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In Search of a Strategy for Innovation Policy of Polish Economy

Abstract

The paper considers the very important problem of innovativeness of Polish economy with particular attention given to its innovation policy. The purpose of the paper is to explain the character of innovation policy which has been implemented in Poland since the beginning of economic transformation. Additionally, the paper attempts to evaluate the level of innovativeness of Polish economy. The analysis is based on the set of indicators applied in the European Innovation Scoreboard and Statistical Survey presenting in Statistical Yearbook of Poland.

Developing effective and consistent innovation policy requires choice of a particular strategy of innovation development which forms the basis for the policy. One can distinguish two such models in modern economy. In the first model, scientific and technical achievements of domestic R&D sector constitute the main factor indispensable for development of innovation. Investments in domestic scientific and development research determine invention and innovation supply. This model is applied in innovation policy of well-developed economies (Japan, the USA, Germany and Sweden). In contrast, the second model, referred to as adaptive, is based on import of new technologies. Poland should develop an adaptive model, however, its effectiveness will be dependent on the increase of the level of R&D investments, especially in the case of enterprises. The problem is that creative adaptation of imported technologies requires appropriate investments in financing domestic R&D institutions.

The paper is divided into three parts. First deals with the characteristics of innovative potential and innovative activity of Polish economy. Second is devoted to the problem of innovation policy in Poland. Considerations presented in this part allow to come to a few conclusions concerning evaluation of

innovation policy implemented in Poland. The last part discusses the issue of innovation strategy suitable for development of Polish economy in long run.

1. Introduction

Knowledge and technology sector is underinvested in Poland, whereas its innovation position is much worse than that of most European Union countries. A technological gap between Poland and European leading countries is quite significant. In some fields, as for example a level of R&D activities in a private sector or economic patent activity, the gap is enormous. Weakness of Polish innovation system, among others, is that most finances for R&D are provided by the budget, not by enterprises as in well-developed countries. Additionally, an insufficient level of technical knowledge commercialization is also a drawback of this system, which is reflected in a low share of high-tech products in Polish exports.

Increase in the level of Polish economic innovation will not be achieved merely in an automatic and spontaneous way. One has to adopt a proper innovation development strategy which would constitute the basis for implementation of innovation policy. The aim of the paper is to present various models of this strategy, as well as an influence of numerous conditions on the choice of a particular strategy in Poland. The author tries to demonstrate that an effective system of innovation formation and diffusion has not been developed yet. In present-day economy there exist established models of innovation strategy. On the basis of the level of domestic innovation ability and possibility of its increase one distinguishes three such models: a) a model based on domestic achievements of R&D sector and high innovation potential of family firms, b) an adaptation model based on import of technologies (this is a strategy making use of an internationalization process), c) an "eclectic model" which is a combination of elements of two previous models.

2. Evaluation of economic innovation in Poland

According to methodology applied by the European Innovation Scoreboard, economic innovation indicators can be divided into two groups (European Innovation Scoreboard, 2005, p. 7):

- indicators which reflect investments in R&D activities (innovation inputs) describing innovation ability of economy, i.e. its potential for innovation formation and commercialization;
- indicators describing innovation outputs, which allow for evaluation of an innovation position of a particular country, i.e. effects of combining society's creativity with financial resources in a defined economic and institutional environment.

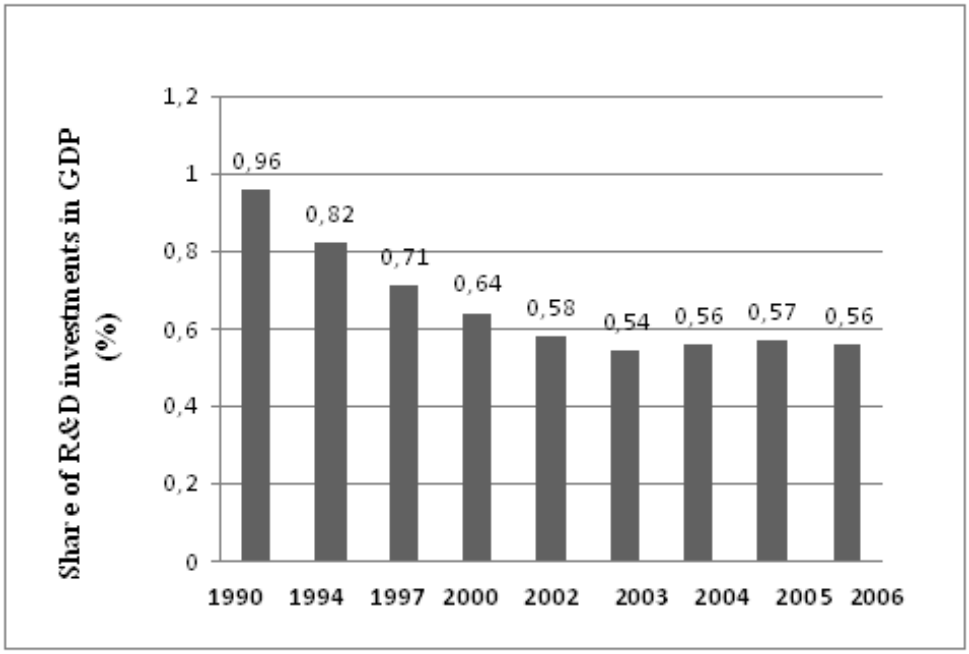
Classification of innovation indicators presented above is an attempt to combine macro- and microeconomic approaches, therefore, it enables to conduct a rather thorough analysis of economic innovation ability. On the basis of comparison of interlinked elements, which describe financial and intangible means determining economic innovation dynamism, one can estimate Poland's position in the field of science, technology and innovation activity (Polska. Raport o konkurencyjności, 2006, pp. 165-166).

2.1. Innovation ability of Polish economy

Both level and structure of financial investments in R&D activities are important measures of economic innovation ability. Figure 1 illustrates the share of financial investments in R&D activities (coming from the state budget, enterprises, research institutes of the Polish Academy of Sciences, R&D units and international organizations) in GDP in 1990-2006.

Analyzing Figure 1 one can come to the conclusion that financial investments in R&D activities in relation to GDP collapsed (decreased) in Poland in a surveyed period. Share index of these investments in GDP decreased drastically from 0.96% in 1990 to 0.56% in 2006. It is worth remembering that the very index was considered to be insufficient and posing a real threat not only to science but also to civilization development of the country yet at the beginning of the nineties. Additionally, it should be mentioned that decrease in financial investments in R&D activities in first years of transformation of Polish economy (1990-1992) was higher than decrease in GDP in the same period. Increasing tendencies occurred in the following years and it seemed that in such conditions promises of politicians, who had declared increase in R&D expenditures following overcoming economic recession, would be fulfilled. Meanwhile, share index of R&D investments coming from the state budget in relation to GDP was decreasing systematically till 2003. Yet in 2004 a decreasing tendency was stopped and the analyzed index increased reaching 0.56%.

Figure 1. Share of investments in R&D activities in relation to GDP in 1990–2006 (current prices)



Source: Rocznik Statystyczny 2007, GUS, Warszawa 2007, p. 426; Nauka i technika w 2002, GUS, Warszawa 2004, p. 29.

An analysis of Poland's position in the ranking of countries based on a share of their R&D investments in GDP indicates that there exists a huge technological gap between Poland and leaders of world science and technology. Indicators for chosen EU countries, Japan and the USA are presented in the table underneath.

Apart from the level of R&D expenditures, structure of these expenditures classified according to their financial sources is also an important element of evaluation of innovation potential of economy. The very R&D expenditures are not sufficient to evaluate innovation potential. The ratio of finances coming from the state budget (governmental) to the ones coming from enterprises is also significant. Analyses which compare innovation systems with diversified structures of these expenditures show that countries with dominating enterprise expenditures are characterized by a higher level of economic innovation than countries in which state budget expenditures predominate. It is caused by the fact that enterprises finance, above all, R&D projects which directly increase

their innovation ability. Data in Table 2 presents a share of investments in R&D activities classified according to their financial sources.

Table 1. Ratio of investments in R&D activities to GDP in EU countries, Japan and the USA in 2006

Countries	R&D INVESTMENTS (% OF GDP)
Japan	3.13
USA	2.56
UE-25	1.85
Sweden	3.74
Finland	3.51
Germany	2.49
France	2.16
Netherlands	1.77
Belgium	1.93
Great Britain	1.88
Czech Republic	1.28
Ireland	1.20
Italy	1.14
Hungary	0.89
Spain	1.07
Portugal	0.78
Greece	0.61
Poland	0.56
Bulgaria	0.49

Source: European Innovation Scoreboard 2006, pp. 34-35.

Table 2. Structure of investments in R&D activities in Poland classified according to their financial sources in 1995-2006 (current prices)

Item	1995	1998	1999	2000	2003	2004	2005	2006
In total:	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
including sources coming from:								
- the state budget	60.2	59.0	58.5	63.4	62.7	61.7	57.7	57.5
- business entities	24.1	29.7	30.6	24.5	23.5	22.6	26.0	25.1
- research institutes of the Polish Academy of Sciences and R&D units	11.9	8.3	7.5	8.1	5.9	7.5	7.0	6.7
- international organizations and institutions	1.7	1.5	1.7	1.8	4.6	5.2	5.7	7.0
- other units	2.1	1.5	1.7	2.2	3.3	3.0	3.6	3.7

Source: Rocznik Statystyczny 2007, GUS, Warszawa 2007, p. 424; Nauka i technika w 2004 r., GUS, Warszawa 2005, p. 28.

An analysis of the structure of investments in R&D activities classified according to their financial sources leads to the conclusion that the share of investments of the state budget in total R&D investments exceeded 50% (in 2005 it reached 57.7%), while the share of investments of business entities (enterprises) reached 22.6%-30.6%.

It should be emphasized that in the case of well-developed countries enterprise investments are the main source of financing R&D activities. In 2006 they constituted in 'old' European Union countries about 70% of total R&D investments (European Innovation... 2006, p. 13). Predominant nature of the share of state budget investments in financing R&D activities is typical of economicly middle-developed countries. OECD countries such as Mexico, Turkey, Portugal and Hungary are characterized by the structure of investments in R&D activities which is similar to Polish one in terms of financial sources.

An indicator which shows a share of enterprise expenditures on innovation in their turnover is useful for evaluating economic innovation ability. In 2006 industrial enterprise expenditures on innovation amounted in Poland to

1.56% of total enterprise turnover (Table 3). This share is similar to the one achieved by new European Union countries (Hungary 1.16%, Lithuania 1.57%, the Czech Republic 2.15%), however, it is lower than the same share in Sweden 3.47% and Finland 2.5%. An indicator which relates venture capital value to GDP is also interesting. This type of capital is the source of financing an early stage of enterprise formation in high-tech industries. Although Poland with the indicator equal 0.007% occupies the first place among new European Union countries, still the indicator's level places Poland beneath the EU average, which reaches in EU-25 0.025% (Table 3).

Ability of economy to create innovation is, to a great degree, dependent on human resources and education level. Comparison of Poland's position with the EU average indicates existence of a huge gap in this respect. At the same time, it is worth emphasizing that this gap has been reduced since the beginning of 1990, which is proved by the following facts:

- systematic increase in the number of graduates of scientific and engineering fields of studies, their share in population aged 20-29 amounts to 9.4%, whereas the rate of the indicator's increase is higher than increase of the EU-25 average;
- dynamic increase of the share of persons with higher education in population aged 25-64; this share is over four times higher than in 1990;
- a relatively high education indicator, 90% of the Poles aged 20-24 have at least secondary education, whereas in the European Union the indicator reaches 76.9% (Table 3).

Connections between various elements of national innovation system are an important factor which favors diffusion of innovation. Innovation friendly environment consists of numerous intangible elements that refer to interactions among entities which form and disseminate knowledge indispensible for an innovation process. A disadvantage of Polish economy in this field is considerably lower co-operation of enterprises in comparison with the EU average as regards innovation activities. According to the EIS data presented in Table 3 hardly 9.1% of small and medium-sized enterprises co-operate in the field of innovation activities. Leading countries in this respect are Denmark (20.8%), Cyprus (16.5%) and Finland (17.3%).

In present economy Internet becomes more and more important in starting enterprise co-operation in the scope of innovation activities. One of indicators of efficiency of innovation environment is broadband penetration rate per 100 population. Poland belongs to a group of countries characterized by a low level of that indicator. In 2005 it amounted to 1.9, whereas the EU average to 10.6. Nevertheless, it is worth mentioning that Poland decreases the gap existing in

this respect, since in 2004 the analyzed broadband penetration rate indicator amounted merely to 0.5 (European Innovation Scoreboard, 2005, p. 34).

Further indicator which describes innovation friendly environment is a share of innovative small and medium-sized enterprises in the total number of enterprises from that sector. In Poland sector of SMEs is characterized by a low level of innovation; in 2005 the share mentioned above amounted to 12.5% and was significantly lower than in Ireland (47.2%), Germany (46.2%) and Cyprus (39.2%) (Table 3).

Table 3. Indicators of economic innovation ability: Poland's position in comparison with the European Union in 2006*

Indicators	UE-25 average	Poland	Leader in UE-15	Leader in EU-10
Financial resources				
1) R&D budget expenditures (% of GDP)	0.65	0.39	Finland (0.99)	Hungary (0.50)
2) R&D enterprise expenditures (% of GDP)	1.20	0.18	Sweden (2.92)	Slovenia (0.97)
3) Share of university R&D expenditures financed by business sector (%)	6.6	6.0	Germany (12.5)	Latvia (23.9)
4) Share of enterprises receiving public funding for R&D (%)	no data	3.1	Luxembourg (39.3)	Cyprus (16.3)
5) Share of medium-high and high-tech manufacturing in R&D expenditures (% of manufacturing R&D expenditures)	89.2	80.0	Sweden (92.7)	Hungary (87.8)
6) Enterprise expenditures on innovation (% of total turnover)	no data	1.56	Sweden (3.47)	Cyprus (2.92)

7) Early-stage venture capital (% of GDP)	0.025	0.007	Denmark (0.068)	Poland (0.007)
8) ICT expenditures (% of GDP)	6.4	7.2	Estonia (9.8)	Estonia (9.8)
Human resources				
1) S&E graduates per 1000 population aged 20-29 (%)	12.7	9.4	Ireland (23.1)	Latvia (17.5)
2) Population with tertiary education (% of population aged 25-64)	22.8	16.8	Finland (34.6)	Estonia (33.3)
3) Life-long learning (% of population aged 25-64)	11.0	5.0	Sweden (34.7)	Slovenia (17.8)
4) Youth education attainment level (% of population aged 20-24 having completed at least upper secondary education)	76.9	90.0	Sweden (87.8)	Slovakia (91.5)
Innovation friendly environment				
1) Broadband penetration rate (per 100 population)	10.6	1.9	Netherlands (22.4)	Estonia (11.1)
2) Innovative SMEs co-operating with others (% of all SMEs)	no data	9.1	Denmark (20.8)	Cyprus (16.5)
3) SMEs implementing innovation (% of all SMEs)	no data	12.5	Ireland (47.2)	Cyprus (39.2)

* 2006 or the last year with available data.

Source: European Innovation Scoreboard 2006. Comparative Analysis of Innovation Performance CEC, Brussels, 2007, pp. 13, 34-35.

2.2. Innovation position of Polish economy

One uses input indicators with respect to the analysis of innovation ability of economy, whereas output indicators characterizing outcomes of innovation activity are applied to define innovation position. All indicators describing output are presented in Table 4.

Table 4. Indicators of innovation output: Poland's position in comparison with the European Union in 2006*

Indicators	UE-25 average	Poland	Leader in UE-15	Leader in UE-10
Output of research and innovation activities				
1. Number of EPO patents (per million population)	136.7	4.2	Germany (311.7)	Slovenia (50.4)
2. Number of USPTO patents (per million population)	50.9	1.2	Germany (123)	Slovenia (15.4)
3. Patents acquired simultaneously in the EU, USA and Japan (per million population)	32.7	0.3	Finland (101.7)	Slovenia (2.8)
4. Trademarks registered in the EU (per million population)	100.7	22.2	Luxembourg (782.7)	Cyprus (152.6)
5. New designs registered in the EU (per million population)	110.9	25.0	Luxembourg (377.6)	Czech Republic (40.9)
Knowledge commercialization				
1. Sales of new-to-market products (% of total turnover)	no data	8.1	Portugal (10.8)	Slovakia (12.8)
2. Sales of new-to-firm products (% of total turnover)	no data	5.4	Portugal (15.1)	Czech Republic (7.8)
3. Exports of high technology products as a percentage share of total exports	18.4	2.7	Ireland (29.1)	Malta (55.9)
Employment				
1. Employment in medium-high and high-tech industries (% of total workforce)	6.66	5.08	Germany (10.43)	Czech Republic (9.42)
2. Employment in high-tech services (% of total workforce)	3.35	2.15	Sweden (5.13)	Czech Republic (3.1)

* 2006 or the last year with available data.

Source: European Innovation Scoreboard 2006. Comparative Analysis of Innovation Performance, CEC, Brussels, 2007, pp. 13, 34-35.

Acquired patents are an important indicator of R&D activities output. Polish economy occupies a significantly lower place in comparison with the EU average in reference to three considered patent indicators. A leading place in patent activity is occupied by Germany, Finland and Sweden, whereas in a group of new European Union countries (including 10 countries) by Slovenia. In this group high patent score is characteristic for the Czech Republic (15.9 patents in the EUP per million population) and Hungary (18.9 patents in the EUP per million population). In comparison with these countries, patent activity of Polish business entities in Europe is highly unsatisfactory (indicator for Poland 4.2).

Number of patents acquired simultaneously in Europe, in the USA and Japan is the most universal indicator which illustrates a given country's input into world development of technological knowledge. There arises a need for wide (global) patent protection, especially in the case of exceptional inventions which can generate high profits. International comparisons show that in Poland number of patents acquired simultaneously on three continents in relation to the number of inhabitants is very low (0.3 per million population). The average EU-25 indicator amounts to 32.7, whereas in countries similar to Poland, e.g. in Slovenia – 2.8, the Czech Republic – 1.5, Hungary – 1.9 and Portugal – 0.6. Low patent activity of Polish economy is a symptom of weak interest and low enterprise patent possibilities.

Indicators reflecting number of trademarks and new designs registered in the European Union are useful while evaluating output of research and innovation activity. In this field, Luxembourg, Denmark, Germany and Austria occupy leading places among EU countries. Among new EU countries, the Czech Republic, Cyprus and Slovenia have the highest corresponding indicators. Polish indicator is lower than the EU average. Indicators of economic ability to commercialize technical knowledge involve: a) a share of sales of new-to-market and modernized products in total turnover, b) a share of sales of new-to-firm products in total turnover, and c) a share of exports of high technology products in total exports of a country. All these indicators in Poland are below the EU average. A noticeably huge gap between Poland and the EU countries exists in the case of exports of high technology products; the EU average of the share of these products in total exports amounts to 18.4%, whereas in Poland merely to 2.7%. Comparison of indicators concerning the share of sales of new-to-market products in total turnover is more favorable; the indicator in Poland reached 8.1% (in 2002 - 3.4%), in Portugal 10.8% and in Slovakia 12.8%.

Indicators concerning employment in high-tech industries and services form the last group of indicators which characterize output of innovative activity. In Poland percentage of persons employed in high-tech industries and

services is below the EU average. In the case of a share of persons employed in high-tech industries the difference between Polish indicators and the EU average is slightly smaller than in the case of a share of persons employed in high-tech services (5.08% and 6.66%, 3.35% and 2.15% respectively).

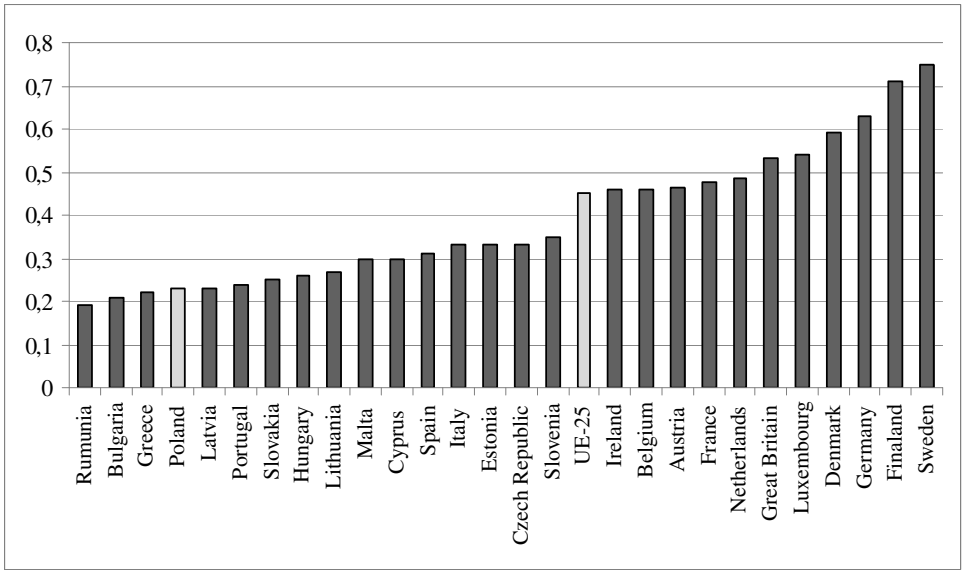
Science and technology sector is still underinvested in Poland, while innovation position of Poland low in comparison with most EU countries. A technological gap between Poland and European leaders is quite substantial. In some areas, as for example in a level of R&D activity in a private sector or economic patent activity, the gap is enormous. Weakness of innovation policy is that most R&D expenditures are financed by the state budget not by enterprises, which is the case in well-developed countries. A disadvantage of Polish innovation system is also commercialization of technological knowledge, which is resembled in a very low share of high-tech products in Polish exports resulting, among others, from low small and medium-sized enterprise innovation. A considerable number of these enterprises export products of low or medium-low technological level.

One can summarize position of Polish economy in comparison with other EU economies using Summary Innovation Index which is the outcome of evaluation conducted by the European Commission, published in the European Innovation Scoreboard 2006[16].

Summary Innovation Indices for the EU countries (27) presented above confirm earlier evaluation of the innovation level of Polish economy. Comparison of Poland with other EU countries shows that total innovation in Poland constitutes a half of the EU average and can be compared merely with innovation of the weakest EU-15 countries (Greece, Portugal) characterized by a similar to Polish level of economic development.

[16] Summary Innovation Index calculated as an average of 25 partial indicators. Value of this indicator oscillates between 0 and 1

Figure 2. Summary Innovation Index (SII), 2006



Source: European Innovation Scoreboard 2006, Comparative Analysis of Innovation Performance, CEC, Brussels 2006, p. 8.

3. Evaluation of innovation policy

Do conditions favorable for innovation growth exist in Poland which has problems with underinvested infrastructure, significant social needs and keeping macroeconomic balance? Analyzing present problems of Polish economy and the character of economic policy of subsequent governments one can be skeptical. A question arises: should one simply comply with traditional assumptions of economic growth, mainly macroeconomic ones, and wait till knowledge-based economy develops itself as a result of activity of market forces? It seems that by accepting such attitude one can never await economy capable of meeting challenges of modern economy. Such opinion is supported, above all, by fear of marginalization of economies, which do not possess trump cards valuable in globalized economy and, thus, have to play a subordinate, subcontracting role in contrast to world centers making an active use of modern scientific and technological achievements. Performing such a role brings about a small value added and causes increase of competition based on low labor costs.

It is difficult to formulate univocal evaluation of chances for accelerating the process of laying the foundations for knowledge-based economy in Poland. On the one hand, one can be optimistic taking into account the size and dynamics of Polish market as regards computer systems, computer equipment, Internet services, medicines, medical equipment, etc. Such market is attractive to enterprises which treat knowledge as their competitive advantage. Additionally, significant research and intellectual potential is still available on Polish market. On the other hand, one should pay attention to the fact that domestic market of modern products is handled to a great degree by foreign enterprises which relatively seldom place in Poland elements of a value chain connected with R&D works and designing. Only 13 out of 27 big supranational corporations which invested in Polish industry located in Poland their research institutes (Garlińska, 2005). These companies most frequently co-operate with Polish enterprises as subcontractors and suppliers of indirect goods. Ireland's example demonstrates that thanks to adequate government's policy on foreign capital one can attract investments which contribute to exports growth, which are based on modern technologies and which use skills of domestic professionals and domestic research institutes.

A crucial role is to acknowledge R&D investments, financed both by the state budget and enterprises, as a priority in economic policy. It is generally accepted that R&D domestic expenditures in relation to GDP which do not reach 1% cause in a long period weakening of driving forces of economic growth and social progress.[17] Avoiding this threat requires political will to make crucial changes in attitude of politicians and opinion presenting élites in reference to the role of science and technology in Polish economy. Poland requires strengthened awareness that future material prosperity is dependent, to a great degree, on the increase of economic innovation activity and that all government's organizational legal and financial ventures should be focused on the very increase.

There exist numerous reasons for neglecting investments in knowledge-based economy in Poland. Above all, throughout the whole transformation period decision-makers believed that Poland as a gaining property country had not possessed financial resources sufficient for innovation activity. Additionally, even financial resources available in the country have been and are still

[17] In report „Procesy innowacyjne w polskiej gospodarce" (Innovation Processes in Polish Economy) elaborated by RSSG (Economic and Social Strategy Council) at Rada Ministrów(the Council of Ministers) (no. 26, 2005) there appears a concept of ‚critical threshold' of R&D budget finincing. In authors' opinion the critical threshold should reach 0.4-0.5% of GDP.

nowadays transferred to research institutions which sometimes implement research projects not satisfying production needs. After Poland's accession to the European Union the argument concerning lack of funds for supporting innovation processes was no longer justified. Billions of Euros coming from structural funds can be invested in creating knowledge-based economy.

Rise in the level of innovation of Polish economy requires from the state elaboration and implementation of coherent and active innovation policy which is in its nature a horizontal policy joining (pairing) scientific and technical policy with industrial one. Therefore, co-ordination of activities of particular ministries is indispensable. They should co-operate in creating a strategy for development of science and technology consistent with directions of restructuring and modernization of economy. Present level of co-operation of those ministries is not satisfactory and does not favor formation of effective innovation policy.

Up till now approach towards increase of innovation of Polish economy reminds of a ritual involving formation of various programs and subprograms. A weak position of Poland in the European Union in terms of innovation proves that effectiveness of those programs is not sufficient. The problem is to be able to choose an innovation strategy, which should be revolutionary; important strategies have their roots in questioning status quo and undertaking activities in accordance with new rules.

4. Which strategy for Poland?

4.1. Models of a strategy

Various models of a strategy for development of innovation have been elaborated in modern economy. They form the basis for choosing particular innovation policy. In relation to the level of development of national innovation abilities and possibilities of their increase, one distinguishes three types of such models (Globalizacja ..., 2002, pp. 96-97):

- a model based on national achievements of R&D sector and strong innovation potential of domestic firms;
- an adaptation model based on making use of technical and technological innovation transferred from abroad (purchase of licenses, import of machines and indirect foreign investments);
- an eclectic model which combines elements of two previous models.

First model is characteristic for a small group of modern world economies: the USA, Japan, Germany, Sweden, Finland and South Korea. The essence of this strategy is development of domestic technological abilities and formation of institutions stimulating co-operation between state, industry and R&D sector. Implementation of this strategy requires high R&D expenditures mainly covered by a sector of private enterprises. A state focuses, above all, on financing national research programs which usually involve basic research of priority value for development of science and technology (Karpiński, 1997, p. 132).

In some countries, for example in the USA, high innovation ability is considered to be a synonym of economic and civilization power. It occupies a leading place not only in values of corporations but also of wide American society circles. Both in Japan and Finland innovation activity was also attributed a high status in national modernization programs (Kasperkiewicz, 1992, p. 234).

An adaptation model proposes an innovation strategy oriented towards acquisition of innovation from abroad, usually from supranational corporations, without investing considerable public funds in R&D sector. According to this strategy, a state can play a double role: on the one hand, state's activities can be limited to creating macroeconomic environment and infrastructure adequate for functioning of those corporations; on the other hand, a state can strive in an active way for indirect foreign investments.

It should be emphasized that making an effective use of foreign technologies is not an automatic process devoid of any costs. A state and enterprises have to invest in development of economic abilities to absorb technological knowledge coming from outside transfers. This ability is a derivative of the level of domestic R&D expenditures. As it follows from research conducted by the World Bank, national R&D sector has a great influence on effectiveness of enterprise absorption of foreign technologies (Goldberg, 2004, p. 19).

Innovation policy based on an adaptation model is adopted by most world economies. Countries which achieved the greatest success in this respect include: Ireland, Singapore, Spain and Taiwan. In the past this model of innovation policy was applied in Japan (in the fifties and sixties of the previous century) and South Korea.

4.2. Finnish and Irish Strategy

It is worth to proceed considerations concerning choice of a particular innovation strategy for Polish economy with a short analysis of experiences of two countries: Finland and Ireland which have achieved significant increase in the level of economic innovation by applying different strategies. It is obvious that ideal and easily copied patterns do not exist.

Finland belongs to a group of the most innovative and competitive world economies. It occupied the first place as the most competitive world economy in 2003 and 2004. Finland relatively quickly transformed from a factor-driven economy, i.e. natural resources and semi-skilled labor force, into innovation-driven economy whose driving force consists of achievements (inventions, know-how) of domestic R&D sector forming the basis for modern technologies (especially in ICT sector), as well as innovation products conquering new markets (Dahlman, Routti, Ylā-Anttila, 2006, p. 6).

Many years of high expenditures on education, research and development works as well as deregulation of numerous markets and sectors, which led to the increase of competitiveness on domestic market and consequently to the increase of labor productivity, are the source of economic success in Finland. Finnish innovation system successfully transformed R&D investments and high education level into a strong industrial high-tech production sector which forms the basis for exports. Finnish government started implementation of a public finance recovery program during an economic crisis at the turn of the eighties and nineties of the previous century. The program acknowledged R&D and education expenditures as priorities, which meant systematic growth of budget expenditures on these areas and allowed the Finnish to form an effective system enhancing development of science and technology. Increase in R&D expenditures was exceptionally fast in the second half of the nineties of the previous century, which was to a certain degree stimulated by an agreement concluded between a private sector and government under which R&D expenditures by the end of the twentieth century amounted to 2.9% in relation to GDP (Kozioł, 2005, p. 159). It is worth reminding that in 1980 these expenditures amounted to about 1% of GDP, in 1990 their share increased to 1.91% of GDP, in 2000 to 3.37%, while in 2004 to 3.5% of GDP (Dahlman, Routti, Ylā-Anttila, 2006, pp. 3-4).

Consistent implementation of a coherent and forward-looking economic strategy oriented towards increase of competitiveness through investments in education and R&D sector is a key element of Finland's success in innovation

field. An important role in this process is played by central institutions responsible for creating innovation policy. These institutions involve: the National Fund for Research and Development (Sitra), the National Technology Agency (Tekes) and the Science and Technology Policy Council. The main role among these institutions in creating innovation policy is played by Tekes which allocates funds for R&D activities to private enterprises, research organizations and universities.[18]Tekes allocates about 30% of budget R&D funds. Basic financial instruments applied by Tekes involve: a) subsidies for industrial R&D activities and loans for private enterprises, and b) subsidies for applied research (connected with new technologies) conducted in public organizations. Subsidies for scientific research are most frequently granted to enterprises and R&D institutions via technological programs developed by Tekes together with these entities. Technological programs determine priorities for particular technologies or industries and define allocation of funds to various R&D areas.

Success of a strategy of economic development based on innovation-driven economy is achieved not only due to economic factors, but also due to important social and institutional innovations. For almost twenty years efficient state governance and a low corruption level have positively influenced formation of innovation and knowledge-based economy. Administrative and political institutions represent a high level of transparency which strengthens their credibility in society. The Committee for the Future is an example of institutional innovation. It is a committee of the Finnish Parliament whose goal is to create 'good climate' for long-term economic ventures, reaching consensus in politics and development of well-balanced knowledge-based economy.[19]

Finland's example proves that a small and relatively peripheral country can create its own efficient innovation policy adjusted to world changes.

In comparison to Finland, Irish economy chose the concept of innovation policy based on an adaptation model strategy. The fact is that since the middle eighties of the previous century Irish economy has been characterized by a relatively low level of innovation activity which is, above all, a result of weak domestic R&D sector. Transfer of technologies within the framework of indirect foreign investments, especially from the USA, has been the main source of innovation.

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[18] Tekes is an agency operating within the Ministry of Trade and Industry.

[19] The Commitee for the Future was founded in 2000 and is one of fifteen permanent Parliament's committees, www.parliament.fi/FutureCommittee.

The National Program for Science and Technology developed in 1983 proposed solutions oriented towards increase of international competitiveness of Irish enterprises through innovation. In 1986 the Parliament passed the Industrial Development Act which introduced support for R&D activities and development of new products in domestic enterprises in the form of grants and fiscal incentives (Kozioł, 2005, p. 168). Despite undertaking these actions, Ireland does not belong to economies characterized by a high level of R&D expenditures in relation to GDP (about 1.2% of GDP). Foreign investments, which in the eighties and nineties of the previous century made out of Ireland a leading industrial world center of advanced technologies and services, played a key role in the increase of innovation of Irish economy.

IBM corporation built in Ireland three large manufacturing plants producing software, computer memory modules and servers, whereas Microsoft and Intel located near Dublin their biggest – outside the USA – manufacturing plants. Nowadays Ireland is second world producer of computer software; 40% of computer software sold in Europe comes from Ireland.

A positive influence of transfer of technologies through foreign companies on modernization of Irish economy could be achieved thanks to applying an effective strategy of inflow of indirect foreign investments. A keynote of this strategy is a drive for attracting foreign investments which meet the following conditions:

- ensure influence of new investments on exports increase;
- investments have to be based on making use of high-tech, as well as local experts and raw materials.

This strategy is based on a selective approach to indirect foreign investments, it favors investors who represent branches and services of industry which make use of advanced technologies. Four branches were chosen: microelectronic industry, pharmaceutical industry, production of medical equipment and financial services. The Industrial Development Agency offers income tax reliefs, modern infrastructure or even budget subsidies to those foreign investors who invest their capital in one of four branches (Roche, 2004).

High quality of human potential also contributed to the increase of innovation of Irish economy. It is a result of forward-looking and consistent state policy in the case of training and education. In the sixties of the previous century thorough reforms were initiated in Irish education system. They introduced many important changes. One of priorities of those reforms was creating unpaid secondary education available to the general public. In turn, in the seventies of the previous century an idea of creating specialized Regional Technical Colleges which would teach modern technologies was popularized.

Thus, one provided conditions in which well-qualified labor force supply was adjusted to labor demand of high-tech sector.

4.3. Choice of a strategy

Universal recipes for developing a strategy which would be equally effective in each economy do not exist. Ideal and easily copied patterns do not exist. However, in search of an innovation strategy for Poland one can refer to experiences of economies which have reached the world lead within the last twenty years.

Answer to the question – 'Which out of presented models of an innovation strategy could form the basis for choosing this strategy in Poland?' – should concentrate on the analysis of possibilities of implementing a particular version of a strategy. Due to a low ratio of R&D expenditures in relation to GDP and lack of strategic thinking in Polish politics, Finnish model is the most difficult to implement and, thus, the least plausible. Nevertheless, it is worth considering 'boundary' conditions which would have to be met in order to ensure model's chances for success in Poland. Finnish model is characterized by a few basic features: firstly, a very high share of R&D expenditures in GDP (3.51%); secondly, a dominating share of expenditures (about 72%) covered by a private sector; thirdly, high dynamics of expenditures on education. Additionally, it is worth emphasizing that Finnish economy is open to global competitiveness and sensible public finances (a budget surplus).

What are perspectives for considerable increase of R&D expenditures in Poland? According to government forecasts, the share of R&D expenditures (including expenditures of the EU Structural Funds) in GDP in 2015 will reach 1.26%, whereas in 2006 it amounted to 0.57%. Budget R&D expenditures in 2015 will be 2.5 times higher than in 2007, and 6 times higher in the case of enterprise sector (Strategia rozwoju nauki ..., 2007, p. 27). As a result, the share of enterprises in financing R&D activities will increase from about 29% of total R&D expenditures in 2007 to 49% in 2015 (Strategia rozwoju nauki ..., 2007, p. 27).

Despite rather significant from a statistical point of view increase of anticipated R&D expenditures till 2015, it is difficult to recognize this forecast as a symptom of a turning point in state's approach towards the role of R&D activity in creating knowledge-based economy. It is worth emphasizing here the fact that Czech economy allocates to R&D sector about 1.3% of GDP, whereas an average EU indicator amounts to about 1.9% of GDP. Comparison of these

indicators with anticipated in Poland increase of the share of R&D expenditures in GDP in 2015 clearly shows that in the nearest eight years the gap between Polish economy and the average EU level in respect of R&D activity will not be decreased.

Ireland's experiences concerning creating innovation strategy cannot seem to be more adequate for Polish conditions than solutions applied in Finland. One can draw such a conclusion form the fact that Ireland does not belong to magnates in terms of research and development potential, which is proved by its relatively low share of R&D expenditures in GDP (1.2%). Moreover, 'boundary' conditions of Irish model are difficult to meet in Polish conditions. Implementing a scenario based on this model would require: firstly, accomplishment of average annual dynamics of GDP growth of about 7% within a dozen or so years; secondly, limitation of state's redistributive function by carrying out a radical public finance reform; thirdly, increase of attractiveness of Polish economy for indirect foreign investments (Bossak J. W. in: Unia Europejska w kontekście strategii ..., 2006).

Taking into consideration real possibilities of economy and awareness of political establishment one should assume that Poland in the nearest perspective ought to develop an innovation strategy based on a particular version of an adaptation model. One should agree with an opinion of S. Gomułka that present „state of innovation in Poland is a normal state, adjusted to existing possibilities" (Procesy innowacyjne ..., 2005, p. 128). Therefore, transfer of innovation from abroad, especially by means of indirect foreign investments, should ensure making up for research and innovation delays. An indispensible condition for effectiveness of this solution is implementation of regulations which will make foreign companies place in Poland not only production cycles but also elements of a value chain connected with R&D processes. Additionally, it is necessary to develop domestic R&D resources in order to improve imported technologies permanently (Unia Europejska w kontekście ..., 2006, p. 13).

Recognizing an adaptation model as the basis for creating innovation strategy should not induce to abandon thinking about perspective target model strongly oriented towards development of knowledge-based economy. It requires development of a strategy which would be adjusted to ongoing changes of global economy. An adaptation strategy implemented in a relatively passive form nowadays can exhaust its possibilities in the future. Access to world-known technologies and easy innovation can be limited in time and Poland will have to face necessity for strengthening domestic system of creating innovation. Relatively rapid economic growth in Poland does not show everything, since it is competitive salaries which are mainly Polish trump card, not modern technologies and management methods. However, quickly

increasing labor costs cause that Polish economy gradually becomes less attractive to foreign companies. In 2007 about 20% of German enterprises resigned from conducting business activity in eastern Europe (mainly in Poland) because of rising labor costs.

At the present stage of development of Polish economy, an adaptation strategy can be successfully enriched by making use of domestic science and technology achievements in specialized fields not seized by large concerns. Examples of enterprises which operate in medium-developed countries and easily maintain competitive advantage on global market based on innovation commercialization (e.g. Hindu and Pakistani software enterprises or Brazilian plane manufacturer) are very instructive. High-tech enterprises which found a niche on the market of modern products and services also function in Poland (Bioton, ComArch, Medicom). Development of high-tech enterprises can become important for improving innovation of Polish economy. World experiences show that developing technology and establishing a high-tech enterprise are long-lasting ventures which require participation of the state budget and capital investment funds in implementing research work results (Procesy innowacyjne ..., 2005, p. 495; Hausner, 2007, p. 117).

5. Conclusion

Recent years have been successful for Polish economy. However, in this period chances for significant increase in the level of economic innovation have been missed. The state budget for 2008 is a budget of continuation devoid of any vision of development of economy. Lack of sufficient funds for development aims and modern technologies constitutes an important drawback of this budget.

Analyzing problem concerning choice of an innovation strategy one should pay attention to a global context. In world economy, competitive pressure of expansive Asian economies (‘rising’) under Chinese leadership intensifies. Therefore, there arises an urgent need for developing a proper innovation strategy which should indicate new sources of competitive advantage.

Indirect foreign investments as a source of innovation of Polish economy gradually exhaust their possibilities in this field. Foreign investors focused their interest on R&D activities in a few sectors (car industry, telecommunications devices and TV sets). In other sectors significance of R&D activity connected with indirect foreign investments is minimal.

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