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ASSESSMENT OF INNOVATION GAP BETWEEN POLAND AND EUROPEAN UNION COUNTRIES

Edyta Dworak

Department of Microeconomics
University of Lodz
e-mail: dworake@gmail.com

K e y w o r d s: innovation, innovation gap, innovativeness, Innovation Union Scoreboard, Summary Innovation Index.

A b s t r a c t

This paper aims to estimate the innovation gap between Poland and European Union countries, and evaluate the innovative position of the Polish economy in relation to EU countries. The assessment was conducted on the grounds of the Summary Innovation Index, presented in the Innovation Union Scoreboard and an examination into the indicators describing the index. Results of the analysis show the occurrence of the innovation gap for the most indicators in comparison to innovative leaders in the EU, as well as to the EU countries with a similar level of economic development, i.e., the Czech Republic, Hungary and Slovenia.

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Edyta Dworak
Katedra Mikroekonomii
Uniwersytet Łódzki

S ł o w a k l u c z o w e: innowacja, luka innowacyjna, innowacyjność, unijna tablica wyników w zakresie innowacji, sumaryczny wskaźnik innowacyjności.

A b s t r a k t

Celem opracowania jest oszacowanie luki innowacyjnej między Polską a krajami Unii Europejskiej i ocena pozycji innowacyjnej polskiej gospodarki na tle krajów UE. Szacunków dokonano na podstawie sumarycznego wskaźnika innowacji, prezentowanego przez Komisję Europejską w unijnej tablicy wyników w zakresie innowacji oraz zmiennych tworzących ten wskaźnik. Wyniki analizy wskazują, że w większości badanych obszarów potencjału innowacyjnego występuje luka między polską gospodarką a innowacyjnymi liderami UE, jak również krajami UE o podobnym poziomie rozwoju gospodarczego, tj. Czechami, Węgrami i Słowenią.

Introduction

The vast majority of countries which in the era of accelerated globalization achieved a high level of economic development, owe this advancement, to the following factors (PAKULSKA 2005, p. 59):

– Developed research potential (in the form of stocks of highly qualified scientific personnel, and physical and financial capital);

– Location of R&D labs of multinational corporations on their territory, most of which are carrying out intensive research (WYSOKIŃSKA 2009, p. 60, 61);

– High propensity of enterprises to absorb innovation in line with the „Innovate or Die" motto;

– Appropriate national innovation policy, resulting from the strategy of economic development, involving promotion and funding by the State of scientific research, personnel training, development of education, investment in research infrastructure, etc.) (DWORAK 2012, p. 214).

Nowadays, the awareness of the positive relationship between enhancing innovation and economic development transcends the borders of developed countries, and is gradually takingroot in the structure of the economies (e.g. in countries such as China, India, and Brazil) which are „catching up" in relation to the world leaders. Under these conditions Poland faces a serious challenge of effective transformation of its economy into an innovative economy, able to compete with the most developed countries.

This paper aims to estimate the innovation gap between Poland and European Union countries, and evaluate the innovative position of the Polish economy in relation to EU countries.

The concept of the innovation gap

The concept of the innovation gap is variously interpreted in the economic literature. S. Kubielas defines the innovation gap as differences in the level of technological advancement between countries and proposes a number of methods to measure its size. He says that it can be measured by the distance between the level of technological activity of the country and the countries at the technological frontier, calculated either as a ratio of the number of patents per capita or the share of research expenditure in value-added or national income (KUBIELAS 2009, p. 137). The literature review shows also indirect measures such as: the share of high-tech products in exports in relation to the similar indicator for the technology frontier, the relation of performance (labour productivity) of a given branch of the country in relation to the country

on the verge of technological frontier or in aggregate terms the relation of GDP per capita to the corresponding indicator of the technological frontier (KUBIELAS 2009, p. 137). The last two approaches identify the technological gap with a productivity gap or income gap. The global technological frontier shall be deemed as the GDP level, which can be achieved by using the given inputs of capital and labour, and the best possible technologies (GROWIEC 2012). This level of GDP is now achieved by the U.S. economy, in which, as stressed by S. Kubielas, the distribution of specializations (between the four Pavitt's sectors) is the standard for a technology leader. The highest competitive advantages are demonstrated by the science-based sector, followed by the specialized suppliers sectors; the consecutive sectors; the scale-intensive, traditional, supplier-dominated sectors are characterized by negative indices of the revealed comparative advantage, of which the traditional is the lowest on the scale of revealed advantages of the U.S. economy (KUBIELAS 2009, p. 153).

In the literature, there is also a concept of the innovation gap, understood as the distance of individual economies to the so-called modern technological frontier, which is identified with the last stage of socio-economic development of economies, i.e., the emergence of a knowledge-based economy (ZACHER 2007, p. 530). To investigate this approach to the innovation gap, one should use a point of reference, which involves initial conditions of building a knowledge--based economy, formulated by J. Kleer. They are as follows (KLEER 2009):

– Economy must achieve a sufficiently high level of income (about $20,000 per capita), and the structure of GDP is characterized by a high share of services in GDP – 70% or more;

– Society is characterized by a high level of education, in which secondary education is widespread, and higher education covers at least half of the economically active population;

– High share of expenditure on R&D (it is generally recognized that the size of the required outlays is about 3% of GDP);

– Innovativeness of the economy manifests itself in minimizing regulations, supporting innovative projects, not only in purely economic areas, but also in high expenditure of the public sector on research promoting directly and indirectly development;

– The economy and society are involved in the exterior exchange, concerning not only the exchange of goods and services, but also the circulation of ideas (for which the information revolution has created enormous opportunities);

– Modern public sector needs to be a mixed model, and not purely liberal.

The United Nations defines the innovation gap slightly generally, as a distance between those who have access to technologies and know how to use them effectively, and those who are not able to do it (KRACIUK 2006). The innovation gap can be considered from the perspective of creating new

technology in the home country, as well as from the perspective of its transfer from other countries and effective adaptation to the needs and national capabilities.

In summary, it can be stated that measuring the innovation gap means to estimate the distance between the economy and the most developed economies of Europe and the world, known today as knowledge-based economies, in many areas, e.g., in the sphere of innovation, education and institutional system.

Rating innovation gap of the Polish economy in the light of Innovation Union Scoreboard 2015

Measuring innovation of economies is a major challenge for economists. Most often measurements are made based on a synthetic index of the level of innovation in the economy. One category, based on the synthetic index of innovation, involves Innovation Union Scoreboard. It is a special research method, developed by the European Commission, whose aim is to assess achievements, trends, strengths, and weaknesses of individual economies in the field of innovation[1]. The last edition of 2015 is an attempt to assess the innovative achievements of European economies based on indicators describing three areas of innovativeness: Enablers, Firm activities, Outputs. Variables belonging to these areas are the basis for calculating the Summary Innovation Index (SII). It is estimated using the weighted value of standardized data, where the highest value in the group of countries under study is 1 and the lowest 0. On the basis of this indicator countries in the European Union are classified into four performance groups: innovation leaders, innovation followers, moderate innovators, and modest innovators. The values of the summary innovation index for the four groups of countries in the years 2007–2014 are shown in Table 1.

According to the data presented in Table 1, the IUS indicator for Poland increased from 0.292 in 2007 to 0.323 in 2011; in 2012 it decreased to 0.303, and then increased to 0.313 in 2014.

Based on the Summary Innovation Index it is possible to assess the level of innovation of the Polish economy and estimate the innovation gap that exists between Poland and EU countries. Table 2 presents detailed picture of Poland's position in terms of innovation compared to the average SII for the EU-28, average SII for each group of countries identified based on this index, and the most advanced Member State.

[1] This is one of a set of indicators developed by the European Commission in order to meet the specific needs of EU economic policy, science, and technology (Niedbalska 2003, p. 185).

Table 1

The values of the Summary Innovation Index for the countries of the European Union in the years 2007–2014

Specification		2007	2008	2009	2010	2011	2012	2013	2014
EU28		0.519	0.519	0.529	0.543	0.545	0.542	0.554	0.555
Sweden	innovation leaders	0.723	0.737	0.742	0.758	0.764	0.766	0.760	0.740
Denmark		0.647	0.659	0.673	0.697	0.696	0.713	0.729	0.736
Finland		0.672	0.672	0.669	0.676	0.682	0.684	0.680	0.676
Germany		0.650	0.655	0.667	0.689	0.685	0.690	0.690	0.676
Netherlands	innovation followers	0.573	0.579	0.583	0.593	0.598	0.642	0.645	0.647
Luxembourg		0.640	0.637	0.643	0.626	0.626	0.644	0.660	0.642
Great Britain		0.565	0.568	0.575	0.607	0.607	0.613	0.625	0.636
Ireland		0.570	0.571	0.591	0.603	0.619	0.611	0.615	0.628
Belgium		0.573	0.580	0.580	0.611	0.616	0.619	0.629	0.619
France		0.544	0.549	0.557	0.573	0.579	0.578	0.586	0.591
Austria		0.557	0.568	0.582	0.556	0.565	0.581	0.597	0.585
Slovenia		0.446	0.468	0.485	0.496	0.519	0.509	0.532	0.534
Estonia	moderate innovators	0.420	0.424	0.466	0.470	0.498	0.503	0.523	0.489
Czech Republic		0.373	0.382	0.387	0.425	0.436	0.421	0.438	0.447
Cyprus		0.449	0.495	0.473	0.491	0.504	0.503	0.489	0.445
Italy		0.393	0.399	0.412	0.427	0.428	0.446	0.448	0.439
Portugal		0.365	0.392	0.403	0.426	0.421	0.396	0.400	0.403
Malta		0.325	0.341	0.348	0.343	0.340	0.311	0.350	0.397
Spain		0.396	0.398	0.403	0.399	0.402	0.411	0.408	0.385
Hungary		0.336	0.345	0.346	0.359	0.366	0.354	0.362	0.369
Greece		0.362	0.374	0.385	0.382	0.380	0.391	0.394	0.365
Slovakia		0.316	0.327	0.334	0.316	0.323	0.373	0.354	0.360
Croatia		0.296	0.305	0.314	0.314	0.318	0.304	0.309	0.313
Poland		0.292	0.302	0.314	0.314	0.323	0.303	0.302	0.313
Lithuania		0.244	0.245	0.254	0.244	0.269	0.281	0.293	0.283
Latvia	modest innovators	0.215	0.225	0.223	0.239	0.260	0.250	0.233	0.272
Bulgaria		0.184	0.201	0.214	0.244	0.249	0.206	0.202	0.229
Romania		0.240	0.250	0.264	0.255	0.275	0.245	0.255	0.204

Source: *Innovation Union Scoreboard 2015*, online: www.proinno-europe.eu/metrics (2015, p. 92).

Table 2

Innovativeness of Polish economy compared to the average SII EU-28, the average SII for different groups of countries classified based on the SII, and the most advanced Member State in 2014

Country/ group of countries	Poland	EU-28	Innovative leaders	Innovation followers	Moderate innovators	Modest innovators	Clear leader (Sweden)
The average value of the SII in 2014	0.313	0.555	0.707	0.610	0.385	0.235	0.740

Source: *Innovation Union Scoreboard 2015*, online: www.proinno-europe.eu/metrics (2015, p. 92).

The analysis of the data presented in Table 2 shows that the level of innovation of the Polish economy, as measured by the Summary Innovation Index, is below the average for the EU-28, the average SII calculated for the group of innovative leaders, as well as below the average index for the innovation followers. It is also lower than the average rate estimated for the group of economies, which includes Poland, i.e., the moderate innovators. The level of innovation of the Polish economy accounts for 56% of the average index for all EU countries, only 44% of the average index for innovative leaders, 51% of the average SII for a group of innovation followers and 81% of the average SII for moderate innovators. Therefore, it can be concluded that Poland's innovative potential gap exists not only in comparison to the most innovative economies of the EU and followers, but also compared to all the moderate innovators with the exception of Lithuania (SII – 0.283).

Table 3
Innovativeness of the Polish economy in comparison to the European Union countries in 2014

Indicator	Poland	Percentage of EU-28 average	EU-28 average	Clear leader
1	2	3	4	5
Human resources				
New doctorate graduate per 1000 population aged 25–34	0.6	33	1.8	Sweden (2.8)
Share [%] of those having completed tertiary education in the 25–34 age group	40.5	109	36.9	Ireland (52.6)
Share [%] of people aged 20–24 having attained at least upper secondary education	89.7	110	81.0	Croatia (95.0)
Research systems				
International scientific co-publications per million inhabitants	237	65	363	Denmark (1916)
Scientific publications among the top 10% most cited publications worldwide as share [%] of total publications of the country	3.8	34	11.0	Netherlands (15.6)
Share [%] of Non-EU doctorate students in the total number of doctorate students	1.9	7	25.5	France (35.4)
Finance and support				
Share [%] of public expenditure on R&D in GDP	0.48	67	0.72	Denmark (1.04)
Share [%] of venture capital investments in GDP	0.036	58	0.062	Great Britain (0.119)

cont. Table 3

1	2	3	4	5
Firm investments				
Share [%] of expenditure on R&D in GDP in the business sector	0.38	29	1.29	Finland (2.29)
Share [%] of Non-R&D investments in turnover	1.04	151	0.69	Estonia (1.55)
Linkages & entrepreneurship				
Share [%] of SMEs innovating in-house in the total number of SMEs	10.1	35	28.7	Netherlands (38.9)
Share [%] of innovative SMEs collaborating with others in the total number of SMEs	3.9	37	10.3	Belgium (22.9)
Public-private co-publications per 1 million inhabitants	4.7	9	50.3	Denmark (193.0)
Intellectual assets				
PCT Patent applications at the European Patent Office per billion GDP	0.42	11	3.78	Sweden (9.16)
PCT patent applications at the EPO in societal challenges per billion GDP (PPS€)	0.09	9	0.98	Denmark (2.76)
Community trademarks per billion GDP (PPS€)	3.61	62	5.83	Malta (30.97)
Community designs per billion GDP (PPS€)	1.62	143	1.13	Luxembourg (2.44)
Innovators				
Share [%] of SMEs with product and process innovations in the total number of SMEs	13.1	43	30.6	Germany (42.4)
Share [%] of SMEs with organizational or marketing innovations in the total number of SMEs	14.2	39	36.2	Luxembourg (52.1)
Share [%] of employment in fast-growing innovative firms in total employment	19.3	108	17.9	Ireland (21.8)
Economic effects				
Employment in knowledge-intensive sectors as % of total employment	9.6	70	13.8	Luxembourg (26.2)
Medium & high-tech product exports as % of total product exports	48.6	92	53.0	Hungary (66.3)
Knowledge-intensive services exports as % of total services exports	33.6	68%	49.5	Ireland (76.1)
Sales of new to market and new to firm innovations as a % of total turnover	6.3	51%	12.4	Denmark (22.1)
License and patent revenues from abroad as % of GDP	0.06	(9%)	0.65	Netherlands (3.75)

Source: Compilation based on: *Innovation Union Scoreboard 2015*, online: www.proinno-europe.eu/metrics (2015, Annexes A–C, p. 88–96).

Relevant information on the innovation gap between the Polish economy and the countries of the EU is provided by the analysis of the variables describing various areas of innovation, underlying the structure of Summary Innovation Index (Tab. 3).

Based on the analysis of the data contained in Table 3 it can be concluded that among the components of the summary indicator of innovation for the Polish economy only five variables are above the EU average: the number of graduates from universities and high schools, Non-R&D innovation expenditures, employment in fast-growing innovative firms and a number of Community industrial designs. In the case of the number of university graduates Poland exceeds the EU average rate by 10%, and in the case of high school graduates by 11%. The Non-R&D innovation expenditures are at a level higher by 50% than the EU average, the number of Community industrial designs is higher by 43%, and employment in innovative firms by 8%. Other indicators show values below the average for the 28 EU countries. The relatively high value in relation to the EU average was recorded in exports of medium-high and high-tech products as % of total export of products (90%). The level of approximately 70% of the average indicator for the 28 EU countries was reached in: employment in knowledge-intensive sectors as % of total employment (70%), knowledge-intensive services exports as % of total services exports (68%), share [%] of public spending on R&D in GDP (67 %), international scientific co-publications per million inhabitants (65%). The following components of the summary innovation indicator are about half the average value of the indicator for the 28 EU countries: share [%] of venture capital investments in GDP (58% of the average), sales of new-to-market and new-to-firm innovations as a percentage of total turnover (51%), share [%] of SMEs with product and process innovations in the total number of SMEs (43%).In contrast, the following indicators are at a significantly low level compared to the EU average: the share [%] of doctorate students from outside the EU in the total number of doctorate students (only 7% of the EU average), license and patent revenues from abroad as percentage of GDP (9% of the EU average) public-private co-publications per million population (9% of the EU average), patent applications at the European Patent Office per billion GDP (11% of the EU average).

The above indices of innovation require a few comments, especially those that point to the existence of the innovation gap between the Polish economy and the EU countries.

Firstly, it is worth noting the relatively high share of medium-high and high-tech product exports in total exports (90% of the EU average). This indicator, however, is an illusory criterion for assessing the level of innovation in the Polish economy, because it results merely from the high innovation of

companies with foreign capital located in Poland which moved here the elements of production, and left research and development centres in the countries of origin of capital (*Competitive Poland: How to advance in world economic league* 2013, p. 27). Owing to foreign capital new industries-Polish--specialties were created: car, home electronics and home appliances assembly plants, manufacturing of components for cars and planes (GROMADA et al. 2015, p. 12). However, in the international chain of creating added value these specialties represent production stage located between the conceptual-research phase and marketing and sales, which means a low return of Polish exports on expenditure incurred. This situation threatens consolidation of economic growth dependent on foreign capital, which has a greater interest in maintaining low labour costs than investing in innovation (GROMADA et al. 2015, p. 12).

Secondly, it is significant that in Poland the indicators on the education system are favourable. This is demonstrated by the data presented in the Innovation Union Scoreboard. However, it must be emphasized that they evidence only a high degree of formal education, not the quality of teaching, which is clearly indicated by the level of innovation in the Polish economy. Polish education system is not conducive to promoting creativity and collaboration capability, it does not encourage building the social capital, understood as a set of informal values and ethical standards common to members of a particular community and enabling them to effectively cooperate.

Thirdly, an insufficient level of development of social capital is demonstrated by the lack of permanent relationship between the actors of the scientific – research sphere and the industry sphere. There is no effective system of cooperation between these spheres in Poland, creating a kind of a „vicious circle" of impossibility in this area. On the one hand, entrepreneurs complain that innovative projects offered by the R&D institutions do not meet their needs and show a passive approach to the commercialization of research results. On the other hand, representatives of the R&D sphere believe that companies are quite poorly interested in using the research results because their strategy is focused primarily on the use of simple reserves of labour productivity growth. In fact, many companies use basic competitive advantages resulting from low manufacturing costs, and not from constant improvement of the quality of products, the power of the created brand or the capital-intensive investments in the development of technology. In turn, those that are interested in innovations, often focus not so much on finding their own solutions (which might require scientists), but on a much simpler purchase of licenses or technologies from outside.

Fourthly, in the absence of incentives to conduct co-operation between scientific-research sphere and businesses it should not be surprising that business expenditures on R&D in Poland are at only 29% of the EU average,

while Non-R&D innovation expenditures exceed the EU average by more than 50%. It is also worth noting that the level of government expenditures on R&D in Poland is among the lowest among the EU and OECD countries and also below the average level observed in the countries of the Visegrad Group. It should be emphasized, however, that increasing public expenditures on R&D is not an action that could significantly affect the growth of innovation in the economy. These expenditures are in fact determined by political decisions, and not, as in the case of the private sector investments, by market mechanisms. Thus, the present situation requires increasing the business expenditure on research and development, rather than increasing government expenditures.

Fifthly, Poland's IUS indicator of patent applications to the European Patent Office accounts for only 11% of the EU average. The research shows that there is a positive relationship between patent activity and the level of development of the country. The culture of innovativeness is a tradition in highly developed countries (e.g., Germany, Anglo-Saxon countries, the countries of the Far East), and patent activity is widespread, while in the countries with a lower level of development there is no sufficiently well-established tradition/institutions in this regard and patent activity is weak (ORŁOWSKI 2013, p. 13). Poland, because of the low level of expenditures on R&D, especially those financed by the private sector, and lack of good of cooperation between universities and industry, is doomed to belong to the second group of countries.

Sixthly, the low number of public-private scientific co-publications results from the above indicators. This indicator for Poland stands at a relatively low level – higher only than those for Bulgaria and Cyprus. It seems that this situation is a result of the shortcomings of social capital, manifested e.g., by the inability to implement tasks jointly and the mistrust and social dislike of public-private actions (*Report on public-private partnership in Poland* 2013).

Seventhly, it is significant that Polish universities also have a low degree of openness to cooperation with foreign countries, as evidenced by the low number of non-EU doctorate students in Polish universities.

Examination of the indicators that describe the level of innovation in the economies of the European Union allows to conclude that only in several respects the innovative position of the Polish economy exceeds the EU average. For most indicators, however, we can talk about the occurrence of the innovation gap in comparison to innovative leaders in the EU, as well as to the EU countries with a similar level of economic development, i.e., the Czech Republic, Hungary, and Slovenia.

Determinants of innovativeness of the Polish economy

In 2015 in the IUS ranking Poland was included in the group of moderate innovators, which means improved position in relation to previous years, however, it is still in the „tail-end" of the group. One should therefore note that the effects of the so far implemented model of supporting innovation in the Polish economy are small. Some of the principles of this model have already been outlined, but it is worth to summarize them:

– Raising the level of innovation in the economy takes place by imitation diffusion, consisting in the almost wholesale import of technology, modern for us, but obsolete in the world, embodied in machinery and equipment (GEODECKI et al., p. 6);

– Technology transfer is done through foreign direct investment, however, transnational corporations invest in Poland elements of the value chain which are associated mainly with the production cycle, and not with research and development activities, they do not therefore increase value added (GROMADA et al. 2015, p. 11).

– Competitive advantages are based on low labour costs, the use of cheap raw materials, and extensive exploitation of the funds raised as a result of the EU allocation,

– The share of expenditure on research and development in GDP is low (0.9%),

– What is necessary is a long-term, coherent and consistent policy of development of science and technology, which would determine the preferred state development directions of scientific research and technology areas in which one could use national potential and achievements of Polish inventors (DWORAK 2012, p. 219).

There is no universal recipe for improving the level of innovation which would be effective in any economy. In search of a strategy for the Polish economy, however, one can refer to the experience of countries which in recent years have advanced to the forefront of the world, e.g., Finland or Ireland. It is thus worth then briefly characterizing these two models of fostering innovation. The Finnish model is based on the achievements of the domestic R&D sector, strong research and innovative potential of domestic companies, as well as on the high expenditure on R&D in relation to GDP (reaching almost 4%), the dominant share of expenditure on R&D (over 70%), incurred by the private sector, and the high growth of spending on education (DWORAK 2012, p. 191). The Irish strategy is on the other hand referred to as an imitation model, based primarily on the use of technological innovations, acquired by transfer from abroad, and a selective approach to foreign direct investments, favouring investors representing industries and services using advanced technologies

and high-quality human capital. The Irish model has in addition a relatively low share of expenditure on R&D in GDP (slightly more than 1.5%).

Taking into account the real possibilities of the Polish economy, it seems that the Irish strategy is more congruent to the Polish conditions. This strategy has to some extent been implemented in Poland – innovation is acquired by means of imitation diffusion – but still regulations are missing which would ensure that foreign companies would locate in Poland, in addition to production cycle, also the elements of the value chain associated with the R&D activities. However, due to the fact that the imitation model in the future may exhaust its possibilities, adopting it as the basis for shaping innovation strategy should not encourage to abandon the thinking about creating and increasing the efficiency of domestic mechanism for generating innovation. It is therefore necessary to make the effort to reconstruct the existing model of supporting the development of innovation in Poland. The success of this project depends on many different factors which affect not only the sphere of economic policy, but also social and cultural conditions.

Firstly, it is important to raise the level of innovation of the Polish economy and bridge the innovation gap in relation to most EU countries and formulate a long-term strategy for socio-economic development. Without such a strategy it is not possible to pursue an internally coherent and consistent policy of development of science and technology, which would designate development directions of scientific research and technology areas preferred by the state, allowing the use of the national potential and achievements of Polish inventors. The existing development strategy of the country, based on the use of knowledge and innovation as the main driving force of this process has a number of shortcomings. The basic weakness of this strategy is the immediate thinking about the economy rather than prospective thinking, which consists in setting long-term development goals. Successive governments, when they come to power, set their own priorities, in isolation from what was already well done or planned by their predecessors. As a result, there is no agreed common strategy setting out the prospects for development of economy and society.

Secondly, a key condition for raising the level of innovation in the economy is to ensure a stable macroeconomic environment, which provides the background for the realization of modernization programmes. Transparent rules of monetary and fiscal policies provide a framework for the activities of economic entities. In this context, of particular importance is the state of public finances, which determines the government's participation in projects supporting development, especially in areas such as education, R&D, supporting firms' innovation (mainly SMEs), and transport or energy infrastructure (*The strategy of innovation and economic efficiency* 2011).

Thirdly, the development of innovation requires a well-functioning institutional system. Qualified human resources and high expenditures on R&D are important drivers of innovation processes, but do not automatically guarantee the effective use (commercialization) of new technologies or accelerate the growth of GDP *per capita* (PŁOWIEC 2010, p. 657). Therefore, it is essential to have an appropriate institutional order which affects the utilization of technological potential of the economy. Empirical studies confirm the existence of a positive, statistically significant correlation between the degree of the development of the economy and the efficiency of the State's systemic activities in developing the institutional order[2]. The institutional environment includes an important element, a widely understood business environment, which facilitates the development of entrepreneurship and innovation. This means, among others, the need to simplify administrative and judicial procedures.

Fourthly, the creation of an effective system for promoting innovation requires increased and adequate allocation of financial outlays on R&D and implementation, coming from the state budget and industry. Changes in this area should consist primarily in increasing industry expenditure on R&D by facilitating access to capital in all phases of the R&D projects. Budgetary outlays on R&D should also be increased, provided that the R&D investments of private enterprises also increase (OKOŃ-HORODYŃSKA 2004, p. 33).

Crucial for financing of firms; innovative projects is the development of the private equity and venture capital market. Existing involvement of private equity funds or venture capital funds in financing this type of activity in Poland is insufficient[3]. The existing important legal acts which could significantly increase the level of innovation in the economy (public procurement, public-private partnership), are also not sufficiently pro-innovative. The development of the public-private partnership system in financing strategic technologies creates opportunities to overcome barriers to the capital, which now discourages, especially small and medium-sized enterprises, to undertake innovation.

Fifthly, to significantly raise the level of innovation in the economy it is necessary to develop permanent links between the entities of R&D sphere and industry. Building a close relationship between R&D institutions and enterprises should focus on the development of projects involving support for:

– The movement of personnel between R&D institutions and the economy, including internships of R&D workers in enterprises and employees of enterprises at universities;

– Cooperation within the clusters, which increase the ability of operators to

[2] The study included the OECD countries in the years 2001–2005 (BALCERZAK 2009, p. 231–241).

[3] Venture capital investments in relation to GDP accounted for 0.043%, and the average rate for the European Union was 0.11%. *Innovation Union Scoreboard 2010* 2010, p. 62.

create, absorb and diffuse innovation; of particular importance in this process are innovation clusters, which consist of research institutes, universities, innovative enterprises, and service providers, mainly in the field of technical, financial, and marketing advice (SKAWIŃSKA, ZALEWSKI 2009, p. 36, *Building the innovative capacity of regions* 2009, p. 36);

– The establishment and development of institutions of innovative companies; environment, such as technological incubators, technology transfer centres, and science and technology parks.

The plan of the new Law on Higher Education, which proposes to give scientists intellectual property rights in the results of their research, creates hope for closer cooperation between the research sector and businesses.

Seventhly, the education system is an important pillar of the strategy for improving innovativeness, which is focusing on developing creativity and ability to work together, life-long learning with a wide range of possibilities to complement the knowledge or even profession and increasing the flexibility of shaping curricula and their internationalization. The efficient use of human capital requires the increase in social capital. The indicators characterizing this capital in Poland are currently the lowest in the European Union. According to a study in the framework of the *Social Diagnosis 2013*, only 14% of Poles trust other people, with an average confidence level of 32% in the European Union (*Social Diagnosis 2013: The conditions and quality of life* 2014, p. 320).

Eighthly, it is necessary to make substantial changes in the system of financial support to undertakings under the Operational Programme Innovative Economy (OPIE). Funds should go to the companies which transform these undertakings into commercial success, and economic effects should be adopted as the measure of success, rather than the pace of spending the funds acquired from the EU. To acquire the financial support it is not enough to fill out correctly a complex application form, it is necessary to arrange a series of meetings between companies and institutions, which the government will set up to assess the companies; research and development potential (panel model).

Conclusions

To sum up the discussion on the level of the innovativeness of the Polish economy it should be emphasized that in terms of the strategic objectives of economic development we cannot accept the opinion that Poland, due to the backwardness in the level of innovation in comparison to the majority of European Union countries, is doomed to be among the economies of peripheral capitalism. The positive experiences of some Asian countries (South Korea,

Taiwan, and Singapore) and Europe (Finland), show that it is possible to change fairly quickly the current place of a given economy on the world map of research and innovation. Nonetheless, it must be clearly understood that there is no universal recipe for increasing the level of innovation strategy, which would work with equal effectiveness in every economy. In search of a strategy for Poland one can, however, call upon the experience of countries which in the last quarter of a century advanced to the group of the most innovative economies in the world. Taking into account the real possibilities of the Polish economy at this stage of its development it should be assumed that Poland in the near future should pursue a strategy based on a specific version of the imitative model. Therefore, it is possible to bridge the gap in in research and innovation by means of the transfer of knowledge and innovation, mainly through foreign direct investments. The necessary condition for the effectiveness of this solution, however, is to introduce regulations that will ensure that foreign companies will locate in Poland, not only the production cycle, but also elements of the value chain related to R&D. It should be added that the transfer of new technologies through direct investments imposes certain obligations on the countries which acquire them. It is therefore necessary for them to have their own R&D facilities and trained engineering and technical staff, as well as financing for the development of imported technologies. It should be emphasized that Poland's imitative strategy is currently implemented in a fairly passive version, but it may exhaust its possibilities in the future. Over time, the access to world-wide well-known technologies and readily available innovation may be constrained and Poland will face the need to increase the efficiency of national mechanisms of generating innovation. The effectiveness of this mechanism is an important condition enabling the Polish economy to absorb foreign innovation and the achievements of world science and technology through indigenous R&D institutions. In the long run the Polish economy should, in selected fields of science and technology in which Poland represents the highest global level, move from the group of „peripheral technology" economies to the group of technology leaders (FIEDOR 2009, p. 281). It would be unrealistic, however, to expect the Polish economy to record spectacular achievements of the Polish economy in the world's major areas of innovation. On the other hand, it is quite possible to find niches in these fields of science and technology which are Polish specialties and have a chance to achieve market success.

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