6. COST CURVES IN THE SHORT-AND LONG-RUN

(A) Firm's Short-Run Cost Curves

The short run is a period in which the firm cannot change its plant, equipment and the scale of organisation. To meet the increased demand, it can raise output by hiring more labour and raw materials or asking the existing labour force to work overtime.

The scale of organisation being fixed, the short-run total costs (*TC*) are divided into total fixed costs (*TFC*) and total variable costs (*TVC*):

$$TC = TFC + TVC$$

Total Costs are the total expenses incurred by a firm in producing a given quantity or a commodity. They include payments for rent, interest, wages, taxes and expenses on raw materials, electricity, water, advertising, etc.

Total Fixed Costs are those costs of production that do not change with output. They are independent of the level of output. In fact, they have to be incurred even when the firm stops production temporarily. They include payments for renting land and buildings, interest on borrowed money, insurance charges, property tax, depreciation, maintenance expenditures, wages and salaries of the permanent staff, etc.. They are also called *overhead* costs.

Total Variable Costs are those costs of production that change directly with output. They rise when output increases, and fall when output declines. They include expenses on raw materials, power, water, taxes, hiring of labour, advertising, etc. They are also known as *direct costs*.

The curves relating to these three total costs are shown diagrammatically in Figure 30.3 . The *TC* curve is a continuous curve which shows that with increasing output total costs *TC* also increase. This curve cuts the vertical axis at a point above the origin and rises continuously from left to right. This is because even when no output is produced, the firm has to incur fixed costs. The *TFC* curve is shown as parallel to the output axis because total fixed costs are the same whatever the level of output. The *TVC* curve has an inverted-S shape and starts from the origin *O* because when output is zero, the *TVCs* are also zero. They increase as output increases. So long as the firm is using less variable factors in proportion to the fixed factors, the total variable costs rise at a diminishing rate. But after a point, with the use of more variable factors in proportion to the fixed factors, they rise steeply because of the application of the law of variable proportions. Since the *TFC* curve is a horizontal straight line, the *TC* curve follows the *TVC* curve at an equal vertical distance.

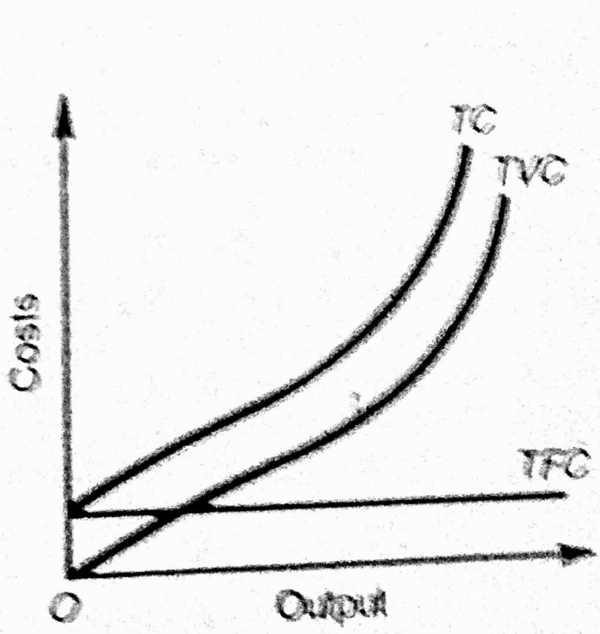

Fig. 30.3

Short-Run Average Costs. In the short run analysis of the firm, average costs are more important than total costs. The units of output that a firm produces do not cost the same amount to the firm. But they must be sold at the same price. Therefore, the firm must know the per unit cost or the average cost. The short-run average costs of a firm are the average fixed costs, the average variable costs, and average total costs.

Average Fixed Costs or AFC equal total fixed costs at each level of output divided by the number of units produced:

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

The average fixed costs diminish continuously as output increases. This is natural because when a constant figure, total fixed costs are divided by a continuously increasing unit of output, the result is continuously diminishing average fixed costs. Thus the *AFC* curve is a downward sloping curve which approaches the quantity axis without touching it, as shown in Figure. 30.4. It is a rectangular hyperbola.

Short-Run Average Variable Costs (or *SAVC*) equal total variable costs at each level of output divided by the number of units produced:

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

The average variable costs decline with the rise in output as larger quantities of variable factors are applied to fixed plant and equipment. But eventually they begin to rise due to the law of diminishing returns. Thus the *SAVC* curve is U-shaped, as shown in Figure 30.4.

Short-Run Average Total Costs (or SATC or SAC) are the average costs of producing any given output. They are arrived at by dividing the total costs at each level of output by the number of units produced:

$$SAC \text{ or } SATC = \frac{TC}{Q} = \frac{TFC}{Q} + \frac{TVC}{Q} = AFC + AVC$$

Average total costs reflect the influence of both the average fixed costs and average variable costs. At first, average total costs are high at low levels of output because both average fixed costs and average variable costs are large. But as output increases, the average total costs fall sharply because of the steady decline of both average fixed costs and average variable costs till they reach the minimum point. This results from the internal economies, from better utilisation of existing plant, labour, etc. The minimum point *B* in the figure represents optimal capacity. As production is increased after this point, the average total costs rise quickly because the fall in average fixed costs is negligible in relation to the rising average variable costs. The rising portion of the *SAC* curve results from producing above capacity and the appearance of internal diseconomies of management, labour, etc. Thus the *SAC* curve is U-shaped, as shown in Figure 30.4.

The U-shape of the *SAC* curve can also be explained in terms of the law of variable proportions. This law tells that when the quantity of one variable factor is changed while keeping the quantities of other factors fixed, the total output increases

but after some time it starts declining. Machines, equipment and scale of production are the fixed factors of a firm that do not change in the short-run. On the other hand, factors like labour and raw materials are variable. When increasing quantities of variable factors are applied on the fixed factors, the law of variable proportions operates. When, say the quantities of a variable factor like labour are increased in equal quantities, production rises till fixed factors like machines, equipment, etc., are used to their maximum capacity. In this stage, the average costs of the firm continue to fall as output increases because it operates under increasing returns. Due to the operation of the law of increasing returns, when the variable factors are increased further, the firm is able to work the machines to their optimum capacity. It produces the optimum output and its average costs of production will be the minimum which is revealed by the minimum point of the *SAC* curve, point *B* in Figure 30.4. If the firm tries to raise output after this point by increasing the quantities of the variable factors, the fixed factors like machines would be worked beyond their capacity. This would lead to diminishing returns. The average costs will start rising rapidly. Hence due to the working of the law of variable proportions the short-run *AC* curve is U-shaped.

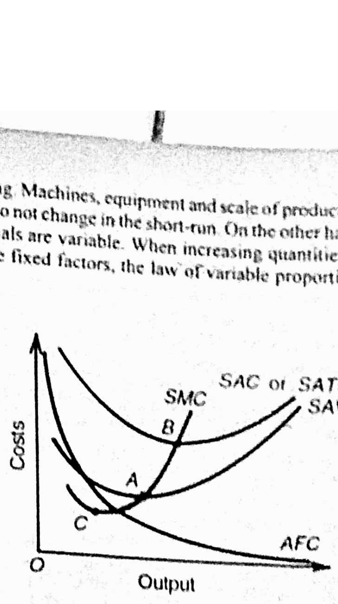

Fig. 30.4

Marginal Cost. A fundamental concept for the determination of the exact level of output of a firm is the marginal cost. Marginal cost is the addition to total cost by producing an additional unit of output:

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

Algebraically, it is the total cost of $n + 1$ units minus the total cost of n units of output, $MC_n = TC_{n+1} - TC_n$. Since total fixed costs do not change with output, therefore, marginal fixed cost is zero. So marginal cost can be calculated either from total variable costs or total costs. The result would be the same in both the cases. As total variable costs or total costs first fall and then rise, marginal cost also behaves in the same way. The *SMC* curve is also U-shaped, as shown in Figure 30.4.

Relationships of Short-Run Cost Curves

The relationships of short-run cost curves are explained in terms of Figure 30.4.

(a) The *AFC* curve declines continuously and is *asymptotic* to both axes. It means that the *AFC* curve approaches both axes but never touches either X-axis or Y-axis. Thus the *AFC* curve is a rectangular hyperbola.

(b) The *SAVC* curve first declines, reaches a minimum at point *A*, and

rises thereafter. When the *SAVC* curve reaches its minimum point *A*, the *SMC* curve equalls the *SAVC* curve.

(c) The *SAC* curve first declines, reaches a minimum at point *B*, and rises thereafter. When the *SAC* curve reaches its minimum point *B*, the *SMC* curve equals the *SAC* curve. Since *SAC* = *AFC* + *A VC*, the vertical distance between the *SAC* and the *SAVC* curves gives the *AFC* curve, So there is no need to draw a separate *AFC* curve. As output expands, the vertical distance between the *SAC* curve and the *SAVC* curve declines because of the falling *AFC* curve.

(d) Relation between AC and MC Curves. There is a direct relationship between *AC* and *MC curves* as shown in Figure 30.5. Both the *AC* curve and the *MC* curve are U-shaped. *When AC falls, MC is less than AC*. This is because the fall in *MC* is related to one unit of output while in the case of *AC* the same decline is spread over all units of output. That is why the fall in *AC* is less and that in *MC* is more. This also explains the fact that *MC* reaches its minimum point *C* before the minimum point *B* of *AC* is reached. So When *MC* starts rising, *AC* is still declining. When *AC is minimum, MC equals AC*. The *MC* curve cuts the *AC* curve from below at its minimum point *B* in the figure.

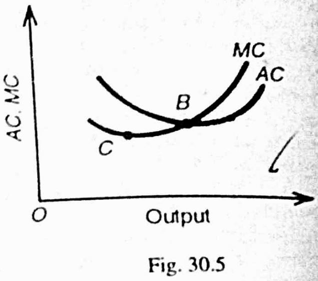

Fig. 30.5

When *AC rises, MC is greater than AC*. *MC* is above *AC* when *AC* is rising but the rise in *MC* is greater than *AC*. This is because the rise in *MC* is the result of the increase in one unit of output while in the case of *AC* the same increase is spread over all units of output.

It should be noted that we cannot say anything about the *direction of MC*, when *AC* rises or falls. When *AC* is falling, it is not essential that *MC* must fall. *MC* can increase or fall but it is definite that *MC* will he less than *AC*. Similarly, when *AC* is increasing, it is not essential that *MC* must rise. *MC* can fall or rise but it is definite that *MC* will be larger than *AC*. But if *AC* is constant, *MC* must be constant.

Relation between SMC and SAVC Curves

The *SMC* curve bears a close relationship to the *SAVC* curve along with the *SAC* curve. So long as the *SMC* curve lies below the *SAVC* and *SAC* curves, it continues to fall and its rate of fall is greater than that of *SAC* and *SAVC* curves. But the *SAVC* and SAC curves start rising from the points *M* and *L* respectively where the *SMC* curve touches them, as shown in Figure 30.6. The *SMC* curve passes through the minimum point of the *SAVC* curve to the left of the minimum point of the *SAC* curve. Since *AC* is the sum total of *SAVC* + *AFC*, therefore when *SAVC* is at its minimum point, *AFC* is falling and it takes time for *SAC* to reach its minimum point. *M* and *L* are thus the respective minimum points of the *SAVC* and *SAC* curves. After these points, the *SMC* curve rises sharply and is above the *SAVC* and *SAC* curves.

Conclusion. Thus the short-run cost curves of a firm are the *SA VC* curve, the *AFC* curve, the *SAC* curve and the *SMC* curve. Out of these four curves, the *AFC* curve is insignificant for the determination of the firm's exact output and is therefore, generally neglected.

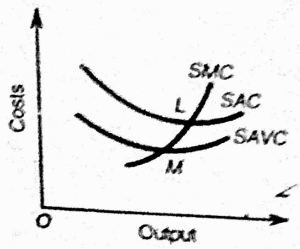

Fig. 30.6

(B) Firm's Long-Run Cost Curves

In the long-run, there are no fixed factors of production and hence no fixed costs. The firm can change its size or scale of plant and employ more or less inputs. Thus in the long-run, all factors are variable and hence all costs are variable.

The long-run average total cost or *LAC* curve of the firm shows the minimum average cost of producing various levels of output from all possible short-run average cost curves *(SAC)*. Thus the *LAC* curve is derived from the *SAC* curves. The *LAC* curve can be viewed as a series of alternative short-run situations into any one of which the firm can move. Each *SAC* curve represents a plant of a particular size which is suitable for a particular range of output. The firm will, therefore, make use of the various plants up to that level where the short-run average costs fall with increase in output. It will not produce beyond the minimum short-run average cost of producing various outputs from all the plants used together.

Let there be three plants represented by their short-run average cost curves SAC_1, SAC_2 *and* SAC_3 in Figure 30.7. Each curve represents the scale of the firm. SAC_1 depicts a lower scale while the movement from SAC_2 to SAC_3 shows the firm to be of a larger size. Given this scale of the firm, it will produce up to the least cost per unit of output. For producing *ON* output, the firm can use SAC_1 or SAC_2 plant. The firm will, however, use the scale of plant represented by SAC_1 since the average cost of producing *ON* output is *NB* which is less than *NA*, the cost of producing this output on SAC_2 plant. If the firm is to produce *OL* output, it can produce at either of the two plants. But it would be advantageous for the firm to use the plant SAC_2 for the *OL* level of output

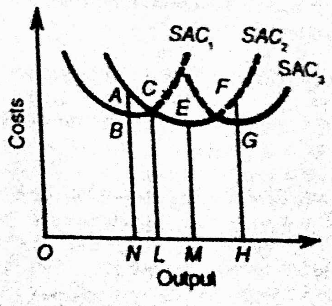

Fig. 30.7

because the larger output *OM* can be obtained at the lowest average cost *ME* from this plant. However, for output *OH*, the firm would use the SAC_3 plant where the average cost *HG* is lower than *HF* of the SAC_2 plant. Thus in the long-run, in order to produce any level of output the firm will use that plant which has the minimum unit cost.

If the firm expands its scale by the three stages represented by SAC_1, SAC_2 and SAC_3 curves, the thick wave-like portions of these curves form the long-run average cost curve. The dotted portions of these *SAC* curves are of no consideration during the long-run because the firm would change the scale of plant rather than operate on them.

But the average long-run cost curve *LAC is* usually shown as a smooth curve fitted to the *SAC* curves so that it is tangent to each of them at some point, as shown in Figure 30.8 where SAC_1, SAC_2, SAC_3, SAC_4 and SAC_5 are the short-run cost curves. It is tangent to all the *SAC* curves but only to one at its minimum point. The *LAC* is tangent to the lowest Point *E* of the curve SAC_3 in Figure 30.8 at *OQ* optimum output. The plant SAC_3 which produces this *OQ* optimum output at the minimum cost *QE* is the optimum plant, and the firm producing this optimum output at the minimum cost with this optimum plant is the *optimum* firm. If the firm produces less than the optimum output *OQ*, it is not working its plant to full capacity and if it produces beyond *OQ*, it is overworking its plants. In both the cases, the plants SAC_2 and SAC_4 have higher average costs of production than the plant SAC_3.

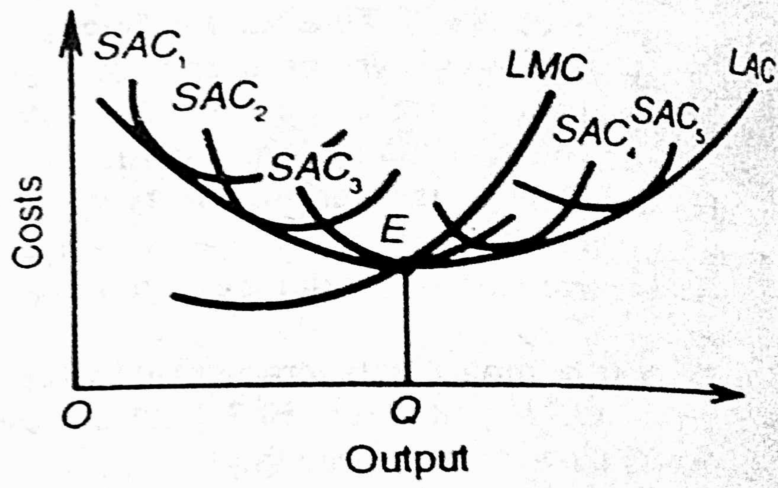

Fig. 30.8

The *LAC* curve is known as an "envelope" curve because it envelopes all the *SAC* curves. According to Stonier and Hague, "In a sense, the term 'envelope' is misleading. An envelope is physically distinct from the letter which it contains. But every point on an envelope long-run cost curve is also a point on one of the short-run cost curves which it envelopes."[1] According to Prof. Chamberlin : "It is composed of plant curves; it is the plant curve. But it is better to call it a "planning" curve because the firm plans to expand its scale of production over the long-run."

The long-run marginal cost *(LMC)* curve of the firm is derived from the *SAC* curves, as illustrated in Figure 30.9 where the SAC_1, SAC_2 and SAC_3 curves are enveloped by the *LAC* curve at points *C*, *E* and *D* respectively. Draw perpendiculars CQ_1, EQ_2 and DQ_3 from these respective points on the *X*-axis. When the points *A*

1. A.W. Stonier and D.C. Hague, A *Text Book of Economic Theory*. 1976.

Chapter 31

The Concept of Revenue

1. TOTAL, AVERAGE AND MARGINAL REVENUE

The revenue of a firm together with its costs determines profits. We, therefore, turn to the study of the concept of revenue.

The term 'revenue' refers to the receipts obtained by a firm from the sale of certain quantities of a commodity at various prices. The revenue concept relates to total revenue, average revenue and marginal revenue.

Total revenue is the total sale proceeds of a firm by selling a commodity at a given price. If a firm sells 2 units of a commodity at Rs. 18, total revenue is $2 \times 18 =$ Rs. 36. Thus total revenue is price per unit multiplied by the number of units sold, *i.e.*, $R = P \times Q$, where R is the total revenue, P the price and Q the quantity.

Average Revenue. (AR or A) is the average receipts from the sale of certain units of the commodity. It is found out by dividing the total revenue by the number of units sold. In our above example, average revenue is $36 \div 2 =$ Rs. 18. The average revenue of a firm is, in fact the price of the commodity at each level of output. Since

$$R = P \times Q$$

$$\therefore \; A = R/Q = P \times Q/Q = P$$

$$\text{and } P = f(Q)$$

Thus the functional relationship $P = f(Q)$ is the average revenue curve which reflects price as a function of quantity demanded. It is also the demand curve.

Marginal revenue (MR or M) is the addition to total revenue as a result of a small increase in the sale of a firm. Algebraically, M is the addition to R by selling $n+1$ units instead of n units. $M = dR/dQ$, where d represents a change.

Since we are concerned mainly with the relationship between average revenue and marginal revenue, we ignore total revenue in our discussion. The relationship between average revenue and marginal revenue under pure competition, monopoly and other market situations is discussed below.

2. RELATION BETWEEN *AR* AND *MR* CURVES

The relation between average revenue and marginal revenue can be discussed under pure competition, monopoly or monopolistic competition or imperfect competition.

(1) Under Pure Competition. The average revenue curve is a horizontal straight line parallel to the X-axis and the marginal revenue curve coincides with it. This is because under pure (or perfect) competition the number of firms selling an