A C T A U N I V E R S I T A T I S L O D Z I E N S I S
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THE ATTRACTIVENESS OF LOCAL LABOUR MARKETS AND THE DIVERSITY OF DEVELOPMENT LEVELS - THE CASE OF WEST POMERANIA REGION

1. INTRODUCTION

Several studies on European labour markets show significant dependence of attractiveness of different places in area of several factors. One of the main factors is position in transportation network and distribution in organized space of activities which may attract citizens.

To investigate the scale of movement between cities in West Pomerania Region the model of intervening opportunities was used. The size of modelled movements depends on position in transportation network on magnitude and distribution of development and on the value of selectivity parameter which shows the preferences of citizens. The model takes into account the negative influence of distance to intensiveness of contacts.

On the other hand many studies look for the spatial dependence between several factors which may describe the level of cities and regions development. These investigations use Moran's *I* statistic to detect spatial autocorrelation. The processes like high and low unemployment or distribution of goods in space have tendency to cluster (Overman, Puga 2000; Niebuhr 2003; Suchecki 2010). This situation is the reason of polarization processes which take place in contemporary Europe. In last 25 years in Poland took place deep changes of labor market as the result of the transformation in Polish economy and the integration process with the European Union.

The paper presents an analysis of spatial relationships among different variables connected with labor market, unemployment and attraction of different places in the space of Westpomerania Region. The attractions are in this case treated like a number of work places. Flows between chosen places in regional space were calculated with the use of intervening

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opportunities model and spatial analysis was made by means of GeoDa software (Anselin 2005). The source of statistical data is GUS (Central Statistical Office – Local Data Bank) and Statistical Yearbook of West Pomerania Region 2013.

2. SHORT CHARACTERISTIC OF WEST POMERANIA REGION

The area of West Pomerania Region is characterized by specific features, resulting from its position in geographical space. The regional capital Szczecin is located at the mouth of the Oder River, near the Polish-German border, and in the close vicinity of the well-developed Nordic countries. It's location on the outskirts of the region creates special conditions for development. West Pomerania Region covers an area of 22 892 km^2 and has a population of above 1.72 million. Substantial remoteness of most cities from the capital of the region and inadequate network of connections on the North-South direction makes difficult to use a beneficial effect on the resources of the bigger development centers like Szczecin and Koszalin.

Most of cities in Region's area there are a small city, with a population of less than 5 thousand inhabitants. The area is one of the least populated areas in Poland, with a population density of 75 persons per sq. km and occupies the 13th place, with the national average of 122 people per km^2. The settlement network of the region in spite of the degree of concentration (one urban unit on 375 km^2, while in Poland for about 370 km^2) is highly diverse in terms of size of cities and their location within the province.

In the space of West Pomerania Region there are four subregions that differ in the size of the occupied area, the number of cities and functional specialisation (*Strategia Rozwoju Województwa Zachodniopomorskiego…*, Szymańska 2009; Chądzyńska 2013). The economy of the region, with such major sector services, industry, tourism and sea transport, generates 4% of the GNP. The level of socio-economic development varies in the region; it is the largest in the agglomeration of Szczecin and on the Baltic coast and lowest in the central part of the region.

3. FLOW MODELING

The method applied in this part uses the communication models of traffic exchange based on the idea of intervening opportunities. These models, derived from the classic version of the Schneider's model (*Chicago Area Transportation* Study 1960) were developed by T. Zipser with research team (Zipser, Sławski 1988; Zipser 1990). The model uses only one parameter – named selectivity which reflects spatial preferences of travelers – the tendency for longer or shorter trips. In this research the version of traffic exchange model with reversing of surplus was used. Schneider's hypothesis assumes that the number of trips between the source area (the starting point) and the destination area (the ending points) depends not only on the destination potential of the latter but also on the number of destinations located between the areas considered, i.e. on the intervening opportunities. In result only a fraction of the trip can reach the area concerned. The notation of the model is:

$$T_{ij} = z_i * P_{ij} \quad \text{for} \quad i, j = 1,2,\ldots,n, \tag{1}$$

where: z_i – the value of the original potential in unit numbered i, P_{ij} – the probability that a journey starting in unit i is terminated in the zone containing the target numbered j.

The final formula takes the following form:

$$T_{ij} = z_i * \left[e^{-sa} - e^{-s(a+a_j)} \right] , \tag{2}$$

where: e – base of natural logarithm, s – travel selectivity, a – number of destinations closer to the origin than the zone numbered j which contains target region, a_j – number of destinations in zone j.

The Model examines the journey time between all pairs of units and, on this basis, specifies distances (Zipser, Sławski 1988; Mynarski 1992). The length of trip is equal the number of not accepted opportunities which are located between origin and destination unit. In the end concentrations of trips are created in those places which attract a lot of people.

The model was applied to the area of West Pomerania Region with the provincial and national road network. Selected cities were treated as centers of spatial units. For trips to work the origin potentials means the number of professionally active inhabitants in spatial units and destinations

– the number of work places located in these units.[1] Model mechanism works on the principle of strengthening these units which offer a lot of occasions. An additional advantage for units is location in transportation network what ensures a quick connection to the other units. The number of arrives (trips to work) to the considered cities in West Pomerania Region shows Figure 1.

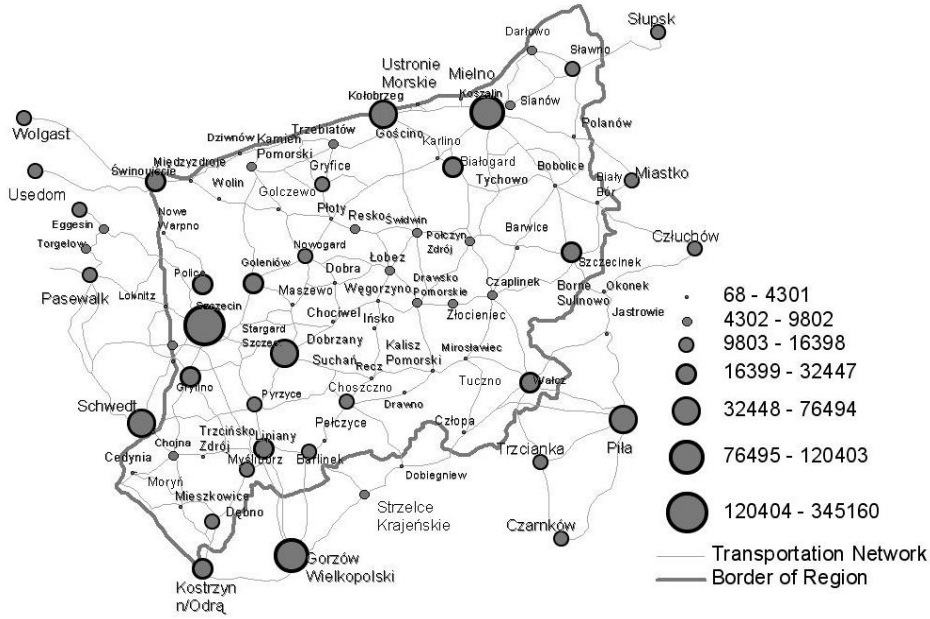

Figure 1. Trips to work in West Pomerania Region (town and cities 2011)

Source: own elaboration based on GUS data and model of intervening opportunities.

We can see that attractiveness of cities in West Pomerania Region as places of jobs is significantly differentiated. The number of trips to each city shows the force of city attraction. This result represents a balance of spatial system. The ratio of destinations (work places) to the number of trips also shows deficiencies in areas where trips far exceeds the number of destinations. For example in Szczecin modeled number of trips is equal 73% destinations, in Koszalin – 139%, Kołobrzeg 13% and Świnoujście – 20%. The most number of trips in comparing with destinations took place in Łobez, Sianów, Pyrzyce and Sławno – more than 300%. Number of travel much more than potential in a single city testifies to the need for greater than existing potential.

The result of modeling also points to the strong dependence of the attractiveness on the position in transportation network. The biggest majority of trips to work on destinations are noticed in central part of the region. Many

[1] Because of lack of data the number of employed persons is applied.

researchers highlight the fact of absence of medium-sized cities in the central part of the province, which could impact positively on the development of neighbouring municipalities (Swianiewicz, Dziemianowicz 1999; Szymańska 2009; Chądzyńska 2013).

4. LEVEL OF DEVELOPMENT

In described earlier model the potentials was located in cities treated like points in spatial system. Because the level of development in cities should be compared with the situation in their environment, than the municipalities of West Pomerania Region has been taken into account. To analyse the attraction of labour markets in them following variables was taken into account: the number of working people (*W*), people working in agriculture (*W_AG*), industry (*W_IN*) and services (*W_SER*) and the number of entities of national economy recorded in REGON register (*ENT*). Data set was for 2003 and 2012.

In the mentioned period the number of entities increased (in considered cities) by 7.14%. Cities with increase of the variable were noticed as a points lying above line. The highest growth was noticed in two municipalities near Szczecin: Dobra (Szczecińska) – 134.11% and Kołbaskowo – 62.69%. The growth was also noticed in some little cities located in south-western part of the region. In Szczecin it was a little growth – about 4%. In four cities decline was recorded (Człopa – 32.1%, Nowe Warpno – 14.8%, Wałcz – 9.4% and Gryfino – 7.7%).

In the first part of statistical analysis the set of cities, which was used in modelling of trips to work was taken into consideration. Scatter plot for the number of all work places, show that in period 2003–2012 significant growth was recorded in Czaplinek (91%) and Wolin (94.9%). The decline of work places was characteristic for small cities located in southern-west and in central part of the region. Scatter plots for the number of working in agriculture, in industry and services shows that the biggest growth appears in Wolin and Resko (Figure 2).

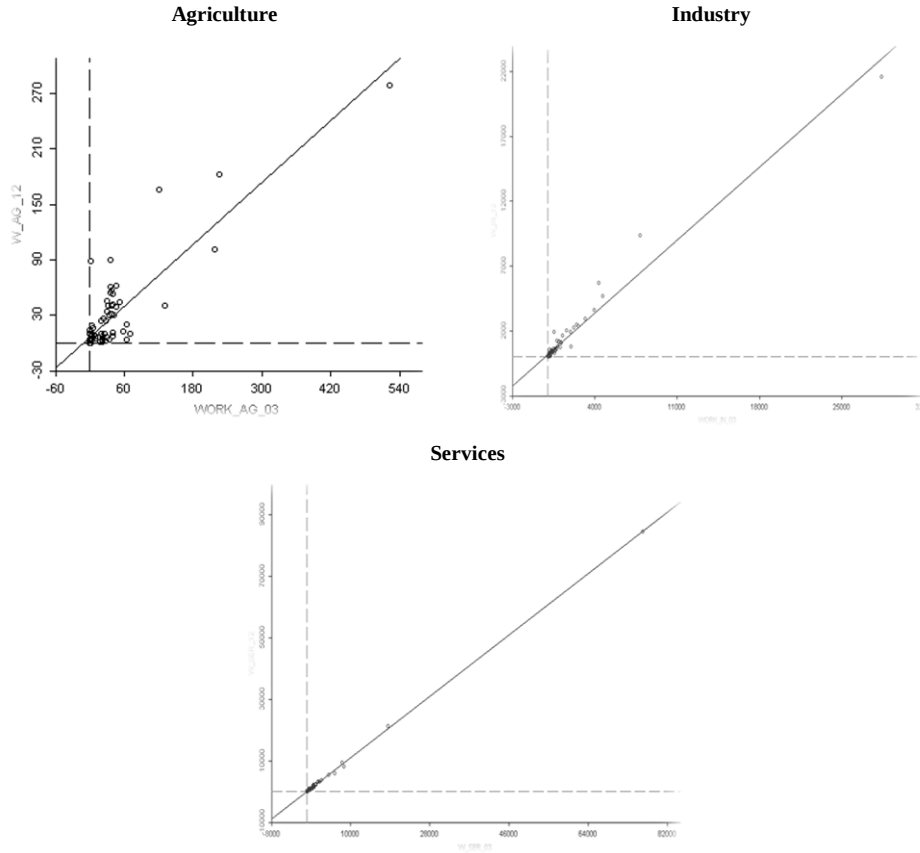

Figure 2. Scatter plots for jobs in three sectors. West Pomerania Region (cities)

Source: own elaboration by using GeoDa.

The most variety and spread character show jobs in agriculture. Generally the number of jobs in agriculture has decreased (in scale of region – 32.8%) but there are cities which note the increase and it does not be connected with a good kind of soil (Wolin, Darłowo, Karlino).

In cities of West Pomerania the employment in industry has decreased by 1.6% and in services has increased by 11.9%.

Changes in economy have effected on labour market especially in small mono-functional towns. In the area of West Pomerania there are large fluctuations in number of jobs and unemployment people and in the level of economic development.

5. THE ANALYSE FOR MUNICIPALITIES (NUTS 5)

Mathematical models of flow are used mainly to the analysis of migration, to find the optimal place of work or place to live etc. The main issue here is to describe the manner in which people make a choice between a numbers of "*opportunities*" in the area. The modelling of trips showed the diversity of cities in West Pomerania Region treated like places of work.

A method that gives a more complete picture of spatial dependencies in local space is spatial autocorrelation between territorial entities.

The Tobler's law (1970) tells that the force of contacts between units in space is stronger between units that are located nearby then these which are distant from each other. In other words the distance has negative influence on contacts. Next the method of statistical autocorrelation was used to determine the diversity of West Pomerania municipalities. It is known that spatial data at different scales give different results. In this reason for next analyse the smaller units of observation – municipallities (gminas NUTS 5) were taken into account. The spatial autocorrelation analysis is handled by means of Moran's I statistics (Moran 1950) and is the method which describes dependency between values of a variable in neighbouring locations. It requires creating a weight matrix describing a local neighbourhood of each considered, located in space unit. Most frequently is using binary connectivity which based on contiguity: w_{ij}=1 if units i and j are adjacent and w_{ij}=0 otherwise. The statistics I based on cross-products of the deviations from the mean and is calculated for observations on a variable X at n locations:

$$I = \frac{n}{S_0} \frac{\sum_i \sum_j w_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\sum_i (x_i - \bar{x})^2}, \tag{3}$$

where: $\bar{x}$ is the mean of the X variable, w_{ij} are the elements of the weight matrix **W**, i,j are number of units and S_0 is the sum of the elements of the weight matrix $S_0 = \sum_i \sum_j w_{ij}$ for $(i, j = 1, 2, ..., n)$.

The Moran's statistics I is a single value which varies from [-1, 1]. High positive spatial autocorrelation means clustered pattern, and high negative spatial autocorrelation – dispersed pattern of units. The value close to 0 means a random arrangement. It is interpreted as the correlation between variable X and the "*spatially lagged*" of X formed by averaging all the values of X for the neighbouring units. At the Moran scatter plot the variable X is on the x-axis and the spatially lagged on the y-axis. Because of standardization of

variables the units in the graph correspond to standard deviation. The slope of the regression line equals the Moran's *I* statistics.

In the next part of analyse the Moran's *I* statistics were calculated for following variables: population (*POP*), population of working age (*W_AGE*), density of population (*POP_DEN*), Webb's type of demography (*WEB_D*), rate of unemployment (*UNEMP*), number of jobs (*JOBS*), number of registered entities (*ENT*), revenue per capita (*INCOM*) and attraction of labour market as number of people coming to work from other municipalities divided by the number of inhabitants working outside their own commune (*ATTR*). All data related to 2012 despite of attraction which is for 2006 (Table 1). Inference for Moran's *I* was based on a permutation approach. A reference distribution was calculated for spatially random layouts with the same value as observed. The number of permutation was 499. The wages matrix was constructed using contiguity to municipalities' boundaries (the first order "*rook*" and "*queen*" contiguity, and 4-nearest neighbours).

Table 1. West Pomerania. Moran's *I* statistics for municipalities

Matrix W	***POP***	***POP_DEN***	***W_AGE***	***WEB_T***	***UNEMP***
rook	-0.0312	-0.0773	-0.029	-0.1334	-0.0646
p-value	0.025	0.02	0.027	0.035	0.025
queen	0.0252	-0.0286	0.0292	0.0364	-0.0117
p-value	0.105	0.0395	0.115	0.02	0.465
4*nn*	-0.0022	-0.0621	0.0004	**0.1483** **0.01**	-0.0377

Matrix W	***JOBS***	***ENT***	***INCOM***	***ATTR***
rook	-0.0291	-0.007	**0.1588**	-0.0579
p-value	0.028	0.31	**0.005**	0.023
queen	0.0269	0.0309	0.141	-0.0082
p-value	0.078	0.085	0.015	0.49
4*nn*	0.0028	0.0111	**0.1667** **0.005**	-0.0043

Source: own calculation based on GUS data and by using GeoDa.

The Moran's *I* statistics is statistically significant at the 0.01 level only for the revenue per capita (0.1667) and Webb's type of municipality (0.1483). For these variables take place positive autocorrelation – Figure 3.

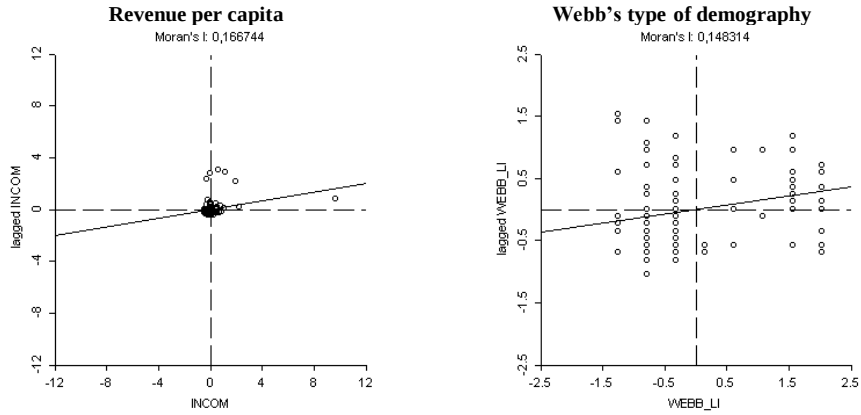

Figure 3. Moran scatter plots. West Pomerania (NUTS 5)

Source: own elaboration by using GeoDa.

In order to identify spatial layouts shall be used indicators of local spatial dependencies. Commonly used method called *LISA* (*Local Identicator of Spatial Association*) was proposed by Anselin (1995). For each unit *i* the value of indicator was calculated according to formula:

$$I_i = z_i \sum_j w_{ij} z_j \,, \tag{4}$$

where: z_i is the standardized form of original variable x_i, w_{ij} is the element of the spatial weight matrix and *j* describes neighbours of unit *i*.

This measure can be used to identify local clusters or outliers – units different from their neighbours and units without statistical significance. To illustrate the local spatial autocorrelation *LISA* cluster map was created. To determine *LISA* the weight based on 4 nearest neighbours was taken into account. This map shows a statistically significant relationship with neighbours and four types of spatial autocorrelation. The positive spatial association takes place when units with high value are surrounded by ones with high value (type high-high, *H-H*) or units with low values have the neighbours with low values (type low-low, *L-L*). The negative value of autocorrelation means that units are different from their neighbours (type high-low, *H-L* or low-high, *L-H*).

In Figure 4 we can see that clusters with high positive spatial association include three neighbouring municipalities of Szczecin Agglomeration – Świnoujście, Nowe Warpno and Stepnica and one isolated Trzebiatów commune (type *H-H*). The municipalities with the lowest budget create cluster in southern west part of the region – Nowogródek Pomorski, Przelewice and Warnice (type *L-L*). The same type includes the area around Wałcz.

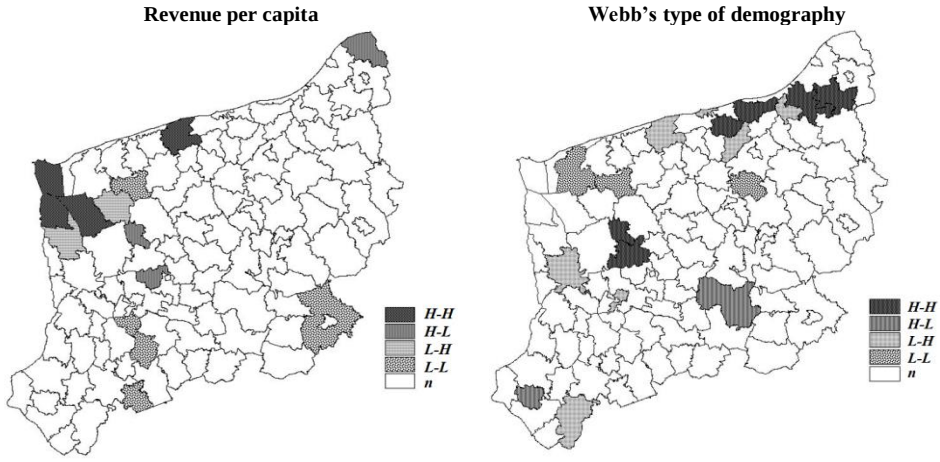

Figure 4. *LISA* cluster maps (West Pomerania Region)

Source: own elaboration by using GeoDa.

The type of demography is important characteristic for development of investigated territory. In the light of this factor in West Pomerania Region there are three clusters of municipalities with positive autocorrelation: Malechowo, Sianów and Będzino, Dygowo in northern – east part of the region and Osina, Maszewo in the east of Szczecin (Figure 4). The low value of local autocorrelation takes place in Wolin and Golczewo (the northern west part of region) and Rąbino.

The higher value of Moran's *I* statistics was received for entities registered in REGON per 1 000 citizens. The wages matrix was constructed using the first order "*rook*" and "*queen*" contiguity, and 6-nearest neighbours (Table 2).

Table 2. West Pomerania. Moran's *I* statistics for entities in 2009 and 2012

Matrix W	***ENT_09***	***ENT_12***
rook	**0.2374**	**0.2376**
p-value	**0.0050**	**0.0060**
queen	0.2373	0.2367
p-value	0.0040	0.0020
6*nn*	0.2083	0.2054
p-value	0.0020	0.0040

Source: own calculation based on GUS data and by using GeoDa.

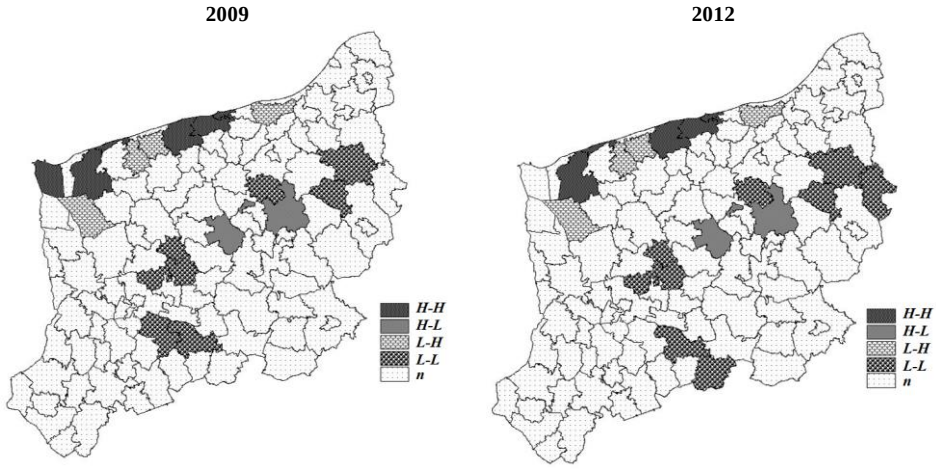

Figure 5. *LISA* cluster maps for entities per 1 000 citizens

Note: weight matrix: "*rook*".

Source: own elaboration by using GeoDa.

The *LISA* map for the entities per 1000 citizens shows two groups of high values in northern part of region. There are high developed municipalities: Świnoujście, Wolin, Dziwnów and a second group Trzebiatów and Kołobrzeg. Four groups of low values are located in east (Bobolice, Rąbino and Grzmiąca), central (Chociwel, Dobra and Stara Dąbrowa) and southern (Bierzwnik, Choszczno) part of region. Between year 2009 and 2012 there are a few differences in spatial patterns. Świnoujście turns from high value to no significant and Biały Bór joined to group of low values (Figure 5).

6. CONCLUSIONS

In this paper it was presented two different methods of analyse of development level and attraction of labour markets in West Pomerania Region. First method based on intervening opportunities model and gave possibility to observe attraction of cities as places of work. In the area of region there are a lot of small cities (especially in central part of region) in which modelled trips overlap existent destinations. These cities are located far from main cities in the region and have any possibility to make use of their labour markets. In cities located at the sea shore could be observed deficiency of trips. This situation may be caused by weak diverse of labour markets in them (mainly

touristic services and fishing). The main cities in region like Szczecin and Koszalin have more balanced situation.

Then division of West Pomerania Region into municipalities (NUTS 5) was taken into account. Among different variables connected with labour market and development were chosen four of them with statistically significant Moran's *I* statistics. For them LISA cluster maps were created. The bigger clusters contained not more than three municipalities. For entities of national economy more developed municipalities form clusters in the north end northern west part of region. Areas with lower values form clusters in central, east and southern part of region. Higher values are characteristic for municipalities located in Agglomeration of Szczecin and in neighbour of Kołobrzeg. High values of Webb's type (good demographic situation) occur in municipalities to the east and west of Koszalin to form a band. Clusters of higher values of all analyzed variables are located in northern and northern west part of region.

In conclusion we can say that the spatial patterns do not form a close-knit group but are rather scattered. This fact shows a little consistency of the tested area.

REFERENCES

Anselin L. (1988), *Spatial Econometrics: Methods and Models,* Kluwer Academic Publishers, Dordrecht.

Anselin L. (1995), *Local Indicators of Spatial Association – LISA, "*Geographical Analysis", 27: pp. 93-115.

Anselin L. (2005), *Exploring Spatial Data with GeoDa™: A Workbook*, Center for Spatially Integrated Social Science, Urbana, IL.

Central Statistics Office of Poland, *Local Data Bank*, (http://www.stat.gov.pl).

Chądzyńska E. (2013), *Zróżnicowanie rozwoju funkcjonalnego małych miast województwa zachodniopomorskiego,* (in:) Heffner K., Twardzik M. (eds.), *Nowoczesne instrumenty polityki rozwoju lokalnego – zastosowania i efekty w małych miastach,* Zeszyty Naukowe Wydziałowe Uniwersytetu Ekonomicznego w Katowicach, Zeszyt 144

Chicago Area Transportation Study (1960), Final Report, Vol. 2.

Moran P. A. P (1950), *Notes on Continuous Stochastic Phenomena,* "Biometrica", 37, pp. 17-23.

Mynarski S. (ed.) (1992), *Badania przestrzenne rynku i konsumpcji*, Przewodnik metodyczny, PWN, Warszawa.

Niebuhr A. (2003), *Spatial Interaction and Regional Unemployment in Europe*, "European Journal of Spatial Development", http://www.nordregio.se/EJSD/

Overman H. G., Puga D. (2000), *Unemployment clusters across European Regions and Countries Centre for Economic Performance*, Discussion Paper 434.

Strategia Rozwoju Województwa Zachodniopomorskiego do roku 2020, http://www.kiph.com.pl/sgd/wazne_ informacje/strategia-zach.pdf.

Suchecki B. (2010), *Ekonometria Przestrzenna. Metody i modele analizy danych przestrzennych*, Wydawnictwo C.H. Beck, Warszawa.

Swianiewicz P., Dziemianowicz W. (1999), *Ranking atrakcyjności inwestycyjnej miast Polski – refleksje po czterech edycjach badań,* "Prace i Studia Geograficzne", T. 35, Warszawa.

Szymańska W. (2009), *Specjalizacja lokalnej działalności gospodarczej miast Pomorza,* "Słupskie Prace Geograficzne", no 6.

Tobler W. (1970), *A Computer Movie Simulating Urban Growth in the Detroit Region*, "Economic Geography", 46 (2), pp. 234-240.

Województwo Zachodniopomorskie. Podregiony. Powiaty. Gminy (2013), Urząd Statystyczny w Szczecinie, Szczecin.

Zipser T. (1990), *The networks as derivatives of concentration process*, (in:) Bagiński E. (ed.), *The model of intervening opportunities in theory and practice of territorial arrangement*, "Prace Naukowe Instytutu Historii, Architektury, Sztuki i Techniki Politechniki Wrocławskiej no. 21, Studia i Materiały no. 10", Wydawnictwo Politechniki Wrocławskiej, Wrocław.

Zipser T., Sławski J. (1988), *Modele procesów urbanizacji. Teoria i jej wykorzystanie w praktyce planowania*, "Studia. PWE", tom XCVII.

ABSTRACT

Modern research methods of economic development of regions and cities pay special attention to the position of the units in the area expressed by geographical position, the distance between the tested individuals and neighbourhood, especially near places with significant economic potential. Modeling of spatial mobility of residents through the use of methods based on identifying the forces affecting positively and negatively on the movement of people in an organized space let us to find places attractive to a large number of citizens.

The article presents the use of intervening opportunities model in order to generate a distribution of travel to work and to determine the diversity of individual attractiveness due to the offer of jobs and position in transportation network. Modeling was made for the set of cities. Because situation in cities should be compared with situation in their environment occurrence of spatial relationships and clusters in gminas of West Pomerania region was detected by using Moran's *I* statistic. The analysis covers the area of West Pomerania and its surrounding. This is a specific area where the differentiation of the level of development is particularly dependent on the position in geographical space.

ATRAKCYJNOŚĆ LOKALNYCH RYNKÓW PRACY I ZRÓŻNICOWANIE POZIOMU ROZWOJU – PRZYKŁAD WOJEWÓDZTWA ZACHODNIOPOMORSKIEGO

ABSTRAKT

Współczesne metody badania rozwoju ekonomicznego miast i regionów zwracają szczególną uwagę na położenie badanych jednostek w przestrzeni wyrażane poprzez położenie geograficzne, odległość między badanymi jednostkami oraz sąsiedztwo, dzięki któremu korzystają obszary położone w pobliżu miejsc skupiających znaczny potencjał gospodarczy. Modelowanie przestrzennej mobilności mieszkańców dzięki zastosowaniu metod opartych na identyfikacji sił wpływających dodatnio i ujemnie na przemieszczenia osób w przestrzeni zagospodarowanej pozwala znajdować miejsca atrakcyjne dla dużej liczby mieszkańców.

Artykuł prezentuje zastosowanie modelu pośrednich możliwości do wygenerowania rozkładu podróży do pracy i określenia zróżnicowania atrakcyjności poszczególnych jednostek ze względu na ofertę miejsc pracy oraz położenie w sieci transportowej. Modelowanie wykonano dla zbioru miast. Ponieważ sytuację w miastach należy porównać z sytuacją w ich otoczeniu, zbadano występowanie przestrzennych relacji oraz rodzajów skupień dla gmin województwa zachodniopomorskiego stosując statystykę *I* Morana. Analiza obejmuje obszar województwa zachodniopomorskiego oraz jego otoczenia. Jest to specyficzny obszar, w którym zróżnicowanie poziomu rozwoju jest szczególnie uzależnione od położenia w przestrzeni geograficznej.