



CHAPTER 3

Cost-Volume-Profit Analysis

A FIVE-STEP DECISION-MAKING PROCESS IN PLANNING AND CONTROL REVISITED

1. Identify the problem and uncertainties
2. Obtain information
3. Make predictions about the future
4. Make decisions by choosing between alternatives, using cost-volume-profit (CVP) analysis
5. Implement the decision, evaluate performance, and learn

FOUNDATIONAL ASSUMPTIONS IN CVP

Changes in production/sales volume are the sole cause for cost and revenue changes.

Total costs consist of fixed costs and variable costs.

Revenue and costs behave and can be graphed as a linear function (a straight line).

Selling price, variable cost per unit, and fixed costs are all known and constant.

In many cases only a single product will be analyzed. If multiple products are studied, their relative sales proportions are known and constant.

The time value of money (interest) is ignored.

BASIC FORMULAE

$$\text{Revenue} - \text{Variable Costs} - \text{Fixed Costs} = \text{Operating Income}$$

Where the following supporting equations hold:

$$\text{Revenue} = \text{Selling Price} \times \text{Quantity Sold}$$

and

$$\text{Variable Costs} = \text{Variable Cost per Unit} \times \text{Quantity Sold}$$

CVP: CONTRIBUTION MARGIN

Manipulation of the basic equations yields an extremely important and powerful tool extensively used in cost accounting: contribution margin (CM).

Contribution margin equals revenue less variable costs.

Contribution margin per unit equals unit selling price less unit variable costs.

CONTRIBUTION MARGIN

Contribution margin also equals contribution margin per unit multiplied by the number of units sold.

Contribution margin percentage is the contribution margin per unit divided by unit selling price.

COST—VOLUME—PROFIT EQUATION

Revenue – Variable Costs – Fixed Costs = Operating Income

- $$\left(\begin{array}{cc} \text{Selling} & \text{Sales} \\ \text{Price} & \text{Quantity} \end{array} \right) * - \left(\begin{array}{cc} \text{Unit} & \text{Sales} \\ \text{Variable} & \text{Quantity} \\ \text{Costs} & \end{array} \right) * - \text{Fixed} = \text{Operating} \\ \text{Costs} & \text{Income}$$

BREAKEVEN POINT

At the breakeven point, a firm has *no profit or loss* at the given sales level.

- $\text{Sales} - \text{Variable Costs} - \text{Fixed Costs} = 0$

Calculation of breakeven number of units

- $\text{Breakeven Units} = \frac{\text{Fixed Costs}}{\text{Contribution Margin per Unit}}$

Calculation of breakeven revenues

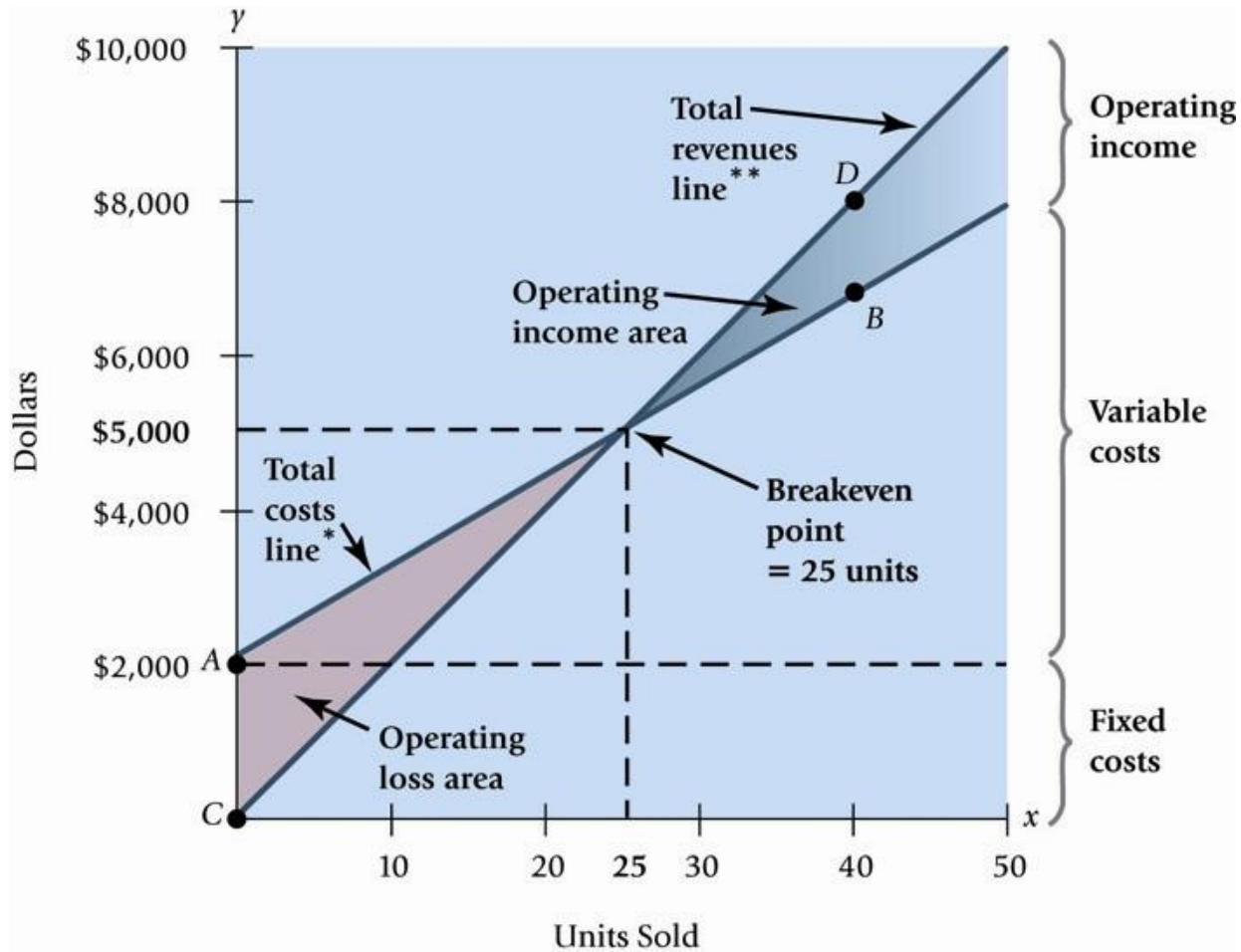
- $\text{Breakeven Revenue} = \frac{\text{Fixed Costs}}{\text{Contribution Margin Percentage}}$

BREAKEVEN POINT, EXTENDED: PROFIT PLANNING

The breakeven point formula can be modified to become a profit planning tool.

- Profit is now reinstated to the BE formula, changing it to a simple sales volume equation.
- Quantity of Units Required to Be Sold = $\frac{(\text{Fixed Costs} + \text{Operating Income})}{\text{Contribution Margin per Unit}}$

CVP: GRAPHICALLY



* Slope of the total costs line is the variable cost per unit = \$120

** Slope of the total revenues line is the selling price = \$200

PROFIT PLANNING, ILLUSTRATED

D5 fx =(\$A5+D\$3)/(\$F\$1-\$B5)						
	A	B	C	D	E	F
1			Number of units required to be sold at \$			200
2			Selling Price to Earn Target Operating Income of			
3		Variable Costs	\$0	\$1,200	\$1,600	\$2,000
4	Fixed Costs	per Unit	(Breakeven point)			
5	\$2,000	\$100	20	32 ^a	36	40
6	\$2,000	\$120	25	40	45	50
7	\$2,000	\$150	40	64	72	80
8	\$2,400	\$100	24	36	40	44
9	\$2,400	\$120	30	45	50	55
10	\$2,400	\$150	48	72	80	88
11	\$2,800	\$100	28	40	44	48
12	\$2,800	\$120	35	50	55	60
13	\$2,800	\$150	56	80	88	96
14						
15	^a Number of units = $\frac{\text{Fixed costs} + \text{Target operating income}}{\text{Contribution margin per unit}}$ = $\frac{\$2,000 + \$1,200}{\$200 - \$100}$ = 32					
16	required to be sold					

CVP AND INCOME TAXES

After-tax profit can be calculated by:

- $\text{Net Income} = \text{Operating Income} * (1 - \text{Tax Rate})$

Net income can be converted to operating income for use in CVP equation

- $\text{Operating Income} = \frac{\text{Net Income}}{(1 - \text{Tax Rate})}$

SENSITIVITY ANALYSIS

CVP provides structure to answer a variety of “what-if” scenarios.

“What” happens to profit “if”:

- Selling price changes.
- Volume changes.
- Cost structure changes.
 - Variable cost per unit changes.
 - Fixed cost changes.

MARGIN OF SAFETY

One indicator of risk, the margin of safety (MOS), measures the distance between budgeted sales and breakeven sales:

- $MOS = \text{Budgeted Sales} - \text{BE Sales}$

The MOS ratio removes the firm's size from the output, and expresses itself in the form of a percentage:

- $MOS \text{ Ratio} = MOS \div \text{Budgeted Sales}$

OPERATING LEVERAGE

Operating leverage (OL) is the effect that fixed costs have on changes in operating income as changes occur in units sold, expressed as changes in contribution margin.

- $OL = \frac{\text{Contribution Margin}}{\text{Operating Income}}$

Notice these two items are identical, except for fixed costs.

EFFECTS OF SALES-MIX ON CVP

The formulae presented to this point have assumed a single product is produced and sold.

A more realistic scenario involves multiple products sold, in different volumes, with different costs.

The same formulae are used, but instead use average contribution margins for bundles of products.

ALTERNATIVE INCOME STATEMENT FORMATS

Contribution Income Statement Emphasizing Contribution Margin (in 000s)			Financial Accounting Income Statement Emphasizing Gross Margin (in 000s)		
Revenues		\$1,000	Revenues		\$1,000
Variable manufacturing costs	\$250		Cost of goods sold (variable manufacturing costs, \$250 + fixed manufacturing costs, \$160)		<u>410</u>
Variable nonmanufacturing costs	<u>270</u>	<u>520</u>	Gross margin		590
Contribution margin		480	Nonmanufacturing costs (variable, \$270 + fixed \$138)		<u>408</u>
Fixed manufacturing costs	160		Operating income		<u>\$ 182</u>
Fixed nonmanufacturing costs	<u>138</u>	<u>298</u>			
Operating income		<u>\$ 182</u>			



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