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## THE EXTERNAL CONDITIONINGS OF INNOVATION OF COMPANIES IN POLAND IN COMPARISON TO SELECTED EUROPEAN UNION COUNTRIES

**Abstract.** The factor which determines the functioning and development of businesses is their competitiveness, both in the domestic and the international market. One of the fundamental factors which influence the competitiveness of companies is the level of their innovation. The capability to develop and to take advantage of innovation is becoming a significant element which determines the efficiency of company operation and its development on the competitive market. The innovative activity of companies depends on numerous factors of both external character and internal character from the point of view of the company. The aim of this study is to conduct a comparative analysis of the external conditionings of innovation of companies in selected countries of the European Union. The level of innovation of companies on the European Union market constitutes one of the most significant factors which determine their international position in terms of competitiveness.

**Keywords:** innovation of companies, conditionings of innovation, synthetic variable, linear ordering, European Union.

### 1. INTRODUCTION

Contemporary research pertaining to economic phenomena refers, to a much bigger and wider extent, to innovation processes which, according to economics, play an essential role in terms of stimulating economic growth and, from the point of view of companies, their development. Innovation is considered to be an essential factor which has influence on the competitiveness of companies, both on the domestic and international market. The notion of innovation of companies shall be construed as their capability to develop and implement innovations, as well as the actual skill of the company to implement new and modernised products, new or modernised technological or organisational-technical processes.

Developing and implementing innovations in the form of new products, services, technologies and management methods allows the company to gain or

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maintain competitive advantage on the market which, in turn, leads to company development, and eventually to the increase in its competitiveness. Businesses which do not implement innovations are threatened with stagnation and falling far behind their competitors. The innovative activity of companies requires favourable conditions and a well thought out stimulation. In the economic reality, it is determined by a number of factors which influence the intensity of innovative activities undertaken by companies in various directions and with various forces.

The conditionings of innovative processes in the company are frequently divided into internal and external. The external conditions refer to the environment in which particular economic entities operate and depend, to a considerable extent, on the general rules of functioning of the economy and creating an appropriate national pro-innovation policy. Whereas, the internal conditionings of the innovative activity of companies stem from their current situation with regard to finances, human resources and technical issues, and are considered to be variables dependent on the company.

Owing to the diversity and the complexity of factors which determine the innovation of companies, as well as the availability of statistical data necessary to carry out quantitative research, this paper concentrates solely on the analysis of the external factors which condition undertaking innovative activities by economic entities.

## **2. IDENTIFICATION AND CLASSIFICATION OF THE CONDITIONINGS OF INNOVATIVE PROCESSES**

The innovative activity of companies is fortified with a number of conditionings (factors, determinants)<sup>1</sup> which have various sources of origin and directions of influence. The activity of companies with respect to implementing innovative undertakings is determined by external and internal conditions of their operation. These conditionings are defined by various factors which influence, in various directions (in a stimulating or discouraging manner) and with various forces, the intensity of innovative strategies undertaken by companies, the choices with regard to specific types of such strategies, the ways in which they are implemented and the desired results (Bojewska B., Skowronek-Mielczarek A. [2003], p. 135).

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<sup>1</sup>In papers devoted to the innovation of companies, the possibility of using the terms: conditionings, factors and determinants interchangeably is justified, and therefore we have adopted a similar approach in this paper. See e.g.: Janasz W., Koziol K.: *Determinanty działalności innowacyjnej przedsiębiorstw* [Determinants of the Innovative Activity of Companies], PWE, Warszawa 2007, p. 41.

When identifying and classifying the determinants of the innovative activity of companies one ought to take into consideration all the significant factors which are present at every stage of the innovative process, i.e. (Niedzielski P., Rychlik K. [2006], p. 93):

- producing creative ideas,
- implementing ideas into company processes and managing their development,
- absorption and adaptation of new solutions,
- diffusion of innovations inside and outside of the company.

In the literature related to the subject matter one can find numerous attempts at identifying and classifying the conditionings of innovative processes. The innovative activity is conditioned by a number of factors which form a new context for managing innovations in companies. These include, among others, the following (Baruk J. [2004], p. 30):

- 1) globalisation of markets,
- 2) increase in the importance of strategic alliances,
- 3) appearance of new, technologically competitive countries on the world economy map,
- 4) increasing internationalisation of businesses, research and the innovative activity,
- 5) more intensive interpenetration of science and technology,
- 6) rising research costs, which exceed the possibilities of individual organisations, regions and even entire economies,
- 7) rise in unemployment,
- 8) increase in the significance of natural environment protection.

In accordance with the “Oslo Manual”, the target of which is to indicate the conditionings of creating innovations, we can single out the following (Janasz K., Janasz W., Świadek A., Wiśniewska J. [2001], p. 87):

- general conditionings, i.e. institutions and general conditions which determine the range of opportunities for introducing innovations,
- science and engineering base, i.e. science and technology institutions which underpin the innovation dynamo,
- technology transfer factors, i.e. human, social and cultural factors which influence the transmission of information to businesses and the learning processes in companies,
- innovation dynamo, i.e. dynamic factors which shape the innovative process.

In the literature one can also come across classifications of conditionings of innovation of companies, restricted merely to the economic determinants of the innovative activity, which include the following factors (Stawasz E. [1999], p. 36):

- 1) internal:
  - stock resources accumulated by the company,
  - capital resources,
  - human resources,
  - system of management and organisational culture in the company,
  - institutional and motivational solutions,
- 2) external general:
  - innovation system,
  - national innovation policy,
  - marketwide conditions,
  - market infrastructure,
  - system of education and trainings,
- 3) external operational:
  - functional sources of innovation which include customers, suppliers and contractors, remaining business partners and competitors,
    - science and technology institutions, e.g. higher education institutions, science and research institutes,
    - institutions and organisations which support and act as go-betweens with respect to innovation e.g. technology parks, technological incubators, technological centres),
    - local and regional environment.

Apart from the economic factors which shape the innovation of companies, what we also ought to identify are the psychological and sociological factors which shape the human potential within the company. The sociological factors include (Janasz W., Koziół K. [2007], p. 46): various needs of employees, especially those related to ambition, recognition and promotion. Whereas, the psychological needs, which determine the attitude towards the innovation processes in the company, include (Janasz W., Koziół K. [2007], p. 46):

- creating something new or improving the existing solutions,
- learning / cognition,
- achieving successes and self-fulfilment.

From the point of view of the innovative activity, one of the most significant strategic resources of the company is the human factor. Human resources encompass all the skills, knowledge and experience of employees and managers of a given organisation. They are manifested through creativity, openness and innovation of the organisation's members, as well as through the level of their internal motivation and abilities to introduce and adjust to changes (Serafin K. [<http://efektywnosc04.ae.wroc.pl/Referat/art29.pdf>], p. 2.). A special role in the context of the business activity of the innovative company is to be played by the

managerial personnel. It has got three principal tasks to perform (Doyle P., Bridgewater S. [1998] p. 69.):

- identify the chances (opportunities) which arise through change; this pertains both to the innovative changes and those in the company environment,
- build networks and supply processes which allow to take advantage of those opportunities,
- build a brand which makes it difficult for competitors to imitate and to take advantage of those chances.

While further reviewing the conditionings of innovative processes in the company, it is worthwhile to present the classifications of factors by M. Oseka and J. Wypijewski. They mention the following conditionings of innovation of companies (Oseka M., Wypijewski J. [1985], pp. 44–45):

- internal processes which take place in the human psyche, which include motivational predispositions and creative activity,
- socio-political climate,
- service processes which include systems of scientific research, systems of scientific and technical, economic and organisational information, as well as systems of education,
- non-economic regulators which include legal rules and administrative orders,
- economic regulators, mainly the market mechanism, economic calculation and prices.

The conditionings of innovative processes in the company are frequently divided into internal and external conditionings.

A. Żoźniński treats the internal innovation potential of the company as a consequence of (Żoźniński A. [2005], p. 6):

- personnel capabilities (knowledge, experience, skills, qualifications and the management method with regard to available resources, including information management),
- research and development (isolated R&D departments, conducted R&D activities, commissioned work, etc.),
- technology (computers, ICT technology, machinery and equipment, the level of their modernity).

K. Poznańska also describes the factors that form the internal innovative potential of the company which includes the following elements (Poznańska K. [1998], pp. 40–41):

- financial potential (own financial resources and the capability to obtain external financial means offered by financial and non-financial institutions which operate in the region),
- human potential (number of employees, their structure, as well as qualifications and skills, and their motivation to implement innovations),

- material potential, i.e. the structure of the production facilities and the advancement of materials and semi-finished products,
- technical knowledge available in the literature and market information.

The division of factors, which influence the innovative process in the company, into internal and external is also conducted by A. Francik and A. Poczowski (Francik A., Poczowski A. [1991], p. 27). In the group of internal factors, which they define as endogenous, they include the following:

- financial strength of the company,
- sense of the market,
- size of the company,
- continuity of company management,
- readiness and motivation of the managerial personnel to take risks,
- the level of the threshold of market entrance,

The external factors, defined as endogenous, encompass the following:

- competition on the market,
- upward trend of the market,
- rate of technical progress,
- overall economic situation,
- scope in which the state influences the economy.

Also in the opinion of W. Kasperkiewicz (Kasperkiewicz W. [2004], pp. 10-11) the innovative activity of companies is the outcome of numerous factors, which are external and internal in character. Among the external factors which determine the innovation of companies, the author mentions, first and foremost, the overall condition of the economy, market pressure and the national innovation policy. Whereas, the internal conditionings, which have an impact on the innovative activity of companies, include the following factors (Kasperkiewicz W. [2004], pp. 10–11):

- financial, among which of greatest importance are own financial resources and the capability to obtain external financial means,
- human-related, i.e. the number of employees, their structure, qualifications and their motivation to undertake innovations,
- technical, which comprise the production facilities, technical knowledge resources and the system of gathering and processing information,
- “soft”, which include innovation culture construed as a specific model of behaviour adopted across the company by a particular group of people.

The division of conditionings into internal and external, narrowed down merely to the economic conditionings, is also presented by A. H. Jasiński (Jasiński A. H. [2006], pp. 52–53). The first type of conditionings is, in the author’s opinion, inside the company. Whereas, among the external determinants, the author defines systemic and functional conditionings. The innovative tendency

of the company depends, first and foremost, on the development of the main systemic solutions of the economy, including solutions applied in the economic policy of the state. Within the functional conditionings, what ought to be mentioned as first is the balanced and competitive market on which the company operates, followed by an abounding and varied offer of projects of new products, or the possibility to purchase foreign licences.

When summarising the discussion of the conditionings of innovative processes in the company, one could state that both on the side of internal and external environment of the company all of the factors could be categorised into three fundamental groups, as follows:

- factors social in character,
- factors economic in character,
- factors technical in character.

All the presented factors can be classified as those which specify the innovative tendency – they determine the interest in changes in technology and the readiness to take risks related thereto, as well as those which specify the innovation capability – intellectual, technical and financial opportunities of carrying out the innovative activity by the company.

### **3. SELECTION AND CHARACTERISTICS OF THE DIAGNOSTIC VARIABLES USED IN THE ANALYSIS**

The subject discussed in this paper is the analysis of the external conditionings of innovation of companies. For the purpose of the empirical research related to the examined subject, we selected twenty-three European Union countries, each of which was described using thirteen variables which characterise the external environment of the innovative processes in the company. The examined countries (subjects) include countries which became members of the European Union after its expansion in the year 2004, exclusive of Luxemburg and Malta<sup>2</sup>. The variables (features) which specify the the external conditionings of the innovative activity of companies were divided into three groups:

- factors social in character,
- factors economic in character,
- factors technical in character.

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<sup>2</sup>These countries were excluded from the analysis owing to a large percentage of missing data in the selected time span. In our study we applied the following principle – in case of missing data pertaining to the variables which characterise individual countries, exclude the subjects, not the variables.

The first group of the diagnostic features used in the conducted research, which pertains to the factors that are social in character, is the “Human Resources for Innovation”. The second group of variables, related to the economic factors which determine the innovative activity, was defined as the “Level and Dynamics of Economic Growth”. The final group of variables is connected with factors that are technical in nature, and it was termed as the “Research and Development Activity”. In order to guarantee the clarity of the presented data, each of them was assigned the symbol  $X_{ij}$ , where  $i$  – refers to the number of the group, in which a variable is present, whereas  $j$  – refers to the number of this variable in a given group.

The analysis conducted in the study covers the period from 1997 to 2005. The principal factor which determined the choice of the time span for the conducted research was the availability of statistical data which referred to the examined subjects and features.

In building the database necessary in order for the analysis to be carried out, we used various sources of statistical data. The statistical information which pertains to the development of indicators that describe the the external conditionings of innovation of companies in the examined countries comes both from databases published in books, as well as from databases published on the Internet. The sources of the collected data include the following:

- <http://w3.unece.org/pxweb/DATABASE/STAT/Economics.stat.asp><sup>3</sup>
- <http://epp.eurostat.ec.europa.eu><sup>4</sup>
- *Science, technology and innovation in Europe, (edition 2006, 2007, 2008)*, Office for Official Publications of the European Communities, Luxembourg 2008,
- European Innovation Scoreboard - Comparative analysis of innovation performance (from the years 2002 - 2007), Office for Official Publications of the European Communities, Luxembourg,
- EIS 2007, 2006, 2005, 2004 Database - <http://www.proinno-europe.eu>,
- *Polska na tle świata i Europy w latach 1995 – 2005 [Poland in Comparison to the World and Europe in the years 1995 – 2005]*, Ministerstwo Gospodarki, Departament Analiz i Prognoz, Warszawa 2006.
- Patent Database, OECD, June 2007.

The collection of the most significant diagnostic features, which best reflect the the external conditionings of innovation of companies in individual countries, comprises the following:

- Group I – Human Resources for Innovation:
  - $X_{11}$  – population aged 25 – 64 that participates in continuing education,

<sup>3</sup> United Nations Economic Commission for Europe (UNECE) database.

<sup>4</sup> Eurostat database.



- $X_{12}$  – graduates of scientific and technical majors, per 1000 people aged 20–29,
- $X_{13}$  – population with higher education aged 25 – 64, as the % of the total population of the same age,
- $X_{14}$  – level of education of young people, as the percentage of population aged 20 – 24 with at least secondary level education.
- Group II – Level and Dynamics of Socio-Economic Growth:
  - $X_{21}$  – Gross Domestic Product per one inhabitant, according to the purchasing power standard expressed in thousands USD (*GDP per capita*),
  - $X_{22}$  – GDP dynamics expressed through individual chain indexes of dynamics (previous year = 100%),
  - $X_{23}$  – unemployment rate (in %), according to BAEL<sup>5</sup>,
  - $X_{24}$  – inflation rate (in %),
  - $X_{25}$  – dynamics of industrial production expressed by means of individual chain indexes of dynamics (previous year = 100%),
- Group III – Research and Development Activity:
  - $X_{31}$  – gross national expenditures for R&D as the percentage of GDP (GERD),
  - $X_{32}$  – the total number of research workers per one thousand people who are professionally active, in the full-time equivalent,
  - $X_{33}$  – new EPO patents, per one million people,
  - $X_{34}$  – new UPSTO patents, per one million people.

#### 4. COMPARATIVE ANALYSIS OF THE EXTERNAL CONDITIONINGS OF INNOVATION OF COMPANIES IN THE EUROPEAN UNION COUNTRIES

In the empirical research referring to the factors which determine the innovative activity of companies in the European Union we used the linear ordering method, where the criterion of the classification of subjects (countries) is the synthetic meter of the external conditionings of innovation of companies (SME-CIN), determined as the synthetic meter without a pattern.

In the adopted set of diagnostic variables, owing to the direction of influence on the examined phenomenon, the two variables, namely inflation and unem-

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<sup>5</sup>Official data from Eurostat is based on the research of the economic activity of people (BAEL). Eurostat measures the harmonised unemployment rate as the participation of people aged 15-74 who remain unemployed, are capable of taking up employment in the next two weeks, who were actively looking for work in the past two weeks, with reference to all professionally active people in a given country.

ployment, are destimulants, while the remaining eleven variables are stimulants. Since for a synthetic meter to be determined, it is required that the set of diagnostic features contains only stimulants, we performed relevant numerical transformations in the set of destimulants, owing to which the direction of influence of these variables on the synthetic variable was altered. The transformation of destimulants into stimulants was accomplished through the application of the following formula:

$$x'_{ijt} = 2\bar{x}_{UEj} - x_{ijt} \quad i \in \{1, 2, \dots, n\}; \quad j \in \{1, 2, \dots, m\} \quad t \in \{1, 2, \dots, k\} \quad (1)$$

As a result of this transformation, negative values of stimulants for a certain subject may occur, which emphasise the highly unfavourable situation in the subject. The obtained stimulant is interpreted as the distance from the double average level of the phenomenon in the EU.

A subsequent stage in forming the SMECIN indicator included performing the normalisation of the diagnostic features. In the analysis we applied the normalisation of variables, by determining a reference point, i.e. in accordance with the following formula:

$$z_{ijt} = \frac{x_{ijt}}{x_{0jt}} \quad i \in \{1, 2, \dots, n\}; \quad t \in \{1, 2, \dots, k\} \quad (2)$$

where:

- $z_{ijt}$  – normalised value of observation of a variable  $x_{ij}$  in the unit of time  $t$ ,
- $x_{ijt}$  – values  $J$ -this variable in  $i$ -this subject in the unit of time  $t$ ,
- $x_{0jt}$  – reference point for  $j$  – this diagnostic variable in the unit of time  $t$ .

A quotient transformation constructed in such a way fulfils the following postulates (Zeliaś A. (ed.) [2004], p. 59):

- additivity postulate – obtaining formal bases to perform the fundamental arithmetic operations in sets of original values of variables with different names,
- non-negativity postulate – all realisations of variables are non-negative.

While forming the synthetic measuring instrument for measuring conditions of innovation of companies, necessary to carry out the classification of the European Union countries with regard to the examined phenomenon, the reference point was the arithmetic mean of the diagnostic variable for the countries of the European Union in the first year covered by the analysis, i.e. 1997 (the so called model with a constant pattern), and therefore:

$$z_{ijt} = \frac{x_{ijt}}{\bar{x}_{UEj1}} \quad i \in \{1, 2, \dots, n\}; t \in \{1, 2, \dots, k\} \quad (3)$$

The normalisation with the adopted pattern constant in time as a reference point allows to retain absolute changes. The consequence of adopting such a pattern is the possibility to compare changes which take place with regard to the average value for the European Union countries in the assumed base period of time.

Table 1. Values of the synthetic meter of the external conditionings of innovation of companies for countries of the European Union in the years 1997–2005

Country	Year								
	1997	1998	1999	2000	2001	2002	2003	2004	2005
Austria	1.1612	1.2456	1.2636	1.3195	1.3223	1.3469	1.3808	1.4220	1.4594
Belgium	1.2400	1.2703	1.3111	1.3556	1.3616	1.3391	1.3715	1.4018	1.3659
Cyprus	0.7125	0.6994	0.7016	0.6937	0.7586	0.7237	0.7609	0.8154	0.7634
The Czech Republic	0.6990	0.6333	0.7075	0.7292	0.7241	0.7632	0.7909	0.7827	0.7716
Germany	1.4727	1.5160	1.5721	1.6333	1.6399	1.6222	1.6129	1.6590	1.6681
Denmark	1.4767	1.5416	1.5517	1.6639	1.7014	1.7152	1.7951	1.8268	1.8486
Estonia	0.6800	0.6626	0.7416	0.7529	0.7230	0.7466	0.8248	0.8369	0.8712
Greece	0.6729	0.6740	0.6741	0.7073	0.6939	0.6770	0.7181	0.7394	0.7347
Spain	0.7676	0.7818	0.7868	0.8410	0.8624	0.8366	0.8691	0.8971	0.9586
Finland	1.7860	1.8740	2.0733	2.1672	2.2557	2.2141	2.3465	2.4284	2.3610
France	1.2636	1.2827	1.3003	1.3494	1.3617	1.3351	1.3875	1.3980	1.4040
Hungary	0.4575	0.5192	0.5694	0.6317	0.6279	0.6894	0.7221	0.6923	0.7253
Ireland	1.1164	1.1744	1.1973	1.2223	1.2562	1.2445	1.2919	1.3257	1.3966
Italy	0.8521	0.8404	0.8331	0.8894	0.8934	0.8863	0.8983	0.9588	0.9446
Lithuania	0.6973	0.7710	0.7209	0.8372	0.7815	0.7590	0.8481	0.8833	0.8855
Latvia	0.5970	0.6160	0.6042	0.6949	0.6778	0.6831	0.6760	0.6761	0.6718
The Netherlands	1.3749	1.3915	1.4150	1.5318	1.5627	1.4998	1.4935	1.5860	1.5911
Poland	0.4757	0.5183	0.5316	0.5146	0.5689	0.5887	0.6409	0.6373	0.6656
Portugal	0.6793	0.6706	0.6558	0.6956	0.6728	0.6535	0.6738	0.7331	0.7376
Sweden	1.9293	2.0081	2.0522	2.1721	2.0831	1.9937	2.1349	2.2105	2.1887
Slovenia	0.7894	0.8149	0.7981	0.8290	0.8083	0.8683	0.9224	1.0439	1.0084
Slovakia	0.7050	0.6476	0.5118	0.5178	0.5984	0.6407	0.5383	0.5730	0.7636
Great Britain	1.3940	1.4234	1.4358	1.5210	1.5630	1.5489	1.5305	1.5098	1.5549

Source: Own calculations.

Upon performing the normalisation of variables, we carried out synthetisation, by calculating the synthetic variable as the arithmetic average of the normalised diagnostic variables. The results are presented in Table 1.

The calculated values of the synthetic meter (SMECIN), which describe the external conditionings of innovation of companies, allowed us to order the countries of the European Union from the best to the weakest, with respect to the analysed phenomenon. The results of classification are presented in Table 2.

Table 2. Ranking of the European Union countries in the years 1997 – 2005 according to the achieved level of conditionings of innovation of companies

Country	Year								
	1997	1998	1999	2000	2001	2002	2003	2004	2005
Sweden	1	1	2	1	2	2	2	2	2
Finland	2	2	1	2	1	1	1	1	1
Denmark	3	3	4	3	3	3	3	3	3
Germany	4	4	3	4	4	4	4	4	4
Great Britain	5	5	5	6	5	5	5	6	6
The Netherlands	6	6	6	5	6	6	6	5	5
France	7	7	8	8	7	9	7	9	8
Belgium	8	8	7	7	8	8	9	8	10
Austria	9	9	9	9	9	7	8	7	7
Ireland	10	10	10	10	10	10	10	10	9
Italy	11	11	11	11	11	11	12	12	13
Slovenia	12	12	12	14	13	12	11	11	11
Spain	13	13	13	12	12	13	13	13	12
Cyprus	14	15	17	20	15	17	17	16	18
Slovakia	15	19	23	22	22	22	23	23	17
The Czech Republic	16	20	16	16	16	14	16	17	16
Lithuania	17	14	15	13	14	15	14	14	14
Estonia	18	18	14	15	17	16	15	15	15
Portugal	19	17	19	18	20	21	21	19	19
Greece	20	16	18	17	18	20	19	18	20
Latvia	21	21	20	19	19	19	20	21	22
Poland	22	23	22	23	23	23	22	22	23
Hungary	23	22	21	21	21	18	18	20	21

Source : Own work

Scandinavian countries ought to be classified in the group of countries with the most favourable conditions for the course of innovative processes. Sweden was assigned the first rank three times and the second rank six times, in Table 2 Finland ranks in second position three times and in the first position six times, whereas Denmark, apart from the year 1999 when it was classified in the fourth place, obtained rank three in the remaining years. Among the countries of the “old” European Union, Greece and Portugal were classified, on account of the examined phenomenon, in the lowest positions i.e. ranks from 16 to 20 and ranks from 17 to 21 respectively. The most favourable conditionings for the innovation of companies among the countries of EU10 were found in Slovenia

and Lithuania, in the case of which the biggest advancement was noted – by three places. The countries with the least favourable conditionings for the innovation of companies included Poland and Slovakia and Hungary. However, in the case of the last two countries, one can observe certain significant changes in the positions in the ranking, whereas in the case of Poland, in the analysed period of time it was always in the last or the last but one position. In view of the conducted research, this means that there were no effective actions taken in order to significantly improve the external factors which determine the innovation of Polish companies.

The calculated values of the synthetic variables also constituted the basis for ordering the countries of the European Union according to the obtained level of factors which determine the innovation of companies in the member states. For the purpose of classifying the countries of the European Union on account of the analysed phenomenon we selected a method in which the classification criterion is based on two fundamental parameters (descriptive characteristics) of the synthetic variable, namely the arithmetic means ( $\bar{s}_t$ ) and the standard deviation ( $S_s$ ). This method allows for the division of the set of examined subjects into four groups which include subjects with the synthetic meter values found in the following ranges:

- Group 1:  $s_i \in \left\langle \bar{s}_t + S_s; \max\{s_i\} \right\rangle i \in \{1, 2, \dots, n\}$  (4)

- Group 2:  $s_i \in \left\langle \bar{s}_t; \bar{s}_t + S_s \right\rangle$  (5)

- Group 3:  $s_i \in \left\langle \bar{s}_t - S_s; \bar{s}_t \right\rangle$  (6)

- Group 4:  $s_i \in \left\langle \min\{s_i\}; \bar{s}_t - S_s \right\rangle i \in \{1, 2, \dots, n\}$  (7)

Such a classification provides the opportunity to immediately identify individual typological groups, on account of the level of development of the examined phenomenon. The subjects which belong to individual groups are ordered according to the value of the synthetic meter of development. The subjects which belong to group 1 are characterised by the highest level of development of the examined phenomenon, while those which belong to group 4 represent subjects characterised by the lowest level of development of the phenomenon.

The results of classification of the European Union countries, carried out on the basis of the synthetic variable, are presented in Table 3.

Table 3. Results of classification of the European Union countries according to the synthetic meter of the external conditionings of innovation of companies

Group	Year			
	1997	2000	2003	2005
Group 1	Sweden, Finland, Denmark, Germany	Sweden, Finland, Denmark, Germany	Sweden, Finland, Denmark	Sweden, Finland, Denmark
Group 2	Great Britain The Netherlands, France, Belgium, Austria, Ireland	Great Britain The Netherlands, France, Belgium, Austria, Ireland	Germany, Great Britain The Netherlands, France, Belgium, Austria, Ireland	Germany Great Britain, The Netherlands, France, Belgium, Austria, Ireland
Group 3	Slovenia, Italy, Greece, Spain, Lithuania, Estonia, The Czech Republic, Cyprus, Slovakia, Portugal, Latvia	Slovenia, Italy, Greece, Spain, Lithuania, Estonia, The Czech Republic, Cyprus, Hungary, Portugal, Latvia	Slovenia, Italy, Greece, Spain, Lithuania, Estonia, The Czech Republic, Cyprus, Slovakia, Portugal, Latvia	Slovenia, Italy, Greece, Spain, Lithuania, Estonia, The Czech Republic, Cyprus, Slovakia, Portugal, Hungary
Group 4	Poland, Hungary	Poland, Slovakia	Poland, Slovakia	Poland, Latvia

Source: Own work.

Pursuant to the classification of the European Union countries conducted on the basis of the synthetic meter of the external conditionings of innovation of companies, we can state that we obtained a high level of convergence of the results of classification in the examined moments in time. The number and compositions of individual groups for the years 1997 and 2000 are almost identical. Only two countries were found in different groups, i.e. in the year 2000 Hungary advanced to the group with better conditionings of innovation of companies, whereas in the year 2000 Slovakia found itself in the group with the worst external conditionings for the course of the innovative processes in companies.

Slovakia improved its position with regard to the analysed phenomenon in the year 2005, by advancing to the group of countries with a higher indicator of the external conditionings of innovation once again. The country which also found itself in another group within the space of the examined years is Germany, which in the first two discussed periods belonged to the group of countries with the most favourable conditionings of the innovative processes, while in the subsequent years it found itself in group 2. As far as Poland is concerned, it was classified in the last group of the European Union countries with the unfavourable conditionings for the innovation of companies. The first two groups are created by countries of the "old" European Union with the highest level of socio-economic and technological growth. Whereas the third group comprises the countries of the EU 10 plus Italy, Greece, Spain and Portugal, that is countries

which, owing to their geographical location, generate a significant amount of their income from tourism, and which do not necessarily concentrate on achieving a high level of technological advancement as a factor which stimulates development and economic growth.

## 5. CONCLUSIONS

While analysing the factors which determine the tendency of the company to the innovative activity, we can divide them into internal and external. However, we ought to remember about their connective influence on the innovation of companies. Inasmuch as the company may have, and usually does have, influence on shaping the internal innovative potential, this influence is scarce or none with reference to the external conditionings. This is not to say that less attention ought to be paid to them, but rather that the company should keep trace of them, adjust to them or anticipate them.

Both on the side of external and internal environment of the company, all the factors which determine the innovation of companies can be divided into three fundamental groups, namely:

- factors social in character,
- factors economic in character,
- factors technical in character.

All the presented factors can be classified as those which specify the innovative tendency – they determine the interest in changes in technology and the readiness to take risks related thereto, as well as those which specify the innovation capability – intellectual, technical and financial opportunities of carrying out the innovative activity by the company.

The methods of classification of the European Union countries applied in the study allowed us to single out four groups of countries characterised by different levels of the external conditionings of innovation of companies. When we generalise the results of the classification obtained for the years 1997 – 2005, the individual groups include the following European Union countries:

- group I (*leading countries*) – Sweden, Finland,
- group II (*average performance countries*) – Germany, Denmark, Great Britain, The Netherlands, France, Belgium, Austria, Ireland.
- group III (*catching up countries*) – Slovenia, Italy, Greece, Spain, Lithuania, Estonia, The Czech Republic, Cyprus, Portugal, Hungary, Latvia,
- group IV (*loosing ground countries*) – Poland, Slovakia.

The conducted analyses revealed that Poland ranks among the European Union countries with the worst external conditionings which determine the innovative activity of companies. The largest distance in comparison to other countries,

with respect to factors which boost the innovative activity, is present in the group of factors “research and development activity” and “human resources for innovation”. Therefore, in those areas which are considered as the fundamental conditionings of the innovative processes Poland is characterised by the greatest shortages, which, in turn, contributes to a low innovative activity of the Polish companies, in comparison to their European Union competitors.

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#### **ZEWNĘTRZNE UWARUNKOWANIA INNOWACYJNOŚCI PRZEDSIĘBIORSTW W POLSCE NA TLE WYBRANYCH KRAJÓW 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 elementem determinującym sprawność działania przedsiębiorstwa oraz jego rozwój na konkurencyjnym rynku. Aktywność innowacyjna przedsiębiorstw zależy od wielu czynników zarówno o charakterze zewnętrznym jak i wewnętrznym z punktu widzenia przedsiębiorstwa. Celem opracowania jest analiza porównawcza zewnętrznych uwarunkowań innowacyjności przedsiębiorstw w wybranych krajach Unii Europejskiej. Poziom innowacyjności przedsiębiorstw na unijnym rynku stanowi jeden z najważniejszych czynników określających ich międzynarodową pozycję konkurencyjną

**Słowa kluczowe:** innowacyjność przedsiębiorstw, uwarunkowania innowacyjności, zmienna syntetyczna, porządkowanie liniowe, Unia Europejska.