UNIT 4  OLIGOPOLY: PRICE AND OUTPUT DECISIONS

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4.0  OBJECTIVES

After studying this unit, you shall be able to:

•  state the meaning and features of oligopoly;

•  discuss the causes of existence of oligopoly;

•  throw light on different models that explain the oligopoly price and output determination;

•  explain the co-operative and non-cooperative behaviour of oligopolistic firms; and

•  appreciate cartel theory of oligopolist.

4.1  INTRODUCTION

Oligopoly refers to a market wherein only a few firms account for most or all of total production.

Ms. Shruti Jain, Assistant Professor in Economics, Mata Sundari College (University of Delhi), Delhi.
4.1.1 Definition of Oligopoly

Oligopoly refers to the presence of few sellers in the market selling the homogeneous or differentiated products. In other words, the Oligopoly market structure lies between the pure monopoly and monopolistic competition, where few sellers dominate the market and have control over the price of the product.

Under the Oligopoly market, a firm either produces homogeneous or heterogeneous products:

- **Homogeneous Product**: The firms producing the homogeneous products are called as Pure or Perfect Oligopoly. It is found in the case of industrial products such as aluminum, copper, steel, zinc, iron, etc.

- **Heterogeneous Product**: The firms producing the heterogeneous products are called as Imperfect or Differentiated Oligopoly. Such type of Oligopoly is found in the production of consumer goods such as automobiles, soaps, detergents, television, refrigerators, etc.

4.1.2 Features of Oligopoly Market

1) **Few Sellers**: Under the Oligopoly market, the sellers are few, and the customers are many. Few firms dominating the market enjoy a considerable control over the price of the product.

2) **Interdependence**: It is one of the most important features of an Oligopoly market, wherein, the seller has to be cautious with respect to any action taken by the competing firms. Since there are few sellers in the market, if any firm makes a change in the price or promotional scheme, all other firms in the industry have to comply with it to remain in the competition.

   Thus, every firm remains alert to the actions of others and plan their counterattack beforehand to escape the turmoil. Hence, there is a complete interdependence among the sellers with respect to their price-output policies.

3) **Advertising**: Under Oligopoly market, every firm advertises their products on a frequent basis with the intention to reach more and more customers and increase their customer base. This advertising makes the competition intense.

   If any firm does a lot of advertisement while the other remained silent, then you will observe that his customers are going to the firm which is continuously promoting its product. Thus, in order to be in the race, each firm spends lots of money on advertisement activities.

4) **Competition**: It is genuine that with a few players in the market, there will be an intense competition among the sellers. Any move by one firm will have a considerable impact on its rivals. Thus, every seller keeps an eye over its rivals and be ready with the counterattack.

5) **Entry and Exit Barriers**: The firms can easily exit the industry whenever they want, but has to face certain barriers to enter into it. These barriers could be Government license, Patent, large firm’s economies of scale, high capital requirement, complex technology, etc. Also, sometimes the government regulations favour the existing large firms, thereby acting as a barrier for the new entrants.
6) **Lack of Uniformity**: There is a lack of uniformity among the firms in terms of their size, some are big, and some are small. Since there are less number of firms, any action taken by one firm has a considerable effect on the other. Thus, every firm must keep a close eye on its counterpart and plan the promotional activities accordingly.

### 4.1.3 Causes for the Existence of Oligopoly

There are certain reasons which have led to the emergence of oligopoly. These are:

1) **Large Investment of Capital**

The number of firms in an industry may be small due to the large requirements of capital. No entrepreneur will like to venture into investing large sums in an industry in which addition to output to the existing level may depress prices. Further, the new entrant may also fear of provoking a price-war by the established firms in the industry. This is always true that in the midst of differentiated products, it is difficult to introduce a new product.

2) **Control of Indispensable Resources**

A few firms may control some indispensable resources which may enable them to secure several advantages in costs over all others. This enables them to operate profitably at a price at which others cannot survive.

3) **Legal Restriction and Patents**

In public utility sector, the entry of new firms is closely regulated through the grant of certificate by the State. This policy of exclusion of rivals may be due to diseconomies of small scale or of duplication of services. Another factor for the emergence of oligopoly is the patent right which a few firms acquire in matter of some goods. Patents have led to many important industrial monopolies in America and elsewhere.

4) **Economies of Scale**

Another factor responsible for emergence of oligopoly is the operations at large scale. In some industries, a few firms can meet the entire demand for the product. It is possible that the demand may be satisfied by a large number of firms, but small firms cannot secure the economies of large scale production. In the industries where there is a lot of mechanisation and where economies of large scale are considerable, only a few firms will survive.

The firms attain such a huge size that just a few of them can satisfy the entire demand. For example, automobiles, steel industry, petroleum etc. Oligopolies are also found in local markets. In small towns, a few firms may be sufficient to satisfy the demand, e.g., petrol, banks, building material suppliers etc. The market is small and therefore can be satisfied by a few firms.

5) **Superior Entrepreneurs**

In some industries there may be some superior entrepreneurs whose costs are lower than inferior rivals. These entrepreneurs under sell and eliminate most of their rivals.

6) **Mergers**

Many oligopolies have been created by combining two or more independent
firms. The combination of two or more firms into one firm is known a merger. The main motives of mergers include increasing market powers, more resources, economies of scale and market extensions etc.

7) **Difficulties of Entry into the Industry**

Lastly, oligopoly may come to exist because of difficulties of entry into the industry. One big difficulty in some industries is the large requirements of capital. Businessmen do not like to venture into those industries entry to which, even of one firm, is likely to depress prices to such an extent as to make it unprofitable for all. They may also be afraid of the price war that their entry may provoke from the established firms in the industry. Prospective entrants to an industry are also deterred by the difficulty of marketing new products or new brands in the presence of already well-established, well-entrenched brands.

**Check Your Progress 1**

1)  What is Oligopoly? Explain with few examples.

2)  Identify and explain the features that shows the existence of oligopoly in market.

3)  A market with many buyers and a few dominant sellers is:
   A) purely competitive
   B) a monopoly
   C) monopolistically competitive
   D) oligopolistic

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**4.2 PRICE AND OUTPUT DETERMINATION UNDER OLIGOPOLY**

Unlike other market forms, price and output under oligopoly is never fixed. Interdependence of firms led uncertainty always exists in the market. In such a situation, it becomes difficult to determine the equilibrium price and output for an oligopolistic firm. An oligopolist cannot assume that its competitors will not change their price and/or output if it changes. Price change by one firm will be followed by other competitors, which will change the demand conditions facing this firm. Therefore, demand curve for any firm is not fixed like other markets. Demand curve for a firm keeps changing as firms change their prices. Therefore, in the absence of a fixed demand (Average Revenue) curve, it is difficult to determine the equilibrium price and output. However, economists have developed some price-output models to explain the behaviour of oligopolistic firms. They are as follows:
I. Some economists ignore the interdependence among the firms when they explain the oligopoly market. In such case the demand will be known and equilibrium price and output can be determined.

II. Another approach is based on collusion. Oligopolists can form a group and maximise their joint output and profit. Best example of such collusion is Cartel (it is a situation when oligopolists agree to work together in the international market). One firm is chosen as a leader. The prices determined by the leader are followed by others in such a case.

III. Third approach assumes that an oligopolist predicts the reaction of its competitors. Problems regarding prices and output determination are solved by such assumptions. Various models based on different assumptions exist in this category. Few of them are: Chamberlin Model, Cournot’s Model, and Paul Sweezy Kinked Demand curve Model etc.

4.2.1 Cournot’s Model

In 1838, Augustin Cournot introduced a simple model of duopolies that remains the standard model for oligopolistic competition.

This model is based on the following assumptions:

1) The two firms produce homogeneous and indistinguishable goods.

2) There are no other firms in the market who produce the same or substitute goods.

3) No other firms can or will enter the market.

4) Collusive behaviour is prohibited. Firms cannot act together to form a cartel.

5) There exists one market for the produced goods.

In addition to the assumptions stated above, the Cournot duopoly model relies on the following:

1) Each firm chooses a quantity to produce.

2) All firms make this choice simultaneously.

3) The model is restricted to a one-stage game. Firms choose their quantities only once.

4) The cost structures of the firms are public information.

In the Cournot model, the strategic variable is the output quantity. Each firm decides how much of a good to produce. Both firms know the market demand curve, and each firm knows the cost structures of the other firm. The essence of the model is that each firm takes the other firm’s choice of output level as fixed and then sets its own production quantities.

Before explaining the model, let us define the reaction curve.

A reaction curve for Firm 1 is a function $Q_1$ that takes input as the quantity produced by Firm 2 and returns the optimal output for Firm 1 given Firm 2’s production decisions. In other words, $Q_1 (Q_2)$ is Firm 1’s best response to Firm 2’s choice of $Q_2$. Likewise, $Q_2 (Q_1)$ is Firm 2’s best response to Firm 1’s choice of $Q_1$. 
Let’s assume that the two firms face a single market demand curve as follows:

\[ Q = 100 - P \]

where \( P \) is the single market price and \( Q \) is the total quantity of output in the market. For simplicity’s sake, let’s assume that both firms face cost structures as follows:

\[ MC_1 = 10 \]
\[ MC_2 = 12 \]

Given this market demand curve and cost structure, we want to find the reaction curve for Firm 1. In the Cournot model, we assume \( Q_2 \) is fixed and proceed. Firm 1’s reaction curve will satisfy its profit maximising condition, \( MR = MC \). In order to find Firm 1’s marginal revenue, we first determine its total revenue, which can be described as follows:

Total Revenue = \( P \) \( Q_1 = (100 - Q) Q_1 = 100Q_1 - (Q_1 + Q_2) Q_1 \)
\[ = [100 - (Q_1 + Q_2)] Q_1 = 100Q_1 - Q_1^2 - Q_2 Q_1 \]
\[ = 100Q_1 - Q_1^2 - Q_2 Q_1 \]

The marginal revenue is simply the first derivative of the total revenue with respect to \( Q_1 \) (recall that we assume \( Q_2 \) is fixed). The marginal revenue for Firm 1 is thus:

\[ MR_1 = 100 - 2Q_1 - Q_2 \]

Imposing the profit maximising condition of \( MR = MC \), we conclude that Firm 1’s reaction curve is:

\[ 100 - 2Q_1 - Q_2 = 10 \]
\[ Q_1 = \frac{90}{2} - \frac{Q_2}{2} \]
\[ Q_1 = 45 - \frac{Q_2}{2} \]

That is, for every choice of \( Q_2 \), \( Q_1 \) is Firm 1’s optimal choice of output. We can perform analogous analysis for Firm 2 (which differs only in that its marginal costs are 12 rather than 10) to determine its reaction curve. We find Firm 2’s reaction curve to be:

\[ Q_2 = 44 - Q_1/2. \]

The solution to the Cournot model lies at the intersection of the two reaction curves. We solve now for \( Q_1 \). Note that we substitute \( Q_2 \) for \( Q_2 \) because we are looking for a point which lies on Firm 2’s reaction curve as well.

\[ Q_1 = 45 - Q_2/2 = 45 - (44 - Q_1/2)/2 \]
\[ = 45 - 22 + Q_1/4 \]
\[ = 23 + Q_1/4 \]
\[ => Q_1 = 92/3 \]

By the same logic, we find:

\[ Q_2 = 86/3 \]

Note that \( Q_1 \) and \( Q_2 \) differ due to the difference in marginal costs. In a perfectly competitive market, only firms with the lowest marginal cost would survive. In this case, however, Firm 2 still produces a significant quantity of goods, even though its marginal cost is 20% higher than Firm 1’s.
An equilibrium cannot occur at a point not at the intersection of the two reaction curves. If such an equilibrium existed, at least one firm would not be on its reaction curve and would therefore not be playing its optimal strategy. It has incentive to move elsewhere, thus invalidating the equilibrium.

The Cournot equilibrium is a best response made in reaction to a best response and, by definition, is therefore a Nash equilibrium. Unfortunately, the Cournot model does not describe the dynamics behind reaching equilibrium from a non-equilibrium state. If the two firms began out of equilibrium, at least one would have an incentive to move, thus violating our assumption that the quantities chosen are fixed. Rest assured that for the examples we have seen, the firms would tend towards equilibrium. However, we would require more advanced mathematics to adequately model this movement.

![Diagram](image)

**Fig. 4.1**

### 4.2.2 Stackelberg’s Model

The Stackelberg duopoly model of duopolies is very similar to the Cournot model. Like the Cournot model, the firms choose the quantities they produce. However, here the firms do not move simultaneously. One firm holds the privilege to choose production quantities before the other. The assumptions underlying the Stackelberg model are as follows:

1) Each firm chooses a quantity to produce.
2) A firm chooses before the other in an observable manner.
3) The model is restricted to a one-stage game. Firms choose their quantities only once.

To illustrate the Stackelberg model, let’s take an example. Assume Firm 1 is the first mover with Firm 2 reacting to Firm 1’s decision. We assume a market demand curve of:

\[ Q = 90 - P \]

Furthermore, we assume all marginal costs are zero, that is:

\[ MC = MC_1 = MC_2 = 0 \]

We calculate Firm 2’s reaction curve in the same way we did for the Cournot Model. Verify that Firm 2’s reaction curve is:

\[ Q_2 = 45 - Q_1/2 \]
To calculate Firm 1's optimal quantity, we look at Firm 1's total revenues.

Firm 1's Total Revenue  
\[ = P \cdot Q_1 = (90 - Q_1 - Q_2) \cdot Q_1 \]
\[ = 90 \cdot Q_1 - Q_1^2 - Q_2 \cdot Q_1 \]

However, Firm 1 is not forced to assume Firm 2's quantity is fixed. In fact, Firm 1 knows that Firm 2 will act along its reaction curve which varies with \( Q_1 \). Firm 2's quantity very much relies on Firm 1's choice of quantity. Firm 1's Total Revenue can thus be rewritten as a function of \( Q_1 \):

\[ R_1 = 90 \cdot Q_1 - Q_1^2 - Q_1 \cdot (45 - Q_1/2) \]

Marginal revenue for firm 1 is thus:

\[ MR_1 = 90 - 2 \cdot Q_1 - 45 + Q_1 \]
\[ = 45 - Q_1 \]

When we impose the profit maximising condition (MR = MC), we find:

\[ Q_1 = 45 \]

Solving for \( Q_2 \), we find:

\[ Q_2 = 22.5 \]

In the Cournot model, both firms make their choices simultaneously and have no communication beforehand. In the Stackelberg model, Firm 1 not only announces first, but Firm 2 knows that when Firm 1 announces, Firm 1's actions are credible and fixed. This demonstrates how a slight change in the flow of information can drastically impact the outcome of a market. Note that Firm 1 decided first. Its decision is to meet half of the market demand. The second firm decides to meet half of remaining market demand. Note that firm which decides first will be able to produce and sell larger quantity. It amounts to capturing larger market share. That is why we say that essence of Stackleberg model lies in its First Movers' Advantage feature.

Illustration 1:

Two firms have marginal costs of 10. They face a market demand curve of \( P = 100 - 4Q \). The government imposes a tax of 10 dollars per unit sold. Determine the Cournot equilibrium quantity.

Assuming that the tax will be paid by the consumer, the effective demand curve becomes \( 90 - 4Q \).

\[ R_1 = (90 - 4Q_1 - 4Q_2) \cdot Q_1 \]

\[ MR_1 = 90 - 8Q_1 - 4Q_2 \]

Setting MR = MC:

\[ Q_1 = 10 - Q_2/2 = \frac{20 - Q_2}{2} \]

By symmetry:

\[ Q_1 = Q_2 = \frac{20 - Q_1}{2} \]

Illustration 2:

Assume three firms face identical marginal costs of 20 with fixed costs of 10. They face a market demand curve of \( P = 200 - 2Q \). Find the Cournot equilibrium price and quantity.
\[ R_1 = (200 - 2(Q_1 + Q_2 + Q_3))Q_1 \]
\[ MR_1 = 200 - 4Q_1 - 2Q_2 - 2Q_3 \]

Applying \( MR = MC \):
\[ Q_1 = 45 - Q_2/2 - Q_3/2 \]

By symmetry:
\[ Q_1 = Q_2 = Q_3 = 22.5 \]

### 4.2.3 Paul Sweezy Model: Kinked Demand Curve Analysis

This model was developed independently by Prof. Paul M. Sweezy on the one hand and Profs. R. C. Hall and C. J. Hitch on the other hand.

**The assumptions of this model are:**

i) There are only a few firms in an oligopolistic market.

ii) The firms are producing close-substitute products.

iii) The quality of the products remains constant and the firms do not spend on advertising.

iv) A set of prices of the product has already been determined and these prices prevail in the market at present.

v) Each firm believes that if it reduces the price of its product, the rival firms would follow suit, but if it increases the price, the rivals would not follow it. They would simply keep their prices unchanged. We shall see presently that, because of this asymmetric pattern of reaction of the rivals, the demand curve of each firm would have a kink at the prevailing price of its product.

#### 4.2.3.1 Why the Kink in the Demand Curve?

In the figure we have drawn two negatively sloped straight line demand curves, viz., \( dd' \) and \( DD' \). Of these two curves, \( dd' \) is more flat than \( DD' \). Now, when one particular firm in the industry changes the price of its product, all other firms keeping their prices constant, the firm’s demand curve will be relatively flatter like \( dd' \), i.e., the magnitude of the change in the demand for its product as its price changes would be relatively larger.

![Fig. 4.2](image)

This is because, as the firm reduces or increases the price of its product, the prices of the products of other firms remaining constant, the product of the firm becomes relatively cheaper or dearer, respectively, than those of the other firms. This will make the demand curve flatter for this firm.
On the other hand, if a firm increases its price, the office firms will not follow
the suit. So there will be an asymmetry in responses of the rivals.
If one firm reduces price, all others follow the suit – otherwise they run the risk
of losing their customers to this firm.
If one raises the price, others do not as they expect to win some customers
from this firm. Together, these responses create a kink in demand curve.
Let us suppose that initially the price of the product of the firm is \( p_1 \) or \( O p_1 \) and
the demand for the product is \( q_1 \) or \( O q_1 \). If the firm now increases its price from
\( p_1 \), the rival firms would keep their prices unchanged according to assumption
(v) of this model.
In this case, the firm’s demand would decrease along the segment \( R d \) of the
relatively more elastic demand curve \( d d' \). On the other hand, if it goes on
decreasing its price from \( p_1 \), its rivals also would be decreasing their prices
according to assumption (v). In this case, the quantity demanded of the firm’s
product will increase along the segment \( R D' \) of the relatively steeper demand
curve \( D D' \).
Therefore, at the price \( p_1 \), the firm’s demand curve would be \( d R D' \). Obviously,
because of assumption (v), the segment \( d R \) of this demand curve would be
more flat or more elastic than the segment \( R D' \) (and the segment \( R D' \) would be
more steep or less elastic than the segment \( d R \)).
As a result, there would be a kink at the prevailing price \( p_1 \), or, at the point \( R 
\) on the firm’s demand curve \( d R D' \), i.e., the demand curve in this model would
be a kinked demand curve.

4.2.3.2 Analysis of the Kinked Demand Curve Model
In the oligopoly model under discussion, the properties of the kinked demand
curve as well as its significance are especially discussed. In the first place, as
the demand curve or the average revenue (AR) curve of the firm has a kink, its
MR curve cannot be obtained as a continuous curve. We may, therefore, begin
with the properties of the MR curve of the kinked demand curve with the help
of Fig. 4.3.
The kinked demand curve of the firm in Fig. 4.3 is \( d R D' \). There is a kink at the
point \( R (p_1, q_1) \) on this curve, because the curve consists of a segment \( d R \) of the
relatively flatter curve \( d d' \) and another segment \( R D' \) of the relatively steeper
curve \( D D' \).

Therefore, in the case of the kinked demand curve \( d R D' \), the firm’s MR curve,
up to \( q = q_1 \), would consist of the MR curve \( d M \) associated with the \( d R \)
segment of the kinked demand curve and for \( q > q_1 \), the MR curve would be
the segment \( N B \) associated with the segment \( R D' \) of the demand curve.
We have obtained above that the firm’s MR curve for its kinked demand curve would consist of two parts, viz., the segments dM and NB, and there would be a vertical gap between the points M and N at \( q = q_1 \).

This implies that as the firm’s output goes on increasing up to \( q_1 \), its MR would go on decreasing along the segment dM up to the amount \( MQ_1 \) and if the firm’s output increases even by an infinitesimally small quantity at \( q = q_1 \), its MR would fall to \( NQ_1 \), and, thereafter, as \( q \) increases, MR would decrease along the segment NB.

In other words, there would be no MR value between \( MQ_1 \) and \( NQ_1 \), i.e., the dotted segment MN is the discontinuity in the firm’s MR curve. We may also say that at the point R on the dR segment of the kinked demand curve, the firm’s MR would be \( MQ_1 \) and, at the point R on the RD’ segment of the demand curve, MR would be \( NQ_1 \).

We may now easily see that the numerical coefficient of elasticity of demand (\( e_1 \)) at the point R on the demand curve segment dR is different from the coefficient (\( e_2 \)) at the point R on the demand curve segment RD’, and the larger the difference between \( e_1 \) and \( e_2 \), the larger would be the length of the discontinuity of the MR curve at the output \( q_1 \).

As we know, at any point \( R (p_1, q_1) \) on the firm’s demand curve in Fig.4.4, numerical coefficient (\( e \)) of price-elasticity of demand is

\[
e = \frac{p_1}{q_1} \times \text{reciprocal of the numerical slope at that point on the demand curve}
\]

now, the reciprocal of the numerical slope of the demand curve \( dRd' \) at the point \( R \) on the segment \( dR > \) the reciprocal of the numerical slope of the demand curve at the point \( R \) on the segment RD’.

Because, the segment \( dR \) is more flat than the segment RD’, therefore, we have

\( e_1 > e_2 \)

Now, MR (= MR₁, say) at the point R on the segment dR’ is

\[
MR_1 = MQ_1 = p_1 \left[ 1 - \frac{1}{e_1} \right]
\]

Also, MR (= MR₂, say) at point R on the segment RD’ is

\[
MR_2 = NQ_1 = p_1 \left[ 1 - \frac{1}{e_2} \right]
\]

Therefore, from the above two equations, we obtain

\[
e_1 > e_2 \Rightarrow 1 - \frac{1}{e_1} > 1 - \frac{1}{e_2} \Rightarrow p_1 \left[ 1 - \frac{1}{e_1} \right] > p_1 \left[ 1 - \frac{1}{e_2} \right]
\]

\[
\Rightarrow MR_1 (=MQ_1) > MR_2 (=NQ_1)
\]

That is, at the point of kink, R, on the demand curve dRD’, or at \( q = q_1 \), we have two different values (\( e_1 \) and \( e_2 \)) of \( e \), and that is why at \( q = q_1 \), we obtain two different values (\( MR_1 \) and \( MR_2 \)) of MR and two different parts of the MR curve. The vertical gap between the two parts of the MR curve at \( q = q_1 \) is \( MQ_1 - NQ_1 = MN \).

It follows from the above discussion that the larger the difference between \( e_1 \) and \( e_2 \), i.e., the more flat the segment dR would be than the segment RD’, i.e., the more prominent the kink would be at the point R, the larger would be the value of MR₁ than that of MR₂ and the larger would be the discontinuity in the MR curve at \( q = q_1 \).
Second, in the model under discussion, the prices of the products are given initially, and a relation between these prices has been established already. The model does not explain how these prices have been determined.

But there is a good chance that the price of the product of a firm would be consistent with its goal of profit maximisation. For example, in Fig. 4.4, the firm’s demand curve is $dRD'$ and the associated MR curve is $MR_1$ – the discontinuity or the vertical gap between the two parts of the $MR_1$ curve is MN.

Now, if the marginal cost ($MC_1$) curve of the firm passes through this gap of MN, then the firm’s price-output combination $R(p_1, q_1)$ is consistent with profit maximisation although here, at $q = q_1$, we have $MR (= Mq_1) > MC (= Lq_1)$, and not $MR = MC$.

Here we see that at $q < q_1$ MR > MC, making the firm increase its output to reach the profit-maximising point. Now, as q increases and becomes equal to $q_1$, then also we have MR > MC. But if the firm increases q beyond $q_1$, MR becomes less than MC ($MR < MC$), i.e., from the production and sale of the marginal unit of its output, the firm now would incur a loss.

Therefore, it would not produce more than $q_1$, and its profit would be maximum at $q = q_1$, in spite of the fact that at $q = q_1$, we have MR > MC, and not MR = MC.

Third, although the assumption (v) of the model regarding the reaction pattern of the rival firms may explain the kink in the firm’s demand curve, it cannot explain how the price of the firm’s product, or, for that matter, the prices of the rivals’ products are determined.

However, the reaction pattern of the rivals, as given by assumption (v), is able to explain why the prices would not tend to change, i.e., why they would be sticky, once they get determined.

For example, if, in Fig. 4.4, the firm’s quantity sold increases from $q_1$ to $q_2$, it would not be inclined to change the assumption regarding the reaction pattern of the rivals, for its conception about the rivals’ reactions, is, by no means, dependent on its quantity sold.

Therefore, it would regard the increase in quantity sold, or an increase in the demand for its product, as caused by a rightward shift in its demand curve—it would think that its demand curve has shifted to the right from $dRD'$ to $dRD"$.
We may note here that although the demand curve has shifted to the right, it has kept the price of its product unchanged, resulting not necessarily in the unfulfilment of its profit maximising goal.

In Fig. 4.4, we have assumed that the two curves, viz., dRD' and dRD", are iso-elastic, and the MC\textsubscript{1} curve passes also through the discontinuity (M\textsubscript{1}N\textsubscript{1}) of the MR\textsubscript{2} curve which is the marginal curve for the demand curve dRD". Therefore, here the firm is able to maximise its profit at the same price $p_{1} = R'q_{2} = Rq_{1}$.

Fourth, in the model under discussion, the firm may not have to change the price of its product, even if its cost of production rises. For example, let us suppose that initially the firm’s AR and MR curves are dRD' and MR\textsubscript{1}, and the MC, curve is the firm’s MC curve.

In this case, the firm’s profit would be maximised if it sells $q_{1}$ of output at the price of $p_{1}$. Now, if the firm’s cost position changes resulting in an upward shift in its MC curve from MC\textsubscript{1} to MC\textsubscript{2}, and if the MC\textsubscript{2} curve also, like MC\textsubscript{1}, passes through the discontinuity (MN) of its MR curve, then the firm would not have to change the price of its product in order to earn the maximum profit. It would be able to maximise profit if it, like the previous case, sells output at the price of $p_{1}$.

If the cost of production rises along with a shift in the demand curve, then also, profit maximisation may not require the firm to change the price of its product. For example, in Fig. 4.4, let us suppose that the firm’s AR, MR and MC curves are, respectively, dRD', MR\textsubscript{2} and MC\textsubscript{1}. In this case, the firm’s profit-maximising price-output combination would be $R' (p_{1} \, q_{1})$.

Now, if the firm’s MC curve rises to MC\textsubscript{2} along with a rightward shift in its demand curve to dRD", then also the firm would not be required to change the price of its product if the MC\textsubscript{2} curve passes through both the discontinuities, MN and M\textsubscript{1}N\textsubscript{1}, of its dRD' and dRD" curves.

It would still be able to earn the maximum profit at the price $P_{1}$; but now its quantity of output produced and sold would be $q_{2}$; that is, now the firm’s price-output combination would be obtained at the point $R' (p_{1}, q_{2})$.

On the basis of the above discussion, we may conclude that in the kinked demand curve model of oligopoly, the firm would not consider it profitable or rational to change the prevailing price of its product because of the assumption (v) relating to the reaction pattern of its rivals.

[This assumption states, that if a particular firm increases the price of its product, its rivals will not increase theirs, but if it reduces the price, they will promptly reduce their prices.] We have seen that, because of these reactions, the demand curve of each oligopolistic firm will be kinked, and the MR curve of this demand curve will have two separate segments, and there will be a vertical gap between them.

However, it is not that the firm’s goal of profit maximisation can never be achieved because of the existence of this vertical gap. Even when the firm’s demand increases, i.e., its demand curve shifts to the right and/or its MC curve shifts upwards, it is not impossible for it to achieve profit maximisation at the prevailing price.

Therefore, although the kinked demand curve model cannot explain the process
of price determination, it can well explain why the prices are sticky in an oligopolistic market.

Check Your Progress 2

1) Let there be two firms under Cournot’s model having market demand curve as \( P = 20 - Q \) where \( Q \) the total production of the two firms 1 and 2. These firms are assumed to be producing under zero cost of production. Determine:

i) Reaction curves of the two firms,

ii) Equilibrium level of output for both the firms

iii) Equilibrium market price

iv) Show graphically the Cournot’s equilibrium

2) Let there be two firms which produce output under zero cost of production. The market demand curve is given by \( P = 20 - Q \) (Where \( Q \) = total output). Calculate output solution for the two firms under Stakelberg’s model.

3) In a duopolist market two firms can produce at a constant average and marginal cost of \( AC = MC = 2 \). They face the market demand curve \( P = 14 - Q \), Where \( Q = Q_1 + Q_2 \)' where \( Q_1 \) is the output of Firm 1, \( Q_2 \) is the output of Firm 2. In the Cournot’s model:

i) Find action-reaction functions of the two firms.

ii) Calculate the profit maximising equilibrium price and output.

iii) What are the profits of the two firms?

iv) Compare it with competitive equilibrium.

4) Assume three firms face identical marginal costs of 20 with fixed costs of 10. They face a market demand curve of \( P = 200 - 2Q \). Find the Cournot equilibrium price and quantity.
5) What do you mean by kink in demand curve?

4.3 CO-OPERATIVE VS. NON-COOPERATIVE BEHAVIOUR

4.3.1 Co-operative Behaviour and Prisoner’s Dilemma

Co-operative behaviour in oligopoly is a situation when firms jointly decide the prices and output and maximise their joint profit. This situation is called collusion. In this situation it becomes profitable for one firm if it defects and undercuts the prices and raises output, as long as others do not do so. Non-cooperative behaviour is a situation when they do not co-operate and decides their prices and output separately and compete with each other. When firms in oligopoly do not co-operate it is called non-cooperative equilibrium or Nash equilibrium (Named after US mathematician John Nash).

In oligopoly, the basic dilemma the firms face is whether to co-operate or to compete. If they co-operate, profit will be maximum and if they do not, profit for all will decrease. Now we will see the behaviour of an oligopolistic firm through an example of game theory. Game theory is the study of decision making in situations where strategic interaction (moves and countermoves) between rival firms occurs. We will assume a case of only two firms in the market, called Duopoly. The case is as follow:

The Oligopolist’s dilemma: to co-operate or to compete.

<table>
<thead>
<tr>
<th>Firm A’s Output</th>
<th>One-half Monopoly output</th>
<th>Two-third Monopoly output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm B’s Output</td>
<td>One-half Monopoly output</td>
<td>20 20 15 22</td>
</tr>
<tr>
<td>Two-third Monopoly output</td>
<td>22 15 17 17</td>
<td></td>
</tr>
</tbody>
</table>

The figure above explains the dilemma faced by oligopolists of whether to co-operate or to compete. It is called Payoff Matrix for a two Firm duopoly game. The right side figures on each cell shows the profits of Firm A and left side figures on each cell show the profits of Firm B (in Rs. Crores). It can be explained that if the two firms co-operate and produce one half of market share each will earn Rs. 20 crores of profit. In case of co-operation they can maximise their profits. If Firm A defects and produces two thirds of output and Firm B produces half of monopoly output then Firm A will earn Rs. 22 crores and Firm B Rs. 15 crores. Similarly if Firm B defects and produces two-third and Firm A produces one-half then Firm B will earn Rs. 22 crores and Firm A will earn only Rs. 15 crores. If both decide to compete and produce two-third
of monopoly output each then profits for both will fall to Rs. 17 crores. This type of game, where they reach a non-cooperative solution when they could cooperate, is called Prisoner’s Dilemma. Prisoner’s Dilemma is shown below:

Table 4.2 : The Prisoner's Dilemma

<table>
<thead>
<tr>
<th>Mr. Shyam</th>
<th>Mr. Ram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confess</td>
<td>6</td>
</tr>
<tr>
<td>Not confess</td>
<td>9</td>
</tr>
<tr>
<td>Not confess</td>
<td>09</td>
</tr>
</tbody>
</table>

Two prisoners Mr. Ram and Mr. Shyam are arrested for committing a crime and interrogated separately. They are told the following:

a) If both are claimed to be innocent, they will get a light sentence that is 1 year in jail.

b) If one confesses and the other does not, then who confesses will be released free and the other will be punished for 9 years in jail, and

c) If both confess, then both of them will get a punishment of 6 years in jail.

The payoff matrix presented in Table 4.2 shows the dilemma of the prisoners about whether to confess or not to confess. If none of them confess then both will get 1 year of jail, but if Ram confesses and Shyam does not then Ram will be left free and Shyam will get 9 year of imprisonment and the vise-versa. And if both of them confess then both will get 6 years of imprisonment. Not confessing is the best solution in this game (Pareto efficient solution) but this leaves one always in uncertainty. This solution is not a stable solution as one gets an imprisonment of 9 years if he/she does not confess and the other does. Therefore, confession dominates in the mind of both the prisoners. If both of them confess then they end up with 6 years jail for both. This kind of equilibrium is called Nash equilibrium. From both the figures above it is clear that it they co-operate then they will earn the maximum profit than if they compete.

4.3.2 Types of Co-Operative Behaviour

In order to avoid uncertainty arising out of interdependence and to avoid price war and cut throat competition, firms under oligopoly often enter into some agreement about determining uniform price and output. The agreement can be of the following two types.

- **Explicit Collusion:** It is situation when firms under oligopoly do formal (explicit) agreement to determine uniform price and output and maximise their joint profit. Such an agreement at international level is called Cartel, Many such agreements have taken place in the past. The best example of cartel is that of OPEC – Organisation of Petroleum Exporting Countries. Saudi Arabia and other countries after 1973 formed this cartel. An individual firm always has incentive to cheat. Possibility of cheating is larger if number of firms is large. Cheating by a small firm has negligible effect on the market price.

- **Tactic Co-operation:** When firms co-operate without any explicit agreement it is called tactic co-operation. For example in Table 4.1, if
Firm A produces one-half of monopoly output hoping that Firm B will do the same and Firm B does so then they achieve the co-operative equilibrium without any formal agreement.

4.3.3 Types of Non-Cooperative Behaviour

In the absence of formal or informal agreements about co-operation, firms under oligopoly compete with each other. Non-Cooperative or Competitive behaviour under oligopoly can be of following types.

**Competition for Market Share:** Firms under oligopoly always compete with each other for market share. They use various forms of non-price competition such as advertising, quality products etc. to increase their market share. For example in Delhi major mobile service providers like Airtel, Hutch and Idea compete for increase their mobile connections.

**Covert Cheating:** In oligopoly, because of huge market share, firms sell their products through contract. Large scale production and distribution is done through contracts. When firms provide secret discounts and rebates to their buyers to increase sales it is called covert cheating.

**Contestable Markets and Potential Entry:** Theory of contestable markets explains that in the long-run, abnormal profits earned by oligopolists can be eliminated without actual entry. Potential entry can also affect the market as much as an actual entry does. It is possible only when the following two conditions are fulfilled:

1) **Entry must be easy to accomplish:** There should not exist any barriers to entry, either natural or firm created.

2) **The existing firms must consider potential entry while making price and output decisions:** The existing firms must react when new firms try to enter into the market. They must cut their prices and sacrifice profits (short run) to restrict the new entrants.

Contestable markets always expect potential entry because of huge profits earned by the existing firms in the market. But entry to such markets is too costly. Fixed costs are very high. To develop, design, and sale a new product in such a market involve huge sunk cost. Sunk costs are those costs which cannot be recovered if a firm leaves the market soon. Firms which produce multiple and differentiated products can easily distribute these costs among those many products. For new firms, producing huge number of differentiated products is not easy. Therefore, these costs are very high for a firm which produces single product in the market.

If a new firm can enter and leave the market without any sunk costs of entry, such markets are called perfectly contestable markets. A market can be perfectly contestable, even if, firms have to pay some costs of entry if these costs are recovered when firms leave the market. If the sunk costs are lower, the market will be more contestable and vise-versa.

Sunk costs of entry constitute entry barriers. Higher the sunk costs, larger will be profits earned by the existing firms. If the firms operate in the market without large sunk costs of entry, then they will not earn large profits. As part of strategy, existing firms keep their prices as low as that can only cover the total costs. If they charge high prices and earn abnormal profits, the new firms will enter and may capture the profits. Contestability forces the existing firms to keep the prices low. The threat of entry into a market is as effective as actual entry to limit profiteering by existing firms.
4.4 CARTEL THEORY OF OLIGOPOLY

A cartel is defined as a group of firms that gets together to make output and price decisions. The conditions that give rise to an oligopolistic market are also conducive to the formation of a cartel. In particular, cartels tend to arise in markets where there are few firms and each firm has a significant share of the market. In the U.S., cartels are illegal; however, internationally, there are no restrictions on cartel formation. The Organisation of Petroleum Exporting Countries (OPEC) is perhaps the best known example of an international cartel. OPEC members meet regularly to decide how much oil each member of the cartel will be allowed to produce.

Oligopolistic firms join a cartel to increase their market power. Members of the cartel work together to determine jointly the level of output that each member will produce and/or the price that each member will charge. By working together, the cartel members are able to behave like a monopolist. For example, if each firm in an oligopoly sells an undifferentiated product like oil, the demand curve that each firm faces will be horizontal at the market price. If, however, the oil producing firms form a cartel like OPEC to determine their output and price, they will jointly face a downward sloping market demand curve, just like a monopolist. In fact, the cartel’s profit maximising decision is the same as that of a monopolist. The cartel members choose their combined output at the level where their combined marginal revenue equals their combined marginal cost. The cartel price is determined by market demand curve at the level of output chosen by the cartel. The cartel’s profits are equal to the area of the rectangular box labelled abcd in Fig. 4.5. Note that a cartel, like a monopolist, will choose to produce less output and charge a higher price than would be found in a perfectly competitive market.

![Cartel Theory Graph](image)

Fig. 4.5

Once established, cartels are difficult to maintain. The problem is that cartel members will be tempted to cheat on their agreement to limit production. By producing more output than it has agreed to produce, a cartel member can increase its share of profits. Hence, there is a built in incentive for each cartel member to cheat. Of course, if all members cheated, the cartel would cease to
earn monopoly profits, and there would no longer be any incentive for firms to remain in the cartel. The cheating problem has plagued the OPEC cartel as well as other cartels and perhaps explains why so few cartels exist.

Check Your Progress 3

1) Explain the prisoner’s Dilemma in oligopoly market.

2) State the types of Non-cooperative behaviour under oligopoly.

3) What do you mean by Cartel?

4.5 LET US SUM UP

Oligopoly is the most prevailing form of markets. It is defined as a market structure in which there are a few sellers of the homogeneous or differentiated products. Oligopoly can be pure or differentiated. Characteristics of Oligopoly are: Few dominant firms, Mutual interdependence, Barriers to entry, Homogeneous or differentiated products. Factors causing oligopoly are: Huge capital investment, Absolute cost advantage to the existing firm, Product differentiation, Economies of large scale production, Mergers.

Price and Output determination in oligopoly is different from other three forms of market structure. Since there are few rival firms and there is mutual interdependence, the price and output policy of a firm will affect the price and quality sold by other firms. There is no general theory under oligopoly. Price and output indeterminateness is an essential feature of oligopoly.

Among models of Non-Collusive Oligopoly, Cournot’s Duopoly Model states that firms attain Nash equilibrium. In equilibrium each firm is doing the best it can given its competitor’s behaviour. It is based on the assumption that each firm is attempting to maximise its total profits assuming that other firm holds its output constant.

Stackelberg’s Duopoly Model is ‘First Mover Advantage’ Model as an alternative explanation of oligopolistic behaviour. In this model, one firm sets its output before other firms do. In this model, neither firm has an opportunity to react. The leader firm produces more output and earns more profit than the other firm. Sweezy’s ‘Kinked demand’ Curve Model explains price rigidity in an oligopoly market by postulating that oligopolist’s will match price decrease but not price increases.
4.6 REFERENCES


http://www.economicsdiscussion.net


4.7 ANSWERS OR HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Read Sub-section 4.1.1 and answer
2) Read Sub-section 4.1.2 and answer
3) (D)

Check Your Progress 2

1) i) Reaction curve for Firm 1: \( Q_1 = 10 - \frac{1}{2}Q_2 \)

   Reaction curve for Firm 2: \( Q_2 = 10 - \frac{1}{2}Q_1 \)

   ii) The equilibrium level of output for both the Firms: 

   \[
   Q = Q_1 + Q_2 = 6.67 + 6.67 = 13.34
   \]

   iii) Equilibrium market price \( P \) is: \( P = 6.66 \)

2) Let Firm 1 set its output first (i.e., be a leader) and Firm 2 be a follower which makes its output decision after studying Firm 1’s output and assuming that Firm 1’s output as fixed. Cournot’s reaction curve of Firm 2 will decide Firm 2’s profit maximising output.

The calculation of Firm 2’s profit maximising output is as follows:

\[
\frac{\Delta R_2}{\Delta Q_2} = 0
\]

Or 

\[
\ldots (MC \text{ is zero is given})
\]

\( R_2 \) (total revenue) is calculated as:

\[
R_2 = P \times Q_2 = (20 - Q) Q_2
\]

\[
= 20 Q_2 - (Q_1 + Q_2) Q_2
\]

\[
= 20 Q_2 - Q_1 Q_2 - Q_2^2
\]

\[
MR_2 = \frac{\Delta R_2}{\Delta Q_2} = 20 - Q_1 - 2Q_2
\]
Putting $MR_2 = 0$, and solving for $P_2$ we get:

$$2Q_2 = 20 - Q_1$$

$$Q_2 = 10 - \frac{1}{2}Q_1$$

(1)

This is Firm 2’s reaction curve.

The calculation of Firm 1’s profit maximising output is as follows:

$$MR_1 = MC$$

$$R_1 = P \cdot Q_1 = (20 - Q) Q_1 = [20 - (Q_1 + Q_2)] Q_1$$

$$= 20Q - Q_1^2 - Q_1Q_2$$

(2)

It is clear from the above equation that total revenue earned by Firm 1 depends upon output of Firm 2. Firm 2 will choose $Q_2$ according to its reaction curve $Q_2 = 10 - \frac{1}{2}Q_1$.

Substituting (1) in (2) we get:

$$R_1 = 20Q_1 - Q_1^2 - Q_1 (10 - \frac{1}{2}Q_1)$$

$$= 20Q_1 - Q_1^2 - 10Q_1 + \frac{1}{2}Q_1^2$$

$$= 10Q_1 - \frac{1}{2}Q_1^2$$

$$MR_1 = \frac{\Delta R_1}{\Delta Q_1} = 10 - Q_1$$

$$\therefore \quad MR_1 = MC = 0 \text{ gives } Q_1 = 10$$

(3)

Substituting (3) in (1), we get:

$$Q_2 = 10 - \frac{1}{2} \cdot 10$$

$$Q_2 = 5$$

(4)

Thus, under the Stackelberg Model, profit maximum output of Firm 1 is 10 and of Firm 2 is 5. Firm 1 produces twice as much as Firm 2.

3) i) Given that the duopolists faces the following market demand curve:

$$P = 14 - Q$$

$$\therefore \quad Q = Q_1 + Q_2$$

$$\Rightarrow \quad P = 14 - (Q_1 + Q_2)$$

Both the firms have

$$AC = MC = 2$$

Case 1:

Reaction Curve for Firm 1

Total revenue $R_1$ is given by

$$R_1 = PQ_1 = [14 - (Q_1 + Q_2)] Q_1$$

$$\Rightarrow \quad R_1 = 14Q_1 - Q_1^2 - Q_1Q_2$$
Marginal revenue, $MR_1$, is just the incremental revenue $\Delta R_1$ resulting from an incremental change in output $\Delta Q_1$.

$$MR_1 = \frac{\Delta R_1}{\Delta Q_1} = 14 - 2Q_1 - Q_2$$

$$MR_1 = MC \ldots \ldots \ldots \ldots \ldots \ldots \ldots \text{in equilibrium}$$

$$\therefore 2 = 14 - 2Q_1 - Q_2$$

$$\Rightarrow Q_1 = \frac{1}{2}(12 - Q_2)$$

Reaction curve of Firm 1

Similarly,

Reaction curve for Firm 2 will be: $Q_2 = \frac{1}{2}(12 - Q_1)$

i) Cournot’s Output is:

$$Q_2 = \frac{1}{2} \left[ 12 - \frac{1}{2} (12 - Q_2) \right]$$

$$Q_2 = \frac{1}{2} \left[ 12 - 6 + \frac{1}{2} Q_2 \right]$$

$$2Q_2 = \frac{1}{2} - 6 + \frac{1}{2} Q_2$$

$$2Q_2 - \frac{1}{2} Q_2 = 6$$

$$\frac{3Q_2}{2} = 6$$

$$Q_2 = \frac{6 \times 2}{3} = 4$$

and $Q_1 = 4$

Cournot’s price is:

$$P = 14 - (Q_1 + Q_2)$$

$$P = 14 - (4 + 4)$$

$$P = 14 - 8$$

$$P = 6$$

ii) Profit of Firm 1 and Firm 2 is:

$$\pi = R_1 - C_1$$

$$= PQ_1 - AC \times Q_1$$

$$= 6 \times 4 - 2 \times 4$$

iii) Comparison of output under perfect competition and Duopoly:

Under Perfect Competition:

$$P = MC$$

$$14 - Q = 2$$

$$Q = 14 - 2$$

$$\therefore Q = 12$$
4) \[ R_1 = (200 - 2(Q_1 + Q_2 + Q_3))Q_1 \]
\[ MR_1 = 200 - 4Q_1 - 2Q_2 - 2Q_3 \]

Applying \( MR = MC \):
\[ Q_1 = 45 - Q_2/2 - Q_3/2 \]

By symmetry:
\[ Q_1 = Q_2 = Q_3 = 22.5 \]

5) Read Sub-section 4.2.3.1 and answer

**Check Your Progress 3**

1) Read Sub-section 4.3.1 and answer

2) Read Sub-section 4.3.3 and answer

3) Read Section 4.4 and answer