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[Academic Script]

Price Leadership, Quantity Leadership Collusive Cartels

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Market with Imperfect Competition (Oligopoly)

Lecture – 3(Two) Price Leadership, Quantity Leadership and Collusive Cartels

Academic Script

1. Introduction

In part 1 of this manuscript discussed in detail the duopoly models developed by Cournot and Bertrand. The concept of reaction curves and their application in achieving equilibrium in oligopoly markets was also explained in part 1.

This part of the manuscript explains the concepts of quantity leadership, price leadership and simultaneous quantity setting that are used in the oligopoly models. Non-collusive stable equilibrium and the working of collusive cartels is also discussed in this part.

Quantity Leadership

The situation of quantity leadership occurs when the firms compete on quantity. This happens when one firm decides to sell specific quantity of a product first, and the second firm takes quantity related decision considering the choice of the first firm. The firm that takes decision first is known as 'quantity leader', and the second firm is called 'quantity follower'. This type of leader-followers competition is called a Stackelberg competition. The Stackelberg leadership model is a strategic non-cooperative game in which the leader firm moves first and the follower firms move sequentially. A German economist Heinrich Freiherr von Stackelberg was the explained this model in his publication "Market Structure and Equilibrium" in 1934. The Stackelberg competition is a model of imperfect competition.

According to Stackelberg, quantity leadership prevails when there is one dominant firm and the other firm is either small or less important in the industry. Stackelberg model represented a turning point in the study of market structure, particularly in the analysis of duopolies, because it provided different conclusions than the Cournot and Bertrand models. The assumptions of Stackelberg model are:

a) There are two firms in the industry, where one firm is the leader, and the other firms is the follower.

b) Both firms compete by making their choice on quantity.

c) Both the firms manufacture a homogenous product.

d) Price in the market depends on their joint output.

Stackelberg model is a sequential game (not simultaneous as in Cournot model). Stackelburg equilibrium is explained with the use of reaction curves shown in Figure 1. Firm 1 is the leader who decides his reaction curve R_1 to sell his product. Firm 2 is the follower who decides his reaction curve R_2 considering the decision of the leader. At equilibrium, Firm 1 abandons his reaction curve R_1 . Instead, he observes his rival's behavior along his reaction curve R_2 , and then chooses point S, which is best for him as the highest iso-profit curve is just tangent to R_2 . Choosing any other point on R_2 means a lower profit for the leader.



Figure 1: Stackelburg Equilibrium

Thus Stackelberg equilibrium is a perfect equilibrium of the game. In this game, the leader has decided not to behave as in the Cournot model. However it is not certain whether the leader would produce more and make more profits than the follower because the production will be larger for the firm with lower marginal costs. Total production will be greater and prices lower, but player one will be better off than player two. This highlights following two aspects:

- (i) Importance of accurate market information while defining a strategy, and
- (ii) Interdependence of decisions when there is a market leader and a follower.

Major differences between the Stackelburg and Cournot models of duopolies are:

a) Stackelbergs model is a sequential game while the Cournot model is a simultaneous game.

b) In Stackelberg duopolies, quantity sold by the leader is greater than the follower while in Cournot duopolies, the quantity sold is the same for both firms.

2. Price Leadership

Price leadership takes place when one firm sets the price and the other firms follow it. It comes into existence either through tacit or formal agreement. Since formal agreement to establish price leadership is illegal, it is established by informal and implicit understanding. This is done in an informal meeting among the competing oligopolists in which a price leader is selected and the other firms agree to follow him in fixing their prices. Price leadership under different situations is of the following types.

- a) First, there is price leadership by a low-cost firm.
- b) Second, there is price leadership by a dominant firm.
- c) Third, there is an expert leadership where a relatively older and more experienced firm performs the role of a leader to protect the interests of all.
- d) Lastly, there is exploitative price leadership by a large or dominant firm who follows aggressive price policies.

Economists have developed different models for price-output determination under price leadership. Price output decisions under leadership by a low cost firm and leadership by dominant firm are discussed below.

Price Leadership by Low-Cost Firm Price-output determination under price leadership by a low-cost firm assumes that:

- a) Cost of production of one firm is lower than the other.
- b) Both firms produce a homogeneous product.
- c) Each firm has equal share in the market.

Price and output determination under price leadership by a low cost firm is explained in Figure2. Each firm faces a demand curve Dd which is half of the total market demand curve DD. MR is the marginal revenue curve of each firm. ACa and MCa are the average and marginal cost curves of firm A and ACb and MCb are the average and marginal cost curves of firm B. MCa and ACa curves of firm A lie below the MCb and ACb curves of firm B because it is assumed that the cost of production of firm A is lower than firm B.

Firm A will maximize profits by selling output OM and setting price OP, since at output OM, its marginal cost is equal to the marginal revenue MR. Firm B will maximize profits when it fixes price OH and sells output ON. The profit- maximizing price OP of firm A is lower than price OH of firm B.



Fig.2: Price-Output Under Low-Cost Leadership

Since firm A and firm B produce homogeneous product, they cannot charge two different prices. As the profit-maximizing price OP of firm A is lower than the profit-maximizing price OH of firm B, firm A will set the price and firm B will follow it. Thus firm B will also charge price OP and produce and sell quantity OM. This is because at price OP, it can sell OM output like firm A because the demand curve facing each firm is the same. Thus both the firms will charge the same price OP and sell the same quantity (OM). Total output of both firms will equate with total market demand OQ (OM+OM=OQ) at price OP.

At price OP, profits earned by A and B would differ. While firm A will be maximizing profits by selling output OM at price OP, the profit earning of B will be below the maximum level because it earns maximum profits at output ON and price OH. Therefore the profits earning of firm B will be less than firm B due to differences in the cost of production.

Price Leadership by Dominant Firm

The duopoly market witnesses a situation of price leadership by a dominant firm when one firm has substantial share in the market while other firms are of smaller size. To explain this situation, it is assumed that the large firm has the information on the market demand for the product. It is also assumed that the dominant firm knows about the production costs especially marginal costs of small firms. This implies that the dominant firm has the mechanism to estimate product supply by small firms at different prices. On the basis of above information, the large firm projects its market demand which is explained in figure 3. In panel (a) of fig.3 let DD represent market demand curve and S_m is the total quantity sold by the small firms. At each price the large firm has the ability to sell that much quantity in the market which the small firms are unable to supply. In other words the demand for the product of the dominant firm will be the difference between total demand DD (at a given price) minus the total supply S_m by the small firms.



Fig.3: Price-Output Under Dominant Firm

For example at price P_1 the demand for the product of the leader firm is zero because the entire quantity P_1R is supplied by the small firms. As price falls below P_1 , the demand for leader's product increases. At price P_2 , total demand is T and small firms supply P_2C while the leader firm supplies the remaining part i.e. CT. At price P_3 and below the entire quantity is supplied by the leader firm as the supply by small firms is zero. Thus below price P_3 , the entire market demand coincides with the leader's demand curve.

In panel (b) of fig. 3 the MR_{L} is the marginal revenue curve of the price leader corresponding to his demand curve d_{L} . AC and MC are his average cost and marginal cost curves. The dominant

price leader will maximize his profits by producing output OQ (or PH) and setting price OP. The price followers (small firms) will sell at price OP and they together will produce PB. It is important to note that the price taker small firms may or may not maximize their profits at price P set by the price leader due to variations in their cost structures.

In fig.3, quantity PH produced by the leader firm in panel (b) is equivalent to the demand BS for the leader's product in panel (a). It is assumed that the small firms cannot sell more than the quantity shown by curve S_m at any given price. Therefore, if the leader wants to maximize profit, then it will have to ensure that small firms not only follow its price but also produce required quantity PB at price P. This implies that to retain profitmaximizing position, the price-leader must have market-sharing agreement with small firms because if they produce less output than PB, then the leader will produce at non-profit maximization position.

3. Non-Collusive Stable Equilibrium

Non-collusive oligopoly is a market where a few number of firms act independently but are aware of each other's actions. Also the numbers of players in the market do not provide sufficient evidence about the market competition. However, the dynamics of competition determines whether oligopoly leads to an efficient market outcome or not. The market dynamics can be identified by a combination of several factors such as price, quality and product diversity. It is important to note that the oligopolistic competition is effective in the presence of certain market features of which some important features are given below:

- a) Non-collusive oligopoliy can bring dynamic efficiency in those industries where innovation and investment is associated with substantial risks.
- b) Competitive pressure can limit the ability of a firm in setting prices above the competitive level.
- c) Competitive pressure threatens the potential entrants that are attracted either by supernormal profits earned by the oligopoly firms or when the existing firms are less efficient or neglect new technologies.

From the aforesaid it is clear that effective oligopolistic competition increases market efficiency in the long run.

Simultaneous Quantity Setting

In many situations of oligopoly markets, the firms take decisions simultaneously, without knowing the strategies of their competitors. Therefore, they forecast each other's behavior while making their own choices. In Cournot competition the firms simultaneously choose to produce their optimal quantity. Simultaneous quantity setting takes place under the following assumptions:

- a) There are two firms.
- b) Each firm produces a homogenous product.
- c) Both the firms choose their optimal product quantity simultaneously.
- d) Marginal costs of production are same for both firms.

When there are only two firms in an industry, strategic interaction between them affect each other's profits. This

assumption is in contrast with the assumptions of perfect competition. The users of game theory formulate a model assuming situations of strategic interaction between the firms. The Cournot model can be characterized as a simultaneousmove quantity-setting duopoly game. The game is played as follows:

First, both firms choose their output levels simultaneously without knowing the level of output the rival firm has chosen. Once these quantities are placed in the market, market demand decides the price and each firm calculates its payoffs (profits) accordingly. The equilibrium reached in Cournot model is the Nash equilibrium in simultaneous-move quantity-setting duopoly game.

An important assumption of the Cournot model is that the firms are treated like rational individual decision makers who aim at maximizing their payoffs. In case of oligopoly models, the payoffs are profits. The payoffs received by the players depend on their choice of move. Each type of move is considered as a strategic variable. In the Cournot model, quantity is the strategic variable. Each firm decides about product quantity simultaneously, and then the market demand curve determines the price at which the output is sold. A best response functions can be used to see what Nash equilibrium will emerge when two firms in an oligopoly choose capacity simultaneously.

4. Collusive Cartels

In a collusive cartel, the oligopolists enter into an agreement to produce limited output in order to maximise profits. The characteristic of collusive cartel is that all the colluding firms behave as single firm and aim at maximizing their joint profits with respect to either price or quantity choice. Therefore, different firms are asked to produce different levels of output in order to minimize total cost. Total cost will be minimized when the various firms in the cartel produce such levels of output at which their marginal costs are equal. If marginal costs of the member firms are not equal, then the marginal units of output will be produced at a smaller cost by the firms with a lower marginal cost than by those with a higher marginal cost.

Figure 4 illustrates how a cartel works and determines its price and output. Suppose two firms form a cartel by entering into an agreement. Also suppose that the aim of the cartel is to maximise joint profits of member firms. First the cartel will estimate total demand for the product. The demand curve for the cartel will be the aggregate demand sloping downward as shown by curve DD in Fig. 4(c). Marginal revenue curve MR of the cartel will lie below the demand curve DD. Marginal cost curve (MC_c) of the cartel is the horizontal addition of the marginal cost curves of the two firms A and B respectively (MC_c=MC_a+MC_b) and indicate the minimum possible total cost of producing each level of output. It may be noted that each level of industry output will be distributed between the two firms in such a way that their marginal costs are equal.

Now, the cartel will maximise profits by fixing output at the level where MR and MC curves of the cartel intersect each other. In Fig. 4(c) the MR and MC curves intersect each other at point R or output OQ. At output OQ, the demand curve DD will determine price equal to QL or OP. After taking decision to produce OQ level of total output, the cartel will allot production quota for each firm so that the marginal cost of each firm is comparable. This is done by drawing a horizontal straight line from point R towards the Y-axis.



Fig.4: Price and Output Determination under Cartel

Fig.4 shows that when firm A produces OQ_1 and firm B produces OQ_2 the marginal costs of the two firms are equal. Thus the output quota of firm A will be OQ_1 and of firm B will be OQ_2 . Total output will be OQ which is equal to the sum of OQ_1 and OQ_2 . At this level of output the joint profits of the colluding firms of the cartel will be maximized. Fig. 4(a) shows that with output OQ_1 and cartel price OP the profits made by firm A are equal to PFTK. Similarly Fig. 4(b) shows that with output OQ_2 , and cartel price OP the profits made in firm B are equal to PEGH. Total profits or joint profits made by the cartel are maximized by equating combined marginal cost (MC_c) with the combined marginal revenue (MR_c).

5. Summary

In many situations of oligopoly markets, the firms take decisions simultaneously, without knowing the strategies of their competitors. Therefore, they forecast each other's behavior while making their own choices. The situation of quantity leadership occurs when the firms compete on quantity. On the other hand price leadership takes place when one firm sets the price and the other firms follow it. While collusive & noncollusive oligopoly are the markets where either few firms behave as a single firm as are bound to an agreement or acts independently. Thus today we have discussed price leadership, quantity leadership and collusive cartels.