Technological Progress as a Generator of Economic Growth and Development

Mladen Rebić,
University of East Sarajevo
Bosnia and Herzegovina
rebicmladen@yahoo.co.uk

Nemanja Šarenac
University of East Sarajevo
Bosnia and Herzegovina
nemanja.sarenac@gmail.com

Abstract: *Bosnia and Herzegovina (B&H), as well as many other countries in transition, was faced with inadequate and insufficient technological progress, which is the result of years of neglect of investment in science, research, and new technology. This paper attempts to present the actual situation in B&H in terms of technological progress, innovation and investment in scientific research, as well as to offer basic guidelines for getting out of this difficult situation. B&H is located at the bottom of the all European countries when it comes to innovation, research and new technologies, and consequently it is not surprising that the B&H economy consistently recorded poor results. Investment in research and development and employee education is the primary goal of any successful company, whether it is a small, medium-sized enterprise or oligopoly. Therefore, the aim of this paper is to determine the guidelines i.e. strategic objectives, which will constitute the basis for future progress of B&H in the field of technological progress. Empirical research, which was conducted in order to determine the strategic objectives, has been carried out by using a questionnaire built on a sample of the leading experts in this field in B&H.*

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Introduction

For decades, technological progress has been considered the key pillar of economic development in the world. Consequently, investment in research and development should be the primary goal of every company in B&H, and also the state.

The progress and success of one country largely depends on science and technology, research and innovation, but if one wants to talk about the existence of high-quality research and technological competitiveness it is necessary to have sufficiently good educational system, i.e. educated workforce, young scientists, researchers, and so on. However, a good educational system implies the existence of active support and protection by the state! B&H cannot boast with high quality education and with much care to invest in scientific research activities, new technologies, inventions and inventors. The reason why the educational system, research, and thus technological progress in Bosnia and Herzegovina, is in such a desperate position is the lack of adequate support from the state.

Finland can be mentioned as a good example of success and taking care of human capital, education, investing in innovation. In the period 1991 – 1995, Finland increased investment in science and education for incredible 82%! The results were impressive. In 1991, Finland was a country with serious problems[i], but in 2000 it realized a budget surplus of 7% and an unemployment rate of 10%. Thanks to investment in education and new technologies, Finland regenerated and significantly increased its technological competitiveness, which was driven by rising exports and industrial production. Here, we speak about industry based on information technology (IT industry), innovation and education, i.e. knowledge economy[ii].

Position of the EU, in this field is not very good, compared to the rest of the world. For many years, the EU has been trying, by size of funds for investment in research and development, to catch up with the U.S. and Asian countries especially[iii]. It suffices to say that in the top twenty companies in the world, by number of innovations, EU has only two firms - German Siemens and Finnish Nokia. It should be mentioned that the lead story on this topic belongs to companies from the U.S., followed by Japan and South Korea. Consequently, EU decision to establish "Innovation Union" is no surprise. The main task of “Innovation Union” will be to raise competitive readiness of the EU compared to the rest of the world in the field of technological progress, i.e. investment in research and development.

Therefore, it is necessary for B&H to begin to follow the path already headed by Finland, Turkey, China, India and so on. It is necessary to pay more attention to education, scientific research, new technologies, as well as to prevent the outflow of "brains" from Bosnia and Herzegovina.

The fact is that progress in the field of new technologies and technological progress in B&H is not possible without adequate help and support from the state. Bosnia and Herzegovina has a very small investment in science, research and development, and therefore it is very important that the already meager funding available is not put into the wrong hands. Help from the state should primarily be directed towards firms (entrepreneurs) who are willing to invest their capital in research and development, employment, local and regional development, in order to stimulate economic growth and technological progress. What are these companies? Which market structures do they belong to? The first part of this paper will try to provide an answer to these questions, in order to give guidance in which direction the government support should be directed when it comes to research, innovation and technological progress. In fact, all major research and analyses carried out in this area are based on the hypothesis of Schumpeter (1928, 1942), which is based on the fact that most of the innovations are implemented by large companies (monopolies). Attention will be based on Schumpeter hypothesis, and the paper will try to come to the knowledge what size of the company (the market structure) is most prepared for serious investment in research and development, i.e. implementation of innovative activities. On the one hand, there is the attitude of Schumpeter that favors highly concentrated markets, i.e. large firms and on the other hand, especially in recent times, there are more and more supporters of the opposite position involving that the greatest willingness to invest in research and development is shown in the small and medium-sized companies - competitive market structures. It is known that the EU is on its way to increase technological competitiveness, giving special attention and support to small and medium enterprises. In fact, there are serious indications that the oligopoly is the most appropriate and best market structure, and also the fastest market structure to implement certain innovative activities.

Due to the loose connection of scientific and business sector, universities and the private sector, the constant neglect of the importance of technological progress, B&H is very low positioned in the field of technological readiness and innovation, which is discussed in the second part of this paper.

In the end, the paper will talk about ICT index, as one of many indices that will enable us to study the competitor readiness and B&H position, relative to other countries in the region and the world, in the field of technological readiness and progress.

Market Concentration and Innovation

Schumpeter's hypothesis

"The fundamental impulse that sets and keeps the capitalist engine in motion comes from the new products, new methods of production or transportation, the new markets, new forms of industrial organization that capitalist enterprise creates."

(Schumpeter, 1942)

As it has been already announced in the introduction of this paper, the starting point of its analysis is Schumpeter's hypothesis, from his work "Capitalism, Socialism, and Democracy" (Schumpeter 1942), that larger firms invest more in research and development. Schumpeter's view was based on the fact that the existence of large firms and their market power are the basis for the implementation of large-scale plans. According to Schumpeter large firms represent "the engine of economic progress." However, the main problem of this approach to the problem might be the fact that Schumpeter never explicitly explained why the big companies are better innovators.

On the other hand, Schumpeter has provided two complex arguments - hypotheses (Hutschenreiter, Leo, 1994: 52):

- Innovations increase more than proportionally with the size of the company,
- Innovations increase along with the increase of concentration.

During the past few decades, many experts in this field have tested these arguments. The results to which most of them came are that they could not fully confirm the claims of Schumpeter.

The small company also may have a relative advantage in innovation in terms of highly innovative industries, in which highly educated workers are essential components. Also, small firms have a relative advantage in innovation when it comes to radical innovation, and also where production is more labor-intensive than

capital-intensive. Under these conditions, and if there are no significant barriers to market entry, a small company can access particular industry with more competitive and flexible ideas, products and manufacturing processes, challenging the domicile companies and continuously disrupting the existing patterns of production in a given industry. The advantage of small businesses rely on the idea that firms with high market power usually become "lethargic" in an effort to adapt to certain changes in technology, and that they are more concerned about maintaining the current technological development rather than initiating new investments in process innovation[iv]. On the other hand, large firms have an advantage in innovation in industries that are capital-intensive, and concentrated, and have the production of differentiated products. Large companies have also advantages in innovation when the environment is stable, where the tastes are not changing fast, and where the product is standardized. Under these circumstances, specialization provides cumulative advantage to current leaders, which allows large companies to achieve abnormal profit, which they will be able to use later for the enormous investment in research and development, and also for the hiring of professional managers and engineers. Large firms possess more assets compared with small firms. Consequently, large firms more easily access loans with more favorable interest rate, they are also capable to quickly reduce their operating costs and invest more in innovation - that finally would lead to the reduction of production costs. All mentioned advantages that large firms can achieve are usually converted to barriers for entry of small firms (Mazzucato, 2000: 33-34).

It is certain that Schumpeter's arguments are not entirely acceptable. On of the reasons to be noted here is the diversity and specificity of certain industries. Of course, there are industries in which large firms are the leading innovators (aluminum, computer equipment - software), and on the other hand, there are industries in which the size of the company means greater investment in research and development (steel).

It should be noted, that the well-known experts in this field such as Mason, Galbraith, even Schumpeter, did not provide an empirical study with which they could provide answer to the aforementioned dilemma. Yet we can conclude that large firms can be considered as engines of economic growth and development of a country, although they are not exclusively and only the greatest innovators.

In the end, it is necessary to mention the term "creative destruction", originating from Schumpeter, where he tried to describe the economic impact of technological

change. The term creative meant the introduction of new technologies in manufacturing processes that would lead to the reduction of production costs, as well as provide new services and products. However, on the other hand, there is the destructive aspect of technological change. The introduction of new technologies inevitably leads to the question of domicile market power of firms that remained faithful to the old, less efficient, technologies. Creative destruction, therefore, rewards successful innovators and at the same time punishes those firms whose technology is obsolete (Lipczynski, 2005: 496).

Firm size and innovation

Readiness for the implementation of the research project, the timing of innovation and the nature of patent competition are determined by the market structure in manufacturing and research industries. There are two links between market structure (firm size) and innovation. First, the patent allows the innovator to exercise some market power on the basis of innovation - competitive (small) firms. Second, firms with some market power can prevent the entry of new firms into the market and potential mimicking by defensive patents, or retain their power through the introduction of new products - monopoly (Carlton, Perloff, 2005: 560).

When it concerns the size of the company, there are usually two extreme cases meant: small firms (competitive market) and large companies (monopolies). The largest number of executed analyzes take the competitive and monopoly market structure as a base for establishing the importance of the interaction between firm size and innovation. However, this mater should seriously include oligopolistic market structures. Why? It is due to the irrefutable arguments that oligopolies are the very market structure - the size of the company which is facing the most innovation. The oligopolies have adequate market power, and thus can have abnormal, i.e. extra profit. Given the market structure to which they belong, they are very prone to innovation, because it is one of the fundamental aspects of their fight against close competitors, and so on. No one can deny these arguments! But in order to better "understand" the very core of the problem, we will start from the beginning.

Monopolies have the best position for innovative activities. The key question that arises here is: Do monopolists need and want to invest in research and development? The answer to this question would be: It depends on the possible competition! Monopolies have a great market power, abnormal profits, low investment risk, low

degree of diffusion[v], the lack of competitive pressure, etc. In other words, monopolies have the money, time and space, which may enable certain technological progress. However, in most cases, monopolies' decision is not to invest in new technologies, except when faced with potential competitive pressure.

Monopolies are usually, due to absence of competition, "put to sleep" - safe market, profit - simply they have no desire to change anything. One of the problems that monopolists often face is a growing bureaucracy, which usually leads to their technical inefficiency. In addition, if the monopolist achieved its current market position based on an earlier successful innovation usually there appears the so-called attachment to existing technology and the shift to another - a new technology is usually considered by the monopoly as a too expensive move. In accordance with the foregoing, it can be concluded that monopolies are not a market structure that most invests in research and development (Lipczynski, 2005: 498).

On the contrary, monopolies are often prone to quite opposite strategy. Monopolies decide not to engage in innovative race with the other participants, waiting for the competitors to carry a serious and compelling innovation. After confirmation of innovation as very successful and profitable, monopolies step into action. Thanks to their market and financial power, and already established "brand" - consumer confidence - monopolies easily copy given innovation and take most (almost all) of the profits from the initial innovators.

Companies in competitive markets (small companies) have a strong desire to invest in new technologies, because the provision of a new product or production process with lower costs is one of the most effective ways to cope with the extremely tough competition in the market. However, unfortunately, firms in competitive markets are faced with the fact that they can earn only normal profits, leaving them little room to invest in high risk investments. Small firms are also faced with a large degree of diffusion, which further negatively affects their willingness to invest in new technologies.

Monopolist usually has only a few research teams, while in a competitive market there exist a lot more of research teams, which compete with each other – who will first succeed to get innovation. Consequently, the conclusion can be drawn that successful innovation could be provided by a competitive market structure rather than by monopolies. Therefore, between monopolies and competitive market, we prefer a competitive market (small businesses).

Regardless of the strong desire for innovation, competitive market structure is not an ideal solution for innovative activities. Why? It is due to the fact that a large number of competitors operate within a given market structure and they are ready to quickly copy the successful innovation, and therefore, for a short period of time substantially reduce the profit of the company which had originally introduced innovation to the market.

After consideration of two basic market structures, attention is going to be paid to the third oligopolistic market structure. Of course, the inclusion of an oligopoly into the consideration further complicates the situation, because oligopolies are just somewhere between the monopoly and competitive market. Two things are important in terms of investing in research and development: the ability of investment (financial, infrastructure) and willingness - mood to invest. So far, it can be concluded that:

- *monopolies* have great opportunities (capital) for investment, but weak – moderate willingness to invest;
- *perfectly competitive firms* have great desire and willingness to invest, but they have little opportunity for it (low - normal profits);
- *oligopolies* possess moderate[vi] - large investment opportunities, as well as the greatest desire and willingness to invest in new technologies.

Based on the above arguments, it can be concluded that oligopolies have the advantage over the monopoly and perfectly competitive firms. The proofs of the previous claim are the industries in which the biggest global oligopolies rule: computer equipment, cars, tires, electronics, cigarettes, beer, power turbines, aircraft, etc. We can claim with high confidence that the large profits achieved in this industry can be used to invest in new technologies. It is known that oligopolies are constantly faced with competitive pressure, and that is why they see investment in new technology as the only successful solution of this competitive struggle. It should be noted that the oligopolies face less degree of diffusion than it is the case with competing firms. Thus, oligopolies have market power, high profits, and great willingness to invest in new technologies because of the constant competitive pressure, the strong interdependence between competitors and the moderate degree of diffusion - as opposed to a competitive market, and so on. The conclusion simply suggests itself: oligopolies are the size of the firm that has the best conditions and the reasons for investing in new technologies. It should also be noted that companies

that have a market share between 20 – 30% achieve the best results in the field of innovation and patent record, and they are oligopolistic firms.

The following table shows the top ten firms in the United States, which achieved the highest number of patents in 2006 along with their ranking in 2005 and 2004. It is important for this study that all ten companies are big companies, of whom the vast majority operate in an oligopolistic market with only a few large firms. Looking at this table, we can draw the conclusion that large firms (oligopoly) in concentrated markets are more innovative (Pepall, Richards and Norman, 2008: 573-574).

Table 1. Top ten companies in the largest number of U.S. patents in 2006, and their ranking in 2005 and 2004

Firm	Number of patents in 2006	Rang in 2005	Rang in 2004
International Business Machines	3,621	1	1
Samsung Electronics	2,451	5	3
Canon Kabushiki Kaisha	2,366	2	4
Matsushita Electric Industrial	2,229	4	2
Hewlett – Packard	2,099	3	6
Intel Corporation	1,959	7	5
Sony Corporation	1,771	12	7
Hitachi	1,732	8	8
Toshiba Corporation	1,672	9	9
Micron Technology	1,610	6	11

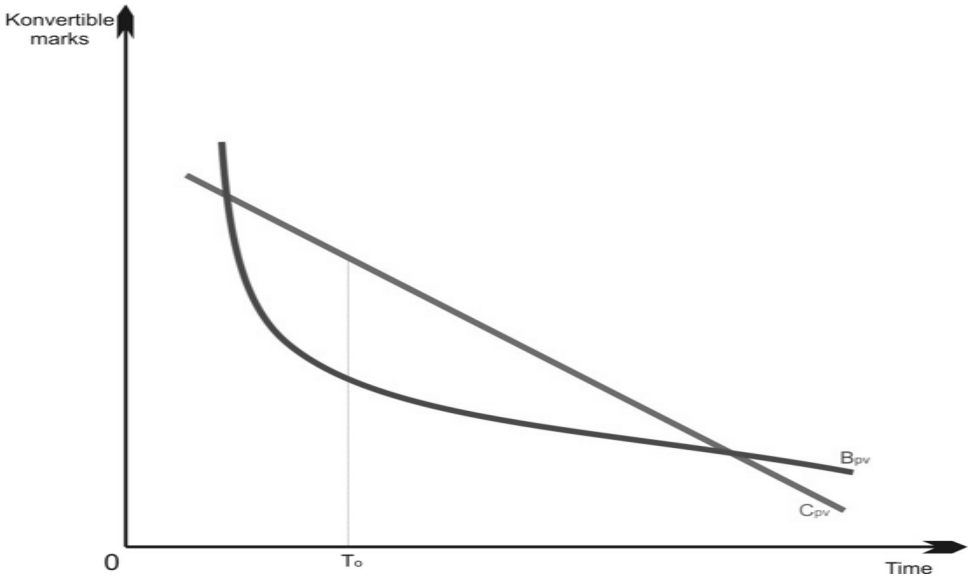
Source: Lynne Pepall, Dan Richards and George Norman, 2008.

The link between market structure, time and innovation

Finally, in addition to the possibility and willingness to invest, it is necessary to take into consideration another important factor - the time of implementation of research programs. When it concerns oligopoly, where there exists a strong interdependence between competitors, the speed has a big impact on the possible success or failure of a particular research project. If the research process is going too slowly, competitors can implement a similar idea before, and take over the patent. However, if the research process is carried out too quickly, it usually leads to some errors, higher costs, but also to less worry about protecting the very idea of imitation - all of these events will inevitably lead to failure in achieving the benefits of their own

investments (Lipczynski, 2005: 503). Given that consideration includes the cost and time, the time - costs analysis represents ideal solution for eliminating concerns when making investment decisions. This analysis usually takes into consideration the present value of the costs and the present value of benefits. Therefore, it is necessary to find the optimal time for technological development and market structure that is closest to meeting given optimum time for the successful realization of the research project, based on the time - costs analysis.

Figure 1. The optimal time for technological development

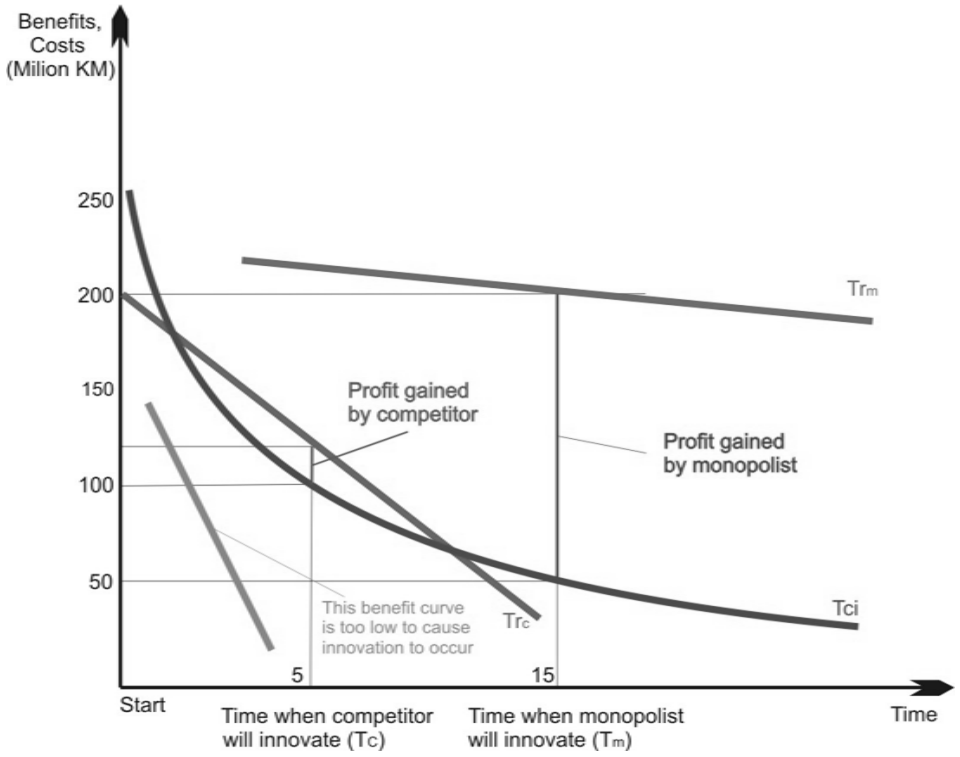


Source: Waldman, Jensen, 2007: 477

The analysis of the previous graph shows that the present value of the costs of developing an innovation is labeled as a curve Cpv (Cost Present Value), where costs are reduced as the development time increases. The present value of benefits from the development of the innovation is labeled as a curve Bpv (Benefit Present Value), which is used to reduce the time required for development increases. Socially optimal time is achieved when the value of the marginal benefits equals the value of marginal costs, for the time To. On this point (To), vertical distance between the two listed curves (profit) is maximized (Waldman, Jensen, 2007: 477).

After getting acquainted with the manner of determining the optimal time for the development of an innovation, we will first conduct an analysis of a dominant firm and a competitive small firm, and then include oligopoly in consideration as well.

Figure 2. Time, costs and benefits of innovators: Monopoly versus small firms



Source: Shepherd, 2004: 115

In the Graph 2, it is assumed that there is a base curve that will represent the ratio of the time-cost (TCi) for a given innovation in a given industry. Let's say that this is a radical innovation, new models of mobile phones. This innovation can be implemented quickly with considerably higher research costs or slower and therefore make less research costs.

Now, we are going to concentrate on our case, monopolies and small businesses. Monopoly will expect the highest profits from innovation only at some future period. This position is represented by the graph 2, the total revenue curve TRm,

which is the total revenue that a monopoly could exercise on the basis of a given innovation. It can be noted that the curve is high, reflecting the size of the revenues. It can also be noticed that the given curve is almost a horizontal line, due to the fact that the monopoly has no fear of a possible takeover of innovation and the related future profits from foreign competition. The advantage of monopoly actually lies in the given fact, the dominant firm can realize innovation slowly, and again "grab" a bigger share of profit. However, this is not the case with a small firm. At the start, a small company can expect less revenue from the same innovation, simply because they start as a firm with lower market share. Small firms are now faced with the fear of the fact that other small firms can realize first a given innovation, or copy it very quickly and so grab profits for themselves. For these reasons, the curve of the total income of a small firm is designated as TRc, and it is much steeper and lower than the monopoly one, barely above TCi in a short period of time. Each firm will maximize its profit when the marginal costs are equal to the marginal revenue. When MC = MR, the vertical distance between the curves is maximized.

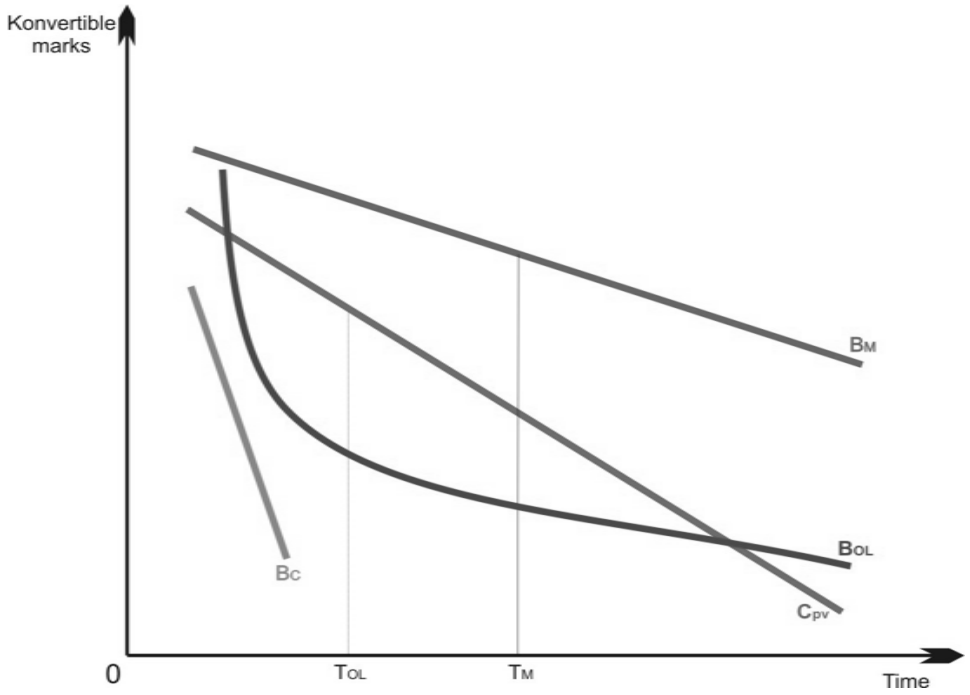
As for the monopoly, it is time Tm, presented as 15 years. For a small business, time is much shorter Tc, and it is represented as 5 years. Small company is also faced with significantly higher costs in the amount of KM 100 million, as opposed to monopoly in which the cost was KM 50 million. Consequently, and due to the fact that it possesses more market power, monopoly has been able to appropriate much more revenue than KM 200 million, and therefore much higher profit of KM 150 million. Small company generated revenue of KM 120 million, and a smaller profit of KM 20 million (Shepherd 2004: 114).

If the consumer surplus is taken as a criterion, small innovator imposes as a faster and better solution[vii]. In these circumstances, the innovation will be implemented by small firms. However, monopolies usually prefer to deliberately "drag" the research process, to make room for the small firms to face the investment risks and the risk of implementation of new ideas. If monopoly notices that some of the ideas implemented by small businesses are successful and profitable, it will react quickly - copy a given innovation in order to catch up and to achieve complete ejection of small innovators from the market. This move of monopolies is commonly called "fast - the second" strategy[viii] (Shepherd 2004: 115).

In the former case, the study has analyzed the behavior of monopoly and small competitive firms, assuming that the investment costs are eligible for both participants. It has been found that the small company will carry a given innovation

for several reasons[ix]. However, the harsh reality says otherwise. Usually high costs of investing in the development of new innovations represent a stumbling block for small competitive firms. That is why they are out of the race compared to oligopolies[x]. Thus, oligopolies emerge as a market structure, which is able to implement research projects in the optimal time possible. Now let us attempt to introduce next graphics.

Figure 3. The link between the market structure and the time required for technological progress



Source: Waldman, Jensen, 2007: 479

This analysis needs the curve of the present value of costs (Cpv), development of given innovation, as well as three curves of the present value of the benefits provided by the development of innovation (Bm, Bc, Bol). The three curves for three different market structures: monopoly (Bm), a small competitive firms (Bc), and oligopolies (Bol). The assumption that the cost function is independent of changes in market structure is understandable, because it is primarily a function of technological

knowledge and input. On the other hand, the curve varies with the change in market structure.

As it can be seen in the graph number 3, the optimal time for the development of innovations in the monopoly is (Tm), and it is higher than in the case of oligopoly (Tol). For small competitive firms, total costs exceed total benefits of given innovation, so there will be no investment (Waldman, 2007: 479).

The curve of the present value of the benefits of monopoly Bm is presented as the tallest and straightest. As it has already been said, regardless of the timing of actual innovation, monopolies achieve the greatest benefit because of their largest market share and the minimum degree of diffusion[xi]. As for the competitive firm, its present value curve is the lowest and steepest. The reason for this is a very small market share of small firms, as well as the highest degree of diffusion. Small firms typically generate smallest benefits of innovation, and the reason for that is the rapid implementation of the innovation process (short time frame). Curve Bc is very vertical, and the reason for this lies in the fact that any delay in presenting new innovations in the market increases the likelihood that another company will imitate a given innovation. Finally, let us analyze the participation of oligopoly. Its curve Bol - present value of the benefits, lies between the previous two curves, because the oligopoly has a larger market share than the competitive companies - but less than monopoly, and because it confronts a moderate degree of diffusion (Waldman, 2007: 478).

So, after analyzing all of the above, it can be noticed that the oligopoly allows for the fastest level of technological progress in most cases. Of course, it is possible that the oligopoly gives up the race if the investment costs are much higher. Then only a monopoly can be the bearer of innovation. The fact is that some innovations do not require large investment, so in that case the small competitive firms emerge as carriers of innovation. However, it is the fact that investment costs are usually higher (in many cases) than small firms can bear, and yet they are not abnormally large that only monopolies can bear it.

So, an oligopolistic firm represents market structure that usually provides the fastest level of technological progress. What does it mean to Bosnia and Herzegovina? Given the very difficult situation in the country in terms of investment in research and development, and innovation, it is logical that B&H needs a quick solution to this important problem. Companies that can provide the fastest progress in the field

of technological progress are oligopolistic firms. Thus, in addition to small and medium-sized enterprises that have been already in the focus of the state, any oligopolistic firm in B&H, which is ready to seriously invest in research and development, should be supported and assisted by the government. However, the fact is that in B&H operates a small number of oligopolistic firms, which in turn shifts the focus of the development of technological competitiveness to small and medium-sized enterprises.

Technological Progress and Innovation in Bosnia and Herzegovina

Bosnia and Herzegovina has made some progress in the field of research and innovation policies. The participation in the Seventh Framework Program for Research (FP7) increased, and teamed with COST and EUREKA. The government has provided funding for entities that prepare projects for FP7, COST and EUREKA. However, administrative and research capacity for taking full advantage of the opportunities offered by European programs and resources to actively stimulate the scientific community is still weak.

Efforts have been made to integrate into the European Research Area and the EU contribution to innovation. Bosnia and Herzegovina joined the EURAXESS network aimed at ensuring the mobility of researchers, and the umbrella organization that coordinates the domestic network EURAXESS was established at the Banja Luka University. There is a slightly increased allocation of funding for research, modernization of infrastructure, equipment and publishing, particularly accessing COBISS library information system. The Republic of Srpska and other entities have increased investment in research and development. However, the level of investment in research remains low in general, particularly in private sector investment. As the entities and cantonal policies are financed from their budgets, it is difficult to direct research policy and avoid fragmentation, which is one of the key objectives of the ERA. There are no reliable statistics of scientific and technological progress.

The economic recovery of Bosnia and Herzegovina is slow and under the influence of long years of continuous unfavorable economic and political conditions and unstable economic environment, problems and difficulties caused by the global economic crisis, with the decline in industrial production, high unemployment and the trade deficit being some of the main difficulties in faster recovery and development. Technological readiness and innovation of B&H in comparison with

other countries in the world can be indirectly drawn from data from the World Economic Forum's Global Competitiveness Report for 2013. According to the "GCI 2012-2013" B&H occupies 88th place out of 144 countries (Sierra Leone and Burundi were the last ones), which is an improvement compared to 2012 when B&H was at the 100th place out of 142 countries. It should be noted that the progress of the 12 places is equivalent to an increase of 0.1 rating points, which in any case would not be considered as a success. Progress on this year's list has not been achieved through implemented reforms and qualitative improvements, but it is largely determined by the lower results of other countries. B&H ranking viewed by items of interest for technological development is shown in Table 1.

Table 2. Position of B&H in the field of technological readiness and innovation according to the Global Competitiveness Report for the period 2009-2012

GCI Indicator for Bosnia and Hertzegovinia	GCI 2010 (of 134)	GCI 2011 (of 139)	GCI 2012 (of 142)	GCI 2013 (of 142)
Technological readiness	**95**	**85**	**73**	**68**
Availability of latest technologies	122	116	105	89
Firm-level technology absorption	131	119	107	105
FDI and technology transfer	115	102	117	98
Internet users	50	59	44	42
Broadband Internet subscriptions	56	56	51	51
Internet bandwidth	-	71	56	66
Mobile broadband	-	-	-	70
Innovation	**131**	**120**	**104**	**99**
Capacity for innovation	121	116	124	101
Quality of scientific research institutions	126	104	98	72
Company spending on R&D	122	104	96	90
University-industry collaboration in R&D	130	117	84	48
Gov't procurement of advanced tech products	129	116	109	94
Availability of scientists and engineers	122	115	68	48
Utility patents per million population	71	69	90	50

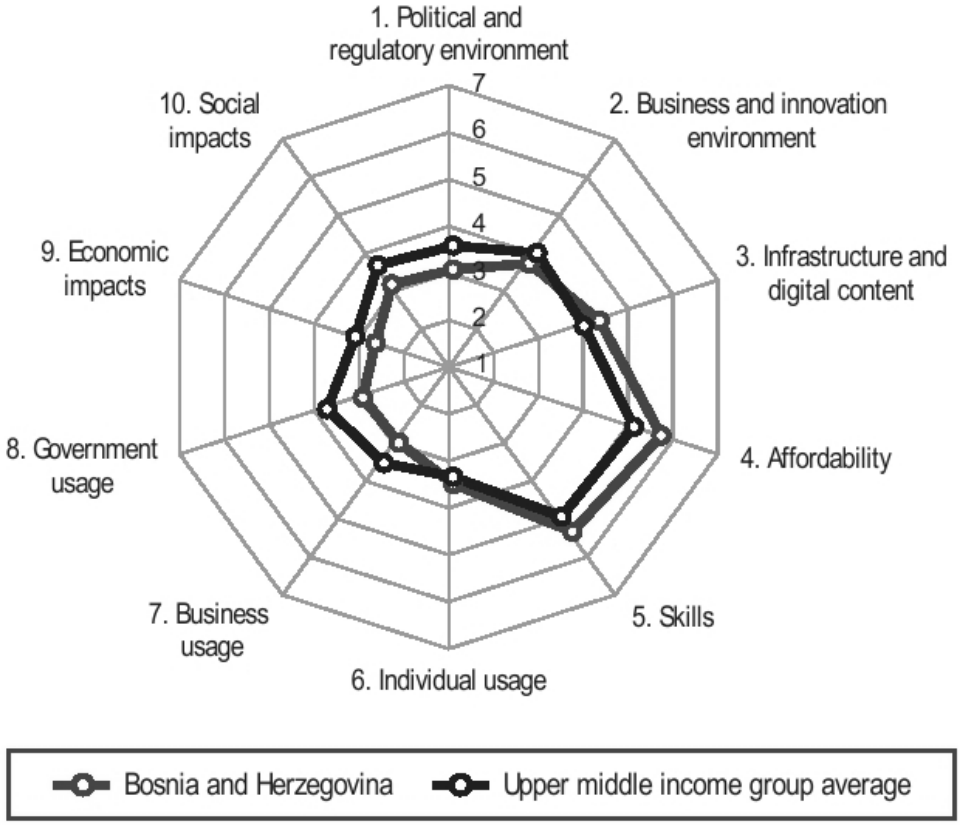
Source: WEF. (2009,2010, 2011, 2012)

Indicators, primarily, indicate a weak association of scientific and economic sectors. Positive developments have been observed over the past three years in technological readiness and innovation. In general, the current situation in B&H is not even close to satisfactory, and in some ways it is the reflection of the overall socio-economic

status, and also a very low awareness of the importance of technological progress in the development of the society.

Regarding The Networked Readiness Index - NRI that measures the propensity of the country to seize the opportunities offered by information technology, Bosnia and Herzegovina is at the 84th position. This position is not due to lack of development of infrastructure and skills of their populations, but is a result of poor political and business environment, the lack of adoption of new technologies (by the public and private sector) and low socio-economic impact of ICT (Figure 4). In addition, there is a serious weakness in its Innovation System, which needs to be restructured and expanded, because it interferes with its ability to use ICT for deeper economic and social changes.

Figure 4. Network readiness index of B&H for 2012.



Source: WEF, (2012b.)

The Lisbon review rates Bosnia and Herzegovina as the lowest ranked country. Out of the eight areas to be evaluated, B&H has the worst rating in six. Only in the areas of innovation and network industries, Albania occupies the lower position than B&H.

Application of ICT Development Index

Unique ICT development (ICT Development Index - IDI) compares developments in the field of ICT in 155 countries. The index is produced in response to calls from ITU Member States to consolidate previous ITU indices into one index, in order to follow the development of the information society. The main index objectives are to survey:

- Levels and the evolution of ICT development over time;
- Progress in ICT development in both developed and developing countries;
- Digital gap, i.e. the difference between countries with different levels of ICT

Development;

- Development potential of ICT and the extent to which the government can use ICT to enhance growth and development, based on the available capabilities and skills.

Development ICT Index consists of 11 indicators grouped into three subgroups: ICT infrastructure and access, ICT efficiency (primarily by individuals and households and businesses) and the intensity of use of ICT and education (human capacity required for the use of ICT).

Table 3. Indicators Index ICT development

ICT access		
1.	Fixed-telephone lines per 100 inhabitants	40%
2.	Mobile-cellular telephone subscriptions per 100 inhabitants	
3.	International Internet bandwidth (bit/s) per Internet user	
4.	Percentage of households with a computer	
5.	Percentage of households with Internet access	
ICT use		
6.	Percentage of individuals using the Internet	40%
7.	Fixed (wired)-broadband Internet subscriptions per 100 inhab.	
8.	Active mobile-broadband subscriptions per 100 inhab.	

ICT skills		
9.	Adult literacy rate	20%
10.	Secondary gross enrolment ratio	
11.	Tertiary gross enrolment ratio	

Source: ITU, (2011.)

Globally speaking, most progress has been made in the area of ICT access, which includes indicators relating to the fixed (wired) and mobile telephony, Internet bandwidth and volume of households with computers and Internet. Slower progress is achieved regarding the use of information and communication technology, which includes a number of indicators of Internet users, the number of fixed and mobile telephony, and so on. There is still very little progress in most countries in broadband access as the latest technology.

The results show that the most developed countries in the top ten come from Europe, except for the Republic of Korea and Japan. Differences between countries are small, but it can be seen that Korea, Sweden and Denmark stand out from the rest. Opportunities for the development of ICT in these countries are truly remarkable. Looking at the first thirty countries, except the U.S. and Canada, all countries come from Europe or East Asia. The index is linked to a high-income countries and the strong correlation between the level of development of ICT and the gross domestic product. Countries with the most dynamic development in ICT Development Index, in the past period, include: Kazakhstan, Brazil, Rwanda (7 places), Bahrain (5 places or 0.66 points), Saudi Arabia (6 places or 0.62 points), Ghana (4 places - with IDI change for 23%).

Table 4. ICT Development Index for 2008, 2010 and 2011

Country	Rank	IDI 2008	Rank	IDI 2010	Rank	IDI 2011
Republic of Korea	1	7.80	1	8.40	**1**	**8.56**
Sweden	2	7.53	2	8.23	**2**	**8.34**
Denmark	3	7.46	4	7.97	**3**	**8.29**
Iceland	7	7.12	3	8.06	**4**	**8.17**
Finland	12	6.92	5	7.87	**5**	**8.04**
Netherland	5	7.30	9	7.61	**6**	**7.82**
Luxembourg	4	7.34	7	7.78	**7**	**7.76**
Japan	11	7.01	13	7.42	**8**	**7.76**
United Kingdom	10	7.03	10	7.60	**9**	**7.75**
Switzerland	9	7.06	8	7.67	**10**	**7.68**

Hong Kong (China)	6	7.14	6	7.79	**11**	**7.68**
Singapore	15	6.71	19	7.08	**12**	**7.66**
Norway	8	7.12	11	7.60	**13**	**7.52**
United States	17	6.55	17	7.09	**15**	**7.48**
Germany	13	6.87	15	7.27	**16**	**7.39**
New Zealand	16	6.65	12	7.43	**17**	**7.34**
France	18	6.48	18	7.09	**18**	**7.30**
Austria	21	6.41	16	7.17	**19**	**7.10**
Ireland	19	6.43	23	6.78	**20**	**7.09**
Australia	14	6.78	14	7.36	**21**	**7.05**
Canada	20	6.42	26	6.69	**22**	**7.04**
Belgium	22	6.31	22	6.83	**23**	**6.89**
Estonia	28	5.81	33	6.16	**24**	**6.81**
Slovenia	24	6.19	24	6.75	**25**	**6.70**
Spain	25	6.18	25	6.73	**28**	**6.62**
Italy	26	6.10	28	6.57	**29**	**6.28**
Poland	38	5.95	41	5.29	**31**	**6.19**
Czech Republic	37	5.97	37	5.42	**32**	**6.17**
Greece	30	5.70	30	6.28	**33**	**6.14**
Lithuania	35	5.44	35	6.04	**35**	**6.06**
Latvia	39	5.31	40	5.90	**36**	**6.06**
Portugal	29	5.70	28	6.57	**37**	**6.05**
Russian Federation	49	4.42	47	5.38	**38**	**6.00**
Slovakia	40	5.30	39	5.94	**39**	**5.86**
Hungary	34	5.47	34	6.04	**41**	**5.77**
Croatia	36	5.43	31	6.21	**42**	**5.75**
Cyprus	43	5.02	36	5.98	**44**	**4.73**
Belarus	58	3.93	52	5.01	**46**	**5.57**
Serbia	47	4.51	50	5.11	**48**	**5.40**
Bulgaria	45	4.75	49	5.19	**51**	**5.20**
Romania	46	4.67	48	5.20	**52**	**5.13**
TFYR Macedonia	52	4.20	53	4.98	**54**	**5.05**
Bosna and Herzegovina	63	3.58	63	4.31	**63**	**4.53**
Ukraine	59	3.83	62	4.31	**67**	**4.40**
Turkey	60	3.81	59	4.42	**69**	**4.38**
Albania	81	2.99	78	3.61	**80**	**3.78**
Niger	152	0.79	151	0.92	**155**	**0.88**

Source: ITU, (2012.) (Adapted)

Bosnia and Herzegovina is still at the bottom of all countries in the region, although according to a new report B&H has moved from middle group to a more advanced group of IDI countries. Otherwise, in the report there are four groups: highly advanced, advanced, intermediate and groups with lower levels of the index. Bosnia and Herzegovina has successfully improved its level of ICT, more than countries with similar previous values. It has achieved an improvement by 0.95 points in 2011, compared to 2008, but it stays at the same place (63rd position). B&H has achieved the greatest progress in the second sub-index use of ICT. ICT skills remained at the same level, and access to ICT recorded the worst result. Out of the neighboring countries, only Albania has worse result than Bosnia and Herzegovina.

Empirical Research

The prime objective of this paper is to determine what are the strategic guidelines, according to the opinion of relevant experts, which represent the key to the improvement of technological progress in B&H. The main goal of this research is to contribute to the development of knowledge about the importance of the set guidelines, which can significantly improve the competitive position of B&H in relation to the region - in terms of technological progress.

The empirical research was conducted through a survey of a sample of relevant specific experts in B&H. Interviewed experts were asked to assess the extent to which the following strategic guidelines are relevant to the improvement of technological progress B&H. There were 20 respondents (experts) to the given questionnaire[xii], of which 75% were employed in the public sector and 25% in private sector. The following table shows the analysis of the importance of the proposed objectives.

Table 5. Analysis of the importance of the strategic guidelines for the improvement of technological progress in B&H

	Questions	Not at all important	Not important	No opinion	Is important	The most important	l
1.	**The importance of technological progress and adoption of new technologies for economic growth and development B&H**	0%	0%	10%	20%	70%	**100%**
2.	**The importance of active state support to education system, human capital and research**	0%	0%	0%	20%	80%	**100%**
3.	**The importance of oligopoly firms in research and development activity and investment in new technologies**	0%	0%	25%	20%	55%	**100%**
4.	**The importance of cooperation between Universities and business sector**	0%	0%	20%	30%	50%	**100%**

Source: Research by author

Analyzing the table above, it can be concluded that none of the guidelines got a response *is not at all important* and *not important*, and the small number of respondents had *no opinion*. This fact shows the significance of the above mentioned guidelines for the technological development of B&H. When we look at answer *very important*, it can be noticed that all guidelines were assessed at 50% or more, of which the guideline *the importance of active state support to education system, human capital and research* achieved the best result. When the final results of the survey on a sample of relevant experts are analyzed, almost the same conclusions can be made as the ones previously mentioned in this study.

Conclusion

Investment in research and development of new technologies by the state - firm, provides them a technological advantage and superiority over those states - firms that do not take action in that field. If looked at all of the most developed countries in the world, it can be noticed that they are precisely characterized by heavy investment in the development of new technologies and ideas in general. Any country that provides decent and constant investing in research and development will provide continuous annual technological progress, which implies further strengthening of the standard of living of the population and the country's competitive position in the world.

Which market structure efficiently implements innovative activities and adopts new technologies? After considering all the facts, the conclusion is that it is oligopoly market structure (oligopolistic firms). On the one hand, monopolies do not have enough interest to include themselves into such a risky investment, but on the other hand, firms in competitive markets (small and medium enterprises) have plenty of interest, but they have little market power, they are moneyless, they have high risk, high possibility of a quick imitation etc. For these reasons it is necessary to pay more attention to oligopolies, because that market structure has sufficient market power, a sufficient amount of money needed for investment, high willingness to innovate, and eventually, a moderate risk of imitation.

It can be said that the situation is very bad for B&H and its position in the field of technological progress, investment in research and development. According to all the relevant parameters, B&H is at the very bottom of the rankings related to innovation, technological progress, patents and so on. Of course, this result is not

surprising, because this country makes "miserable" investments in research and development, and science in general.

To move forward, it is necessary to change the approach that B&H has to science, research and technological progress, but also awareness of companies in B&H. The largest number of firms in B&H looks at investment in research and development as one big expense and risk, rather than as an opportunity for future benefits and increase of the competitive position in the European and world markets. It is noted that B&H companies will never be competitive on the world market if they allow obsolescence of their production technology and if they continue to offer products with poor quality on the European and world markets.

The results of the ICT Development Index for Bosnia and Herzegovina are not satisfactory. B&H is at the 63rd place, although it recorded a growth of ICT index. Taking into consideration the neighboring countries, Bosnia and Herzegovina has improved a result only in relation to Albania. Furthermore, the results show that out of 155 observed countries, the Scandinavian countries achieved best results. The top ten countries in 2011 come from Europe, with the exception of the Republic of Korea and Japan.

The survey shows that most experts share the same opinion on the relevance of the strategic guidelines for the improvement of technological progress in B&H. Interviewed experts awarded the top mark to the guideline which is entitled *the importance of active state support to education system, human capital, and research.*

In order to remedy this bad situation, B&H must take measures to improve technological and business infrastructure. Modern scientific and technological innovation and business improvement cannot be ensured without adequate human resources, scientific research institutions, ICT equipment and systems, the relevant databases, incubation centers and technology parks, networking of all stakeholders in the country, and last but not least, all this cannot exist without adequate financial investments. It is necessary to encourage the use of modern ICT and accelerate development of information society in B&H. In order to increase innovation and competitiveness of its economy, B&H needs to strengthen technological innovation activities and link them with firms, and in that way speed up necessary changes. It should also encourage the employment of highly educated people in the economy and increased cooperation with research and educational institutions. Inclusion in the world of scientific research trends, international cooperation, as well as better

integration into the European Research Area is a key aspect of further development. To improve the design and monitoring of adopted policies to increase competitiveness and innovation it is needed to build effective institutions, following the European model, which monitor and direct the business sector. Managing of these processes means planning, organizing and directing the human and capital resources to new knowledge and ideas that create a successful production, new products and services and therefore a more competitive position of B&H in the world.

Therefore, if it wants to move away from the bottom of the list and become competitive with other countries in the region, it is necessary to: provide greater investment in science and research in general by the state, provide constant encouragement and stimulating of scientific research, increase investment in research and training of companies' personnel, promote extensively through seminars the importance of investing in research and development, etc.

References

Pepall, Lynne; Richards,Dan and Norman, George. (2008) *Industrial Organization: Contemporary Theory and Empirical Applications.* Oxford: Blackwell Publishing.

Shepherd, William G. and Shepherd, Joanna M.. (2004) *The Economics of Industrial Organization – Fifth Edition.* Long Grove: Waveland Press, Inc.

Waldman, Don E. and Jensen, Elizabeth J. (2007) *Industrial Organization: theory and practice – 3rd ed.* Boston: Addison Wesley.

Davies, Stephen and Lyons, Bruce. (1996) *Industrial Organization in the European Union: Structure, Strategy, and the Competitive Mechanism*. New York: Oxford University Prec Inc.

Casson, Mark and Creedy, John. (1993) *Industrial Concentration and Economic Inequality.* Hants: Edward Elgar Publishing Limited.

Mansfield, Edwin. (1964*) Monopoly Power and Economic Performance: An Introduction to a Current Issue of Public Policy.* New York: Norton and Company.

Reinganum, Jennifer F. (2000) *Uncertain Innovation and the Persistence of Monopoly. Readings in Industrial Organization.* Oxford: Blackwell Publishers Ltd.

Rebic, Mladen. (2010) *The Importance and Speed of Technological Changes and Investment in Research and Development.* Tehnološke inovacije generator privrednog razvoja - Zbornik radova Međunarodnog naučno-stručnog skupa. Banja Luka: Privredna komora RS.

Hutschenreiter, Gernot and Hannes, Leo. (1994) *Empirical Evidence on Schumpeterian Hypothesis in Austria*. Dordrecht: Kluwer Academic Publishers.
Mazzucato, Mariana. (2000) *Firm Size, Innovation and Market Structure: The Evolution of Industry Concentration and Instability.* Cheltenham: Edward Elgar.

Carlton, Dennis W. & Perloff, Jeffrey M. (2005) *Modern Industrial Organization - Fourth Edition.* Boston: Addison Wesley.

Lipczynski, John; Wilson, John and Goddard, John. (2005) *Industrial Organization: Competition, Strategy, Policy – 2nd Edition.* Harlow: Prentice Hall.

Utton, M. A. (2003) Market Dominance and Antitrust Policy – Second Edition. Cheltenham: Edward Elgar.

European Commission. (2011) *Bosnia and Herzegovina 2011 progress Report.* Brussels
ITU. (2012) *Measuring the Information Society*. Geneva

WEF. (2009) *The Global Competitiveness Report 2009–2010*. Geneva

WEF. (2010) *The Global Competitiveness Report 2010–2011.* Geneva

WEF. (2011) *The Global Competitiveness Report 2011–2012.* Geneva

WEF. (2012a) *The Global Competitiveness Report 2012–2013*. Geneva

WEF. (2012b) *The Global Information Technology Report 2012*. Geneva

Vijeće ministara, DEI. (2010) *Strategija razvoja Bosne i Hercegovine.* Sarajevo.

[i] In 1991, Finland's GDP has declined by as much as 13%, unemployment rate was 17%, which is a clear signal that the country was faced with difficult problems.

[ii] Not about heavy industry.
[iii] Japan, Korea, and more recently China are seriously involved in this race, with the goal of becoming the market leaders in technological progress in Asia and the world.
[iv] Innovations that are based on the reduction of production costs through the introduction of newer and more sophisticated technologies in the production process, which will ultimately lead to lower costs.
[v] Weak ability to copy, as opposed to a competitive market.
[vi] Possibilities of oligopoly to invest in research and development are influenced by the size of the profit and the size of profits depends on the intensity of competition it faces within its market.
[vii] Faced with the fact that the monopoly in relation to small business, will launch the same product in another ten years, and when we add twice the price that monopoly will determine for the same product, then it is quite logical why the offer from small firms looks more acceptable to the customer.
[viii] We will quote the example of "fast-second" strategy: Wilkinson was first to introduce the famous razor blades with steel (1960), but the Gillette responded quickly and by using this strategy easily caught up with Wilkinson, Apple was the first innovator in the field of personal computers until the end of the seventies, but the IBM soon took the lead in the eighties of the last century, however, it did not last long.
[ix] It concerns the following reasons: the criterion of consumer excess, fast-second strategy of monopoly and so on.
[x] And the position of monopoly is already known in terms of the race to innovate.
[xi] Diffusion is the time - speed for imitating new ideas - innovation.
[xii] The questionnaire was sent to over 30 experts selected at random. Only 20 of them responded to this questionnaire.