ADVANCED MICRO ECONOMICS - II

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ADVANCED MICRO ECONOMICS – II

UNIT – I

Pricing under Oligopoly – Non – Collusive Models – Cournot – Bertrand – Edgeworth – Chamberlin – Stackleberg Model – Paul Sweezy's Kinked Demand model – Collusive Models – Cartels – Price Leadership Models (Low Cost & Dominant Firm) - Bain's Limit Pricing.

UNIT – II

Recent Developments in Managerial Theories of Firm – William Baumol's Sale Revenue Maximizing Model – Marris Model of Managerial Enterprise – Williamson's Model of Managerial Discretion – Behavioural Model of Cyert and March.

UNIT – III

Factor Pricing in Perfectly Competitive Market – Factor Pricing in Imperfectly Competitive market – Elasticity of Substitution – Euler's Theorem of Product Exhaustion.

UNIT – IV

General Equilibrium Theory - Interdependence – The Walrasian System – Graphical Treatment of the Two Factors, Two Commodities and Two Consumer General Equilibrium System – General Equilibrium and Resource Allocation.

UNIT – V

Welfare Economics – Criteria of Social Welfare by Adam Smith, Bentham, and Cardinalists – Pareto Optimality Criteria – Kaldor Hicks Compensation Criteria – Scitovsky Double Criterion – Bergson's Social Welfare Criterion – Maximisation of Social Welfare – Derivation of Grand Utility Possibility Frontier.

UNIT – I

Price and Output Determination under Oligopoly

Price and Output Determination under Oligopoly!
It consists of the 'tight' oligopoly situation in which two or three firms dominate the entire market and the 'loose' oligopoly situation where six or seven firms occupy the maximum share of the market.

Other firms share the balance. It includes both differentiation and standardization. It encompasses the cases in which firms are acting in collusion and in which they are acting independently. Therefore, the existence of various forms of oligopoly prevents the development of a general theory of price and output. The element of mutual interdependence in oligopolistic market further complicates the determination of price and output.

In-spite of these difficulties, two interrelated characteristics of oligopolistic pricing stand out:
1. Oligopolistic prices tend to be inflexible or Sticky Price change less frequently in Oligopoly than they happen under other competitions like perfect, competition, monopoly and monopolistic competition.

2. When oligopolistic prices change, firms are likely to change their prices together they act in collusion in setting and changing prices.

Keeping these facts in mind, the price and output determination under oligopoly is in the following situations:

1. Price Determination in Non-Collusive Oligopoly:

In this case, each firm follows an independent price and output policy on the basis of its judgment about the reactions of his rivals. If the firms are producing homogeneous products, price war may occur. Each firm has to fix the price at the competitive level. On the contrary, in case of differentiated oligopoly, due to product differentiation, each firm has some monopoly control over the market and therefore charge near monopoly price.

Thus the actual price may fall between the two limits:

(i) The Upper Limit of Monopoly Price and,

(ii) The Linear limit of Competitive Price.

Practically, there is every possibility to determine the exact price within these limits. However there may be the following possibilities:

(i) There may be complete price instability in the market which results in price war.

(ii) The price may settle down at intermediate level due to the working of the market forces.

(iii) The firm may accept the prevailing price and adjust itself according to prevailing price.

So long as the firm earns adequate profits at the prevailing price, it may not try to change it. Any effort to change it may create uncertainties in the market. A firm will stick to that price to avoid uncertainties. Thus the price tends to be rigid where oligopolist takes independent action.

B. Equilibrium under Collusion:

The modern economists are of the view that independent price determination cannot exist for long in oligopoly. It leads to

uncertainty and insecurity and to overcome them there is a tendency among oligopolists to act collectively by tacit collusion. In addition, the firms can gain the economics of production. All the firms in oligopoly tend to enlarge their size and lower their costs of production per unit and capture maximum share of the market.

Collusive oligopoly is a situation in which firms in a particular industry decide to join together as a single unit for the purpose of maximising their joint profits and to negotiate among themselves so as to share the market.

The former is known as:
(i) The joint profit maximisation cartel and

(ii) The latter as the market-sharing cartel. There is another type of collusion, known as leadership, which is based on tacit agreements.

Under it, one firm acts as the price leader and fixes the price for the product while other firms follow it. Price leadership is of three types: low-cost firm, dominant firm, and barometric.

Non Collusive Models

Cournot Oligopoly

The CournotAugustus Cournot (1801–1877). oligopoly model is the most popular model of imperfect competition. It is a model in which the number of firms matters, and it represents one way of thinking about what happens when the world is neither perfectly competitive nor a monopoly.

In the Cournot model, there are n firms, who simultaneously set quantities. We denote a typical firm as firm i and number the firms from $i = 1$ to $i = n$. Firm i chooses a quantity $q_i \geq 0$ to sell, and this quantity costs $c_i(q_i)$. The sum of the quantities produced is denoted by Q. The price that emerges

from the competition among the firms is $p(Q)$, and this is the same price for each firm. It is probably best to think of the quantity as really representing a capacity, and competition in prices by the firms determining a market price given the market capacity.

The profit that a firm i obtains is $\pi_i = p(Q)\, q_i - c_i(q_i)$.

Each firm chooses q_i to maximize profit. The first-order conditionsBear in mind that Q is the sum of the firms' quantities, so that when firm i increases its output slightly, Q goes up by the same amount. give

$$0 = \partial \pi_i \partial q_i = p(Q) + p'(Q)\, q_i - c'_i(q_i).$$

This equation holds with equality provided $q_i > 0$. A simple thing that can be done with the first-order conditions is to rewrite them to obtain the average value of the price-cost margin:

$$p(Q) - c'_i(q_i)\, p(Q) = -p'(Q)\, q_i\, p(Q) = -Q\, p'(Q)\, p(Q)\, q_i\, Q = s_i \varepsilon.$$

Here $s_i = q_i / Q$ is firm i's market share. Multiplying this equation by the market share and summing over all firms $i = 1, \ldots, n$ yields $\sum_{i=1}^{n} p(Q) - c'_i(q_i)\, p(Q)\, s_i = 1\, \varepsilon \sum_{i=1}^{n} s_i^2 = \mathrm{HHI}\, \varepsilon$ where $\mathrm{HHI} = \sum_{i=1}^{n} s_i^2$ is the Hirschman-Herfindahl Index (HHI).The HHI is named for Albert Hirschman (1915–), who invented it in 1945, and Orris Herfindahl (1918–1972), who invented it independently in 1950. The HHI has the property that if the firms are identical, so that $s_i = 1/n$ for all i, then the HHI is also $1/n$. For this reason, antitrust economists will sometimes use 1/HHI as a proxy for the number of firms, and describe an industry with "2 ½ firms," meaning an HHI of 0.4.To make matters more confusing, antitrust economists tend to state the HHI using shares in percent, so that the HHI is on a 0 to 10,000 scale.

We can draw several inferences from these equations. First, larger firms, those with larger market shares, have a larger deviation from competitive behavior (price equal to marginal cost). Small firms are approximately competitive (price nearly equals marginal cost), while large firms reduce output to keep the price higher, and the amount of the reduction, in price-cost terms, is proportional to market share. Second, the HHI reflects the deviation from perfect competition on average; that is, it gives the average proportion by which price equal to marginal cost is violated. Third, the equation generalizes the "inverse elasticity result" proved for monopoly, which showed that the price-cost margin was the inverse of the elasticity of demand. The generalization states that the weighted average of the price-cost margins is the HHI over the elasticity of demand.

Because the price-cost margin reflects the deviation from competition, the HHI provides a measure of how large a deviation from competition is present in an industry. A large HHI means the industry "looks like monopoly." In contrast, a small HHI looks like perfect competition, holding constant the elasticity of demand.

The case of a symmetric (identical cost functions) industry is especially enlightening. In this case, the equation for the first-order condition can be rewritten as $0=p(Q)+ p'(Q) Q n - c'(Q n)$ or $p(Q)= \varepsilon n \varepsilon n-1 c'(Q n)$.

Thus, in the symmetric model, competition leads to pricing as if demand was more elastic, and indeed is a substitute for elasticity as a determinant of price.

Bertrand's Duopoly Model

Bertrand developed his duopoly model in 1883. His model differs from Cournot's in that he assumes that each firm expects that the rival will keep its price constant, irrespective of its own decision about pricing.

Thus each firm is faced by the same market demand, and aims at the maximization of its own profit on the assumption that the price of the competitor will remain constant.

The model may be presented with the analytical tools of the reaction functions of the duopolists.

In Bertrand's model the reaction curves are derived from isoprofit maps which are convex to the axes, on which we now measure the prices of the duopolists. Each isoprofit curve for firm A shows the same level of profit which would accrue to A from various levels of prices charged by this firm and its rival.

The isoprofit curve for A is convex to its price axis (P_A). This shape shows the fact that firm A must lower its price up to a certain level (point e in figure 9.11) to meet the cutting of price of its competitor, in order to maintain the level of its profits at Π_{A2}. However, after that price level has been reached and if B continues to cut its price, firm A will be unable to retain its profits, even if it keeps its own price unchanged (at P_{Ae}). If, for example, firm B cuts its price at P_B, firm A will find itself at a lower isoprofit curve (Π_{A1}) which shows lower profits. The reduction of profits of A is due to the fall in price, and the increase in output beyond the optimal level of utilization of the plant with the consequent increase in costs. Clearly the lower the isoprofit curve, the lower the level of profits.

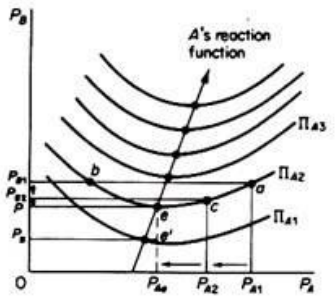

Figure 9.11

To summaries for any price charged by firm B there will be a unique price of firm A which maximizes the latter's profit. This unique profit-maximizing price is determined at the lowest point on the highest attainable isoprofit curve of A. The minimum points of the isoprofit curves lie to the right of each other, reflecting the fact that as firm A moves to a higher level of profit, it gains some of the customers of B when the latter increases its price, even if A also raises its price.

If we join the lowest points of the successive isoprofit curves we obtain the reaction curve (or conjectural variation) of firm A: this is the locus of points of maximum profits that A can attain by charging a certain price, given the price of its rival. The reaction curve of firm B may be derived in a similar way, by joining the lowest points of its isoprofit curves (figure 9.12).

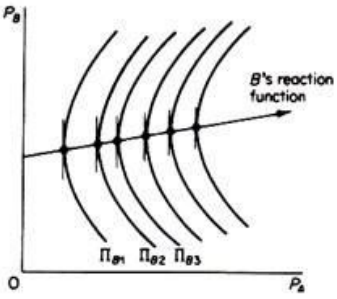

Figure 9.12

Bertrand's model leads to a stable equilibrium, defined by the point of intersection of the two reaction curves (figure 9.13). Point e denotes a stable equilibrium, since any departure from it sets in motion forces which will lead back to point e at which the price

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charged by A and B are P_{Ae} and P_{Be} respectively. For example, if firm A charges a lower price P_{A1}, firm B will charge P_{B1}, because on the Bertrand assumption, this price will maximize B's profit (given P_{A1}).

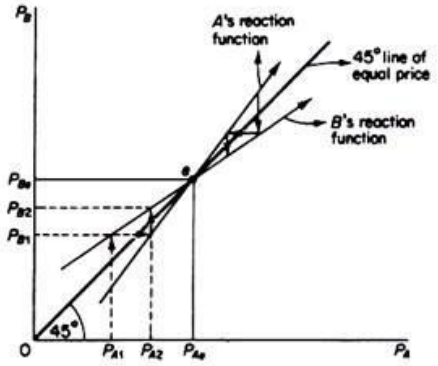

Figure 9.13

Firm A will react to this decision of its rival by charging a higher price P_{A2}. Firm B will react by increasing its price, and so on, until point e is reached, when the market will be in equilibrium. The same equilibrium will be reached if firms started by charging a price higher than P_{Ae} or P_{Be} a competitive price cut would take place which would drive both prices down to their equilibrium level P_{Ae} and P_{Be}.

Note that Bertrand's model does not lead to the maximization of the industry (joint) profit, due to the fact that firms behave naively, by always assuming that their rival will keep its price fixed, and they never learn from past experience which showed that the rival did not in fact keep its price constant. The industry profit could be increased if firms recognized their past mistakes and abandoned the Bertrand pattern of behaviour (figure 9.14).

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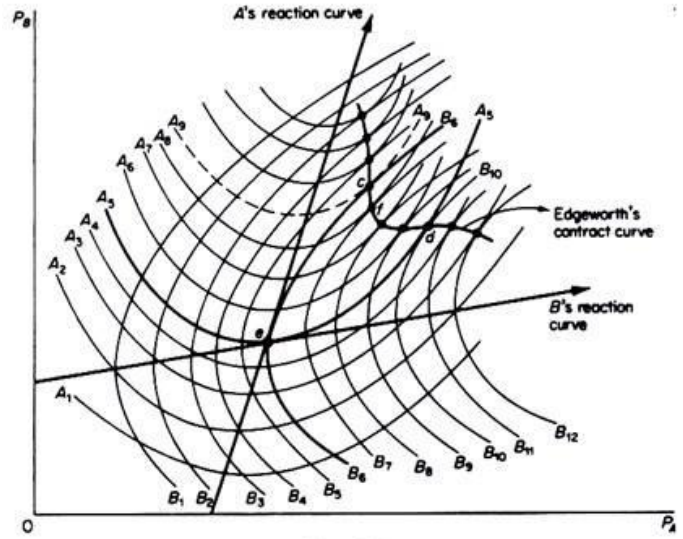

Figure 9.14

If firms moved on any point between c and d on the Edge-worth contract curve (which is the locus of points of tangency of the isoprofit curves of the competitors) one or both firms would have higher profits, and hence industry profits would be higher. At point c firm B would retain the same profit (B_6) as at point e, while A would move to a higher profit level (A_9). At point d firm A would have the same profit (A_5) as at the Bertrand equilibrium e, but firm B would move to a higher isoprofit curve (B_{10}). Finally, at any point between c and d (e.g. at f) both firms would realize higher profits (A_7 and B_8) as compared to those attained at Bertrand's solution ($A_7 > A_5$ and $B_8 > B_6$).

Bertrand's model may be criticised on the same grounds as Cournot's model:

The behavioural pattern emerging from Bertrand's assumption is naive: firms never learn from past experience.

Each firm maximises its own profit, but the industry (joint) profits are not maximized.

The equilibrium price will be the competitive price. (In the example of costless mineral-water production, the price in Bertrand's model would fall to zero. If production is not costless, then price would fall to

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the level which would cover the costs of the duopolists inclusive of a normal profit.)

The model is 'closed'-does not allow entry.

The interesting feature of both Cournot's and Bertrand's models is that the limit of duopoly is pure competition. Neither model refutes the other. Each is consistent and is based on different behavioural assumptions. We may say that Bertrand's assumption (about the fixity of price of the rival) is more realistic, in view of the observed preoccupation of firms with keeping their prices constant (except in cost inflation situations).

Furthermore, Bertrand's model focused attention on price setting as the main decision of the firm. The serious limitations of both models are the naive behavioural pattern of rivals; the failure to deal with entry; the failure to incorporate other variables in the model, such as advertising and other selling activities, location of the plant, and changes in the product.

Product differentiation and selling activities are the two main weapons of non-price competition, which is a main form of competition in the real business world; both models do not define the length of the adjustment process. Although dealing in terms of 'time periods,' their approach is basically static; both models assume that the market demand is known with accuracy; both models are based on individual demand curves which are located by making the convenient assumption of constant reaction curves of the competing firms.

Edgeworth duopoly model

The Edgeworth duopoly model, also known as Edgeworth solution, was developed by *Francis Y. Edgeworth* in his work "*The Pure Theory of Monopoly*", 1897. It is a *duopoly* model similar to the *duopoly model* developed by *Joseph Bertrand*, in which two firms producing the same *good* compete in terms of prices. Edgeworth's model presents a slight modification as it also includes constraints in the *production*

capacity of the firms. In this *market structure*, firms have two potential options, to *collude* or not.

When firms choose to collude they will split and share the market and the *production* of the good. $Firm_1$ will produce from *O* to *F* and $firm_2$ from *O* to *G*, in this way the *supply* is limited and prices will be set at *p*. Revenues of each firm correspond to the rectangle above *FO* and *OG*, and each firm would enjoy an equal share. Note that d_1 and d_2 are parts of total demand, each part being supplied by one of the firms.

Collusion is not always possible as firms have incentives to break cooperation in their search for higher profits. Collusion is also considered an illegal business practice in many countries. Eventually one of the firms will decide to lower their prices and increase production in order to gain market share from the other competitor. Consequentially the other firms will do the same. This process will escalade up to the point in which the maximum production of both firms is achieved. When this point is reached (*OD* for $firm_1$ and O*E* for $firms_2$), price will not be reduced any further and will remain at *p'*, as the increase in demand that follows price reduction will not be satisfied with a larger amount of production. On the contrary, prices will start to rise little by little so firms will be able once again to increase their profits. Overtime this process will be repeated and prices will oscillate from *p* to P'

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, Chamberlin's Oligopoly Model

Chamberlin's contribution to the theory of oligopoly consists in his suggestion that a stable equilibrium can be reached with the monopoly price being charged by all firms, if firms recognize their interdependence and act so as to maximize the industry profit (monopoly profit).

Chamberlin accepts that if firms do not recognize their interdependence, the industry will reach either the Cournot equilibrium.

If each firm acts independently on the assumption that the rivals will keep their output constant; or the industry will reach the Bertrand equilibrium if each firm acts independently, trying to maximize its own profit on the assumption that the other rivals will keep their price unchanged.

Chamberlin, however, rejects the assumption of independent action by competitors. He says that the firms do in fact recognize their interdependence. Firms are not as naive as Cournot and Bertrand assume. Firms, when changing their price or output, recognize the direct and indirect effects of their decisions. The direct effects are those which would occur if competitors were assumed to remain passive (either in the Cournot or in the Bertrand sense).

The indirect effects are those which result from the fact that rivals do not in fact remain passive but react to the decisions of the firm which changes its price or output. The recognition of the full effects (direct and indirect) of a change in the firm's output (or price) results in a stable industry equilibrium with the monopoly price and monopoly output.

Chamberlin assumes that the monopoly solution (with industry or joint profits being maximized) can be achieved without collusion the entrepreneurs are assumed to be intelligent enough to quickly recognize their interdependence, learn from their past mistakes and adopt the best (for all) position, which is charging the monopoly price.

Chamberlin's model can best be understood if presented in a duopoly market. Initially Chamberlin's model is the same as Cournot's. The market demand is a straight line with negative slope, and production is assumed costless for simplicity (figure 9.15). If firm A is the first to start production it will produce the profit-maximizing output $0X_M$ and

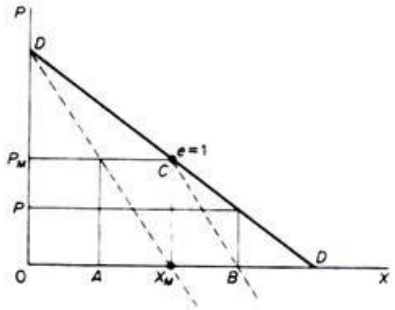

Figure 9.15

sell it at the monopoly price P_M. Firm B, under the Cournot assumption that the rival A will retain his quantity unchanged, considers that its demand curve is CD and will attempt to maximize its profit by producing one-half of this demand, that is, quantity X_MB (at which B's MR = MC = 0). As a consequence the total industry output is OB and the price falls to P. Now firm A realizes that its rival does in fact react to its actions, and taking that into account decides to reduce its output to 0A which is one-half of $0X_M$ and equal to B's output.

The industry output is thus $0X_M$ and price rises to the monopoly level $0P_M$. Firm B realizes that this is the best for both of them and so will keep its output the same at $X_MB = AX_M$. Thus, by recognizing their interdependence the firms reach the monopoly solution. Under the assumption of our example of equal costs (that is, costs = 0) the market will be shared equally between A and B (clearly $0A = AX_M$). Chamberlin's model is an advance over the previous models in that it assumes that the firms are sophisticated enough to realise their interdependence, and that it leads to a stable equilibrium, which is the monopoly solution.

However, joint profit maximisation via non-collusive action implies that firms have a good knowledge of the market-demand curve and that they soon realise their mistakes. That is, they somehow acquire a knowledge of the total-supply curve (i.e. of the individual costs of the rivals) and hence they define the (monopoly) price which is best for the group as a whole. Without collusion joint profit maximisation is impossible unless all firms have identical costs and demands.

Chamberlin's small group model suffers also from the defect of ignoring entry. It is a 'closed' model. If entry does occur it is not certain that the stable monopoly solution will ever be reached, unless special assumptions are made concerning the behaviour of the old firms and the new entrant.

It should be noted that although the 'kinked-demand curve' appears in Chamberlin's analysis (of both the 'large group' and the 'small group'), he does not use it explicitly as a tool of analysis of the behaviour of the firm. The 'kinked-demand curve model' as an operational oligopoly model was presented by P. Sweezy in 1939. We turn to the examination of this model.

Stackelberg's Duopoly Model

This model was developed by the German economist Heinrich von Stackelberg and is an extension of Cournot's model.

It is assumed, by von Stackelberg, that one duopolist is sufficiently sophisticated to recognise that his competitor acts on the Cournot assumption.

This recognition allows the sophisticated duopolist to determine the reaction curve of his rival and incorporate it in his own profit function, which he then proceeds to maximise like a monopolist.

Assume that the isoprofit curves and the reaction functions of the duopolists are those depicted in figure 9.20. If firm A is the sophisticated oligopolist, it will assume that its rival will act on the basis of its own reaction curve. This recognition will permit firm A to choose to set its own output at the level which maximizes its own profit. This is point a (in figure 9.20) which lies on the lowest possible isoprofit curve of A, denoting the maximum profit A can achieve given B's reaction curve.

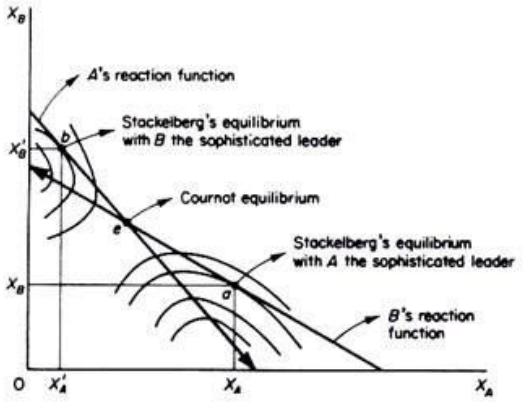

Figure 9.20

Firm A, acting as a monopolist (by incorporating B's reaction curve in his profit-maximizing computations) will produce X_A, and firm B will react by producing X_B according to its reaction curve. The sophisticated oligopolist becomes in effect the leader, while the naive rival who acts on the Cournot assumption becomes the follower. Clearly sophistication is rewarding for A because he reaches an isoprofit curve closer to his axis than if he behaved with the same naivete as his rival. The naive follower is worse off as compared with the Cournot equilibrium, since with this level of output he reaches an isoprofit curve further away from his axis.

If firm B is the sophisticated oligopolist, it will choose to produce X'_B, corresponding to point b on X's reaction curve, because this is the largest profit that B can achieve given his isoprofit map and A's reaction curve. Firm B will now be the leader while firm A becomes the follower. B has a higher profit and the naive firm A has a lower profit as compared with the Cournot equilibrium.
In summary, if only one firm is sophisticated, it will emerge as the leader, and a stable equilibrium will emerge, since the naive firm will act as a follower.

However, if both firms are sophisticated, then both will want to act as leaders, because this action yields a greater profit to them. In this case the market situation becomes unstable. The situation is known as

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Stackelberg's disequilibrium and the effect will either be a price war until one of the firms surrenders and agrees to act as follower, or a collusion is reached, with both firms abandoning their naive reaction functions and moving to a point closer to (or on) the Edge-worth contract curve with both of them attaining higher profits. If the final equilibrium lies on the Edge-worth contract curve the industry profits (joint profits) are maximised (figure 9.21).

Von Stackelberg's model has interesting implications.

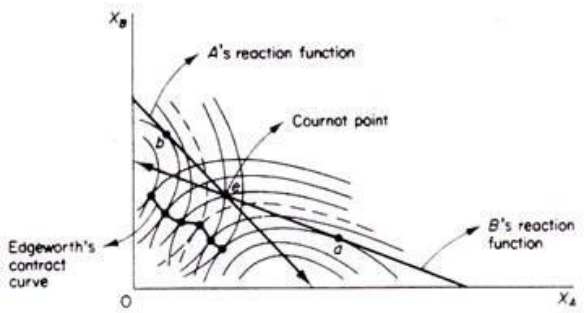

Figure 9.21

It shows clearly that naive behaviour does not pay. The rivals should recognise their interdependence. By recognizing the other's reactions each duopolist can reach a higher level of profit for himself. If both firms start recognising their mutual interdependence, each starts worrying about the rival's profits and the rival's reactions. If each ignores the other, a price war will be inevitable, as a result of which both will be worse off.

The model shows that a bargaining procedure and a collusive agreement becomes advantageous to both duopolists. With such a collusive agreement the duopolists may reach a point on the Edge-worth contract curve, thus attaining joint profit maximisation.

It should be noted that Stackelberg's model of sophisticated behaviour is not applicable in a market in which the firms behave on Bertrand's assumption. In a Cournot-type market the sophisticated firm 'bluffs' the rival, by producing a level of output larger than the one that would

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be produced in the Cournot equilibrium and the naive rival, sticking to his Cournot behavioural reaction pattern, will be misled and produce less than in the Cournot equilibrium.

However, in a Bertrand-type market the sophisticated duopolist can do nothing which would increase his own profit and persuade the other to stop price-cutting. The most he can do is to keep his own price constant, that is, behave exactly as his opponent expects him to behave.

If both entrepreneurs adopt Stackelberg's sophisticated pattern of behaviour, each will examine his profits if he acts as a leader and if he acts as a follower, and will adopt the action that will yield him the greatest profit.

Firm A calculates its profits both as a leader and as a follower:
If A is the leader his profits are 3267

If A is the follower his profits are 3003

Clearly firm A will prefer to act as the leader.

Firm B similarly, calculates its profits as a leader and as a follower:
If B is the leader his profits are 918-75

If B acts as the follower his profits are 155-50

Thus firm B will also choose to act as the leader.

With both firms acting in the sophisticated way implied by Stackelberg's behavioural hypothesis both will want to act as leaders. As they attempt to do so they find that their expectations about the rival are not fulfilled and 'warfare' will start, unless they decide to come to a collusive agreement.

We may now summarise Stackelberg's model. Each duopolist estimates the maximum profit that he would earn (a) if he acted as leader, (b) if he acted as follower, and chooses the behaviour which yields the largest maximum.

Four situations may arise:
(1) Duopolist A wants to be leader and B wants to be follower.

(2) Duopolist B wants to be leader and A wants to be follower.

(3) Both firms want to be followers.

(4) Both firms desire to be leaders.

In situations (1) and (2) the result is a determinate equilibrium (provided that the first- and second-order conditions for maxima are fulfilled).

If both firms desire to be followers, their expectations do not materialize (since each assumes that the rival will act as a leader), and they must revise them. Two behavioural patterns are possible. If each duopolist recognises that his rival wants also to be a follower, the Cournot equilibrium is reached. Otherwise, one of the rivals must alter his behaviour and act as a leader before equilibrium is attained.

Finally, if both duopolists want to be leaders a disequilibrium arises, whose outcome, according to Stackelberg, is economic warfare. Equilibrium will be reached either by collusion, or after the 'weaker' firm is eliminated or succumbs to the leadership of the other.

KINKED DEMAND CURVE MODEL OF OLIGOPOLY

Assumptions of the Kinked Demand Curve Model:
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, then the rivals would not follow it, they would simply keep their prices unchanged. We shall see presently that, because of this asymmetric reaction pattern of the rivals, the demand curve of each firm would have a kink at the prevailing price of its product.

Why the Kink in the Demand Curve?

In Fig. 14.18 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.

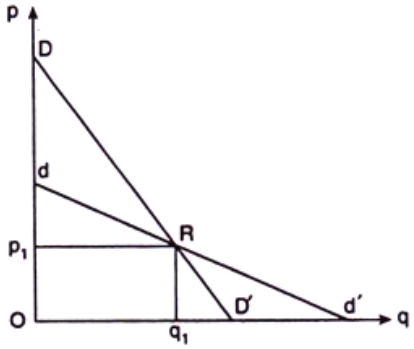

Fig. 14.18 Explaining the kink in the demand curve

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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.

On the other hand, if a particular firm in the industry changes the price of its product, and following this, all other firms also change their prices in the same direction, and, say by the same proportion, for the sake of simplicity, then the firm's demand curve would be relatively more steep like DD'.

This is because, in this case, as the firm decreases or increases the price, its product does not become neither relatively cheaper nor dearer. Therefore, now its demand curve would be less elastic, or more steep, than dd'—now the demand curve would be like DD'.

Let us suppose that initially the price of the product of the firm is p_1 or Op_1 and the demand for the product is q_1 or Oq_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 Rd of the relatively more elastic demand curve dd'. 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 RD' of the relatively steeper demand curve DD'.
Therefore, at the price p_1, the firm's demand curve would be dRD'.
Obviously, because of assumption (v), the segment dR of this demand curve would be more flat or more elastic than the segment RD' (and the segment RD' would be more steep or less elastic than the segment dR).
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 RD', i.e., the demand curve in this model would be a kinked demand curve.

Collusive Oligopoly

In a model of collusive oligopoly, we discuss the economics of agreement between the firms in an undifferentiated oligopolistic industry. When these firms get together and agree to set prices and outputs so as to maximise total industry profits, they are known as a cartel.

Assumptions of the Cartel Model:

For the sake of simplicity, we shall make here the following assumptions:

(i) There are only two firms in the oligopolistic industry, i.e., here we have a case of duopoly.

(ii) Each firm produces and sells a product that is a perfect substitute for that of the other.

(iii) The product is perishable.

(iv) There are many knowledgeable buyers of the product.

(v) Each firm knows the market demand for the product.

(vi) The two firms have different cost curves.

(vii) Both the firms have the same expectations about the prices and productivities of the inputs which they use.

(viii) The price of the product is the sole parameter of action of each firm.

(ix) The two firms are contemplating whether or not to form a cartel and agree upon a price that will promise the maximum maximorum of profits per period to both of them jointly.

Analysis of the Cartel Model:

Let us discuss the choice of this price [mentioned in assumption (ix)] and its implications with the help of Fig. 14.16. Here, in part (a), the average and marginal cost curves of duopolist A are given to be AC_A and MC_A, and those of duopolist B are given to be AC_B and MC_B in part (b).
As is seen in these figures in 14.6, the cost levels of A have been assumed here to be lower than those of B. The curve DD in part (c) of the figure is the market demand curve for the product produced by the duopolists.
Here the dupolists A and B are exploring the possibility of jointly producing and selling the product and earning the maximum maximorum of profits. Henceforth, we shall call the duopoly firms A and B that have come under collusion, the firms A + B (the **"plus"** sign indicates collusion).
In our attempt to analyse the price-output-profit policy of the firms A + B, we shall first see how the firms would distribute the production of any particular quantity (q) of their product between the plants of A and B, so that the cost may be minimum. We may call the plants of the two firms plant A and plant B.

Now, the total cost (C) of producing any particular quantity of output, q is

$$c = C_A(q_A) + C_B(q_B) = C(q_A, q_B) \qquad (14.72)$$

subject to

$q = q_A + Q_B$ = constant (14.73)

where q_A = quantity of output to be produced in plant A,

and q_B = quantity of output to be produced in plant B,
C_A = cost of production in plant A
and C_B = cost of production in plant B
Given these, the first-order conditions (FOCs) of producing the output quantity, q, in the two plants at minimum cost.

Conditions (14.75) and (14.76) give us that two (or more) oligopoly firms under collusion (here firms A + B) would distribute the production of any particular quantity of output between their plants in such a way that the marginal cost (MC) in each plant may become the same.

We may easily understand the economic significance of this condition. Instead of MC_A being equal to MC_B, if we have $MC_A > MC_B$ (in the two-firm case), then the firms A + B would reduce the quantity of production in the higher cost plant A and increase the quantity in the lower cost plant B, total output remaining the same.
The firms would do this because then they would be able to produce the same quantity of total output (q) at a lower cost.

Now, as we know, for the sake of profit maximisation, and, therefore, for the sake of efficient production, firms A + B would operate along the upward sloping segments of the MC curves of plants A and B that correspond to the second stage of production. That is why, as the firms decrease and increase q_B, MC_a will fall and MC_B will rise, and ultimately, at some distribution, MC_A will become equal to MC_B.
This distribution is the cost-minimising distribution of the output quantity, q, between the two plants. For if $MC_A = MC_B$, then it will not be possible for the firms to reduce the cost further by transferring output production from plant A to plant B, or, the other way round.

On the other hand, if $MC_A < MC_B$, the firms A + B will reduce output in plant B and increase it in plant A, till MC_A rises and MC_B falls to become equal to each other.
Thus, we come to the conclusion that the duopoly firms under collusion (i.e., firms A + B) will distribute the production of any particular quantity of output over the two plants in such a way that the MC in each plant may become the same; only then it would be able to produce the said quantity at the minimum cost.
Therefore, that at each quantity of output, q, there is a problem of cost- minimisation, or, profit-maximisation (the price, p, and, therefore, total revenue, p x q, being given by the demand curve). Here equilibrium will be obtained at that quantity, q*, at which profit is maximum among the maximums, or, maximum.

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 organization 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, and members 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-maximizing decision is the same as that of a monopolist, as Figure reveals. 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 labeled *abcd* in Figure . 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.

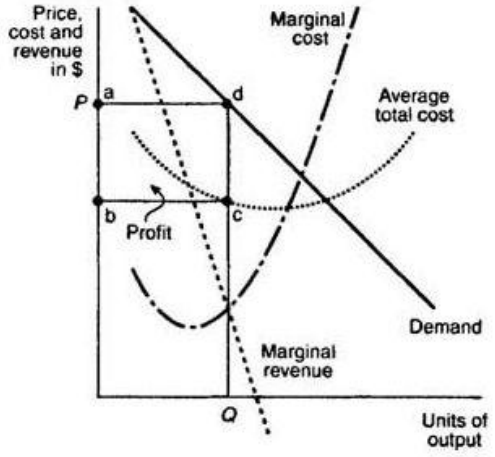

Figure 1 Profit maximization by oligopolistic cartel

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 the cartel's 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.

Price Leadership under Oligopoly

There are a number of oligopolistic organizations in the market, but one of them is dominant organization, which is called price leader.

Price leadership takes place when there is only one dominant organization in the industry, which sets the price and others follow it.

Sometimes, an agreement may be developed among organizations to assign a leadership role to one of them. The dominant organization is treated as price leader because of various reasons, such as large size of the organization, large economies of scale, and advanced technology. According to the agreement, there is no formal restriction that other organizations should follow the price set by the leading organization. However, sometimes agreement is formal in nature.

Price leadership is assumed to stabilize the price and maintain price discipline.

This also helps in attaining effective price leadership, which works under the following conditions:

i. When the number of organizations is small

ii. Entry to the industry is restricted

iii. Products are homogeneous

iv. Demand is inelastic or less elastic

v. Organizations have similar cost curves

Types of Price Leadership:

Price leadership helps in stabilizing prices and maintaining price discipline. There are three major types of price leadership, which are present in industries over a passage of time.

These three types of price leadership are explained as follows:

i. Dominant Price Leadership:

Refers to a type of leadership in which only one organization dominates the entire industry. Under dominant price leadership, other organizations in the industry cannot influence prices. The dominant organization uses its power of monopoly to maximize its profits and other organizations have to adjust their output with the set price.

The interests of other organizations are ignored by the dominant organization. Therefore, dominant price leadership is sometimes termed-as partial monopoly. Price leadership by the leading organization is most commonly seen in the industry.

ii. Barometric Price Leadership:

Refers to a leadership in which one organization declares the change in prices at first and assumes that other organizations would accept it. The organization does not dominate others and need not to be the leader in the industry. Such type of organization is known as barometer.

This barometric organization only initiates a reaction to changing market situation, which other organizations may follow it if they find the decision in their interest. On the contrary, the leading organization has to be accurate while forecasting demand and cost conditions, so that the suggested price is accepted by other organizations.

Barometric price leadership takes place due to the following reasons:

a. Lack of capacity and desire of organizations to estimate appropriate supply and demand conditions. This influences organizations to follow

price changes made by the barometric organization, which has a proven ability to make correct forecasts.

b. Rivalry among the organizations may make a leader, which can be unacceptable by other organizations. Thus, most of the organizations prefer barometric price leadership.

iii. Aggressive Price Leadership:

Implies a leadership in which one organization establishes its supremacy by threatening the organizations to follow its leadership. In other words, a dominant organization establishes leadership by following aggressive price policies and forces other/organizations to follow the prices set by it.

Price-Output Determination under Price Leadership:

Price leadership takes place when there is only one dominant organization in the industry, which sets the price and others follow it. Different economists have developed different models for determining price and output in price leadership.

Here, we would discuss a simple model for determining price and output in price leadership, which is shown in Figure-4:

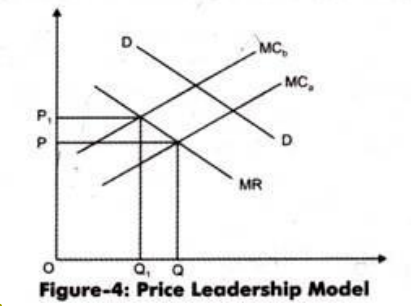

Figure-4: Price Leadership Model

Suppose there are two organizations, A and B producing identical products where organization A has a lower cost of the production than organization B. Therefore, consumers are indifferent between these

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two organizations due to identical products. This implies that both the organizations would face same demand curve, which further represents equal market share.

In Figure-4, DD is the demand curve of both the organizations and MR is their marginal revenue. MC_a and MC_b are the marginal cost curves of organization A and B respectively. As stated earlier, the cost of production of organization A is less than B, thus, MC_a is drawn below MC_b.
Let us first start the discussion of price leadership with the case of organization A. The profits of organization A would be maximized at a point where MR intersects MC_a. At this point, the output of organization A would be OQ with the price level OP. On the other hand, the profits of organization B would be maximized at a point where MR intersects MC_b with output OQ_1 and price OP_1.

In such a case, the price of organization B is more as compared to organization A. However, both the organizations have to charge the same price as products are homogeneous. In this case, organization A is the price leader and organization B is the follower.

Thus, organization A will dictate the price to organization B. Both the organizations will follow the same output, OQ and price OP. However, the profits earned by organization B are less than A, as it has to produce at price OP which is less than its profit maximizing price, OP_1. In addition, the organization B also has high costs of production that leads to lower profits at price OP_1.

Drawbacks of Price Leadership

i. Makes it difficult for the price leader to assess the reactions of followers.

ii. Leads to malpractices, such as charging lower prices by rival organizations in the form of rebates, money back guarantees, after delivery free services, and easy installment facility. The prices charged

by rival organizations are comparatively less than the prices set by the price leader.

iii. Leads to non-price competition by rival organizations in the form of aggressive promotion strategies.

iv. Influences new organizations to enter into the industry because of price rise. These new organizations may not follow the leader of the industry.

v. Poses problems if there are differences in cost of price leaders and price followers. In case, if cost of production of price leader is less, then he/she would fix lower prices. This will lead to a loss for a price follower if his/her cost of production is more than the price leader.

Bain's Limit-Pricing Theory

Bain formulated his 'limit-price' theory in an article published in 1949, several years before his major work Barriers to New Competition which was published in 1956.

His aim in his early article was to explain why firms over a long period of time were keeping their price at a level of demand where the elasticity was below unity, that is, they did not charge the price which would maximize their revenue.

His conclusion was that the traditional theory was unable to explain this empirical fact due to the omission from the pricing decision of an important factor, namely the threat of potential entry. Traditional theory was concerned only with actual entry, which resulted in the long-run equilibrium of the firm and the industry (where P = LAC).

However, the price, Bain argued, did not fall to the level of LAC in the long run because of the existence of barriers to entry, while at the same time price was not set at the level compatible with profit maximization because of the threat of potential entry. Actually he

maintained that price was set at a level above the LAC (= pure competition price) and below the monopoly price (the price where MC = MR and short-run profits are maximized).

This behaviour can be explained by assuming that there are barriers to entry, and that the existing firms do not set the monopoly price but the 'limit price', that is, the highest price which the established firms believe they can charge without inducing entry. Bain, in his 1949 article, develops two models of price setting in oligopolistic markets.

Assumptions:

1. There is a determinate long-run demand curve for industry output, which is unaffected by price adjustments of sellers or by entry. Hence the market marginal revenue curve is determinate. The long-run industry-demand curve shows the expected sales at different prices maintained over long periods.

2. There is effective collusion among the established oligopolists.

3. The established firms can compute a limit price, below which entry will not occur.

The level at which the limit price will be set depends:
(a) On the estimation of costs of the potential entrant,

(b) On the market elasticity of demand

(c) On the shape and level of the LAC,

(d) On the size of the market,

(e) On the number of firms in the industry.

4. Above the limit price, entry is attracted and there is considerable uncertainty concerning the sales of the established firms (post entry).

5. The established firms seek the maximization of their own long-run profit.

Model A: there is no collusion with the new entrant:
Assume that the market demand is DABD' and the corresponding marginal revenue is Dabm (figure 13.1).

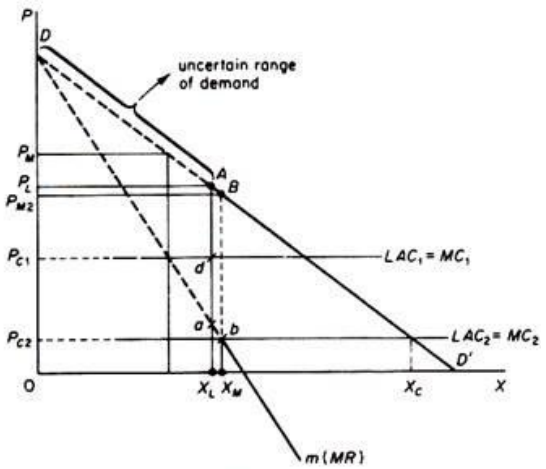

Figure 13.1

Assume further that the limit price (P_L) is correctly calculated (and known both to the existing firms and to the potential entrants). Given P_L, only the part AD' of the demand curve and the section am of the MR are certain for the firms. The part to the left of A, that is, DA is uncertain, because the behaviour of the entrant is not known. Whether the firms will charge the P_L or not depends on the profitability of alternatives open to them, given their costs. Assume the LAC (which is uniquely determined by the addition of the LMC = LAC of the collusive oligopolists) is LAC_1. In this case two alternatives are possible.

Either to charge the P_L (and realise the profit P_LAdP_{c1} with certainty). Or to charge the monopoly price, that is, the price that corresponds to the intersection of $LAC_1 = MC_1$ with the MR. This price will be higher than P_L (given LAC_1), but its precise level is uncertain post-entry. Thus the profits in the second alternative are uncertain and must be risk-

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discounted. The firm will compare the certain profits from charging P_L with the heavily risk-discounted profits from the second 'gamble' alternative, and will choose the price (P_L or P_M) that yields the greatest total profits.

Assume that the LAC is $LAC_2 = MC_2$. In this case the price that maximises profit is P_{M2} (corresponding to the intersection MC_2 and MR over the certain range of the latter). The P_{M2} is lower than P_L. The firm will clearly charge P_{M2} which maximises the profits. In this case the ceiling set by the price P_L is not operative.

The observed fact of setting the price at a level where $e < 1$ is justified by a situation where the limit price is low, cutting the demand curve at a point at which the MR is negative (figure 13.2). Clearly if the limit price is P_L* the MR is b* which is negative and hence the elasticity of demand at price P_L is less than unity.

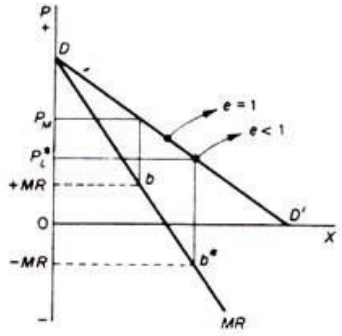

Figure 13.2

In summary: given that an entry-preventing price P_L is defined, the alternatives open to the established firms are three:

1. To charge a price equal to P_L and prevent entry.
2. To charge a price below P_L and prevent entry (this will be adopted if $P_M < P_L$).
3. To charge a price above P_L and take the risks associated with the ensuing entry and the indeterminate situation that arises in the post-entry period. (This course of action will be in any case adopted if $P_L <$ LAC).

The firm will choose the alternative which maximises profit.

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Model B: collusion takes place with the new entrant:

With collusion assumed to take place between the established firms and the entrant the conclusions are as before. The model is easier, however. With collusion the whole D curve shifts to the left by the share which is allocated to the new entrant at each price. The new DD" curve is known with certainty at all its points, as a consequence of the collusion, and so is the corresponding m" (figure 13.3).

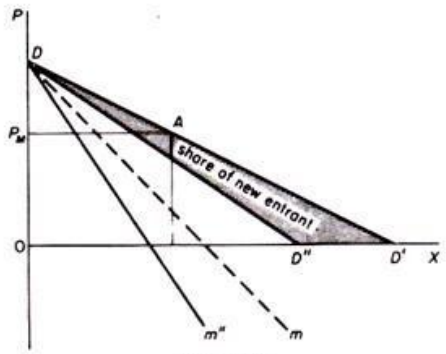

Figure 13.3

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Again the alternatives open to the firm are three:

1. Either charge P_L and exploit AD' without entry.
2. Or charge a price above P_L and attract entry. The firm will eventually move to a point on the share-of-the-market curve DD", via collusive agreement with the new entrant.
3. Or charge the profit-maximizing price P_M, if $P_M < P_L$.

Among these alternatives the firm will choose the one that yields maximum profits.

The basic and crucial assumptions of the above analysis are firstly, that the entrants react on the basis of the current price they expect the price charged by the established firms to continue in the post-entry period; secondly, that the established firms are aware of the threat of potential entry; thirdly, that the established firms can estimate correctly the limit price.

Then three major possibilities exist:

The policy of pricing to maximize industry profit with no entry resulting is adopted when $P_L > P_M$, i.e. the limit price is not operative because by charging the lower P_M price (monopoly price corresponding to MC = MR) profits (certain in this case) are maximized.
Pricing to forestall entry with industry profits not maximized, but the profit of established sellers maximized, is adopted when $P_L < P_M$ and the certain profit accruing by charging P_L is greater than the heavily risk-discounted profit which would accrue if the higher P_M were charged and an uncertain quantity sold.
Pricing to maximize industry profit but with resulting entry. This implies $P_M > P_L$. This action would be chosen if it is more profitable as compared with charging P_L and necessarily, if $P_L <$ LAC.
The first two situations lead to long-run equilibrium of the industry without entry or exit. The third case implies an unstable equilibrium since entry would be taking place.

In all the above cases one should add to the profits of established sellers any transitional profit which the established sellers might gain while raising the price above P_L and before entry became effective.
The new element of Bain's model is the redrawing of the market demand so as to account for the threat of entry. Once the demand is redefined, the model accepts collusion and profit maximisation as valid hypotheses, capable of explaining the policy of setting a price below the monopoly level, that is, below the level that maximises profit. Bain's model is not incompatible with profit maximisation.

The limit price will be chosen in favour of monopoly price if the former yields maximum long-run profits. The rationale of adopting an entry-prevention policy is profit maximisation. Whenever such a limit price is adopted it is implied that the firm has done all the relevant calculations of profits of alternative policies and has adopted the limit price because this yields maximum profits.