Comparative Economic Research. Central and Eastern Europe
Volume 25, Number 2, 2022
https://doi.org/10.18778/1508-2008.25.15

Assessing the Effectiveness of Selected European Innovation Systems

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Abstract

The growing importance of innovation in the modern economy has revived the interest of economic sciences in studies on the mechanisms that govern innovation and its impact on economic development. This growth of interest induced the concept of the national system of innovation (NSI), which occupies an important place in the innovation policy of all developed market economies. The economic literature distinguishes various typologies of innovation systems. The aim of the article is to assess the effectiveness of the system of European integration, the socio-democratic system, and the mutated system, measured by the level of innovation of the economies that belong to these systems, in 2014 and 2019. The article analyzes the literature on the subject of innovation systems. The method of linear ordering, which makes it possible to build a synthetic measure calculated using the Hellwig method, is used to assess the effectiveness of innovation systems. The article formulates a research hypothesis that the most effective innovation systems are the socio-democratic system and the system of European integration. This hypothesis has been positively verified.

Keywords: innovation, national innovation system, innovation ranking

JEL: O30, O31, O43

Introduction

The growing importance of innovation in the modern economy has revived the interest of economic sciences in studies on the mechanisms that govern innovation and its impact on economic development. This growth of interest induced the concept of the national system of innovation (NSI), which occupies an important place in the innovation policy of all developed market economies. The economic literature distinguishes various typologies of innovation systems, one of which is the classification that includes the market system, the European integration system, the socio-democratic system, the meso corporative system, and the mutated system (Godinho, Mendonca and Pereira 2003; Okoń-Horodyńska 1998, p. 81; Weresa 2014, pp. 66–70).

The article aims to assess the effectiveness of innovation systems, measured by the level of innovation of the economies that belong to these systems, in 2014 and 2019. Due to the scarcity of data, the study covers three European systems, the system of European integration, the socio-democratic system, and the mutated system. The article analyzes the literature on the subject of innovation systems. Multidimensional statistical analysis was used to assess the effectiveness of innovation systems – this is the method of linear ordering that makes it possible to build a synthetic measure calculated using the Hellwig method. The article hypothesizes that the most effective innovation systems are the socio-democratic system and the system of European integration. This hypothesis has been positively verified.

The concept and classification of the national innovation system

The concept of the national innovation system (NIS) became the subject of in-depth research and studies in the late 1980s and early 1990s (Vonortas 2009, p. 174). The works of Freeman (1992), Nelson and Rosenberg (1993), Patel and Pavitt (1994), Edquist (1997), and Lundvall (1992) were the milestones in the development of this concept.

The emergence of the NIS is inextricably linked with the thesis adopted by the above-mentioned economists that the innovation or innovative capacity of the economy should be analyzed in the context of the economic, institutional, and cultural conditions that are specific to a given national economy.

Various definitions of the NIS exist in the economic literature. One of the most frequently cited is from Lundvall, who defines it as an arrangement of production, scientific and technical subsystems, institutional solutions, and the relationships between them, which affect the level of innovation in the economy (Lundvall 1992, pp. 12–20). An NIS defined in this way can, according to Lundvall, be analyzed from a narrow and broad perspective. In the narrow sense, it covers all institutions in the research and development sphere, such as universities, research institutes (private and public), and the research and development units of enterprises. On the other hand, from a broad perspective, an NIS includes various participants that represent individual subsystems of the structure of a given economy, including, primarily, universities, research and development institutions, industrial enterprises, financial and marketing institutions, and public institutions (Lundvall 1992, pp. 12–15).

The literature on the subject distinguishes several NIS models (Okoń-Horodyńska 1998, p. 81; Weresa 2014, pp. 66–70):

– The first category is the free-market system, which occurs mainly in Anglo-Saxon economies (e.g., the USA, Great Britain, Canada, and Australia). These economies are characterized by the importance of the education system, in which emphasis is placed on the development of life sciences (mainly medicine, biology, and biochemistry), a flexible labor market, industry specialization, which involves supporting high technology fields (pharmaceutical and space industries, and biological sciences), an efficiently operating financial sector that actively participates in building the NIS, and enterprises that focus their innovative activities within their own organizations.
– The second model involves the system of European integration. It is characterized by a focus on developing the exact sciences and is oriented towards supporting the chemical and machine industries. The education system and research and development play an important role in its development. It is mainly based on the public sector and synchronizing the following activities: promoting economic growth, active methods of counteracting unemployment, care for social welfare, and intensive innovation policy. The system of European integration occurs in France, Germany, Belgium, the Netherlands, and Italy.
– The third model, the socio-democratic system, includes Scandinavian countries (Finland, Sweden, and Norway). Especially important are the internationalization of research and development, technological specialization in the development of industries based on the intensive use of raw materials, R&D financed primarily from private funds, the implementation of modern production methods, implementation of high education standards, supported by significant expenses, especially from the budget state, and education at the university level.
– The fourth model is the Japanese innovation system, called meso corporative, due to the high degree of sectoral specialization. It is characterized by the dynamic management of technologies, a flexible and mobile labor market, concentrating research at the level of applied research, primarily in the field of engineering sciences, high efficiency of applied research, significant industry specialization, and a strong connection with the NISs of other countries through foreign trade.
– The fifth model is an innovation system created in economies that were once in the process of systemic transformation, known as a mutated or changing (mutant). These economies had to face a significant challenge, i.e., to develop institutions that would enable the creation of international cooperation under condi-

tions that were favorable to domestic entities. This system includes the economies of Estonia, the Czech Republic, Hungary, and Poland.

Due to the lack of data, the next subchapter will assess the effectiveness of three European innovation systems, i.e., the socio-democratic system, the European integration system, and the mutated system.

Research methodology

To evaluate the effectiveness of the selected European innovation systems, multidimensional statistical analysis was used, specifically the method of linear ordering to determine the Hellwig synthetic measure. This measure replaces a large set of features of the studied objects with one aggregated variable (Krakowiak-Ball 2005, p. 71), and it makes it possible to compare the general level of innovation between countries and rank them in terms of the development of this particular field. Nevertheless, the study begins by properly selecting the diagnostic variables, i.e., variables that significantly characterize the examined, complex, and multidimensional phenomenon.

In this study, reference is made to the methodological proposals contained in the Oslo Manual 2018 (*Podręcznik Oslo 2018* 2020, pp. 63–64), which result from the joint work of Eurostat and OECD. Following the Oslo methodology, 13 variables, potential indicators of innovation, were included in the input data set. The set of potential diagnostic variables is presented in Table 1. All potential indicators that describe innovation were treated as stimulants, i.e., variables whose increasing values have a positive impact on the studied phenomenon.

Table 1. A set of potential diagnostic indicators of innovation

Symbol	Innovation index
X1	R&D expenditure in euro per capita – all sectors
X2	R&D expenditure in euro per capita – business enterprise sector
X3	R&D expenditure in euro per capita – government sector
X4	R&D expenditure in euro per capita – higher education sector
X5	High-tech patent applications to the EPO per million inhabitants
X6	EU trademark applications per million population
X7	Students in tertiary education by age group as % of corresponding age population
X8	Total high-tech trade in million euro as % of total (imports)
X9	R&D personnel as % of the labor force
X10	High-tech exports as % of total exports
X11	Employment in knowledge-intensive activities as % of total employment
X12	Product or process innovative enterprises engaged in cooperation as % of innovative enterprises
X13	Triadic patent families per million inhabitants

Source: Eurostat, Database by theme: Science, Technology, Digital Society; Education and Training, accessed: January 20, 2021.

In the first step, the usefulness of the indicators for the analysis was assessed using descriptive statistics. At this stage, there is a transition from a set of acceptable indicators, determined based on substantive and formal premises, to a set of diagnostic indicators (Panek 2009, pp. 20–21).

The next stage of the preliminary data analysis involves assessing the correlation of potential diagnostic indicators. Of the many methods to reduce and select diagnostic variables due to their informational potential, the parametric Hellwig method is used (Panek 2009, pp. 20–21). It is based on Pearson's linear correlation coefficient matrix and removes features that are strongly correlated with the others, usually at a level greater than 0.9 (which was also the level adopted in this study). Therefore, as a result of the correlation analysis for countries of the European integration system, the following variables were removed from further analysis: x1, x5, and x7, for 2014, and x1, x11, and x13, for 2019. For countries of the socio-democratic system, the following variables were removed: x1, x2, x3, x6, x8, x9, x12, and x13 for 2014, and x2, x3, x4, x8, x9, x10, x12, and x13 for 2019. On the other hand, for countries of the mutated system, x2, x4, x6, x9, x12, and x13 for 2014, and x1, x2, x8, x11, and x13 for 2019 were removed. Thus, the variables shown in Table 2 were used in the multivariate statistical analysis.

Table 2. Diagnostic indicators of the level of innovation for countries of the three innovation systems in 2014 and 2019

	Countries of the European integration system	Countries of the socio-democratic system	Countries of mutated system
	Variables used in multidimensional statistical analysis		
2014	x2, x3, x4, x6, x8, x9, x10, x11, x12, x13	x4, x5, x7, x10, x11	x1, x3, x5, x7, x8, x10, x11
2019	x2, x3, x4, x5, x6, x7 x8, x9, x10, x12	x1, x5, x6, x7, x11	x3, x4, x5, x6, x7, x9, x10, x12

Source: author's own compilation.

The basic stages of linear ordering using the Hellwig measure are as follows (Bąk 2013, p. 57):

- Determining the nature of variables (stimulants, destimulants, nominants). A variable is a stimulant if its growth positively influences the assessment of the subject. A variable is a destimulant if its decreasing values have a positive effect on the object's assessment. A nominant is a variable whose values have a positive effect on the object up to a certain point, and when this threshold is exceeded, it adversely affects the assessment of the object.
- Standardization of variables.
- Calculating the pattern coordinates: $z_{0j} = \begin{cases} \max\limits_i \left\{ z_{ij} \right\} \text{for stimulants} \\ \min\limits_i \{ z_{ij} \} \textit{ for destimulants} \end{cases}$.

– Calculating the distance from the pattern: $d_{i0} = \sqrt{\sum_{j=1}^{m} \left(z_{ij} - z_{0j}\right)^2}$.

– Determining the value of the measure of economic development: q_i (usually $q_i \in [0;1]$). – $q_i = 1 - \frac{d_{i0}}{d_0}$,

where: $d_0 = \bar{d}_0 + 2s_d$, $\bar{d}_0 = \frac{1}{n}\sum_{i=1}^{n} d_{i0}$, $s_d = \sqrt{\sum_{i=1}^{n} \left(d_{i0} - \bar{d}_0\right)^2}$.

The method used will make it possible to assess the level of innovation and build innovation rankings of countries that belong to different innovation systems. The pl-lord package operating in the R environment was used for linear ordering (Bąk 2013, p. 58).

Analysis of the effectiveness of selected European innovation systems

The article analyzes the effectiveness of the three selected European innovation systems, i.e., the European integration system, the socio-democratic system, and the mutated system, in 2014 and 2019. First, the focus was on presenting the average values of diagnostic indicators that describe the level of economic innovation in countries of the three innovation systems, as well as on the assessment of the diversity of these variables in the analyzed countries.

Table 3. Average values of diagnostic variables and coefficients of variation for three innovation systems for 2014 and 2019

Variable	Year	Countries of the European integration system		Countries of the socio-democratic system		Countries of the mutated system	
		Mean	Coefficient of variation (%)	Mean	Coefficient of variation (%)	Mean	Coefficient of variation (%)
X1	2014	820.3	39.8	1290.1	7	189.7	38.5
	2019	970.2	39.9	1381.7	11.4	256	32
X2	2014	439	34.9	811	13.5	102.8	40.7
	2019	614	35.7	861	18.7	153.3	32.8
X3	2014	93	36.6	116	49.5	30.3	45.6
	2019	96.5	44.5	117	51	30	70.8

Variable	Year	Countries of the European integration system		Countries of the socio-democratic system		Countries of the mutated system	
		Mean	Coefficient of variation (%)	Mean	Coefficient of variation (%)	Mean	Coefficient of variation (%)
X4	2014	172	29.7	358	16.9	55.3	57.3
	2019	192	30.6	393.7	20.9	70.4	51.4
X5	2014	28.7	41.8	56.8	53.4	4.6	75.4
	2019	27	38.8	51.2	54.8	3.3	47.8
X6	2014	174	27.5	156	42.2	45.8	45.7
	2019	200.2	27.5	209.7	43.8	72.3	66.1
X7	2014	22.6	68.1	0.73	42.1	2.5	60.8
	2019	24.5	67.5	0.53	23.4	2.5	64.9
X8	2014	11.1	18.9	10.5	29.8	12.4	10.4
	2019	11.3	4.5	10.9	25.2	12.1	11.7
X9	2014	2	13.3	2.8	44.3	1.4	25.6
	2019	2.2	10.7	2.6	41.5	1.6	20.6
X10	2014	14	38.1	7.6	53.1	13.5	24
	2019	15	35.8	6.9	48	13.4	27.6
X11	2014	38	7.9	40.4	6.8	32.1	5.8
	2019	38	8.9	41.2	7	32	4.9
X12	2014	29.7	35.5	36.4	11.3	38.2	11.6
	2019	31.5	40.9	31.1	11.8	37.6	12.4
X13	2014	26.3	44.9	24.9	46.6	1.45	34.8
	2019	18.1	62.9	9.7	57.9	0.81	35

Source: author's own compilation based on Eurostat, Database by theme: Science, Technology, Digital Society; Education and Training (accessed: 20.01.2021).

As can be seen from Table 3, the highest average values of most diagnostic indicators are recorded by countries of the socio-democratic system. Only for two variables – x7 and x10 – are the highest average values shown by countries of the European integration system. Similarly, the highest mean values of the two diagnostic indicators – x8, x12 – are recorded by the countries of the mutated system.

Among the three analyzed innovation systems, the countries of the European integration system are the least diversified in terms of the development of diagnostic variables (for all variables, except x7, the coefficients of variation are below 45%). With regard to the presented indicators, the countries of the socio-democratic system are slightly more diversified. Several indicators (x3, x5, x10, x13) are characterized by above-average variation (over 45%). The economies of the mutated system are the most diversified – 5 variables (x3, x4, x5, x6, x7) are characterized by strong variation (over 45%).

The results of the linear ordering using the Hellwig method for 2014 (divided by innovation system) are presented in Figure 1.

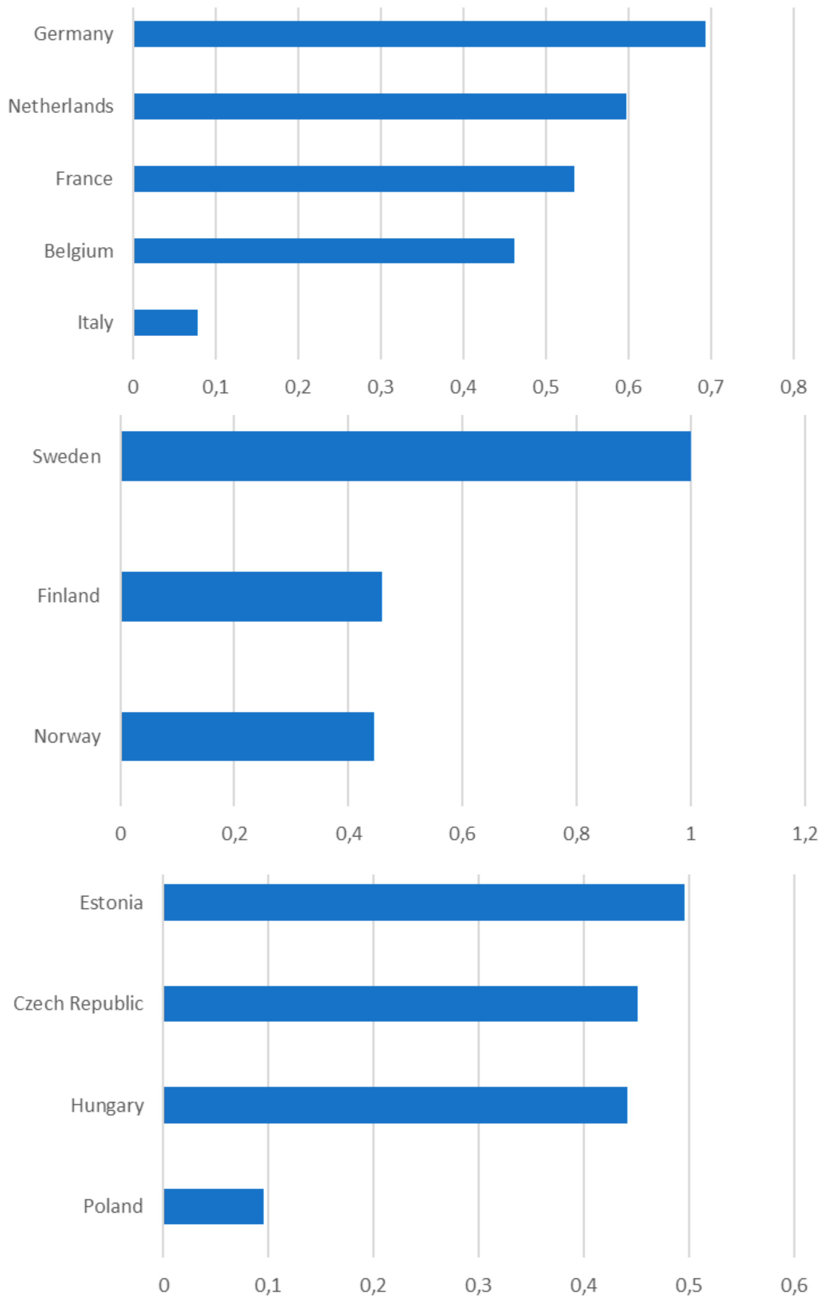
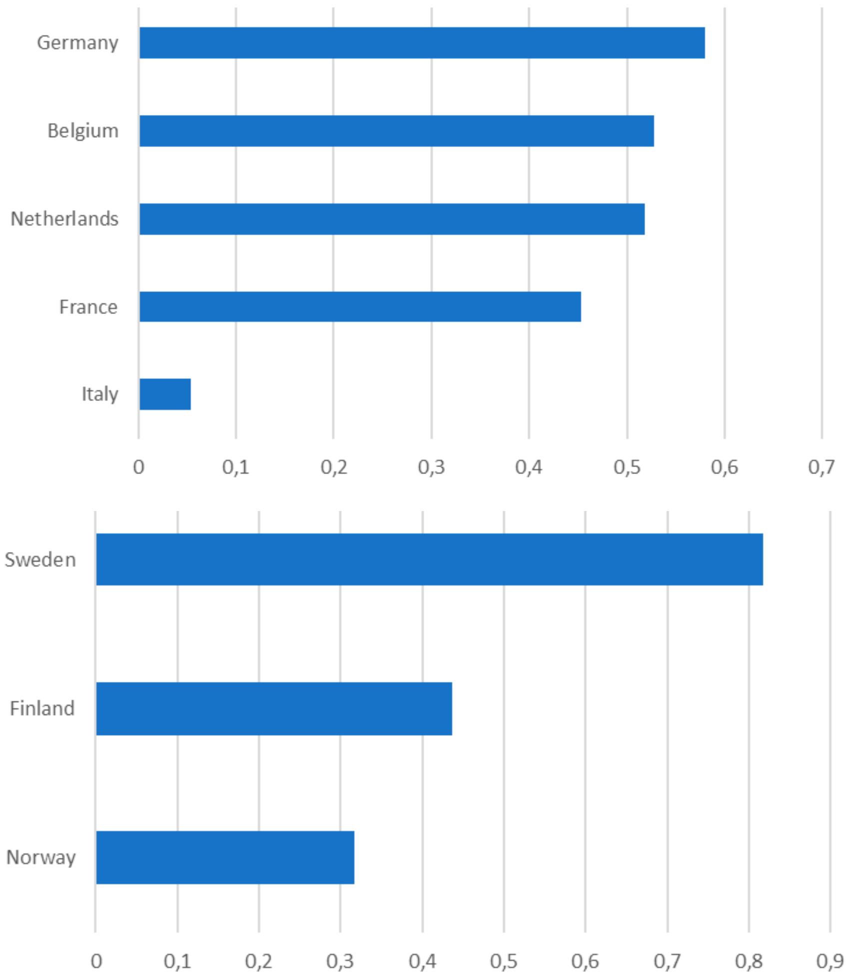


Figure 1. The results of the linear ordering of countries of the three innovation systems in 2014 using the Hellwig method (divided by innovation system)
Source: author's own study in the pllord package (R environment) based on Eurostat, Database by theme: Science, Technology, Digital Society; Education and Training (accessed: 20.01.2021).

As shown by the data in Figure 1, according to the synthetic Hellwig measure, in 2014, the highest level of innovation in the group of countries of the European integration system was achieved by Germany (0.69), and the lowest by Italy (0.07). In the socio-democratic innovation system, Sweden ranked the highest (1), while Finland the lowest (0.44). Among the countries from the mutated system, the highest level of innovation was recorded in Estonia (0.49) and the lowest in Poland (0.09).

The results of the Hellwig linear ordering for 2019 (divided by innovation system) are presented in Figure 2.



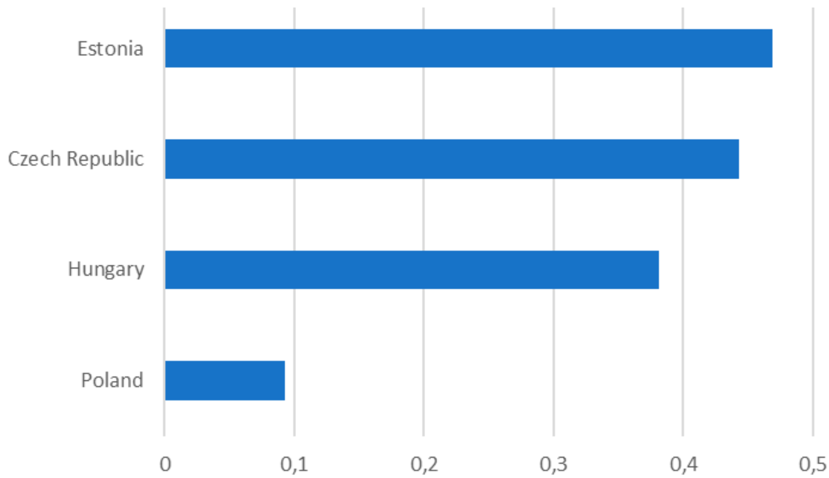


Figure 2. Results of the linear ordering of countries of the three innovation systems, using the Hellwig method, in 2019 (division by innovation system)
Source: author's own study in the pllord package (R environment) based on Eurostat, Database by theme: Science, Technology, Digital Society; Education and Training (accessed: 20.01.2021).

Based on the data in Figure 2, in 2019, in the group of countries from the European integration system, the highest level of innovation was shown by Germany (0.58), followed by Belgium (0.52), the Netherlands (0.51), France (0.45), and Italy (0.05). Among the countries from the socio-democratic system, Sweden was ranked the highest (0.81), and Norway the lowest (0.44). In the group of countries from the mutated innovation system, the highest level of innovation was again shown by Estonia (0.47), followed by the Czech Republic (0.44), Hungary (0.38), and Poland (0.09).

Summarizing the results of the analysis so far, between 2014 and 2019, the highest position in the European integration system in terms of the level of innovation, measured by the Hellwig synthetic index, was occupied by Germany, and the lowest by Italy. In the socio-democratic system, during the entire period of the analysis, Sweden ranked the highest, although Finland was the lowest in 2014, and Norway in 2019. On the other hand, in the mutated system, in both years, Estonia ranked the highest in terms of the level of innovation, and Poland the lowest. These results are presented in Table 4.

Table 4. Countries with the highest and lowest positions according to the synthetic Hellwig index in the years 2014 and 2019 in the three innovation systems

Innovation system	System of European integration		Socio-democratic system		Mutated system	
Year	2014	2019	2014	2019	2014	2019
Top position in terms of Hellwig synthetic innovation index	Germany	Germany	Sweden	Sweden	Estonia	Estonia
The lowest position in terms of Hellwig synthetic indicator of innovation	Italy	Italy	Finland	Norway	Poland	Poland

Source: author's own compilation based on Eurostat, Database by themes: Science, Technology, Digital Society; Education and Training (accessed: 20.01.2021).

The next part of the analysis focuses on assessing the level of innovation in all countries, without dividing them into particular groups (i.e., innovation system).

Figure 3 presents the results of the linear ordering of countries by the Hellwig method in 2014 without dividing them into groups.

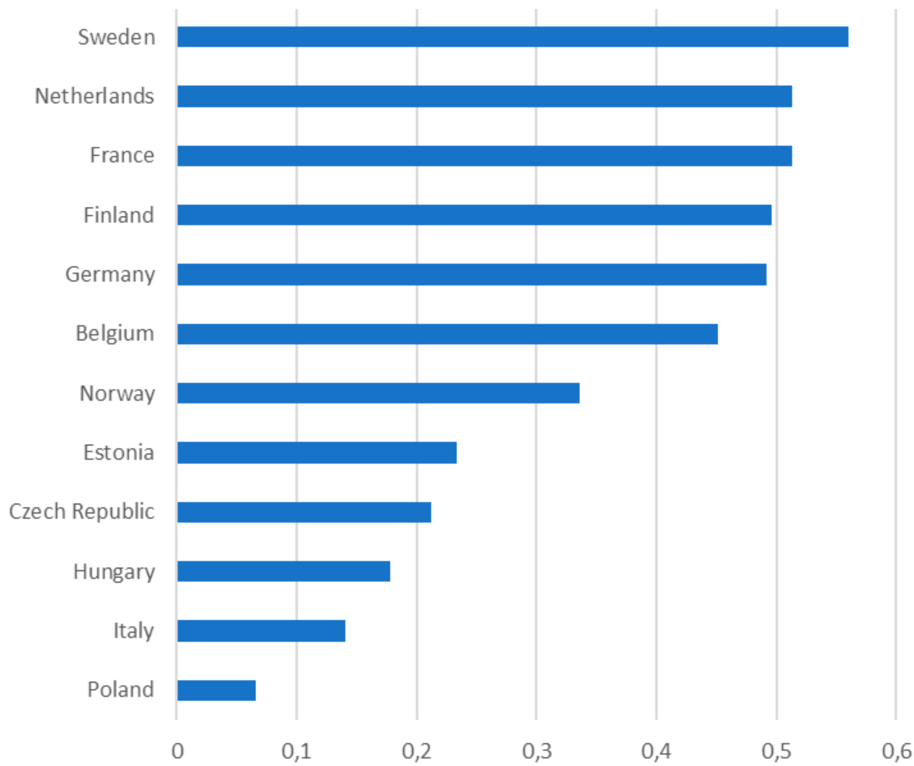


Figure 3. Results of the linear ordering of all countries in 2014 using the Hellwig method without dividing them into groups (i.e., by innovation system)
Source: author's own study in the pllord package (R environment) based on Eurostat, Database by theme: Science, Technology, Digital Society; Education and Training (accessed: 20.01.2021).

As shown by the data in Figure 3, in 2014, the highest level of innovation was reported by Sweden (0.56), the Netherlands (0.51), France (0.51), Finland (0.50), and Germany (0.49), i.e., countries from the system of European integration and socio-democratic system. Countries from the mutated system (Estonia, the Czech Republic, Hungary, and Poland) and Italy ranked lower. Poland was again the last in terms of the level of innovation, measured using the Hellwig method.

Figure 4 presents the results of the linear ordering of all countries using the Hellwig method in 2019 without grouping them.

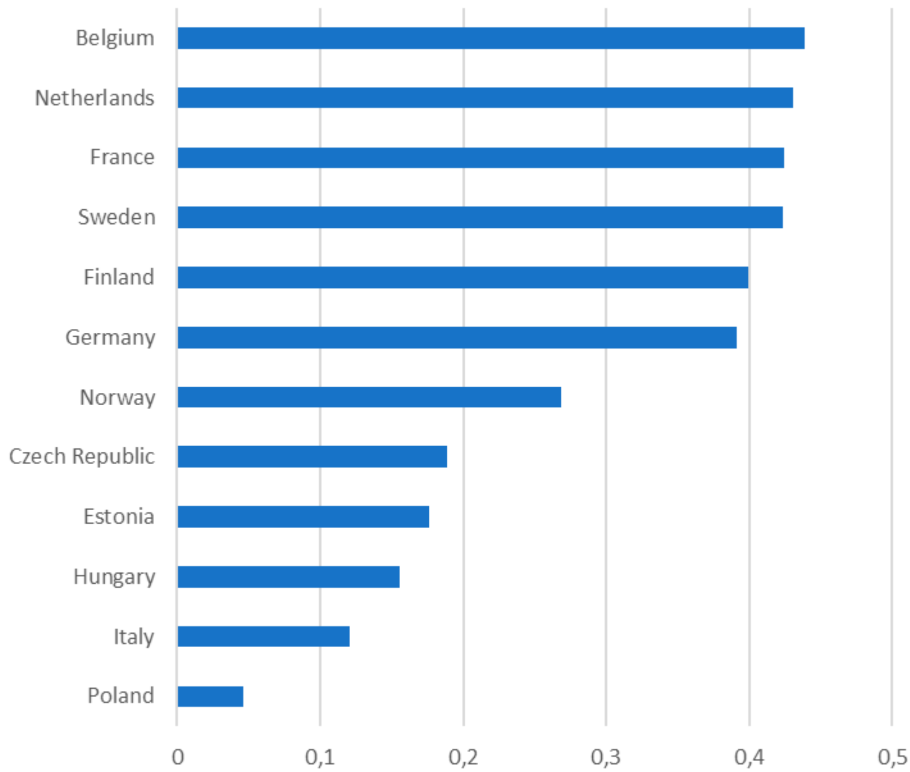


Figure 4. Results of the linear ordering of all countries using the Hellwig method in 2019 without grouping them (i.e., by innovation system)
Source: author's own study in the pllord package (R environment) based on Eurostat, Database by themes: Science, Technology, Digital Society; Education and Training (accessed: 20.01.2021).

The results of linear ordering using the Hellwig method (Figure 4) indicate that the countries of the European integration and socio-democratic systems, i.e., Belgium (0.44), the Netherlands (0.43), France (0.42), Sweden (0.42), and Finland (0.39), were characterized by the highest level of innovation in 2019 while a lower level of innovation was recorded, as in previous years, by countries from the mutated system, i.e., the Czech Republic (0.19), Estonia (0.18), Hungary (0.16), and Poland (0.05). Italy, from the European integration system, was last but one (0.12).

Table 5 shows the countries with the highest and the lowest levels of innovation in 2014 and 2019, measured using the Hellwig method.

Table 5. Countries with the highest and the lowest levels of innovation in the years [between] in 2014 and 2019, measured using the Hellwig method

Year	2014	2019
Country with the highest level of innovation, measured by the Hellwig method	Sweden (socio-democratic system)	Belgium (European integration system)
Country with the lowest level of innovation, measured by the Hellwig method	Poland (mutated system)	Poland (mutated system)

Source: author's own compilation.

Conclusions

As can be seen from the considerations on the selected European innovation systems, in 2014 and 2019, the highest level of innovation was demonstrated by countries of the socio-democratic innovation system and the European integration system. It can therefore be concluded that the hypothesis formulated in the introduction to the article has been positively verified.

Particularly noteworthy is the high position in the innovation rankings of the Swedish and German economies. The success of the Swedish innovation system is based on a coherent and long-term strategy aimed at increasing the innovativeness of the economy through investments in education, human capital, and R&D. The Swedish innovation system is characterized by the internationalization of scientific research, industrial orientation towards technological and innovative activity, rapid adaptation of new techniques, and high expenditure on education (Prystrom 2012, p. 504). The policy of creating clusters and tax incentives for R&D plays a vital role in it.

On the other hand, the main source of the success of the German innovation system is the equally consistent policy of supporting the innovation of the economy, based on three pillars (Gorynia-Pfeffer 2012, p. 218): (a) improving the conditions for the development of innovation by simplifying the taxation system, reducing tax burdens, and reducing bureaucratic procedures, (b) promoting innovative behavior by providing financial aid, and (c) improving the education and learning system in order to create highly qualified human resources.

As for the Belgian innovation system, it is headed by a government that operates through federal and local authorities and administrative bodies. Financial support flows directly into the research sector from these organizations. At the same time, the R&D sector is supported by industry and international institutions (Szajt 2009, p. 23).

The results of the analysis also indicate distant positions in the rankings of innovativeness of economies belonging to the mutated system. Nevertheless, Estonia occupies the highest position in this group in terms of economic innovation (Wojtowicz and Mikos 2012, p. 169). After gaining independence in 1991, the country began to implement the "Tiger's Jump" policy, which involved technological development, investments in the Internet infrastructure, and incentives for foreigners to open a business.[1] Estonia's success was possible thanks to high social capital, based on mutual trust, trust in state institutions, as well as openness to foreign citizens. It is also based on an efficiently functioning and friendly institutional environment.[2]

In the group of countries from the mutated innovation system, Poland has the lowest position in the rankings of economic innovativeness presented in the article, as well as in other rankings.[3] There is no doubt that this is due to the ineffectiveness of the innovation policy pursued in Poland. The lack of a long-term strategy to increase the level of innovation in the economy (Dworak 2012, p. 219), which would combine the achievements of various governments, is the fundamental weakness of this policy. The dependence of many elements of the Polish innovation system on the public finance sector is another drawback.[4] The structure of scientific research is also unfavorable from the point of view of increasing innovation – in Poland, applied research, i.e., research that is "closer to the market", has too low a share in the overall structure of research. The lack of permanent connections between entities from the scientific and research sphere and the sphere of enterprises has also been disturbing for years,[5] which results from the shortages of social capital and the lack of appropriate state support for such cooperation.

1 Estonia focuses primarily on supporting foreigners to create innovative start-ups, the availability of administrative and government services via the Internet, e.g., electronic cards for residents have been introduced, which are proof of social security insurance. (Najważniejsze wiadomości-Estonia-kolebka innowacji i kraj o rozwiniętej infrastrukturze sieciowej 2019).

2 The elements of this environment include clear laws, little bureaucracy, and simplified rules for establishing enterprises (e-Residence program). (Najważniejsze wiadomości-Estonia-kolebka innowacji i kraj o rozwiniętej infrastrukturze sieciowej 2019).

3 In the rankings of the European Innovation Scoreboard, Global Competitiveness Report, and Global Innovation Index, Poland occupies a distant position. (Dworak, Grzelak 2020, pp. 38–50).

4 This relationship is evidenced by the fact that approx. 80% of Polish R&D potential, measured by the number of research and development employees, is employed in the state sector, i.e., approx. 80% of "scientific production" is generated outside enterprises – a reverse proportion than in highly developed countries. It is also worth adding that about 60% of financial expenditure on research and development comes from the state budget and EU funds, while the share of enterprises in this financing is about 30%. This does not mean that state expenditures should decrease – on the contrary, they should increase and be the driving force for R&D expenditures from enterprises, but enterprises expenditures should grow faster than state expenditures, also thanks to easier access to capital at all stages of implementation of R&D projects (Jasiński 2018, p. 235).

5 Almost 80% of Polish innovations are based on ideas and solutions developed in enterprises, which is because Polish companies use the achievements of scientific units only to a small extent. Because of this, Polish technical innovations represent a relatively low level of modernity. (Jasiński 2018, p. 235).

Summing up the considerations, the countries that hold high positions in the rankings of economic innovation owe this advance to the synergy of several factors, i.e., the implementation of an appropriate state policy, based on supporting R&D and education (Roszko-Wójtowicz and Grzelak 2020, p. 658; Roszko-Wójtowicz, Grzelak, and Laskowska 2019, p. 720), the development of an efficient and friendly institutional environment, as well as launching social capital, conducive to the development of creativity and ability to cooperate. Regarding the Polish economy, it is therefore necessary to try to reconstruct the current model of supporting the development of innovation.

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Ocena efektywności wybranych europejskich systemów innowacji

Wzrost znaczenia aktywności innowacyjnej we współczesnej gospodarce ożywił zainteresowanie nauk ekonomicznych studiami dotyczącymi mechanizmów rządzących procesami innowacyjnymi i wpływu innowacji na rozwój gospodarczy. Na fali wzrostu tego zainteresowania powstała koncepcja narodowego systemu innowacji (NSI), która zajmuje ważne miejsce w polityce innowacyjnej wszystkich rozwiniętych gospodarek rynkowych. W literaturze ekonomicznej wyodrębnia się różne typologie systemów innowacji. Celem artykułu jest ocena efektywności systemu integracji europejskiej, systemu społeczno-demokratycznego i systemu zmutowanego, mierzonej poziomem innowacyjności gospodarek należących do tych systemów, w latach 2014 i 2019.

W artykule dokonano analizy literatury przedmiotu poświęconej systemom innowacji; do oceny efektywności systemów innowacji wykorzystano metodę wielowymiarowej analizy statystycznej – metodę porządkowania liniowego, pozwalającą na zbudowanie miernika syntetycznego Hellwiga. W artykule sformułowano hipotezę badawczą zakładającą, że najbardziej efektywnymi systemami innowacji są system społeczno-demokratyczny i system integracji europejskiej. Hipoteza ta została zweryfikowana pozytywnie.

Słowa kluczowe: innowacja, narodowy system innowacji, ranking innowacyjności

Received: 5.05.2021; verified: 15.11.2021. Accepted: 25.02.2022