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TAXONOMIC ANALYSIS OF DIVERSITY OF LOCAL LABOUR MARKETS IN POLAND

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Abstract. *The situation in the labour market is conditioned by many factors that often have a local dimension. Identification of different levels of development of labour demand as well as potential of labour supply on the local level is a crucial element of diagnosis of reasons for regional and local diversity and implementation of an appropriate labour market policy. As there is available a variety of indicators describing regional labour relations, there is a need to create synthetic measure to include different aspects of the labour market situation. The aim of the paper is identification of the diversity of the situation in the local labour markets of all 16 Polish voivodeships. At the first step, a synthetic measure including eight variables was created. At the second stage 16 Polish voivodeships were clustered following Ward's and k-means methods. As the authors assume that the position of voivodeship labour markets is connected with the position of capital cities, the analysis was deepened by ranking voivodeship cities based on Hellwig's method. As a result of conducted research and the classification of Polish voivodeships and their capital cities in the context of the situation in the labour market, there have been identified the reasons of regions' positions and proposed recommendations for the labour market policy.*
Keywords: *local labour market, regional diversity, Hellwig's method, the cluster analysis.*

Introduction

The concept of the local labour market refers to its spatial dimension. The criteria of local delimitation of labour markets, which are the most frequently suggested in the literature, are the administrative criterion and the criterion of labour force mobility (Góra & Sztanderska, 2006; Głuszczuk, 2012). According to the first criterion, the local labour market is a space that is a part of the country's labour market. In the case of Poland, it is a voivodeship, poviat or municipality area that is considered to be the individual territorial level. According to the second criterion, the local labour market is an economically integrated geographical area where inhabitants may find employment or change it without changing the place of residence (Gruchociak, 2012).

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Local labour markets differ in terms of the economic, social or demographic situation, which is not constant and can be changed under the influence of internal and external circumstances (Słomińska, 2009). Therefore, the comparison of the situation in local labour markets is a complex issue. It should take into account all major economic categories that are associated with labour supply and labour demand. Diagnosing the situation of local labour markets, it seems reasonable to consider indicators reflecting the degree of use of labour resources, working conditions and potential opportunities to create new jobs (Adamczyk, 2015).

The aim of the article is identification of the diversity of the situation in the local labour markets of all 16 Polish voivodeships. To achieve the aim, a ranking of territorial units was created, which was based on the values of the previously constructed synthetic variable describing the state of the local labour market. In the paper, local labour markets in Poland are determined spatially at the level of 16 voivodeships.

As a research method, taxonomic analysis was applied for the purpose of classifying territorial units in Poland based on selected criteria. The research study was based on data of the Local Data Bank of the Central Statistical Office of Poland. It covers the most recent available data for 2016.

At the first step, a synthetic measure of the labour market situation was created, which included eight variables. At the second stage, 16 Polish voivodeships were clustered following Ward's and k-means methods, which were used for the analysis of diversity of labour markets. The cluster analysis is widely used in the literature to present the heterogeneity of labour markets (Rollnik-Sadowska, 2016; Pivonka & Loster, 2013, Muntaner et al., 2012). As the authors assume that the position of voivodeship labour markets is connected with the position of capital cities, the analysis was deepened by ranking voivodeship cities based on Hellwig's method. This method of selection of variables in linear model is popular in Polish literature for creation of ranking of territorial units (Michoń, 2017).

The paper is structured as follows. In the first section, there are described the main theories of local development. Section 2 identifies possible determinants of the labour market situation in Poland. The following section presents the taxonomic analysis of voivodeship labour markets. The summary and concluding remarks are given in the last section.

Determinants of local diversity – theoretical assumptions

The problem of diversifying the economic development of regions, and hence the diversification of regional labour markets, can be considered through the prism of various theories of regional development (Pietak, 2014). The explanation of differences in regional development is one of the most popular

challenges undertaken by economists, geographers and representatives of other social sciences. Interest in this issue began in the 1950s. From that moment on, at least a few dozen theories and concepts of various scope have arisen, which, starting from different methodological orientations, explain the diverse spatial dynamics of socio-economic processes (Kisiała & Stępiński, 2013).

Among them there are concepts formulated in the so-called Keynesianism period (referring to the centre-periphery model). They include such theories as: the concept of growth poles, the export base, uneven development and polarized development, structuralism theories (theory of product life cycle), theories inspired by critical realism (theory of spatial division of labour), theories formed on the basis of system analysis (theory of spatial self-organization) and theories and institutional concepts (concept of learning regions, regional innovation systems, related diversity and the triple helix) (Kisiała & Stępiński, 2013). Each of these concepts identifies one or more factors determining the development of the region and indicate the mechanisms of inter-regional differences.

Some of them refer to traditional factors of regional development, including natural resources, capital resources and labour resources. Part, in turn, to factors of qualitative nature, including, inter alia, scientific, technical and technological progress. Institutional theories, however, assign a significant role efficiency of public administration institutions in regional development (Glińska et al., 2017).

According to Pietak (2014), by emphasizing every new factor of development, these groups of theories are not mutually exclusive. At the same time, however, they do not provide a single answer explaining the problem of regional divergence.

In the context of the analyses carried out for the purposes of this paper, the theory of growth poles by Francois Perroux is particularly relevant. It indicates the spatial concentration of regional development and its economic and political consequences. In accordance with its assumption, in metropolitan centres, business entities representing technologically advanced branches of industry are characterized by high competitiveness. In this way, these centres become the nucleus of the region, gaining an advantage over smaller cities and surrounding areas. The most developed regions, in turn, are winning economic competition with peripheral regions and making them dependent on their own industrial and commercial policy (Grosse, 2002).

Factors differentiating the labour market situation in Poland

The labour market differs from other markets because it is, in fact, a conglomerate of many labour sub-markets (Góra & Sztanderska, 2006).

The dependencies on the regional labour market are extremely comprehensive and understanding them requires analysing both the situation on

the labour demand and supply side, as well as issues related to their interaction and the environment of the labour market (Decker & Rollnik-Sadowska, 2015).

Labour demand and supply in the market economy are shaped by a number of variables, among which the level of wages, labour productivity and demand for products resulting from work, the number of people with specific qualifications, non-wage benefits from work, non-wage benefits from alternative activities can be mentioned and socio-cultural determinants of professional activity. However, this list of determinants is much wider, as the shaping of demand and supply depends on: labour mobility, amount of unemployment benefit and its relation to the minimum wage rate in the given country, the activity of trade unions, policies made by the state on the labour market, tax rates, labour costs, as well as the general economic climate. The situation in the labour market is the resultant of many interrelated factors (Milewski, 2000; Sloman, 2006; Blanchard, 2006).

The labour market situation in Poland is spatially heterogeneous when it comes to the level of unemployment (including long-term unemployment) (Maksim & Wojdyło-Preisner, 2015) and the employment potential. The labour market variables are spatially diversified (Dykas & Misiak, 2014). It mainly concerns the structure of age of labour supply, the level of natural increase and net migration. Moreover, spatial diversification is noticed in Poland in the field of labour demand – in this, above all, the number of entities, investment expenditures and level of wages.

Spatial diversity in the labour market in Poland

The research was preceded by both the substantive and statistical selection of diagnostic features (Jarocka, 2013). In order to select the list of potential indicators, one of the heuristic methods – brainstorming among the authors of the paper – was used. In order to perform a comparison analysis of voivodeships of Poland in regard to factors for the socio-geographical, economic, economic infrastructure as well as the employment market spheres, the following variables were selected:

- X1 - people registered as unemployed for a period lasting longer than 1 year (% of overall unemployed), inhibitor
- X2 - average monthly number of people registered as unemployed per one job offer, inhibitor
- X3 - unemployment rate, %, inhibitor
- X4 - average monthly gross earnings in relation to the national average (Poland=100), %, booster
- X5 - newly registered entities per every 10 thousand of working age population, booster
- X6 - business investment expenditures per one working age person, booster

X7 - national economy entities per one thousand working age citizens, booster

X8 - employment rate – employed/number of working age people *100, %, booster.

Values of variables portraying the labour market situation of individual voivodeships of Poland in 2016 have been presented in Table 1.

Table 1 **Values of variables portraying the labour market situation of individual Voivodeships of Poland in 2016** (source: developed by the authors on the basis of the Local Data Bank of the Central Statistical Office of Poland)

Voivodeship	X1	X2	X3	X4	X5	X6	X7	X8
Dolnoslaskie	36.7	11	7.2	102.2	160	8 477	200.7	40.6%
Kujawsko-pomorskie	41.9	20	12	85.6	124	4 104	149.8	34.2%
Lubelskie	45.4	34	10.3	88.9	109	2 915	132.4	27.7%
Lubuskie	33.1	10	8.6	87.1	147	5 695	176.0	34.4%
Lodzkie	43.1	19	8.5	91.5	135	6 111	161.2	37.3%
Malopolskie	39.9	17	6.6	95.0	155	5 087	177.0	35.5%
Mazowieckie	45.4	21	7	122.1	208	10 445	241.8	46.5%
Opolskie	37.3	10	9	91.5	100	10 368	159.7	32.3%
Podkarpackie	45.2	35	11.5	85.2	107	4 135	125.4	31.3%
Podlaskie	46.0	36	10.3	87.8	109	3 380	134.3	28.3%
Pomorskie	35.6	11	7.1	99.6	180	6 002	201.1	36.8%
Slaskie	37.9	11	6.6	100.1	123	7 085	165.7	41.0%
Swietokrzyskie	37.7	29	10.8	85.5	118	2 639	144.0	29.1%
Warminsko-mazurskie	38.9	30	14.2	84.4	114	3 286	137.0	29.6%
Wielkopolskie	35.0	11	4.9	90.8	156	6 905	192.2	41.7%
Zachodniopomorskie	36.5	14	10.9	92.0	167	3 871	207.7	30.8%

The subsequent stage of analysis consisted of a statistical verification of the set of characteristics of voivodeships. The concept of the statistical criterion for the selection of diagnostic variables mainly came down to the elimination of variables having a low level of diagnosticity.

The values of variation coefficients are presented in Table 2.

Since the values of their coefficients of variation are greater than 10 %, all the indicators selected for analysis are characterized by high discrimination ability.

In the selection of variables, the correlation analysis was omitted. In the theory of multidimensional comparative analysis, there are opinions about not rejecting diagnostic features even strongly correlated with each other, as soon as their substantive value is high (Pociecha, 1996). Therefore, the selection of comparative criteria will be mainly determined by substantive factors.

Table 2 **The values of variation coefficients** (source: own study)

Statistics	X1	X2	X3	X4	X5	X6	X7	X8
Standard deviation	4.22	9.79	2.48	9.54	30.83	2485.6	32.76	0.05
Arithmetic mean	39.7	19.9	9.1	93.1	138.3	5 656.6	169.1	0.3
Variation coefficients	10.6%	49.1%	27.2%	10.2%	22.3%	43.9%	19.4%	15.8%

In the next part of the study, a comparative analysis of voivodeships was made. The choice of methods for research was determined by their popularity and access to the research tool – Statistica 13.1 software.

In order to classify Polish voivodeships in regard to their labour market situation cluster methods – agglomerative Ward's and k-means methods - were used.

To identify voivodeships whose labour market situations were similar, we first completed the standardization of indicators selected for the research study and then clustered them utilizing Ward's method and the Euclidian distance method. As a result of this classification, voivodeships were divided into three groups that were different but which contained regions with similar labour market situations (Figure 1).

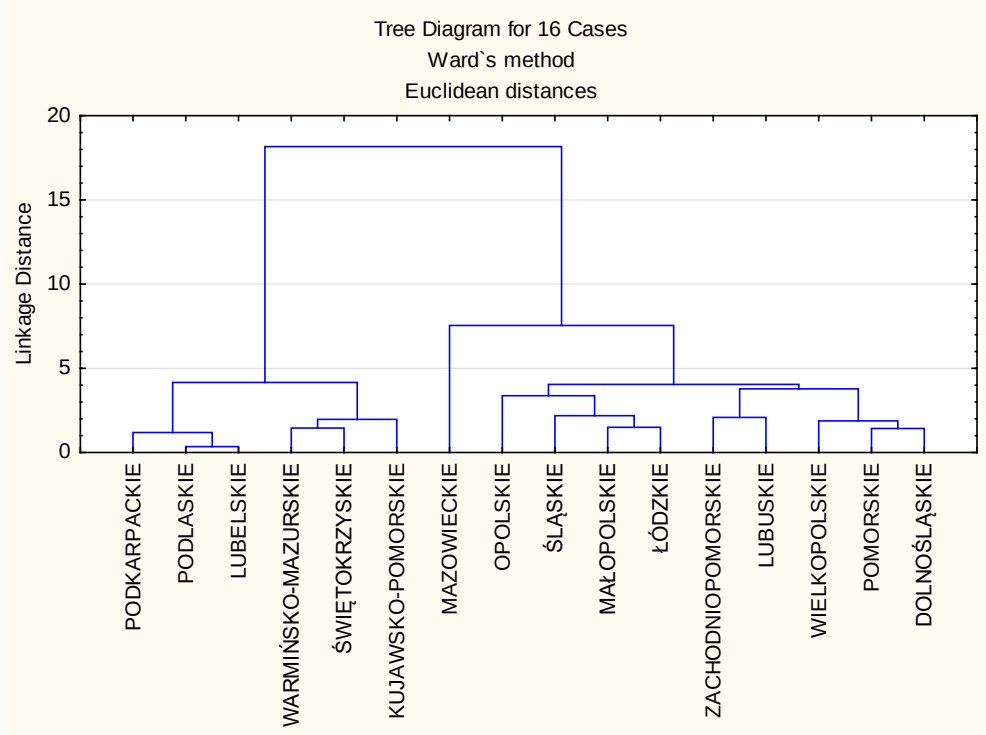

Figure 1. **Classification of Polish voivodeships in regard to their labour market situation** (source: developed by the authors using the STATISTICA 13.1 software)

One of the groups thus formed contains the Podkarpackie, Podlaskie, Lubelskie, Warminsko-Mazurskie, Swietokrzyskie and Kujawsko-Pomorskie voivodeships. Another group – the most numerous one in regard to having similar diagnostic characteristics describing their situation in the labour market – includes the Opolskie, Slaskie, Malopolskie, Lodzkie, Zachodniopomorskie, Lubuskie, Wielkopolskie, Pomorskie and Dolnoslaskie voivodeships. The third set consists of only one voivodeship – Mazowieckie. Additionally, through a detailed analysis of the tree diagram, it is possible to identify voivodeships or groups of them which are the most similar. A comparable labour market situation can be seen in the following pairings of voivodeships: Podlaskie and Lubelskie, Swietokrzyskie and Warminsko-Mazurskie, Malopolskie and Lodzkie, Zachodniopomorskie and Lubuskie as well as Pomorskie and Dolnoslaskie.

To characterize the individual groups of regions (voivodeships), a different classification method, the k-mean method, was used. The calculations resulted in the same distribution of objects as that obtained through the use of Ward's agglomeration method. Elements of resulting clusters are presented in Table 3.

Table 3 **Voivodeships of Poland divided into clusters obtained through the use of the k-means** (source: developed by the authors using the STATISTICA 13.1 software)

Number of cluster	Cluster elements	Distance from the centre of cluster
No. 1	Kujawsko-pomorskie	0.521376
	Lubelskie	0.380413
	Podkarpackie	0.342876
	Podlaskie	0.414290
	Swietokrzyskie	0.448981
	Warminsko-mazurskie	0.495535
No. 2	Dolnoslaskie	0.536780
	Lubuskie	0.517473
	Lodzkie	0.628684
	Małopolskie	0.411740
	Opolskie	0.879356
	Pomorskie	0.509172
	Slaskie	0.516936
	Wielkopolskie	0.587902
	Zachodniopomorskie	0.805285
No 3	Mazowieckie	0.000000

To compare voivodeships within each cluster as well as to visually identify differences of mean values of indicators being considered between clusters and subsequently determine features characteristic to individual groups of regions, a linear graph of means for clusters, presented in Figure 2, has been developed.

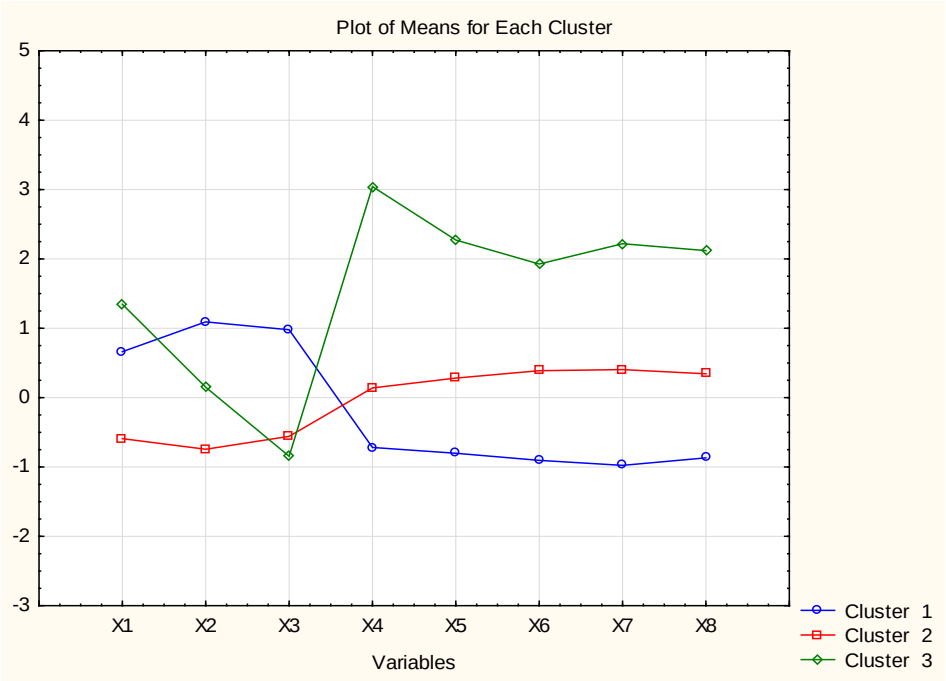

Figure 2. **Means graph for individual clusters** (source: developed by the authors using the STATISTICA 13.1 software)

The diagram shows that voivodeships from cluster 1 have the worst labour market situations. Cluster 2 includes voivodeships whose selected indicator values indicate an average labour market situation. The Mazowieckie voivodeship, the sole element of cluster number 3, stands out in comparison to other voivodeships. Only in regard to people registered as unemployed for a period longer than one year (X1) as well as in respect to the average monthly number of people registered as unemployed per job offer (X2) it does show unfavourable values in comparison to the other administrative units of Poland.

During the next stage of the spatial variation analysis of regions of Poland in regard to their labour market situations, a ranking of voivodeship capitals was created. Its structure was based on X1-X8 variables used in the classification of voivodeships. Values of the diagnostic characteristics used in the construction of this ranking are presented in Table 4.

Table 4 **Values of variables reflecting the labour market situation of Polish voivodeship capitals in 2016** (source: developed by the author on the basis of the Local Data Bank of the Central Statistical Office of Poland)

City	X1	X2	X3	X4	X5	X6	X7	X8
Wroclaw	38.9	5	2.7	111.9	265	12 167	299.9	66,7%
Bydgoszcz	35.1	9	4.8	92.1	156	5 877	200.9	55,0%
Torun	36.2	13	6.1	97.2	180	5 090	210.0	48,9%
Lublin	49.5	32	7.2	97.2	188	6 354	214.8	55,7%
Gorzow Wielkopolski	23.3	8	3.9	85.5	178	9 566	236.8	50,5%
Zielona Gora	29.2	4	4.6	91.4	206	7 018	249.4	50,4%
Lodz	49.7	18	7.9	98.6	186	6 587	225.9	54,9%
Krakow	45.0	9	3.5	108.0	251	9 425	287.4	67,1%
Warszawa	43.7	10	2.6	133.8	364	19 304	404.3	83,5%
Opole	37.0	3	4.9	102.0	182	8 098	287.0	70,7%
Rzeszow	54.4	15	6.6	100.7	197	8 093	226.2	70,1%
Bialystok	47.5	37	8.9	92.5	159	3 747	186.4	43,5%
Gdansk	36.6	9	3.5	119.3	238	13 585	270.7	56,5%
Katowice	39.9	8	2.8	122.9	195	9 847	260.8	86,7%
Kielce	43.7	26	7.6	91.4	176	5 511	242.9	59,9%
Olsztyn	33.6	20	5.1	99.2	168	6 118	216.7	57,3%
Poznan	32.3	8	1.9	111.2	270	11 264	338.5	72,1%
Szczecin	34.2	9	4.7	105.8	227	5 001	279.9	43,4%

The Hellwig method was used to compile the ranking of cities. Based on an array of standardized diagnostic characteristics, the coordinates of a standard unit were established using the formula: $z_{oj} = \max_i\{z_{ij}\}$ for boosters and $z_{oj} = \min_i\{z_{ij}\}$ for inhibitors where $i = 1, \ldots, n$, $j = 1, \ldots, m$. Then, using the Euclidian metric $d_{i0} = \left[\sum_{j=1}^{m}\left(z_{ij} - z_{0j}\right)^2\right]^{0,5}$, $i = 1, \ldots, n$, distances of every region from the standard were calculated. After assigning synthetic measures defined as (Panek, 2009): $s_i = 1 - \frac{d_{i0}}{\bar{d}_0 + 2S(d_0)}$, where:

$$\bar{d}_0 = \frac{1}{n}\sum_{i=1}^{n} d_{i0},\ S(d_0) = \left[\frac{1}{n}\sum_{i=1}^{n}\left(d_{i0} - \bar{d}_0\right)^2\right]^{0,5}$$

a list ranking the cities was created.

The results of the ranking of voivodeship capitals in regard to their labour market situations are presented in Table 5.

Table 5 **Ranking of voivodeship capital cities in respect to the labour market situation** (source: own study)

Position on the ranking list	City	Voivodeship	The value of a synthetic variable
1	Warszawa	Mazowieckie	0.746849
2	Poznan	Wielkopolskie	0.628588
3	Wroclaw	Dolnoslaskie	0.569431
4	Gdansk	Pomorskie	0.523351
5	Katowice	Slaskie	0.484786
6	Krakow	Malopolskie	0.46947
7	Opole	Opolskie	0.407485
8	Szczecin	Zachodniopomorskie	0.345421
9	Zielona Gora	Lubuskie	0.327909
10	Gorzow Wielkopolski	Lubuskie	0.306023
11	Olsztyn	Warminsko-mazurskie	0.272795
12	Rzeszow	Podkarpackie	0.26103
13	Bydgoszcz	Kujawsko-pomorskie	0.235099
14	Torun	Kujawsko-pomorskie	0.234099
15	Lodz	Lodzkie	0.205872
16	Kielce	Swietokrzyskie	0.198642
17	Lublin	Lubelskie	0.169395
18	Bialystok	Podlaskie	0.027803

The ranking of voivodeship capital cities is topped by Warsaw which stood out on account of its significant economic potential. The municipalities around Warsaw create the largest local labour market in Poland (Gruchociak, 2015). Highly ranked in regard to their labour market situation are such cities as: Poznan, Wroclaw, Gdansk or Katowice. These cities distinguish themselves from the others through their high development of entrepreneurship determining high demand for employees. Kielce, Lublin and Bialystok occupied the lowest places on the list proclaiming their weakest labour market situation in comparison to the capitals of other provinces.

The lowest indicator for Bialystok is worrying because the provincial city is the only major centre of the Podlaskie voivodeship (Gruchociak, 2015). At the same time the position of Podlaskie province in the weakest cluster but not on the last position testifies to the importance of other centres (smaller cities) for the development of the local labour market.

Conclusions

Local diagnosis of the labour market is extremely important (Słomińska, 2009). The example of Poland proves that regional labour markets are diverse.

The conducted analysis allowed for identification of three clusters of voivodships in terms of the situation in the local labour market. One of the clusters covers only the Mazowieckie voivodeship, which is characterized by the best situation in the labour market in terms of almost all criteria included in the analysis (which is largely influenced by the specificity of the city of Warsaw as the capital of the region and at the same time the capital of the country). The second cluster includes voivodships with the lowest labour market rates. These are mainly regions located in north-eastern and eastern Poland. The remaining voivodeships were qualified to the third cluster. They are characterized by a moderate situation in the labour market.

The diversity of the needs of local labour markets signals the necessity for decentralization of the labour market policy. Local authorities will be able to identify the causes of the existing situation on the labour market as well as to adjust actions to improve it. The existence of clusters among Polish voivodships points to the possibility of exchanging good practices and experiences among regions characterized by a comparative potential on the labour market.

As a part of the further research procedure, it is preferable to deepen the analysis of the local labour market in Poland at the level of poviats and municipalities to analyse labour market diversity not only at the national level, but also at the level of individual voivodships.

Based on the conducted taxonomic analysis, it can be concluded that the position of voivodeship labour markets in Poland is significantly determined by the economic potential of its centres – capital cities. Voivodships with the best situation in the labour market are characterized by having economically strong capitals, while voivodships located lowest in the ranking have capitals whose situation is relatively worse. It is recommended, following the Perroux concept, to develop existing growth poles (capital cities) or to create the new ones (smaller cities with strategic importance for the local labour market).

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