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AN ANALYSIS OF THE INNOVATION LEVEL OF ENTERPRISES IN THE EUROPEAN UNION

Abstract. The factor that is decisive for the functioning and development of enterprises is their competitive abilities in the domestic and international markets. The level of innovation is a key factor affecting the competitive abilities. The ability to create and use innovation becomes a major factor determining the effectiveness of operation and development of enterprises in the competitive market.

The goal of this paper is to make a comparative analysis of the level of innovation activities of industrial enterprises in the European Union countries as well as of selected external conditions affecting innovation processes in those countries. The innovation level of enterprise in the EU market is a key factor determining their international competitive position.

Key words: innovation, enterprises, European Union, R&D sector, patent statistics.

1. INTRODUCTION

The level of innovation is a key factor that affects competitive edge of enterprises in the domestic and international markets. Generation of innovation by enterprises allows to achieve or maintain competitive advantage in the market that results in development of the enterprise and improvement of its competitive edge. Since enterprises play a major role in the economy, innovation is also a major factor of growth and economic development.

The category of innovation to economic sciences was for the first time introduced by J.A. Schumpeter who treats innovation as a factor of economic development. In his interpretation, innovation is a new combination in the following instances (Schumpeter 1960, p. 104):

- manufacturing of a new product or marketing of products with new properties,
- introduction of a new manufacturing method,
- opening of a new market,
- finding a new source of raw materials,
- a new organisation of an industry, e.g. creation or liquidation of a monopoly.

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The coverage of the definition is very broad and includes all changes of technical, organisational and economic nature that take place in economic entities. A similarly broad (global) definition of innovation is used by P. F. Drucker (Drucker 1968, p. 58) who is of the opinion that innovation penetrates all spheres of operations of companies. Those can be changes in product models, marketing methods, offered price, customer service or changes in organisation and management methods.

In economic literature there is also a narrower and more precise notion of innovation, assuming that not every novelty can be treated as innovation. Usually, the definition by Ch. Freeman is used (Freeman 1982, p. 7) in whose opinion innovation is the first commercial marketing of a product, process, system or device. This notion of innovation disregards innovation related to social and organisational changes with focus on technical innovation. That is primarily due to the fact that the scope of technical (technological) changes most effectively determines transformations in the manufacturing process and economic development. also statistical research performed by Eurostat is limited solely to technological innovation. Within the meaning of the Oslo methodology, technological innovation occurs when a new or improved product is marketed or when a new or improved process is applied to production while the product or process are new at least from the viewpoint of the marketing entity.

Innovation means an inclination and ability of enterprises to create new products or improve the quality and novelty of existing products, new or improved technological or technical-organisational processes and management and motivation systems. The key role of innovation as a major source of competitive advantage is stressed by M. Porter (Porter 2001, p. 202.) who states that enterprises achieve competitive advantage by way of innovation. They strive for innovation in the broadest meaning, both in the sense of new technology and new manner of proceeding. They notice a new base for competition or improve the existing ways of competing. The special role in the relation innovation – competitiveness is stressed by J. Bogdanienko, (Bogdanienko 1998, p. 10) who states that innovation is key to competitiveness of enterprises, that is their ability to survive in the market. therefore, it is not true that introduction of innovation is risky – quite on the contrary, no innovation may pose a hazard to the existence of enterprises.

Among the premises to select innovation as a leading factor affecting competitiveness there are the following (Sosnowska 2002, p. 10):

- innovation in the very word contains an element of novelty and change, it is of dynamic and developmental nature,
- innovation is a factor related to the other factors affecting increased competitiveness,

– innovation exerts strong impact on creation of market demand which in turn is a very important factor to develop competitiveness.

The above premises, proving the leading role of innovation in achieving competitive advantage, show that innovation for Polish enterprises and Poland's economy is an indispensable condition to achieve a favourable position in the future in global economy, primarily within the EU economic system.

The goal of this paper is to make a comparative analysis of the level of innovation activity of industrial enterprises in EU Member States as well as of selected external conditions to innovation processes in those countries. The level of innovation of enterprises in the EU market is a major factor to determine their international competitive position.

2. MEASUREMENT OF INNOVATION OF ENTERPRISES IN EU STATISTICS

Along with growing significance of innovation for economic development, there has been a parallel development of research methodology concerning monitoring of innovation. At present, among the sector comprising scientific and technical statistics, there are two groups of issues (Report on innovation 2006, p. 164). The first group covers sectors with well developed and tested standard methodology. The data in those sectors is fully comparable in time and in space (in each country). The data is collected and analyses on the basis of common international standards. Those sectors include:

- statistics of R&D operations,
- patent statistics,
- innovation statistics,
- balance of payments in technology,
- high tech products and areas,
- indices concerning human resources for science and technology.

The other group includes sectors with methodology in the development stage and without uniform international standards as to the ways to determine indices and the scope of collected data, characteristic for the sectors. In result, the data concerning those sectors, if available, is not fully comparable in time and in space. The group comprises primarily the following issues:

- application of advanced manufacturing technologies,
- IT and ICT technologies,
- intangible investments,
- forecasts of technology development,

– indices based on information from technology periodicals (concerning in particular measurement of innovation, e.g. the LIBIO index).

At present, the most common international comparative statistics of innovation of enterprises in the OECD methodology. The measurement methodology of innovation operations by enterprises was presented in the “Oslo Manual” series. Now it is the universally accepted international standard of methodology to study innovation of industrial enterprises and in market service sectors. The Oslo methodology covers the following areas:

- outlays on innovation operations by sector of industry,
- effect of innovation operations and measurement methods,
- sources of information for innovation operations,
- goals of innovation operations,
- barriers to innovation operations.

The scope of the Oslo Manual so far covered only product and process innovation in the sector of enterprises. In the 2005 version of the manual, the definition of innovation was expanded by organisational innovation and marketing innovation.

The European Statistical Office (Eurostat) is involved in collecting and analysing data on innovation of enterprises in the European Union. Eurostat’s methodology is similar to the methodology of innovation operations presented in the Oslo Manual.

Research on the level of innovation of enterprises in the European Union is conducted within the long-term research project called Community Innovation Survey (CIS). So far four rounds of research have been performed within the program: CIS-1, CIS-2, CIS-3 and CIS-4. The first round of research concerned only technological innovation introduced in industrial enterprises. The subject scope of the second round organised in 1998 was extended by enterprises of the so-called market service sector. The other two research programs were held at the break of 2001–2002 and in 2005. The last round of research CIS-4 covers the years of 2002–2004.

Now the CIS type research covers enterprises in industry and the so-called market service sector with more than 9 employees. Pursuant to the new EU regulations concerning innovation statistics (*vide infra*), in the future expanded CIS-type innovation research will be held every two years. In a somewhat longer term, such expanded innovation research will be conducted every year.

The results obtained from the CIS program, based on statistics from a large number of enterprises, are now the key source of information on the various aspects of innovation operations of European enterprises in different sectors of the economy.

The other source of information on the innovation level of enterprises in the European Union is the so-called European Innovation Scoreboard (EIS). It in-

cludes totally 17 measures divided into five categories, describing innovation efficiency of the economies of the EU Member States. The indices concern such indices as:

- human resources for innovation,
- education, including tertiary education,
- outlays on R&D activity,
- innovation operations, financing and effects,
- co-operation in innovation operation,
- patent operations split in to EPO¹ and USPT² patents,
- dissemination of new knowledge and its practical application,
- investment outlays on ICT technologies.

Basing on the indices from the EIS system, the European Commission prepares the composite innovation index, used to assess innovation efficiency of each EU country.

3. CONDITIONS TO ENTERPRISE INNOVATION

Activity of enterprises to undertake innovation projects is determined by external and internal conditions of their functioning. The conditions are subject to various factors, acting in various directions (stimulating or destimulating) and with varying force on the intensity of undertaking innovation strategies by enterprises, on selection of specific types of strategy, on implementation methods and the desired results (Bojewska, Skowronek-Mielczarek 2003, p.135).

In literature there are several types of classification concerning the environment of innovation processes. Pursuant to the “Oslo Manual”, whose goal is to designate the conditions required to create innovation, there are the following (Janasz, Janasz, Świadek, Wiśniewska 2001, p. 87):

- general conditions, such as institutions and general conditions determining the potential to develop innovation,
- scientific and technological base, that is scientific and technical institutions supporting innovation,
- technology transfer factors, that is human, social and cultural factors, affecting information transfer to companies and learning processes in companies,
- innovation dynamo, that is dynamic factors affecting the innovation process.

Conditions to innovation processes in enterprises are usually divided into internal and external conditions. The external conditions refer to the environment in which economic entities function while internal conditions to innovation

¹ Patents registered with the European Patent Office.

² Patents registered with the US Patent and Trademark Office.

processes of enterprises refer to their current financial, personnel and technological situation and those are considered as variables depending on the enterprises. The internal conditions of innovation of enterprises are defined with the following elements (Poznańska 1998, pp. 40–41):

- financial potential (internal funds and ability to acquire external resources offered by financial and non-financial institutions operating in the region),
- human potential (number of employees, their structure as well as qualifications and motivation to introduce innovation),
- material potential, that is the structure of the production mechanism and advancement of materials and semi-finished products,
- know-how available in literature and market information.

The group of external factors affecting taking up innovation operations by economic entities depends to a large extent on the general rules of functioning of the economy and the support provided to technology development by the State. Most often such factors are listed (Bogdanienko, ed, 1998, p. 49):

- economic situation and level of economic development,
- foreign competition and forms of international co-operation,
- system of personnel education and promotion, developing the training and prestige of technology creators,
- industrial and scientific-technological policies, determining e.g. funds for research and the applicable principles of distribution thereof,
- patent and licence policies.

Using the competitiveness of countries internationally as the division criterion, the following are the economic factors of innovation processes (Janicki 1999, pp. 3–4):

- the strength of national economy – economic productivity, change of economic activity, the nature of competitive force of operations producing value added,
- extent of internationalisation – share in international trade and investment flows,
- extent of State interference in the economy – influence by the State on the economy, legal environment, monetary and fiscal policies,
- finances – availability of capital, distribution and efficiency of capital markets,
- infrastructure – availability and efficiency of use of natural resources as well as adequacy and flexibility of the infrastructure, supporting business needs,
- management – level of entrepreneurship and its power, marketing orientation, trade efficiency,
- science and technology – outlays on R&D, R&D personnel, protection of intellectual property,

– people – qualification, education structure, employment structure, life quality.

In the literature, there are many more other typologies of conditions to innovation processes. However, for the purposes of this paper I will restrict only to those presented above. Due to the variety and complexity of factors affecting innovation of enterprises as well as availability of statistics, I will focus in the paper only on an analysis of selected external factors conditioning taking up of innovation operations by enterprises in specific countries of the European Union.

One of the key external factors of innovation of enterprises is the country's economic situation (level of economic development). The research conducted in Poland on relations between the level of innovation of enterprises and the country's macroeconomic situation (Jasiński 2003, p. 56) shows that innovation achievements of enterprises in Poland are parallel – although somewhat delayed – to the changes in growth dynamism of the national economy. Assuming that in other EU countries there is a similar interdependence, it seems necessary to analyse the economic situation in each EU country. The most frequently used synthetic measure of growth and economic development is Gross Domestic Product (GDP). The dynamism of GDP measured with the use of chain indices is presented in Table 1.

Table 1

Indices of Gross Domestic Product

Countries	2000	2001	2002	2003	2004	2005
	previous year = 100					
1	2	3	4	5	6	7
EU 15	103.9	102.0	101.2	101.1	102.3	101.5
EU25	104.0	102.0	101.3	101.3	102.5	101.8
Austria	103.4	100.8	101.0	101.4	102.4	101.9
Belgium	103.9	101.0	101.5	100.9	102.6	101.2
Cyprus	105.0	104.1	102.1	101.9	103.9	103.8
Czech Republic	103.9	102.6	101.5	103.2	104.7	106.0
Denmark	103.5	100.7	100.5	100.7	101.9	103.4
Estonia	107.9	106.5	107.2	106.7	107.8	109.8
Finland	105.0	101.0	102.2	102.4	103.6	102.1
France	104.1	102.1	101.2	100.8	102.3	101.5
Germany	103.2	101.2	100.1	99.8	101.6	100.9
Greece	104.5	105.1	103.8	104.8	104.7	103.7
Hungary	105.2	104.3	103.8	103.4	104.6	104.1
Ireland	109.2	106.2	106.1	104.4	104.5	104.7
Italy	103.6	100.8	100.3	100.0	101.1	100.0
Latvia	108.4	108.0	106.5	107.2	108.5	110.2
Lithuania	103.9	106.4	106.8	110.5	107.0	107.5
Luxembourg	108.4	102.5	103.6	102.0	104.2	104.0
Malta	106.4	99.6	101.7	97.4	99.4	102.4

Table 1 (cont.)

1	2	3	4	5	6	7
Netherlands	103.9	101.9	100.1	99.9	101.7	101.1
Poland	104.2	101.1	101.4	103.8	105.3	103.4
Portugal	103.9	102.0	100.8	98.9	101.2	100.4
Slovakia	102.0	103.2	104.1	104.2	105.4	106.1
Slovenia	104.1	102.7	103.5	102.6	104.2	103.9
Spain	105.0	103.5	102.7	103.0	103.1	103.4
Sweden	104.3	101.1	102.0	101.7	103.7	102.7
United Kingdom	104.0	102.2	102.0	102.5	103.1	101.8

Source: *Poland in the World's and Europe's background in 1995–2005*, Ministry of Economy, Warsaw 2006, p. 12–13.

The level of innovation and thus the level of competitiveness in the EU countries is to a large extent subject to innovation of the entire economy. Innovation of the economy should be understood as the ability and motivation of enterprises to constantly look for and implement results of R&D work, new concepts and inventions. Among the key factors affecting innovation of the economy there is the research potential of a country. In order to characterise the situation of the R&D sector in a country, it is necessary to use measures and the structure of outlays on R&D as well as the number of persons employed in R&D. The domestic expenditure index on R&D (GERD) calculated in relation to GDP for EU countries is presented in Table 2.

In 2000 the European union in Lisbon approved the Lisbon Strategy with a goal of developing the world's most competitive economy by 2010. In line with the strategy, EU Member States to close the distance to the United States decided in Barcelona in 2002 to increase their expenditure on R&D so that in all the Member States the GDP share was 3% by 2010. The data presented in Table 2 shows that the highest R&D expenditure was in Finland, being more than twice the EU-25 average. Large expenditure on R&D is also in EU high developed countries, like Germany, France, Austria or Denmark where gross R&D expenditure is from 2% to 2.5% of GDP. With respect to the new member states, their R&D expenditure was much lower than in EU-15. In the group, the largest expenditure is in the Czech Republic and Slovenia. In the Czech Republic it is 1.20% – 1.42% of GDP while in Slovenia in 2001 the expenditure accounted for as much as 1.50% of GDP. In Poland the level is among the lowest. The GERD index in 2000–2005 dropped from 0.66% to 0.57% of GDP and was among the lowest among EU countries. A lower level is only in Slovakia and Cyprus. Such a low index in Poland means that it is highly improbable for the R&D expenditure index to reach 1.5% in 2006, as planned in the National Development Plan for 2004–2006.

Table 2

Gross domestic expenditure on R&D (GERD) as a percentage of GDP

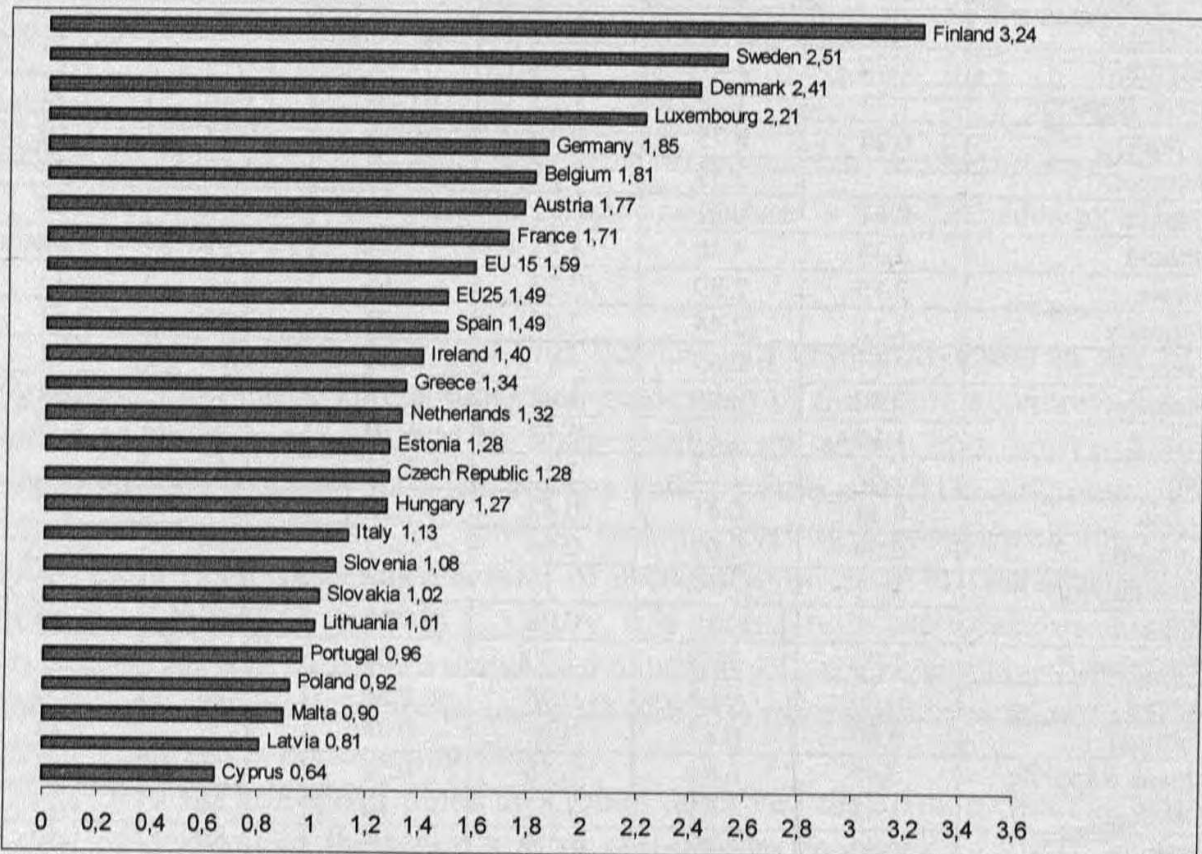
Countries	2000	2001	2002	2003	2004	2005
EU15	1.86	1.88	1.88	1.87	1.84	1.84
EU 25	1.77	1.88	1.89	1.88	1.85	1.85
Austria	1.91	2.03	2.12	2.19	2.26	2.36
Belgium	2.00	2.11	1.96	1.89	1.90	1.82
Czech Republic	1.23	1.22	1.22	1.26	1.28	1.42
Cyprus	0.24	0.25	0.30	0.35	0.37	0.40
Denmark	..	2.39	2.53	2.62	2.48	2.44
Estonia	0.61	0.71	0.72	0.79	0.88	0.94
Finland	3.38	3.38	3.43	3.48	3.51	3.48
France	2.15	2.20	2.23	2.18	2.16	2.13
Germany	2.45	2.46	2.49	2.52	2.49	2.51
Greece	..	0.65	..	0.62	0.61	0.61
Hungary	0.80	0.95	1.02	0.95	0.88	0.94
Ireland	1.14	1.11	1.12	1.19	1.21	1.25
Italy	1.07	1.11	1.16	1.11	1.10	..
Latvia	0.44	0.41	0.42	0.38	0.42	0.57
Lithuania	0.59	0.67	0.66	0.67	0.76	0.76
Luxembourg	1.71	..	..	1.78	1.75	1.56
Malta	..	..	0.26	0.26	0.63	0.61
Netherlands	1.90	1.88	1.80	1.84	1.78	..
Poland	0.66	0.64	0.58	0.56	0.58	0.57
Portugal	0.80	0.85	0.80	0.78	0.77	0.81
Slovak Republic	0.65	0.64	0.58	0.58	0.53	0.51
Slovenia	1.43	1.55	1.52	1.32	1.45	1.22
Spain	0.91	0.92	0.99	1.05	1.07	1.12
Sweden	..	4.29	..	3.98	..	3.86
United Kingdom	1.86	1.87	1.89	1.88	1.73	..

Source: OECD Factbook 2006: Economic, Environmental and Social Statistics, OECD 2006; <http://epp.eurostat.ec.europa.eu/portal/>.

Another measure of R&D potential of each EU country is employment in the R&D sector. Graph 1 presents the percentage share of R&D workers in overall employment in 2004.

Apart from financial capital, the other resource required to develop innovation potential is human capital. An analysis of employment level in R&D in the EU countries shows that the Scandinavian countries are in the lead. R&D personnel is 3.24 % in Finland, 2.51% in Sweden and 2.4% in Denmark of overall employment. The average employment level in R&D sector in EU-15 was 1.59% in 2004 while in EU-25 it was 1.49%. The countries with a higher R&D employment ratio than the average are: Luxembourg (2.21%), Germany (1.85), Belgium (1.81%) and Austria (1.77%) and France (1.71%). Among the new EU member states, the highest proportion of R&D employment is in the Czech Re-

public (1.28%), Estonia (1.28%) and Hungary (1.27%). Poland, similarly to Portugal, Malta, Latvia and Cyprus, is among the countries with the lowest R&D employment ratio of below 1% in relation to overall employment.



Graph 1. R&D personnel as a percentage of persons employed in 2004

Source: own calculations on the basis of: *Science, Technology and Innovation in Europe. 2007 edition*, European Communities, 2007, p. 40.

In summary, the Scandinavian countries have the largest R&D potential. The level is somewhat lower in other developed countries, major for the Union's economic potential, like Germany, France. Austria and Belgium and the UK. Among the new Member States, the R&D sector is best represented in the Czech Republic, Slovenia and Hungary. The functioning of the R&D sector in those countries has been adjusted to the market economy requirements and is convergent with the guidelines of the Lisbon Strategy. Poland is a EU member with the lowest R&D potential only with the smallest EU countries – Cyprus and Malta behind it.

The R&D works should result in inventions that are reported for patent protection by the authors. In international comparison concerning patent activity of each country, data is used on pending and granted patents in the European Patent Office (EPO) and in the US Patent Office (USPTO). The first is an international

patent office while the other is the patent office of the major "patent market" in the world. The data concerning reported and registered patents by EPO and USPTO per 1 million of inhabitants are presented in Tables 3 and 4.

Table 3

New EPO patents per million population

Countries	1998	1999	2000	2001	2002
EU25	109.2	118.3	133.6	142.0	133.6
Austria	142.3	140.3	158.4	180.3	174.8
Belgium	140.0	145.1	157.7	160.9	148.1
Cyprus	13.3	13.2	10.1	20.0	9.9
Czech Republic	9.7	9.8	13.5	11.4	10.9
Germany	247.6	273.5	305.1	320.4	301.0
Denmark	139.7	168.5	199.3	225.7	214.8
Estonia	5.0	5.8	11.7	12.4	8.9
Greece	7.1	8.1	6.1	8.3	8.1
Spain	21.0	23.3	24.9	28.8	25.5
Finland	260.2	294.2	343.7	377.4	310.9
France	125.7	131.0	144.4	150.2	147.2
Hungary	13.3	13.4	18.3	20.9	18.3
Ireland	55.2	69.9	95.4	92.9	89.9
Italy	64.4	68.1	76.8	80.6	74.7
Lithuania	1.1	0.6	1.4	2.6	2.6
Luxembourg	143.5	200.5	198.7	216.6	201.3
Latvia	4.5	4.9	3.8	7.6	6.0
Malta	7.9	10.6	18.4	12.8	17.7
Netherlands	178.3	197.3	228.8	255.4	278.9
Poland	2.0	1.5	3.1	3.2	2.7
Portugal	2.4	4.7	4.0	6.5	4.3
Sweden	307.0	308.5	361.5	383.0	311.5
Slovenia	17.1	25.7	25.1	43.7	32.8
Slovakia	5.9	4.3	6.8	7.1	4.3
United Kingdom	101.0	111.2	128.4	138.4	128.7

Source: EIS 2005 database.

In the analysed period, inventors from Germany and the Scandinavian countries were most active with respect to patents. In those countries, the number of patents granted by EPO and USPTO per 1 million of inhabitants in each year was almost twice as high as the EU average. There is a large disproportion with respect to R&D effects between new and old EU countries. The only exceptions are Portugal and Greece where the number of patents pending with the European Patent Office per 1 million of inhabitants in 2002 was only 4.3 and 8.1 respectively. In Poland the number of patents pending with EPO and USPTO is very low. The number of Polish patents registered with EPO in the best 2001 was

only 3.2 per 1 million of inhabitants while those registered with USPTO in the same year was only 0.6. among the new EU member states, the largest number of granted patents is for Hungary. It should also be noted that despite low R&D expenditure, there are good results in terms of the number of patents registered with EPO and USPTO in Malta. The presented specification shows that EU inventors more frequently report their inventions to the EPO rather than USPTO.

Table 4

New USPTO patents per million population

Countries	1998	1999	2000	2001	2002
EU25	61.0	63.0	66.7	71.8	71.3
Austria	49.3	60.4	64.2	72.0	65.4
Belgium	68.6	64.3	69.1	71.9	70.4
Cyprus	0.8	..	1.5	1.5	2.1
Czech Republic	2.4	3.0	3.5	2.4	3.9
Germany	111.0	114.2	124.9	137.0	137.2
Denmark	75.0	91.7	81.7	91.3	83.8
Estonia	..	0.7	3.0	1.1	2.7
Greece	1.6	2.0	1.7	2.5	1.9
Spain	6.5	6.0	6.9	6.9	8.0
Finland	116.4	126.5	119.5	143.4	158.6
France	63.3	65.4	65.4	68.9	68.1
Hungary	5.0	4.1	3.8	5.8	4.9
Ireland	20.4	26.0	34.1	36.9	32.4
Italy	27.8	26.1	29.5	29.9	30.3
Lithuania	0.6	0.4	...	0.9	0.5
Luxembourg	45.5	44.5	90.4	77.0	96.3
Latvia	0.8	1.7	1.1	0.5	0.3
Malta	2.7	..	5.3	5.1	2.5
Netherlands	80.1	80.3	80.0	83.1	86.6
Poland	0.6	0.7	0.5	0.6	0.4
Portugal	0.9	0.7	1.2	1.2	1.3
Sweden	139.2	158.7	178.7	196.5	187.4
Slovenia	9.5	5.5	8.9	11.4	8.4
Slovakia	0.7	1.6	1.4	0.6	1.9
United Kingdom	59.1	60.7	61.9	66.5	64.5

Source: EIS 2005 database.

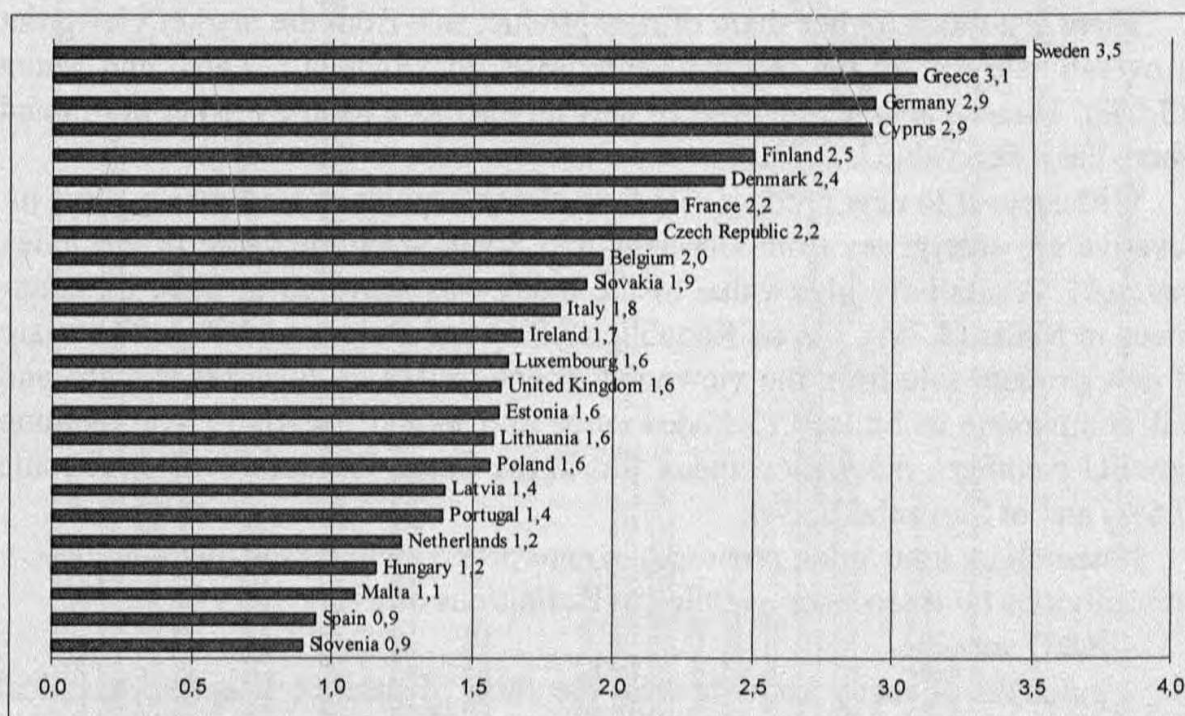
4. INNOVATION OPERATIONS OF ENTERPRISES IN THE EUROPEAN UNION

In order to present the differences in the innovation level of enterprises in each EU country, I will use four indices, namely:

- innovation intensity ratio,

- index of the proportion of new product sales in sold industrial production,
- R&D expenditure index in the sector of enterprises,
- Index of share of high tech products in overall exports.

For international comparison of the innovation level of enterprises, the best measure is the innovation intensity index, presenting the share of expenditure of enterprises on innovation in sold industrial production. The index for 2004 (excepting Finland and the UK for 2000 and Latvia and Slovenia for 2002) is presented in Graph 2.



Graph 2. Innovation expenditures (% of turnover)

Source: own calculations on the basis of EIS 2006 database

The largest share of innovation expenditure in total sales is held by enterprises in Sweden (3.5%), Greece (3.1%) and Germany (2.9%). Innovation intensity in Poland's sector of enterprises in 2004 was 1.6%, like for enterprises in Estonia and Lithuania. Among the new EU member states, the largest innovation intensity index was held by the enterprise sector in Cyprus (2.9%). Innovation expenditure higher than in Poland was incurred by enterprises in the Czech Republic (2.2%) and in Slovakia (1.9%). Innovation expenditure is relatively low in Portugal (1.4%) and the Netherlands (1.2%). The enterprise sector in Spain had the lowest level of innovation intensity in 2004.

Another measure identifying the innovation level of enterprises in the EU use din this analysis is the share ratio of new product sales value in overall in-

dustrial production sold (Graph 3). For the needs of the analysis, a differentiation was made between new products from the market viewpoint and new products from the viewpoint of the marketing enterprise, resulting from diffusion of innovation marketed earlier by competitors.

A specification of the share ratio of new product sales value from the market viewpoint in industrial production sold for Poland and other EU countries shows that innovation in Poland sector of enterprises was relatively high. At the level of 8.1% the ratio is comparable with Sweden (8.3%) and higher than in other West European countries like Germany (7.5%), France (6.2%), Belgium (4.8%).

There is a much higher share of new product sale from the market viewpoint in overall sale was in the sector of enterprises in Slovakia (12.8%) and Malta (13.6%). There is also a high level of new product sale for the market in Finland where the index value is 9.7%.

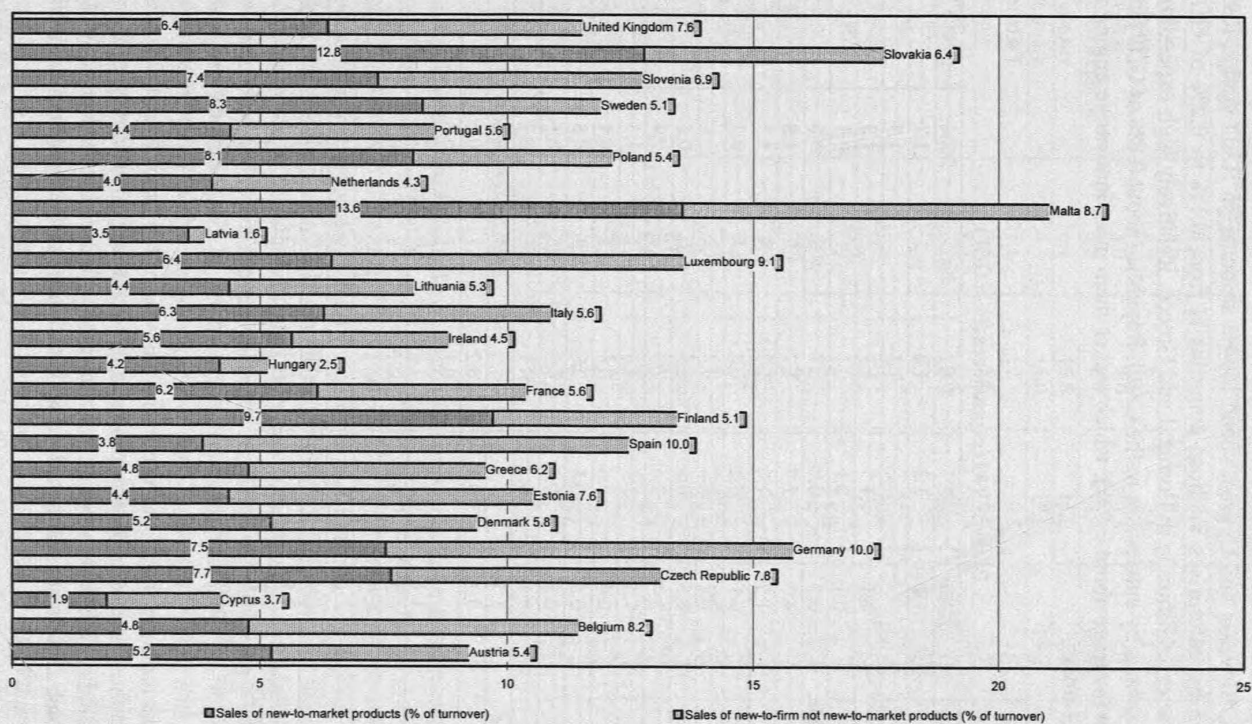
With respect to new product sale from the viewpoint of enterprises, most innovative are enterprises from Germany and Spain since the value of the index was 10%. A similarly high value of the index was achieved in 2004 by enterprises in Malta (8.7%), Czech Republic (7.8%) and Belgium (8.2%). The share of new product sale from the viewpoint of enterprises in Poland was 5.4% and was comparable to Finland (5.1%), France (5.6%) and Austria (5.4%). Among new EU members, the highest index was in the Czech Republic (7.8%), Estonia (7.6%) and in Slovenia (6.4%).

Research on innovation processes in enterprises includes the main innovation activities by enterprises as follows (Definitions of terms1999, p. 64) :

- R&D activities,
- purchase of ready know-how in the form of patents, licences, technical services,
- purchases of material technologies, so-called "innovation" machines and equipment, usually with advanced technical parameters, required to implement new processes and manufacturing of new products.

The above shows that innovation of enterprises is also measured by expenditure incurred by enterprises on R&D. The measure presenting the involvement of enterprises in R&D works is the index of internal expenditure on R&D in the sector of enterprises (Table 5).

Among all EU countries, the largest R&D expenditure is incurred by enterprises in Finland and Sweden where in the years 2000 – 2005 the expenditure was 2.3% to 2.5% of GDP for Finland and 2.9% to 3.3% of GDP. The countries with a similar structure of expenditure by enterprises in R&D works is Germany, Austria, Denmark, Belgium, Luxembourg, France and the UK. Expenditure by enterprises on R&D works was from 1.2% to 1.8% of GDP.



Graph 3. Sales of new-to-market and new-to-firm not new-to-market products (% of turnover)

Source: own calculations on the basis of EIS 2006 database.

Among the new EU members, enterprises from Poland, similarly to Lithuania, Latvia, Slovakia and Cyprus, spend lowest amounts on R&D works. R&D expenditure by enterprises in those countries is from 0.1% to 0.2% of GDP. Equally low expenditure is in Portugal and Greece. Relatively high expenditure on R&D works is by enterprises in the Czech Republic (about 0.8% of GDP) and in Slovenia (average about 0.9%), which makes them most innovative among all new EU members.

Table 5

Business R&D expenditures (% of GDP)

Countries	2000	2001	2002	2003	2004	2005
EU25	1.2	1.2	1.2	1.2	1.2	..
Austria	..	..	1.4	..	1.5	..
Belgium	1.4	1.5	1.4	1.3	1.3	..
Cyprus	0.1	0.1	0.1	0.1	0.1	0.1
Czech Republic	0.7	0.7	0.7	0.8	0.8	0.9
Germany	1.7	1.7	1.7	1.8	1.8	1.8
Denmark	1.5	1.6	1.7	1.8	1.7	1.7
Estonia	0.1	0.2	0.2	0.3	0.3	0.4
Greece	0.2	0.2	0.2	0.2	..	..
Spain	0.5	0.5	0.5	0.6	0.6	0.6
Finland	2.4	2.4	2.3	2.4	2.4	2.5
France	1.3	1.4	1.4	1.4	1.3	1.3
Hungary	0.4	0.4	0.4	0.3	0.4	0.4
Ireland	0.8	0.8	0.8	0.8	0.8	0.8
Italy	0.5	0.5	0.5	0.5	0.5	0.6
Lithuania	0.1	0.2	0.1	0.1	0.2	0.2
Luxembourg	1.5	..	..	1.5	1.5	1.3
Latvia	0.2	0.2	0.2	0.1	0.2	0.2
Malta	..	..	0.1	0.1	0.5	..
Netherlands	1.1	1.1	1.0	1.0	1.0	..
Poland	0.2	0.2	0.1	0.2	0.2	0.2
Portugal	0.2	0.3	0.3	0.3	0.3	0.3
Sweden	..	3.3	..	2.9	..	2.9
Slovenia	0.8	0.9	0.9	0.8	1.0	..
Slovakia	0.4	0.4	0.4	0.3	0.3	0.3
United Kingdom	1.2	1.2	1.3	1.2	1.2	..

Source: EIS 2006 database.

The last measure that I will use in the analysis of the innovation level of enterprises is the share of high tech products in overall exports (Table 6). The application of the high tech product index to assess innovation is due to the fact that high tech sectors are characterised with a high level of innovation and a high R&D intensity.

Table 6

Exports of high technology products as a share of total exports

Countries	2000	2001	2002	2003	2004
EU25	21.4	21.1	18.8	18.4	18.4
Austria	14.0	14.6	15.7	15.3	14.7
Belgium	8.7	9.0	7.5	7.4	7.1
Cyprus	3.0	4.0	3.5	4.2	15.9
Czech Republic	7.8	9.1	12.3	12.4	13.7
Germany	16.1	15.8	15.2	14.8	15.4
Denmark	14.4	14.0	15.0	13.4	13.3
Estonia	25.1	17.1	9.8	9.4	10.1
Greece	7.5	5.6	6.6	7.5	7.1
Spain	6.4	6.1	5.7	5.9	5.7
Finland	23.5	21.1	20.9	20.6	17.8
France	25.5	25.6	21.9	20.7	20.1
Hungary	23.1	20.4	20.8	21.8	21.7
Ireland	40.5	40.8	35.4	29.9	29.1
Italy	8.5	8.6	8.2	7.1	7.1
Lithuania	2.6	2.9	2.4	3.0	2.7
Luxembourg	20.6	27.9	24.7	29.6	29.5
Latvia	2.3	2.2	2.3	2.8	3.2
Malta	64.4	58.1	56.5	55.5	55.9
Netherlands	22.8	22.3	18.7	18.8	19.1
Poland	2.8	2.7	2.5	2.7	2.7
Portugal	5.6	6.9	6.4	7.5	7.5
Sweden	18.7	14.2	13.7	13.1	14.1
Slovenia	4.5	4.8	4.9	5.8	5.2
Slovakia	2.9	3.1	2.6	3.3	4.6
United Kingdom	28.9	29.8	28.6	24.4	22.8

Source: EIS 2006 database.

Against the background of other EU countries, Poland is characterised by a relatively low level of share of high tech products in exports. In 2004 the share was 2.7% while in the entire EU it was 18.4%. With respect to the share of high tech products in exports, Poland – similarly to Lithuania and Latvia – is much below the results in other EU countries. Among all EU countries the most innovative in terms of the share of high tech products in exports is Malta for which the share is over 55% in the analysed period. Also Irish and Luxembourg enterprises are characterised by high innovation since the index in 2004, despite a downward trend in the analysed period, was 29.1% for Ireland and 29.5% for Luxembourg.

Among the old EU members there are two groups of countries for which the value of the share index high tech product exports is similar. The first group comprises France, the Netherlands and the UK. For the group, the index value is at about 20%. The other group is comprised of Germany, Denmark, Finland and Sweden with the share of the index value of high tech products in overall exports

in 2004 was from 13% to 18%. Among the new EU members, the higher innovation level is among enterprises in the Czech Republic and Hungary for which the high tech index in 2004 was 13.7% and 21.7% respectively.

5. CONCLUSIONS

The above analysis of innovation of enterprises in EU countries and of external conditions for innovation processes showed significant differences among EU countries. On the basis of the analysis of external factors affecting innovation activities of enterprises the following conclusions can be drawn:

– the new EU Member States (EU-10) in the analysed period had a much faster economic growth rate than the old Member States (EU-15). The average economic growth rate in 2005 for the first group was 5.72% while for the other group it was 1.5%. The largest economic growth level was in the Baltic States where the average GDP growth rate in 2005 was 9.1%. For Poland the economic growth rate was only 103.4% and was among the lowest among EU-10 countries.

– With respect to R&D potential, EU-15 have a much higher potential than the new Member States with respect to R&D expenditure and employment in the sector. No doubt, in EU-15 the implementation of the Lisbon Strategy with respect to R&D financing seems realistic while for EU-10 countries the level of 3% GDP for R&D works in 2010 seems highly improbable. The exceptions may only be the Czech Republic and Slovenia since they are close to the level of EU-15. The situation of Poland's R&D sector in relation to other EU countries is poor. Poland is characterised by a lowest employment level in R&D and R&D expenditure below 0.6% GDP. The poor situation on the R&D sector in Poland and other new EU countries is due to the low share of budgetary funds in financing R & D.

– The low share of R&D expenditure and the inappropriate structure in EU-10 countries results in no measurable effects in the form of pending and granted patents. In effect, with respect to the number of patents registered with EPO and USPTO, inventors from EU-15 are much more creative.

– There is a positive relation between the situation of the R&D sector in each country in the terms of R&D expenditure and the employment in R&D sector vs. the number of patents granted to inventors in each country.

A better situation of the environment of innovation processes, including the R&D sector, is transferred to the innovation level of enterprises in each EU country. Analysing the indices applied to assessment of innovation of enterprises in the EU, the following conclusions can be drawn:

– The largest innovation in terms of innovation intensity is among enterprises in Sweden, Greece, Germany and Cyprus. In terms of expenditure by

enterprises on innovation, there is a relatively high innovation among enterprises in the Czech Republic (2.2%) and Slovakia (1.9%). The other EU-10 countries have a lower innovation level of the sector of enterprises than enterprises from EU-25 countries. The only exception are enterprises from Spain which have a lowest level of innovation intensity among all EU enterprises.

– Assessing innovation activities of enterprises on the basis of internal expenditure of enterprises on R&D activities, it should be noted that much more innovative are enterprises from EU-15. They spend several times more money on R&D than enterprises from the new EU countries. Polish enterprises are little innovative since the R&D expenditure is only 0.2%.

– Among the new EU Member States, the most innovative are enterprises in the Czech Republic. Among the EU-15 countries, the most innovative are enterprises from Sweden, Finland and Germany.

– The scientific and technological level of a country has more impact on innovation on enterprises than the dynamism of economic growth. Despite a lower economic growth rate of enterprises in EU-15 countries, they have a higher level of innovation.

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ANALIZA POZIOMU INNOWACYJNOŚCI PRZEDSIĘBIORSTW PRZEMYSŁOWYCH W WYBRANYCH KRAJACH UNII EUROPEJSKIEJ

Czynnikiem decydującym o funkcjonowaniu i rozwoju przedsiębiorstw jest ich konkurencyjność zarówno na rynku krajowym jak i międzynarodowym. Jednym z podstawowych czynników mających wpływ na konkurencyjność przedsiębiorstw, jest poziom ich innowacyjności. Zdolność kreowania i wykorzystania innowacji staje się istotnym czynnikiem determinującym sprawność działania przedsiębiorstwa oraz jego rozwój na konkurencyjnym rynku.

Celem opracowania jest analiza porównawcza poziomu aktywności innowacyjnej przedsiębiorstw przemysłowych w państwach Unii Europejskiej, a także wybranych zewnętrznych warunków procesów innowacyjnych w tych krajach. Poziom innowacyjności przedsiębiorstw na unijnym rynku stanowi jeden z najważniejszych czynników określających ich międzynarodową pozycję konkurencyjną.

Słowa kluczowe: innowacje, Unia Europejska, przedsiębiorstwo, działalność patentowa, sektor B+R.