



ANGLO-CHINESE JUNIOR COLLEGE

JC1 Economics

H2

Firms and Decisions (1)

PRODUCTION & COSTS

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Reference Texts:

1. Case, Fair and Oster. *Principles of Economics*, Special Edition for ACJC, Pearson, 2013. Chapters 7-9
2. John Sloman. *Economics*, 8th Edition, Prentice Hall. Chapter 5.
3. Mankiw, Quah & Wilson. *Principles of Economics*, an Asian Edition, CENGAGE Learning. Chapter 13

WHAT IS THIS TOPIC ABOUT?

In the free market economy, resources are allocated through the price mechanism, i.e. forces of demand and supply. The topic “Firms and How They Operate” examines issues related to resource allocation and resource utilisation from the perspective of firms. This topic gives you a better understanding of what decisions lie behind the supply curve in a market. This topic is divided into two main sections:

- (1) Production & Costs
- (2) Market Structure

Firms allocate resources to produce goods and services, with the aim of making profit. Profit is the difference between revenue earned from the sale of the goods and the cost incurred in producing the goods.

$$\text{i.e. Profit} = \text{Total Revenue} - \text{Total Cost}$$

Section (1), Production & Costs, begins with the examination of production behaviour of firms since firms are primarily the agent that is responsible for transforming inputs (i.e. resources) into outputs (i.e. goods and services) for consumers.

From production behaviour, we will go on to determine how cost varies when firms decide to adjust its output in the short run and in the long run.

In Section (2), Market Structure, we then examine the concept of revenue (what firms get when they sell an output) and highlight the difference between average revenue and marginal revenue of firms in perfectly competitive markets as well as markets with imperfect competition. With the knowledge of cost and revenue, we can derive the firm's profit. This section then examines what is meant by “profit” and the different types of profit. This topic also analyses the behaviour of firms and whether the resulting outcomes are desirable in terms of efficiency, equity and product's quality and variety.

LEARNING OUTCOMES

Enduring Understanding:

- Profit is the difference between total revenue and total cost, with Economic profit taking Opportunity Cost into account.
- In the short run, the firm incurs both fixed costs and variable costs.
- In the long run, the firm incurs only variable costs.
- Total Revenue is the product of price per quantity unit and quantity sold: $TR = P \times Q$
- Internal economies and diseconomies of scale can affect the firm's average cost.

Essential Question:

What influences the quantity of output a firm decides to produce?

Recall:

1. What is the central economic problem?
2. What is the firm's main objective when deciding how to allocate resources?
3. Which economic principle do firms use to decide on the quantity to produce?



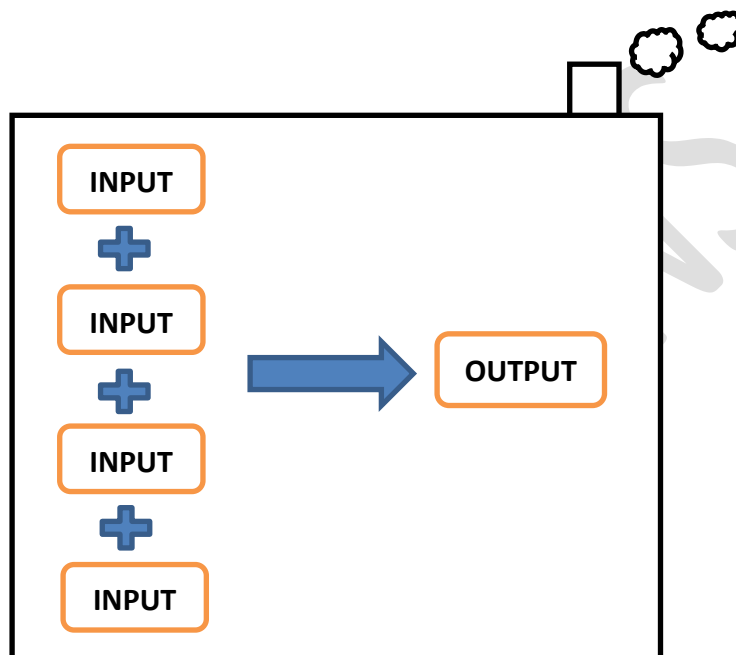
SLS Lesson:
"Overview"

1. **OBJECTIVES OF FIRMS**

A firm is a business unit that combines units of factors of production (inputs) to produce goods and services (outputs).



SLS Lesson:
"Objectives
of Firms"



1.1 Primary Objective of Firms: Profit- maximisation

- Profit is the difference between Total Revenue (TR) and Total Cost (TC). Firms can increase profit by either raising total revenue or reducing total cost.
- A primary assumption in economics is that all firms aim to maximise profit or minimise loss if they are experiencing losses.
- By the marginal principle, total profit will be maximised at the output level where **Marginal Revenue = Marginal Cost**. This output level is termed the firm's **equilibrium output**.

Note: The profit-maximising condition will be covered in the next set of lecture notes, "Market Structure".

1.1.1 Revenue Concepts

Total Revenue (TR) is a firm's earnings from the total outputs sold, i.e.

$$TR = \text{Price (P)} \times \text{Output (Q)}$$

1.1.2 Cost Concepts

Accounting Cost

Considers only the actual expenses incurred, e.g. the monetary cost from payments on factor of production (such as cost of labour, capital goods and raw materials) in the form of wages, interest and rent. These are actual monetary expenses incurred also known as **explicit cost**.

Economic Cost

Economists measure costs in terms of both explicit and implicit/opportunity cost. The economic cost is the sum of the explicit/accounting and implicit/opportunity cost

Opportunity Cost

Opportunity cost refers to the value (or net benefit) of the **next best alternative forgone**. To a firm, this refers to the revenue forgone when deciding to produce an alternative good other to the one it is currently producing. In economics, opportunity costs need to be included to provide an accurate reflection of the true costs in producing a good or a service. Some examples of opportunity costs include:

- Value of the alternative good/ service that the resources could have been used to produce
- Profits earned as an entrepreneur in a different industry

1.1.3 Profit Concepts

$$\text{Profit} = \text{Total Revenue} - \text{Total Cost}$$

Accounting Profit

Accounting profit only considers accounting cost, i.e. the explicit cost incurred. Thus, accounting profit = total revenue - total accounting cost.

Economic Profit

Economic profit considers economic cost, i.e. the explicit cost and implicit cost incurred. Thus, economic profit = total revenue - total economic cost.

- When $TR=TC$, firms are making **normal profit**, i.e. an earning equivalent to the next best alternative earnings (whether another job or industry).
- When $TR>TC$, firms are said to make **supernormal profit**.
- When $TR<TC$, firms are said to be making a loss and **subnormal profit**.

Summary of types of profit:

Economic Profit	TR & TC relationship	What it means
Normal or Zero Economic Profit	$TR = TC$, or $TR - TC = 0$	- Considered as a <u>profitable</u> firm. - The minimum profit required for a firm to remain in the industry in the long run. - No incentive for movement of resources out of or into this industry as the profit made is equivalent to the next highest outside of the industry.
Supernormal Profit	$TR > TC$, or $TR - TC > 0$	- Profit earned exceeds the minimum required for firm to stay in the industry. - Considered as a <u>profitable</u> firm. - There is an incentive for resources to flow into this industry via expansion of existing firms or the entry of new firms, if there are no or weak barriers to entry¹.
Subnormal Profit Or Losses	$TR < TC$ or $TR - TC < 0$	- Firm is making a loss. - Considered as an <u>unprofitable</u> firm. - Firm must decide whether to stay or leave, depending on the different types of cost it faces - Some existing firms would leave the industry and/or fewer resources are put into this industry.

**Note: The concepts on types of profits will be covered in greater details in the next set of lecture notes "Market Structure".*

¹ Barriers to entry refer to restrictions or constraints that make entry of new firms into an industry difficult or impossible. The idea of barriers to entry will be covered in greater details in the next set of lecture notes.

2. DECISIONS BY FIRMS: PRODUCTION AND COST CONCEPTS



SLS Lesson:
"Decisions by
Firms"

2.1 Production and Cost Concepts

A firm needs to make decisions on its production methods and factor inputs used. These determine the cost of production incurred by the firms. These factor inputs, or factors of production, can be classified into **fixed and variable inputs**. These factors will influence the types of cost faced by a firm in its production: **fixed and variable costs**. The classification of these costs and types of inputs will affect the time period the firm operates under: **short versus long-run**.

2.1.1 Fixed Factors versus Variable Factors

A firm's factor inputs can be divided into **fixed factors** and **variable factors**.

Fixed Factor	Variable Factor
• Fixed Factors are factor inputs that do <u>not</u> vary with output, i.e. the quantity of the fixed factor does not change as the firm raises or lowers its output. • Exist only in the short-run e.g. land space, capital goods (machines)	• Variable Factors are factor inputs that vary with output, i.e. the quantity of variable factors inputs used increases as the firm increases its output. • Exist in both the short and long-run e.g. labour and raw materials

Example of fixed and variable factors:

As a bakery increases its output, for example cakes during the pre-Chinese New Year season, more ingredients like flour and sugar and more labour like cashiers or bakers must be used. Such ingredients are **the variable factors**. Yet the bakery will be constrained by the existing number of ovens and the bakery site (shop size). These will remain unchanged and are known as **the fixed factors** in the short run.

2.1.2 Short-Run versus Long-Run

Short-Run	Long-Run
• The period where not all factors of production are variable; at least one factor is fixed. • The firm is able to vary the quantity of some factors of production as the quantity of output changes. • The firm incurs fixed and variable costs • Total cost = total fixed cost + total variable cost	• The period where all factors of production are variable. • The firm is able to vary the quantity of all factors of production as the quantity of output changes. • No fixed costs; all costs are variable (since all factors are variable factors) • Total cost = total variable cost

Note:

- There is **no** particular definition of short-run or long-run in terms of length of time in calendar terms.
- As long as a firm is tied down by any factor input which it cannot vary as it changes its output, the firm is operating in the short run period.
- It is assumed that in the short-run, the use of certain factor inputs are bound by contracts and agreements and thus the firm is unable to vary its quantities of these factor inputs, hence known as fixed factor inputs
- When the firm is no longer bound by such contracts and able to change the quantity of its fixed factor, it is in the long-run period.

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3. SHORT RUN COST OF PRODUCTION

When operating in the short run, the firm uses both fixed factors and variable factors. Thus, the firm's total cost of production is the sum of its Total Variable Cost and Total Fixed Cost.

$$\text{Total Cost} = \text{Total Variable Cost} + \text{Total Fixed Cost}$$



SLS Lesson:
"Short-Run
Cost of
Production"

3.1 Total Cost (TC)

Total Fixed Cost [TFC]	Total Variable Cost [TVC]	Total Cost [TC]
- Cost of fixed factors Does not vary directly with output, i.e. incurred even when output produced is zero - Occurs only in the short run E.g. rent, depreciation cost of plant and equipment	- Cost of variable factors Varies directly with output, i.e. cost increases as output produced increases, cost is zero when output produced is zero - Exist in both short and long run E.g. wages and cost of raw materials	- Summation of the total fixed cost and variable cost $TC = TFC + TVC$, where TFC = Average Fixed Cost (AFC) x Quantity (Q) and TVC = Average Variable Cost (AVC) x Q

3.2 Marginal Cost (MC)

Marginal Cost is the additional cost of production when an additional unit of output is produced i.e. it is the **increase in additional cost added to the total cost given the production of one more unit of output**.

Recall that Total Cost is the summation of Total Fixed and Total Variable Cost, and only the variable cost changes with output while fixed cost does not vary with output. (i.e. there will be no change in Total Fixed Cost, $\Delta TFC = 0$, as output changes. Thus, marginal cost can be measured by the change in Total Cost, ΔTC or the change in Total Variable Cost, ΔTVC .

**Note: Derivation of cost and revenue is not needed.*

$$\begin{aligned} \text{Marginal Cost} &= \frac{\Delta \text{ in Total Cost}}{\Delta \text{ in Total Output (Q)}} = \frac{\Delta \text{ in TFC} + \Delta \text{ in TVC}}{\Delta \text{ in Total Output (Q)}} \\ &= \frac{\Delta \text{ in TVC}}{\Delta \text{ in Total Output (Q)}} \quad (\text{Since TFC is constant, } \Delta TFC = 0) \end{aligned}$$

The MC curve is U-shaped (Figure 1) because of the **law of diminishing marginal returns**. The law of diminishing marginal returns states that

after a certain output level, when additional units of a variable input are added to a fixed input, the marginal product of the variable input declines.

A firm's marginal cost depends on its marginal product. Marginal product is the additional output that is produced by using an additional unit of specific input, ceteris paribus.

The relationship between marginal product and marginal cost is premised on the law of diminishing marginal returns.

- MC falls as MP increases
- MC rises as MP decreases

The law of diminishing marginal returns suggests that firms will reach a point when each additional unit of input will produce less additional output than the previous unit; thus, the marginal cost curve is U-shaped.

Refer to Annex 1 for the explanation and numerical example of Law of diminishing marginal returns and further elaboration on the shape of the MC curve.

3.3 Average Cost (AC)

- **Average Fixed Cost (AFC)** is the cost of fixed factors per unit of output.

$$\text{Average Fixed Costs} = \text{Total Fixed Cost} / \text{Total Output (Q)}$$

As the firm increases its output, its fixed cost is spread out over larger and larger output and thus decreases. Hence the AFC curve is downward sloping.

- **Average Variable Cost (AVC)** is the cost of variable factors per unit of output.

$$\text{Average Variable Costs} = \text{Total Variable Cost} / \text{Total Output}$$

Since AVC can be derived from TVC / Q , and TVC is the summing of the production cost of each additional unit of output (i.e. marginal cost), the shape of AVC would be derived from marginal cost as well, in this case, a U-shaped due to the law of diminishing marginal returns (Figure 1). It first slope down from left to right as output increases, it then reaches a minimum point, before rising as output increases further. (For details on the marginal cost and law of diminishing marginal returns, refer to the next section.)

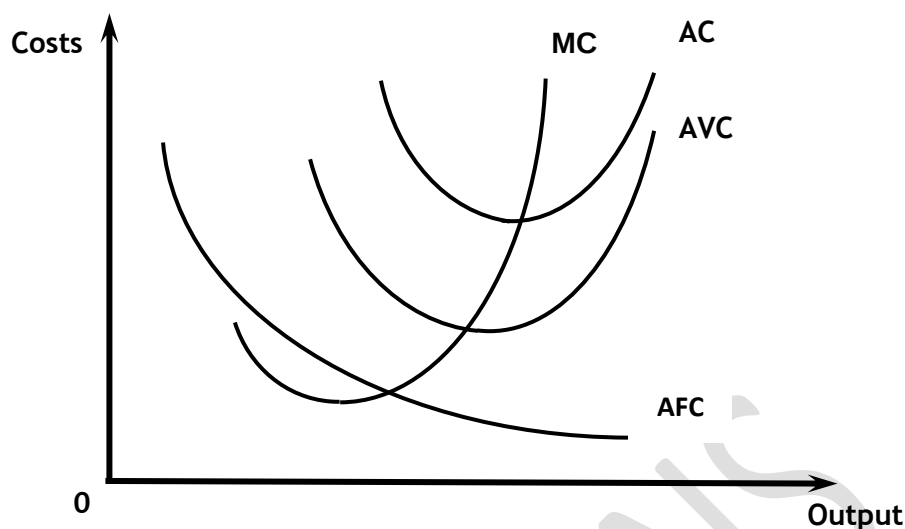
- **Average Cost (AC)** is the total cost of production per unit of output. This curve has a similar shape to the AVC curve. It falls and then rises because it is the summation of the AFC and AVC curves.

$$\text{Average Cost} = \text{Total Cost} / \text{Total Output}$$

$$= [\text{Total Fixed Cost} + \text{Total Variable Cost}] / \text{Total Output}$$

$$= \text{Average Fixed Cost} + \text{Average Variable Cost}$$

Figure 1: Average Cost and Marginal Cost curves



Refer to Annex 2 for a numerical example for these short run costs curves.

4. LONG RUN COST OF PRODUCTION

Long run production occurs when all factors, both labour and capital, are variable. As there are no fixed factors and fixed cost in the long run, the long run average cost of production is the average variable cost. So, in the long run,

$$\text{Average Cost of Production} = \text{Total Variable Cost} / \text{Total Output}.$$

The determinant of the shape of the LRAC curve is the **law of returns to scale**. The scale of production looks at how scaling up the production (through increasing **all its inputs** by the same proportion) would affect the output produced. This is possible as all the factors of production are now variable in the long run.

A firm can experience **increasing, constant and decreasing returns to scale**.

- Increasing returns to scale means that a given percentage increase in inputs will lead to a **larger percentage increase in output**.
- Constant returns to scale means that a given percentage increase in inputs will lead to the **same percentage increase in output**.
- Decreasing returns to scale means that a given percentage increase in inputs will lead to a **smaller percentage increase in output**.

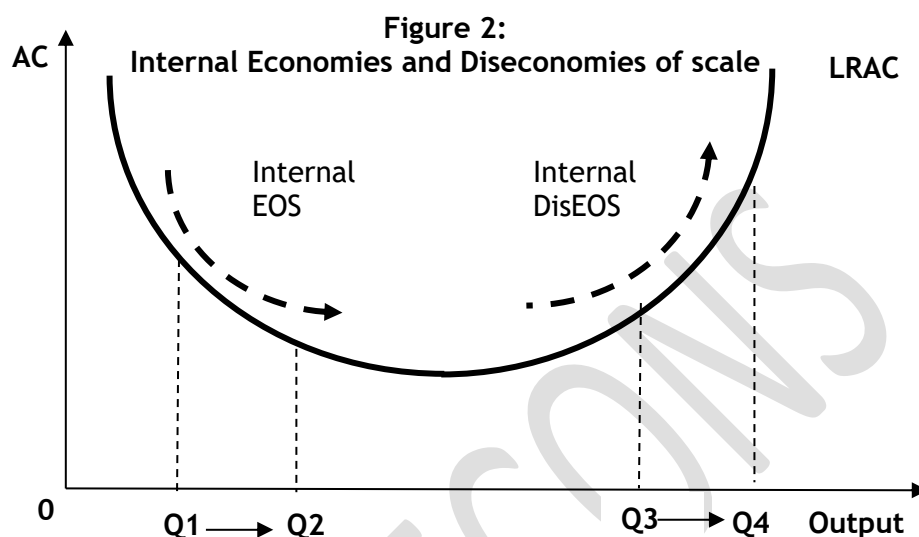


SLS Lesson:
"Long-Run
Cost of
Production 1"

4.1 Internal Economies & Diseconomies of Scale

4.1.1 Internal Economies of scale

Internal Economies of Scale (EOS) refers to cost savings arising from the increase in output by expanding the firm's scale of production (size of firm). Internal EOS enables the firm to spread its cost over a larger output, hence lowering its Long-Run Average Cost (falling LRAC).



Sources of Internal Economies of Scale

*Note: The description of the source of internal economies of scale must ultimately show how it leads to a decrease in the long-run average cost.

(i) Technical economies of scale (automation)

A large firm with a higher output can use machineries with larger productive capacity to produce a larger quantity of output. Additionally, producing at a higher output allows the firm to achieve greater capacity utilization, meaning that the machinery and equipment are used closer to their full potential, further contributing to cost reductions. Therefore, the cost of production is spread over a larger output leading to a decrease in long run average cost.

For example, large photocopying companies can better utilise the functions of an advance photocopying machine by making large number of printings or mass printing. Thus, the cost of the high-tech photocopying machine is spread over a larger output leading to a decrease in long run average cost. On the other hand, smaller printing shops have smaller output or fewer number of printings and thus, unable to fully utilise the capacity of the advance photocopying machine. Thus, the cost of the machine is spread over a smaller output leading to higher long run average cost.

(ii) Administrative economies of scale

Output expansion allows firms to spread overhead costs involving the employment of management staff, thus administrative cost per unit of output is lowered. Large firms such as Apple Inc. can employ specialist

managers for different specific functions - such as finance, human resource, centralized administrative advertisement, billing, and staff training. This will raise productivity where output per worker increase as such specialised staff are trained specifically for their functions as compared to a general staff that is not trained in any function and thus would take a longer time to complete the same task. Hence, the administrative cost is spread over larger output, reducing its long run average costs. On the contrary, it may not be economically feasible for smaller firms to hire specific people for specific job scopes due to the much smaller output.

(iii) Marketing economies of scale

Large firms are in a better bargaining position than small firms, thus they can purchase inputs in bulk at discounted prices. This enables them to spread advertising costs over a larger output leading to a decrease in long run average cost.

For example, NTUC is able to negotiate with food suppliers for bulk purchases at lower prices compared to owners of small provision shops. Similarly, NTUC can spread the advertising costs over larger output, hence lowering marketing cost per unit of output.

(iv) Financial economies of scale

Large firms are thought to be more credit worthy and less risky than small firms primarily due to their greater financial resources, such as cash reserves and investment portfolios, which offer substantial buffers against economic downturns. Large firms would have more cash reserves to buffer against periods where they may suffer from economic losses due to a fall in revenue from a fall in demand of their goods/services during economic downturns. In addition, large firms are more likely to have a more diversified business whereby they are active in different markets. As such, the impact of a fall in revenue in one market can be cushioned by potential gain in revenue in the other markets which mitigate the impact of any single failure and thus reduce the overall risk. Thus, they are usually given banks loans with more favourable (lower) rates of interest as they are deemed as less risky borrowers. This lowers the cost of borrowing and thus lowers the cost of production, if loans are needed to finance production. Thus, the cost is spread over a larger output, reducing the long run average cost.

(v) Risk-bearing economies of scale

Large firms may diversify their products to spread out risks as losses incurred by one product can be offset by profits earned from another product. In the process of diversification, firms may also enjoy risk-bearing economies of scale.

For example, Samsung diversifies their products from electric appliances to smartphones and smartwatches. This could require Samsung to spend significant investment to carry out research and development. Subsequently, when the products are produced on larger scale, the entrepreneurial cost is spread across a larger output, lowering the long run average cost of production.

For example, Razer Inc. was cofounded by entrepreneurs Tan Min-Liang and Robert Krakoff. They diversify their products from mouse devices and keyboards to laptops, smartphones and gaming chairs. When Razer Inc. diversifies, the entrepreneur cost is spread across a larger output.

4.1.2 Internal Diseconomies of Scale

Internal Diseconomies of Scale refers to the cost increases, or cost disadvantages, due to expansion of the firm. Internal Diseconomies of Scale leads to **rising long run average cost as the firm continues to expand (rising LRAC)**. The firm is considered to have over-expanded such that greater complexity in management results in rising costs.

Sources of Internal Diseconomies of Scale

(i) Problems of a bureaucratic structure

The larger firm producing much larger output levels can be bogged down by rules, regulations and standard procedures. Decision-making is slowed down by red-tape and bureaucracy. This results in lower productivity where output per worker falls. Thus, the cost is spread over a lower output which increases per unit cost. As a result, this leads to an increase in long run average cost.

(ii) Problems of coordination and management of information (Administrative diseconomies of scale)

As the firm expands, there is greater complexity in coordination between several large departments performing different functions. This results in higher cost to disseminate and manage information, hence long run average cost starts to increase.

(iii) Absence of motivational elements

As a firm expands and hires more workers, it can create a work environment where employees feel more isolated and less appreciated. In smaller companies, workers often experience a close-knit atmosphere where their contributions are more visible and directly recognised by management. However, in a larger firm, individual efforts might be less noticeable, and employees can feel like just another cog in the machine. This lack of recognition and personal connection can lead to lower staff morale. When employees feel undervalued and disconnected from their work and colleagues, their motivation and engagement tend to decrease, which may reduce their productivity where output per worker decrease. Thus, the cost is spread over a lower output leading to an increase in per unit labour cost hence increasing long run average cost of production.

4.2 Minimum Efficient Scale (MES) of Production

Among the factors that firms will likely consider in the decision whether to expand or not will be the extent of the economies of scale (cost savings from size expansion) they can enjoy.

The more capital-intensive production is, the greater the incentive for firms to expand to better optimize the use of their capital resources (such as machinery).

Minimum efficient scale (MES) is a term referring to **the level of output that enables a firm to produce at the lowest possible long run average**



SLS Lesson:
"Long-Run
Cost of
Production 2"

Learning

cost (i.e. the minimum point of the LRAC) with the current state of technology. At this point, the scope for internal economies of scale is fully exploited.

Once the MES of production is reached, any further increase in scale of production will result in internal diseconomies of scale.

The typical shape of the LRAC curve in an industry and the firm size needed to reach the MES will determine whether the industry will have many small firms or just a few big firms

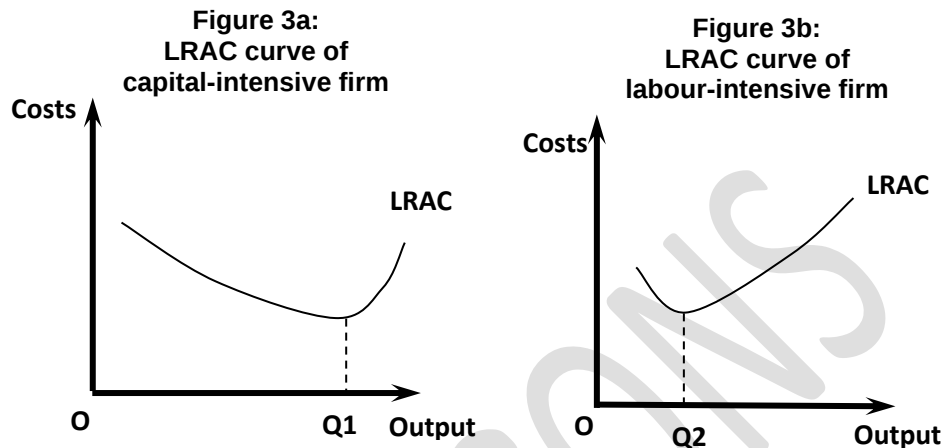


Figure 3a: For a capital-intensive industry, the firm's LRAC continues to fall at a higher scale of production. This is usually the case because they require large investments in machinery, equipment, or infrastructure. These fixed costs are substantial. To achieve cost efficiency, the firm must spread these fixed costs over a large volume of output. Hence, MES output is greater at Q1. It is likely that the domestic market can support only a few large firms or only one firm. If there are too many firms in the industry, firms will not be able to produce at cost effective conditions, incurring higher a long run average cost of production, affecting their profitability.

Figure 3b: For a labour-intensive industry, the firm's LRAC rises at a lower scale of production. This is usually the case because they rely more on human workers, which are variable costs. At higher levels of output, it is more difficult to coordinate the workers and control the quality of the products, resulting in higher costs incurred. Hence, MES output is lower at Q2. It is likely that the domestic market can support more firms and there will be many small firms in the industry. This suggests that there can be many small firms in the industry.

The MES gives us a **rough measure of the appropriate number of firms** in the industry and therefore the **degree of competition**.

Note that the number of firms in the industry will determine the extent of competition (and consequential welfare effects on society).

MES can be represented as follows:

Table 1: Minimum Efficient Scale (MES) for selected products

Product	MES as a % of UK production	MES as a % of EU production
Cellulose fibres	125	16
Steel	72	10

Cigarettes	24	6
Shoes	0.3	0.03
Cars	200	20
Lorries	104	21

If the MES is small relative to industry total production, there is room for many small-sized plants, all operating near their MES. This suggests that the degree of competition in that industry is likely to be high. This can be seen in the shoe industry, where the MES as a % of UK and EU production is very low, 0.3% and 0.03% respectively. This means that even if a firm exhausted its economies of scale (i.e. MES output level was reached), its output is still small relative to total UK and EU production. This means that in the shoe industry, there would be room for many, small shoe firms operating at optimal capacity.

However, in other industries like cellulose fibres industry in UK, its MES is greater than 100%. This means that even if a single plant or firm were large enough to produce the whole output of the industry in the UK, it would still not be large enough for the firm to experience the full potential economies of scale. In these industries, there is no possibility of competition from within the country. As long as the MES exceeds 50% of the industry, there will not be room for more than one firm large enough to gain full economies of scale (unless they export and have a larger market). In this case, the industry is said to be a **natural monopoly** and would be less competitive.

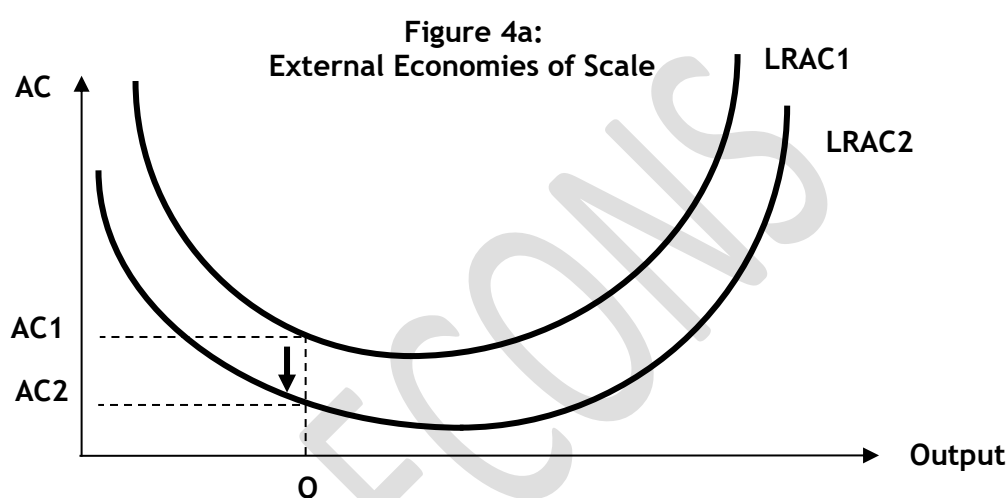
**Note: More details on ‘natural monopoly’ as well as the correlation between the sizes of MES output to the typical market structure of the industry will be covered in the next set of lecture notes ‘Firms and how they operate: Market Structure’, Section 2.2.1:Natural Monopoly.*

4.3 External Economies & Diseconomies of Scale

4.3.1 External Economies of scale

External economies of scale are cost savings which firms enjoy due to **industry-based expansion** or growth in availability of facilities. When the industry grows, **all firms in the industry will experience a decrease in average cost, regardless of size of firm.**

External economies of scale is depicted by a **downward shift of the long-run average cost curve**. This is because the **lower cost is enjoyed at every output level; regardless of the size of the individual firm**. This can be seen at the same output Q , where LRAC falls from $AC1$ to $AC2$



Sources of External Economies of scale

External economies of scale occur due to the **geographical concentration** of firms in the industry. For instance, the Silicon Valley which is located in San Francisco Bay is an area that has attracted many world's largest high-tech corporations, and start-ups companies to set up headquarters there so as to tap on the infrastructure, pool of talents there.

Hence, geographical concentration often brings with it several benefits:

(i) Development of industrial amenities e.g. water, electricity, gas

As more and more firms are set up in the same area, industrial amenities such as water and electric power will be better developed. The relevant authorities and suppliers will provide these for the convenience of the industries. Such developments will greatly facilitate production, reduce costs for the individual firms and hence lower long run average cost for all firms in the region.

(ii) Development of a better transportation infrastructure

With the expansion of the industry, there is a more pressing need for better transport infrastructure such as highways, railroads, ports for the movement of raw materials from suppliers of factor inputs to the plants, and of finished products from the factories to the markets to reduce possible congestion as more firms start to use the same transport infrastructure. As such, a better transport infrastructure will eventually be developed. Improved transportation infrastructure facilitates faster, more reliable, and cost-effective movement of goods

and services. This results in lower transportation costs and improved delivery times. These benefits arise from improvements in the broader economic environment, rather than from changes within the individual firms themselves. The reduction in transport costs will lower long run average cost for all firms who are using the transport system.

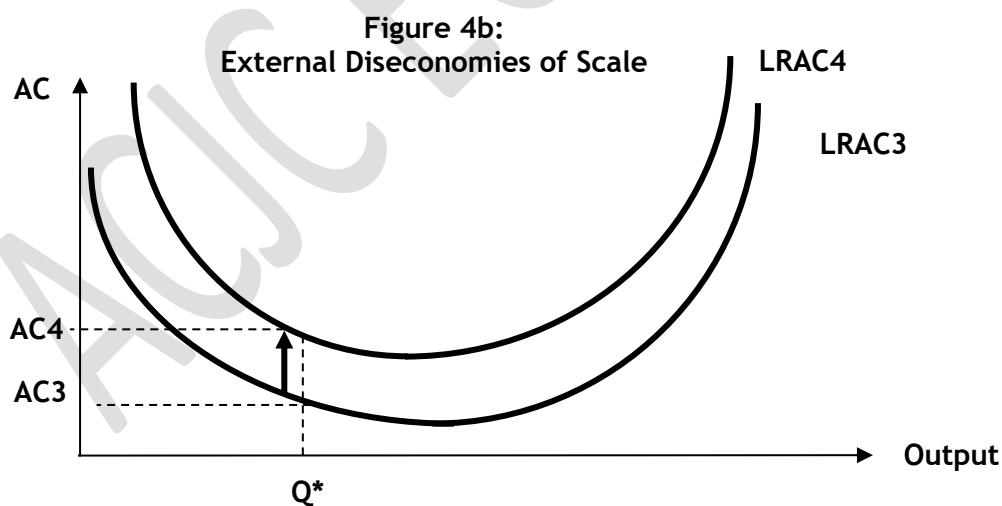
(iii) Development of research facilities

Research to develop better production techniques and new products often emanates from industrial growth. Firms may combine efforts to engage in research or the government may set up a research centre to develop better methods and products of higher quality. If these improvements and innovations lead to an increase in productivity which lowers cost per unit output, then all firms, even those who do not spend on research and development will stand to benefit as they can adopt these innovations and improvements without incurring costs. This will help to lower long run average cost for all the firms.

4.3.2 External Diseconomies of Scale

External diseconomies of scale refer to rising average cost of the firm due to the over expansion of the industry or over concentration of firms in a particular area. All the firms in such industry will experience external diseconomies of scale, and **increase in long run average costs**, regardless of the size of the firm.

External diseconomies of scale are depicted by an **upward shift of the long-run average cost curve**. A higher AC is experienced at every output level; at the same output Q^* , LRAC increases from AC3 to AC4.



Sources of External Diseconomies of Scale

(i) Factor prices

When there is an over concentration of firms in a particular area, it will lead to strong competition for labour, land and other factors of production in that region/area. As a result, such over concentration of firms may raise wages, rental cost and other costs of production. Given the same output, a higher cost of production will lead to higher long run average cost.

(ii) Crime rates

In a general recession or within a declining industry, areas with a high concentration of firms may experience mass unemployment. This economic hardship can lead to increased crime rates and social unrest in the region. High unemployment often results in financial desperation, driving some individuals toward criminal activities as a means of survival. The rise in crime and instability elevates risks for businesses operating in these areas, leading to higher costs in several ways. Firms may need to spend more in security measures, such as hiring security personnel, installing surveillance systems, and fortifying their properties. Additionally, insurance companies may charge firms higher insurance premiums due to the higher risk of theft, vandalism, and other criminal activities. The environment may become less attractive to workers, forcing firms to offer higher wages, increasing operating costs. Given the same output, a higher cost of production will lead to higher long run average cost. These factors collectively increase the long-run average costs for all firms in crime-prone areas.

(iii) Infrastructural bottleneck

Infrastructural bottlenecks refer to limitations in public infrastructure, such as transportation networks, utilities, and communication systems, that can impede the growth and efficiency of firms. When there is over expansion of the industry, the existing infrastructure may become overloaded and inadequate to meet the increased demand. This leads to congestion, delays, and higher costs for businesses. For example, crowded roads can cause delays in the delivery of goods and increased transportation costs. Similarly, inadequate utilities like electricity and water supply can disrupt production processes and increase operational costs. These bottlenecks represent external diseconomies of scale because they arise from factors outside the firm's control and affect all firms in the area. As such these infrastructural constraints would lead to higher average cost of production, which increases their long run average costs.

Learning Reflection

*Congratulations! You have completed this lecture topic.
How much have you understood?*

Below are the checklists which you may use to assess how much you have understood.

	<i>Content Checklist: Are you able to do the following?</i>	<i>Checked</i>
1.	Define Economic Profit and differentiate it from Accounting profit.	
2.	Explain how firms make (basic) decisions when pursuing profit-maximization and consider the relevance of costs in their decision making.	
3.	Define Average Variable Cost, Average Fixed Cost and Marginal Cost.	
4.	Explain the reasons for the nature of firm's production cost in the short run and long run respectively.	
5.	Explain the types of internal and external economies and diseconomies of scale and how it affects firm's long run average cost.	

ANNEX 1

Law of Diminishing Marginal Returns

- The law of diminishing marginal returns states that **after a certain level of output production**, when **additional units of a variable input are added to a fixed input**, the **marginal product of the variable input declines**.

Marginal product (MP) refers to the change in total output as a result of employing one more unit of input.

(I.e. the employing of an additional factor of production (variable factor) will eventually cause a relatively smaller increase in total output.)

- Recall: In the short run, at least one factor of production is fixed (e.g. machine).
 - The MC falls at first as the additional variable factor (e.g. labour) could engage in specialisation and division of labour better. This brings about an increase in marginal product.
 - However, there comes a point when the increased in variable factor (labour) results in MC rising. This is because the productivity of the variable factor (labour) could be hampered - for instance, the additional labour might get in each other's way, or long wait time as there might be insufficient machines for each labour to use.
- Thus, the law of diminishing returns can be used to explain for the **U-shaped of AC, AVC and MC curves**. I.e. the curves would first slope down from left to right as output increases, it then reaches a minimum point, before rising as output increases further.

An example of the law of diminishing marginal returns:

- A sandwich shop with only one worker can produce a total of 10 sandwiches per day. A standard rate is paid to its workers, \$50 a day.
- Since firms need to use more input to produce more output, it would be adding variable factors (e.g. labour) to its fixed factors (machine) in production.
- MC falls as output increase at increasing rate:
 - Initially, the **output increases at an increasing rate** as the variable factor (labour) gets more and more productive. Thus, the **Marginal Product (MP) rises** and **Marginal Cost falls** as output increases as they can divide and specialise in their work.
 - This is seen when a **second worker** is hired, the total sandwiches produced per day increases from 10 to 25. Thus, the **Marginal Product** of the **second worker** is **15** sandwiches which is higher as specialisation can take place, and the marginal cost is $50/15 = 3.33$.

No. of workers	TVC (spent on wages)	Total no. of sandwiches	Marginal product	Marginal cost
1	\$50	10	10	5
2	\$100	25	15	3.33
3	\$150	30	5	10
4	\$200	32	2	25

- MC rises as output increases at decreasing rate:
 - As the firm continues to add more units of a variable factor (labour) to the fixed factor (shop space), the **fixed factor is more and more utilised** and when it is beyond its optimal utilisation level, it becomes **over-utilised**.
 - When the fixed factor becomes over-utilised, this is when additional units of variable factor (labour) becomes less and less productive. The **output produced is thus increasing at a decreasing rate**.
 - This can be seen upon hiring the **third worker**; the total sandwiches produced increases from 25 to 30. Thus, the **Marginal Product** of the 3rd worker falls to 5 as compared to 15 previously, which means marginal productivity has fallen.
- Marginal Cost is given as $(\Delta \text{ in TVC} \div \Delta \text{ in Q})$ and **as the Total Variable Cost increases faster than the number of sandwiches produced (falling marginal product), the Marginal Cost rises**. This continues, as the fourth worker is hired and Marginal Product falls to 2 and Marginal Cost increases.
- Observe the rate of change in Marginal Product and Marginal Cost above. This is the **Law of Diminishing Marginal Returns** at work, as additional units of variable factor are added to the fixed factor, eventually the marginal productivity will diminish. This means the total output produced will increase at a decreasing rate, because the marginal product falls.

**Note: Technical analysis of law of diminishing marginal returns is not required.*

ANNEX 2

Short-run Costs of a Hypothetical Firm

The table below displays the numerical example of a short-run costs of a hypothetical firm. The table is a useful guide to understanding the shape of the average costs and marginal costs curve.



Try it yourself:

Try using the data from column (1), (3), (4), (7) and (8) and plot the curves on a diagram.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
q	TVC	MC (ΔTVC)	AVC (TVC/q)	TFC	TC ($TVC + TFC$)	AFC (TFC/q)	ATC (TC/q or $AFC + AVC$)
0	\$ 0.00	\$ -	\$ -	\$100.00	\$100.00	\$ -	\$ -
1	20.00	20.00	20.00	\$100.00	120.00	100.00	120.00
2	38.00	18.00	19.00	\$100.00	138.00	50.00	69.00
3	53.00	15.00	17.66	\$100.00	153.00	33.33	51.00
4	65.00	12.00	16.25	\$100.00	165.00	25.00	41.25
5	75.00	10.00	15.00	\$100.00	175.00	20.00	35.00
6	83.00	8.00	13.83	\$100.00	183.00	16.67	30.50
7	94.50	11.50	13.50	\$100.00	194.50	14.28	27.78
8	108.00	13.50	13.50	\$100.00	208.00	12.50	26.00
9	128.50	20.50	14.28	\$100.00	228.50	11.11	25.39
10	168.50	40.00	16.85	\$100.00	268.50	10.00	26.85