Cost-Profit-Volume Analysis

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BREAK -EVEN ANALYSIS

Break –even Analysis refer to a system of determination of activity where total cost equals total selling price. It is also known as cost-volume- profit analysis. The analysis is a tool of financial analysis whereby an attempt is made to measure variations in volume, costs, price, and product-mix on profits with reasonable accuracy. For instance, cost vary due to choice of plant, scale of operations, technology, efficiency of work-force and management efficiency. Also costs of inputs are affected by market forces.

The management is always interested in knowing that which product or product mix is most profitable, what effect a change in the volume of output will have on the cost of production and profit etc. All these problems are solved with the help of the cost-volume-profit analysis.

INTERPLAY AND EFFECT OF FACTORS ON PROFIT

Sales price change → **Volume change** → **Unit cost change** → **Profit structure change**

CVP is proposed to evaluate the effect of

❑ **Price changes on net profit**

❑ **Volume changes on net profit**

❑ **Price and volume changes on net profit**

❑ **An increase or decrease in variable cost on net profit**

❑ **An increase or decrease in fixed cost on net profit**

❑ **Changes in volume, price, fixed costs, variable cost on net profit**

Contribution

The basic CVP model is based on the following equations.

Sales - Variable (Marginal Cost) cost = Contribution

Contribution – Fixed Cost = Profit (or Loss)

From the above equation, we can understand that in order to earn profit, the contribution must be more than the fixed cost. To avoid any loss, the contribution must be equal to fixed cost.

PROFIT VOLUME RATIO (P/V RATIO)

Profit volume ratio (P/V ratio or contribution sales ratio or marginal income ratio or variable profit ratio) is the **percentage of contribution to sales**. The formula for computing the P/V ratio is given below:

- P/V Ratio = Contribution ÷ Sales

- P/V Ratio = {Fixed Cost + Profit } ÷ Sales

- P/V Ratio = { Sale − Variable Cost} ÷ Sales

- P/V ratio = Fixed Cost ÷ BEP

The ratio indicate the relative **profitability of different products**. The profit of a business can be increased by improving P/V ratio. A **higher ratio means a greater profitability** and vice versa. As such management will make efforts to improve the ratio.

So management will increase the P/V ratio:

o **By increasing sales price per unit**

o **By decreasing variable costs**

o **By increasing the production of products which is having a high P/V ratio and vice-versa.**

Illustration 1: **From the given data, compute Profit Volume Ratio.**

Marginal Cost: Rs. 2400;   Selling Price: Rs. 3000

Solution: Contribution = Selling Price - Marginal Cost = Rs. 3000 - Rs. 2400 = Rs. 600

P/V Ratio = (Contribution ÷ Sales) X 100 = (Rs. 600 ÷ Rs. 3000) X 100 = 20%

BREAK-EVEN POINT

Break-even-point is a point where the total sales (total revenue or income) is equal to total cost, and after which loss ceases and profit begins. Hence, if production is increased beyond this point, profit shall accrue and if it is reduced below this level, loss will be suffered.

Break-even-point can be determined by the following formula:

Break-even point in output = Fixed cost ÷ contribution per unit

Break-even point in sales   = Break-even Output x Selling price per unit

= (Fixed cost ÷ contribution per unit) x Selling price per unit

= (Fixed cost ÷ contribution) x Total sales

= Fixed cost ÷ (Contribution ÷ Total Sale)

= (Fixed cost x Sale) ÷ Contribution

= (Fixed Cost ÷ P/V ratio)

Break-even point in sales   **=(Fixed cost ÷ contribution per unit) x Selling price per unit**

                    = Fixed cost ÷ (1 - variable cost per unit ÷ selling price per unit)

                    = Fixed cost ÷ (1 - total variable cost ÷ total sales)

At break-even point, profit is zero. To calculate volume of output and sales for a desired profit, the amount of desired profit should be added to fixed costs as given bellow.

Units of output for a desired profit = (Fixed cost + desired profit)÷ contribution per unit

Sales for a desired profit = (Fixed cost + desired profit)÷ P/V ratio

Example 1: From the following information, you are required to compute break-even point Variable cost per unit - Rs. 12; Fixed cost- Rs. 60000; Selling price per unit- Rs. 18.

Solution:

Contribution = Selling Price - Variable Cost

= Rs. 18 - Rs. 12 = Rs. 6

B.E.P. in Units = Fixed Cost ÷ Contribution per Unit

= Rs. 60000 ÷ Rs. 6 = 10000 Units

Break Even Point in Sales = Rs. 18 X 10000 Units = Rs. 180000

Example 2: A company estimates that next year it will earn a profit of Rs. 50000. The budgeted fixed costs and sales are Rs. 250000 and 993000 respectively. Find out the break-even point for the company

Solution:

Contribution = Fixed Cost + Profit = Rs. 250000 + Rs. 50000 = Rs. 300000

B.E.P. (in sales) = (Fixed Cost ÷ P/V ratio) = Fixed Cost ÷ (contribution ÷ Sale)

= Rs. 250000 ÷ (Rs. 300000 ÷ Rs. 993000) = Rs. 827500

Example 2: From the following information, you are required to compute break-even point Variable cost per unit - Rs. 12; Fixed cost- Rs. 60000; Selling price per unit- Rs. 18.

Solution: **Contribution per unit** = Selling Price per unit - Variable Cost per unit

= Rs. 18 - Rs. 12 = Rs. 6

B.E.P. in Units (output) = Fixed Cost ÷ Contribution per Unit

= Rs. 60000/Rs. 6 = 10000 Units

Break Even Point in Sales = Rs. 18 X 10000 Units = Rs. 180000

Example3: From the following information, you are required to compute break-even point Variable cost per unit - Rs. 12; Fixed cost- Rs. 60000; Selling price per unit- Rs. 18.

Solution: Contribution = Selling Price - Variable Cost

= Rs. 18 - Rs. 12 = Rs. 6

B.E.P. in Units = Fixed Cost ÷ Contribution per Unit

= Rs. 60000 ÷ Rs. 6 = 10000 Units

Break Even Point Sales = Selling price X BEP in Units

= Rs. 18 X 10000 Units

= Rs. 180000

Margin of safety is the **excess of sales (budgeted or actual) over the break-even sales**. It shows the amount by which sales may decrease before loss is incurred.

Margin of safety can be expressed in absolute sales amount or in percentage.

i.e.   Margin of safety = Actual Sales - Sales at B.E.P.

Margin of Safety ratio =   (Actual Sales - Sales at B.E.P.) ÷ Actual sales

= Profit ÷ (P/V) ratio

High margin of safety indicates the soundness of a business because even with substantial fall in sale or fall in production, some profit shall be made. Small margin of safety on the other hand is an indicator of the weak position of the business and even a small reduction in sale or production will adversely affect the profit position of the business.

Margin of safety can be increased by:

- Decreasing the fixed cost;

- Decreasing the variable cost;

- Increasing the selling price;

- Increasing output and sales;

- Changing to product mix that improves P/V ratio

Illustration 7: From the following details find out i) Profit Volume Ratio ii) B.E.P. and iii) Margin of safety.

Sales- Rs. 1,00,000; Total Cost- Rs. 80,000; Fixed Cost- Rs. 20,000 and Net Profit- Rs. 20,000

Solution:

i) P/V ratio =(Contribution ÷ Sales)X 100

= {(100000 - 60000) ÷ 100000} X 100% = 40%

ii) B.E.P. = Fixed Cost ÷ Profit volume ratio

= Rs. 20000 ÷ 40% = Rs. 50000

iii) Margin of safety = Profit ÷ Profit Volume ratio

= Rs. 20000 ÷ 40% = Rs. 50000

Or Margin of Safety = Actual Sales - Sales at BEP

= Rs. 100000 - Rs. 50000

= Rs. 50000

Illustration 8: From the following data, calculate: i) P/V Ratio ii) Profit when sales are Rs. 20000 iii) New Break Even Point if selling price is reduced by 20%; Fixed Expenses- Rs. 4000; Break-Even Point- Rs. 10000

Solution:

i) Break Even Sales = Fixed Expenses ÷ Profit Volume Ratio

Profit Volume Ratio = Fixed Expenses ÷ Break Even Sales

= (Rs. 4000 ÷ Rs. 10000) X 100 % = 40%

ii) When sales are Rs.20000, the profit is

= Sales X Profit Volume Ratio - Fixed Expenses

= Rs. 20000 X 40% - Rs. 4000

 = Rs. 4000

iii) If selling price is reduced by 20%, the new break even point would be Rs. 80 (say Rs.100 - Rs. 20).

Variable Cost per Unit = 100 - 40% = Rs. 60

New P/V Ratio = {(80 - 60) ÷ 80 }X 100% = 25%

New Break Even Point in sales = (4000 X 100) ÷ 25 = Rs. 16000
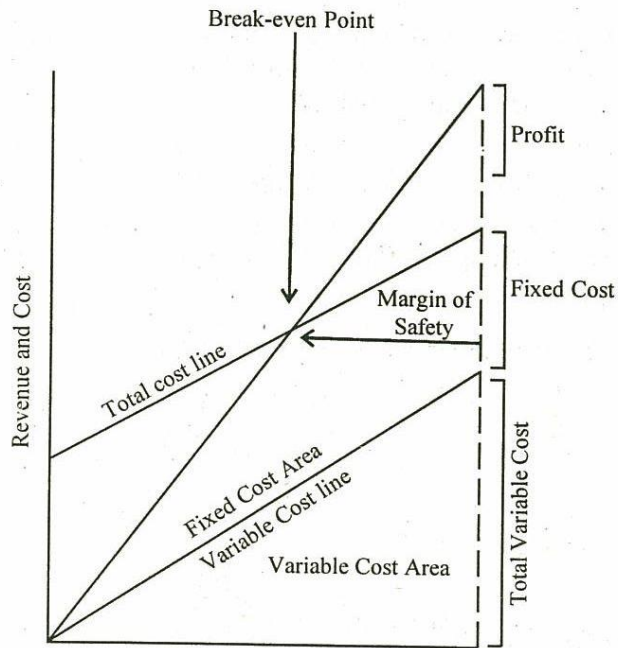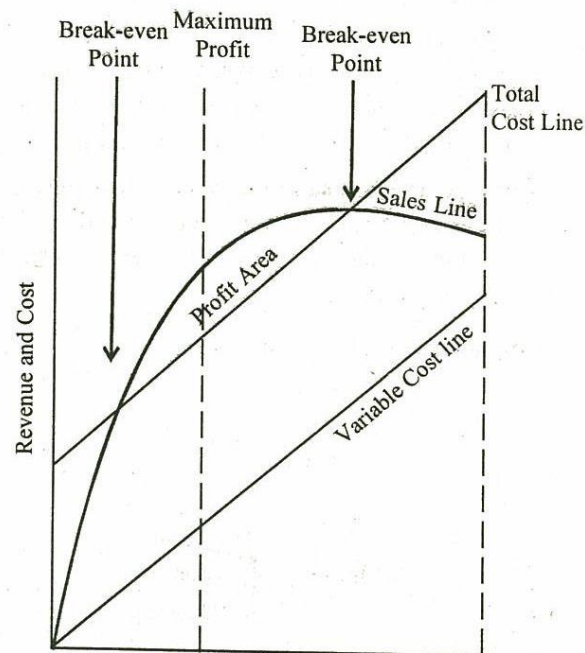
Break-even Chart

You will appreciate the break-even analysis is a transitional stage of CVP analysis. Many authors, in fact, discuss the interchangeability of these two because the derivation of break-even analysis from CVP analysis is very subtle.

The break-even chart also emerges from the Profit Graph, but the contribution line is replaced by the total cost. The new relationships which must receive attention in the wake of this major change, viz., replacement of the contribution line by the total cost line are presented in the two graphs below:


Figure 9.4

Figure 9.5

BREAK- EVEN CHART

Break-even Chart

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Figure 9.4

Figure 9.5

Figure 9.4 provides an idea of a conventional break-even chart. Figure 9.5, however, depicts a situation where sales revenue may have declined as a result of lowering selling prices to liquidate a higher volume of goods and the company moves into a situation where loss is incurred. The point of maximum profit is also shown on the graph.
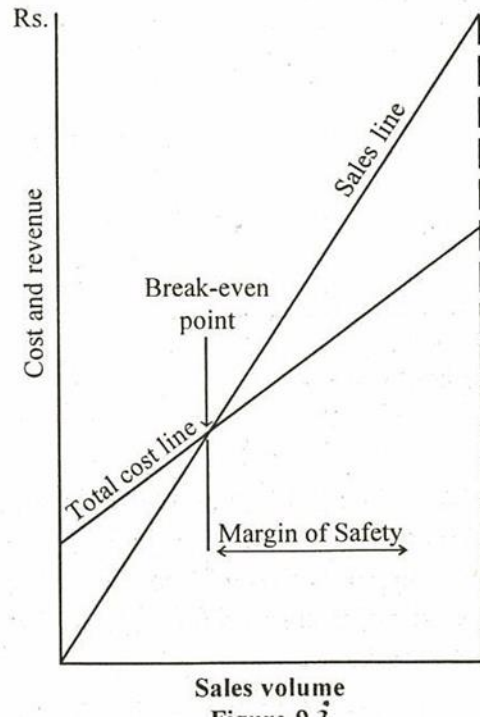
A graphical glimpse into cost-volume –profit structures: Two cases of companies A and B are presented. You may examine the sales and total cost lines and offer your comments. You should note the differences between these graphs and the profit graph presented earlier.

Company A: High ratio of fixed cost to total cost
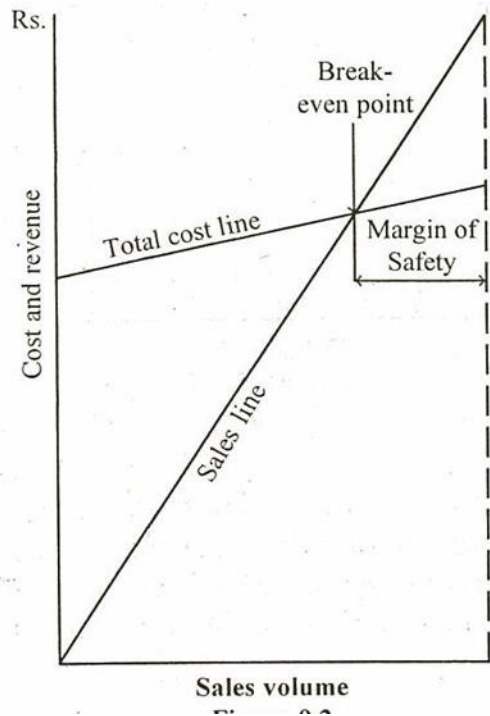
Company B: Low ratio of fixed cost to total cost

A major difference between companies. A and B is in terms of the location and slope of their respective total cost line. Company A has a high ratio of fixed cost to total cost because the vertical intercept of its total cost line is very high. In contrast, company B's vertical intercept is quite low and it has accordingly a low ratio of fixed costs to total costs. The following results follow:

a) Once the break-even point is reached for company A, large profits are made quickly as volume rises. The profit growth for company is slower after this break-even point.

b) Company B, however, has larger Margin of Safety than company A and can, therefore, sustain difficult business spells without immediately cutting down on its level of activity. Company A cannot hazard a similar course and may have to shut down much earlier.

BREAK-EVEN CHART

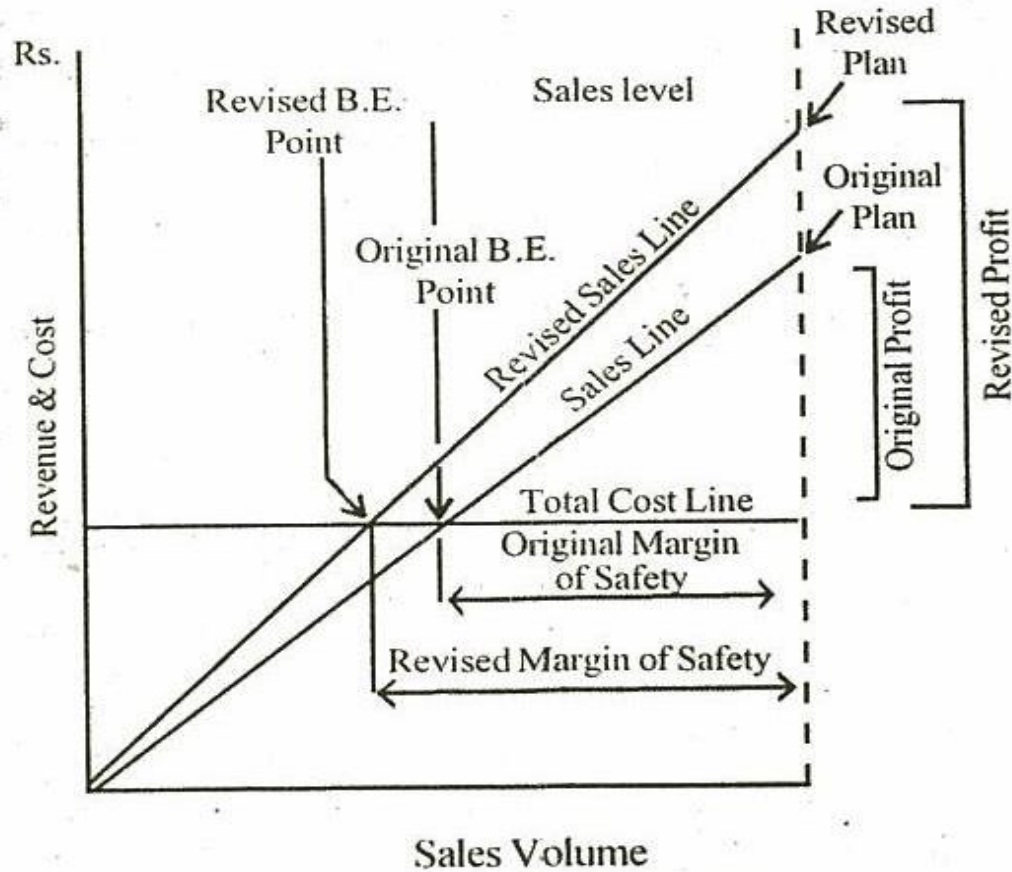## VISUAL REPRESENTATION OF BREAKEVEN CHART AT DIFFERENT SITUATIONS

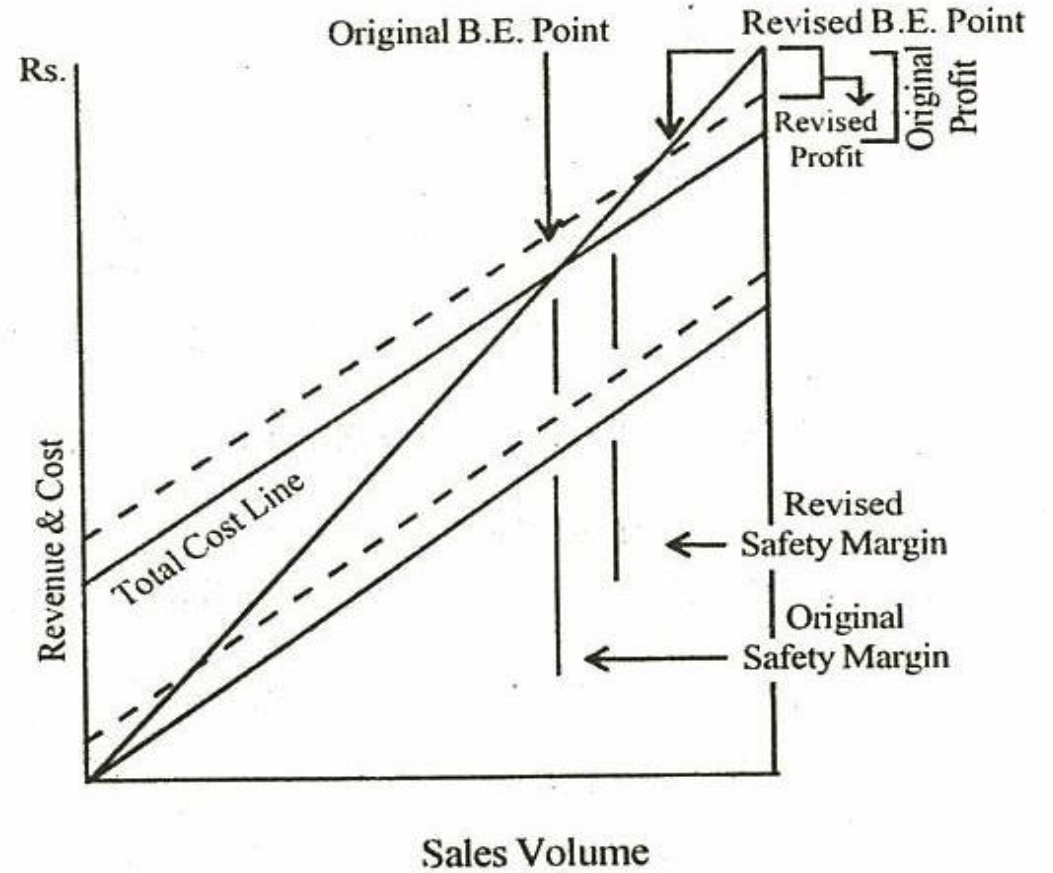Fig. 9.6 : Effect of Sales price changes on Profits.

Fig. 9.7 : Effect of increase in variable cost

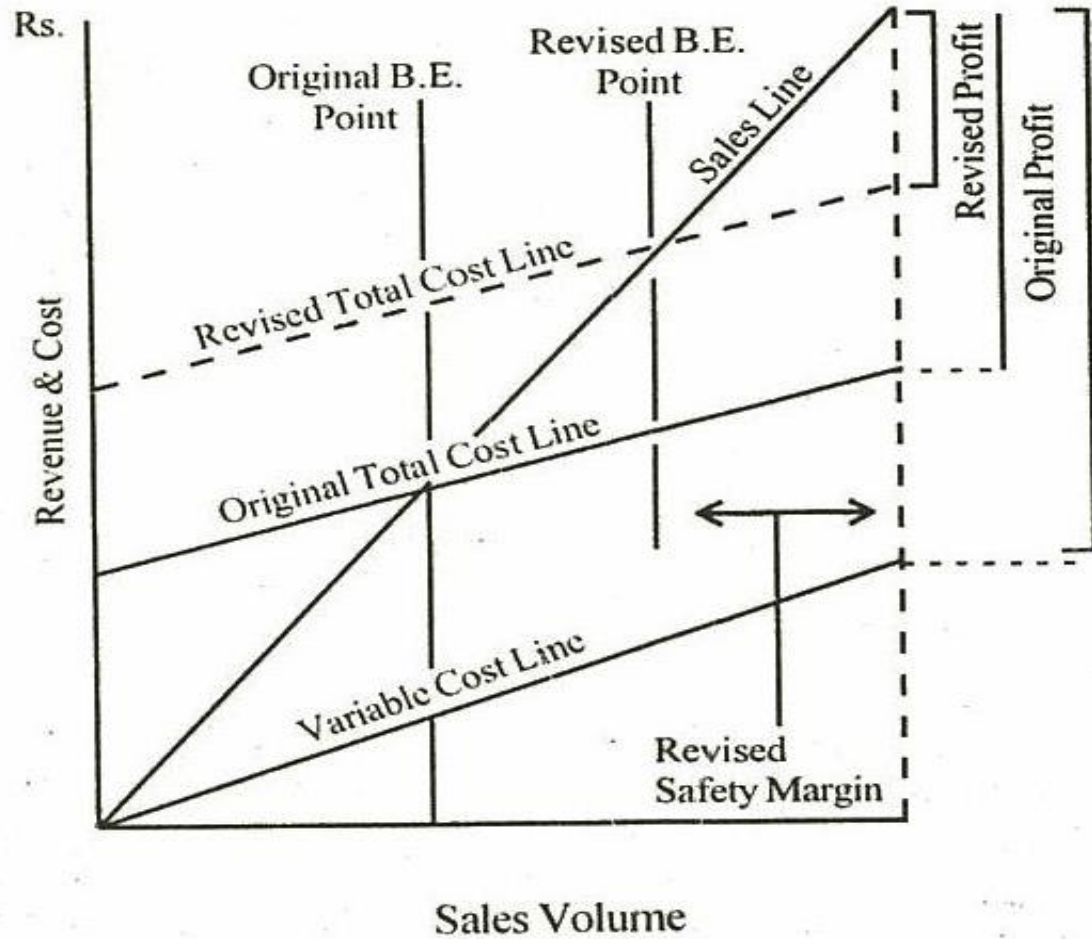## VISUAL REPRESENTATION OF BREAKEVEN CHART AT DIFFERENT SITUATIONS
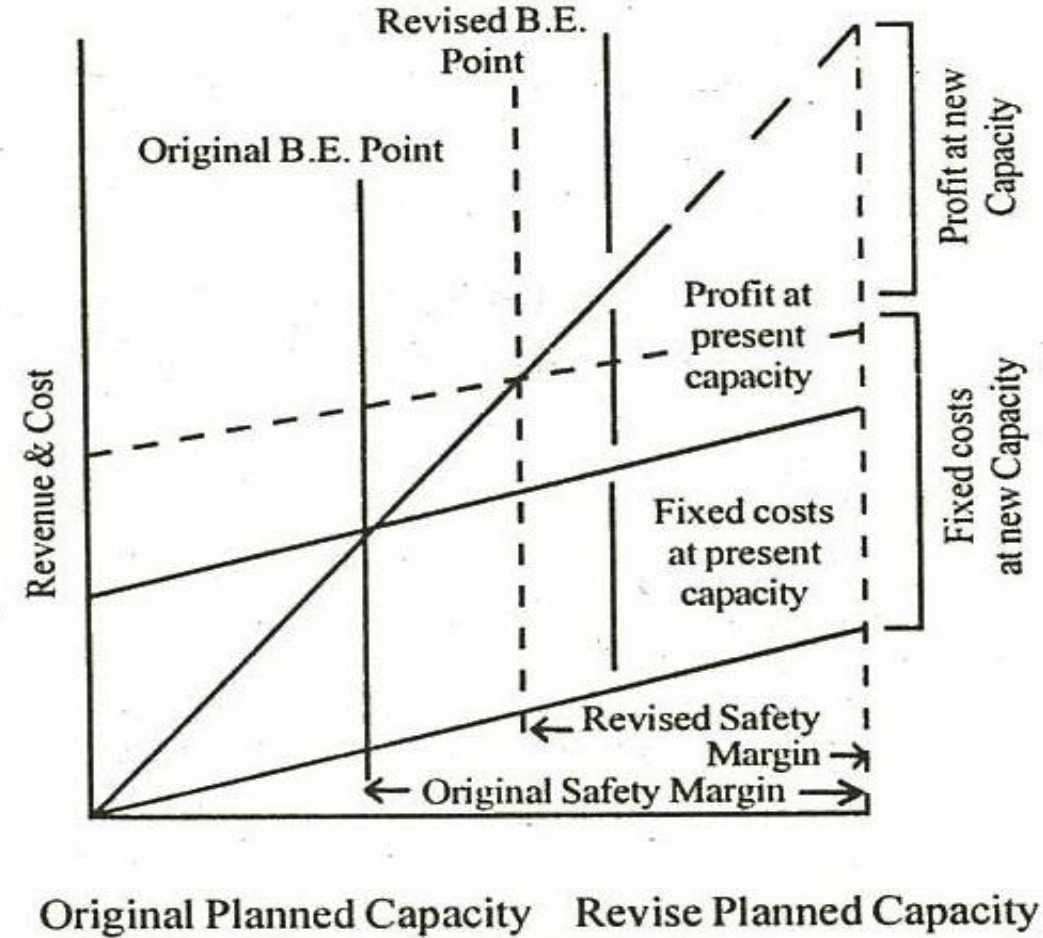

Fig. 9.8 : Effect of increase in fixed cost

Fig. 9.9 : Effect of increase in capacity

BREAK-EVEN CHART contd.

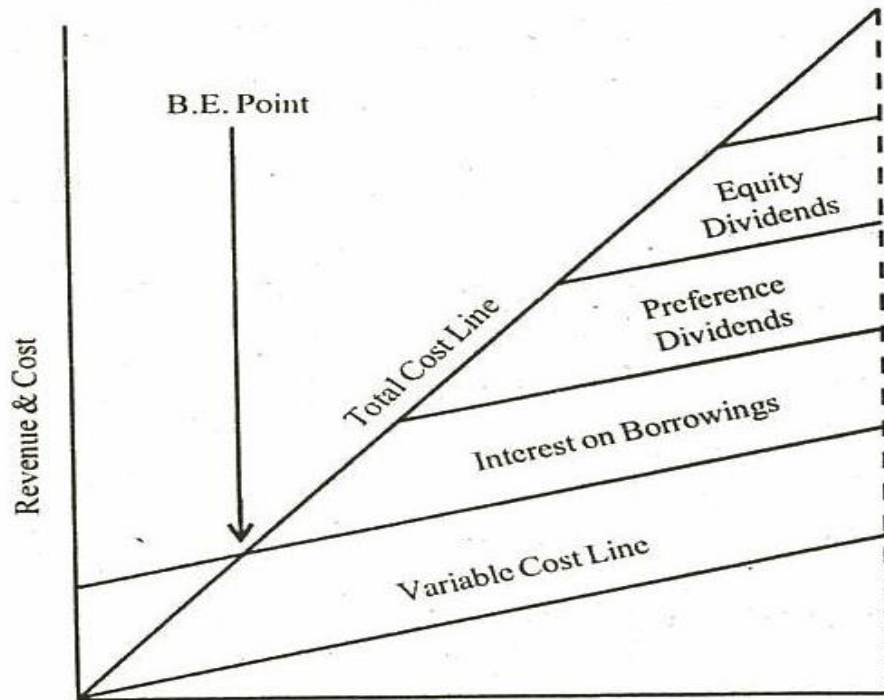## VISUAL REPRESENTATION OF BREAKEVEN CHART AT DIFFERENT SITUATIONS
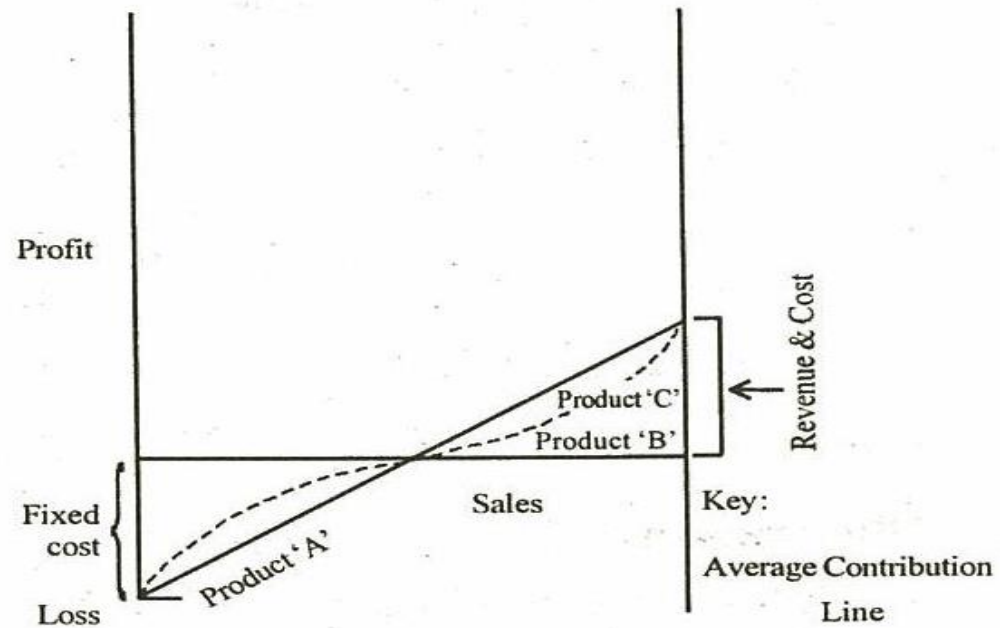

Fig. 9.10 : Effect of profit appropriation

Fig. 9.11 : Contribution effect of three products to overall profitability