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The Impact of Innovative New Economy Products on Market Competition: Competition Might Decrease

Kiracı A.[1]

1 Siirt University, FEAS Economics Department, Street Gures, 56100 Siirt/Turkey

arzdar.kiraci@gmail.com

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Kiracı A.

Abstract

This paper presents a parametric Cournot type of game theoretic model that uses Rogers' Diffusion of Innovations Theory to construct a model that simulates the strategic interaction between firms. The constructed model simulates the strategic interaction of old economy firms that compete with the adoption of an innovative information and communication technologies based product, which is produced by a monopolistic New Economy firm. The model incorporates the accelerated product innovation process, globalization and interaction of firms in competitive environment. This paper confirms the expected result that innovator firms gain by adopting profitable New Economy products; however, surprisingly, under some circumstances market competition might decrease even when there is globalization. It is proven that this result is valid for markets with large (customer) demands when firms of the New Economy that produce innovative products charge high prices for their products. Firms of the New Economy that produce innovative products are given the privilege to be monopolists for the duration of their patent, but according to the findings of this paper they need to be regulated by competition authorities.

Keywords: Game Theory, Cost structure, New Economy, Globalization, Competition, Innovative Product.

JEL classification: C72, O14, O33, D42, L11.

1. Introduction

Editor Stephen B. Shepard of the journal Business Week wrote in "The New Economy: what it really means" about a new type of economy (Shepard, 1997). In addition, Kallio, Mallat, Riipinen and Tinnilä (2004) report that in an opinion pool in March 2000, 57% of American consumers believed that the US economy had entered into a New Economy that is significantly different from the industrial economy. The reason for this belief has been the globalization of businesses around the world and the developments in information and communication technology (ICT) based products (Kallio et al, 2004; Pohjola, 2002). Both of these reasons gave rise to a transformation and to a new kind of economy (Kiraci, 2013).

Jalava and Pohjola (2002) report statistical evidences for the transition to the New Economy. Approximately 2/3 of improvement in labour productivity can be attributed to ICTs in the United States. Koski, Rouvinen and Ylä-Anttila (2002) report that ICT industries accounted for 3-4% of employment, 6-9% of value added, 10-25% of exports and 25-40% of research and development expenditure in the business sectors of the European Union, Japan and

United States. Kallio et al. (2004) and Pohjola (2002) note that ICT spending is strongly correlated with the level of income but significant disparities also exist between countries at similar income levels and different countries are in a different transition phase of the New Economy. Shao and Shu (2004) indicate using the Malmquist Total Factor Productivity index that productivity growth among the 14 countries examined, 10 had witnessed productivity growth in their ICT industries and most of the productivity growth measured is due to technological progress and each country's ICT industry manifests its own particular patterns in various performance measures. Therefore, each country has its own patters and the countries that have managed the globalization process well have shown that globalization can be a powerful force for economic growth (Stiglitz, 2003) and the structural changes that are called the New Economy are ongoing (DeLong & Summers, 2001). Galbi (2001), Lee, Gholamib and Tong (2005) and Salvatore (2003) are other papers that support these claims.

The link between the ICTs and economic growth is as follows. The rapid improvements in ICT based products are one of the main contributors to the New Economy. These products contribute especially to the possibilities of sharing, storing,and analyzing information throughout the different sectors of the economy and this increases firms' capabilities. These increased capabilities improve productivity and lead to economic growth. The improvement of ICT based products relates to both the quality of equipment and software as well as to the sharp decline in quality adjusted prices (Kallio et al, 2004). There are many examples in Gates (1999) and Tapscott (1997) for ICT based innovative products (InovPs) that increase productivity and reduce production costs and this is one of the main assumptions of this paper. In this article, ICT based products that gave rise to a new economy are named as ICT based innovative products or simply InovPs. In addition, firms producing these InovPs are characterized as New Economy firms while the firms using these products are old economy firms.

Globalization allows InovPs to be available at the same time for all firms worldwide; however, not all firms adopt these innovations immediately. Diffusion of innovation theory by Rogers (2003) provides a detailed overview of the theoretical basis for how an innovation comes to be widely used in a population and it provides a detailed discussion of the theoretical basis for adoption. According to this theory certain firms adopt innovations more quickly than others and Rogers' (2003) classification scheme divides the firms as innovators, early adopters, early majority, late majority and laggards, based on their receptivity. The 2.5% of the firms are named as the innovators, who are the risk takers that are willing to take the initiative and time to try something new and therefore they are leaders. Afterwards, there is a period of time of rapid growth as a large wave of follower firms when they directly observe the benefit of products and become convinced of it and decide to use it. Innovators are followed by 13.5% of the firms named as early adopters, who tend to be respected group leaders and more integrated into the social system, with a more local orientation than innovators. Early adopters are known for discreet, successful use of innovations. Early adopters are followed by 34% of the firms named as early majority, who tend to be the careful, safe, deliberate firms unwilling to risk time or other resources. They are known for their high levels of interaction with other groups. Early majority are followed by 34% of the firms named as late majority, who resist to a change and are hard to move without significant influence. Late majority are followed by 16% of the firms named as laggards, who are consistent or even adamant in resisting change, where pressure is needed to force them to change. Laggards adopt an innovation only when existence within the social system absolutely demands it (Rogers, 2003). In the following model part of this paper, five time periods are considered, in which the corresponding group members adopt the innovation. For example, in the first time period all of the innovators adopt the product the others follow in the next periods and at last in the fifth period the laggards start to use it.

In addition to Rogers (2003) book there are many examples supporting Rogers' diffusion theory. For example, Gosling, Westbrook and Braithwaite (2003) provides evidence about clinical team functioning, Dickerson and Gentry (1983) about home computers, Casey (1995) about school counsellors, Ram and Jung (1994) about personal computers and Jacobsen (1998) about integration of computer technology for teaching and learning. Other examples can be found in Lewis and Orton (2000), Moore (2004) and Martins, Steil and Todesco (2004).

In the following part, a model with outcomes for various scenarios is considered. In the third part, a comparative analysis is performed and in the fourth part a monopolistic firm that produces these InovPs is added to the model in order to predict different possible outcomes in the market and a possible strategy for the innovators is presented. The last part concludes with comments on the consequences of this model.

2. THE MODEL

In this part, using the information or assumptions given in the previous part, the strategic interaction between old economy firms in the New Economy with an InovP is simulated with the help of Rogers' diffusion of innovation theory and game theory. It is assumed that an InovP is introduced to the market by an international firm and all firms have access to this InovP. The product is launched at the same time all around the world that has either one or more than one of the following economic benefits to the firm: It decreases operation costs of the firms, increases performance of output, changes the type (quality) of output positively, increases customer number or increases the share in the market. All of these benefits have a decreasing effect on the marginal cost (MC) or variable cost of the firm, who adopt the InovP.

Assume that there are 2 countries, *A* and *B*, with *N* number of firms in both of the countries that are similar in every aspect except for the timing in adoption of the InovP (where country *B* can also be considered as the rest of the world). In the beginning, innovators decide to adopt an InovP or not, with the knowledge that their adoption will trigger adoption of this product by the rest of the firms. If innovators (2.5% of the firms) decide to adopt this product then in the following periods the early adopters (13.5% of the firms), early majority (34% of the firms), the late majority (34% of the firms) and the laggards (16% of the firms) adopt this product only **if it is still profitable** for them to adopt it. One assumption in this paper is that a firm belonging to one of these groups above can/will not change its group behaviour. This implies that if a product is not adopted by the innovators it will also not be adopted by the rest of the firms.

In order to describe a variable multiple indexes are used; an upper-index represents destination country, first sub-index represents origin of the firm and second sub-index represents identity of the firm. For example, Q_{Bj}^{A} is the quantity supplied by firm j from country B in country A.

2.1. Assumptions About Cost

In both countries firms have the same technological structure, therefore the same cost structure represented by $C(Q) = c_0 + c_1 Q$ ($c_0 > 0$, $c_1 > 0$). In economic theory a technology is defined anything that raises the amount of output that can be produced with a given amount of input (Taylor, 2004). This definition can alternatively be stated as, a technology is anything that decreases input quantities for a fixed output amount. Decreasing input implies decreasing variable cost, therefore, in this paper adopting an InovP decreases the marginal cost (MC), c_1, and because of investment expenditures it increases fixed cost, c_0. Assume also that the sub-index i or j also represents the willingness of a firm to adopt an InovP. A small index number indicates that this firm is more innovative than a firm with higher index number.

Further assume that foreign firms have the same transportation costs, which is a linear function of the form $T(Q) = t_0 + t_1 Q$ ($t_0 > 0$, $t_1 > 0$). The consumers in country A (or B) have a demand of $P^A(Q) = d_0 - d_1 Q_T$ ($d_0 > 0$, $d_1 > 0$, same in both countries), where Q_T is the total quantity of a good supplied in country A (or B). There is a Cournot type of competition in the market and entry-exit is not restricted. In addition, (high) demand allows many profitable firms to operate in the market, i.e.,

$$N > 1,\ d_0 >> c_1,\ d_0 >> t_1,\ d_0 > [c_1 + (N+1)t_1] \text{ and } d_0 > 2Nc_1 \tag{1}$$

Three cases are investigated in this model. In the first case a situation with no globalization (no free-trade) is considered and the formulas for outcome, Q; price, P; profit, Π; in both countries are calculated. In the second case globalization is considered, in the third case an InovP is introduced to the market and the same variables are recalculated. Afterwards, a comparative static analysis is performed.

2.2. Case 1: Situation in country A when there is no globalization

Profit of a typical domestic firm i in country A is $\Pi_{Ai}^{A} = P^A Q_{Ai}^{A} - c_0 - c_1 Q_{Ai}^{A}$ ($i = 1,..., N$). The best reaction function is obtained using profit maximization and Cournot type of competition solution. In addition, with the assumption that all the firms have the same technology and hence the same cost structure implies that the outcome of the firms to be the same, i.e., $Q_A^A = Q_{Ai}^A$ ($i = 1,..., N$). Using the best reaction function and previous assumptions the reduced form of outcome and price in country A can be written as:

$$Q_A^A = \frac{d_0 - c_1}{(N+1)d_1} > 0 \text{ and } P^A = \frac{d_0 + c_1 N}{N+1} > 0 \tag{2}$$

Note that the results in (2) are consistent with perfectly competitive markets when the number of firms in this market becomes very large, i.e., $N \rightarrow \infty$ then $P^A \rightarrow c_1 = \text{MC}$ and $Q_A^A \rightarrow 0$. Therefore, the results of this model can also be extended to perfectly competitive markets if parameter values satisfy the assumptions in (1). Substituting price and quantities into the profit functions the following parametric profit value can be obtained for firm i (= 1,..., N) in country A as $\Pi_{Ai}^A = \Pi_A^A = (d_0 - c_1)^2/[(N + 1)^2 d_1] - c_0 = d_1(Q_A^A)^2 - c_0$.

The formulas derived in this section are also valid for the firms in country B and can be obtained by changing the indexes from A to B. Assuming further that the price level makes free-trade possible, i.e., $P^A > c_1 + t_1$, this way the following cases can be investigated.

2.3. Case 2: Situation in country A when there is globalization, but no InovP is introduced in the markets of both countries

Profit of a typical domestic firm i in country A is $\Pi_{Ai}^A = P^A Q_{Ai}^A - c_0 - c_1 Q_{Ai}^A$ (i = 1,..., N) and profit of a typical foreign firm j in country A is $\Pi_{Bj}^A = P^A Q_{Bj}^A - c_0 - c_1 Q_{Bj}^A - t_0 - t_1 Q_{Bj}^A$ (j = 1,..., N).

With the same assumptions as in case 1 and Cournot type of competition solution, the reduced form of outcome for domestic firms (Q_A^A), outcome for foreign firms (Q_B^A), price and profit functions for domestic (Π_A^A) and foreign firms (Π_B^A) in country A are:

$$Q_A^A = \frac{(d_0 - c_1) + Nt_1}{(2N+1)d_1} \geq 0, \; Q_B^A = \frac{(d_0 - c_1) - (N+1)t_1}{(2N+1)d_1} \geq 0, \; P^A = \frac{d_0 + N(2c_1 + t_1)}{(2N+1)} \geq 0 \tag{3}$$

$$\Pi_A^A(N) = d_1\left(\frac{d_0 + Nt_1 - c_1}{(2N+1)d_1}\right)^2 - c_0 = d_1(Q_A^A)^2 - c_0,$$

$$\Pi_B^A(N) = d_1\left(\frac{(d_0 - c_1) - (N+1)t_1}{(2N+1)d_1}\right)^2 - c_0 - t_0 = d_1(Q_B^A)^2 - c_0 - t_0$$

2.4. Case 3: Situation in country A when there is globalization and an InovP is introduced in the markets of both countries

A cost reducing InovP (technology) will change the cost structure of the firms that adopt this product, as explained in part 2.1. For firms that adopt this InovP MC decreases ($\underline{c}_1 < c_1$) but fixed cost increases ($\underline{c}_0 > c_0$). Assume further that the first k firms adopt the product then the outcome for domestic firm is represented by $\underline{Q}_{Ai}^A$, its profit function of $\underline{\Pi}_{Ai}^A = P^A \underline{Q}_{Ai}^A - \underline{c}_0 - \underline{c}_1 \underline{Q}_{Ai}^A$ (i = 1,..., k) and the outcome of a typical foreign firm j from country B in country A is represented by $\underline{Q}_{Bj}^A$ with its profit function of $\underline{\Pi}_{Bj}^A = P^A \underline{Q}_{Bj}^A - \underline{c}_0 - \underline{c}_1 \underline{Q}_{Bj}^A - t_0 - t_1 \underline{Q}_{Bj}^A$ (j = 1,..., k).

The variables for the $N - k$ firms that do not adopt the InovP are: the outcome for a typical domestic firm i is represented by $\overline{Q}_{Ai}^A$ with its profit function of $\overline{\Pi}_{Ai}^A$ ($i = k$ + 1,..., N), the outcome of a typical foreign firm j in country A is represented by $\overline{Q}_{Bj}^A$ with its profit function of $\overline{\Pi}_{Bj}^A$ ($j = k$ + 1,..., N) and the representation of profit functions are the same as the ones in case 2, only an upper bar is put to emphasize the difference between the variables of firms that adopt the InovP or not.

With the same assumptions as in case 2 the reduced form of outcome of domestic firms, who adopt the InovP is $\underline{Q}^A_{Ai} = \underline{Q}^A_A$ (i = 1,..., k), who do not adopt the InovP is $\overline{Q}^A_{Ai} = \overline{Q}^A_A$ ($i = k$ + 1,..., N), foreign firms, who adopt the InovP is $\underline{Q}^A_{Bj} = \underline{Q}^A_B$ (j = 1,..., k), who do not adopt the InovP is $\overline{Q}^A_{Bj} = \overline{Q}^A_B$ ($j = k$ + 1,..., N) and price P^A in country A is:

$$\underline{Q}^A_A = \frac{d_0 + Nt - (2(N-k)+1)\underline{c}_1 + 2(N-k)c_{11}}{(2N+1)d_1}, \tag{4}$$

$$\overline{Q}^A_A = \frac{d_0 + Nt + 2k\underline{c}_1 - (2k+1)c_{11}}{(2N+1)d_1}$$

$$\underline{Q}^A_B = \frac{d_0 - (N+1)t_1 - (2(N-k)+1)\underline{c}_1 + 2(N-k)c_1}{(2N+1)d_1},$$

$$\overline{Q}^A_B = \frac{d_0 - (N+1)t_1 + 2k\underline{c}_1 - (2k+1)c_1}{(2N+1)d_1}$$

$$P^A = \frac{d_0 + Nt + 2k\underline{c}_1 + 2(N-k)c_{11}}{2N+1}$$

Substituting price and quantities into the profit functions the following reduced parametric variable values for profits of domestic, who adopt the InovP is $\underline{\Pi}^A_{Ai}(k) = \underline{\Pi}^A_A(k)$ (i = 1,..., k); profits of foreign firms, who adopt the InovP is $\underline{\Pi}^A_{Bj}(k) = \underline{\Pi}^A_B(k)$ (j = 1,..., k); profits of domestic, who do not adopt the InovP is $\overline{\Pi}^A_{Ai}(k) = \overline{\Pi}^A_{Ai}(k)$ ($i = k$ + 1,..., N); profits of foreign firms, who do not adopt the InovP is $\overline{\Pi}^A_{Bj}(k) = \Pi^A_B(k)$ ($j = k$ + 1,..., N); and can be obtained in country A as follows:

$$\underline{\Pi}^A_A(k) = d_1\left(\frac{d_0 + Nt_1 - (2(N-k)+1)\underline{c}_1 + 2(N-k)c_1}{(2N+1)d_1}\right)^2 - \underline{c}_0 = d_1(\underline{Q}^A_A)^2 - \underline{c}_0 \tag{5}$$

$$\overline{\Pi}^A_A(k) = d_1\left(\frac{d_0 + Nt_1 + 2k\underline{c}_1 - (2k+1)c_1}{(2N+1)d_1}\right)^2 - c_0 = d_1(\overline{Q}^A_A)^2 - c_0$$

$$\underline{\Pi}^A_B(k) = d_1\left(\frac{d_0 - (N+1)t_1 - (2(N-k)+1)\underline{c}_1 + 2(N-k)c_1}{(2N+1)d_1}\right)^2 - \underline{c}_0 - t_0 = d_1(\underline{Q}^A_B)^2 - \underline{c}_0 - t_0$$

$$\overline{\Pi}^A_B(k) = d_1\left(\frac{d_0 - (N+1)t_1 + 2k\underline{c}_1 - (2k+1)c_1}{(2N+1)d_1}\right)^2 - c_0 - t_0 = d_1(\overline{Q}^A_B)^2 - c_0 - t_0$$

3. COMPARATIVE STATIC ANALYSIS

In the following parts formulas for change in market price and total output in country A, change in output/profit for domestic firms and change in output/profit for foreign firms in different cases are derived.

3.1. Comparing The Variables Between Case 1 And Case 2

Calculating the change in variables after globalization in country *A*, output for the domestic firm decreases, output for the foreign increases, total output increases, price decreases, profit for the domestic firm decreases and profit for the foreign firm increases. The reduced formulas are as follows:

$$\Delta Q_A^A = \frac{-Nd_0}{(N+1)(2N+1)d_1} < 0,\ \Delta Q_B^A = \frac{d_0 - [c_1 + (N+1)t_1]}{(2N+1)d_1} > 0,$$

$$\Delta Q_T = \frac{d_0}{(N+1)(2N+1)d_1} > 0,\ \Delta P^A = -\frac{Nd_0}{(N+1)(2N+1)} < 0$$

$$\Delta \Pi_A^A = d_1(Q_A^A - \Delta Q_A^A)\Delta Q_A^A < 0,\ \Delta \Pi_B^A = (d_1(Q_B^A)^2 - c_0 - t_0) - 0 > 0$$

3.2. Comparing The Variables Between Case 2 And Case 3

Calculating the change in variables in globalization after an InovP is introduced in country *A*, the following reduced formulas are derived:

$$\underline{Q}_A^A - Q_A^A = \underline{Q}_B^A - Q_B^A = \frac{(2(N-k)+1)(c_1 - \underline{c}_1)}{(2N+1)d_1} > 0, \tag{6}$$

$$\overline{Q}_A^A - Q_A^A = \overline{Q}_B^A - Q_B^A = \frac{2k(\underline{c}_1 - c_1)}{(2N+1)d_1} < 0$$

$$\Delta P^A = \frac{2k(\underline{c}_1 - c_1)}{2N+1} < 0$$

$$\underline{\Pi}_A^A(k) - \Pi_A^A = \underbrace{d_1\underbrace{\left(\underline{Q}_A^A - Q_A^A\right)}_{+}\underbrace{\left(\underline{Q}_A^A + Q_A^A\right)}_{+} + \underbrace{c_0 - \underline{c}_0}_{-}}_{?},$$

$$\overline{\Pi}_A^A(k) - \Pi_A^A = d_1\underbrace{\left(\overline{Q}_A^A - Q_A^A\right)}_{-}\underbrace{\left(\overline{Q}_A^A + Q_A^A\right)}_{+} < 0$$

$$\underline{\Pi}_B^A(k) - \Pi_B^A = \underbrace{d_1\underbrace{\left(\underline{Q}_B^A - Q_B^A\right)}_{+}\underbrace{\left(\underline{Q}_B^A + Q_B^A\right)}_{+} + \underbrace{c_0 - \underline{c}_0}_{-}}_{?},$$

$$\overline{\Pi}_B^A(k) - \Pi_B^A = d_1\underbrace{\left(\overline{Q}_B^A - Q_B^A\right)}_{-}\underbrace{\left(\overline{Q}_B^A + Q_B^A\right)}_{+} < 0$$

The results imply that for each firm that adopts the InovP whether domestic or foreign its market share increases, $\underline{Q}_A^A - Q_A^A = \underline{Q}_B^A - Q_B^A > 0$ and the only condition required for this fact to become true is that the InovP to decrease the MC or variable cost of production. For the firms that do not adopt the InovP whether domestic or foreign, $\overline{Q}_A^A - Q_A^A = \overline{Q}_B^A - Q_B^A < 0$, lose their market share.

The number of firms that adopt the InovP is represented with the variable k. Using the equations in the first line of (6) it should be noted that as the number of adopting firms k increases then for the firms, who have previously adopted and for those, who did not adopt the InovP the market share decreases. In addition, as the number of adopting firms k increases then the market price decreases, $\Delta P^A < 0$.

Market price decreases and non-adopting (domestic or foreign) firms lose market share, as a result this profits of those firms decreases, $\overline{\Pi}_A^A(k) - \Pi_A^A < 0$ and $\overline{\Pi}_B^A(k) - \Pi_B^A < 0$. However, a guess about profits of the firms, who adopt the InovP is not possible. For example, for the domestic firms in country A, who have adopted the innovation change in profits ($\underline{\Pi}_A^A(k) - \Pi_A^A$), depends on two factors. The first factor is the change in profits due to decrease in variable cost, $d_1(\underline{Q}_A^A - Q_A^A)(\underline{Q}_A^A + Q_A^A)$ and the second factor is an increase in fixed cost, $c_0 - \underline{c}_0$, which is the expenditure for the InovP. One thing to note here is the fact that the expenditure to the InovP is the revenue of the monopolistic supplier of these InovPs.

4. Competition Between old Economy Firms with a Monopolistic Supplier of InovP

New Economy or informational products are costly to produce, but cheap to reproduce (Karagiannopoulos, Georgopoulos and Nikolopoulos 2005; Conkling, 2004). Full cost recovery might be possible only with some monopoly power, which is why firms that are the supplier of InovP have a patent that allows them to be the sole producer of this product for some period of time (Taylor, 2004).

Monopolistic supplier of the InovP has also the objective to sell their product with the highest possible profit (revenue). In this paper, it is assumed that the InovP promises decreased operational costs and therefore decreased MC of $c_b = c_1 - \underline{c}_1$, which is an exogenous parameter. In addition, price charged by the monopolist, P^M, is the source of fixed cost increase for the old economy firms, who adopt this product. In addition, it is assumed that all old economy firms adopt one quantity of this product and the relation between monopoly price and change in fixed cost is $P^M = \underline{c}_0 - c_0$. If the marginal cost of an additional copy (intangible or tangible) is near zero or reproduction is negligibly cheap or MC is almost constant for any production level then revenue maximization is equivalent to profit maximization (Karagiannopoulos et al, 2005; Conkling, 2004). Therefore, the last assumption about the monopolist is that it maximizes its total revenue, Max $P^M Q^M$, where Q^M is the quantity of InovP sold.

The monopolist has to determine the price for its product and how much to produce/sell. Lower prices increases sales of the monopolist but this does not necessarily maximize revenue. In this paper, the demand of firms for the InovP is not continuous; therefore, for given parameter vales optimum P^M and Q^M values have to be calculated by considering different possible situations in the market.

4.1. Situation where all firms stay in the market:

One possible situation is that the monopolist maximizes its revenue by selling its product to all old economy firms at the highest possible price. This condition is satisfied if the change in profits after adopting the InovP is non-negative even for foreign laggards. The condition for P^M and Q^M to satisfy, if all firms including foreign laggards adopt the InovP can be obtained by substituting ($k = N$) in (6) is as follows:

$$\underline{\Pi}_B^A(N) - \Pi_B^A = d_1\left(\frac{c_b}{(2N+1)d_1}\right)\left(\frac{2d_0 - 2(N+1)t_1 - 2c_1 + c_b)}{(2N+1)d_1}\right) - P^M \geq 0$$

If the monopolist sets the maximum possible price given the benefit c_b for its product then revenue of the monopolist becomes:

$$R_1 = P^M Q^M = P^M 2N = 2Nd_1\left(\frac{c_b}{(2N+1)d_1}\right)\left(\frac{2d_0 - 2(N+1)t_1 + c_b - 2c_1}{(2N+1)d_1}\right) \quad (7)$$

4.2. Situation where only innovators are left in the market:

Another extreme possibility is when the monopolists maximizes its revenue by a pricing policy that allows only one (or preferred) group of firms to stay in the market. In this extreme case assume that it is the innovator group. One of the conditions for this pricing policy to be sustainable is that innovators should have positive profit when their followers leave the market and this profit must be larger than the profit before adopting the InovP. Another condition is that other groups to have negative profits after adopting and not adopting the InovP.

The condition that innovators have positive profit after their followers leave the market can be derived as follows. The number of innovator firms is 2.5%, therefore, substituting $0.025N$ into the profit functions in equations (3) for domestic and foreign firms gives the profit of innovator firms after all of following firms have left the market:

$$\Pi_A^A(0.025N) = d_1\left(\frac{d_0 + 0.025Nt_1 - c_1}{(0.05N+1)d_1}\right)^2 - \underline{c}_0 > 0 \quad (8)$$

$$\Pi_B^A(0.025N) = d_1\left(\frac{(d_0 - c_1) - (0.025N+1)t_1}{(0.05N+1)d_1}\right)^2 - \underline{c}_0 - t_0 > 0$$

The condition that innovators have greater positive profit than the profit before adopting the InovP, which can be represented as follows:

$$\underline{\Pi}_A^A(0.025N) - \Pi_A^A(N) = \frac{1}{d_1(0.05N+1)^2}(M_1 + c_b)(M_2 + c_b) - P^M \geq 0 \quad (9)$$

$$M_1 = \frac{1.95Nd_0 - 1.95Nc_1 - 0.975Nt_1}{(2N+1)},$$

$$M_2 = \frac{(2.05N+2)d_0 + (0.1N+1.025)t_1N - (2.05N+2)c_1}{(2N+1)}$$

$$M_3 = \frac{(2.05N+2)d_0 - (2.05N+2)c_1 - (0.1N^2 + 3.075N + 2)t_1}{(2N+1)}$$

Another condition is that other groups have negative profits when adopting and not adopting the InovP. In this case, it is enough to concentrate on the profits of early adopter group, because according to Rogers' theory if they don't adopt the following groups also don't adopt the InovP. Another reason is that if early adopter group has negative profits after adopting the product then the profits of all other firms become smaller after adoption. This can be justified by taking the derivatives of equations in (5). The equations for early adopter group that has negative profits when not adopting the InovP are:

$$\overline{\Pi}_A^A(0.025N) = d_1\left(\frac{d_0 + 0.05N\underline{c}_1 - (0.05N+1)c_1 + Nt_1}{(2N+1)d_1}\right)^2 - c_0 < 0 \qquad (10)$$

$$\overline{\Pi}_B^A(0.025N) = d_1\left(\frac{d_0 + 0.05N\underline{c}_1 - (0.05N+1)c_1 - (N+1)t_1}{(2N+1)d_1}\right)^2 - c_0 - t_0 < 0$$

The profit of early adopter group is again negative after early adopter group adopts the InovP, for k=0.16N the reduced equations are:

$$\underline{\Pi}_A^A(0.16N) = d_1\left(\frac{d_0 - c_1 + (1.68N+1)c_b + t_1N}{(2N+1)d_1}\right)^2 - c_0 < P^M \qquad (11)$$

$$\underline{\Pi}_B^A(0.16N) = d_1\left(\frac{(d_0 - c_1 + (1.68N+1)c_b - (N+1)t_1)}{(2N+1)d_1}\right)^2 - c_0 - t_0 < P^M$$

The crucial point here is the existence of P^M for given parameters that satisfy equations (8) – (11). For the existence a simple proof is given in the following proposition and the existence is illustrated with an example in the following pages.

Proposition: For large d_0 there exists a P^M that satisfies equations (8) – (11).

Proof:

In equations (9) $M_2 - M_3 = \dfrac{(0.2N^2 + 4.1N + 2)t_1}{(2N+1)} > 0$, implying

$$\frac{(M_1 + c_b)(M_2 + c_b)}{d_1(0.05N+1)^2} \geq \frac{(M_1 + c_b)(M_3 + c_b)}{d_1(0.05N+1)^2} \geq P^M$$

In addition, in equation (11), $\underline{\Pi}_A^A(0.16N) > \underline{\Pi}_B^A(0.16N)$. Combining these equations gives the following inequality for P^M :

$$d_1\left(\frac{d_0 - c_1 + (1.68N+1)c_b + t_1N}{(2N+1)d_1}\right)^2 - c_0 < P^M \leq \frac{(M_1 + c_b)(M_3 + c_b)}{d_1(0.05N+1)^2}$$

Define $\theta = \dfrac{(M_1 + c_b)(M_3 + c_b)}{d_1(0.05N+1)^2} - \dfrac{[d_0 - c_1 + (1.68N+1)c_b + t_1N]^2}{(2N+1)^2 d_1} + c_0$

if d_0 is very large and for $N \geq 1$ then

$$\theta \approx \frac{1.95N(2.05N+2){d_0}^2}{d_1(0.05N+1)^2(2N+1)^2} - \frac{{d_0}^2}{(2N+1)^2 d_1} + c_0 > 0$$

Therefore, for a constant δ ($0 \leq \delta \leq \theta$) there exists prices that satisfy equations (8) – (11) and they can be formulated as follows:

$$P^M = \frac{(M_1 + c_b)(M_3 + c_b)}{d_1(0.05N+1)^2} - \delta > 0 \quad (12)$$

□

Assume the monopolist sets the price to the maximum possible value ($\delta = 0$) in equation (12). Then the revenue of the monopolist becomes:

$$R_2 = P^M Q^M = P^M 0.05N = 0.05N \frac{(M_1 + c_b)(M_3 + c_b)}{d_1(0.05N+1)^2}$$

If $R_2 > R_1$ then the monopolist prefers the situation, where only innovators are left in the market. There are too many parameters, using the assumptions in equation (1), for high d_0 values this inequality reduces to

$$(3.9N^2 + 2N - 39)c_b^2 + (7.8N^2 + 2N - 78)d_0 c_b + 1.95N(2.05N+2)d_0^2 > 0$$

This is a second order inequality and if the discriminant Δ of it is negative then for positive d_0 and c_b this inequality is always positive.

For Δ the following inequalities can be obtained:

$$\Delta = [(7.8N^2 + 2N - 78)]^2 - 4(3.9N^2 + 2N - 39)1.95N(2.05N+2) < 0$$

For $N \geq 3$ the discriminant Δ is negative implying that $R_2 > R_1$. Of course, this is the worst possible situation and depending on the market parameters in some situations N might have a smaller number then the one predicted by the discriminant Δ. This result proves that there exists a market structure where the monopolist sets a high price for its product and decreases the competition in the market. This situation is illustrated in the following example.

4.3. Example

This example presents a market structure with the parameter values in Table 1, where the monopolist sets a high price for its product and decreases the competition in the market. For Cournot type of competition, results are listed in Table 2 and Table 3.

Table 1: Parameter values for the example

d_0	d_1	N	c_1	c_0	t_1	t_0	c_b
100000	20	1000	250	110	1	4	140

Table 2 gives the results for the ex-ante situation when there is globalization, but no InovP is introduced in the market. For different possible pricing policies of the monopolist, the results are in Table 3.

Table 2: Situation when there is globalization, but no InovP is introduced in the markets

		Domestic firms		Foreign firms
Output	$Q_A^A =$	2.52	$Q_B^A =$	2.47
Profit	$\Pi_A^A =$	16.76	$\Pi_B^A =$	7.77
Market price			$P^A=$	300.35

Table 3: Situation when there is globalization and an InovP is introduced in the markets

Pricing policy of monopolist so that all firms stay in the market				
		Domestic firms		Foreign firms
Output	$\underline{Q}_A^A =$	2.52	$\underline{Q}_A^A =$	2.47
Profit	$\underline{\Pi}_A^A =$	16.76	$\underline{\Pi}_A^A =$	7.77
Market price			$P^A=$	160.42
Price of the product			$P^M =$	0.3455
Revenue of monopolist			$R_1 =$	691.04
Number of firms in the market			$N =$	1000

Pricing policy of monopolist so that only innovators are left in the market				
		Domestic firms		Foreign firms
Output	$\underline{Q}_A^A =$	97.96	$\underline{Q}_A^A =$	97.91
Profit	$\underline{\Pi}_A^A =$	207.63	$\underline{\Pi}_A^A =$	7.77
Market price			$P^A=$	2069.12
Price of the product			$P^M =$	191589
Revenue of monopolist			$R_2 =$	9579473
Number of firms in the market			$k =$	25

The following events will take place in the market. Ex-ante as shown in Table 2, domestic or foreign, all of the firms have positive profits. The monopolist is going to set the price of the InovP to $P^M = 191589$ and the innovator group of firms are going to adopt this product. The profit of innovators is going to be negative in the short-run. However, the profits of firms, who did not adopt will also be negative. The numerical values can be calculated from equations in (5), which yield $\overline{\Pi}_A^A(0.025N) = -0.246$ for domestic firms and $\overline{\Pi}_B^A(0.025N) = -8.882$ for foreign firms. The natural reaction to this situation would be that the early adopters group to start adopting the InovP. If they adopt their profits is going to be again negative which can be calculated as $\underline{\Pi}_A^A(0.16N) = -190288$ for domestic firms and $\underline{\Pi}_B^A(0.16N) = -190309$ for foreign firms from equations in (5). Therefore, these firms are going to leave the market in the long-run and only 2.5% of previous firms will stay in the market. The profits of these firms can be calculated from equations (3) or (8) as $\Pi_A^A(0.025N) = 207.632$ for domestic firms and $\Pi_B^A(0.025N) = 7.77$ for foreign firms, which are higher than the ones in Table 2. As a result, competition decreases, which also affects consumers negatively because the market price increases from 300 to 2069. The prices in the market, when there was no globalization can be calculated from equation (2) as 349.65, which is lower than the prizes after globalization.

4.4. Outcome for different marginal cost structures

Depending on the cost structure of the monopolist in some situations the results change. If the monopolist is working with a constant returns to scale function then the operational costs will have a constant MC, therefore, the results presented in this paper are valid. If the monopolist is working with a decreasing returns to scale function then the number of firms in the market will be lower than the one predicted from this model. The opposite is true for increasing returns to scale function and depending on the cost function the optimum number of firms that maximize its profit has to be calculated. However, this optimum number will be larger than the one predicted in this model. New Economy or ICT based products have usually high fixed cost but low MC (Karagiannopoulos et al, 2005). If MC is negligible, no matter what the production function, the results presented in this paper are valid.

5. RESULTS AND DISCUSSION

The results of the game theoretic model confirm the expected results about the market structure in the New Economy: globalization with ICT based InovPs increases competition and benefits the customers by decreasing prices, if the monopolistic new economy firms do not hinder competition. However, using the model of this paper it is also proven that if the parameters of the market are suitable then ICT based InovPs might just have the opposite effect. Competition might decrease and market prices might increase. The reason for this unexpected result is that firms in the New Economy that produce these InovPs are given the privilege to be monopolists for the duration of their patent, which allows them to charge high prices for their products. They will try to sell their products as expensive as possible. These facts together with Rogers' diffusion of innovations theory result in the most important contribution of this paper. This contribution is the possibility that innovator firms have the chance to control the destiny of the market and they can achieve this goal by selling expensive InovPs to their favourite customer firms.

The findings in this paper suggest that firms have to understand the benefits of the cost reducing products brought by the monopolistic New Economy firms to their industries before their rivals, because if their rivals in adopt the innovations then these products can be used as an effective weapon in competition. To overcome this risk the firms in the New Economy might start automatically adopting an innovation as long as their domestic or foreign rivals have the same chance of adopting it. This, however, creates another permanent cost component for firms, because in the New Economy the number of these InovPs and its release frequency has increased considerably. For example, Microsoft has released 29 and more versions of *Windows*^{TM} for desktop computers in the past 29 years (Wikipedia, 2014). This in turn implies that the firms might have to buy/upgrade these products with increasing frequency. In addition, globalization will force domestic firms to adopt these InovPs because of the threat of foreign firms, who have already adopted the product abroad. Therefore, besides labour and capital costs, InovP costs in might enter in the long-run cost structure of firms the New Economy.

Another interesting result of this paper is that if innovators succeed to drive their rivals out of the market then market prices might even be higher than the ones when there is no globalization. The market structure changes to a less competitive environment where innovator firms dominate. This situation is possible if the monopolistic supplier of InovP increases its revenue by selling its InovP very expensive. In addition, the model provides formulas to calculate various different possibilities in the market depending on the cost/benefit of the InovP. The parametric results obtained in this paper allow to make experiments with the model and to consider different possibilities, which is an advantage for future investigation.

The model also supports the view that any firm can profit in foreign markets as long as transportation cost allow for this fact. In addition, globalization increases the number of firms in domestic markets, but exactly because of this reason domestic firms have to invest in InovPs or enter into foreign markets to compensate their losses due to loss of shares in their markets. As a last note it should be noted that the results presented in this paper are not valid for the monopolistic new economy firms that produce these InovPs, but only valid for the old economy firms.

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