# CHAPTER - 5

## PRODUCT PRICING

## CONCEPT OF MARKET EQUILIBRIUM:

Market equilibrium is an economic state when the demand and supply curves intersect and suppliers produce the exact amount of goods and services consumers are willing and able to consume. Essentially, this is the point where quantity demanded and quantity supplied is equal at a given time and price. There is no surplus or shortage in this situation and the market would be considered stable. In other words, consumers are willing and able to purchase all of the products that suppliers are willing and able to produce. Everyone wins.

If the market price is above the equilibrium value, there is an excess supply in the market (a surplus), which means there is more supply than demand. In this situation, sellers will tend to reduce the price of their good or service to clear their inventories. They probably will also slow down their production or stop ordering new inventory. The lower price entices more people to buy, which will reduce the supply further. This process will result in demand increasing and supply decreasing until the market price equals the equilibrium price.

If the market price is below the equilibrium value, then there is excess in demand (supply shortage). In this case, buyers will bid up the price of the good or service in order to obtain the good or service in short supply. As the price goes up, some buyers will quit trying because they don't want to, or can't, pay the higher price. Additionally, sellers, more than happy to see the demand, will start to supply more of it. Eventually, the upward pressure on price and supply will stabilize at market equilibrium.
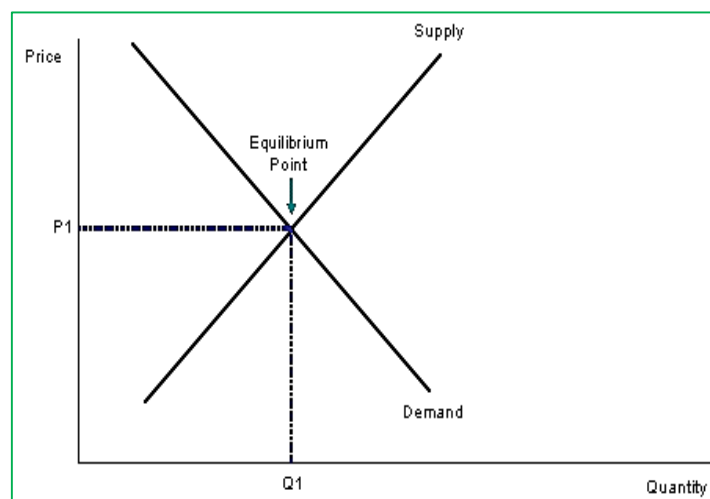


## CONCEPT OF FIRM EQUILIBRIUM:

A firm is in equilibrium when it has no tendency to change its level of output. It needs neither expansion nor contraction. It wants to earn maximum profits. In the words of A.W. Stonier and D.C. Hague, "A firm will be in equilibrium when it is earning maximum money profits." Equilibrium of the firm can be analyzed in both short-run and long-run periods. A firm can earn

the maximum profits in the short run or may incur the minimum loss. But in the long run, it can earn only normal profit.

## PRICE AND OUTPUT DETERMINATION UNDER PERFECT COMPETITION:

A firm is said to be in equilibrium when it satisfies the following conditions:

1. The first condition for the equilibrium of the firm is that its profit should be maximum.
2. Marginal cost should be equal to marginal revenue.
3. MC must cut MR from below.

*The above conditions of the equilibrium of the firm can be examined in two ways:*

### 1. Total Revenue and Total Cost Approach:

In this approach, total revenue and total cost are under consideration. Since, the objective of the firm is profit maximization. Profit is the difference between total revenue (TR) and total cost (TC). We have, Profit $(\pi)$ = Total Revenue (TR) - Total Cost (TC).

Under this approach there are three types of profit:

a. When, TR > TC $\Rightarrow \pi > 0$, i.e. abnormal profit. (since normal profit is included in cost)
b. When TR = TC $\Rightarrow \pi = 0$, i.e. normal profit.
c. When TR < TC $\Rightarrow \pi < 0$, i.e. loss

The profit is maximized at the output where there is the biggest gap or highest difference between TR and TC, which is given by PM in the figure below. TR-TC approach is shown in figure below.
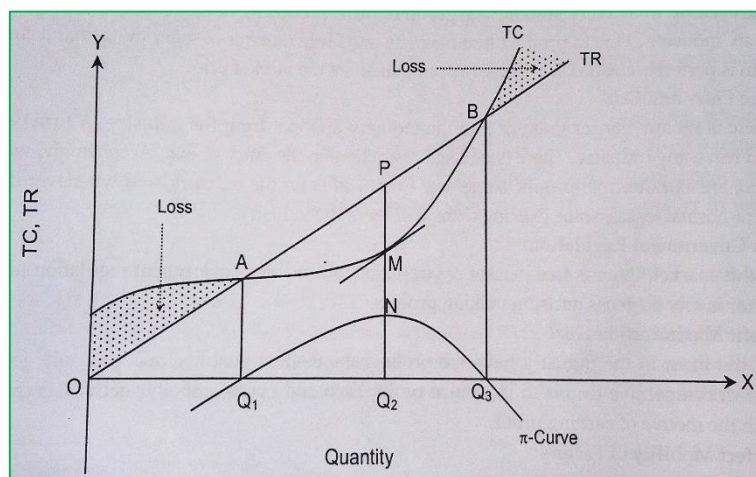


In above figure, TR curve under perfect competition is a straight line, positively sloped and passes through origin. It is because of the price being constant. TC curve is inverse S-shaped comprising total variable cost and total fixed cost. TR curve intersects TC curve at points A and B. at point A output is $Q_1$ and at point B output is $Q_3$. In the figure, before the output level $Q_1$ and after output level $Q_3$, there is loss because TR curve lies below the TC curve (i.e. TR < TC). The output between $Q_1$ and $Q_3$, there is TR > TC which shows there is profit. The biggest gap between TR and TC i.e. MP is at output level $Q_2$ where profit is maximum. Thus, the output at this position gives the equilibrium output of the firm.

Profit curve (i.e. π-curve) is drawn measuring the gap between TR and TC curves. Before the output $Q_1$ and after the output $Q_3$ the π-curve lies below X-axis. It shows there is loss to the firm. Between outputs from $Q_1$ to $Q_2$ the π-curve rises, showing that there is profit which increases as increase in output. In the similar fashion, the π-curve starts to fall from the outputs between $Q_2$ and $Q_3$. The maximum profit ($Q_2N$) is at the output $Q_2$. The profit curve reaches a maximum point N when output is $OQ_2$.

### 2. **Marginal Revenue and Marginal Cost Approach.**

In this approach marginal revenue (MR) and marginal cost (MC) are used to determine the profit maximization conditions. The profit maximization conditions are mentioned below:

a. **Necessary Condition:** MR and MC must be equal to each other i.e. MR = MC
b. **Sufficient Condition:** Slope of MC curve should be greater than Slope of MR curve or MC curve cuts MR curve form below.

This can be explained by the figure below:
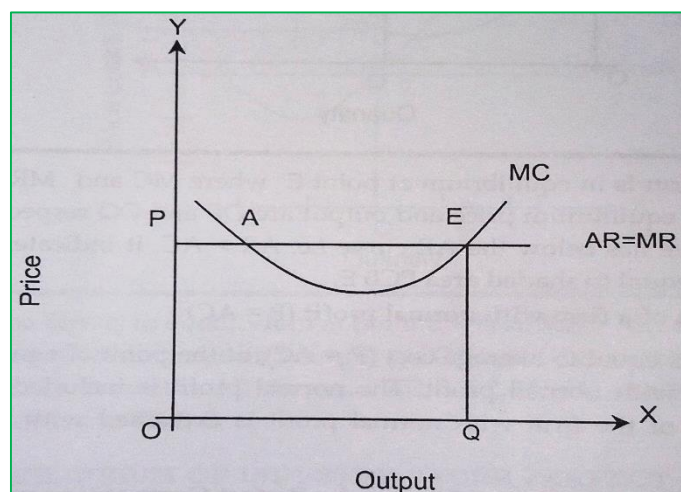


In above figure, MC intersects MR through the point A and E. therefore necessary condition (MR = MC) is satisfied in both points but sufficient condition is satisfied at point E only. Hence, E is the profit maximization condition.

## SHORT-RUN EQUILIBRIUM OF FIRM UNDER PERFECT COMPETITION:

Short run is a period of time in which the firm can change its level of output by changing variable factors of production i.e. it is a period in which market supply cannot be varied according to change in market demand due to lack of sufficient time.

The firm in short run equilibrium does not necessarily mean that it makes abnormal profits. Whether the firm makes abnormal profit or normal profit or losses depends on the level of AC and AR i.e. price and average cost. There are three types of firms which are in equilibrium in the short run. They are given below:

### 1. **Equilibrium of a Firm with Abnormal Profit (P > AC):**

If price is greater than average cost of the firm at the point of equilibrium, the firm is enjoying abnormal profit. It is given by the following diagram.
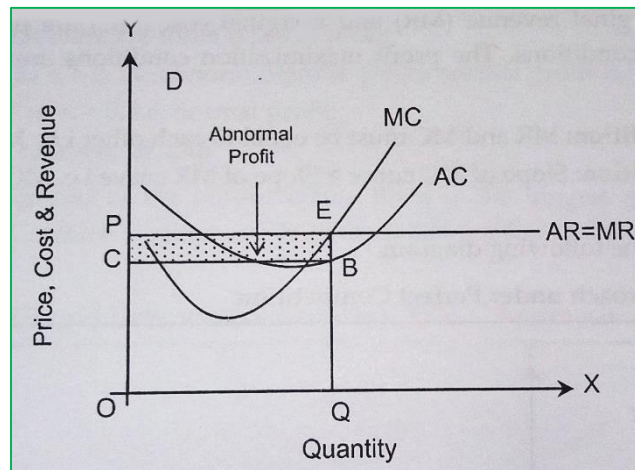
In figure above, the firm is in equilibrium at point E where MR = MC and MC cuts MR from below. The equilibrium price and output are OP and OQ respectively. The minimum point of AC curve lies below the AR curve i.e. AR > AC. It indicates that the firm A enjoys abnormal profit equal to shaded area PCBE.

### 2. Equilibrium of a Firm with Normal Profit (P = AC):

If the price is equal to average cost (P = AC), at the point of equilibrium the firm is in equilibrium with normal profit. The normal profit is included in average cost. The equilibrium of the firm with normal profit is explained with the help of following diagram.
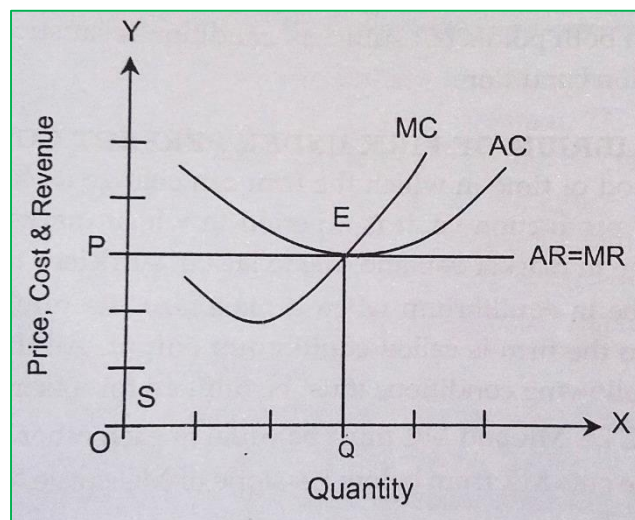


In figure above, the firm is in equilibrium at point E, where MR = MC and MC cuts MR from below. The equilibrium price and output are OP and OQ respectively. The minimum point of AC curve just equal to AR curve i.e. AR = AC. It indicates that firm B enjoys only normal profit.

### 3. Equilibrium of a Firm with Loss (P < AC):

If the price is less than average cost (P < AC) at the point of equilibrium, the firm is facing a loss. The following figure shows the equilibrium of the firm is short run. The equilibrium of a firm with loss is explained by the following figure.
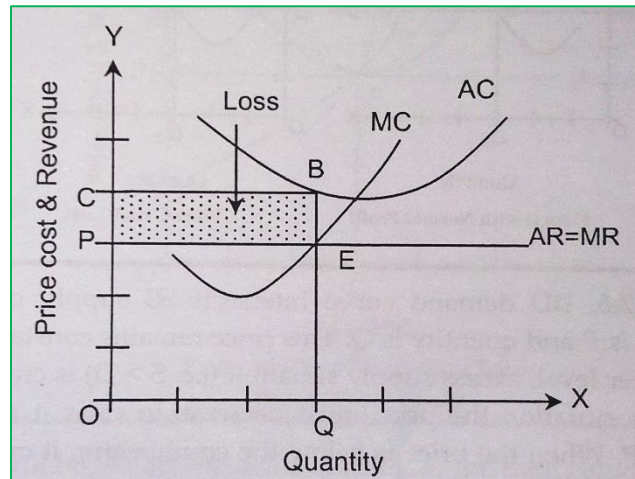
In the figure above, the firm is in equilibrium at point E, where MR = MC and MC curve cuts MR curve from below. The equilibrium price and output are OP and OQ respectively. The minimum point of AC curve lies above the AR curve i.e. AR < AC. It indicates that firm C is bearing losses equal to shaded area PEBC.

### 4. Shut Down Point (Losses = Total Fixed Cost):

Simple question is why firms continue producing the product if they are making losses. In the short run, the firms cannot go out of the industry by disposing off the plant. Why do they not shut down? It is because they cannot change the fixed factors and they have to face fixed costs even if the firm is shut down.

The firm can avoid only variable costs but it has to bear the fixed costs whether to produce or not. The firm will continue producing till the price covers the average variable cost. If the price covers some part of the average fixed costs besides the variable costs, the producer will continue producing. Thus the firm will continue producing so long as price exceeds average variable cost. The shutdown point can be shown with the help of a diagram.
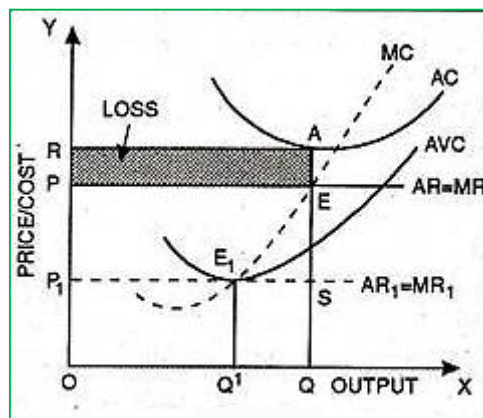


In diagram above equilibrium is at E where MR = MC and MC cuts MR from below. The price is EQ and OQ is the output. This price covers the average variable cost. Average cost corresponding to this output is AQ. In that way loss per unit is AE which is equal to average fixed cost. The total losses are equal to total fixed costs. If price is slightly below OP, level, the firm will not produce at all. The firm will simply shut down production and wait for some good days to come.

## Short-Run Equilibrium of Industry and Firm under Perfect Competition:

In an industry there are large numbers of firms producing homogenous product. All the firms under the industry are in equilibrium. Due to cost conditions of the firm all the firms are not enjoying abnormal profit. There are three types of firms in the industry. Some firms are equilibrium with abnormal profit, some firms are in equilibrium with normal profit and some firms may be in equilibrium with loss also. The sum of total outputs of all these three types of firms is equal to the output of the industry. The firm A represents those types of firms which are in equilibrium with abnormal profit, firm B represents those types of firms which are in equilibrium with normal profit and firm C represents those types of firms which are in equilibrium with loss.

Price and output of an industry is determined intersection of negatively sloped demand curve and positively sloped supply curve of the industry. It is shown in figure below. All the firms in the industry are price takers not price makers because each firm possess perfectly elastic demand curve. It can be explained with the help of following graph.



Firm A with Abnormal Profit     Firm B with Normal Profit     Firm C with Loss     Equilibrium of Industry
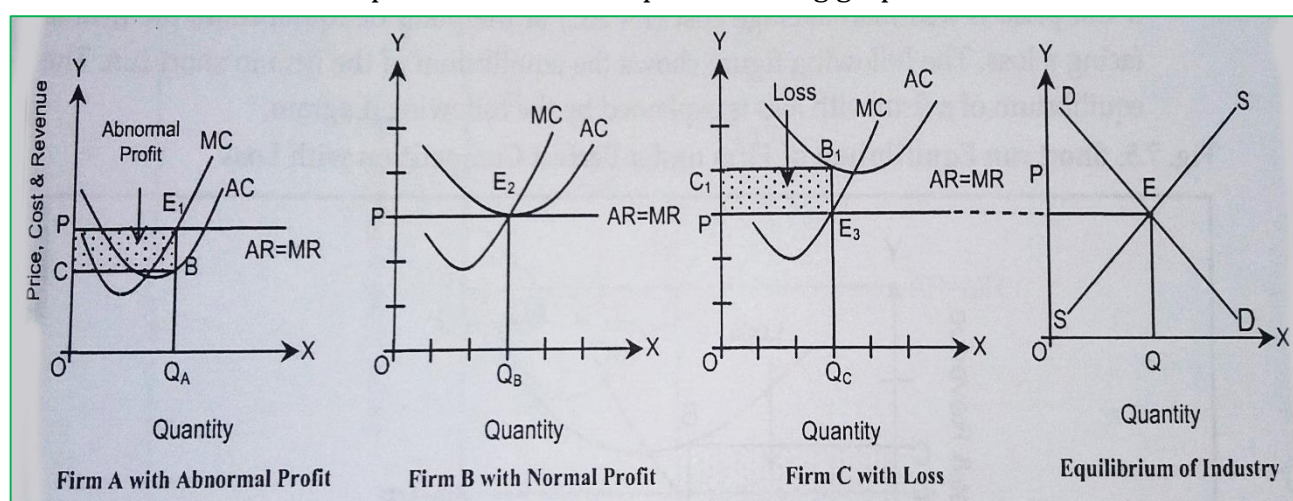
In above figure, DD demand curve intersects SS supply curve at point E, where equilibrium price is P and quantity is Q. This price remains constant for all the firms. If the price rises to higher level, excess supply situation (i.e. S > D) is created. When market faces the excess supply situation the price is below the equilibrium, it creates the excess demand situation (i.e. D > S). It causes increase in price again to the original position P. Thus, it remains constant at P if demand and supply curves are the same. The equilibrium output of the industry also remains same at point Q. It is the horizontal summation of quantity supplied by all the firms in the industry.

All the firms are price takers not price makers and a single firm cannot affect the market price of the product. At this price, firm determines their output. The output produced by firm A is $OQ_A$, firm B is $OQ_B$ and firm C is $OQ_C$. The total output, $OQ = OQ_A + OQ_B + OQ_C$.

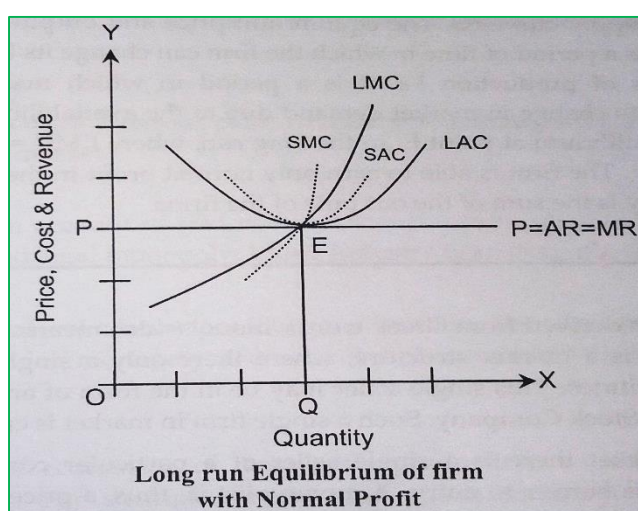## Long-Run Equilibrium of Firm under Perfect Competition Market:

Long run is a period of time in which the firm can change its level of output by changing all the factors of production i.e. it is a period in which market supply can be adjusted according to change in market demand due to the availability of sufficient time. If there is abnormal profit in the short run, more firms are attracted into the market and output increases consequently price falls to normal level in the long run.

Similarly, if there is loss in short run. The firms either improve or change their plants to reduce cost or exit from the industry so that the remaining firms enjoy normal profit only. In this way all the firms are equilibrium with normal profit in long run.

All the firms in the industry are price takers. All the firms in the industry get normal profit in the long run. All the firms are able to utilize their plants at optimal capacity i.e. the minimum point of LAC curve just equal to AR or P. The following condition must be fulfilled for a firm to be in equilibrium:

➢ MR = MC i.e. long run MR must be equal to long run MC curve
➢ LMC curve cuts MR from below.

The long run equilibrium of firm under perfect competition can be explained with the help of following graph.



**Long run Equilibrium of firm with Normal Profit**

In figure above, the firm will be in equilibrium at point E in the long run, where MR = LMC = LAC = SMC = SAC and LMC curve cuts MR curve from below. The equilibrium price and output are OP and OQ respectively. The minimum point of LAC is just equal to AR line i.e. LAC = AR, which indicates that the firm is able to earn only normal profit in the long run.

### Long-Run Equilibrium of Firm and Industry under Perfect Competition Market:

Industry is the group of firms which is equilibrium at that price where quantity demands is equal to the quantity supply. Long run is a period of time in which the firm can change its level of output by changing all the factors of production i.e. it is a period in which market supply can be adjusted according to change in market demand due to the availability of sufficient time. It can be better explained with the help of following graph.

Equilibrium of firm with Normal Profit

Equilibrium of Industry
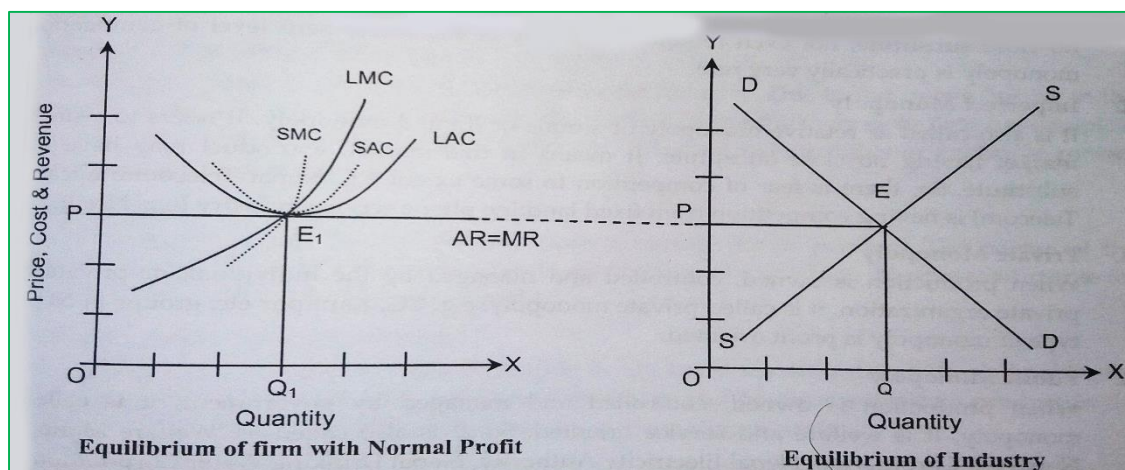
In the above figure, industry will be in equilibrium at point E, where demand curve DD is equal to supply curve SS. The equilibrium price and output are OP and OQ respectively. Long run is a period of time in which the firm can change its level of output by changing all the factors of production i.e. it is a period in which market supply can be adjusted according to change in market demand due to the availability of sufficient time. The firms will be equilibrium at point E1 in the long run, where LMC = MR and LMC cuts MR from below. The firm is able to earn only normal profit in the long run. The total output of the industry is the sum of the outputs of the firms.

## PRICE AND OUTPUT DETERMINATION UNDER MONOPOLY:

A firm is said to be in equilibrium when it satisfies the following conditions:

1. The first condition for the equilibrium of the firm is that its profit should be maximum.
2. Marginal cost should be equal to marginal revenue.
3. MC must cut MR from below.

*The above conditions of the equilibrium of the firm can be examined in two ways:*

### 1. Total Revenue - Total Cost (TR - TC) Approach:

In this approach, total revenue and total cost are under consideration. Since, the objective of the firm is profit maximization. Profit is the difference between total revenue and total cost i.e.

Profit ($\pi$) = Total Revenue (TR) - Total Cost (TC)

Under this approach there are three types of profit:

a. When, TR > TC $\Rightarrow \pi > 0$, i.e. abnormal profit. (since normal profit is included in cost)
b. When TR = TC $\Rightarrow \pi = 0$, i.e. normal profit.
c. When TR < TC $\Rightarrow \pi < 0$, i.e. loss

The profit is maximized at the output where there is the biggest gap or highest difference between TR and TC, which is given by PM in the figure below. TR-TC approach is shown in figure below.
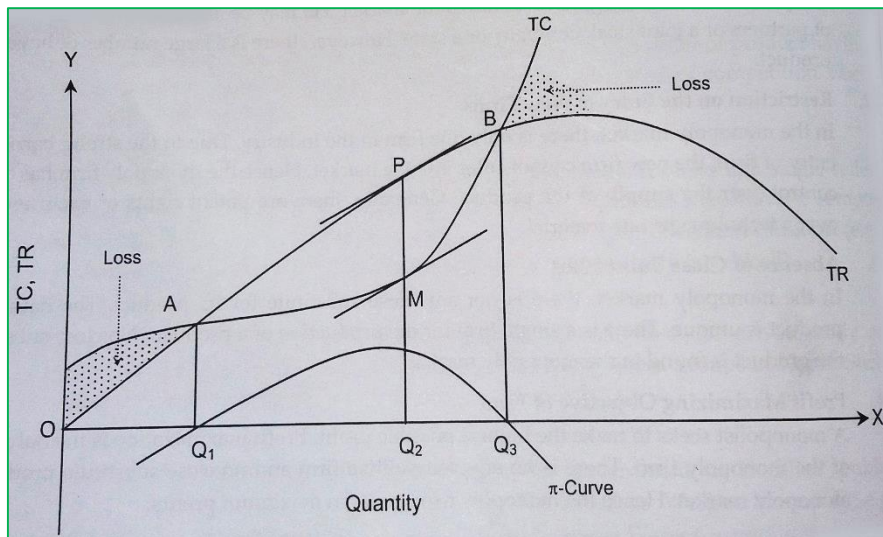
In the above figure, TR curve under monopoly market is bell shaped. It shows the TR initially rises, reaches at maximum and then after falls when quantity sold increases. It is because there is negative relationship between price and quantity sold in the market. TC curve is inverse S-shaped comprising total variable cost and total fixed cost. TR curve intersects TC curve at points A and B. At point A output is $Q_1$ and at point B output is $Q_3$.

In the figure above, before the output level $Q_1$ and after output $Q_3$, there is loss because TR curve lies below the TC curve (i.e. TC > TR). The output between $Q_1$ and $Q_3$, there is TR > TC which shows there is profit. The biggest gap between TR and TC i.e. MP is at output level $Q_2$ where, profit is maximum. Thus, the output at this position gives the equilibrium output of the firm.

In the below portion of the figure, profit curve (i.e. $\pi$-curve) is drawn measuring the gap between TR and TC curves. Before the output $Q_1$ and after the output $Q_3$ the $\pi$-curve lies below x-axis. It shows there is loss to the firm. Between outputs from $Q_1$ to $Q_2$ the $\pi$-curve rises showing that there is profit which increases as increase in output. In the similar fashion, the $\pi$-curve starts to fall from the outputs between $Q_2$ to $Q_3$. The maximum profit is at the output $Q_2$. Thus, $Q_2$ is the equilibrium output level of the firm.

2. **Marginal Revenue - Marginal Cost (MR - MC) Approach:**

In this approach, marginal cost and marginal revenue curves are considered to determine the equilibrium of the firm. In this approach marginal revenue (MR) and marginal cost (MC) are used to determine the profit maximization conditions. The profit maximization conditions are mentioned below in MR - MC approaches:

➤ **Necessary Condition:** MR and MC must be equal to each other i.e. MR = MC
➤ **Sufficient Condition:** Slope of MC curve > Slope of MR curve i.e. MC curve cuts MR curve from below.

It can be better explained with the help of following figure.
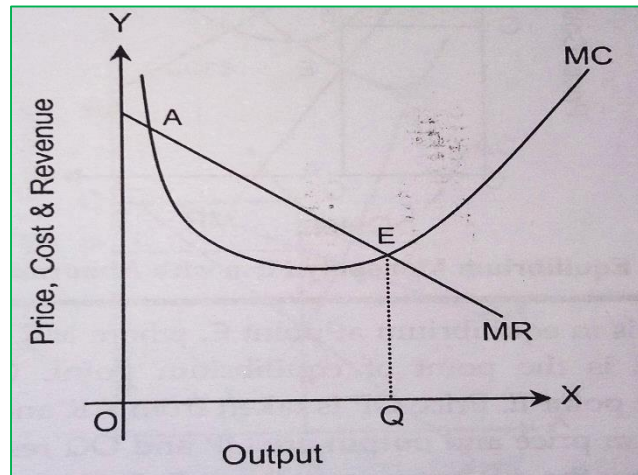
In the above figure, MC intersects MR through the point A and E. therefore necessary condition (MR = MC) is satisfied in both points but sufficient condition is satisfied at point E only. Hence, E is the profit maximization condition.

## Short-Run Equilibrium of Firm under Monopoly Market:

In short run, a monopoly firm can only change the output by changing variable factors. The monopolist has no sufficient time to expand its plant size. The objective of the monopoly firm is to maximize the profit.

Industry is the group of firms. But in monopoly market, the firm itself is an industry since there is single seller to produce and sell a particular commodity. The monopoly firm faces a downward slopping demand curve in a market. Thus, the firm under monopoly faces downward slopping demand curve. Demand curve is also represented by AR curve, AR curve also negatively sloped. MR curve is also downward slopping and lies below the AR curve.

The profit of a monopolist is maximized when the firm fulfills following two conditions:

➢ MR = MC i.e. MC and MR curve must be equal to each other.
➢ MC curve cuts MR curve from below.

Being a sole seller, monopolist may enjoys abnormal profit i.e. AR > AC at short run. However, there is no certainty that a monopoly firm will always earns an abnormal profit. A monopolist may earn abnormal profit or normal profit or incur loss in short run depending upon the AC in comparison to AR.

1. **Equilibrium of the Monopoly firm with Abnormal Profit (P > AC):**

When price is greater than AC, there will be abnormal profit. It can be explained with the help of following figure.

**Equilibrium Monopoly Firm with Abnormal Profit**
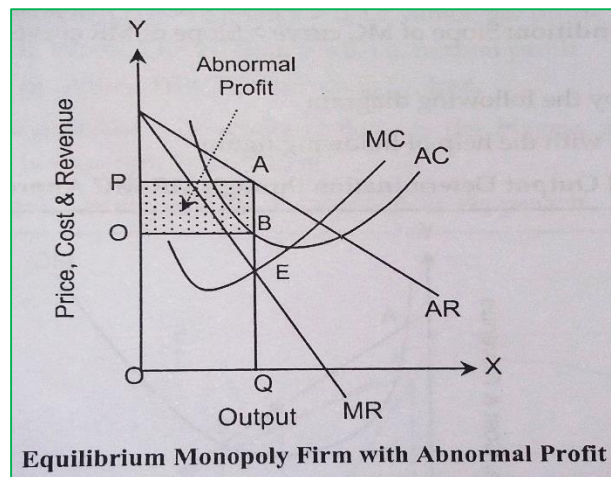
In the above figure, the firm is in equilibrium at point E, where MR = MC and MC curve cuts MR curve from below. The point E is the point of equilibrium point. Output is taken from X-axis corresponding to the point E. Price OP is taken from AR and cost is taken from AC, which is QB. The equilibrium price and output are OP and OQ respectively. The minimum point of AC curve lies below the AR curve i.e. AR > AC. It indicates that the firm is able to earn abnormal profit equal to shaded area POBA.

### 2. Equilibrium of the Monopoly firm with Normal Profit (P = AC):

When price is equal to average cost, there is normal profit. In this case AC is tangent to AR. It can be explained with the help of following graph.
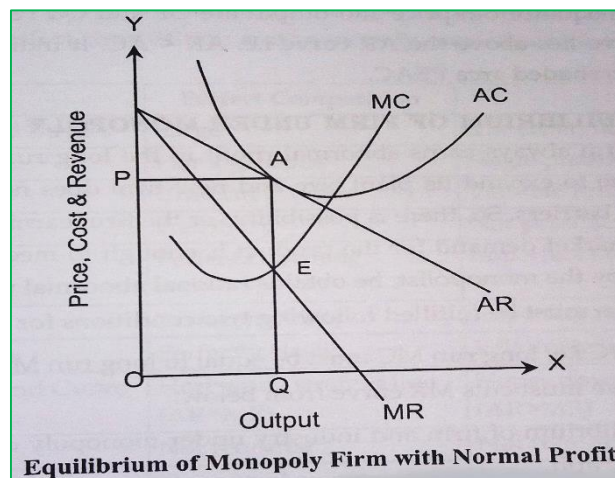


**Equilibrium of Monopoly Firm with Normal Profit**

In figure above, the firm is in equilibrium at point E where MR = MC and MC curve cuts MR curve from below. The equilibrium price and output are OP and OQ respectively. The minimum point of AC curve just equal to the AR curve i.e. AR = AC. It indicates that the firm is able to earn only normal profit.

### 3. Equilibrium of Monopoly Firm with Loss (P < AC):

If the price is less than average cost, the firm is in equilibrium with loss. It can be explained with the help of following graph.

Equilibrium of Monopoly Firm with Loss
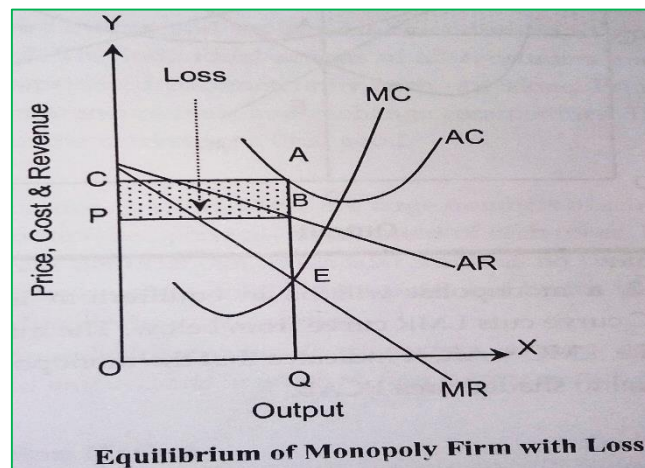
In above figure, the firm is in equilibrium at point E where MR = MC and MC curve cuts MR curve from below. The equilibrium price and output are OP and OQ respectively. The minimum point of AC curve lies above the AR curve i.e. AR < AC. It indicates that the firm has to bear loss equal to shaded area CPBA.

## Long-Run Equilibrium of Firm under Monopoly:

The monopoly firm always earn abnormal profit in the long run because the monopolist has sufficient time to expand its plant size and new firm does not enter into the industry due to the strong barriers. So, there is possibility for the firm earning abnormal profit in the long run. If the market demand for the product is enough to meet the output produced at optimal capacity by the monopolist, he obtains rational abnormal profit. The monopoly firm must be fulfilled following two conditions for equilibrium.

➢ MR = LMC i.e. MR curve must be equal to LMC
➢ LMC curve must cuts MR curve from below.

The long run equilibrium of firm and industry under monopoly can be explained with the help of following graph.
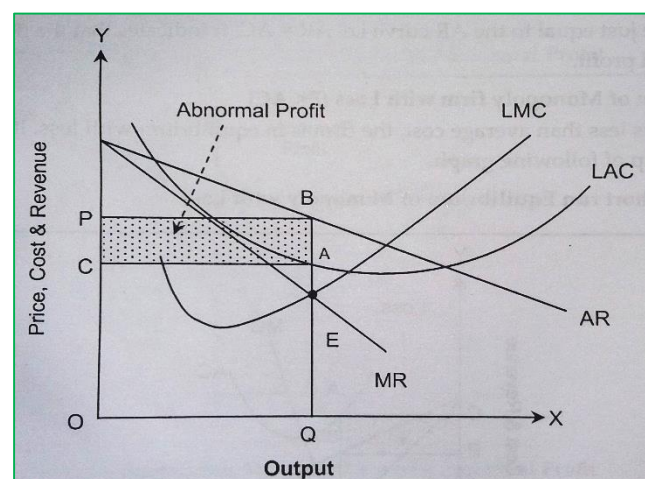


In above figure, a monopolist will be in equilibrium in long run at point E, where LMC = MR and LMC curve cuts MR curve from below. The minimum point of LAC curve lies below the AR curve i.e. LMC < AR. It indicates that the monopoly firm is able to earn abnormal profit in long run equal to shaded area PCAB.

# Effect of Tax upon Market Equilibrium and Price:

Let initial price be $OP_1$ and quantity of demand be $OQ_1$. When government impose tax for goods and services, then the tax will affect current equilibrium i.e. $E_1$. The effect of tax is different according to elasticity of demand and supply. It sometimes affect consumer only, sometimes producers only but mostly affect both.
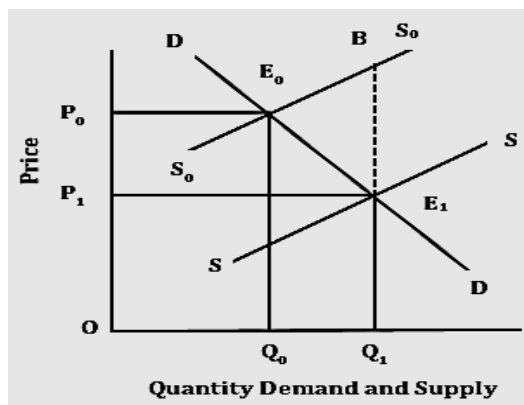


In the above figure, initial demand curve DD and supply curve SS intersect at a point $E_1$, which gives the equilibrium quantity demand $OQ_1$ at the price $OP_1$. After the taxation, there is increase in the cost of production, which shift supply curve leftward and is denoted by $S_0S_0$. Shift in supply curve $S_0S_0$ intersect demand curve DD and form new equilibrium point at $E_0$, where we can find $OQ_0$ quantity demanded and supplied and $OP_0$ price level. So, after imposing tax price of goods increases to the new level and quantity of goods decreases. In the figure, $E_1B$ is the tax burden which is shared by both consumer and producer.


# Effect of Subsidy upon Market Equilibrium and Price:

After imposing subsidy for producer own goods, the cost of production will decrease. When the cost of production decreases, there will be increase in supply as a result price of goods will decrease which will shift the supply curve rightward.
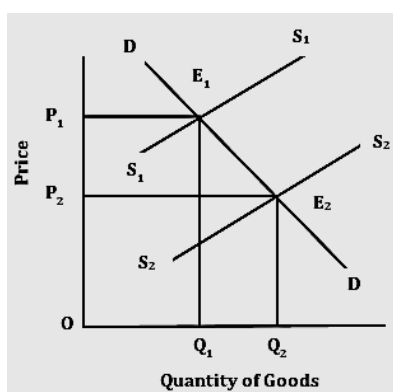


In the above figure, S1S1 is the supply curve and DD is the demand curve which intersect at a point E1and shows that OP1 is the current price level and OQ1 is the current quantity of goods. After imposing subsidy supply curve shifted rightward from S1S1 to S2S2 and intersect demand

curve DD at a point E2, which shows that Price level decreases from OP1 to OP2 and quantity of goods increases from OQ1 to OQ2.


## Linear Programming:

Linear programming (LP or linear optimization) is a method to achieve the best outcome (such as maximum profit or lowest cost) in a mathematical model whose requirements are represented by linear relationships. Linear programming is a special case of mathematical programming.

More formally, linear programming is a technique for the optimization of a linear objective function, subject to linear equality and linear inequality constraints. Its feasible region is a convex polyhedron, which is a set defined as the intersection of finitely many half spaces, each of which is defined by a linear inequality. Its objective function is a real-valued affine function defined on this polyhedron. A linear programming algorithm finds a point in the polyhedron where this function has the smallest (or largest) value if such a point exists.

Linear programs are problems that can be expressed in canonical form:

$$
\begin{aligned}
\text{maximize} \quad & \mathbf{c}^T \mathbf{x} \\
\text{subject to} \quad & A\mathbf{x} \le \mathbf{b} \\
\text{and} \quad & \mathbf{x} \ge \mathbf{0}
\end{aligned}
$$

Where x represents the vector of variables (to be determined), c and b are vectors of (known) coefficients, A is a (known) matrix of coefficients, and is the matrix transpose. The expression to be maximized or minimized is called the objective function ($cTx$ in this case). The inequalities Ax ≤ b and x ≥ 0 are the constraints which specify a convex polypore over which the objective function is to be optimized. In this context, two vectors are comparable when they have the same dimensions. If every entry in the first is less-than or equal-to the corresponding entry in the second then we can say the first vector is less-than or equal-to the second vector.

Linear programming can be applied to various fields of study. It is used in business and economics, but can also be utilized for some engineering problems. Industries that use linear programming models include transportation, energy, telecommunications, and manufacturing. It has proved useful in modeling diverse types of problems in planning, routing, scheduling, assignment, and design.

Steps to solving linear programming problems.

1. Read the problem carefully.
2. Write the constraints or inequalities.
3. Graph the inequalities. Find the feasible region.
4. Find the vertices of the feasible region.
5. Write a function to find the minimum or maximum value.
6. Plug the vertices into the function.
7. Find the maximum or minimum

# Cost-Benefit Analysis (CBA):

Cost-benefit analysis (CBA), sometimes called benefit–cost analysis (BCA), is a systematic approach to estimating the strengths and weaknesses of alternatives that satisfy transactions, activities or functional requirements for a business. It is a technique that is used to determine options that provide the best approach for the adoption and practice in terms of benefits in labor, time and cost savings etc. CBA is also defined as a systematic process for calculating and comparing benefits and costs of a project, decision or government policy.

Broadly, CBA has two purposes:

1. To determine if it is a sound investment/decision (justification/feasibility),
2. To provide a basis for comparing projects. It involves comparing the total expected cost of each option against the total expected benefits, to see whether the benefits outweigh the costs, and by how much.

CBA is related to, but distinct from cost-effectiveness analysis. In CBA, benefits and costs are expressed in monetary terms, and are adjusted for the time value of money, so that all flows of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their "net present value."

The following is a list of steps that comprise a generic cost–benefit analysis.

1. List alternative projects/programs.
2. List stakeholders.
3. Select measurement(s) and measure all cost/benefit elements.
4. Predict outcome of cost and benefits over relevant time period.
5. Convert all costs and benefits into a common currency.
6. Apply discount rate.
7. Calculate net present value of project options.
8. Perform sensitivity analysis.
9. Adopt recommended choice.