Break-Even Analysis

Break-even analysis is a branch of cost-volume-profit analysis. It determines the break-even sales, or the level of sales where total costs equal total revenue. It is usually accomplished by first estimating variable costs and fixed costs; and then plugging these numbers into a version of the cost-volume-profit equation, and solving for output.

It is easiest to illustrate break-even analysis with an example. Assume we have a company that earned $ 1 billion dollars in period 1 and $ 1.3 billion dollars in period 2. For simplicity, we will show all numbers divided by 1,000,000. Therefore $ 1 billion will display as $ 1000.

	Period 1	**Period 2**	
Sales	$ 1000	$ 1,300	$ 300
Operating Profit	$ 200	$ 320	
Total Costs	$ 800	$ 980	$ 180
VC/Sales			0.60
Variable Costs	$ 600	$ 780	
Fixed Costs	$ 200	$ 200	

Also, assume operating profit in period 1 was $ 200, and in period 2, it was $ 320. This means from period 1 to period 2, sales increased by $ 300 and total costs increased by $ 180. Assuming fixed costs stayed fixed from period 1 to period 2, this means variable costs to sales (VC/Sales) can be calculated as 0.60 (i.e. 180/300). It also means that variable costs in period 1 were $ 600 (i.e. 0.60 * $ 1000) and variable costs in period 2 were $ 780 (i.e. 0.60 * $1,300). Finally, fixed costs can be calculated as $ 200 (i.e. $800 - $600 or $ 980 - $ 780).

We now can plug many of these numbers into the cost-volume-profit equation. As a reminder we show the cost-volume-profit equation below:

$$y = a + bx$$

$$y = cost\ of\ x\ number\ of\ units$$
$$a = fixed\ costs$$
$$b = variable\ cost\ per\ unit\ of\ x$$
$$x = number\ of\ items\ produced$$

We know what variable costs per sales are, 0.60. But to complete the rest of the analysis, we need to know b (variable costs per unit of x). We don't know how many units were produced in period 1 or period 2. We also don't know the price or even what "units" means.

But we do not need to know these things. For simplicity, we can assume the number of units produced in period 1 was 1000. This means the price was $1. Assuming the price remained constant, units produced in period 2 was 1,300. Furthermore we can calculate b (variable cost per unit of x) as 0.60 (this equals VC/Sales multiplied by $1).

	Period 1	**Period 2**
Units	1000	1300
Price	$ 1.00	$ 1.00
b	0.60	0.60

We now can complete the cost-volume-profit equation.

$$y = \$\ 200 + 0.60\ x$$

This equation says total cost equals fixed costs of $ 200 plus 0.60 multiplied by number of units.

Furthermore, we know that total revenue equals price multiplied by units, px. And we know that the firm will break-even when total revenue equals total costs. Therefore, we can equate total revenue, px, to total cost and solve for x.

$$p\ x = \$\ 200 + 0.60\ x$$
$$\$1\ x = \$\ 200 + 0.60\ x$$
$$x - 0.60\ x = 200$$
$$0.4\ x = 200$$
$$x = 500$$

$$p = price\ per\ unit$$
$$x = units\ produced\ and\ sold$$

At units of 500, total revenue and total costs will be equal. This hypothetical company will break even at a level of 500 units. If it is able to sell more than 500 units, it will be profitable. If it sells less than 500 units, it will lose money.

From the few simple numbers we started with and a few very reasonable assumptions, we were able to back out a firm's variable costs, fixed costs, and break-even point.