Chapter 12 Using break-even analysis to make decisions

This chapter will help you to apply methods used by a business to analyse the impact of different costs and prices on profit. You will examine how costs, revenue and profit information is then used to inform business decisions, such as whether or not to launch a new business or product.

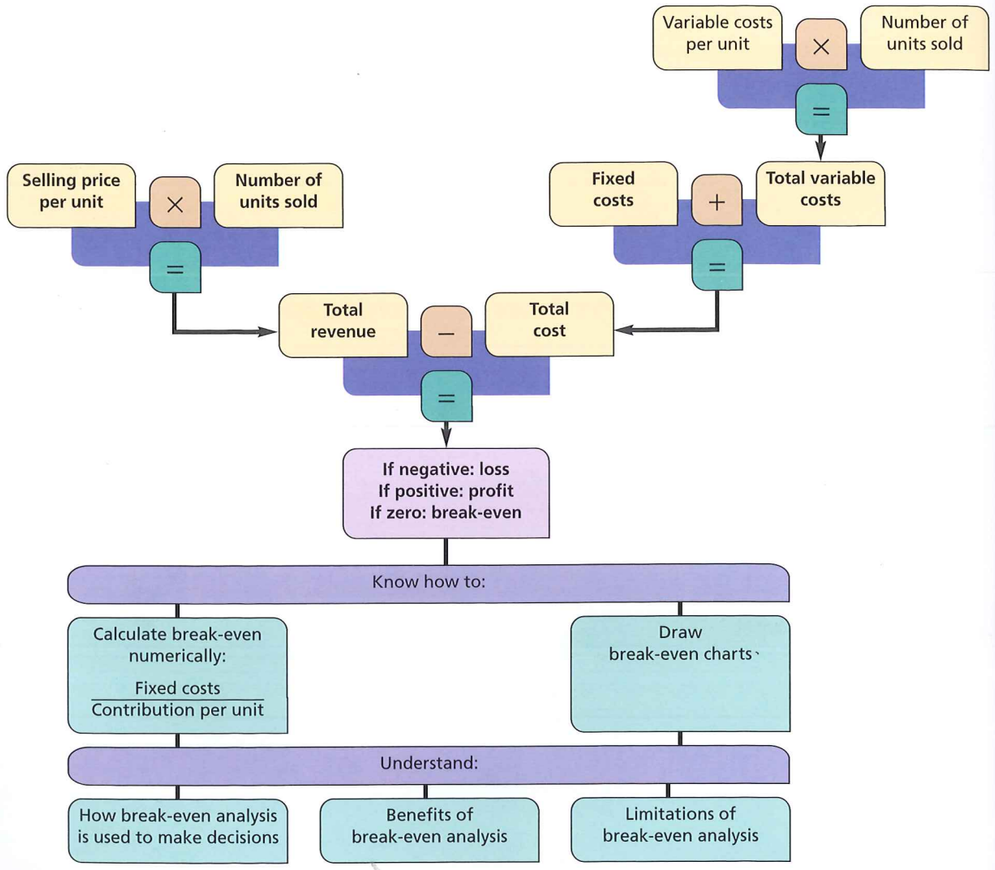


Figure 12.1 Using break-even analysis to make decisions

Why worry about profit?

Why should individuals and companies commit time and resources to a business? For many, it is because businesses have the potential to make a profit. After all, it is the profit motive that drives many entrepreneurs towards starting out in business in the first place.

However, before starting out in a new venture and risking their time and resources, it is useful to be able to assess what the likelihood of that business making a profit will be and by how much.

Many business ideas could be profitable but not at a high enough return to actually make them worthwhile. In the worst case scenario, a new business idea or product may sound good, but in reality it will never make any profit at all if not enough customers can be found to buy the product at a high enough price to cover all the costs.

Why use break-even?

A business can only make a profit when its total revenue is greater than its total costs. If costs are greater than revenue then the business will make a loss. **Break-even** is the point at which total revenue and total costs are equal. At this point the business will not make any losses *or* any profits.

Imagine you are an entrepreneur setting up a business or launching a product. It is important you know how much your product costs to manufacture or provide. This information will help you to decide:

- what your selling price needs to be
- how many products you have to sell to cover costs and avoid making a loss
- the minimum amount that need to be sold to make an acceptable profit
- if things change, by how much prices could drop, or costs increase, before the product became unprofitable.

Break-even analysis is a simple and valuable forecasting technique. Businesses can use break-even analysis to:

- estimate the levels of output they need to produce and sell to make an acceptable return on the time, money and resources they have risked
- assess the impact of price changes on profit and sales
- assess how changes in costs impact on profits
- determine their **margin of safety** and what changes in levels of demand they can survive.

Key terms

Break-even The point at which a business sells the exact number of products so that its total revenue equals its total costs. In other words, at break-even the business makes no profit but also incurs no loss.

Contribution The amount of money a single item makes over and above its own variable cost of production. It represents the income generated by each sale that first goes towards paying the business's fixed costs and then towards making a profit.

Margin of safety The amount by which the current amount made and sold by the business (the SOP – see below) exceeds the amount necessary to break even.

Selected operating point (SOP) The actual level of output and sales at which the business is currently operating or, in the case of a new business, the forecast level of output and sales they anticipate.

The key terms revenue, fixed costs, variable costs and total costs are covered in Chapter 11.

Contribution and contribution per unit

Contribution is an important part of break-even analysis and is used in calculating how many items need to be sold to cover all the costs (fixed and variable). First a product needs to be sold for more than its own variable cost of production.

Consider if a sandwich's variable costs were:

- 10p – labour for making it
- 40p – cost of ingredients.

You wouldn't sell that sandwich for less than 50p or you would be losing money on every individual sandwich sold. So you need to set a selling price higher than the total variable cost of making it.

However, even if you sold each sandwich at £2, you are still not yet making a profit. This is because although the selling price is enough to cover the variable costs, the business still has its fixed costs to pay. So, the excess money made from the sale of each sandwich (£1.50) is now used to pay the fixed costs.

This is called contribution or contribution per unit. Each individual sandwich the shop sells contributes £1.50 towards paying the fixed costs. So:

Contribution = the selling price per unit minus the variable cost per unit

£1.50 = £2.00 – 50p

If, in our example, the sandwich shop had fixed costs such as rent, insurance and some utility bills totalling £300 per day, then the shop needs to sell 200 sandwiches each day generating a £1.50 contribution before all the fixed costs were paid, that is, 200 × £1.50 = £300.

So, if the business sold fewer than 200 sandwiches per day, insufficient contributions would be made, the fixed costs would never be covered and the business would make a loss.

If, however, the business sells more than 200 sandwiches, each additional sandwich still makes a contribution of £1.50 but there are no more fixed costs to pay. This excess now becomes profit.

So, if the business made and sold 300 sandwiches per day, then 200 would be contributing to paying the fixed costs and 100 would be generating profit.

Calculating break-even

A business will find it useful to estimate the number of units it needs to sell to break even. This can be done numerically or by plotting a break-even chart.

To calculate the break-even point numerically, a business needs to know:

- the level of fixed costs
- the selling price per unit
- the variable costs per unit
- contribution per unit = selling price (per unit) minus variable cost (per unit).

For the sandwich shop discussed earlier, the contribution per sandwich is: £2.00 – £0.50 = £1.50.

It is now only a short step to calculating the break-even point. If fixed costs are £300 per day, how many sandwiches – generating £1.50 contribution each – must be sold to cover these fixed costs? The answer can be calculated using the formula:

$$\frac{\text{Fixed costs}}{\text{Contribution per unit}} = \text{Break-even output}$$

In this example, the answer is:

$$\frac{\text{£300 fixed costs per day}}{\text{£1.50 contribution per sandwich}} = \text{200 sandwiches per day need to be sold to break-even}$$

The 200th sandwich to be sold will generate the final £1.50 contribution needed to cover all the fixed costs. The 201st sandwich sold will generate a £1.50 contribution and this time it will be profit. Here we have calculated the break-even output per day; however, this could be done weekly, monthly or yearly as well.

There is a simple relationship between break-even and profit.

- If total output and sales are greater than break-even, then revenue is greater than cost: the business makes a profit.
- If total output and sales are equal to break-even, then revenue equals total costs: the business breaks even.
- If total output and sales are less than break-even, then revenue is less than total cost: the business makes a loss.

Activity

Read the case study below.

1 Calculate how many times George needs an average ride to run per year to break even.
2 Using the answer from question 1, calculate how many rides this is per day to break even, if the Whirlwind can operate for 250 days of the year.
3 Do you think George should go ahead with his idea?

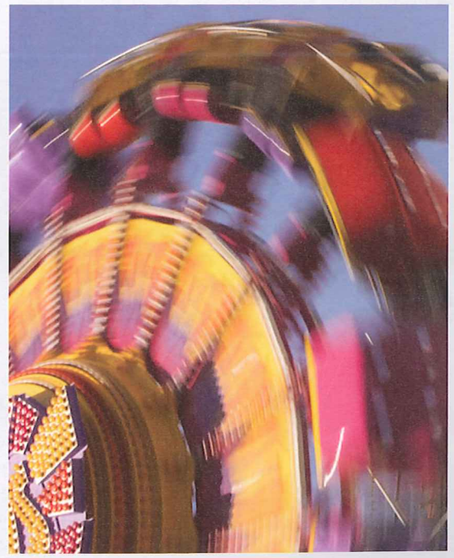
For example...

Fares Fair

As a child, George Mooney was always fascinated by fairgrounds, rides and rollercoasters. His ambition in life was to become the managing director of one of the UK's major theme parks. However, when one day he happened to spot in his local paper an advert for the sale of a second-hand Whirlwind ride, he couldn't resist and immediately started to talk to his wife about quitting his job and remortgaging their house to buy the equipment.

His wife, Amy, suggested taking a more sensible and studied approach, and advised George to back his idea up with some facts and figures before she would even consider the idea. So, having spoken to the seller, George came back two days later with the following information:

- Fixed costs for running the ride each year included insurance, health and safety checks, maintenance, storage over winter and the cost of the equipment itself, which totalled £320,000 per year.
- The variable costs for running each ride included labour and power, and equalled £8 per ride.



Each ride can take a maximum of 25 passengers, but an average ride runs with 16 passengers on board each paying £1.50.

Break-even charts

The break-even point can also be represented by a chart. A break-even chart (see Figure 12.2) is a visual representation of a business's revenues and costs at different levels of output. This is useful, as diagrammatic representation makes it easier for non-mathematical people to understand what is going on. It enables the business to identify:

- how many units need to be sold to break even
- what level of profit or loss will be made at any output
- what effect a change in costs or selling price might have on the break-even point and the level of profit or loss.

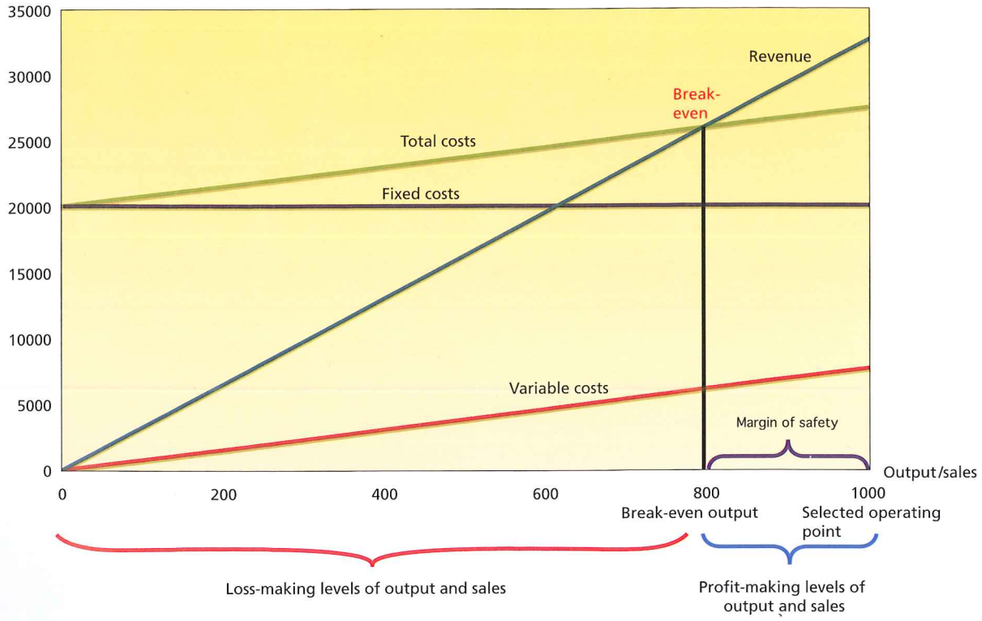


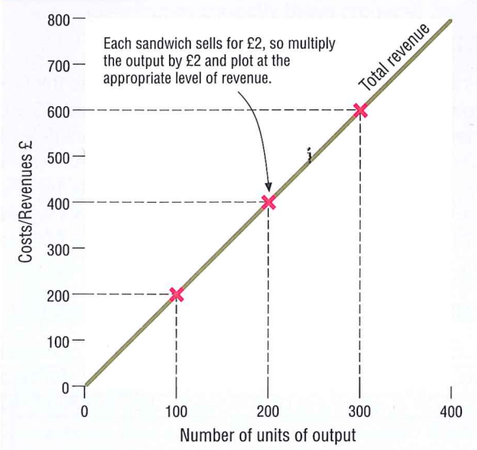
Figure 12.2 An example of a break-even chart

Constructing break-even charts

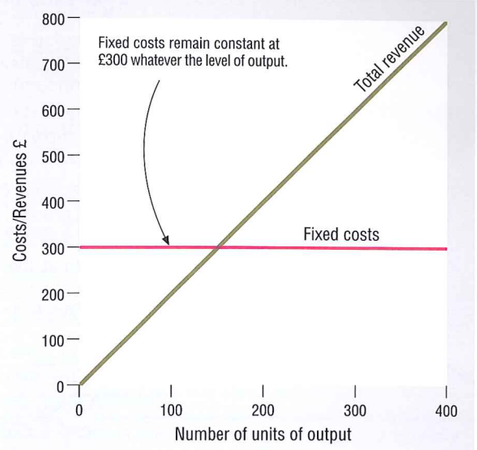
A break-even chart is compiled from plotting costs and revenue information on a graph. The horizontal axis shows the output scale (the number of units per period of time). The vertical axis displays the possible values of costs and revenues in pounds (£s). For the sandwich shop, the scales need to show an output of up to 400 sandwiches per day. If every sandwich were sold, revenue would be £800, and so this is the maximum value that needs to go on the vertical axis.

There are four stages to constructing a break-even chart, as shown in Figure 12.3.

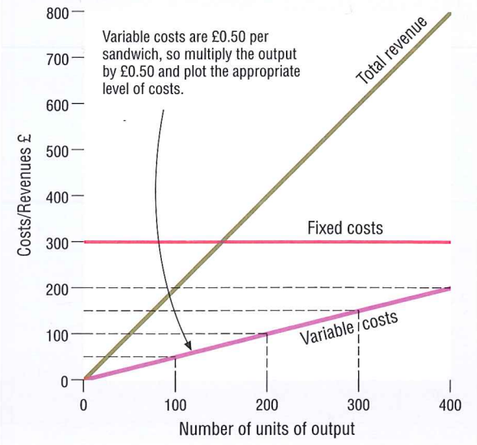
Stage 1



Stage 2



Stage 3



Stage 4

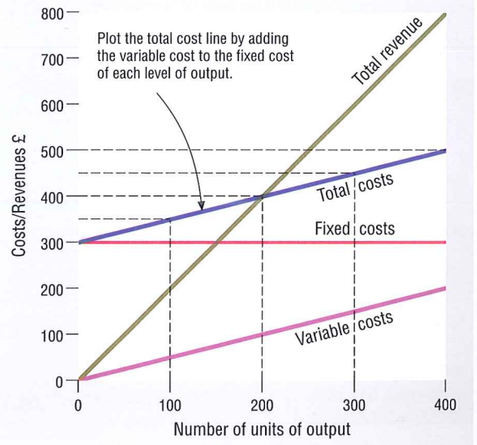


Figure 12.3 Constructing a break-even chart

STAGE 1: PLOT TOTAL REVENUE LINE

If no sandwiches are produced or sold, there will be £0 revenue, and so the total revenue line begins at the origin. Each sandwich is sold for £2. Multiplying any level of output by £2 will give the appropriate level of revenue on the vertical axis. The easiest way to plot the total revenue line is to calculate revenue for the maximum level of output, so for 400 sandwiches, the total revenue would be £800; plot this point and then draw the line from this point back to zero at the origin.

STAGE 2: PLOT FIXED COSTS LINE

Even if there is no output, fixed costs must be paid. As an increase in output has no effect on fixed costs, the fixed costs

line will be horizontal. For the sandwich shop, the fixed costs are at £300 per day.

STAGE 3: PLOT VARIABLE COSTS LINE

If no sandwiches are produced, variable costs will be £0, and so this line begins at the origin. Each sandwich produced costs an additional £0.50. Multiplying any level of output by £0.50 will give the appropriate level of cost on the vertical axis. As with total revenue, the easiest way to plot the variable cost line is to calculate the variable costs for the maximum level of output, so for 400 sandwiches, variable costs would equal £200; plot this point and draw the line from this point back to zero at the origin.

STAGE 4: PLOT TOTAL COSTS LINE

To plot the total costs line, add the variable costs at each level of output to the fixed costs line. The total costs line will begin at £300 for zero output, rising to £500 at an output of 400 sandwiches as £300 fixed costs + £200 variable costs.

Analysing break-even charts

Once the break-even chart has been drawn, it can be interpreted to show the following (see Figure 12.4):

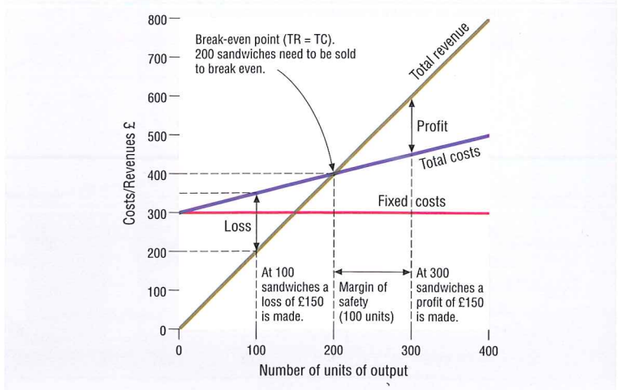


Figure 12.4 Analysing a break-even chart

BREAK-EVEN LEVEL OF OUTPUT

The point at which the total costs line crosses the total revenue line is the break-even point. Reading down from this point it can be seen that, to break even, 200 sandwiches must be sold each day. Or alternatively, £400 must be taken in revenue.

LEVEL OF PROFIT OR LOSS AT EACH LEVEL OF OUTPUT

At levels of output below 200, total costs are greater than total revenue, so the business is making a loss. The level of loss is represented by the vertical distance between the two lines. The amount of loss can be read off the vertical scale. The level of profit can be found at levels of output above 200 sandwiches per day.

MARGIN OF SAFETY

The number of units currently being produced above the break-even level is called the margin of safety. For example, if the sandwich shop were to produce 300 sandwiches per day, the margin of safety would be:

Current output	–	Break-even output	=	Margin of safety
300 units	–	200 units	=	100 units

The higher the margin of safety is, the more profitable the business will be and the less likely that a fall in demand will lead to making a loss.

BREAK-EVEN ANALYSIS: PROS AND CONS

Benefits

- Break-even charts provide a clear, visual demonstration of some vital financial information. They show at a glance break-even output and levels of profit or loss. This knowledge allows a business to predict its likely profit from a certain output and to plan how many units it needs to make and sell in order to reach a profit target.
- Break-even analysis is not a complex, expensive or time-consuming process, and so could prove particularly useful to those starting up or running a small business.
- Break-even charts can be used to show the likely financial impact of changes in costs or selling price (see Figures 12.5 and 12.6).
- Break-even can be used to model whether or not a new business or product would be worthwhile before committing any resources into the venture.
- Break-even charts can be used to model 'what if' situations before any real resources are committed to a business, project or product.

Limitations

- To keep break-even analysis simple, a number of assumptions are made that are unrealistic. For example, it is assumed that:
  - all the output is also sold. Break-even analysis cannot cope with items that are made but not sold.
  - the total revenue and variable costs lines are linear (that is, they increase at a constant rate). In reality, both selling price and the variable costs per unit will change as output increases. Economies of scale, such as bulk-buying discounts, are likely to mean that variable costs per unit will fall at higher levels of output.
- The analysis is intended to help predict the effects of changes, such as selling price. It says nothing about the effect that such a change may have on customer demand and hence on actual level of profit or loss. This will depend on the price elasticity of demand, which is not considered in the break-even chart.
- The constantly changing nature of costs and prices in the real world means that a break-even chart is unlikely to remain valid for very long.
- Finally, it is worth noting that any information gained from break-even charts or calculations is only as accurate as the information it was based upon. Collecting accurate information is expensive and time-consuming, and often difficult for inexperienced entrepreneurs.

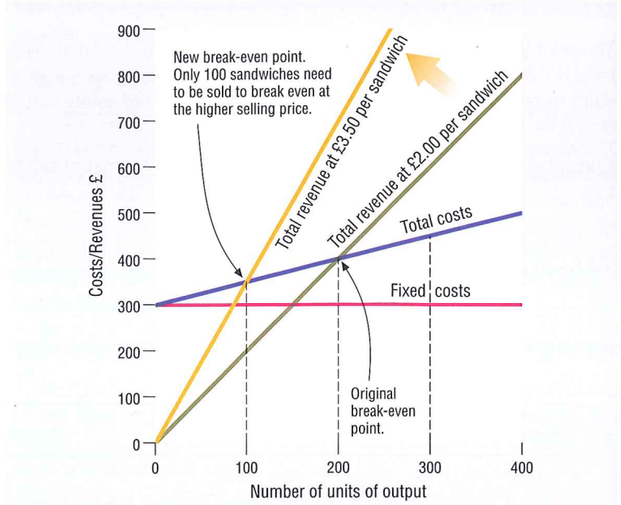


Figure 12.5 Impact of raising the price on break-even output

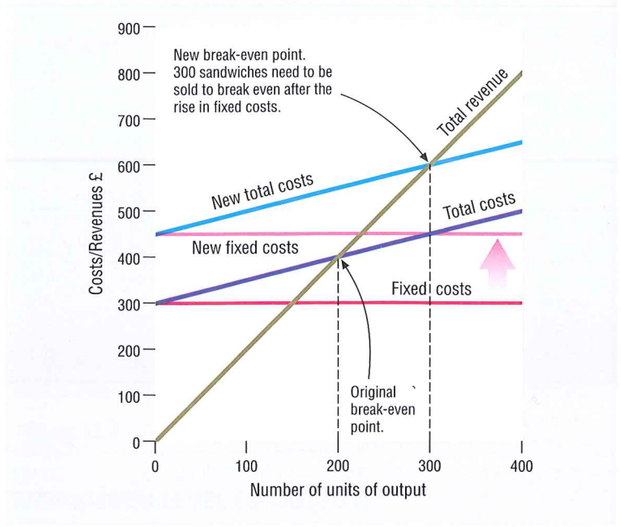


Figure 12.6 Impact of higher fixed costs on break-even output

The effects of changing costs and revenues on break-even output

Few business situations remain constant. Changes in the economy, markets, tastes and fashions affect costs and revenues. The break-even point will change if a business's costs or prices change. Figure 12.6 summarises the effect that some price and cost changes will have on a company's break-even position.

Change	Impact on break-even
Fixed or variable costs rise	Total costs also rise, so more units have to be sold to cover costs. The number of units needed to break even increases (see Figure 12.6).
Fixed or variable costs fall	Total costs also fall, so fewer units have to be sold to cover costs. The number of units needed to break even falls.
Sales price rises	Each unit produces more revenue, so costs are covered more quickly. The break-even number of units decreases (see Figure 12.5).
Sales price falls	Each unit sold earns less revenue, so it takes more units to cover costs. The break-even output point increases.

Figure 12.7 Factors affecting break-even

THE EFFECT OF RAISING SELLING PRICE

Figure 12.5 shows the impact of a higher price. The total revenue line becomes steeper as revenue rises at each level of output. An increase in the price per sandwich to £3.50 would cause the break-even output to fall to just 100 sandwiches.

THE EFFECT OF CHANGING COSTS

Figure 12.6 shows the impact on the business of higher fixed costs – such as an increase in rent. The fixed cost line shifts upwards from £300 to £450, and so the total cost line shifts upwards by the same amount. The impact is to raise the break-even level of output from 200 to 300 sandwiches per day.

Further material and resources relating to this section can be found at **www.collins.bized.co.uk**. Keep checking for updates.