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ANALYSIS OF SPATIAL CONCENTRATION OF THE REGIONAL OPERATIONAL PROGRAMMES FUNDS SUPPORT USE[**]

1. INTRODUCTION

Financial support is the main instrument of regional development policy in the European Union. In the Third Cohesion Report concentration principle, with programming and partnership, are presented as a one of "core principles" for improving the effectiveness of structural expenditure (Crescenzi 2007, p. 5). In the meaning of this principle, financial support should be limited to a few key objectives.

Moreover the funds intervention in order to be effective should support the areas in most need (Pietrzyk 2002, p. 186), to "compensate" the structural disadvantage of the assisted parts of the Community (Crescenzi 2007, p. 5). To implement a proper spatial distribution of funding among Member States, leading to achieve regional competitiveness and employment within their territories, the allocation was made on the basis of EU criteria. These criteria was relating to population, unemployment, employment, educational attainment and population density. Further, the Commission continues to have responsibility for appraising and adopting the operational programmes, which it has used to try and influence the spatial allocation of funding. (Bachtler, Mendez 2007, p. 544). The division of resources among operational programmes in Poland results from the diagnosis of the present situation, contained in *National Strategic Reference Framework* and the proposed development strategy, as well as striving at decentralisation in management of development processes, including EU resources.

The algorithm of funds division was established on the basis of criteria: population criteria, wealth level and unemployment rate in a given voivodship, which reflects the horizontal objective of NSRF connected with counteracting marginalisation of the regions. The algorithm, preference is assigned to voivodships of Eastern Poland, which belong to the poorest EU regions, as well as areas characterised by high unemployment rate. Those voivodships would be less competitive, attract fewer direct investments, develop slower and take more time to reform their economies.

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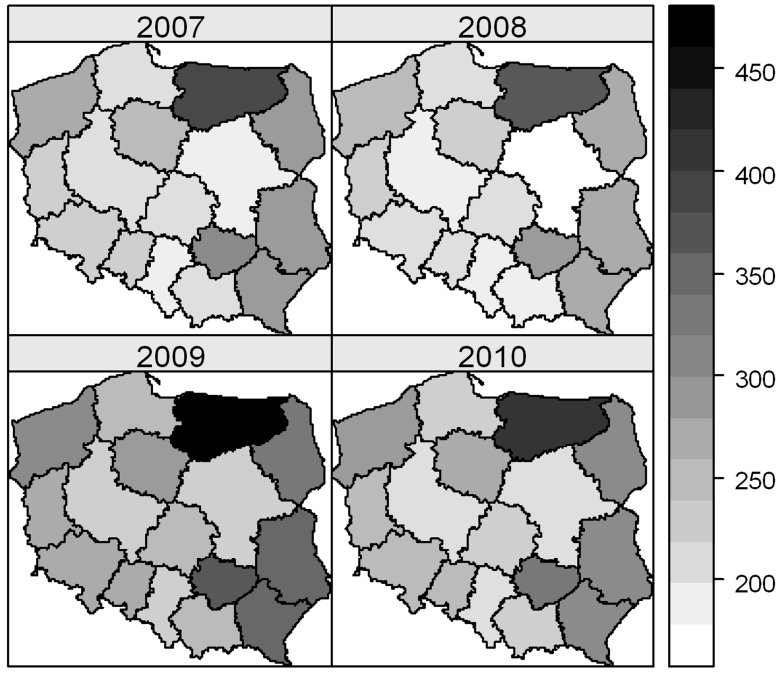

Figure 1. Total allocation of Regional Operational Programmes funds among 16 voivodships per capita in PLN

Source: own calculations in R Cran 2.15.

The application of the algorithm causes differentiation of transfers per capita in particular voivodships is maximum as 1:2.16. In the division of funding among particular voivodships in the Regional Operational Programmes, an algorithm was used which was based on the following criteria:

Criterion I. Poland as a whole conforms to present eligibility criteria for areas comprised by Objective 1 of EU structural funds. This justifies the dominating role of the population criterion in a regional division of support resources. 80% of those resources were divided in proportion to the number of inhabitants in particular voivodships.

Criterion II Taking into consideration intervoivodship differentiation in the level of GDP per capita, 10% resources were divided in proportion to the number of inhabitants in voivodships, in which the average level of GDP per capita was lower than 80% of the average level per capita in Poland.

Criterion III Taking into consideration the high unemployment rate and the threat recorded in many poviats of lasting marginalisation of considerable social groups, 10% of support resources were allocated for those poviats in which the average unemployment rate exceeded 150% of the national average value. (*National Strategic Reference Framework* 2007–2013, pp. 118–119).

Geographical concentration of funds let to decrease the number of beneficiaries and enlarge amount of resources to flow in selected regions. (Crescenzi 2007, p. 12). On the other hand, not only allocation criteria determinates the effective use of structural funds. Effectiveness depends on the abilities of the regions to initiate and co-finance these projects (Mohl, Hagen 2010, p. 353). The main aim of this paper is to assess potential bias in the geographical allocation of the funds from Regional Operational Programmes in the 2007–2010 period.

2. DATA

The analysis of spatial patterns in the distribution of usage of funds from Regional Operational Programmes was based on data describes values of subsidies, which have been co-financing finished grants in 379 provinces (NUTS 4) from 2007 to 2010. The data was obtained from *SIMIK 2007–2013 Standard report on the status of implementation of structural funds*, which is generated periodically. SIMIK gathers data about grant agreements by their subjects of aid and information about beneficiaries. In this research, the expenditures were divided into ten areas of intervention, a groups of intervention category according to European Commission Regulation (EC) No 1828/2006 of 8 December 2006, which consists of groups of categories (see: Table 1).

Table 1. Areas of interventions

BR	research and technological development, innovation and entrepreneurship (cat. 1–9)
SI	information society (cat. 10–15),
TR	transport (cat. 16–32)
SP	environment, prevention and control of natural and technological hazards (cat. 33–43)
IE	energy investments (cat. 44–54)
TU	tourism (cat. 55–57)
K	culture (cat. 58–60)
R	revitalization of urban and rural areas (cat. 61)
OZ	investments in infrastructure, health and social work (cat. 75–79)
PT	technical assistance (cat. 80–89)

Source: Smętkowski, Wójcik 2010, p. 9.

To account for differences in the levels of usage of funds between voievodships there was constructed an indicator. The indicator takes value of share of total value of finished projects in PLN[1] at current prices (application for final payment was signed) per 1 inhabitant in the each *r* province (NUTS 4), in *i* area of intervention and in *t* year in allocation value of aid form Regional Operating Program in proper voivodship (NUTS 2) for r province, per 1 inhabitant (the numbers of people actually living on the 31th December) in *t* year.

[1] Allocation values in EURO was counted in PLN by average year exchange rate of EURO.

If the values of x in r poviat and i area of intervention overcome 1, that indicates that (NUTS 4) the total value of projects per capita in analysed poviat was higher than the allocation value per capita in all poviats in proper voivodship (NUTS 2).

$$x_{r,j} = \frac{\text{(Value of finished projects per 1 inhabitant in } r \text{ province in } j \text{ support area)}_{r,j,t}}{\text{(Allocation value of aid form ROP in NUTS2 proper for } r \text{ province, per 1 inhabitant)}_{t}} . \quad (1)$$

Comparison of indicator values between poviats located in different voivodships gives possibility to investigate if the relative use of funds were concentrated in the poorest voivodships.

3. CONCENTRATION MEASURES

Classical concentration measures like Herfindahl's, Ellison-Glaeser, Gini's entropy indices, coefficient of variation or Theil's entropy measure are permutationally invariant. Different spatial patterns (from overdispered to agglomerated) can give the same values. This phenomena is so-called *anonimity property* (Arbia G., Piras G. 2009, p. 4471). To show differences between spatial and classical (a-spatial) concentration measures four hypothetical distributions of firms are considering (Guimarães, Figueiredo, Woodward 2011, p. 680).

Table 2. Four hypothetical distribution of 12 firms

1a.				**1b.**				**1c**				**2b**			
3	3			3									1	1	1
3	3			3					3		3		1	1	1
				3									1	1	1
				3					3		3		1	1	1

Source: Guimarães, Figueiredo, Woodward 2011, pp. 680.

Comparing distributions of 12 firms across 16 regions (Table 1) it is intuitively evident, that the highest spatial concentration is observed in situation 1a and the lowest in situation 2b.

Table 2. contains values of spatial measures and statistic of spatial autocorrelation.

The same values of standard measures of concentration in situations 1a-1c., indicates that they do not take into account spatial distribution of values of analyzed variables.

Table 3. Values of standard and spatial variants of concentration measures for hypothetical distribution of 12 firms (table 1)

		1a	1b	1c	2b
Standard concentration measures	H	0.250	0.250	0.250	0.083
	G	0.188	0.188	0.188	0.021
	$\hat{\gamma}$	0.127	0.127	0.127	– 0.067
Measures of concentration with spatial weights	H^s	0.411	0.342	0.250	0.156
	G^s	0.286	0.232	0.125	0.026
	$\hat{\gamma}^s$	0.266	0.198	0.065	– 0.059
Statistics of spatial autocorrelation	I	0.525	0.238	– 0.333	0.238

Note: in cited article Authors used row-standardized contiguity matrix with rook's definition of neighbors, see: Guimarães, Figueiredo, Woodward 2011, pp. 680–681. In this paper Moran's I statistics calculations are based on row-standardized contiguity matrix with queen's definition of neighbors.

Source: own calculations in R Cran 2.15.

Herfindahl concentration index assumes a homogenous economics areas, does not differ the distribution of interests with reference distribution (Guimarães, Figueiredo, Woodward, 2011, p. 681). The value of index ranges from $1/R^2$ to 1. The construction of index shows that the value of measure is determined by regions which have the highest share of the total value of analyzed variable (Guimarães, Figueiredo, Woodward, 2011, p. 680.).

$$H_j = \sum_{r=1}^{R} s_{r,j}^2 = \mathbf{s's} \,. \tag{2}$$

where: $s_{r,i,}$– share of region's $r=\{1, 2, \ldots, R\}$ value of support in $j=\{1, 2, \ldots, J\}$ area of intervention in the sum of support in the all regions (2).

$$s_{r,j} = \frac{x_{r,j}}{\sum_{r=1}^{R} x_{r,j}} \,. \tag{3}$$

[2] In this research R=379, hence 1/R=0.0026.

Ellison-Glaeser raw concentration index, is a modified version of Hoover's coefficient of location. This index is a relative concentration measure because it compares the distribution of interest values of analyzed variable with a reference distribution that captures the unequal distribution of overall economic activity across the economic landscape (Guimarães, Figueiredo, Woodward 2011, p. 680)**.**

$$G = \sum_{r=1}^{R} (s_{r,j} - u_r)^2 = (\mathbf{s}-\mathbf{u})'(\mathbf{s}-\mathbf{u}), \tag{4}$$

$\mathbf{u}'=(u_1, u_2, \ldots, u_R)$ **–** is a vector containing the elements of reference distribution, the share of total regional value of support in total amount of support in all regions (5).

$$u_r = \frac{\sum_{j=1}^{J} x_{r,j}}{\sum_{r=1}^{R}\sum_{j=1}^{J} x_{r,j}}. \tag{5}$$

Ellison-Glaeser index of concentration is based on the theory of localization choice. Takes on the value of zero when the values of X are randomly distributed across locations. A positive values of the index indicates a higher than random level of spatial concentration (Overman, Puga, 2010, p. 143).

$$\hat{\gamma}_j = \frac{G_j - H_j(1-\mathbf{u}'\mathbf{u})}{(1-H_j)(1-\mathbf{u}'\mathbf{u})}. \tag{6}$$[3]

Moran I global statistics of spatial autocorrelation captures the positions of regions similarity of values in neighboring localizations. The value of Moran's I statistics usually ranges from –1 to 1. Significant, negative value indicates that nearby locations tend to have different values of analyzed variable. A non-significant value means that values of analysed characteristics are distributed randomly among geographical units A significant positive values inform that in nearby locations occur similar values.

$$I_j = \frac{R}{\sum_{r=1}^{R}\sum_{i=1}^{R} w_{ri}} \frac{\sum_{r=1}^{R}\sum_{i=1}^{R} w_{ri}(x_r - \overline{x})(x_i - \overline{x})}{\sum_{r=1}^{R}(x_i - \overline{x})^2} = \frac{R}{S_0} \cdot \frac{\mathbf{z}'\mathbf{W}\mathbf{z}}{\mathbf{z}'\mathbf{z}}. \tag{7}$$

[3] Guimarães, Figueiredo, Woodward, 2011, p. 681.

where: **W** is binary matrix with a value of 1 for contiguous units and 0 otherwise, **z'**=(z_1, z_2, …, z_R) – column vector with elements: $z_r = x_r - \overline{x}$. For $\mathbf{W}^*$ row-standardised spatial contiguity matrix S_0=*R*, therefore:

$$I_j = \frac{\sum_{r=1}^{R}\sum_{i=1}^{R} w_{ri}^{*}\left(x_r - \overline{x}\right)\left(x_i - \overline{x}\right)}{\sum_{r=1}^{R}\left(x_i - \overline{x}\right)^2} = \frac{\mathbf{z'W^*z}}{\mathbf{z'z}}. \qquad (8)^4$$

4. SPATIAL EFFECTS

One of proposed in literature solution of accounting for spatial interactions in classical concentration measures is an application of row-standardized spatial contiguity matrix. The spatial lags of Herfindahl's index of concentration, Ellison-Glaesler raw concentration index and Ellison-Glaesler index are described by formulas (equation 8–10, based on Guimarães, Figueiredo, Woodward 2011, pp. 682–683).

$$H_j^S = \mathbf{s'\Psi s}. \qquad (9)$$

$$G_j^S = (\mathbf{s}-\mathbf{u})'\mathbf{\Psi}(\mathbf{s}-\mathbf{u}). \qquad (10)$$

$$\hat{\gamma}_j^S = \frac{G_j^S - H_j(1-\mathbf{u'\Psi u})}{(1-H_j)(1-\mathbf{u'\Psi u})}. \qquad (11)$$

where: $\mathbf{\Psi} = \mathbf{I} + \mathbf{W}^*$, **I** is the identity matrix, $\mathbf{W}^*$ is row-standardized contiguity matrix , with queen's definition of neighbors. The differences between concentration measures with spatial contiguity matrix are shown in table 2.

5. RESULTS AND DISCUSSION

Analyzing the patterns of spatial distribution of total use of funds from Regional Operational Programmes for voivodships across their poviats, it is worth to notice, that form 2007 to 2009 spatial dispersion of this phenomenon has been decreasing. In 2010, the most active poviats in using of financial aid were localized in Opolskie and Lubelskie. Spatial distribution of total support value in provinces per capita divided by total value of allocation in proper voivodship per capita is illustrated at Figure 1.

[4] Suchecki, 2010, pp. 112–113.

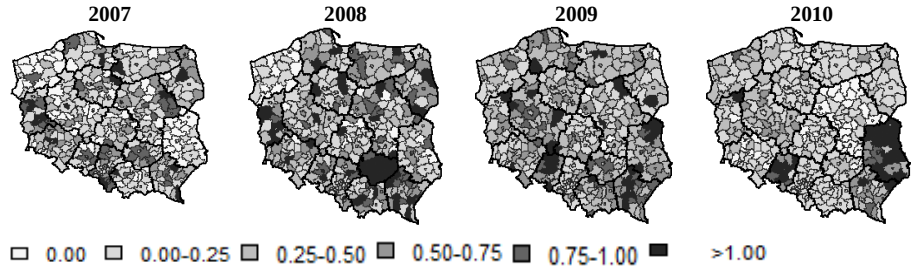

Figure 1. The Regional Operational Programmes support use as a share of total finished grants values in NUTS 4 in total allocation values in proper NUTS 2 region

Source: own calculations in R Cran 2.15.

Changes in values of concentration measures across time and areas of intervention, illustrated at figure 2. confirm increasing level of funds support concentration across poviats. The highest level of significant spatial concentration took place in 2010 in such areas of intervention as: BR – research and technological development, innovation and entrepreneurship (cat. 1–9), SI – information society (cat. 10–15), TR – transport (cat. 16–32), SP – environment, prevention and control of natural and technological hazards (cat. 33–43), IE – energy investments (cat. 44–54). K – culture (cat. 58–60) and OZ – investments in infrastructure, health and social work (cat. 75–79). Despite high levels of Ellison-Gaelser spatial index of use of financial aid in TU – tourism (cat. 55–57), R- revitalization of urban and rural areas (cat. 61) and PT – technical assistance (cat. 80–89), spatial concentration due to p-value of Moran I statistics, was insignificant.

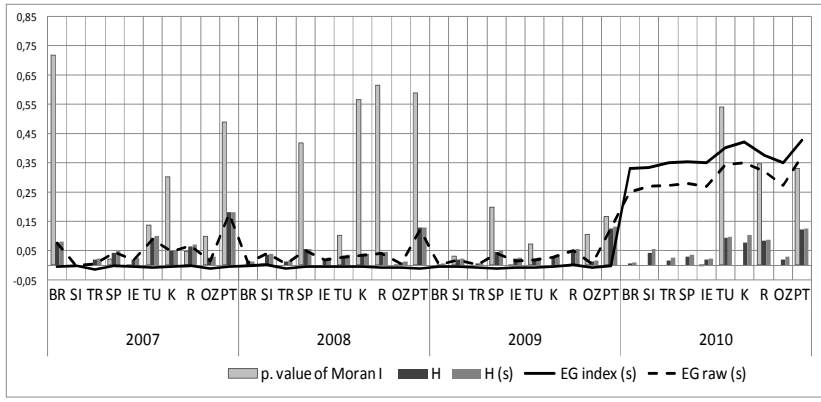

Figure 1. Values of the H(s) – Herfindahl's and EG (s) – Ellison-Glaeser indices

Notes: H – Herfindahl's concentration index, H(s) – Herfindahl's concentration index with spatial weights, EG index (s) – Ellison-Glaeser index of concentration with spatial weights, EG raw (s) – Ellison-Glaeser raw concentration index with spatial weights.

Source: own calculations.

Note that values of Ellison-Gaelser's raw spatial index have been changing similar to standard Herfindahl's index (without spatial lags) from 2007–2009. This relationship indicates that before 2010 high share of aid use in counties was highly fragmented. In 2010, the poviats aid use showed a tendency to clustering, which respectively increased the value of EG index.

Table 3. Values of concentration measures in 2007–2010 across intervention areas

Area	Year	H	H (s)	EG raw	EG raw (s)	EG index	EG index (s)	Moran I	p value
BR	2007	0.080	0.082	0.079	0.078	– 0.001	– 0.002	– 0.020	0.719
	2008	0.010	0.014	0.008	0.010	– 0.002	-	0.177	–
	2009	0.005	0.008	0.002	0.002	– 0.003	– 0.002	0.164	–
	2010	0.007	0.011	0.256	0.253	0.336	0.333	0.213	–
SI	2007	–	–	–	–	–	–	–	–
	2008	0.036	0.041	0.037	0.041	0.002	0.006	0.083	0.004
	2009	0.022	0.025	0.019	0.019	– 0.003	– 0.003	0.053	0.031
	2010	0.043	0.056	0.261	0.272	0.319	0.335	0.276	–
TR	2007	0.019	0.023	0.007	0.008	– 0.012	– 0.012	0.075	0.005
	2008	0.015	0.019	0.005	0.006	– 0.010	– 0.009	0.159	–
	2009	0.010	0.013	0.004	0.004	– 0.006	– 0.005	0.134	–
	2010	0.019	0.028	0.266	0.273	0.343	0.352	0.400	–
SP	2007	0.044	0.049	0.044	0.045	–	0.001	0.063	0.022
	2008	0.055	0.058	0.052	0.053	– 0.003	– 0.002	0.004	0.416
	2009	0.048	0.052	0.041	0.041	– 0.007	– 0.008	0.022	0.199
	2010	0.030	0.037	0.278	0.281	0.352	0.356	0.136	–
IE	2007	0.021	0.027	0.017	0.018	– 0.005	– 0.003	0.110	–
	2008	0.021	0.029	0.016	0.020	– 0.005	– 0.001	0.254	–
	2009	0.023	0.028	0.016	0.017	– 0.007	– 0.006	0.109	–
	2010	0.019	0.024	0.268	0.272	0.345	0.350	0.125	–
TU	2007	0.094	0.100	0.088	0.090	– 0.006	– 0.004	0.032	0.136
	2008	0.033	0.037	0.029	0.030	– 0.004	– 0.003	0.039	0.103
	2009	0.024	0.028	0.019	0.019	– 0.005	– 0.005	0.046	0.071
	2010	0.097	0.098	0.344	0.344	0.400	0.402	– 0.006	0.541
K	2007	0.052	0.054	0.048	0.049	– 0.003	– 0.002	0.014	0.302
	2008	0.040	0.042	0.036	0.036	– 0.003	– 0.003	– 0.008	0.566
	2009	0.032	0.038	0.027	0.029	– 0.005	– 0.003	0.125	–
	2010	0.078	0.105	0.325	0.350	0.386	0.423	0.329	–
R	2007	0.067	0.073	0.065	0.068	– 0.001	0.002	0.049	0.048
	2008	0.046	0.048	0.043	0.040	– 0.004	– 0.006	– 0.012	0.614
	2009	0.049	0.056	0.046	0.052	– 0.003	0.004	0.099	0.001
	2010	0.085	0.089	0.318	0.322	0.371	0.376	0.009	0.348
OZ	2007	0.027	0.030	0.018	0.017	– 0.010	– 0.010	0.036	0.100
	2008	0.012	0.015	0.007	0.008	– 0.005	– 0.004	0.106	0.001
	2009	0.014	0.016	0.008	0.007	– 0.006	– 0.006	0.038	0.105
	2010	0.022	0.031	0.265	0.273	0.339	0.350	0.375	–
PT	2007	0.182	0.183	0.177	0.178	– 0.004	– 0.003	– 0.002	0.488
	2008	0.130	0.130	0.123	0.122	– 0.007	– 0.007	– 0.010	0.589
	2009	0.128	0.132	0.125	0.128	– 0.002	0.002	0.028	0.166
	2010	0.125	0.128	0.372	0.374	0.424	0.428	0.011	0.331

Notes: H – Herfindahl's concentration index, H(s) – Herfindahl's concentration index with spatial weights, EG index (s) – Ellison-Glaeser index of concentration with spatial weights, EG raw (s) - Ellison-Glaeser raw concentration index with spatial weights.

Source: own calculations in R Cran 2.15.

6. CONCLUSIONS

The inclusion of the spatial weights matrix to traditional measures of concentration made it possible to better reflect the spatial concentration of financial support use from form Regional Operational Programmes. In 2007-2009 use of fund support was dispersed across poviats in all voivodships (for example in Mazowieckie voivodship). Observed distribution of activity of poviats in effective application and spending funds seems to be incompatible with assumption of concentration principle. The results of research show, that in 2010, the level of use of financial aid compared to value of allocations has concentrated in Lubelskie and Opolskie voivodships. The significant concentration was probably caused of the fact, that in this year most long-term projects was finished.

A significance spatial concentration in 2010, characterizes mainly the shares of funds in total allocation in such areas as research and technological development, innovation and entrepreneurship, information society, transport, environment, prevention and control of natural and technological hazards, energy investment, culture and investments in infrastructure, health and social work.

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ANALYSIS OF SPATIAL CONCENTRATION OF THE REGIONAL OPERATIONAL PROGRAMMES FUNDS SUPPORT USE

The cost-effective allocation of aid within the framework of EU regional policy, in accordance with the concentration principle, requires limiting support from European Union funds only to a few aims, which have fundamental significance to achieving economic and social cohesion. The spatial dimension of this principle is based on a concentration of aid in the least favored regions. The results of empirical studies show a limited or even insignificant impact of structural fund expenditure on the economic performance. The literature explains this lack of convergence by the redistributive expenditure and a significant spatial dispersion of aid projects.

The purpose of this paper is to analyze the spatial concentration and structure of intervention funded form Regional Operational Programmes. The research was based on data about the state of implementation of European funds in the poviats (NUTS 4) in 2007–2010., generated from the National Information System SIMIK 07–13.

ANALIZA KONCENTRACJI PRZESTRZENNEJ WYKORZYSTANIA FUNDUSZY POMOCOWYCH Z REGIONALNYCH PROGRAMÓW OPERACYJNYCH WOJEWÓDZTW

Efektywna alokacja środków pomocowych w ramach realizacji polityki regionalnej Unii Europejskiej, zgodnie z zasadą koncentracji, wymaga ograniczenia zakresu prowadzonych działań do programów mających szczególne znaczenie dla osiągnięcia spójności gospodarczej i społecznej. Wymiar przestrzenny omawianej zasady, sprowadza się do koncentracji środków pomocowych w regionach zapóźnionych rozwojowo. Wyniki badań empirycznych wskazują na niewielki lub nieistotny wpływ funduszy europejskich na poziom konwergencji gospodarczej regionów. Wśród przyczyn niskiej efektywności projektów pomocowych, wymienianych w literaturze przedmiotu, oprócz redystrybucyjnego charakteru wydatkowanych środków, wskazywane jest również znaczne rozproszenie przestrzenne realizowanych projektów pomocowych.

Celem niniejszego artykułu jest analiza koncentracji przestrzennej oraz struktury realizowanych projektów pomocowych. Badanie zostało przeprowadzone na podstawie zestawienia wygenerowanego z Krajowego Systemu Informatycznego SIMIK 07–13, o stanie wdrażania funduszy europejskich w powiatach (NUTS 4) w latach 2007–2010.