Supplementary Problem 6: Cost-Volume-Profit (CVP) Analysis

CVP analysis examines the behavior of total revenue, cost, and profit as the output level (volume), selling price, variable costs, or fixed costs changes. CVP analysis helps managers to answer "what-if"-type questions: What if volume increases by 5,000 units - how will profit, revenues, and/or costs be affected? What if we raise our price - what will be the effect of profit? In effect, CVP analysis is a planning tool that utilizes information about cost behavior to provide managers with an overview of the effects of short-run financial changes.

CVP analysis typically involves several assumptions that must be reasonably satisfied for the analysis to be valid. First, the behavior of total revenue and costs is linear (straight-line) with respect to output units within the relevant range. Second, total costs can be divided into fixed, variable, or semivariable with respect to output units within the relevant range. Third, the unit selling price, unit variable costs, and fixed costs are known. Finally, the analysis involves a single product, or in multiproduct firms, the sales mix remains constant over the relevant range. In more complex analyses, some of these assumptions may be relaxed.

CVP analysis is often associated with calculating a break-even point. Although, this is discussed in your text, a slightly more detailed discussion is provided here. Several methods exist to find the break-even point. Two will be discussed here. First, there is the equation method. This method starts expresses the income statement as follows:

Revenues - Variable Costs - Fixed Costs = Operating Income

This equation is then restated using per unit values for variable revenues and costs:

(Unit Sales Price * Quantity) - (Unit Variable Cost * Quantity) - Fixed Costs = Income

Next, simply plug in the per unit values for sales price, variable cost, plug in total fixed costs, set income to zero, and solve for Quantity. If you desire to compute the unit sales needed to reach a target profit level instead of the break-even point, simply plug the target profit into the equation and solve. This is a very general approach and easy to remember. Second, the break-even point may be calculated using the contribution margin method. This method is derived from the above equation. Simply solving the above equation for quantity yields:

$$\text{Quantity} = \frac{\text{Fixed Cost + Income}}{\text{(Selling price - Variable Cost)}} = \frac{\text{Fixed Cost + Income}}{\text{Contribution margin per unit}}$$

This is the method illustrated on page 40 of your text. Note that this method is valid only for a single product and a single cost driver (variable costs must vary based on only one factor). The equation method is more general and is easier to apply to more complex situations (multiple products, multiple cost drivers).

When multiple products exist, complexity is added to the CVP analysis. With multiple products, the unit contribution margin will vary for each product. Therefore, you

must first compute a weighted average unit contribution margin – this is the average of the multiple products' unit contribution margins weighted by the relative sales (sales mix) of each product. For example, assume that ABC Company has 2 products, Y and Z, with unit contribution margins of $80 and $40, respectively and total fixed costs are $2,000. Additionally, assume that ABC's sales mix is 2/3 product Y and 1/3 product Z. The weighted average unit contribution margin is $66.67. You can now perform CVP analysis (contribution margin method) as discussed above:

Break-even point = $2,000 / $66.67 ≈ 30 units
Units of Y = 30 * 2/3 = 20 units
Units of X = 30 * 1/3 = 10 units

Try to find the break-even point for alternate sales mix's (e.g., produce only Y, produce only Z, produce 50% Y and 50% Z, etc.). Additionally, find the amount of profit for these alternate sales mixes assuming 50 units will be sold. If you keep track of the alternate break even points and profit figures, a common-sense picture emerges. That is, to increase profit, a manager should push the high-contribution margin product. However, this assumes there are no production constraints. Typically, these constraints prevent us from implementing the common-sense result noted above. Instead, managers must deal with constraints by choosing the products with the highest contribution margin per the constrained resource. See page 44 of your text for an example of this situation. An additional complication, discussed on page 42-43 of your text involves the effect of taxes. See your text for a discussion of this situation.

Problem Assignment - CVP Analysis, Multiple Products, Taxes[*]

ABC Electronics manufactures and sells two products, recorders and calculators. Recorders sell for $15 each and have variable costs of $7.80 per unit. Calculators sell for $20 and have variable costs of $8.90 per unit. Fixed manufacturing costs are $280,000 and fixed selling and administrative costs are $1,097,000. The firm's income tax rate is 55%. Management estimates a sales mix of 80% calculators and 20% recorders.

1. Calculate the break-even point (in units) for ABC Electronics. How many recorders and calculators are included in this figure?

2. What must total sales revenue be for ABC Electronics to report income after taxes equal to $50,000? How many recorders and calculators are included in your answer?

[*] This material is obtained and used with permission from Dr. Ed McIntyre at Florida State University. It has been slightly modified from its original version.