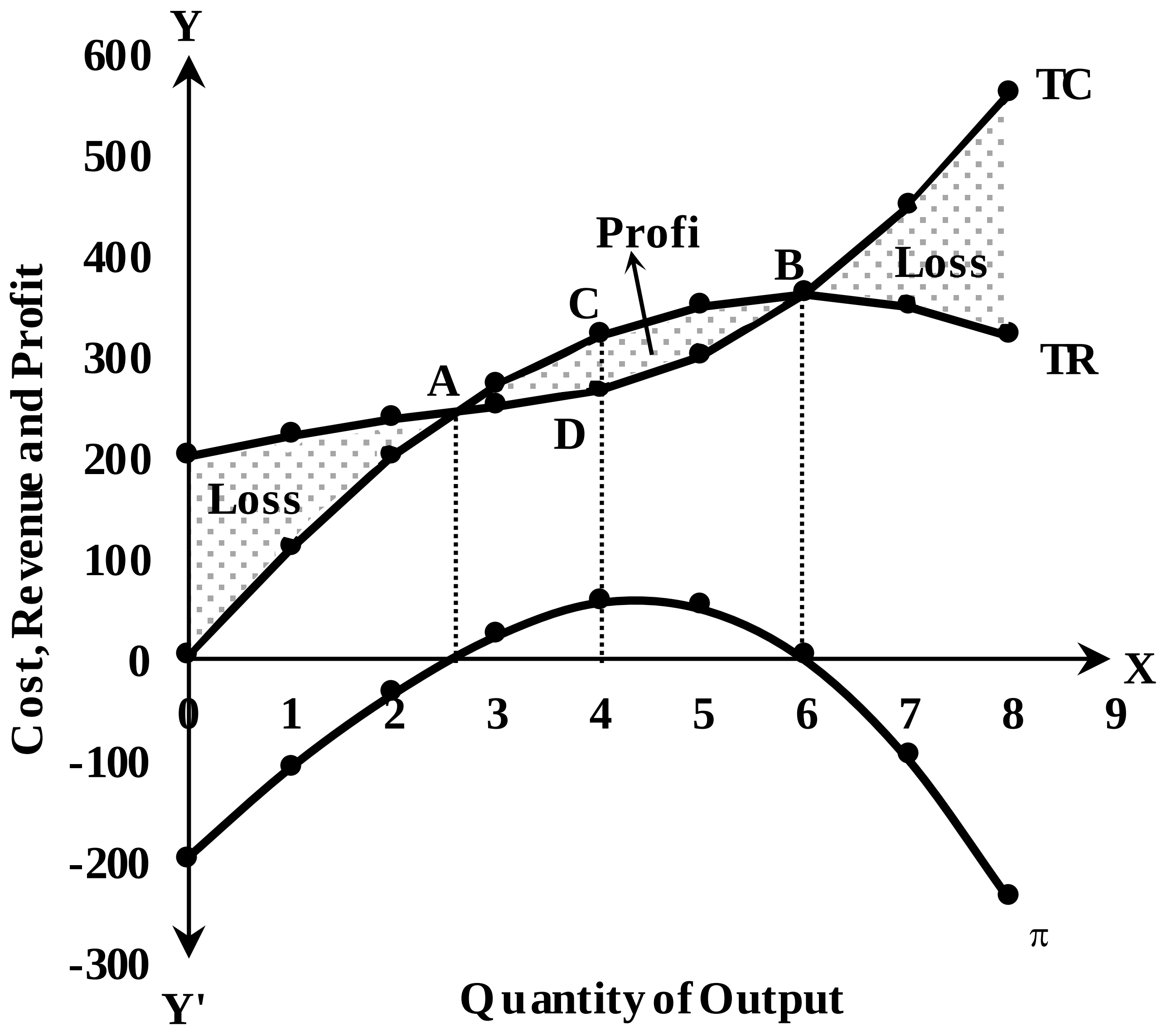


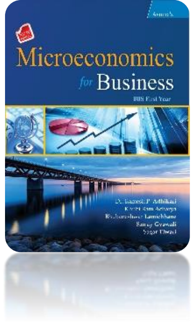
SOLUTION

a.

Output	TR	TC	Profit
0	0	200	-200
1	110	220	-110
2	200	236	-36
3	270	248	22
4	320	264	56
5	350	300	50
6	360	360	0
7	350	448	-98
8	320	560	-240

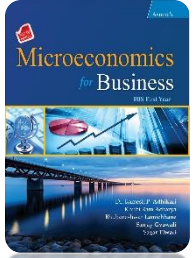
b.


Y
600
500
400
300
200
100
0
-100
-200
-300
Y'
Cost, Revenue and Profit
TC
TR
Profi
Loss
Loss
A
B
C
D
0 1 2 3 4 5 6 7 8 9
X
π
Quantity of Output



In the above figure, X-axis represents quantity of output and Y-axis represents total cost and total revenue and profit. The curves TC, TR and π represent total cost curve, total revenue curve and total profit curve respectively. These curves has been derived based on the completed table. Thus, TR and TC curves are intersecting each other at point A and B. At points A and B, TC and TR are equal. Therefore, these points are called break-even points. Before point A and beyond point B, TC > TR. Therefore, there is loss. Between point A and B, there is profit because TR > TC. At 4^{th} unit of output, there is maximum profit or maximum difference between TR and TC. Therefore, the firm is equilibrium at 4^{th} unit of output. At this level of output, the firm's total profit is equal to Rs. 56.

c. This shows or indicates imperfect competition (monopoly or monopolistic competition) because total revenue is increasing at the decreasing rate upto point B and their after it is failing.



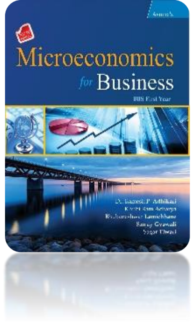
Numerical Examples 3

The total revenue and total cost functions of a perfectly competitive firm are given as:

$$TR = 10Q$$

$$TC = 100 + 2Q + 0.01Q^2$$

Determine level of output that maximizes profit and find the total profit at that level of output.



SOLUTION

We have,

$TR = 10Q$

$TC = 100 + 2Q + 0.01Q^2$

Here,

$$MR = \frac{d}{dQ}(TR) = \frac{d}{dQ}(10Q) = 10$$

$$MC = \frac{d}{dQ}(TC) = \frac{d}{dQ}(100 + 2Q + 0.01Q^2) = 2 + 0.02Q$$

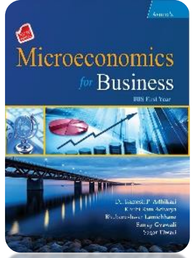
Condition for profit maximization

$MC = MR$

$2 + 0.02Q = 10$

or, $0.02Q = 8$

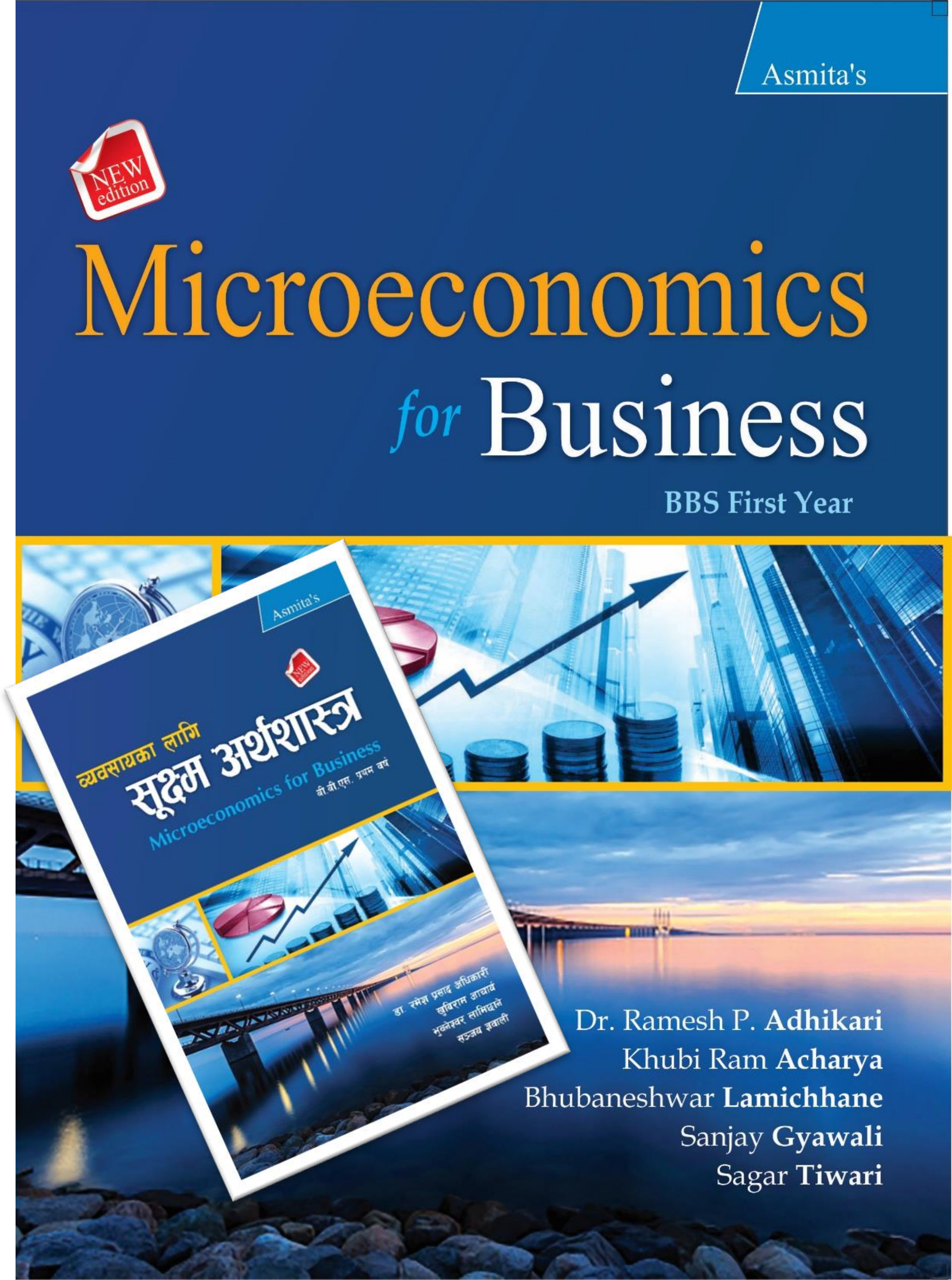
or, $Q = 400$ units



$$
\begin{aligned}
\text{Total profit } (\pi) &= TR - TC \\
&= 10Q - (100 + 2Q + 0.01Q^2) \\
&= 10Q - 100 - 2Q - 0.01Q^2 \\
&= -100 + 8Q - 0.01Q^2 \\
&= -100 + 8 \times 400 - 0.01 \times 400^2 \\
&= -100 + 3200 - 1600 \\
&= \text{Rs. } 1500
\end{aligned}
$$

Hence, total profit is maximized at $Q = 400$ units and total profit = Rs. 1500

Thank You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Sagar Tiwari