COSTS OF PRODUCTION
Concepts and short run cost curves

- Cost Concepts
- Short run cost output relationship
- Break even analysis

Cost Concepts

- Explicit cost
- Implicit Cost
- Private cost
- Social Cost
- Money cost
- Real Cost
- Opportunity cost
- Sunk Cost

Explicit & Implicit Cost

- **Explicit cost** refers to the making of actual payments in the process of production. They are called out of pocket expenses.

- Whereas I**mplicit cost** implies that although the work gets done yet there is no corresponding payment for it in terms of money. Indirect expenses which are never expressed in money or own accounted expenses.

Private and Social Cost

- **Private costs** are those that accrue directly to the individuals or firms engaged in relevant activity.

- **External costs/Social Costs** on the other hand are passed on to persons not involved in the activity in any direct way (ie they are passed to society at large)

Money cost

- **Money cost** refers to the payments made to the factors of production in terms of money proper in return for their services enjoyed by the producer in his process of production. For e.g. payments made for purchasing raw material, rent of land, wages for labour.

Opportunity Cost (Alternative or Transfer Cost)

- "The opportunity cost is the cost of next best alternative foregone."

- Resources are limited and therefore they cannot be used for more than one purpose at the same time. E.g. If land is used for building a house, the same land cannot be used for agricultural purpose. In general terms, if a resource can produce either 'A' or 'B', then the opportunity cost of producing 'A' is the loss of 'B'.

Sunk Cost

- A **sunk cost** is an expenditure that has been made and cannot be recovered.
- Since it cannot be recovered, it should be ignored while taking economic decisions.
  - Eg: a firm buys a highly specialized machine for a plant. It can be used only what it was designed for. That is, it cannot be put in alternative uses. Its *opportunity cost is zero.*

Short Run Cost Function

- The cost function is a functional relationship between cost and output. It explains that the cost of production varies with the level of output, given other things remain the same (*ceteris paribus)*.
- This can be mathematically written as:
  - C = *f*(X)
- where C is the cost of production and X represents the level of output.

Short run Costs

- Total fixed costs (TFC)
- Average fixed costs (AFC)
- Total variable costs (TVC)
- Average variable cost (AVC)
- Total cost (TC)
- Average total cost (ATC)
- Marginal cost (MC)

Fixed Costs (Overhead costs)

- Result from owning a fixed input or resource.
- Incurred even if the resource isn't used.
- Don't change as the level of production changes (in the short run).
- Exist only in the short run.
- Not under the control of the manager in the short run.
- The only way to avoid fixed costs is to sell the item.

Total Fixed Cost

- Fixed cost refers to the cost of fixed inputs. It does not change with the level of output (thus, fixed). Fixed inputs include building, machinery etc. Hence the cost of such inputs such as rent or cost of machinery constitutes fixed costs. Also referred to as *overhead costs, supplementary costs* or *indirect costs*, these costs remain the same irrespective of the level of output.
- Hence, if we plot the Total Fixed Cost (TFC) curve against the level of output on the horizontal axis, we get a straight line parallel to the horizontal axis. This indicates that these costs remain the same and that they have to be incurred *even if the level of output is zero.*

- The **fixed cost** (**FC**) of production is the cost of production that *does not vary with output level*. The fixed cost is the cost of the fixed inputs in production, such as the cost of a machine (capital) that costs the same to operate no matter how much production is happening. An example of such a machine is a conveyor belt in a factory that moves a streetcar chassis through various stages of an assembly line. The belt is either on or off, but the cost of running it does not change depending on how many streetcars it carries at any point in time.

Fixed cost

- Examples:
  - Taxes on property
  - Interest
  - Depreciation
  - Rent
  - Insurance

Fixed Costs

- **Total fixed cost (TFC):**
  - **All costs associated with the fixed input.**
- **Average fixed cost per unit of output:**

$$AFC = \frac{TFC}{Output}$$

Total Variable Cost

- The cost incurred on variable factors of production is called Total Variable Cost (TVC). These costs vary with the level of output or production. Thus, when production level is zero, TVC is also zero. Thus, the TVC curve begins from the origin.
- The shape of the TVC is peculiar. It is said to have *an inverted-S shape*. This is because, in the initial stages of production, there is scope for efficient utilization of fixed factor by using more of the variable factor (eg. Workers employing machinery).

- Hence, as the variable input employed increases, the productive efficiency of variable inputs ensures that the TVC increases but at a *diminishing rate*. This makes the first part of the TVC curve that is *concave.*
- As the production continues to increase, more and more variable factor is employed for a given amount of fixed input. The productive efficiency of each variable factor falls and it adds more to the cost of production. So the TVC increases but now at an *increasing rate*. This is where the TVC curve is *convex* in shape. And so the TVC curve gets an inverted-S shape.

- The **variable cost** (**VC**) of production is the cost of production that *varies with output level*. This is the cost of the variable inputs in production, for example the cost of the workers that assemble the electronic devices along a conveyor belt. The number of workers might depend on how many devices the factory is trying to produce in a day. If its production target increases, it uses more labor. Thus the hourly wages it pays for these workers are a variable cost. Variable cost generally increases with the amount of output produced.

- There are three short-run average cost measures: the average variable cost, average fixed cost and average total cost.
- **Average variable cost** (**AVC**) is the variable cost per unit of output. Mathematically, it is simply the variable cost divided by the output:
- AVC = VC/Q
- Note that since variable cost generally increases with the amount of output produced, the average variable cost can increase or decrease as output increases.

- **Average fixed cost** (**AFC**) is the fixed cost per unit of output. Mathematically, it is simply the fixed cost divided by the output:
- AFC = FC/Q
- Because fixed cost does not change with the amount of output produced, the average fixed cost always decreases as output increases.

- **Average total cost** (**AC**), or simply **average cost**, of production is total cost per unit of output. This is the same as the sum of the average fixed cost and the average variable cost:
- AC = $AC/Q = AFC + AVC$
- Because it is the sum of the average fixed cost, which is always declining with output, and the average variable cost, which may increase or decrease with output, the average total cost may increase or decrease with output.

- **Marginal cost** (**MC**) is the additional cost incurred from the production of one more unit of output. Thus marginal cost is:
- $MC=\Delta C/\Delta Q$
- The only part of total cost that increases with an additional unit of output is the variable cost, so we can re-write the marginal cost as:
- $MC=\Delta VC/\Delta Q$
-

Variable Costs

- Can be increased or decreased by the manager.
- Variable costs will increase as production increases.
- Variable costs exist in the short-run and long-run:
  - In fact, all costs are considered to be variable costs in the long run.

Variable Costs

- **Total Variable cost (TVC) is the summation of the individual variable costs.**

- **VC = (the quantity of the input) X (the input's price).**

Variable Costs

- **Total variable cost (TVC):**
  - **All costs associated with the variable input.**
- **Average variable cost per unit of output:**

$$AVC = \frac{TVC}{Output}$$

- **Total Cost**
- Total cost (TC) refers to the sum of fixed and variable costs incurred in the short-run. Thus, the short-run cost can be expressed as
  - TC = TFC + TVC
- Note that in the long run, since TFC = 0, TC =TVC. Thus, we can get the shape of the TC curve by summing over TFC and TVC curves.
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Total Cost

- The sum of total fixed costs and total variable costs:

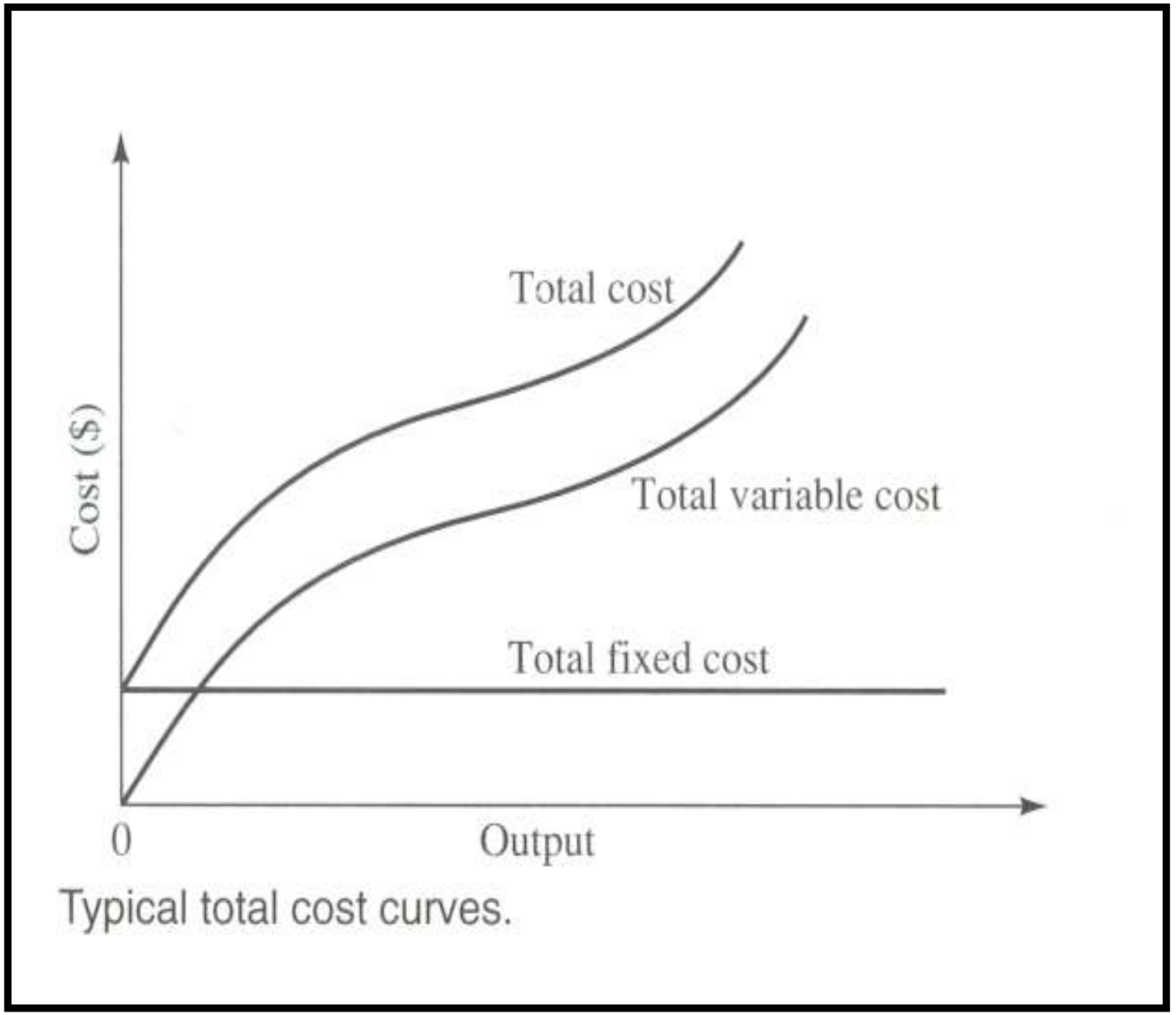
$$TC = TFC + TVC$$

- In the short run, TC will only increase as TVC increases.

Total Cost Schedule

Output	TFC	TVC	TC
0	20	0	20
1	20	10	30
2	20	17	37
3	20	22	42
4	20	25	45
5	20	27	47
6	20	33	53

Total Cost Curves



Typical total cost curves.

Typical Total Cost Curves (selected attributes)

- TFC is constant and unaffected by output level.
- TVC is always increasing:
  - First at a decreasing rate.
  - Then at an increasing rate.
- TC is parallel to TVC:
  - TC is higher than TVC by a distance equal to TFC.

Short Run Cost Analysis
Cost Schedule

Output	TFC	TVC	TC	AFC	AVC	AC	MC
1	20	10	30	20	10	30	----
2	20	18	38	10	9	19	8
3	20	25	45	6.6	8.8	15	7
4	20	28	48	5	7	12	3
5	20	30	50	4	6	10	2
6	20	52	72	3.33	8.7	12	22
7	20	85	105	2.9	12.1	15	33
8	20	140	160	2.5	17.5	20	55

Average Total Cost

- **Average total cost per unit of output:**

$$AFC + AVC$$

$$ATC = \frac{TC}{Output}$$

Average Fixed Cost (AFC)

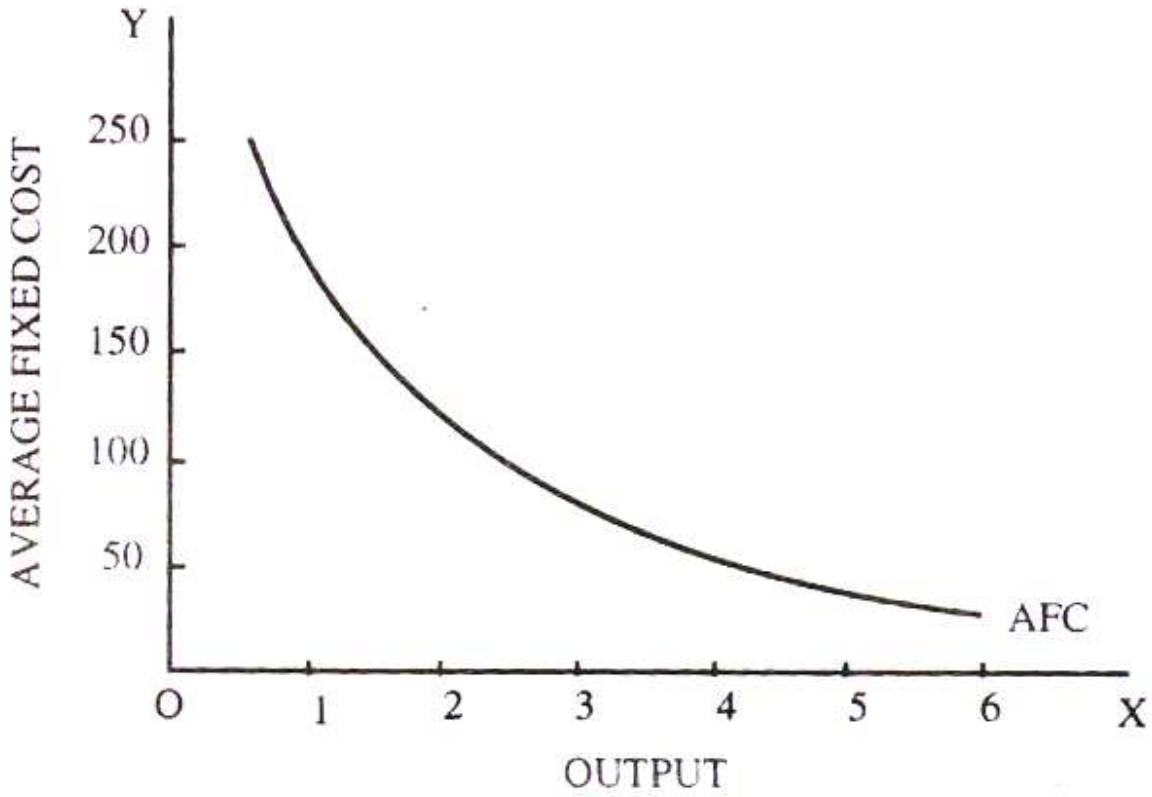


Fig 7.2 AFC Curve

Average Variable Cost (AVC)

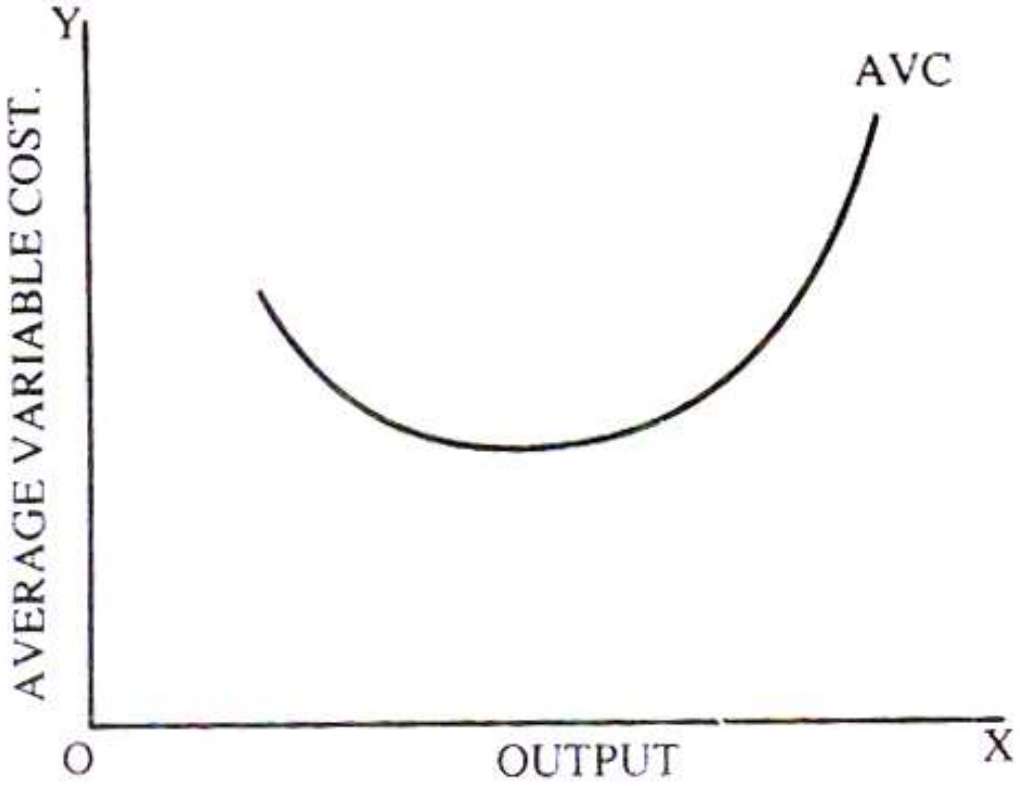
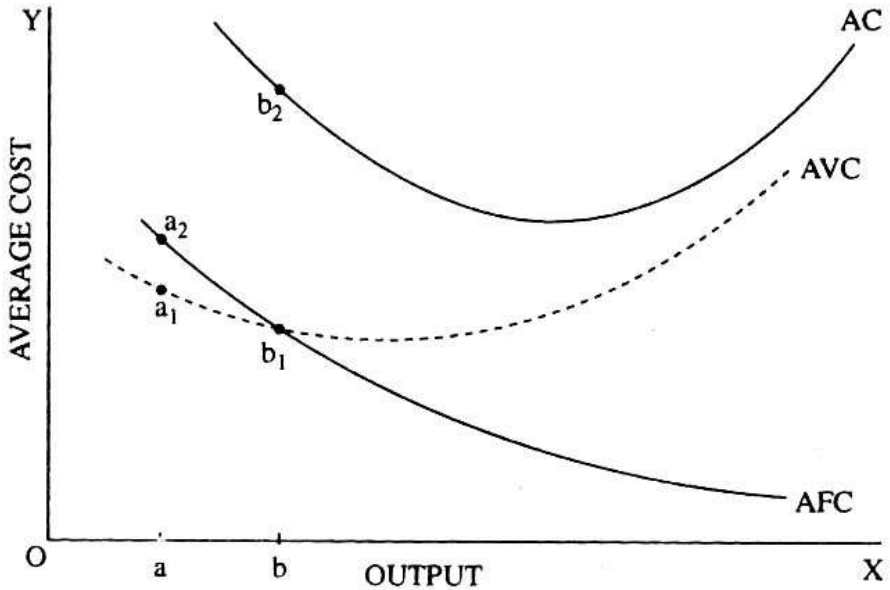


Fig. 7.3 AVC Curve

Short run cost curve

The AC curve is the lateral summation of the average fixed and variable cost curves.

AC = AFC + AVC



7.4 Average Cost Curves

Marginal Cost

- **The additional cost incurred from producing an additional unit of output:**

$$MC = \frac{\Delta TC}{\Delta \text{ Output}}$$

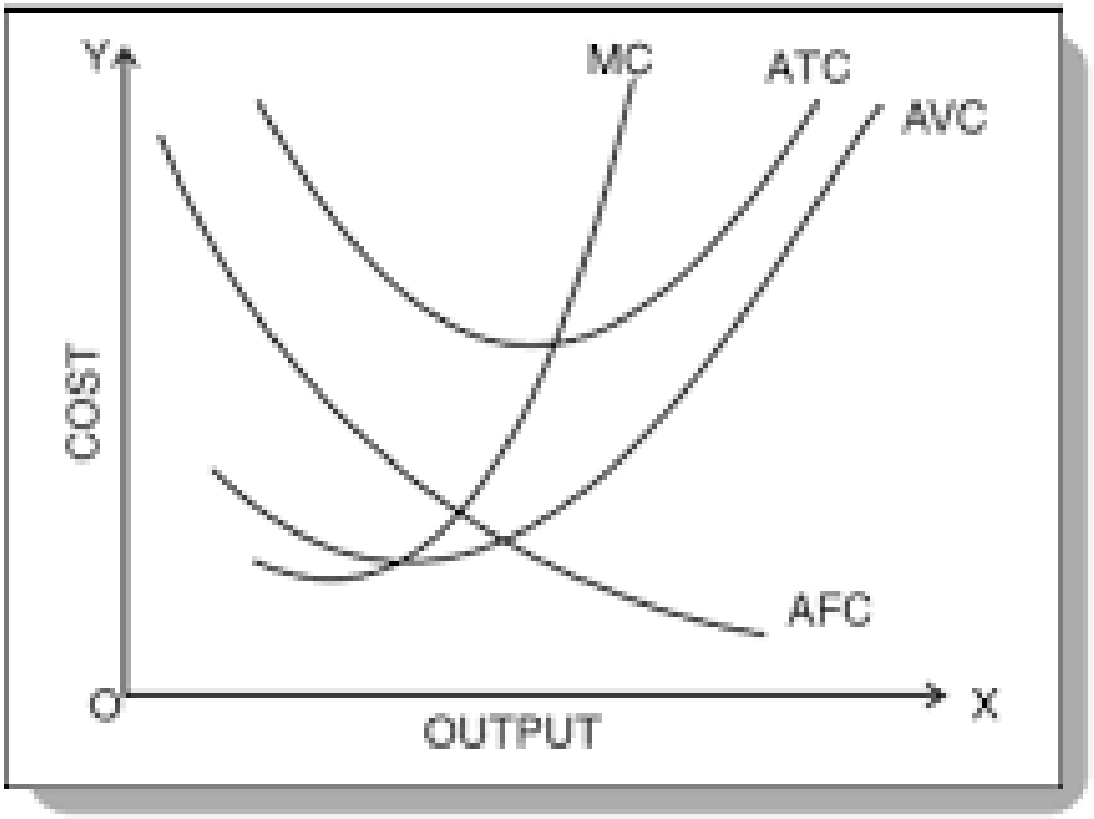
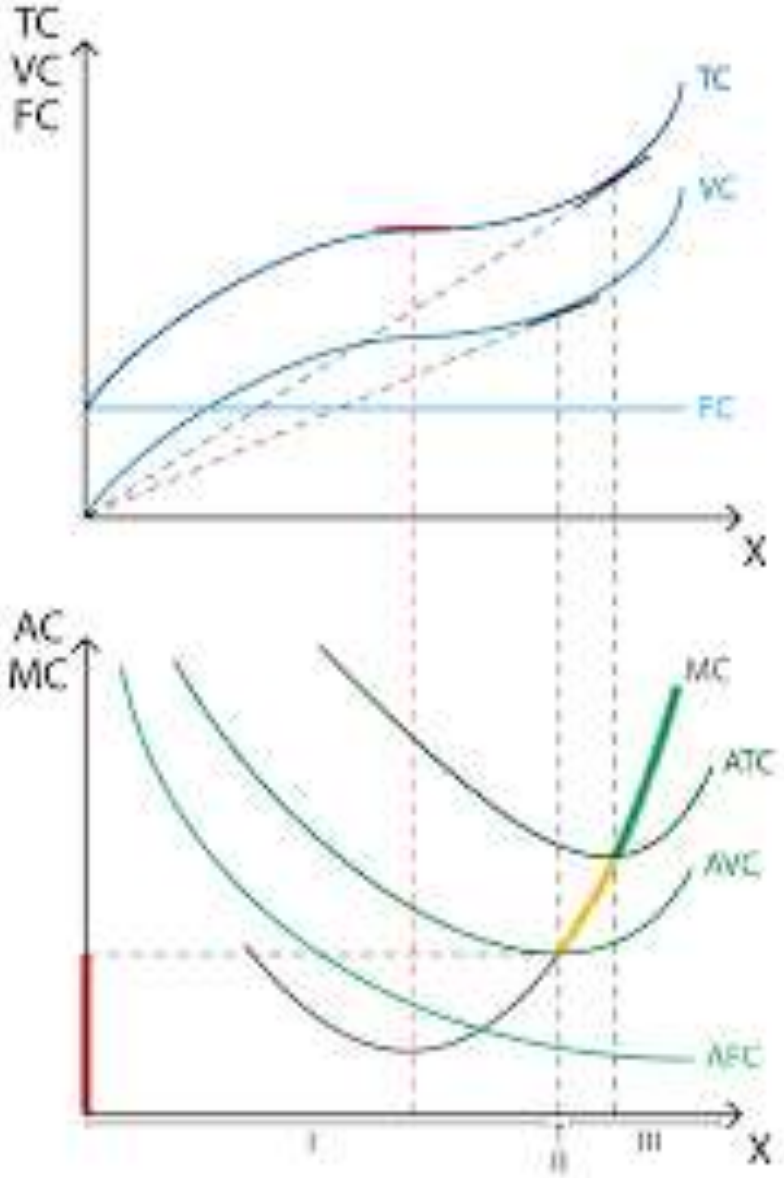


Fig. 1 : Short run Average and Marginal Cost Curves


TC
VC
FC
TC
VC
FC
X
AC
MC
MC
ATC
AVC
AFC
I
II
III
X

Shape of short run cost curves

- The short run cost curves AVC, AC and MC are U shaped because of the **law of variable proportions**. According to this law, in the initial sages of production, as the firm combines its fixed and variable factors to begin with, to produce more and more of output, the productivity of the variable factors increases, and per unit costs falls.
- Then, they reach the stage of minimum costs at the level of optimum combination of fixed and variable factor. Thereafter, as the use of variable input increases given the fixed factor to increase the output, the productivity of variable factor fall, resulting in rise in per unit costs.

Discussion

- Three Industries
  - Personal computers
  - Software
  - Restaurant

Break Even Analysis

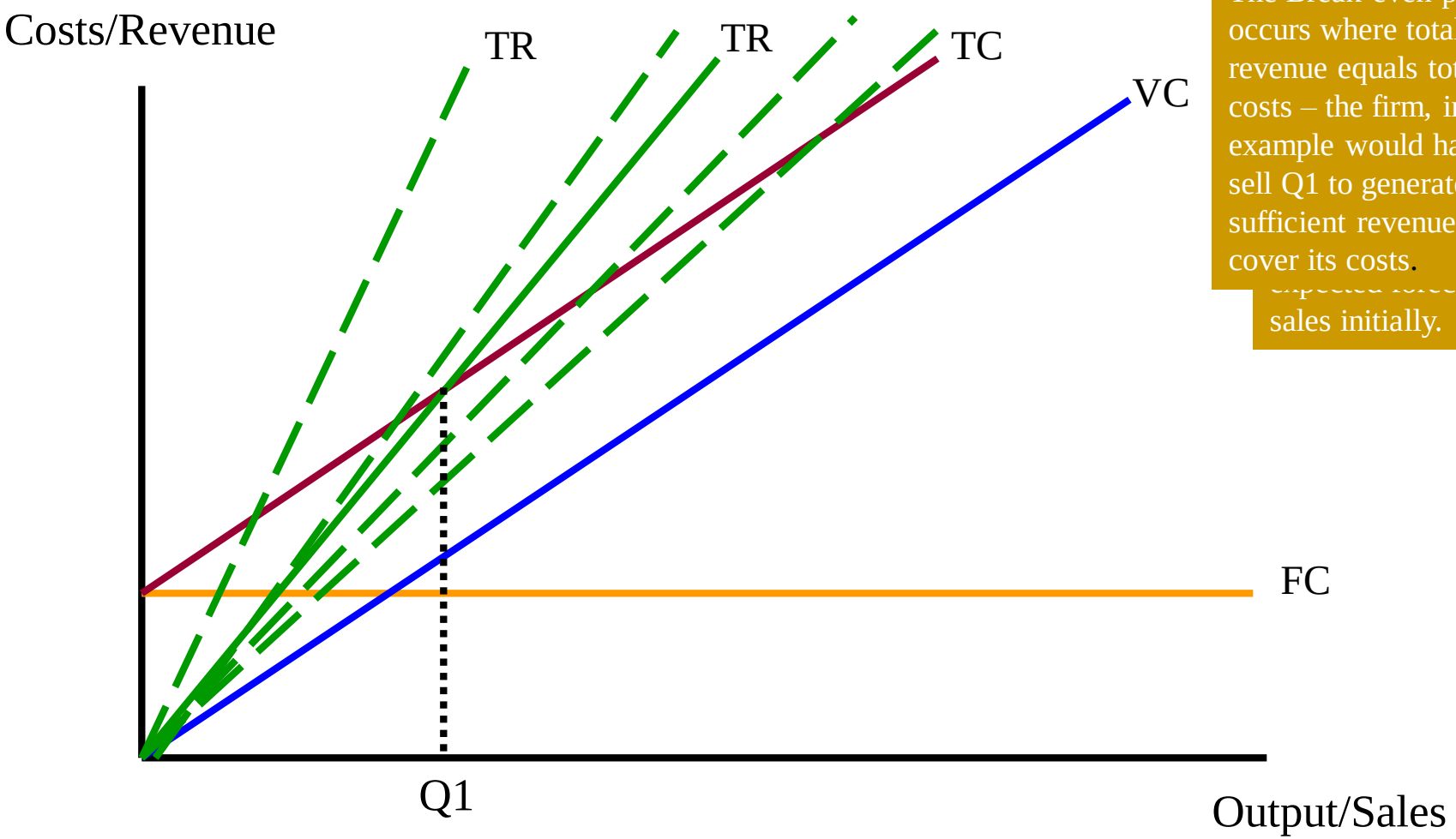
Break Even Analysis

- Break even is the point of production where a firm's revenue is equal to the total costs of production
- When total revenue is equal to total cost the process is at the break-even point.

$$TC = TR$$

- Margin of safety – the difference between the firms current level of output and break even output

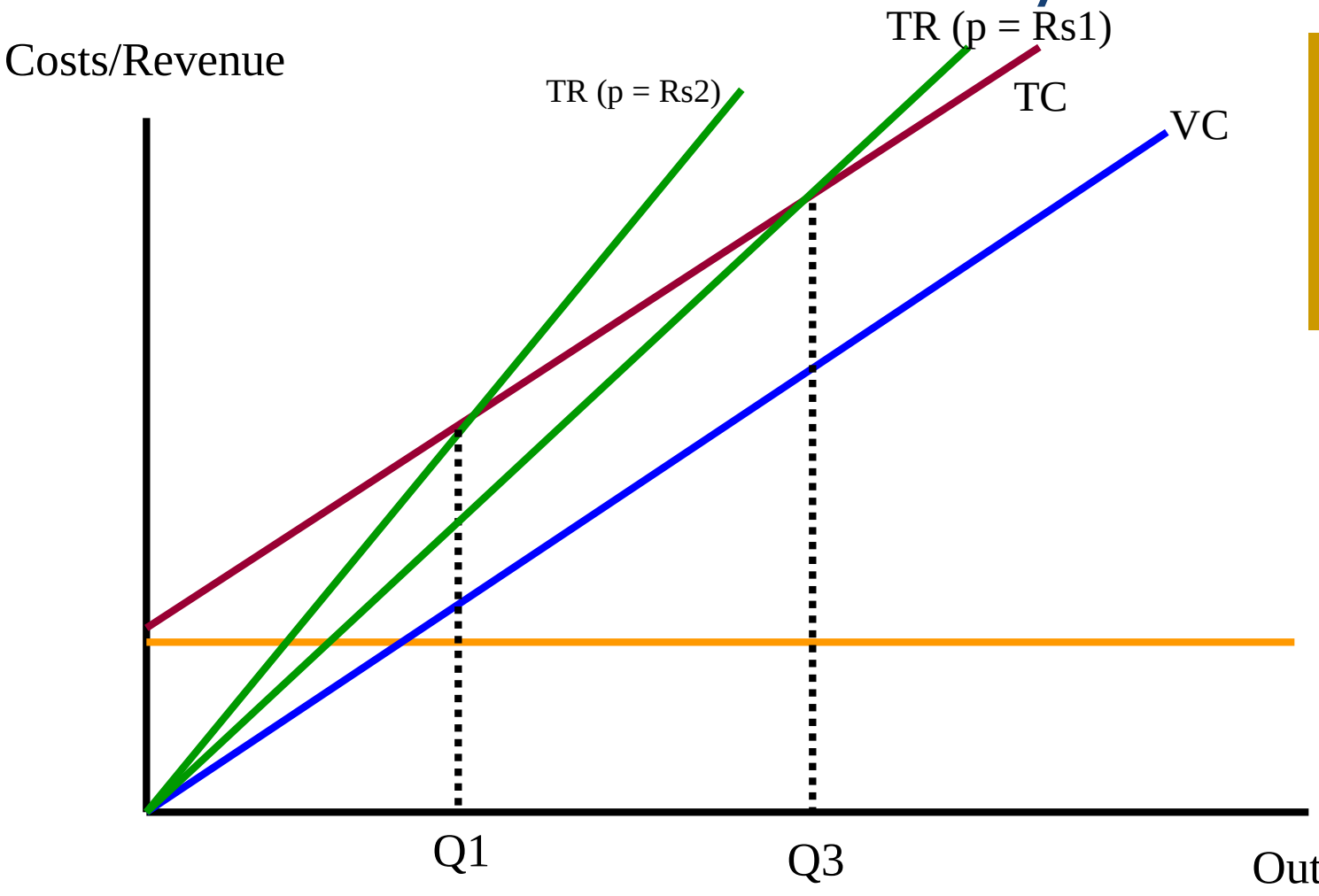
Break-Even Analysis



The Break-even point occurs where total revenue equals total costs – the firm, in this example would have to sell Q1 to generate sufficient revenue to cover its costs.

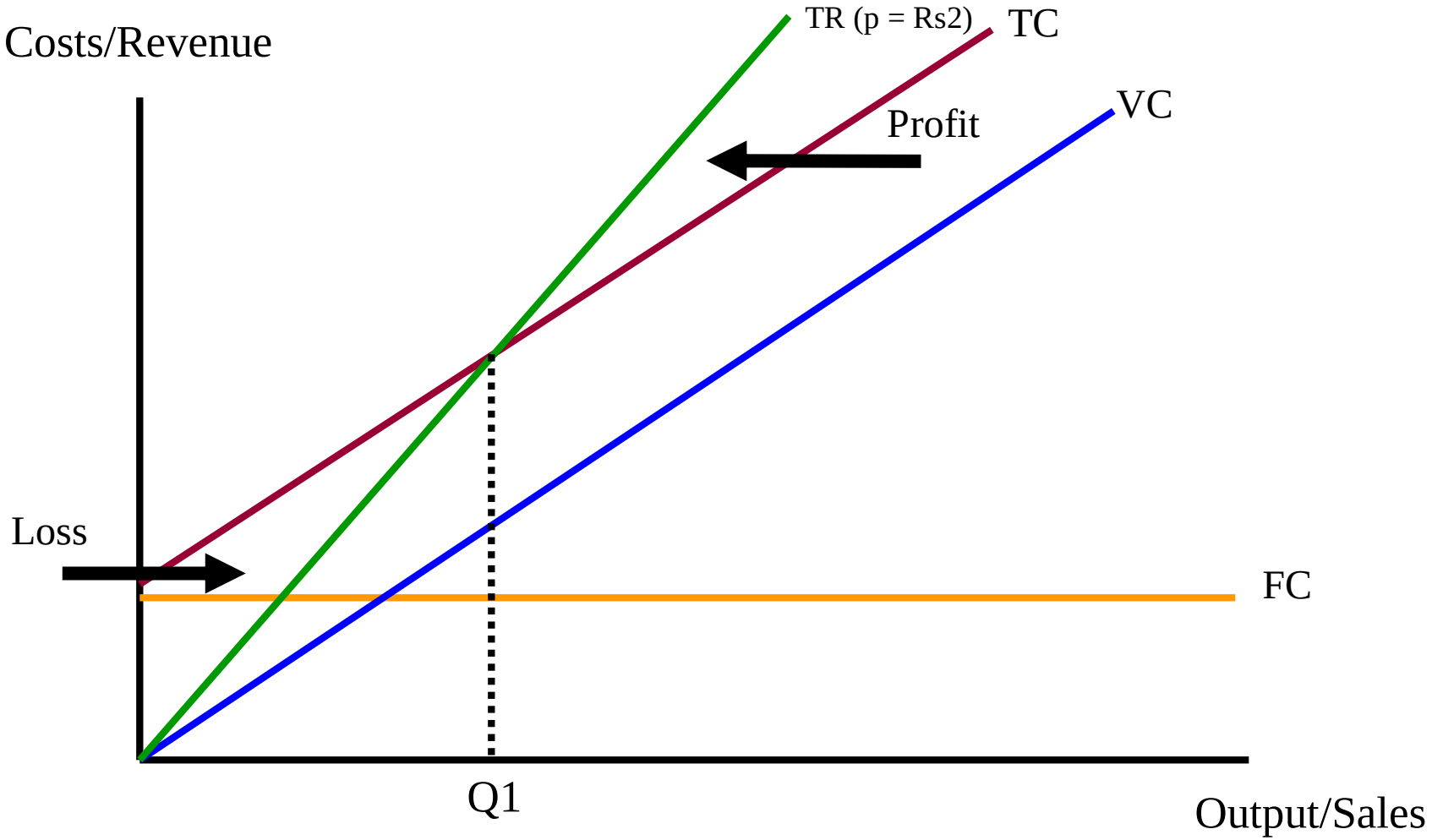
sales initially.

Break-Even Analysis

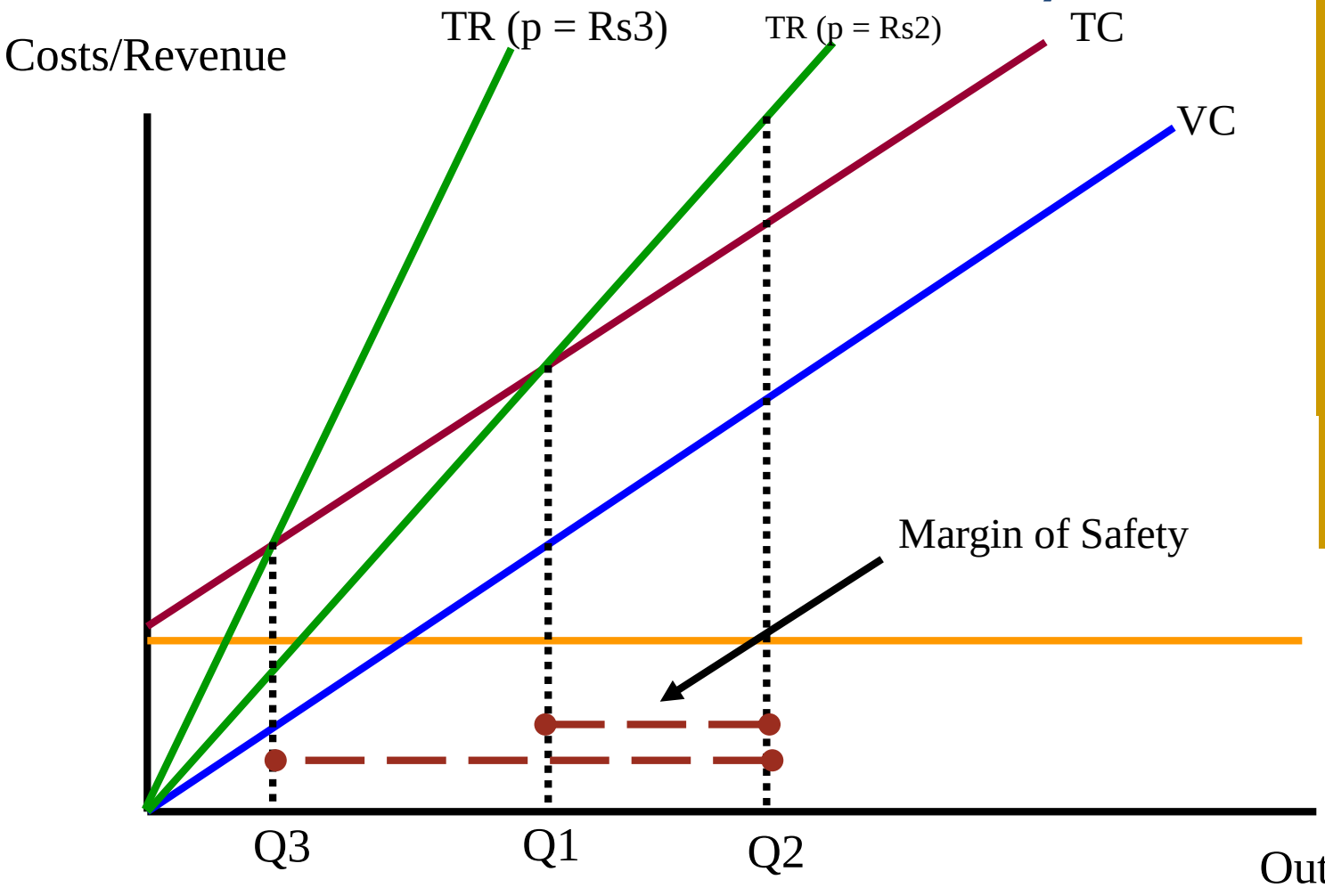


If the firm chose to set prices lower (say Rs1) it would need to sell more units before covering its costs

Break-Even Analysis



Break-Even Analysis



A higher price would lower the break even point and the margin of safety would widen

before a loss would be made

Cost-Volume-Profit Graph