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SPATIAL ASSOCIATIONS IN THE SCOPE OF INVESTMENT ACTIVITY OF MUNICIPALITIES IN POLAND

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Purpose: The aim of the article is to identify spatial correlation concerning the involvement of municipalities in investment activity in Poland.
Design/methodology/approach: The subject literature was studied to show the specificity of the investment activity of local governments and various factors influencing the capital expenditures of these units. Then, using the data for the period 2019-2023 for the population of municipalities in Poland, the spatial autocorrelation statistics were calculated and visualized to identify the spatial associations, i.e. spatial clusters and outliers.
Findings: The paper shows that there are significant spatial associations between municipalities in Poland in the field of investment activity, i.e. a tendency toward positive clustering of similar values of the share of investment expenditures in total expenditures. This tendency increased during the period of increased investment activity of municipalities. At the same time, there were also outliers, mainly of the 'black sheep' type, i.e. units with the low values of the analysed ratio, surrounded by the municipalities with the high values of the indicator studied.
Research limitations/implications: The paper presents the character of spatial associations in the field of the share of investment expenditures in the total expenditures in the municipalities in Poland, which contributes to the selection of the variables examining the investment activity at the sub-national level.
Practical implications: The research study is aimed at examining the significance and types of the spatial associations in the field of investment activity of the local governments. This may contribute to the selection of variables for the model explaining the capital spending of these units.
Social implications: The survey contributes to the higher recognition of the spatial relationships in the field of investment activity, e.g., in the process of creating local and regional strategies or regulations concerning joint implementation of tasks.
Originality/value: The research study identifies significance and types of spatial associations related to the investment activity of municipalities in Poland. There is a dearth of surveys showing the scope of spatial relations in the geographical space.
Keywords: municipality, investments, Moran Index, spatial autocorrelation.
Category of the paper: Research paper.

1. Introduction

Investments or capital expenditures of local government are important for multiple reasons. They aim to develop infrastructure for local social sustainability, quality of life, the need to expand infrastructure to support economic growth and welfare of the local community (Rivenbark et al., 2018, p. 402). As a part of public investments, they stimulate the economic activity through short-term effects on the aggregate demand, and raise the productivity of existing private, physical and human capital. Moreover, they encourage a new private investment to take advantage of the higher productivity (Miyamoto et al., 2020, p. 15). Their effects might be determined by the source of financing (Olejnik, 2024, p. 15). However, the specificity of local government investments is their ongoing nature, which is why the expenditures for their implementation systematically appear in the public budget. As a consequence of economic development, local governments are required to provide new services or develop new areas for industrial activities or housing, which determine the need for capital spending (Galiński, 2011, p. 62).

The investment activity of municipalities may be determined by various circumstances related to the local budget condition, the situation of the public finance sector, socio-economic conditions or political issues. However, these factors do not take into account spatial interactions and the complexity of processes in the economy. Moreover, many standard statistical methods may be inappropriate to identify certain associations in geographic space (Comber, Brunsdon, 2021, p. 3). Thus, there is a dearth of the studies examining the possibility of the existence of the spatial relationship between municipalities in terms of the role of the capital spending. These ties are visible in the area of the financial liquidity (Galiński, 2023a, p. 148), or the debt (Galiński, 2023b, p. 127). Therefore, it is crucial to detect the spatial associations to investigate their nature and specificity. Taking into consideration these issues the aim of the article is to identify spatial correlation concerning the involvement of municipalities in investment activity in Poland. These local public units operate in a specific institutional environment and can therefore influence each other. Thus, the research hypothesis of the study is that there are significant spatial associations between municipalities in Poland in the field of investment activity.

2. Literature review

The concept of ‘investment’ is widely described in the economic literature. Investment is most often understood as an outlay of money intended to generate income or the process by which monetary resources are converted into other assets. Many definitions of investments

emphasize primarily the desire to obtain specific cash flows as a result of the implementation of specific economic projects. However, the issue of functioning of local governments as public units requires adapting the investment concept to the specific nature of their activities and the scope of public tasks performed. This results from the purpose of local government investments, which should primarily meet the needs of the local or regional community, and not only seek to achieve financial benefits (Galiński, 2011, p. 61).

In local government, 'investment' is identified with 'capital expenditure', where the incurred spending brings benefits spread over many years (Jacobs, 2008, p. 4). In a broad sense, the capital spending or the investment spending is any outlay focused on long-term benefits (Staff Paper, 1998). According to this definition, local authorities can possess physical assets for local government use (e.g., office buildings), physical assets to support private sector development (e.g., roads, water systems), and intangible assets (e.g., education, research) (Jacobs, 2008, p. 4). Capital assets are particularly important because of their support for the delivery of public services and economic growth (Lewis, Oosterman, 2011, p. 149). In this context, certain types of investments might be distinguished, i.e.: (a) replacement investments – related to the reconstruction of used fixed assets; (b) modernization investments – aimed at improving the current technical and economic parameters by rebuilding fixed assets; (c) development investments – related to the creation of new production or service equipment (Sierak, 2014, p. 97).

The capital spending of local government is an integral portion of the public investment activity, which is determined by the miscellaneous factors, e.g.: the level of unemployment, the level of corporate investment, the share of agriculture in GDP, the government efficiency or the political cycle (Chmura, 2023, p. 363). The investment activity of local governments is, in turn, affected by financial constraints resulting from the shortage of funds in relation to the imposed tasks, the need to comply with fiscal rules, limited availability of financial instruments or little interest of private partners in certain types of investments (e.g. implemented in the public-private partnership formula) (Filipiak, Dylewski, 2015, p. 870). This activity is also affected by the socio-economic, legal, political, administrative, technical, geographical, historical and cultural factors (Zawora, 2020, p. 155). Interest rates are also taken into account in the investment process when the debt finances that activity but may not be a primary factor in capital expenditure decisions (Page-Hoongrajok, 2021, p. 203).

In turn, Ryu et al. (2022, pp. 347-349) argue that from managerial and political perspectives, the main factors influencing capital spending decisions (investments) are resource availability and political dynamics. In the latter case, partisan theory suggests that local politicians pursue or behave as if they were pursuing specific ideological goals through the party. In turn, the political budget cycle theory suggests that incumbents (opportunistic policymakers) use capital spending to increase their chances of re-election (Veiga et al., 2017).

Thus, capital expenditures of local governments are affected by two main factors, i.e. (Galiński, 2011, p. 65): (a) external factors, resulting primarily from the financial system in the field of revenues, legally defined public tasks, and the general economic, social, financial, institutional (e.g. fiscal rules) and political situation in the country and in the world; (b) internal factors, as a consequence of the financial, socio-economic, political (Wang, Wu, 2018, pp. 79-80), asset situation of local government unit and its area, e.g. trends and modifications in the industrial and commercial structure of the commune, the rate of wear and tear of existing assets and the need to replace them or changes in the demand for the new infrastructure (Pagano, 2002, p. 2).

The presented classification of factors influencing the investment activity of municipalities shows that the scholars do not take into account spatial associations between the units studied. However, according to the Waldo Tobler's First Law of Geography everything is related to everything else, but near things are more associated than distance things (Anselin, Li, 2020, p. 494). This is therefore the foundation of the fundamental concept of spatial dependence. In addition, the Second Law of Geography indicates that the phenomenon external to an area of interest affects what goes on inside in the unit (Yan, 2019, p. 6). Miller (2004, p. 284) claims that spatial association does not necessarily imply causation. Two related things may create a causal relationship, or there may be other hidden variables causing the relationship. He adds that although correlation is not causation, it provides evidence for causation that might be evaluated in the context of theory, or specifics of the system, in which the units operate. These links may therefore result from similar structures of revenues and expenditures resulting from demographic or geographic composition. The municipalities may perform their tasks together (e.g. investment projects) or may apply similar tax rates. The latter case refers to the concept of tax competition, which describes a situation in which the tax policy in a commune is determined by the policy pursued in neighbouring communes (Felis, Rosłaniec, 2019, p. 51). In addition, the similarity in the level of investment outlays may result from the availability of external resources, including EU funds, which in Poland are also managed at the regional (voivodeship) level. Moreover, the development strategy of the municipality should be consistent with the development strategy of the voivodeship (Article 10e para. 2, Act of 8 March 1990 on Gmina Local Government), which determines the investment policy.

3. Methodology and Data

Spatial associations between municipalities (the basic units of local government in the administrative division in Poland) in the field of the share of investment expenditures in total expenditures of municipalities in Poland are identified using the Moran's Index (*I*). This measure is separately calculated for each year between 2019-2023, using the data provided

by the Central Statistical Office (CSO) as part of the Local Data Bank for the population of all 2411 municipalities and 66 cities with county status in Poland.

The Moran's *I* statistic of spatial autocorrelation takes the form (Dubé, Legros, 2014, p. 68):

$$\text{Moran's } I = \frac{N\sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij}(y_i-\bar{y})(y-\bar{y})}{\sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij}\sum_{i=1}^{n}(y_i-\bar{y})^2}, \quad (1)$$

where:

N represents the total number of observations (municipalities in this research study),

y_i is the observation in the municipality *i*,

$\bar{y}$ denotes the mean of all the observation units,

w_{ij} stands for the matrix of binary spatial weights or the strength of interactions between observations *i* and *j* (w_{ij} = 1 if they share a common border, or 0 otherwise, and it is the sum of all the observations) (Gao, 2022, p. 100).

In the study, the Moran's *I* was calculated based on a spatial weight matrix by the queen contiguity (order contiguity = 1) (Li, 2022, p. 284). The Moran's *I* is interpreted based on the expected value, a pseudo *p*-value, and a *z*-score under the null hypothesis of no spatial autocorrelation (Grekousis, 2020, p. 223). Since the Moran's *I* statistic is a measure of spatial autocorrelation, the expected value, in large samples, vary between -1 and +1, testing its significance. However, the index higher than 0.3 or lower than -0.3 is an indication of relatively strong positive or negative autocorrelation (Grekousis, 2020, pp. 211-215). Thus, this index shows the relationships of the analysed investment activity in the local government with the value of the phenomenon in neighbouring units, taking into account the significant due to the level of the *p*-value (Galiński, 2023c, p. 597).

The article also presents the local indicators of spatial autocorrelation (or association), which refer to the acronym LISA (I_i), and are calculated as follows (Grekousis, 2020, pp. 222-223):

$$I_i = \frac{(y_i-\bar{y})\sum_{i=1}^{N} w_{ij}(y_j-\bar{y})}{\frac{\sum_{i=1}^{N}(y_i-\bar{y})^2}{N}}. \quad (2)$$

As a result, I_i provides a measure of the spatial association of each unit (municipality) within the larger study region (neighbouring units) (Burt, Barber, Rigby, 2009, p. 560).

The outcomes of the calculation of this measure are visualised on the LISA cluster map, within which there are presented four types of spatial relations, i.e. (Galiński, 2023c, p. 598; Wang, 2011, p. 183; Dubé, Legros, pp. 84-85):

- 'high-high' - high values surrounded by neighbours of similar high values ('hot spots'),
- 'low-low' - low values surrounded by neighbours of similar low values ('cold spots),
- 'low-high' - low values surrounded by the high values ('black sheeps'),
- 'high-low' - high values surrounded by the low values ('diamonds in the rough'),
- 'not significant' - areas that are not significant at significance level of 0.05.

The appearance of ‘black sheeps’ and ‘diamonds in the rough’ indicates the presence of outliers in geographical space (Mohanty et al., 2019, p. 472).

4. Results and Discussion

The investment activity is a crucial sphere of functioning of municipalities in the context of economic development. In Poland, the average share of investment expenditures in total expenditures ranged from 14% to 18% in 2019-2022, and in 2023 it increased to almost 28% (figure 1). In 2020, despite the Covid-19 pandemic, these activities were not significantly disrupted. However, the rapid increase in the analysed ratio resulted in the continuation of the relaxation of fiscal rules concerning local debt in order to ensure that local government units can make maximum use of their investment opportunities. In addition, it was caused by the availability of the additional central funds for investment purposes at the local level in Poland (CM, 2024, pp. 8-9).

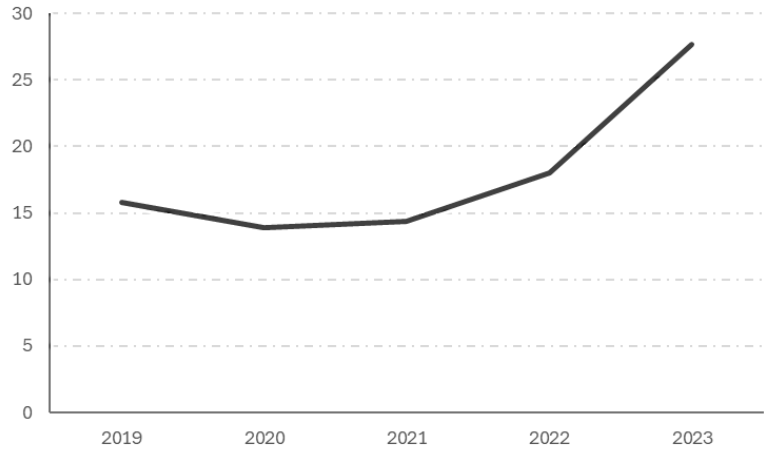

Figure 1. Average the share of investment expenditures in total expenditures (%) for municipalities in Poland in 2019-2023.

Source: own elaboration based on BDL GUS (2024).

Table 1.
Moran’s I and the spatial associations for the investment activity in the municipalities in Poland in 2019-2023

Year	2019	2020	2021	2022	2023
Moran’s *I*	0.1208	0.0851	0.0829	0.0680	0.1655
p-value	0.0010	0.0010	0.0010	0.0010	0.0010
Spatial relations - no. of the municipalities					
high-high	108	96	99	99	183
low-low	161	134	114	97	172
low-high	83	65	73	71	75
high-low	53	60	48	58	59
not significant	2 072	2 122	2 143	2 152	1 988

Source own elaboration.

As far as the spatial associations in the field of the share of investment expenditures in total expenditures are concerned, there were positive associations throughout the 2019-2023 period (table 1). Therefore, it reflects tendency toward positive clustering of similar values, i.e. 'high-high" or 'low-low'. So, in Poland in the years 2019-2023 the neighbouring municipalities have similar values in the field of the share of investment expenditures in total expenditures. However, Moran's *I* values ranging from 0.0680 (2022) to 0.1655 (2023) (table 1) indicate very weak global spatial autocorrelations in each year, which indicate low spatial dependencies. It is worth noting that the highest value of this index occurred in the year characterized by the highest share of investment activity, i.e. in 2023. It shows that increased investment activity of the municipalities in 2023 has resulted in greater spatial dependencies in this year.

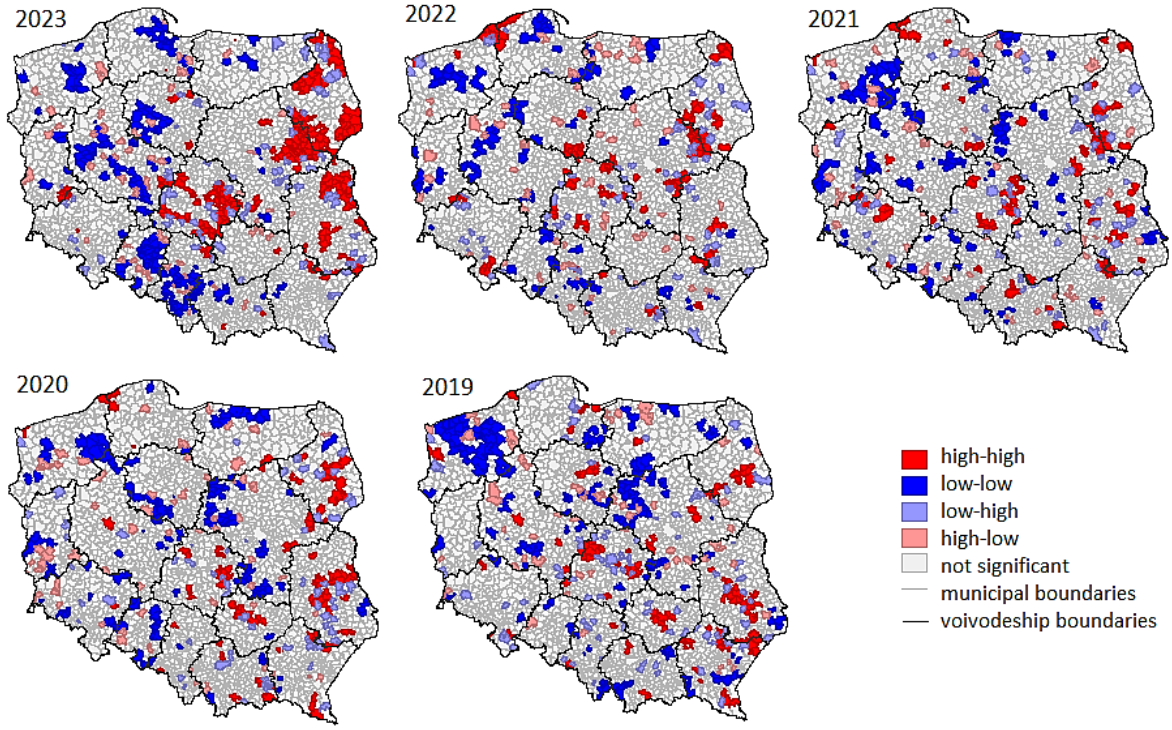

Figure 2. LISA cluster maps for the investment activity in the municipalities in Poland in 2019-2023. Source: own elaboration.

As can be seen from the LISA cluster maps for investment activity (figure 2), there is no consistent pattern in the distribution of spatial relations in the years 2019–2023. In terms of significant spatial associations, the 'low-low' relationship dominated in each of the years 2019-2021. Thus, from 114 (2021) to 161 (2019), a low value of this indicator was associated with a low value in the neighbours. In turn, in 2022 and 2023, the 'high-high' type of the relationship prevailed. It means that in the above cases, i.e. both 'low-low' and 'high-high', local authorities were to some extent guided by their investment activity based on their neighbours. According to the findings of Zimny (2008, pp. 118-119) joint investment projects with other municipalities as part of an inter-municipal association/agreement are undertaken much more often by

municipalities characterised by a low degree of financial independence than by municipalities with a high degree of independence. The joint investment activity is also determined by the investment propensity, measured by the share of investment expenditures in the total expenditures or investment expenditures per capita (Zimny, 2008, p. 46). Therefore, the similarity in terms of investment involvement may result from the revenue structure of individual local governments or investment needs. However, implementation of infrastructure tasks by more than one municipality creates benefits in the form of opportunities for more effective cooperation. Nevertheless, there are also certain risks of this form of functioning, i.e. blurring of competences, inadequate preparation of these entities to apply for external funds or even disputes regarding the achievement of benefits by individual members of certain agreement (NIK, 2021, p. 6).

In each year, the group of spatial outliers was dominated by 'black sheeps', i.e. municipalities with a low share of investment expenditures in total expenditures surrounded by units with increased investment activity.

The findings also show that there is no common spatial pattern of behaviour in investment activity in Poland or in the voivodeship (the highest-level administrative division) that has been maintained for many years. In 2023, the 'high-high' spatial associations were located mainly in the eastern and central parts of the country, while the majority of the 'low-low' cases were located in the western part of the country. In many cases the cluster boundaries were consistent with the voivodeship boundaries (figure 2). It can therefore be seen those certain characteristics of the voivodeships determined the spatial relationships in the field of investment activity.

5. Conclusions

The investment activity of local government is determined by various factors related to the economy, finance, demographics and politics. Therefore, scholars try to include these determinants in their surveys. However, most studies omit the existence of specific spatial associations or do not take into account factors that shape these relationships. This concerns aspects of linking the spheres of revenues or expenditures of the budgets of individual units, as a result of joint implementation of tasks (local infrastructure management and development) or imitation in the sphere of shaping tax policy (e.g. similar tax rates). In addition, units can operate in a specific area, which determines their development strategy and financial potential. Municipalities with strong budget management capabilities can achieve high level of investment outlays as an indicator of budget efficiency, which translates into better functioning of local government administration (Sutopo, Siddi, 2018, p. 229). Investment outlays may positively affect local governments' performance (Zamzami, Rakhman, 2023, p. 333).

The article reveals that there are significant spatial associations between municipalities in Poland in the field of investment activity, i.e. in the share of investment expenditures in the total expenditures. Thus, the research hypothesis was positively verified. Throughout the entire analysed period, there were significant positive spatial associations, i.e. a tendency toward positive clustering of similar values of the examined ratio. This tendency increased during the period of increased investment activity of municipalities, which contributes to the spatial clustering. Hence, the municipalities imitate their investment policy to some extent. In turn, there were spatial outliers. This group was dominated by municipalities with a low share of investment expenditures in total expenditures, surrounded by units with a high level of this ratio. This indicates that there is room for searching for specific factors influencing studied spatial associations to strengthen the investment potential of municipalities.

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