MODERN MANAGEMENT REVIEW **2019**
MMR, vol. XXIV, 26 (1/2019), p. 47-56 **January-March**

Rafał KLÓSKA[1]

PROINNOVATIVE REGIONAL DEVELOPMENT IN POLAND IN THE SECOND DECADE OF THE 21ST CENTURY IN A STATISTICAL CONTEXT

As the aim of regional research is usually a description and an assessment of sets of object, the main two research tasks, presented in many research papers, are assumed to consist of grouping and linear ordering. This paper is part of author's series of publications devoted to the findings of the proposed original concept that allows for joint consideration of regional innovation and regional development. *Proinnovative regional development* is a term introduced for a certain overriding criterion enabling the author to consider the discussed multidimensional economic categories together in the mutual relationship and not, like so far, separately. The aim of the article is to present the quantification of this research area and its statistical analysis using the methods of linear ordering at the regional level in Poland.

Keywords: innovation, development, region, statistical analysis.

1. INTRODUCTION

Regional development can be perceived as the complex economic category describing – considered usually at the basic regional level – the process of constant socio-economic changes of particular areas, involving individual regions and leading to the improvement of the current situation taking the adopted criteria into consideration (Kudłacz, 1999; Markowska, 2002; Korenik, 2004;). Regional innovation can be perceived as an ability and willingness of the entities, operating in and for the given region not only in the social and economic sphere but also in the field of regional policy, to create and absorb innovation as well as to a constant search for and practical implementation of the results of research studies, research and development works, new ideas, suggestions, inventions and solutions with the aim to make positive changes of the quantitative growth and qualitative development in the region, to respond better to the needs of inhabitants as well as to use the available resources more effectively (Strahl, 2010; Brol, 2011; Świadek, 2011). Both economic categories under consideration hold an important place in the economic theory and play a significant role in the contemporary economies (Korenik, 2004; Strahl, 2006; Hollanders, Esser, 2007; Brol, 2011; Markowska, 2012). The evolution of theoretical views, the change of paradigms and the observed processes and phenomena taking place in the world result in the fact that

[1] Rafał Klóska, PhD, Professor at Szczecin University, Faculty of Management and Economics of Services, Szczecin University, Szczecin, Cukrowa 8, 71-004; e-mail: rafal.kloska@wzieu.pl. ORCID: 0000-002-1881-3355.

the currently fundamental development is becoming to be based on knowledge and innovation (Marciniak, 2010; Janasz, 2011; Weresa, 2012;). It was, therefore, assumed that regional development is a broader term and innovation (more specifically: regional innovation) is becoming one of the main factor that defines it. A higher innovation level has a pro-development influence on the region, it has also a beneficial effect on the obtained economic results and improves the general socio-economic situation of a given region. On the other hand, however, one should be aware that pro-innovative activities in the region are to some extent determined by the level of development already achieved in that area. Underdeveloped regions of a low level of wealth usually have less funds on research and implementation of innovation, which makes their possibilities more limited and in consequence frequently leads to the lower economic growth rate.

Regional development, as well as regional innovation, from the statistical point of view, are treated as multidimensional characteristics, and due to their complexity, they are usually considered separately. Nevertheless, the correlation between these makes it possible to analyze them jointly as well. The proposed approach has been referred to as *proinnovative regional development* (Klóska, 2015).

2. QUANTIFICATION OF THE RESEARCH AREA

In literature of the subject different indicators of changes in regions are considered (Strahl, 2005; Pięta-Kanurska, 2005; Sobczak, 2006; Prusek, Kudełko, 2009; Pawłas, 2010). Multidimensional character and various conditions of regional development make it impossible to define it in a universal and unambiguous way and this results in huge difficulties with the research area quantification. Theoreticians have long been looking for determinants of development, that is such factors, which have a most significant effect and analysts select (most often on the basis of substantive prerequisites) and ultimately choose (relying sometimes on particular formal procedures) diagnostic variables, which in a possibly comprehensive way – with limitations noticed nowadays resulting mainly from limited accessibility and frequently also from the lack of reliable and comparable statistical data – would describe regional development and innovation. When it comes to a more extensive scientific discussion on the quantification of the research area of both economic categories under consideration works of such authors as D. Strahl (Strahl, 2006), J. Korol (Korol, 2008), M. Obrębalski (Obrębalski, 2002), T. Borys (Borys, 2005), R. Klóska (Klóska, 2018), B. Godin (Godin, 2004), L. Marins (Marins, 2008) czy H. Hollanders, A. van Cruysen (Hollanders, van Cruysen, 2008) are recommendable.

The list of twenty six indicators presented in tab. 1, being a summary of variables taken into account in research on innovativeness of regions and regional development in Poland (Klóska, 2015) sis homogeneous with regard to its substantive value, and it reflects, as much as possible, the key aspects of the superior criterion, which in the proposed research approach combines both economic categories. Individual characteristics are carriers of various pieces information on the phenomenon being analyzed, and their overall evaluation does not give rise to any objections. This fact is justified, as – while the issues being discussed are complex – both regional innovativeness and regional development are to lead to positive changes in terms of quantitative increase and qualitative progress in specific areas. Their components, which are often difficult to grasp and sometimes substitutive, are complementary in leading to achievement of the same objective: aiming for changes for better. Assuming that regional development is a term broader than innovativeness of region, it seems

that the structure of the set of statistical features (containing more pro developmental than proinnovative indicators), used in table 1 to describe proinnovative regional development as the concept of combined analysis of these economic categories, seems reasonable.

Table 1. Proinnovative regional development indicators in Poland

Indicator symbol	**Name of indicator**
I_1	R&D expenditures in relation to GDP (%)
I_2	Percentage of persons aged 15 and older having university education (%)
I_3	R&D expenditures of the enterprises sector in relation to GDP (%)
I_4	Percentage of industrial SMEs cooperating in cluster initiatives or engaged in other formalized forms of cooperation (%)
I_5	Share of innovative enterprises in the total number of industrial enterprises (%)
I_6	Share of innovative enterprises in the total number of enterprises of the services sector (%)
I_7	Share of R&D employees in total employed population (%)
I_8	Share of net revenues from sales of products in entities classified as representing in high and medium-high-tech sectors (enterprises hiring more than 9 employees) (%)
Indicator symbol	**Name of indicator**
R_1	Infant mortality per 1000 live births
R_2	Risk-of-relative-poverty rate (%)
R_3	Number of university students per 10 thousand inhabitants
R_4	Registered unemployment rate (%)
R_5	Number of road fatalities per 100 thousand inhabitants
R_6	Water consumption by national economy and total population (hm^3) per 10 thousand inhabitants
R_7	GDP (current prices) per capita in PLN
R_8	Share of expenditures of business entities for R&D activity in total (%)
R_9	Number of newly registered national economy entities in private sector in ten thousands inhabitants
R_{10}	Employed per 1000 inhabitants
R_{11}	Total investment expenditures (current prices) per capita in PLN
R_{12}	Percentage of population with access to sewage treatment plant (%)
R_{13}	Afforestation (%)
R_{14}	Recycling of packaging waste (%)
R_{15}	Share of devastated and degraded land requiring recultivation in total area (%)
R_{16}	Share of waste (excluding municipal waste) subject to recovery in the quantity of waste generated during the year (%)
R_{17}	Share of production of electricity from renewable forces in total production of electricity (%)
R_{18}	Electricity consumption per 1 million PLN of GDP (GWh)

Source: own compilation on the basis of: (Klóska, 2015).

3. METHODOLOGICAL REMARKS

This (methodological) chapter presents the issues of undertaken research determined by the title of the article. As a preliminary point it is worth to underline huge possibilities of applying the methods of multivariate statistical analysis in regional research. A considerable

scientific achievements of Polish statisticians and econometricians in this scope should be highlighted due to their significant contribution to the global development of grouping and linear ordering methods. Z. Hellwig (Hellwig, 1968) spotlighted the need of using measures that would give a synthetic and at the same time precise enough information about the character of observed changes of social-economic phenomena and it initiated many methodical proposals in this area. Interesting notes and proposals were presented by among others: M. Cieślak (Cieślak, 1974), S. Bartosiewicz (Bartosiewicz, 1976), T. Borys (Borys, 1978), W. Pluta (Pluta, 1977), M. Wypych (Wypych, 1982), E. Nowak (Nowak, 1977), T. Grabiński, A. Malina, A. Zeliaś (Grabiński, Malina, Zeliaś, 1990), S. Wydmus (Wydmus, 1984), D. Strahl (Strahl, 1987) or M. Walesiak (Walesiak, 2002). From the latest theoretical-research items publiced in Poland of the main priority for regional studies works of among others: A. Młodak (Młodak, 2006), J. Korol (Korol, 2007) or M. Markowska (Markowska, 2012) should be taken into consideration. Same important and interesting are the scientific achievements presented in the world literature. In this point it is worth to mention works of such authors as among others: J.A. Hartigan (Hartigan, 1975), A.A. Afifi, V. Clark (Afifi, Clark, 1999), I. Borg, P.J.F. Groenen (Borg, Groenen, 1997), M.E. Johnson (Johnson, 1987), H.H. Bock (Bock, 2002), B. Mirkin (Mirkin, 2005), B.S. Everit, S. Landau, M. Leese, D. Stahl (Everitt, Landau, Leese, Stahl, 2011) or B.F. Manly (Manly, 1986).

For the set of indicators used in table 1, statistical material was gathered, which allowed for a more or less complex description of proinnovative regional development in Poland. The necessary data comes from statistical reports, and all analyses were conducted on the basis of a descriptive (deterministic) and not a stochastic approach. The variables discussed are not random, and the problem of a random sample being representative of the population is not present here. All objects (sixteen provinces in Poland), constituting the entire population, are considered in the observation, and the empirical data obtained is constant. Therefore, there is no need to examine the potential stochastic characteristics of the list of observations. After gathering numerical data, diagnostic characteristics were determined, expressed using the ratio scale of measurement, and, as this type of a strong scale makes it possible to use all arithmetic operations, it does not limit the possibilities of applying specific statistical method. At the same time, the assumption of a homogeneous scale of measurement of the variables analyzed, usually required for multidimensional statistical analysis methods, has been met[2]. With regard to the formal aspects, it should be added that the characteristics applied are quantitative (and not qualitative) and continuous (and not discrete), and thus their observed increment (increase or decrease) can constitute even the smallest part of the unit, and the set of possible values is not quantifiable (Walesiak, 1993). As it can be concluded on the basis of the above analysis, values of variables have been presented using positive real numbers, which can be ordered clearly along the number line, assuming a certain specific, but freely chosen unit, where zero represents a complete lack of value of the feature being measured. High values (cf. table 1) of most of the assumed variables (boosters) are desirable, while only seven of these are dampers, marked in table 1 as: R_1, R_2, R_4, R_5, R_6, R_{15} and R_{18}. It is also worth noting here that it requires a well thought-

[2] www.stat.gov.pl (access: 03.12.2018). Rare shortages of data were complemented by using some methods of interpolation and extrapolation or – as it is sometimes being done (cf.: *European Innovation Scoreboard 2018 – Methodology Report,* European Union, Belgium 2018) – data from the last available year were acknowledged.

out decision only to determine the system of weights of the characteristics examined. Nevertheless, up to date, this issue has not been decisively resolved, and there is no universal, generally applicable procedure; as a result, it was decided – as it is in practice by most researchers (Grabiński, 1984) – to assign the same value to every variable, applying equal weights.

In this study, the research task undertaken is linear ordering, included in the scope of multidimensional statistical analysis. It can be brought down to determination of the order of objects analyzed according to a specific criterion, represented by the assumed set of diagnostic features, which makes it possible to specify their hierarchy. In order to valuate the objects being compared, we establish an appropriate synthetic development measure, taking into account the fact that various aggregation formulas may generate different end results, even with reference to the general criterion, represented by the same list of diagnostic variables (Czyżycki, 2012). In the approach described, the synthetic measure of development has been calculated separately for each year in the examined period of 2011-2017, which allowed for determination of hierarchy of objects (provinces of Poland) from the perspective of proinnovative regional development (taking into account twenty six variables presented in table 1). A well-known aggregation formula was applied, methodically consistent with the Summary Innovation Index, used widely in the EU nomenclature (European Innovation Scoreboard, 2018), that is, the arithmetic average of diagnostic variables brought down to comparability through zeroed unitarisation, multiplied by one hundred (Klóska, 2018).

This can be expressed by the formula:

$$W_i = \frac{100}{k} \sum_{j=1}^{k} \alpha_j z_{ij} \tag{1}$$

where: W_i – synthetic development measure,
k – the number of variables taken into consideration,
α_j – prominence of j variable,
z_{ij} – x_{ij} of the statistic variables taken into consideration in the study normalised by the zeroed unitarisation method, whereas the algorithm of boosters is as following:

$$z_{ij} = \frac{x_{ij} - \min\{x_{ij}\}}{\max\{x_{ij}\} - \min\{x_{ij}\}} \tag{2}$$

and for dampers:

$$z_{ij} = \frac{\max\{x_{ij}\} - x_{ij}}{\max\{x_{ij}\} - \min\{x_{ij}\}} \tag{3}$$

The values of this measure may range from zero to one hundred, and the higher their value, the higher their place in the ranking. In the discussion of the approach taken, the author analyzed changes in proinnovative development in Poland in years 2011-2017.

4. STATISTICAL DESCRIPTION OF THE DATA

The structure of provinces in Poland in terms of innovativeness (I_1-I_8 in tab. 1) is differentiated most in terms of percentage share of expenditures (including the sector of enterprises) for R&D activity in relation to GDP, and these values throughout the examined period, despite a slight improvement, have been maintained on a relatively low level. Definitely unfavorable are the low values of the shares of innovative enterprises in the total number of enterprises in the services sector, as well as in industry (although there is a slight improvement noticeable in this regard as well). On the basis of the assumed research criterion, it can be assessed as positive that there is a visible trend of growth in the percentage of persons aged 15 and more with university education. Education, as well as awareness of the need for lifelong learning, is a significant proinnovative factor. However, it should be underlined that a number of measures presented in table 2 show little change over time, which, from the perspective of the variables being examined, does not exert positive impact on improvement of innovativeness of regions.

The same approach was applied to determination of the statistical model of regional development in Poland (R_1-R_{18} in tab. 1). Analysis of the indicators R_1-R_{18} in tab. 1 can be conducted in three spheres: social (the first six indicators), economic (the following five indicators) and environmental (the last seven indicators). In the first dimension, the provinces of Poland are most diversified in terms of water consumption for the purposes of national economy and the total population per 10 thousand inhabitants. In provinces recording the highest consumption (Świętokrzyskie and Zachodniopomorskie) this indicator ranged between 8-11 hm^3, while in the region of the lowest consumption (Podlaskie), it did not exceed 0.74 hm^3. There is a positive trend when it comes to the number of road fatalities per 100 thousand inhabitants and infant mortality, as well as a visible improvement in the recent years in terms of unemployment. On the other hand, there is a negative trend of constant decrease in the number of university students per 10 thousand inhabitants. From the economic perspective, with regard to the indicators applied, the Polish regions are most differentiated in terms of percentage share of expenditures of business entities for R&D activity in total. Visibly higher values of most of the measures applied in year 2017 in comparison with year 2011 should be assessed positively from the perspective of development. As for the environmental aspect, the most significant differentiation of the Polish provinces is visible when it comes to recycling of packaging waste and the share of electricity production from renewable sources to total production of electricity. A number of variables presented have changed very little over time; at the same time, there is a visibly positive, pro-developmental trend of increase in the percentage of the population with access to sewage treatment plants.

5. RANKING OF PROVINCES IN TERMS OF PROINNOVATIVE REGIONAL DEVELOPMENT IN POLAND

In the research part of the article, the author presented the results of a linear ordering of the Polish regions addressed on the basis of the adopted diagnostic variables. The original values of the synthetic measure of development applied made it possible to put the provinces of Poland in order with regard to proinnovative regional development in years 2011-2017, and their places in the ranking have been presented in tab. 2.

Table 2 Ranking of provinces in terms of proinnovative regional development in Poland in years 2011-2017

Province	Ranking place in year						
	2011	2012	2013	2014	2015	2016	2017
Dolnośląskie	4	4	4	5	4	4	5
Kujawsko-Pomorskie	12	14	14	14	11	14	14
Lubelskie	9	13	12	7	12	11	11
Lubuskie	10	8	11	10	10	13	10
Łódzkie	14	12	9	13	14	10	13
Małopolskie	3	2	2	3	2	2	3
Mazowieckie	1	1	1	1	1	1	1
Opolskie	8	11	10	11	13	12	9
Podkarpackie	5	5	3	4	5	5	4
Podlaskie	11	9	8	8	7	7	12
Pomorskie	2	3	5	2	3	3	2
Śląskie	6	6	6	6	6	6	6
Świętokrzyskie	16	16	16	16	16	16	16
Warmińsko-Mazurskie	15	15	15	15	15	15	15
Wielkopolskie	7	7	7	9	8	8	7
Zachodniopomorskie	13	10	13	12	9	9	8

Source: own compilation on the basis of data of the Central Statistical Office.

On the basis of information provided in tab. 2, it can be noticed that in the examined period, the leader of proinnovative regional development in Poland every year has been Mazowieckie Province. As for the remaining places among the top three provinces, there has been some rotation, although most often the second and third places were occupied by Małopolskie and Pomorskie provinces. Podkarpackie, Dolnośląskie and Śląskie provinces also tend to occupy high places. The lowest score among all provinces of Poland has been assigned each time to Świętokrzyskie Province (with Warmińsko-Mazurskie Province being only slightly better). Variability of the ranking position (that is, the range measured as the difference between the first and the last place) is different for each region, ranging from zero (for Mazowieckie, Śląskie, Świętokrzyskie and Warmińsko-Mazurskie) to six positions (for Lubelskie), and the total of all ranges is 43. It should also be noted that low range is usually applicable to regions occupying the top and bottom positions in the rankings under concern, which indicates deepening or at least strengthening of the disproportion between the strongest and the weakest provinces in Poland in terms of proinnovative regional development in the second decade of the 21st century.

6. CONCLUSIONS

In conclusion, it should be noted that the subject matter discussed does not constitute a finished stage of the research. The observations and results of the study provide greater insight into the title economic categories and allow to identify their changes within the recent years in Poland. While some problems have been solved, some other ones have only

been indicated and may undoubtedly constitute an introduction to scientific discussions. The multi-faceted nature of these issues makes it difficult to expect clear-cut solutions and, therefore, the research studies in this scope should be continued. Further studies on the proposed combined approach to regional innovation and regional development in the form of *proinnovative regional development* seem particularly important.

REFERENCES

Afifi, A.A., Clark, V. (1999). *Computer-Aided Multivariate Analysis*. Boca Raton, London, New York, Washington: Chapman & Hall/CRC.

Bartosiewicz, S. (1976). *Propozycja metody tworzenia zmiennych syntetycznych. Prace Naukowe nr 84 Akademii Ekonomicznej im. Oskara Langego we Wrocławiu.* Wrocław: Wydawnictwo Akademii Ekonomicznej we Wrocławiu.

Bock, H.H. (2002). *Clustering Methods: From Classical Models to New Approaches. "Statistics in Transition"*, Vol. 5/2002.

Borg, I., Groenen, P.J.F. (1997). *Modern Multidimensional Scaling*. New York: Springer Verlag.

Borys, T. (1978). *Propozycja agregatowej miary rozwoju obiektów*. „Przegląd Statystyczny" R. XXV, z. 3.

Borys, T. red. (2005). *Wskaźniki zrównoważonego rozwoju*. Warszawa–Białystok: Ekonomia i Środowisko.

Brol, R. (2011). *Innowacyjność regionu w teorii i praktyce* [w:] Brol, R., red., *Problemy rozwoju regionalnego*, Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu nr 180. Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu

Cieślak, M. (1974) *Taksonomiczna procedura programowania rozwoju gospodarczego i określania potrzeb na kadry kwalifikowane*. *„Przegląd Statystyczny"* R. XXI, z. 1.

Czyżycki, R. (2012). *Badanie rozwoju społeczno-gospodarczego województw – wpływ metodyki badań na uzyskane wyniki*. Zeszyty Naukowe Wyższej Szkoły Bankowej w Poznaniu nr 42. Poznań: Wydawnictwo Wyższej Szkoły Bankowej w Poznaniu.

European Innovation Scoreboard 2018, European Union, Belgium 2018

European Innovation Scoreboard 2018 – Methodology Report, European Union, Belgium 2018

Everitt, B.S., Landau, S., Leese, M., Stahl, D. (2011). *Cluster Analysis*. London: John Wiley & Sons.

Godin, B. (2004). *The obsession for competitiveness and its impact on statistics: the construction of high-technology indicators*. *„Research Policy"*, Vol. 33, Issue 817-1229.

Grabiński, T. (1984). *Koncepcja badań efektywności procedur porządkowania liniowego*. Zeszyty Naukowe Akademii Ekonomicznej w Krakowie nr 181. Kraków: Wydawnictwo Akademii Ekonomicznej w Krakowie.

Grabiński, T., Malina, A., Zeliaś, A. (1990). *Metody analizy danych empirycznych na podstawie szeregów przekrojowo-czasowych.* Kraków: Wydawnictwo Akademii Ekonomicznej w Krakowie.

Hartigan, J.A. (1975). *Clustering algorithms*. New York: Wiley

Hellwig, Z. (1968). *Zastosowanie metody taksonomicznej do typologicznego podziału krajów ze względu na poziom ich rozwoju oraz zasoby i strukturę wykwalifikowanych kadr*. *„Przegląd Statystyczny"* R. XV, z. 4.

Hollanders, H., Esser, F. C. (2007). *Measuring innovation efficiency*. Maastricht: INNO-Metrics.

Hollanders, H., van Cruysen, A. (2008). *Rethinking the European Innovation Scoreboard: A New Methodology for 2008–2010*. Maastricht: Pro Inno Europe, Inno Metrics.

Janasz, W., red. (2011). *Innowacje w zrównoważonym rozwoju organizacji*. Warszawa: Difin.

Johnson, M.E. (1987). *Multivariate statistical simulation*. New York: Wiley.

Klóska, R. (2015). *Innowacyjność jako determinanta rozwoju regionalnego w Polsce*. Szczecin: Wydawnictwo Naukowe Uniwersytetu Szczecińskiego.

Klóska, R. (2018). *Innowacyjność Polski na tle innych państw Unii Europejskiej w świetle problematyki pomiaru*. *„Modern Management Review"*, nr 1/2018.

Korenik, S. (2004). *Rozwój regionalny – nowe tendencje*. Prace Naukowe Akademii Ekonomicznej we Wrocławiu nr 1016. Wrocław: Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu.

Korol, J. (2008). *Ocena zrównoważonego rozwoju regionalnego Polsce w latach 1998–2005. „Gospodarka Narodowa"* nr 7-8.

Korol, J. (2007). *Wskaźniki zrównoważonego rozwoju w modelowaniu procesów regionalnych.* Toruń: Wydawnictwo Adam Marszałek.

Kudłacz, T. (1999). *Programowanie rozwoju regionalnego*. Warszawa: Wydawnictwo Naukowe PWN.

Manly, B.F. (1986). *Multivariate statistical methods*. London: Chapman & Hall.

Marciniak, S. (2010). *Innowacyjność i konkurencyjność gospodarki*. Warszawa: Wydawnictwo C.H. Beck.

Marins, L. (2008). *The challenge of measuring innovation in emerging economies' firms: a proposal of a new set of indicators on innovation*. Maastricht: United Nations University, UNU-MERIT.

Markowska, M. (2012). *Dynamiczna taksonomia innowacyjności regionów*. Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.

Markowska, M. (2002). *Czynniki rozwoju regionalnego*, Prace Naukowe Akademii Ekonomicznej we Wrocławiu nr 939. Wrocław: Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu.

Mirkin, B. (2005). *Clustering for Data Mining. A Data Recovery Approach*. London: Chapman & Hall/CRC.

Młodak, M. (2006). *Analiza taksonomiczna w statystyce regionalnej*. Warszawa: Difin.

Nowak, E. (1977). *Syntetyczne mierniki plonów w niektórych krajach europejskich. „Wiadomości Statystyczne"* 10/1977.

Obrębalski, M. (2002). *Rozwój regionalny – identyfikacja, pomiar i ocena* [w:] *Gospodarka lokalna w teorii i w praktyce*. Prace Naukowe Akademii Ekonomicznej we Wrocławiu nr 939. Wrocław: Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu.

Pawłas, I. (2010). *Zastosowanie wielowymiarowej analizy porównawczej do oceny poziomu rozwoju społeczno-gospodarczego województw Polski*, Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu nr 113. Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.

Pięta-Kanurska, M. (2005). *Zróżnicowania rozwoju społeczno-gospodarczego w Polsce na początku XXI wieku*, Prace Naukowe Akademii Ekonomicznej im. Oskara Langego we Wrocławiu Nr 1083. Wrocław: Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu.

Pluta, W. (1977). *Wielowymiarowa analiza porównawcza*. Warszawa: PWN.

Prusek, A., Kudełko, J. (2009). *Analiza i ocena zróżnicowania poziomu rozwoju polskich regionów w latach 2000-2006 w świetle polityki spójności.* Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu nr 46. Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.

Sobczak, E. (2006). *Ocena dysproporcji międzyregionalnych jako podstawa informacyjna kształtowania polityki regionalnej Unii Europejskiej*. Prace Naukowe Akademii Ekonomicznej we Wrocławiu Nr 1129. Wrocław: Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu, p. 126-132.

Strahl, D. (1987). *Dyskryminacja struktur*. Prace Naukowe nr 360 Akademii Ekonomicznej im. Oskara Langego we Wrocławiu. Wrocław: Wydawnictwo Akademii Ekonomicznej we Wrocławiu.

Strahl, D. (2005). *Zróżnicowanie rozwoju regionalnego na poziomie NUTS-2 w krajach Unii Europejskiej*. Prace Naukowe Akademii Ekonomicznej we Wrocławiu nr 1083. Wrocław: Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu.

Strahl, D., red. (2006). *Metody oceny rozwoju regionalnego*. Wrocław: Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu.

Strahl, D., red. (2010). *Innowacyjność europejskiej przestrzeni regionalnej a dynamika rozwoju gospodarczego*. Wrocław: Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu.

Świadek, A. (2011). *Regionalne systemy innowacji w Polsce*. Warszawa: Difin.

Walesiak, M. (1993). *Statystyczna analiza wielowymiarowa w badaniach marketingowych.* Prace Naukowe Akademii Ekonomicznej we Wrocławiu nr 449. Wrocław: Wydawnictwo Akademii Ekonomicznej im. Oskara Langego we Wrocławiu.

Walesiak, M. (2002). *Uogólniona miara odległości w statystycznej analizie wielowymiarowej*. Wrocław: Wydawnictwo Akademii Ekonomicznej we Wrocławiu.

Weresa, M.A. (2012). *Systemy innowacyjne we współczesnej gospodarce światowej*. Warszawa: PWN.

Wydmus, S. (1984). *Metody wielowymiarowej analizy rozwoju społeczno-gospodarczego*. Kraków: Wydawnictwo Akademii Ekonomicznej w Krakowie.

Wypych, M. (1982). *Syntetyczna miara rozwoju w badaniach ekonomiczno-przestrzennych. „Przegląd Statystyczny"* R. XXIX, z. 3/4.

www.stat.gov.pl.

DOI: 10.7862/rz.2019.mmr.4

The text was submitted to the editorial office: December 2018.
The text was accepted for publication: March 2019.