



Innovative Products, Prisoner Dilemma and an Increasing Cost Component for the Firms in the New Economy

Arzdar Kiraci®

Siirt University

ABSTRACT

Technological developments in information and communication sectors combined with globalization has started a transformation process and a new economy. New Economy firms that produce new technologies encourage the use of their products by stressing the economic advantage of their products and the advantage of early adopting their products in this transformation process. In addition, New Economy firms remind that the ones who predict the direction of this transformation and successfully adopt themselves to the new environment become stronger and the continuous change in the new environment is eliminating the institutions resisting to the change before they are able to observe the consequence of these changes. This is a marketing strategy. This paper investigates this marketing strategy and the behavior of adopting firms by constructing a game theoretic model. One of the interesting results is that if the parameters of the game are suitable then adopting an innovative product is a strictly dominant strategy and this results in a prisoner dilemma. Adopting an innovative product is a gain in the first stage but at the end makes the adopter worse off.

Keywords: *Cost Structure, Firm Decision, Game Theory, Globalization, New Economy*

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® Assoc. Prof. Arzdar Kiraci, Siirt University, Faculty of Economics and Administrative Sciences, Güres Caddesi 56100 Siirt/Türkiye, (email: arzdarkiraci@siirt.edu.tr, arzdar.kiraci@gmail.com), Tel: +90 (484) 223 12 24 - 223 17 39 - 224 11 38, Fax: +90 (484) 223 19 98.

1. INTRODUCTION

Charles Alexander (1983) noticed the transition from heavy industry to a new technology based economy in a cover article in Time magazine. Business Week Editor in Chief Stephen B. Shepherd (1997) wrote in an editorial entitled “The New Economy: What it Really Means” about a new economy. In addition, in an opinion pool in March 2000, 57% of American consumers believe that the US economy has entered to a new economy that is significantly different from the industrial economy (Kallio and Mallat, 2004) and henceforth this kind of economy is called the New Economy. The reason for this belief has been the developments in information and communication technologies (ICTs) and the globalization of businesses around the world. Both of these reasons gave rise to a transformation and to a new kind of economy.

Public opinions do not provide sufficient evidence to claim that there is a new kind of economy; however, there are also statistical evidences for the transition to the New Economy. Jalava and Pohjola (2002) find that about two-thirds of the recent improvement in labor productivity can be attributed to ICT in the United States. In 1997, ICT industries accounted for 3–4 per cent of employment, 6–9 per cent of value added, 10–25 per cent of exports and 25–40 per cent of research and development expenditure in the business sectors of the EU, Japan and United States (Koski et al., 2002). The results in Ketteni et al. (2011) indicate that for a range of OECD countries there exist a nonlinear relationship between ICT and productivity along with a nonlinear relationship between human capital and productivity. Kallio and Mallat (2004) use the same paper with Pohjola (2002) to argument that ICT spending is strongly correlated with the level of income but significant disparities also exist between countries at similar income levels. In addition, they state that different countries are in a different transition phase of the New Economy. Sánchez et al. (2009) confirms the strong impact of ICT on per capita income using data of 102 countries. In their paper Shao and Shu (2004) measure productivity growth of ICT using the Malmquist Total Factor Productivity (TFP) index and its results indicate that each country's ICT industry manifests its own particular patterns in various performance measures. 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. Jorgenson et al. (2011) find evidence that TFP originating from the ICT-producing sector accounted for 40% of aggregate productivity growth. Visco (2000), Daveri and Mascotto (2006) are other works that supports this claims. Thus, the case for an ICT revolution led shift to the New Economy seems to be finding support from fundamental statistics.

There are also other names for new economy like Digital Economy, Network Economy, Information Economy or Knowledge Economy. However, there are also names that only describe a part of this economy, which are not sufficient to describe the whole transformation, like Internet Economy or E-Economy (Tapscott, 1997). For the scope of this paper the New Economy can be defined shortly as follows:

The new economy is the adoption of ICTs and globalization to the production and trade process of old economy.



The reason for this definition are the conjectures in the New Economy that include changes in productivity, the inflation-unemployment tradeoff, the business cycle, and the valuation of enterprises (Deardorff's Glossary of International Economics, 2013). It is difficult to give a correct definition for the New Economy, because it is an ongoing process and its mechanism has not been correctly determined today.

On the other hand, there are many definitions for the New Economy because the characteristics of this new economic structure are not fully understood and even some people don't believe that a new structure has started yet. In addition, the transformation process to the New Economy is still going on so one can only define its main characteristics until this process is completed. For now, only some of the factors that cause this transformation can be observed.

The link between the New Economy and economic growth is simple. One of the main contributors to the New Economy is the rapid improvement in ICTs. These improvements have contributed especially to the possibilities of storing, sharing and analyzing information throughout the different sectors of the economy. Increased capabilities increase productivity and lead to economic growth. The improvement of ICT relates to both the quality of equipment and software as well as to the sharp decline in quality adjusted prices. This of course leads to rationally behaving firms substituting ICT equipment and services for other goods and services (Kallio and Mallat, 2004). This might be one of the reasons to believe that growth with these technologies will not cause inflation, as in US.

There are many examples for the benefits of ICTs to the firms. Gates (1999) gives in his book examples of how a firm has sold all of its physical structures and has moved its business to virtual Internet environment thereby improved its sales and financial status; how planes designed in virtual computer environment save more fuel; how firms decreased their cost by using Internet facilities instead of the ordinary telephone system. Damme and Dellaert (2001) give the car crash test into the wall of Ford example and how it dropped costs from 60'000\$ to 200\$ per crash with the help of simulation on a computer. Tapscott (1997) contains examples of how ICTs improved the financial status of firms. Brynjolfsson and Yang (1996), Bartelsman and Doms (2000), Dedrick et al. (2003), Kohli and Devaraj (2003) imply that ICT products have positive effect on firm performance in terms of profitability, market value, market share, process efficiency, service quality, organization and process flexibility, and customer satisfaction. Alternatively stated ICTs have increased productivity and reduced costs (Lymer, 1997; Gichoya, 2005).

Especially firms in the New Economy that produce these new technologies encourage the use of their products by stressing the economic advantage of their products. This type of information can be found in Internet web pages of firms producing ICT products if a search is executed in their search engines about "success stories" or "competitive advantage". Besides the cost reducing examples in these success stories similar to the ones mentioned in the previous paragraph, the idea of a competitive advantage using best opportunity to gain that can improve productivity, differentiate the shopping experience and increase profitability in

the early stages of the product are also stressed (HP, 2004; HP, 2008; HP, 2011; IBM, 2003; IBM, 2007; IBM, 2013; Intel, 2007; Intel, 2008; Intel, 2013a; Intel, 2013b).

Another important contributor to the New Economy is the globalization effect. It has found strength after an aborted military coup in 1991 when the Soviet Union ceased to exist. Afterwards, many formerly communist and Soviet Union countries accepted the free market system. Free Trade Areas like North American Free Trade Agreement and European Union (EU) increased the globalization effect. Globalization reached its peak after People's Republic of China joined the World Trade Organization. The internationalization of businesses in different sectors has made globalization an important economic topic for firms by increasing competition in every market. Lastly, the Internet has brought producers and customers closer than ever by eliminating many transaction barriers and creating the first global marketplace.

Globalization is a term used to describe the changes in societies and the world economy that are the result of dramatically increased trade and cultural exchange. Specifically in economic contexts, it refers to the effects of trade, particularly trade liberalization or free trade (Answers, 2013). International trade and investment play a greater role in most of countries economy today than they did 20 years ago. Average barriers to international trade have shrunk from the post second world war era of 40% to the current level of less than 4%. This naturally has had a large impact on the structures of different economies. Globalization leads to better allocation of the resources of the world and enables different economies to utilize the comparative advantages they have. Globalization of businesses leads to, for example, better utilization of economies of scale in different industries. The result of globalization is an increase in the growth rate of productivity and faster economic growth (Kallio and Mallat, 2004).

ICTs and globalization have increased the importance of different aspects of business life in the New Economy. Kelly (1998) approves that the rules of the economic game/competition have completely changed. Bobe (2002) stresses that Competition in the New Economy is more monopolistic and this type of competition is special in that the rules of the game are not known in advance and develop as the game proceeds. In this type of competition game theory is successfully able to predict the outcome. Game theory models can be used whenever one (players) firms decision affects the gain of other firms, i.e., there is a strategic interaction between firms (Bierman and Fernandez, 1998). Therefore, game theory will be very helpful in analyzing New Economy concepts.

Nalebuff and Brandenburger (1997) also confirm that the rules in the New Economy have changed by saying that succeeding in the New Economy requires a different approach. In addition, they stress the fact that success of firms in the New Economy is possible when firms work successfully with complementor firms. A firm X is complementor of firm Y if customers value the firm Xs product more when they have that product with firm Ys product than they have one firms product alone. Example for this can be Intel and Microsoft. Prasada et. al (2003) examine the number of options, the subscription price and the amount of advertising that should be offered to consumers by Internet websites. They try to find optimal strategies with the possibility of giving viewers of the same program the option to pay a higher price and view fewer advertisements, or pay a lower price but view more



advertisements. Walker (1997) provides a useful review of information economics and subsequent economic theories of financial information supply based on game theory. Foss et al. (2004) introduce a simple game theoretic model and discusses marketing applications and possible strategies. This way they develop a new theory of marketing in the emerging New Economy. Ausubel (2005) investigates auction theory for the New Economy using game theory, because auctions occupy a conspicuous place in the commerce of the New Economy. Shapiro and Varian (1998) is a good example of how strategies are important in the New Economy.

Similar game theoretic topics as the one presented in this paper can be found in Whang (1992), who studied the structure of software contracts from a game theoretic perspective; Chaudhury et al. (1995), who developed an analytical model of contracting as a two-stage bidding game; Banker et al. (2000), who modeled the impacts of ICTs on the contracting process and they proposed that ICTs leads to more complete contracting by reducing the cost of writing contracts.

Kiracı (2005) simulates the competition in the New Economy when the firms are in a Cournot type competition and behaviour of firms in time is according to Rogers diffusion of innovation theory (Rogers, 2003). In addition to this work Kiracı (2008) proves that depending on market parameters New Economy firms are able to cause some group of firms to leave the market using suitable pricing choices. Kiracı (2009) proves that depending on market parameters New Economy firms with complementary innovative firms to cause 95% of firms to leave the market. In addition to this work Kiracı (2011) proves that competition in market might decrease, consumers might be harmed economically, some part of consumer surplus and majority of producer surplus could pass to the New Economy firms. These firms' marketing strategy to convince customer firms with short-term gains and sell the product to all firms, causes this situation. Again in Kiracı (2011) it is demonstrated that if all firms start to use the same product profitability could fall and even profits might become less than profits before the use of the product. In addition, the possibility in Kiracı (2011) that technology diffusion in markets is vulnerable to manipulation from supply-side can be found in Lim et al. (2004). This paper simplifies Kiracı (2011) and proves using strategic form representation that prisoners dilemma situation may arise.

The new economy provides new innovative products that give a firm advantage over its rivals when it adopts these products. These products are not only available to a country or region but because of globalization they are available to any firm around the world. Normally, firms learn how to deal in such situations through experience, which is a time consuming process. However, after enough experience is gained the economic environment changes its structure and new experience is needed. Game theory is useful in such situations, because it allows us to analyze the situation beforehand and develop new strategies accordingly and take the correct action before the game ends. The following second part tries to simulate this kind of strategic interaction of different type of firms using game theory. The third section presents the results and a discussion about the results. The last section contains the conclusions of this paper.

2. THE GAME THEORETHIC MODEL

In this part, using the information given about New Economy and globalization in the previous parts, the strategic interaction between monopolistically competitive or oligopolistic firms in the New Economy will be simulated with the help of game theory. For this purpose the following assumptions are presented and different possible situations for different type of firms are analyzed.

2.1. Assumptions

Two time periods are considered, where the first describes the situation of firms in the short-run and the second the situation of firms in the long-run. In the short-run it is assumed that a new innovative product is introduced to the market by an international firm. 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:

- decreases operational (variable) costs of the firms
- increases performance of output
- changes the type (quality) of output positively
- increases customer number
- increases the share in the market

In the short-run some of the firms will adopt the innovative product and some not. This fact is true not just for firms in a country, but also true for all firms in other countries. It is assumed that in the long-run the economic importance of this innovative product become clear to all firms and because of globalization foreign firms can enter to the domestic markets. These situations are investigated under the following sub-headings.

2.2. Cost of the Firms in the Short-Run

In the short-run there can be two types of firms that are very similar in many aspects in the domestic market; namely, the first type of firms who represent the firms that have the tendency to use the new products and the second type of firms that do not have the tendency to use it. The short-run in this paper also represents the time period where New Economy firms with advertisements of the performance increasing property of their products create expectations. The following table summarizes the situation in the short-run:

		Second type of firms	
		Adopt the new technology	Status quo
First type of firms	Adopt the new technology	$\{x, x\}$	$\{u_2, y_2\}$
	Status quo	$\{y_1, u_1\}$	$\{z, z\}$

Payoff: {First type of firms, second type of firms }

Table 2.1 Strategic interaction of the two types of firms in the short-run



In the Table 2.1 above the parameters represent different expected cumulative gains for one of the firms in that group that have started using the new product (first type of firms) and the one that has not started (yet) using it (second type of firms). After the adoption of the product the profits of first type of firms will start to increase and this will be an advantage over its rivals. This situation can be represented in Table 2.1 by $(u_1 \text{ or } u_2) > z$ if a firm adopts the product when its rivals have not adopted it (yet). Increases in revenues also enable the firms to decrease prices and thereby increase their market shares so that their profits increase further. Alternatively, a firm which has not adopted the innovative product can increase its profit and regain its customers by adopting the new technology represented by $x > (y_1 \text{ or } y_2)$. If both type of firms end up selecting the same strategy then their market shares and revenues will be the same. If there is no change in the market share or all other variables affecting both types of firms then the return of the investment will determine the relative magnitudes of x and z . If the long-run return is larger than the investment or maintenance costs then cumulative gain from the innovative product will be larger than using the old technologies, i.e., $x > z$ (and if it is not than $x < z$).

There is only one solution to this game where each type of firm has the strictly dominant strategy of “adopt the new technology” strategy. The firms are forced to select this strategy because whatever the rival is choosing this strategy guarantees a higher payoff. Note that there is the possibility that $x < z$ then this game is a prisoners dilemma, i.e., the firms are better off by not incurring an investment cost that at the end has a smaller return.

2.3. Cost of the Firms in the Long-run

In order to determine the cost of the firms in the long-run international competition has to be taken in to account. The long-run is a time period, where the benefits of the innovation is clear to every firm in the economy and international firms that have the opportunity to enter a domestic market. Adding international competitors to the game that have adopted the innovative product and have entered the domestic market can be represented in Table 2.2 as a new player that has the strategies “enter (into the market)” and “do not enter (into the market)” and the following strategic interaction in Table 2.2 is obtained.

If international firms enter to the domestic market the domestic firms will lose customers and market share, which will decrease the gain of domestic firms. New foreign rivals in domestic markets will decrease the payoffs of both types of domestic firms and this fact is represented with $\epsilon_1, \epsilon_2, \epsilon_3, \epsilon_4, \epsilon_5, \epsilon_6 > 0$. In Bierman and Fernandez (1998:60) there is a chapter on strategic policy that takes international competition into account with a Cournot type competition between two different countries that have a firm and a market with same parameters. It is a good example for the fact that international firms will gain by entering into domestic markets if the current market price is higher than per unit transportation cost or any type of similar costs. Using the same argument international firms will gain in any case but with different amounts depending on the structure in the domestic market and this can be represented in the table as $\delta_1, \delta_2, \delta_3, \delta_4 > 0$. Using this information in Table 2.2, “enter” strategy becomes a strictly dominant strategy for international firms that have adopted the innovative product in the short-run.

International firms

First type of firms		International firms			
		<u>Do not enter</u>		<u>Enter</u>	
		Second type of firms		Second type of firms	
		Adopt	Status quo	Adopt	Status quo
Adopt	$\{x, x, 0\}$	$\{u_2, y_2, 0\}$	Adopt	$\{x-\varepsilon_6, x-\varepsilon_6, \delta_4\}$	$\{u_2-\varepsilon_4, y_2-\varepsilon_5, \delta_2\}$
Status quo	$\{y_1, u_1, 0\}$	$\{z, z, 0\}$	Status quo	$\{y_1-\varepsilon_2, u_1-\varepsilon_3, \delta_3\}$	$\{z-\varepsilon_1, z-\varepsilon_1, \delta_1\}$

Payoff: {First type of firms, second type of firms, international firms }

Table 2.2 Strategic interaction of the two types of firms and international firms in the long-run.

In Table 2.2 the sub-table in left where the international firms do not enter the market as explained previously is the Table 2.1. The sub-table in right where the international firms enter the market contains the losses of domestic firms. Using the same arguments as in Table 2.1 the following inequalities can be obtained $x-\varepsilon_6 > y_1-\varepsilon_2$ or $x-\varepsilon_6 > y_2-\varepsilon_5$ and $u_1-\varepsilon_3 > z-\varepsilon_1$ or $u_2-\varepsilon_4 > z-\varepsilon_1$. Again, for both type of domestic firms the strategy of “adopting the new technology” becomes strictly dominant strategy. The equilibrium outcome of this game is that all the firms adopt the new technologies and foreign firms enter the market. international/domestic firms that have not adopted the new technologies have neither advantage in their countries nor in foreign market, because the profit margins shrink considerably with international competition. This is another reason for the firms to adopt the new technologies. In this game the profits have changed from z to $x-\varepsilon_6$, which increases the probability that $z > x-\varepsilon_6$. As a result, even in the case that the innovative product increases the gains of first type domestic firms in the short run, in the long run international competitors will decrease that gain. There will, with a high probability, be a prisoners dilemma.

3. RESULTS & DISCUSSION

The findings in this paper are in agreement with the work of Cogert (2000), who stressed at the end of his writing that the firms have to understand the benefits of the cost reducing products brought by the New Economy to the industries before their rivals, because if they fall behind their rivals in adopting the innovations then these products can be used as an effective weapon in competition. This is exactly the reason why adopting these innovative products is a strictly dominant strategy. This implies that the firms will automatically adopt an innovative products as long as their domestic or foreign rivals have the same opportunity to adopt it. Another reason for the adoption is according to Mosher (2000) the first mover advantage, which is one of the seven main mechanisms in the New Economy companies. This, however, is a bad new for the firms, because in the New Economy the number of these innovative products and its release frequency has increased considerably. For example, Microsoft has released 93 versions of Windows™ for desktop and server computers in the past 27 years (Wikipedia, 2013). This in turn implies that the firms have to buy more and more of these innovative products and this with increasing frequency. Therefore, these cost will have a large share in the very long-run cost structure of firms.



Similar game theoretic papers exist that were not directly written for the New Economy concept, but that are compatible with this paper. Lim et al. (2004:725) present a game theoretic model where they consider a simple model with two users of technology adoption in the presence of network externality. They found two pure strategy Nash equilibria, either both users stick with the old technology or both users adopt the new one. In addition, they write that the firms switch to the new technology for fear of getting stranded when a momentum arises. In this paper, globalization and the advertisements of firms providing the innovative products are the reasons for this momentum.

It should also be noted that the results presented in this paper are not valid for the New Economy firms, i.e., firms who produce patented products of ICTs. These type of firms are monopolies because they have internationally accepted patents and copyrights. A patent allows a firm to be the sole producer of this product for 20 years (Taylor, 2004:254). For example, Intel's patent is the source of its monopoly on its computer chips. Therefore, the results presented in this paper are valid for the old economy firms.

4. CONCLUSION

This paper has simulated the strategic interaction between old economy firms in the New Economy when there is an innovative product that promises advantage to a firm over its rivals.

When the game theoretic model, examples in the text and outcome of strategic interaction are considered then the following results can be obtained:

1. In the New Economy in the long-run the number of domestic and foreign old economy firms will increase.
2. The possibility that a rival has the opportunity to adopt an innovation will force all the firms to adopt it (Adopting the innovative product is a strictly dominant strategy).
3. There is a probability that after adoption, the investment cost are higher than the revenue gained (A prisoner dilemma).
4. In the very long-run, products of the New Economy (will) have an important share in the cost structure of the firms. There can be a "adopt it or leave" trade off.
5. Domestic firms that loose market power will try to compensate their losses by entering in foreign markets (Globalization effect).

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