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Perfect Competition: Defining Features

A perfectly competitive market has two defining features

1. The market consists of buyers and sellers (that is, firms). All firms in the market produce a certain homogeneous (that is, undifferentiated) good.
2. Each buyer and seller in the market is a price-taker.

Revenue

In a perfectly competitive market, a firm believes that it can sell as many units of the good as it wants by setting a price less than or equal to the market price. But, if this is the case, surely there is no reason to set a price lower than the market price. In other words, should the firm desire to sell some amount of the good, the price that it sets is exactly equal to the market price.

A firm earns revenue by selling the good that it produces in the market. Let the market price of a unit of the good be p. Let q be the quantity of the good produced, and therefore sold, by the firm at price p. Then, total revenue (TR) of the firm is defined as the market price of the good (p) multiplied by the firm's output (q). Hence,

$$TR = p \times q$$

Let the market for candles be perfectly competitive and let the market price of a box of candles be Rs 10. For a candle manufacturer, the table shows how total revenue is related to output. Notice that when no box is produced, TR is equal to zero; if one box of candles is produced, TR is equal to 1 × Rs 10 = Rs 10; if two boxes of candles are produced, TR is equal to 2 × Rs 10 = Rs 20; and so on.

Boxes Sold	TR (in Rs.)
0	0
1	10
2	20
3	30
4	40
5	50W

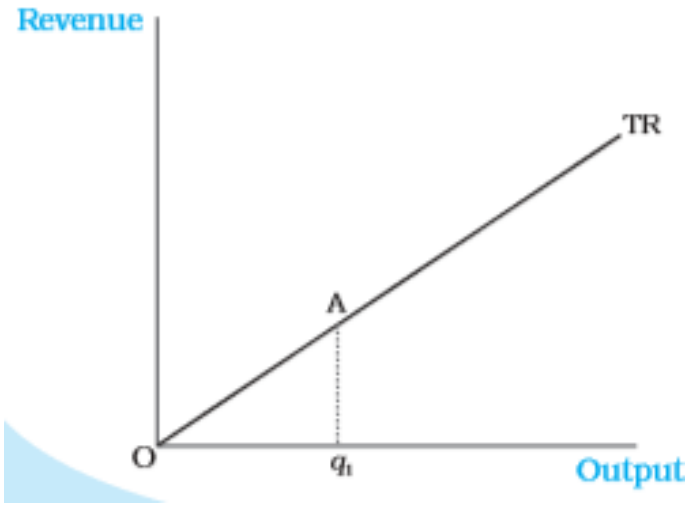
In a perfectly competitive market, a firm views the market price, p, as given. With the market price fixed at p, the total revenue curve of a firm shows the relationship between its total revenue (y-axis) and its output (x-axis).

The diagram shows the total revenue curve of a firm. Three observations are relevant here.

First, when the output is zero, the total revenue of the firm is also zero. Therefore, the TR curve passes through point O.

Second, the total revenue increases as the output goes up. Moreover, the equation 'TR = p × q' is that of a straight line. This means that the TR curve is an upward rising straight line.

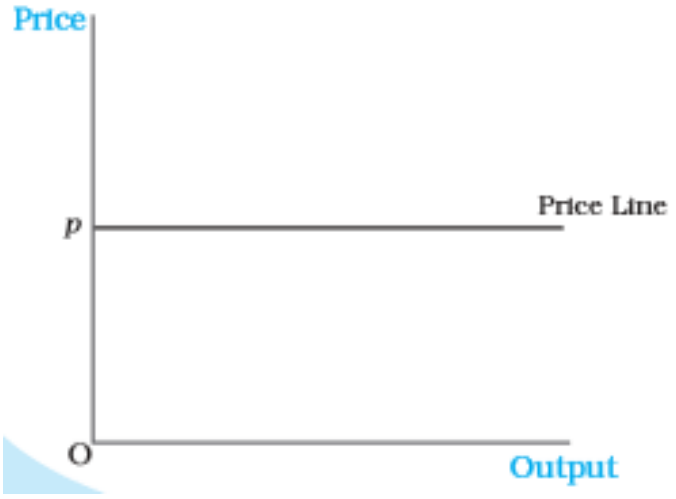
Third, consider the slope of this straight line. When the output is one unit, the total revenue is p × 1 = p. Therefore, the slope of the straight line is $Aq_1/Oq_1 = p$.



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 shows the relationship between the market price and a firm's output level. The vertical height of the price line is equal to the market price, p. The price line also depicts the demand curve facing a firm.

Observe that in the diagram it 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.



Average Revenue

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 × q. Hence

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

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

$$MR = [p \times (q^0 + 1)] - (pq^0) = p$$

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

Profit Maximization

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

$$\pi = TR - TC$$

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:

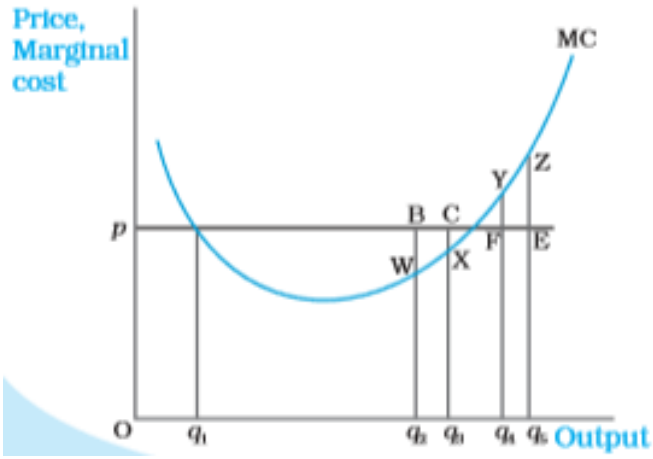
1. The market price, p, is equal to the marginal cost at q_0.
2. The marginal cost is non-decreasing at q_0.
3. In the short run, the market price, p, must be greater than or equal to the average variable cost at q_0. In the long run, the market price, p, must be greater than or equal to the average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

Condition 1

1. Price greater than MC is ruled out

Observe that for all output levels slightly to the right of q_2, the market price continues to exceed the marginal cost. So, pick an output level q_3 slightly to the right of q_2 such that the market price exceeds the marginal cost for all output levels between q_2 and q_3. Suppose, now, that the firm increases its output level from q_2 to q_3. The increase in the total revenue of the firm from this output expansion is just the market price multiplied by the change in quantity; that is, the area of the rectangle q_2q_3CB.

On the other hand, the increase in total cost associated with this output expansion is just the area under the marginal cost curve between output levels q_2 and q_3; that is, the area of the region q_2q_3XW. But, a comparison of the two areas shows that the firm's profit is higher when its output level is q3 rather than q_2. But, if this is the case, q_2 cannot be a profit maximising output level.



2. Price less than MC is ruled out

Observe that for all output levels slightly to the left of q_5, the market price remains lower than the marginal cost. So, pick an output level q4 slightly to the left of q_5 such that the market price is less than the marginal cost for all output levels between q_4 and q_5.

Suppose, now, that the firm cuts its output level from q_5 to q_4. The decrease in the total revenue of the firm from this output contraction is just the market price multiplied by the change in quantity; that is, the area of the rectangle q_4q_5EF.

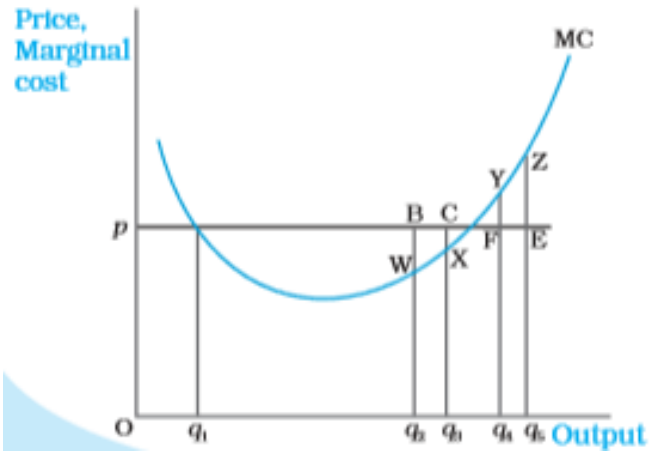
On the other hand, the decrease in total cost brought about by this output contraction is the area under the marginal cost curve between output levels q_4 and q_5; that is, the area of the region q_4 q_5 ZY. But, a comparison of the two areas shows that the firm's profit is higher when its output level is q_4 rather than q_5. But, if this is the case, q_5 cannot be a profit-maximising output level.

Condition 2

Note that at the output level q1, the market price is equal to the marginal cost; however, the marginal cost curve is downward sloping.

Observe that for all output levels slightly to the left of q_1, the market price is lower than the marginal cost.

But, the argument outlined in case 2 immediately implies that the firm's profit at an output level slightly smaller than q_1 exceeds that corresponding to the output level q_1. This being the case, q_1 cannot be a profit maximising output level.



Condition 3

Case 1: Price must be greater than or equal to AVC

In the short run is true by arguing that a profit-maximising firm, in the short run, will not produce at an output level wherein the market price is lower than the AVC.

Observe that at the output level q_1, the market price p is lower than the AVC. We claim that q_1 cannot be a profit-maximising output level

Observe that at the output level q_1, the market price p is lower than the AVC. We claim that q_1 cannot be a profit-maximising output level.

Notice that the firm's total revenue at q_1 is as follows

TR = Price × Quantity

= Vertical height Op × width Oq_1

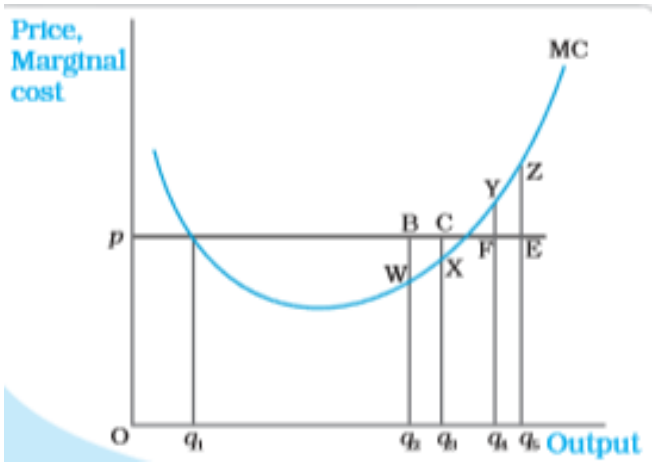
= The area of rectangle $OpAq_1$

Similarly, the firm's total variable cost at q_1 is as follows

TVC = Average variable cost × Quantity

= Vertical height OE × Width Oq_1

= The area of rectangle $OEBq_1$



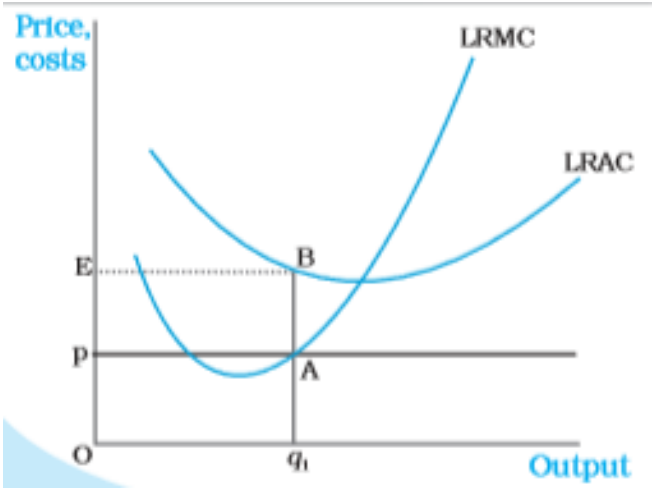
Case 2: Price must be greater than or equal to AC in long run

Observe that at the output level q_1, the market price p is lower than the (long run) AC. We claim that q_1 cannot be a profit-maximizing output level

Notice that the firm's total revenue, TR, at q_1 is the area of the rectangle $OpAq_1$ (the product of price and quantity) while the firm's total cost, TC, is the area of the rectangle $OEBq_1$ (the product of average cost and quantity).

Since the area of rectangle $OEBq_1$ is larger than the area of rectangle $OpAq_1$, the firm incurs a loss at the output level q_1. But, in long run set-up, a firm that shuts down production has a profit of zero.

This means, of course, that q_1 is not a profit maximizing output level.

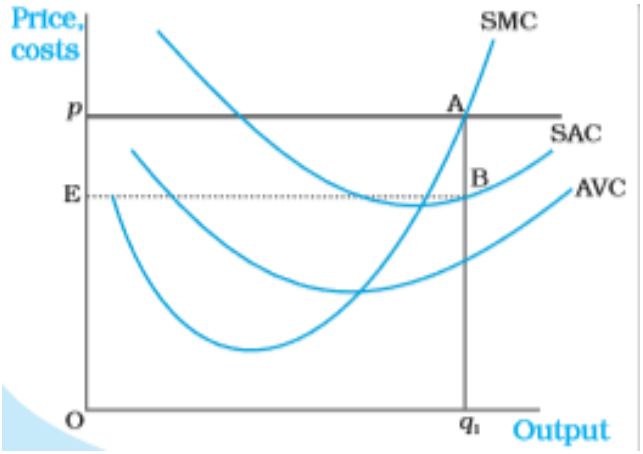


Profit Maximization Problem: Graphical Representation

Equating the market price with the (short run) marginal cost, we obtain the output level q_0. At q_0, observe that SMC slopes upwards and p exceeds AVC.

The total revenue of the firm at q_0 is the area of rectangle $OpAq_0$ (the product of price and quantity) while the total cost at q_0 is the area of rectangle $OEBq_0$ (the product of short run average cost and quantity).

So, at q_0, the firm earns a profit equal to the area of the rectangle EpAB.



Supply

Short Run Supply Curve of a Firm

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

Case 1: Price is greater than or equal to the minimum AVC

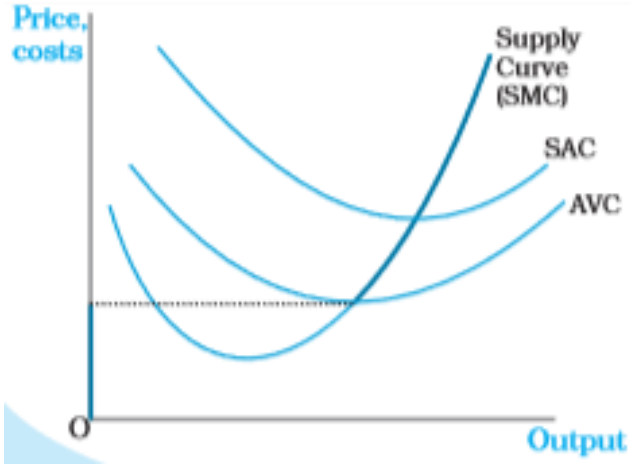
Suppose the market price is p1, which exceeds the minimum AVC. We start out by equating p1 with SMC on the rising part of the SMC curve; this leads to the output level q1.

Note also that the AVC at q1 does not exceed the market price, p1. Thus, all three conditions highlighted in section 3 are satisfied at q1. Hence, when the market price is p1, the firm's output level in the short run is equal to q1.

Case 2: Price is less than the minimum AVC

Suppose the market price is p2, which is less than the minimum AVC. If a profit-maximising firm produces a positive output in the short run, then the market price, p2, must be greater than or equal to the AVC at that output level.

Combining cases 1 and 2, we reach an important conclusion. 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



Long Run Supply Curve of a Firm

As in the short run case, we split the derivation into two parts. We first determine the firm's profit-maximizing 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-maximizing 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 p1, which exceeds the minimum LRAC. Upon equating p1 with LRMC on the rising part of the LRMC curve, we obtain output level q1. Note also that the LRAC at q1 does not exceed the market price, p1. Thus, all three conditions highlighted in section 3 are satisfied at q1.

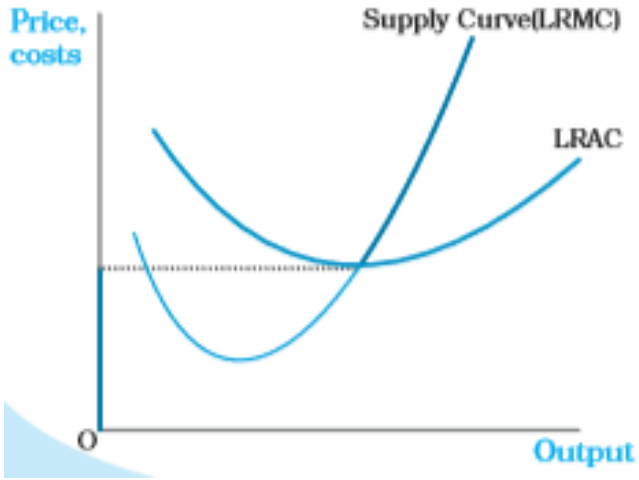
Hence, when the market price is p1, the firm's supplies in the long run become an output equal to q1.

Case 2: Price less than the minimum LRAC

Suppose the market price is p2, which is less than the minimum LRAC. We have argued (see condition 3 in section 3) that if a profit-maximizing firm produces a positive output in long run, the market price, p2, must be greater than or equal to the LRAC at that output level.

for all positive output levels, LRAC strictly exceeds p2. In other words, it cannot be the case that the firm supplies a positive output. So, when the market price is p2, the firm produces zero output.

Combining cases 1 and 2, we reach an important conclusion. A firm's long run supply curve is the rising part of the LRMC curve from and above the minimum LRAC together with zero output for all prices less than the minimum LRAC.



The 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 long run, however, the shutdown point is the minimum of LRAC curve

The Normal Profit and Break-even Point

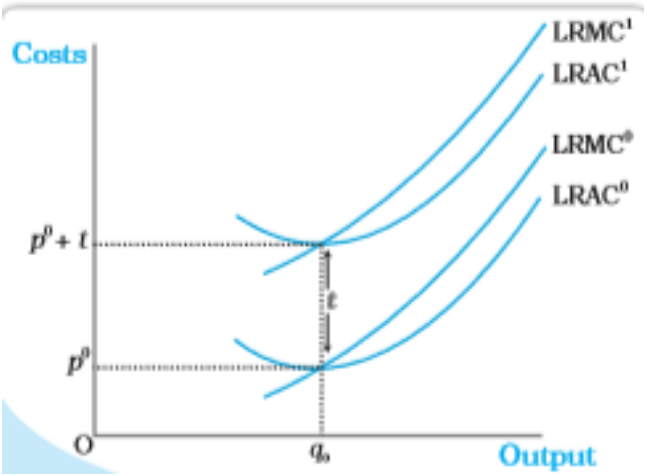
There may be some other kinds of inputs which the firm owns, and therefore, does not need to pay to anybody for them. These inputs though do not involve any explicit cost, they involve some opportunity cost to the firm. The firm instead of using these inputs in the current production process could have used them for some other purpose and get some return. This forgone return is the opportunity cost to the firm.

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. If a firm includes both its explicit costs and opportunity costs in the calculation of total cost, the normal profit becomes that level of profit when total revenue equals total cost, i.e., the zero level of profit. Profit that a firm earns over and above the normal profit is called the super-normal profit.

In the long run, a firm does not produce if it earns anything less than the normal profit. In the short run, however, it may produce even if the profit is less than this level. The point on the supply curve at which a firm earns normal profit is called the break-even point of the firm. The point of minimum average cost at which the supply curve cuts the LRAC curve (in short run, SAC curve) is therefore the break-even point of a firm.

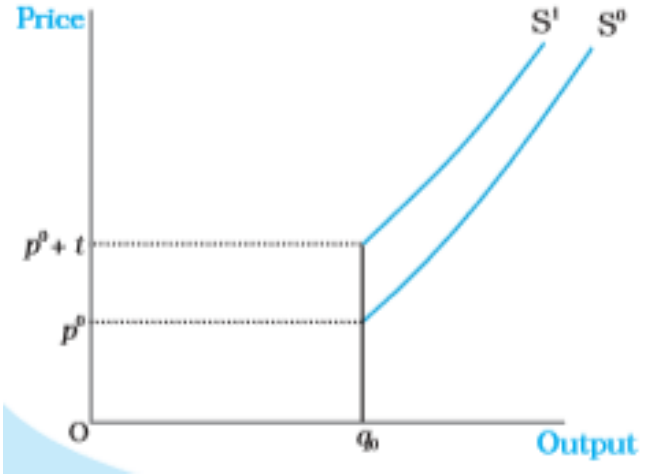
Determinants of a Firm's Supply Curve

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. 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.

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 × Rs 2 = Rs 20. Before the unit tax is imposed, $LRMC^0$ and $LRAC^0$ 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



The long run supply curve of a firm is the rising part of the LRMC curve from and above the minimum LRAC together with zero output for all prices less than the minimum LRAC. Using this observation, it is immediate that S^0 and S^1 are, respectively, the long run supply curve of the firm before and after the imposition of the unit tax.

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)

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 other words, the market supply at price p is the summation of the supplies of individual firms at that price. Let us now construct the market supply curve geometrically with just two firms in the market: firm 1 and firm 2. The two firms have different cost structures.

Firm 1 will not produce anything if the market price is less than $\bar{p}_1$while firm 2 will not produce anything if the market price is less than $\bar{p}_2$. Assume that $\bar{p}_2$is greater than $\bar{p}_1$.

In panel (a) we have the supply curve of firm 1, denoted by S1;

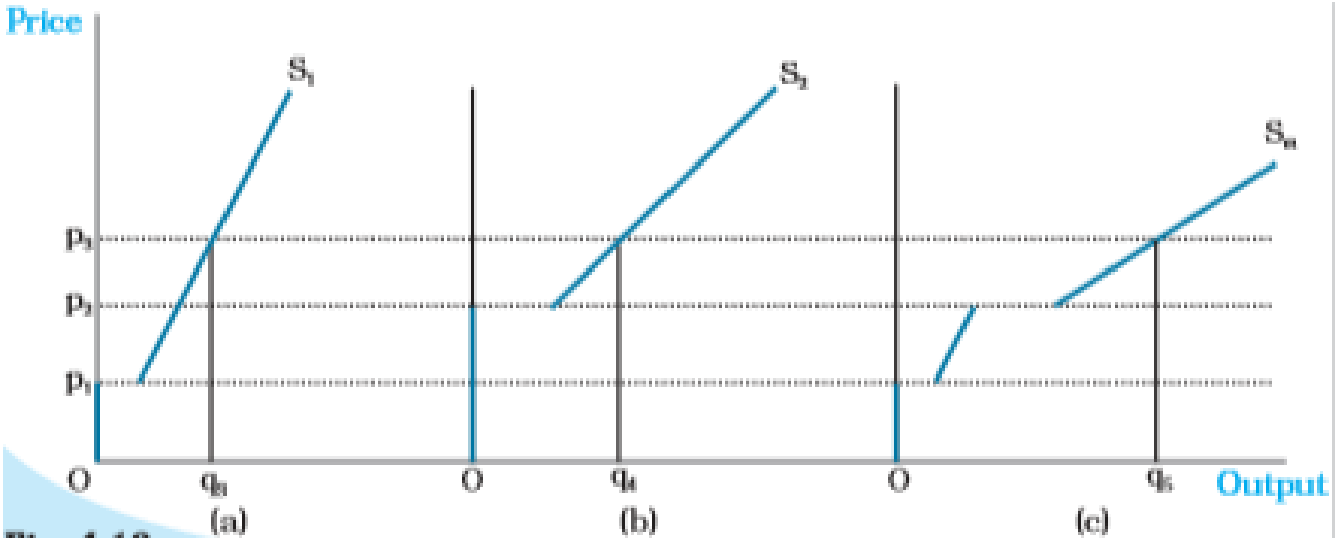
In panel (b), we have the supply curve of firm 2, denoted by S2.

Panel (c) shows the market supply curve, denoted by S_m.

When the market price is strictly below $\bar{p}_1$ 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 $\bar{p}_1$but strictly less than $\bar{p}_2$, 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 $\bar{p}_2$ both firms will have positive output levels.

For example, consider a situation wherein the market price assumes the value $\bar{p}_3$. Given $\bar{p}_3$, firm 1 supplies q_3 units of output while firm 2 supplies q4 units of output. So, the market supply at price p_3 is q_3, where $q_5=q_3+q_4$.

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.



Price Elasticity of Supply

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

$$e_s = \frac{Percentage\ change\ in\ quantity\ supplied}{Percentage\ change\ in\ price}$$

This can be written as

$$e_s = \frac{\frac{q^1}{q^0} - 1}{\frac{p^1}{q^0} - 1}$$

When the supply curve is vertical, supply is completely insensitive to price and the elasticity of supply is zero. In other cases, when supply curve is positively sloped, with a rise in price, supply rises and hence, the elasticity of supply is positive. Like the price elasticity of demand, the price elasticity of supply is also independent of units.