ANNALS OF THE POLISH ASSOCIATION OF AGRICULTURAL AND AGRIBUSINESS ECONOMISTS

received: 10.06.2019
acceptance: 10.07.2019
published: 20.09.2019
Annals PAAAE • 2019 • Vol. XXI • No. (3)

JEL codes: C21, H70, I30
DOI: 10.5604/01.3001.0013.2803

MARIUSZ MALINOWSKI

Poznań University of Life Sciences, Poland

THE FINANCIAL SITUATION AT A MUNICIPAL GOVERNMENT LEVEL VS. STANDARDS OF LIVING OF THE POPULATION IN THE WIELKOPOLSKIE VOIVODSHIP: A SPATIAL ANALYSIS

Key words: standard of living, linear ordering, spatial regression

ABSTRACT. The purpose of this paper is to identify the (spatial) relationships between the standards of living of the population and the financial capacity of municipalities, with particular focus on rural areas, based on 2017 data. The survey covered all of the 226 municipalities of the Wielkopolskie voivodship. As a result of the multidimensionality of economic categories covered by the analysis, this study used the TOPSIS method to assess the standards of living of the population and the financial capacity of municipalities. An analysis of spatial autocorrelation between the synthetic indicators was carried out based on Moran's *I* statistics (local and global) to identify the clusters of municipalities reporting a similar level of aspects covered by this study. A spatial regression analysis was carried out to assess the strength of spatial relationships between the synthetic indicators of the standards of living and the financial capacity of municipalities. A strong correlation exists between the synthetic indicators. Moreover, both the indicator of the standards of living in the municipalities considered and the indicator of the municipalities' financial capacity demonstrate a statistically significant spatial autocorrelation. The spatial autocorrelation model developed in this study takes account of the mean error in neighbouring locations to better explain the dependencies between these aspects than a traditional least-squares model.

INTRODUCTION

The financial capacity of local government units (LGUs) plays a particular role in creating the standards of living for the population. Adequate financial capacity is a prerequisite for the ability to meet the defined objectives and fulfill the tasks assigned by state authorities (including the quality of public services). Undeniably, certain human needs can only be addressed on an individual basis. However, certain needs are met with public resources (e.g. the need for security and order in the surroundings), through the direct or indirect activity of state authorities or LGU agencies.

Although the standards of living spark a lively public debate and are subject to numerous scientific research projects, their quantification and the identification of stimulating factors are problems yet to be fully solved. In this context, it is important to highlight the extensive taxonomic analysis of the standards of living of the EU population carried out by Aleksander Zeliaś et al. [2004], including the identification of groups of countries which are similar in that respect. Scientists who relied on taxonomic methods to measure the standards of living include Agnieszka Majka [2015] who used them to classify Polish voivodships, and Zhou Liang et al. [2017] who used the TOPSIS method to order the cities of the Guizhou province by standards of living of the local population. Although some papers exist that address the issue of LGU financing and the population's standards (or quality) of living (including Nikolaos Hlepas [2013], Bożena Oleszko-Kurzyna [2014], Ana Cárcaba et al. [2017]) or local development (including Joanna Dynowska, Emil Rudowicz [2007], Hanna Pondel [2017]), there is scarcity of empirical analyses that take spatial interactions between these phenomena into account. While researchers pay particular attention to stimulating factors, relatively little emphasis is placed on spatial interactions between these categories. This is all the more important since the standards of living in different LGUs evolve in line with the changing political, legal, economic or socio-cultural environment. It is also worth emphasizing that the standards of living in one LGU may affect how people live in a neighboring unit. Therefore, analyses based on spatial regression become increasingly important as they take spatial relationships between LGUs into consideration. The failure to take account of spatial interactions in the structure of econometric models may have an adverse impact on the estimation quality of the models' structural parameters.

Therefore, the purpose of this paper is to identify the relationships between synthetic indicators of the standard of living of the population and the financial capacity of LGUs in municipalities of the Wielkopolskie voivodship, taking spatial interactions into account. The TOPSIS method was used in order to determine the development level of aspects covered by this analysis. An analysis of spatial autocorrelation was carried out to determine the strength of spatial relationships between different municipalities in terms of standards of living and financial capacity. A spatial regression analysis (based on 2017 data) was also carried out. The study covered 226 municipalities (including 113 rural municipalities, 94 urban-rural municipalities and 19 urban municipalities).

MATERIAL AND METHODS OF STUDIES

In the first phase of this study, 24 potential diagnostic variables were proposed which refer to the population's standard of living and are divided into 6 thematic groups based on substantive criteria [cf. Zeliaś 2004, p. 27-28, Słaby 2007, p. 122]:

1) Labour market: X_1 – share of registered unemployed people in the working-age population, X_2 – share of long-term unemployed in the working-age population, X_3 – employed per 1,000 of the population,
2) Healthcare: X_4 – population served by 1 pharmacy, X_5 – outpatient clinics per 1,000 of the population, X_6 – total deaths per 100,000 of the population, X_7 – population growth rate per 1,000,
3) Environment: X_8 – illegal landfill sites per 100 km^2, X_9 – water consumption per capita, X_{10} – share of parks, greenways and housing estate greenery in the total area, X_{11} – industrial and municipal waste water which requires treatment and is discharged into water or soil per capita, X_{12} – total protected areas per 100 ha, X_{13} – share of the

population served by waste water treatment plants with enhanced biological nutrient removal in the total population,
4) Housing conditions: X_{14} – usable floor area per person, X_{15} – percentage of residents served by water supply networks, X_{16} – percentage of residents served by sewage systems, X_{17} – percentage of residents served by gas supply networks,
5) Culture: X_{18} – library members per 1,000, X_{19} – cinema seats per capita, X_{20} – community halls, centers and clubs per capita,
6) Education: X_{21} – number of children aged 3 to 5 per kindergarten seat, X_{22} – number of children attending nursery schools and related facilities per 1,000 children aged up to 3, X_{23} – number of students per class in primary schools, X_{24} – net enrollment rate for junior secondary schools.

A set of 11 variables referring to income and expenditure per capita was used to determine the financial capacity of municipalities:

I_1 – municipal budget income;
I_2 – municipalities' own income;
I_3 – EU funds granted to finance Union programmes and projects;
I_4 – total expenditure;
I_5 – education expenditure;
I_6 – culture and national heritage protection expenditure;
I_7 – atmosphere and climate protection expenditure;
I_8 – property-related expenditure;
I_9 – housing management expenditure;
I_{10} – healthcare expenditure;
I_{11} – transport and communications expenditure.

The choice of variables was determined by the availability of complete, up-to-date data for all objects. The variables covered by this study are ratios. The characteristics with a coefficient of variation below the critical threshold value of 10% (fixed arbitrarily) were eliminated from both sets of variables (and were found to be *quasi-constant*). As a consequence, considering the discriminatory capacity as a basic criterion for the selection of statistical variables, X_{15} (percentage of residents served by water supply networks) was eliminated [cf. Młodak 2006, Panek, Zwierzchowski 2013].

The inverse correlation matrix was used to assess the information value (for a broader description, see: Młodak 2006, Panek, Zwierzchowski 2013). This criterion resulted in eliminating I_4 and X_1. All variables related to the municipalities' financial capacity were found to have a stimulating effect. In turn, when it comes to variables referring to the population's standards of living, X_2, X_4, X_6, X_8, X_9, X_{11}, X_{21} and X_{23} were found to have an inhibiting effect. Other variables have a stimulating effect. With a view to ensure the comparability of characteristics expressed with different units and of different orders of magnitude, the standardization procedure was performed.

The classic TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution) method was used to linearly order the municipalities by standard of living and financial capacity. According to this method, the synthetic indicator is created based on the Euclidean distance both from the positive ideal solution (pattern) and from the negative ideal solution (anti-pattern). The smaller the distance from the positive ideal solution is (and the greater the distance from the negative ideal solution), the higher the value of the synthetic variable (for a broader description, see: Ching-Lai Hwang, Kwangsun Yoon [1981]).

The analysis of socio-economic events based on cross-sectional data should cover the impact of the spatial structure of objects (e.g. municipalities) on the phenomenon considered. This is because the spatial structure is usually impacted by specific factors, mostly historic, cultural or sociological in nature [Zeliaś 1991]. As a consequence, what is referred to as spatial autocorrelation may exist between neighbouring areas. In such analyses, a major problem is to define the neighbourhood structure expressed with the connectivity matrix. The approach used in this paper considers a shared border to be the proximity criterion [cf. Chen 2013, Dorman et al. 2007, Getis 2008].

The global Moran's I was used to analyze the interactions between the values of synthetic indicators of living standards and financial capacity at a municipality level and the corresponding values recorded in neighbouring municipalities [Chen 2013, Kopczewska 2007]:

$$I = \frac{1}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}} \cdot \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

where: x_i, x_j – values observed in locations i and j ($i, j = 1, 2, ..., n$), $\bar{x}$ – average value in all areas under consideration, w_{ij} – entries of the spatial weight matrix. An in-depth analysis can be carried out by calculating the local Moran's I:

$$I_{i(w)} = \frac{(x_i - \bar{x})\sum_{j=1}^{n} w_j^*(x_j - \bar{x})}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

A spatial regression analysis was carried out to assess the strength of spatial relationships between the synthetic indicators of the standards of living and the financial capacity of municipalities. Spatial models can be considered as an extension of "classical" econometric models supplemented with additional variables to address the spatial interactions. The presence of spatial relationships contributes to a change in the properties of structural parameters in models estimated with the least squares method. If spatial effects are identified, the spatial regression model is estimated in a manner to minimize their impact on the model's discriminatory capacity[1]. In the spatial regression models, in addition to spatial interactions in the form of autoregression or autocorrelation of the random effect,

[1] Generally, three models of spatial interaction processes can be identified [cf. LeSage 2008, Suchecki 2010]:
- SSAR (Simultaneous Spatial Autoregression), SAR/SEM (Spatial Autoregression/Spatial Error Models),
- SMA (Spatial Moving Average, with the endogenous variable's expected value being zero),
- SEC (Spatial Error Components, with the random variability being decomposed into two random components). The first component is interpreted as the regional effect whereas the second one stands for effects specific to different locations.

the analysis should also extend over spatial heterogeneity, i.e. the instability in the space of relationships (which can be, for instance, of an economic nature). This can result from many factors, including the asymmetry of the relationship between central and remote areas. The spatial regression model is homoscedastic if α = 0. The null and alternative hypotheses are formulated as::

H_0: $\alpha_i = 0$; $H_1 = \alpha_i = 0$, $i = 1, 2, \ldots, k$.

Heteroscedasticity may be verified with the Breusch-Pagan (BP) test, with the statistic being formulated as:

$$BP = \tfrac{1}{2}[g^T Z(Z^T Z)^{-1} Z^T g - N] \overset{as}{\sim} \chi^2_{(k)}$$

where: g – vector created based on residuals of the model developed with the least squares method; entries of the vector are $g_i = \frac{e_i^2}{(\frac{e^T e}{N})}$, $e = y - X\hat{\beta}_{MNK}$, e_i^2 – squared residuals in the least squares method, Z is the complete matrix of explanatory variables, N is the total number of objects (e.g. municipalities).

Another option is the Koenker-Bassett test with the following statistic:

$$KB = \frac{1}{Var(\varepsilon^2)}(u - \bar{u}i)^T Z(Z^T Z)^{-1} Z^T (u - \bar{u}i)$$

where: $Var(\varepsilon^2) = \frac{1}{N}\sum_{i=1}^{N}(e_i^2 - \frac{e^T e}{N})^2$, $u = [e_1^2\ e_2^2 \ldots e_N^2]$, $\bar{u} = \frac{e^T e}{N}$, i – column vector of N ones.

RESULTS OF THE STUDY

The table below shows the selected results of the procedure of ordering the municipalities of the Wielkopolskie voivodship by standards of living of the population and financial capacity of the municipality.

The highest values of synthetic indicators of the population's standards of living were recorded in municipalities comprising the Poznań agglomeration (Poznań, Suchy Las, Tarnowo Podgórne; in total, there were 7 of them in the top 15 municipalities found to have the highest standards of living). As many as 7 out of 15 municipalities reporting the highest synthetic indicators of standards of living are urban municipalities. In this context, it is worth noting that urban municipalities often accumulate a significant part of the socioeconomic potential of the entire district, or even of the entire voivodship (including business environment institutions and cultural institutions). This can contribute to what is referred to as the "big city shadow," and could be reflected by an understatement of indicators of the standard of living in municipalities that surround the cities (primarily including urban districts). As a consequence, rural municipalities sharing a border with corresponding urban municipalities are observed to rank low (e.g. the rural municipalities of Ostrów Wielkopolski – ranked 173rd, Złotów – 104th and Wągrowiec – 84th).

Table 1. Selected values of the synthetic indicator of standards of living in municipalities of the Wielkopolskie voivodship, as calculated with TOPSIS (15 highest and 15 lowest values)

Municipality	SISL	R	Municipality	SIFC	R
Poznań (1)	0.7104	1	Poznań (1)	0.6600	1
Suchy Las (2)	0.7061	2	Luboń (1)	0.5515	2
Tarnowo Podgórne (2)	0.6636	3	Tarnowo Podgórne (2)	0.5334	3
Leszno (1)	0.6448	4	Suchy Las (2)	0.5292	4
Luboń (1)	0.6397	5	Komorniki (2)	0.4869	5
Komorniki (2)	0.6362	6	Swarzędz (3)	0.4745	6
Swarzędz (3)	0.6337	7	Leszno (1)	0.4210	7
Ostrów Wielkopolski (1)	0.6321	8	Wijewo (2)	0.3975	8
Dopiewo (2)	0.6280	9	Rokietnica (2)	0.3956	9
Złotów (1)	0.6265	10	Buk (3)	0.3950	10
Nowy Tomyśl (3)	0.6261	11	Ryczywół (2)	0.3881	11
Wągrowiec (1)	0.6257	12	Wysoka (3)	0.3849	12
Czarnków (1)	0.6248	13	Środa Wielkopolska (3)	0.3827	13
Wolsztyn (3)	0.6229	14	Dopiewo (2)	0.3817	14
Środa Wielkopolska (3)	0.6208	15	Złotów (1)	0.3815	15
…			…		
Olszówka (2)	0.3665	212	Kazimierz Biskupi (2)	0.1282	212
Rychtal (2)	0.3406	213	Trzemeszno (3)	0.1256	213
Niechanowo (2)	0.3379	214	Krajenka (3)	0.1250	214
Koźmin Wielkopolski (3)	0.3346	215	Słupca (1)	0.1241	215
Miasteczko Krajeńskie (2)	0.3312	216	Miasteczko Krajeńskie (2)	0.1234	216
Rogoźno (3)	0.3153	217	Lipka (2)	0.1233	217
Kołaczkowo (2)	0.2857	218	Golina (3)	0.1229	218
Malanów (2)	0.2855	219	Koźmin Wielkopolski (3)	0.1229	219
Miejska Górka (3)	0.2823	220	Mycielin (2)	0.1221	220
Trzemeszno (3)	0.2804	221	Chocz (3)	0.1211	221
Grodziec (2)	0.2793	222	Słupca (2)	0.1199	222
Mycielin (2)	0.2770	223	Wapno (2)	0.1196	223
Czerniejewo (3)	0.2764	224	Jutrosin (3)	0.1177	224
Chrzypsko Wielkie (2)	0.2758	225	Witkowo (3)	0.1160	225
Wyrzysk (3)	0.2274	226	Mieleszyn (2)	0.1154	226

Symbols: SISL – synthetic indicator of the standards of living, SIFC – synthetic indicator of financial capacity

Values in brackets: 1 – urban municipality, 2 – rural municipality, 3 – urban-rural municipality

Source: own study based on the Local Data Bank of the Central Statistical Office [BDL GUS]

The highest value was identified in Poznań, primarily due to high levels of variables referring to the number of employed, the number of outpatient clinics, population served by waste water treatment plants with enhanced biological nutrient removal, and the percentage of residents served by gas supply networks. As regards 75% of municipalities, the synthetic indicator of standards of living was not above 0.5402 with a maximum and minimum at 0.6104 and 0.2274, respectively.

Based on the analysis, the indicators of financial capacity may be concluded to vary considerably across the municipalities considered. In 2017, the maximum-to-minimum ratio was 5.72 while the coefficient of variation was above 38.59%. When it comes to the synthetic indicator of financial capacity, the 15 top-ranked municipalities included 9 within the Poznań agglomeration. The lowest levels of synthetic indicators were recorded in the Jutrosin, Witkowo and Mieleszyn municipalities. This is primarily due to low or extremely low values of variables referring to: EU funds granted to finance Union programmes and projects; atmosphere and climate protection expenditure; and housing management expenditure. The synthetic indicator of financial capacity demonstrated a right-side asymmetry (the coefficient of skewness was 1.58). This means the values equal to or below the arithmetic mean dominated. As regards three quarters of municipalities, that indicator was not above 0.2560 with a maximum and minimum of 0.6600 and 0.1154, respectively.

A correlation analysis was carried out to determine the strength and direction of relationships between the population's standards of living and financial capacity. The nonparametric Spearman rank correlation coefficient was used in order to eliminate the negative impact of outliers, if any, on the results of the correlation analysis. The calculated coefficient of correlation between the defined synthetic measures was 0.6025, which suggests a quite strong relationship between the aspects covered by the analysis, and allows to conclude that the correlation coefficient was significant at $p < 0.05$. If account is only taken of rural municipalities, the Spearman rank correlation coefficient is 0.6550.

The global Moran's I statistic, calculated for the synthetic indicator of financial capacity at a municipal level and for the synthetic indicator of standards of living, was 0.3163 and 0.1037, respectively, and was statistically significant in both cases. The significance test was based on the analysis of histograms of the randomized permutation test. The hypothesis was verified based on the pseudo-significance level. The number of permutations was 9,999.

The values of local statistics will enable identifying clusters of territories at similar levels of the phenomenon under consideration. Based on local Moran's I, 12 low-low areas (reporting low values of the variable under analysis) were identified for the synthetic indicators of the municipalities' financial capacity. These formed a large compact cluster of 8 municipalities in the central part of the voivodship (extending over rural municipalities of Gniezno, Powidz, Orchowo, Strzałkowo, Słupca and Lądek, the urban municipality of Słupca and the urban-rural municipality of Witkowo) and a smaller cluster of 4 municipalities in the eastern part of the voivodship (3 rural municipalities of Grzegorzew, Koło, Osiek Mały and 1 urban-rural municipality of Dąbie). The structure of municipalities was also observed to include 14 high-high areas (a high value of the indicator surrounded by high values). These were municipalities comprising the Poznań agglomeration, i.e. rural municipalities of Suchy Las, Kleszczewo, Dopiewo, Czerwonak, Komorniki, Tarnowo Podgórne and Rokietnica; urban municipalities of Poznań, Mosina and Luboń; and urban-rural municipalities of Stęszew, Buk, Swarzędz and Kórnik. Also, 5 geographically dispersed high-low areas (a high value of the indicator surrounded by low values) and 6 low-high areas were identified. 18 high-high objects (mainly including the large cluster formed by municipalities located within the Poznań agglomeration) were identified based on the maps of local Moran's I statistics created for the synthetic indicators of the population's standard of living. Also, 4 low-low objects were identified (3 rural municipalities of Orchowo, Olszówka and Lądek, and one urban municipality of Słupca). Also, 8 geographically dispersed high-low areas and 8 low-high areas were identified in the structure of municipalities covered by this analysis.

A spatial regression analysis was performed as a next step in exploring the relationships between the phenomena considered. In accordance with a widely employed strategy for the selection of spatial regression models, the classical least squares method was used to estimate the structural parameters of the linear regression model in the first step of this study. The results of the Jarque-Bera test do not permit the rejection of the hypothesis of normal distribution of the random effect. Therefore, the values of asymptotic Lagrange multiplier tests can be calculated, and the maximum likelihood method can also be used. This is important because if spatial autocorrelation exists, the classical estimator based on the least squares method can be incompatible (or at least inefficient) with SEM models, for instance. Spatial tests (including the Moran's I test for residuals and the Lagrange multiplier test) were carried out afterwards.

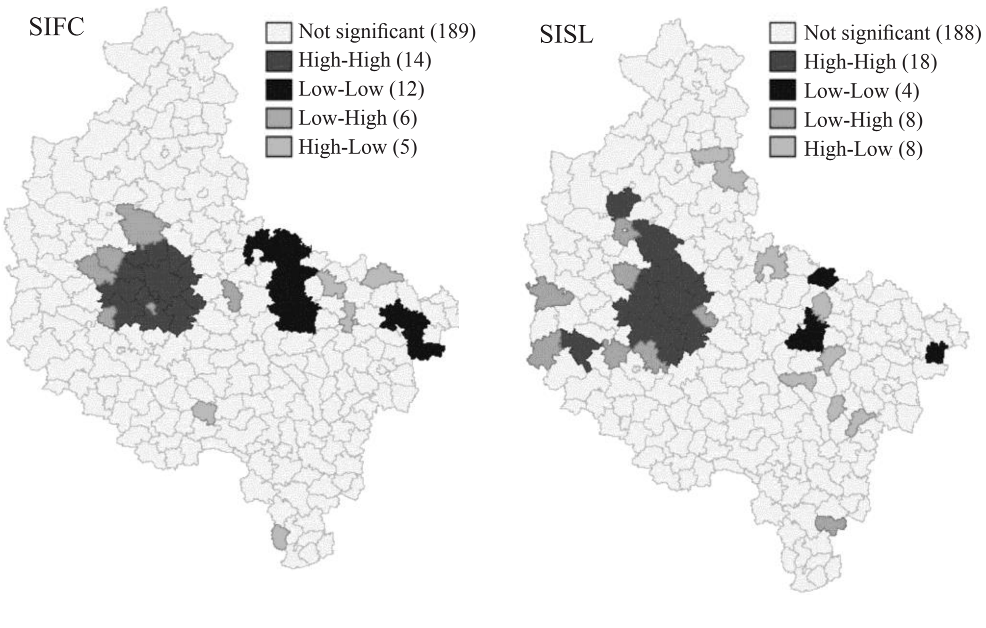

Figure 1. Maps of values of the local Moran's I statistics by cluster type

Source: own study

Table 2. Estimation results for the model of the population's standards of living

Models	Classical model	SEM
	Estimation	
λ (spatial autocorrelation parameter)	-	-0.2436 (0.0167)
Intercept	0.3239 (0.0000)	0.2314 (0.0000)
SIFC	0.6660 (0.0000)	0.6765 (0.0000)
Akaike Information Criterion	-564.9400	-570.5890
Schwarz Criterion	-558.0980	-563.7480
Log likelihood	284.4700	287.2946
	Normality test	
Jarque-Bera test	4.0479 (0.1321)	-
	Heteroscedasticity tests	
Breusch-Pagan test	3.5850 (0.0583)	2.8259 (0.0928)
Koenker-Bassett test	3.0710 (0.0797)	-
	Spatial autocorrelation tests	
Moran's *I* error significance test	-2.1687 (0.0301)	-
Lagrange multiplier test for SAR	1.7411 (0.1870)	-
Lagrange multiplier test for SEM	5.1504 (0.0232)	-

Symbols: the calculated significance levels for the rejection of the null hypothesis are put in brackets

Source: own calculations

As shown by the calculations, spatial autocorrelation exists between residuals (a low p-value for the Moran's I statistic calculated for the regression residuals). Hence, spatial estimation methods need to be used in the estimated model. As mentioned earlier, there are two groups of models which specify this type of spatial relationships: SAR, SLM (spatial lag models) and SEM (spatial error models). The spatial lag model includes what is referred to as the spatially lagged endogenous variable, which makes it an autoregression model. In turn, the spatial error model assumes the existence of spatial autocorrelation between residuals.

The Lagrange multiplier tests were used to determine the type of spatial interaction: LM_{SEM} (for the autocorrelation of the random effect) and LM_{SAR} (for the autoregression of the explained variable). Only the value of the LM_{SEM} test was statistically significant ($p < 0.05$), and, therefore, the spatial error model was used later in this analysis. The general form of spatial error models (SEM) is as follows:

$$y = \beta X + u, u = \lambda W u + \varepsilon, \varepsilon \sim IID\ N(0,1)$$

where: λ – spatial autocorrelation parameter, Wu – spatially lagged error term (mean error in neighbouring locations), ε – model's independent error term.

In its structural form, the estimated model may be written as:

$$SISL = 0{,}2314 + 0{,}6765 \cdot SIFC + u, \quad u = -0{,}2436 \cdot W_u + \varepsilon$$

All regression coefficients are statistically significant. This means the variables included affect the synthetic indicator of standards of living in the municipalities considered. The statistical significance of λ (-0.2436, p-value = 0.0167) implies the existence of spatially autocorrelated extra-model factors that affect standards of living. This means that the model fails to take account of some non-observed (e.g. non-measurable or random) variables which can be spatially correlated. It may also be assumed that because of the presence of a spatial dependency of errors, the exogenous shock in a given territory within the spatial error model will not only affect the situation prevailing in that very unit but also the condition of neighbouring territories [Kopczewska 2007, p. 133].

The estimated SEM model gives grounds for concluding that (in 2017) a 1% increase in the value of the synthetic indicator of the municipalities' financial capacity results, *ceteris paribus*, in a 0.7% increase in the synthetic indicator of the population's standards of living. The adjusted R^2 for the estimated spatial error model and the classical model was 0.4411 and 0.4176, respectively. The use of the spatial model contributed to a slight decrease in the standard estimation error (0.0675 in SEM vs. 0.0690 in the classical model). It can, therefore, be concluded that the inclusion of spatial interactions had a positive, though minor, impact on the estimation of the ranks of structural parameters. Based on the Akaike and Schwarz information criteria, the model which includes the mean error in neighbouring locations may be concluded to be better than the one based on classical least squares. Similar conclusions may be drawn based on the likelihood logarithm. Neither the Breusch-Pagan nor the Koenker-Bassett test allowed to reject the null hypothesis on the homoscedasticity of the random effect (at $p > 0.05$). The linear regression model developed could have been used in the analysis without the need to introduce any enhancing variables (reflecting the parameters' variability, e.g. east/west).

SUMMARY

The statutory mission of local government authorities is to create conditions that foster improvement in the population's standards of living. The scope, duration and efficiency of the relevant measures significantly depend on the LGUs' financial capacity. As shown by the above analyses, a statistically significant correlation exists between the municipalities' financial capacity and standards of living. The coefficient of correlation between the defined synthetic indicators is 0.6025 (and goes up to 0.6550 if account is only taken of rural municipalities). The results of the spatial regression analysis give grounds to conclude that (in 2017) a 1% increase in the synthetic indicator of the municipalities' financial capacity results in a nearly 0.7% increase in the synthetic indicator of standards of living (on a *ceteris paribus* basis). The presence of spatial autocorrelation for the model's residuals means that the occurrence of exogenous factors in a given municipality will trigger changes in neighbouring territories.

The results of analyses (e.g. municipality rankings) may be used indirectly by many stakeholders, including local authorities in charge of local and regional development when setting development priorities at a territorial unit level. Also, the awareness of spatial development structures may help in adjusting strategic management processes (e.g. changing the structure of expenditure) or in taking measures to align public services with what residents expect. This is because the standards of living in one municipality can affect how people live in neighbouring municipalities. In further research, other spatial statistics could be used, including both global (e.g. Geary's *C*) and local ones (e.g. the Getis-Ord statistic). Alternatively, another spatial neighbourhood structure could be employed. It would also be interesting to carry out causality tests (e.g. the Granger test) between particular sub-variables. However, this was not done due to restricted datasets (short time series).

BIBLIOGRAPHY

BDL GUS. (Data Bank of the Central Statistical Office – CSO, https://bdl.stat.gov.pl/BDL/start, access: 20.04.2019.

Cárcaba Ana, Eduardo González, Juan Ventura, Rubén Arrondo. 2017. How Does Good Governance Relate to Quality of Life? *Sustainability* 9 (4): 1-16. DOI: 10.3390/su9040631.

Chen Yanguang. 2013. New Approaches for Calculating Moran's Index of Spatial Autocorrelation. *PLOS ONE* 8 (7): 1-27.. DOI: 10.1371/journal.pone.0068336.

Dormann Carsten, Jana McPherson, Miguel Araújo, et al. 2007. Methods to account for spatial autocorrelation in the analysis of species distributional data: a review. *Ecography* 30: 609-628. DOI: 10.1111/j.2007.0906-7590.05171.x.

Dynowska Joanna, Emil Rudowicz. 2007. Oddziaływanie samorządu terytorialnego na rozwój lokalny gmin (Impact of local government on local development at municipal level)*, Acta Scientiarum Polonorum. Oeconomia* 6 (2): 27-35.

Getis Arthur. 2008. A History of the Concept of Spatial Autocorrelation: A Geographer's Perspectiv, *Geographical Analysis* 40: 297–309.

Hlepas Nikolaos. 2013. Quality of life and local governance. *Search Working Paper* 5: 1-20.

Hwang Ching-Lai, Kwangsun Yoon. 1981. *Multiple Attribute Decision Making: Methods and Applications*. Berlin, Heidelberg, New York: Springer-Verlag.

Kopczewska Katarzyna. 2007. Ekonometria *i statystyka przestrzenna z wykorzystaniem programu R-Cran* (R-Cran used in econometrics and spatial statistics). Warszawa: CeDeWu.

LeSage James. 2008. An Introduction to Spatial Econometrics. *Revue D'économie Industrielle* 123 (3): 19-44.

Liang Zhou, Shi Changdi, Lua Liming. 2017. *Application of AHP Method and TOPSIS Method in Comprehensive Economic Strength Evaluation of Major Cities in Guizhou Province*. [In] International Conference on Computer Science and Application Engineering (CSAE 2017).

Majka Agnieszka. 2015. *Taksonomiczna analiza zróżnicowania poziomu życia w Polsce* (Taxonomic analysis of differences in standards of living across Polish regions). *Scientific Papers of the Wrocław University of Economics* 407: 354-363.

Młodak Andrzej. 2006. *Analiza taksonomiczna w statystyce regionalnej* (Taxonomic analysis in regional statitics). Warszawa: Difin.

Oleszko-Kurzyna Bożena. 2014. Jakość życia a procesy zarządzania rozwojem gmin wiejskich (Quality of living vs. development management processes of rural municipalities). *Studia Ekonomiczne. Katowice University of Economics* 179: 85-93.

Panek Tomasz, Zwierzchowski Jan. 2013. *Statystyczne metody wielowymiarowej analizy porównawczej. Teoria i zastosowania* (Statistical methods of multivariate comparative analysis. Theory and applications). Warszawa: Oficyna Wydawnicza Szkoła Główna Handlowa w Warszawie.
Pondel Hanna. 2017. Rola samorządu gminnego w stymulowaniu rozwoju obszarów wiejskich (Role of local government at municipal level in stimulating rural development). *Studia BAS* 1 (49): 109-131.
Słaby Teresa. 2007. Poziom i jakość życia. [W] *Statystyka społeczna* (Standards and quality of living. [In] Social statistics), ed. T. Panek, 99-130. Warszawa: PWE.
Suchecki Bodgan (ed.). 2010. *Ekonometria przestrzenna. Metody i modele analizy danych przestrzennych* (Spatial econometrics. Methods and models for spatial data analysis). Warszawa: C.H. Beck Publishing House.
Zeliaś Aleksander. 1991. *Ekonometria przestrzenna* (Spatial econometrics). Warszawa: PWE.
Zeliaś Aleksander. 2004. *Poziom życia w Polsce i krajach Unii Europejskiej* (Standards of living in Poland an in European Union countries). Warszawa: PWE.

***

SYTUACJA FINANSOWA SAMORZĄDÓW GMINNYCH A POZIOM ŻYCIA MIESZKAŃCÓW W WOJEWÓDZTWIE WIELKOPOLSKIM – ANALIZA PRZESTRZENNA

Słowa kluczowe: poziom życia, porządkowanie liniowe, regresja przestrzenna

ABSTRAKT

Celem artykułu jest określenie zależności (przestrzennych) między poziomem życia mieszkańców a możliwościami finansowymi gmin dla danych z 2017 roku, ze szczególnym uwzględnieniem obszarów wiejskich. Badaniem objęto wszystkie 226 gmin w województwie wielkopolskim. Ze względu na wielowymiarowość analizowanych kategorii ekonomicznych, do oceny poziomu życia mieszkańców i możliwości finansowych gmin wykorzystano metodę TOPSIS. Dla skonstruowanych syntetycznych mierników przeprowadzono analizę autokorelacji przestrzennej w oparciu o statystyki (lokalne i globalne) Morana I, aby wyznaczyć skupienia gmin o podobnym poziomie analizowanych zjawisk. W celu zbadania siły związków przestrzennych między syntetycznymi miernikami poziomu życia mieszkańców i możliwości finansowych gmin przeprowadzono analizę regresji przestrzennej. Między skonstruowanymi syntetycznymi miernikami zachodzi silna zależność korelacyjna. Ponadto zarówno w przypadku miernika odnoszącego się do poziomu życia w rozpatrywanych gminach, jak i możliwości finansowych gmin zachodzi istotna statystycznie autokorelacja przestrzenna. Skonstruowany model regresji przestrzennej uwzględniający średni błąd z lokalizacji sąsiedzkich, lepiej wyjaśnia zależności między rozpatrywanymi zjawiskami niż model operaty o klasyczną metodę najmniejszych kwadratów.

AUTHOR

MARIUSZ MALINOWSKI, PHD
ORCID: 0000-0002-9602-6672
Poznań University of Life Sciences
Faculty of Economics and Social Sciences, Department of Economics
28 Wojska Polskiego St., 60-637 Poznań, Poland