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# Theory of Cost

(1) Total cost of production

$Q = f(L, K)$ — $L$: labour, $K$: capital (factors of production)

Cost of production depends on amount of production 'Q'.

Short-run concept of Total cost:

- Fixed inputs like capital → cost of fixed inputs → Total fixed cost (TFC)
- Variable inputs like Labour → cost of variable inputs → Total variable cost of production (TVC)

Total product in Q ⇒ depends on L & K.

∴ Total cost of Q, $TC = TVC + TFC$

(1) TVC ⇒ depends on total production i.e output 'Q'.

that means if $Q = 0$ implies no cost of variable inputs

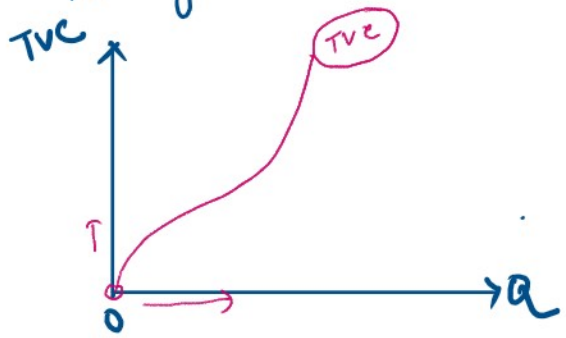
i.e, $TVC = 0$

And with increase in production 'Q' more Labour and raw materials are used.

That is why Total variable cost of production will increase.

That is ... production will increase.

∴ TVC is an upward sloping curve passing through the origin.

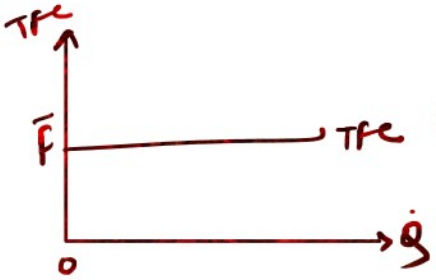



(2) Total Fixed cost, TFC = it is the cost of fixed input like capital, which do not change in short-run

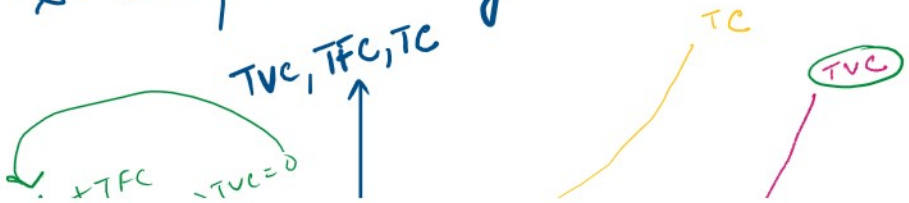
∴ Total fixed cost (TFC) doesn't depends on production.

which mean if production, Q=0, then TFC = const
if production increases TFC will remain constant.

∴ TFC is horizontal line and do not depend on output.



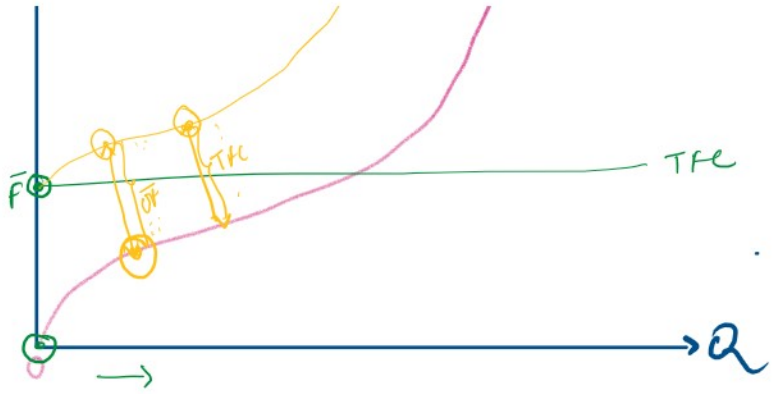

We know,
∴ Total cost TC = TVC + TFC
So diagrammetically it is as follows:



$TC = TVC + TFC$

Now when $Q = 0 \Rightarrow TVC = 0$

$\therefore TC = TFC = OF$




# Average Cost curves:

$$AC = \frac{\text{Total cost } (TC)}{\text{Total product } (Q)}$$

$$\boxed{AC = \frac{TC}{Q}}$$

We know, $TC = TVC + TFC$

If we divide TC by Q, we get,

$$\frac{TC}{Q} = \frac{TVC}{Q} + \frac{TFC}{Q}$$

$$\boxed{AC = AVC + AFC}$$

$\therefore$ Average total cost $(AC) = \frac{TC}{Q}$

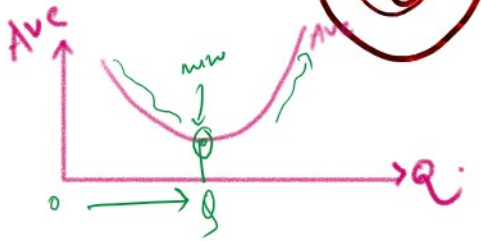
Average variable cost $(AVC) = \frac{TVC}{Q}$

Average fixed cost $(AFC) = TFC/Q$

Let us discuss the shapes of these cost curves:

(1) AVC = (TVC) -> if Q rises then initially

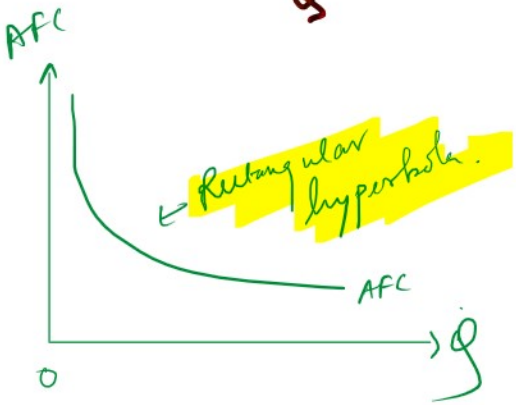
① $AVC = \frac{TVC}{Q}$ ↑ ⇒ if Q ↑ s then initially AVC falls, then reaches a minimum point and then increases.




∴ AVC is U-shaped.

② $AFC = \frac{TFC}{Q}$ Now we know $TFC = \bar{OF}$ = fixed.

$\therefore AFC = \frac{\bar{OF}}{Q}$ which means if production 'Q' increases for a const TFC (i.e $\bar{OF}$) then Average fixed cost (AFC) will fall.

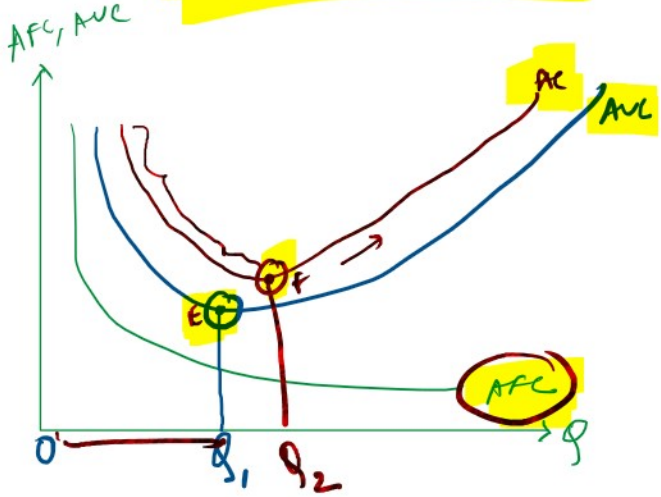



∴ AFC is a rectangular hyperbola.

∴ AC = AVC + AFC

initially both AVC and AFC are falling ∴ AC is also falling.

⇒ AVC starts to rise at $OQ_1$ but AC is still falling because AFC dominates AVC ∴ AC continues to fall till $OQ_2$




⇒ After $OQ_2$ ↑ se in AVC dominates falling AFC ∴ AC starts to increase

⇒ After $OQ_2$ ↑ in AVC dominates falling ∴ AC starts to increase

∴ AC is U-shaped and minimum point of AC is on the right side of the minimum point of AVC that is point E, lies on right of point F.

(7) Marginal Cost Curve (MC) = $\frac{\Delta TC}{\Delta Q}$ or $\frac{\Delta TVC}{\Delta Q}$

ie change in Total cost due to change in production by one unit.

# marginal cost (MC) depends only on total variable cost (TVC) and not on total fixed

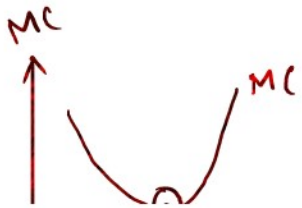
Because total fixed cost do not change.

ie, $TC = TVC + TFC$

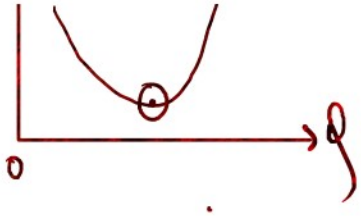
or, $\frac{\Delta TC}{\Delta Q} = \frac{\Delta TVC}{\Delta Q} + \frac{\Delta TFC}{\Delta Q}$

but TFC = const Therefore, $\Delta TFC = 0$

or, $MC = \frac{\Delta TVC}{\Delta Q}$




...cost (TC) is due to



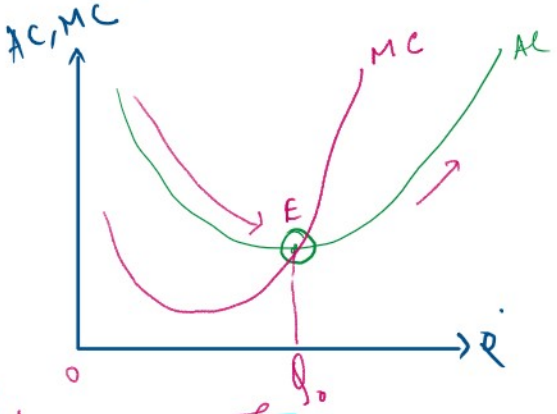

$\left(\frac{\Delta TC}{\Delta Q}\right)$

i.e change in total cost (TC) is due to change in total variable cost (TVC) only.

$\therefore$ **MC is U-shaped**

## Relation between Marginal cost and Average Cost (AC)

(MC)

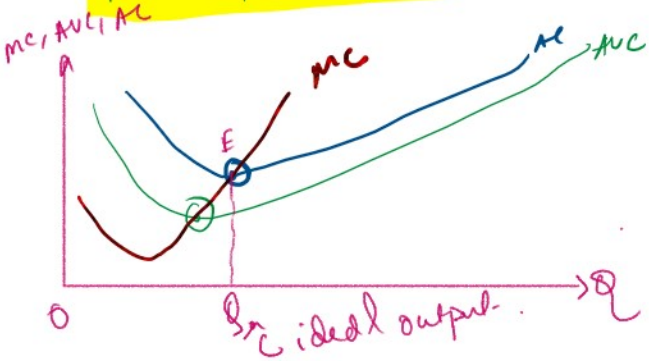



(1) when AC is falling till $OQ_0$, then MC is below AC throughout i.e **MC < AC**.

(2) when AC is at its minimum (E) then **MC = AC**.

(3) when AC is rising / increasing after $OQ_0$, then MC above AC i.e **MC > AC**

**Two important points to note:**




(1) MC should always cut AC and AVC at its minimum point.

(2) Output produced at the minimum point of AC curve is called ideal output (because of minimum cost of production).


**Q1** Consider the following statements:

a) When MC is below AC ⇒ AC is rising ✗ false

b) When MC is above AC ⇒ AC is falling ✗ false

c) When MC curve cuts AC ⇒ AC is constant ✓ true

Which of the above statements are true.

**Q2** Suppose, $TC = 5Q^2 + 20Q + 5$

calculate AC at Q = 5 units

We know $AC = \frac{TC}{Q} = \frac{5Q^2+20Q+5}{Q}$

$$AC = \frac{5Q^2}{Q} + \frac{20Q}{Q} + \frac{5}{Q}$$

$$AC = 5Q + 20 + \frac{5}{Q}$$

at Q = 5: $AC = 5\times5 + 20 + \frac{5}{5}$

$= 25 + 20 + 1$

$= 55 + 1$

$AC = 56$ (ans)

**Q3** A firm's average total cost is ₹60, it's average variable cost is ₹55, and it's output is 50 units, what is it's total fixed cost (TFC)?

ATC = 60 AVC = 55 Q = 50

TFC = ?

We know ATC = AVC + AFC

60 = 55 + AFC

∴ AFC = 5

We know $AFC = \frac{TFC}{Q}$

∴ TFC = AFC × Q

TFC = 5 × 50 = 250 ans

#

| Output (Q) | Fixed cost (FC) | Variable cost (VC) | Total cost (TC) (TC = FC + VC) | Marg cost (MC) MC = ΔTC / ΔQ | Avg fixed cost (AFC) = TFC/Q | Avg var cost (AVC) = TVC/Q | Avg Total cost (AC) AFC + AVC |
|---|---|---|---|---|---|---|---|
| 0 | 50 | 0 | 50+0 = 50 | | | | |
| 1 | 50 | 50 | 50+50 = 100 | 100-50 / 1-0 = 50 | 50 | 50 | 50+50 = 100 |
| 2 | 50 | 78 | 50+78 = 128 | 128-100 / 2-1 = 28 | 25 | 39/2 | 25+39 |
| 3 | 50 | 98 | 50+98 = 148 | → 20 | 50/3 | 49/2 | |
| 4 | | 112 | 50+112 = 162 | → 14 | 50/4 | 112/2 | |
| 5 | | 130 | 50+130 = 180 | → 18 | 50/5 | 130/2 | |
| 6 | | 150 | 50+150 = 200 | → 20 | | | |
| 7 | | 175 | 50+175 = 225 | → 25 | | | |
| 8 | | 204 | 50+204 = 254 | → 29 | | | |
| 9 | 50 | 242 | 50+242 = 292 | → 38 | | | |
| 10 | | 300 | 50+300 = 350 | → 58 | | | |
| 11 | | 385 | 50+385 = 435 | → 85 | 50/11 | 385/2 | |

Returns to scale and Long-run Average Cost

IRS — Increase in Returns [Economies of scale]

↓

Suppose L and K are ↑ed twice then if Q ↑es more than that (more than proportionate increase in Q)

⇒ Decreasing cost
⇒ AC is falling

DRS — Decrease in Returns [Diseconomies of scale]

↓

Suppose L & K are ↑ed twice then if Q is increased less than 2 times (less than proportionate increase in Q)

⇒ Increasing cost
⇒ AC is rising

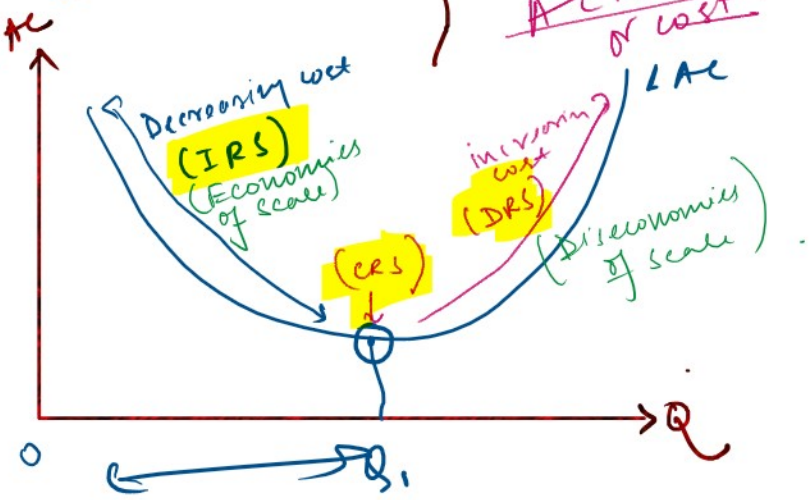
CRS — Constant Returns.

↓

Suppose L and K are ↑ed twice, then if output (Q) is also increased 2 times. (i.e proportionate increase in output)

⇓ constant cost

⇓ AC is min or cost.




# Economies and Diseconomies of Scale:

(Related to Returns to scale)

1) IRS → avg cost decreases → economies of scale
2) DRS → avg cost increases → diseconomies of scale.

Long-run Avg cost (LAC) and Short-run Avg cost (SAC).

LAC is called envelope curve of short-run AC.

Long-run

LAC is called envelope curve of short-run AC.