

Models of Oligopolist's Behavior in the Market

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Abstract: This article deals with the presentation, critical analysis and the possibilities of applications of selected price and output management strategies for profit maximization in characteristic oligopoly situations. First the paper presents the classical oligopoly models of market strategy for profit maximization (Cournot, Stackelberg, Bertrand-Edgeworth) then turns to contemporary strategies of leadership price, collusion in cartels, and so on. The results of the research presented in this work can be used for defining the solutions of concrete market situations where large organizations can be found, in other words, for defining their optimal profit maximization strategies.

Key words: profit maximization, function of reactions, price leadership, market strategies, market share

1 Classical Oligopoly Models

Today among the numerous theorists who have been carrying out research into various problems of the market are the mechanism of price forming, business policies of companies and similar accepted and applied classifications of market structures which were identified by the German economist **Stackelberg**. The appearance of Stackelberg's classification in the thirties represents an important contribution to the theoretical studies of market structures of those days, in the first place because until the appearance of his classification the morphology of the market was considered overly simplified. Until the thirties in the twentieth century in economical analysis the starting point were extreme market situations – complete competition and total monopoly, in other words, the starting points were such situations, which are hard to find in real-life economy. In price theory, Cournot's duopoly has until today remained one of the most studied forms of oligopoly market situations. In the first theories of duopoly, the duopolist appears as a company which ignores the interests of other competing parties. Thus with Cournot appears the duopolist who makes modifications in his offers for higher profit, not taking into consideration the fact that this will decrease the profit of the

competitors. Profit appears as a function of his own offer and that of the competitor.

Cournot makes the assumption that there are no costs of production, using the famous theoretical example of mineral water [7,322], therefore the profit of every duopolist is the function of his own offer and the price formed on the market. The price in this case appears as a function of the aggregate sold amount of product.

The optimal result of a duopolist is achieved when the branch income equals 0, or under the condition that there is no reaction from any other party to their own modifications to the offer, duopolist **I** will increase his own offer with the aim to achieve maximum profit under the given market price.

In Cournot's model the assumption is made that duopolists ignore interdependence whereas every seller takes the offer of the competitor as given. In company strategy to achieve maximum profit, the company develops a policy and decides upon the range of production which will lead to maximum profit, assuming that the other participant will not make changes concerning their offer. Since both participants have a satellite position, there are several subsequent processes to adjust their products, carried out by profit maximization, until after a certain period of simultaneous moves, balance sets in.

These simultaneous reactions of both participants can be represented in the form of a diagram [7, 339], in which the abscissa denotes the range of production of duopolist **I**, and the ordinate represents the range of production of duopolist **J**. The reaction curve **II'** shows what range of production is optimal for the company, with the appropriate range of production of company **J** (while company **I** leads the politics of satellite towards the duopolist). With duopolist **J**, who also leads the politics of satellite towards company **I**, profit grows with the decrease of the range of production of the duopolist **I**. Duopolist **I** starts with a range of production **A**, at which point the range of production of **J** is **G**. After that duopolist **I** increases the offer to **B**, and the range of production of **J** forms on the level of **E**. In the third step, **I** decides on production **C**, and the range of production of **J** will be created on the level **F**.

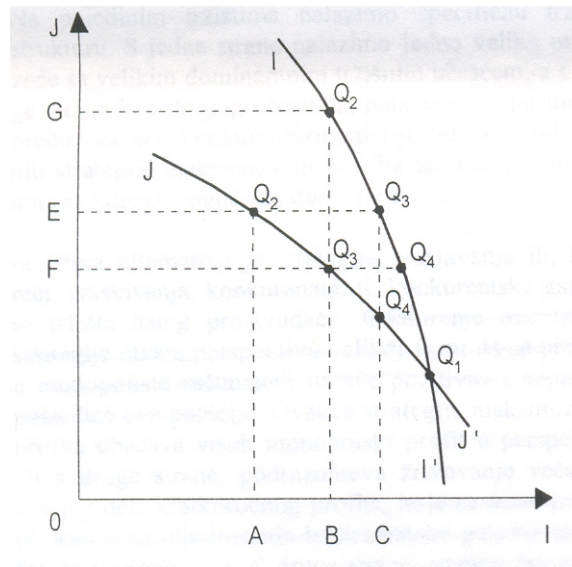


Figure 1
Cournot's duopoly

After a shorter or longer period of time of determining their own offers, as functions of effective offers towards the competitor, balance is achieved in point Q_1 , where the curves of reaction of both sellers intersect.

In the first theories of oligopoly, oligopolists appear as companies which function autonomously, where the **offer** in Cournot's model is the 'subject' of reactions of two competitors, and in the interpretation of J. Bertrand and Y. Edgeworth, these are **prices**. The first among the economists who will offer an essentially different assumption is A. Bowley, who takes into consideration the interdependence of duopolists. His interpretation of profit making strategies of a company in duopoly conditions points out that every duopolist adjusts to the decisions of the competition. In this work, due to lack of space, this particular theory will be left out along with some others in the search for a balancing solution in oligopoly structures. With Cournot's model of duopoly this balance is of stable character, thus it denotes a solution which duopolists do not feel a stimulation to deter from.

The characteristics of the homogenous and heterogeneous duopoly is the subject of numerous analyses in economic literature: Cournot, Bertrand, Edgeworth, Bowley, Stackelberg, Krelle, Marchal, Weintraub, Ryan, Chamley and others. In this work the characteristics of the homogenous oligopoly competition are presented, besides the model of Cournot, Stackelberg's model is also dealt with.

Stackelberg's duopoly. In economic theory this model is often called 'leader model' because in this model one participant has the dominance – he behaves like a leader, while the other accepts the role of satellite. Setting out from the power of

the first participant, and the wish to take a favourable position on the market, the other participant passively follows the imposed politics of dominance. The advantage of this model is that it takes into consideration the interdependence of duopolists, because the economic budget of each participant on the market, under the conditions of all types of oligopolies, has to set out from the interdependence of oligopolists.

In these conditions, the leader, knowing the behaviour of the other competitor, with his production, induces such a reaction from his competitor that with the overall movement achieves maximum profit for himself. The competitor, on the other hand, who leads passive politics, takes his decisions about the range of production as independently given facts, and optimizes his status within that framework. Since this model results in stable patterns of behaviour, the question of balance can be solved within this model.

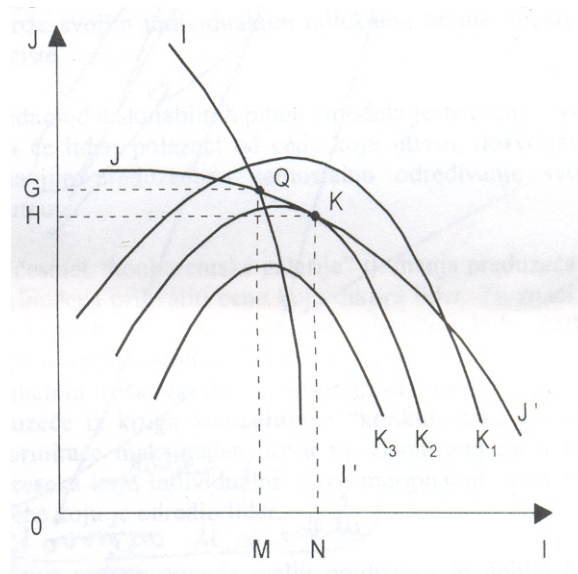


Figure 2
Stackelberg's duopoly

Based on Stackelberg's analysis graphically this can be represented as follows: if the curves of duopolists are denoted II' and JJ' , then the point of balance, Q , from the previous model of Cournot's duopoly, moves towards point K . In Stackelberg's duopoly, which is characteristic for duopolists of different power levels, the point of balance moves to level K , which represents a tangent point between the curve of reaction JJ' and the group of similar curves of equal profit for duopolist I (who is the leader in this case, while duopolist J is the satellite). The curve K_1 brings less profit than the curve K_2 , while K_3 is more favorable than K_2 , but does not have tangent points with the curve of reaction JJ' , which means

that duopolist **J** cannot accept such condition of satellite. Balance in the Stackelberg model is, unlike in Cournot's, **unstable**, because duopolist **J** will be in position to opt for another solution due to profit decrease: he will reject the politics of being a satellite, withdraw from the given market, or, will enter an agreement with the duopolist, in which case the duopoly turns into monopoly.

2 Strategy of Price Leadership

In contemporary conditions a specific market situation relatively often occurs in which leader organizations can be found. This is the case when in a certain branch of the market a company has dominant participation on the market, or has other advantages which assure him the leader position. In such case in profit maximization strategy the company in leader position can implement methods of price leadership. Here we can present characteristic forms of price leadership: a) price leadership of the dominant company and b) price leadership of the companies with low production costs.

2.1 Price Leadership of the Dominant Company

On certain markets we find a specific market structure: on the one hand, there are large companies with dominant market share, and on the other hand, as the other participant, we find a group of smaller companies, the so-called competitor gallery of the leader. When choosing the profit maximization strategy for the dominant company (the leader) there are two possible alternatives:

a) The first alternative is the strategy of destruction or, to put it another way, the pushing out of the competitor, i.e. the competitor gallery from the market of a given product. Such profit maximization strategy promises high monopoly profit in perspective, while on the other hand, implies the sacrificing of bigger or smaller part of the short-term profit.

b) The other alternative is for the leader to try to maximize his own profit and for a short period, allow smaller companies, i.e. his competitor gallery the survival on the market of that particular product. Such strategy supposes sharing the market between the leader and the 'competitor gallery'. But it will, however, enable the large company, in this alternative, to control the prices, and through the prices, the majority of the output of the smaller competitor companies, allowing them limited market share. Applying this strategy, the leader chooses the strategy, i.e. the price, which fulfills the criteria for maximizing short-term profit. The model of profit maximization strategies by price leadership of a dominant company is illustrated in diagram 3.

In this model the curve of offer of small companies comes from the horizontal summing of individual curves of branch costs. On diagram 3 [5,209] the curve

MCC shows the curve of offer of small companies in the function of price. The leader company has set out from precisely this curve when determining its own individual curves of demand. The curve **DD** represents the entire demand of a certain output. The horizontal difference between **DD** and **MC_c** points out to the leader which output he could realize at that price. The individual curve of demand is marked **dd** in the sense of the difference between **DD** and **MC_c**. At the point of intersection of the curve **d_d** with the **Y**-axis the price marked **P₁** is formed, which means that at the price **P₁** or some higher price the small company could meet the overall market demand. The price at level **P₃**, or lower would mean the suspension of work for the 'competitor gallery'. The price is formed by the leader, at the level of output that provides him with the maximum short-term profit. This output is determined at the intersection of the curve of short-term marginal costs of the leader **SMC_d** and its curves of marginal incomes **MR_d**. The size of the leader's output is **q_d**, and the price is **P_d**.

Setting out from this price, the small companies will increase their outputs, as it is on the market of complete competition, until the level of their marginal costs does not equal the price set by the leader. The small companies will have an overall output at the sum of **q_c**, which will, along with the leader's output **q_d** meet the overall market demand at the price **P_d**. The overall output is **q = q_c + q_d**.

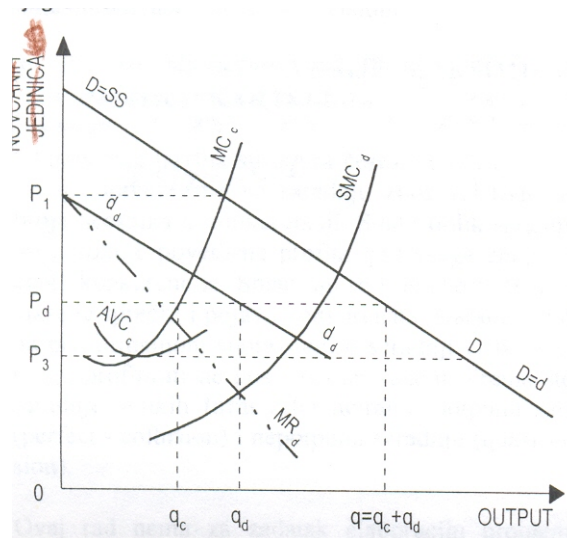


Figure 3
Price leadership of dominant firms

Diagram 3 illustratively models the case of price leadership. However, the model does not always have to be real and valid. Mostly, the assumption that the leader accepts the offer of smaller companies without any conditions does not hold. In practice the leader usually allows the existence of only a small number of smaller companies with a limited offer.

2.2 Price Leadership of the Producer with Low Production Costs

A specific case of profit maximization strategy is the market form when a small number of large companies has an approximately similar share in the market of a certain product, but there is a significant difference in the height of production costs by output unit. In this case the profit maximization strategy will be dictated by the company which, compared with its competitors, has the lower costs of production. (For the sake of simplicity, only two companies are taken for the model, thus a duopoly will be presented). The position of the dominant company, meaning the leader, in this case goes to the competitor who has the lower production costs, and can choose between two strategies for profit maximization:

a)

One alternative is to try to push out the competitor(s) from the market of a given product with the politics of low prices, which the rival cannot keep up with due to his own higher production costs. This option is the so-called 'war of prices'. Considering that the competitor company also has considerable economic strength, this option contains a high risk, even if it works. From this 'war of prices' even the winner comes out weakened. If he established himself the position of monopolist he can count on state intervention concerning price formation or the appearance of potential competitors whose aspiration, now, post-'war of prices', have probably risen.

b)

The other strategy the leader can apply in the above-described situation refers to choosing the price which, from the leader's point of view, yields maximum profit, therefore choosing the balance of prices, according to the output $MC = MR$. This price does not target the merciless destruction of the competitor with higher costs, but decreases their profit and market share. This strategy is chosen more often by the leader, of course, also taking into consideration other relevant circumstances.

For the competitor with the higher level of production costs the profit maximization strategy determines the behavior of the leader. These companies tend to maximize their profit accepting the price dictated by the leader, i.e. the company which deals with lower production costs. The competitor that has higher production costs optimizes his position, as this is done by companies on a competitive market. In the long run the position of these companies can improve in various ways: development of technologies and decreasing production costs, change of range of products, but they can also withdraw from the given area of production, looking for other areas that promise higher profits.

Diagram 4 [5,210] presents a model of price leadership of a company with low production costs.

members of the cartels can also profit by disregarding the agreement. Based on the level of collusion of large companies we differentiate between perfect collusion and quasi-collusion.

This paper does not have the tasks to elaborate on the issue of cartels from various, mainly general economic points of view. The task at hand is to study the efficiency of the profit maximization strategy of companies that are in some form of cartel collusion agreement. The profit maximization strategy of large companies is going to be looked into (a) in the case of complete collusion, assuming, for the sake of simplicity, a duopoly; and (b) a cartel in duopoly with different cost relations.

3.1 The Behavior of the Oligopolist in Case of Complete Collusion

Large companies are aware that there is interdependence between their business strategies. Diagram 5 [5,214] shows which collusion is more useful, for example, between two companies in relation to their conditions of internal competition. In the diagram $d_c d_c$ marks the function of demand, in the sense of Cournot's model, whereas $d_k d_k$ denotes the function of demand under cartel conditions. The sign MR_c represents the function of marginal income, according to Cournot's postulate, and MR_k stands for the function of marginal income of the cartel. The signs p_c and q_c describe the price formation and output according to Cournot's model, while P_k and q_k mark the price and amounts in cartel conditions.

It will be assumed that both large companies have identical cost relations and that $AC = MC$, and they are constant. In this case, both one and the other member of the duopoly will achieve maximum profit if they opt for the price and output which forms a monopoly. The price is P_m and the output is q_m . The diagram at the same time shows the price and output in the situation if, instead of the agreement and monopolist behavior, the oligopolists behave according to Cournot's model of duopoly. If they cooperate as the previous diagram shows, they will fare better than in any other form without collusion.

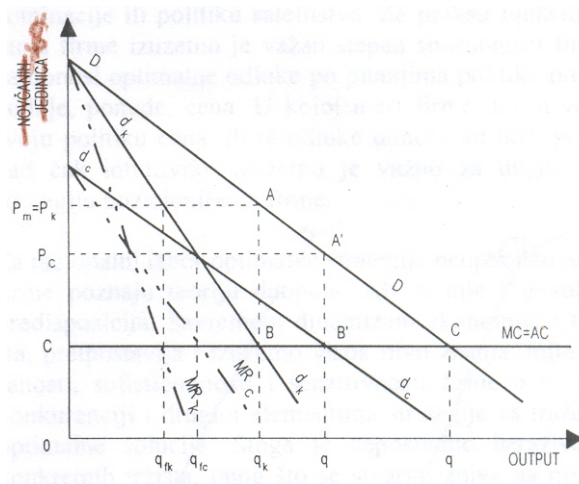


Figure 5
Complete collusion of duopoly in the cartel

3.2 Profit Maximization of Cartel Members with Different Production Costs

If the cost relations of companies that collude are identical, a formal and open cartel agreement is not always necessary in order to form an output on the level of a monopolist. It is enough to have an agreement that they will swap information among themselves about plans to change the prices. That is the so-called quasi-collusion, which, however, does not represent a guarantee that the formation of output and prices will provide maximum profit. This question is especially significant in the cases of significant differences in the height of production costs. Diagram 6 illustrates the case of duopoly in which the duopolists have equal market share but their costs are different.

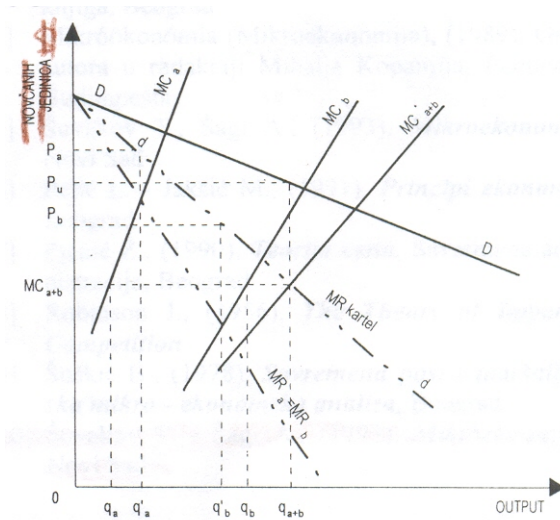


Figure 6

Cartel in duopoly with different cost relations

The curve **dd** represents the individual curve of demand of both companies. According to quasi-collusion, the individual curve of demand makes up half of the overall market demand. Considering that the curve of marginal income of the branch also represents half of the curve of market demand, an overlapping of **MR** and **dd** occurs. The individual curves of branch income of the companies are marked **MR_a** and **MR_b**, while their curves of marginal costs are **MC_a** and **MC_b**. The entire curve of marginal costs of the branch comes from the horizontal summing of the curves of marginal costs of both companies, and is marked as **MC_{a+b}**. The combination of price and output for **A**, which provides him with maximum profit results in **P_a** and **q_a**, while the combination of price and output for **B**, which provides him with maximum profit results in **P_b** and **q_b**. However, for the entire branch, neither the price **P_a**, nor the price **P_b** will yield maximum profit. Maximum profit comes from the price which corresponds to the point of intersection of **MC_{a+b}** and **MR_a** on the curve **DD**. This is the balance price **P_c** at the output **q_{a+b}**. This price though does not provide equal market share. The share of **A** in the market is only **q_a**, which is significantly smaller than **B**'s, i.e. **q_b**. In the case of cartels the criteria for maximum profit is the equality of the sum of branch income with individual marginal costs of the competitor companies, meaning:

$$\mathbf{MR_{a+b} = MC_a = MC_b}$$

The situation which provides maximum profit for the branch cannot be explained without a cartel agreement. The advantage of the cartel agreement is obvious: the agreement enables the realization of maximum profit on the level of the entire branch. However, in this case, the cartel must carry out a division of part of the

profit in benefit of those members whose profits were decreased for the optimal combination of \mathbf{P} and \mathbf{q} for the entire cartel.

The definition of strategy for the cartel members towards the companies that have already left the cartel, in other words the 'dissidents' [4,417] presents a separate problem. The interests of the remaining cartel members may vastly differ.

Conclusion

In the analysis of these, as well as a number of other famous models in economic literature, the search for a solution for oligopoly sets out from the assumption of well-informed duopolists as far as relevant facts are concerned in order to be able to make rational decisions. In real-life economy, however, it is difficult to assume this perfection even though some companies have a high degree of insight into the position of the competition. Nowadays the development of a range of scientific disciplines contributes to the search for optimal strategies for a company to achieve maximum profit, or at least helps companies to foresee the competitors' behavior and their reaction to changes of their own market strategies with a greater degree of certainty.

In this segment, just like in others, numerous questions remain to be answered concerning the relation between economic theory and practice. One of the significant questions is connected to making a rational decision about which politics the oligopolist is going to lead, will he take up the politics of dominance or that of satellite. For the practice of making a company function, the capability of the company to make optimal decisions is of vital importance, especially concerning questions of production policies, offers and prices. To what extent companies really lead their own price politics, or make decisions in an ad hoc manner, at times even intuitively, is of great importance for the long-term strategy for the positioning of the company.

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