

THEORY OF COST

COST OF PRODUCTION:

Cost of production refers to the total cost incurred by a business to produce a specific quantity of a product or offer a service.

In economics, the cost of production is defined as the expenditures incurred to obtain the factors of production such as labor, land, and capital, that are needed in the production process of a product.

COST FUNCTION:

A cost function is a function of input prices and output quantity whose value is the cost of making that output given those input prices. Cost functions are derived functions. They are derived from the production function, which describes the available efficient methods of production at any one time. Cost is a function of output,

$$C = f(X), \text{ ceteris paribus.}$$

Economic theory distinguishes **between short-run costs and long-run costs.**

Short run cost function

Short-run costs are the costs over a period during which some factors of production (usually capital equipment and management) are fixed.

The short-run costs are the costs at which the firm operates in any one period.

the short-run cost function

$$C = f(X, T, P_f, k)$$

Where,

C = total cost

X= output

T = technology

P_f = prices of factors

k = fixed factor(s)

Long run cost function

The long-run costs are the costs over a period long enough to permit the change of all factors of production. Such as planning cost. In the long run all factors become variable.



Symbolically we may write the long-run cost function as

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

Where,

C = total cost

X= output

T= technology

P_f = prices of factors

❖ Short run Costs

Since there are three types of product, there are three types of costs in the short-run:

- Total costs, *TC*
- Marginal cost, *MC*
- Average cost, *AC*

Total Fixed Cost (TFC) Total fixed cost is the sum of expenses incurred on those inputs that remain same at different levels of output. Total fixed cost is graphically shown in Fig. 8.1. It is a straight line parallel to output or x-axis. TFC is the total fixed cost curve parallel to x-axis indicating that it remains constant at all levels of output

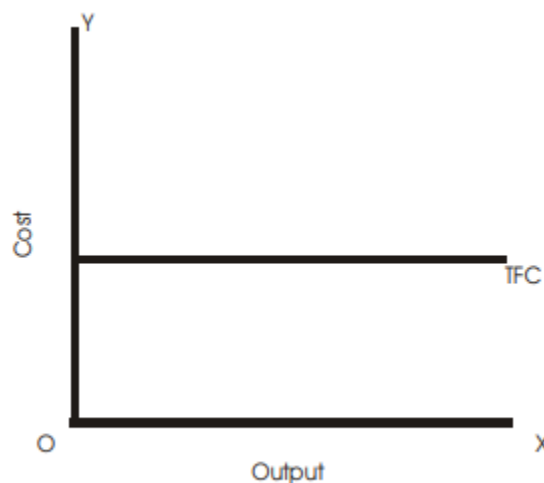


Fig. 8.1

Total Variable Cost (TVC) Total variable cost is the sum of expenses incurred on those factor inputs whose quantity varies with a change in the level of output. Total variable cost curve TVC

is shown in the Fig. 8.2. It has inverse-S shape. Total variable costs increase as the level of output increases.

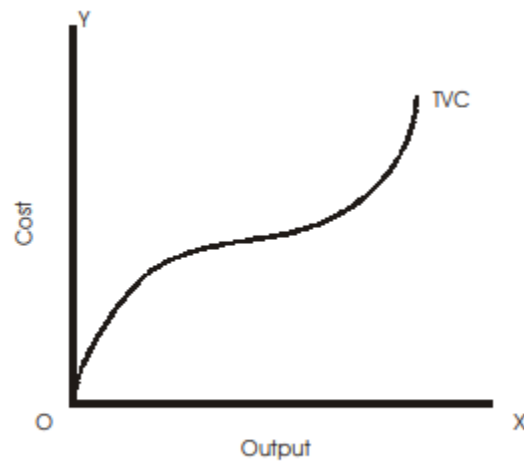


Fig. 8.2

Total Cost (TC) to a producer for the various levels of output is the sum of total fixed costs and total variable costs, i.e.,

$$TC = TFC + TVC$$

The adjacent Fig. 8.3 shows total cost of production which is the sum of total variable cost and total fixed cost.

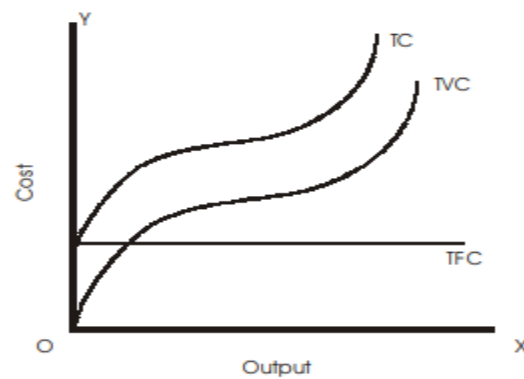


Fig. 8.3

Average Fixed Cost (AFC) Average fixed cost is total fixed cost divided by total output. It is per

unit cost on fixed factors. Symbolically,

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

Where, TQ is the total output.

Average fixed cost is shown as under. AFC curve is a rectangular hyperbola, indicating same magnitude at all points as TFC remains constant throughout. This is shown in the Fig. 8.4 below:

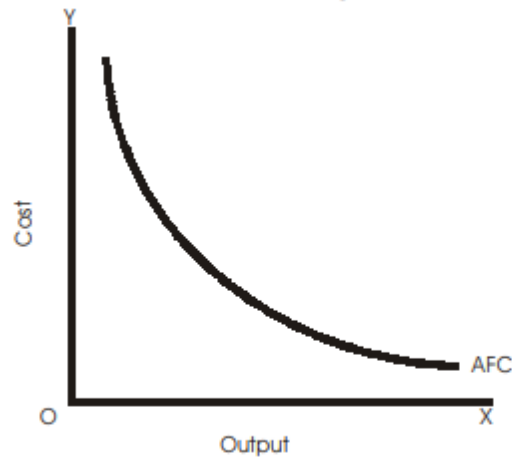


Fig. 8.4

Average Variable Cost (AVC) The average variable cost is found by dividing the total variable costs by the total units of output, i.e., it is per unit cost of the variable inputs. Symbolically

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

Average variable cost falls initially, reaches a minimum when the plant is operated optimally and rises after the point of normal capacity has been reached. This is shown graphically below in Fig. 8.5.

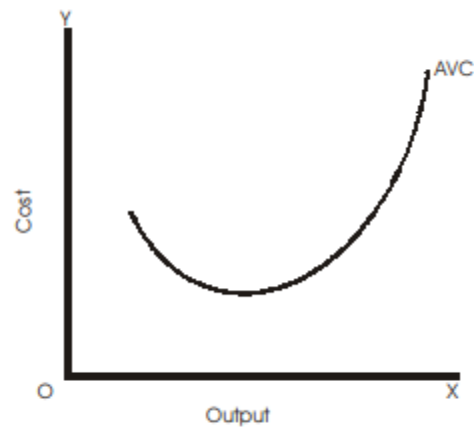


Fig. 8.5

Average Total Cost (ATC/AC)

ATC is the per unit cost of both fixed and variable inputs. Average total cost of production can be obtained by dividing total cost by the units of output, i.e.,

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

or

or

Average total cost or ATC curve has the similar shape as that of AVC, that is, U-shaped. The figure below shows AC curve.

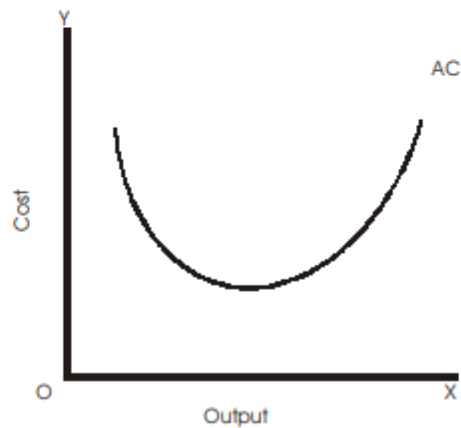


Fig. 8.6

Marginal Cost

Marginal cost is the addition to the total cost as a result of a unit (one unit) increase in the output. It is expressed as:

$$MC_N = TC_N - TC_{N-1}$$

Where, N is the number of units of output. Alternatively, marginal cost can also be expressed as follows:

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

Where, ΔTC stands for the change in total cost and ΔTQ for total output.

Graphically, MC curve is the slope of the TC curve, which is shown in Fig. 8.7. MC curve also has U-shaped. It first falls, goes to a minimum and then rises sharply.

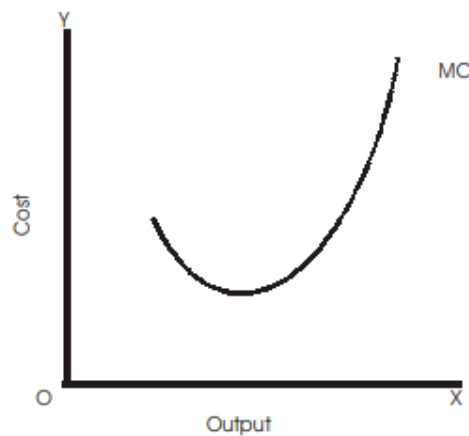


Fig. 8.7

Fig. 8.7

The table below shows the relationship among fixed, variable costs, total, average and marginal costs.

<i>Units of output</i>	<i>TFC</i>	<i>TVC</i>	<i>TC</i>	<i>AFC</i>	<i>AVC</i>	<i>AC</i>	<i>MC</i>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0	10	0	10	-	-	-	-
1	10	4	14	10	4	14	4
2	10	7	17	5	3.5	8.5	3
3	10	9	19	3.3	3	6.3	2
4	10	11	21	2.5	2.7	5.2	2
5	10	14	24	2	2.8	4.8	3
6	10	19	29	1.6	3.1	4.7	5

RELATIONSHIP BETWEEN AVERAGE COST AND MARGINAL COST

Average cost is obtained by dividing total costs by the units of output. Marginal cost is the change in total costs resulting from a unit increase in output. The relationships between the two are as follows:

1. When average cost falls with an increase in output, marginal cost is less than the average cost (before point P).
2. When average cost rises, marginal cost is greater than the average cost (after point P).
3. Marginal cost curve cuts the average cost curve at its minimum point (minimum point on the average cost curve is also the point of optimum capacity) i.e., at the point of optimum capacity, $MC = AC$ (at point P).

With increase in average cost, marginal cost rises at a faster rate. This relationship between AC and MC is illustrated in the adjacent Fig. 8.8.

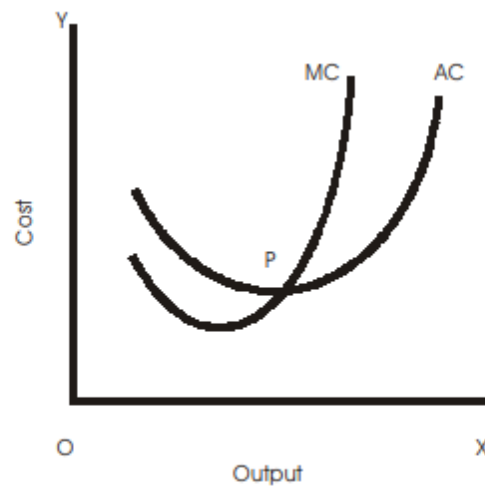


Fig. 8.8

► Another Explanation of the Concepts of Costs

Fixed Cost

Fixed costs are the cost which are incurred in the fixed factors of production. More simply, fixed cost are the costs that don't changes with the quantity of output produced. Fixed costs are expenses that must be paid even if the firm produces zero output. They consist of items such as rent for factory or office space, interest payments on debts, salaries of

tenured faculty and so forth.

For example, if you want to open a burger restaurant, you will need to pay rent for your location. Let's TK. 1000 per month. This is fixed cost because it does not matter how many burgers you sell; you will still have to pay the rent. Similarly, you have to pay your waitress' salary, regardless of the number of burgers she serves. If she/he earns TK. 1000 per month. Then your fixed costs add up to Tk. 2000 per month.

Variable cost

Variable costs are the cost which are incurred in the variable factors of production. More simply, Variable costs are the costs that changes with the quantity of output produced. That is, they usually increase as output increases and vice-versa. Unlike fixed costs, variable costs are not incurred if there is no production. They consist of item such as raw materials, wage and so forth.

For example, in case of burger restaurant, the costs of meat, burger buns, lettuce, and BBQ sauce would be considered variable costs. Let's assume all ingredients add up to TK. 10 per burger. If you sell 20 burgers and your variable costs are the costs of the ingredients, your total variable costs result in TK. 200. By contrast, if you sell 200 burgers, your total variable costs add up to TK. 2000. If you don't sell any burgers at all, your total variable cost is zero.

Total cost

Total cost describes the sum of total fixed cost and variable cost. It incurred all the costs that are incurred during the production process. Again, let's say you managed to sell 200 burgers in your first month. In this case, your total cost of running your burger restaurant add up to TK. 4000 (i.e., Tk. 2000 Fixed cost + TK. 2000 variable cost).

Average cost

The average cost is defined as the total cost divided by the quantity of output (i.e., number of units produced). In addition, to the average total cost, we can calculate the average fixed cost (Total fixed cost divided by the number of units produced) and average variable cost (Total variable cost divided by the number of units produced).

In our example, the total average cost is TK. 20 (Tk. 4000/ 200 Burgers).

The average fixed cost is TK. 10 (TK. 2000/200 burger).

The average variable cost TK. 10 (Tk. 2000/200 burger).

Marginal cost

Marginal cost denotes the extra or additional cost of producing one additional unit of output. For example, let's instead of 200 burgers you sell 201 burgers. Now the total cost is 4010 which equals to an increase of TK.10. Thus, the marginal cost of producing the 201st burgers is TK.10 (Tk. 10/1 burger).

Graphical Explanation of Marginal Cost Curve

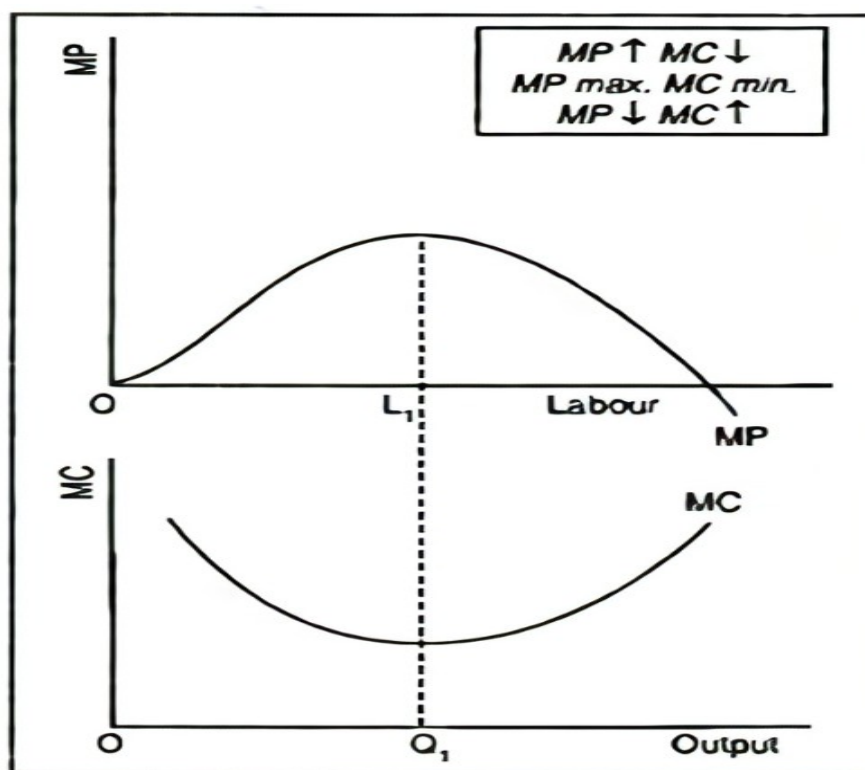
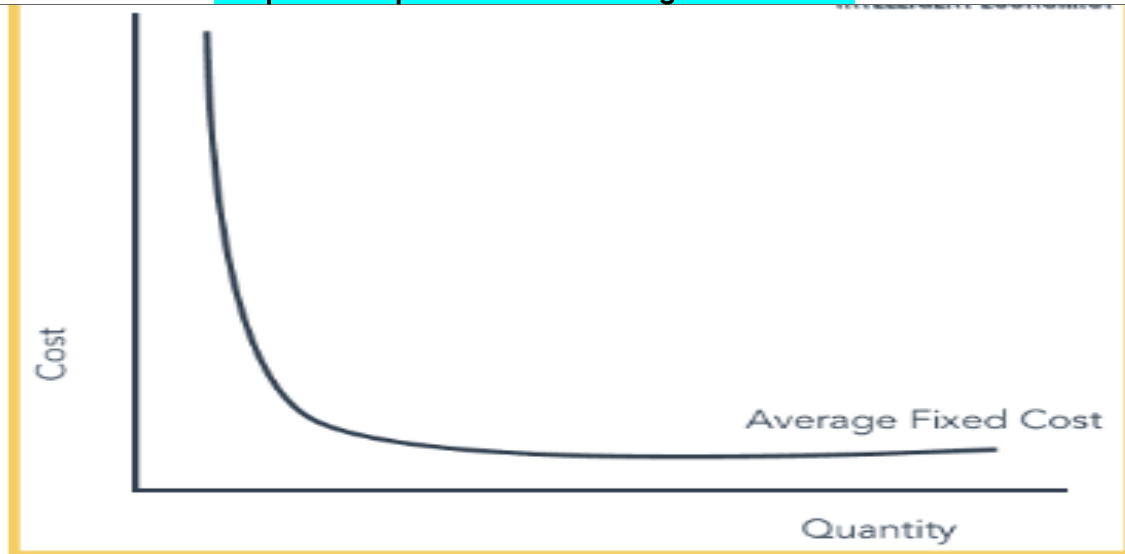


Fig. 3.18: MP and MC Curves

It is due to operation of law of variable proportion according to which MP first rises, reaches its maximum and then declines. Since increasing returns means diminishing cost and diminishing returns imply increasing cost, therefore, MC first falls because of increasing returns, reaches its minimum and then rises due to operation of diminishing returns. As a result MC curve becomes U-shaped.

Graphical Explanation of Average Fixed Cost

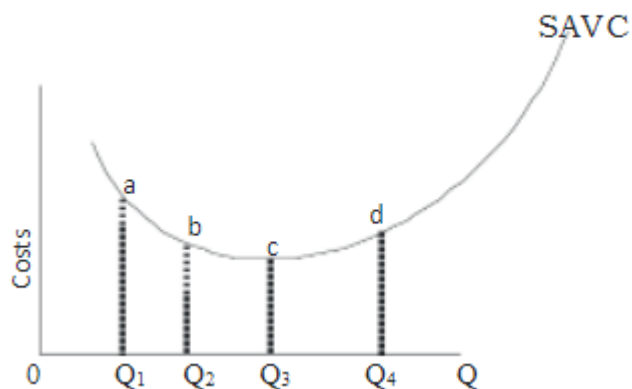


In the above diagram, we see that when the quantity produced is low, the average fixed cost is very high and this cost lowers as the quantity produced increases.

For example, if the Fixed Cost is \$100 and initially you produce two units, then the average fixed cost is \$50. If you start creating 20 units, then the average fixed cost falls to \$5.

Graphical Explanation of Average Variable Cost

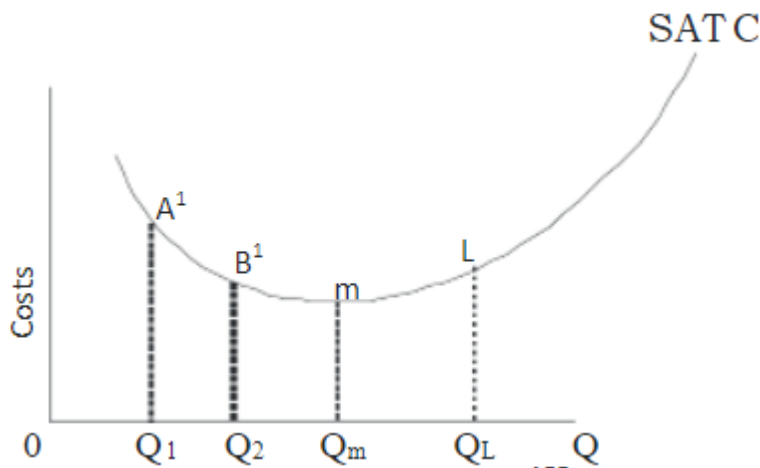
Figure 5.5: Short-run Average variable Cost



The SAVC curve falls initially as the productivity of the variable factor(s) increases, reaches a minimum when the plant is operated optimally (with optimal combination of fixed and variable factors), and rises beyond that point, due to law of diminishing returns.

Graphical Explanation of Average Cost

Figure 5.6: short-run Average Total cost



Graphically, the ATC curve is derived in the same way as the SAVC. The shape of the ATC is similar to that of AVC (both being U-shaped). Initially, the ATC declines, it reaches a minimum at the optimal operation of the plant (Q_m) and subsequently rises again, as seen in Figure 5.6.

Concepts of Total, Average and Marginal Revenue

Total revenue is the income the firm generates from selling its products. We calculate it by multiplying the price of the product times the quantity of output sold:

$$\text{Total Revenue} = \text{Price} \times \text{Quantity}$$

- Marginal revenue is the change in total revenue when one more unit of a commodity is sold.

$$MR = \frac{\text{change in TR}}{\text{change in quantity sold}}$$

- Average revenue refers to revenue per unit of output.

$$AR=TR/Q$$

Each business, regardless of size or complexity, tries to earn a profit:

$$\text{Profit} = \text{Total Revenue} - \text{Total Cost}$$

Why economies arise in large scale production?

Small- and large-scale Production:

Small scale production is production with small capital outlay and therefore at a low level of output. On the other hand, large scale production is production with a large-scale outlay and therefore results in high level of output.

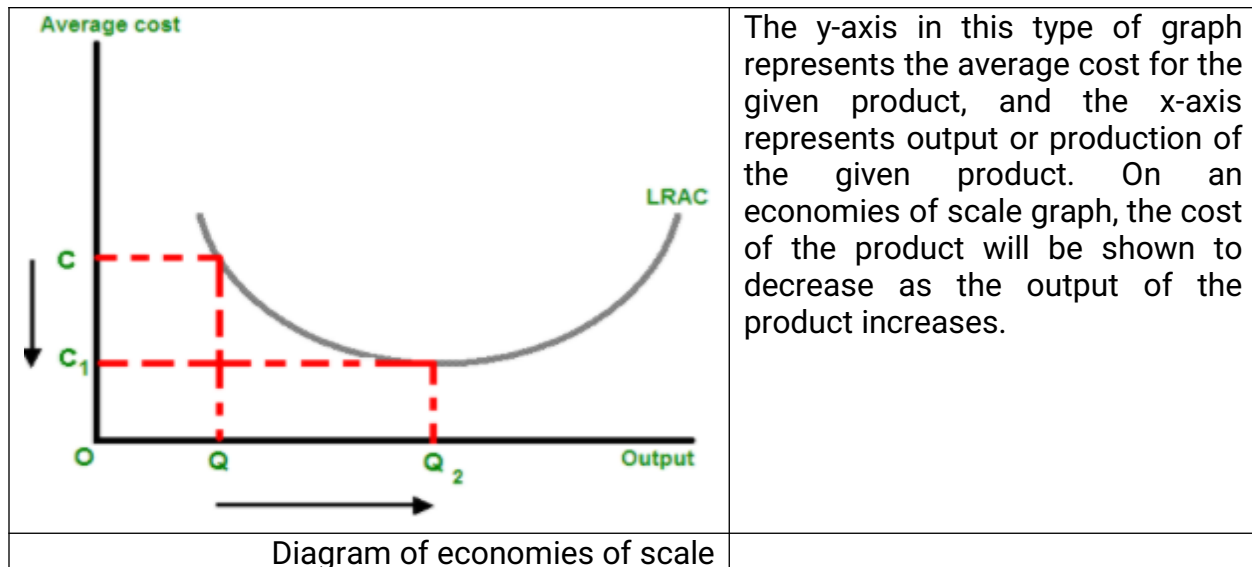
Economies of Scale

Economies of scale refer to the cost advantage experienced by a firm when it increases its level of output. The advantage arises due to the inverse relationship between per-unit fixed cost and the quantity produced. The greater the quantity of output produced, the lower the per-unit fixed cost.

Economies of scale also result in a fall in average variable costs (average non-fixed costs) with an increase in output. This is brought about by operational efficiencies and synergies as a result of an increase in the scale of production.

- ❖ As a firm grows in size, it is-possible for it to reduce its cost. The reduction in costs, as a result of increasing production is called economies of scale. The economies of scale are obtained by the firm up to the lowest point on the firms long run average cost curve.
- ❖ Economies of scale occur when increasing output leads to lower long-run average costs. It means that as firms increase in size, they become more efficient.





❖ The main sources of economies of scale are in brief as under.:

Economies of large-scale production are classified by **Marshall** into:

(1) Internal Economies and (2) External Economies.

1. **Internal Economies of scale:**

Internal economies of scale are those economies which are internal to the firm. These arise within the firm as a result of increasing the scale of output of the firm. A firm secures these economies from the growth of the firm independently. The main internal economies are grouped under the following heads:

(i) **Technical Economies:** When production is carried on a large scale, a firm can afford to install up to date and costly machinery and can have its own repairing arrangements. As the cost of machinery will be spread over a very large volume of output, the cost of production per unit will therefore, be low.

A large establishment can utilize its byproducts. This will further enable the firm to lower the price per unit of the main product. A large firm can also secure the services of experienced entrepreneurs and workers which a small firm cannot afford. In a large establishment there is much scope for specialization of work, so the division of labor can be easily secured.

(ii) **Managerial Economies:** When production is carried on a large scale, the task of manager can be split up into different departments and each department can be placed under the supervision of a specialist of that branch. The difficult task can be taken up by the entrepreneur himself. Due to this functional specialization, the total return can be increased at a lower cost.

(iii) **Marketing Economies:** Marketing economies refer to those economies which a firm can secure from the purchase or sale of the commodities. A large establishment is in a better position to buy the raw material at a cheaper rate because it can buy that commodity on a large scale. At the time of selling the produced goods, the firm can secure better rates by effectively advertising in the newspapers, journals and radio, etc.

(iv) **Financial Economies:** Financial economies arise from the fact that a big establishment can raise loans at a lower rate of interest than a small establishment which enjoys little reputation in the capital market.

(v) **Risk Bearing Economies:** A big firm can undertake risk bearing economies by spreading the risk. In certain cases, the risk is eliminated altogether. A big establishment produces a variety of goods in order to cater the needs of different tastes of people. If the demand for a certain type of commodities slackens, it is counter balanced by the increase in demand of the other type of commodities produced by the firm.

2. **External Economies of Scale**

External economies of scale are those economies which are not specially availed of by any firm. Rather these accrue to all the firms in an industry as the industry expands. The main external economies are as under:

(i) **Economies of localization.** When an industry is concentrated in a particular area, all the firms situated in that locality avail of some common economies such as (a) skilled labor, (b) transportation facilities, (c) post and telegraph facilities, (d) banking and insurance facilities etc.

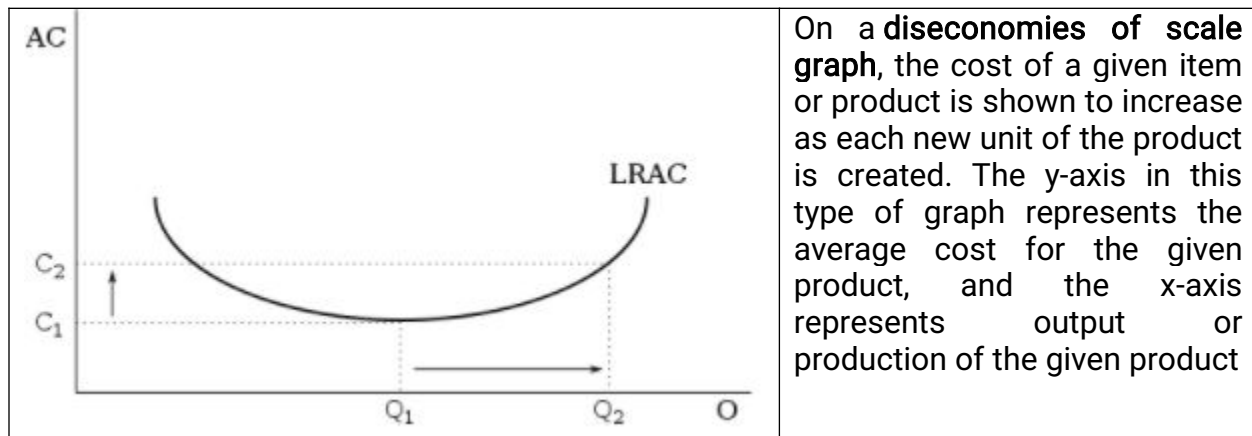
(ii) **Economies of vertical disintegration.** The vertical disintegration implies the splitting up the production process in such a manner that some Job are assigned to specialized firms. For example, when an industry expands, the repair work of the various parts of the machinery is taken up by the various firms' specialists in repairs.

(iii) **Economies of information.** As the industry expands it can set up research institutes. The research institutes provide market information, technical information etc. for the benefit of all the firms in the industry.

(iv) **Economies of byproducts.** All the firms can lower the costs of production by making use of waste materials.

Diseconomies of scale:

The extensive use of machinery, division of labor, increased specialization and larger plant size etc., no doubt entail lower cost per unit of output but the fall in cost per unit is up to a certain limit. As the firm goes beyond the optimum size, the efficiency of the firm begins to decline. The average cost of production begins to rise.



1. **Internal Diseconomies of scale:**

Factors of internal diseconomies of scale

The main **factors causing diseconomies** of scale and eventually leading to higher per units' cost are as follows:

(i) **Lack of co-ordination.** As a firm becomes large scale producer, it faces difficulty in coordinating the various departments of production. The lack of co-ordination in the production, planning, marketing personnel, account, etc., lowers efficiency of the factors of production. The average cost of production begins to rise.

(ii) **Loose control.** As the size of plant increases, the management loses control over the productive activities. The misuse of delegation of authority, the redtapisim bring diseconomies and lead to higher average cost of production.

(iii) **Lack of proper communication.** The lack of proper communication between top management and the supervisory staff and little feedback from subordinate staff causes diseconomies of scale and results in the average cost to go up.

(iv) **Lack of identification.** In a large organizational structure, there is no close liaison

between the top management and the thousands of workers employed in the firm. The lack of identification of interest with the firm results in the per unit cost to go up

2. **External Diseconomies of scale:**

A firm or an industry cannot avail of economies for an indefinite period of time. With the expansion and growth of an industry, certain disadvantage also begins to arise. The **diseconomies of large-scale production** are:

(i) Diseconomies of pollution, (ii) Excessive pressure on transport facilities, (iii) Rise in the prices of the factors of production, (iv) Scarcity of funds, (v) Marketing problems of the products, (iv) Increase in risks.

A Numerical Example Table 8.6 presents some data for another hypothetical firm. Let us assume that the market has set a \$15 unit price for the firm's product. Total revenue in column 6 is the simple product of $P \times q$ (the numbers in column 1 times \$15). The table derives total, marginal, and average costs exactly as Table 8.4 did. Here, however, we have included revenues, and we can calculate the profit, which is shown in column 8.

TABLE 8.6 Profit Analysis for a Simple Firm

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
q	TFC	TVC	MC	$P = MR$	TR ($P \times q$)	TC ($TFC + TVC$)	Profit ($TR - TC$)
0	\$10	\$ 0	\$—	\$15	\$ 0	\$10	\$-10
1	10	10	10	15	15	20	-5
2	10	15	5	15	30	25	5
3	10	20	5	15	45	30	15
4	10	30	10	15	60	40	20
5	10	50	20	15	75	60	15
6	10	80	30	15	90	90	0

2. Fill the columns in the following table. What quantity should a profit maximizing firm produce? Verify your answer with marginal reasoning.

q	TFC	TVC	MC	P=MR	TR	TC	Profit
0	\$20	\$ 0		\$ 22			
1	\$20	10		\$ 22			
2	\$20	15		\$ 22			
3	\$20	25		\$ 22			
4	\$20	40		\$ 22			
5	\$20	60		\$ 22			
6	\$20	90		\$ 22			

3. Calculate the costs in the table:

q	TFC	TVC	TC	AFC	AVC	AC	MC
0	\$1000	0					
1	\$1000	10					
2	\$1000	18					
3	\$1000	24					
4	\$1000	32					
5	\$1000	42					

Book: 1. Modern_Microeconomics_by_Koutsoyiannis. Chapter-4, Theory of cost- Page 106

2. Economics by Paul Samuelson, William Nordhaus. Chapter-7, Chapter-7, Analysis of Costs, Page-126- 130

Website link for this chapter:

https://www.researchgate.net/publication/326841533_CHAPTER_FIVE_THEORY_OF_COSTS

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