Cost Volume Profit (CVP) Analysis
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Introduction

Cost-Volume-Profit (CVP) analysis examines the relationships between changes in activity and changes in total sales revenue, costs and profit. It may provide very useful information particularly for a business that is commencing operations or facing difficult economic conditions. CVP analysis assists by determining how many units of a product must be sold so that the business 'breaks even' i.e. total costs, both fixed and variable are covered by total sales revenue. It allows the business to consider the effect on profits of various changes in operating costs and revenues such as a reduction in selling price or an increase in fixed costs; to determine the sales volume required to achieve a specific profit level and to establish the amount by which the current sales level can decrease before losses are incurred. However, it is important to remember that CVP analysis makes a number of assumptions about the environment within which the business operates. This article firstly describes these assumptions as the starting point of developing an understanding of CVP analysis; it continues by defining key terms and listing commonly used equations and finally concludes by presenting a simple calculation example.

Assumptions

For CVP analysis to be useful the assumptions on which it is based must recognised. These assumptions set the rules for examining relationships between sales volume, costs and profits. The conditions which are assumed to apply when CVP analysis is used are presented below.

1. *All variables remain constant except volume*
   This assumption suggests that volume is the only factor that can cause cost and profits to change. Factors such as increasing production efficiency, changing sales mix and price levels are not considered.

2. *Only one product is being produced or there is a constant sales mix*
   Following on from the previous assumption, CVP analysis only applies where one product is being examined or if there are a number of products then they are always sold in same proportions or combination.

3. *Total costs and total revenue are linear functions*
   This assumption suggests that the variable cost per unit and the selling price per unit do not change i.e. they are not affected by discounts.

4. *Profits are calculated using variable (marginal) costing*
   Variable costing facilitates profit analysis as it separates variable and fixed costs and treats fixed costs as a period expense rather than attempting to allocate them to products.

5. *Costs can be accurately divided into their fixed and variable elements*
   This is a key requirement of variable costing. The suggestion is that where there are semi-variable costs, that they can be accurately split by using techniques such as the high-low method.

6. *The analysis applies only to the relevant range*
   The relevant range is considered to be a sales volume range (E.g. between sales of 10,000 units and 80,000 units) within which the selling price and variable cost per unit remain constant. CVP analysis does not apply outside of the boundaries of this sales volume range (i.e. sales less than 10,000 units or greater than 80,000 units).

7. *The analysis applies only to a short-term horizon*
   CVP analysis examines the relationship between sales volume, costs and profit during the period of one year and during this time it is suggested that it would be difficult to change selling prices, variable and fixed costs which is in agreement with the other assumptions above.

Contribution, break-even point, target profit and margin of safety

In adopting the variable (marginal) costing approach, CVP analysis highlights contribution as a key factor of an organisation's operations. Contribution is defined as total sales revenue minus total variable costs and this represents the amount that is contributed towards covering total fixed costs and generating a profit. If an organisation has sufficient contribution to cover total fixed costs but not generate a profit, or incur a loss, this is called break-even point (BEP). Once the BEP has been reached any further contribution generated represents profit. Using CVP analysis an organisation may also calculate the total sales revenue (or sales volume) required to generate a particular level of profit, called target profit. While it is important for an organisation to know its BEP in sales volume or revenue, it is also useful to know how this relates to its current or expected level of activity. The difference between the organisation's current or expected sales volume (or revenue) and its BEP sales volume (or revenue) is called the margin of safety (MoS). It shows by how much current (or expected) sales volume (or revenue) call fall before the organisation starts to make losses.

CVP analysis may be presented graphically using charts or using a numerical approach based on equations. This article focuses on the numerical approach and the table below lists the equations commonly used in CVP analysis.

Contribution per unit	Selling price per unit minus variable cost per unit
Break-even point (BEP) (in units)	$\frac{\text{Total fixed costs}}{\text{Contribution per unit}}$
Break-even point (BEP) (in sales revenue)	BEP in units x selling price per unit OR $\frac{\text{Total fixed costs}}{\text{Contribution margin ratio (CMR)}}$
Contribution margin ratio (CMR)	$\frac{\text{Contribution (total or per unit)}}{\text{Sales (total or per unit)}}$
Target profit (in units)	$\frac{\text{Total fixed costs + Target profit}}{\text{Contribution per unit}}$
Target profit (in sales revenue)	Target profit in units x selling price per unit OR $\frac{\text{Total fixed costs + Target profit}}{\text{Contribution margin ratio (CMR)}}$
Margin of safety (MoS) (in units)	Current/expected sales in units minus BEP in units
Margin of safety (MoS) (in sales revenue)	Current/expected sales in € minus BEP in €
Margin of safety (MoS) in %	$\frac{\text{MoS in units (or sales revenue)}}{\text{Current/expected sales in units (or sales revenue)}} \times 100$

The following example shows how CVP analysis may be applied.

Conex Limited – Example of CVP analysis
Conex Limited sells one product, Supercreme, a cream suitable for a variety of first aid uses. The company commenced operations earlier this year and expects to sell 100,000 tubes of Supercreme. The following information is available:

	€
Selling price per tube	7.00
Direct material cost per tube	2.10
Direct labour cost per tube	1.35
Variable overhead cost per tube	0.75
Total fixed costs for the year	210,000

CVP analysis may provide answers to the following questions:

a) For Conex Limited, what is the Break-even point (BEP) in tubes and sales revenue?
b) If the company wanted to earn a profit of €46,200 for the year how many tubes of Supercreme must be sold?
c) By how much could expected sales revenue fall before Conex Limited starts to make a loss?

Conex Limited - Solution

	€
Selling price per tube	7.00
Less total variable costs per tube €(2.1+1.35+0.75)	4.20
Contribution per tube	2.80

a) BEP in units $= \frac{\text{Total fixed costs}}{\text{Contribution per tube}} = \frac{€210,000}{€2.80}$

= 75,000 tubes

Conex Limited must sell 75,000 tubes of Supercreme to break-even i.e. earn no profit and incur no loss

BEP in sales revenue = BEP in units x selling price per unit
= 75,000 tubes x €7.00
= €525,000

OR

BEP in sales revenue $= \frac{\text{Total fixed costs}}{\text{Contribution margin ratio}}$

Contribution margin ratio $= \frac{\text{Contribution}}{\text{Sales}} = \frac{€2.80}{€7.00} = 0.40$

BEP in sales revenue $= \frac{€210,000}{0.40}$

= €525,000

Conex Limited must generate sales totalling €525,000 to break-even.

b) Target profit in units = $\frac{\text{Total fixed costs + Target profit}}{\text{Contribution per unit}}$

= $\frac{€210,000 + €46,200}{€2.80}$

= 91,500 tubes

Conex Limited must sell 91,500 tubes of Supercreme to make a profit of €46,200 for the year

c) Margin of safety (MoS) in sales revenue = Current/expected sales revenue minus BEP sales revenue

= (100,000 x €7) - €525,000
= €175,000

Conex Limited sales revenue can fall by €175,000 before the company starts making losses.

Further complication
Conex Limited is considering outsourcing production of Supercreme to another manufacturer. The manufacturer has quoted a product cost of €4.25 per tube plus 5% of selling price for each tube of Supercreme that is sold. Total fixed costs of Conex Limited will fall to €100,000 if the outsourcing option is chosen. At what level of sales will profits be the same if Conex Limited continues to produce internally or outsource production to another manufacturer?

Solution
If the production is outsourced:
Let y = number of tubes sold
Total profit = Total Contribution - Total fixed costs
Total profit = (sales minus product cost and % charged based on sales) - Total fixed costs
Profit = 7y– 4.25y – [(0.05 x 7) y] - 100,000 = 2.40y – 100,000

If product is made internally:
Total profit = Total contribution - Total fixed costs
Total profit = 2.80y - 210,000

To find level of sales where profit will be the same set both profit equations equal to each other and solve for y:
2.80y - 210,000 =2.40y – 100,000 => 0.40y = 110,000 => y = 275,000 tubes

At a sales volume of 275,000 tubes of Supercreme the profits from manufacturing internally are the same as if the company outsources production to another manufacturer.

Proof	Make internally	Outsource
	€	€
Sales: 275,000 tubes x €7 each	1,925,000	1,925,000
Less variable costs		
275,000 tubes x €4.20	1,155,000	
275,000 tubes x €4.25		1,168,750
5% of sales price: 5% x €7 x 275,000 tubes		96,250
Contribution	770,000	660,000
Total fixed costs	210,000	100,000
Profit	560,000	560,000

Having read this article and worked through the example, hopefully you should have a better understanding of CVP analysis. To consolidate your learning it would be beneficial to attempt, under examination conditions, CVP analysis questions from past papers.