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Assessment of the Economic Development of Polish Regions in the Context of the Implementation of the Concept of Sustainable Development - Taxonomic Analysis

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Abstract
The aim of the article is to conduct a multidimensional assessment of the diversification of economic development of Polish regions in the context of the progress made in the implementation of the concept of sustainable development in 2010 and 2017. The authors focused primarily on determining the position of Lubusz Province on the economic map of Poland. Given that economic development is a complex category, taxonomic (synthetic) measures developed on the basis of selected methods of multivariate comparative analysis were used in the research. The synthetic measures were constructed using the proposed partial indicators (explanatory variables), which, according to the authors, best illustrate economic development and the idea of sustainable development at regional level. Based on the constructed measures, a linear ordering of Polish regions by level of economic development in the context of the implementation of the concept of sustainable development was made, and the convergence of the orders was examined. In addition, the regions were grouped by level of economic development. Subsequently, the effectiveness of the obtained groupings was evaluated. The research shows that in 2017, compared to 2010, the overall level of economic development in all Polish regions increased. In what concerns Lubusz Province, a conclusion can be made that its position in the overall ranking is improving.

Keywords: Linear ordering; Region; Sustainable development; Economic development; Polish regions

1. Introduction

The following two studies present the results of the analysis and evaluation of the implementation of the concept of sustainable development of Polish regions in the scope of the level of economic development. The first one contains the evaluation of regional differentiation of values of explanatory variables (partial variables) of the economic development divided into thematic areas, such as: potential of the economy, economic activity of households, economic activity of enterprises, innovativeness of the economy, production and transportation, in 2010 and 2017 (Barska, Jędrzejczak-Gas 2019).
The aim of the presented document is a multidimensional evaluation of the diversity of economic development of Polish regions in the context of progress in the implementation of the concept of sustainable development in 2010 and 2017. The authors focused their attention primarily on the determination of the position of Lubuskie region on the economic map of Poland. This is because the preparation of the publication counted withfinancial support from the Board of Lubuskie Provinceas part of the initiative "Small Grants for Public Universities".

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Due to the fact that economic development is a complex category, the research used taxonomic (synthetic) measures that were constructed on the basis of selected methods of multidimensional comparative analysis. Synthetic measures were constructed on the basis of proposed partial indicators (potential explanatory variables), which were divided into five subjective groups as indicated above. According to the authors, these indicators illustrate economic development and the idea of sustainable development at the regional level in the best way. The use of synthetic measures, which replaced the description of the studied objects (regions) with the description of one aggregate size using a number of variables, made it possible to measure the multidimensional phenomenon of economic development in particular regions, as well as to linearly rank the studied objects (regions).
The first part of the article presents selected alternative ways of measuring economic development. Then, the methodology and results of the study were presented. They use two selected methods, i.e. Hellwig's Method and TOPSIS Method. Synthetic measures were constructed and linear ranking of Polish regions was carried out due to the level of economic development in the context of the implementation of the concept of sustainable development. The use of two taxonomic methods is a kind of "confirmatory analysis" and enables the comparison of the obtained results. Moreover, using the so-called threshold method, a grouping of the examined regions was carried out. The analysis covered all 16 regions of Poland. The selection of explanatory variables was made on the basis of substantive, statistical and formal criteria (first of all, relevance, completeness and accessibility for the examined regions in 2010 and 2017).

2. Measuring the Level of Economic Development - Literature Review

The literature on the subject presents various indicators of growth and economic development. Economic growth is a process of increasing national wealth over time and refers only to the measurable part of the economy. On the other hand economic development is the process of transforming low-income economies into modern industrial economies. This term takes into account both quantitative and qualitative changes in economies (Encyclopædia Britannica 2003).
In the 1970s, attention was drawn to the need for sustainable development. In 1972, a UN Conference was held in Stockholm, during which the term "sustainable development" was used for the first time (Stockholm Declaration 1972). In 1987, the UN Environment Commission presented the Brundtland report, with the idea of sustainable development, which consists in meeting the needs of the present without depriving future generations of the ability to meet their own needs (Brundtland 1987). Sustainable development pursues three types of objectives: social, economic and environmental (Serageldin 1994). The introduction of the term sustainable development has led to the presentation of new concepts for measuring prosperity.
Measures of economic growth and development can therefore be divided into two groups: 1) measures based on the system of national calculi (traditional measures), 2) measures of sustainable development.
Traditional measures include: Gross Domestic Product, Net National Product, Net National Product, Net National Product, Gross National Product per capita. Although burdened with many defects (Talberth *at al.* 2007), these measures are still very often used

to assess the level of development of countries and regions. In order to eliminate the disadvantages of traditional measures, they have been modified to include qualitative aspects of the standard of living. Among others such measures include: Measure of Economic Welfare (MEW) (Nordhaus, Tobin 1972), Net National Welfare (NNW) (Kanamori *at al.* 1977), Economic Aspects of Welfare (EAW) (Zolotas 1981). These measures bridge the gap between traditional measures of economic growth and measures of sustainable development. For example, the Measure of Economic Welfare (MEW) developed by W. Nordhaus and J. Tobin (1972) takes into account, among other things, the value of leisure time, the effects of household activities, damage to the environment and urbanisation. However, it is often pointed out in the literature that modified national accounts are also burdened with various shortcomings and that it is difficult to obtain data for their calculation. For example, the disadvantages of MEW include the fact that it does not consider the issue of wealth distribution, the choice of its components is subjective, and the estimates of its components are often approximate and based on unreliable data.

Therefore, national calculi are increasingly being replaced by multifaceted measures that consider different qualitative dimensions of economic development. Examples of such measures include the Net Economic Prosperity Index (Beckerman, Bacon 1966), the Geneva Method (Drewnowski, Scott 1966), the Human Development Index (HDI). These measures are called synthetic measures or taxonomic measures and include many variables with different measures. The development of synthetic measures based on taxonomic methods was initiated by W. Beckerman and R. Bacon (1966). They developed the Net Economic Prosperity Index, which included such variables as: real private consumption, annual consumption of crude steel, annual cement production, the number of subscribed magazines, or the number of radio and road vehicles. In this method, the United States is usually taken as the benchmark. The concept of the Geneva method, also known as the UNRISD method, was developed by J. Drewnowski and W. Scott (1966). The core of this method and the direction of research, which has developed on its basis in many countries of the world, including Poland, is the concept of need. The approach presented in this method is multidimensional. However, the problem is to establish universal indicators and representative measures.

An important synthetic indicator of socio-economic development is the Human Development Index (HDI). It has been used in international reports prepared by the United Nations Development Programme (UNDP). HDI combines the economic sphere with the qualitative aspects of development. Other synthetic indicators that are derived from HDI include the Human Poverty Index (HPI) (Chakravarty *at al.* 2005), the Gender-Related Development Index (GDI) and the Gender Empowerment Measure (GEM) (Schüler 2006).

On the basis of the HDI methodology, a number of other indices were constructed, taking into account environmental aspects: Sustainable Human Development Index (SHDI) (Constantini, Monni 2008), Pollution Sensitive Human Development Index (HDPI) (Florczak 2008), Environment Endangerment Index (EEI) (Neumayer 2004).

The measures used by the UN (United Nations) are also: Economic Vulnerability Index (EVI) and Human Assets Index (HAI). HAI and EVI and GDP per capita measures are used by UN experts to determine the criteria for belonging to the group of least developed countries.

The biggest difficulty in constructing synthetic measures is to determine the elements that are to compose them and to give them appropriate rank (Jędrzejczak-Gas *at al.* 2019). A common accusation against sustainable development measures is that they pay too much attention to the qualitative elements of prosperity, taking its quantitative dimension to the background. Moreover, in the period of the idea of the greening of economic life, which has been very popular in recent years, there is a danger that these measures will focus too much on aspects related to environmental protection, reducing the role of other aspects of national wealth (Cieślik 2008).
Despite numerous measures of social and economic development already constructed, the problem of evaluation of economic development in the context of implementation of the concept of sustainable development remains not fully solved. Therefore, an attempt was made to construct a synthetic measure and to assess the level of development of Polish regions.

3. Research Methodology

In the presented study two historically first methods of linear ordering were used, i.e. Hellwig's method and TOPSIS method. The first method was proposed by Z. Hellwig on the basis of economics (taxonomy) in 1968 under the name "measure of economic development" (1968). The second method was proposed by C.L. Hwang and K. Yoon on the basis of decision theory (multi-criteria decision-making) in 1981 under the name TOPSIS - Technique for Order Preference by Similarity to Ideal Solution (1981).
The procedure for the construction of synthetic measures using the above methods was carried out in several stages.
The first stage was to determine a set of potential variables. They apply substantive and formal criteria (first of all, the significance of the variables and their availability). A set of 30 potential diagnostic variables was determined and divided into five subjective groups:
I. Potential of the economy: X1- GDP per capita (current prices, Poland = 100), X2 - Investment outlays per capita (current prices, Poland = 100), X3 - Investment rate for environmental protection and water management (expenditure on fixed assets for environmental protection and water management relative to GDP) (%), X4 - Water absorption of the economy (consumption of water for needs of the national economy and population relative to GDP value) (dam3 / PLN '000), X5 - Energy intensity of transportation relative to GDP (Poland = 100), X6 - Energy intensity of industry relative to GDP (Poland = 100).
II. Innovativeness of the economy: X7 - Share of innovative enterprises in the total number of enterprises (%), X8 - Share of enterprises from the industrial sector that incurred outlays on innovative activity in the total number of enterprises (%), X9 - Share of R&D employees in the economically active population (%), X10 - Number of inventions reported to the Patent Office of the Republic of Poland per 1,000,000 residents, X11 - R&D outlays relative to GDP (current prices, %), X12 - Share of sold production of new/significantly improved products in industrial enterprises in the value of sales of products in total, X13 - Expenditure on innovative activity in enterprises per one economically active person.
III. Economic activity of enterprises: X14 - Number of business entities per 1,000

working-age population, X15 - Number of newly registered entities per 10,000 working-age population, X16 - Share of de-registered entities in the total number of entities (%), X17 - Share of newly registered creative-sector entities in the number of newly registered entities (%), X18 - Investment outlays of enterprises per enterprise (Poland = 100).
IV. Production and transportation: X19 - Water consumption for the needs of industry relative to the number of industrial enterprises, X20 - Share of renewable energy in total electricity production (%), X21 - Emission of air pollutants from particularly burdensome plants per 1 km2 area (t/a), X22 - Share of organic farms in the total number of farms (%), X23 - Share of agricultural land used by organic farms in the total agricultural area, X24 - Number of passenger transport means per urban dweller.
V. Economic activity of households: X25 - Coefficient of economic activity, X26 - Secondary-school graduates per 10,000 population, X27 - Index of average monthly disposable income per capita in households (Poland 100), X28 - Non-working age population per 100 working-age population, X29 - Unemployment rate (%).
The next step was to examine the discriminatory ability of variables and their capacity, i.e. the degree of correlation with other variables. From the set of potential variables, those for which the coefficient of variation value was lower than the arbitrary, critical threshold value of this coefficient (r*=10%) were eliminated from the set of potential variables. Therefore, the variables X16, X25, X27 and X28 were eliminated from further research.
Correlation was assessed using the reverse correlation matrix method. This method consists in the determination of a matrix opposite to the correlation matrix:

$$R^{-1} = \left[\tilde{r}_{jj'}\right], jj' = 1,2,\ldots,m$$

Where:

$$\tilde{r}_{jj'} = \frac{(-1)^{j+j'}\left|R_{jj'}\right|}{|R|}$$

$R_{jj'}$ - reduced matrix after deletion of the jth row and j'th column.
$|R|, \left|R_{jj'}\right|$ - determinants of the R matrix and $R_{jj'}$ matrix, respectively.
In the next step - if necessary - the variable with the highest diagonal value, exceeding arbitrarily determined threshold value (usually r*=10), is eliminated. The inverse correlation matrix (for a reduced correlation matrix) is then recalculated and it is checked that the diagonal values do not exceed a fixed threshold value. The procedure shall be continued until all the diagonal values below the fixed threshold have been obtained. An inverse correlation matrix has therefore been calculated for each group of variables. If necessary, the variable with the highest diagonal value exceeding an arbitrarily fixed threshold value (r*=10) was eliminated. The procedure led to the elimination of 5 variables (X7, X14, X15, X22, X23). The remaining variables were used for further research.
In taxonomic methods, one of the main requirements for the final diagnostic variables is their comparability (additionality postulate). Then the next step was to normalize the variables with simultaneous transformation of the destimulant into stimulants. In the Hellwig method, standardization was used to normalize the variables, while in the TOPSIS method, the so-called zero unitization was used:

- standardisation:

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j}$$

- zero unitarization:

$$z_{ij} = \frac{x_{ij} - min_{x_{ij}}}{max_{x_{ij}} - min_{x_{ij}}}$$

Both methods used in the research are model methods, while in the Hellwig method the reference point of objects in the multidimensional space is the standard, and in the TOPSIS method two reference points - the standard and the anti-model - are determined. The next step was to determine the coordinates of the standard, and in the case of TOPSIS method also the coordinates of the anti-model:

(1) Hellwig's method

• the coordinates of the pattern:

$$z_0 = [z_{01}, z_{02}, \dots, z_{0m}]$$

$$z_{0j} = \begin{cases} \max_i\{z_{ij}\} \text{ for variable stimulants} \\ \min_i\{z_{ij}\} \text{ for variable destimulants} \end{cases}$$

$$z_{ij} - \text{ of the normalized value of j variable for i} - \text{of this object}$$

(2) (TOPSIS method

• the coordinates of the pattern:

$$z_0^+ = [z_{01}^+, z_{02}^+, \dots, z_{0m}^+]$$

$$z_{0j}^+ = \begin{cases} \max_i\{z_{ij}\} \text{ for variable stimulants} \\ \min_i\{z_{ij}\} \text{ for variable destimulants} \end{cases}$$

$$z_{\text{ij}} - \text{of the normalized value of j variable for i} - \text{of this object}$$

• the coordinates of the anti-model:

$$z_0^- = [z_{01}^-, z_{02}^-, \dots, z_{0m}^-]$$

$$z_{0j}^- = \begin{cases} \min_i\{z_{ij}\} \text{ for variable stimulants} \\ \max_i\{z_{ij}\} \text{ for variable destimulants} \end{cases}$$

Then the distances of objects (regions) from the pattern were determined, and in the case of TOPSIS method also from the anti-pressurizer:

(1) Hellwig's method

• the distance between objects and the pattern:

$$d_{i0} = \sqrt{\frac{1}{n}\sum_{i=1}^{m}(z_{ij} - z_{0j})^2}$$

(2) TOPSIS method

• the distance between objects and the pattern:

$$d_{i0}^+ = \sqrt{\sum_{j=1}^{m}(z_{ij} - z_{0j}^+)^2}$$

• distance between objects and the pattern:

$$d_{i0}^- = \sqrt{\sum_{j=1}^{m}(z_{ij} - z_{0j}^-)^2}$$

The last stage of linear ranking was the calculation of the synthetic measure and the preparation of the ranking of the examined regions. This stage was carried out in the following way:

(1) Hellwig's method:

$$s_i = 1 - \frac{d_{i0}}{d_0}$$

Where:

in general, $s_i \in [0; 1]$, $\max_i\{s_i\} - \text{best object}$, $\min_i\{s_i\} - \text{worst object}$

$$d_0 = \bar{d}_0 + 2S_d$$

$$\bar{d} = \frac{1}{n}\sum_{i=1}^{n} d_{i0}$$

$$S_d = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(d_{i0} - \bar{d}_0\right)^2}$$

(2) TOPSIS method:

$$s_i = \frac{\bar{d_{i0}}}{d_{i0}^{+} + \bar{d_{i0}}}$$

Where:

in general, $s_i \in [0; 1]$, $\max_i\{s_i\} - \text{best object}$, $\min_i\{s_i\} - \text{worst object}$

In order to examine the convergence between the results obtained by the Hellwig method and the TOPSIS method, the value of Spearman's rank correlation coefficients and the values of τKendall correlation coefficients between synthetic measures were calculated.

In the presented study a grouping of objects (studied regions of Poland) was also carried out due to a similar level of economic development. Using the so-caled threshold method, four groups of regions characterized by different levels of economic development in the context of the implementation of the concept of sustainable development were distinguished (Wysocki 2010):

Group I - very high level of development: $s_i \geq \bar{s}_i + s_{s_i}$

Group II - high level of development: $\bar{s}_i + s_{s_i} > s_i \geq \bar{s}_i$

Group III - medium level of development: $s_i > s_i \geq \bar{s}_i - s_{s_i}$

Group IV - low level of development: $s_i < \bar{s}_i - s_{s_i}$

where $\bar{s}_i$ is the arithmetic mean of the meter value, while s_{s_i} is a standard deviation.

4. Research Results and Discussion

Hellwig's method indicates that in Poland there is a significant variation in the level of economic development in the context of the implementation of the concept of sustainable development. In 2010, the average value of the synthetic measure for the Hellwig method was 0.2341. The highest level of this measure was in the Mazowieckie region (0.4991) and the lowest in the Lubuskie region (0.0639). The value of synthetic measurement for the Lubuskie region was therefore almost eight times lower than for the Mazowieckie region. In 2017, the average value of this measure amounted to 0.2742, the highest value was also recorded in the Mazowieckie region (0.5398), and the lowest in the Świętokrzyskie region (0.0121). The Świętokrzyskie region was the only region where there was such a drastic decrease in the synthetic measurement (by over 84%), which resulted in a five-fold increase in the distance between the most developed region (Mazowieckie) and the least developed region (Świętokrzyskie). A confirmation of a significant diversification of the economic development of regions in Poland is also a high coefficient of variation, which in the case of the Hellwig method, both in 2010 and 2017, amounted to over 56%.

Analysing the value of the synthetic measure calculated according to the Hellwig method for the Lubuskie region under study, it should be stated that this region recorded a significant growth and economic development (the synthetic measure increased by over 95%), which resulted in a decrease in its distance from the most developed region (twice) and in relation to the standard. Lubuskie region was the only region in Poland that recorded such a large growth and economic development and at the same time implemented the concept of sustainable development. In the Lubuskie region there was a significant increase in, among others, the share of renewable energy in total electricity production and the share of people employed in R&D in the professionally active population.

The TOPSIS method also points to regional differences in the level of economic development in Poland, although the differences between regions are not as great as in the case of the Hellwig method. Both in 2010 and 2017, the highest TOPSIS measure value was also recorded in the Mazowieckie region and the lowest in the Świętokrzyskie region. The Lubuskie region also achieved growth and development and reduced the distance from the region with the highest level of economic development (Mazowieckie).

The survey also shows that in Poland in 2017, as compared to 2010, most regions recorded an increase in synthetic measurement, which means an increase in economic development. In the case of the Hellwig method, 13 regions recorded an increase in the synthetic measure (a decrease of 3 regions), and in the case of the TOPSIS method 10 regions recorded an increase (a decrease of 6 regions).

Table 1. Synthetic measure of economic development in the context of sustainable development

Region	The Hellwig method		The TOPSIS method	
	2010	**2017**	**2010**	**2017**
Dolnośląskie	0,3212	0,4401	0,5413	0,5865
Kujawsko-pomorskie	0,1993	0,2171	0,4520	0,4324
Lubelskie	0,1923	0,2333	0,4631	0,4621
Lubuskie	0,0639	0,1248	0,3913	0,4178
Łódzkie	0,1845	0,2788	0,4655	0,4709
Małopolskie	0,3521	0,4531	0,5580	0,6198
Mazowieckie	0,4991	0,5398	0,6933	0,6803
Opolskie	0,1545	0,1928	0,4346	0,4484
Podkarpackie	0,2409	0,3076	0,4907	0,5159
Podlaskie	0,2028	0,2475	0,4833	0,4636
Pomorskie	0,4136	0,4084	0,5751	0,5673
Śląskie	0,2663	0,3010	0,5116	0,5162
Świętokrzyskie	0,0762	0,0121	0,3285	0,2781
Warmińsko-mazurskie	0,1408	0,0818	0,4429	0,3968
Wielkopolskie	0,3154	0,3475	0,5197	0,5086
Zachodniopomorskie	0,1233	0,2022	0,3895	0,4219
MIN	0,0639	0,0121	0,3285	0,2781
MAX	0,4991	0,5398	0,6933	0,6803
Average	0,2341	0,2742	0,4838	0,4867
standard deviation	0,1209	0,1416	0,0859	0,0967

Source: own study.

On the basis of values of synthetic measures, rankings of Polish regions were created based on the level of economic development in the context of sustainable development.
In particular years no significant differences were observed between the ranks of particular regions, obtained on the basis of the used methods of ranking.
The highest position, both in 2010 and 2017, was recorded by the Mazowieckie region, which for many years has been characterised by the highest level of economic development in Poland. The next most economically developed regions in Poland are: Małopolskie, Dolnośląskie, Pomorskie. The lowest positions in the ranking of regions were taken by: Świętokrzyskie, Warmińsko-mazurskie and Lubuskie. Such low ranks of these regions are a consequence of low or very low values of included partial variables.

Table 2. Rankings of regions due to the level of economic development in the context of sustainable development

Lp.	Region	Hellwig method			TOPSIS method		
		2010	**2017**	Rank change	**2010**	**2017**	Rank change
1	Dolnośląskie	4	3	+1	4	3	+1
2	Kujawsko-pomorskie	9	11	-2	11	12	-1
3	Lubelskie	10	10	0	10	10	0
4	Lubuskie	16	14	+2	14	14	0
5	Łódzkie	11	8	+3	9	8	+1
6	Małopolskie	3	2	+1	3	2	+1
7	Mazowieckie	1	1	0	1	1	0
8	Opolskie	12	13	-1	13	11	+2
9	Podkarpackie	7	6	+1	7	6	+1
10	Podlaskie	8	9	-1	8	9	-1
11	Pomorskie	2	4	-2	2	4	-2
12	Śląskie	6	7	-1	6	5	+1
13	Świętokrzyskie	15	16	-1	16	16	0
14	Warmińsko-mazurskie	13	15	-2	12	15	-3
15	Wielkopolskie	5	5	0	5	7	-2
16	Zachodniopomorskie	14	12	+2	15	13	+2

Source: own study.

In order to examine the convergence of the results achieved by Hellwig and TOPSIS methods, the values of Spearman's rank correlation coefficients between them were calculated. In the analysed period these coefficients were very high and exceeded the value of 0.9515. The critical value of Spearman's rank correlation coefficient at the level of significance $\alpha=0.05$ and for 16 observations is 0.5029, so it can be concluded that there is a statistically significant convergence of the order of regions between particular comparisons.
In order to confirm the convergence of the results obtained using both methods, the values of the τKendall correlation coefficients were also calculated. The analysis of these coefficients confirmed the high correlation between the Hellwig and TOPSIS methods.

Table 3. Compliance of the results of the rankings of Polish regions by the level of economic development

	Hellwig method		TOPSIS method	
	I	II	I	II
2010				
The Hellwig method	1.0000	1.0000	0.9515	0.8667
The TOPSIS method	0.9515	0.8667	1.0000	1.0000
2017				
The Hellwig method	1.0000	1.0000	0.9879	0.9555
The TOPSIS method	0.9879	0.9555	1.0000	1.0000

Markings: I - Spearman's rank correlation coefficient; II - Kendall's τ correlation coefficient.
Source: own study.

Due to a similar level of economic development in the context of the implementation of the sustainable development concept, the examined regions were divided into four groups: group I - regions with a very high level of development, group II - regions with a high level of development, group III - regions with a medium level of development, group IV - regions with a low level of development (Table 4).

Table 4. Classification of Polish regions into groups by level of economic development

Group	Level of development	Grouping rule		Region	
		2010	2017	2010	2017
Hellwig method					
I	very high	$z_i \geq 0.3550$	$z_i \geq 0.4159$	Mazowieckie, Pomorskie	Mazowieckie, Dolnośląskie, Małopolskie
II	high	$0.3550 > z_i \geq 0.2341$	$0.4159 > z_i \geq 0.2742$	Dolnośląskie, Małopolskie, Podkarpackie, Śląskie, Wielkopolskie	Podkarpackie, Śląskie, Wielkopolskie, Pomorskie, Łódzkie
III	medium	$0.2341 > z_i \geq 0.1132$	$0{,}2341 > z_i \geq 0.1326$	Kujawsko-pomorskie, Lubelskie, Łódzkie, Opolskie, Podlaskie, Warmińsko-mazurskie, Zachodniopomorskie	Kujawsko-pomorskie, Lubelskie, Opolskie, Podlaskie, Zachodniopomorskie
IV	low	$z_i < 0.1132$	$z_i < 0.1326$	Lubuskie, Świętokrzyskie	Lubuskie, Świętokrzyskie, Warmińsko-mazurskie
TOPSIS method					
I	very high	$z_i \geq 0.5696$	$z_i \geq 0.5833$	Mazowieckie, Pomorskie	Mazowieckie, Dolnośląskie, Małopolskie
II	high	$0.5696 > z_i \geq 0.4838$	$0.5833 > z_i \geq 0.4867$	Dolnośląskie, Małopolskie, Podkarpackie, Śląskie, Wielkopolskie	Podkarpackie, Śląskie, Wielkopolskie, Pomorskie
III	medium	$0.4838 > z_i \geq 0.3979$	$0.4867 > z_i \geq 0.3900$	Kujawsko-pomorskie, Lubelskie, Łódzkie, Opolskie, Podlaskie, Warmińsko-mazurskie, Zachodniopomorskie	Kujawsko-Pomorskie, Lubelskie, Opolskie, Podlaskie, Zachodniopomorskie, Lubuskie, Łódzkie, Warmińsko-mazurskie
IV	low	$z_i < 0.3979$	$z_i < 0.3900$	Lubuskie, Świętokrzyskie	Świętokrzyskie

Source: own study.

In 2010, the results of grouping using both methods proved to be convergent. In 2017, only 3 regions - Lubuskie, Łódzkie, Warmińsko-mazurskie - were in a different group.

Most regions were in group III (44% in 2010, 31% in 2017 according to the Hellwig method and 50% according to the TOPSIS method), while the least regions were in group I and group IV. Thus, it can be concluded that most regions in Poland are characterised by an average level of economic development. In 2010, the Lubuskie region was classified into the last group IV. On a positive note, however, in 2017 the region was included in the group of regions with a higher level of development (TOPSIS method).

5. Conclusion

The presented research was conducted in two approaches - spatial and temporal. The first approach concerns the assessment of the diversity of regions in Poland in terms of economic development in the context of the implementation of the concept of sustainable development in 2010 and 2017. The second approach refers to the assessment of the regions' progress towards economic development in the context of sustainable development in 2017 in relation to 2010. Particular attention was paid to the Lubuskie region, because of author's interest in this region.

The conducted research shows that in the analysed period the situation of most regions in Poland improved . 13 and 10 regions moved towards the standard according to the Hellwig's and the TOPSIS method, respectively. However, the pace of development was diversified. The level of regional cohesion did not change in the audited period - the coefficient of variation remained at the same level. This means that there was a large regional variation in economic development in Poland both in 2010 and 2017. For many years now, the Mazowieckie region has been the most developed region. In 2017, Dolnośląskie and Małopolskie regions joined the group of the most developed regions. The majority of regions in Poland are characterised by an average level of economic development.

Although the studied Lubuskie region is characterised by a low level of economic development and is divided by a large distance from the regions which are leaders, in the analysed period it recorded a significant progress and decreased its distance both in relation to the ranking leaders and in relation to the standard.

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