



**SILESIA  
UNIVERSITY**

SCHOOL OF BUSINESS  
ADMINISTRATION IN KARVINA

# COST-VOLUME-PROFIT RELATIONSHIPS

Ing. Markéta Šeligová, Ph.D.  
MANAGERIAL ACCOUNTING/NANMU

## OUTLINE OF THE LECTURE

1. Cost-volume-profit (CVP) analysis
2. Contribution margin
3. Applications of CVP concepts
4. Target profit analysis
5. Sales mix

### **COST-VOLUME-PROFIT (CVP) ANALYSIS (1)**

- helps managers make many important decisions such as what products and services to offer, what prices to charge, what marketing strategy to use, and what cost structure to maintain
- its primary purpose is to estimate how profits are affected by the following five factors:
  - 1. selling prices
  - 2. sales volume
  - 3. unit variable costs
  - 4. total fixed costs
  - 5. mix of product sold

### **COST-VOLUME-PROFIT (CVP) ANALYSIS (2)**

- to simplify CVP calculations, managers typically adopt the following assumptions with respect these factors
  - selling price is constant. The price of a product or service will not change as volume changes
  - costs are linear and can be accurately divided into variable and fixed element. The variable element is constant per unit. The fixed element is constant in total over the entire relevant range
  - in multiproduct companies, the mix of products sold remains constant

### CONTRIBUTION MARGIN

- contribution margin is the amount remaining from sales revenue after variable expenses have been deducted
- thus, it is the amount available to cover fixed expenses and then to provide profits for the period
- contribution margin is used first to cover the fixed expenses, and then whatever remains goes toward profits
- if the contribution margin is not sufficient to cover the fixed expenses, then a loss occurs for the period

## CVP RELATIONSHIPS IN EQUATION FORM (1)

- the contribution format income statement can be expressed in equation form as follows:
- ***Profit = (Sales - Variable expenses) - Fixed expenses***
- When a company has only a single product, we can further refine the equation as follows:
- *Sales = Selling price per unit X Quantity sold = P x Q*
- *Variable expenses = Variable expenses per unit X Quantity sold  
= V x Q*
- ***Profit = (P x Q - V x Q) - Fixed expenses***

### CVP RELATIONSHIPS IN EQUATION FORM (2)

- it is often useful to express the simple profit equation in terms of the unit contribution margin (Unit CM) as follows:
- $Unit\ CM = Selling\ price\ per\ unit - Variable\ expenses\ per\ unit$   
 $= P - V$
- $Profit = (P \times Q - V \times Q) - Fixed\ expenses$
- $Profit = (P - V) \times Q - Fixed\ expenses$
- **$Profit = Unit\ CM \times Q - Fixed\ expenses$**

### CONTRIBUTION MARGIN RATIO (CM RATIO) (1)

- the contribution margin ratio can be used in cost-volume-profit calculations
- the contribution margin as a percentage of sales is referred to as the contribution margin ratio (CM ratio).
- this ratio is computed as follows:

$$\text{CM ratio} = \frac{\text{Contribution margin}}{\text{Sales}} \text{ in } (\%)$$

- the CM ratio can also be computed on a per unit basis as follows:

$$\text{CM ratio} = \frac{\text{Unit contribution margin}}{\text{Unit selling price}} \text{ in } (\%)$$



### CONTRIBUTION MARGIN RATIO (CM RATIO) (2)

- the CM ratio shows how the contribution margin will be affected by a change in total sales
- for example, CM ratio of 40% means that for each dollar increase in sales, total contribution margin will increase by 40 cents (\$1 sales x CM ratio of 40%)
- net operating income will also increase by 40 cents, assuming that fixed costs are not affected by the increase in sales
- Generally, the effect of a change in sales on the contribution margin is expressed in equation form as:

*Change in contribution margin = CM ratio x Change in sales*

### CONTRIBUTION MARGIN RATIO (CM RATIO) (3)

- the relation between profit and the CM ratio can also be expressed using the following equations:

$$\textit{Profit} = \textit{CM ratio} \times \textit{Sales} - \textit{Fixed expenses}$$

- Or, in terms of changes,

$$\textit{Change in profit} = \textit{CM ratio} \times \textit{Change in sales} - \textit{Change in fixed expenses}$$

## APPLICATIONS OF CVP CONCEPTS

- **the variable expense ratio is the ratio of variable expenses to sales**

$$\text{Variable expense ratio} = \frac{\text{Variable expenses}}{\text{Sales}}$$

- **it can be computed by dividing the total variable expenses by the total sales, or in a single product analysis, it can be computed by dividing the variable expenses per unit by the unit selling price**

$$\text{CM ratio} = \frac{\text{Contribution margin}}{\text{Sales}}$$

$$\text{CM ratio} = \frac{\text{Sales} - \text{Variable expenses}}{\text{Sales}}$$

$$\text{CM ratio} = 1 - \text{Variable expense ratio}$$

## BREAK - EVEN ANALYSIS

- to calculate the break-even point (in unit sales and dollar sales), managers can use either of two approaches - the equation method or the formula method

### The Equation Method

- the equation method relies on the basic profit equation
- we will use the contribution margin form of this equation to perform the break-even calculations
- Profit = Unit CM x Q – Fixed expense

### The Formula Method

- the formula method is a shortcut version of the equation method
- each unit sold provides a certain amount of contribution margin that goes toward covering fixed expenses
- Units sales to break even =  $\frac{\text{Fixed expenses}}{\text{Unit CM}}$

### BREAK-EVEN IN DOLLAR SALES

- in addition to finding the break-even point in unit sales, we can also find the break-even point in dollar sales using three methods:
  - we could solve for the break-even point in unit sales using the equation method or formula method and then simply multiply the result by the selling price
  - we can use the equation method to compute the break-even point in dollar sales
  - we can use the formula method to compute the dollar sales needed to break even

$$\text{Dollar sales to break even} = \frac{\text{Fixed expenses}}{\text{CM ratio}}$$

## TARGET PROFIT ANALYSIS (1)

- target profit analysis is one of the key uses of CVP analysis.
- In target profit analysis, we estimate what sales volume is needed to achieve a specific target profit
- to determine the unit sales and dollar sales needed to achieve a target profit, we can rely on the same two approaches - the equation method or the formula method

### The Equation Method

$$\text{Profit} = \text{Unit CM} \times Q - \text{Fixed expense}$$

## TARGET PROFIT ANALYSIS (2)

### The Formula Method

- in general, in a single product situation, we can compute the sales volume required to attain a specific target profit using the following formula
- *Unit sales to attain the target profit* = 
$$\frac{\text{Target profit} + \text{Fixed expenses}}{\text{Unit CM}}$$

### Target Profit Analysis in Terms of Dollar Sales

- *Dollar sales to attain a target profit* = 
$$\frac{\text{Target profit} + \text{Fixed expenses}}{\text{CM ratio}}$$

## THE MARGIN OF SAFETY

- the margin of safety is the excess of budgeted or actual sales dollars over the break-even volume of sales dollars
- it is the amount by which sales can drop before losses are incurred
- the higher the margin of safety, the lower the risk of not breaking even and incurring a loss

*Margin of safety in dollars = Total budgeted (or actual) sales – Break-even sales*

- in percentage:

*Margin of safety percentage =  $\frac{\text{Margin of safety in dollars}}{\text{Total budgeted (or actual) sales in dollars}}$*



## OPERATING LEVERAGE

- is a measure of how sensitive net operating income is to a given percentage change in dollar sales; acts as a multiplier
- if operating leverage is high, a small percentage increase in sales can produce a much larger percentage increase in net operating income
- the degree of operating leverage at a given level of sales is computed by the following formula:
  - Degree of operating leverage =  $\frac{\text{Contribution margin}}{\text{Net operating income}}$
- the degree of operating leverage is a measure, at a given level of sales, of how a percentage change in sales volume will affect profits

## THE DEFINITION OF SALES MIX (1)

- refers to the relative proportions in which a company's products are sold
- the idea is to achieve the combination, or mix, that will yield the greatest profit
- most companies have many products, and often these products are not equally profitable
- profits will depend to some extent on the company's sales mix
- profits will be greater if high-margin rather than low-margin items make up a relatively large proportion of total sales
  - changes in the sales mix can cause perplexing variations in a company's profits

### THE DEFINITION OF SALES MIX (2)

- a shift in the sales mix from high-margin items to low-margin items can cause total profits to decrease even though total sales may increase
- a shift in the sales mix from low-margin items to high-margin items can cause the reverse effect - total profits may increase even though total sales decrease
- it is one thing to achieve a particular sales volume; it is quite another to sell the most profitable mix of products

## SALES MIX AND BREAK-EVEN ANALYSIS

- if a company sells more than one product, break-even analysis is more complex than discussed to this point
- the reason is that different products will have different selling prices, different costs, and different contribution margins
- the break-even point depends on the mix in which the various products are sold
- If the sales mix changes, then the break-even point will also usually change

## COST-VOLUME-PROFIT RELATIONSHIPS

### Acoustic Concepts, Inc. Contribution Income Statement For the Month of June

	Total	Per Unit
Sales (400 speakers) . . . . .	\$100,000	\$250
Variable expenses . . . . .	<u>60,000</u>	<u>150</u>
Contribution margin . . . . .	40,000	<u>\$100</u>
Fixed expenses . . . . .	<u>35,000</u>	
Net operating income . . . . .	<u>\$ 5,000</u>	

## COST-VOLUME-PROFIT RELATIONSHIPS

### Contribution Income Statement Sales of 1 Speaker

	Total	Per Unit
Sales (1 speaker) . . . . .	\$ 250	\$250
Variable expenses . . . . .	<u>150</u>	<u>150</u>
Contribution margin . . . . .	100	<u>\$100</u>
Fixed expenses . . . . .	<u>35,000</u>	
Net operating loss . . . . .	<u><u>\$(34,900)</u></u>	

## COST-VOLUME-PROFIT RELATIONSHIPS

### Contribution Income Statement Sales of 350 Speakers

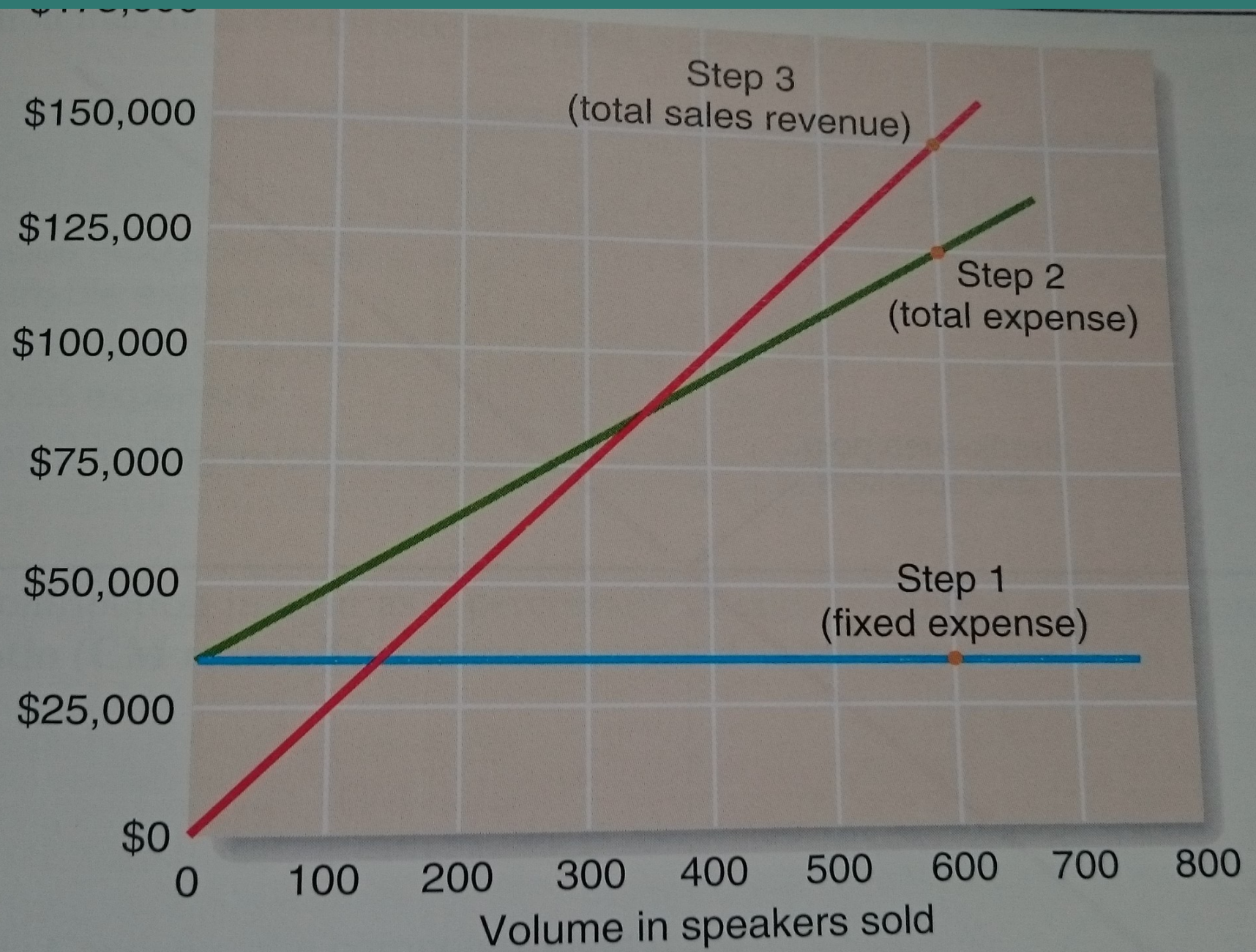
	Total	Per Unit
Sales (350 speakers) . . . . .	\$87,500	\$250
Variable expenses . . . . .	<u>52,500</u>	<u>150</u>
Contribution margin . . . . .	35,000	<u>\$100</u>
Fixed expenses . . . . .	<u>35,000</u>	
Net operating income . . . . .	<u>\$ 0</u>	

## COST-VOLUME-PROFIT RELATIONSHIPS

Fixed expense .....	\$ 35,000
Variable expense (600 speakers × \$150 per speaker) .....	<u>90,000</u>
Total expense .....	<u><u>\$125,000</u></u>



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