

## Unit 4

- I. Choose the correct answer (each question carries 1 mark)
- In a perfect competition each firm produces and sells
    - Heterogenous products
    - Homogenous products**
    - Luxury goods
    - Necessary goods
  - The increase in total revenue for a unit increase in the output is
    - Marginal revenue**
    - Average revenue
    - Total revenue
    - Fixed revenue
  - The firm's profit is denoted by
    - $\Sigma$
    - $\Delta$
    - $\emptyset$
    - $\Pi$**
  - When the supply curve is vertical the elasticity of supply is:
    - $es=1$
    - $es>1$
    - $es=0$**
    - $ex=\infty$
  - The revenue per unit of output of a firm is called as
    - TR**
    - MR
    - AR
    - None of the above

II. Fill in the blanks (each question carries 1 mark)

1. Price taking behaviour is the single most distinguishing characteristic of \_\_\_Perfect Market\_\_\_\_\_
2. \_\_\_Unit\_\_\_\_\_ is a tax that the government imposes per unit sale of output
3. For a price taking firm marginal revenue is equal to \_\_\_price\_\_\_\_\_
4. The point of minimum AVC where the SMC curves cut the AVC curves is called \_\_\_shut-down point\_\_\_\_\_
5. \_\_\_Opportunity cost\_\_\_\_\_ cost of some activity is the gain forgone from the second-best activity

III. Match the following (each question carries 1 mark)

A	B
TR	Perfect information
$\Pi$	Zero profit
AR	$P \times Q$
Normal Profit	$TR - TC$
Perfect Competition	$TR/Q$

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TR	$P \times Q$
$\Pi$	Zero profit
AR	$TR/Q$
Normal Profit	$TR - TC$
Perfect Competition	Perfect information

**IV. Answer the following questions in a sentence / word (each question carries 1 mark)**

1. Define marginal revenue

The marginal revenue (MR) of a firm is defined as the increase in total revenue for a unit increase in the firm's output. Consider a situation where the firm's output is increased from  $q^0$  to  $(q^0 + 1)$ . Given market price  $p$ , notice that  $MR = (\text{TR from output } (q^0 + 1)) - (\text{TR from output } q^0) = (p \times (q^0 + 1)) - (pq^0) = p$

2. To which side does the supply curve shift due to technological progress

It is expected that this will lower the firm's marginal cost at any level of output; that is, there is a rightward (or downward) shift of the MC curve.

3. Write the formula to calculate average revenue

$$AR = \frac{TR}{q}$$

Where TR is total revenue

q is quantity

4. What is normal profit?

The firm normally expects to earn a profit that along with the explicit costs can also cover the opportunity costs. The profit level that is just enough to cover the explicit costs and opportunity costs of the firm is called the normal profit.

5. Give the meaning of super-normal profit

Profit that a firm earns over and above the normal profit is called the super-normal profit

6. What does market supply curve?

The market supply curve shows the output levels (plotted on the x-axis) that firms in the market produce in aggregate corresponding to different values of the market price (plotted on the y-axis).

**V. Answer the following questions in 4 sentences (each question carries 2 marks)**

1. Mention the conditions needed for profit by a firm under perfect competition.

Three conditions must hold:

- The market price,  $p$ , is equal to the marginal cost at  $q^0$ .
- The marginal cost is non-decreasing at  $q^0$ .
- In the short run, the market price,  $p$ , must be greater than or equal to the average variable cost at  $q^0$ . In the long run, the market price,  $p$ , must be greater than or equal to the average cost at  $q^0$ .

2. Give the meaning of shut-down point.

Along the supply curve as we move down, the last price-output combination at which the firm produces positive output is the point of minimum AVC where the SMC curve cuts the AVC curve. Below this, there will be no production. This point is called the short run shut down point of the firm. In the long run, however, the shutdown point is the minimum of LRAC curve.

3. Give the meaning of opportunity cost with an example.

For example, if a firm employ labour it has to pay wages to them; if it uses some raw materials, it has to buy them. There may be some other kinds of inputs which the firm owns, and therefore, does not need to pay to anybody for them. These inputs though do not involve any explicit cost, they involve some opportunity cost to the firm. The firm instead of using these inputs in the current production process could have used them for some other purpose and get some return. This forgone return is the opportunity cost to the firm.

4. Mention the two determinants of a firm's supply curve

- A change in input prices also affects a firm's supply curve. If the price of an input (say, the wage rate of labour) increases, the cost of production rises. The consequent increase in the firm's average cost at any level of output is usually accompanied by an increase in the firm's marginal cost at any level of output; that is, there is a leftward (or upward) shift of the MC curve.
- A unit tax is a tax that the government imposes per unit sale of output. For example, suppose that the unit tax imposed by the government is Rs 2. Then, if the firm produces and sells 10 units of the good, the total tax that the firm must pay to the government is  $10 \times \text{Rs } 2 = \text{Rs } 20$ .

5. Give the meaning of price elasticity of supply and write the formula.

The price elasticity of supply of a good measure the responsiveness of quantity supplied to changes in the price of the good. More specifically, the price elasticity of supply, denoted by  $e_s$ , is defined as follows

$$\text{Price elasticity } (e_s) = \frac{\text{Percentage change in quantity supplied}}{\text{Percentage change in price}}$$

**VI. Answer the following questions in 12 sentences (each question carries 4 marks)**

1. Write a short note on profit maximization of a firm under the following conditions:
  - a)  $P = MC$
  - b) MC must not be decreasing at  $q_0$

A firm produces and sells a certain amount of a good. The firm's profit, denoted by  $\pi$ , is defined to be the difference between its total revenue (TR) and its total cost of production (TC).

In other words

$$\pi = TR - TC$$

Clearly, the gap between TR and TC is the firm's earnings net of costs. A firm wishes to maximise its profit. If the firm's output is perfectly divisible, we now show that if there is a positive output level,  $q_0$ , at which profit is maximised, then three conditions must hold:

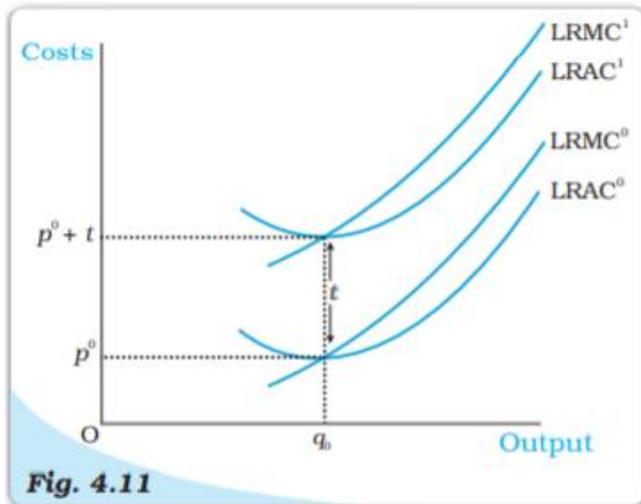
1. The market price,  $p$ , is equal to the marginal cost at  $q_0$ .
2. The marginal cost is non-decreasing at  $q_0$ .
3. In the short run, the market price,  $p$ , must be greater than or equal to the average variable cost at  $q_0$ . In the long run, the market price,  $p$ , must be greater than or equal to the average cost at  $q_0$

2. Explain the determinants of a firm's supply curve

Any factor that affects a firm's marginal cost curve is of course a determinant of its supply curve.

**Technological Progress:** Suppose a firm uses two factors of production – say, capital and labour – to produce a certain good. After an organisational innovation by the firm, the same levels of capital and labour now produce more units of output. Put differently, to produce a given level of output, the organisational innovation allows the firm to use fewer units of inputs. It is expected that this will lower the firm's marginal cost at any level of output; that is, there is a rightward (or downward) shift of the MC curve. As the firm's supply curve is essentially a segment of the MC curve, technological progress shifts the supply curve of the firm to the right. At any given market price, the firm now supplies more units of output.

**Input Prices** A change in input prices also affects a firm's supply curve. If the price of an input (say, the wage rate of labour) increases, the cost of production rises. The consequent increase in the firm's average cost at any level of output is usually accompanied by an increase in the firm's marginal cost at any level of output; that is, there is a leftward (or upward) shift of the MC curve. This means that the firm's supply curve shifts to the left: at any given market price, the firm now supplies fewer units of output.



**Unit Tax** A unit tax is a tax that the government imposes per unit sale of output. For example, suppose that the unit tax imposed by the government is Rs 2. Then, if the firm produces and sells 10 units of the good, the total tax that the firm must pay to the government is  $10 \times \text{Rs } 2 = \text{Rs } 20$ .

Before the unit tax is imposed, LRMC<sup>0</sup> and LRAC<sup>0</sup> are, respectively, the long run marginal cost curve and the long run average cost curve of the firm.

Now, suppose the government puts in place a unit tax of Rs  $t$ . Since the firm must pay an extra Rs  $t$  for each unit of the good produced, the firm's long run average cost and long run marginal cost at any level of output increases by Rs  $t$ . In the diagram, LRMC<sup>1</sup> and LRAC<sup>1</sup> are, respectively, the long run marginal cost curve and the long run average cost curve of the firm upon imposition of the unit tax.

### 3. Explain the features of perfect competition

To analyse a firm's profit maximisation problem, we must first specify the market environment in which the firm functions.

A perfectly competitive market has two defining features

- a) The market consists of buyers and sellers (that is, firms). All firms in the market produce a certain homogeneous (that is, undifferentiated) good.
- b) Each buyer and seller in the market is a price-taker. A price-taking firm believes that should it set a price above the market price, it will be unable to sell any quantity of the good that it produces.

On the other hand, should the set price be less than or equal to the market price, the firm can sell as many units of the good as it wants to sell. A buyer would obviously like to buy the good at the lowest possible price.

However, a price-taking buyer believes that should she ask for a price below the market price, no firm will be willing to sell to her. On the other hand, should the price asked be greater than or equal to the market price, the buyer can obtain as many units of the good as she desires to buy.

4. Explain the average revenue or price line of a firm under perfect competition with the help of a diagram.

Here, we plot the market price (y-axis) for different values of a firm's output (x-axis). Since the market price is fixed at  $p$ , we obtain a horizontal straight line that cuts the y-axis at a height equal to  $p$ . This horizontal straight line is called the price line. The price line also depicts the demand curve facing a firm.

Observe that the diagram shows that the market price,  $p$ , is independent of a firm's output. This means that a firm can sell as many units of the good as it wants to sell at price  $p$ .

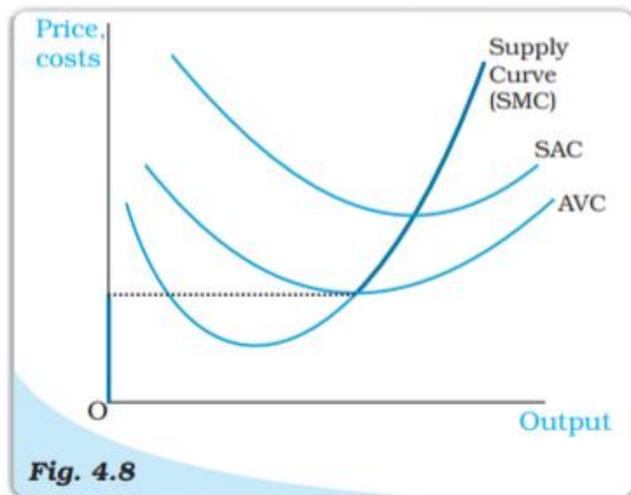
The average revenue (AR) of a firm is defined as total revenue per unit of output. Recall that if a firm's output is  $q$  and the market price is  $p$ , then TR equals  $p \times q$ . Hence

$$AR = \frac{TR}{q} = \frac{p \times q}{q} = p$$

In other words, for a price-taking firm, average revenue equals the market price.

**VII. Answer the following in 20 sentences (each question carries 6 marks)**

1. Explain the short run supply curve of a firm with the help of a diagram



Case 1: Price is greater than or equal to the minimum AVC. Suppose the market price is  $p_1$ , which exceeds the minimum AVC. We start out by equating  $p_1$  with SMC on the rising part of the SMC curve; this leads to the output level  $q_1$ . Note also that the AVC at  $q_1$  does not exceed the market price,  $p_1$ . Hence, when the market price is  $p_1$ , the firm's output level in the short run is equal to  $q_1$ .

Case 2: Price is less than the minimum AVC. Suppose the market

price is  $p_2$ , which is less than the minimum AVC. If a profit-maximising firm produces a positive output in the short run, then the market price,  $p_2$ , must be greater than or equal to the AVC at that output level. But notice that for all positive output levels, AVC strictly exceeds  $p_2$ . In other words, it cannot be the case that the firm supplies a positive output. So, if the market price is  $p_2$ , the firm produces zero output.

A firm's short run supply curve is the rising part of the SMC curve from and above the minimum AVC together with zero output for all prices strictly less than the minimum AVC.

2. Explain the market supply curve with the help of a diagram

Consider a market with  $n$  firms: firm 1, firm 2, firm 3, and so on. Suppose the market price is fixed at  $p$ . Then, the output produced by the  $n$  firms in aggregate is [supply of firm 1 at price  $p$ ] + [supply of firm 2 at price  $p$ ] + ... + [supply of firm  $n$  at price  $p$ ].

In panel (a) we have the supply curve of firm 1, denoted by  $S_1$ ;

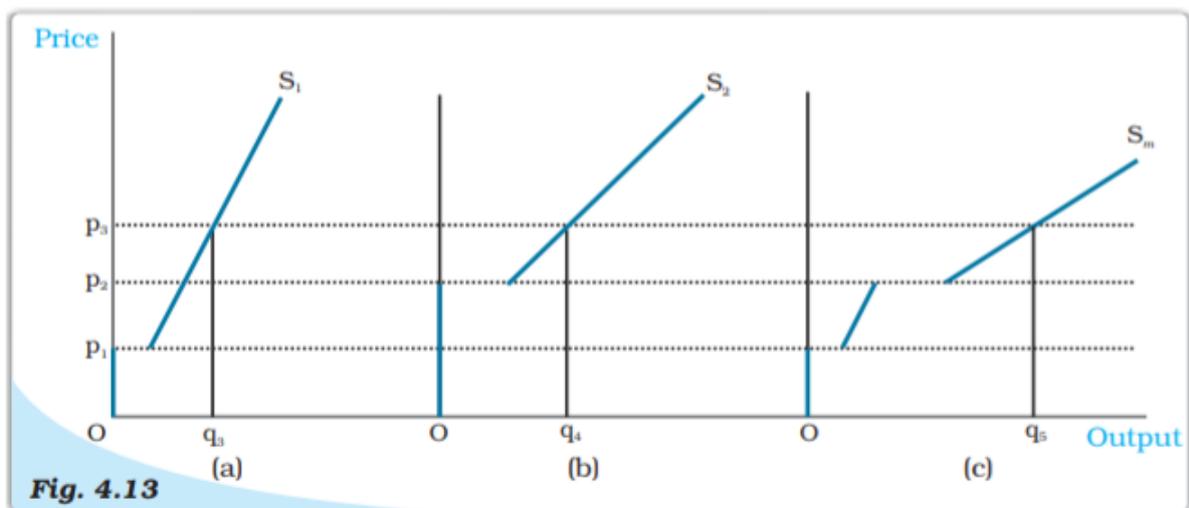
The market supply at price  $p$  is the summation of the supplies of individual firms at that price in panel (b), we have the supply curve of firm 2, denoted by  $S_2$ .

Panel (c) shows the market supply curve, denoted by  $S_m$ . When the market price is strictly below  $p_1$ , both firms choose not to produce any amount of the good; hence, market supply will also be zero for all such prices.

For a market price greater than or equal to  $p_1$  but strictly less than  $p_2$ , only firm 1 will produce a positive amount of the good. Therefore, in this range, the market supply curve coincides with the supply curve of firm 1.

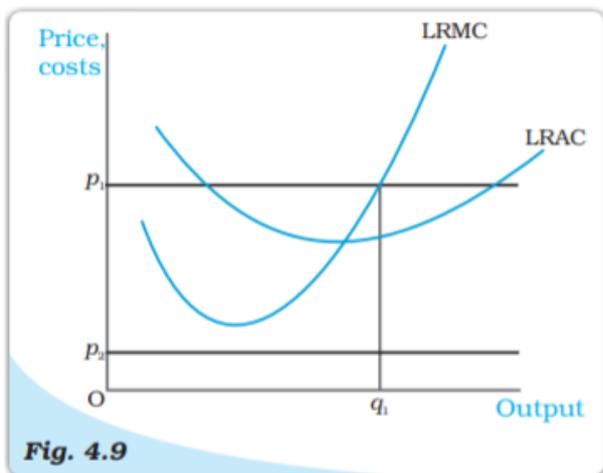
For a market price greater than or equal to  $p_2$ , both firms will have positive output levels. For example, consider a situation wherein the market price assumes the value  $p_3$  (observe that  $p_3$  exceeds  $p_2$ ). Given  $p_3$ , firm 1 supplies  $q_3$  units of output while firm 2 supplies  $q_4$  units of output. So, the market supply at price  $p_3$  is  $q_5$ , where  $q_5 = q_3 + q_4$ .

Notice how the market supply curve,  $S_m$ , in panel (c) is being constructed: we obtain  $S_m$  by taking a horizontal summation of the supply curves of the two firms in the market,  $S_1$  and  $S_2$ . It should be noted that the market supply curve has been derived for a fixed number of firms in the market. As the number of firms changes, the market supply curve shifts as well. Specifically, if the number of firms in the market increases (decreases), the market supply curve shifts to the right (left).

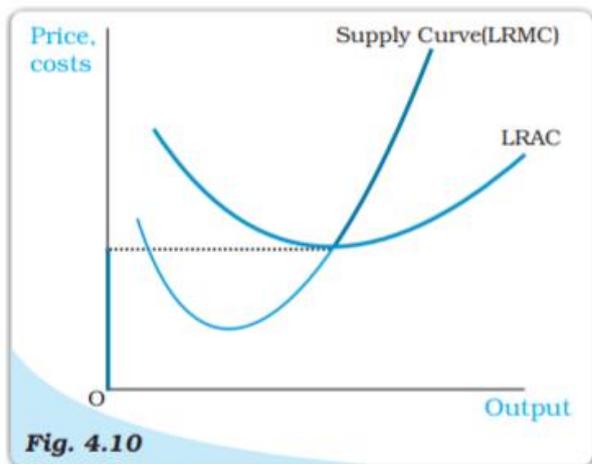


3. Explain the long run supply curve of a firm with the help of diagram.

We first determine the firm's profit-maximising output level when the market price is greater than or equal to the minimum (long run) AC. This done, we determine the firm's profit-maximising output level when the market price is less than the minimum (long run) AC.



Case 1: Price greater than or equal to the minimum LRAC. Suppose the market price is  $p_1$ , which exceeds the minimum LRAC. Upon equating  $p_1$  with LRMC on the rising part of the LRMC curve, we obtain output level  $q_1$ . Note also that the LRAC at  $q_1$  does not exceed the market price,  $p_1$ .



Case 2: Price less than the minimum LRAC. Suppose the market price is  $p_2$ , which is less than the minimum LRAC. If a profit-maximising firm produces a positive output in the long run, the market price,  $p_2$ , must be greater than or equal to the LRAC at that output level. But notice from the diagram, that for all positive output levels, LRAC strictly exceeds  $p_2$ . In other words, it cannot be the case that the firm supplies a positive output. So, when the market price is

$p_2$ , the firm produces zero output.