

REGIONAL DISPARITIES IN DEVELOPMENT BASED ON TAXONOMIC RESEARCH: A CASE OF POLAND

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ABSTRACT

Based on sixteen Polish provinces the author discusses, explores, evaluates and diagnoses the regional disparities in development of Poland's provinces. First, four fields are studied, such as: demographic potential, social development, economic development and technical infrastructure. Next, the author compares sixteen Polish provinces in relation to the level of synthetic measure of socioeconomic development. Research covers the years 2006, 2010 and 2015 and has been conducted using statistical material provided by the Central Statistical Office. The research tools used in the article include literature studies, descriptive analysis and selected methods of multivariate comparative analysis. Multivariate comparative analysis has proved that Mazovia Province is a leader in terms of demographic potential and economic development, while Silesia Province takes the first position in both social development and technical infrastructure. The highest levels of synthetic measure of socioeconomic development have been observed in Mazovia Province and Silesia Province. In addition, the author presents theoretical aspects of socioeconomic development and discusses the relevance of regional policy.

KEYWORDS: *development, Poland, provinces, multivariate comparative analysis, taxonomic analysis.*

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Introduction

Regional disparities constitute one of important problems of the Polish economy. Despite Poland's active participation in the implementation of the European Union Policy of Economic, Social and Territorial Cohesion, disparities among Poland's regions persist, and in some cases, even get wider and wider (Borowiec, 2011; GUS, 2015; Moussis, 2015; Pawlas, 2014; Pawlas, 2011; Pawlas, 2010).

The problem of research. The main problem of this article is the exploration, evaluation and diagnosis of disparities in development of Poland's provinces.

The aim of research. The article aims at presenting the results of research on socioeconomic development of the Polish regions on NUTS 2 level, i.e., sixteen Polish provinces (voivodships). First, four fields are studied, in particular the following: demographic potential, social development, economic development and technical infrastructure. Then, Polish provinces are compared in relation to the level of synthetic measure of socioeconomic development.

The object of research is Poland's regions on NUTS 2 level, i.e., sixteen Polish provinces (voivodships). The research was conducted based on data of the year 2006, 2010 and 2015.

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The tasks of research: 1) to select a set of diagnostic variables; 2) to explore and diagnose a situation in the analysed subjects, i.e., Poland's provinces (voivodships), in order to make a hierarchy of these subjects in each field in terms of: demographic potential, level of economic development, level of social development and technical infrastructure; 3) to make a hierarchy of the analysed subjects, i.e., Poland's provinces (voivodships), in regard to synthetic measure of socioeconomic development; 4) to group sixteen provinces (voivodships) into four clusters according to the level of socioeconomic development.

The methods of research. The research tools used in the article included literature studies, descriptive and multivariate comparative analysis, and in particular Z. Hellwig's taxonomic measure of development, as well as standard deviation method. Also, for the analysis the author used statistical material provided by the Central Statistical Office which is based on Statistical Yearbook of the Regions – Poland 2007, Statistical Yearbook of the Regions – Poland 2011 and Statistical Yearbook of the Regions – Poland 2016.

1. Socioeconomic development: theoretical aspects

Economic development involves economic growth accompanied by structural transformations, i.e., economic growth plus positive structural changes in the economy (Ezeala-Harrison, 1996: 3). Economic development, therefore, constitutes a really broad category, which includes both quantitative changes in an economy, expressed by indices of economic growth, as well as qualitative changes in socioeconomic structure of a country (Krueger, Myint, 2011; Melnikas, 2013). Economic development is considered a key concept describing the economic structure of contemporary world (Balcerowicz, 1995). Improvement in standard of living is the main development challenge (World Bank, 2003). Economic development should be characterised by sustainability, social cohesion and protection of natural environment (Piasecki, 2003: 15). Economic development is determined by many economic and non-economic factors, internal and external ones, including geographical factor, demographic potential, capital (inner accumulation and investment), technical infrastructure, research and development activity, innovation, technical progress, health care system, common access to education and science, institutions of a state (Zhang, Warner, Homsy, 2017), developed financial system (Schumpeter, 2004; Obrębski, 2013; Dornbusch, Reynoso, 1989). On the other hand, however, development and growth are limited by: poor health and low level of education, lack of necessary infrastructure (inadequate infrastructure such as roads, schools and hospitals), flight of capital (shortage of inner capital combined with low attractiveness for foreign investment), political instability (instability of government is likely to scare investors and hinder investment), institutional framework (the situation when local regulations do not adequately protect rights is highly disadvantageous) (Agarwal, 2017). Development means improvement of economic situation and – as a consequence – social development. Development of an economy is also linked to rising share of knowledge-intensive services and high-tech industry (Czerny, 2005). Therefore, development is a multidimensional process, embracing relevant changes in social structure and attitudes, institutional changes, increased economic growth, reduction of inequalities and reduced poverty. Development is also treated as a whole set of changes, thanks to which a whole social system, social groups and individuals achieve the stage where standard of living is perceived as better (World Bank, 2002).

In *Routledge Dictionary of Economics*, D. Rutherford defines development in two ways, namely as “the movement of an economy from agricultural activities using simple technology to the production of industrial products and a range of services using modern technology” and as “the cumulative growth of *per capita* income, accompanied by structural and institutional changes.” (Rutherford, 2002: 139).

According to *The Princeton Encyclopaedia of the World Economy*, “economic development embraces three fields that go beyond increasing GDP *per capita*, namely (Davis, 2009):

- development of a country's economic system – economic development is facilitated by structural changes, including urbanisation, the rise in size of firms, relative decline of the agricultural sector in terms of employment and output with expansion of manufacturing and services, the geographical expansion of markets, and increases in the diversity of goods produced and traded;
- the distribution of gains from economic development enabling the reduction of poverty;

- sustainable development which can be defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs”.

Economic development is complemented by social development, i.e., “directed social process, resulting in continuous increase of variables important for society” (Sztompka, 2005). Crucial elements for social development include: diversity, quality and pace of scientific and cultural heritage creation, as well as accessibility of economic development effects, changes in standards, attitudes, knowledge and awareness of individuals and social groups.

Socioeconomic development can be defined as a process of positive quantitative and qualitative changes, thanks to which current phenomena in any economic, cultural and social activity and in the field of both socio-productive relations and political and institutional relations improve, develop and new phenomena are observed. Those changes are both temporal and spatial in character. According to M. Noga, socioeconomic development “includes, apart from changes determined by economic growth, changes in economy and society functioning, changes in natural environment and advanced civilisation” (Noga, 2009). R. Przybyszewski states that due to close interdependence between economic and social elements, one cannot consider pure economic development or pure social development; he believes that one should talk of socioeconomic development or just development. (Przybyszewski, 2007). V. Cojanu draws attention to the necessity of complex and multivariate attitude to the problem of development, the attitude that concerns economic development, institutional development, social development and cultural development (Cojanu, 2010). However, D. Głuszczyk perceives regional development as changes in co-existing and inter-related economic systems, social systems, technical systems and technological systems of some areas (e.g., units in the administrative structure of a country), changes by which current state of play is replaced by a better one, i.e., assessed positively from a perspective of adopted set of criteria (Głuszczyk, 2011: 74). Moreover, *the National Strategy of Regional Development 2010–2020: Regions, Cities, Rural Areas* stressed the need to stimulate regional dimension of competitiveness and to increase territorial cohesion. It also underlined the necessity to increase effectiveness of regional policy and better use of endogenous potential of each and every region (Ministerstwo Rozwoju Regionalnego, 2010).

Poland’s membership in the European Union created new environment for the county’s regional development. The implementation of Common Regional Policy / New Cohesion Policy / EU Policy of Economic, Social and Territorial Cohesion in Poland resulted in an access to both structural funds and Cohesion Fund for beneficiaries in Poland. Poland joined the EU as a collection of sixteen poor provinces (voivodships) with *per capita* GDP below 75 per cent of the EU average, and as a poor EU member state with *per capita* GNI below 90 per cent of the EU average. Therefore, the EU policy has become a significant co-financer of regional policy efforts in Poland (OECD, 2016). For the period 2004–2006 Poland was granted EUR 12.8 billion for regional development (Rada Ministrów, 2003). National Development Plan for Poland 2004–2006 consisted of several operational programmes, co-funded by structural funds:

- Integrated Operational Programme of Regional Development (EUR 2.97 billion),
- Sectoral Operational Programme Human Capital Development (EUR 1.47 billion),
- Sectoral Operational Programme Increase of Enterprises’ Competitiveness (EUR 1.25 billion),
- Sectoral Operational Programme Transport (EUR 1.16 billion),
- Operational Programme Technical Assistance (EUR 0.28 billion),
- Sectoral Operational Programme Restructuring and Modernisation of Food Sector and Development of Rural Areas (EUR 1.19 billion),
- Sectoral Operational Programme Fisheries (EUR 0.20 billion).

In addition, the Cohesion Fund was used as a financial stimulus for the development of transport infrastructure and environmental protection projects in Poland (EUR 4.18 billion). Moreover, Poland participated in the implementation of two Common Initiatives: EQUAL and INTERREG III (EUR 0.25 billion).

Multiannual financial perspective 2007–2013 was much more advantageous for Poland (both generally and in terms of New Cohesion policy funding): Poland was granted EUR 67.3 billion from the European

Regional Development Fund, European Social Fund and Cohesion Fund. The following operational programmes were introduced in order to implement the National Cohesion Strategy of Poland 2007–2013:

- Operational Programme Infrastructure and Environment (EUR 28.3 billion),
- Operational Programme Innovative Economy (EUR 8.7 billion),
- Operational Programme Human Capital (EUR 10.0 billion),
- 16 Regional operational Programmes (EUR 17.3 billion),
- Operational Programme Eastern Poland Development (EUR 2.4 billion),
- Operational Programme Technical Assistance (EUR 0.5 billion),
- Operational Programmes of European Territorial Cooperation (EUR 0.7 billion) (Ministerstwo Rozwoju Regionalnego, 2007).

The current multiannual period 2014–2020 is even better for Poland: Poland (the biggest beneficiary of all 28 EU member states) is to receive about EUR 80 billion for the implementation of the EU Policy of Economic, Social and Territorial Cohesion. Poland prepared a set of operational programmes:

- Operational Programme Infrastructure and Environment (EUR 27.4 billion),
- Operational Programme Smart Growth (EUR 8.6 billion),
- Operational Programme Knowledge, Education, Development (EUR 4.7 billion),
- Operational Programme Digital Poland (EUR 2.2 billion),
- Operational Programme Eastern Poland (EUR 2.0 billion),
- Operational Programme Technical Assistance (EUR 0.7 billion),
- European Territorial Cooperation Programmes (EUR 0.7 billion),
- 16 Regional Operational Programmes (altogether EUR 31.15 billion, ROP Silesian Voivodship amounting to EUR 3.45 billion is the biggest one) (European Funds Portal, 2015).

It is important to note that some operational programmes have been implemented on the national level, while others have been deployed on the regional level. Such a way of introduction of operational programmes seems a good idea: regional programmes have made it possible to take into account considerable disparities in overall socioeconomic situation among 16 Polish provinces (voivodships). Operational Programme Eastern Poland is another good point: this operational programme has been built especially for the five poorest and most problematic provinces (voivodships) of Poland.

The institutional and political conditions that resulted from Poland's membership in the EU should be considered as a significant stimulus for economic development of the Polish regions. The EU structural funds and the Cohesion Fund constitute a major source of public investment in the period 2014–2020. They represent more than half of public investment in Poland (European Commission, 2016).

2. Objectives and scope of research

The main aim of research was to study, explore and evaluate disparities in socioeconomic development of sixteen Polish provinces (voivodships). Due to the fact that socioeconomic development is a very complex category, a number of elements had to be taken into account. The analysis was undertaken in four areas/fields. The following areas/fields were taken into consideration: I – demographic potential, II – social development, III – economic development and IV – technical infrastructure. A few variables were used to describe every category listed above. The demographic potential (field I) was analysed taking into account the following eight variables: X1 – population density (population per 1 square kilometre), X2 – natural increase per 1000 population, X3 – infant deaths per 1000 live births, X4 – number of employed persons per 1000 population, X5 – population in urban areas in % of total population, X6 – number of students per 10 thousand population, X7 – unemployment rate and X8 – graduates of higher education institutions per 10 thousand population. The following eleven variables were taken into account evaluating social development (field II): X9 – population per bed in general hospitals, X10 – population per provider of out-patient health

care, X11 – average useful floor area in dwelling *per capita*, X12 – number of dwellings per 1000 population, X13 – number of seats in cinemas per 1000 population, X14 – number of seats in theatres and music institutions per 1000 population, X15 – number of books per 1000 population, X16 – number of shops per 100 square kilometres, X17 – number of fuel stations per 100 square kilometres, X18 – beneficiaries of social assistance benefits per 10 population, X19 – number of ascertained crimes per 10 thousand population. The level of economic development (field III) was described using nine variables: X20 – GDP *per capita*, X21 – gross value of fixed assets *per capita* (in PLN), X22 – employed in agriculture in % of total, X23 – gross expenditure on research and development (R&D) activity *per capita* (in PLN), X24 – gross value added per employed person (in PLN), X25 – gross nominal disposable income in the households sector *per capita* (in PLN), X26 – sold production of industry *per capita* in PLN, X27 – total investment outlays *per capita*, X28 – yields of basic cereals per 1 ha (in decitonnes). Then, seven variables were used for the evaluation of technical infrastructure development (field IV): X29 – railway per 100 square kilometres (in kilometres), X30 – hard surface public roads per 100 square kilometres (in kilometres), X31 – water supply network per 100 square kilometres (in kilometres), X32 – sewage network per 100 square kilometres (in kilometres), X33 – gas supply network per 100 square kilometres (in kilometres), X34 – population connected to wastewater treatment plants in % of total population and X35 – postal offices per 100 square kilometres. To summarise, in total, a set of thirty-five variables was used in the analysis.

It is important to mention that due to complexity of a category of socioeconomic development a set of variables (not just one variable) should be used for analysis and surveys. However, a number of variables depends on the scope of research. Sometimes the lack of statistical data results in reducing the initial set of variables. Moreover, researchers are free to select and analyse variables they consider appropriate. Thus, a set of diagnostic variables used for the analysis of disparities in socioeconomic development of Polish provinces (voivodships) distinguished crucial areas of socioeconomic life of the analysed subjects. The diagnostic variables presented economies of the studied subjects (Polish provinces) fully and synthetically.

3. Research method

Research was conducted applying Z. Hellwig's method of taxonomic measure of development. This method of multivariate comparative analysis allowed to make a hierarchy in every field of the analysed subjects, i.e., Poland's provinces (voivodships), in terms of demographic potential, level of economic development, level of social development and technical infrastructure, as well as in regard to synthetic measure of socioeconomic development. After selecting a set of diagnostic variables, the character of each variable was determined. The majority of variables were considered stimuli. The following variables were treated as *destimuli*: infant deaths, unemployment rate, population per bed in general hospitals, population per provider of outpatient health care, beneficiaries of social assistance benefits per 10 population, ascertained crimes per 10 thousand population. Variables were standardised and a development model was constructed – a model unit, where diagnostic of variables were determined according to the rule, where: $z_{0j} = \max_i (z_{ij})$ for stimuli or

$z_{0j} = \min_i (z_{ij})$ for destimuli. The distance of i -unit from the development model was calculated using Euclid's measure:

$$d_o = \sqrt{\sum_{j=1}^m (z_j - z_p)^2} .$$

Finally, taxonomic measure of development (TMD) was calculated according to the formula (Hellwig, 1968; Pluta, 1977; Pluta, 1986; Nowak, 1990):

$$\text{TMD}_i = 1 - \frac{d_o}{d_o} , i=1,2,\dots,n, \text{ where: } d_o = \bar{d}_o + 2S_o, \text{ and:}$$

$$\bar{d}_0 = \frac{1}{n} \sum_{i=1}^n d_{\phi} , S_0 = \sqrt{\frac{1}{n} \sum_{i=1}^n (d_{\phi} - \bar{d}_0)^2} , \text{ while: } TMD_i \in [0; 1], \text{ for } i=1,2,\dots,n.$$

The last thing was to arrange the analysed subjects in order according to the level of development expressed by taxonomic measure of development (TMD). At first, the research was carried out in each of four fields. Then, a synthetic measure was constructed in which all four fields were taken into consideration. Such a plan of research made it possible to make a hierarchy of sixteen studied provinces (voivodships) separately in terms of demographic potential, social development, economic development, transport infrastructure, and jointly in terms of socioeconomic development measured by synthetic measure of development (TMD).

Additionally, implementation of cluster analysis for the research resulted in grouping of the analysed subjects – sixteen provinces (voivodships) – into four clusters according to the level of socioeconomic development in 2006, 2010 and 2015. A selected method of grouping of linearly ordered objects, and in particular, the method of standard deviation was used for this purpose. Sixteen Polish provinces (voivodships) were divided into four groups, according to the following rule:

- $G_1 : s_i < \bar{s} - S(s)$,
- $G_2 : \bar{s} > s_i \geq s_i - S(s)$,
- $G_3 : \bar{s} + S(s) > s_i \geq \bar{s}$,
- $G_4 : s_i \geq \bar{s} + S(s)$,

where: \bar{s} – arithmetic mean of synthetic variable (in this study: arithmetic mean of TMD), while $S(s)$ – standard deviation of synthetic variable (in this study: standard deviation of TMD), s_i – value of the synthetic variable of the object i (in this study: TMD value in i province).

4. Research results

Tables 1 to 4 present the achieved results of multivariate comparative analysis conducted by applying Z. Hellwig's method of taxonomic measure of development in every field. With respect to demographic potential Mazovia Province (Mazowieckie) took the first position in every analysed period of time (2006, 2010 and 2015). The next place was taken by Małopolskie (Lesser Poland Province). The worst results in this field were observed in Warmińsko-mazurskie (Warmia-Masuria province) (in 2006 and 2015) and Lubuskie (Lubusz Province) (in 2010). The highest position of Mazovia Province has resulted from: the highest number of employed persons per 1000 population, the highest number of students per 10 thousand population, the highest number of higher education institutions graduates per 10 thousand population, as well as a relatively low unemployment rate and natural increase being above zero.

Table 1. Ranking of Polish provinces in terms of demographic potential

Position	2015		2010		2006	
	Province	TMD	Province	TMD	Province	TMD
1	Mazowieckie	0.645	Mazowieckie	0.598	Mazowieckie	0.596
2	Małopolskie	0.616	Małopolskie	0.547	Małopolskie	0.443
3	Dolnośląskie	0.473	Wielkopolskie	0.497	Wielkopolskie	0.419
4	Pomorskie	0.426	Śląskie	0.414	Dolnośląskie	0.356
5	Wielkopolskie	0.388	Pomorskie	0.404	Łódzkie	0.332
6	Śląskie	0.299	Łódzkie	0.384	Śląskie	0.331
7	Zachodniopomorskie	0.270	Dolnośląskie	0.362	Pomorskie	0.318
8	Kujawsko-pomorskie	0.240	Lubelskie	0.305	Kujawsko-pomorskie	0.262
9	Łódzkie	0.236	Podlaskie	0.302	Lubelskie	0.258
10	Lubelskie	0.235	Kujawsko-pomorskie	0.222	Świętokrzyskie	0.257
11	Podlaskie	0.222	Podkarpackie	0.203	Podlaskie	0.221
12	Lubuskie	0.216	Zachodniopomorskie	0.193	Zachodniopomorskie	0.199
13	Podkarpackie	0.213	Opolskie	0.177	Lubuskie	0.126
14	Opolskie	0.189	Świętokrzyskie	0.141	Podkarpackie	0.111
15	Świętokrzyskie	0.156	Warmińsko-mazurskie	0.114	Opolskie	0.101
16	Warmińsko-mazurskie	0.143	Lubuskie	0.105	Warmińsko-mazurskie	0.097

Legend: Dolnośląskie – Lower Silesia Province; Kujawsko-pomorskie – Kuyavia-Pomerania Province; Łódzkie – Lodz Province; Lubelskie – Lublin Province; Lubuskie – Lubusz Province; Małopolskie – Lesser Poland Province; Mazowieckie – Masovia Province; Opolskie – Opole Province; Podlaskie – Podlasie Province; Podkarpackie – Subcarpathia Province; Pomorskie – Pomerania Province; Śląskie – Silesia Province; Świętokrzyskie – Świętokrzyskie Province; Warmińsko-mazurskie – Warmia-Masuria Province; Wielkopolskie – Greater Poland Province; Zachodniopomorskie – West Pomerania Province.

Source: the author's calculations based on Central Statistical Office data (Central Statistical Office, 2017; Central Statistical Office, 2012; Central Statistical Office, 2008).

In terms of social development Silesia Province (Śląskie) was a leader in every analysed period of time (2006, 2010 and 2015). The top five provinces in terms of social development in the analysed years were also: Łódzkie (Lodz Province), Małopolskie (Lesser Poland Province) and Mazowieckie (Mazovia Province). The lowest level of social development was observed in Warmińsko-mazurskie (Warmia-Masuria Province) and Pomorskie (Pomerania Province): positions 16th and 15th respectively in all analysed periods of time. The highest position of Silesia Province resulted mostly from: the lowest number of population per bed in general hospitals, the highest density of shops, and the highest density of fuel stations.

Table 2. Ranking of Polish provinces in terms of social development

Position	2015		2010		2006	
	Province	TMD	Province	TMD	Province	TMD
1	Śląskie	0.388	Śląskie	0.575	Śląskie	0.634
2	Łódzkie	0.337	Mazowieckie	0.432	Łódzkie	0.418
3	Podlaskie	0.261	Łódzkie	0.385	Małopolskie	0.346
4	Małopolskie	0.259	Dolnośląskie	0.361	Dolnośląskie	0.336
5	Mazowieckie	0.258	Małopolskie	0.334	Mazowieckie	0.321
6	Wielkopolskie	0.242	Podlaskie	0.303	Wielkopolskie	0.305
7	Dolnośląskie	0.239	Wielkopolskie	0.288	Opolskie	0.265

Position	2015		2010		2006	
	Province	TMD	Province	TMD	Province	TMD
8	Świętokrzyskie	0.216	Opolskie	0.252	Zachodniopomorskie	0.256
9	Lubelskie	0.209	Świętokrzyskie	0.247	Lubelskie	0.222
10	Kujawsko-pomorskie	0.170	Zachodniopomorskie	0.227	Podlaskie	0.213
11	Zachodniopomorskie	0.147	Lubelskie	0.212	Podkarpackie	0.210
12	Opolskie	0.144	Kujawsko-pomorskie	0.198	Świętokrzyskie	0.204
13	Podkarpackie	0.135	Lubuskie	0.138	Lubuskie	0.163
14	Lubuskie	0.106	Podkarpackie	0.137	Kujawsko-pomorskie	0.161
15	Pomorskie	0.059	Pomorskie	0.105	Pomorskie	0.124
16	Warmińsko-mazurskie	0.002	Warmińsko-mazurskie	0.057	Warmińsko-mazurskie	0.074

Source: the author's calculations based on Central Statistical Office data (Central Statistical Office, 2017; Central Statistical Office, 2012; Central Statistical Office, 2008)

Mazovia Province remained a leader in terms of economic development in 2006, 2010 and 2015. The top five included also the following provinces: Dolnośląskie (Lower Silesia), Śląskie (Silesia), Wielkopolskie (Greater Poland) and Pomorskie (Pomerania). It seems of vital importance here that the order of provinces which constituted the top five was the same in 2006, 2010 and 2015. The lowest level of economic development was characteristic for Lubelskie (Lublin Province). A very low level of economic development was also noted in the case of the following provinces: Podkarpackie (Subcarpathia), Świętokrzyskie and Podlaskie (Podlasie). The highest place of Mazovia Province resulted from: the highest level of GDP *per capita* and the highest gross value of fixed assets *per capita*, as well as the greatest value of gross expenditure on research and development (R&D) activity *per capita*, and a relevant advantage over other provinces in terms of total investment outlays *per capita*.

Silesia Province occupied the first position in terms of technical infrastructure in the analysed period of time. The next positions took the provinces as follows: Małopolskie (Lesser Poland), Dolnośląskie (Lower Silesia) and Mazowieckie (Mazovia). The lowest level of technical infrastructure was observed in Lubelskie (Lublin Province) in 2015, while Podlaskie (Podlasie Province) took the last position in terms of technical infrastructure in both 2010 and 2006. Moreover, a really weak technical infrastructure was also characteristic for the following provinces: Warmińsko-mazurskie (Warmia-Masuria), Zachodniopomorskie (West Pomerania) and Lubuskie (Lubusz). The highest place of Silesia Province resulted from its relevant advantage in terms of railway density, hard surface public roads density, as well as water supply network density, sewage network density and gas supply network density.

The differences among the four fields in different years resulted from a number of reasons. The character of conducted research makes it impossible to define one predominant reason; the differences should be viewed as an effect of a combination of changes of individual variables in each area/field. Referring to demographic potential, differences were caused (among others) by relative changes in employment rate, unemployment rate, natural increase and infant mortality rate. However, relative changes among provinces in population per bed in general hospitals, population per provider of out-patient health care, beneficiaries of social assistance benefits per 10 population and a number of ascertained crimes per 10 thousand population resulted in different outcomes in regard to social development of sixteen Polish provinces (voivodships) in 2006, 2010 and 2015. The following variables caused different results in terms of economic development: relative changes of GDP per capita, gross value of fixed assets per capita, gross value added per employed person, gross nominal disposable income in the household's sector per capita, sold production of industry per capita, and total investment outlays per capita. When it comes to technical infrastructure development, here a different order of Polish provinces (voivodships) in 2006, 2010 and 2015 appeared from relative changes in railway and public roads network, water supply network, sewage network and gas supply network.

Table 3. Ranking of Polish provinces in terms of economic development

Position	2015		2010		2006	
	Province	TMD	Province	TMD	Province	TMD
1	Mazowieckie	0.661	Mazowieckie	0.731	Mazowieckie	0.573
2	Dolnośląskie	0.447	Dolnośląskie	0.516	Dolnośląskie	0.431
3	Śląskie	0.438	Śląskie	0.454	Śląskie	0.397
4	Wielkopolskie	0.408	Wielkopolskie	0.447	Wielkopolskie	0.391
5	Pomorskie	0.398	Pomorskie	0.432	Pomorskie	0.378
6	Łódzkie	0.340	Zachodniopomorskie	0.345	Łódzkie	0.366
7	Małopolskie	0.305	Lubuskie	0.341	Zachodniopomorskie	0.319
8	Lubuskie	0.282	Łódzkie	0.322	Małopolskie	0.278
9	Kujawsko-pomorskie	0.276	Opolskie	0.286	Opolskie	0.259
10	Opolskie	0.270	Kujawsko-pomorskie	0.284	Kujawsko-pomorskie	0.247
11	Zachodniopomorskie	0.270	Małopolskie	0.282	Lubuskie	0.237
12	Warmińsko-mazurskie	0.188	Warmińsko-mazurskie	0.229	Warmińsko-mazurskie	0.204
13	Podlaskie	0.158	Świętokrzyskie	0.169	Podlaskie	0.127
14	Świętokrzyskie	0.139	Podkarpackie	0.151	Podkarpackie	0.122
15	Podkarpackie	0.108	Podlaskie	0.150	Świętokrzyskie	0.096
16	Lubelskie	0.094	Lubelskie	0.089	Lubelskie	0.057

Source: the author's calculations based on Central Statistical Office data (Central Statistical Office, 2017; Central Statistical Office, 2012; Central Statistical Office, 2008).

Table 4. Ranking of Polish provinces in terms of technical infrastructure development

Position	2015		2010		2006	
	Province	TMD	Province	TMD	Province	TMD
1	Śląskie	0.789	Śląskie	0.908	Śląskie	0.883
2	Małopolskie	0.504	Małopolskie	0.545	Małopolskie	0.532
3	Dolnośląskie	0.419	Dolnośląskie	0.414	Dolnośląskie	0.430
4	Mazowieckie	0.396	Podkarpackie	0.389	Kujawsko-pomorskie	0.365
5	Kujawsko-pomorskie	0.354	Kujawsko-pomorskie	0.369	Wielkopolskie	0.362
6	Pomorskie	0.345	Wielkopolskie	0.362	Podkarpackie	0.359
7	Wielkopolskie	0.332	Opolskie	0.350	Łódzkie	0.349
8	Łódzkie	0.304	Pomorskie	0.345	Pomorskie	0.340
9	Świętokrzyskie	0.283	Łódzkie	0.342	Opolskie	0.339
10	Podkarpackie	0.282	Świętokrzyskie	0.312	Świętokrzyskie	0.313
11	Opolskie	0.282	Mazowieckie	0.299	Mazowieckie	0.274
12	Zachodniopomorskie	0.225	Lubuskie	0.224	Lubuskie	0.226
13	Lubuskie	0.188	Lubelskie	0.224	Lubelskie	0.220
14	Warmińsko-mazurskie	0.168	Zachodniopomorskie	0.219	Warmińsko-mazurskie	0.197
15	Podlaskie	0.147	Warmińsko-mazurskie	0.193	Zachodniopomorskie	0.193
16	Lubelskie	0.135	Podlaskie	0.161	Podlaskie	0.155

Source: the author's calculations based on Central Statistical Office data (Central Statistical Office, 2017; Central Statistical Office, 2012; Central Statistical Office, 2008).

Synthetic measure of socioeconomic development of the studied provinces (voivodships) was presented in Table 5 and in Figures 1, 2 and 3. Mazovia Province (the year 2015) and Silesia Province (the years 2006 and 2010) took the leading positions, i.e., became leaders in fields I and III and II and IV, respectively. Dolnośląskie (Lower Silesia Province) and Małopolskie (Lesser Poland Province) were classified on the next two positions in the analysed period of time. The lowest level of socioeconomic development was characteristic for Warmińsko-mazurskie (Warmia-Masuria Province) in all years (2006, 2010 and 2015).

Table 5. Synthetic measure of socioeconomic development of Polish provinces

Position	2015		2010		2006	
	Province	TMD	Province	TMD	Province	TMD
1	Mazowieckie	0.462	Śląskie	0.515	Śląskie	0.488
2	Śląskie	0.412	Mazowieckie	0.448	Mazowieckie	0.373
3	Dolnośląskie	0.365	Dolnośląskie	0.373	Dolnośląskie	0.347
4	Małopolskie	0.363	Małopolskie	0.350	Małopolskie	0.340
5	Wielkopolskie	0.310	Wielkopolskie	0.341	Łódzkie	0.321
6	Pomorskie	0.273	Łódzkie	0.299	Wielkopolskie	0.319
7	Łódzkie	0.260	Pomorskie	0.258	Pomorskie	0.234
8	Kujawsko-pomorskie	0.216	Opolskie	0.213	Kujawsko-pomorskie	0.201
9	Zachodniopomorskie	0.187	Kujawsko-pomorskie	0.212	Opolskie	0.193
10	Opolskie	0.179	Zachodniopomorskie	0.192	Zachodniopomorskie	0.190
11	Lubuskie	0.159	Świętokrzyskie	0.153	Świętokrzyskie	0.148
12	Świętokrzyskie	0.137	Lubuskie	0.149	Podkarpackie	0.140
13	Podlaskie	0.137	Podkarpackie	0.149	Lubuskie	0.135
14	Podkarpackie	0.124	Podlaskie	0.147	Lubelskie	0.114
15	Lubelskie	0.103	Lubelskie	0.122	Podlaskie	0.111
16	Warmińsko-mazurskie	0.080	Warmińsko-mazurskie	0.086	Warmińsko-mazurskie	0.085

Source: the author's calculations based on Central Statistical Office data (Central Statistical Office, 2017; Central Statistical Office, 2012; Central Statistical Office, 2008)

Additionally, seeking to group sixteen Polish provinces (voivodships) into classes (according to the level of their socioeconomic development) there was applied standard deviation method for classification of linearly ordered subjects. As a result, sixteen provinces were grouped into four classes, where class G4 included provinces with the highest TMD (TMD of those provinces amounted to at least the arithmetic mean of TMD plus standard deviation of TMD), and class G1 included provinces with the lowest TMD (for those provinces TMD was lower than the arithmetic mean of TMD minus standard deviation of TMD). The results of the analysis (the years 2006, 2010 and 2015) applying standard deviation method for classification of linearly ordered subjects are presented in Table 6.

In 2015, there were four provinces (voivodships) in class G4, namely: Mazowieckie (Mazovia Province), Śląskie (Silesia Province), Dolnośląskie (Lower Silesia Province) and Małopolskie (Lesser Poland Province). The next class, G3, was formed out of three provinces (voivodships): Wielkopolskie (Greater Poland Province), Pomorskie (Pomerania Province) and Łódzkie (Lodz Province). Yet Class G2 embraced seven provinces (voivodships), which are as follows: Kujawsko-pomorskie (Kuyavia-Pomerania Province), Zachodniopomorskie (West Pomerania Province), Opolskie (Opole Province), Lubuskie (Lubusz Province), Świętokrzyskie (Świętokrzyskie Province), Podlaskie (Podlasie Province) and Podkarpackie (Subcarpathia Province). Finally, two provinces (voivodships) with the lowest level of synthetic measure of socioeconomic development TMD formed Class G1, namely: Warmińsko-mazurskie (Warmia-Masuria Province) and Lubelskie (Lublin Province).

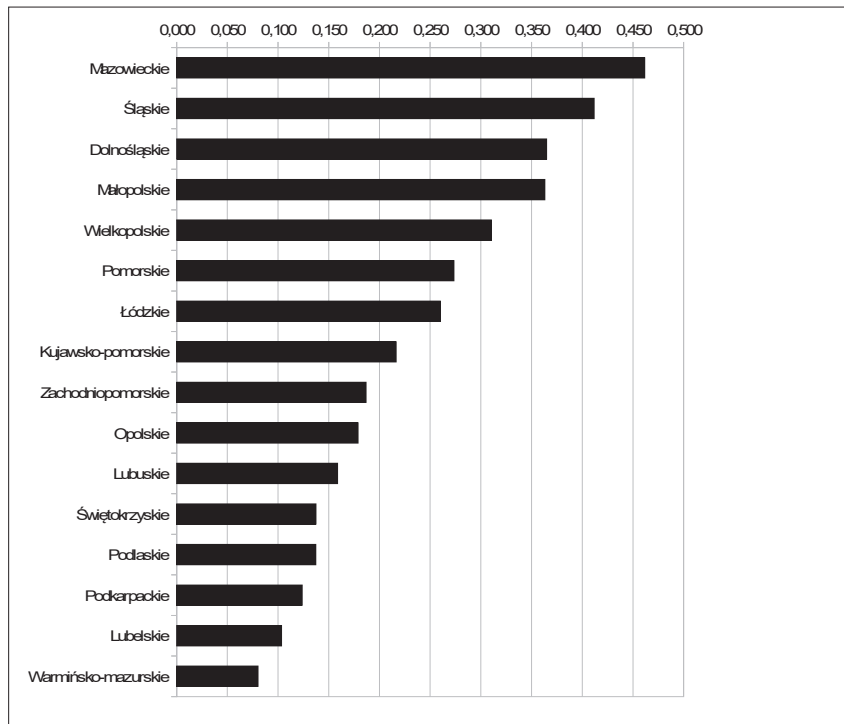


Fig. 1. Ranking of Polish provinces according to synthetic measure of socioeconomic development in 2015

Source: the author's elaboration based on Table 5.

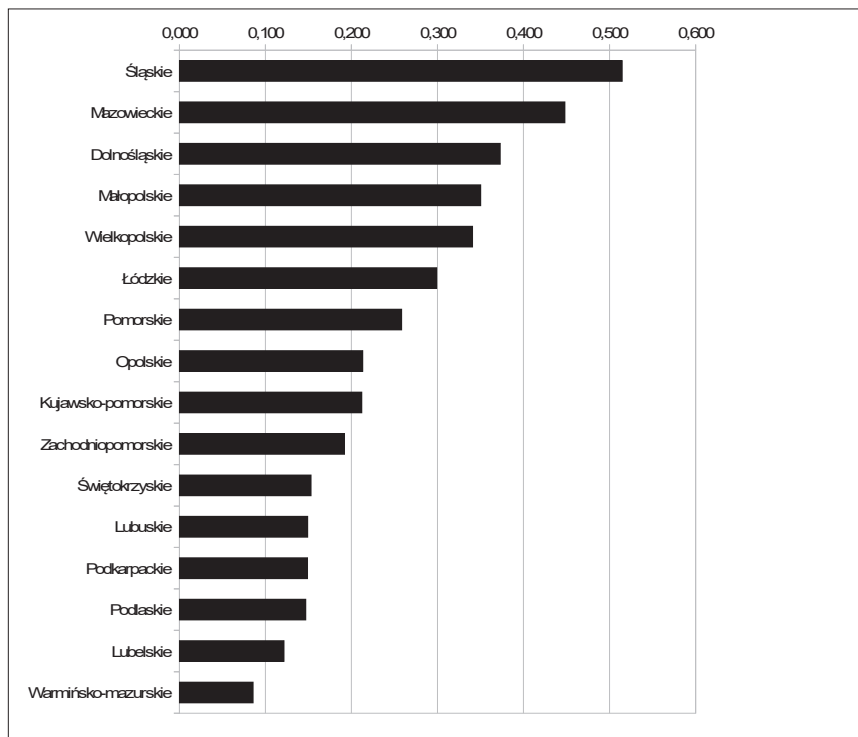


Fig. 2. Ranking of Polish provinces according to synthetic measure of socioeconomic development in 2010

Source: the author's elaboration based on Table 5.

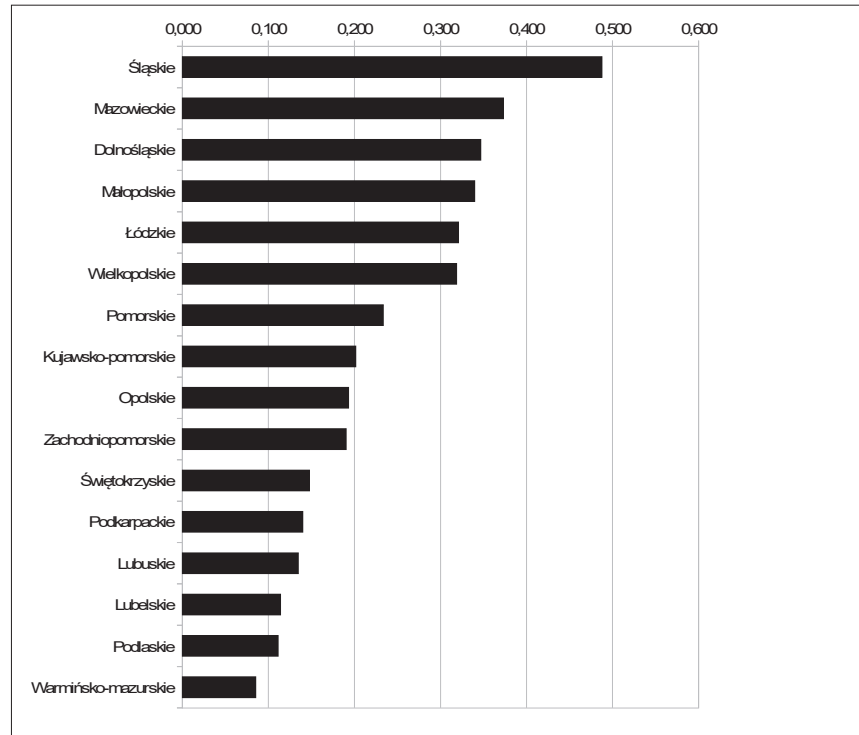


Fig. 3. Ranking of Polish provinces according to synthetic measure of socioeconomic development in 2006

Source: the author's elaboration based on Table 5.

In 2010, class G4 was formed out of three provinces (voivodships), namely: Śląskie (Silesia province), Mazowieckie (Mazovia Province) and Dolnośląskie (Lower Silesia Province). This time Małopolskie (Lesser Poland Province) was an element of class G3 together with provinces: Wielkopolskie (Greater Poland Province), Łódzkie (Lodz Province) and Pomorskie (Pomerania Province). Whereas Class G2 was made of seven provinces (voivodships) – the same provinces which were included in the class G2 in 2015. And again, a two-element class G1 constituted Warmińsko-Mazurskie (Warmia-Masuria Province) and Lubelskie (Lublin Province).

In 2006, class G4 included only two provinces (voivodships) with the highest level of socioeconomic development expressed by TMD: Śląskie (Silesia Province) and Mazowieckie (Mazovia Province). Class G3 embraced four provinces (voivodships): Dolnośląskie (Lower Silesia Province), Małopolskie (Lesser Poland Province), Łódzkie (Lodz Province) and Wielkopolskie (Greater Poland Province). However, Podlaskie (Podlasie Province) was no longer an element of class G2: it formed a three-element class G1 together with Warmińsko-mazurskie (Warmia-Masuria Province) and Lubelskie (Lublin Province).

Table 6. Division of Polish provinces into classes according to synthetic measure of socioeconomic development in 2006, 2010 and 2015

2015		2010		2006	
Province	Class	Province	Class	Province	Class
Mazowieckie	G4	Śląskie	G4	Śląskie	G4
Śląskie	G4	Mazowieckie	G4	Mazowieckie	G4
Dolnośląskie	G4	Dolnośląskie	G4	Dolnośląskie	G3

2015		2010		2006	
Province	Class	Province	Class	Province	Class
Małopolskie	G4	Małopolskie	G3	Małopolskie	G3
Wielkopolskie	G3	Wielkopolskie	G3	Łódzkie	G3
Pomorskie	G3	Łódzkie	G3	Wielkopolskie	G3
Łódzkie	G3	Pomorskie	G3	Pomorskie	G2
Kujawsko-pomorskie	G2	Opolskie	G2	Kujawsko-pomorskie	G2
Zachodniopomorskie	G2	Kujawsko-pomorskie	G2	Opolskie	G2
Opolskie	G2	Zachodniopomorskie	G2	Zachodniopomorskie	G2
Lubuskie	G2	Świętokrzyskie	G2	Świętokrzyskie	G2
Świętokrzyskie	G2	Lubuskie	G2	Podkarpackie	G2
Podlaskie	G2	Podkarpackie	G2	Lubuskie	G2
Podkarpackie	G2	Podlaskie	G2	Lubelskie	G1
Lubelskie	G1	Lubelskie	G1	Podlaskie	G1
Warmińsko-mazurskie	G1	Warmińsko-mazurskie	G1	Warmińsko-mazurskie	G1

Source: the author's calculations based on Central Statistical Office data (Central Statistical Office, 2017; Central Statistical Office, 2012; Central Statistical Office, 2008).

5. Conclusions

The undertaken research proved the persistence of huge development disparities among the Polish regions on the level of provinces (voivodships), i.e. NUTS 2 level. It stems from the multivariate comparative analysis that Mazovia Province leads in terms of demographic potential, as well as in terms of economic development. On the other hand, Silesia Province remains a leader in regard to social development and technical infrastructure. In 2015, the highest level of synthetic measure of socioeconomic development was noted in Mazovia Province and Silesia Province took the second place. In 2006 and 2010 Silesia Province was a leader in terms of synthetic measure of socioeconomic development and Mazovia Province took the second position. The lowest level of socioeconomic development was observed in Warmia-Masuria Province.

Application of standard deviation method for grouping linearly ordered subjects made it possible to group sixteen Polish provinces (voivodships) into four classes. In 2006, class G4 including provinces with the highest level of synthetic measure of socioeconomic development TMD was formed of two provinces (voivodships) only: Silesia Province and Mazovia Province; in 2010, class G4 was supplemented by Lower Silesia Province, and in 2015, Lesser Poland Province was also included into class G4. Therefore, it can be concluded that in the analysed period of time (over the years 2006 to 2015) a considerable socioeconomic improvement was noted in Lower Silesia Province and Lesser Poland Province; this improvement has resulted in the reduction of distance between those two provinces and the provinces characterised by the highest level of socioeconomic development. The effective implementation of the Common Regional Policy 2004–2006 and New Cohesion Policy 2007–2013 in both Dolnośląskie (Lower Silesia Province) and Małopolskie (Lesser Poland Province) helped to obtain such an upgrade of their position. In 2006, Class G1, i.e., the class including provinces with the lowest level of synthetic measure of socioeconomic development, made up three provinces: Warmińsko-Mazurskie (Warmia-Masuria Province), Podlaskie (Podlasie Province) and Lubelskie (Lublin Province); here it should be noted that Podlaskie (Podlasie Province) was upgraded to class G2 in 2010 and 2015.

There is a number of reasons for such huge territorial differences among Polish provinces: geographical location (centrally located regions tend to be better developed, while peripherally situated ones – especially along the Eastern border of Poland – tend to be less developed), social and technical infrastructure (Silesia Province has been the one best equipped in regard to density of roads, railways, hospital beds, shops and fuel stations), human capital (Mazovia Province has been the one with the best situation in terms of employed

persons per 1000 population, students per 10 thousand population, higher education institutions graduates per 10 thousand population, unemployment rate and natural increase). The provinces of highest socioeconomic development attract highly educated labour force. They also tend to attract home and foreign capital – thanks to high investment attractiveness such regions get more chances for further development.

The question is how to promote further development of Polish provinces (voivodships)? How to obtain better results, especially in the most problematic regions (provinces)? The consistent implementation of regional policy is of vital relevance here, and in particular taking advantage of opportunities created by the EU membership. Therefore, it is of crucial importance to make every effort to use the European Regional Development Fund, European Social Fund and Cohesion Fund to reduce disparities in socioeconomic development. Thus, the author's suggestions for regional policy emphasise the relevance of promoting effective use of the EU funds offered to Poland and Polish provinces (voivodships). Undoubtedly, the EU multiannual financial perspective 2014–2020 is the most favourable for Poland. For the period 2014–2020 Poland has been allocated around EUR 80 billion in total of the EU Policy of Economic, Social and Territorial Cohesion funding. Brexit and other challenges for the EU are likely to result in considerable changes in the way the EU spends the money after 2020. So far, the support of the EU funds was used mostly to improve the quality of life instead of entrepreneurship and competitiveness of the Polish economy and Poland's provinces. It is strongly recommended to use structural funds and Cohesion Fund to stimulate dynamic growth and promote competitive development of the Polish regions (Dotti, 2016). One more aspect must be considered here with respect to the use of the EU funds intended for regional development of provinces (voivodships): in the period 2004–2006 and 2007–2013 all 16 Polish provinces (voivodships) were treated as convergence regions of the EU, i.e., the ones with *per capita* GDP below the EU average. Therefore, the conditions for using the EU funds in all Polish provinces (voivodships) were more or less the same (e.g., the share of the EU funds in financing individual projects). In the current multiannual financial perspective of the EU for 2014–2020 the situation is different: Mazovia Province is no longer considered a convergence region: its *per capita* GDP is above 90% of the EU average. Therefore, Regional Operational Programme Mazovian Voivodship is much smaller and beneficiaries from Mazovia Province get reduced financial assistance (the EU share in total eligible cost of projects introduced on the territory of Mazovia Province is also smaller in the case of operational programmes managed on the national level). It may result in reducing (partly) the gap between Mazovia Province and the rest of Poland within the next couple of years.

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REGIONINIAI SKIRTUMAI, PAGRĪSTI TAKSONOMINIAIS TYRIM AIS. LENKIJOS ATVEJIS

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Santrauka

Autorė išanalizavo ir įvertino šešiolikos Lenkijos provincijų regioninius vystymosi skirtumus. Analižuotos keturios skirtingos sritys: demografinės galimybės, socialinis vystymasis, ekonominis vystymasis, techninė infrastruktūra. Straipsnio autorė pasirinko analizei sukurta socialinio vystymosi metodiką ir palygino šešiolika Lenkijos provincijų. Tyrimui pasirinkti skirtingi metai: 2006, 2010 ir 2015. Pasirinkti šių metų statistiniai duomenys iš centrinio statistikos departamento. Taikyti šie tyrimo metodai: mokslinės literatūros studijos, aprašomoji analizė, taikant pasirinktą metodiką atlikta daugialypė lyginamoji analizė.

Pastaroji įrodė, kad Mazovijos provincija yra lyderė vertinant demografinį potencialą ir ekonominį vystymąsi. Tuo tarpu Silezijos rajonas pirmauja socialinio vystymosi ir techninės infrastruktūros srityse. Taigi aukščiausi įverčiai gauti Mazovijos ir Silezijos provincijose. Be to, autorė pateikė teorines socioekonominio vystymosi regioninės politikos išvalgas. Tyrimas atskleidė ir tai, kad Lenkijos provincijose egzistuoja didžiuliai teritoriniai skirtumai. Tai geografinė vieta: centrinėje šalies dalyje esantys regionai geriau išsivystę, tuo tarpu periferijoje, ypač rytinėse Lenkijos pasienio teritorijose, – kur kas mažiau. Socialinė ir techninė infrastruktūra: Silezijos provincija pasižymi viena geriausių susisiekimo ir kitų infrastruktūrų: keliai, geležinkeliai, ligoninės, parduotuvės, degalinės: Mazovijos provincijoje viena geriausių situacijų dėl žmoniškųjų išteklių – darbuotojų: vienam tūkstančiui gyventojų tenka didelė dalis studentų, esama aukštųjų mokyklų, žemas nedarbo lygis, natūralus gyventojų prieaugis. Geriau išsivysčiusios provincijos pritraukia darbuotojus, turinčius aukštąjį išsimokslinimą, jos patrauklesnės ir užsienio kapitalui. Tai didina regiono patrauklumą vietiniams gyventojams ir sudaro palankias tolesnio vystymosi galimybes.

PAGRINDINIAI ŽODŽIAI: *vystymasis, Lenkija, provincija, taksonominė analizė, daugialypė lyginamoji analizė.*

JEL KODAI: O11, R11.