CHAPTER

07

Perfect Competition

- Properties
- Short Run Equilibrium
- Normal Profit vs Supernormal Profit
- Shut-down Point
- Profit Contribution
- Short Run Supply Function
- Long Run Equilibrium
- Producer Surplus
- Economic Efficiency

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7.1 Properties

Perfect competition is a market structure in which large number of buyers and sellers trade homogeneous units of goods. Perfectly competitive market is characterised by the following properties.

1. **Large Number of Buyers and Sellers**

   The number of buyers and sellers in a competitive market is so large that a single buyer or seller or a group of buyers or sellers cannot influence market because each seller's share in the market is very small relative to total market share. Thus a firm cannot exercise any market power. Similarly, the buyers cannot exert any pressure on market because of the presence of numerous buyers apart from the ones who group together to refuse buying from the competitive sellers.

2. **Homogeneous Products**

   All units of goods sold by the sellers in competitive market are homogeneous. Product differentiation is completely absent in such market. Buyers can buy from any seller they wish without any hesitation regarding the quality of the product since all sellers sell identical products. Because of large number of sellers and homogeneous products, price (P) in a competitive market remains fixed. Once a market price is determined, no player can manipulate it.

   Demand curve of a firm would be parallel to the output axis as in the right panel of Figure 7.1 suggesting that any amount of good can be bought at a fixed price P_0. Left panel of Figure 7.1 shows how price is determined in the industry through interaction between the industry demand and the industry supply.

   Total revenue, $TR = P \times Q$

   Average revenue, $AR = \dfrac{TR}{Q} = \dfrac{P \times Q}{Q} = P$

   Marginal revenue is the change in total revenue due to one unit change in quantity of output.

Demand of a Competitive Firm

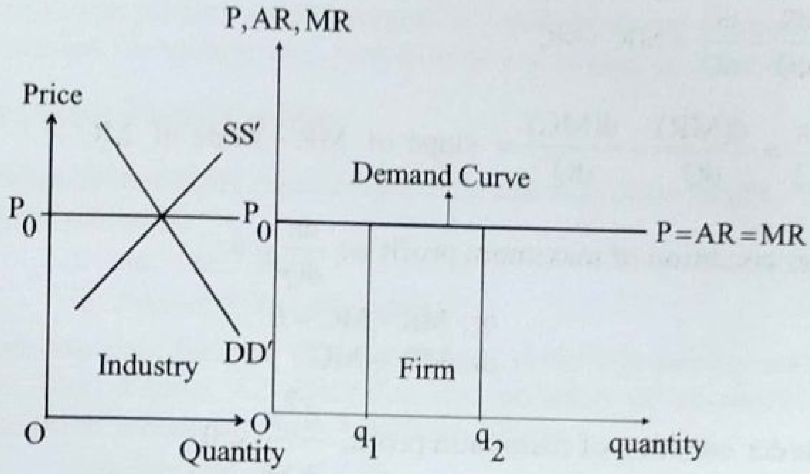

Figure- 7.1

Marginal revenue, $MR = \dfrac{d(TR)}{dQ}$

$$= \frac{d}{dQ}(P \times Q) = P \text{; (because price is constant)}$$

In perfect competition, price, average revenue (AR) and marginal revenue (MR) are equal (P = AR = MR).

3. Free Entry and Exit

Firms can enter the competitive industry or exit from the industry under any circumstances if they want. There is no barrier that could prevent firms from such free movement. Existence of the economic profit attracts new entrants, and the possibility of loss discourages the firms to stay in the industry. Free entry and exit, however, is a long-run feature. If the existing firms make profit for long time then new firms will be motivated to get in and such action would lower the profit of existing firms. The opposite occurs when the firms make loss in the long run. In the event of loss, they get out of the industry. This action lowers the loss of existing firms.

4. Profit Maximization

The key objective of a competitive firm is profit maximization. Firms try to maximize profit both in the short run and in the long run. In the long run, however, economic profit disappears because of influx of new firms, but competitive firms are able to secure excess profit in the short run. There are two conditions of profit maximization. The conditions are derived mathematically.

By definition,
Profit (π) = Revenue (R) – Cost (C)

$$\pi = R(Q) - C(Q) = \pi(Q)$$

$$\therefore \frac{d\pi}{dQ} = \frac{dR}{dQ} - \frac{dC}{dQ} = MR - MC$$

$$\text{and } \frac{d^2\pi}{dQ^2} = \frac{d(MR)}{dQ} - \frac{d(MC)}{dQ} = \text{slope of MR} - \text{slope of MC}$$

First order condition of maximum profit is: $\frac{d\pi}{dQ} = 0$

or, $MR - MC = 0$
or, $MR = MC$

Second order condtion of maximum profit, $\frac{d^2\pi}{dQ^2} < 0$

or, slope of MR – slope of MC < 0
or, slope of MR < slope of MC

Two conditions of profit maximization
1. MR = MC
2. Slope of MR < Slope of MC

5. **No Government Regulation**
Government does not play any role in a perfectly competitive market. Government has the authority to impose tax, grant subsidy, issue quota or restrict licenses. But in a competitive market structure, none of the above interruptions would prevail. Plainly speaking, government is just absent or silent in a competitive environment. Although this sounds unrealistic, the perfect competition itself is just an imaginary ideal market structure which is studied to understand the possible real life markets.

6. **Perfect Knowledge**
Buyers and sellers of competitive market have perfect knowledge about the market. This knowledge is about the quality of the product, number of buyers and sellers, about present and future situation of the market. Because of complete awareness, firms have no chance of differentiating product or charging higher price.

7. **Absence of Advertisement and Selling Activities**
Perfectly competitive firms sell homogeneous products. Advertisement and other selling activities are completely absent in a competitive market. This is because advertisement is a device to differentiate products but perfect competition is devoid of product differentiation.

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8. **Perfect Mobility of Factors of Production**

Special feature of competitive market structure is the mobility of factors. If the factors wish to move to other firms, they can do so. Imposition of any restriction on factors' movement is unlikely under competitive environment. Firm has no monopsony power in hiring labour or other factor.

7.2 Short Run Equilibrium

A competitive firm attains equilibrium if it can maximise profit. Two conditions of profit maximization are

i. MR = MC and

ii. slope of MR < slope of MC

In the short run equilibrium, firms can earn economic profit, normal profit or can even make loss. Figure 7.2 describes the situation of economic profit. E is the equilibrium point where MC cuts MR from below.

Equilibrium price: OP_0

Equilibrium quantity: Oq_0

Average cost = OA

Total revenue $= \text{Price} \times \text{Quantity} = OP_0 \times Oq_0 = OP_0Eq_0$

Total cost $= \text{Average Cost} \times \text{Quantity}$

$= OA \times Oq_0 = OABq_0$

Profit $= \text{Revenue} - \text{Cost} = OP_0Eq_0 - OABq_0 = ABEP_0$

Short Run Equilibrium with Economic Profit

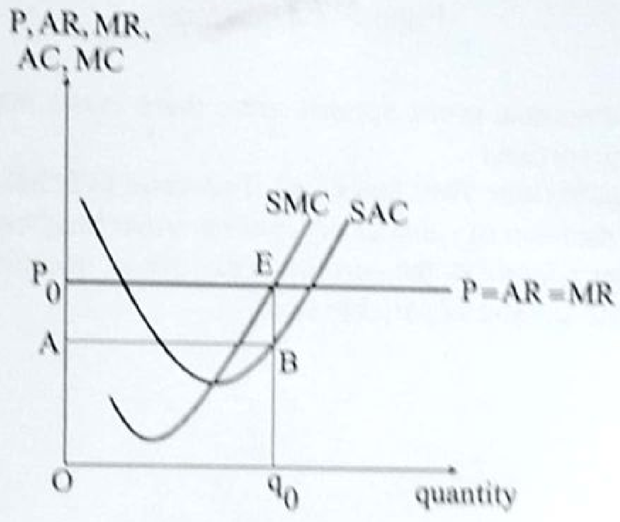

Figure- 7.2

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This profit is also called *economic profit* or *supernormal profit* or *abnormal profit* or *excess profit*.

Figure 7.3 portrays equilibrium with neither profit nor loss. Equilibrium price and quantity, corresponding to equilibrium point F, are $O\bar{P}$ and $O\bar{q}$ respectively. In this case average cost is exactly equal to price. Consequently, total revenue $O\bar{P}F\bar{q}$ is equal to total cost and therefore profit is zero.

No-Profit-No-Loss Equilibrium

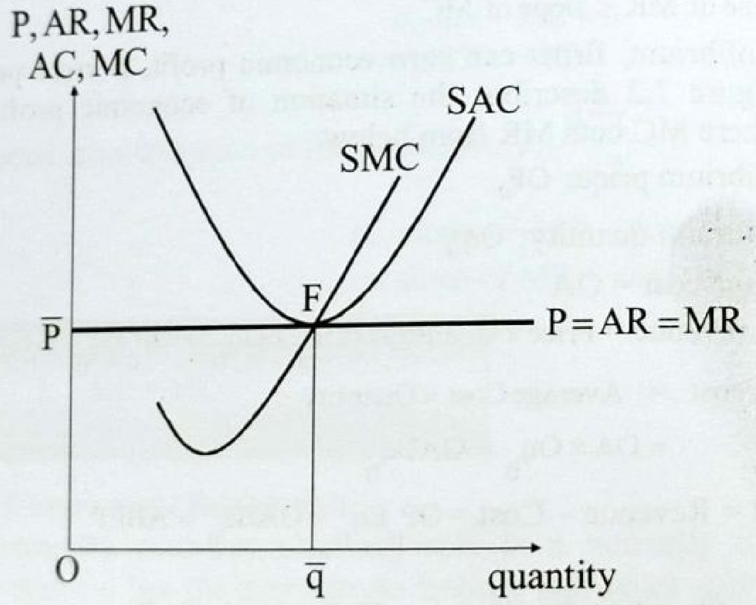

Figure- 7.3

Although the economic profit appears zero, there exists normal profit equal to the return to the entrepreneur.

In short run equilibrium, firm faces loss if revenue falls below cost. In the situation of loss, firm's decision of running or shutting down business depends on the size of the variable cost relative to the earning. The firm in question would run business if price exceeds the amount of variable cost.

Running Business with Loss

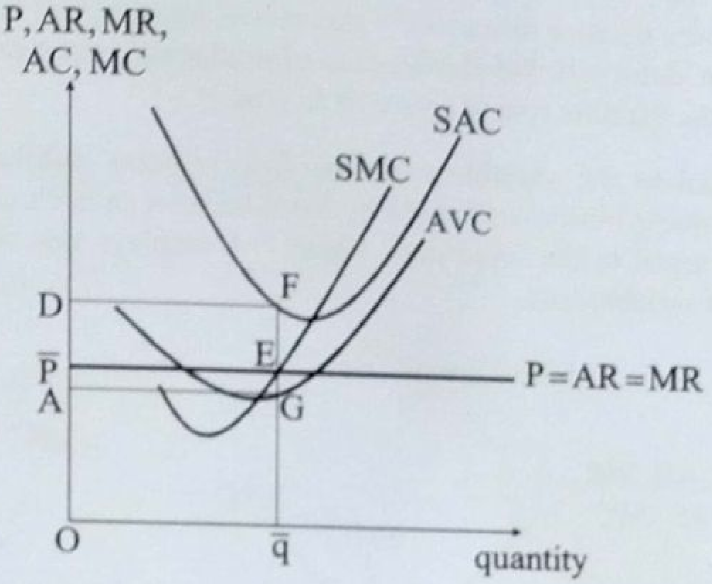

Figure- 7.4

In Figure 7.4 price $O\overline{P}$ exceeds average variable cost OA. Firm can realise entire variable cost (OA) and a portion $(A\overline{P})$ of fixed cost; but $\overline{P}D$ amount of fixed cost remains unrealised which accounts for loss. In this case firm's decision to continue producing output would be the right decision because if firm shuts down then the amount of loss would be higher.

Price Below Variable Cost

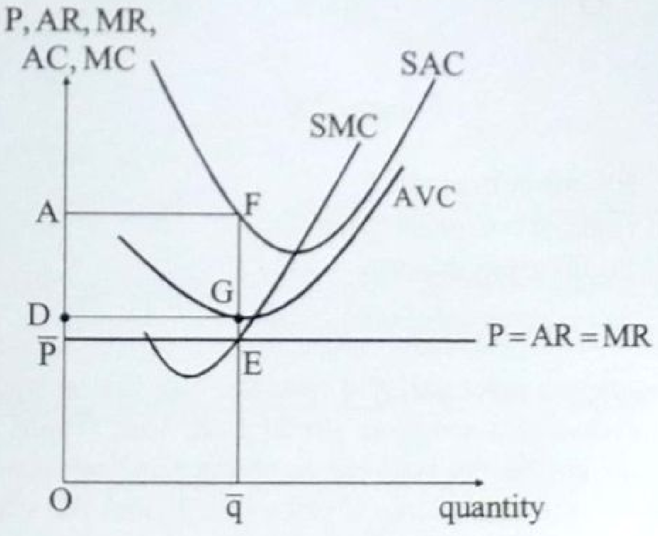

Figure- 7.5

Firm will of course shut down if price falls below the variable cost. In Figure 7.5 price $O\overline{P}$ falls short of per unit variable cost OD. Therefore, the best decision would be to stop business because in such case shut-down decision will involve a loss equal to the fixed cost alone, whereas the decision of producing output will amplify loss by adding part of the variable cost to entire fixed cost.

If price is equal to the variable cost, the firm remains indifferent between the decisions of running business or shutting down because in each case the amount of loss would be equal to the fixed cost. Figure 7.6 displays this cut-off situation of equal price and variable cost.

Shut Down Case

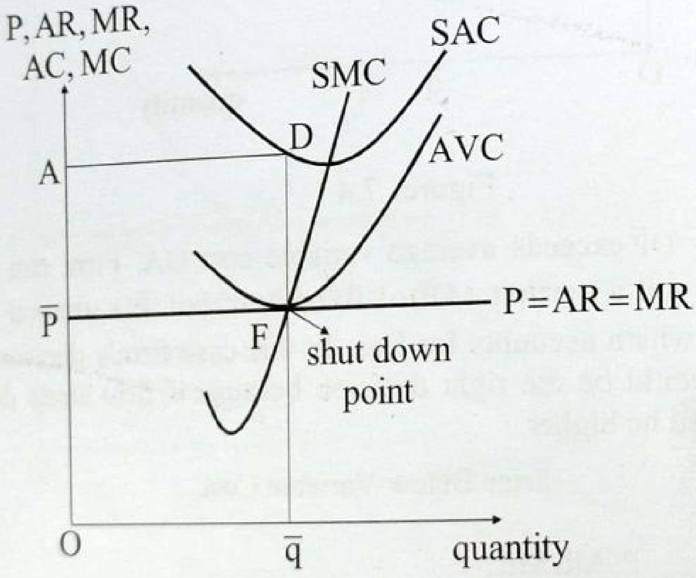

Figure- 7.6

Equilibrium point: F
Equilibrium price = $O\overline{P}$
Equilibrium quantity = $O\overline{q}$
Average variable cost = $O\overline{P}$

Price is just enough to meet variable cost. Per unit loss is equal to the fixed cost $\overline{P}A$. If the producer does not continue production, loss would be the same. Thus the producer remains indifferent between producing and not producing output. Producer will not, however, produce output if price falls below the variable cost. This is why, minimum point of AVC is known as the shut-down-point. Point F in Figure 7.6 is shut-down point.

Example 7.1

Short run cost function of a perfectly competitive firm is $C(Q) = Q^3 - 45Q^2 + 1000Q + 800$. Find the amount of maximum profit assuming $P = 1000$.

Solution

Total revenue, $R = \text{Price} \times \text{Quantity} = 1000Q$

Marginal revenue, $MR = \dfrac{dR}{dQ} = 1000$

Slope of MR $= \dfrac{d(MR)}{dQ} = 0$

Given, $C(Q) = Q^3 - 45Q^2 + 1000Q + 800$

Marginal cost, $MC = \dfrac{dC}{dQ} = 3Q^2 - 90Q + 1000$

Slope of MC $= \dfrac{d(MC)}{dQ} = 6Q - 90$

Profit maximization requires, MC = MR

$$\text{or, } 3Q^2 - 90Q + 1000 = 1000$$

$$\text{or, } 3Q^2 - 90Q = 0$$

$$\text{or, } 3Q(Q - 30) = 0$$

Thus, either $Q = 0$ or, $Q = 30$

When $Q = 30$, Slope of MC $= 6Q - 90 = (6 \times 30) - 90 = 90$ and slope of MR $= 0$.

Since slope of MR < slope of MC, profit would be maximum at $Q = 30$. You can see that $Q = 0$ does not satisfy the second order condition of profit maximization.

When $Q = 30$, total revenue $= \text{Price} \times \text{Quantity} = 1000 \times 30 = 30000$

Total cost, $C = 30^3 - (45 \times 30^2) + (1000 \times 30) + 800 = 27000 - 40500 + 30000 + 800 = 17300$

Therefore, profit = total revenue – total cost = 30000 - 17300 = 12700

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Example 7.2

A competitive firm's short run cost function is estimated as $C = \frac{1}{3}Q^3 - 30Q^2 + 800Q + 21000$. Market price is fixed at 400. Does the firm earn economic profit in equilibrium? Should the firm continue business? Give an intuitive explanation.

Solution

Total revenue (R) = Price × Quantity = 400Q

$$\text{Marginal revenue,} \quad MR = \frac{dR}{dQ} = 400$$

$$\text{Slope of MR} = \frac{d(MR)}{dQ} = 0$$

$$\text{Total cost,} \; C = \frac{1}{3}Q^3 - 30Q^2 + 800Q + 21000$$

$$\text{Marginal cost,} \; MC = \frac{dC}{dQ} = Q^2 - 60Q + 800$$

$$\text{Slope of MC} = \frac{d(MC)}{dQ} = 2Q - 60$$

Setting $\quad MC = MR$

$$Q^2 - 60Q + 800 = 400$$

$$\text{or, } Q^2 - 60Q + 400 = 0$$

$$\therefore Q = \frac{-(-60) \pm \sqrt{(-60)^2 - 4 \times 1 \times 400}}{2}$$

$$= \frac{60 \pm \sqrt{3600 - 1600}}{2} = \frac{60 \pm 44.72}{2} = 52.36 \quad \& \quad 7.64$$

If $Q = 52.36$, Slope of MC $= 2Q - 60 = (2 \times 52.36) - 60 = 44.72$ and slope of MR $= 0$.
Thus slope of MR < slope of MC.
If $Q = 7.64$, Slope of MC $= 2Q - 60 = (2 \times 7.64) - 60 = -44.72$ and slope of MR $= 0$
Therefore, slope of MR > slope of MC.
This suggests, second order condition of profit maximization is satisfied when $Q = 52.36$.

Thus profit maximizing output = 52.36

Total revenue, $R = \text{Price} \times \text{Quantity} = 400 \times 52.36 = 20944$

Total cost, $C = \frac{1}{3}Q^3 - 30Q^2 + 800Q + 21000$

$$= \frac{1}{3}(52.36)^3 - 30(52.36)^2 + (800)(52.36) + 21000$$

$$= 28490.44$$

Since total revenue falls below total cost, the firm makes loss.
Amount of loss = total cost - total revenue
$= 28490.44 - 20944 = 7546.44$
Despite making loss the firm should continue business because its revenue exceeds variable cost.

In this case, total variable cost, $TVC = \frac{1}{3}Q^3 - 30Q^2 + 800Q$

$$= \frac{1}{3} \times (52.36)^3 - 30 \times (52.36)^2 + 800 \times 52.36 = 7490.44$$

Total revenue = 20944.

The firm can meet entire amount of variable cost by spending a portion of its revenue and the residual amount is spent to finance fixed cost.
After meeting variable cost the firm is left with (20944 - 7490.44) = 13453.56.
An amount of fixed cost, however, remains unrealised, which remains as loss.
Under present situation, total fixed cost = 21000.
Amount of fixed cost borne by the firm = 13453.56
Amount of fixed cost that can't be borne = 21000 - 13453.56 = 7546.44, which is loss.
If the firm does not run business then its loss would be equal to 21000. Thus the firm should stay in business.

Example 7.3

Assume short-run cost function of a competitive firm: $C = Q^3 - 10Q^2 + 100Q + 500$.
Determine the minimum price below which the firm will shut down business.

Solution

A firm should stop business if price falls below the variable cost. In order to determine shut-down price, one has to watch the minimum average variable cost (AVC).

Here, $TVC = Q^3 - 10Q^2 + 100Q$

$$AVC = \frac{TVC}{Q} = Q^2 - 10Q + 100$$

First order condition for minimum AVC is $\frac{d(AVC)}{dQ} = 0$

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We got, $AVC = Q^2 - 10Q + 100$

$$\therefore \frac{d(AVC)}{dQ} = 2Q - 10$$

Setting, $\frac{d(AVC)}{dQ} = 0$

or, $2Q - 10 = 0$

or, $2Q = 10$

$\therefore Q = 5$

$$\frac{d^2(AVC)}{dQ^2} = 2 > 0$$

Since $\frac{d^2(AVC)}{dQ^2} > 0$, AVC would be minimum at $Q = 5$.

Amount of minimum AVC $= 5^2 - (10 \times 5) + 100 = 25 - 50 + 100 = 75$

If price falls below 75, the firm will shut down.

7.3 Short Run Supply Function of a Competitive Firm

Supply function shows the combinations of price and output supplied.

Short Run Supply Function

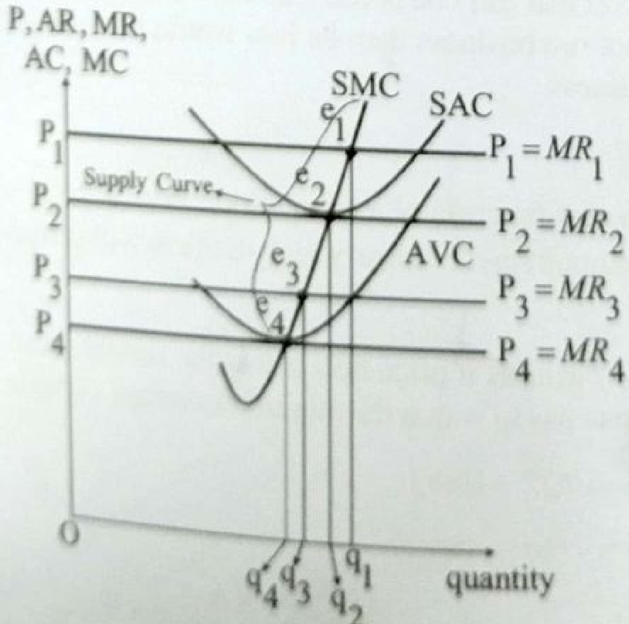

Figure- 7.7

Figure 7.7 provides the description of deriving supply curve of a competitive firm in the short run. Equality between marginal revenue and marginal cost determines price and output decision of a firm. Initial equilibrium point is e_1 where price and output are P_1 and q_1 respectively. At point e_1 the firm is making economic profit. Since e_1 point denotes a pair of price and corresponding quantity, e_1 is a point on the supply curve, which is also a point of marginal cost curve. At P_2 price, zero-profit-equilibrium is achieved at point e_2. Price and output are P_2 and q_2 respectively. e_2 point, representing one-to-one correspondence between price P_2 and output q_2, is another point of supply curve, which is again a point on marginal cost curve. Although incurring loss, e_3 is another production point representing price P_3 and output q_3. e_3 is simultaneously a point on supply curve and marginal cost curve. In each case, we observe that the points on supply curve are indeed the points on marginal cost curve. However, if price falls below the average variable cost then the firm will shut down. Therefore, the segment of marginal cost curve that lies above the average variable cost curve is the short run supply curve of a competitive firm.

7.4 Short Run Industry Supply Curve

Industry supply is the horizontal summation of firms' supply. Simple summation of firms' supply is denoted as Σs_f in Figure 7.8. At OP_1 price, total supply of all firms is equal to OQ_1 which is industry supply at this price. Combination of this price and supply is denoted as point E on Σs_f. If price increases, all firms expand output. At OP_2 price total supply along Σs_f is OQ'_2.

Industry Supply Curve

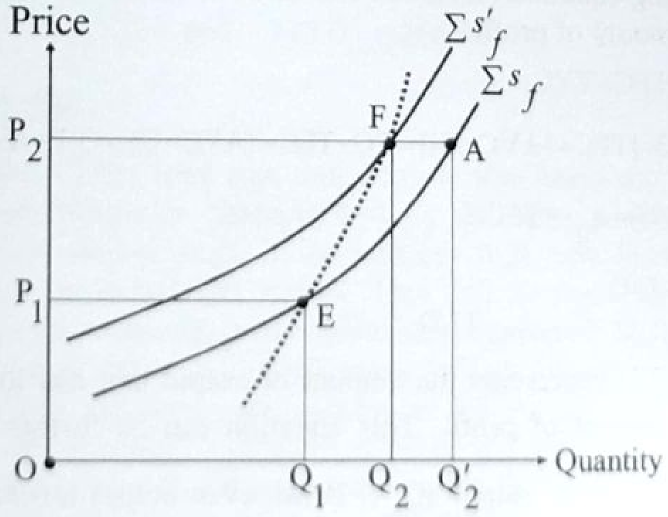

Figure- 7.8

Note that an increase in price is a good signal to the firms as business becomes more profitable. Firms aim at increasing output hence require more factors of production. Growing demand for factors of production is likely to raise factor price. Increase in the factor price increases the marginal cost of production. Marginal cost curve, which is the firm's supply curve, shifts up. At OP_2 price summation of firms' supply curve shifts from Σs_f to $\Sigma s'_f$. Point F shows the amount of actual supply OQ_2 at price OP_2. Industry supply curve is drawn by joining the points E and F.

If there is no impact of expansion in output on factor prices then industry supply curve would be the simple summation of firms' supply curve Σs_f which is relatively flat, but if factor price changes then, in the short-run, industry supply becomes steeper.

7.5 Profit Contribution

Profit contribution refers to the revenue excess of variable cost. A firm cannot avoid fixed costs anyway but it can avoid variable cost by stopping production for a short while. Viability of production depends on whether the firm can bear its variable expenses. If the earning, however, exceeds the variable cost then the firm enters into a favourable atmosphere because it can finance fixed cost by spending the residual amount net of variable cost. The difference between price and average variable cost is known as the profit contribution.

i.e., Profit Contribution = P - AVC

The concept of profit contribution has important bearing on firm's goal. Suppose a typical firm has the target of making π_R amount of profit. π_R stands for required profit.

Where, π_R = Revenue - Cost = PQ - (TFC + TVC) .... (7.1)

Here TFC and TVC stand for total fixed cost and total variable cost respectively. Manipulating equation (7.1), one can find out the rate of output that will generate the required amount of profit.

$$\pi_R = PQ - (TFC + TVC)$$

$$\text{or, } \pi_R = PQ - [TFC + (AVC \times Q)] = PQ - TFC - (AVC \times Q) = Q(P - AVC) - TFC$$

$$\text{or, } Q(P - AVC) = \pi_R + TFC$$

$$\therefore Q = \frac{\pi_R + TFC}{P - AVC} \quad \text{..... .....} \quad (7.2)$$

Equation (7.2) represents the amount of output that has to be produced in order to make π_R amount of profit. This equation can be further simplified to derive the break-even level of output (Q_b). Break-even output level refers to the output level that corresponds to zero economic profit $(\pi_R = 0)$.

Set $\pi_R = 0$ into (7.2)

$$Q_b = \frac{TFC}{P - AVC} \quad \text{......} \quad \text{......} \quad (7.3)$$

The above analysis of profit contribution is based on a very restrictive assumption of constancy of AVC. There is no reason why AVC should be constant if total cost is normally shaping cubic function.

Example 7.4

Reconsider example 7.2 where cost function was assumed

$$C = \frac{1}{3}Q^3 - 30Q^2 + 800Q + 21000$$

Price, $P = 400$
Profit maximizing output level, $Q^* = 52.36$
Amount of loss = 7546.44
Determine the amount of profit contribution.

Solution

Total variable cost,

$$TVC = \frac{1}{3}Q^3 - 30Q^2 + 800Q$$

$$= \frac{1}{3} \times (52.36)^3 - 30 \times (52.36)^2 + (800 \times 52.36)$$

$$= 7490.44$$

Average variable cost, $AVC = \dfrac{TVC}{Q} = \dfrac{7490.44}{52.36} = 143.06$

Thus profit contribution $= P - AVC = 400 - 143.06 = 256.94$

7.6 Long Run Equilibrium

Perfectly competitive firms, in the long run, can neither earn economic profit nor make loss. Long run equilibrium is characterised as the zero economic profit situation. If there prevails economic profit in the industry then new firms enter the industry, causing an expansion in industry output. This will decrease market price. The process continues until all economic profits have been exploited. If, on the other hand, loss occurs then some firms will shut down. Such layoff leads to the contraction of industry output and hence an increase in the market price. With the advantage of increased price, existing firms will get rid of the loss and survive with normal profit. Final equilibrium will be a situation with no profit and no loss. Sometimes, for the reason discussed above, long run equilibrium of competitive firm is termed as zero-profit-theorem.

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Long Run Equilibrium

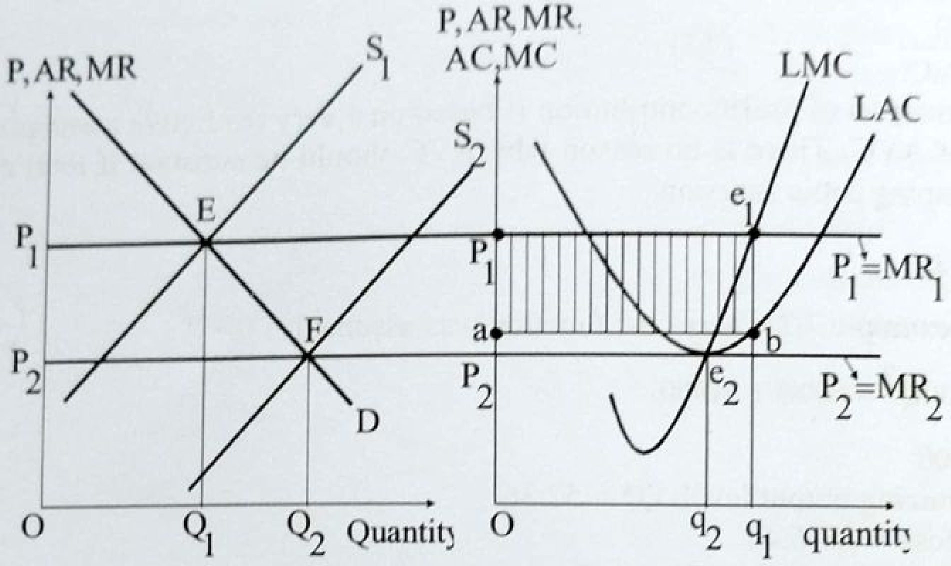

Figure- 7.9

Left panel of figure 7.9 reveals the industry equilibrium under perfect competition. Demand curve D intersects supply curve S_1 at point E. Market price is determined at P_1. This price is taken by all firms of the industry. One such firm's equilibrium is presented in the right panel of figure 7.9. The firm is initially earning an economic profit equal to abe_1P_1 area. Questing for economic profit, new firms will enter the industry. This will lead to an increase in the industry supply causing a rightward shift in the industry supply curve and a drop in the market price. The process will continue until the market price falls to a level just enough to generate normal profit to all firms within the industry. Long run industry equilibrium is attained at point F where the shifted supply curve S_2 intersects the demand curve D determining equilibrium price OP_2. Final equilibrium of the firm is at point e_2 in the right panel of the diagram. e_2 is the minimum point of LAC where the firm neither makes profit nor loss.

At final equilibrium point, P = AR = MR = MC = minimum AC.

7.7 Long Run Industry Supply

Depending on the nature of cost, long run industry supply curve may be upward sloping, horizontal or even downward sloping. Expansion of output requires hiring additional factors of production. Increased demand for factors of production may cause increase in factor prices. If this happens, the industry is called increasing cost industry. If factor price remains unchanged with increased demand, the industry is called constant cost industry. Sometimes specialization of a particular product leads to the availability of trained up factors. For example, in recent years Bangladesh extensively specialised in the production of readymade garments. As a result, availability of skilled labour in RMG production has considerably increased and unit labour cost has decreased. In a decreasing cost industry, the long run supply curve slopes downward.

Figure 7.10 describes the case of increasing cost industry. Initial demand curve D_1 and supply curve S_1 intersect at point E where price is set at OP_1. At this price all firms in the competitive industry are earning only normal profit, thus the long-run equilibrium is achieved. Right panel of the diagram shows zero profit at point e where $MR_1 = MC$. Suppose, there is an exogenous increase in demand from D_1 to D_2, generating a new equilibrium at point H in the right panel of Figure 7.10. Price OP_2 corresponding to equilibrium point H yields economic profit. Typical firm's economic profit is shown as the shaded area designated by *abtw*. Being lured by economic profit, new entrants will enter the industry and hence industry supply curve will shift rightward. There will be an increased demand for factors of production. In an increasing cost industry, increased demand for factors leads to an increase in factor price and thus increase in average cost of production. Average cost curve shifts up from LAC to LAC'. Industry supply increases through the influx of new firms. New supply curve S_2 intersects D_2 at point F where equilibrium price is determined at OP*. Upward sloping long run industry supply curve LS is drawn by joining the points E and F.

Industry Supply in Increasing Cost Industry

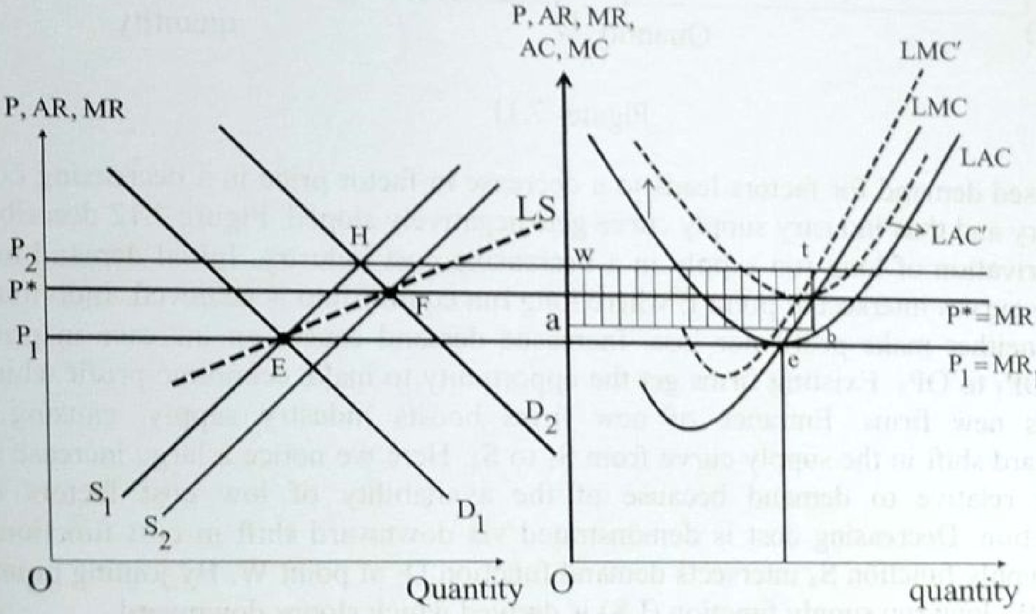

Figure- 7.10

Derivation of the constant cost industry supply curve is illustrated in Figure 7.11. In this case, enhanced demand for factors does not cause any change in factor price, thus cost of production remains unchanged. However, because of new entrants, industry supply increases from S_1 to S_3. New supply curve S_3 intersects D_2 at point T. Long run industry supply curve LS, demonstrated as a dashed line, is derived by joining points E and T. In this case industry supply curve appears horizontal.

Industry Supply in Constant Cost Industry

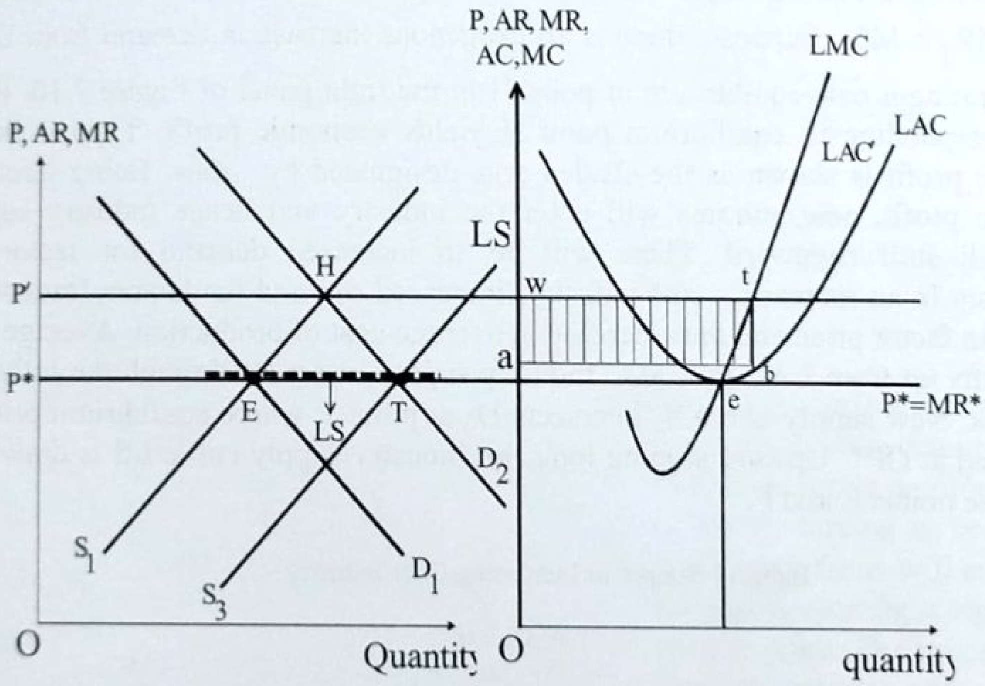

Figure- 7.11

Increased demand for factors leads to a decrease in factor price in a decreasing cost industry and thus industry supply curve gets negatively sloped. Figure 7.12 describes the derivation of long run supply in a decreasing cost industry. Initial demand and supply curves intersect at point E where long run equilibrium is achieved. Individual firms neither make profit nor loss. Increased demand causes an increase in price from OP_1 to OP_2. Existing firms get the opportunity to make economic profit which attracts new firms. Entrance of new firms boosts industry supply, causing a rightward shift in the supply curve from S_1 to S_4. Here we notice a large increase in supply relative to demand because of the availability of low cost factors of production. Decreasing cost is demonstrated via downward shift in cost functions. New supply function S_4 intersects demand function D_2 at point W. By joining points E and W, long run supply function (LS) is derived which slopes downward.

Industry Supply in Decreasing Cost Industry

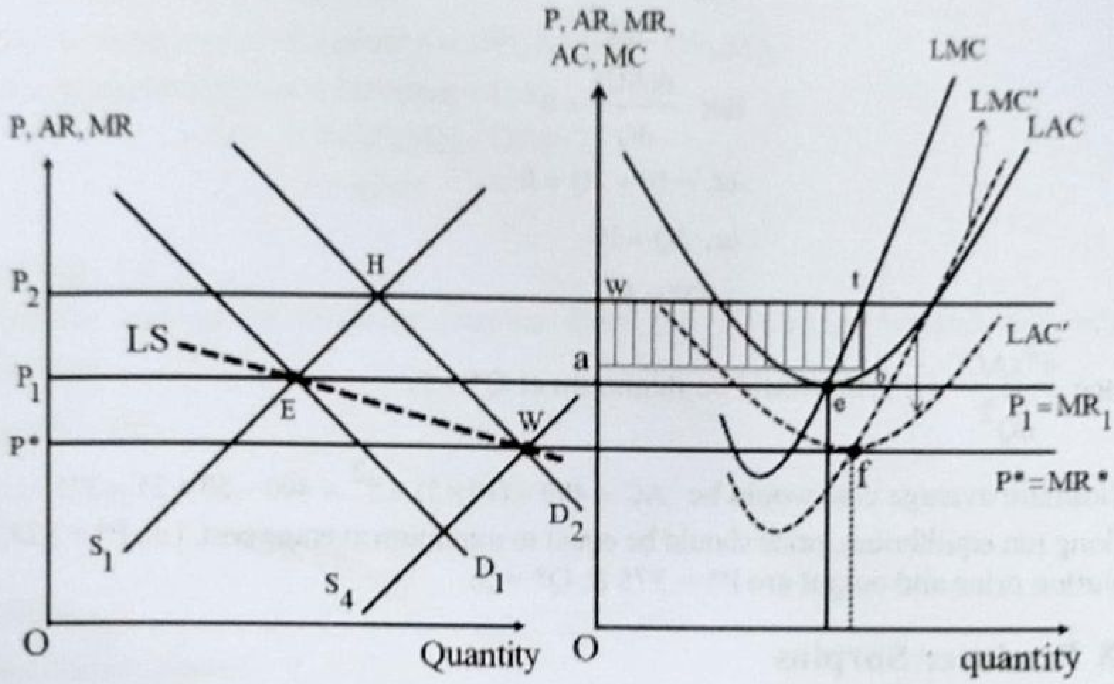

Figure- 7.12

Example 7.5

Southern Publication is publishing since long in a competitive environment. Determine equilibrium price and quantity in long run equilibrium considering the cost function: $C = 400Q - 10Q^2 + Q^3$

Solution

Long-run equilibrium would be attained if price is set equal to minimum average cost.

Given total cost $C = 400Q - 10Q^2 + Q^3$

Average cost, $AC = \frac{C}{Q} = \frac{400Q - 10Q^2 + Q^3}{Q} = 400 - 10Q + Q^2$

First order condition for minimum average cost is: $\frac{d(AC)}{dQ} = 0$

$$\text{Here, } AC = 400 - 10Q + Q^2$$

$$\therefore \frac{d(AC)}{dQ} = -10 + 2Q$$

$$\text{and} \quad \frac{d^2(AC)}{dQ^2} = 2 > 0$$

$$\text{Set} \quad \frac{d(AC)}{dQ} = 0$$

$$\text{or,} \ -10 + 2Q = 0$$

$$\text{or,} \ 2Q = 10$$

$$\therefore \ Q^* = 5$$

Since $\frac{d^2(AC)}{dQ^2} > 0$, AC would be minimum at $Q^* = 5$.

Minimum average cost would be $AC = 400 - (10 \times 5) + 5^2 = 400 - 50 + 25 = 375$

In long run equilibrium, price should be equal to minimum average cost, i.e., $P^* = 375$.
Solution price and output are $P^* = 375$ & $Q^* = 5$.

7.8 Producer Surplus

Producer surplus is the difference between total revenue and total cost of the producer. It is equivalent to economic profit.

Producer surplus = total revenue – total cost.

Multiplication of price by quantity yields total revenue. Total cost, if directly not available, can be computed by taking the integration of marginal cost in a specified range of output. Since supply function is a portion of the marginal cost function, the area below the supply function measures the total cost of production. This comes from the geometric interpretation of a definite integral. Figure 7.13 describes the graphical method of determining the producer surplus from Q_0 amount of output.

Producer Surplus

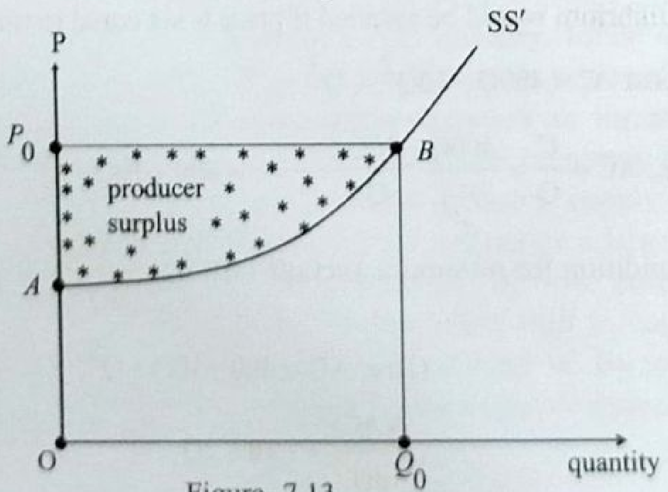

Figure- 7.13

Total cost of producing Q_0 amount of output is the area below the supply function up to Q_0 output, which is $OABQ_0$.

Total revenue = price X quantity = OP_0 X OQ_0 = OP_0BQ_0

Thus, producer surplus = Revenue – Cost

$$= OP_0BQ_0 - OABQ_0$$

$$= AP_0B$$

Example 7.6

Find the amount of producer surplus from the following demand and supply functions.

$P_d = 62 - 2Q$

$P_s = 2 + 3Q$

Solution

Equilibrium requires $P_d = P_s$

This follows, $62 - 2Q = 2 + 3Q$

$$\text{or, } 62 - 2Q = 2 + 3Q$$

$$\text{or, } 5Q = 60$$

$$\therefore \overline{Q} = 12$$

Plug Q = 12 into the demand and supply functions and obtain $\overline{P} = 38$.

Total revenue of the producer = Price X Quantity = 12 X 38 = 456

Total cost of producing 12 units of output can be obtained by taking the integration of the supply function from 0 to 12.

$$TC = \int_0^{12}(2+3Q)dQ = 2\int_0^{12} dQ + 3\int_0^{12} Q dQ = 2[Q]_0^{12} + \frac{3}{2}\left[Q^2\right]_0^{12} = (2\times12) + (\frac{3}{2}\times12^2) = 240$$

Producer surplus = revenue – cost = 456 – 240 = 216

7.9 Perfect Competition and Economic Efficiency

Perfectly competitive firms produce output at a minimum cost using the optimum plant, charge the minimum price and therefore it is argued that competitive market structure is compatible with the economic efficiency.

Economic Efficiency

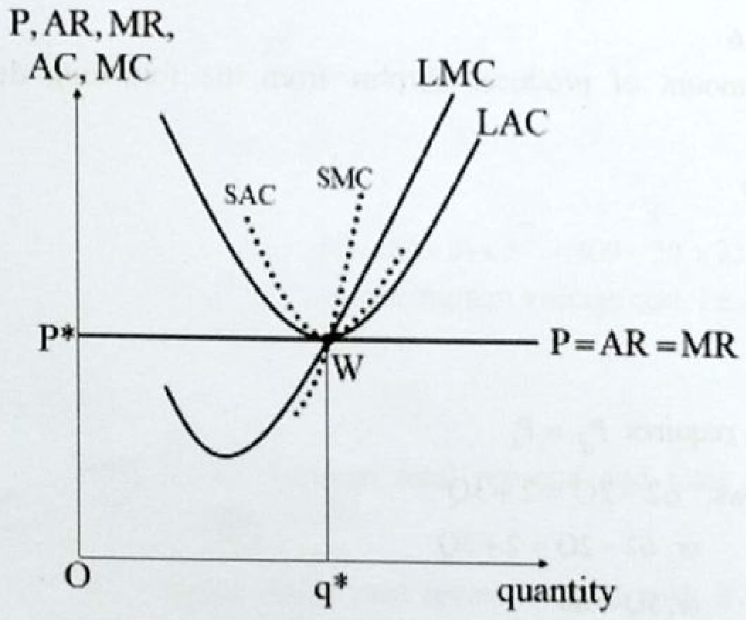

Figure- 7.14

Figure 7.14 represents the long run equilibrium of a competitive frim. The typical firm produces at point 'W' where marginal revenue equals marginal cost. Price, average cost and marginal cost are equal. Total revenue equals total cost and abnormal profit does not exist. If the market price stays above the unit cost then new firms enter into the industry and thus market supply increases, which lowers price. The reverse occurs if the market price stays below the average cost. In the latter case, some firms exit the industry because of loss, which causes a fall in the market supply and thus increase in the market price. Final equilibrium achieves with the normal profit alone.

Consumers buy goods at a minimum price, which confirms the allocative efficiency in perfect competition. Producers produce goods at the minimum point of long run average cost curve by utilizing optimum plant, hence unit cost of production is minimum, which confirms the efficiency in production. Any movement from the long-run equilibrium would involve the reduction in the welfare of either consumer or producer or both. Resources of the economy are efficiently utilized and thus output mix falls on the production possibility curve, welfare of the society is maximized at given prices and therefore the society reaches the highest community indifference curve.

Efficiency in Perfect Competition

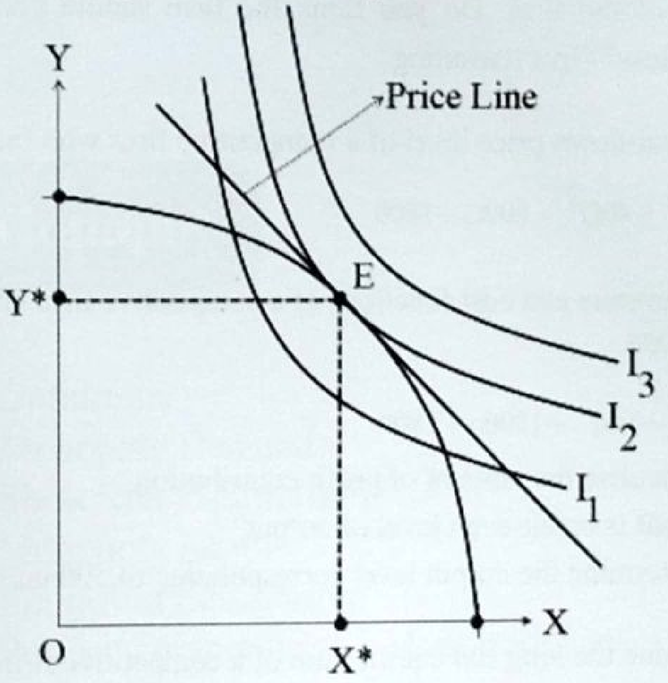

Figure 7.15

Figure 7.15 is drawn to describe the economic efficiency under perfect competition assuming that only two goods X and Y are produced in the economy. All points of production possibility curve (PPC) are, by definition, efficient. Equilibrium is obtained at point E where PPC is tangent to the maximum possible social welfare function I_2. Optimum output mix is OX* of X and OY* of Y.

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Exercise 7

1. Determine the profit maximizing level of output of a competitive firm whose cost and demand functions are given below

   $C(Q) = Q^3 - 30Q^2 + 500Q + 800$

   $P = 400$

2. Cost and revenue functions of a competitive firm are $C = \frac{1}{3}Q^3 - 30Q^2 + 800Q + 14000$ & $R = 400Q$. Find equilibrium rate of output of the firm. Do you think the firm should continue business if it makes loss? Give reasoning.

3. Find shut-down price level of a competitive firm who faces the cost function

   $C = Q^3 - 40Q^2 + 800Q + 1800$

4. Total revenue and cost functions of a competitive firm are as follows

   $R = 1400q$

   $C = q^3 - 60q^2 + 1500q + 1800$

   i. Calculate the amount of profit contribution.
   ii. What is break-even level of output?
   iii. Determine the output level corresponding to 500 unit profit.

5. Determine the long run equilibrium of a competitive firm assuming its cost function $C = 800Q - 20Q^2 + Q^3$

6. Compute the amount of producer surplus from the sale of 15 unit output. Marginal cost function is

   $MC = Q^2 + 5Q + 10$

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