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SPATIAL ASSOCIATIONS IN THE SPHERE OF LOCAL GOVERNMENT REVENUE INDEPENDENCE: THE CASE OF POLAND

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Background and Objective: The revenue independence of local governments is a key issue in the functioning of these units in the context of sustainable development. Simultaneously, various financial, economic, political, geographical and environmental factors are studied as potential determinants of this dimension of local autonomy. However, there is a dearth of studies exploring spatial associations in this field. Thus, the purpose of the article is to identify types of spatial associations in the field of the revenue independence of local governments in Poland and the development of such associations over time.

Study Design/Materials and Methods: Spatial associations in the municipalities in Poland in the field of revenue independence are studied using Moran's Index and local indicators of spatial autocorrelation (LISA). These measures were separately calculated for each year between 2019 and 2023 using the data provided by Statistics Poland for the population of all 2 477 local governments in Poland. In addition, types of spatial associations were presented on the LISA cluster map to show certain clustering of the units and spatial outliers.

Results: The paper proved that there are significant and time-stable spatial associations between municipalities in Poland in terms of the level of revenue independence. In the years 2019–2023, there was a tendency for the positive clustering of similar values. Hence, neighbouring local governments imitate one another's fiscal policy to some extent. In many cases, the spatial associations studied occurred within the borders of regions (voivodeships), while revenues from PIT and CIT contributed to the creation of clusters of units with high financial independence around metropolitan areas.

Practical implications: The research study reveals that there is a tendency towards clustering among local governments with low levels of revenue independence, mainly in eastern and south-eastern Poland. Thus, there is a need to adapt some policies and regulations to the specificity of these areas to improve independence and fiscal efficiency.

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Conclusion and summary: There is a space to search for specific issues affecting spatial associations in terms of revenue independence, regarding economic, geographical and environmental conditions, to enhance the revenue independence of local governments in the context of sustainable development.

Keywords: local government, revenue independence, spatial associations

JEL classification: H71

Paper type: research study

1. Introduction

A key feature of the functioning of the public sector is the transfer of financial (fiscal) independence to local governments, as a dimension of decentralisation. This transfer may include both revenue and expenditure perspectives and refers to the concept of autonomy (Schneider, 2003, pp. 41–46). Therefore, there are approaches in which fiscal autonomy is treated as the extent to which a local government can tax its population independently (Ladner & Keuffer, 2021, p. 219), and is dependent on the right to levy taxes, set tax rates, tax reliefs, preferences, exemptions or collect taxes (Pavlova-Banova, 2018, p. 5). Moreover, revenue independence is a fundamental condition for the sustainable development of a region (Dziekański, 2020, p. 53).

In the subject literature, one can find approaches that allow for a wide range of financial independence of local governments, which is defined by the level of own revenues against the background of subsidies and grants from the state budget constituting non-own revenues, or transfers (Guziejewska, 2015, p. 46). At the same time, there are various definitions of own revenues in the subject literature, which can be viewed from an economic or legal perspective. They refer to revenues transferred to the budgets of local governments in full and for an indefinite period, with some freedom in their determination, and which are linked to the local economic base. These include, in a sensu stricto perspective, local taxes and fees, income from property, fees for public services provided and, in a sensu largo perspective, are increased by shares in tax revenues as state budget revenues (Życzkowska & Dziuba, 2023, p. 172). This results from including these shares, in the theory of fiscal federalism, as a general transfer from the state budget (Guziejewska, 2015, pp. 46–47). As a result, scholars try to find factors that influence the size of own revenues and, consequently, the level of revenue independence. Hence, miscellaneous financial, economic, political, geographical and environmental factors are studied here. At the same time, there is a dearth of studies showing spatial associations in this field. However, in accordance with Waldo Tobler's First Law of Geography, everything is related to everything else, but things (objects, territories) that are close are more related than things that are distant (Church, 2018, p. 288). This is therefore the basis for the concept of spatial dependence. In addition, Waldo Tobler's Second Law

shows that a phenomenon external to an area of interest affects what goes on inside a given territory (Bettencourt, 2021, p. 295). Miller (2004, p. 284) claims that spatial association does not necessarily imply causation. Two related objects may create a causal relationship, or other hidden variables may be responsible for the relationship in the spatial perspective. Thus, the purpose of the article is to identify types of spatial associations in the field of the revenue independence of local governments (municipalities) in Poland and the development of such associations over time. It is aimed at exploring knowledge regarding the scope and significance of different spatial relationships. The research hypothesis of the paper is that there are significant and time-stable spatial associations between municipalities in Poland in terms of the level of revenue independence, which influence the fiscal policy in a given area.

2. Literature Review

The revenue independence of local government units means the right of local government authorities to manage certain financial resources, including their determination and collection (Surówka & Rechul, 2024, p. 150). This influences the own fiscal policy of local government authorities in the sphere of revenues in a specific area. Therefore, there are mutual interactions between revenue independence and the situation of the local economy (Kozera & Kozera, 2023, p. 229). A principal issue of this independence is to guarantee the possibility of increasing the amount of own revenues and collecting such revenues from various sources in the context of risk to functioning. As a result, local government revenue independence serves as a way to operationalise the concept of fiscal decentralisation. In addition, there are certain approaches related to the operationalisation of revenue independence, i.e. emphasising the structure of revenues attributed to local governments and the decision-making capacity of local governments with respect to specific revenue streams – i.e. the power to raise taxes (Turała, 2020, pp. 341–342).

Therefore, the notion of revenue independence should be understood as the right of local authorities not only to have access to financial resources, but also the actual ability to determine tax elements, e.g. the object of taxation, tax base, tax rate, taxpayers or tax preferences, which determine the level of this autonomy. However, the right to shape tax revenues is not unconditional due to the fact that local governments might have limitations in the scope of setting upper tax rates, certain reliefs, or payments for services. Thus, local authorities cannot maximise tax revenues without limit (Surówka, 2019, p. 138) because of tax competition, the possibility of taxpayer migration and the local economic conditions. Motek (2024, p. 356) illustrates that decisions to introduce tax preferences in a given local government are a response to what is happening in neighbouring units. Moreover, restricted revenue independence results primarily from the limited stability and efficiency of own revenues, caused by the low effectiveness of local tax sources. This autonomy is also affected by frequent

changes in the legal system (Jastrzębska, 2023, p. 67). Thus, there are miscellaneous issues affecting the revenue independence of local governments, i.e. economic, financial and legal circumstances (Andonova & Trenovski, 2023, pp. 11–14; Galiński & Jackowska, 2023, p. 14), demography, geography, the environment (Psycharis et al., 2016, p. 277), or political factors (Jemna et al., 2013, p. 53).

As far as spatial associations are concerned, Schweizer (1985) shows that central cities, in which a spatial concentration of production can be observed, will provide the surrounding agglomeration with certain public goods and services. This, in turn, determines their budgets. At the same time, due to fiscal decentralisation within the agglomeration, people and companies residing in the city centre must cover a large part of public spending from their taxes. This may determine mutual relationships within the unit in terms of revenues. Simultaneously, sub-national governments that gain taxpayers tend to put less emphasis on pumping taxpayer wealth into the budget, instead allowing taxpayers more freedom with the management of their financial assets (Wilford & Kilty, 2022, p. 6).

Spatial associations in terms of revenue independence are also related, as it was mentioned, to tax competition, i.e. a situation in which the tax policy in a given local government is determined by the policy pursued in neighbouring units (Felis & Rosłaniec, 2019, p. 51). This activity is aimed at supporting or increasing the attractiveness of a given territory as a favourable place to conduct business or live. On the one hand, tax competition forces the rationalisation of public spending, influences the development of entrepreneurship and economic recovery, limits the possibility of politicians interfering in the economy, and influences the inflow of capital in the context of economic growth. On the other hand, tax competition may negatively affect the supply of public goods, abandon spending policy in the key area of infrastructure development, and force authorities to seek compensation for losses caused by lower revenues (Działo, 2015, pp. 38–49) or to use debt to cover revenue losses (Maličká, 2021, p. 682). Therefore, local authorities should resist pressure from residents and entrepreneurs seeking to reduce public levies (Surówka, 2019, p. 139) or tax rates and pursue responsible fiscal policy in the context of an unstable economic situation. Tax competition at the local level in Poland was proved by Swianiewicz and Łukomska (2016, p. 42), who revealed that the level of tax rates was statistically correlated with tax burdens in neighbouring areas. At the same time, tax competition is strongest not in the case of tax with a mobile tax base, but in the case of agricultural tax, followed by residential real estate tax. In turn, Janeba and Osterloh (2013, p. 99) showed that in Germany smaller districts rely less on capital taxation than larger ones. This effect is offset by external competition from cities in other metropolitan regions due to the fact that cities react more strongly to external competition than hinterlands.

In turn, Kozera and Głowicka-Wołoszyn (2016, pp. 526–538), examining the self-sufficiency of local governments (understood as a composition of specific fi-

nancial indicators), found that there are certain spatial associations between units in the metropolitan area (characterised by high self-sufficiency) and in economically underdeveloped agricultural communes (characterised by low self-sufficiency). Moreover, Kozera and Kozera (2023, p. 239) emphasise that a high level of financial autonomy is characteristic of many small towns located near urban centres, taking advantage of their location and acting as dormitory towns.

3. Methodology

Spatial associations in the municipalities in Poland (the basic units of local government in the administrative division) in the field of revenue independence are studied measuring Moran's Index (*I*) and local indicators of spatial autocorrelation in the GeoDa software tool. Moran's Index is separately calculated for each year between 2019 and 2023. The adopted period, in which external events determining revenue independence occurred (e.g. the Covid-19 pandemic), allows for the assessment of the stability of the findings. In the research, data were applied provided by Statistics Poland as part of the Local Data Bank for the population of all 2 477 local governments, i.e. 2 411 municipalities and 66 cities with county status in Poland. For this purpose, data on two basic indicators of local government revenue independence were used, i.e. (Wichowska, 2021, p. 47):

1. share of own revenues in total revenues, % (Revenue Independence Sensu Largo – RISL);
2. share of own revenues excluding PIT and CIT inflows in total revenues, % (Revenue Independence Sensu Stricto – RISS).

Moran's *I* statistic of spatial autocorrelation takes the form (Bivand et al., 2008, p. 259):

$$I = \frac{n}{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}} \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(y_i - \bar{y})(y - \bar{y})}{\sum_{i=1}^{n}(y_i - \bar{y})}, \quad (1)$$

in which n represents the total number of localities (2 477 municipalities in Poland), y_i is the ith observation, $\bar{y}$ is the mean of the variable of interest, and w_{ij} is the spatial weight of the link between i and j. Moran's *I* was calculated using a spatial weight matrix based on queen contiguity (order contiguity = 1) (Anselin, 2024, p. 258). This statistic is interpreted by calculating the expected value, pseudo *p*-value, and *z*-score under the null hypothesis of no spatial autocorrelation (Grekousis, 2020, p. 223). Since this index measures spatial autocorrelation, the expected value in large samples when testing its significance takes values between –1 and +1. In addition, a statistic higher than 0.3 or lower than –0.3 characterises a relatively strong positive or negative autocorrelation (Grekousis, 2020, pp. 211–215). To sum up, a positive and significant value of Moran's *I* indicates that similar values of the analysed variable characterise neighbouring local areas (municipalities in this study). On the other

hand, a significant negative value of this statistic shows the presence of different values of the variable in contiguous local governments (Murgante & Rotondo, 2013, p. 129).

In the research study, local indicators of spatial autocorrelation (LISA, I_i) were also measured according to the formula (Grekousis, 2020, pp. 222–223):

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

For each location, I_i enables an assessment of the similarity of each observation with its surroundings. Five scenarios, visualised on the LISA cluster map, emerge (Murgante & Rotondo, 2013, p. 130):

— locations with high values of revenue independence and a high level of similarity to the surroundings (High-High), defined as 'hot spots';
— locations with low values of revenue independence and a high degree of similarity to the surroundings (Low-Low), defined as 'cold spots;
— locations with low values of revenue independence and a low degree of similarity to the surroundings (Low-High), defined as 'spatial outliers – black sheep';
— locations with high values of revenue independence and a low level of similarity to the surroundings (High-Low), defined as 'spatial outliers – diamonds in the rough';
— locations devoid of significant autocorrelations (Not Significant).

LISA can effectively relate an index of the degree of spatial association relative to its surroundings to each territorial unit (municipality in this analysis), allowing the type of spatial concentration to be presented for the detection of spatial clusters or outliers.

4. Results

Revenue independence is a key aspect of the functioning of municipalities in Poland. In the years 2019–2023, the average share of own revenues in total revenues (RISL) was between 37.30% and 42.22%, whereas the average share of own revenues excluding PIT and CIT inflows in total revenues (RISS) was between 23.37% and 28.69% (Figure 1). In 2020, despite the Covid-19 pandemic, these indicators increased, and standard deviations decreased (Table 1). At the same time, there were large disproportions between municipalities with high and low levels of revenue independence, both sensu largo (RISL) and sensu stricto (RISS) (Min vs Max – Table 1). It is worth noting that in each year of 2019–2023 there was a strong positive and statistically significant correlation between RISL and RISS (Figure 1).

In terms of spatial associations for revenue independence, there were positive associations for both RISL and RISS over the entire period 2019–2023 (Table 2, Table 4). Thus, this indicates a tendency towards the positive clustering of similar

values of revenue independence indicators, i.e. mainly 'Low-Low' and then 'High-High'. Therefore, in Poland, lots of neighbouring communes had similar values in terms of RISL (Table 2) and RISS (Table 3) in the years 2019–2023. Simultaneously, Moran's *I* values for RISL, ranging from 0.4651 (2023) to 0.4939 (2019), show relatively strong and significant spatial associations. In turn, lower Moran's *I* values for RISS indicate that revenues from PIT and CIT intensified these spatial associations. Hence, in many cases, low or high values of revenue independence affect this autonomy in neighbouring municipalities.

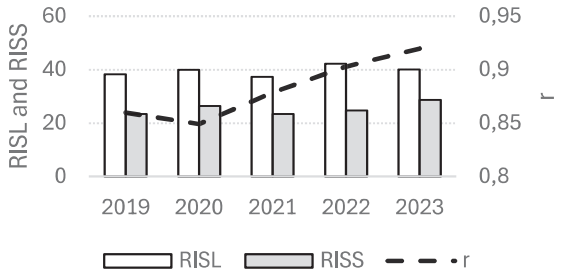

Figure 1. Level of revenue independence indicators (RISL and RISS) and the Pearson correlation coefficient (r) between them in the years 2019–2023

Source: own elaboration.

Table 1. Descriptive statistics for RISL and RISS

Indicator	Year	Obs	Mean	Std.dev	Min	Max
Revenue Independence Sensu Largo – RISL	2019	2 477	38.2644	12.1456	14.6388	90.2687
	2020	2 477	39.9117	10.8407	14.9973	89.4212
	2021	2 477	37.2977	11.8530	14.4354	88.7420
	2022	2 477	42.2241	10.7187	19.0089	87.4997
	2023	2 477	40.0737	12.9786	11.7386	88.3597
Revenue Independence Sensu Stricto – RISS	2019	2 477	23.3694	8.7493	6.7369	83.6080
	2020	2 477	26.4721	8.2420	9.2875	83.8554
	2021	2 477	23.4351	8.5213	7.4646	76.0744
	2022	2 477	24.7947	8.8558	6.5363	77.1726
	2023	2 477	28.6889	9.4416	7.9609	77.5722

Source: own elaboration.

Table 2. Moran's *I* and the spatial associations for Revenue Independence Sensu Largo (RISL) in the municipalities in Poland in 2019–2023

Year	2019	2020	2021	2022	2023
Moran's *I*	0.4939	0.4761	0.4900	0.4842	0.4651
p-value	0.0010	0.0010	0.0010	0.0010	0.0010
Number of spatial associations of municipalities by type					
High-High	344	353	358	328	356
Low-Low	456	433	453	467	397
Low-High	41	39	38	31	50
High-Low	60	52	51	53	54
Not Significant	1 576	1 600	1 577	1 598	1 620

Source: own elaboration.

Table 3. Moran's *I* and the spatial associations for Revenue Independence Sensu Stricto (RISS) in the municipalities in Poland in 2019–2023

Year	**2019**	**2020**	**2021**	**2022**	**2023**
Moran's *I*	0.3745	0.3419	0.3936	0.3852	0.3774
p-value	0.0010	0.0010	0.0010	0.0010	0.0010
Number of spatial associations of municipalities by type					
High-High	210	214	246	224	275
Low-Low	427	356	425	413	371
Low-High	51	49	52	48	66
High-Low	45	65	44	47	47
Not Significant	1 744	1 793	1 710	1 745	1 718

Source own elaboration.

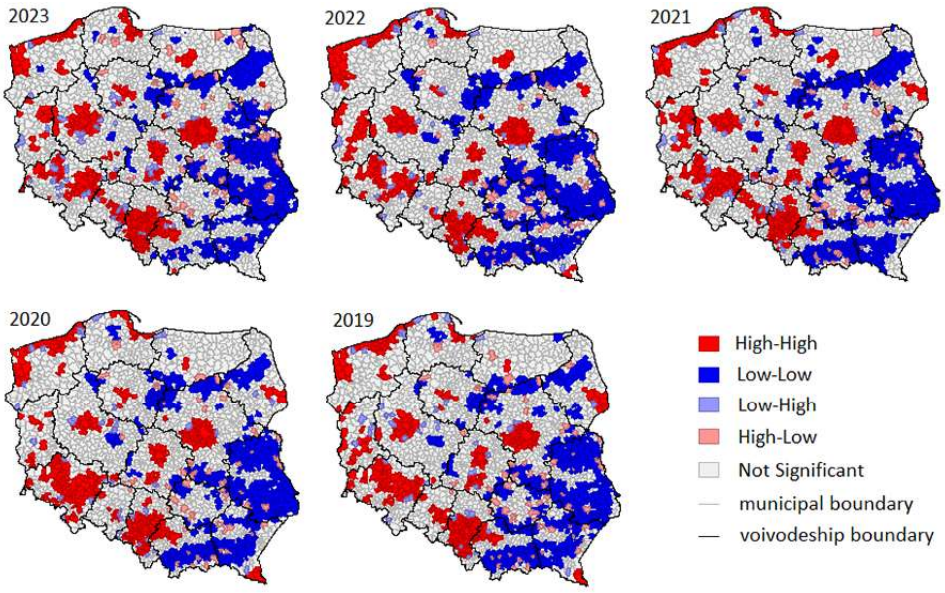

Figure 2. LISA cluster maps for Revenue Independence Sensu Largo (RISL) in the municipalities in Poland in 2019–2023

Source: own elaboration.

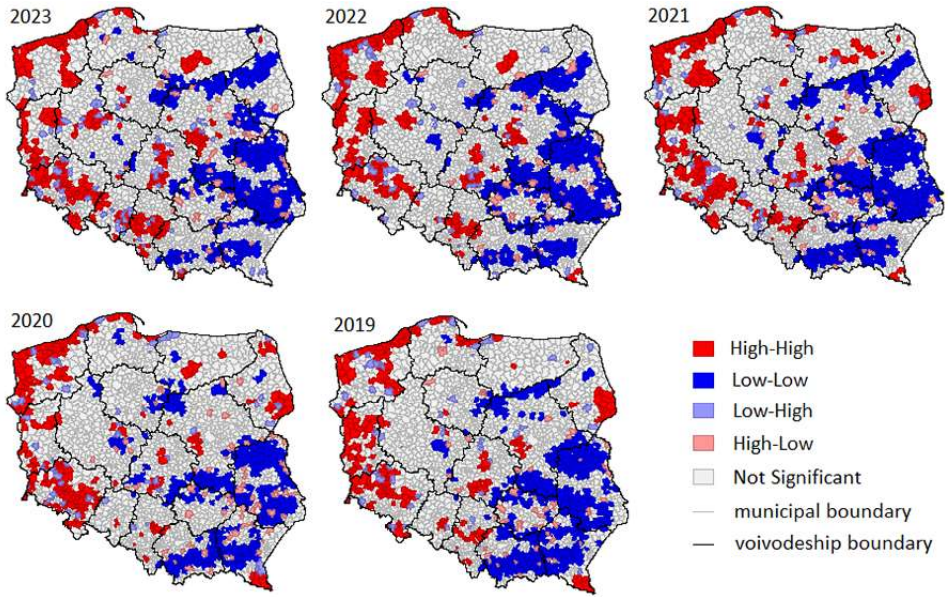

Figure 3. LISA cluster maps for Revenue Independence Sensu Stricto (RISS) in the municipalities in Poland in 2019–2023

Source: own elaboration.

The analysis of LISA cluster maps for RISL (Figure 2) and RISS (Figure 3) shows that there are consistent patterns in the distribution of spatial associations across these revenue independence indicators for the period 2019–2023. In terms of significant spatial associations, the 'Low-Low' relationship dominated in each of the years 2019–2021, both for RISL (Figure 2) and RISS (Figure 3). Thus, the number of RISL cases from 397 (2023) to 467 (2022) means that the low value of this indicator was associated with a low value among neighbours (Table 2, Figure 2). In turn, for RISS, the 'Low-Low' associations occurred in 371 cases in 2023 and in 427 cases in 2019. The next type of association regarding these indicators was 'High-High' (Table 3, Figure 3). This signifies that in the above cases, i.e. both "Low-Low" and "High-High", the fiscal policy of local authorities resulted to some extent from the financial independence that emerged among their neighbours. In many regions (voivodeships in Poland, as regional level units of the local government), these associations occur within their borders and link with the border units of neighbouring regions (Figure 2, Figure 3). This means that the source of the associations presented here is not primarily the fiscal policy of regional authorities, but other factors, e.g. the economic situation, geographical and environmental conditions, or even tax competition. Furthermore, in the south-eastern and eastern parts of Poland, the 'Low-Low' association dominates, while the 'High-High' type appears mainly in the west, south-west, north-west, and in some areas of the centre. It is worth adding the findings of Ciołek (2017, pp. 82–83), who showed that in the area of GDP per capita for counties in Poland, a spatial correlation of the 'Low-Low' type also appeared in the south-eastern part of Poland. Moreover, revenues from PIT and CIT strengthen the 'High-High' type of spatial association between an agglomeration and its suburbs (Figure 2), including in the case of the capital of Poland, where Ciołek (2017, pp. 82–83) also presented this association in terms of GDP per capita. Moreover, Kozera and Głowicka-Wołoszyn (2016, p. 525) also revealed that clusters of local units with a high level of self-sufficiency were concentrated around metropolitan centres, while clusters with a low level of self-sufficiency appeared in economically underdeveloped agricultural areas. In the research study, in each year there were also groups of spatial outliers, both 'black sheep' and 'diamonds in the rough'.

5. Conclusions

The revenue independence of local governments is determined by many factors related to the structure of tax revenues, as well as factors in the field of the economy, finance, demography, geography, the environment and politics. Therefore, researchers should include such determinants in their studies to precisely characterise fiscal autonomy. However, most studies do not take into account specific spatial relationships or do not consider the factors that shape specific spatial associations. This also concerns aspects of linking the revenue spheres of local government budg-

ets due to tax competition. Thus, local units may operate in a specific area, which determines their fiscal policy and financial potential.

The paper proved that there are significant and time-stable spatial associations between municipalities in Poland in terms of the level of revenue independence, i.e. in the share of own revenues in total revenues (Revenue Independence Sensu Largo – RISL), and in the share of own revenues excluding PIT and CIT inflows in total revenues (Revenue Independence Sensu Stricto – RISS). Thus, the research hypothesis was positively verified. Throughout the entire analysed period, there were statistically significant positive spatial associations, i.e. a tendency for the positive clustering of similar values, firstly low, and subsequently, high levels of the examined revenue independence indicators. As a result, neighbouring municipalities imitate one another's fiscal policy to some extent. However, the "Low-Low" type of association reduces the potential for the sustainable development of the entire region. In addition, there were spatial outliers within revenue independence. Nevertheless, the permanently shaped "Low-Low" spatial relations in eastern and south-eastern Poland indicate the need to adjust some policies and regulations to their specificity to improve the revenue independence of these units in the context of sustainable development. This indicates the possibility of searching for specific issues affecting spatial correlations in terms of revenue independence, mainly in the area of economic, geographical and environmental conditions, to enhance the fiscal efficiency of local governments. In many cases, the examined spatial associations occurred within the borders of the regions (voivodeships in Poland). Moreover, it was proved that revenues from PIT and CIT had a significant influence on Revenue Independence Sensu Largo and, as a result, contributed to the creation of clusters of local governments with high financial independence around metropolitan areas.

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