INSTITUTE OF ACTUARIAL & QUANTITATIVE STUDIES

Class: SY BSc

Subject : Business Economics - Micro

Chapter: Unit 3 Chapter 1

Chapter Name: Cost, Revenue & Profits

Today's Agenda

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1. Arising Questions

2. Theory of firm

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   2. Factors of Production
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Today's Agenda

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    1. Loss Minimization – Short Run
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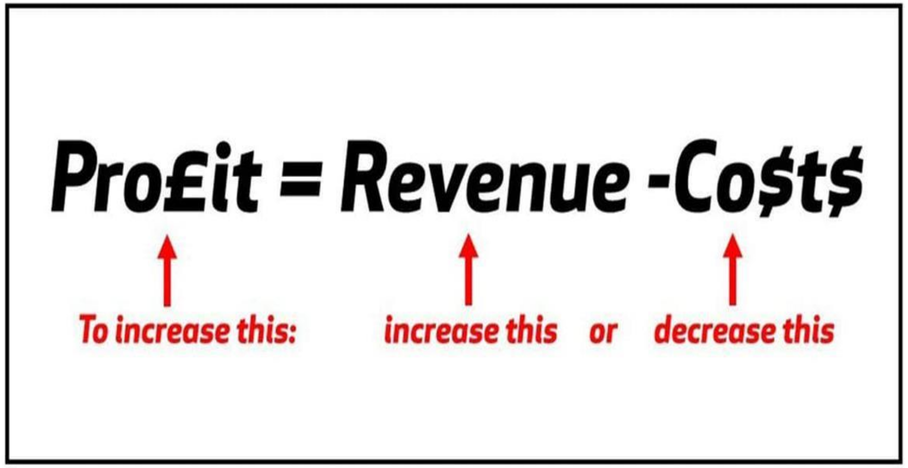
1 Introduction

Consider you are starting a business shop of readymade garments in which you are completely new.
What are the basic objectives towards which you will work on?

- Maximisation of Profit
- Maximisation of Sales
- Survival
- Growth

1 Introduction

Profit is made by firms earning more from the sale of goods than they cost to produce. A firm's total profit is thus the difference between its total sales revenue (TR) and its total costs of production (TC):



1 Introduction

So far we studied

- Demand
- Supply
- Equilibrium
- Consumer Behaviour

Now the we need to focus on firms

- Cost
- Revenue
- Profit

1 Introduction

Discuss why some firms are doing very well while others are struggling even to survive

Discuss the examples –

1. Amazon
2. TATA Group
3. Air India & Jet Airways
4. YES Bank, Punjab National Bank & SBI
5. Wipro, Microsoft & Infosys
6. Vodafone Idea
7. IL&FS Group
8. DHFL
9. BSNL & MTNL

2 Arising Questions

Now question arises

- How much will be produced?
- What combination of inputs will be used?
- How much profit will be made?

2 Arising Questions

How should the firm resource to make profit?

How should the firm reduce cost, be efficient & Maximize profit?

What is the best price to obtain revenue?

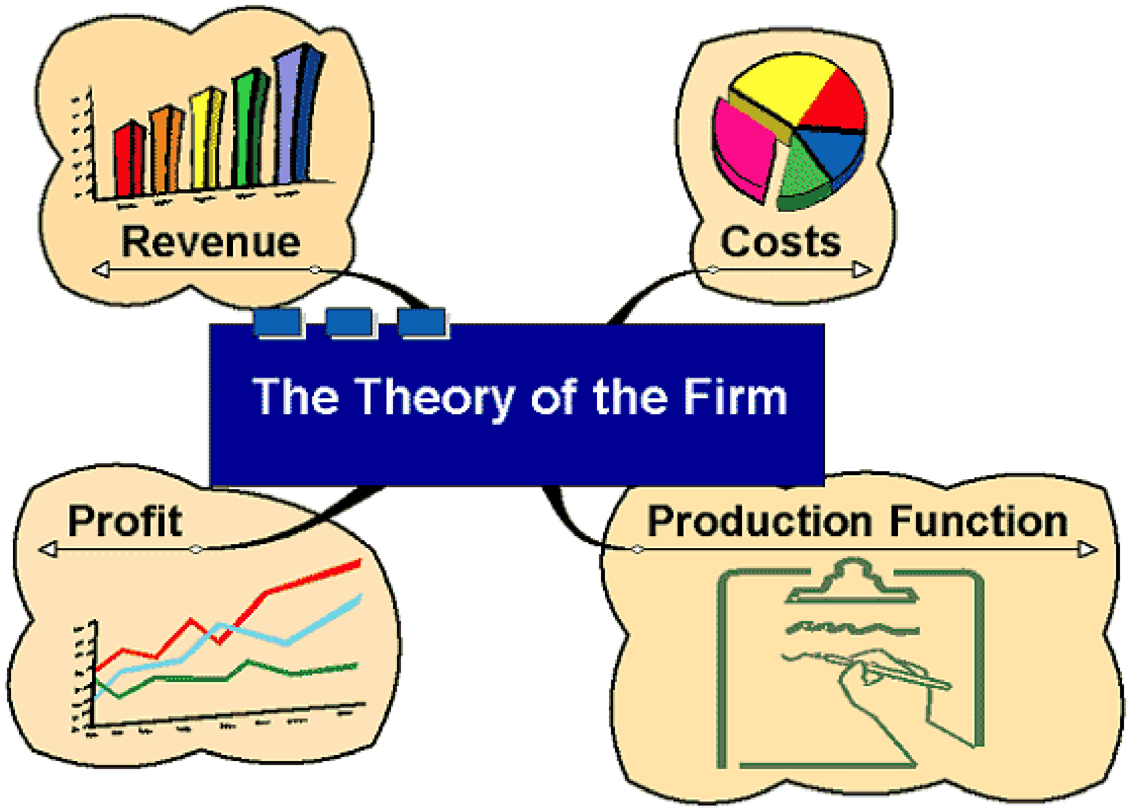
How many unit should the firm produce to make most revenue?

How should the firm plan for future in terms of price & quantity?

How can the firm respond to business cycle?

3 Theory of firm

The theory of the firm is a microeconomic concept that states that a firm exists and make decisions to maximize profits.



3 Theory of firm

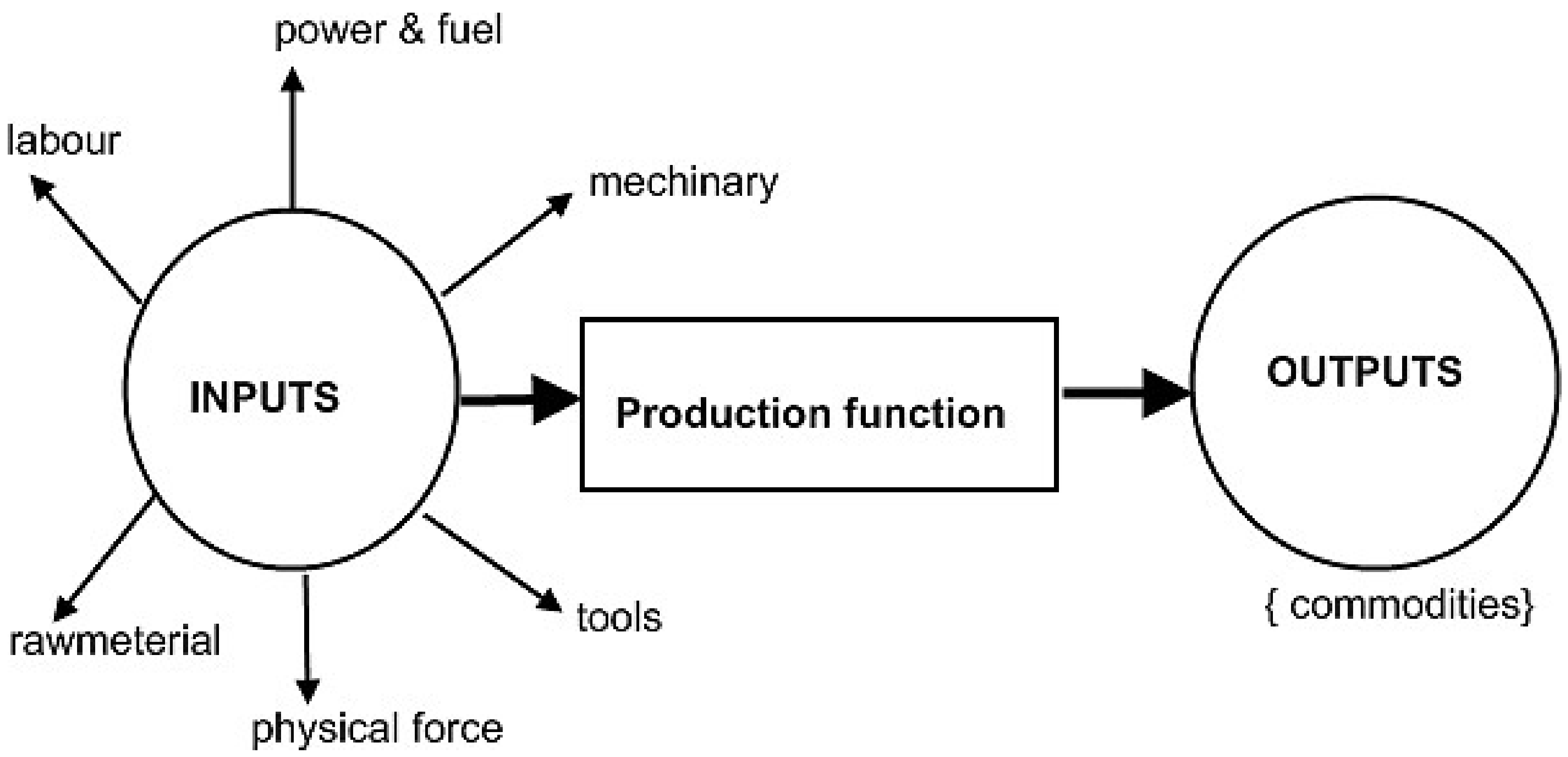
Helps us to identify

- Best level of output
- Best price to sell at
- Best price to breakeven
- Price to shut down
- Optimum level of profit

4 Production

- An activity which creates value in production
- In other words it is transformation of input into output
- Example
  1. Operating jewelery store
  2. Drilling for oil
  3. Cultivation etc

4.1 Production function



4.2 Factors of Production

- Land

Anything which is gift of nature & not the result of human effort

- Labour

Physical or mental efforts of human being that undertakes the production process

- Capital

Wealth which is used for further production as machine/equipment/intermediary goods

- Entrepreneur

The ability & action to take the risk of collecting, coordinating & utilising all the factor of production for the purpose of uncertain economic gains.

4.3 Factors payments

- Land

Land receives payment in from of rent

- Labour

Labour receives payments in term of wages

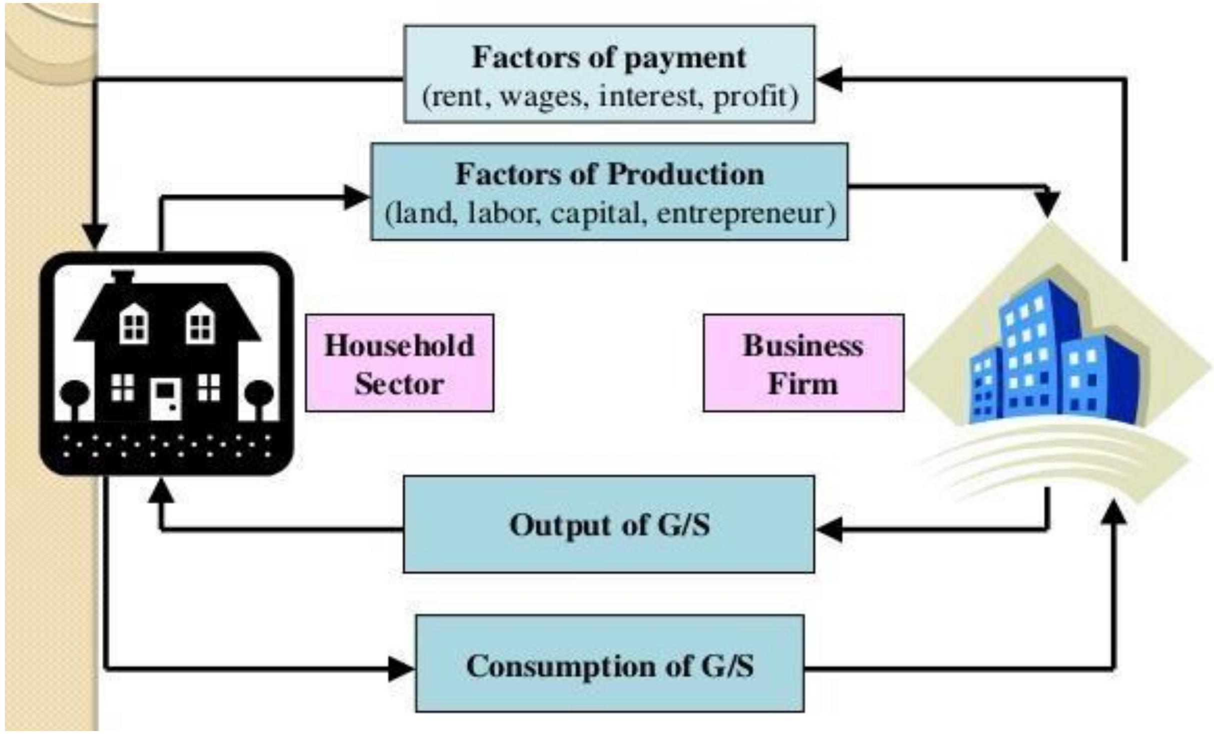
- Capital

Capital receives payment in terms of interest

- Entrepreneur

Entrepreneur receives reward in terms of profit

4.4 Circular flow model



4.5 Factors

Fixed factors are those which remain unchanged as output of the firm changes in the short-run

Variable factors are those factor inputs which change with the change of output in the short run

4.5 Factors

Identify whether the following are fixed factors or variable factors

- Rent
- Labour
- Fuel
- Equipment
- Raw material
- Machinery

Fixed Factors	Variable Factors
• Rent • Equipment • Machinery	• Raw material • Labour • Fuel

4.6 Long run and Short run

- Short run is time period where you can not change certain fixed factors such as Land, Machinery etc
- Long run is a time period where all factors are variable

Short Run	Long Run	Very Long Run
One factor of production is fixed (e.g. capital fixed. Labour variable)	Both labour and capital are variable	When all factors of production are variable, including technology / regulation
1 day to 4-6 months	Roughly greater than 4-6 months	Over several years

4.6 Long run and Short run

?

Charlie, who works in an umbrella manufacturing firm, says long run in economics refers to any period over 2 years.
His friend Alan, who works as a hardware engineer in NASA, says it refers to any period over 14 years.
Which of them is correct?

4.6 Long run and Short run

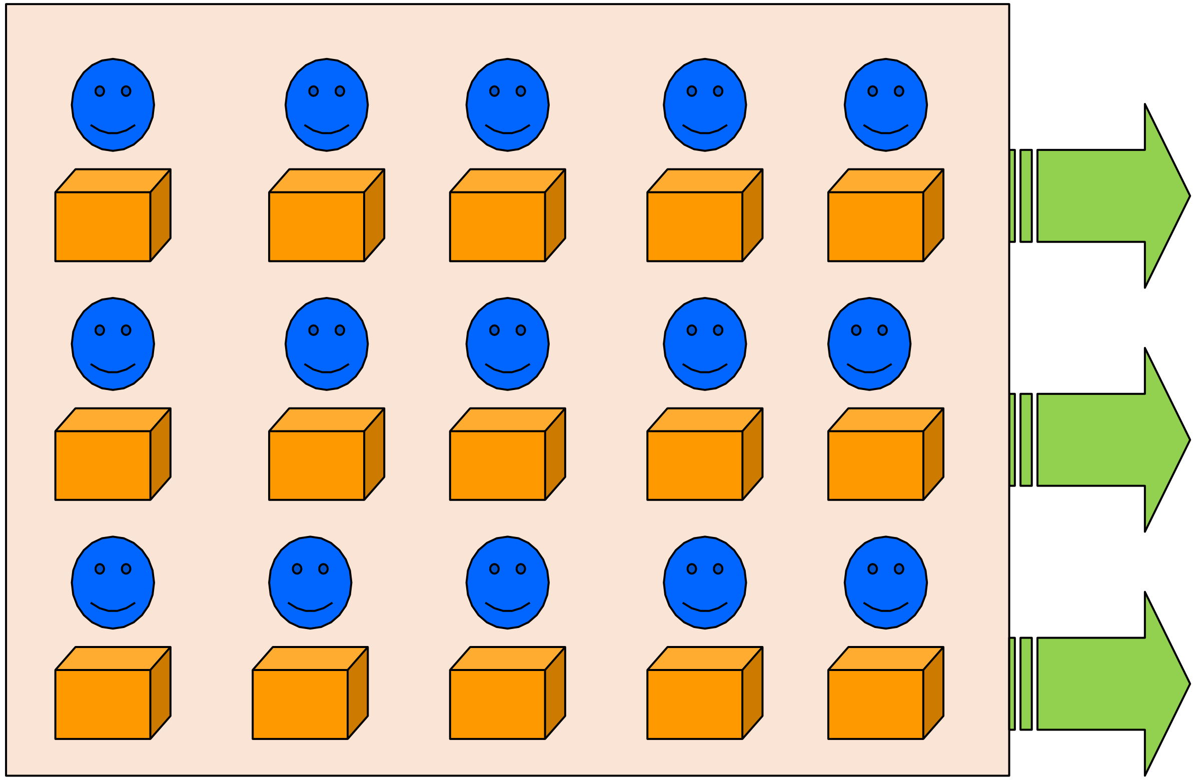
Discuss the short run and long run periods in the following industries

1. Telecom industry
2. Paper industry
3. Medicine industry
4. Automobile industry
5. Space rocket industry
6. Coffee powder manufacturing industry
7. Mobile phones manufacturing industry

4.7 Analysis of Production Function – Short run

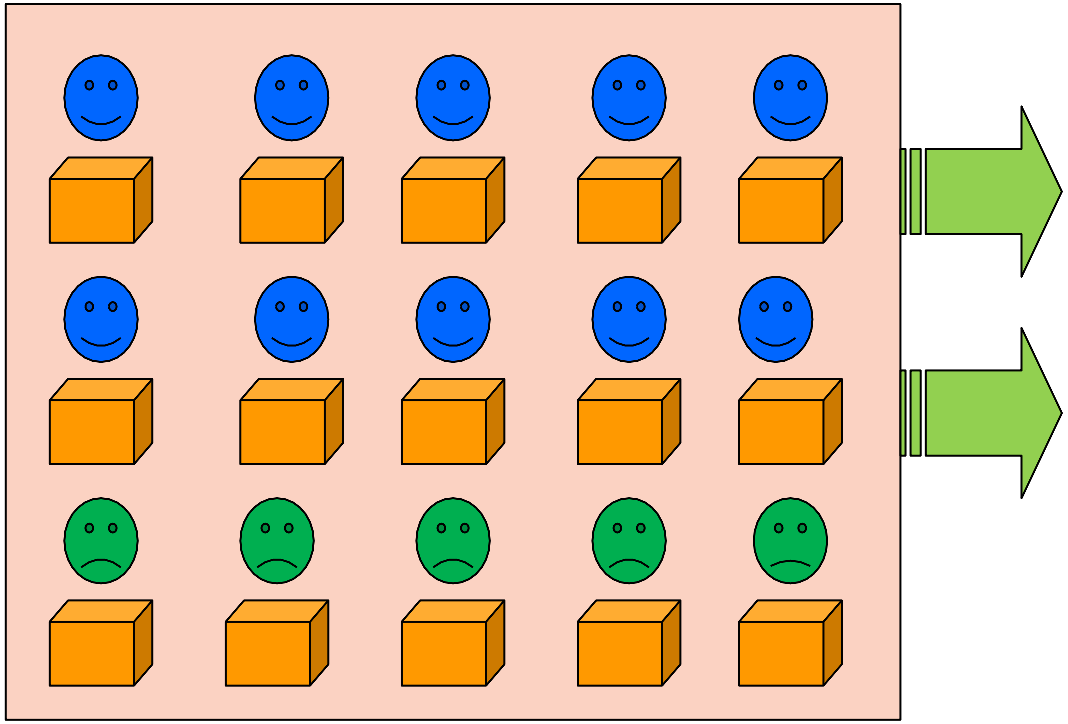
- In the short run at least one factor fixed in supply but all other factors capable of being changed
- Reflects ways in which firms respond to changes in output (demand)
- Can increase or decrease output using more or less of some factors but some likely to be easier to change than others
- Increase in total capacity only possible in the long run

4.7 Analysis of Production Function – Short run



In times of rising sales (demand) firms can increase labour and capital but only up to a certain level – they will be limited by the amount of space. In this example, land is the **fixed factor** which cannot be altered in the short run.

4.7 Analysis of Production Function – Short run



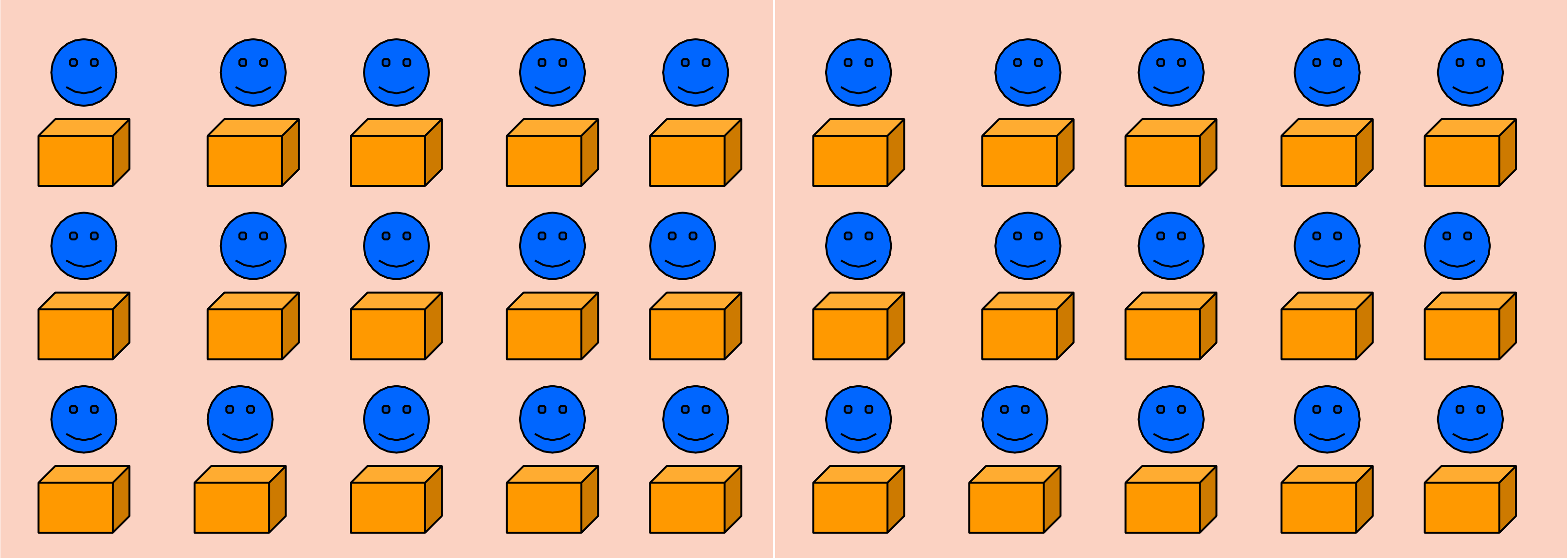
If demand slows down, the firm can reduce its variable factors – in this example it reduces its labour and capital but again, land is the factor which stays fixed.

4.7 Analysis of Production Function – Long run

The long run is defined as the period of time taken to vary all factors of production

- By doing this, the firm is able to increase its **total capacity** – not just short term capacity
- Associated with a change in the **scale of production**
- The period of time varies according to the firm and the industry
- In electricity supply, the time taken to build new capacity could be many years; for a market stall holder, the 'long run' could be as little as a few weeks or months!

4.7 Analysis of Production Function – Long run



In the long run, the firm can change all its factors of production thus increasing its total capacity. In this example it has doubled its capacity.

4.8 The law of diminishing marginal returns

The law of diminishing marginal returns states that when increasing amounts of a variable factor are used with a given amount of a fixed factor, there will come a point when each extra unit of the variable factor will produce less extra output than the previous unit.

5.1 Total Physical Product

- When a variable factor is added to a fixed factor the total output that results is often called total physical product (TPP).
- This states that total physical product (i.e. the output of the farm) over a given period of time is a function of (i.e. depends on) the quantity of land and labor employed.
- The total physical output illustrated by the short-run production function shows the maximum output that can be produced by adding more of a variable input to a fixed input: i.e. it shows points that are all technically efficient.

5.1 Total Physical Product

- The relationship between inputs and output is shown in a production function.

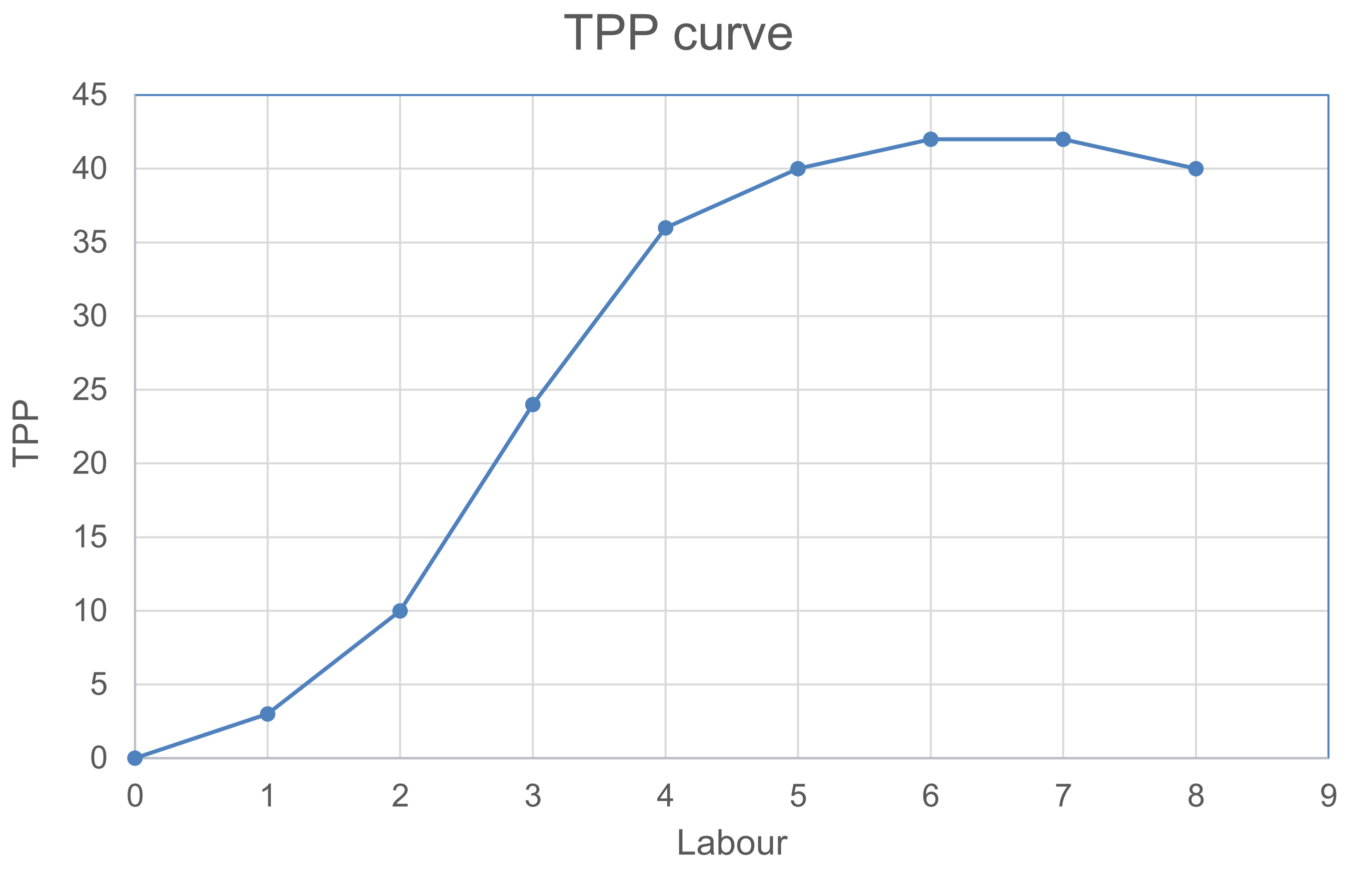
Mathematical representation of the relationship:
Q = f (K, L, La)

- Output (Q) is dependent upon the amount of Capital (K), Land (L) and Labour (La)

5.1 Total Physical Product

Wheat production

No. of labour	TPP
0	0
1	3
2	10
3	24
4	36
5	40
6	42
7	42
8	40



5.1 Total Physical Product

An economic student, Carol, argues that the graph is wrong.
Her argument is based on the opinion that since TPP is the total output, additional labor will always add something to the output and hence TPP can never be constant or reduce when additional labor is added
Do you agree with her opinion or not? Why?

5.2 Average Physical Product & Marginal Physical Product

Complete the Average Physical Product (APP) and Marginal Physical Product (MPP) columns of the following table

Wheat production

No. of labour	TPP	APP	MPP
0	0	0	0
1	3	3	3
2	10	5	7
3	24	8	14
4	36	9	12
5	40	8	4
6	42	7	2
7	42	6	0
8	40	5	-2

5.2 Average Physical Product & Marginal Physical Product

Average physical product

This is output (TPP) per unit of the variable factor (Qv). In the case of the farm, it is the output of wheat per worker.

In symbols, it can be expressed as:

$$APP = TPP/Q_v$$

Marginal physical product

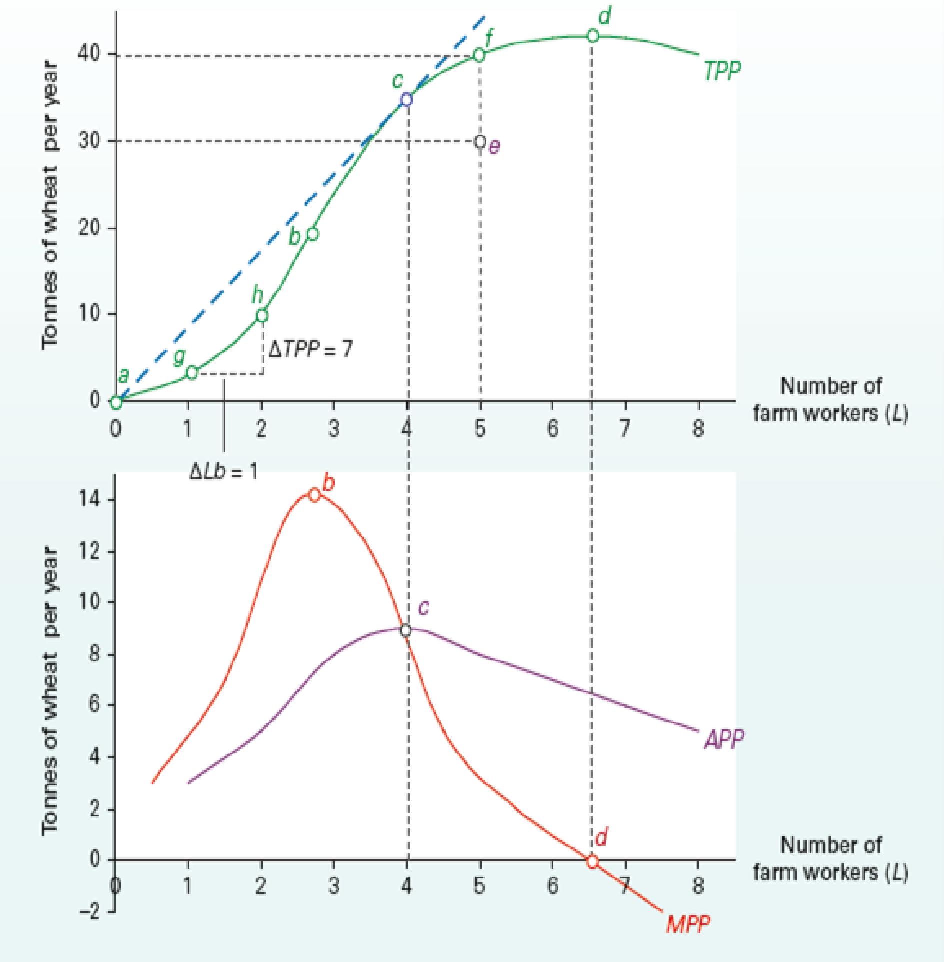
This is the extra output (ΔTPP) produced by employing one more unit of the variable factor.

In symbols, marginal physical product is given by:

$$MPP = \Delta TPP/\Delta Q_v$$

5.2 Average Physical Product & Marginal Physical Product

- TPP is increasing at speed rate till 4 labour was employed
- APP decreases when 5 labour was employed (Too many cook spoil the soup) & MPP also started decreasing
- MPP becomes zero & negative at point where 7 & 8 labours were employed respectively
- APP never becomes 0 (because even if there are many labour then also there will be some production is expected to produce)



5.3 Relation between TPP, APP & MPP

MPP	TPP
Positive and rising	Rises at an increasing rate
Positive and falling	Rises at a decreasing rate
Zero	Stays constant (maximum)
Negative	Falls

MPP	APP
MPP > APP	Rises
MPP < APP	Falls

‘Diminishing Returns and the Production Function’ – Video

5.3 Relation between TPP, APP & MPP

TPP, MPP and APP all can be zero and go negative.
Do you agree or not? Why?

Questions

Calculate average physical product and marginal physical product, given the following information about total physical product of a firm.

Employment of Variable Factor (Units)	Employment of Fixed Factor (Units)	Total Physical Product (Units)
0	5	0
1	5	10
2	5	24
3	5	40
4	5	56
5	5	70
6	5	80
7	5	84

Solutions

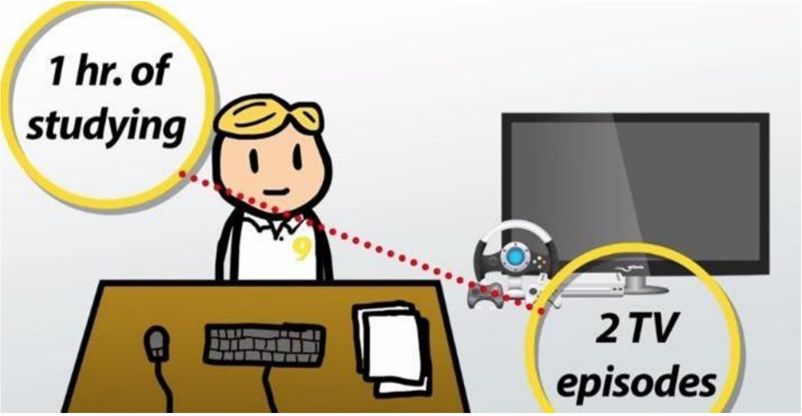
Factor (Units)	(Units)	(Units)	(Units)
0	0	0	0
1	10	10	10
2	24	12	14
3	40	13.33	16
4	56	14	16
5	70	14	14
6	80	13.33	10
7	84	12	4

6 Cost

- Cost, in common usage, the monetary value of goods and services that producers and consumers purchase.

- In a basic economic sense, cost is the measure of the alternative opportunities foregone in the choice of one good or activity over others. This fundamental cost is usually referred to as opportunity cost.

- For a consumer with a fixed income, the opportunity cost of purchasing a new domestic appliance may be, for example, the value of a vacation trip not taken.



6 Cost

Factors not owned by the firm: explicit costs

- Explicit costs are the payments to outside suppliers of inputs. The opportunity cost of using factors not already owned by the firm is simply the price that the firm has to pay for them. Thus if the firm uses £100 worth of electricity, the opportunity cost is £100. The firm has sacrificed £100, which could have been spent on something else.

Factors already owned by the firm: implicit costs

- When the firm already owns factors (e.g. machinery), it does not as a rule have to pay out money to use them. Their opportunity costs are thus implicit costs. They are equal to what the factors could earn for the firm in some alternative use, either within the firm or hired out to some other firm.
- Example – A firm draws £100 000 from the bank out of its savings in order to invest in new plant and equipment. The opportunity cost of this investment is not just the £100 000 (an explicit cost), but also the interest it thereby forgoes (an implicit cost).

6 Cost

Other types of costs:

1. Sunk costs

Some costs may remain unaffected by whatever decision a firm makes. These are not opportunity costs and so are irrelevant. They are called sunk costs.
The 'bygones' principle states that sunk costs should be ignored when deciding whether to produce or sell more or less of a product. Only those costs that can be avoided should be taken into account

2. Historic costs

The original amount the firm paid for factors it now owns

6 Cost

Cost and input

A firm's costs of production will depend on the factors of production it uses. The more factors it uses, the greater will its costs be. More precisely, this relationship depends on two elements:

Productivity of factors	
The productivity	↑
The cost	↓
& vice versa	

Price of factors	
The price of factor	↑
The cost	↑
& vice versa	

6 Cost

Total Cost – The sum of all costs incurred in production

$$TC = TVC + TFC$$

Average Cost – The cost per unit of production

$$AC = \frac{TC}{Q} \qquad OR \qquad AC = AFC + AVC$$

Marginal cost - is the extra cost of producing one more unit: that is, the rise in total cost per one unit rise in output:

$$MC = \frac{\Delta TC}{\Delta Q}$$

TC – Total Cost TFC – Total Fixed Cost TVC – Total Variable Cost AC – Average Cost
MC – Marginal Cost

6.1 Fixed Cost and Variable Cost

Costs are classified as:

- **Fixed cost**

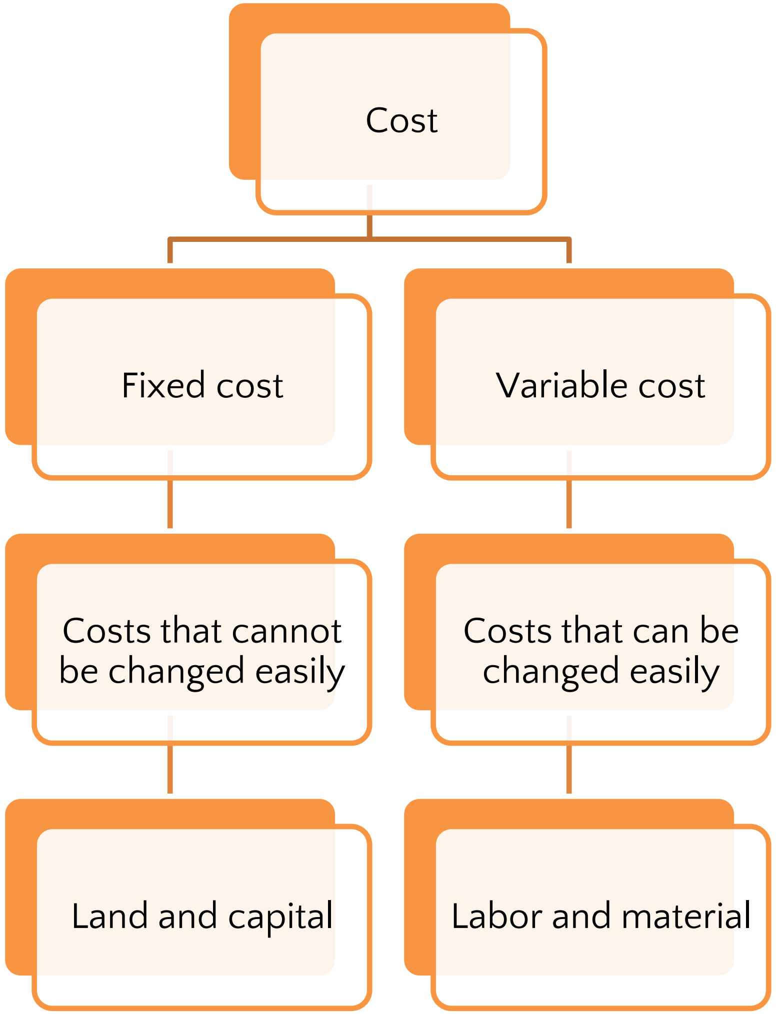
  Costs that are not related directly to production – rent, rates, insurance costs, admin costs. They can change but not in relation to output

- **Variable Cost**

  Costs directly related to variations in output. Raw materials primarily

6.1 Fixed Cost and Variable Cost

Difference between fixed cost and variable cost :



6.2 Total Cost

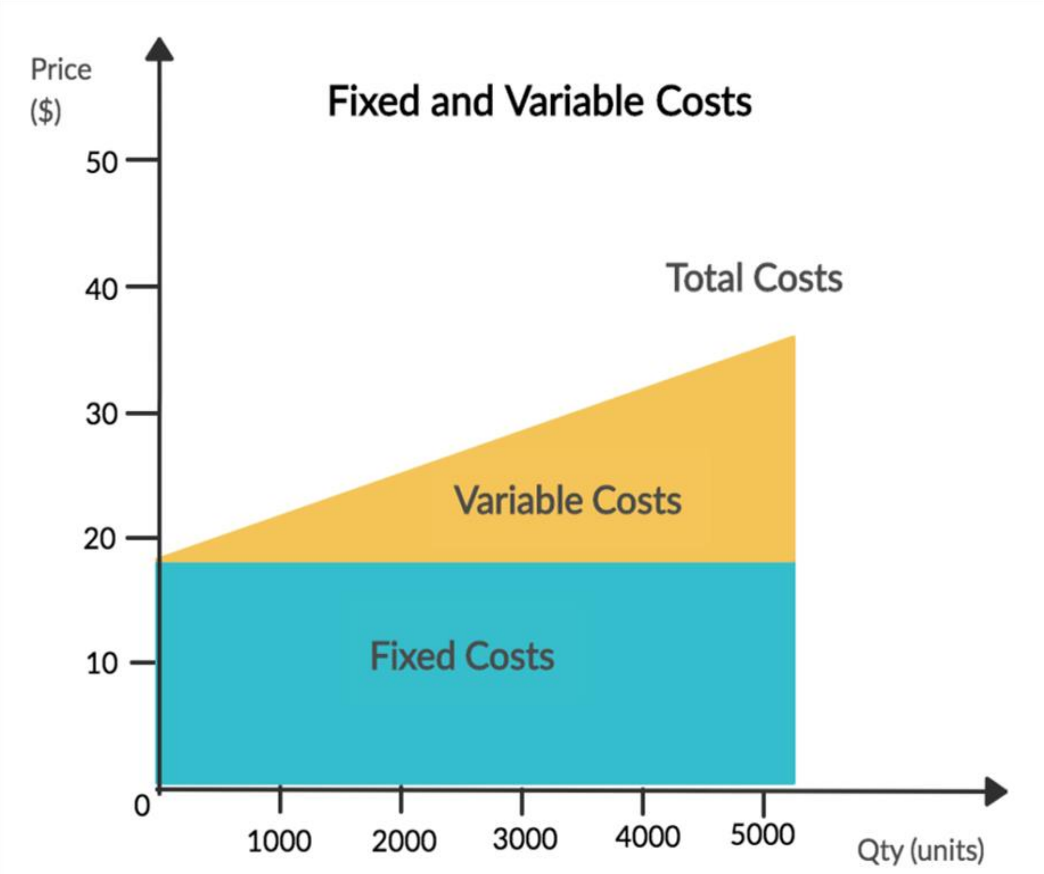
Total Fixed Cost (TFC)

+

Total Variable Cost (TVC)

→

Total Cost (TC)



6.3 Average Cost

Average
Fixed
Cost
(AFC)

+

Averag
e
Variable
Cost
(AVC)

Average Cost

(AC) $= \frac{TC}{TQ}$

6.4 Marginal Cost

- Marginal Cost is cost of producing extra unit
- $MC_n = TC_n - TC_{n-1}$

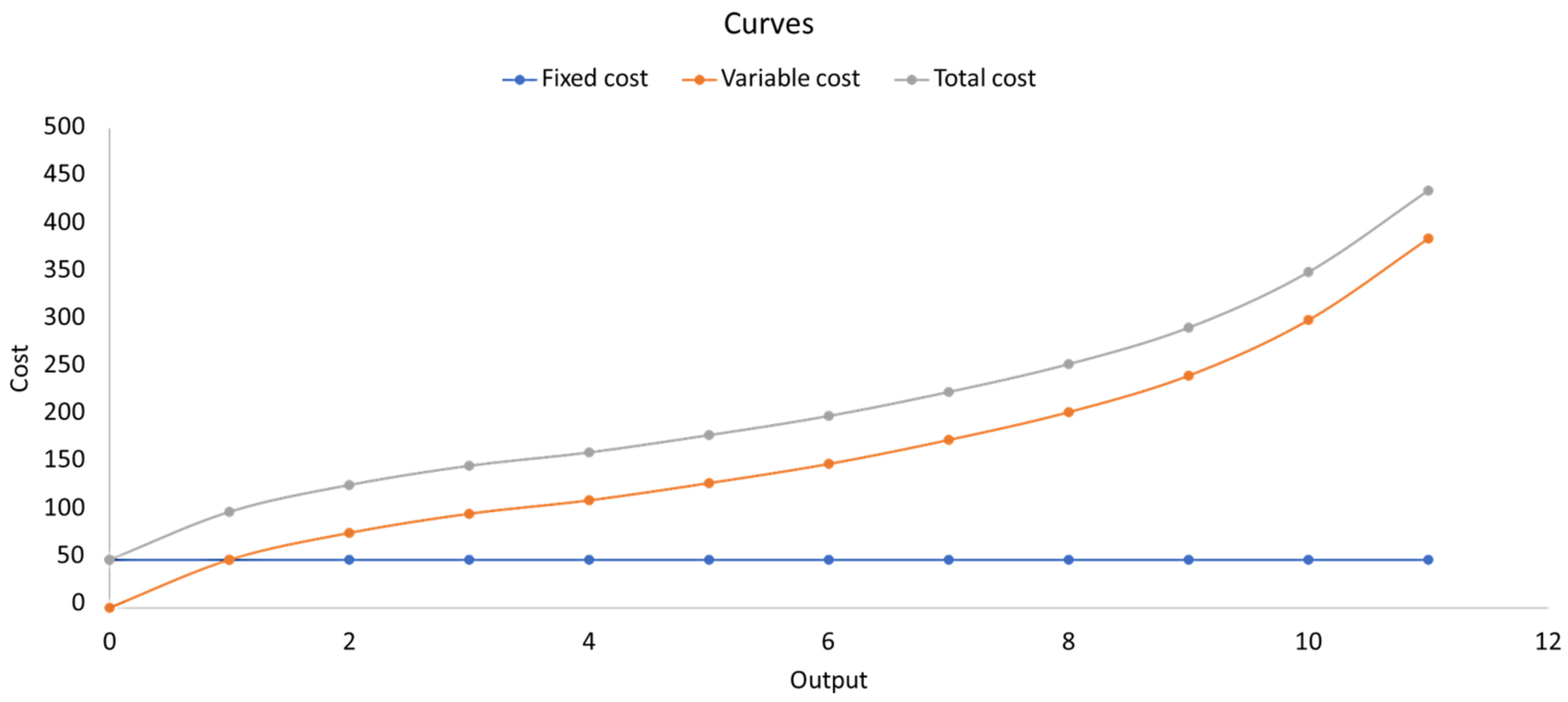
n = Number of units produced
MCn = Marginal cost of the nth unit
TCn = Total cost of nth unit
TCn-1 = Total cost of previous units

6.4 Cost Table

Complete TC, MC, AFC, AVC and AC columns of the table

Output	Fixed cost	Variable cost	Total cost	Marginal cost	Average Fixed cost	Average Variable cost	Average cost
0	50	0	50				
1	50	50	100				
2	50	78	128				
3	50	98	148				
4	50	112	162				
5	50	130	180				
6	50	150	200				
7	50	175	225				
8	50	204	254				
9	50	242	292				
10	50	300	350				
11	50	385	435				
12	50	480	530				

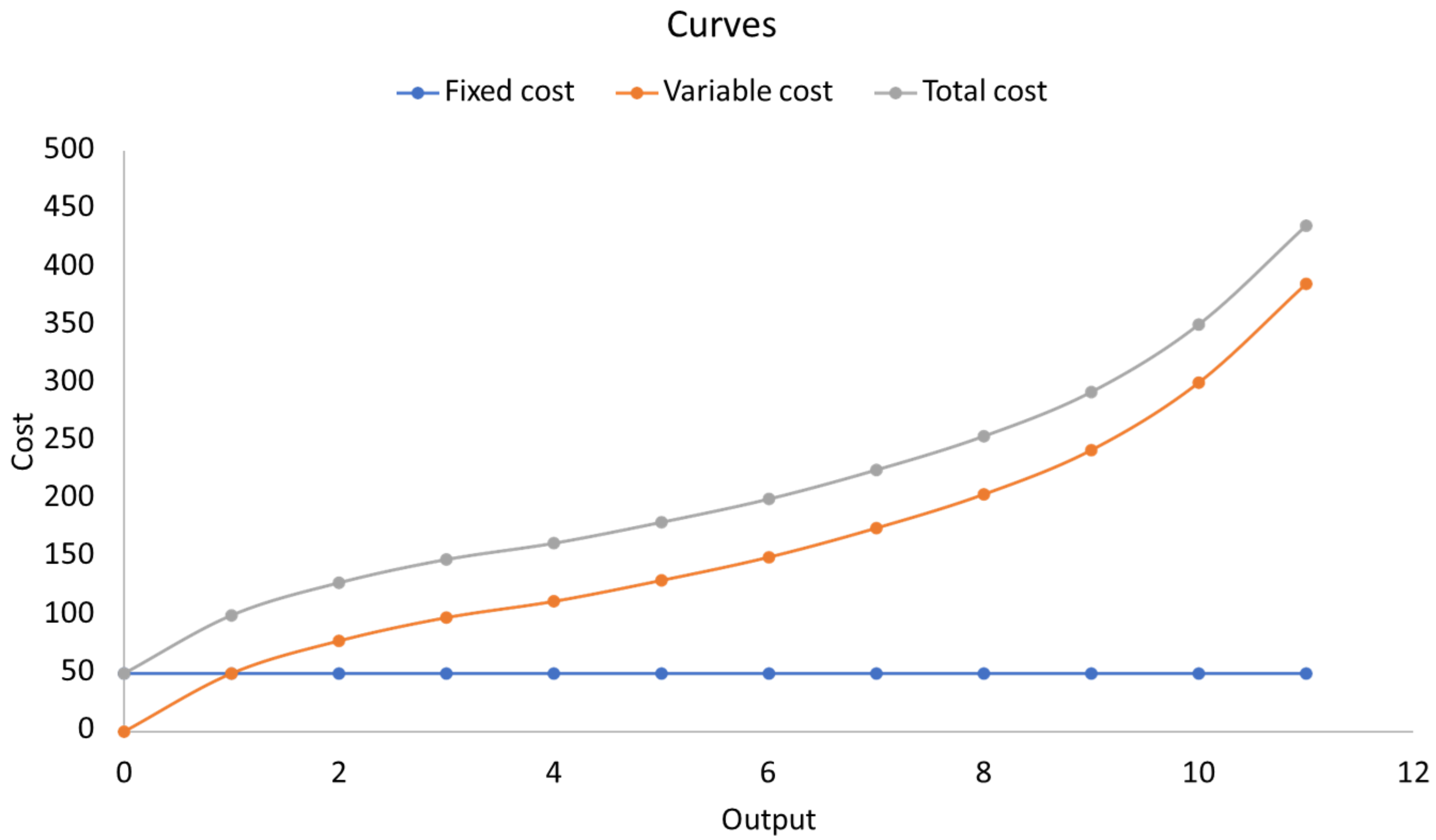
6.5 Cost Curves



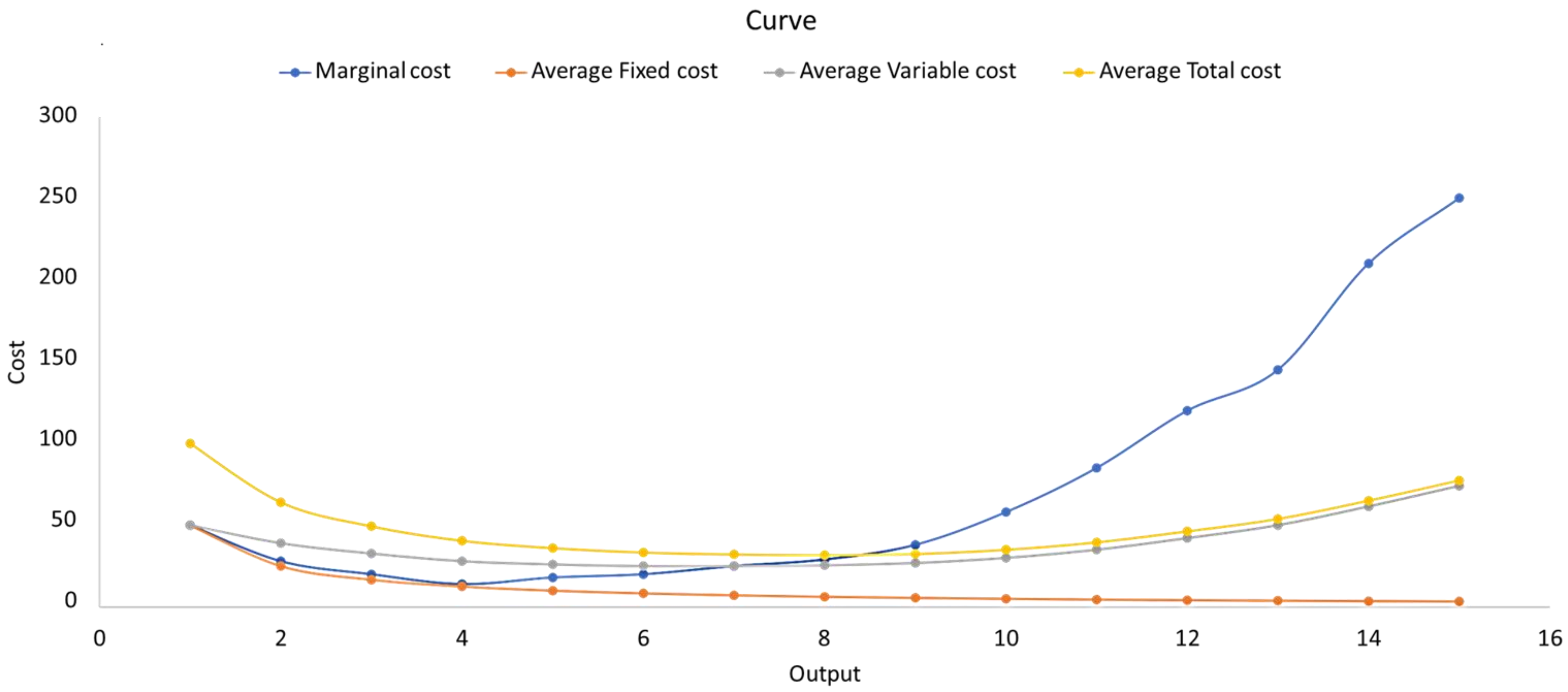
6.5 Cost Curves

- Total cost curve represents fixed & variable cost

- Total cost curve moves in parallel position to total variable cost curve

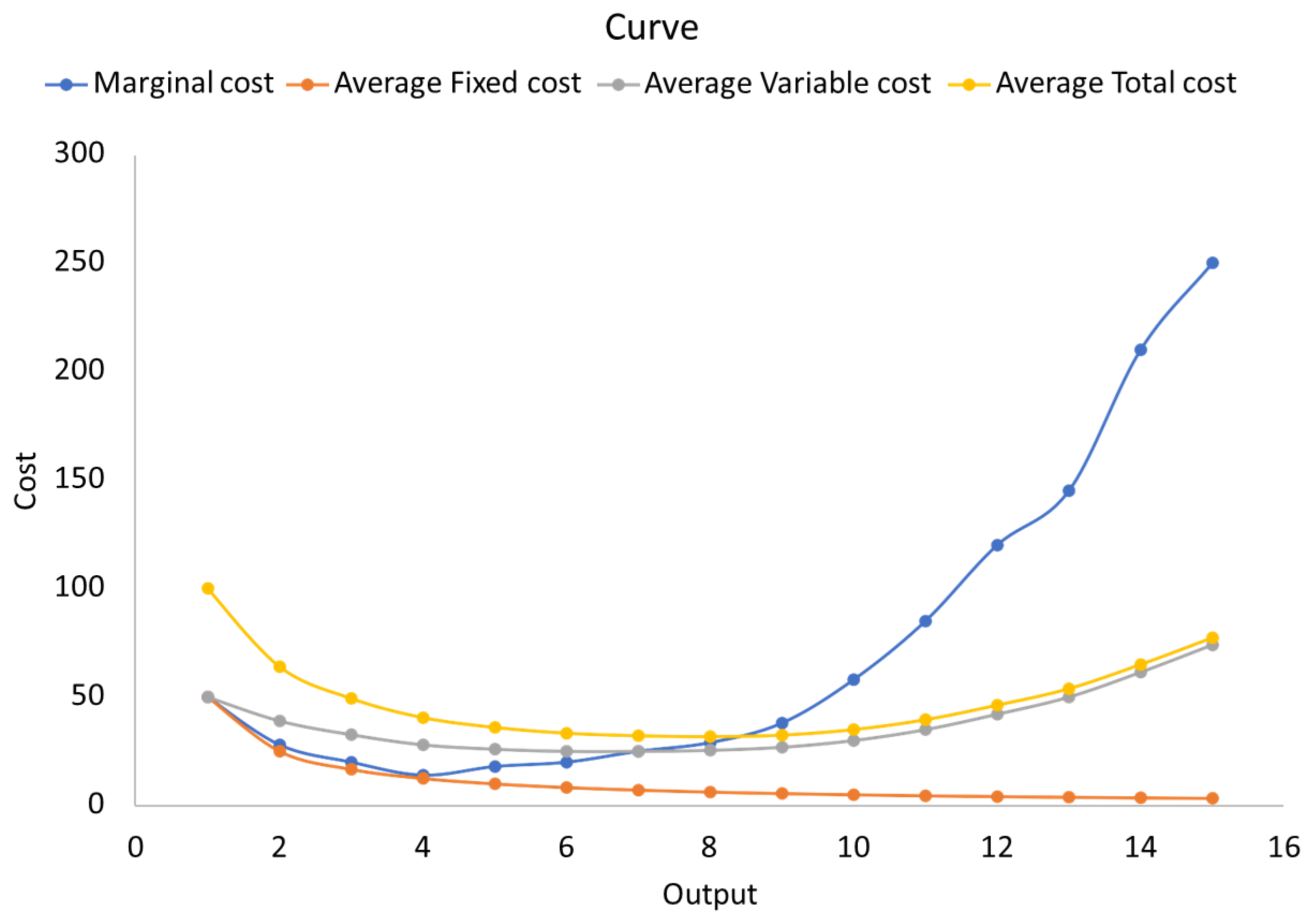


6.5 Cost Curves



6.5 Cost Curves

- Both average variable cost and average cost decrease at first but increase thereafter
- Average fixed cost decreases with greater the output but it can never be 0
- Marginal cost is decreasing at start then increases



6.5 Cost Curves

As Total Variable Cost is parallel to Total Cost, Average Variable Cost is also parallel to Average Cost
Do you agree or not? Why?

Questions

Calculate total cost, average cost, average fixed cost, average variable cost and marginal cost on the basis of the following information :

Output (units)	0	1	2	3	4
TFC (Rs)	60	60	60	60	60
TVC (Rs)	0	50	90	180	300

Solution:

TC	60	110	150	240	360
AFC	–	60	30	20	15
AVC	–	50	45	60	75
ATC	–	110	75	80	90
MC	–	50	40	90	120

7 Revenue

- The Revenue of the firm is its sale receipts or money receipts from the sale of a product. It is also called sale proceeds.

- Example:
  You are running a factory producing Ice Cream. You produce 100 Ice Cream slabs daily. By selling these Ice Cream slabs you get Rs.1,000. In economics, this amount of Rs. 1,000 is called revenue. Thus by selling a commodity whatever money a firm receives is called its Revenue.

7 Revenue

Total Revenue - Total revenue is the firm's total earnings per period of time from the sale of a particular amount of output (Q).

$$TR = Quantity \times Price$$

Average Revenue – Average revenue is the amount the firm earns per unit sold.

$$AR = \frac{Total\ revenue}{quantity}$$

Marginal Revenue – Marginal revenue is the extra total revenue gained by selling one more unit (per time period).

$$MR = \frac{\Delta\, Total\ revenue}{\Delta\, quantity}$$

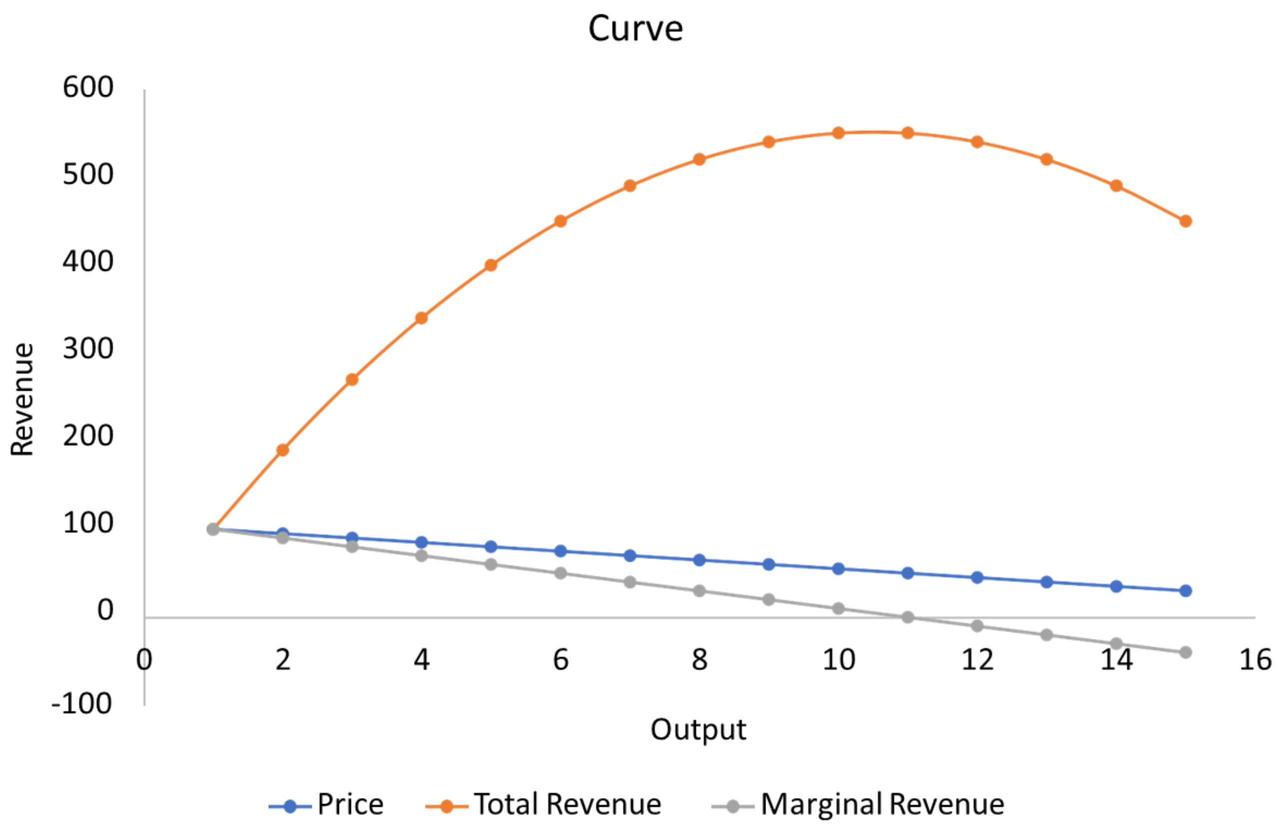
TR – Total Revenue
AR – Average Revenue
MR – Marginal Revenue

7.1 Revenue Table

Complete TR and MR columns of the table

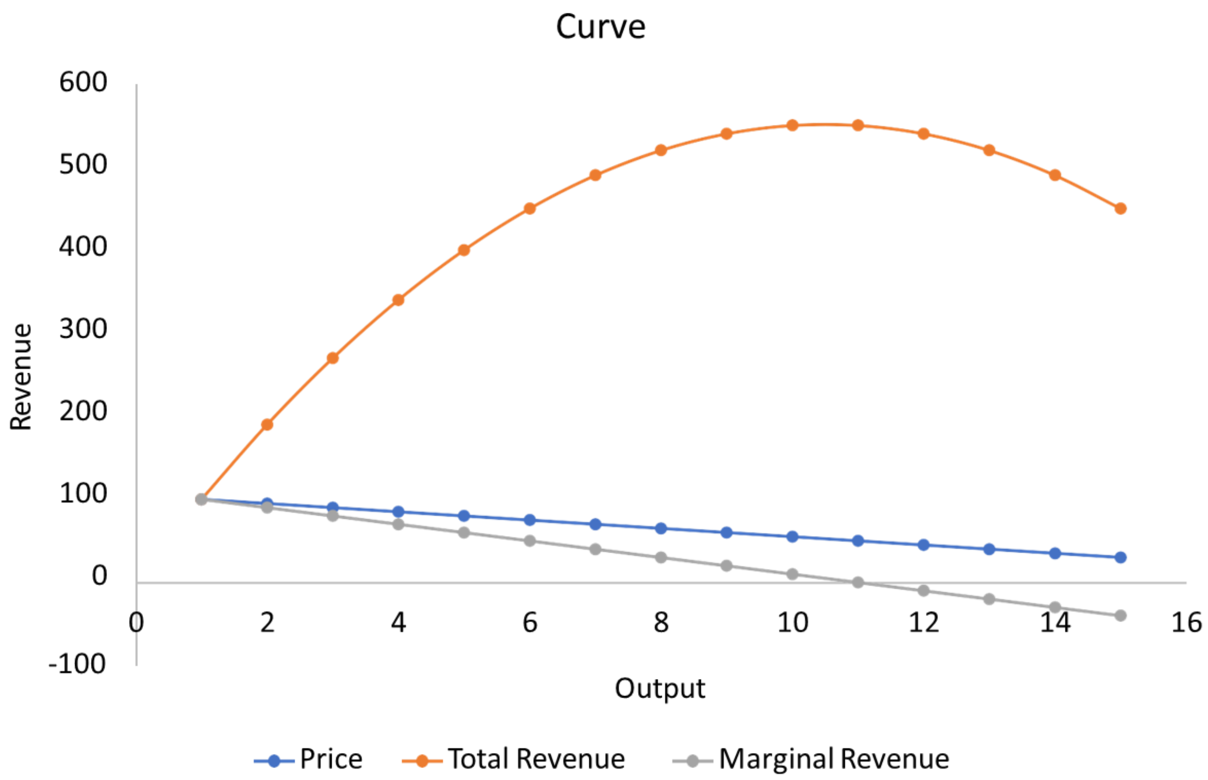
Output	Price	Total Revenue	Marginal Revenue
0	50		
1	50		
2	50		
3	50		
4	50		
5	50		
6	50		
7	50		
8	50		
9	50		
10	50		
11	50		
12	50		

7.2 Revenue Curves



7.2 Revenue Curves

- When TR is increasing at increasing rate MR should be increasing.
- When TR is increasing at constant rate MR should be constant.
- When TR is increasing at diminishing rate MR should be diminishing.
- When TR is maximum MR is Zero.
- When TR is diminishing MR is negative.
- When AR curve is sloping downward, MR curve should be below the AR curve as in monopoly or monopolistic competition



8 Long run theory of production

- In the long run, all factors of production are variable. There is time for the firm to build a new factory, to install new machines, to use different production techniques and to combine its inputs in whatever proportion and in whatever quantities it chooses.

- In the long run, then, there are several decisions that a firm has to make:
  Decisions about the scale and location of its operations and what techniques of production it should use.

- These decisions affect the costs of production. It is important, therefore, to get them right.

8.1 Scale of production

- If a firm were to double all of its inputs – something it could do in the long run – would it double its output? Or will output more than double or less than double? We can distinguish three possible situations:

		Number of machine				
		1	2	3	4	5
No. of worker	1	4	7	13	13	12
	2	11	16	19	20	21
	3	16	21	24	25	26
	4	19	24	27	29	30
	5	21	25	28	30	32

8.1 Scale of production

- The numbers in the table show the maximum output (the technically efficient output) that can be produced by employing different combinations of capital and labour.
- For example, if one worker is employed with one machine the maximum output that can be produced is 4.
- If a second worker is employed with one machine the total output is 11 and so on.
- The impact of increasing the amount of capital – i.e. the number of machines – can be seen by working across each row.

		Number of machine				
		1	2	3	4	5
No. of worker	1	4	7	13	13	12
	2	11	16	19	20	21
	3	16	21	24	25	26
	4	19	24	27	29	30
	5	21	25	28	30	32

8.2 Increasing Return to Scale

- Percentage increase in inputs leads to a larger percentage increase in output.
- For example, look what happens in Table,
- If both the number of workers and machines used in production are both doubled from 1 to 2. Total output increases from 4 to 16 (look diagonally downwards).
- In this case a 100 per cent increase in the inputs used in production leads to a 300 per cent increase in output. Production exhibits increasing returns to scale.

		Number of machine				
		1	2	3	4	5
No. of worker	1	4	7	13	13	12
	2	11	16	19	20	21
	3	16	21	24	25	26
	4	19	24	27	29	30
	5	21	25	28	30	32

8.3 Constant Return to Scale

- Percentage increase in inputs leads to the same percentage increase in output.
- This is illustrated in Table,
- when the number of workers and machines are both increased from 2 to 3.
- This 50 per cent increase in inputs leads to a 50 per cent increase in output

		Number of machine				
		1	2	3	4	5
No. of worker	1	4	7	13	13	12
	2	11	16	19	20	21
	3	16	21	24	25	26
	4	19	24	27	29	30
	5	21	25	28	30	32

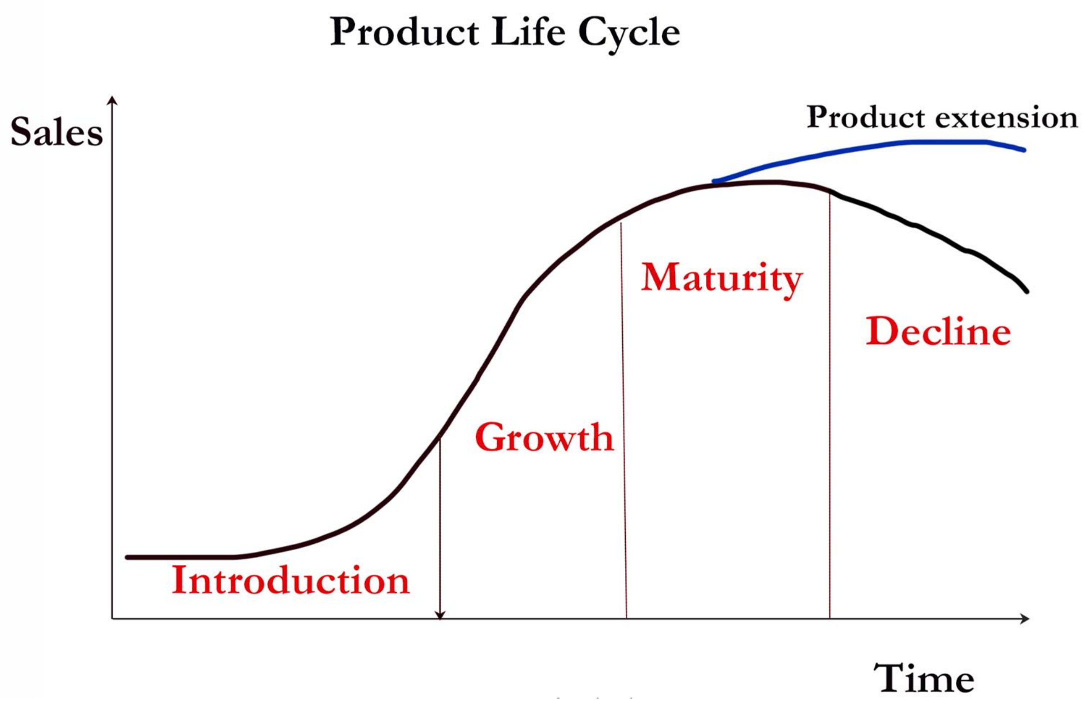
8.4 Decreasing Return to Scale

- Percentage increase in inputs leads to a smaller percentage increase in output.
- If, in the table, both the number of workers and machines are increased from 3 to 4 (a 33.3 per cent increase) then output increases from 24 to only 29 (a 20.8 per cent increase).

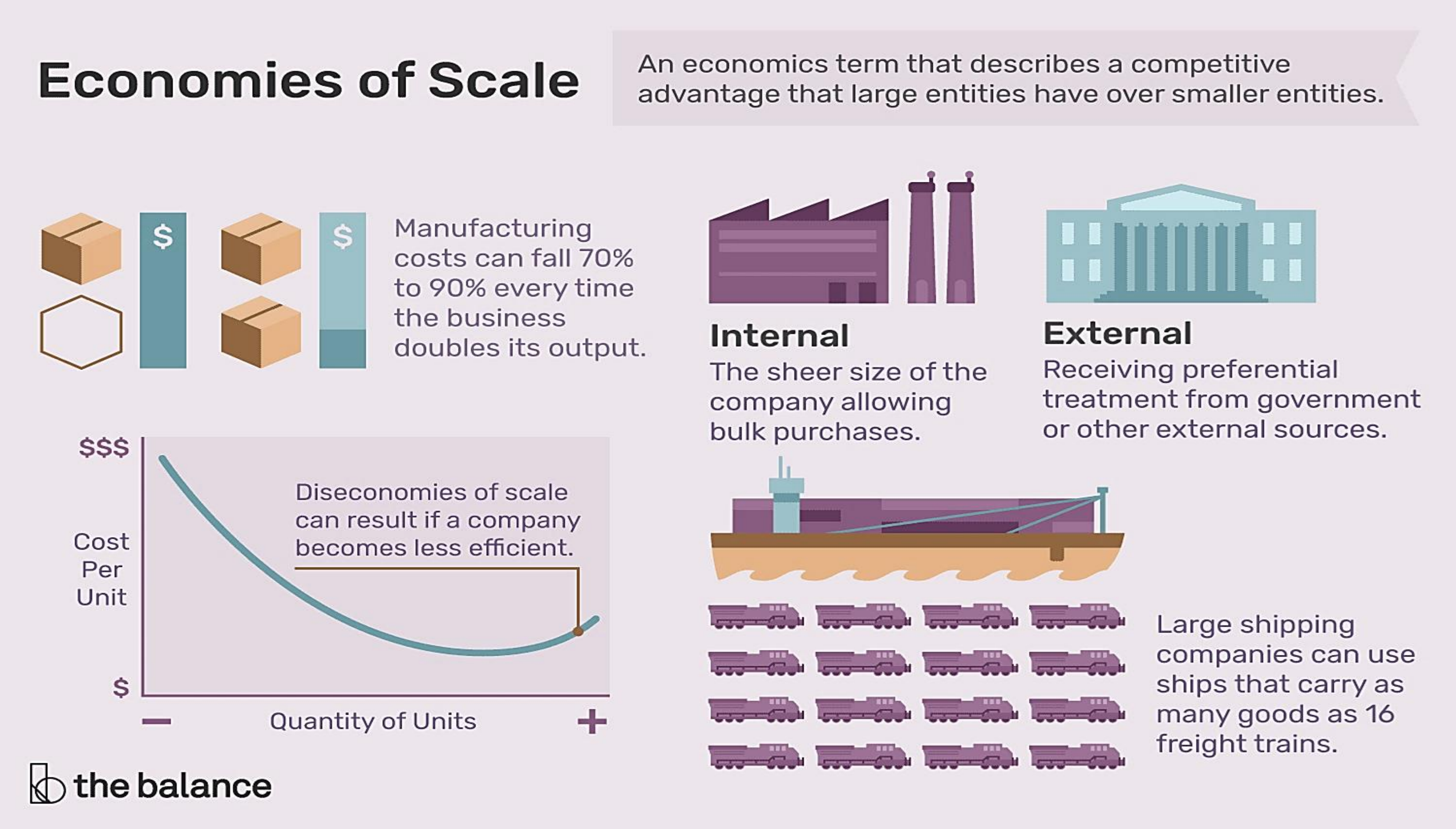
		Number of machine				
		1	2	3	4	5
No. of worker	1	4	7	13	13	12
	2	11	16	19	20	21
	3	16	21	24	25	26
	4	19	24	27	29	30
	5	21	25	28	30	32

9 Economies of Scale

What do you mean by the term ‘economies of scale’?
In what stage of the product life cycle can we expect economies of scale?

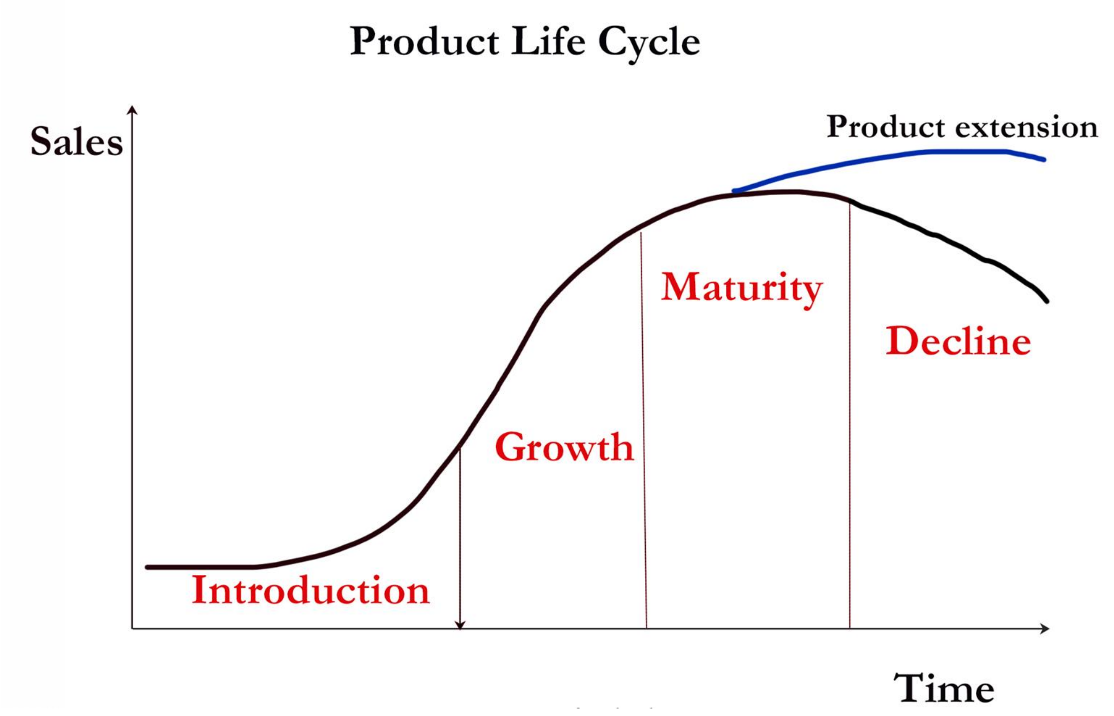


9 Economies of Scale



9 Economies of Scale

In what stage of the product life cycle can we expect economies of scale?
What are the reasons that a firm might experience diseconomies of scale?



9 Economies of Scale

- Economies of scale are cost advantages reaped by companies when production becomes efficient. Companies can achieve economies of scale by increasing production and lowering costs.

- It represent the cost-savings and competitive advantages larger businesses have over smaller ones.

- Discuss – Local Grocery store & D'Mart outlet

9 Economies of Scale

	Capital	Land	Labour	Output	TC	AC
Scale A	5	3	4	100		
Scale B	10	6	8	300		

Assume each unit of capital = £5, Land = £8 and Labour = £2

Calculate TC and then AC for the two different ‘scales’ (‘sizes’) of production facility

What happened from scale A to scale B and why?

9 Economies of Scale

	Capital	Land	Labour	Output	TC	AC
Scale A	5	3	4	100	57	0.57
Scale B	10	6	8	300	114	0.38

Doubling the scale of production (a rise of 100%) has led to an increase in output of 200% – therefore cost of production PER UNIT has fallen

Overall ‘costs’ will rise but unit costs can fall

9.1 Economies of Scale – Reasons

9.1.A Specialization & Division of labor

- In large-scale plants workers can often do simple, repetitive jobs. With this specialisation and division of labour less training is needed; workers can become highly efficient in their particular job, especially with long production runs; there is less time lost in workers switching from one operation to another; and supervision is easier.

- Workers and managers can be employed who have specific skills in specific areas.

9.1 Economies of Scale – Reasons

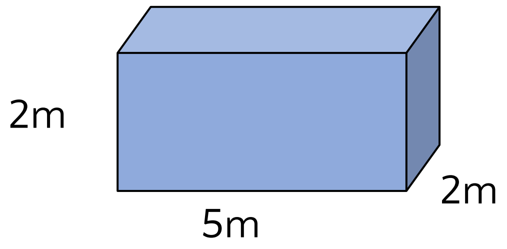
9.1.B Indivisibility

- Some inputs are of a minimum size: they are indivisible. The most obvious example is machinery.

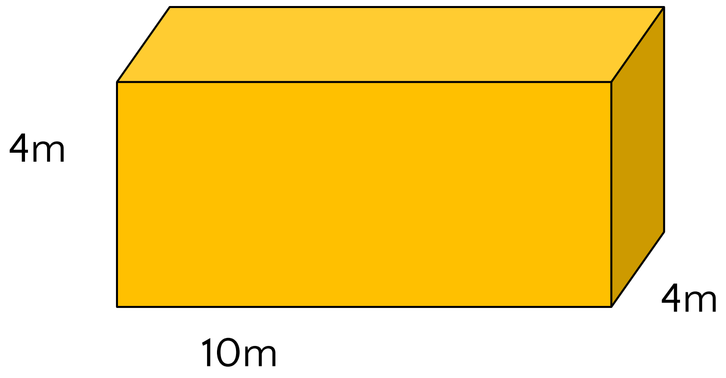
9.1 Economies of Scale – Reasons

9.1.C The 'Container Principle'

Increased Dimensions:



Total Cost: Construction, driver, fuel, maintenance, insurance, road tax = £600 per journey
AC = £30m3



Transport container = Volume of $160m^3$
Total Cost = £1800 per journey
AC = £11.25m³

9.1 Economies of Scale – Reasons

9.1.D Greater efficiency of large machines

- Large machines may be more efficient in the sense that more output can be gained for a given amount of inputs.

- For example, only one worker may be required to operate a machine whether it be large or small. Also, a large machine may make more efficient use of raw materials.

9.1 Economies of Scale – Reasons

9.1.E By-Product

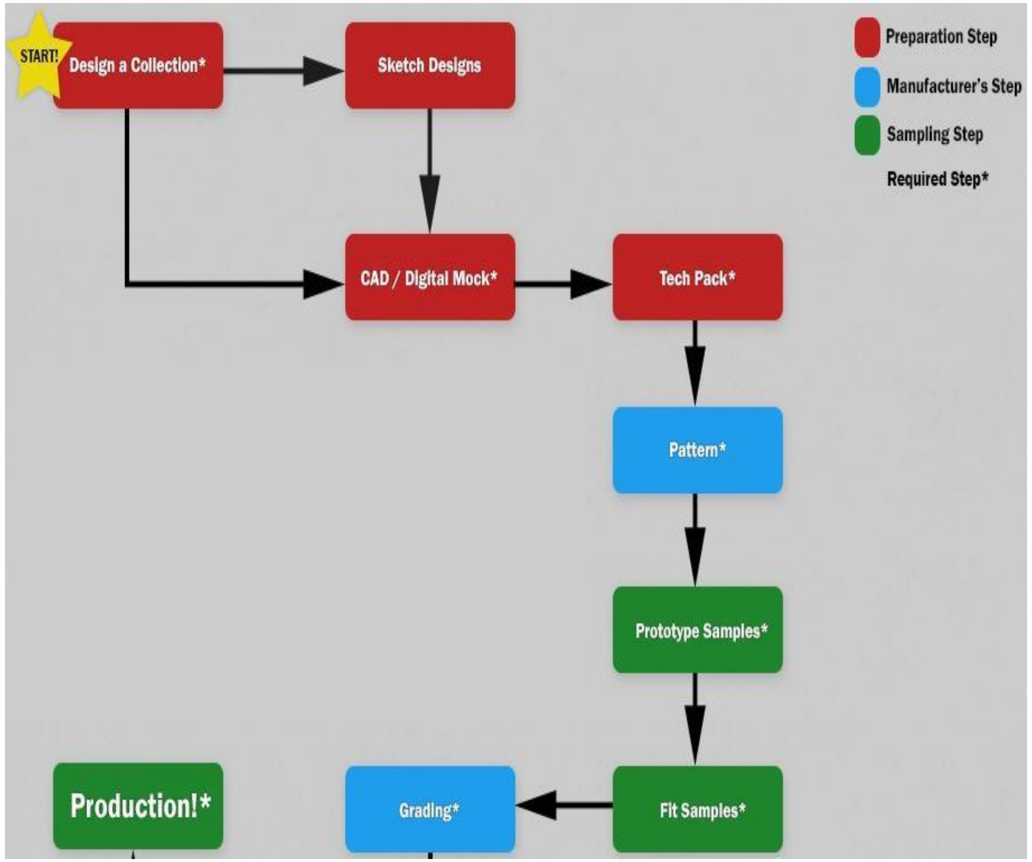
- When the process of making one thing results in a second product as well, that second thing is called a byproduct.
- Sawdust is a byproduct of the lumber industry, and feathers are a byproduct of poultry processing.
- In each of these cases, the byproduct is important and useful, but secondary to the initial product.

9.1 Economies of Scale – Reasons

9.1.F Multi stage production

- A large factory may be able to take a product through several stages in its manufacture. This saves time and cost in moving the semi-finished product from one firm or factory to another.

- For example – A large cardboard-manufacturing firm may be able to convert trees or waste paper into cardboard and then into cardboard boxes in a continuous sequence.



9.1 Economies of Scale – Reasons

9.1.G Organizational economies

- With a large firm, individual plants can specialise in particular functions. There can also be centralized administration of the firm;

- For example – 1 human resource department could administer all the wages. Often, after a merger between two firms, savings can be made by rationalising their activities in this way.

9.1 Economies of Scale – Reasons

9.1.H Spreading overheads

- Some expenditures are economic only when the firm is large
- For example – research and development – only a large firm can afford to set up a research laboratory. This is another example of indivisibilities, only this time at the level of the firm rather than the plant. The greater the firm’s output, the more these overhead costs are spread.

9.1 Economies of Scale – Reasons

9.1.I Financial Economics

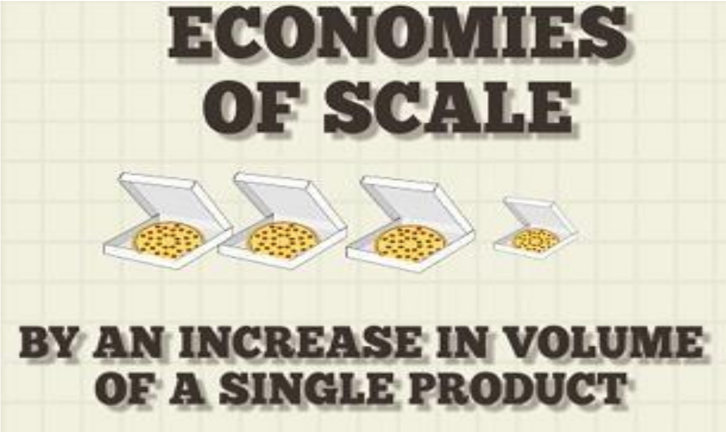
- Large firms able to negotiate cheaper finance deals
- Large firms able to be more flexible about finance – share options, rights issues, etc.

9.1 Economies of Scale – Reasons

9.1.J Economics of scope

- Often a firm is large because it produces a range of products. This can result in each individual product being produced more cheaply than if it was produced in a single-product firm.

- For example – A firm that produces a whole range of DVD players, televisions and hard disk recorders can benefit from shared marketing and distribution costs and the bulk purchase of electronic components.



9.2 Diseconomies of Scale

- Diseconomies of scale happen when a company or business grows so large that the costs per unit increase.

- Reasons
  1. Management Problems
  2. Workers Mindset
  3. Industrial Relation
  4. Production-line Process

10 Location

- In the long run, a firm can move to a different location. The location will affect the cost of production since locations differ in terms of the availability, suitability and cost of the factors of production.

- Factors that influence the choice of location:

1. Transport costs : Ideally a firm will wish to be as near as possible to both its raw materials and the market for its finished product to reduce transport cost.

1. Price of raw materials: If the raw materials are more expensive to transport than the finished product, the firm should be located as near as possible to the raw materials.

11 The size of the industry

- As an industry grows in size, this can lead to external economies of scale for its member firms.
- For example, the firm may benefit from having access to specialist raw material or component suppliers, labor with specific skills, etc

- Where a firm's costs per unit of output decrease as the size of the whole industry grows is called external diseconomies of scale.
- For example, as an industry grows larger, this may create a growing shortage of specific raw materials or skilled labour. This will push up their prices, and hence the firms' costs

12 Optimum combination of factors

?

For any given scale, how should the firm decide what technique to use?
How should it decide the optimum 'mix' of factors of production?

12 Optimum combination of factors

The simple two-factor case:

Take first the simplest case where a firm uses just two factors: labour (L) and capital (K). The least-cost combination of the two will be where :

$$\frac{MPP_L}{P_L} = \frac{MPP_K}{P_K}$$

in other words, where the extra product (MPP) from the last pound spent on each factor is equal.

Since no further gain can be made by substituting one factor for another, this combination of factors or 'choice of technique' can be said to be the most efficient. It is the least cost way of combining factors for any given output. Efficiency in this sense of using the optimum factor proportions is known as productive efficiency.

12 Optimum combination of factors

The multi-factor case :

Where a firm uses many different factors, the least-cost combination of factors will be where:

$$\frac{MPP_a}{P_a} = \frac{MPP_b}{P_b} = \frac{MPP_c}{P_c} \dots\dots\dots\dots \frac{MPP_n}{P_n}$$

A major problem for a firm in choosing the least-cost technique is in predicting future factor price changes. If the price of a factor were to change, the MPP/P ratios would cease to be equal. The firm, to minimize costs, would then like to alter its factor combinations until the MPP/P ratios once more became equal. T

13 Cobb–Douglas production function

Like other production functions, this shows how output (TPP) varies with inputs of various factors (F1, F2, F3, etc.). In the simple two-factor case it takes the following form:

TPP = f(F1, F2) =$TPP = f(F_1, F_2) = AF_1^{\propto}F_2^{\beta}$

If $\alpha + \beta = 1$, there are constant returns to scale;
if $\alpha + \beta > 1$, there are increasing returns to scale;
if $\alpha + \beta < 1$, there are decreasing returns to scale.

14 Cost in long run

- Since there are no fixed factors in the long run, there are no long-run fixed costs.

- Long run average cost is the cost per unit of output feasible when all factors of production are variable

- Assumptions
  1. Factor prices are given
  2. State of technology & factor quality is given
  3. Firm chooses least combination of factors at each output

14 Cost in long run

Economies of Scale and Long Run Average Cost (LRAC)

- In the long run all costs are variable and the scale of production can change (i.e. no fixed inputs)

- Economies of scale are the cost advantages from expanding the scale of production in the long run. The effect is to reduce average costs over a range of output

- These lower costs represent an improvement in productive efficiency and can give a business a competitive advantage in a market. They lead to lower prices and higher profits – this is called a positive sum game for producers and consumers (i.e. the welfare of both will improve)

14.1 Long run cost table

Long Run Output (Units)	Total Costs (£s)	Long Run Average Cost (£ per unit)
100	1200	12
200	2000	10
500	4500	9
1000	8000	8
2000	14400	7.2
5000	33000	6.6
10000	64000	6.4
50000	300000	6

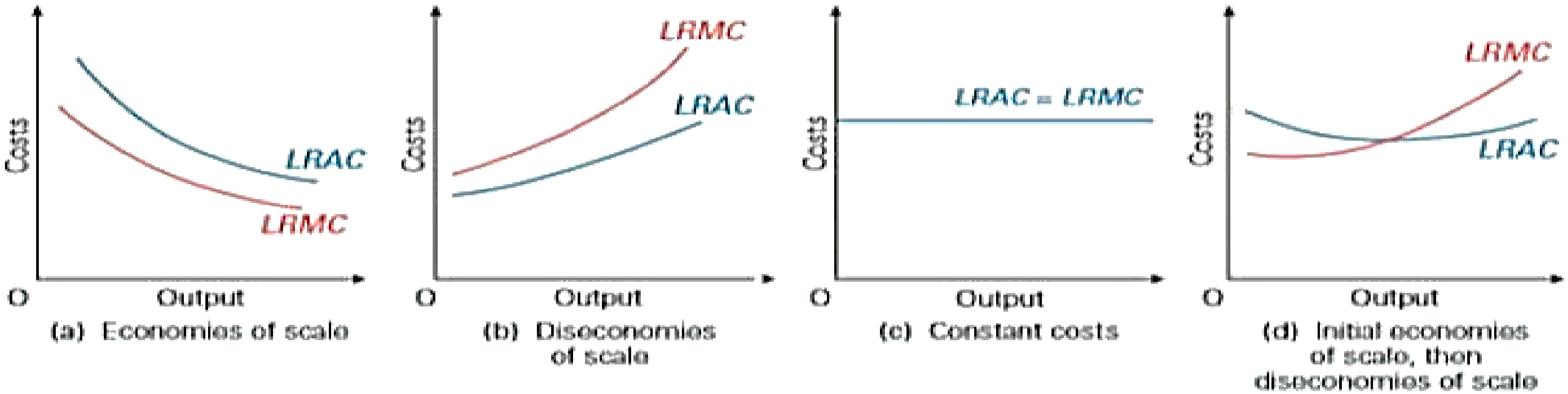
14.2 Economies of scale table

Factor Inputs				Production	Costs	
	(K)	(La)	(L)	(Q)	(TC)	(TC/Q)
	Capital	Land	Labour	Output	Total Cost	Average Cost
Scale A	5	3	4	100	3256	32.6
Scale B	10	6	8	300	6512	21.7
Scale C	15	9	12	500	9768	19.5

Costs: Assume the cost of each unit of capital = £600, Land = £80 and Labour = £200

Because the % change in output exceeds the % change in factor inputs used, then, although total costs rise, the average cost per unit falls as the business expands from scale A to B to C

14.3 Long run – Marginal cost curve



(a) Additional units of output will add less to costs than the average.

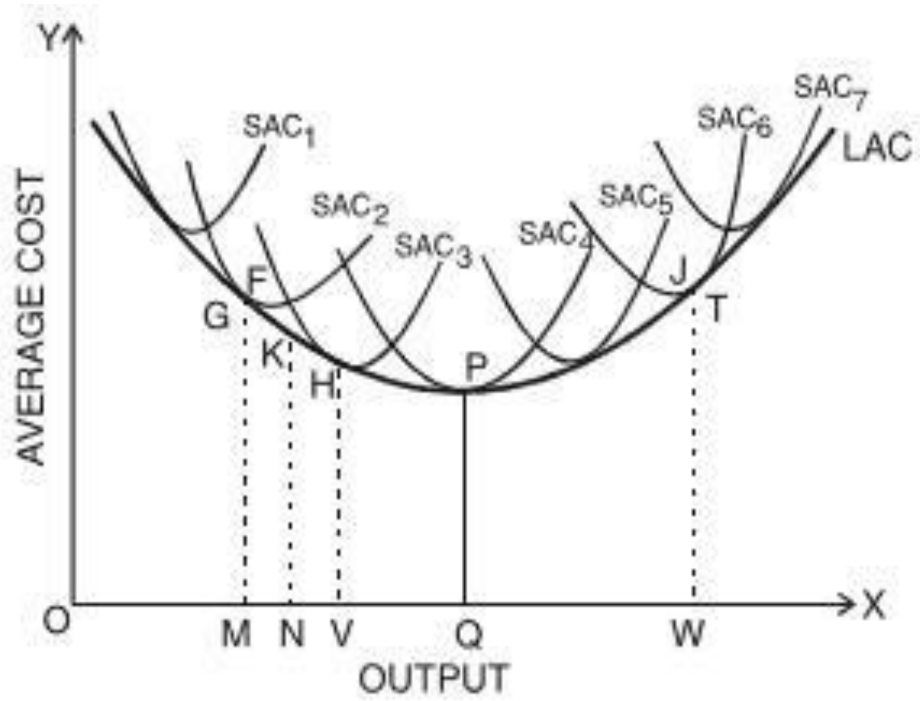
(b) Additional units of output will cost more than the average.

(c) Additional units of output will cost the same as the average cost

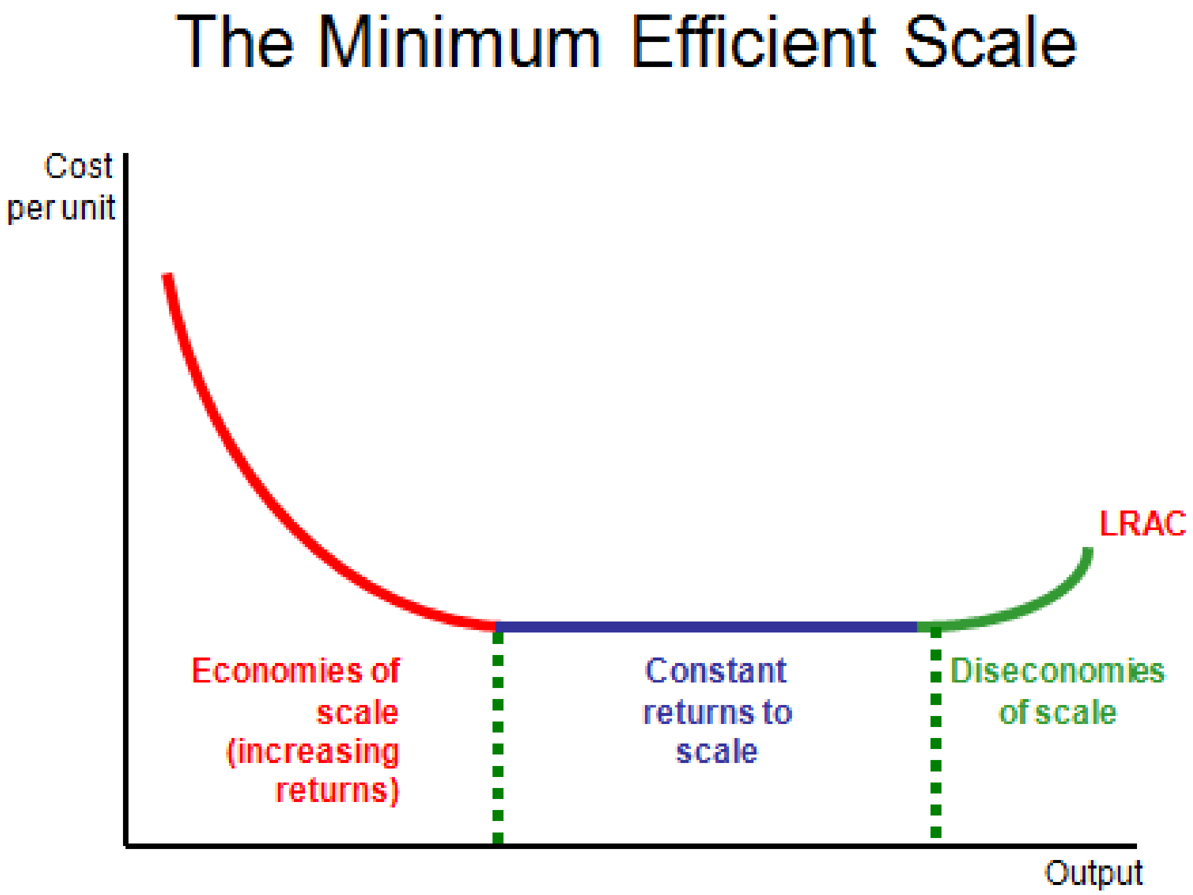
(d) Combination of all 3

14.4 Long run - Average cost curve

- Long run average cost is made by combining short term average cost curves
- Firm will produce at point G, K, H, P, T
- Because Firm chooses least combination of factors at each output

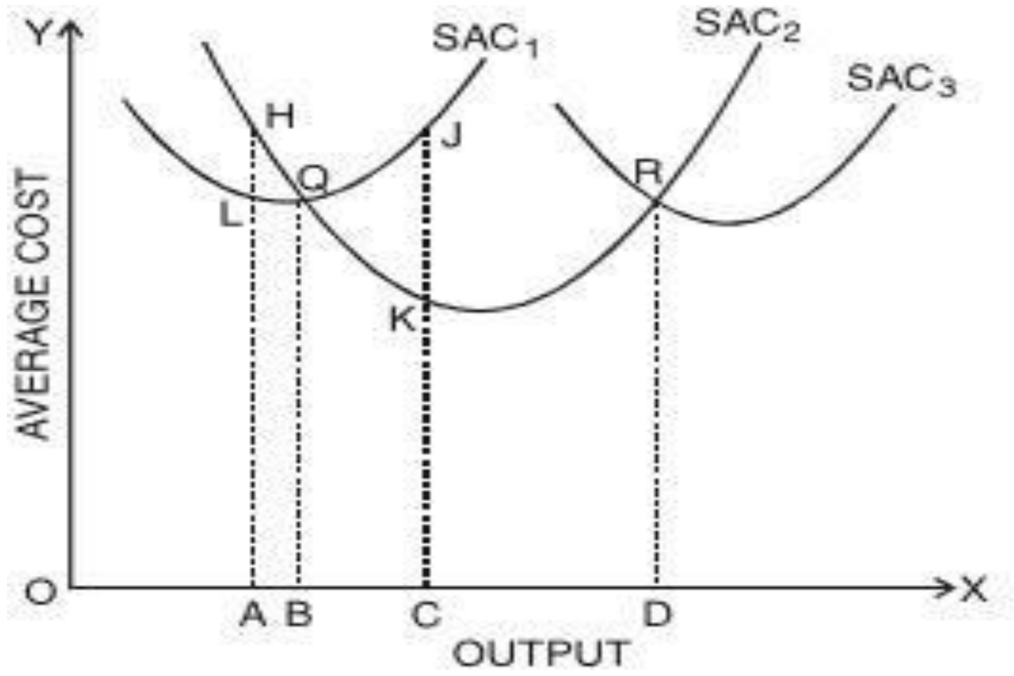


14.4 Long run - Average cost curve



15 Cost in Short run

- In the short run, some inputs are fixed while the others are variable.

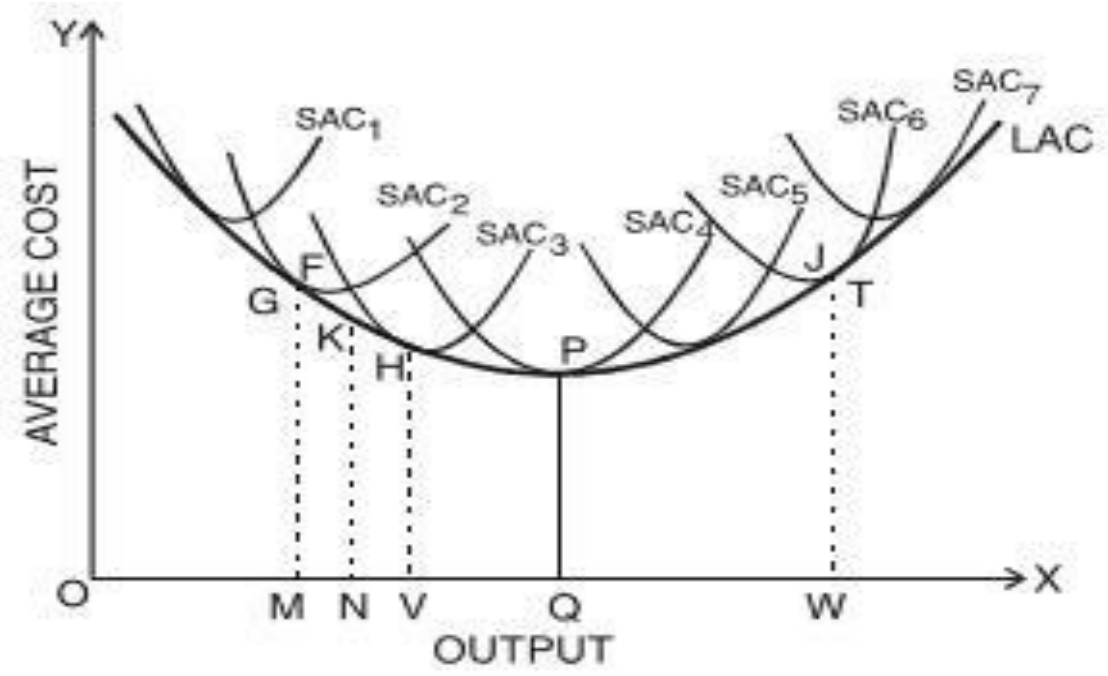


Short run Average Cost Curves

16 Relationship between short & long run curve

- From this succession of short-run average cost curves we can construct a long-run average cost curve, as shown in figure.

- This is known as the envelope curve, since it envelopes the short-run curves..



Long run Average Cost Curves

17 Profit maximization

- We are now in a position to put costs and revenue together to find the output at which profit is maximised, and also to find out how much that profit will be.

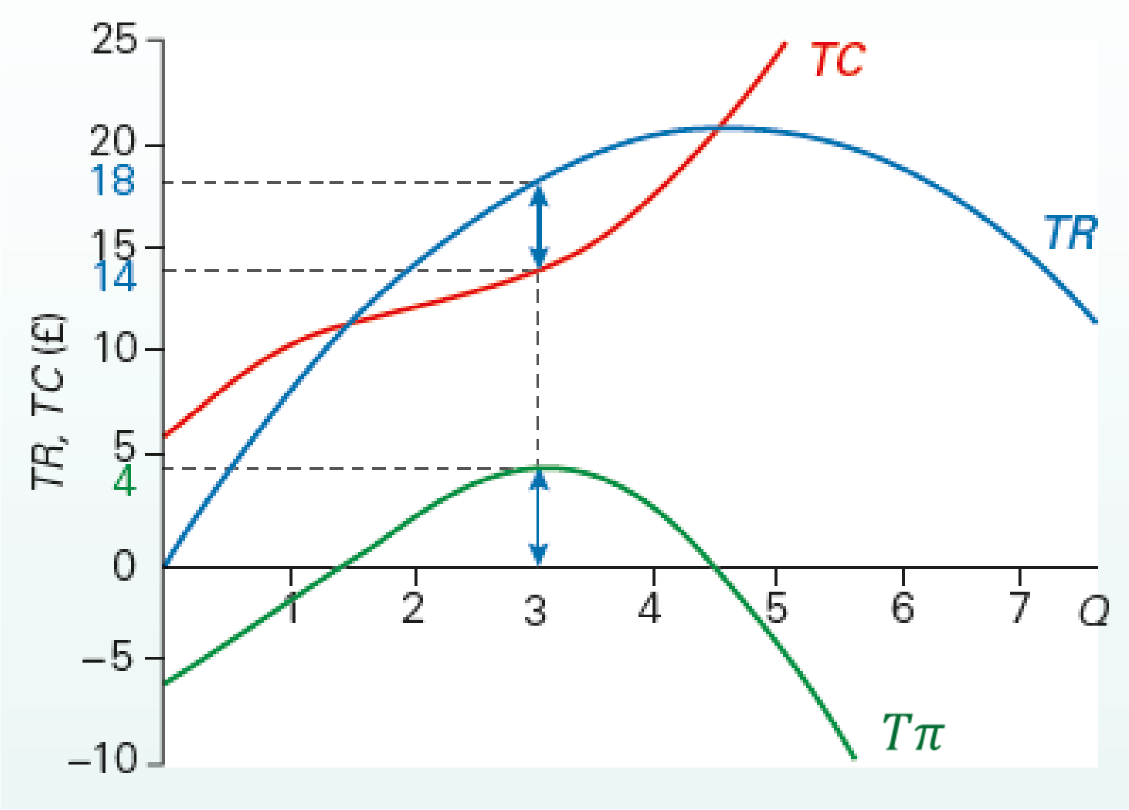
- There are two ways of doing this.

  1. The first and simpler method is to use total cost and total revenue curves.

  1. The second method is to use marginal and average cost and marginal and average revenue curves.

17 Profit maximization

Unit	Price	Total Revenue	Total Cost	Profit
0	9	0	6	-6
1	8	8	10	-2
2	7	14	12	2
3	6	18	14	4
4	5	20	18	2
5	4	20	25	-5
6	3	18	36	-18
7	2	14	56	-42



17 Profit maximization

- Point below M & after N
  TR < TC (Loss)

- At AB
  TR > TC (Profit)
  Point E is maximum profit that firm can make

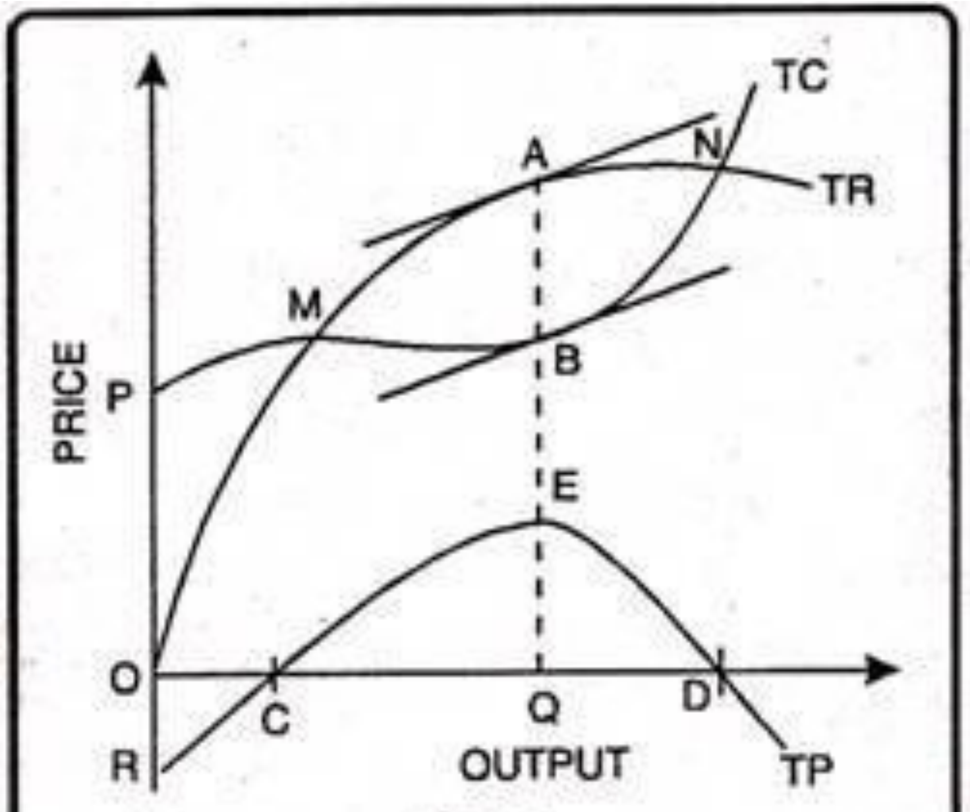


Fig. 2.

17.1 Short run profit maximization

- Finding the maximum profit that a firm can make is a two stage process.
- The first stage is to find the profit-maximising output. To do this we use the MC and MR curves.
- The second stage is to find out just how much profit is at this output. To do this we use the AR and AC curves.

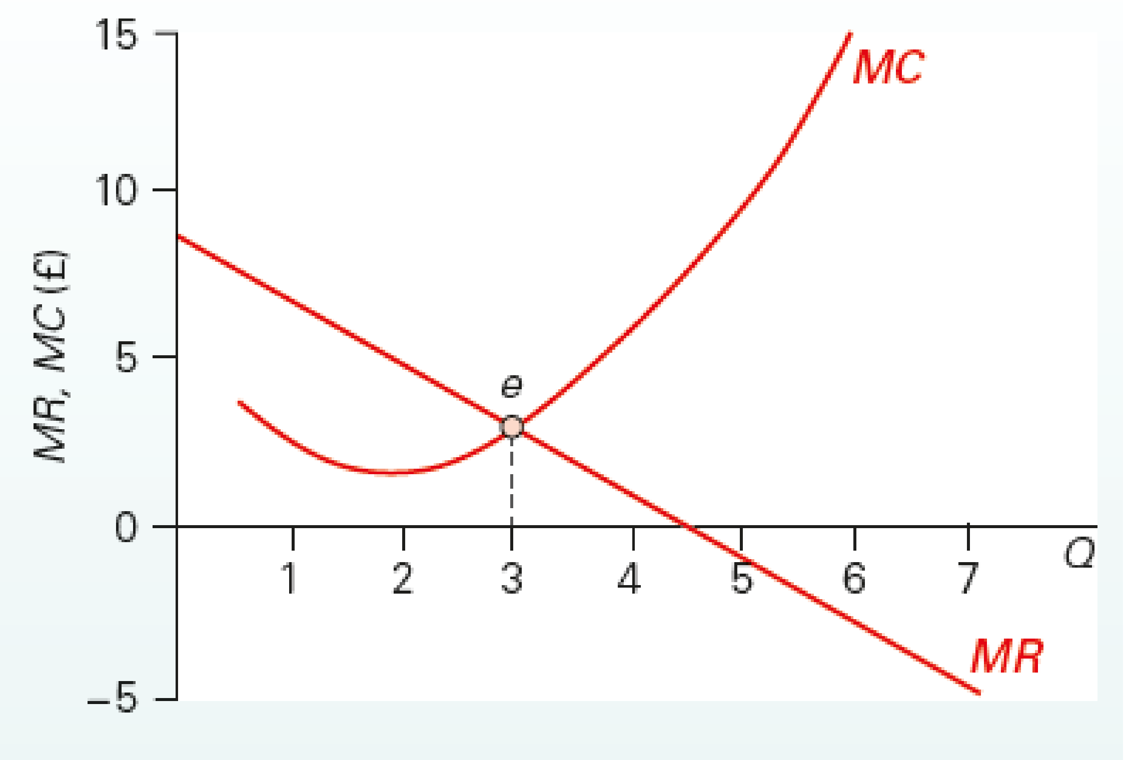
17.1 Short run profit maximization

Unit	Price	Total Revenue	Marginal Revenue (MR)	Total Cost	Average Cost	Marginal Cost (MC)	Profit	Average Profit
0	9	0	-	6	-	6	-6	-
1	8	8	8	10	10	4	-2	-2
2	7	14	6	12	6	2	2	1
3	6	18	4	14	4.7	2	4	1.3
4	5	20	2	18	4.5	4	2	0.5
5	4	20	0	25	5	7	-5	-1
6	3	18	-2	36	6	11	-18	-3
7	2	14	-4	56	8	20	-42	-6

17.1 Short run profit maximization

Stage 1: Using marginal curves to arrive at the profit maximizing output

- There is a very simple profit-maximizing rule if profits are to be maximized, MR must equal MC.
- At point e, MR = MC



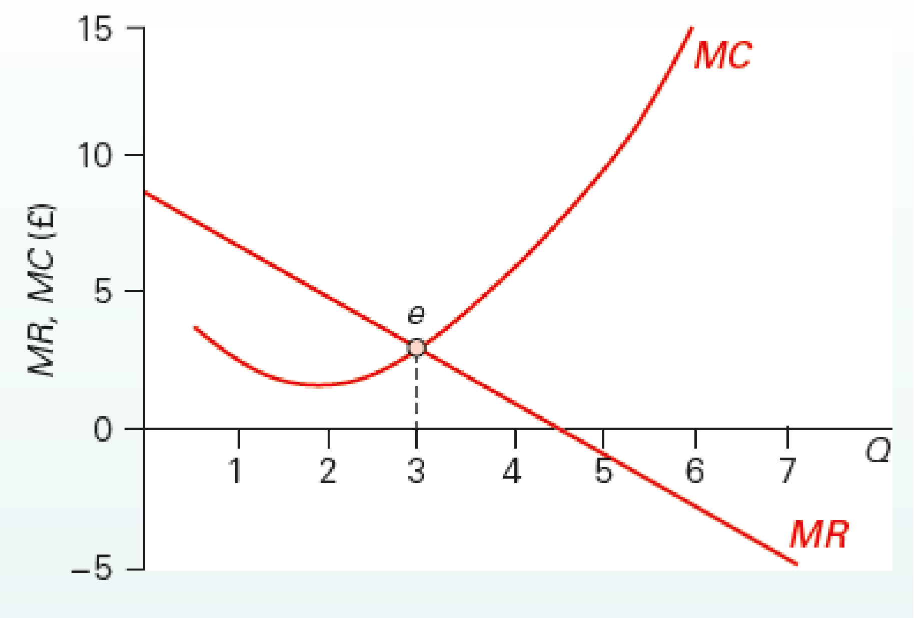
17.1 Short run profit maximization

Explain why profits are maximized when MC = MR?

- At a level of output below 3, MR exceeds MC. This means that by producing more units there will be a bigger addition to revenue (MR) than to cost (MC).
  Total profit will increase. As long as MR exceeds MC, profit can be increased by increasing production.

- At a level of output above 3, MC exceeds MR. All levels of output above 3 thus add more to cost than to revenue and hence reduce profit.
  As long as MC exceeds MR, profit can be increased by cutting back on production.

- Profits are thus maximized where MC = MR:



17.1 Short run profit maximization

Derivation behind Maximum profit
At maximum point slope is 0
For maximum profit

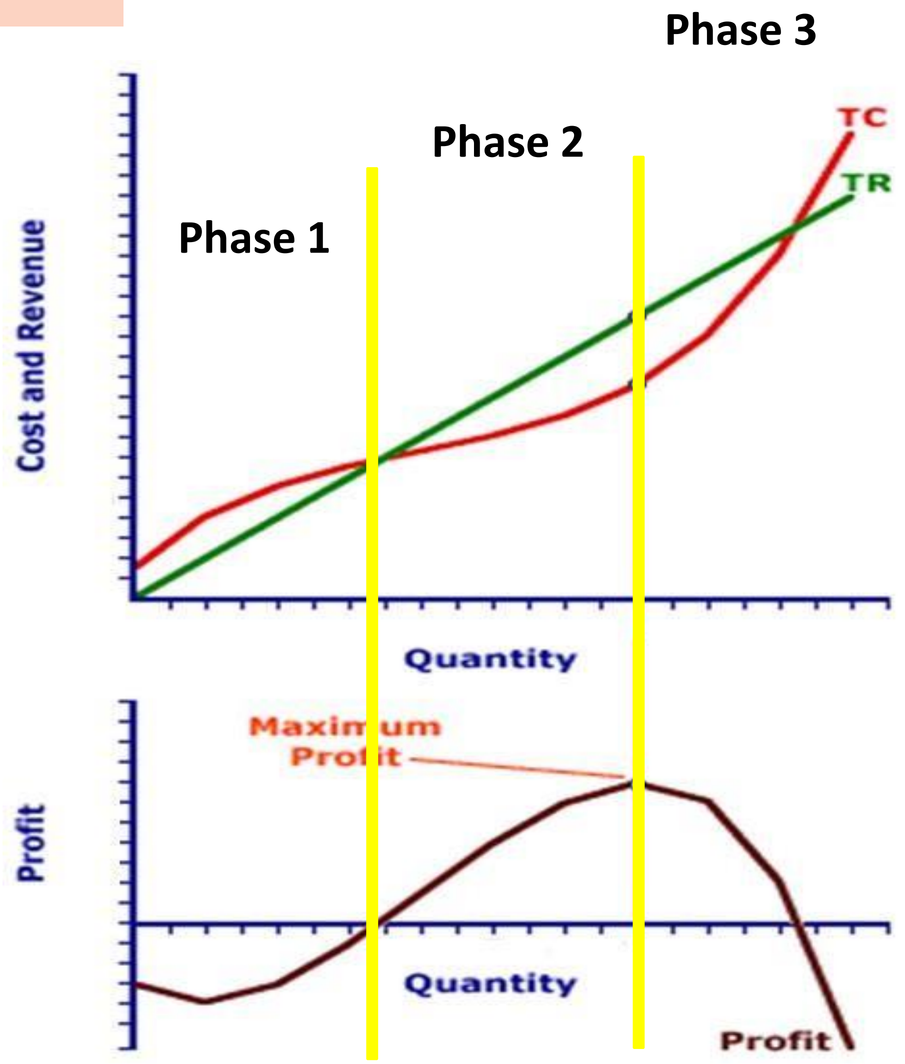
1. $\frac{\Delta Profit}{\Delta Quantity(Q)} = 0$

2. $\frac{\Delta (TR - TC)}{\Delta Q} = 0$

3. $\frac{\Delta TR}{\Delta Q} - \frac{\Delta TC}{\Delta Q} = 0$

4. $MR - MC = 0$

5. $MR = MC$



17.1 Short run profit maximization

Why TR>TC is not profit maximization situation?

Phase 1

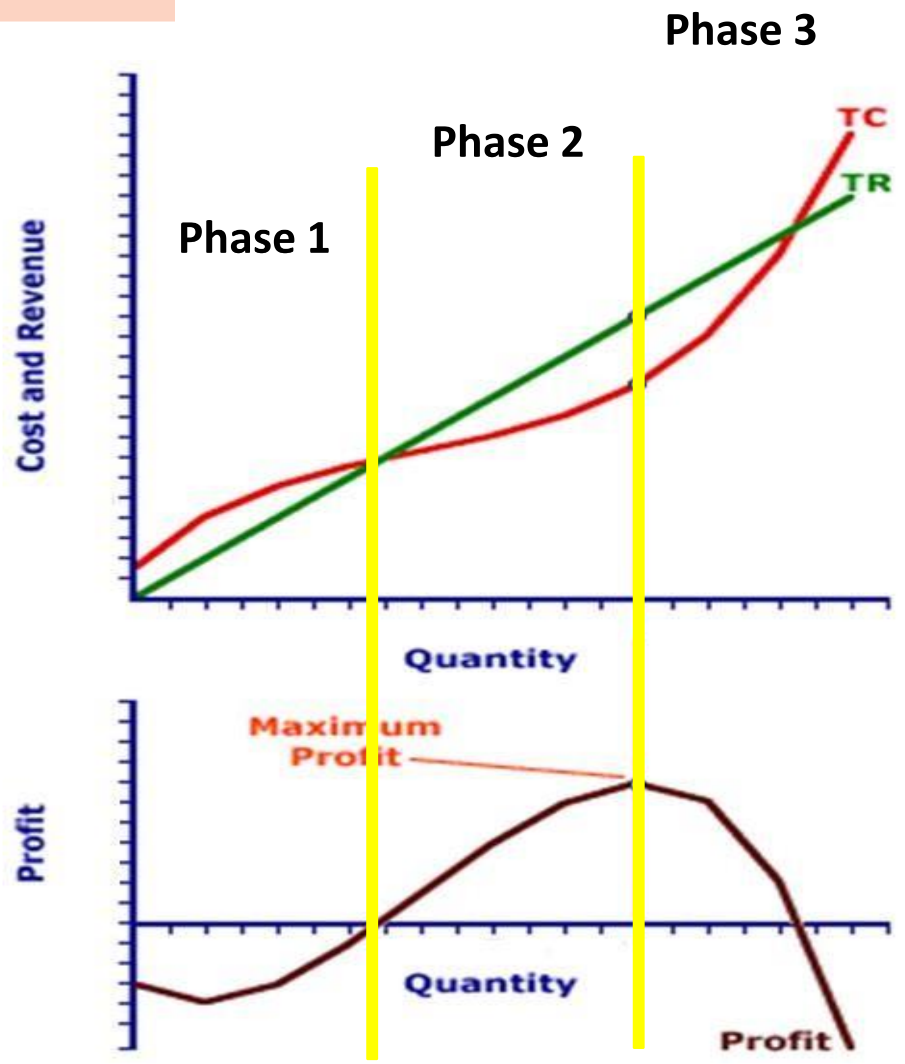
- TC > TR (Loss)
- In second diagram Brown line is below X axis indicating loss

Phase 2

- TC < TR (Profit)
- The brown line is above X axis & also shows maximum profit

Phase 3

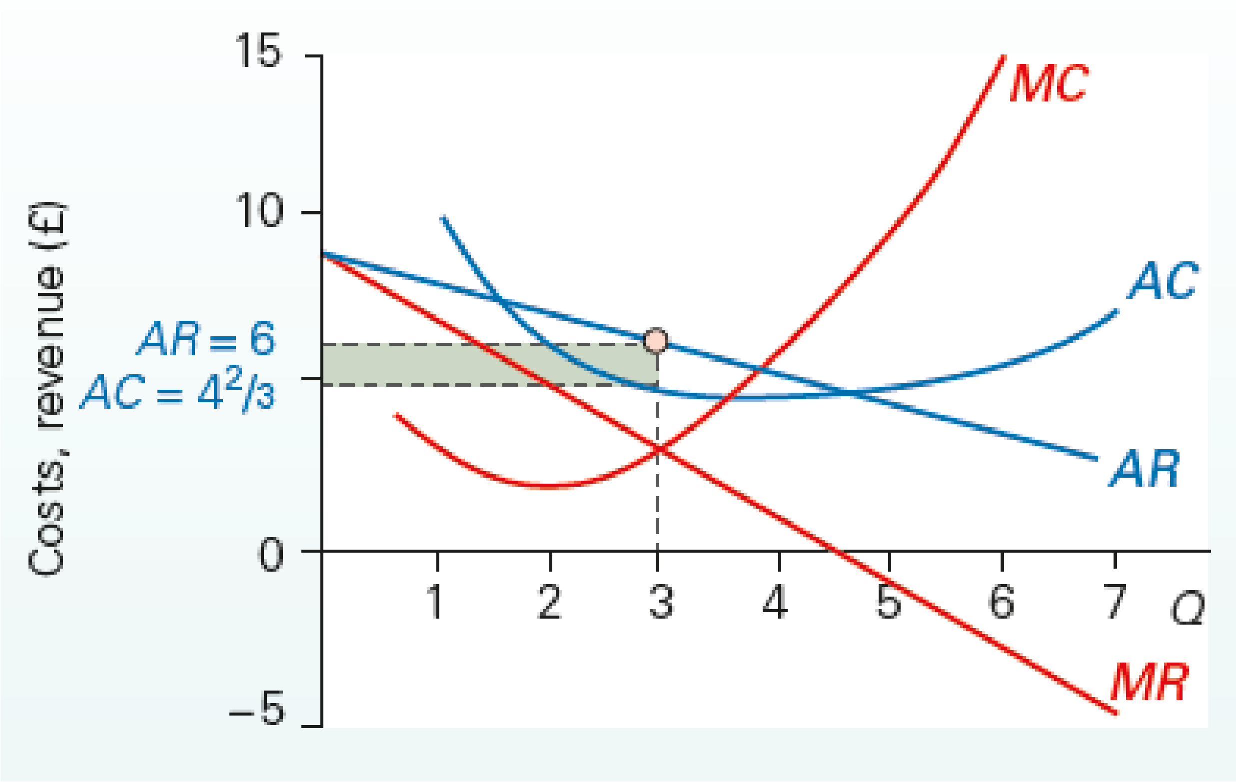
- Phase 3 is same as phase 1



17.1 Short run profit maximization

Stage 2: Using average curves to measure the size of the profit

- At output 3, AR > AC (Profit)
- Profit = 6 – 4.67 = 1.33



17.2 Long run profit maximization

- Assuming that the AR and MR curves are the same in the long run as in the short run, long-run profits will be maximised at the output where MR equals the long-run MC.

- The reasoning is the same as with the short-run case.

17.2 Long run profit maximization

Rate of interest (R.O.I) on riskless loan

+

A risk premium

→

Normal Profit

17.2 Long run profit maximization

- **Normal Profit = Rate of interest on riskless loan + A risk premium**

- **Rate of interest on riskless loan**

  There is an opportunity cost. This is the interest that could have been earned by lending it in some riskless form (e.g. by putting it in a savings account in a bank).

- **A risk Premium**

  The risk premium varies according to the line of business. In those with fairly predictable patterns, such as food retailing, it is relatively low.
  Where outcomes are very uncertain, such as mineral exploration or the manufacture of fashion garments, it is relatively high.

17.2 Long run profit maximization

If there is only normal profit → The owner should (just) stay in industry

If there is more than normal profit → The owner should (obviously) stay in industry

If there is less than normal profit → The owner should leave industry

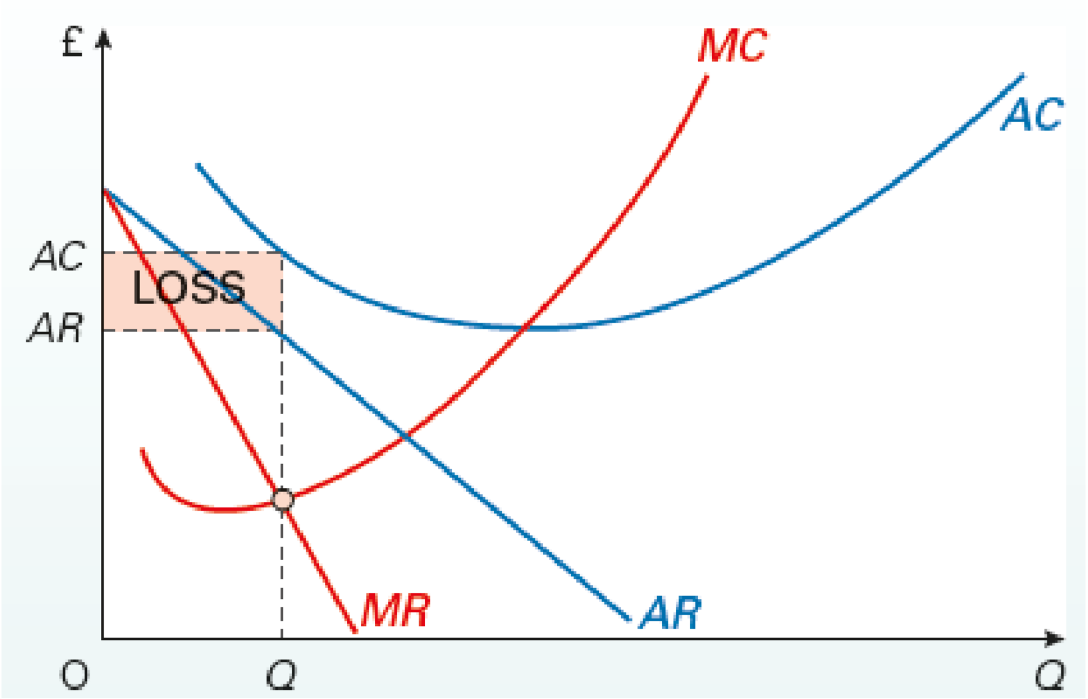
18 Loss Minimization

If firm is making loss then they should try to minimise the loss

Loss Situation will be at

1. AC curve is above the AR curve at all levels of output.

1. In this case, the output where MR = MC will be the loss minimizing output.

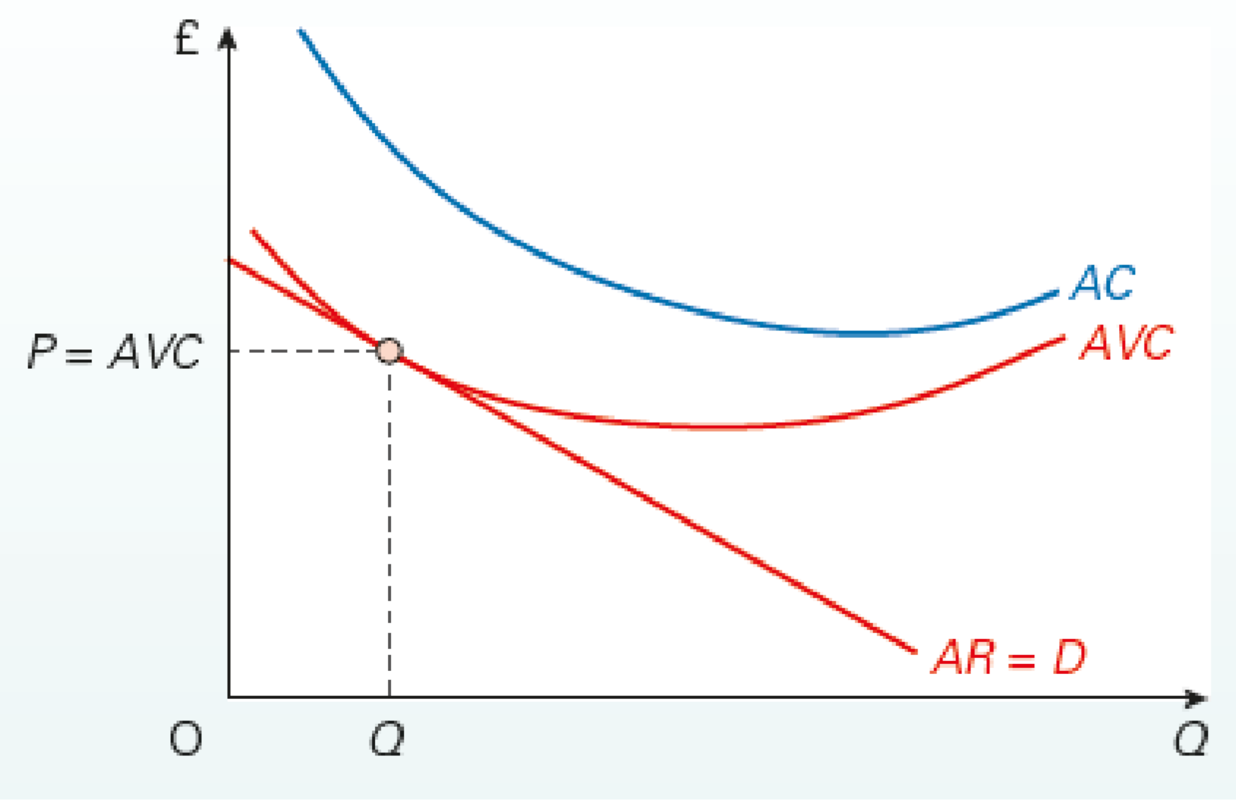


18.1 Loss Minimization – Short Run

- Fixed costs have to be paid even if the firm is producing nothing at all such as rent
- Fixed costs are also sunk costs.
- This means that providing the firm is able to cover its variable costs, it is no worse off than it would be if it temporarily shut down.

18.1 Loss Minimization – Short Run

- If the firm's revenue is not enough to cover its variable costs: that is, if the AVC curve is above, or the AR curve below.
- In that case the firm is worse off than if it only has fixed costs and it will shut down production.
- This situation is known as the short- run shut-down point.



18.2 Loss Minimization – Long Run

- All costs are variable in the long run.
- If the firm cannot cover its long-run average costs (which include normal profit), it will close down.
- The long-run shut-down point will be where the AR curve is tangential to the LRAC curve.