

Chapter 3**Introduction****Cost-Volume-Profit Relationships****Cost-volume-profit analysis**

examines the behavior of

total revenues

total costs

operating income

as changes occur in the

output level

selling price

variable costs per unit

fixed costs.

Cost-Volume-Profit Assumptions and Terminology 1

Changes in the level of revenues and costs arise only because of changes in the number of units produced and sold (one revenue driver and one cost driver).

Total costs can be divided into a fixed component and a component that is variable with respect to the level of output.

Cost-Volume-Profit Assumptions and Terminology 2

The behavior of total revenues and total costs is linear (straight-line) in relation to output units within the relevant range (and time period).

The unit selling price, unit variable costs, and fixed costs are known and constant.

Cost-Volume-Profit Assumptions and Terminology 3

Assumes a single product or that the sales mix when multiple products are sold will remain constant as the level of total units sold changes.

All revenues and costs can be added and compared without taking into account the time value of money.

Cost-Volume-Profit Assumptions and Income Definitions

Operating income =
Total revenues from operations
- Cost of goods sold
- Operating costs

Net Income =
Operating income
+ Non-operating income (e.g. investment income)
- Non-operating costs (e.g. such as interest cost)
- Income taxes

Contribution margin

The only numbers that change are total revenues and total variable cost.

$$\text{Contribution margin} = \text{Total revenues} - \text{Total Variable Costs}$$

$$\text{Unit Contribution Margin} = \text{Unit Selling Price} - \text{Unit Variable Cost}$$

Contribution margin percentage

$$\begin{aligned} \text{Contribution margin percentage} &= \text{contribution margin ratio} \\ &= \text{Unit Contribution Margin} \div \text{Unit Selling Price} \end{aligned}$$

Breakeven Point...

⇒ the sales level at which operating income is zero.

At the breakeven point, sales revenue minus variable costs equals fixed expenses.

$$\text{Total revenues} = \text{Total costs}$$

Breakeven Point – Equation Method

$$\begin{aligned} \text{Operating income} &= \text{Unit sales price} \times \text{units sold} \\ &- \text{Unit Variable Cost} \times \text{units sold} \\ &- \text{Fixed costs} \end{aligned}$$

$$\begin{aligned} \text{Operating income} + \text{Fixed costs} \\ (\text{Unit Sales Price} - \text{Unit Variable Cost}) \times \text{units sold} \end{aligned}$$

$$\begin{aligned} \text{Unit sales needed} &= (\text{Target Operating income} + \text{Fixed costs}) \div \\ &(\text{Unit Sales Price} - \text{Unit Variable Cost}) \end{aligned}$$

Abbreviations

- USP Unit selling price
- UVC Unit variable costs
- UCM Unit contribution margin
- CM% Contribution margin percentage
- FC Fixed costs
- Q Quantity of output (units sold or produced)
- OI Operating income
- TOI Target operating income
- TNI Target net income

Contribution Margin Method - Units

With the contribution margin method, Unit sales needed is calculated by

$$\begin{aligned} \text{USP} \times \text{Q} - \text{UVC} \times \text{Q} - \text{FC} &= \text{OI} \\ (\text{USP} - \text{UVC}) \times \text{Q} &= \text{FC} + \text{OI} \\ \text{UCM} \times \text{Q} &= \text{FC} + \text{OI} \\ \text{Q} &= [\text{FC} + \text{TOI}] \div \text{UCM} \end{aligned}$$

Contribution Margin Method – Dollars

$$\begin{aligned}
 & \$ \text{ sales needed} \\
 & = Q \times \text{USP} \\
 & = [\text{FC} + \text{OI}] \div \text{UCM} \times \text{USP} \\
 & = [\text{FC} + \text{OI}] \div [\text{UCM} \div \text{USP}] \\
 & = [\text{FC} + \text{OI}] \div \text{Contribution margin ratio}
 \end{aligned}$$

Example 1

Target Net Income and Income Taxes

Tax Rate = TR

Unit sales needed is calculated by using the following relationship:

$$\begin{aligned}
 [\text{USP} \times Q - \text{UVC} \times Q - \text{FC}] \times [1 - \text{TR}] &= \text{NI} \\
 (\text{USP} - \text{UVC}) \times Q &= \text{FC} + \text{NI} / [1 - \text{TR}] \\
 \text{UCM} \times Q &= \text{FC} + \text{NI} / [1 - \text{TR}] \\
 Q &= [\text{FC} + \text{NI} / (1 - \text{TR})] \div \text{UCM}
 \end{aligned}$$

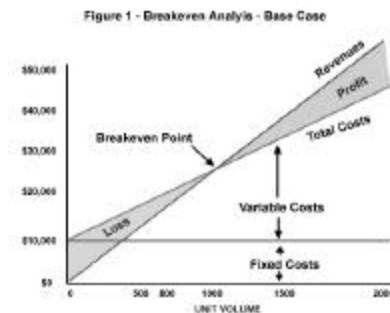
Target Net Income and Income Taxes

Graph

Plot a line for total revenues and total costs.

The breakeven point is the point at which the total revenue line intersects the total cost line.

The area between the two lines to the right of the breakeven point is the profit area.



Operating Leverage...

⇒ measures the relationship between a company's variable and fixed expenses.

It is greatest in organizations that have high fixed expenses and low unit variable costs.

Operating leverage shows =

$$\% \text{ change in sales volume} \div \% \text{ change in OI}$$

Degree of operating leverage

$$= \text{Contribution margin} \div \text{Operating income}$$

Operating Leverage

Mix Changes - Titanic

		Revenue	Contrib.	CM ratio
Theater	Plan	440	\$390	0.89
	Actual	440	\$396	0.90
Video	Plan	576.0	\$395	\$0.68
	Actual	518.4	\$358	\$0.69
TV	Plan	125	\$125	1.00
	Actual	125	\$125	\$1.00
Total	Plan	1,141	\$910	\$0.80
	Actual	1,083	\$879	\$0.81

**Contribution Margin
versus
Gross Margin**

Financial accounting income statement emphasizes gross margin.

Revenues
 - Cost of goods sold
 = Gross margin
 - Operating costs
 = Operating income

Financial Accounting

Revenue
 - Cost of Goods Sold:
 Variable Production Costs
 Fixed Production Costs
 = Gross Margin
 - SG&A
 Variable SG&A costs
 Fixed SG&A costs
 = Operating Income

Management Accounting

Revenue
 - Variable costs:
 Variable Production costs
 Variable SG&A costs
 = Contribution Margin
 - Fixed Costs
 Fixed Production Costs
 Fixed SG&A costs
 = Operating Income

Income Statement

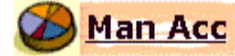
Operating Income
 + Non Operating Income:
 Income from affiliates, Interest income

 = Earnings Before Interest & Taxes
 - Interest Expense

 = Earnings Before Taxes
 - Tax Expense

 = Net Income

Examples: Cost-Volume-Profit



Assume that Newman Inc. can purchase dresses for \$32 from a local factory; other variable costs amount to \$10 per dress.

Assume also that the average selling price per dress is \$ 70
 Total fixed costs amount to \$ 84,000

1	Sell	2,500	3,000	dresses
	Revenue	_____	_____	
	Variable costs	_____	_____	
	Fixed Costs	_____	_____	
	Profit	_____		

- 2** What is the Contribution margin per unit
 What is the total contribution margin when 2,500 dresses are sold?
 Newman Inc.'s contribution margin percentage?
- 3** Using the contribution margin percentage, what is the breakeven point in \$ of revenue for Newman Inc. by Newman Inc.?
 Assume that Newman Inc. wants to have an operating income of \$14,000.
 How many dresses must it sell?
 What dollar sales are needed to achieve this income?
- 4** Newman Inc. would like to earn an after tax income of \$35,711. The tax rate is 30%
 What is the target operating income?
 How many units must be sold?
- 5** Suppose Newman Inc. anticipates selling 3,200 dresses. Management is considering an advertising campaign that would cost \$10,000. It is anticipated that the advertising will increase sales to 4,000 dresses. Should Newman Inc. advertise?
- 6** Instead of advertising, management is considering reducing the selling price to \$61 per dress. It is anticipated that this will increase sales to 4,500 dresses. Should Newman Inc. decrease the selling price per dress ?
- 7** Suppose that the factory Newman Inc. is using to obtain the merchandise offers Newman Inc. the following NEW arrangement: Decrease the price they charge Newman Inc. from \$32 to \$25 and charge an annual administrative fee of \$30,000. Management questions what sales volume would yield an identical operating income regardless of the arrangement.
- 8** Assume that Newman Inc. is considering selling blouses. This will not require any additional fixed costs. It expects to sell 2 blouses at \$20 each for every dress it sells. The variable cost per blouse is \$9. What is the breakeven point?