**Chapter 3**

**Cost Volume Profit Analysis**

Managers are concerned about the impact of their decisions on proﬁt. The decisions they make are about volume, pricing, or incurring a cost. Therefore, managers require an understanding of the relations among revenues, costs, volume, and proﬁt. The cost accounting department supplies the data and analysis, called cost-volume-proﬁt (CVP) analysis that supports these managers.

Cost-volume-proﬁt analysis helps managers evaluate the impact of alternative product pricing strategies on proﬁts. It can also be useful for evaluating competitors’ pricing strategies and efforts to grow market share.

**COST-VOLUME-PROFIT-** (CVP) ANALYSIS STUDY OF THE RELATIONS AMONG REVENUE, COST, AND VOLUME AND THEIR EFFECT ON PROFIT.

**Proﬁt Equation**

The key relation for CVP analysis is the proﬁt equation. Every organization’s ﬁnancial operations can be stated as a simple relation among total revenues (TR), total costs (TC), and operating proﬁt:

Operating proﬁt = Total revenues - Total costs

Proﬁt = TR - TC

**PROFIT EQUATION-** OPERATING PROFIT EQUALS TOTAL REVENUE LESS TOTAL COSTS.

Total revenue (TR) equals average selling price per unit (P) times the units of output (X):

Total revenue = Price \* Units of output produced and sold

TR = PX

Total costs = (Variable costs per unit \* Units of output) + Fixed costs

TC = VX + F

Substituting the expanded expressions in the proﬁt equation yields a form more useful for analyzing decisions:

Proﬁt = Total revenue - Total costs

= TR - TC

TC = VX + F

Therefore,

Proﬁt = PX - (VX + F)

Collecting terms gives

Proﬁt = (Price - Variable costs) \* Units of output - Fixed costs

= (P - V) \* X - F

**Unit contribution margin-** Difference between revenues per unit (price) and variable cost per unit.

**Total contribution margin-** Difference between revenuesand total variable costs.

Price - Variable cost per unit

P – V

Total contribution margin is the unit contribution margin multiplied by the number of units (Price - Variable costs) \* Units of output, or (P - V) X. It is the amount that units sold contribute toward (1) covering ﬁxed costs and (2) providing operating proﬁts.

Thus, V is the sum of variable manufacturing costs per unit and variable marketing and administrative costs per unit; F is the sum of total ﬁxed manufacturing costs and ﬁxed marketing and administrative costs for the period; and X refers to the number of units produced and sold during the period.

**CVP Example**

Jamaal opened U-Develop; he offered one service only, developing prints. He charged an average price of SR .60. The average variable cost of each print was SR .36.

The ﬁxed costs to operate the store for March were SR 1,500.

In March, U-Develop processed 12,000 prints.

What volume is required to break even (earn zero proﬁts)? What volume is required to make an SR 1,800 operating proﬁt?

**Break-even point-** Volume level at which proﬁts equal zero.

Break-even volume (in units) = Fixed costs/ Unit contribution margin

SR 1,500

=---------------

SR .24

= 6,250 prints

**Break-Even Volume in Sales Riyals-** To ﬁnd the break-even volume in terms of sales dollars, we ﬁrst deﬁne a new term, contribution margin ratio. **The contribution margin ratio is the contribution margin as a percentage of sales revenue.**

Unit contribution margin

Contribution margin ratio =---------------------------------------

Sales price per unit

SR .24

**= -------------**

SR .60

= .40 OR 40%

Fixed costs

Break-even volume sales riyals =------------------------------------------

Contribution margin ratio

1,500

Break-even sales riyal =--------------

.40

= SR 3,750

F

Break-even volume (in units) = -------------

P – V

F \* P

Break-even volume (in Riyal) = --------------

P – V

Proﬁt = Contribution margin - Fixed costs

= (P - V) X - F

= (SR .60 - .36) \* 12,000 prints – SR 1,500

= SR 1,380

**Target Volume in Units-** To ﬁnd the target volume in units is

Fixed costs + Target proﬁt

Target volume (units) =--------------------------------------------

Contribution margin per unit

SR 1,500 + SR 1,800

= -------------------------------

SR .24

= 13,750 prints

**Target Volume (in Riyal) -** To ﬁnd the target volume (in riyal) is

Fixed costs + Target proﬁt

Target volume (in riyal) =--------------------------------------------

Contribution margin ratio

SR 1,500 + SR 1,800

= -------------------------------

.40

= SR 8,250

**Use of CVP to Analyze the Effect of Different Cost Structures**

**Cost structure-** Proportion of an organization’s ﬁxed and variable costs to its total costs.

An organization’s cost structure is the proportion of ﬁxed and variable costs to total costs. Cost structures differ widely among industries and among ﬁrms within an industry. Electric utilities such as Southern California Edison or Public Service of New Mexico have a large investment in equipment, which results in a cost structure with high ﬁxed costs. In contrast, grocery retailers such as Albertsons or Safeway have a cost structure with a higher proportion of variable costs. The utility is capital intensive; the grocery store is labour intensive.

An organization’s cost structure has a signiﬁcant effect on the sensitivity of its proﬁts to changes in volume. Operating leverage describes the extent to which an organization’s cost structure is made up of ﬁxed costs. Operating leverage can vary within an industry as well as between industries.

**Operating leverage-** Extent to which an organization’s cost structure is made up of ﬁxed costs.

Operating leverage is high in ﬁrms with a high proportion of ﬁxed costs and a low proportion of variable costs and results in a high contribution margin per unit. The higher the ﬁrm’s ﬁxed costs, the higher the break-even point. Once the break-even point has been reached, however, proﬁt increases at a high rate.

**Comparison of Cost Structures**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Lo-Lev Company  (1,000,000 units) | | Hi-Lev Company  (1,000,000 units) | |
| Amount | Percentage | Amount | Percentage |
| Sales  Variable costs  Contribution margin  Fixed costs  Operating proﬁt  Break-even point  Contribution margin per unit | 1000000  750000  250000  50000  200000  20000 Units  .25 | 100  75  25  5  20 | 1000000  250000  750000  550000  200000  733334 Units  .75 | 100  25  75  55  20 |

Note that although these ﬁrms have the same sales revenue and operating proﬁt, they have different cost structures. Lo-Lev Company’s cost structure is dominated by variable costs with a lower contribution margin ratio of .25. Every dollar of sales contributes SR .25 toward ﬁxed costs and proﬁt. Hi-Lev Company’s cost structure is dominated by ﬁxed costs with a higher contribution margin of .75. Every dollar of sales contributes .75 toward ﬁxed costs and proﬁt.

Suppose that both companies experience a 10 percent increase in sales. Companies with lower ﬁxed costs have the ability to be more ﬂexible to changes in market demands than do companies with higher ﬁxed costs and are better able to survive tough times.

**Margin of Safety**

**The margin of safety is the excess of projected (or actual) sales over the break-even sales level.** This tells managers the margin between current sales and the break-even point. In a sense, margin of safety indicates the risk of losing money that a company faces, that is, the amount by which sales can fall before the company is in the loss area. The margin of safety formula is:

Sales volume - Break-even sales volume = Margin of safety

If U-Develop sells 8,000 prints and its break-even volume is 6,250, then its margin of safety is

= Sales - Breakeven

= 8,000 - 6,250

= 1,750 prints

Sales volume could drop by 1,750 prints per month before it incurs a loss, all other things held constant. In practice, the margin of safety also may be expressed in sales riyal or as a percent of current sales.

The excess of the projected or actual sales volume expressed as a percentage of the break-even volume is the margin of safety percentage. If U-Develop sells 8,000 prints and the break-even volume is 6,250 prints, the margin of safety percentage is 22 percent (=1,750 / 8,000). This means that volume can fall by 22 percent before U-Develop ﬁnds itself operating at a loss.

**Income Taxes**

Assuming that operating proﬁts before taxes and taxable income are the same, income taxes may be incorporated into the basic model as follows:

After-tax proﬁt = [(P - V) X - F] \* (1 - t)

Where t is the tax rate.

Rearranging, the target volume as follows;

Fixed costs + [Target proﬁt/ (1-t)]

Target volume (units) =-----------------------------------------------

Contribution margin per unit

**Assumptions and Limitations of CVP Analysis**

As with all methods of analysis, CVP analysis relies on certain assumptions and these assumptions might limit the applicability of the results for decision making. It is important to understand, however, that the limitations are due to the assumptions that the cost analyst makes; that is, they are not inherent limitations to the method of CVP analysis itself.

For example, many people point to the assumptions of constant unit variable cost and constant unit prices for all levels of volume as important limitations of CVP analysis. As we saw, however, these assumptions are simplifying assumptions that are made by the analyst. If we know that unit prices are lower for higher volumes, we can incorporate that relation into the CVP analysis.

The lesson from this is that CVP analysis is a tool that the manager can use to help with decisions.

**Questions for practice-**

**1.** Cambridge, Inc., is considering the introduction of a new calculator with the following price and cost characteristics:

Sales price . . . . . . . . . . . . . SR 18 each

Variable costs . . . . . . . . . . . 10 each

Fixed costs . . . . . . . . . . . . . . . . 20,000 per month

**Required**

a. What number must Cambridge sell per month to break even?

b. What number must Cambridge sell to make an operating proﬁt of SR 16,000 for the month?

**2.** Balance, Inc., is considering the introduction of a new energy snack with the following price and cost characteristics:

Sales price . . . . . . . . . . . SR 1.00 per unit

Variable costs . . . . . . . . . 0.20 per unit

Fixed costs . . . . . . . . . . . 400,000 per month

**Required**

a. What number must Balance sell per month to break even?

b. What number must Balance sell per month to make an operating proﬁt of SR 100,000?

**3.** Rainbow Tours gives walking tours of Springﬁeld. Rainbow charges SR 40 per person for the tour and incurs SR 16 in variable costs for labour, drinks, and maps. The monthly ﬁxed costs for Rainbow Tours are SR 3,600.

**Required**

a. How many tours must Rainbow sell every month to break even?

b. Rainbow Tours’s owner believes that 175 people a month will sign up for the walking tour.

What is the margin of safety in terms of the number of people signing up for the tour?

**4.** Crest Industries sells a single model of satellite radio receivers for use in the home. The radios have the following price and cost characteristics:

Sales price . . . . . . . . . . . SR 80 per radio

Variable costs . . . . . . . . . SR 32 per radio

Fixed costs . . . . . . . . . . . SR 360,000 per month

Crest is subject to an income tax rate of 40 percent.

**Required**

a. How many receivers must Crest sell every month to break even?

b. How many receivers must Crest sell to earn a monthly operating proﬁt of SR 90,000 after taxes?

**Q1.** What do you mean by cost volume profit analysis?

**Ans.** Cost-volume-profit**-** (cvp) analysis study of the relations among revenue, cost, and volume and their effect on profit.

**Q2.** Write profit equation.

**Ans.** Profit equation - operating profit equals total revenue less total costs.

Proﬁt = Total revenue - Total costs

**Q3.** Explain to Break-even point.

**Ans.** Break-even point-Volume level at which proﬁts equal zero.

**Q4.** What do you mean by cost structure?

**Ans.** Cost structure -Proportion of an organization’s ﬁxed and variable costs to its total costs.

**Q5.** What is operating leverage?

**Ans.** Operating leverage**-** Extent to which an organization’s cost structure is made up of ﬁxed costs.

**Q6.** What is margin of safety?

**Ans.** The margin of safety is the excess of projected (or actual) sales over the break-even sales level. T