PRODUCTION FUNCTION

PRODUCTION FUNCTION

What is Production Function?

The basic relationship between the factors of production and the output is reffered to as a Production Function.

The firm's production function for a particular good (q) shows the maximum amount of the good that can be produced using alternative combinations of capital (K) and labor (L)

$$q = f(K,L)$$

TYPES OF PRODUCTION FUNCTION

The nature of production function, ie.how output varies with change in the quantity of inputs,depends upon the time period allowed for the adjustement of inputs.

On this basis Production function is classified into two types:

Production function

- **short run production function-** Time when one input (say, capital) remains constant and an addition to output can be obtained only by using more labour.
- **long run production function=** Both inputs become variable

Important facts about production function

- A Production function is expressed with reference to a particular period of time.
- It expresses a physical relation because both inputs and outputs are expressed in physical terms.
- Prodction function describes a purely technological relation because what can be produced from a given amount of inputs depends upon the state of technology

Short Run vs. Long Run

Short Run → Plant size is fixed, labor is variable

Short Run → To increase production firms increase Labor but can't expand their plant

Firms produce in the short run

Total Product Function (TP)

- Represents the relationship between the number of workers (L) and the TOTAL number of units of output produced (Q) holding all other factors of production (the plant size) constant.
  - For a coffee shop, output would be measured in "number of coffee cups a day"
  - For a steel mill, output would be measured in "tons of steel produced a day"

Marginal Product (MP)

The additional output that can be produced by adding one more worker while holding plant size constant.

Average Product (AP)

- Represents the amount of output produced by each worker on average.

Or

- Output per worker.

Law of Variable Proportions

Law of Variable Proportions (Short run Law of Production)

Assumptions:

- One factor (say, L) is variable and the other factor (say, K) is constant
- Labour is homogeneous
- Technology remains constant
- Input prices are given

Schedules and graphs

- Short run production function

TOTAL,AVERAGE AND MARGINAL PRODUCTS SCHEDULE(CONSIDER A SMALL SANDWICH SHOP)

NO.OF WORKERS (L)	TOTAL PRODUCT (TP) sandwich	AVERAGE PRODUCT (AP)	MARGINAL PRODUCT (MP)	
0	-	-	-	
1	100	100	100	
2	220	110	120	1
3	360	120	140	
4	520	130	160	
5	650	130	130	
6	750	125	100	
7	840	120	90	2
8	880	110	40	
9	880	97.7	0	
10	830	83	50	3
11	770	77	60	

GRAPH OF LAW OF VARIABLE PROPORTION

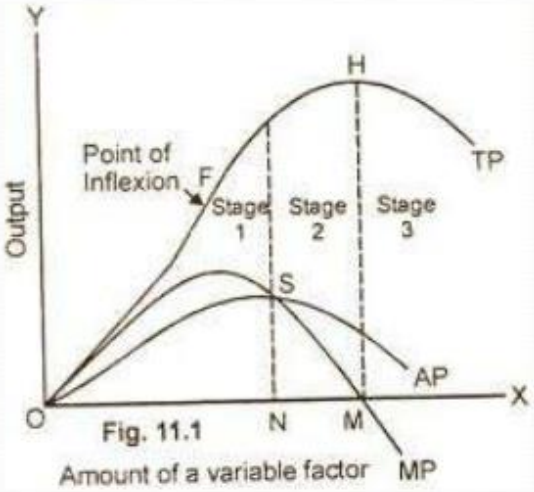


Fig. 11.1

Three stages of production

- **Stage 1**: average product rising.
- **Stage 2**: average product declining (but marginal product positive).
- **Stage 3:** marginal product is negative, or total product is declining.

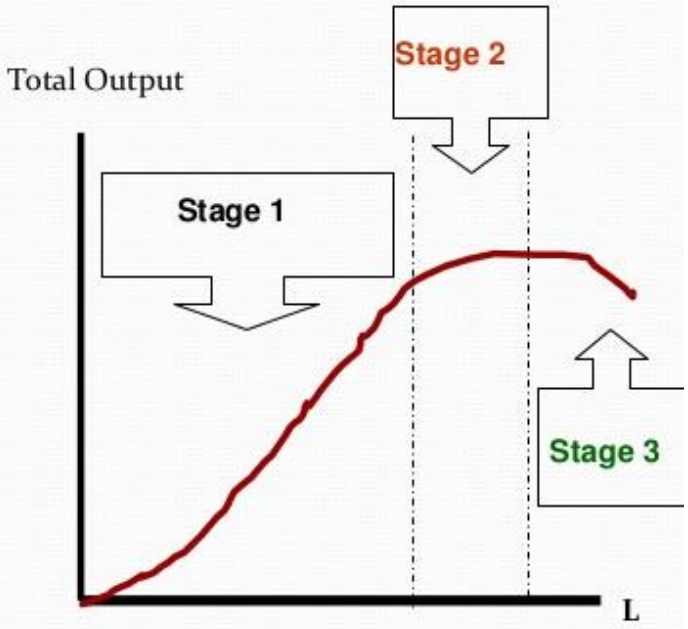


Figure 7.4 on Page 306

RELATIONSHIP BETWEEN DIFFERENT PRODUCTS

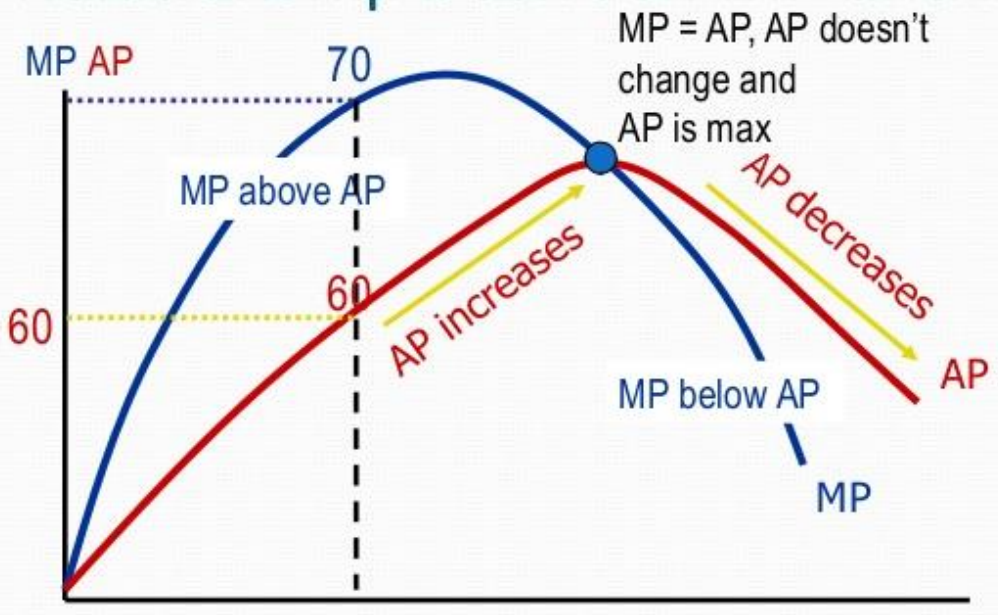
Between AP and MP

- WHEN MP > AP,AP INCREASES
- WHEN MP < AP,AP DECREASES
- WHEN MP = AP,AP IS MAXIMUM

Between TP and MP

- WHEN TP INCREASES AT INCREASING RATE,MP INCREASES
- WHEN TP INCREASES AT DECREASING RATE,MP DECREASES
- WHEN TP IS MAXIMUM,MP IS 0
- WHEN TP DECREASES,MP IS NEGATIVE

Relationship between MP and AP



conclusion

- Production function is simply a catalogue of production possibilities.
- It is an engineering concept and since money prices do not appear in it,it merely depicts the physical relationship between the output and inputs.

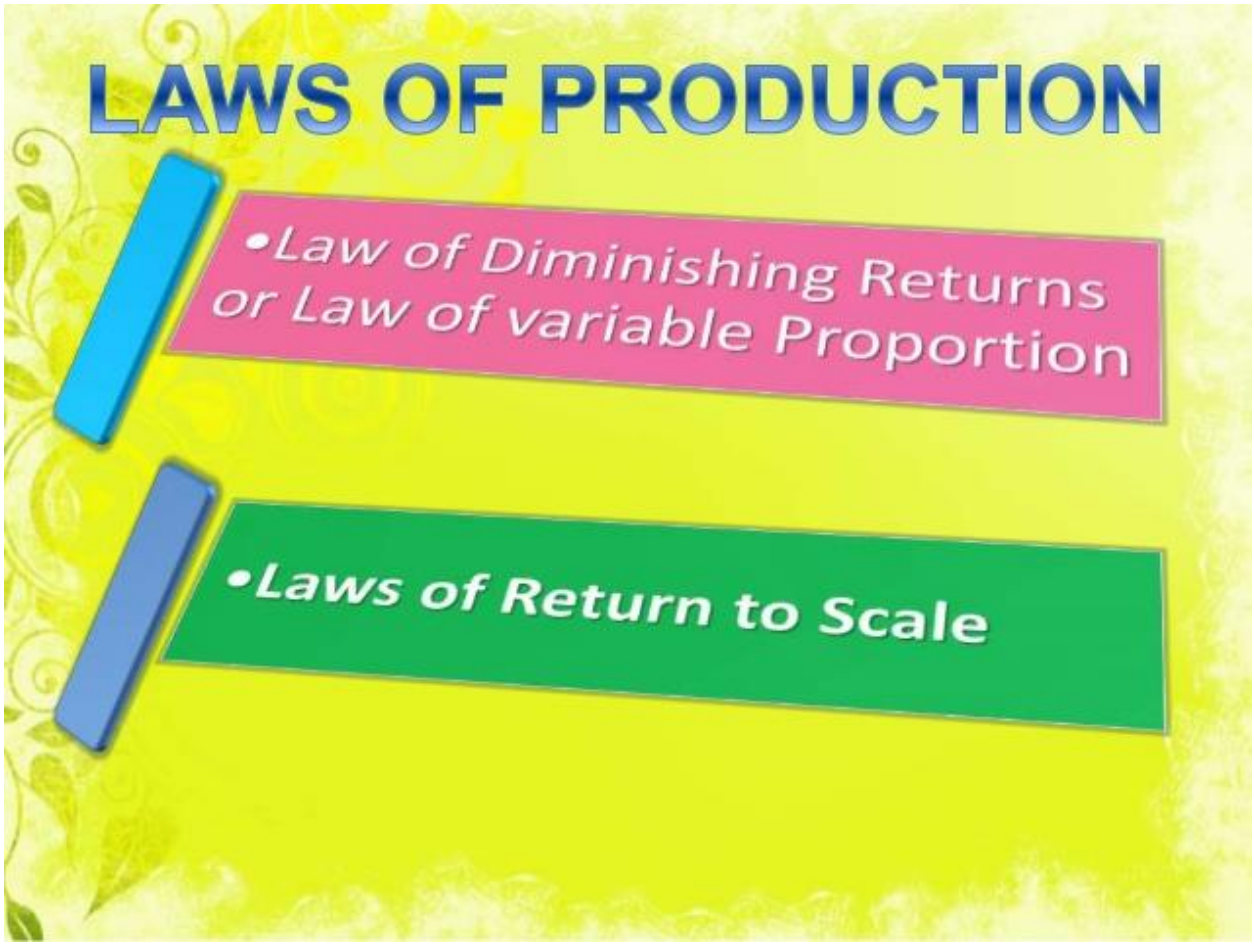
Law of Variable Proportion

It states that:

- If one factor is used more & more,keeping the other factors constant.
- The total output will increase at an increasing rate in the beginning and then at diminishing rate and eventually decreases absolutely.

ASSUMPTIONS :

- Constant Technology
- Short run
- Homogeneous Factors
- Variable Input Ratio


LAWS OF PRODUCTION
•Law of Diminishing Returns or Law of variable Proportion
•Laws of Return to Scale

Law of Variable Proportion

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ASSUMPTIONS :

- Constant Technology
- Short run
- Homogeneous Factors
- Variable Input Ratio

Table illustrates the operation:

Units of Labour L	Total Product (Quintals) Q	Average Product (Quintals)	Marginal Product (Quintals)	
1	80	80	80	
2	170	85	90	IR
3	270	90	100	
4	368	92	98	
5	430	86	62	
6	480	80	50	DR
7	504	72	24	
8	504	63	0	
9	495	55	-9	Negative
10	480	48	-15	

Three Stages of Production:

STAGE 1 : INCREASING RETURNS

As the production of one factor in the combination of factor is increased upto a point, the MP of the factor will increase.

Reasons:

- Indivisibility of factors
- Quantity of fixed factor
- Division of labour
- Economies

STAGE 2 : DIMINISHING RETURNS

As the production of one factor in the combination of factor is increased after a point the average & MP of that factor will diminishing.

Reasons:

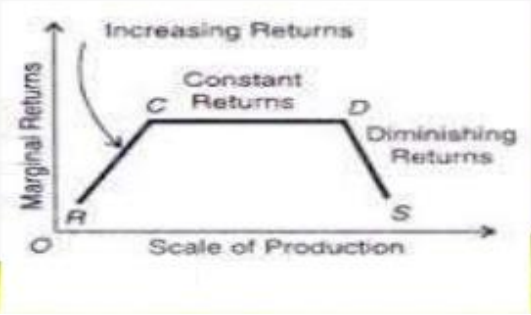
- Scarcity of fixed factors
- Indivisibilty of fixed factor
- Lack of perfect substitution of factor of production

Law of Returns to Scale

- It is a Long run analysis & all factors are variable.
- It seeks to analyse the effects of scale on the level of output.

Three kinds of returns to scale:

- INCREASING RETURNS TO SCALE
- CONSTANT RETURNS TO SCALE
- DECREASING RETURNS TO SCALE

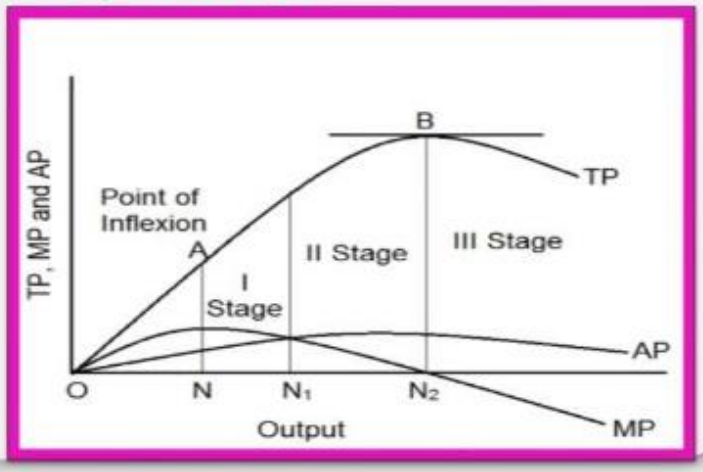


STAGE 3 : NEGATIVE RETURNS

MP of variable factor is negative.

Reasons:

- Excessive variable factor
- Inefficiency of fixed factor



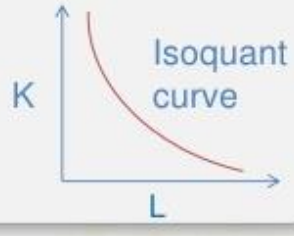
ISOQUANTS

Isoquant is a curve representing the various combinations of two inputs that produce the same amount of output.
Also called as **equal product curve.**

Slope of an isoquant indicates the rate at which factors K and L can be substituted for each other while a constant level of production is maintained.

ASSUMPTIONS :

- There are two inputs: Labour L & Capital C to produce a commodity X.
- L,K & X are Perfectly divisible.
- Technology of product is given.



Types of Isoquant

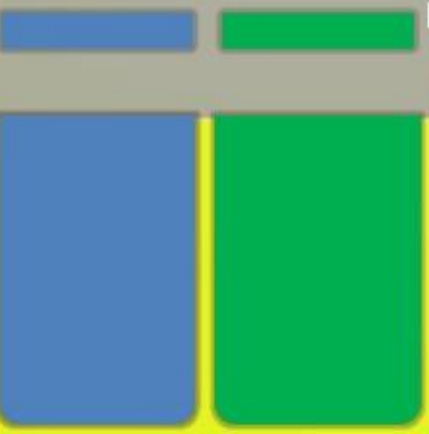
The shapes depends upon degree of substitutability of inputs:

Linear Isoquant:

Perfect substitutability between factors of production.

An output can be produced by

either using one or both.



Input- Output Isoquant

Strict complementarity's between inputs.

If a quantity

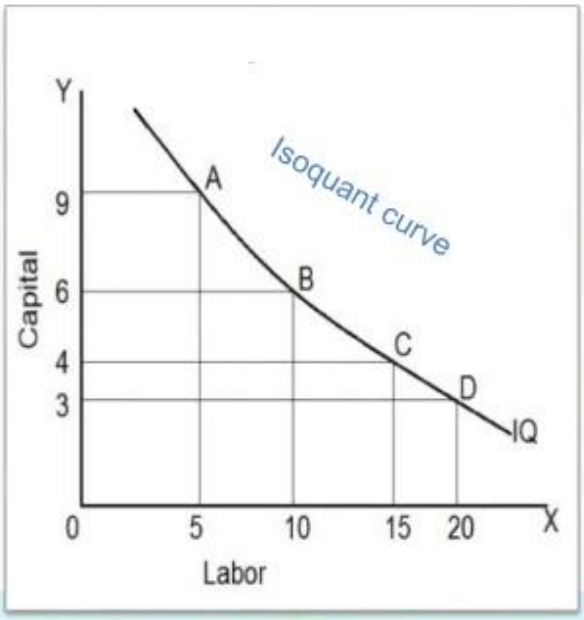
of one input is

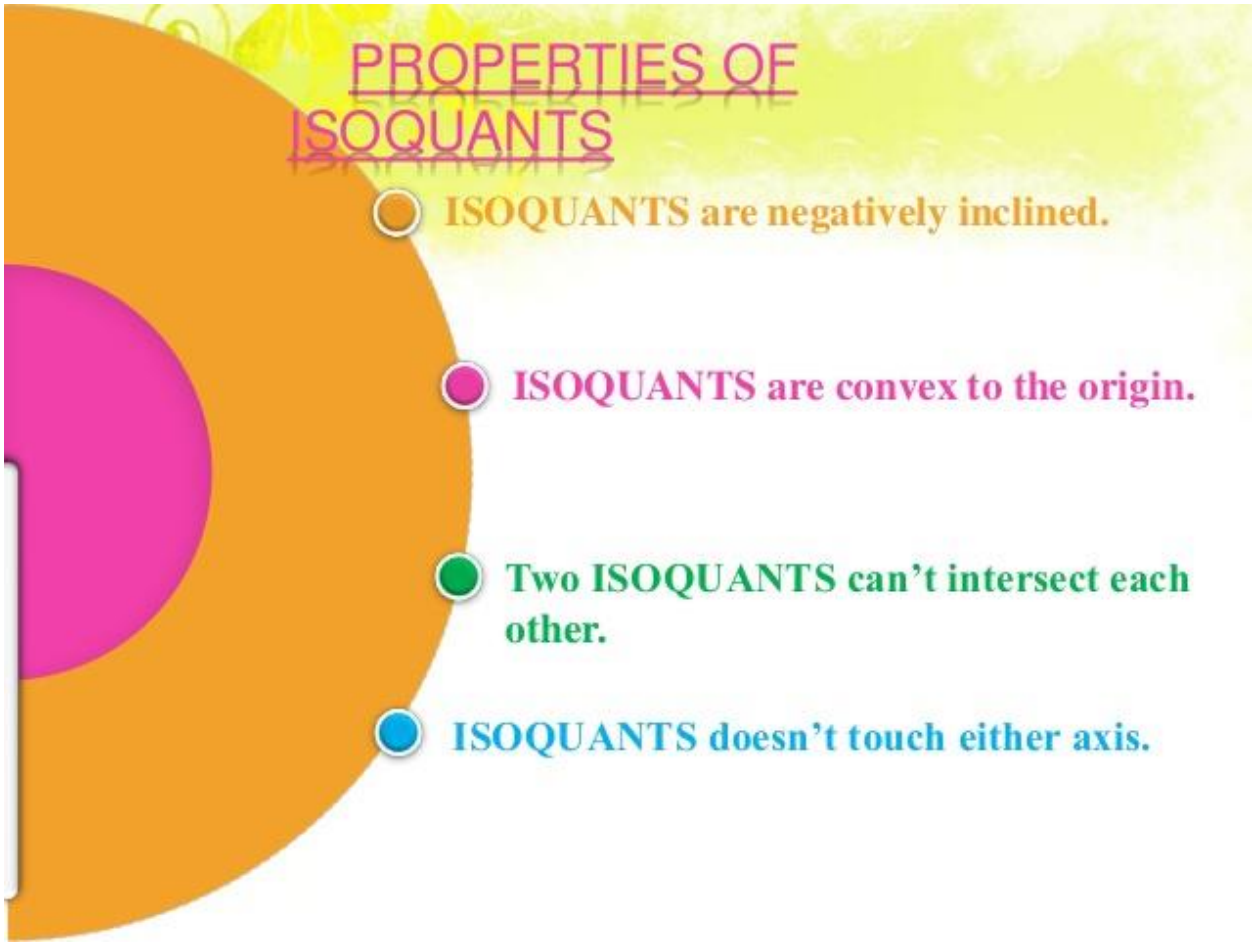
increased there will be

no change in output

Example:

Factor Production	Labour	Capital
A	5	9
B	10	6
C	15	4
D	20	3
E	25	2





Breakeven Chart: Functions, Analysis and Limitations

After reading this article you will learn about:- 1. Functions (Scope) of Breakeven Chart 2. Construction of Breakeven Chart 3. Interpretations and Analysis 4. Procedure to Draw 5. Limitations.

Functions (Scope) of Breakeven Chart:

1. A breakeven chart is an aid to management and it depicts a clearer view of the position of a business.

2. It is one of the most useful graphic presentation of accounting data.

3. It is a graphic presentation of an economic rather than an accounting concept.

4. It portrays likely profits or losses at various output levels.

5. It depicts relationship between marginal costs and fixed costs.

6. It marks no profit no loss situation.

7. It portrays margin of safety.

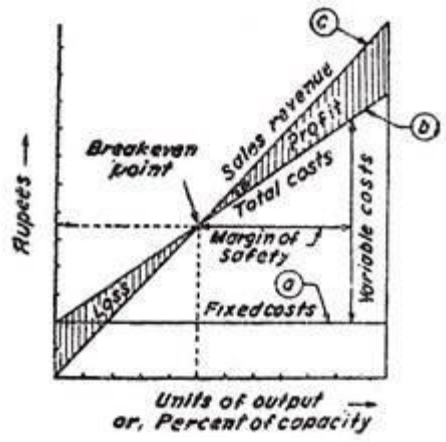
8. It can help make specific plans to effect profits through the control of expenses.

9. It can nicely sum up the impact of alternative decisions on costs and profits.

10. It is a decision making tool in the hands of management.

Construction of Breakeven Chart:

Fig. 27.3 portrays a breakeven chart.



θ : Angle of incidence.

Fig. 27.3. A Breakeven chart.

The breakeven chart consists of an ordinate (y-axis) and an abscissa (x-axis). The ordinate presents a scale of rupees against which fixed costs, variable costs, and rupees of revenue can be measured. The abscissa can be dimensioned in terms of the production volume, i.e., number of units produced. Three lines marked as a, b and c can be noticed on the breakeven chart. Line 'a' is a fixed cost function.

Fixed charges do not change as a function of increased volume of production. Line 'b' is an increasing linear, monotonic function that increases with increasing volume of production. It represents total costs which result from the summation of fixed and variable costs. The variable costs assigned to the production system are shown by the triangular area between the fixed cost line and total costs line, i.e., 'a' and line 'b'.

Line 'c' is the sales revenue line. A linear relationship is utilized to describe revenue; which indicates that the

price at which any quantity of the output can be sold is fixed and does not change with volume of production. This line indicates income at varying levels of output or production volume.

Interpretations and Analysis of a Breakeven Chart:

1. The breakeven point marking no profit no loss situation occurs for a given volume of production.

2. The cross-hatched area between the total cost line and revenue line on the left-hand side of the breakeven point marks loss to the concern whereas the area between the same lines on the right-hand side of the breakeven point represents profit to the enterprise or concern.

3. Profit appears only when more than a minimum volume of output is reached. Profit increases at a faster rate than do total costs.

4. Profit margin as %

= 1 – Variable cost/Sales

Where, sales = Fixed costs + (Variable costs as a % sales) sales.

5. Effect of an increase in fixed costs [Fig. 21. 4 (a)]. An increase in fixed costs, possibly owing to the purchase of a new machine, increases the total costs and thus shifts BEP (Breakeven Point) towards the right-hand side. This shows that the company's profit position will be impaired if all other conditions remain the same. Therefore, one

should study the market conditions carefully before purchasing the new equipment.

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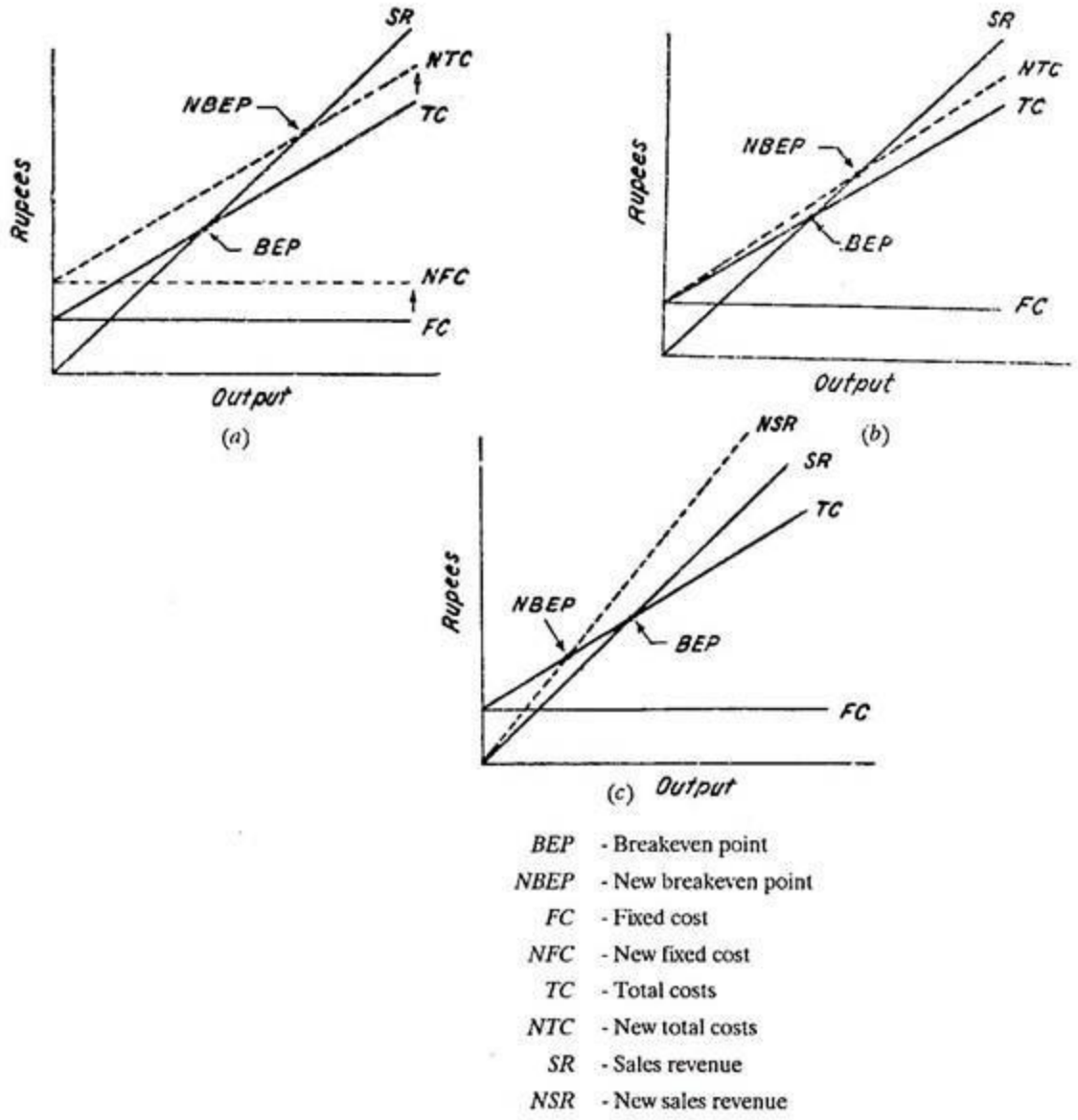

BEP - Breakeven point
NBEP - New breakeven point
FC - Fixed cost
NFC - New fixed cost
TC - Total costs
NTC - New total costs
SR - Sales revenue
NSR - New sales revenue

Fig. 27.4. Effect of changing different parameters on breakeven chart.

6. Effect of an increase in variable cost [Fig. 21A (b)].

An increase in variable cost and therefore in total costs, possibly owing to an increase in labour cost, would shift the BEP towards the right-hand side. This involves a decrease in profit for the same units of output. Therefore the management may think of going for some new labour saving equipment to maintain its profits as before.

7. Effect of an increase in sales price [Fig. 27.4 (c)]. If the price of an article rises, a new sales revenue will be drawn with a greater slope. This shifts the BEP towards the left-hand side and thus increases the company profits for the same volume of output.

8. Effects of a decrease, in fixed cost, variable cost and sales price can be visualised in the same manner as above by drawing separate breakeven charts as in Fig. 27.4.

Margin of safety:
(i) Margin of safety can be presented on the breakeven chart as the distance between BEP and the output being produced (Fig. 27.3).

(ii) If this distance is large, it indicates that profits will be there even if there is a serious drop in production.

(iii) If this distance is relatively small, it hints that profits will be reduced considerably even if there is a small drop in productive capacity or sales.

(iv) Margin of safety may be expressed in monetary terms or as a percentage — the margin of safety in relation to total sales.

Angle of incidence:
(i) This is the angle (θ) at which sales revenue line cuts the total costs line (refer Fig. 27.3).

(ii) A large angle indicates that profits are being made at a high rate.

(iii) A large angle of incidence with a high margin of safety, mark the extremely favourable business position.

Procedure to Draw Breakeven Chart:

1. Draw the fixed cost line (AB) at Rs. 80,000 on the graph paper.

2. Variable cost = No. of units x Variable cost per unit

= 10,000 x 4 = Rs. 40,000.

Variable cost varies from 0 at 0 units to Rs. 40,000 at 10,000 units.

3. Draw variable cost line (AC) above the fixed cost line. The variable cost when added to fixed cost gives the total cost.

4. Sales revenue is zero at 0 units and it is 200,000 at 10,000 units. Therefore draw the sales revenue line OD.

Breakeven chart has been drawn in Fig. 27.5.

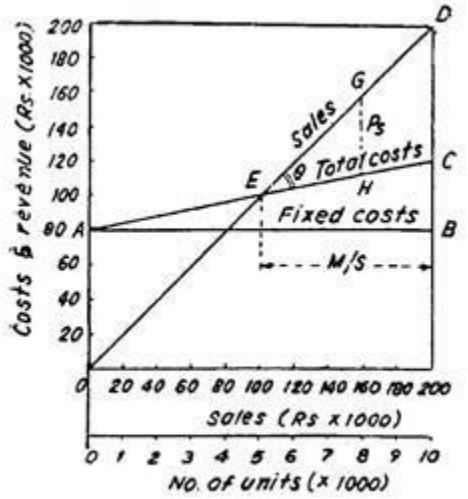

Fig. 27.5. Breakeven Chart.

(i) In the breakeven chart, point E represents the breakeven point. It is at 5,000 units or Rs. 100,000, i.e., where production when sold will return Rs. 100,000 in revenue to the company.

(ii) The company should produce and sell more than 5,000 units to seek profit.

(iii) The profit earned at a turnover of Rs. 160,000 is marked by P_s in Fig. 27.5 and it is equal to Rs. 48,000.
(iv) The margin of safety at 10,000 units has been marked by M/S in Fig. 27.5 and it is

= Total sales-Sales figure at B.E.P.

= Rs. 200,000-100,000=Rs. 100,000

Also, margin of safety when represented as a percentage is

= Margin of safety/Total sales x 100

= 100,000/200,000 x 100 = 50%

(v) The angle of incidence 6 has been marked in Fig. 27.5 and is 34.3°.

Limitations of Breakeven Chart:

1. The breakeven point is difficult to determine in many instances because of the difficulty in properly classifying costs as either fixed or variable and because market conditions may not remain constant over the range of projected capacity.

2. The breakeven chart is a tool for short run analysis; it cannot be used for 8 or 10 year projections because of the difficulty of indicating variables in each of the costs line on the chart.

3. The total cost line, representing the variable costs added to fixed costs, need not be straight line, in actual fact, costs do not usually vary in direct proportion.

4. The straight line which represents sales revenue may also misrepresent the true facts.

5. The breakeven chart represents a static picture whereas business operations are far from static.

6. Analysis of breakeven chart presents additional difficulties, (e.g., in product mix) when a company produces a variety of products.

Example:

The fixed costs for the year 1975-76 are Rs. 80,000. The estimated sales for the period are valued at Rs. 200,000. The variable cost per unit for the single product made is

Rs. 4. If each unit sells at Rs. 20, and the number of units involved coincides with the expected volume of output, construct the Breakeven Chart.

(i) Determine the breakeven point.

(ii) Above how many units, the company should produce in order to seek profit.

(iii) Determine the profit earned at a turnover of Rs. 160,000.

(iv) Find the margin of safety.

(v) Measure the angle of incidence.

Solution:

Given: F = Rs. 80,000 (fixed cost)

V = Rs. 4 (variable cost per unit).

P = Rs. 20 (selling price of each unit).

Estimated sales, S = Rs. 200,000.

∴ No. of units sold = 20,000 (S)/20(P) = 10,000.