ANGLO-CHINESE JUNIOR COLLEGE

JC1 Economics

H2 | **Firms and Decisions (1)**
PRODUCTION & COSTS

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.

i.e. Profit = Total Revenue – 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. This topic also examines issues pertaining to firms such as mergers, outsourcing and off-shoring.

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.

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 x 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"

This article is to be **read and following the questions answered** before your Economics lecture.

Article (Pre-Lecture Reading):

Are your sports shoes worth what you paid for them?

The former National Basketball Association (NBA) star Stephon Marbury thinks shoe companies and their celebrity endorsers are ripping you off. With sneaker costing upwards of £100, it's not hard to see why he feels this way. Marbury now believes the market is ready to welcome his branded sneaker line Starbury that costs less than £10.

Many activities go into creating a product from the design and manufacturing to the shipping, branding and retailing. These form part of the value chain, and thus the cost of a shoe. Often the physical assembly is done in low labour-cost locations like China. However, this is only a small piece of the chain and not much of a cost for the company.

Rather, shoes sold in the US actually get 70% of their value from work done in the US. This includes design, choosing the materials, hiring sponsors, spending on advertising and retail. Customers want to make sure that when they buy shoes they have a guarantee of quality from the brand, and that has a price tag.

More shoemakers are turning to high-quality materials such as kangaroo leather or mirror finishes that change colour which adds to the cost. 3-D printing is also becoming popular as a way to produce the soles of trainers. The materials are getting better and that means the material costs go up, so prices increase.

Arguably the most expensive piece of the value chain is building the brand. Footwear companies have to spend money to make their shoes desirable, cool and fashionable. And the field is becoming more competitive as athlete endorsers are increasingly being joined by other trendsetters like artists, musicians and graffiti artists. Companies spend a lot to get celebrity endorsers like Kanye West or Michael Jordan, as consumers are far more likely to pay a lot for shoes worn by their idols.

The design of the shoe is also a large part of its value. Brands that work with endorsers typically ask for their input on the look and performance of the shoe. Once the shoe solves a problem like arch support, increased speed or more slip resistance, companies have to protect their plans through patents. Billions of pounds are spent by apparel companies each year to protect against counterfeits. That cost eventually gets tied into the price of a pair of shoes.

If Marbury is serious about getting his £10 shoes to shops he will have to figure out ways to radically limit costs. At least as a star himself he won't need to hire celebrity endorsers. And he has already proved that using social media is a quick and low-cost way of marketing.

Zoe Thomas, BBC business reporter, 2 December 2015

Questions: *(to be attempted before first lecture)*

1) **Why does Marbury want to start his own line of sneakers?** (Hint: what might be his objective(s)?)

2) **What are some costs that he should consider before starting and operating Starbury?** (Hint: consider the cost incurred for production and possible opportunity cost)

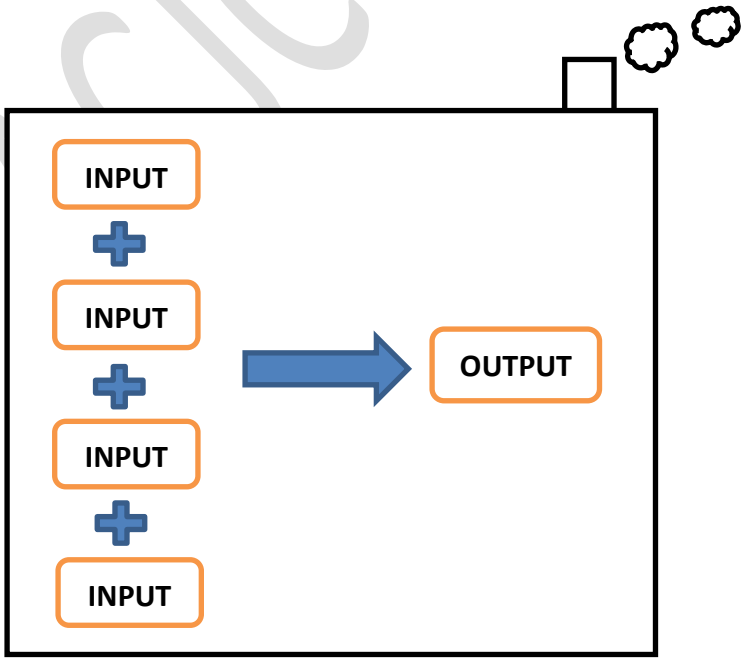
3) **What are some difficulties he might face that could prevent him from reaching his objective(s)?** (Hint: consider what are some possible constraints)

1. *OBJECTIVES OF FIRMS*

SLS

SLS Lesson: *"Objectives of Firms"*

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



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 = Price (P) x Output (Q)

Think about this:

1. **Does earning a large amount of revenue mean that a firm is in a good position?**
2. What are some actual costs a firm would face? *(Recall the example on the Starbury line of sneakers)*
3. Are these the only costs faced? *(Hint: recall and consider what could be the opportunity cost Marbury faces in producing Starbury sneakers?)*

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

Profit = Total Revenue – 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**.

Think about this:
How does the level of profit earned affect the movement of resources and hence an economy's resource allocation?

Summary of types of profit:

Profit	TR & TC relationship	What it means
Normal or Zero Profit	TR = TC, or TR–TC = 0	• Considered a profitable 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 a profitable 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 entry.
Subnormal Profit Or Losses	TR < TC or TR–TC < 0	• Firm is making a loss. • Considered an unprofitable 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".*

1.2 Alternative Objectives of firms

Although a firm is assumed to be profit maximising, in reality, there are circumstances in which a firm may pursue other objectives. Nonetheless in the long run, most firms ultimately aim to maximise profits.

1.2.1 Profit Satisficing

Some firms may aim to make a **sufficient level of profit** rather than maximising it. This may apply for the following cases:

- The **costly and difficult to obtain sufficient information** to make profit-maximising decisions could be significantly high in some cases. This includes firms that have several production locations internationally (where firms specialise parts of its production processes in different countries) and multiple product offerings (where a firm is involved in the production more than just one product under its brand name). These firms are likely to find it harder and costlier to gather information about costs, making it harder for such firms to fulfil its profit-maximising condition of MC=MR.
- As such, they may resort to simpler pricing models such as cost-plus pricing*, which is a mark-up on top of the average cost of goods. This price can be adjusted according to how well the goods are selling. While this ensures the firm is profitable, it may not have reached its optimum level.

  **Note: More details on 'cost-plus pricing' will be covered in the next set of lecture notes 'Firms and how they operate - Market Structure'.*
- Some firms and workers prefer to **avoid undue stress** or perceived challenges from expansion that comes with increasing profit levels. For example, family-run businesses. They may choose to just produce a lower output than profit-maximising output level.
- Shareholders and the decision-makers such as managers may be **pursuing different objectives**:
  - *Shareholders (owners)* of the firm might be interested in maximising profits, but are too far removed from the operations of the firm to be fully aware of the optimal decisions that need to be made in order to maximise profits.
  - *Actual decision-makers, such as regional managers*, could be aiming to achieve a given level of profits that are deemed to be acceptable by the shareholders although it is lower than the profit-maximising level. This allows them to enjoy other benefits such as shorter operating hours, lower levels of stress, and better staff welfare.

1.2.2 Revenue Maximisation

This may apply for sales managers and commission-based employees whose **income is dependent on the total revenue** earned by the firm. For example, car salesmen and insurance agents might choose to maximise revenue rather than profits because job performance may be measured by amount of revenue brought into the company. This is usually because increasing sales and maximizing revenue may also be a way of raising market share in an industry.

In order to maximise revenue, sales managers and commission-based employees might make decisions to increase production levels to the point where marginal revenue is zero and in so doing, set a price that is lower than what is required for profit-maximising. **Revenue maximisation occurs when marginal revenue is zero** as,

- If marginal revenue is positive, this means that the additional quantity sold would add to the total revenue. Thus, the total revenue increases (i.e. revenue maximisation has not yet been reached).
- If marginal revenue is negative, this means that the additional quantity sold would actually leads to a fall in total revenue.
- Only when marginal revenue is zero will total revenue have been maximised.

Thus, sales managers' decisions will enable the firm to increase its total revenue but not necessarily profits, and profits level depends on the total cost as production levels increases too.

**Note: The concept on revenue-maximisation will be covered in greater details in the next set of lecture notes "Market Structure".*

1.2.3 Gain Market Dominance

Firms may aim to **capture larger market share or maintain their market dominance** rather than profit maximising by setting a lower price than profit-maximizing price. This could be due to:

(i) Firms wanting to **drive rival firms out** of the market and increase their market share so that the firm **could dominate the market**.

Prior to the Grab and Uber merger, Grab and Uber would often engage in fierce competition by offering discounts to their ride hailing services. This is with the intention of capturing larger market share and dominant the market.

As firms drive rival firms out and capture more market share, there will be fewer substitutes in the market. Hence, their demand becomes more price inelastic. In the long run, this allows the firm to set higher prices to earn higher revenue and possibly higher profit.

(ii) Firms being **aware of potential entrants** into the market. To avoid losing market share to these new entrants, incumbent (those existing in the industry) firms could decide to focus on retaining their market share dominance or increasing their market share.

For example, in 2016 SingTel, StarHub and M1 rolled out lower price plan and new data plans in anticipation of the entry of TPG Teleco into the telco market. This is done to retain its customers or prevent existing

customers from switch to TPG, maintaining this market share and hence possible market share dominance.

Market share dominance ensures that their demand remains price inelastic, hence allowing the firms to set high prices and high revenue.

1.2.4 Increase of Social Welfare

This aim is likely to be upheld by state-owned companies or social enterprises which may make social welfare a greater consideration than profit maximisation.

A social enterprise is a business entity that is set up with clear social or environmental goals and where resources are allocated to fulfil its objectives. They produce products and sell them to tackle social problems, improve local communities, or the environment. Examples include (these)abilities Pte Ltd and Little Heroes' Dreams Ltd in Singapore that aim to help persons with disabilities (PwDs) and underprivileged children respectively.

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**. 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

In the short run production, the firm's factor inputs can be divided into **fixed factors and variable factors.**

Fixed Factor	Variable Factor
• **Fixed Factors** are **factor inputs that do not 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 have to 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.

3. *SHORT RUN COST OF PRODUCTION*

SLS

SLS Lesson: *"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.

Total Cost = Total Variable Cost + Total Fixed Cost

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 = AFC x Q and TVC = 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, Δ TFC = 0, as output changes. Thus, marginal cost can be measured by the change in Total Cost, Δ TC or the change in Total Variable Cost, ΔTVC.

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

$$\textbf{Marginal Cost} = \frac{\textbf{Δ in Total Cost}}{\textbf{Δ in Total Output (Q)}} = \frac{\textbf{Δ in TFC + Δ in TVC}}{\textbf{Δ in Total Output (Q)}}$$

$$= \frac{\textbf{Δ in TVC}}{\textbf{Δ in Total Output (Q)}} \quad \textit{(Since TFC is constant, ΔTFC = 0)}$$

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.

Refer to Annex 1 for the explanation and numerical example of Law of diminishing marginal returns.

3.3 Average Cost (AC)

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

  Average Fixed Costs = Total Fixed Cost / 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.

  Average Variable Costs = Total Variable Cost / 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.

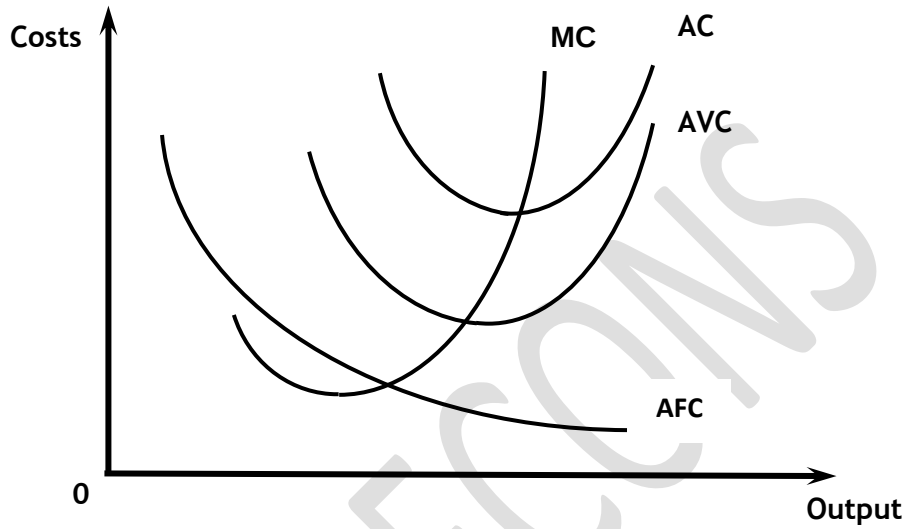
  Average Cost = Total Cost/Total Output

  = [Total Fixed Cost + Total Variable Cost] / Total Output

  = Average Fixed Cost + 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.



In summary: Why is the Marginal Cost Curve U-shaped?

Refer to Annex 1 for more elaboration on the shape of the Marginal Cost Curve.

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.

Think about this:

Why does the MC curve always cut the AC and AVC curves at their minimum point?

4. *LONG RUN COST OF PRODUCTION*

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

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,

Average Cost of Production = Total Variable Cost / 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**.

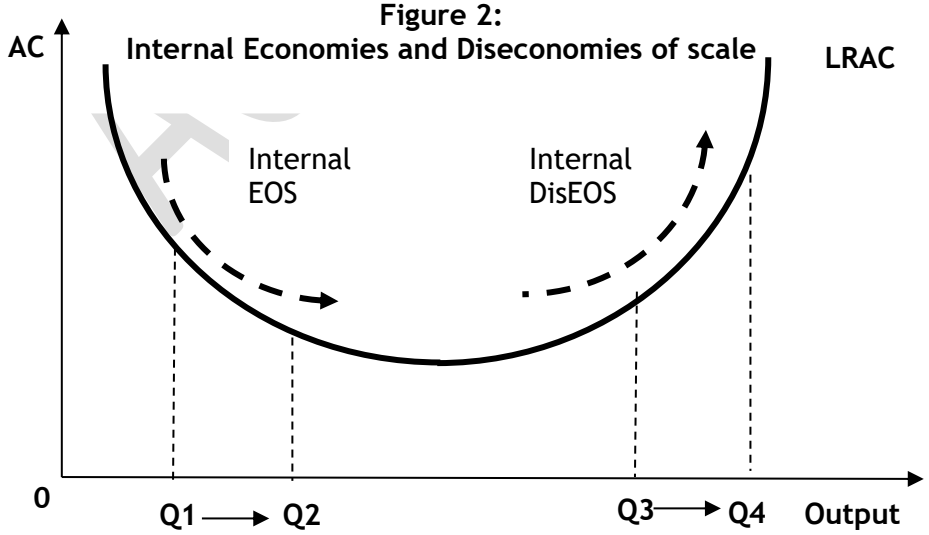
- Increasing returns to scale means that a given percentage increase in inputs will lead to a **larger percentage increase in output**.
- Constant returns to scale means that a given percentage increase in inputs will lead to the **same percentage increase in output**.
- Decreasing returns to scale means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

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)**.

Figure 2:
Internal Economies and Diseconomies of scale



Think about this:
What is the relationship between Returns to Scale and Economies of Scale?

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 higher output is able to efficiently use **machinery** with **larger productive capacity** to produce a large quantity of output.

For example, large photocopying companies are able to 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.

For example, large firms such as Apple Inc. can employ specialist managers for different functions – such as finance, human resource, centralized administrative advertisement, billing, and staff training. This will raise productivity where output per worker increase. Hence, the administrative cost is spread over larger output, reducing its average costs. On the contrary, it may not be economically feasible for smaller firms to hire specific people for specific job scope due to the much smaller output.

(iii) Marketing economies of scale

Large firms are in a better bargaining position than small firms, thus able to purchase inputs in bulk at discounted prices.

For example, NTUC is able to negotiate with food suppliers for bulk purchases at lower prices than 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 and are given banks loans with more favorable rates of interest. 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 average cost.

(v) Risk-bearing economies of scale

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 large scale, the entrepreneur cost is spread across a larger output, lowering the 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.

Think about this:

Internet or online shopping has grown rapidly in recent years. Low barriers to entry have allowed a wide range of small specialised retail firms to market their products on the internet. At the same time, **economies of scale** have led to a small number of large internet retail companies dominating the market for other products.

Identify and explain two possible types of EOS enjoyed by the large internet retail companies (one has been done for you).

1. Marketing EOS: Large internet retail companies have larger consumer base, hence able to purchase inputs in bulk at discounted prices. This helps to reduce the average cost of production.

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 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 tends to be bogged down by rules, regulations and standard procedures. Decision-making is slowed down by red-tape and bureaucracy. This results in lower productivity and increased per unit 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 average cost of each output starts to increase.

(iii) **Absence of motivational elements**

As the firm grows larger and hire more workers, this could result in workers to feel more isolated and less appreciated. This could lead to lower staff morale, leading to falling productivity and an increase in per unit labour cost hence increasing average cost of production.

4.2 Minimum Efficient Scale (MES) of Production

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

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 (and dominate the market) to better optimize the use of its capital resources (such as machinery) efficiently.

Minimum efficient scale (MES) is a term referring to the scale of production for **the level of output that enables a firm to reach the minimum LRAC with 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: LRAC curve of capital-intensive firm

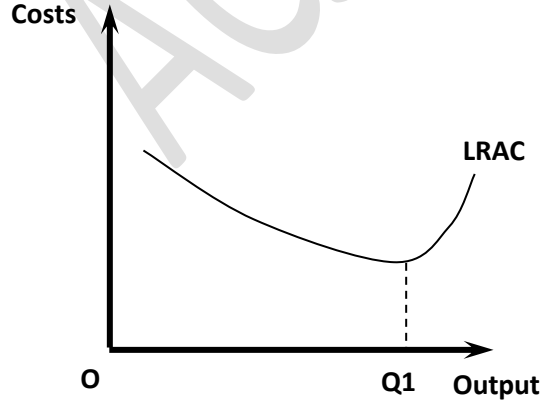


Figure 3b: LRAC curve of labour-intensive firm

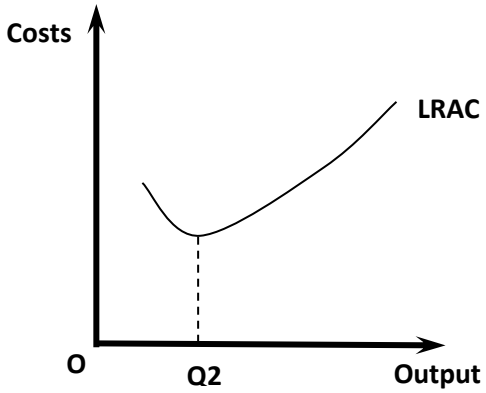


Figure 3a: For a capital intensive industry, firm's LRAC continues to fall at a higher scale of production. MES output occurs at an output (Q1) that is a large proportion of the domestic market or beyond, this suggests that the domestic market can support only a few large firms or only one firm. If there 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 survivability.

Figure 3b: The case of industries with very limited scope of internal economies of scale (labour intensive industry). MES output occurs at a level of output (Q2) that is very small in proportion to the domestic market. 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 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'.*

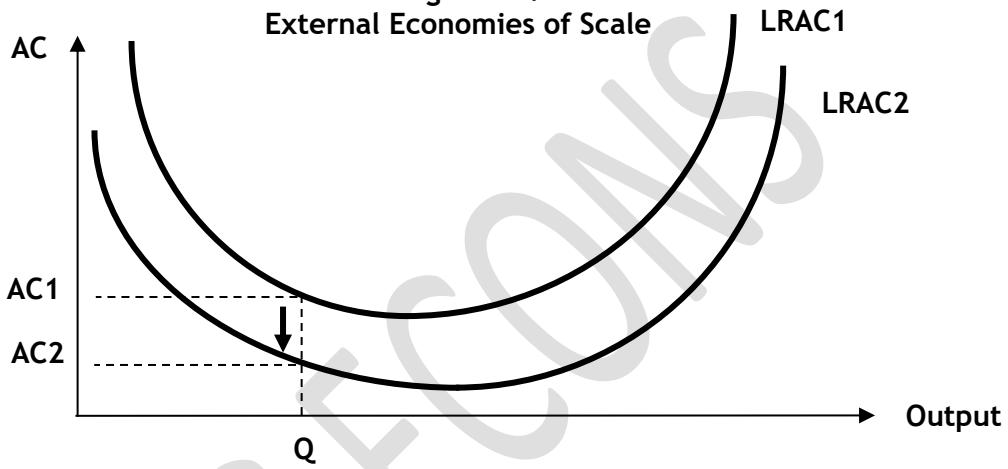
4.3 External Economies & Diseconomies of Scale

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

Figure 4a:
External Economies of Scale



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 average cost.

(ii) Development of a better transport system

With the expansion of the industry as a whole, there is a more pressing need for efficient movement of raw materials from suppliers of factor inputs to the plants, and of finished products from the factories to the markets.

A better transport network will eventually be developed. As a result, transport costs are reduced.

(iii) Development of research facilities

Research to develop better production techniques and new products often emanates from industrial growth.

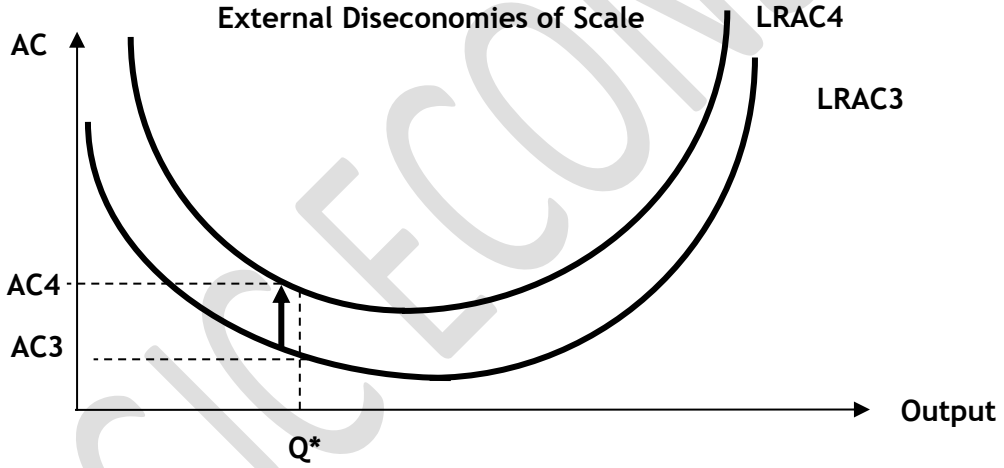
Firms may combine efforts to engage in research or the government may set up a research centre to develop better methods and products of higher quality. Every firm will benefit from these improvements and innovations.

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 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.

Figure 4b:
External Diseconomies of Scale



Sources of External Diseconomies of Scale

(i) Factor prices

Strong competition for labour and other factors of production in that region or area may raise wages and other costs of production.

(ii) Crime rates

In a general recession or in a declining industry when a large number of firms are concentrated in an area, mass unemployment may result in that region and this would lead to the area being crime-prone with unrest, all of which would increase risks and costs.

(iii) Infrastructural bottleneck

When there is over expansion of the industry, it might lead to over-crowding and hence traffic congestion during peak hours. This may lead to higher transport cost and loss of productivity as workers are trapped in traffics. Thus, firms incurring higher average cost of production.

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.

	Content Checklist: Are you able to do the following?	***Checked***
1.	Define Economic Profit and differentiate it from Accounting profit.	
2.	Identify and explain the types of firm's objectives.	
	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 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 output.)

- Recall: Iin 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 getting 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 are able to 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 (Δ in TVC ÷ Δ 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, where **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