THE OLIGOPOLY MARKET AND THE R&D EXPENDITURE

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Abstract: *The firms in the oligopoly market, producing substitutable commodities, are committed in a strong competition. Measuring the competitiveness degree by the substitution degree of commodities represents the way to describe how the firms in the oligopoly market choose the level of expenditure for research and development. The paper will prove how the competitiveness level among firms influences the innovation level. The relation between innovation and competitiveness is not linear. The firms in the oligopoly market can spend excessively for R&D when competition is intense; otherwise the level of expenditure for R&D can record even decreases.*

Key words: *oligopoly market, R&D expenditure, innovation, competitiveness.*

1. Introduction

Beginning with the second term of the year 2009, the state of economic recession was officially declared in Romania. In 2009 and the first half of 2010, the Romanian economic difficulties have intensified.

In 2009, Romania's GDP decreased by 7.1%. [1] The consequence was a significant increase in unemployment - 762.4 thousand people of recorded unemployment at the end of February 2010, which meant an unemployment rate of 8.3%. [2]

Comparing the number of unemployed people at the end of February 2010 with the same month from the last year, February 2009, it increased by 284.5 thousands persons.

These difficulties of the Romanian economy require the search for measures aimed at solving the crisis situation. The macroeconomic measures envisage the reduction of public expenditure and the increase in the state budget income. There

were few measures with microeconomic character.

This paper points out the necessity of analyzing and reconsidering the importance of the microeconomic bases of the economic activity. In this context, the importance of competition is underlined in generating economic efficiency growth and stimulating the increase in the economic productive capacity.

On the contrary, competition is limited by the multiplication of the monopoly situations or market structures which do not have a behaviour similar with monopolies (cartels, secret settlements, tacit agreements about prices increase and production reduction and so on) conducting to a limitation of production levels and the maintenance of prices at a high level (over the marginal cost).

Investments represent an essential element of economic development. The essential role of investments should be emphasized in the economic development process, in generating and unfolding

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cyclical flows, as well as in reducing costs and growing the demand, i.e. the R&D investments.

The data available show the increase in the import of new technologies by companies, but the R&D public expenditure reduces and will continue to do so. It is considered that the state will finance those research projects with general character, but the projects for new technologies and products development unfold in the private medium.

For this reason, it becomes very important to analyze ways of stimulating private companies to increase the expenditure for R&D programs.

2. Classical Competition Models

In many situations, competition is more efficient than monopoly (except for some situations of natural monopoly), because competitive companies are more able to invest in R&D, to use new technologies and promote innovation, as compared to monopoly companies.
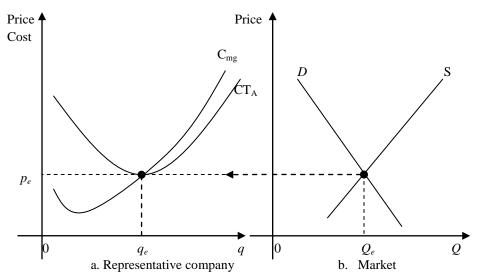
The classical models of competition are known as the two hypothetical competition situations: perfect competition and monopoly.

A short presentation of both competition models with their characteristics is meant to emphasize the contrast between them and the place of real competition in this context.

Although the medium in which competition takes place and the specific aspects of certain markets cannot be comprised by these models, knowing them is essential for each discussion related to competition.

Competition brings a lot of advantages to the development of a society. On a competitive market, the allocation of resources is done in an efficient way. The production cost is minimum and the price tends to be equal with the marginal cost, as presented in Figure 1.

To keep these benefits, competition deserves to be protected. This is because there is a permanent fight on the market to eliminate competition.

a. Representative company   b. Market

CT_A - average total cost
C_{mg} - marginal cost
q_e, Q_e - quantity of production at equilibrium price
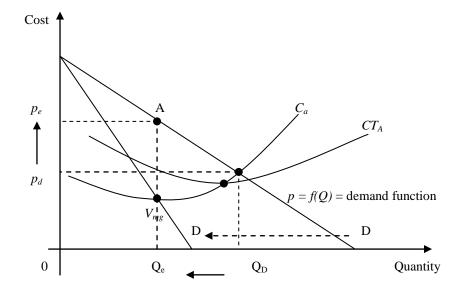D   - demand
S   - supply

Fig. 1. *Equilibrium on the long term, market with perfect competition*

Every deviation from competition can bring disadvantages for buyers.

The market power of a company is defined as being its capacity of maintaining the price over the marginal cost, i.e. over the price in competitive conditions. The market power is maximum when there is a monopoly situation. To maximize the profit, the monopoly reduces the produced quantity (O) and increases the price, as presented in Figure 2.

Even though both perfect competition and monopoly are two artificial constructions representing extreme cases of market structure, their comparison represents a way to highlight the advantages of competition.

V_{mg} - marginal income
Q_D - demanded quantity
p_d - price of demanded quantity
C_a - average cost

Fig. 2. *Equilibrium on a monopoly market*

In a static perspective, the presence of monopoly conducts to a loss of wealth which results by reducing the sales volume. The marginal income is less than the price because the increasing of sales implies the reducing of price for all the sold units. To maintain the profitability, the marginal income must be kept greater than the marginal cost. Even a monopoly company does not confront with a direct competition it can not act independently of market conditions, represented in Figure 2, as the demand curve.

The measure of lost wealth due to the monopoly presence is expressed as a function of variables as the ratio between price and marginal cost, market size and demand elasticity. The lost appears due to an inefficient allocation of resources, searching for activities with a high rent and inefficiency of productive processes.

3. Opinions on the Effects of Competition

The authors trying to measure the loose of wealth due to the market power of monopolies are: Harberger (1954), Posner (1975) Crowling (1978), Neumann (2000), Majumdar (2002) and others.

There were also contrary opinions stating that the presence of monopolies and the manifestation of their market power represent an advantage, because monopolies can sustain the high level of the expenditure for innovation and development more easily. Shumpeter (1942), Gilbert and Newbery (1982), Grossman and Helpman (1991), Romer (1992) and others argued that companies make innovations to profitably explore the opportunities that appear from having monopoly power.

This point of view is justified by the fact that monopoly companies make the market less uncertain and they can implement more rapidly the results obtained from R&D activities. Moreover, they can obtain financing for R&D investments more easily due to the high profits.

On the contrarily, Arrow (1962) showed that the effects of *substitution and efficiency* tend to determine the increase in innovation efforts, in accordance with a stronger competition.

In his seminal study, Nickell (1996) researched the way competition improves company performances. His results, based on an analysis of 670 big companies from Great Britain, clearly show that the performances obtained are higher in the conditions of a powerful competition. Nickell emphasized the fact that the market power determines the reduction of the productivity level. He also concluded that competition is associated with a higher level of total productivity of factors.

Ahn (2002) and Zitzewitz (2003) emphasized the relationship between competition and productivity in certain sectors or industrial branches. Their results show that the higher the competition, the higher the level of global efficiency of productive activity is.

The analysis of liberalization in some fields like production and distribution of electricity, gas, water, but also the banking and financial sectors, revealed the important increases in productivity in these domains, after the liberalization measures had been applied.

Griffith and Harrison (2004), Maher and Wise (2005) gave an emphasis to these effects of increasing competition.

Even though this analysis presents the dark side of monopoly, there are also situations in which its presence is desired. Definitely, *the natural monopoly* which is recorded when the demand curve intersects the average cost curve of monopoly on its decreasing part – the whole demand can be satisfied by one company and the average cost cannot be minimum, because such a production level is not needed– is such an example.

From a dynamical perspective, there have been extensive studies concerning the way market power represents a precondition of technical progress and can be desirable from the social point of view.

The empirical results show that the market power of monopoly determines a slowing of innovation pace. Although the wish to have a monopoly position represents probably the most important individual reason in approaching the economic activities, but having permanently such o position, it conducts to loose wealth and to economic inefficiency.

4. Differences between Competition and Monopoly

The two stages model shows the differences between competition and monopoly: in the first stage, the research and development program is chosen and in the second stage, the companies having the R&D program from the first stage establish the conditions of maximizing profits (price and quantity).

The analysis is based on a duopoly Cournot. The main considerations concerning the two stages of the model are the following:

The first stage is the period when the optimum R&D program is established for the companies to maximize their expected profit in the second stage. The R&D program unfolds in the first period, but its effects may be seen in the following periods. The R&D program can have two kinds of effects:

- cost reduction, when the results bring about the marginal cost decrease;
- increase in demand, when the program results determine the demand curve to move to the right.

The R&D program can generate both types of effects.

The effects can be also negative, meaning that the application of the R&D program can generate an increase in the marginal cost and/or a decrease in demand. The possibility of some losses generated by the implementation of new technologies as a result of a new R&D program, determines firms to be careful in the allocation of resources for research and development.

To diminish this risk, they try to implement known technologies, which are eventually important, but which cannot be considered to be new ones.

The R&D program does not consist only of the unfolding process whose results can be uncertain. The R&D activities also include the acquisition and implementation of a new technology, but also the testing of the new technology for implementation. The R&D program implies a cost. The decision of adopting the R&D program depends on the R&D cost, which is the main element to be considered.

In the second stage, this cost is a past fixed cost (sunk cost) and it does not matter in the decision of maximizing the profit. The expenditure for unfolding the R&D program can be uncertain, because there can be unexpected expenditures to finalize it.

Often, when buying new technologies, the cost is known. [3] This study continues considering the specific function of the R&D costs:

$$Cost(R\&D)_i = m + nC_i + pI_i, \quad i = 1,2, i \neq j$$

where *m, n* and *p* are known positive constants (parameters), C_i represents the research cost of company *i* and I_i represents the implementing cost for the new technology of the company *i* (the cost for replacing old technology with a new one).

During *the second stage,* each company tries to maximize the profit π_i, considering the already known production value of other companies. Also, each company knows, at this stage, the established costs of R&D program from the first stage, for itself and for rival companies.

The profit function for each company is:

$$\Pi_i = \pi_i - Cost(R\&D)_i, \quad i = 1,2 \ i \neq j$$

where π_i is the operational profit of the company *i* (the profit from producing and selling the products), and $Cost(R\&D)_i$ is

the cost of the R&D program of company i, established in the first stage and which is known. The operational profit of company i can be expressed in the following form:

$$\pi_i = (a_i + bq_i + dq_j)q_i - c_iq_i, \quad i = 1,2 \ \ i \neq j$$

where $a_i + bq_i + dq_j = p_i$ represents the inverse function of demand for company i. The ratio b/d can be considered as a measure of substitution degree between the products of both competitors. For each of these companies, the price depends on their own quantity produced, but also on the quantity produced by the rival company. The produced quantities of both companies are: q_i, respectively q_j. The marginal cost of each company is c_i, so that the operational cost (except for the R&D cost) for each company is:

$$C_i(q_i) = c_iq_i, \quad i = 1,2$$

The profit function of each company is:

$$\Pi_i = (a_i + bq_i + dq_j)q_i - c_iq_i - Cost(R\&D)_i,$$
$$i = 1,2 \ \ i \neq j$$

The company i chooses the quantity q_i which maximizes the profit, considering as given the produced quantity of company j. The conditions of equilibrium Nash – Cournot are obtained:

$$q_i^* = \frac{(c_i - a_i) - d(c_j - a_j)}{4b^2 - d^2}, \quad i = 1,2 \ \ i \neq j$$

In this stage, the R&D costs are considered to be sunk costs. As it can be noticed, these costs are constant and do not influence the optimum quantity.

The optimum quantity can be influenced by the effects of the R&D program. The effects, as it was already mentioned, can be represented by the changes of the marginal cost or the changes of demand:

$$c_i = c_0 + \alpha\lambda_i \quad i = 1,2$$

$$a_i = a_0 + \beta\lambda_i \quad i = 1,2$$

where α, β are known constants. The effects of R&D program are considered by the random measure λ_i. Depending on the sign of α, respectively on β and on the values taken by λ_i, these can be positive or negative.

Analyzing the obtained results by applying this model, the following conclusions can be formulated:

- Competition represents a stimulus for searching, testing and implementing new technologies. The propensity of introducing new technologies is socially desirable. Competition is better than monopoly.
- When the competition degree is low, companies spend less for R&D activities.
- When the competition degree is high, the expenditure for R&D might be in excess.
- The expected profits must cover the R&D costs to make companies interested in allocating the resources for new technologies.
- The industry output (the cumulated results of the two companies) is greater when the substitution degree between goods is higher.

In Romania, competition protection is ruled by Law 21 from 10 April 1996 – *Competition Law*, which started to be considered at 1 February 1997. The Competition Council was constituted, whose objective is to protect and stimulate the competition to promote consumer

interests. The Competition Council aims at creating and maintaining a competitive medium, controlling the markets and the ways the companies act on these markets.

5. Ruling the Competition in Romania

The competition policy, ruled by the Competition Law, is harmonized with the regulations on competition at European level. According to this Law, agreements of any kind between economic agents are forbidden, and so are the decisions established by economic associations. The actions which have the objectives or the effects of reducing, keeping down or misrepresenting competition on the Romanian market, or a part of it, are not permitted, especially regarding:

- directly or indirectly setting selling or buying prices, tariffs, discounts, adds and any commercial conditions,
- limiting or controlling production, distribution, technological development or investments,
- sharing the sales markets or provision sources by territorial criteria, sales and acquisitions volumes, or on other criteria,
- applying some unequal conditions for commercial partners with equivalent services, causing a disadvantage in the competition position for some of them,
- conditioning the implementation of contracts with partners accepting additional clauses which, neither by their nature, nor by commercial customs, have any connection with the objects of those contracts,
- willingly participating with false supplies in auctions or any form of offers` competition,
- eliminating competitors, limiting or impinging on their access on the market

and on the liberty to practice competition for other economic agents, and also the agreements not to buy or not to sell to certain economic agents without any reasonable explanation.

The Competition Law aims at establishing the prices of products and the tariffs of services by free determination, by competition, based on demand and supply.

The prices and the tariffs of some activities which have character of natural monopoly or which are established by law are fixed and adjusted with the agreement of state institutions.

By adopting the Competition Law, Romania fulfils all the obligations in the competition field, assumed at the time of joining the European Union. It is important to apply this law, in order to protect the competition in our country.

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Notes

1. INSSE, Monthly Statistical Bulletin, nr. 2/2010, p. 138.
2. INSSE, Buletin statistic lunar, nr. 2/2010, p. 130.
3. Tishler, A., Milstein, I.: "R&D war and the effects of innovation on the success and survivalbility of firms in oligopoly markets", International Journal of Industrial Organization, nr. 27 (2009), pp. 519-531 proposes a structure of R&D cost which is a quadratic function of mathematical expectation of program results, which are random.