# Cost Concepts

# Introduction

- Cost is defined in simple terms as a sacrifice or foregoing which has already occurred or has potential to occur in future with an objective to achieve a specific purpose measured in monetary terms.
- Cost results in current or future decrease in cash or other assets, or a current or future increase in liability.
- Determinants of cost:
  - ☐ Price of inputs
  - ☐ Productivity of inputs
  - ☐ Technology
  - ☐ Level of output
- Mathematically we can express the cost function as:

$$C= f(Q, T, P_f)$$

where C=cost; Q=output; T=technology; $P_f$ = price of inputs.

# Kinds of Costs

- **Accounting Costs/ Explicit Costs/ Out of Pocket Costs**
  - □ Which can be identified, measured and accounted for; e.g. cost of raw materials, wages and salary and capital costs like cost of the factory building.
  - □ Which result in cash outflow or increase in liability
- **Opportunity Costs**
  - □ Help in evaluation of the alternative uses of an input other than its current use in production

- **Implicit Costs**
  - □ Do not involve cash outflow or reduction in assets, or increase in liability; e.g. owner working as manager in own building
  - □ Important for opportunity cost measurement

# Costs in Short Run

Costs

C ————————————————— TFC

O ————————————————→ Quantity

Costs

————— TFC

————

—————
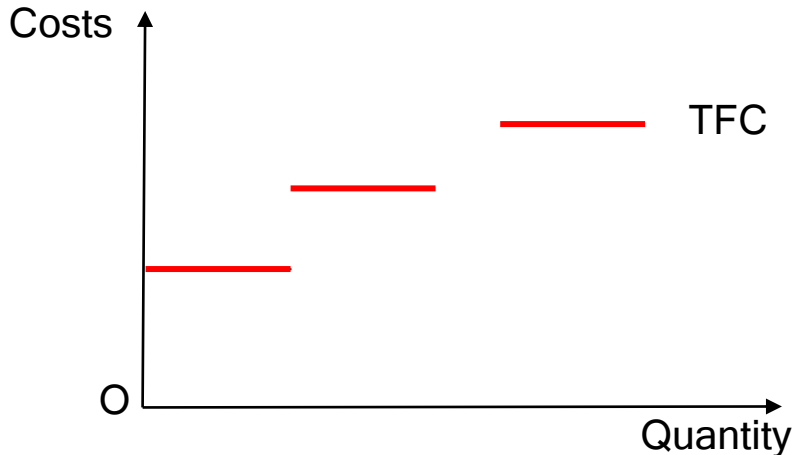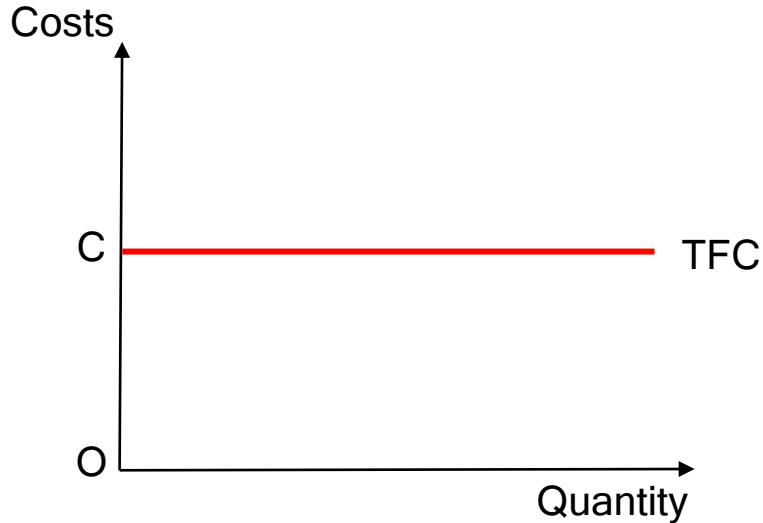
O ————————————————→ Quantity

- **Fixed Costs**
  - Do not vary with output; e.g. plant, machinery, building.
  - Total Fixed Cost (TFC) curve is a straight line, parallel to the quantity axis, indicating that output may increase to any level without causing any change in the fixed cost.
  - In the long run plant size may increase hence FC curve may be step like, where each step showing FC in a particular time period.

# Costs in Short Run
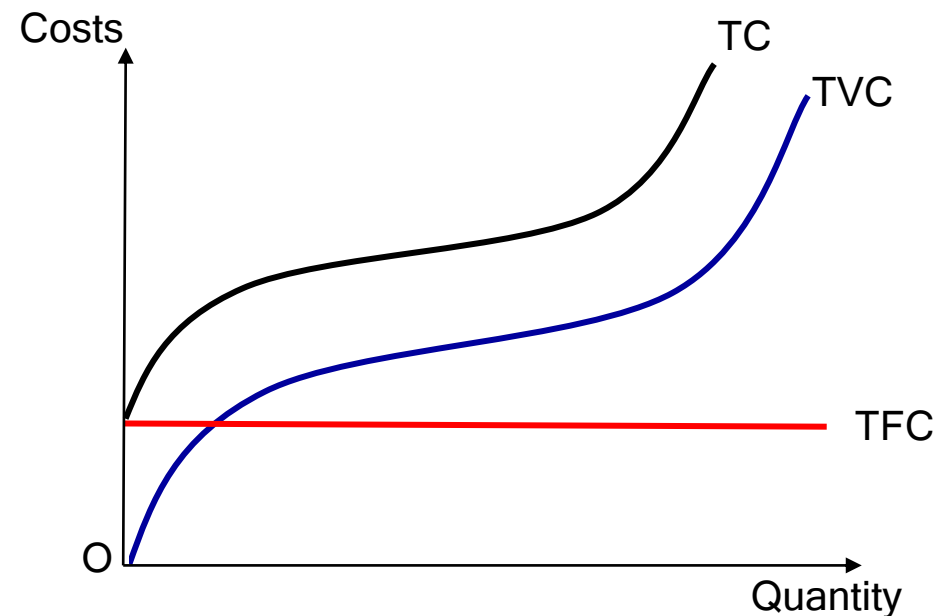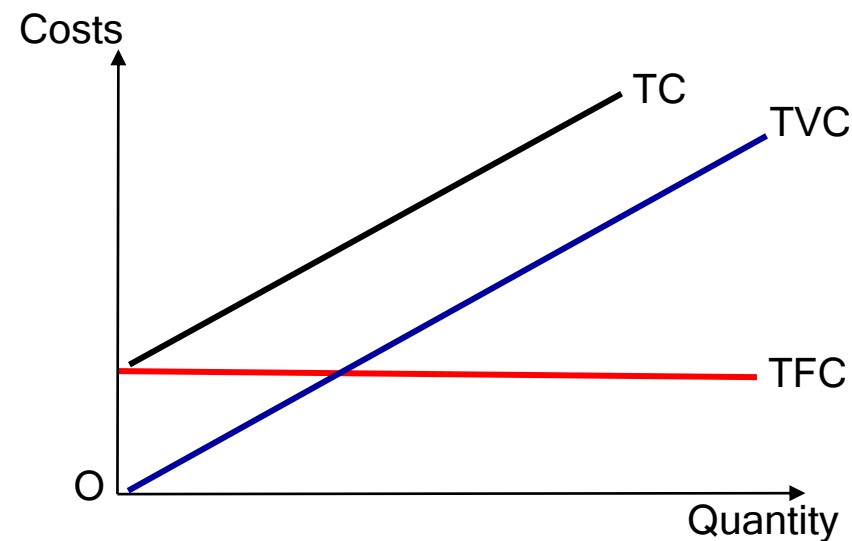


- **Variable Costs**
  - Costs that vary with level of output and are zero if no production; e.g. cost of raw materials, wages.
  - Normally TVC is like a straight line starting from origin.
  - TVC may be an inverse S shaped upward sloping curve, due laws of variable proportions.

- **Total cost (TC)**
  - Sum of TFC and TVC
  - Slope of TC curve is determined by that of the TVC.

# Average and Marginal Cost

- Average Cost (AC) is total cost per unit of output.
  - AC =(TC/Q)
  - AC=AFC+AVC
- AFC= TFC/Q
- AVC= TVC/Q
- Marginal cost (MC) is the change in total cost due to a unit change in output.
  - $MC_Q = TC_Q - TC_{Q-1}$
- Since the fixed component of cost cannot be altered, MC is virtually the change in variable cost per unit change in output.
  - Also known as rate of change in total cost.

# Average and Marginal Cost Functions

AC/MC

MC

AC

AVC

AFC

O

Quantity
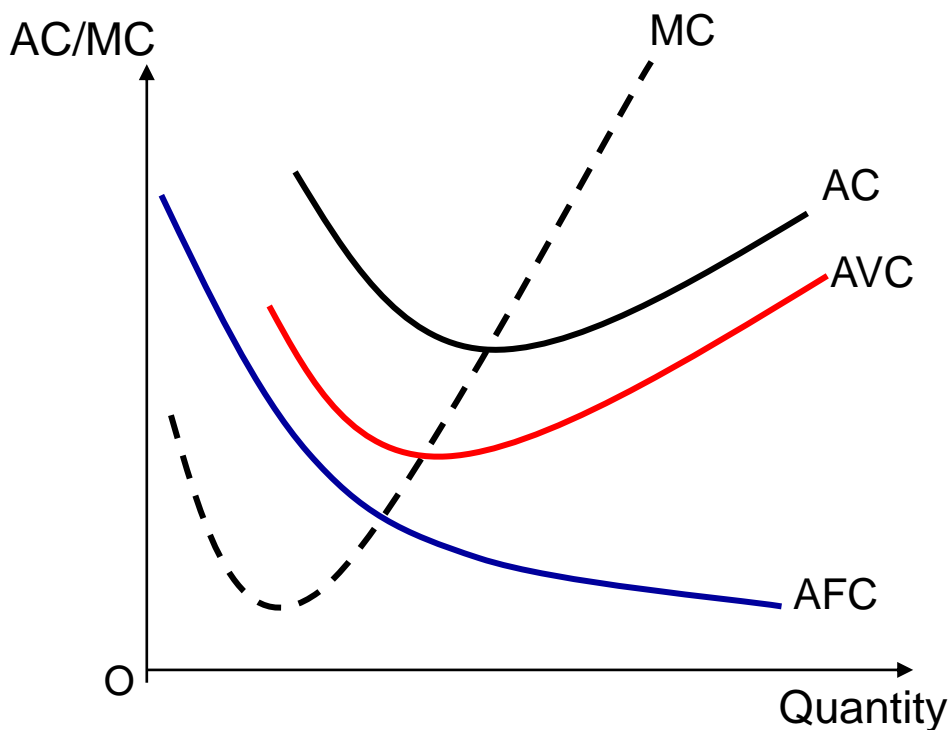
- AC curve is U shaped
- When both AFC and AVC fall, AC also falls and when AVC rises AC starts increasing.
- When average costs decline, MC lies below AC.
- When average costs are constant (at their minimum), MC equals AC.
  - □ MC passes through the lowest point of AC curves.
- When average costs rise, MC curve lies above them.

# Costs in Long Run

- All costs are variable in the long run since factors of production, size of plant, machinery and technology can be varied in the long run.

- The long run cost function is often referred to as the "planning cost function" and the long run average cost (LAC) curve is known as the "planning curve".

- As all costs are variable, only the average cost curve is relevant to the firm's decision making process in the long run.

- The long run consists of many short runs, therefore the long run cost curve is the composite of many short run cost curves.

# Costs in Long Run

- In the long run the firm may increase plant size to increase output.
- As output is increased from $q_0$ to $q_1$ capacity at $SAC_1$ is overworked.
- Hence the firm shifts to a higher plant size $SAC_2$.
- This shift would lower the average cost of the firm.
- The same process would be repeated if the firm increases its output further to $q_2$.
- It shows scalloping curve as the plant costs are not smoothened.

AC, MC

$MC_1$

$SAC_1$

$MC_2$

$SAC_2$

$MC_3$

$SAC_3$

**LAC**

O

$q_0$

$q_1$

$q_2$

Quantity
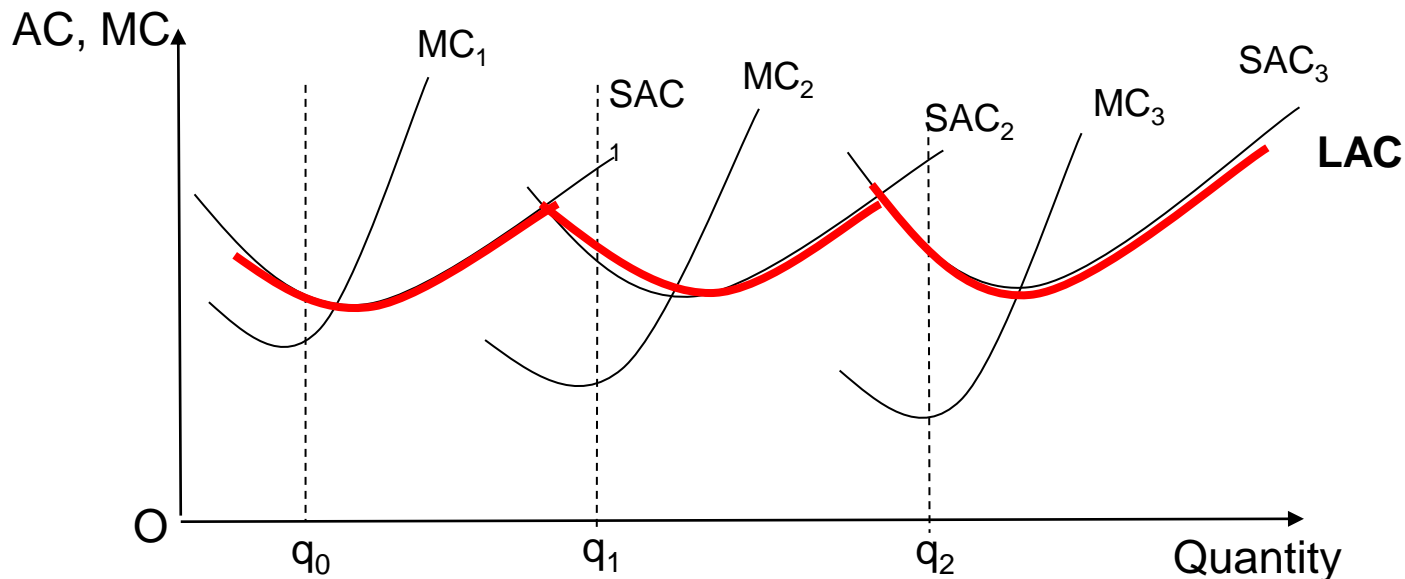
# Long Run Average Cost

- The LAC function can be shown as an envelope curve of the short run cost functions.
- Each of the SAC curves represents the cost conditions for a plant of a particular capacity.
- LAC curve envelopes $SAC_1$, $SAC_2$, $SAC_3$, showing the average cost of production at different levels of output turned out by plants 1, 2 and 3.
- LMC curve corresponds to LAC curve.
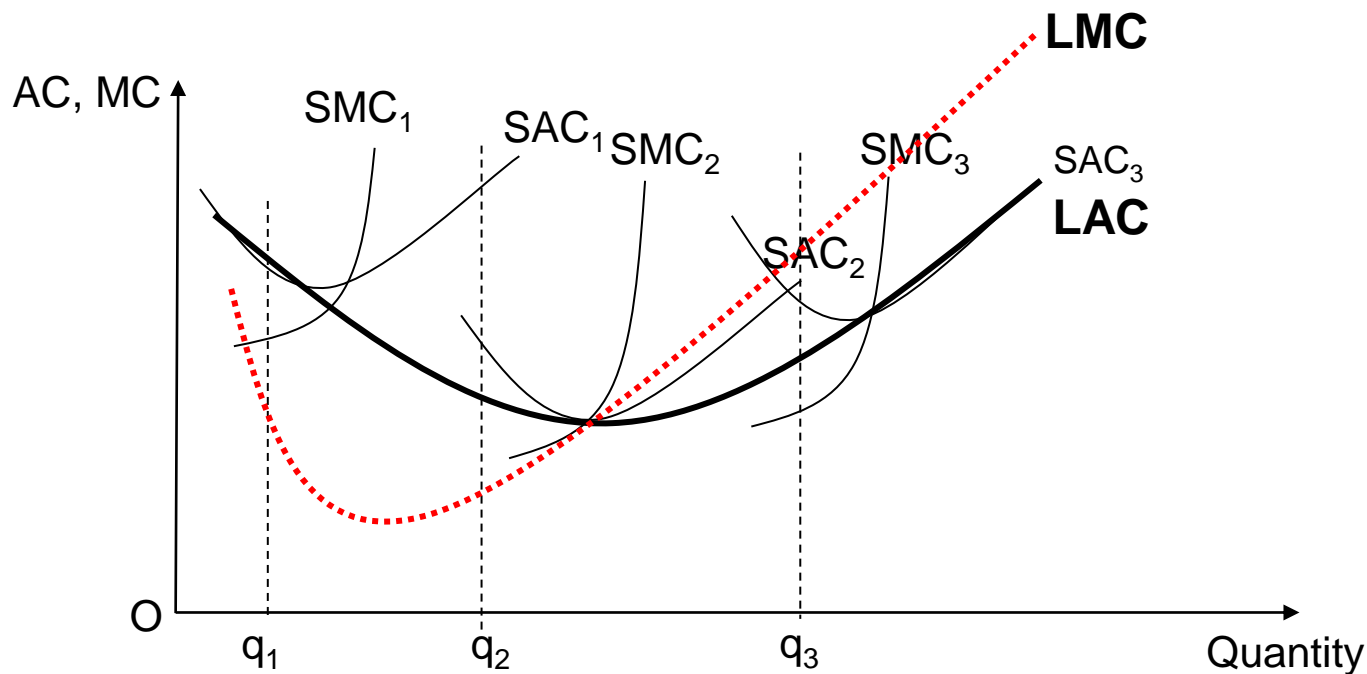
# Long Run Marginal Cost

- Long run marginal cost (LMC) curve joins the points on the short run marginal cost (SMCs) curves that are associated with short run average costs corresponding to each level of output on the LAC curve.
- The optimum plant size is II, assuming sufficient demand.
- Optimal level of output is Oq*, where long run and short run marginal and average costs are all equal.
- LMC must be less than LAC when the latter is decreasing
- It would be equal to LAC when the latter reaches its minimum.
- LMC is greater than LAC when the latter is increasing.

# problems

- Suppose the firm faces a cost function of C=8+4q +q²

- Find out fixed cost, average variable cost & Marginal cost?

# Costs of a Multi Product Firm

- Assuming that a multi product firm manufactures two goods, with the same plant and machine.

- Total cost (TC) of production would be the sum of TFC and the total of variable costs ($C_1$ and $C_2$) of producing both the products, times the quantities of the two goods ($Q_1$ and $Q_2$).

$$TC = TFC + C_1Q_1 + C_2Q_2$$

- If the two products are produced in fixed proportions, then we can use the concept of weighted average cost (ACw) defined as:

$$ACw\ (Q) = \frac{F + C_1(X_1Q) + C_2(X_2Q)}{Q}$$

(where $X_1$ and $X_2$ are the proportions in which products 1 and 2 are produced (or the weights used in calculating average costs) and Q is the total output. )

# Costs of Joint Products

- Two or more products undergo the same production process up to a split off; i.e. if one good is produced the other will automatically be produced; e.g. agriculture, minerals.
- **Common costs**
  - ☐ Cannot be identified with a single joint product.
- **Separable costs**
  - ☐ Can be identified with a particular joint product.
  - ☐ Incurred for the product separated beyond the split off point.

## Methods of allocating common costs

- **Physical measure**
  - ☐ Common costs are allocated in proportion to a physical measure identified to describe the quantity of each product obtained at the split off point.
- **Sales value at split off**
  - ☐ Common costs can be allocated in proportion to the sales value of the products after split off point.

# Linkage between Cost, Revenue and Output

**Total Revenue (TR)**

- The total amount of money received by a firm from goods sold (or services provided) during a certain time period.

  TR=Q.P, where Q is the quantity sold and P is the price per unit.

**Average Revenue (AR)**

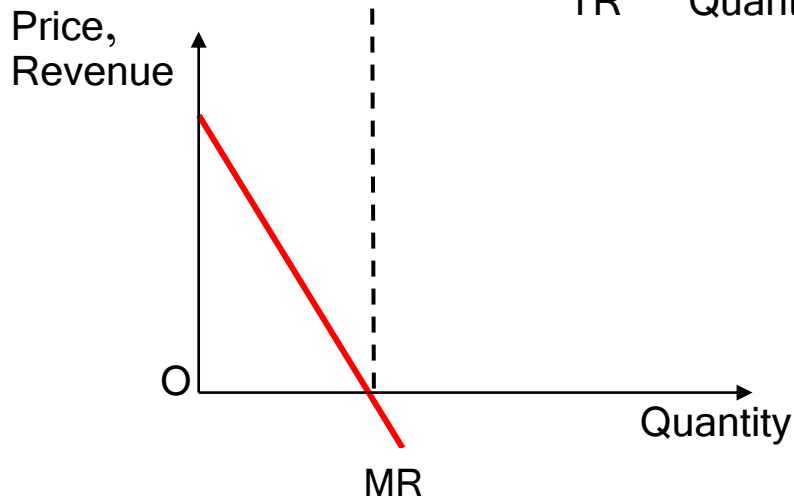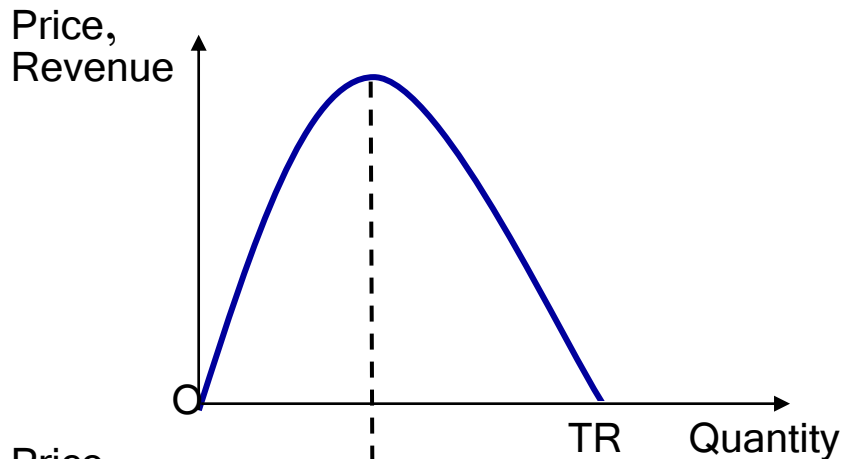- Revenue earned per unit of output sold.

  AR=TR/Q =P

**Marginal Revenue (MR)**

- Revenue a firm gains in producing one additional unit of a commodity.
- Calculated by determining the difference between the total revenues produced before and after a unit increase in production.

  $MR_Q = TR_Q - TR_{Q-1}$;      or

  MR= $\dfrac{dTR}{dQ}$

# Relationship between TR and MR



- TR curve has the shape of an inverted U, starting from the origin, and dipping across the quantity axis after reaching a maximum.

  - TR will be zero when nothing is sold, and zero again when a great deal is sold at a zero price.

- MR is the slope of the TR curve.

- Rise in the total revenue curve is the change in total revenue with rise in level of output.

# Relationship between AR and MR

- AR curve can have the following positions:
  - AR is a *straight line*, MR will lie midway to AR
  - AR is *convex* to the origin, MR will lie less than midway to AR
  - AR is *concave* to the origin, MR will lie more than midway to AR
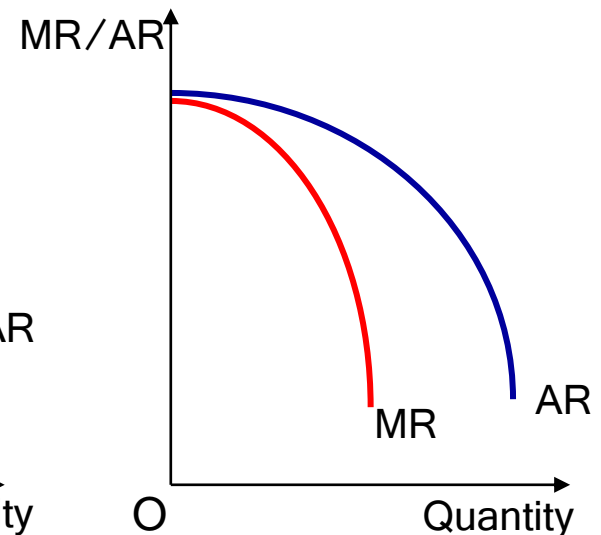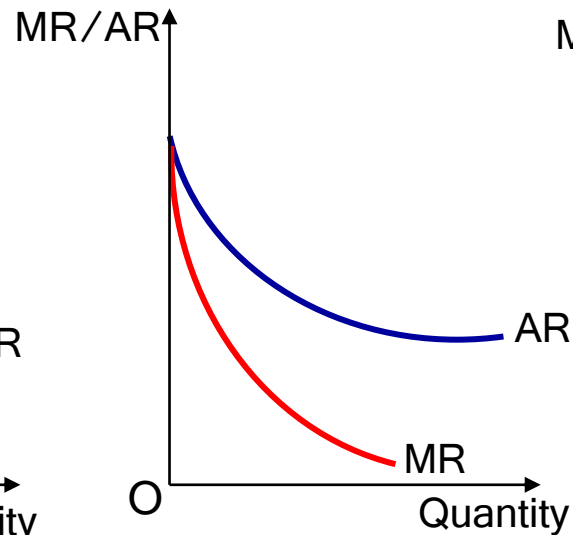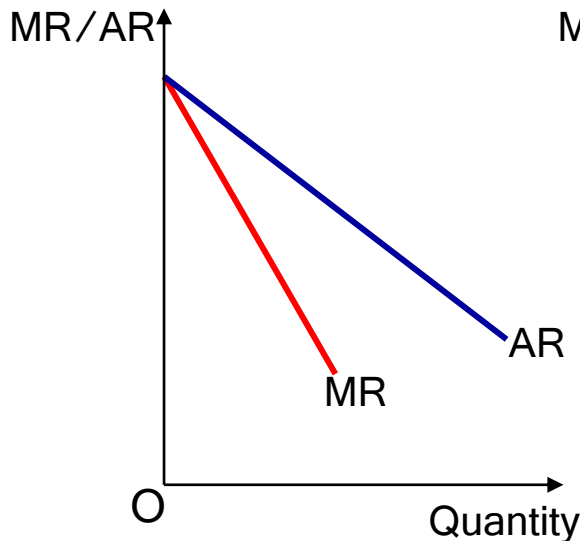
# Break Even Analysis

- Examines the relation between total revenue, total costs and total profits of a firm at different levels of output.

- Used synonymously with Cost Volume Profit Analysis.

- **Breakeven point** is the point where total cost just equals the total revenue, in other words it is the *no profit no loss point*.

## Approaches to break even analysis:

- **Algebraic Method**

  - If P be the price of a good, Q the quantity produced' the breakeven output is where total revenue equals total cost (Q* ).

  Total Revenue= P.Q

  Total Cost= TFC+TVC = TFC+AVC.Q

  P.Q*=TFC+AVC.Q*

  (P-AVC)Q*=TFC

  Q*= $\dfrac{TFC}{P-AVC}$

# Break Even Analysis

**Contribution Margin**

- Represents that portion of the price of the commodity produced by the firm that can cover the fixed costs and contribute to profits.

  Contribution Margin = P - AVC

**Profit Volume (PV) Ratio**

- Also defined as the ratio of marginal change in profit and marginal change in sales.

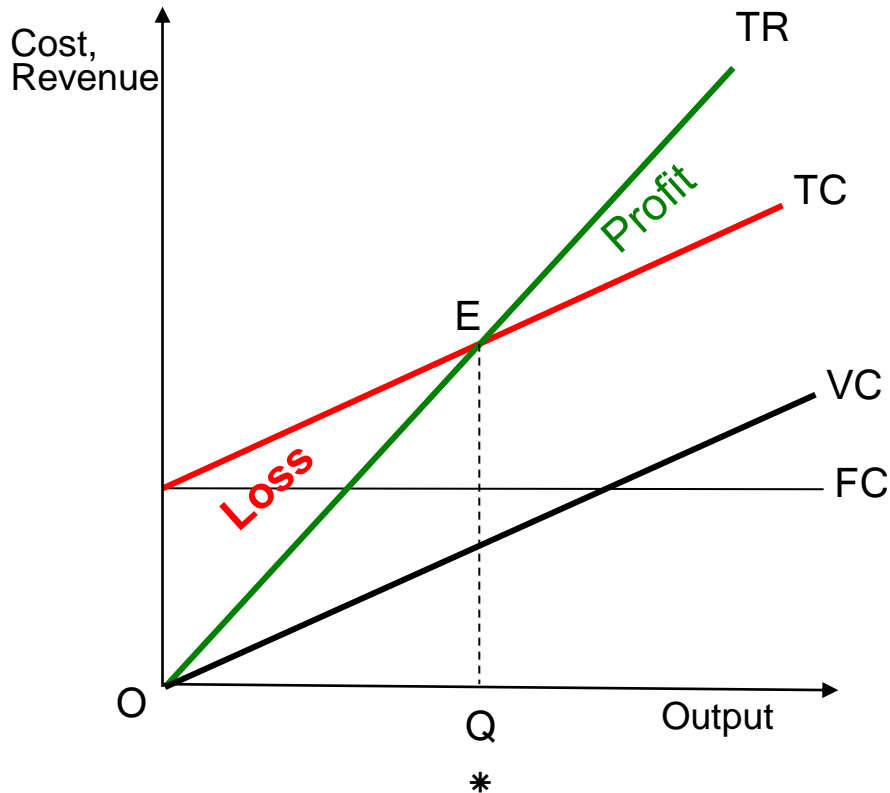$$\text{PV Ratio} = \frac{Contribution}{Sales}$$

- Using PV ratio also, Break even point = $\dfrac{FC}{PVratio}$

**Margin of Safety**

- Margin of Safety = Planned sales – Breakeven sales

# Break Even Analysis
## Graphical Method



- Plot cost and revenue on the Y axis and output on the X axis.

- TC is a straight line because AVC is assumed to be constant

- Total revenue is proportional to output and the TR is a straight line through the origin.

- Point of intersection of TR and TC (E) is the Break Even point, i.e. no profit no loss at output Q*
  - □ Prior to E is loss zone
  - □ After E is the profit zone.

- Shows the profit (or loss) resulting from each level of sales by the firm.

# Economies of Scale

- Economies of scale refers to the efficiencies associated with larger scale operations
- This level is reached once the size of the market is large enough for firms to take advantage of all economies of scale.
- Two types of economies of scale:
  - Internal economies (which occur to the firm due to large size of operations);
    - e.g. Division of labour/ specialization, Financial economies, better managerial functions.
  - External economies (which occur due to expansion of the *industry*, and the firm also benefits).
    - Technological advancement, development of infrastructure pool of skilled workers

# Economies of Scope

- When the production capacity can be utilised for producing more than one goods, average costs are less as compared to when they are produced by different firms separately; e.g. Computers and printers; heavy vehicles and light vehicles.

- Practice of economies of scope to business strategy is heavily based on the development of high technology.

- Globalization has made such economies even more important to firms in their production decisions.

- Measured by the ratio of average costs to marginal costs, when the firm produces joint or multiple products.

- Assume three products at individual costs of C1, C2 and C3, while Ct is the total cost when the three activities are carried out *together*, the Scope Index (S):

$$S = \frac{(C^1 + C^2 + C^3 - C^t)}{C^1 + C^2 + C^3}$$

# Cost and Learning Curves

- In economics learning by doing refers to the process by which producers learn from experience.

- The concept of learning curve is used to represent the extent to which average cost of production falls in response to increase in output.

- The equation of learning curve can be expressed as:

$$C=AQ^b$$

(where C is the cost of input for the $Q^{th}$ unit of output produced and A is the cost of the first unit of output obtained).

- Since increase in cumulative output leads to a decrease in cost, "b" has a negative value.

- Logarithmic form of this equation is :

$$\ln C = \ln A + b.\ln Q,$$

(where b is the slope of the learning curve).

# Summary

- Total Revenue is the total amount of money received by a firm from goods sold (or services provided) during a certain time period. Average Revenue is the revenue earned per unit of output sold.

- Marginal Revenue is the revenue a firm gains in producing one additional unit of a commodity. Profit is the difference between Total Revenue and Total Cost; the profit function shows a range of outputs at which the firm makes positive (or supernormal) profits.

- Economies of scale refer to the efficiencies associated with larger scale operations; it is a situation in which the long run average costs of producing a good or service decrease with increase in level of output.

- Economies of scope refer to a situation in which average costs of manufacturing a product are lower when two complementary products are produced by a single firm, than when they are produced separately.

- Learning by doing refers to the process by which producers learn from experience, while technological change is an increase in the range of production techniques that provides new vistas to producing goods.