INTRODUCTION

This chapter deals with engineering or technological tools that help managers answer complex questions relating to the production process. It is necessary that the managers need to know how much can be produced with a given set of inputs. Or how much volume of each input is needed for a given amount of output. The production function provides information about such questions.

The output does not always increase commensurate with increase in inputs. The production is governed by certain laws of returns. There are certain economies the firm enjoys because of its size. Growth beyond the manageable size may lead to diseconomies also, unless it is strategically managed. This chapter also explains the laws of returns and economies and diseconomies of scale.

THE PRODUCTION FUNCTION

Samuelson defines the production function as "the technical relationship which reveals the maximum amount of output capable of being produced by each and every set of inputs". It is defined for a given state of technical knowledge.

Michael R Baye defines production function as "that function which defines the maximum amount of output that can be produced with a given set of inputs".

From these definitions, it can be seen that:

- The production function is more concerned with physical aspects of production. It is the concern of the engineer rather than that of the manager to know how much can be the production with a given set of inputs.
- Production function is defined at a given stage of technical knowledge. It means that if there is any technological breakthrough, there could be further jump in the volume of production for the given set of inputs.
- Production function is an engineering relation that expresses the maximum amount of output that can be produced with a given set of inputs.
- At any given time, the output from a given set of inputs is always fixed.
- Production function enables us to understand how best we can make use of technology to its greatest potential.

INPUT-OUTPUT RELATIONSHIP OR PRODUCTION FUNCTION

The inputs for any product or service are land, labour, capital, organisation and technology. In other words, the production here is the function of these five variable inputs. Mathematically, this is expressed as

$$Q = f(L_1, L_2, C, O, T)$$

where Q is the quantity of production, f explains the function, that is, the type of relation between inputs and outputs, L_1, L_2, C, O, T refer to land, labour, capital, organisation and technology respectively. These inputs have been taken in conventional terms. In reality, materials also can be included in a set of inputs.

A manufacturer has to make a choice of the production function by considering his technical knowledge, the process of various factors of production and his efficiency level to manage. He should not only select the factors of production but also should work out the different permutations and combinations which will mean lower cost of inputs for a given level of production.

A production function as outlined above depicts the relationship between the inputs and the output in general. In a specific situation, some factors of production may be important and the relative importance of the factors depend upon the final product to be manufactured. For example, in the case of the software industry, land is not an input factor as significant as that in case of an agricultural product.

In the case of an agricultural product, increasing the other factors of production can increase the production; but beyond a point, increased output can be had only with increased use of agricultural land. Investment in land forms a significant portion of the total cost of production for output; whereas, in the case of the software industry, other factors such as technology, capital, management and others become significant. With change in industry and the requirements, the production function also needs to be modified to suit to the situation.

Production Function with One Variable Input and Laws of Returns

The Laws of Returns states that when at least one factor of production is fixed or factor input is fixed and when all other factors are varied, the total output in the initial stages will increase at an increasing rate, and after reaching certain level of output the total output will increase at declining rate. If variable factor inputs are added further to the fixed factor input, the total output may decline. This law is of universal nature and it proved to be true in agriculture and industry also. The Law of Returns is also called the *Law of Variable Proportions or the Law of Diminishing returns*.

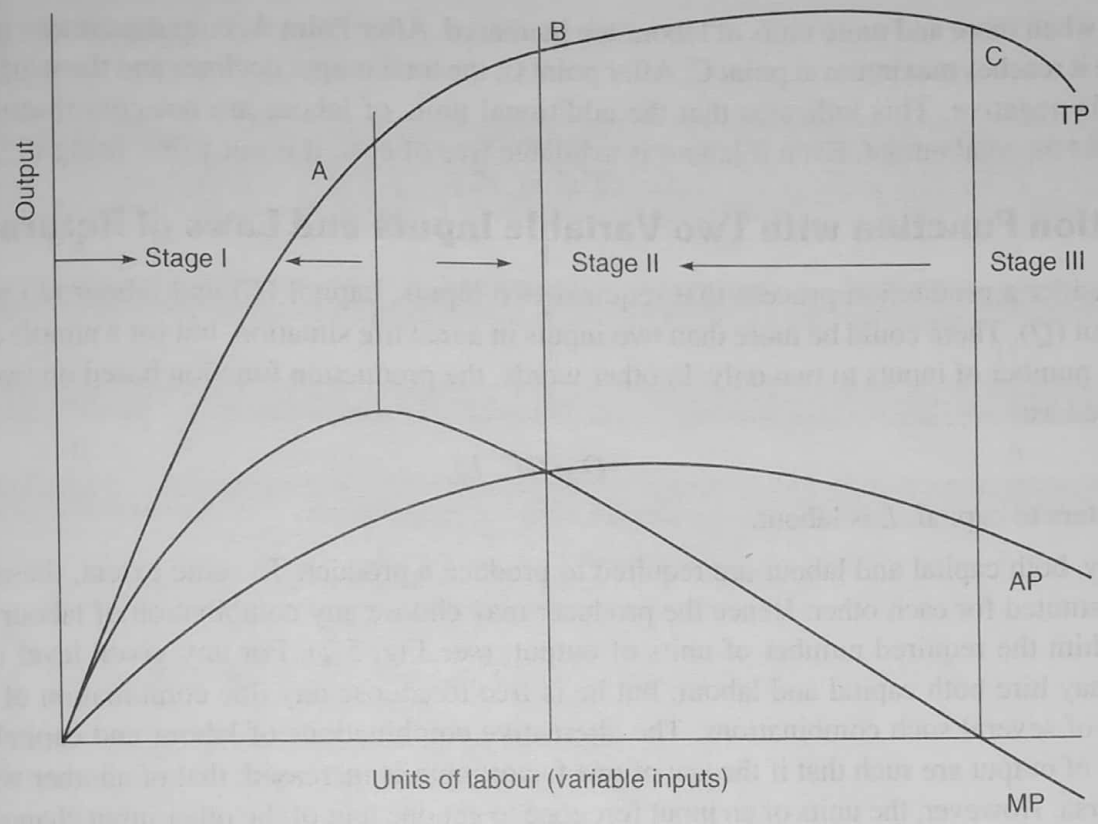

Fig. 5.1 Total Product, Average Product and Marginal Product curves

Table 5.1 Output with Fixed Capital and Variable Labour Inputs

Units of Labour	*Total Product (TP)*	*Marginal Product (MP)*	*Average Product (AP)*	*Stages*
0	0	0	0	Stage I
1	10	10	10	
2	22	12	11	
3	33	11	11	State II
4	40	7	10	
5	45	5	9	
6	48	3	8	
7	48	0	6.85	State III
8.	45	–3	5.62	

In the short run, it is assumed that capital is a fixed factor input and labour is variable input. It is also assumed that technology is given and is not going to change. Under such circumstances, the firm starts production with a fixed amount of capital and uses more and more units of labour. In the initial stages, output increases at an increasing rate because capital is grossly underutilised. Productivity will increase up

to point A when more and more units of labour are increased. After Point A, output increases at a declining rate till the it reaches maximum at point C. After point C, the total output declines and the marginal product of labour is negative. This indicates that the additional units of labour are not contributing any thing positively to the total output. Even if labour is available free of cost, it is not worth using it.

Production Function with Two Variable Inputs and Laws of Returns

Let us consider a production process that requires two inputs, capital (C) and labour (L) to produce a given output (Q). There could be more than two inputs in a real life situation, but for a simple analysis, we restrict the number of inputs to two only. In other words, the production function based on two inputs can be expressed as:

$$Q = f(C, L)$$

where C refers to capital, L is labour.

Normally, both capital and labour are required to produce a product. To some extent, these two inputs can be substituted for each other. Hence the producer may choose any combination of labour and capital that gives him the required number of units of output. (see Fig. 5.2). For any given level of output, a producer may hire both capital and labour, but he is free to choose any one combination of labour and capital out of several such combinations. The alternative combinations of labour and capital yielding a given level of output are such that if the use of one factor input is increased, that of another will decrease and vice versa. However, the units of an input foregone to get one unit of the other input changes, depends upon the degree of substitutability between the two input factors. Based on the techniques or technology used, the degree of substitutability may vary.

ISOQUANTS

'Iso' means equal; 'quant' means quantity. Isoquant means that the quantities throughout a given isoquant are equal. Isoquants are also called isoproduct curves. An isoquant curve shows various combinations of two input factors such as capital and labour, which yield the same level of output.

As an isoquant curve represents all such combinations which yield equal quantity of output, any or every combination is a good combination for the manufacturer. Since he prefers all these combinations equally, an isoquant curve is also called 'product indifference curve'.

The concept of isoquant is explained in Table 5.2 and Fig. 5.2.

Table 5.2 shows the different combinations of input factors to yield an output of 20,000 units of output. As the investment goes up, the number of labourers can be reduced. The combination of A shows 1 unit of capital and 20 units of labour to produce say, 20,000 units of output. All the above combinations of inputs can be plotted on a graph, the locus of all the possible combinations of inputs shows up an Isoquant as shown in Fig. 5.2.

Features of an Isoquant

1. *Downward sloping* Isoquants are downward sloping curves because, if one input increases, the other one reduces. There is no question of increase in both the inputs to yield a given output. A degree of substitution is assumed between the factors of production. In other words, an isoquant cannot be increasing, as increase in both the inputs does not yield same level of output. If it is

Table 5.2 An Isoquant

Combinations	*Capital (Rs. in lakh)*	*No. of Labourers*
A	1	20
B	2	15
C	3	11
D	4	8
E	5	6
F	6	5

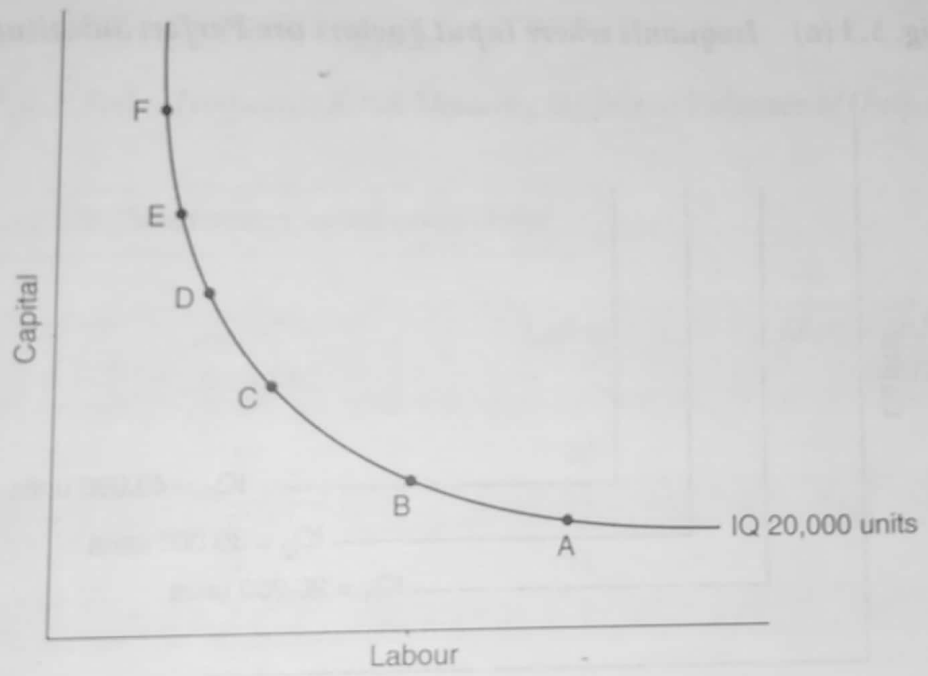

Fig. 5.2 Isoquant Yielding 20,000 Units of Production

constant, it means that the output remains constant though the use of one of the factors is increasing, which is not true. Isoquants slope from left to right.

2. *Convex to origin* Isoquants are convex to the origin. It is because the input factors are not perfect substitutes. One input factor can be substituted by other input factor in a 'diminishing marginal rate'. If the input factors were perfect substitutes, the isoquant would be a falling straight line (Fig. 5.3(a)). When the inputs are used in fixed proportion, and substitution of one input for the other cannot take place, the isoquant will be L shaped (Fig. 5.3(b)).
3. *Do not intersect* Two isoproducts do not intersect with each other. It is because, each of these denote a particular level of output (Fig. 5.3(c)). If the manufacturer wants to operate at a higher level of output, he has to switch over to another isoquant with a higher level of output and vice versa.
4. *Do not touch axes* The isoquant touches neither X-axis nor Y-axis, as both inputs are required to produce a given product.

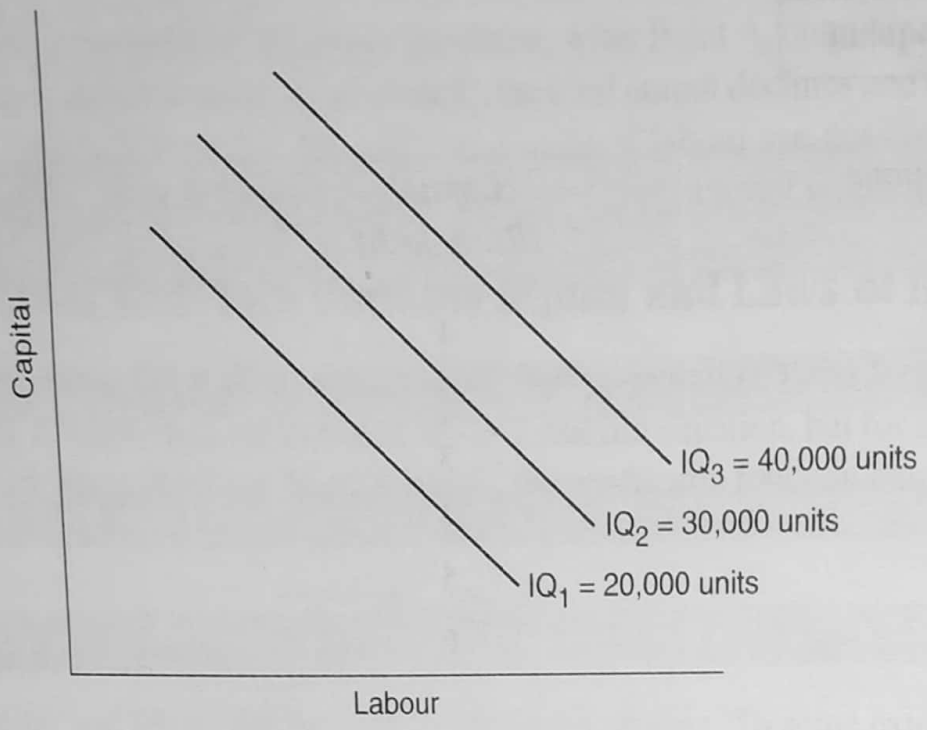

Fig. 5.3 (a) Isoquants where Input Factors are Perfect Substitutes

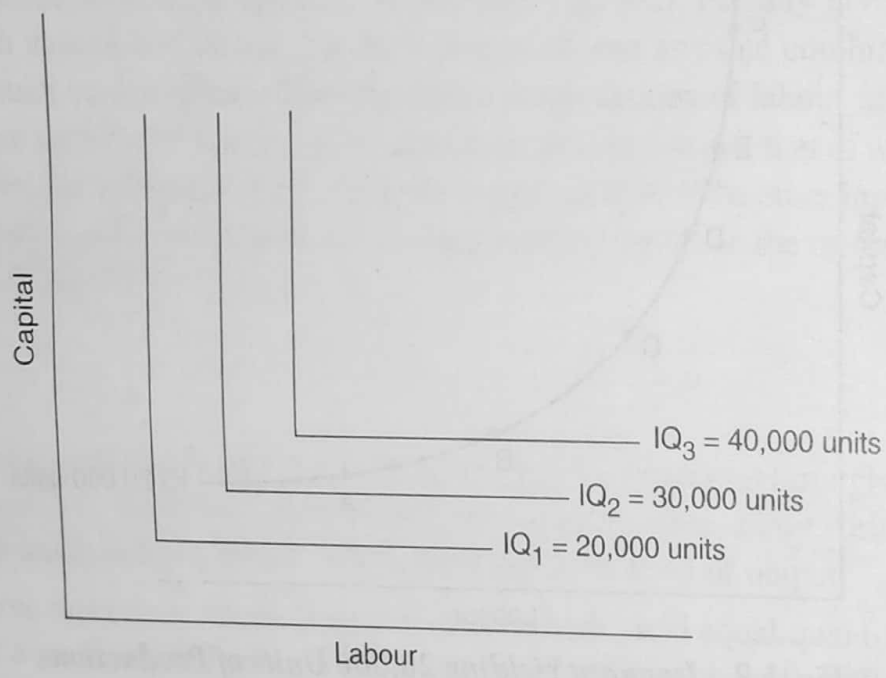

Fig. 5.3 (b) Isoquants where Input Factors are not Perfect Substitutes

MARGINAL RATE OF TECHNICAL SUBSTITUTION

The marginal rate of technical substitution (MRTS) refers to the rate at which one input factor is substituted with the other to attain a given level of output. In other words, the lesser units of one input must be compensated by increasing amounts of another input to produce the same level of output. Table 5.3 presents the ratio of MRTS between the two input factors, say capital and labour. 5 units of decrease in labour are compensated by an increase in 1 unit of capital, resulting in a MRTS of 5:1.

ISOCOSTS

Isocost refers to that cost curve that represents the combination of inputs that will cost the producer the same amount of money. In other words, each isocost denotes a particular level of total cost for a given

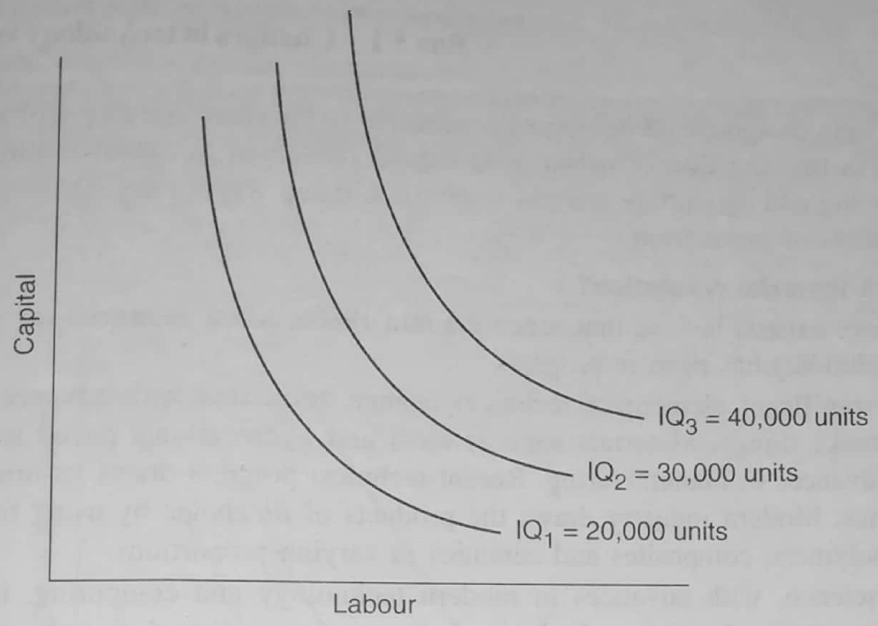

Fig. 5.3(c) Isoquants Each Showing Different Volumes of Output

Table 5.3 Ratio of MRTS between Capital and Labour

Combinations	*Capital (Rs. in lakh)*	*Labour*	*Marginal Rate of Technical Substitution (MRTS)*
A	1	20	—
B	2	15	5:1
C	3	11	4:1
D	4	8	3:1
E	5	6	2:1
F	6	5	1:1

level of production. If the level of production changes, the total cost changes and thus the isocost curve moves upwards, and vice versa. Figure 5.4 presents three downward sloping straight line cost curves (assuming that the input prices are fixed, no quantity discounts are available) each costing Rs. 1.0 lakh, Rs. 1.5 lakh and Rs. 2.0 lakh for the out output levels of 20,000, 30,000 and 40,000 units. (The total cost, as represented by each cost curve, is calculated by multiplying the quantity of each input factor with its respective price.) Isocosts farther from the origin, for given input costs, are associated with higher costs. Any change in input prices changes the slope of isocost lines.

Least Cost Combination of Inputs

The manufacturer has to produce at lower costs to attain higher profits. The isocosts and isoquants can be used to determine the input usage that minimises the cost of production.

Where the slope of isoquant is equal to that of isocost, there lies the lowest point of cost of produc
This can be observed by *superimposing* the isocosts on isoproduct curves (Fig. 5.5). It is evident that t
producer can, with a total outlay of Rs. 1.5 lakh, reach the highest isoquant curve which is IQ_2. If he wa
to reach IQ_3, he has to bring additional resources, which is, let us assume, not possible. He can
compromise with IQ_1, as it means lower output. There is no other input combination on IQ_2 other tha
point Q, which is cheaper than Rs. 1.5 lakh. So the obvious choice for the producer is Q combination o
inputs only on IQ_2.

The *points of tangency* P, Q and R on each of the isoquant curves represent the least cost combinat
of inputs, yielding maximum level of output. Any output lower or higher than this will result in higher co
of production.

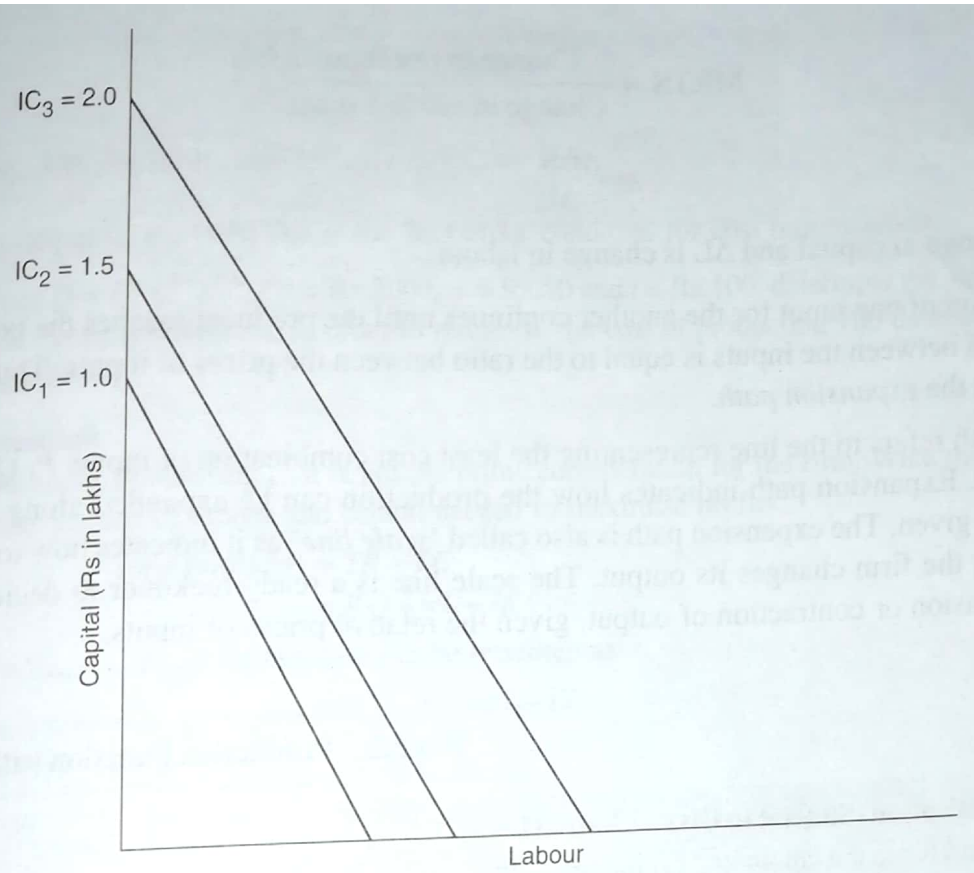

Fig. 5.4 Isocosts Each Representing Different Levels of Total Cost

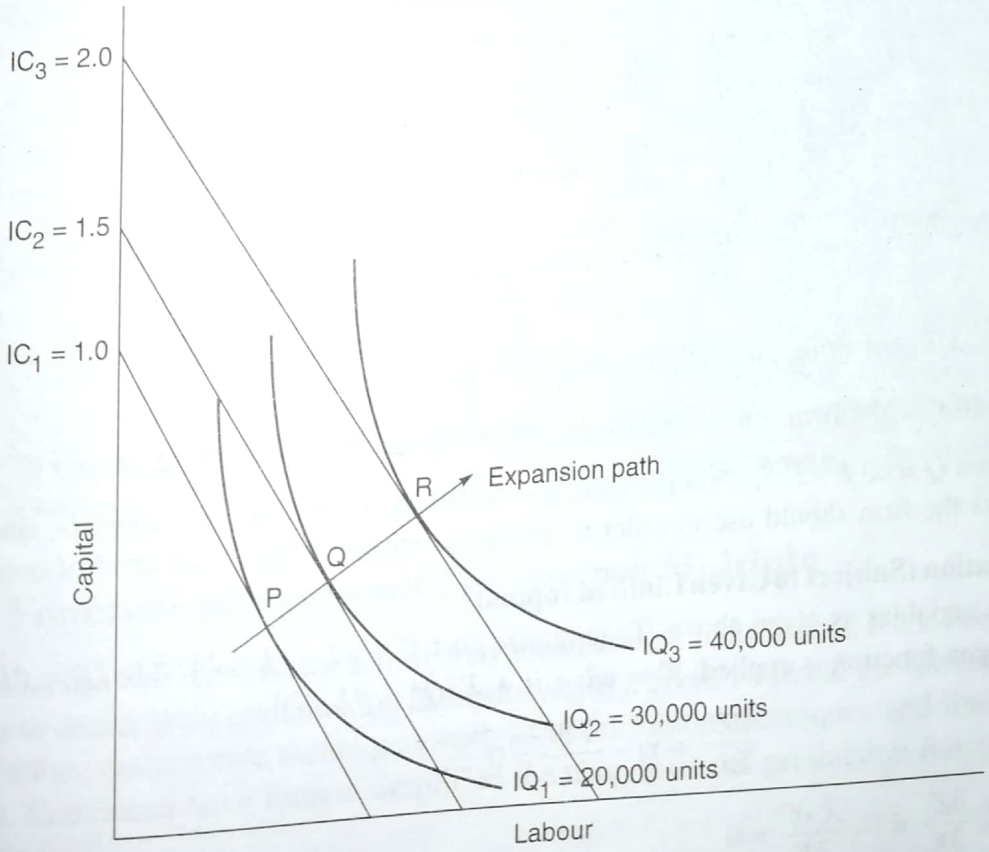

Fig. 5.5 Least Cost Combination of Inputs

COBB-DOUGLAS PRODUCTION FUNCTION

Cobb and Douglas put forth a production function relating output in American manufacturing industries from 1899 to 1922 to labour and capital inputs. They used the following formula:

$$P = bL^a C^{1-a}$$

Where P is total output,

L = the index of employment of labour in manufacturing

C = index of fixed capital in manufacturing

The exponents a and 1-a are the elasticities of production. These measure the percentage response of output to percentage changes in labour and capital respectively.

The function estimated for the USA by Cobb and Douglas is

$$P = 1.01L^{0.75} C^{0.25}$$

$$R^2 = 0.9409$$

The production function shows that one percent change in labour input, capital remaining the same, is associated with a 0.75 percent change in output. Similarly, one percent change in capital, labour remaining the same, is associated with a 0.25 percent change in output. The coefficient of determination (R^2) means that 94 percent of the variations on the dependent variable (P) were accounted for by the variations in the independent variables (L and C). It indicates constant returns to scale which means that there are no economies or diseconomies of large scale of production. On an average, large or small scale plants are considered equally profitable in the US manufacturing industry, on the assumption that the average and marginal production costs were constant.

Though Cobb-Douglas production function was based on macro-level study, it has been very useful for interpreting economic results. Later investigations revealed that the sum of the exponents might be very slightly larger than unity, which implies decreasing costs. But the difference was so marginal that constant costs would seem to be a safe assumption for all practical purposes.

RETURNS TO SCALE AND RETURNS TO FACTORS

Returns to scale refer to the returns enjoyed by the firm as a result of change in all the inputs. It explains the behaviour of the returns when the inputs are changed simultaneously. The returns to scale are governed by laws of returns to scale.

Law of Returns to Scale

There are three laws of returns governing production function. They are

(a) Law of Increasing Returns to Scale This law states that the volume of output keeps on increasing with every increase in the inputs. Where a given increase in inputs leads to a more than proportionate increase in the output, the law of increasing returns to scale is said to operate. We can introduce division of labour and other technological means to increase production. Hence, the total product increases at an *increasing* rate.

(b) Law of Constant Returns to Scale When the scope for division of labour gets restricted, the rate of increase in the total output remains constant, the law of constant returns to scale is said

to operate. This law states that the rate of increase/decrease in volume of output is same to that of rate of increase/decrease in inputs.

(c) Law of Decreasing Returns to Scale Where the proportionate increase in the inputs does not lead to equivalent increase in output, the output increases at a decreasing rate, the law of decreasing returns to scale is said to operate. This results in higher average cost per unit.

These laws can be illustrated with an example of agricultural land. Take one acre of land. If you till the land well with adequate bags of fertilisers and sow good quality seeds, the volume of output increases. The following table illustrates further:

Table 5.4 The Laws of Returns to Scale

Capital (in units)	*Labour (in units)*	*Percentage of Increase in both both inputs*	*Output (in units)*	*Percentage of Increase in ouput*	*Laws applicable*
1	3	—	—	—	
2	6	100	120	140	Law of increasing returns to scale
4	12	100	240	100	Law of constant returns to scale
8	24	100	360	50	Law of decreasing returns to scale

From the above table, it is clear that with 1 unit of capital and 3 units of labour, the firm produces 50 units of output. When the inputs are doubled two units of capital and six units of labour, the output has gone up to 120 units. (From 50 units to 120 units). Thus, when inputs are increased by 100 percent, the output has increased by 140 percent. That is, output has increased by more than double. This is governed by *Law of Increasing Returns to Scale.*

When the inputs are further doubled that is to 4 units of capital and 12 units of labour, the output has gone up to 240 units. (from 120 units to 240 units). Thus, when inputs are increased by 100 per cent, the output has increased by 100 per cent. That is, output also has doubled. This is governed by *Law of Constant Returns to Scale.*

ECONOMIES AND DISECONOMIES OF SCALE

The economies of scale result because of increase in the scale of production. Alfred Marshal divides the economies of scale into two groups: internal or external.

Internal Economies

Internal economies refer to the economies in production costs which accrue to the firm alone when it expands its output. The internal economies occur as a result of increase in the scale of production.

The internal economies may be of the following types:

(a) Managerial Economies As the firm expands, the firm needs qualified managerial personnel to handle each of its functions: marketing, finance, production, human resources and others in a professional way. Functional specialisation ensures minimum wastage and lowers the cost of production in the long-run.

(b) Commercial Economies The transactions of buying and selling raw materials and other operating supplies such as spares and so on will be rapid and the volume of each transaction also grows as

the firm grows. There could be cheaper savings in the procurement, transportation and storage costs. This will lead to lower costs and increased profits.

(c) Financial Economies There could be cheaper credit facilities from the financial institutions to meet the capital expenditure or working capital requirements. A larger firm has larger assets to give security to the financial institution which can consider reducing the rate of interest on the loans.

(d) Technical Economies Increase in the scale of production follows when there is sophisticated technology available and the firm is in a position to hire qualified technical manpower to make use of it. There could be substantial savings in the hiring of manpower due to larger investments in the technology. This lowers the cost per unit substantially.

(e) Marketing Economies As the firm grows larger and larger, it can afford to maintain a full-fledged marketing department independently to handle the issues related to design of customer surveys, advertising material, promotion campaign, handling of sales and marketing staff, renting of hoardings, launching a new product and so on. In the normal course, the firm spends large amounts on issues in marketing and is still not sure of the results because these are handled by different outside groups, on whom there is little control for the firm.

(f) Risk-bearing Economies As there is growth in the size of the firm, there is increase in the risk also. Sharing the risk with the insurance companies is the first priority for any firm. The firm can insure its machinery and other assets against the hazards of fire, theft and other risks. The large firms can spread their risk so that they do not keep all their eggs in one basket. They purchase raw material from different sources. They, more often, deal in more than one product to offset the losses by the profits from the sale of others.

(g) Indivisibilities and Automated Machinery To manufacture goods, a plant of certain minimum capacity is required whether the firm would like to produce and sell at the full capacity or not. For example, to be in business a firm requires a telephone, a manager, an accountant and a typist. Just because the production is lesser, the firm cannot hire half the manager or half the telephone. Likewise, with a given plant certain minimum quantity can be produced. A firm producing below such minimum quantity, will have to bear higher costs.

(h) Economies of Larger Dimension Large-scale production is required to take advantage of bigger size plant and equipment. For example, the cost of a 1,00,000 units capacity plant will not be double that of 50,000-units capacity plant. Like wise, the cost of a 10,000-tonne oil tanker will not be double that of a 5,000-tonne oil tanker. Engineers go by what is called Two by three (2/3) rule wherein when the volume is increase by 100 per cent, the material required will increase only by two-thirds. Technical economies are available only from large size, improved methods of production processes and when the products are standardised.

(i) Economies of Research and Development Large organisations such as Dr. Reddy's Labs, Hindustan Lever spend heavily on research and development and bring out several innovative products. Only such firms with a strong R&D base can cope with competition globally.

External Economies

External economies refer to all the firms in the industry, because of growth of the industry as a whole or because of growth of ancillary industries. External economies benefit all the firms in the industry as the

industry expands. This will lead to lowering the cost of production and thereby increasing the profitability. The external economies can be grouped under three types:

1. Economies of Concentration Because all the firms are located at one place, it is likely that there is better infrastructure in terms of approach roads, transportation facilities such as railway lines and so on, banking and communication facilities, availability of skilled labour and such factors.

2. Economies of R & D All the firms can pool resources together to finance research and development activities and thus share the benefits of research. There could be a common facility to share journals, newspapers and other valuable reference material of common interest.

3. Economies of Welfare There could be common facilities such as canteen, industrial housing, community halls, schools and colleges, employment 'bureau', hospitals and so on, which can be used in common by the employees in the whole industry.

6

COST ANALYSIS

Learning Objectives

After completing this chapter, you should be able to understand

- cost concepts
  - (a) fixed and variable costs
  - (b) explicit and implicit cost
  - (c) out of pocket and imputed costs
  - (d) opportunity costs
- cost-output relationship
- optimum size

INTRODUCTION

The managerial economist is concerned with making managerial decisions. Different business proposals are evaluated in terms of their costs and revenues. To know what costs are to be examined, it is necessary to understand what 'cost' is and how to analyse the same. This chapter also deals with the possible variations in the concept of cost and its relationship with output both in the short-run and long-run. The concept of 'optimum size' of the firm is explained here.

THE CONCEPT AND NATURE OF COST

Cost refers to the expenditure incurred to produce a particular product or service. All costs involve a sacrifice of some kind or other to acquire some benefit. For example, if I want to eat food, I should be prepared to sacrifice money.

Costs may be monetary or non-monetary; tangible or intangible, determined subjectively or objectively. Social costs such as pollution, noise or traffic congestion add another dimension to the cost concept. The people in the neighbourhood face the social costs by bearing with the smoke generated by the factory, adverse health effects, and the resultant clean up costs. It is not uncommon to find psychic costs such as frustration or dissatisfaction resulting from the stress and strain of the modern industrial activity.

The cost of production normally includes the cost of raw materials, labour, and other expenses. This cost is known as total cost (TC). This is compared with the total revenue (TR) realised on the sale of the products manufactured. The difference between the total revenue and total cost is termed as profit (TR – TC = Profit). This is the financial accountant's interpretation of total cost, total revenue and profit. This may provide a valid base to serve legal purpose. In general, financial records speak about the expenses already incurred in the past. They can rarely explain the costs to be incurred in the future.

In decision-making, 'cost' needs to be analysed and understood in a wider perspective. Though the data for studying the costs is obtained from the financial records, these need to be supplemented by specific details. In other words, financial records cannot provide all the necessary information about costs. The costs as reported by financial accounts are more suited to the legal and financial purposes for which they are designed. But for business decision-making, the relevant cost concept will usually be different from those costs as reported by the conventional accounting system.

Hence, an understanding of the meaning of various cost concepts is essential for clear business thinking. They facilitate clear understanding of the management problem, and also of the concept of cost that is relevant for it. They provide familiarity with the nature of each type of business and its financial records. It is true that the managerial economist develops a sense of ingenuity and boldness with the knowledge of cost analysis.

Normally, the accounting and statistical records of the company form the significant source of cost information. In some cases, it may be necessary to make a special effort to collect more details to supplement the cost information.

The following are the possible variations in the concept of cost.

Long-run vs Short-run Costs

The distinction between the long-run and short-run is the basic one in economic theory.

Long-run is defined as a period of adequate length during which a company may alter all factors of production with high degree of flexibility. The short-run is defined as the period relatively shorter when at least some of the factors of production are fixed.

Long-run costs cover the cost of changes in the size and kind of plant. Short-run costs cover the costs associated with the variation in the utilisation of fixed plant or other facilities. In long-run, there is perfect flexibility in the size of plant, labour force, executive talent and so on. Such a degree of flexibility is lacking in short-run.

The length of short-run differs from industry to industry. The concept of short-run is very important because it helps to observe the effect of short-run changes in the output sold; on costs and on profits. In short-run, it is necessary that the firm may continue to produce if all its variable costs are covered.

For instance, a general machine may be an unspecialised input factor and it can be resold in the seconds market below its original price with no difficulty. On the other hand, in the case of a special purpose machine built over two years time after a lot of efforts say on design and development, it may be difficult to sell it in the market because not many may find use for it. The more specialised the fixed asset is, the longer time it takes for its disposal and the longer will be the period of short-run.

Long-run is the time period beyond the short-run. In long-run, it is very important for the firm to see that all its costs are recovered.

It is to be noted that the long-run cost curves are called *planning curves* and the short-run cost curves are called *operating curves*. As the factors of production such as plant and equipment are variable in the long-run, the management can plan its capacity better, given an estimated demand function. Operating decisions follow, once the optimal plant has been designed and set up. Operating decisions have little flexibility once the major decisions are taken in respect of plant capacity and size.

Fixed vs Variable Costs

Variable costs are differentiated from fixed costs based on the degree of their variability in relation to the rate of output.

The distinction between fixed and variable costs is based on an assumption that time has a significant role to play in decision-making. Given more time, all the costs are variable. Consider the example of a fixed asset already available in the plant such as machinery. In the short-run, say less than one year; it may not be possible to expand the scale of production. We assume this is not possible because it takes considerable time in planning additional capital, getting new machinery, and getting it installed. Also in the short-run, the demand can change suddenly. Hence, the cost of machinery is referred to as fixed cost. If we assume differently, that it is possible within the given time to find finance to buy new machinery and install it in order to expand the scale of production to meet sudden upsurge in demand (such as meeting an export order), these costs become variable. In other words, in the long-run, all the costs are variable.

Fixed costs are those costs that are fixed in the short-run. Whether production is taken up or not, we have to incur certain expenses such as rent for factory and office buildings, insurance, telephone, electricity and so on. Even if the production is stopped temporarily for a short period, we continue to spend on these fixed costs. In other words, total fixed costs are fixed or constant in the short-run. Fixed cost per unit changes with volume of production. The more you produce, the less is the fixed cost per unit and vice versa.

Variable costs are those costs that vary with the volume of production. Variable costs comprise the cost of raw materials, wages paid to the labour and so on. These costs are incurred only when there is production. If the production is temporarily suspended, there will not be any variable costs. In other words, the more the production, the more are the variable costs and vice versa.

Semi-fixed or Semi-variable Costs

While the variable costs are continuous functions of output, it is assumed that, some costs that remain fixed over considerable ranges of production, increase by jumps discontinuously, at various levels of output. This strange phenomenon gives rise to yet another category of costs: semi-fixed or semi-variable costs.

Semi-fixed or semi-variable costs refer to such costs that are fixed to some extent beyond which they are variable. Telephone charges or electricity charges form good example for this. If we have connection, we have to pay the minimum charges. This is fixed charge. The more you use the facility, the more you have to pay. Semi-fixed or semi-variable costs are not absolutely fixed or absolutely variable.

Marginal Cost

Marginal cost refers to '*the additional cost incurred for producing an additional unit*'. It equals the change in the variable cost per unit. This change is due to a change in the level of output. The concept of

marginal cost, in economic theory, is useful in matters relating to allocation of resources, product pricing decisions, make or buy decisions and so on.

It is to be noted that marginal cost is different from incremental cost. Marginal cost is ascertained for *one additional product* whereas incremental cost is ascertained *for a change in level of activity*. The change in level of activity may be increase in output, or introducing the product in a new market, finding new uses for an existing product or producing the goods adopting a new process and so forth.

Controllable vs Non-controllable Costs

Whether the costs can be classified as controllable or non-controllable depends upon the level of management. Some costs are not controllable at the shop level since they depend on the decision at higher level. At some level of management, all costs come into the discretionary area of an executive. The fact that all costs are controllable implies that they are assignable to some executive for control responsibility. One cannot just cut costs. The guiding principle to control the costs is the economy in operations. The direct and variable costs cannot be cut whereas the overheads such as R&D costs, advertising, salaries of the top executives and so on, can be controlled.

The distinction of costs based on controllability, is primarily useful for expense and efficiency control by setting up budgets corresponding to the managerial responsibility held.

Opportunity vs Outlay Costs

Opportunity costs can be distinguished from outlay costs based on the nature of sacrifice. Outlay costs are those costs that involve cash outflow at sometime and hence they are recorded in the book of account. Opportunity costs refer to *earnings/profits that are foregone from alternative ventures by using given limited facilities for a particular purpose*. They represent only the sacrificed alternatives. So, they are never recorded in the books of account. However, these costs must be considered for decision-making.

Opportunity costs refer to the *'costs of the next best alternative foregone'*. We have scarce resources and all these have alternative uses. Where there is an alternative, there is an opportunity to reinvest the resources. In other words, if there are no alternatives, there are no opportunity costs. It is necessary that we should always consider the cost of the next best alternative foregone before committing the funds on a given option. In other words, the benefits from the present option should be more than the benefits of the next best alternative.

Opportunity cost is said to exist when the resources are scarce and there are alternative uses for these resources. A resource that is used for one purpose cannot be used for something else at the same time. Where a firm, for example, chooses to invest Rs 25,000 in a residential plot instead of buying a government bond, the interest that could have been earned on the bond must be added to the explicit cost of Rs 25,000. In other words, the cost of the residential plot is not just Rs 25,000 but Rs 25,000 plus the interest on the bond that could have accrued had the amount been invested in the bonds.

Also, consider the following examples:

- In military affairs, the cost of sending bombers is not just the cost of ammunition alone. It is the worth of the infrastructure that could have been damaged had they been sent on a different mission.
- Assume that a company has some space available in one of its own old buildings (written off completely in the books of accounts). If this building is still in good condition, it can be rented out for say, Rs 5000 per month. The company has a proposal to utilise the same space in connection

with an expansion of its business. In assessing the feasibility of this proposal, a charge for space equivalent to Rs 5,000 should be considered. This much could have been earned from by renting out the premises, though the asset is fully written off.

- The cost of getting a college education is not merely what you spend on college fee and the books. It also includes the earnings you have foregone throughout the year by not taking up a full time job.

The concept of opportunity cost is useful for long-run decisions involving problems of major strategy. In other words, this concept is useful not only at the micro level (i.e. organisation) but also at the macro level (say, society or a nation). Since the resources are scarce and versatile, no country can afford everything its citizens wish to have. Employing the resources for the production of one alternative means the other alternative is either sacrificed or minimised. For example, a society wants more hospitals and more roads. Since the resources are limited and if the government chooses to build more hospitals, then it can build only fewer roads. The opportunity cost of building hospitals is its next best alternative foregone, that is, the number of roads not built.

The amount of the opportunity cost is determined by comparing the benefits or advantages of a choice with those of the next best alternative. When one alternative is selected it means that the opportunity of gaining benefits from the other alternatives is foregone. In business, cost estimates are made not on the basis of what the firm is doing but on the basis of what the firm can do. Often this aspect is ignored.

Incremental vs Sunk Costs

Incremental costs are the '*added costs of a change in the level or nature of activity*'. Incremental cost is also called *differential cost*. In other words, the difference in the total cost as a result of change in the quality or level of production or nature of activity is called incremental cost.

Incremental costs vary with a change in the alternatives. The change can be anything such as adding a new product to the existing product mix or dropping an existing product from the same, changing the channel of distribution, adding new plant and machinery and so on.

In case of competition, most of the firms accept the orders if their incremental costs are covered. If the contract price is more than the incremental costs, it may cover the overheads and minimum profits. The business may improve meanwhile. A stage will soon come when the firm will turn away more profitable business because of capacity constraints. In such a case, the incremental costs are the increased production costs of other business and also the foregone profits due to the capacity constraints, and these have to be considered for decision-making.

Sunk costs are those costs that have already been committed or spent in the past. They do not affect the current production. The question of change in the level of activity does not arise here. Alternatives may change but not the sunk costs, which remain the same. Once an asset is bought, the funds are blocked forever. They can neither be changed nor controlled. They are not, any more, useful for forward planning or determining the optimal course of action. For instance, the cost of storing in case of a firm having unused warehouse space that will otherwise stand empty is the sunk cost and this has to be considered while deciding whether to produce a new product or not.

Similarly, a firm may have spent towards Rs 10,000 in connection with its proposal to purchase a new machinery at a price of Rs 1,00,000. Later, suppose, it is offered another machine, of equally good quality, for Rs 70,000. The amount of Rs 10,000 spent in connection with the first proposal is a sunk cost. It will no more be a decisive factor in deciding whether the second property has to be acquired or not. To

Explicit vs Implicit Costs

The costs of using resources in production involve both explicit costs (also called out-of-pocket costs) and other non-cash costs called implicit costs.

Explicit costs involve payment of cash. The rent for the landlord, wages for the labourer, interest paid on the funds borrowed, taxes and duties paid to the government and so on, are the explicit costs.

Implicit costs are also called imputed costs. Implicit costs do not involve payment of cash as they are not actually incurred. They would have been incurred had the owner not been in possession of the facilities. Hence, these are only notional costs. Examples of implicit costs are: interest on own capital, savings in terms of salary due to own supervision, rent of own premises and so forth.

Both implicit and explicit costs are important for decision-making. If ignored, they lead to over-estimation of profits, which is not desirable.

Out-of-Pocket vs Book Costs

Basis of Distinction Among Cost Concepts

The basis of distinction, in respect of each of the above cost concepts, is outlined in the following table:

Cost Concepts	*Basis of Distinction*
1. Short-run vs Long-run costs	Time factor involved in adapting to present output
2. Variable vs Fixed costs	Degree of variability
3. Opportunity costs vs Outlay costs	Nature of sacrifice
4. Past vs Future costs	Degree of anticipation
5. Separable vs Joint costs	Traceability to unit of operation
6. Out-of-pocket vs Book costs	Involvement of cash flow
7. Incremental vs Sunk costs	Increase in the level of activity
8. Escapable vs Unavoidable costs	Degree of compulsion
9. Controllable vs Non-controllable costs	Degree of controllability
10. Replacement vs Historical costs	Timing of valuation
11. Urgent vs Postponable costs	Degree of urgency

INTRODUCTION

Profit maximisation is one of the major goals of any business. The other goals include enlarging the customer base, entering new markets, innovation through major investments in research and development, and so on. The volume of profit is determined by a number of internal and external factors. As a part of monitoring the profitability of the operations of the business, it is necessary for the managerial economist to study the impact of changes in the internal factors such as cost, price and volume on profitability. Breakeven analysis comes very handy for this purpose.

BREAK-EVEN ANALYSIS

Break-even analysis refers to analysis of the break-even point (BEP). The BEP is defined as a no-profit or no-loss point. Why is it necessary to determine the BEP when there is neither profit nor loss? It is important because it denotes the minimum volume of production to be undertaken to avoid losses. In other words, it points out how much minimum is to be produced to see the profits. It is a technique for profit planning and control, and therefore is considered a valuable managerial tool.

Break-even analysis is defined as analysis of costs and their possible impact on revenues and volume of the firm. Hence, it is also called the cost-volume-profit analysis. A firm is said to attain the BEP when its total revenue is equal to total cost (TR = TC).

Total cost comprises fixed cost and variable cost. The significant variables on which the BEP is based are fixed cost, variable cost and total revenue.

Key Terms used in Break-even Analysis

(a) **Fixed cost** Fixed costs remain fixed in the short-run. Examples are rent, insurance, depreciation, factory supervisor's salaries, directors' salaries, and so on.

(b) **Variable costs** The variable cost per unit vary with the volume of production. The variable costs include cost of direct materials, direct labour, direct expenses, operating supplies such as lubricating oil, and so on.

(c) **Total cost** The total of fixed and variable costs

(d) **Total revenue** The sales proceeds (selling price per unit × number of units sold)

(e) **Contribution margin** The contribution margin is the difference between the selling price per unit and the variable cost per unit. It is also determined as (fixed cost per unit + profit per unit)

(f) **Profit =** Contribution – Fixed cost

(g) **Contribution margin ratio** It is the ratio between contribution per unit and the selling price per unit.

(h) **Margin of safety in units** The excess of actual sales (in units) *minus* the break-even point (in units)

(i) **Margin of safety in sales volume** The excess of actual sales (in rupees) *minus* the break-even point (in rupees)

(j) **Angle of incidence** The angle formed where total cost curve cuts the total revenue curve (see the BEP chart in Fig. 5.1).

(k) **P/V ratio** The ratio between the contribution and sales

Determination of Break-even Point

The following are the key terms used in determination of break-even point:

$$\text{Selling price} = \text{Fixed cost} + \text{Variable cost} + \text{Profit}$$

$$\text{Selling price} - \text{Variable cost} = \text{Fixed cost} + \text{Profit}$$

$$= \text{Contribution}$$

$$\text{Contribution per unit} = \text{Selling price per unit} - \text{Variable cost per unit}$$

Having studied the nature of fixed and variable costs in the earlier, we will now discuss how to determine break-even point.

(i) Determination of Break-even Point in Units:

$$\text{Break-even point} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}}$$

Where contribution margin per unit= (Selling price per unit – Variable cost per unit)

(ii) Determination of BEP in value:

$$\text{BEP} = \frac{\text{Fixed costs}}{\text{Contribution margin ratio}}$$

Where contribution margin ratio is the ratio of contribution margin per unit to selling price per unit.

Example 1

A firm has a fixed cost of Rs 10,000; selling price per unit is Rs 5 and variable cost per unit is Rs 3.

(i) Determine break-even point in terms of volume and also sales value

(ii) Calculate the margin of safety considering that the actual production is 8000 units.

Solution

(i) Determination of BEP:

$$\text{Break-even point in units} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}}$$

Where contribution margin per unit = Selling price per unit – Variable cost per unit

$= 5 - 3$

$= 2$

So, $$\text{BEP in units} = \frac{10{,}000}{2}$$

$= 5000$ units.

BEP can also be determined in terms of value (in rupees).

The formula is

$$\text{BEP in sales value} = \frac{\text{Fixed costs}}{\text{Contribution margin ratio}}$$

$$\text{where contribution margin ratio} = \frac{\text{Selling price} - \text{Variable cost}}{\text{Selling price}}$$

In the above example, the contribution margin ratio is $(5 - 3)/5 = (2/5)$

BEP in terms of sales value is calculated as below:

$$= \frac{10{,}000}{2/5}$$

= Rs 25,000

This can be verified by the formula:

Total revenue = Total cost

= (No. of units at BEP) × (Selling price per unit)

= 5000 units × Rs 5 per unit

Rs 25,000

In other words, at BEP Total revenue = Total cost. This implies that the profit or loss is zero. This is the reason why BEP is called no profit or no loss point.

BEP can be determined graphically as shown in Fig. 5.1.

(ii) Determination of margin of safety

Margin of safety (units) = Number of units sold – Break-even point in units

Margin of safety = 8000 – 5000

= 3000 units.

The margin of safety is 3000 units. If there is any unfavourable business conditions such as labour problem, the company can stand firm and continue discussions as long as volume of production does not fall below 5000 units. Once it reaches the BEP, it is advisable for the firm to reach an understanding as it cannot afford any more delay. If production falls below BEP, the firm suffers loss.

Example 2

A high-tech rail can carry a maximum of 36,000 passengers per annum at a fare of Rs 400. The-variable cost per passenger is Rs 150 while the fixed costs are 25,00,000 per year. Find the break-even point in terms of number of passengers and also in terms of fare collections.

Solution

(a) Determination of BEP:

$$\text{Break-even point in units} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}}$$

Where contribution margin per passenger = Fare per passenger – Variable cost per passenger

$$= 400 - 150$$

$$= 250$$

So, BEP in number of passengers $\frac{25,00,000}{250}$

$$= 10,000 \text{ passengers}$$

BEP in terms of collections (in rupees).

The formula is

$$\text{BEP in sales value} = \frac{\text{Fixed costs}}{\text{Contribution margin ratio}}$$

$$\text{where contribution margin ratio} = \frac{\text{Selling price} - \text{Variable cost}}{\text{Selling price}}$$

the contribution margin ratio is (400 – 150)/400 = (250)/(400)

BEP in terms of sales value is calculated as below:

$$= \frac{25,00,000}{(250/400)}$$

$$= \text{Rs } 40,00,000$$

Example 3

rikanth Enterprises deals in the supply of hardware parts of computer. The following cost data is avail-*ble for two successive periods:*

	Year I (Rs)	*Year II (Rs)*
Sales	50,000	1,20,000
Fixed costs	10,000	20,000
Variable cost	30,000	60,000

ermine (a) Break-even point (b) Margin of safety.

Solution

Here the per unit data is not available. Hence use the formula of P/V ratio to find out BEP.

Profit-volume (P/V) ratio = (Contribution/Sales) × 100

Contribution and profit during the year II and I are calculated as below:

	Year I (Rs)	*Year II (Rs)*
Sales	50,000	1,20,000
Less Variable cost	30,000	60,000
Contribution	20,000	60,000
Less: Fixed costs	10,000	20,000
Net profit	10,000	40,000

	Year I (Rs)	*Year II (Rs)*
P/V ratio $= \frac{\text{Contribution}}{\text{Sales}} \times 100$	$= \frac{20,000}{50,000} \times 100$ $= 40\%$	$= \frac{60,000}{1,20,000} \times 100$ $= 50\%$
BEP $= \frac{\text{Fixed costs}}{\text{P/V ratio}}$	$= \frac{10,000}{40\%}$ $= \text{Rs. } 25,000$	$= \frac{20,000}{50\%}$ $= \text{Rs. } 40,000$
Margin of safety $= \frac{\text{Net Profit}}{\text{P/V ratio}}$	$= \frac{10,0000}{40\%}$ $= 25,000$	$= \frac{40,000}{50\%}$ $= 80,000$

The answers can be verified by using the following formula:

Sales = BEP sales + Margin of safety

Graphical representation of Break-even Point (BEP):

From the Fig. 7.1, we understand:

(i) TC = Total Variable Cost (TVC) + Total Fixed Cost + (TFC)

(ii) The variable cost line is drawn first. It varies proportionately with volume of production and sales.

(iii) The total cost line is derived by adding total fixed costs line to the total variable cost line. The total cost line is parallel to variable cost line.

(iv) The total revenue line starts from 0 point and increases along with volume of sales intersecting total cost line at point BEP.

(v) The zone below BEP is loss zone and the zone above BEP is profit zone.

(vi) OP is the quantity produced/sold at OC the cost/price at BEP.

(vii) The angle formed at BEP, that is, the point of intersection of total Revenue and total cost is called *angle of incidence*.

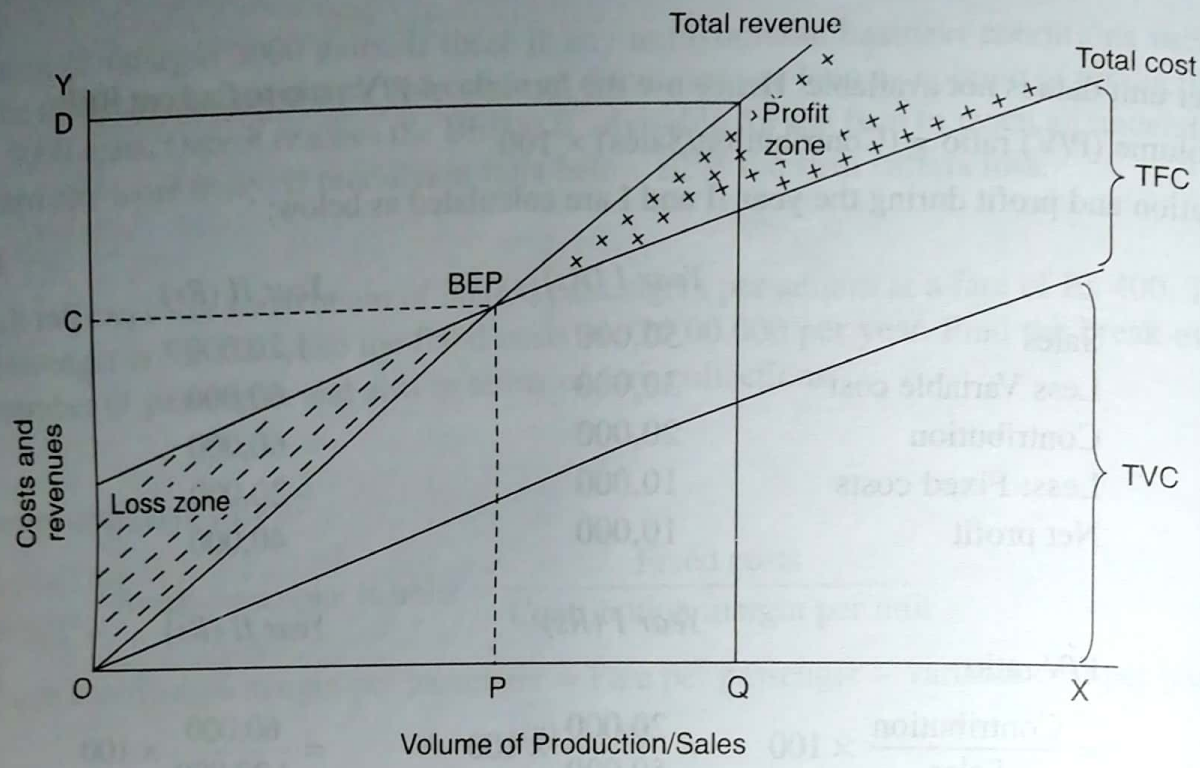

Fig. 7.1 Graphical Representation of Break-even Point

(viii) The larger the angle of incidence, the higher is the quantum of profit once the fixed costs are absorbed.

(ix) Margin of safety refers to the excess of production or sales over and above the BEP of production/sales. The margin of safety is OQ minus OP. The sales value at OQ is OD. It can be observed that the firm reaches break even point at point BEP. At BEP, the total cost is equal to total revenue. OP is the volume of production/sales at the cost/revenue of OC. The zone below BEP is called loss zone and zone above BEP is called profit zone. Total cost curve is based on the total of fixed cost and variable cost.

Assumptions Underlying Break-even Analysis

The following are the assumptions underlying break-even analysis:

(a) Costs can perfectly be classified into fixed and variable costs.

(b) Selling price does not change with volume changes. It remains fixed. It does not consider the price discounts or cash discounts.

(c) All the goods produced are sold. There is no closing stock.

(d) There is only one product available for sale. In case of multi-product firms, the product mix does not change.

Different Formulae Used in Break-even Analysis and their Applications

The following are the variations of the formula of break-even analysis:

1. *Profit-volume (P/V) ratio* = (Contribution/Sales). If multiplied by 100, it can be expressed in terms of percentage.

This has been derived from the following basic formula:

$$\frac{\text{Fixed cost} \times \text{Sales}}{\text{Sales} - \text{Variable cost}}$$

or

$$\frac{\text{Fixed cost}}{P/V \text{ ratio}}$$

2. Margin of safety can be determined by the following formula:

$$\text{Margin of safety} = \frac{\text{Profit}}{P/V \text{ ratio}}$$

3. To ascertain the volume of sales required to achieve a targeted amount of profit:

$$\text{Volume of sales to attain a targeted profit} = \frac{\text{Fixed costs} + \text{Targeted profit}}{\text{Contribution margin}}$$

Application of Break-even Analysis

The following are some of the significant areas of applications of break-even analysis.

1. Make or Buy Decision Often, the manager is confronted with 'make or buy' decisions the necessary components or spare parts. Where the consumption is large, making may be economical. To illustrate,

Example 4

A lathe workshop owner uses 150 units of a certain spare part. He buys this from the market for Rs 250. The same can be manufactured in his workshop with a fixed cost of Rs 40,000 and a variable cost of Rs 50. Do you suggest him to make or buy from the market? It is possible that he can sell 500 units of the same spare part to other lathe shops in the town.

$$\text{BEP} = \frac{\text{Fixed costs}}{\text{Purchase price per unit} - \text{Variable cost per unit}}$$

$$= \frac{40{,}000}{250 - 50}$$

$$= \frac{40{,}000}{200}$$

$$= 200 \text{ units.}$$

The BEP is 200 units. This means that producing less than this is not economical. The total demand for the spare part is 650 units (150 + 500). It is recommended that this can be manufactured.

2. Choosing a Product Mix when there is a Limiting Factor It is very likely that the company may be dealing in more than one product and company wants to know, in view of the limited plant capacity,

What combination would yield maximum profits? To illustrate

The maximum net profit resulting from a p...

3. Drop or Add Decisions It is common that the firms keep on adding new products to their product range while dropping the old ones to keep pace with the changing demand. In this process, how do we know whether the new product really adds to profit and the old one proposed to be dropped saves the firm from the losses? Break-even analysis helps in such decisions.

Example 6

A firm has two products B and C. The particulars of the price per unit, variable cost per unit and percentage of share in the total sales volume are given in the following table.

Table 7.2 Product Mix — I

Products	*Selling Price*	*Variable Cost*	*% of Share*
B	Rs. 40	Rs. 16	40 %
C	Rs. 50	Rs. 20	60 %

The total fixed costs during the year amount Rs 100,000. The total volume of sales is Rs 8,00,000.

The company wants to drop product B as it is yielding less contribution per unit. In stead it wants to add Product D. If D is added, the new fixed cost is likely to be Rs 125,000 and the sales volume is likely to increase to Rs 9,00,000. The new scenario will be as given below:

Table 7.3 Product Mix — II

Products	*Selling Price*	*Variable Cost*	*% of share*
C	Rs 50	Rs 20	70%
D	Rs 60	Rs 24	30%

Do you recommend the change?

Solution

There are two situations here. Situation I with products B and C. Situation II with product C and D. Compare the net profit earned in both the situations. Then we can decide which situation is better.

Situation I (with products B and C):

Let us find out the contribution ratio of each product:

$$\text{Contribution ratio} = \frac{\text{Selling price} - \text{Variable cost}}{\text{Selling price}} \times \text{percentage share in the total sales}$$

$$\text{Contribution ratio for product B} = \frac{40-16}{40} \times 0.4$$
$$= 0.6 \times 0.4$$
$$= 0.24$$

$$\text{Contribution ratio for product C} = \frac{50-20}{50} \times 0.6$$
$$= 0.4 \times 0.6$$
$$= 0.36$$

Total of the Contribution ratios for

products B and C $= 0.24 + 0.36$
$= 0.6$

Total contribution = Sales × Contribution ratio
= 8,00,000 × 0.6
= Rs 4,80,000.

Profit = Contribution – Fixed cost
= 480,000 – 100,000
= Rs 3,80,000

Situation II (with products C and D)

$$\text{Contribution ratio for product C} = \frac{50 - 20}{50} \times 0.7$$
$$= 0.6 \times 0.7$$
$$= 0.42$$

$$\text{Contribution ratio for product D} = \frac{60 - 28}{60} \times 0.3$$
$$= 0.53 \times 0.3$$
$$= 0.16$$

Total of the Contribution ratios for products C and D $= 0.42 + 0.16$
$= 0.58$

Total contribution $=$ Sales $\times$ Contribution ratio
$= 900{,}000 \times 0.58$
$=$ Rs 5,22,000

Profit $=$ Contribution $-$ Fixed cost
$= 5{,}22{,}000 - 1{,}25{,}000$
$=$ Rs 3,97,000

The profit in the second situation is higher, and hence the change is recommended.

Impact of changes in cost or selling price on BEP:

BEP is a short-run phenomenon. Given an amount of total fixed cost and variable cost and selling price, the BEP is determined. If there is any change in one of these variables, BEP also is likely to change. The following are the likely conclusions:

(a) If the fixed cost increases, the profits will come down. To maintain the same level of profit, the firm has to produce more volume.
(b) If the fixed cost decreases, the firm attains BEP at lower level of production itself.
(c) If variable cost increases, the contribution margin gets reduced. Hence, to maintain the same profitability, the firm has to produce more to reach BEP.
(d) If variable cost decreases, the contribution margin increases. The firm can attain BEP at lower level of production.
(e) If selling price increases, the contribution margin increases. The firm can attain BEP at lower level of production.
(f) If selling price decreases, the contribution margin gets reduced. Hence, to maintain the same profitability, the firm has to produce more to reach BEP.

Let us illustrate one of these scenarios.

Determining BEP when there is an increase in fixed cost

Example 7

A firm has a fixed cost of Rs 50,000; selling price per unit is Rs 50 and variable cost per unit is Rs 25. Present level of production is 3500 units.

(i) Determine break-even point in terms of volume and also sales value.

(ii) Calculate the margin of safety.

(iii) What is the change in BEP and margin of safety if fixed costs increase from Rs 50,000 to Rs 60,000?

Solution

(i) Determination of BEP

$$\text{Break-even point in units} = \frac{\text{Fixed costs}}{\text{Contribution margin per unit}}$$

Where contribution margin per unit = Selling price per unit – variable cost per unit

= 50 – 25

= Rs 25

So, $$\text{BEP in units} = \frac{50,000}{25}$$

= 2000 units.

BEP in terms of value (in rupees):

The formula is

$$\text{BEP in Sales Value} = \frac{\text{Fixed costs}}{\text{Contribution margin ratio}}$$

$$\text{Where contribution margin ratio} = \frac{\text{Selling price} - \text{Variable cost}}{\text{Selling price}}$$

In the above example, the contribution margin ratio is (50 – 25)/50 = (25/50)

BEP in term's sales value is calculated as below:

$$= \frac{50,000}{(25/50)}$$

= Rs 1,00,000

(ii) Determination of margin of safety:

Margin of safety = Number of units sold – break-even point in units

Margin of safety = 3500 – 2000

= 1500 units.

(iii) Determination of BEP with fixed costs of Rs.60,000

Where contribution margin per unit = Selling price per unit – variable cost per unit

= 50 – 25

= 25

So, $$\text{BEP in units} = \frac{60,000}{25}$$

= 2400 units.

BEP in terms of value (in rupees).

The formula is

$$\text{BEP in sales value} = \frac{\text{Fixed costs}}{\text{Contribution margin ratio}}$$

$$\text{Where contribution margin ratio} = \frac{\text{Selling price} - \text{Variable cost}}{\text{Selling price}}$$

In the above example, the contribution margin ratio is (50 – 25)/50 = (25/50)

BEP in terms sales value is calculated as below:

$$= \frac{60{,}000}{(25/50)}$$

$$= \text{Rs } 1{,}20{,}000$$

Determination of margin of safety:

$$\text{Margin of safety} = \text{Number of units sold} - \text{break-even point in units}$$

$$\text{Margin of safety} = 3500 - 2400$$

$$= 1100 \text{ units.}$$

The above calculations show that the firm has to produce 400 more units (2400 – 2000) in the event of increase in fixed costs by Rs 10,000. This reduces margin of safety also by 400 units (1500 – 1100).

SIGNIFICANCE OF BEA

Break-even analysis is a valuable tool

- to ascertain the profit on a particular level of sales volume or a given capacity of production
- to calculate sales required to earn a particular desired level of profit
- to compare the product lines, sales area, methods of sale for individual company
- to compare the efficiency of the different firms
- to decide whether to add a particular product to the existing product line or drop one from it
- to decide to 'make or buy' a given component or spare part
- to decide what promotion mix will yield optimum sales
- to assess the impact of changes in fixed cost, variable cost or selling price on BEP and profits during a given period

LIMITATIONS OF BEA

Break-even analysis has certain underlying assumptions which form its limitations.

1. Break-even point is based on fixed cost, variable cost and total revenue. A change in one variable is going to affect the BEP.
2. All costs cannot be classified into fixed and variable costs. We have semi-variable costs also.
3. In case of multi-product firm, a single chart cannot be of any use. Series of charts have to be made use of.
4. It is based on fixed cost concept and hence holds good only in the short-run.

5. Total cost and total revenue lines are not always straight as shown in the figure. The quantity and price discounts are the usual phenomena affecting the total revenue line.
6. Where the business conditions are volatile, BEP cannot give stable results.

The above limitations do not deter the utility of break-even analysis. Even today, the business proposals are evaluated on the concept of BEP. The project is chosen if the BEP is lower. Similarly, the bankers and other financial agencies excessively rely up on the BEP of the borrower. If the BEP is lower, only then borrower is favoured. In other words, the break-even analysis continues to be practical tool for the business community.