

Managerial Economics

M.Com IV Sem.

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Date: 26/04/2020

Cost Analysis

Contt..

8.3.3 Costs in the Long Run

The long run is a period of time during which the firm can vary all its inputs. None of the factors is fixed and all can be varied to expand output. Long run is a period of time sufficiently long to permit changes in the plant, that is, in capital equipment, machinery, land, etc., in order to expand or contract output. The long run cost of production is the least possible cost of production of producing any given level of output when all inputs are variable including the size of the plant. In the long run there is no fixed factor of production and hence there is no fixed cost.

$$\text{If } Q = f(L, K)$$

$$TC = L.P_L + K.P_K$$

Given factor prices and a specific production function, one can draw an expansion path which gives the least costs associated with various levels of output which in fact yields the long run total cost schedule/curve. LTC is an increasing function of output. The rates of change in these two variables are not known unless the qualitative relationship is quantified. If one recalls the concept of returns to scale and assumes fixed factor prices, one could see three things:

When returns to scale are increasing, inputs are increasing less than in proportion to increases in output. It follows that total cost also must be increasing less than in proportion to output. This relationship is shown in Figure 8.3(a).

When returns to scale are decreasing, total cost increases at a faster rate than does output. This relationship is shown in Figure 8.3(b).

When returns to scale are constant, total cost and output move in the same direction and same proportion. This is also shown in Figure 8.3(c).

Thus, depending upon the nature of returns to scale, there will be a relationship between LTC and output, given factor prices. It is generally found that most industries and firms reap increasing returns to scale to start with which are followed by constant returns to scale which give place to decreasing returns to scale eventually. In this case, the long run total cost function first would increase at a decreasing rate and then increase at an increasing rate as shown in Figure 8.4. Such a total cost function would be associated with a U-shaped long run average cost function.

From LTC curve we can derive the firm's long run average cost (LAC) curve. LAC is the long run total cost (LTC) divided by the level of the output (Q). That is,

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

Similarly, from the LTC curve we can also derive the long run marginal cost (LMC) curve. This measures the change in LTC per unit change in output and is given by the slope of the LTC curve. That is,

$$LMC = \frac{\Delta LTC}{\Delta Q} \text{ or } \left(\frac{dLTC}{dQ} \right)$$

The relationships among the long run total cost, long run marginal cost with respect to output are explained in the following table and Figure 8.5.

Figure 8.3(a): Increasing Returns in Scale

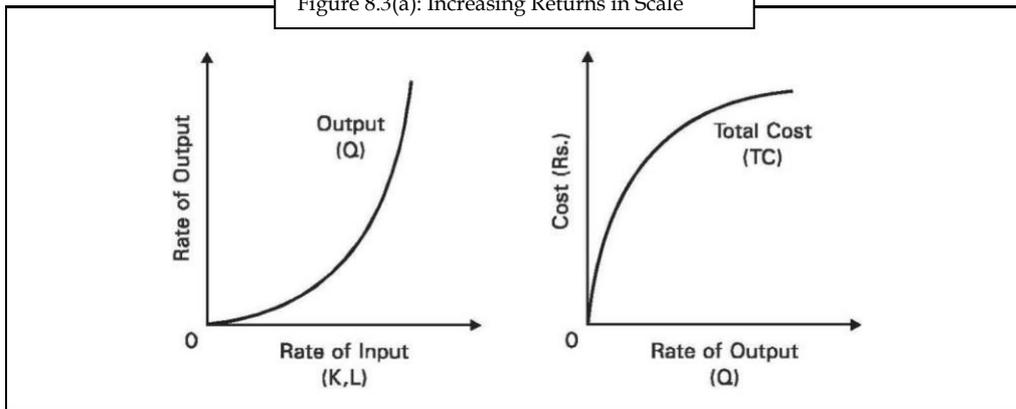


Figure 8.3(b): Decreasing Returns in Scale

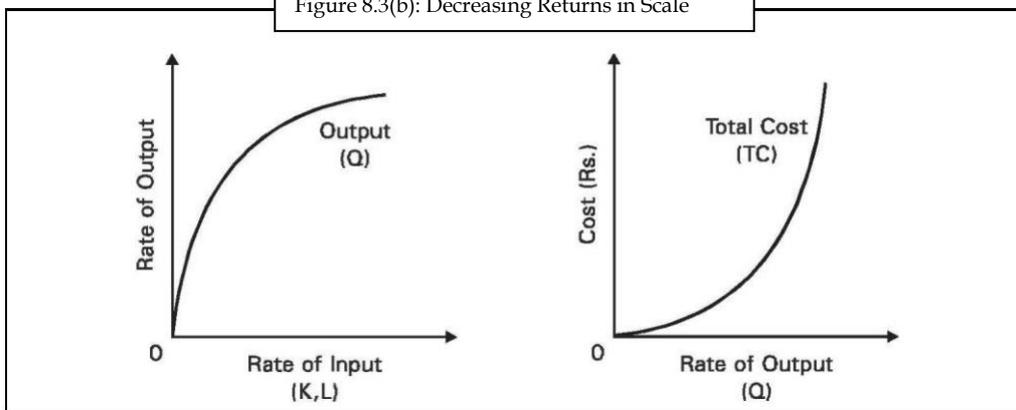
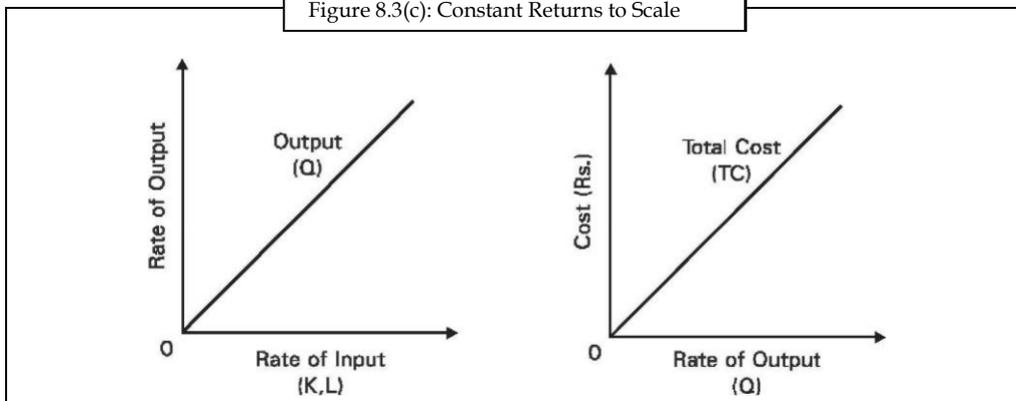
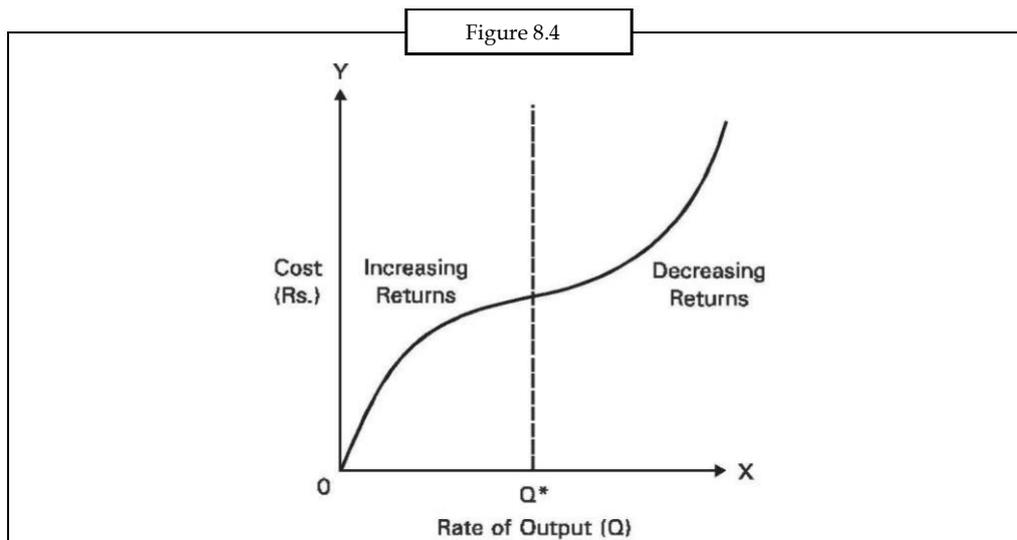


Figure 8.3(c): Constant Returns to Scale





The graphs of above relationships are provided in Figure 8.5.



Did u know? Can average cost curve be stair shaped or L-shaped?

Economic theory often mentions U-shaped nature of average cost curve, but in reality, we come across various other types like the stair-shaped one, L-shaped learning curve or flat bottomed average cost curve. To take care of these empirical situations, the modern theory of costs has been developed.

Table 8.2

| Q | LTC | LAC | LMC |
|----|-----|------|-----|
| 0 | 0 | - | - |
| 5 | 25 | 5.00 | 5 |
| 10 | 45 | 4.50 | 4 |
| 15 | 60 | 4.00 | 3 |
| 20 | 85 | 4.25 | 5 |
| 25 | 120 | 4.85 | 7 |
| 30 | 180 | 6.00 | 12 |

The LTC curve gives the least total cost for various levels of output when all the factors of production are variable. Its shape is such that the curve is first concave and then convex as looked from the output axis. As seen above its shape follows from the operations of the varying degrees of returns of scale, given the factor prices.

The relationship between LAC and LMC follow from that of LTC curve. Both LAC and LMC are U-shaped. Further, the following relationships hold good:

At the point of inflection on LTC curve (A), LMC takes the minimum value.

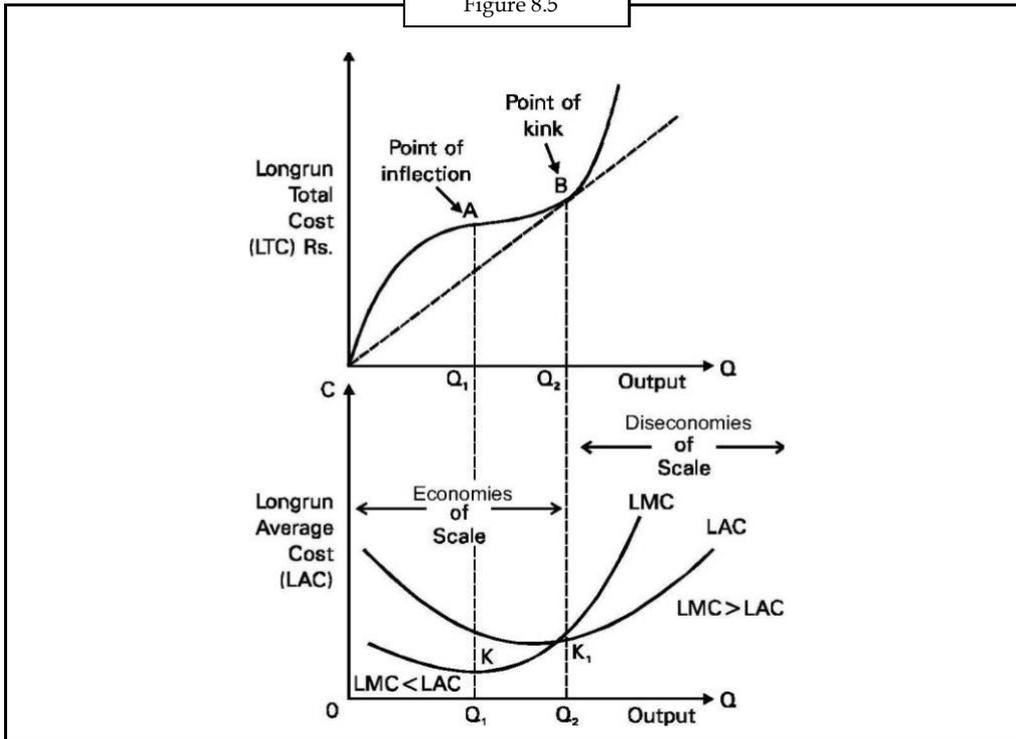
At the point of kink of LTC curve (B) – where the slope of the straight line from origin to the LTC curve is the minimum – LAC assumes the minimum value.

LAC is the least when $LMC = LAC$.

LAC curve is falling when $LMC < LAC$

LAC curve is rising when $LMC > LAC$.

Figure 8.5



Fill in the blanks in the following table:



Task

| Output | TFC | TVC | TC | MC | AFC | AVC | ATC |
|--------|-----|-----|-----|----|-----|-----|-----|
| 1 | 100 | 50 | | | | | |
| 2 | | | | 30 | | | |
| 3 | | | | | | 40 | |
| 4 | | | 270 | | | | |
| 5 | | | | | | | 70 |

8.4 Total Cost, Average Cost and Marginal Cost

Total cost includes all cash payments made to hired factors of production and all cash charges imputed for the use of the owner's factors of production in acquiring or producing a good or service. Thus, total cost of a firm is the sum total of the explicit plus implicit expenditures incurred for producing a given level of output. For example, a shoe maker's cost will include the amount he spends on leather, thread, rent for his workshop, wages, interest on borrowed capital, salaries of employees, etc., and the amount he charges for his services and his own funds invested in the business.

Average cost is the cost per unit of output assuming that production of each unit of output incurs the same cost. That is, it is obtained by dividing the total cost by the total quantity produced. If $TC=100$ and $X=10$, $AC = 10$.

Marginal cost is the extra cost of producing one additional unit. At a given level of output, one examines the additional costs being incurred in producing one extra unit and this yields the marginal cost. For example, if the total cost of a firm is 5,000 when it produces 10 units of a good but when 11 units of the good are produced, it increases to 5,300 then the marginal cost of the eleventh unit is $5,300 - 5,000 = 300$. In other words, marginal cost of n th units (MC_n) is the difference between total cost of n th unit (TC_n) and total cost of $n-1$ th unit (TC_{n-1}).

$$MC_n = TC_n - TC_{n-1}$$

The relationship between MC, AC and TC is shown in the following table.

Table 8.3

| Units of goods produced (1) | Total Cost (TC) (2) | Average Cost (3 = 2/1) | Marginal Cost ($TC_n - TC_{n-1}$) (4) |
|--------------------------------|------------------------|---------------------------|---|
| 10 | 5,000 | 500 | - |
| 11 | 5,300 | 481.82 | 300 |
| 12 | 5,550 | 462.5 | 250 |
| 13 | 5,700 | 438.46 | 150 |
| 14 | 5,950 | 425.00 | 250 |
| 15 | 6,350 | 423.33 | 400 |

The total cost concept is useful in break-even analysis and in finding out whether a firm is making profits or not. The average cost concept is significant for calculating the per unit profit of a business concern. The marginal and incremental cost concepts are needed in deciding whether a firm needs to expand its production or not. In fact, the relevant costs to be considered will differ from one situation to the other depending on the problem faced by the manager.



Example The Cost of Producing Rings

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| Output (1) | Fixed Costs (TFC) (2) | Variable Costs (TVC) (3) | Total Costs (TC) (TFC+TVC) (4) | Average Fixed (TC) Costs (AFC=FC/Output) (5) | Average Variable Costs (AVC=VC/Output) (6) | Average Costs (ATC= AFC+AVC) (7) |
|---------------|--------------------------|-----------------------------|-----------------------------------|---|---|-------------------------------------|
| 4 | 50 | 50 | 100 | 12.50 | 12.50 | 25.00 |
| 5 | 50 | 60 | 110 | 10.00 | 12.00 | 22.00 |
| 10 | 50 | 100 | 150 | 5.00 | 10.00 | 15.00 |
| 11 | 50 | 106 | 156 | 4.54 | 9.64 | 14.18 |
| 17 | 50 | 150 | 200 | 2.94 | 8.82 | 11.76 |
| 18 | 50 | 157 | 207 | 2.78 | 8.72 | 11.50 |
| 21 | 50 | 182 | 232 | 2.38 | 8.67 | 11.05 |
| 23 | 50 | 200 | 250 | 2.17 | 8.70 | 10.87 |
| 24 | 50 | 210 | 260 | 2.08 | 8.75 | 10.83 |
| 28 | 50 | 250 | 300 | 1.79 | 8.93 | 10.72 |
| 29 | 50 | 265 | 315 | 1.72 | 9.14 | 10.86 |
| 32 | 50 | 350 | 400 | 1.56 | 10.94 | 12.50 |

$$TC = FC + VC$$

$$ATC = TC/Q$$

$$AFC = FC/Q$$

$$AVC = VC/Q$$

$$ATC = AFC + AVC$$

Managerial economics devotes a great deal of attention to the behaviour of costs. Total cost varies directly with output. The more output a firm produces, the higher will be its production cost and vice versa. This is because increased production requires increased use of raw materials, labour, etc., and if the increase is substantial even fixed inputs like plant and equipments and managerial staff may have to be increased. The relationship between cost and output is rather important.

8.5 Economies of Scale

A larger plant will lead to lower per unit cost in the long run. However, beyond some point, successive larger plants will mean higher average costs. Exactly, why is the long run ATC curve U-shaped, needs further explanation.

It must be emphasised, first of all, that the law of diminishing returns is not applicable here for it presumes that one resource is fixed in supply and also that in the long run resource prices are variable. Also, we assume that

resource prices are constant in the short run. The U-shaped long run average cost curve is explainable, thus, in terms of “economies and diseconomies” of large scale production.

Economies and diseconomies of scale are concerned with the behaviour of average cost curve as the plant size is increased. Economies of scale explain the down sloping part of the long run AC curve. As the size of the plant increases, LAC typically declines over some range of output for a number of reasons. The most important is that, as the scale of output is expanded, there is greater potential for specialisation of productive factors. This is most notable with regard to labour but may apply to other factors as well. Other factors contributing to declining LAC include ability to use more advanced technologies and more sophisticated capital equipment, managerial specialisation, opportunity to take advantage of lower costs for some inputs by purchasing larger quantities, effective utilisation of by-products, etc.

But after sometime, expansion of a firm’s output may give rise to diseconomies, and therefore, higher per unit cost. Further expansion of output beyond a reasonable level may lead to problems of over crowding of labour, managerial inefficiencies, etc., pushing up per unit cost.

All these are examples of internal economies and diseconomies of scale arising due to the firm’s own expansion. According to Marshall, external economies and diseconomies of scale may arise due to the expansion of industry as a whole.



Example: Improved infrastructure facilities due to industrial expansion may lead to reduction in per unit cost of production in all the firms in an industry.

8.6 Types of Revenue Curves and their Applications

We have already discussed the shapes of the revenue curves in the previous unit. Just to refresh your memories, we will define the terms once again.

Total revenue (TR) is the total money received from the sale of any given quantity of output during a given period of time. ($TR = P \times Q$, where P is the Price per unit and Q is the total quantity sold)

Average revenue (AR) is the total receipts from sales divided by the number of units sold, i.e., $AR = TR/Q$. It plays a major role in the determination of a firm’s profit. The ‘per unit profit’ of a firm is determined as average revenue minus average (total) cost. A firm generally seeks to produce the quantity of output that maximises profit. (We will discuss this concept in subsequent units.)

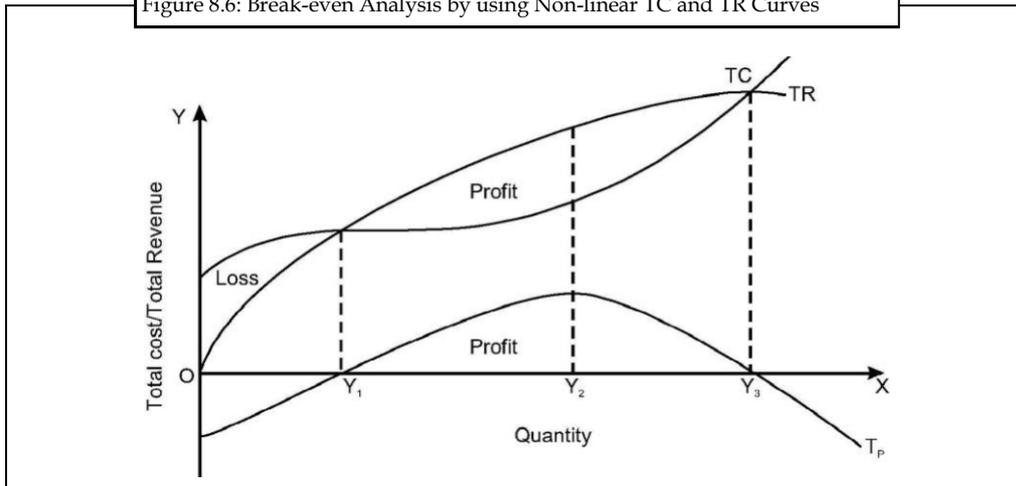
Marginal Revenue is the revenue associated with one additional unit of production. Marginal revenue is calculated as:

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

Break-even Analysis

Many of the planning activities that take place within a firm are based on anticipated level of output. The study of the interrelationship among firm’s sales, costs and operating profits at various level of output levels is known as cost-volume profit analysis or break-even analysis. This analysis is often used by business executive to determine the sales volume required to break even and total profits and losses at different output levels. For illustrating the breakeven analysis. It is assumed that the cost and revenue curves are non-linear as shown in Figure 8.6. Total revenue is equal to the number of units of output sold multiplied by the price per unit. The concave form of revenue curve implies that the firm can sell additional units of output only by lowering the price. The total cost curve is based on traditional approach of relationship between cost and output in short-run.

Figure 8.6: Break-even Analysis by using Non-linear TC and TR Curves



The difference between total revenue and total cost at any level of output represents the total profit or loss that will be realised. The total profit (TP) at any level of output is given by vertical distance between the total revenue (TR) and total cost (TC) curves. A breakeven situation (zero profit) occurs whenever total revenue equals total cost. In Figure, breakeven condition occurs at two different output level- Y_1 and Y_3 . Below an output level Y_1 losses will incurred because $TR < TC$. Between Y_1 and Y_3 profits will be obtained because $TR > TC$. An output level above Y_3 , losses will occur again because $TR < TC$. Total profit are maximised within the range of Y_1 to Y_3 , where the vertical distance between the TR and TC curves is greatest, that is at an output level of Y_2 .

For practical decision making the non-linear revenue output and cost output relationship of economic theory are generally replaced by linear functions. The breakeven analysis based on linear function is shown in Figure 8.7

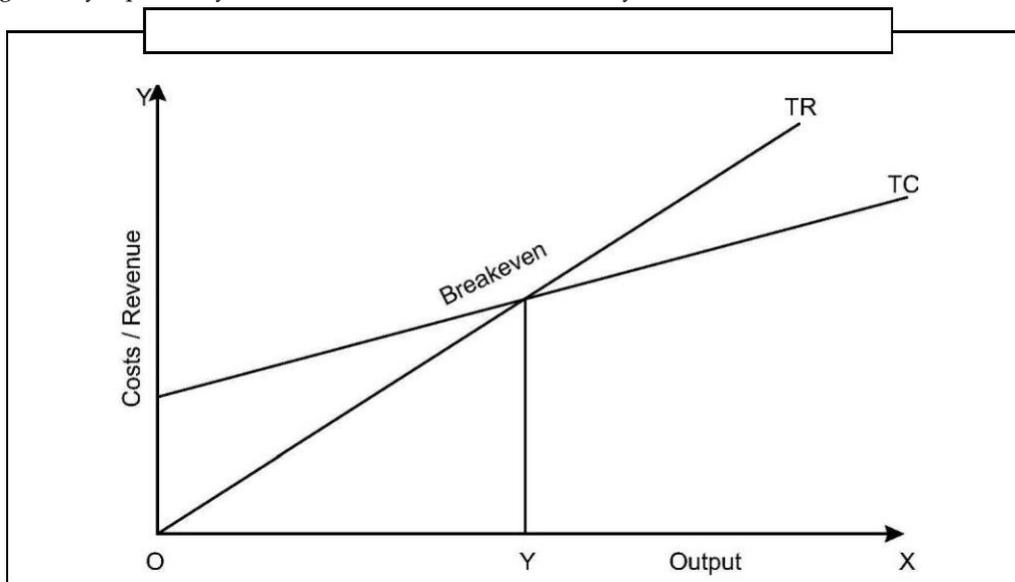


Figure 8.7: Break-

even Analysis by using Linear TC and TR Curves

Here TR is a straight line assuming that firms change a constant selling price P per unit of output. In case of cost curve, total cost is taken as sum of fixed cost which are independent of the output level plus the variable costs which increases at a constant rate per unit of output. In this case the breakeven analysis occurs at point Y_b in Figure 8.7 where TR and TC intersect. If a firm's output level is below this breakeven point that is If $TR < TC$, it incurs operating losses. If firm's output level is above this breakeven point that is if $TR > TC$ it realises operating profits. Algebraically, it can be defined as:

Total revenue is equal to the selling price per unit times the output level.

$$TR = P \times Y$$

Total cost is equal to fixed cost plus variable cost, where the variable cost is the product of the variable cost per unit times the output level.

$$TC = TFC + AVC \times QY$$

Now break-even output level is that level where profit is zero.

$$TR = TC.$$

$$P \times Y = TFC + AVC \times Y$$

$$P \times Y - AVC \times Y = TFC$$

$$Y (P - AVC) = TFC$$

$$Y =$$

$$\frac{TFC}{P - AVC}$$

8.7 Summary

Costs enter into almost every business decision and it is important to use the right analysis of cost. Different business problems call for different kinds of costs such as future and past costs, incremental and sunk cost, out of pocket and book costs, replacement and historical costs etc.

- Fixed costs are those costs which do not vary with the change in the level of output in the short run. Variable costs change with output levels.

The short run is a period of time in which the output can be increased or decreased by changing only the amount of variable factors such as labour, raw materials, chemicals, etc. Long run, on the other hand, is defined as the period of time in which the quantities of all factors may be varied.

- There are short run average fixed cost and variable cost as well as long run average costs.
- Total cost is the sum of total of the explicit plus implicit expenditure. Average cost is the cost per unit of output. Marginal cost is the extra cost of producing one additional unit.
- Economies of scope are reductions in average costs attributable to an increase in the number of goods produced.

8.8 Keywords

Abandonment costs: Costs incurred for disposing of the fixed assets, when any plant is to be permanently closed down.

Book costs: Costs that do not require current cash expenditure.

Direct costs: Costs which can be directly attributed to the production of a unit of a given product.

Explicit costs: Expenses which are actually paid by the firm (paid-out-costs).

Implicit costs: Theoretical costs which go unrecognized by the accounting system.

Incremental costs: Costs that are defined as the change in overall costs that result from particular decision being made.

Indirect costs: Costs which cannot be separated and clearly attributed to individual units of production.

Opportunity costs: The return from the second best use of the firm's resources which the firm forgoes in order to avail itself of the return from the best use of the resources.

Shut-down costs: Costs incurred when the production operations are suspended and will not be incurred, if the production operations continue.

Sunk costs: Costs that are not affected or altered by a change in the level or nature of business activity.

Variable costs: Costs which are incurred on the employment of variable factors of production whose amount can be altered in the short-run.

8.9 Self Assessment

1. State true or false for the following statements:

Past cost are unadjusted historical cost data which have been recorded in the books. (b) Incremental costs include only variable cost.

Replacement costs means the price that would have to be paid currently for acquiring the same plant.

Explicit costs cannot be regarded as paid out costs.

Actual costs are also called absolute costs or outlay costs.

Average cost is obtained by dividing the total cost by the total quantity produced.

Fixed costs can be altered in short run.

Social cost is the total cost to the society on account of production of a good.

2. Fill in the blanks:

Shut-down costs are required to be incurred when the production operations are

Economic costs can be calculated at two levels

Marginal cost is the extra cost of producing

(d) AVC first, reaches a minimum and rises thereafter.

(e) Implicit costs are the costs which go unrecognized by the

(f) Capital equipment is a factor.

(g) The total cost concept is useful in analysis.

(h) Direct costs are costs.

Answers: Self Assessment

- | | | | |
|-----------------------|---------------------------------|-------------------------|---------------|
| 1. (a) True | (b) False | (c) True | (d) False |
| (e) True | (f) True | (g) False | (h) True |
| 2. (a) suspended | (b) micro level and macro level | (c) one additional unit | (d) declines |
| (e) accounting system | (f) fixed | (g) break even | (h) traceable |