

UNIT-III

(Production and Cost Analysis)

MODULE- 2: COST OUTPUT RELATIONSHIP-I

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2.0: OBJECTIVES:

The objective of this module is to discuss the cost output relationship. After reading this module you should be able to understand the relationship between output and

Total cost

Total fixed cost

Total variable cost.

2.01: Total cost:

The value of fixed and variable factors of production employed by the business firm to produce a given level of output is called total cost. Output is the result of combining together fixed and variable factors in required proportions. The fixed factors are plant, machinery, salaries to permanent employees etc. The variable factors are rawmaterial, fuel, power charges, other working expenses etc. Therefore, the total cost consists of fixed and variable costs together. As the volume of output increases the total cost also increases. In the short run, the shape and position of total cost curve is influenced by the nature of returns experienced by the business firm. Where as in the long run the shape and position of total cost curve is determined by the nature of returns to scale.

2.02: Total Fixed Cost:

The expenditure incurred by a firm towards employing fixed factors of production is called total fixed cost. In the short run total fixed will remain constant. The time period (short run) is such that, it doesn't allow the managers' to make adjustment in fixed factors

of production. Regardless of level of output, business firms' have to bear these fixed costs in the short run. The basic nature of fixed costs is that, they do not change as a result of variations in volume of output. Even at zero level of output, the fixed costs are positive.

2.03: Total Variable Cost:

The expenditure incurred by a business firm towards employing variable factors of production is called as total variable cost. These costs vary as a result of variations in volume of output. As output increases, variable cost also increases and vice versa. In the beginning, as output increases, total variable cost also increases but at a decreasing rate. As there is an increase in output further, variable cost increases at an increasing rate.

We can understand the relationship between output and cost in the short run with the help of following numerical example:

		Output	Total Fixed
Cost	Total Variable Cost	Total Cost	
		(In '000Units)	(Rs in
		crores)	(Rs in crores)
		(Rs in crores)	

0	100

100	
1	100
30	
130	
2	100
45	
145	
3	100
55	
155	
4	100
60	
160	
5	100
62	
162	
6	100
78	
178	

7	100
105	
205	
8	100
160	
260	
9	100
225	
325	
10	100
300	
400	

It is clear from the above example that total fixed cost remains constant regardless of the volume of output produced by a firm. In the short run business firm by employing Rs 100 crore worth of fixed factors, can produce any volume of output i.e from 0 (zero) units to 10 thousand units. In the short run, the fixed nature of fixed costs acts as an obstacle on the part of business firm. In the short run if there is sudden increase in the demand for the product, business firm cannot make adjustment in fixed factors to meet increased demand. It has to produce an increased quantity with the

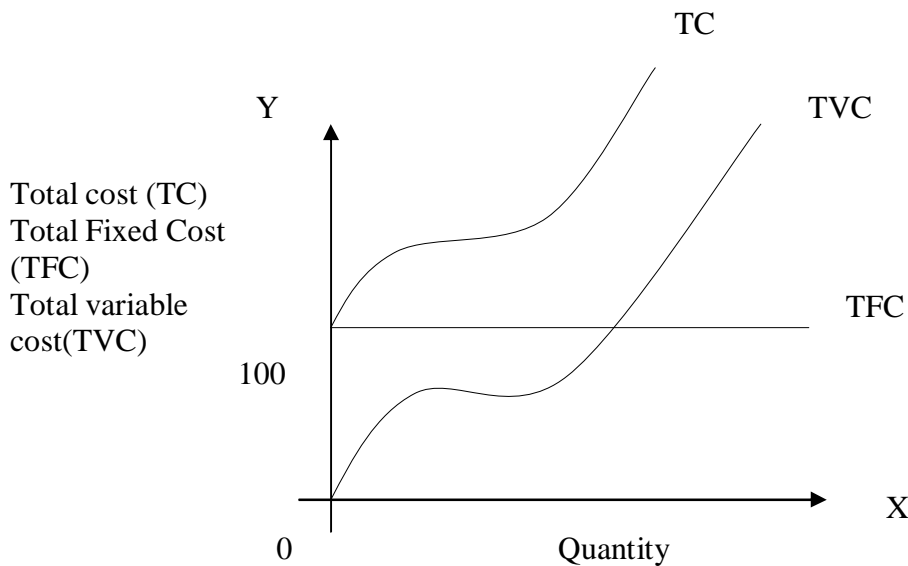
same fixed factors. The time period is not long enough to affect changes in fixed factors of production.

As the volume of output increases, variable cost also moving in the same direction. In the beginning, total variable cost is increasing at a decreasing rate up to the production level of 5000 units. This is due to the increasing returns experienced by the firm in the production process. Beyond 5000 units, as output increases, total variable cost is increasing at an increasing rate. This is due to the diminishing returns experienced by the firm. At zero level of output, total variable cost is zero. If firm is not producing output i.e zero output, there is no need for the firm to incur any amount towards variable cost.

Total cost is the sum of fixed and variable cost at any given level of output. That is $TC = TFC + TVC$. Here TC is the total cost, TFC is the total fixed cost and TVC is the total variable cost. As the volume of output increases, total cost also moving in the same direction. In the beginning, total cost is increasing at a decreasing rate up to the production level of 5000 units. This is due to the increasing returns experienced by the firm in the production process. Beyond 5000 units, as output increases, total cost is increasing at an increasing rate. This is due to the diminishing

returns experienced by the firm. At zero level of output, total cost is Rs 100 crore. We can understand the cost output relationship with the help of following diagram.

GRAPH-1



2.04: Cost Functions and cost Estimation:

The important problem of managerial economist is that of choosing the type of equation or cost function that fits the data best. There are three types of cost functions a managerial economist can adopt. They are : (1) Linear (2) quadratic (3) cubic cost function.

Linear cost function:

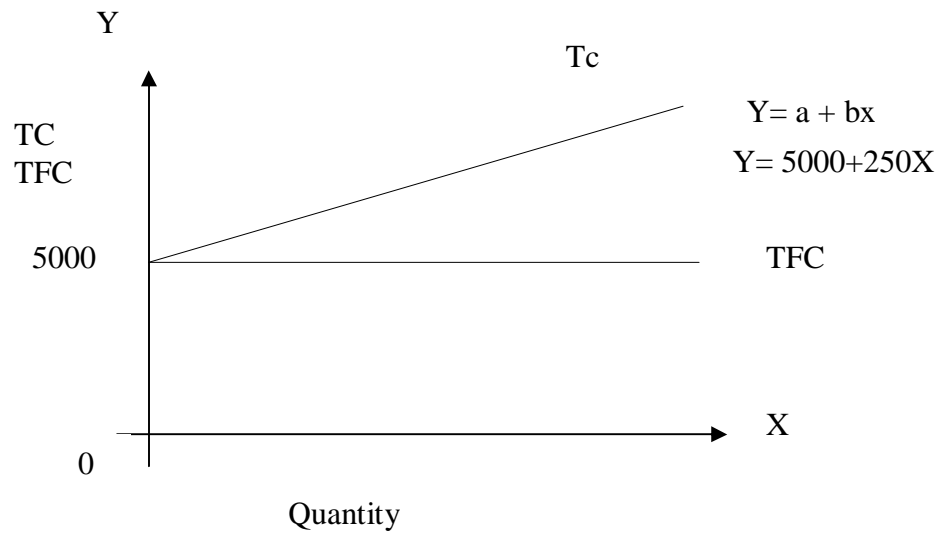
$Y = a + bX$. Here 'a' is the fixed cost and 'b' is the proportion of variable cost. 'X' is output. bX is the total variable cost. 'Y' is the total cost. The underlying assumption of this function is that, the firm has fixed costs which must be met irrespective of the quantity of output produced. In the linear cost function 'b' is assumed to be constant and hence total cost is represented by upward sloping straight line.

Let us assume that the estimated cost function is $Y = 5000 + 250X$. Given this function we can estimate cost at different levels of output as shown below.

Output(X) Cost(Y) (Units) (Rs.)	Total
0	5000
1	5250
2	5500
3	5750
4	6000

5	6250
6	6500

GRAPH-2



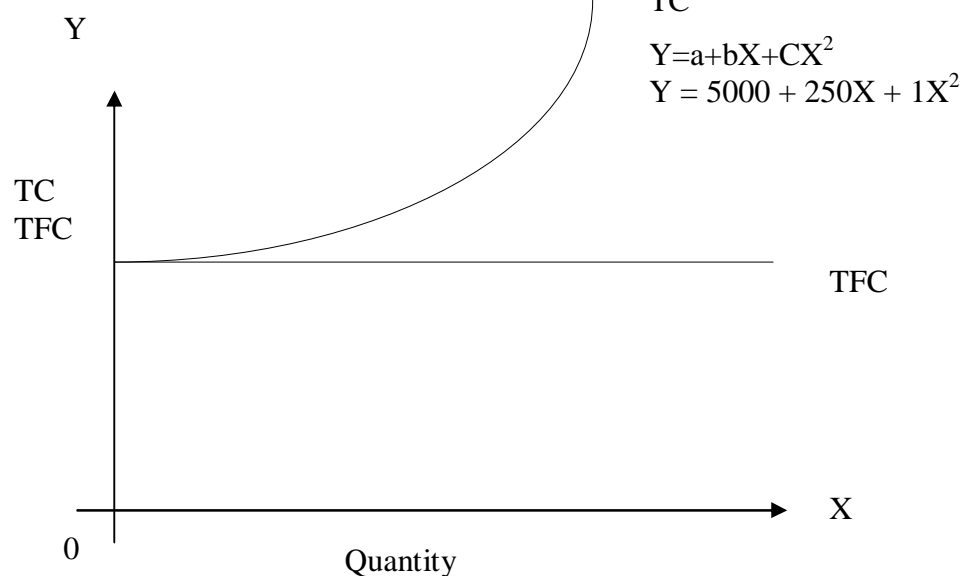
Quadratic Cost Function:

$$Y = a + bX + cX^2$$

This function indicates that as output (X) increases, total variable in the beginning increases at a decreasing rate. Beyond a level of output, Cx^2 in the function shows that, total variable cost increases at an increasing rate. Let us assume that estimated total cost

function as $Y = 5000 + 250X + 1X^2$. This function indicates, that the fixed costs of the firm Rs 5000 and whose variable costs are $250X + 1X^2$. The last variable might arise if the firm's initial cost of labour and rawmaterial for producing X units is Rs $250X$ and the growing demand for the limited supply of inputs bids up their prices by the amount X^2 as output increases. By substituting the quantity of output in place of 'X' in the above estimated cost function; we can derive the relationship between output and total cost.

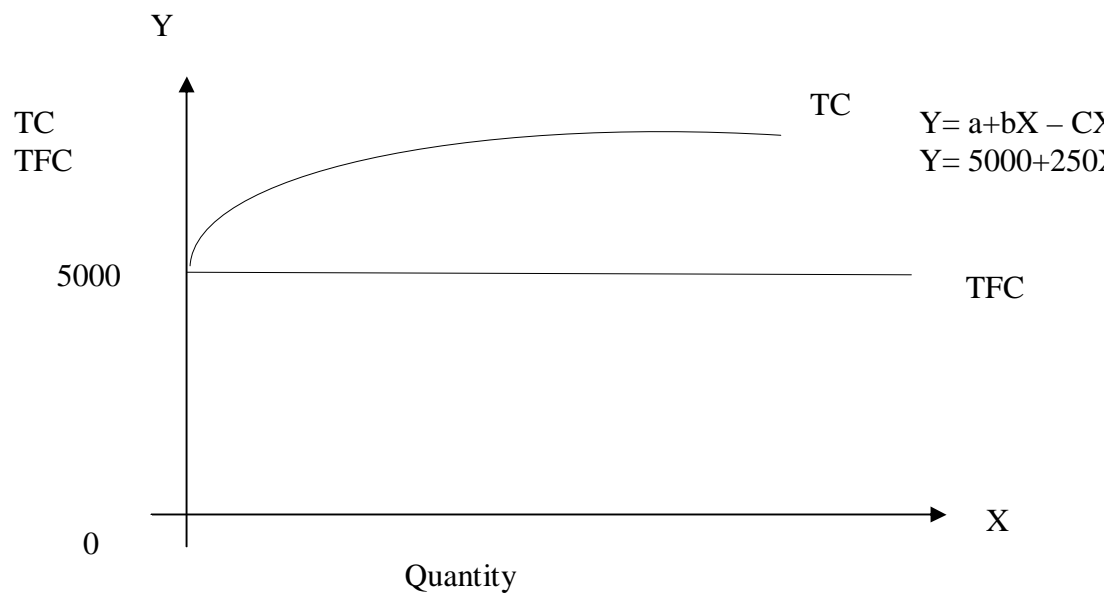
GRAPH-3



Managers' can also use quadratic function as $Y = a + bX - cX^2$. This function indicates that as the quantity of output increases,

even though the demand for factors of production increases, factor prices decreases due to elastic supply of factors of production. Let us assume the estimated demand function as $Y = 5000 + 250 X - 0.1 X^2$. Given the values of quantity, it is possible to find out the cost output relationship.

GRAPH- 4

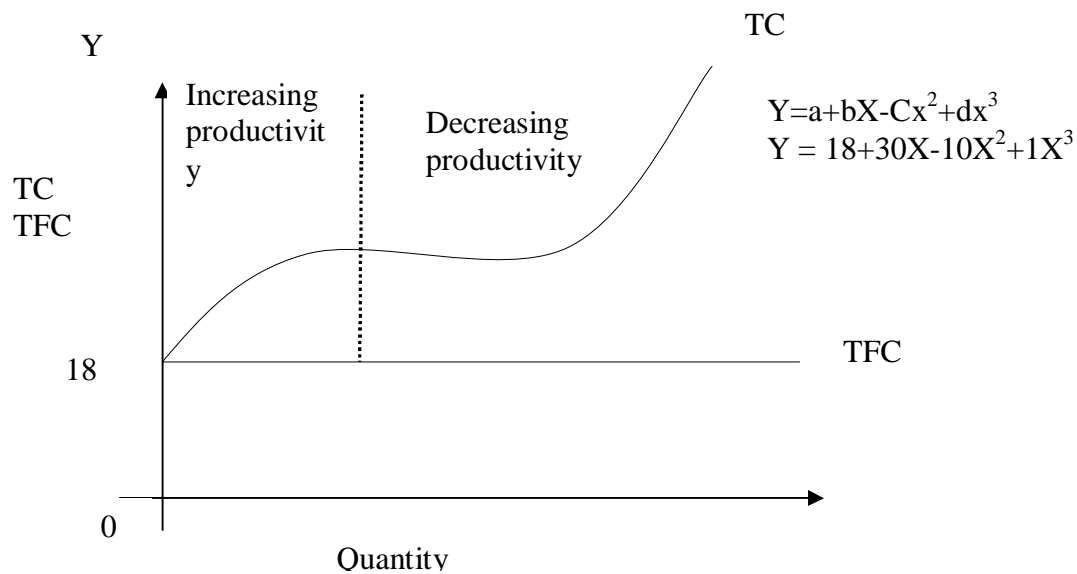


Cubic Cost function:

The form of this cost function is $Y = a + b X - c X^2 + dx^3$. This function indicates that as the volume of output increases, it leads to increase in the productivity of variable factors of production.

Hence total cost increases but at a decreasing rate. Beyond a point if output increases, it leads to fall in productivity of variable factors of production. Hence total cost increases at an increasing rate. Let us assume the estimated cost function as $Y = 18 + 30X - 10X^2 + X^3$. Given the level of output, we can find out cost –output relationship using the cubic cost function.

GRAPH- 5



ACTIVITY-1

1. Given the cost function $Y = 10 + 3X - 6X^2 + X^3$ derive the cost output relation and show the same with the help of graph.

2. Given the cost function $Y = 6000 + 200X + 0.1X^2$, Find the total cost and total variable cost at output level 400 units and 600 units.

2.05: Cost estimation methods:

Four broad approaches exist for the measurement of actual cost output relationship. They are:

Accounting method:

This method is used by the cost accountants. In this method the data is classified in to various categories. By plotting the output levels and corresponding costs on a graph and joining them by a line the cost functions are estimated. The cost functions thus found may be linear or non-linear.

Statistical or Econometric method:

This method adopts statistical techniques to find cost output relationship. The economic data may relate to past records of the firm i.e. the time series data or different firms in the same business at a point of time. i.e. cross section data.

Survivorship method:

This method is based on the rationale that over time competition tends to eliminate firms of inefficient size and that only the firms with efficient size will survive and these will have lower average cost. In this method firms in the industry are classified in to size groups. Growth of firms in each size is examined. The size –group whose share in the industry grows the most during a specified time period is considered the most efficient size. For example if the share of small firms in the industry moved upwards at the cost of the share of large firms, it implies that the optimum size of a firm in the present case is the small sized one.

Engineering Method:

In this method, the cost functions are estimated with the help of physical relationships such as weight of the finished product and the weight of rawmaterials used. Then these rawmaterials are converted into money terms to arrive at an estimate of cost.

2.06: Summary:

In this module an attempt has been made to discuss and understand cost output relationship. The expenditure incurred by a firm on various inputs to produce a given level of output is called total cost. Total cost consists of total fixed cost and total variable cost. In the short-run total fixed cost will remain constant. On the other

hand, total variable cost depends on the nature of returns experienced by the business firm. In the beginning, as the volume of output increases, total variable cost increases at a decreasing rate. Beyond a level of output, total variable cost increases at an increasing rate. In the short-run the shape of the total cost curve is influenced by the nature of total variable cost. Economists generally use mathematical cost functions i.e. linear, quadratic, cubic, to identify the nature of cost output relationship.

2.07: References:

1. P.L.Mehta : *Managerial Economics- Analysis, Problems and Cases.*
2. Dominick Salvatore : *Managerial Economics in a global economy*
3. R.L Varshney and Maheswari : *Managerial Economics.*
4. H.Craig Petersen and Cris Lewis: *Managerial Economics*

2.08: Self assessment test:

1. Discuss the relationship between cost and output in the short run with the help of total cost function.
2. Explain mathematical cost functions.