

3.3.2 Costs

Short Run vs Long Run

Short Run

The **short run** is a period of time where at least **one** factor of production is fixed.

- Usually **capital** is fixed, such as the size of the shop floor/kitchen or machinery.
- Variable factors such as **labour** can be increased relatively easily.
- This means firms face both **fixed costs** and **variable costs** in the short run.

Long Run

The **long run** is a period of time where **all** factors of production are variable.

Firms can change their **scale of production**, for example by building a larger kitchen, purchasing additional machinery or increasing productive capacity.

Total Costs in the Short Run

Total Fixed Cost (TFC)

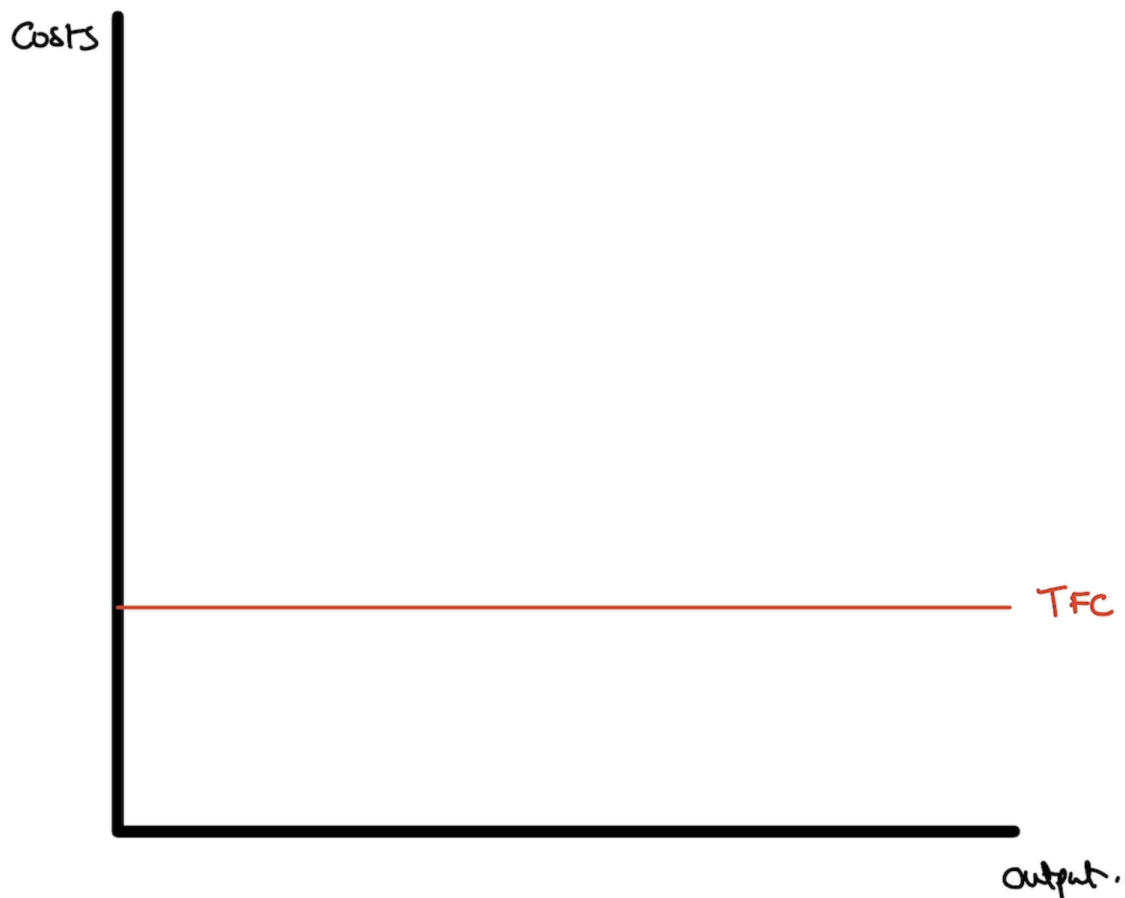
Total fixed costs are costs that do not change as output changes.

Examples include:

- Rent
- Insurance
- Salaries

These costs still have to be paid even when **output = 0**.

On a total cost diagram, **TFC is a horizontal line** because it remains constant as output increases.



Total Variable Cost (TVC)

Total variable costs are costs that change as output changes.

Examples include:

- Raw materials
- Wages of workers

As output increases, total variable costs increase:

Output $\uparrow \rightarrow$ TVC $\uparrow$

Total Cost (TC)

Total cost is the combination of fixed and variable costs:

$$\text{TC} = \text{TFC} + \text{TVC}$$

The TC curve is therefore effectively the TVC curve shifted upwards by the amount of fixed costs.

The vertical distance between TC and TVC = TFC.

Average Costs

Average Fixed Cost (AFC)

Average fixed cost is the fixed cost per unit of output:

$$\text{AFC} = \text{TFC} \div Q$$

As output increases, the same fixed cost is spread across more units:

$Q \uparrow \rightarrow \text{fixed costs spread over more units} \rightarrow \text{AFC} \downarrow$

For example:

- £1,000 rent $\div$ 100 units = **£10 AFC**
- £1,000 rent $\div$ 1,000 units = **£1 AFC**

Therefore, **AFC continuously falls as output increases**.

To aid your memory to remember it is the Always Falling Curve



Average Variable Cost (AVC)

Average variable cost is the variable cost per unit of output:

$$\text{AVC} = \text{TVC} \div \text{Q}$$

AVC is typically **U-shaped** because of increasing and then diminishing marginal productivity.

At low levels of output:

More workers → **greater specialisation and better use of fixed capital** → **marginal productivity** ↑ → **more output produced by each additional worker** → **cost of producing each additional unit** ↓ → **AVC** ↓

Eventually:

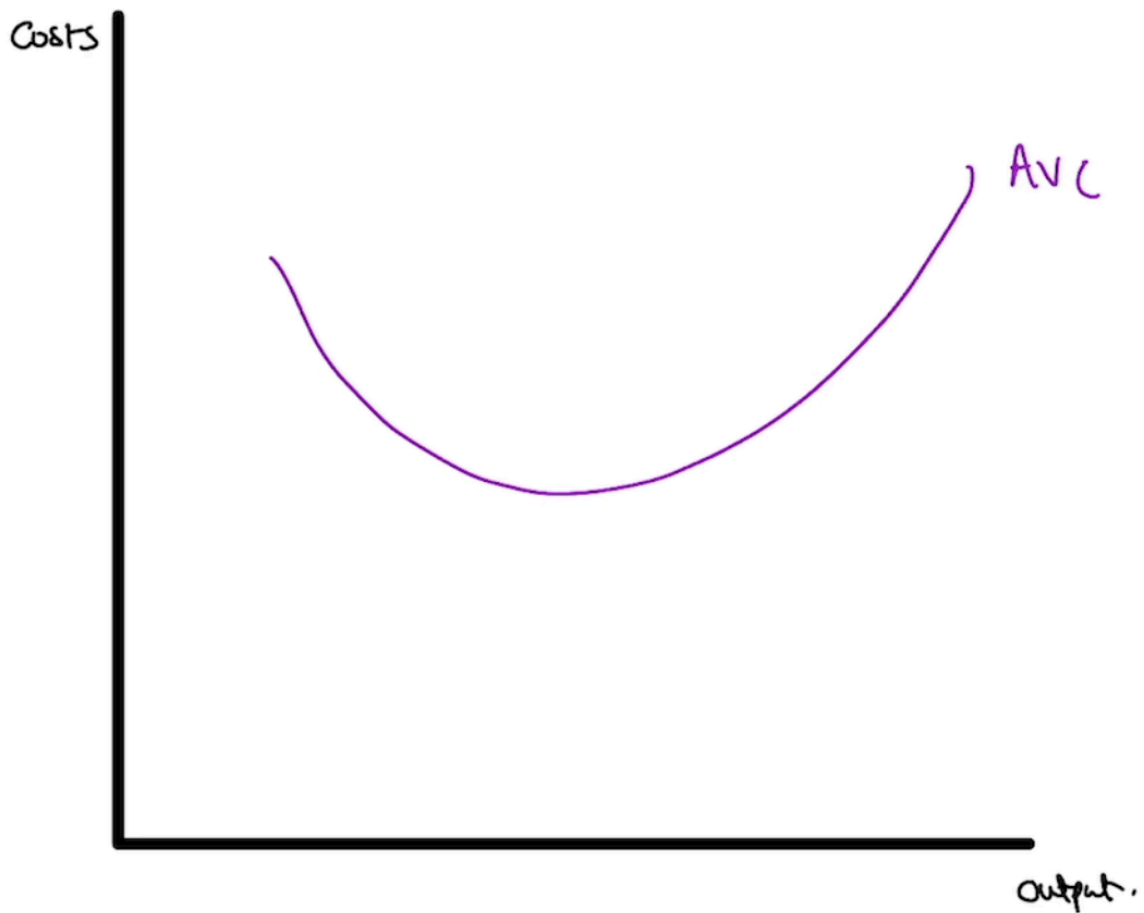
More workers added to fixed capital → **capital becomes a constraint / workers get in each other's way** → **diminishing marginal productivity** → **additional workers produce progressively smaller increases in output** → **AVC** ↑

Therefore:

- **Increasing marginal productivity** → **AVC** ↓
- **Diminishing marginal productivity** → **AVC** ↑

For example, In an Amazon warehouse with fixed packing stations, initial hiring increases worker specialization and lowers unit labor costs (**AVC** ↓), but over-hiring leads e.g at christmas / holiday season to aisle congestion, falling marginal productivity, and rising unit

labor costs (**AVC** ↑)



Average Total Cost (ATC / AC)

Calculating ATC

Average total cost is the total cost per unit of output:

$$\text{ATC} = \text{TC} \div Q \text{ or } \text{ATC} = \text{AFC} + \text{AVC}$$

ATC is **U-shaped**.

Initially:

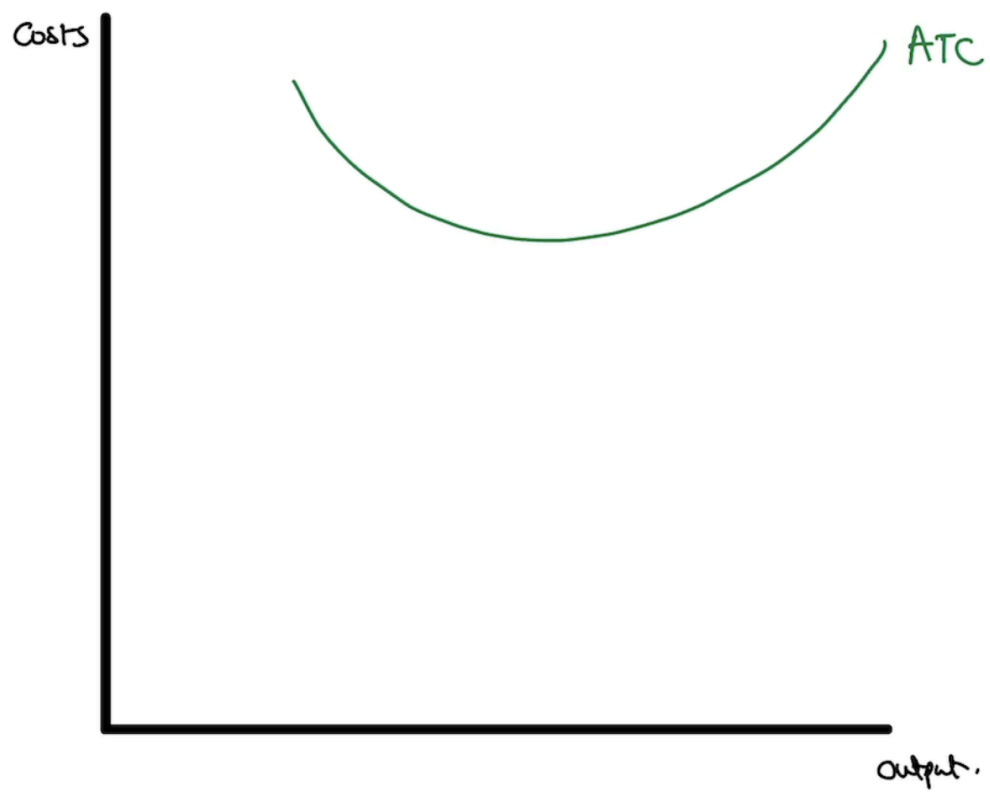
Output ↑ → AFC ↓ + AVC ↓ due to increasing marginal productivity → ATC ↓

Eventually:

Diminishing marginal productivity → AVC ↑ → rising AVC eventually outweighs falling AFC → ATC ↑

Therefore:

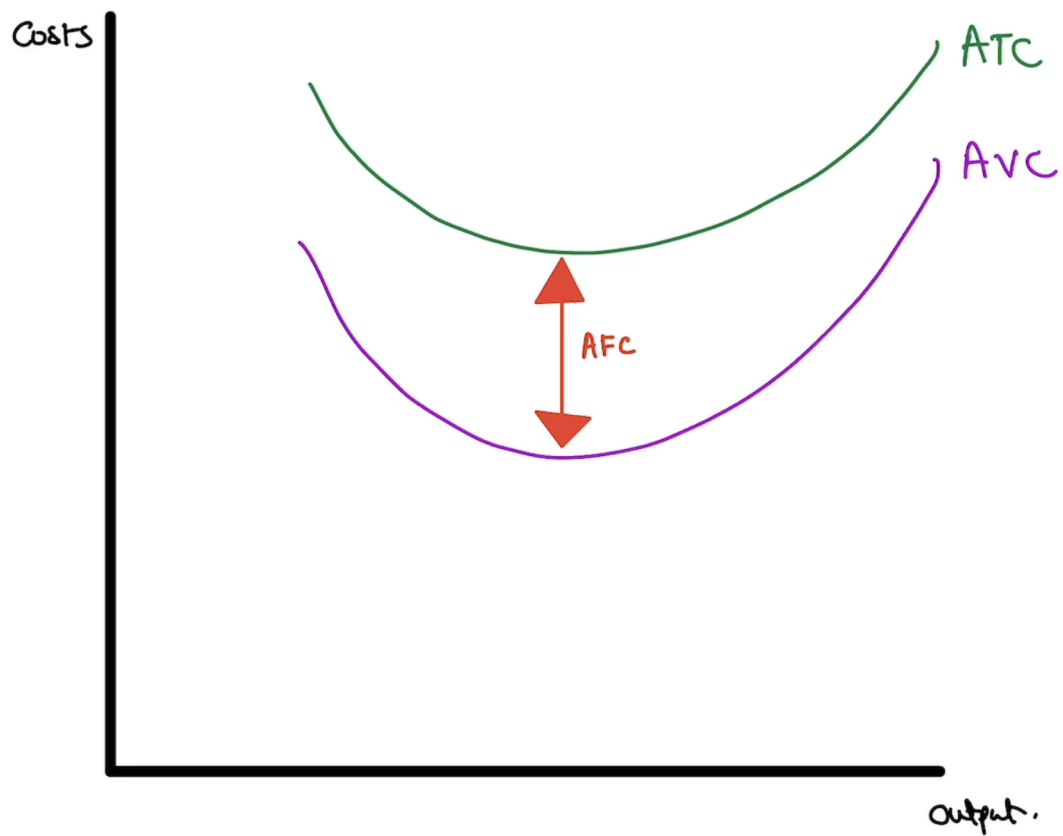
- Increasing marginal productivity + spreading fixed costs $\rightarrow$ ATC $\downarrow$
- Diminishing marginal productivity $\rightarrow$ ATC $\uparrow$



Relationship Between AVC and ATC

The difference between average total cost and average variable cost is average fixed cost:

$$ATC - AVC = AFC$$



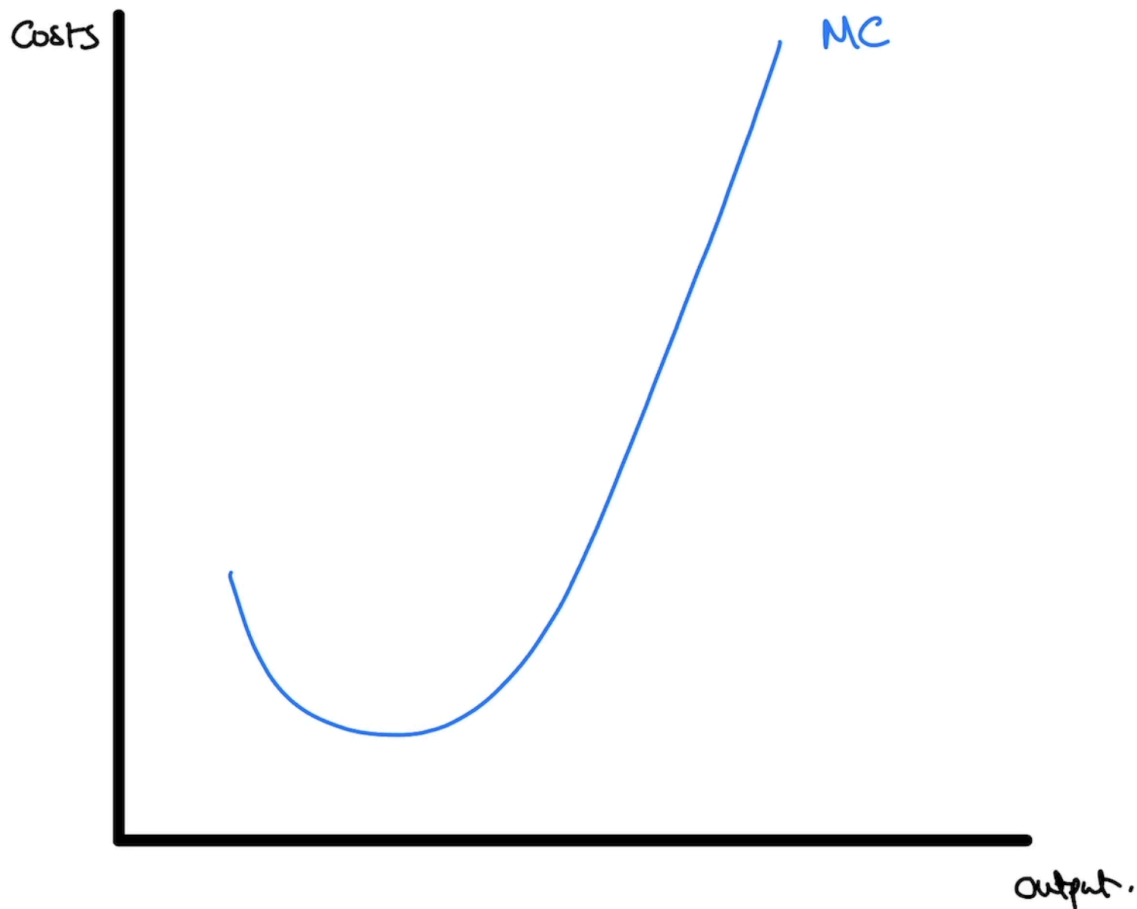
Marginal Cost

What is Marginal Cost?

Marginal cost (MC) is the cost of producing one additional unit of output.

$$MC = \Delta TC \div \Delta Q \text{ aka } MC = \text{Change in TC} \div \text{Change in output}$$

Fixed costs do not change when output changes. Therefore changes in marginal cost therefore come from changes in variable costs.



Why is MC U-Shaped?

Initially:

More workers → increasing marginal productivity → each additional worker produces more output → additional output becomes cheaper to produce → **MC ↓**

Eventually:

Diminishing marginal productivity → each additional worker produces less additional output → more labour required to produce another unit → **MC ↑**

Relationship Between MC and ATC

When $MC < ATC$

When **MC < ATC**, the additional unit costs less to produce than the existing average.

MC < ATC → pulls the average down → **ATC ↓**

When $MC > ATC$

When $MC > ATC$, the additional unit costs more to produce than the existing average.

$MC > ATC \rightarrow$ pulls the average up $\rightarrow ATC \uparrow$

When $MC = ATC$

When $MC = ATC$, the additional unit costs exactly the same as the existing average.

It therefore neither pulls the average up nor down:

$MC = ATC \rightarrow$ minimum ATC

Therefore, **MC cuts the ATC curve at its minimum point.**

MC also cuts the **AVC curve at its minimum point** for the same reason.

Diminishing Marginal Productivity and Short-Run Costs

LAW OF DIMINISHING RETURNS (SHORT RUN)					udoecon.com
 Example: A small burger shop with fixed kitchen size and equipment. We add more workers to see how output changes.					
NUMBER OF WORKERS 	TOTAL PRODUCT (TP) Burgers per hour 	MARGINAL PRODUCT (MP) Extra burgers from one more worker 	AVERAGE PRODUCT (AP = TP ÷ Workers) Burgers per worker 	WHAT'S HAPPENING? 	
1	10	10	10.0	Starting production. All equipment well used.	
2	25	15	12.5	Better specialisation. MP increases.	
3	45	20	15.0	Specialisation at its best. MP is highest.	
4 (NEW)	53	8	13.25	Kitchen starts to feel busy. MP < AP, so AP begins to fall.	
5 (NEW)	60	7	12.0	Crowding increases. MP falls further, AP continues falling.	
6 (NEW)	63	3	10.5	Too many workers. Small extra output. AP falls.	

TP = Total Product (total burgers produced)
MP = Marginal Product (extra burgers from one more worker)
AP = Average Product (output per worker)

WHAT THIS SHOWS:

Workers 1 → 3
Better specialisation and use of fixed equipment → MP rises (10 → 15 → 20) → After 3 workers
Kitchen is crowded, equipment becomes a constraint → MP and AP fall (MP: 20 → 8 → 7 → 3) (AP: 15 → 13.25 → 12 → 10.5)
Diminishing marginal returns set in

Increasing Marginal Productivity

At relatively low levels of output:

More workers $\rightarrow$ better utilisation of fixed capital + greater specialisation $\rightarrow$ **MP $\uparrow$** $\rightarrow$ each additional worker produces more output $\rightarrow$ cost of producing an additional unit $\downarrow \rightarrow$ **MC $\downarrow$** $\rightarrow$ **AVC $\downarrow$**

Diminishing Marginal Productivity

Eventually:

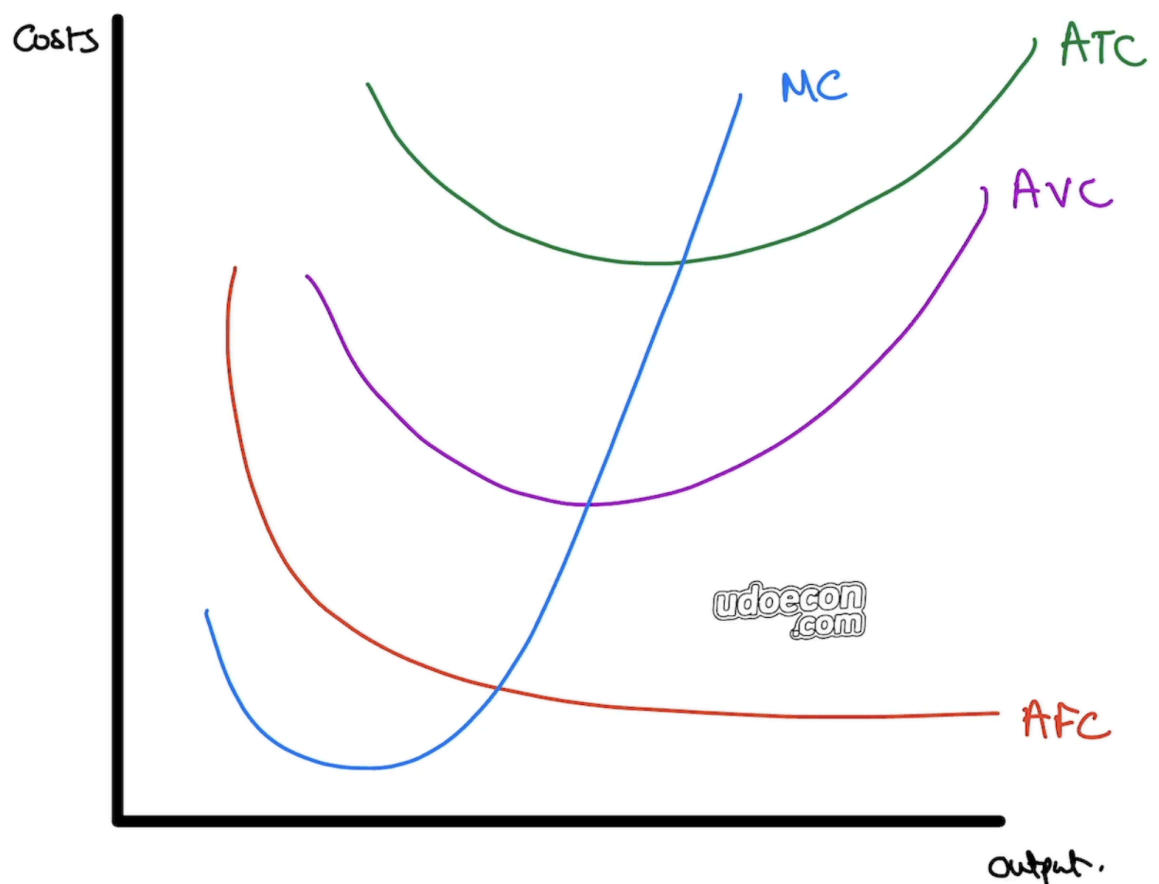
More workers → amount of capital remains fixed → workers have less capital to work with / overcrowding occurs → $MP \downarrow$ → each additional worker produces less additional output → more labour needed to produce each additional unit → $MC \uparrow$ → $AVC \uparrow$

The law of diminishing marginal productivity therefore explains the **upward-sloping** sections of **MC** and **AVC**.

Key Short-Run Cost Relationships

Formulas

- $TC = TFC + TVC$
- $ATC = AFC + AVC$
- $AFC = TFC \div Q$
- $AVC = TVC \div Q$
- $ATC = TC \div Q$
- $MC = \Delta TC \div \Delta Q$



Short-Run vs Long-Run Average Costs

Short Run

In the **short run**, at least one factor of production is fixed.

This limits the firm's ability to change its combination of inputs and its scale of production.

Long Run

In the **long run**, all factors of production are variable.

Firms therefore have greater flexibility to change their combination of inputs and their scale of production.

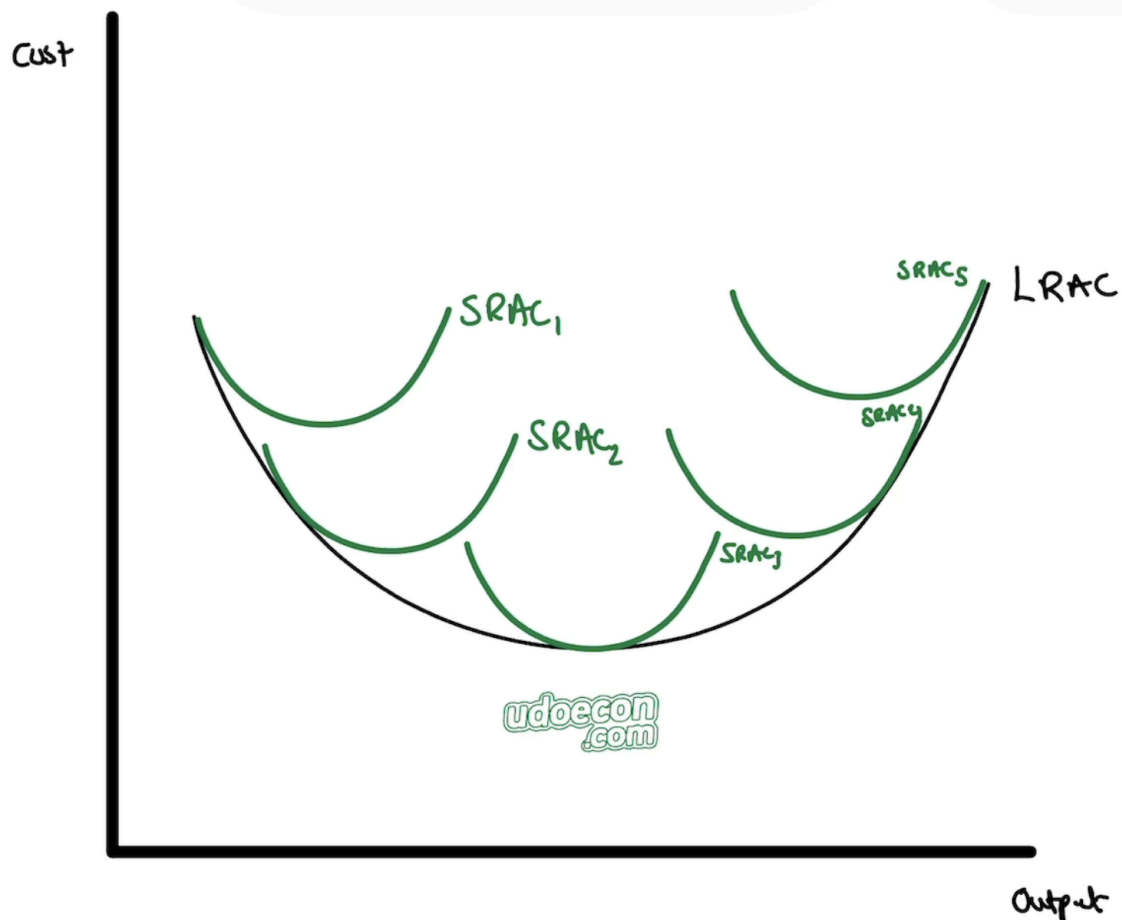
Short-Run Average Cost (SRAC)

Each **SRAC curve represents a different size of firm**, based on a different level of fixed capital.

For example:

- **SRAC₁ → small factory**
- **SRAC₂ → medium factory**
- **SRAC₃ → large factory**

Once the firm is operating on a particular SRAC curve, it cannot change its fixed factors in the short run.



Long-Run Average Cost (LRAC)

Changing the Scale of Production

In the long run, firms can change their fixed factors and therefore move between different SRAC curves.

For example:

Demand $\uparrow$ $\rightarrow$ firm wants greater output $\rightarrow$ expands factory $\rightarrow$ increases capital $\rightarrow$ moves from SRAC₁ to SRAC₂

If this reduces average costs:

Scale of production $\uparrow$ $\rightarrow$ average cost $\downarrow$ $\rightarrow$ economies of scale

As the firm continues to grow, it may repeatedly expand onto new SRAC curves.

Relationship Between SRAC and LRAC

The reason for the U-shape differs between short-run and long-run average costs:

- **SRAC U-shape** → increasing/diminishing marginal productivity + falling AFC
- **LRAC U-shape** → economies and diseconomies of scale