

Theory of Cost, Revenue and Firms

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For the production of goods and services, a firm must use the raw materials and other factor of productions which are called inputs and the expenditures made on such inputs are called cost.

Cost is defined as the money expenditure incurred in the production process.

The structure and size of the cost is essential whether to expand/increase or contract/decrease the output and also whether to leave and enter into the market.

Introduction to Cost

Concept of Costs

Costs are the monetary expenses incurred in the process of production of a commodity. Different inputs like land, labour, capital, etc. are used while producing output and the expenses incurred on these inputs are called cost of production. Expenditure on factors of production of goods and services and raw materials is known as cost. The followings are some of the basic concepts of costs.

Opportunity Cost

Opportunity cost refers to the loss of earnings due to opportunities foregone due to scarcity of resources.

Alternatively, opportunity cost refers to what an input could earn in its best alternative job.

For example: if a farmer produces paddy from his land and due to this paddy production his possible income from the wheat is forgone. In this case the possible income from the wheat is considered as opportunity cost. In the most cases, calculation of opportunity cost becomes difficult, but it has to be considered in the production

If resources were unlimited, there would be no need to forego any income-yielding opportunity and, therefore, there would be no opportunity cost.

Therefore, the opportunity cost may be defined as the expected returns from the second best use of the resources foregone due to the scarcity of resources. The opportunity cost it is also called alternative cost.

Explicit cost

Simply the out-of-pocket cost is known as explicit cost. In other words, all the monetary payments for the factors of productions which aren't owned by the firm are categorized in explicit cost. For example; wages for labors, rent for land, interest for capital, expenditure on raw materials etc. such costs are maintained in account book.

Implicit cost

Implicit cost is defined as the value of factor inputs that are owned and used by the firm owner himself/herself in the production process.

For example: If a medical doctors open a medical shop investing own capital and using own houses, he doesn't pay salaries to self and doesn't pay rent to self; but it has to be calculated. If he works in the hospital and if he provides his home to rent, he would generate revenue.

- In this context, implicit cost is similar to the opportunity cost. It must be taken into account while calculating economic profit.

Implicit cost

Implicit cost is defined as the value of factor inputs that are owned and used by the firm in the self production process.

For example: if a medical doctors open a medical shop investing own capital and using own houses, he doesn't pay salaries to self and doesn't pay rent to self; but it has to be calculated. If he works in the hospital and if he provides his home to rent, he would generate revenue.

In this context, implicit cost is similar to the opportunity cost. It must be taken into account while calculating economic profit.

Example: Tejaswini, a fashion designer working as a manager of a boutique for Nrs. 120,000 per year wants to start her own business by investing her own money Nrs. 400,000 on which she could earn 10% interest if deposited in a bank. Her estimated revenue during the first year of operation is Nrs. 300,000 and costs are Salaries to employee: Nrs. 90,000, Supplies: Nrs. 30,000, Rent: Nrs. 20,000 Utilities: Nrs. 2,000

a) What is business profit?

b) What is the economic profit?

c) If she seeks your advice on whether to stay on business or not, what would be your advice and why?

d) What would be your advice if she could earn only 2% interest on her own money if deposited in a bank?

a) Revenue		NRs. 3,00,000
• Less: Explicit Cost		
salaries to employees	NRs. 90,000	
Supplies	NRs. 30,000	
Rent	NRs. 20,000	
Utilities	NRs. 2,000	NRs. 1,42,000
Business Profit/Accounting Profit		NRs. 1,58,000
b) Business Profit/Accounting Profit		NRs. 1,58,000
Less: Implicit Cost/Opportunity Cost		
Salary	NRs. 1,20,000	
Interest of NRs. 4,00,000 @10%	NRs. 40,000	NRs. 1,60,000
Economic Profit		(-) NRs.2,000

c) On the basis of above calculation, the business isn't profitable because the economic profit is negative. It means the business couldn't cover the opportunity cost.

d)

Business Profit/Accounting Profit Less: Implicit Cost/Opportunity Cost

Salary NRs. 1,20,000

Interest of NRs. 4,00,000 @2% NRs. 8,000

NRs1,58,000

NRs1,28,000

Economic Profit

NRs.30,000

On the basis of above calculation, she should stay on her business because the economic profit is positive and equal to NRs. 30,000. It means the business is able to cover the opportunity cost if she stay in her business.

Accounting cost

- Accounting cost is defined as the cost that involves direct payment of money by entrepreneur to the various factors of production.
- Alternatively, accounting costs are recordable on book of account. The concept of accounting cost is similar as explicit cost.

Economic Cost

- The sum of explicit cost and implicit costs is popularly known as economic cost.

Fixed cost

- Fixed cost is defined as the all expenses on fixed factors of production. That factors which cannot be changed in short run is considered as fixed factors and expenses on such headings is known as fixed costs. For example: buildings, land, large equipment etc.

Variable cost

- It is defined as the expenses incurred on variable factors of production. Those factors are said to be variables which can be changed in the short period. It includes expenses on raw materials, electricity, cost of fuel, wages of workers etc. The variable cost remains zero with the zero level of production and increase with the increase in production.

Meaning of short run and long run cost

Short run cost

- 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 labor and raw materials. In the short run, fixed factors, such as capital, equipment, skilled labors etc. cannot be changed to change the level of output.
- In simple words, all types of costs incurred on short run production function are known as short run costs. In short run, cost can be classified as fixed costs and variable costs.

Short run total costs

1. Total fixed costs (TFC)

- Total fixed cost implies the cost which doesn't change with the change in production level. In other words, all type of money costs incurred on fixed factors of production employed in the production process are known as total fixed costs. It includes; salaries to the permanent staffs, all types of constructions, all types of machinery costs, all types of rental cost etc. It is also called unavoidable cost.

2. Total variable cost (TVC)

- All types of cost incurred by a firm on the use of the variable factors are called variable costs. It varies directly with the change in level of production. As production increases, total variable cost increases and vice versa. It includes; expenses on raw materials, running cost of capital such as electricity, fuel, the cost of direct labors, expenses on transports etc. It is also called avoidable cost i.e. if the producer wants to shut down the production for some time, there wouldn't be variable cost because no variable factors are used during that period. The TVC curve is inverse S-shaped which reflects law of variable proportions. It means, initially TVC increase at a decreasing rate and increases at an increasing rate.

3. Total cost (TC)

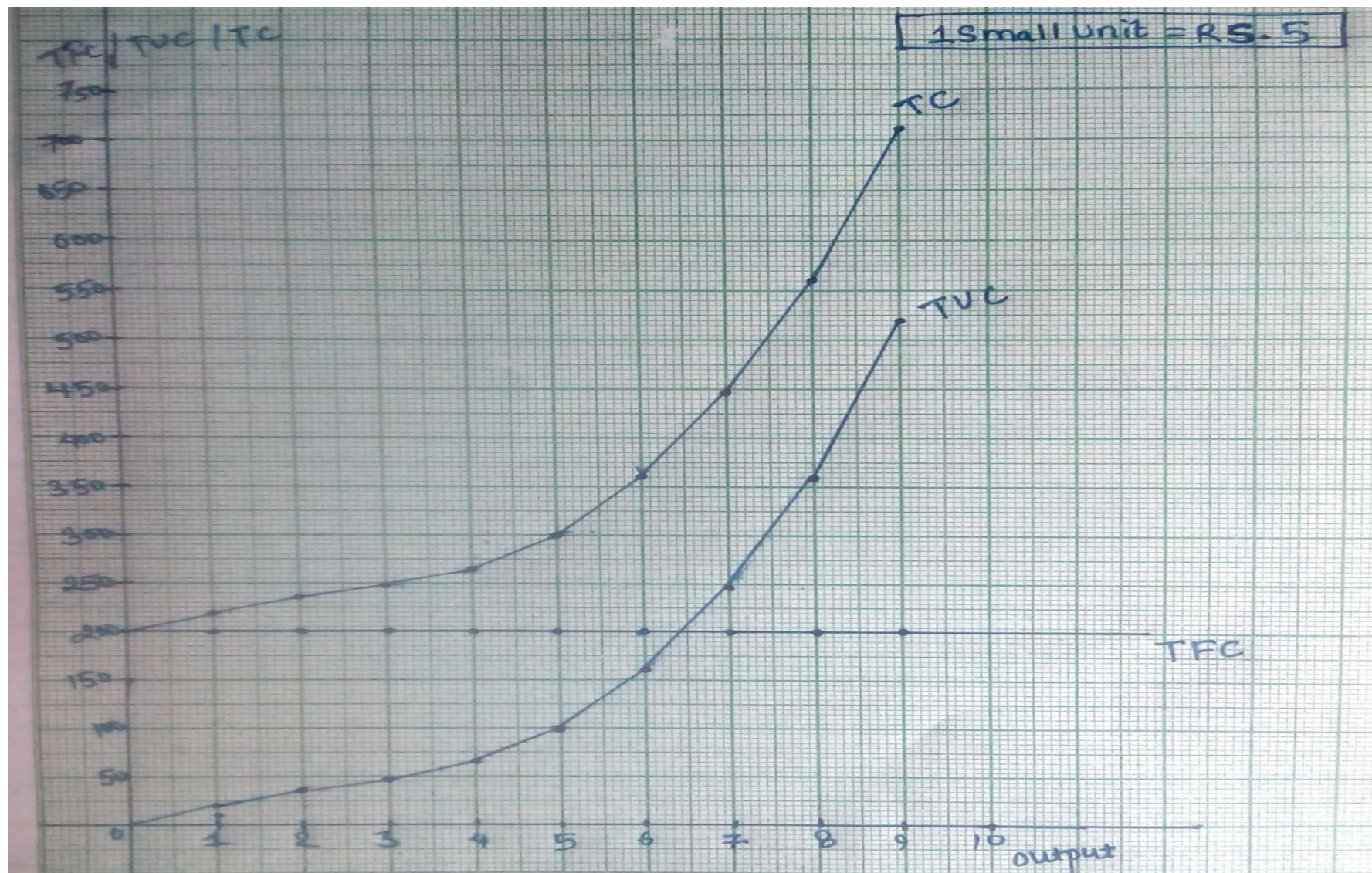
- It is the sum of TFC and TVC. In other words the cost incurred by a firm for fixed factors as well as variable factors of production in the production process is termed as total cost.

$$\text{i.e. } TC = TFC + TVC$$

- Since, the fixed cost is constant the shape of TC depends upon the shape of TVC. Thus TC also increases at a decreasing rate in the initial phase of production and then increases at an increasing rate. So, this also becomes inverse S-shaped.

	TFC	TVC	TC
0	200	0	200
1	200	20	220
2	200	36	236
3	200	48	248
4	200	64	264
5	200	100	300
6	200	160	360
7	200	248	448
8	200	360	560
9	200	520	720

If we plot this figure in the graph, we obtain following figure



- **Why do the TC and TVC curves slope upward to the right as inverse S-shaped?**
- The behavior of the TC and TVC curve follows directly from the law of variable proportion. The TVC or TC increases first at a diminishing rate due to application of increasing returns and then at an increasing rate due to applications of diminishing returns. Therefore, TC and TVC curve slopes upwards to the right, as inverse S-shaped due to the application of law of variable proportion.

Short run average costs

1. Average Fixed Cost (AFC)

- It is also called per unit costs of the fixed factors. When we divide TFC by total produced output, we obtain AFC. Symbolically,

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

- AFC declines as output increases. So, it is downward sloping from left to right as shown in the combined figure.

2. Average Variable Costs (AVC)

- It is also called per unit variable factor costs and it is obtained by dividing TVC by the level of production. When TVC increases at a decreasing rate, average variable cost decreases and when TVC increases at an increasing rate, AVC also increase. Symbolically,

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

- In the combined figure shown in the coming slide, till the 4th unit of production, AVC is declining and after the 4th unit of production, it is increasing continuously, so that AVC curve is U-shaped.

3. Average Cost (AC)

- It is the sum of AFC and AVC. In other words, it is obtained when we divide Total cost by the level of production. Symbolically,

$$\begin{aligned} AC &= \frac{TC}{Q} \\ AC &= \frac{TFC + TVC}{Q} \\ AC &= \frac{TFC}{Q} + \frac{TVC}{Q} \\ \therefore AC &= AFC + AVC \end{aligned}$$

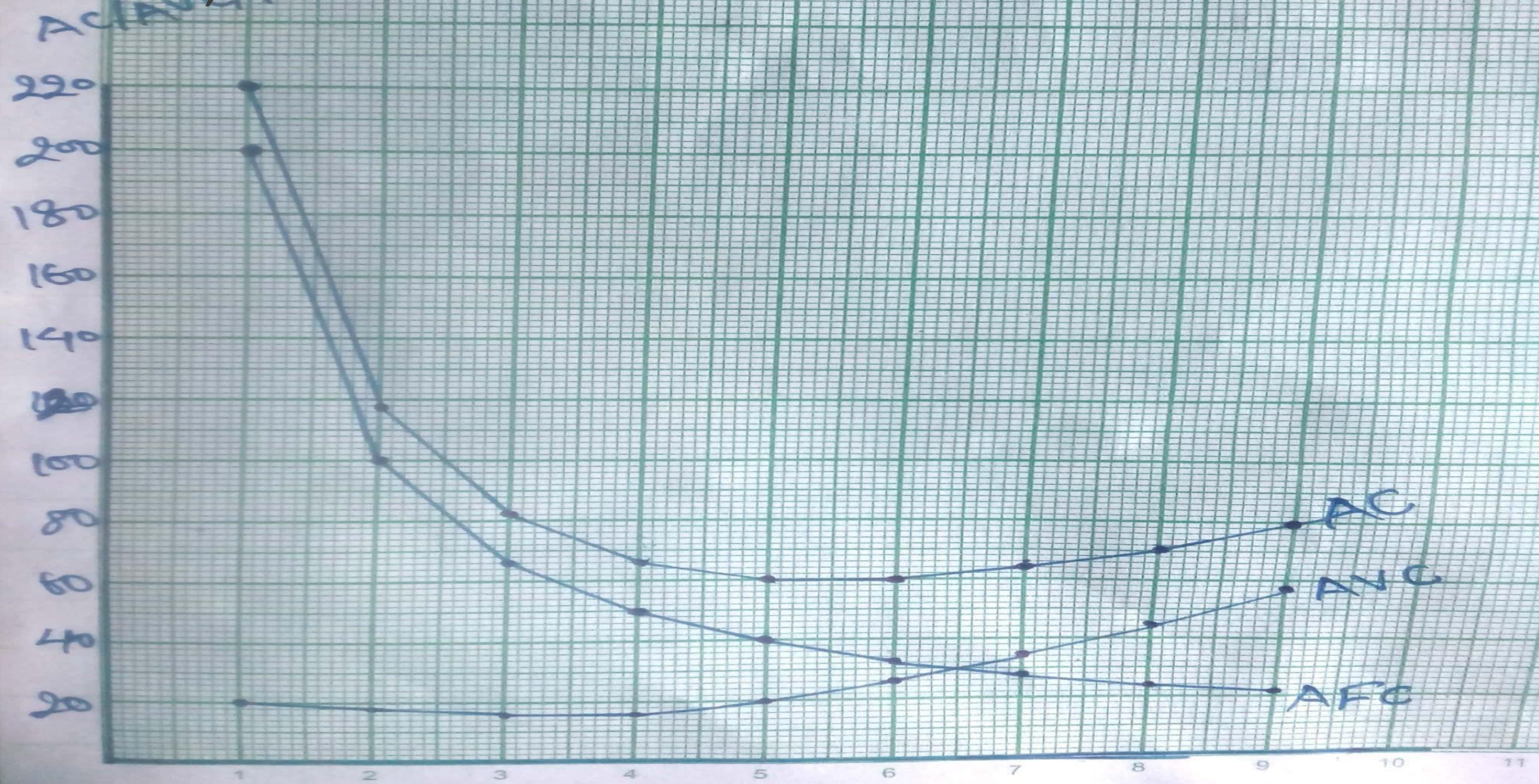
- This equation justifies that the shape of AC depends upon the trend of AFC and AVC.

Quantity	AFC	AVC	AC	MC
0	-	-	-	-
1	200	20	220	20
2	100	18	118	16
3	66.67	16	82.67	12
4	50	16	66	16
5	40	20	60	36
6	33.33	26.67	60	60
7	28.57	35.43	64	88
8	25	45	70	112
9	22.22	57.78	80	160

Complete the table

Output	TFC	TVC	TC	AFC	AVC	AC	MC
0	200	0					
1		20					
2		36					
3		48					
4		64					
5		100					
6		160					
7		248					
8		360					
9		520					

AFC, AVC and AC Curves



Marginal cost curve (MC)

- Marginal cost is defined as the change in total cost due to a unit change in output. In other words, marginal cost is the ratio of change in total cost to the change in total output. Symbolically,

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

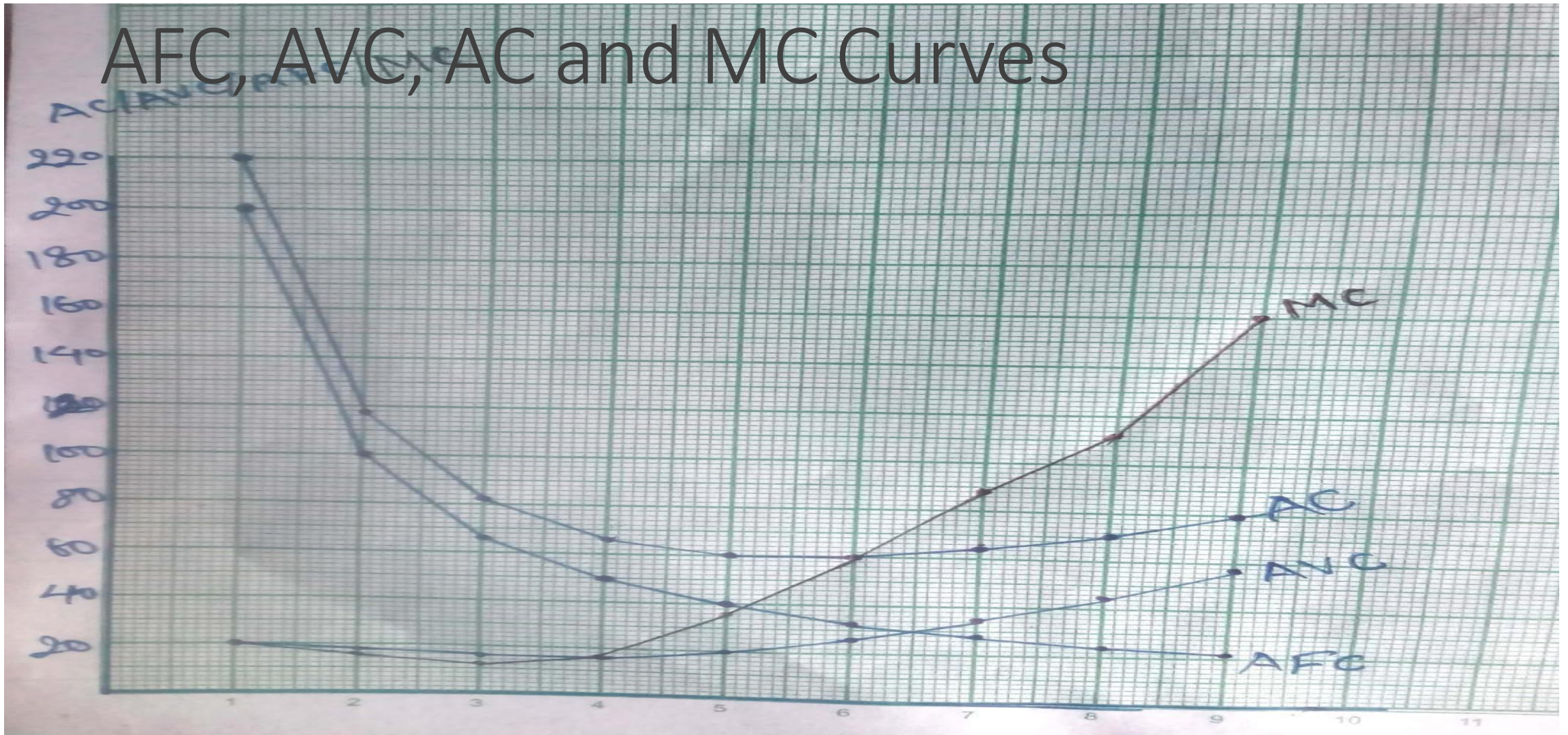
$$\text{Or, } MC = TC_n - TC_{n-1}$$

- In the short run, due to fixed cost is constant and there is only change in variable cost, we can say

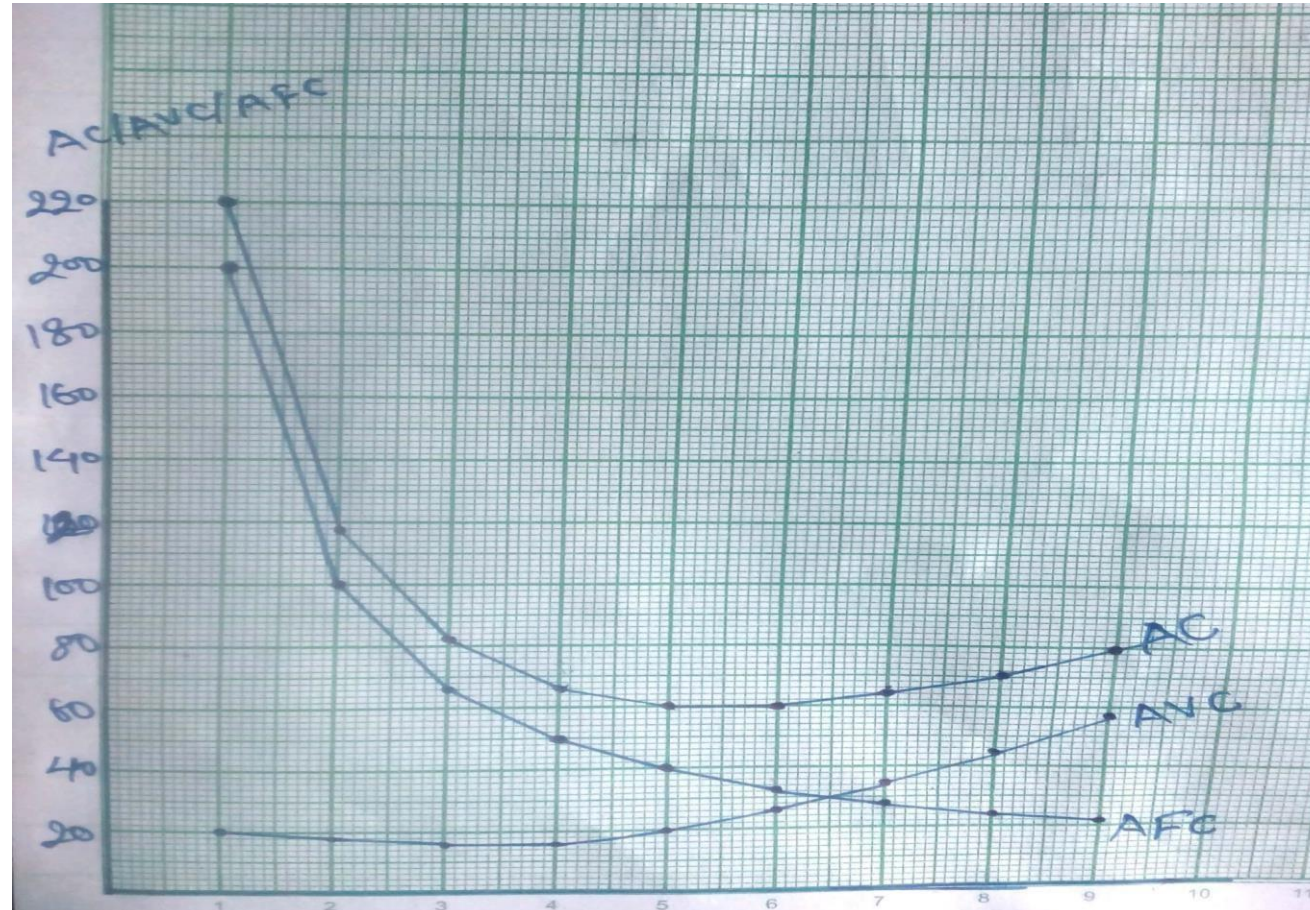
$$MC = \frac{\Delta TVC}{\Delta Q}$$

$$MC = TVC_n - TVC_{n-1}$$

AFC, AVC, AC and MC Curves

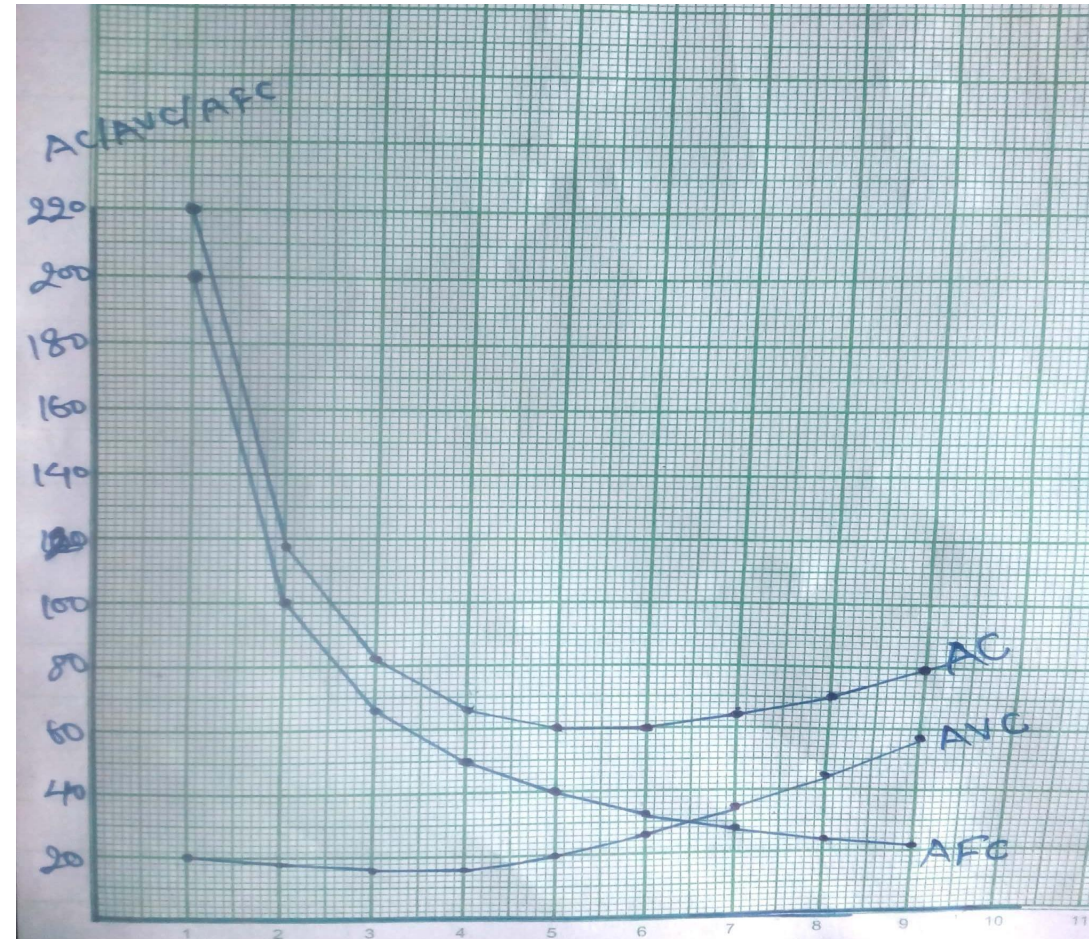


AFC, AVC and AC Curves



Relationship between AC and AVC

- Both are U-shaped, reflecting the law of variable proportion.
- The minimum point of AC is right and upward of minimum point of AVC.
- AC is above AVC ($AC > AVC$) because AC is the sum of AVC and AFC.
- At the beginning, both AC and AVC decline. After reaching the minimum point both increase.
- Since AFC falls continuously with the increase in output, AVC approaches nearer to the AC. In other words, distance between AVC and AC decreases as output increase because of decline in AFC.

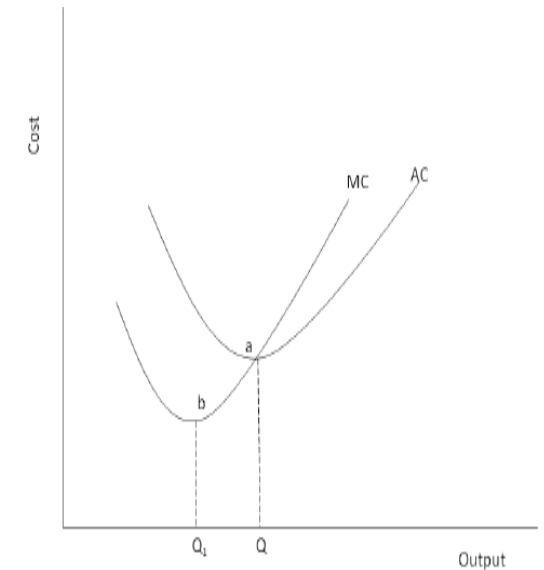


Relationship between AC and MC in the short run

- There is close relationship between AC and MC. As previously explained, MC is the change in TC as the change in one unit production where AC is defined as the total cost divided by level of output. We can present both AC and MC in the following figure.

On the basis of the above figure, we can derive following relationship between AC and MC.

- Both AC and MC are calculated from Total Cost.
- Both AC and MC curve are U-shaped.
- When AC is falling, the MC curve is always below the AC curve and because MC falls faster than the AC.
- When AC is rising, the MC curve lies above the AC because; MC rises faster than the AC.
- When AC is minimum, MC equals to the AC. in other words, MC always cuts AC at its minimum points.



Derivation of long run cost curve

- In the long run, all factors are assumed to be variable. It means, a firm can change all its inputs in the long run. Therefore, there is no any fixed cost in the long run. That is why, in the long run, a firm can change its scale of production according to its needs.
- In the short run, size of a plant or the scale remains fixed while, in the long run, changes in plant size can be made. In the long run, a firm can move from one plant to another plant thereby giving rise to different cost relationships. If the situation demands, it can build up a large- sized plant or a smaller one.

- It is to be mentioned here that long run is a “**planning horizon**” in the sense that it acts as a guide to the firm relating to the future output decision. We know that production takes place in the short run. In brief, short run is the ‘**operating period**’ of a firm. Every firm aims at production for a future date and chooses many aspects of the short run situations among which the firm may choose.
- LAC is, thus, derived from the SAC curves. LAC depicts the lowest possible average cost for producing various possible levels of output. To derive the LAC curve, we assume that there are three different sizes of plants in an industry— small, medium and large. Small-sized, medium-sized, and large-sized plants are represented by the SAC curves—SAC1, SAC2 and SAC3, respectively, as shown in the figure.

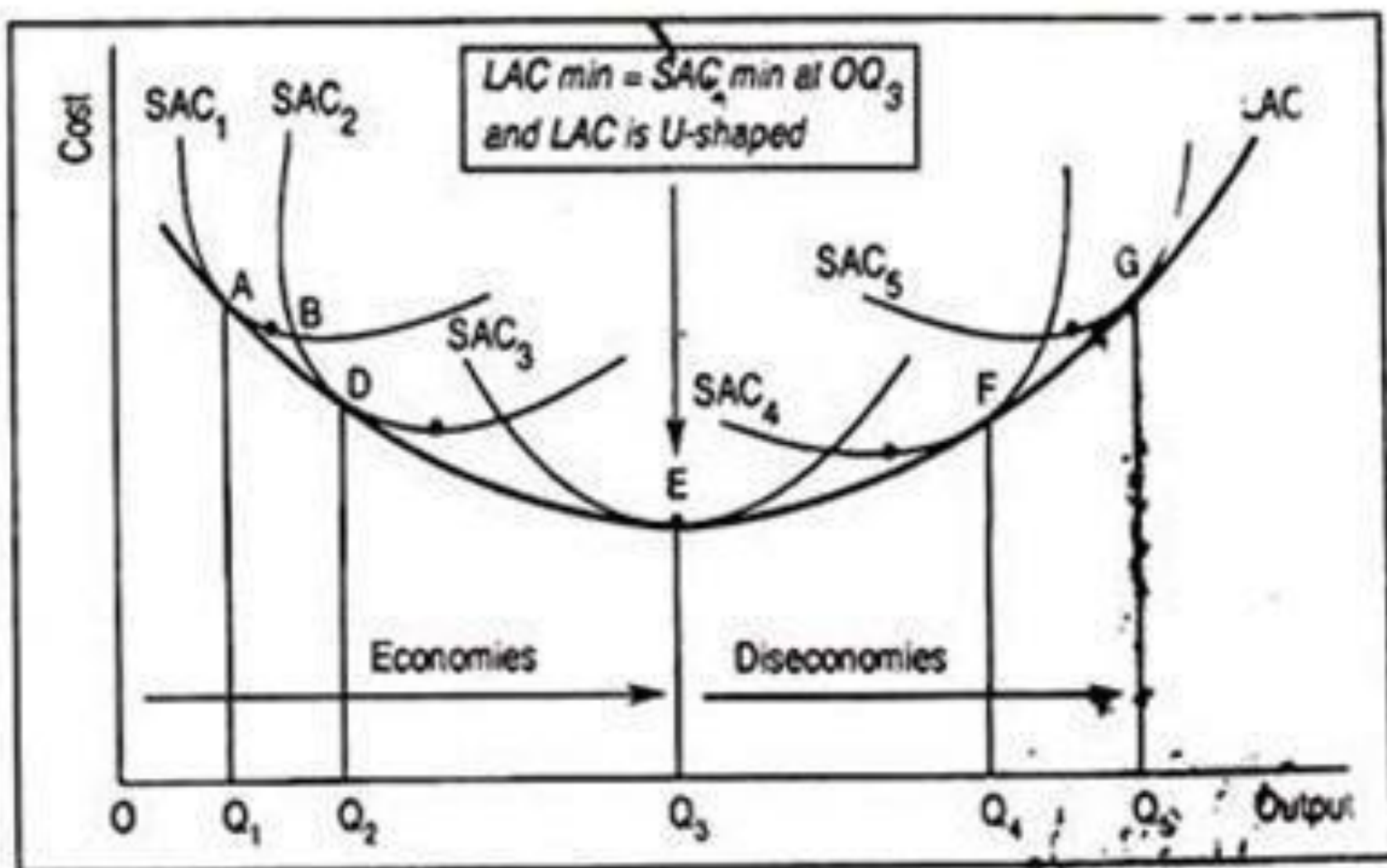


Fig. 3.25: The LAC Curve: The Relationship between SAC and LAC

Derivation of Long-Run Marginal Cost Curve (LMC)

- Long run marginal cost is defined as the additional cost of producing an extra unit of the output in the long-run i.e. when all inputs are variable

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

Where, LMC= Long Run Marginal Cost curve

ΔLTC = change in long run total cost

- The LMC curve is derived from the short run marginal cost curves. Note an important relation between LMC and SAC here. When LMC lies below LAC, LAC is falling, while when LMC is above LAC, LAC is rising. At the point where $LMC = LAC$, LAC is constant and minimum.

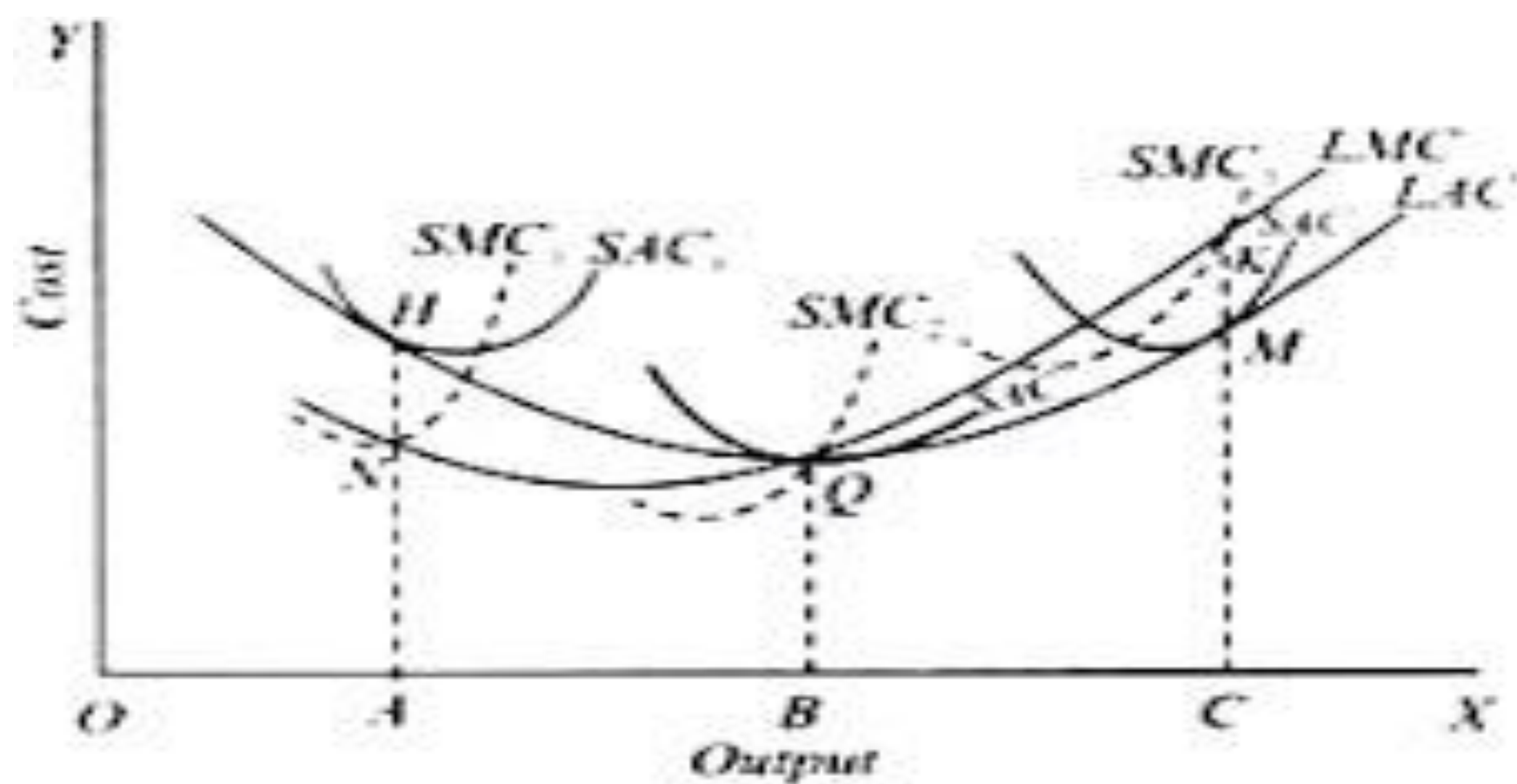
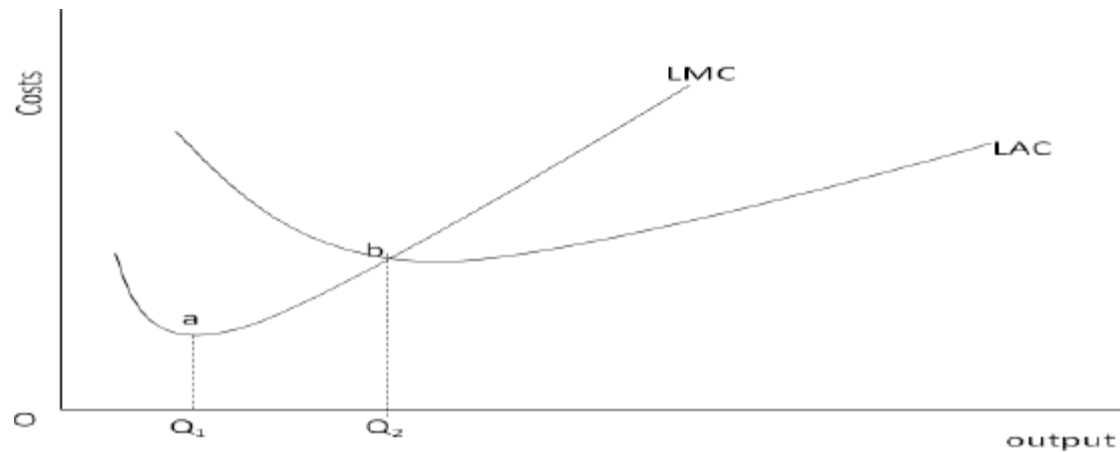


Fig.19.12 . *Derivation of Long-Run Marginal Cost Curve*

- In the figure, if output OA is produced in the long run, then its average cost will be HA on the basis of its SAC_1 or LAC and its MC will be NA on the basis of its SMC_1 . Here at OA level of production, $AC > MC$. Similarly, if the producer increases its output to OB units, its AC and MC would be QB level on the basis of its SAC_2 or LAC and SMC_2 . At this OB level of production, $SAC = SMC$. If again a producer produces OC units of production, its AC would be CM and MC would be CK. Here at OC level of production, $MC > AC$. When these Marginal cost points are joined, we receive, Long run Marginal cost curve.

Relationship between LAC and LMC

- The relationship between LAC and LMC are explained by the help of following figure.
- In the following figure, X-axis shows output and Y axis shows cost of production. The U-shaped curves LAC and LMC representing long run average cost and long run marginal cost respectively. The minimum point of LAC is 'b' whereas minimum points of LMC is 'a'. The further relationships are as follows:



Contd.

- Both are U-shaped and derived from LTC.
- When LAC is minimum at 'b', $LMC = LAC$.
- When LAC is declining, $LAC > LMC$.
- When LAC is rising, $LAC < LMC$.
- The minimum point of LAC i.e. 'b' is right and upward from the minimum point of LMC i.e. 'a'.

Economies of Scope

- Economies of scope are the situation in which it is cheaper to produce various products jointly by a firm than the separate production. In other words, if a firm produces two or more than two interrelated products, its cost will be reduced in comparison the individual production.

Symbolically,

$$TC(A + B) < TC(A) + TC(B)$$

Causes of economies of scope

- Common production facilities
- Use of by products
- Common marketing and administration

Measurement of economies of scope

$$S = \frac{[TC(A) + TC(B) - TC(A+B)]}{TC(A+B)}$$

Where, S= degree of economies of scope

TC(A) = total cost of producing only product A

TC(B) = total cost of producing only product B

TC(A+B) = total joint cost of producing both product A and B

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

- Suppose ABC firm of Kathmandu produces 500 units of shirts only its cost is estimated Rs. 12000. If the firm produces 200 units of pants only, the estimated cost is Rs. 9000. But if the firm produces 500 units of shirts and 200 units of pants together its joint cost will be Rs 16000. Then calculate the degree of economies of scope.

Let shirt is denoted by A and pant is denoted by B.

On the basis of question,

$$TC(A) = \text{Rs. } 12000$$

$$TC(B) = \text{Rs. } 9000$$

$$TC(A+B) = 16000$$

Then,

$$\begin{aligned}
 \text{degree of economies of scope (S)} &= \frac{[TC(A) + TC(B) - TC(A+B)]}{TC(A+B)} \\
 &= \frac{12000 + 9000 - 16000}{16000} \times 100\% \\
 &= \frac{5000}{16000} \times 100\% \\
 &= 31.25\%
 \end{aligned}$$

Hence there is economies of scope is 31.25%.

- It means that if the firm produces both products together rather than separately, the cost will be reduced by 31.25%.

1. Let the cost function $C=128+169Q-Q^2+Q^3$ in which costs are expressed in rupees. Then calculate TFC, TVC, TC, AC, AFC, AVC and MC at output level is 10 unit.

2. Compute the AFC, AVC, ATC and MC from the following information if total cost is Rs. 200.

Units of output	1	2	3	4	5	6	7	8
TVC in Rs.	10	18	24	32	42	54	70	90

3. Compute AVC, AFC, AC and MC with the help of following data.

Output	TVC	TFC
1	100	100
2	210	100
3	330	100
4	460	100
5	600	100

4. Complete the following table and answer the given questions.

Output	TFC	TVC	TC	AFC	AVC	AC	MC
0	100	0	-	-	-	-	-
1	-	10	-	-	-	-	-
2	-	18	-	-	-	-	-
3	-	24	-	-	-	-	-
4	-	32	-	-	-	-	-
5	-	50	-	-	-	-	-
6	-	80	-	-	-	-	-
7	-	124	-	-	-	-	-
8	-	180	-	-	-	-	-

a. Explain the graph AC, MC and their relationship.

5. The total cost function of a producer is given as $C = 868 + 47Q + 0.5Q^2$. Compute TFC, TVC, TC, AFC, AC and MC at the output range from 0 to 12 units.

6. Consider the following cost schedule

Output (Q)	0	1	2	3	4	5	6	7	8
TVC	0	30	54	72	96	150	240	372	540

i. Calculate TC, AFC, AVC, AC and MC if TFC is 300.

7. The short run total cost is $TC = 200 + 5Q - 0.04Q^2 + 0.001Q^3$. If $Q = 10$, find; TFC, AVC, AFC and MC.

8. 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.

Theory of Revenue

- In economics, the income earned by producer by selling the output in a market at a given price is called revenue. In other words, money receipt of a firm from the sales of its product is called revenue. There are three concepts of revenue; i.e. total revenue, average revenue and marginal revenue.

- **Total revenue:**

Total revenue is the total amount of money received from the sales of given level of output. It is the product of total quantity and price per unit.

Mathematically, $TR = P \times Q$

Alternatively, Total revenue is the sum of aggregate marginal revenue.

$$TR = MR_1 + MR_2 + \underset{n}{MR_3} + \cdots + MR_n$$

$$TR = \sum_{i=1} MR_i$$

- **Average revenue:**

Average revenue is the revenue per unit of output sold. Alternatively, AR is the price per unit. It is obtained dividing total revenue by the number of output sold.

Mathematically,

$$\begin{aligned} AR &= \frac{TR}{Q} \\ AR &= \frac{P \times Q}{Q} \\ \therefore AR &= P \end{aligned}$$

- **Marginal revenue:**

Marginal revenue is defined as the ratio of changes in the total revenue with the change in level of output sold.

$$MR = \frac{\Delta TR}{\Delta Q}$$

- Alternatively, marginal revenue is the addition to total revenue from the sales of an additional unit of the commodity. Mathematically,

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

Perfect Competition

- If there are a large number of producers and a large number of buyers with homogeneous products at the uniform price, then the market structure becomes perfect competition. In this market a large number of firms produce perfectly homogeneous products. The aggregate demand and the supply of goods determines the general price level or the price of the product.

Features/ Characteristics of Perfect Competition

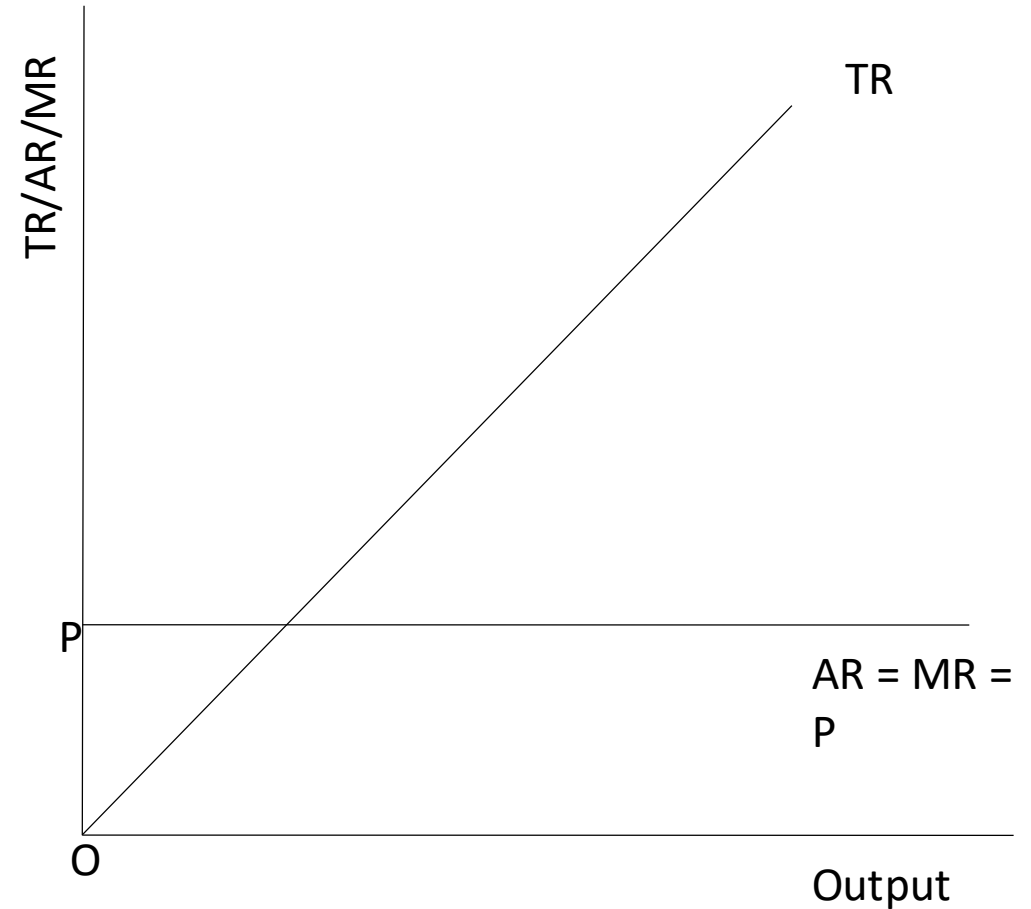
1. A large number of producers and buyers
2. Homogeneous products
3. Free to entry and exit
4. No government intervention
5. Perfect mobility of the factors
6. Complete knowledge about the market
7. Profit maximization objective

Revenue under perfectly competitive market

- Perfect competition is the market structure where the large number of buyers and sellers deal with the homogeneous product. The price of commodity is determined by the industry not by the individual firms under perfect competition so that average revenue or the price along with the marginal revenue remains constant. Here in the perfect competition, every firm is just a price taker. The relationship between TR, MR and AR under perfect competition can be shown in the following table.

Unit sales	Price per unit	TR= P x Q	AR	MR
1	12	12	12	12
2	12	24	12	12
3	12	36	12	12
4	12	48	12	12
5	12	60	12	12

- From the above table, due to the constant price, TR is increasing in a constant rate due to which the AR and price are equal to each other. Due to constant increase rate in TR, MR is also constant.
- In the adjoining figure, output is measured in X- axis whereas TR/AR/MR is measured in Y- axis. The TR is the total revenue curve which has been sloping upward at a constant rate. The MR and AR curves are coincided to each other and perfectly elastic to output due to the constant price level in the market.



Monopoly

- A market structure where there is a single seller but a large number of buyers is called monopoly. In this type of market, there is the absence of close substitutes in the market. A monopolist works as a price-maker not price-taker.

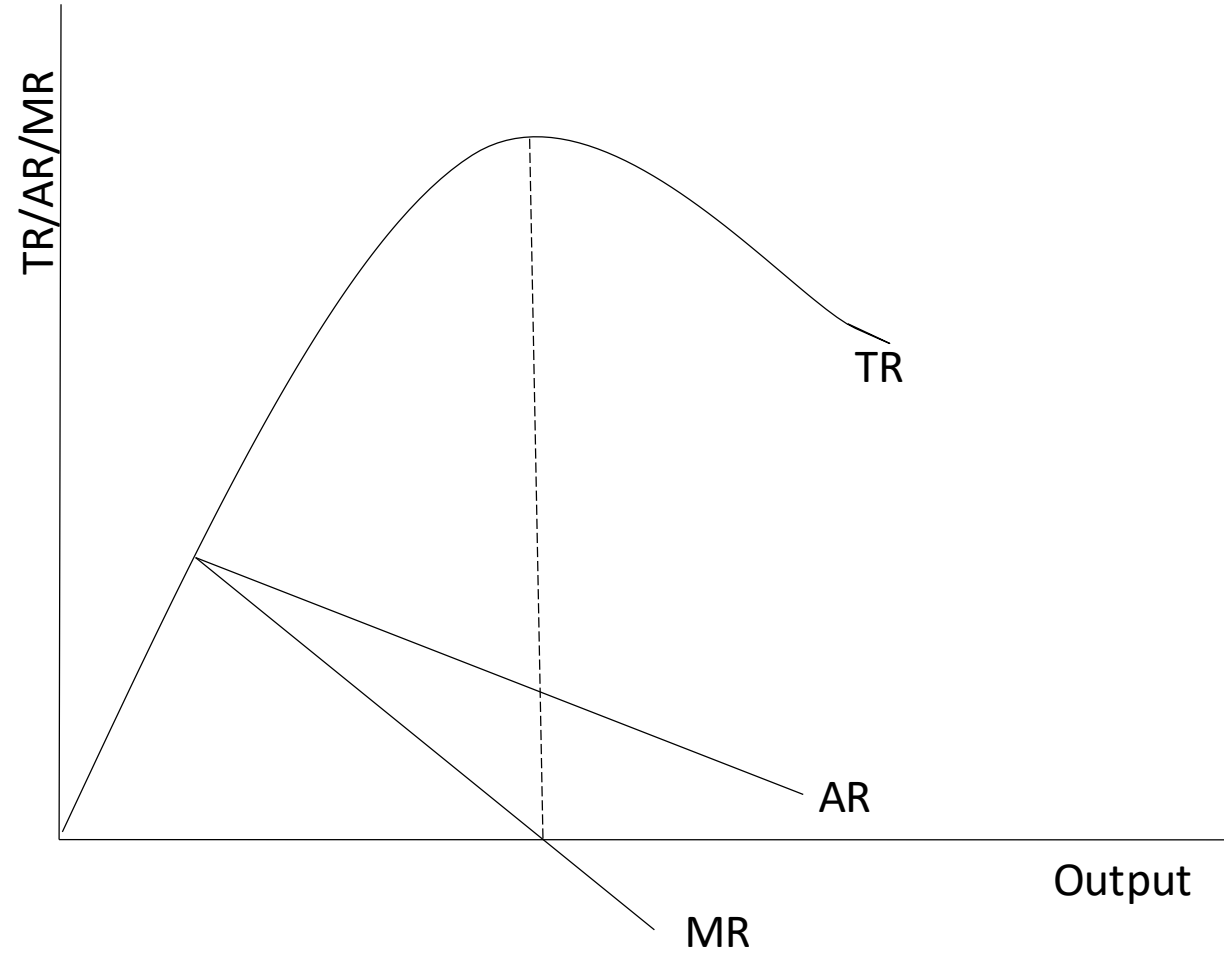
Features /Characteristics of the Monopoly

1. A single seller and a large number of buyers
2. No close substitutes
3. Barriers to entry
4. Firm itself is an industry
5. Independent price policy
6. Price discrimination is possible
7. Profit maximization

Revenue under Monopoly

- Monopoly is a market structure in which there is a single seller to produce and sell particular commodity which has no close substitute goods. There is a strong barrier to enter into the industry. In other words, single firm itself is an industry. In monopoly, a firm has to reduce the price in order to sell more units of output. The concept of AR, MR and TR would be further clear with the help of following table.

Units	Price per unit	TR = P x Q	AR= TR/Q	MR= TR _n -TR _{n-1}
1	16	16	16	-
2	15	30	15	14
3	14	42	14	12
4	13	52	13	10
5	12	60	12	8
6	11	66	11	6
7	10	70	10	4
8	9	72	9	2
9	8	72	8	0
10	7	70	7	-2



- In the above figure, TR is increasing in diminishing rate, reaches to the maximum and starts falling. It is because a monopolist must have to reduce price in order to sell more units of output. The AR and MR both are falling with the increase in output but the MR has been falling faster than the AR. When the MR positive TR is increasing in decreasing rate when MR is zero, the total revenue is maximum, beyond which when MR becomes negative TR starts falling. Since the price never becomes zero, AR doesn't touch axis.