Barometr Regionalny
Tom 14 nr 4

Evaluation of Innovative Undertakings with the European Union Funds. Polish Voivodships Scope

Aleksandra Zygmunt
Opole University of Technology, Poland

Abstract

The main purpose of the paper is the assessment of the European Union funds engagement in innovative undertakings in Polish voivodships. Firstly, it was made the considerations about innovations as an essential component of an integrated approach in terms of regions' competiveness improvement. Furthermore, it was examined the differentiation in the participation of the EU funds in innovative undertakings between Polish voivodships. In this respect was applied cluster analysis, on base which was isolated space groups, which allow to comparison of the European Union funds involvement between voivodships of Poland. The research were based on data from Central Statistical Office of Poland — Local Data Bank — concerning particularly the Programme Innovative Economy. The scope of examinations contains period 2011–2015. The effects of examinations affects the ability to identify voivodships similar in scope of the accepted variables. This identification may contribute to create of comparative base actions taken to improve innovations, which could lead to an increase in the competitiveness of regions.

Keywords: innovative undertakings, the EU funds, competiveness of region

Introduction

Increasing regions competitiveness is treated as an essential component of the European Union integration policy. In this regard are taken a number of actions aimed to improve regions' value. Therefore, the substantial importance is focused on enhancing the innovation potential of regions. In this area the crucial place constitutes stimulation of innovative behaviors and supporting innovative undertakings by the EU funds. For this reason is necessary to conduct studies concerning the European Union funds engagement in innovative undertakings in Polish voivodships.

The main aim of this article is the assessment of the European Union funds involvement in innovative undertakings in Polish voivodships. In this area the special regard was put on the comparison of applications number for final payment and an average participation of the EU funding in a framework of the Programme Innovative Economy following Priority Axes: Research and development of new technologies, R&D infrastructure, Capital for innovation, Investments in innovative undertakings, Diffusion of innovation, Polish economy on the international market and Information society — increase of innovativeness of economy. The examinations were based on cluster analysis, which was applied for creation the clusters of the first order. The examinations uses data from Central Statistical Office of Poland — Local Data Bank concerning the period 2011–2015.[1]

1 Innovations as the essential component of an integrated approach

Integrated approach emphasizes essentially on increasing regions' growth. In this respect the special attention is put on smart, inclusive and green growth.[2] Among them the substantial place

1. See: https://bdl.stat.gov.pl/BDL/.
2. See: Regional Policy, an Integrated Approach. A 360° View. Panorama Inforegio 34, Summer 2010, page 4,

constitute regions' competitiveness improvement, which is expressed mainly by innovations. That is why innovations are treated as a fundamental factor of regional development nowadays (A. Zygmunt 2014, 13; J. Zygmunt 2014, 29). Innovations create the basis for the development of entities operating in region, their entrepreneurship potential, and, consequently, innovations impact on regions' growth. In its issue innovations provide a knowledge necessary for development (Makieła 2013, 15) and obtainment competitive advantage in turbulent environment. That is why innovations are treated as the "main engine of growth — essential for other growth's factors."[3]

It should be pointed that innovations are belonged to endogenous determinants of regions' growth. In its issue endogenous determinants[4] characterize regions' capacity to respond to changes in the macro surrounding (Brol 2006, 16). Nowadays, the rank of endogenous determinants in regions' increasing competitiveness is enormous (Malik 2011, 28). That is why innovations should be considered as the main component of regions' development (Klasik and Kuźnik 1998, 395–404). The importance of innovations as the essential component of an integrated approach requires action supporting innovations potential. In this area the special attention should be put on a creation a supportive environment for innovations (Lichniak 2010, 16). As a result, the crucial importance is connected with providing funds for innovative undertakings. In this respect the special place occupy the European Union funds, which might increase, among others, facilitate access to new technologies and enterprises' foreign expansion (Szewczuk-Stępień 2014, 231–232).

2 The methodology of the research

The conducted examinations were concentrated on evaluation of the European Union funds involvement in innovative undertakings in voivodships of Poland. In this respect the special place was put on the differentiation of the EU funding for innovative undertakings between Polish voivodships. To the studies was used cluster analysis,[5] which was applied for recognition the space groups differ in the European Union funds involvement in innovative undertakings (in voivodships perspective).

The research were based on data relating to the Programme Innovative Economy[6] originated from Central Statistical Office of Poland — Local Data Bank. The special attention was put on data connected with such Priorities Axis of the Programme Innovative Economy as Research and development of new technologies, R&D infrastructure, Capital for innovation, Investments in innovative undertakings, Diffusion of innovation, Polish economy on the international market and Information society — increase of innovativeness of economy. From the examinations were excluded Information Society — establishment of electronic administration Priority Axis and Technical assistance Priority Axis due to the fact that their realization concerned only central level. The studies contain period 2011–2015.

To the examination were chosen the following variables:

x_1 — a number of applications for final payment in Research and Development of new technologies Priority Axis in each voivodship in period 2011–2015

x_2 — a number of applications for final payment in R&D infrastructure Priority Axis in each voivodship in period 2011–2015

x_3 — a number of applications for final payment in Capital for innovation Priority Axis in each voivodship in period 2011–2015

[@:] http://ec.europa.eu/regional_policy/sources/docgener/panorama/pdf/mag34/mag34_en.pdf.

3. See: Strategie ponadregionalne — wymiar terytorialny polityki rozwoju, Ministerstwo Infrastruktury i Rozwoju, Warszawa, marzec 2015, page 9, [@:] https://www.mr.gov.pl/media/3355/20150312_strategie_ponadreg_wymiar_teryt.pdf.

4. Among endogenous determinants should be mentioned region's real estate potential as the determinant of regions' development (Mach 2015, 81).

5. To the research was used cluster analysis method created by Florek, Łukaszewicz, Perkal, Steinhaus, and Zubrzycki (1951).

6. The Programme Innovative Economy belongs to programmes under National Strategic Reference Framework. In its issue the Programme supports various innovation undertakings classified in nine Priorities Axis. See: About the Programme. (accessed: 2016.11.23), [@:] http://www.poig.2007–2013.gov.pl/english/Strony/Introduction.aspx.

x_4 — a number of applications for final payment in Investments in innovative undertakings Priority Axis in each voivodship in period 2011–2015
x_5 — a number of applications for final payment in Diffusion of innovation Priority Axis in each voivodship in period 2011–2015
x_6 — a number of applications for final payment in Polish economy on the international market Priority Axis in each voivodship in period 2011–2015
x_7 — a number of applications for final payment in Information society — increase of innovativeness of economy Priority Axis in each voivodship in period 2011–2015
x_8 — an average participation (eligible expenditure) of the EU funding in Research and development of new technologies Priority Axis in each voivodship in period 2011–2015
x_9 — an average participation (eligible expenditure) of the EU funding in R&D infrastructure Priority Axis in each voivodship in period 2011–2015
x_{10} — an average participation (eligible expenditure) of the EU funding in Capital for innovation Priority Axis in each voivodship in period 2011–2015
x_{11} — an average participation (eligible expenditure) of the EU funding in Investments in innovative undertakings Priority Axis in each voivodship in period 2011–2015
x_{12} — an average participation (eligible expenditure) of the EU funding in Diffusion of innovation Priority Axis in each voivodship in period 2011–2015
x_{13} — an average participation (eligible expenditure) of the EU funding in Polish economy on the international market Priority Axis in each voivodship in period 2011–2015
x_{14} — an average participation funding (eligible expenditure) of the EU in Information society — increase of innovativeness of economy Priority Axis in each voivodship in period 2011–2015

On the basis of analyzed variables was defined the data matrix ($X = [x_{ij}]$), which was standardized using the following formula (Kukuła 2000, 82):

(1) $$z_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j}, \text{ when } x_j \text{ is stimulant, or}$$

(2) $$z_{ij} = \frac{\bar{x}_j - x_{ij}}{s_j}, \text{ when } x_j \text{ is destimulant,}$$

where:
z_{ij} is standardized diagnostic atribute x_{ij},
$\bar{x}_j = 1/n \cdot \sum_{i=1}^{n} x_{ij}$,
$s_j = \sqrt{1/n \cdot \sum_{i=1}^{n} (x_{ij} - \bar{x}_j)^2}$.

Next, it was selected the similarity measure (Młodak 2006, 48):

(3) $$d_{ij} = \sqrt{\sum_{k=1}^{m} (z_{ik} - z_{jk})^2}.$$

The similarity measure was applied to isolate space groups — i.e., the clusters of the first order (Heffner and Gibas 2007, 69–72), which enabled the comparison of innovative undertakings financed with involvement of the European Union funds between voivodships of Poland. In this regard similarity measure was used to calculate distances between particular voivodships, on the base which was computed the elements of matrix clusters distances between objects. Then it was located the closer element (for each element of matrix) in order to collate similar units (summary of the closest elements) with minimal taxonomic distance and was eliminated one from two the same connections. Next it was made the connection the other units to create the clusters of the first order.

3 The results of the assessment of the European Union funds involvement in innovative undertakings in Polish voivodships perspective

The effects of examinations conduct to the conclusion about differential involvement of the EU funds in innovative undertakings between Polish voivodships within 2011–2015 (tab. 1, fig. 1).

Tab. 1. The presentation of the first order clusters in terms of the European Union funds involvement in innovative undertakings (2011–2015)

Group	Voivodship	Variable														Closest elements	Min. dist.
		x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}	x_{13}	x_{14}		
I	Łódzkie (NUTS PL11)	137	4	17	424	40	553	656	0,66	0,85	0,36	0,51	0,66	0,51	0,63	Łódzkie – Podlaskie	3,34
	Podlaskie (NUTS PL34)	33	2	0	97	26	180	286	0,56	0,85	0,00	0,50	0,84	0,51	0,64		
II	Mazowieckie (NUTS PL12)	557	89	232	661	104	2 783	3 759	0,53	0,85	0,58	0,38	0,77	0,49	0,60		
	Śląskie (NUTS PL22)	252	8	154	544	91	1 324	1 459	0,52	0,85	0,47	0,34	0,74	0,57	0,62	Mazowieckie – Wielkopolskie	5,52
	Wielkopolskie (NUTS PL41)	264	18	71	596	49	1 770	2 198	0,52	0,85	0,53	0,35	0,76	0,55	0,61	Śląskie – Wielkopolskie	2,34
	Dolnośląskie (NUTS PL51)	142	9	175	228	31	1 002	871	0,57	0,85	0,53	0,34	0,84	0,47	0,62	Śląskie – Dolnośląskie	3,18
III	Lubelskie (NUTS PL31)	55	1	10	115	30	266	579	0,54	0,85	0,68	0,51	0,82	0,64	0,63		
	Świętokrzyskie (NUTS PL33)	47	2	25	82	41	241	375	0,44	0,85	0,69	0,47	0,69	0,68	0,62	Lubelskie – Lubuskie	3,80
	Lubuskie (NUTS PL43)	42	0	18	123	1	214	318	0,49	0,00	0,82	0,49	0,59	0,54	0,64	Lubelskie – Świętokrzyskie	2,14
	Opolskie (NUTS PL52)	68	0	22	119	22	275	309	0,48	0,00	0,56	0,47	0,74	0,71	0,60	Świętokrzyskie – Opolskie	3,49
	Warmińsko-Mazurskie (NUTS PL62)	33	3	5	140	28	212	219	0,45	0,85	0,43	0,47	0,85	0,74	0,63	Świętokrzyskie – Warmińsko-Mazurskie	2,07
IV	Małopolskie (NUTS PL21)	355	33	39	663	84	1 693	1453	0,57	0,85	0,75	0,47	0,60	0,47	0,64		
	Podkarpackie (NUTS PL32)	101	3	33	448	64	793	1 320	0,41	0,85	0,63	0,47	0,84	0,44	0,60	Podkarpackie – Kujawsko-Pomorskie	2,58
	Zachodniopomorskie (NUTS PL42)	86	15	17	104	0	389	307	0,61	0,85	0,7	0,44	0,00	0,62	0,62	Małopolskie – Pomorskie	3,89
	Kujawsko-Pomorskie (NUTS PL61)	86	4	15	287	25	630	587	0,46	0,85	0,74	0,48	0,62	0,54	0,59	Zachodniopomorskie – Kujawsko-Pomor.	4,55
	Pomorskie (NUTS PL63)	33	3	5	140	28	212	219	0,45	0,85	0,43	0,47	0,85	0,74	0,63	Kujawsko-Pomorskie – Pomorskie	2,58

Source: Own calculations based on data by Central Statistical Office of Poland—Local Data Bank, as published on 2016.05.23
[In the journal European practice of number notation is followed—for example, 36 333,33 (European style) = 36 333.33 (Canadian style) = 36,333.33 (US and British style).—Ed.]

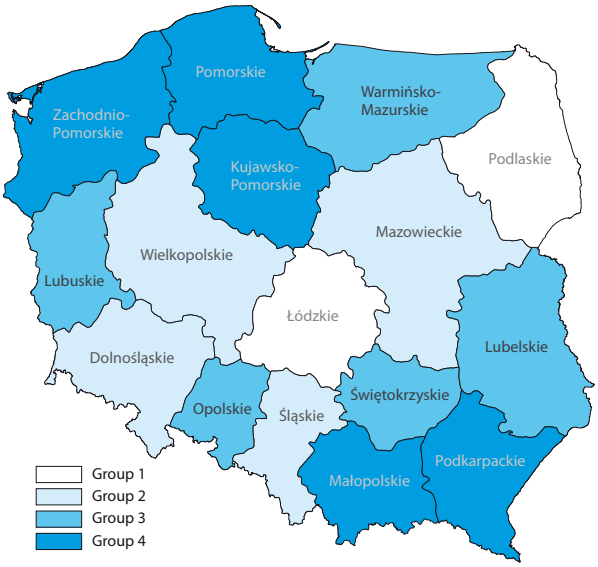

Fig. 1. The spatial presentation of the European Union funds involvement in innovative undertakings in Polish voivodships perspective in period 2011–2015

Source: Own elaboration based on data by Central Statistical Office of Poland at Local Data Bank, as published on 2016.05.23

The cluster analysis application allowed to indicate the four space groups in the terms of the accepted variables. First of them covers such voivodships as Łódzkie (NUTS PL11) and Podlaskie (NUTS PL34). In the framework of the first group the special attention should be put on similarity in an average participation of the EU funding connected with R&D infrastructure projects (on average 85%) as well as in Investments in innovative undertakings (on average 50%–51%), Polish economy on the international market (on average 51%) and Information society — increase of innovativeness of economy (on average 51%). In comparison to other voivodships of Poland the mentioned voivodships distinguish relatively the highest the European Union funds involvement in such fields as Investments in innovative undertakings (on average 50%–51%) and Information society — increase of innovativeness of economy (on average 63%–64%).

According to the achieved results the second space group contains the following voivodships: Mazowieckie (NUTS PL12), Śląskie (NUTS PL22), Wielkopolskie (NUTS PL41) and Dolnośląskie (NUTS PL51). Mentioned voivodships stand out distinctively from the other Polish voivodships in the field of innovativeness improving. This occurrence is especially noticeable in a number of applications for final payment in connection with the Programme Innovative Economy. In this respect voivodships in question distinguish relatively the highest number of application for final payment in Research and Development of new technologies (142–557), R&D infrastructure (8–89), Capital for innovation (71–232), Investments in innovative undertakings (228–661), Diffusion of innovation (31–104), Polish economy on the international market (1 002–2 783) and Information society — increase of innovativeness of economy (871–3 759) Priority Axes. The voivodships belonged to the second group feature also relatively the lowest average participation (eligible expenditure) of the EU funding in Capital for innovation Priority Axis in period 2011–2015.

The examinations outcomes indicate the third space group of voivodships in terms of the European Union funds involvement in innovative undertakings: Lubelskie (NUTS PL31), Świętokrzyskie (NUTS PL33), Lubuskie (NUTS PL43), Świętokrzyskie (NUTS PL33), Opolskie (NUTS PL52), and Warmińsko-Mazurskie (NUTS PL62). Above voivodships characterize particularly the relatively low number of applications for final payment in the area of R&D infrastructure (0–3), Investments in innovative undertakings (82–140), Polish economy on the international market (212–275) and Information society — increase of innovativeness of economy (219–579) Priority Axes. Additionally, the effects of examination allow to indicate that unlike other voivodships, Lubuskie (NUTS PL43) and Opolskie (NUTS PL52) distinguish lack of the EU funds involvement in undertakings connected with R&D infrastructure in period 2011–2015.

Taking into account accepted variables the effects of research indicate also the fourth space group, which consist of such voivodships as: Małopolskie (NUTS PL21), Podkarpackie (NUTS PL32), Zachodniopomorskie (NUTS PL42), Kujawsko-Pomorskie (NUTS PL61) and Pomorskie (NUTS PL63). Within the period 2011–2015 the above voivodships distinguished mostly the relatively high number of applications for final payment in area of Research and Development of new technologies (33–355), Investments in innovative undertakings (104–663), Polish economy on the international market (212–1693) and Information society — increase of innovativeness of economy (219–1453) Priority Axes. Moreover, it should be underlined that mentioned voivodships characterize relatively the highest involvement of the European Union funds in Capital for innovation field (in comparison to other Polish voivodships). This occurrence was especially seen in case of Małopolskie (NUTS PL21) (on average 75%) and Kujawsko-Pomorskie (NUTS PL61) (on average 74%).

Conclusions

The conducted research lead to the several conclusions. Firstly, the undertaken studies emphasize differential engagement of the European Union funds in innovative undertakings between voivodships of Poland in period 2011–2015. Above appearance might arise from diverse needs of Polish voivodships in regard to innovative undertakings and innovation potential increasing. Consequently, that occurrence might influence on differential demand for the EU funds. On the other hand, the undertaken examinations predicate of the conclusions about the existence of the voivodships' groups with relatively close involvement of the European Union funds in innovation undertakings scope (in terms of the accepted variables). This situation might contribute with relatively the approximate voivodships' objectives for improvement of innovative undertakings.

In this regard the obtained results might constitute comparative base which allow the comparison of actions taken by Polish voivodships to improve innovations and their effectiveness (especially in the regard of the EU funds acquisition for innovative undertakings in the Perspective for 2014–2020) and, as a result, might contribute in increasing competitiveness position of particular region. Moreover, the results of examination highlight the differentiation in directions of the EU funds involvement in innovative undertakings. In period 2011–2015 Polish voivodships embraced mostly the European Union funds for R&D infrastructure. This occurrence should be treated as positive because R&D potential determines the value of regions. Furthermore, the relatively high engagement of the EU funds concerned Diffusion of innovation and Information society — increase of innovativeness of economy. The complexity of the European Union funds involvement in innovative undertakings issues require further studies. They should be concentrated especially on the identification of the EU funds impact on benefited entities' innovation potential and their competitiveness position and thus the increase of regions competitiveness.

References

Brol, R. 2006. "Rozwój regionalny jako kategoria ekonomiczna." In *Metody oceny rozwoju regionalnego*, edited by D. Strahl, 13–37. Wrocław: Wydawnictwo Akademii Ekonomicznej im. Oskara Langego.

Florek, K., J. Łukaszewicz, J. Perkal, H. Steinhaus, and S. Zubrzycki. 1951. "Taksonomia wrocławska." *Przegląd Antropologiczny* (17):193–211.

Heffner, K., and P. Gibas. 2007. *Analiza ekonomiczno-przestrzenna, Prace Naukowe/Akademia Ekonomiczna im Karola Adamieckiego*. Katowice: Wydawnictwo Akademii Ekonomicznej im. Karola Adamieckiego.

Klasik, A., and F. Kuźnik. 1998. "Planowanie strategiczne rozwoju lokalnego i regionalnego." In *Funkcjonowanie samorządu terytorialnego — doświadczenia i perspektywy. Tom 2*, edited by S. Dolata. Opole: Wydawnictwo Uniwersytetu Opolskiego.

Kukuła, K. 2000. *Metoda unitaryzacji zerowanej, Biblioteka Ekonometryczna*. Warszawa: Wydawnictwo Naukowe PWN.

Lichniak, I. 2010. "Innowacja, proces innowacyjny, system innowacyjny." In *Innowacyjność jako czynnik wzrostu atrakcyjności inwestycyjnej polskich regionów w latach 2002–2007*, edited by H. Godlewska. Warszawa: Szkoła Główna Handlowa. Oficyna Wydawnicza.

Mach, Ł. 2015. "Analiza potencjału infrastruktury mieszkalnictwa oraz jej wpływ na zrównoważony rozwój regionalny ze szczególnym uwzględnieniem RPO Województwa Opolskiego 2014–2020." *Barometr Regionalny. Analizy i Prognozy* no. 13 (4):81–88.

Makieła, Z. 2013. *Przedsiębiorczość i innowacyjność terytorialna. Region w warunkach konkurencji, Zarządzanie Przedsiębiorczość*. Warszawa: Wydawnictwo C. H. Beck.

Malik, K. 2011. *Ewaluacja polityki rozwoju regionu. Metody, konteksty i wymiary rozwoju zrównoważonego, Studia/Komitet Przestrzennego Zagospodarowania Kraju PAN*. Warszawa: KPZK PAN.

Młodak, A. 2006. *Analiza taksonomiczna w statystyce regionalnej*. Warszawa: Centrum Doradztwa i Informacji Difin.

Szewczuk-Stępień, M. 2014. "Zarządzanie rozwojem przedsiębiorstwa przy wsparciu z funduszy UE." In *Zarządzanie organizacją w realnym i wirtualnym środowisku. Szanse i wyzwania*, edited by V. Marková, J. Foltys, M. Adamska and V. Hiadlovský, 227–236. Opole: Oficyna Wydawnicza Politechniki Opolskiej.

Zygmunt, A. 2014. "R&D Expenditures in Poland. Voivodship Perspective." *Barometr Regionalny. Analizy i Prognozy* no. 12 (2):13–20.

Zygmunt, J. 2014. "Firms as a Component of Smart Specialisation in the Opolskie Voivodship Development Strategy." *Barometr Regionalny. Analizy i Prognozy* no. 12 (3):29–34.