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PAŃSTWOWY INSTYTUT BADAWCZY

Assessment of territorial cohesion in terms of technical infrastructure in municipalities in Poland in 2005-2015

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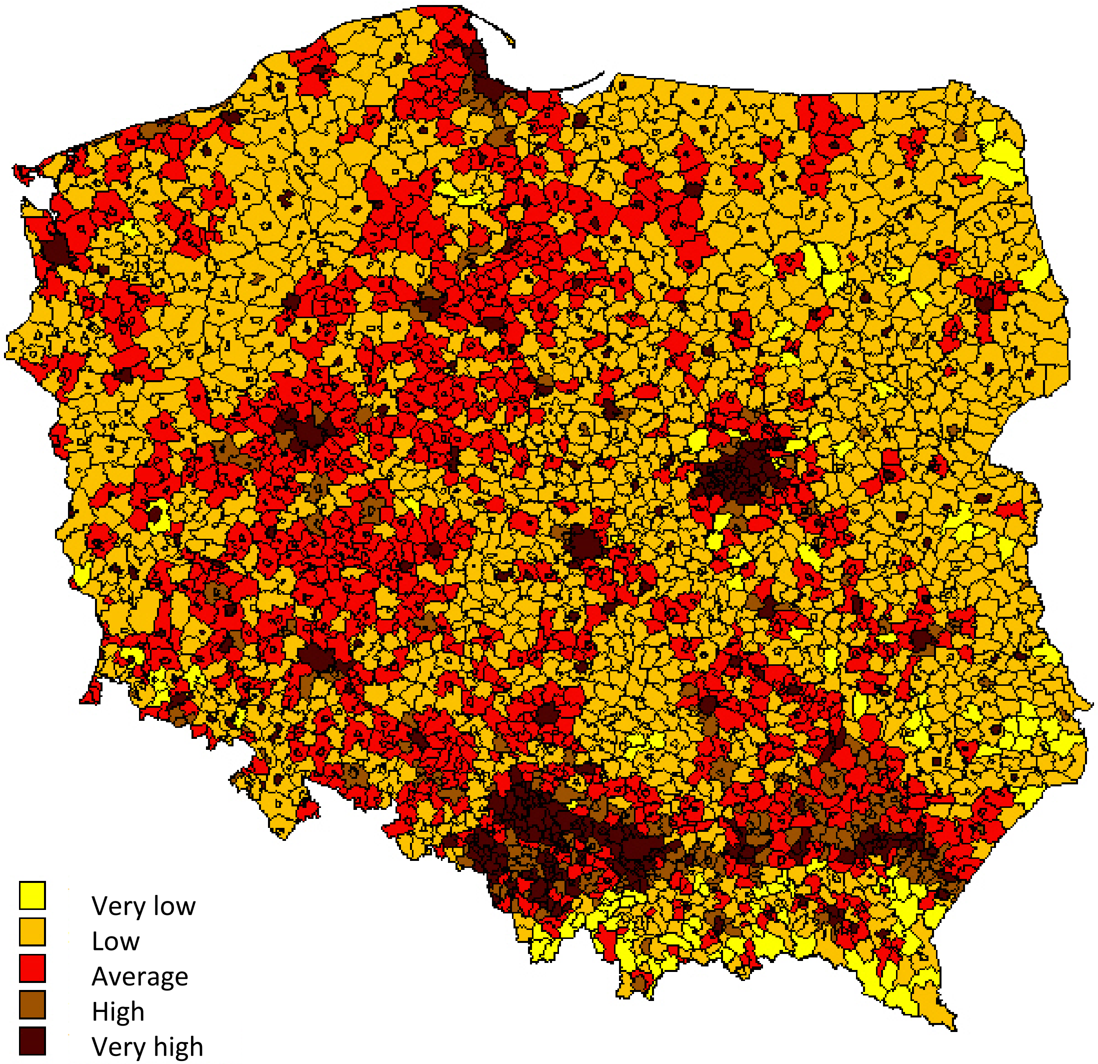
Assumptions of analysis

- From a European perspective, the concept of territorial cohesion refers to equalizing the level of development between countries or regions with financial support from the EU using cohesion funds. In Poland, this concept mainly refers to the avoidance of excessive spatial variations within the regions as well as between regions.
- The presented work covers the analysis of territorial cohesion of the entire population of municipalities (gminas) in Poland in terms of technical infrastructure in 2005-2015.
- It has been assumed that the change of a single element of a technical infrastructure causes changes in other elements, the feedback between them intensify interactions and the deep local infrastructural transformations are sometimes cause of inequality (divergence) that are difficult to reverse, leading to marginalization.
- It was assumed that particularly big cities exert a significant influence on the spatial variations of areas located in the affected zone.
- The aim of the study was to delimit territorial cohesion in terms of technical infrastructure in rural areas compared to cities, identify areas affected by polarization of technical infrastructure development, and identify spatial clusters in technical infrastructure.
- The aggregated indicator of technical infrastructure development based on the density of water supply, sewage and gas networks in the municipality was used.
- The methodology and tools of spatial statistics - Moran spatial autocorrelation was used.

Measure of technical infrastucture development

Level of technical infrastructure development of municipalities in Poland in 2015



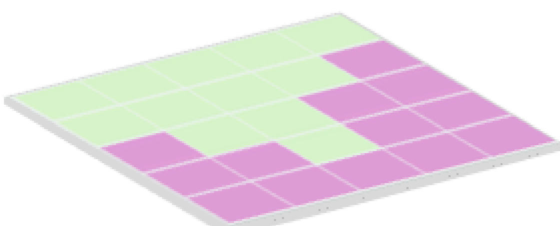
Level of development of technical infrastructure with respect to the type and size of the municipality

Type and size of municipalities	Technical infrastructure					
	Level of development			Coefficient of variation		
	2005	2010	2015	2005	2010	2015
urban	203,4	199,7	202,5	33,2	34,1	30,1
< 10	136,2	134,3	142,6	36,9	35,8	40,6
10 – 20	186,3	178,9	187,8	32,6	33,3	30,2
20 – 50	228,5	221,2	220,5	28,3	30,9	25,0
50 – 100	228,2	230,2	228,1	25,9	26,3	22,9
> 100	229,4	226,4	224,5	18,3	17,3	16,7
rural	82,2	83,4	82,8	26,9	29,1	31,5
< 2,5	64,8	65,0	62,0	23,5	15,9	26,0
2,5 – 5	76,7	74,5	73,9	19,3	17,6	21,8
5 – 10	81,6	82,3	81,9	24,8	24,5	27,6
10 – 15	96,3	103,0	102,0	29,3	32,0	32,9
> 15	111,8	118,1	115,9	36,4	34,8	34,5
urban-rural	94,0	92,7	93,0	20,4	26,2	24,5
< 5	79,7	78,8	74,9	12,1	20,0	16,6
5 – 7,5	82,6	79,3	80,4	13,9	13,5	15,6
7,5 - 15	90,1	88,3	88,7	16,4	19,3	18,1
15 – 30	101,2	100,1	101,0	17,6	23,4	21,9
> 30	126,1	130,1	130,2	17,9	30,8	23,5

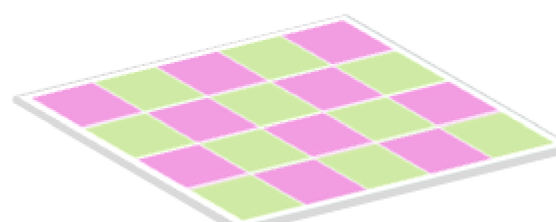
Measure of spatial autocorrelation

Everything is related to everything else, but near things are more related than distant things → **First law of geography** (Waldo R. Tobler)

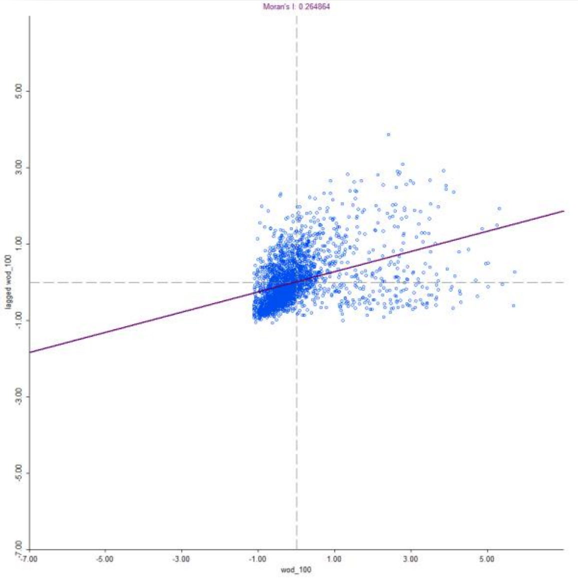
- **Spatial autocorrelation →** the degree to which one object is similar to other nearby objects - indicates some homogeneity of spatial structures
- The **(univariate) Moran's I** index (Moran 1950) is the correlation coefficient for the relationship between a variable (e.g. level of technical infrastructure) and its surrounding values-similar to Pearson's correlation
- Popular neighborhood definitions include **distance bands** (e.g. units within X km) and **k nearest neighbors** (e.g. the 2 closest neighbors)
- Values of I usually range from -1 to +1. Moran's I can be classified as positive, negative and no spatial autocorrelation
- **Positive** spatial auto-correlation occurs when Moran's I is close to +1. This means values cluster together i.e neighbouring regions have similar values
- **Negative** spatial auto-correlation occurs when Moran's I is near -1. i.e neighbouring regions have different values. A value of 0 for Moran's I typically indicates no autocorrelation.



This clustered pattern generates a Moran's I of 0.60



A checkerboard is an example where Moran's I is -1 because dissimilar values are next to each other



Moran's scatter plot

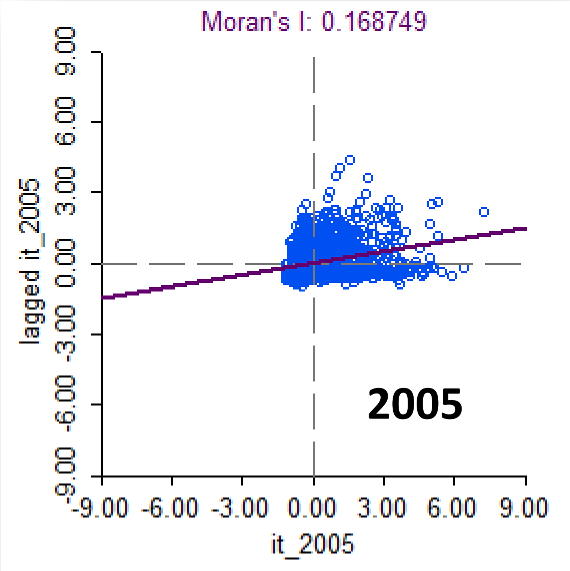
→The upper right and lower left quadrants represent positive spatial autocorrelation, which means clustering of similar values

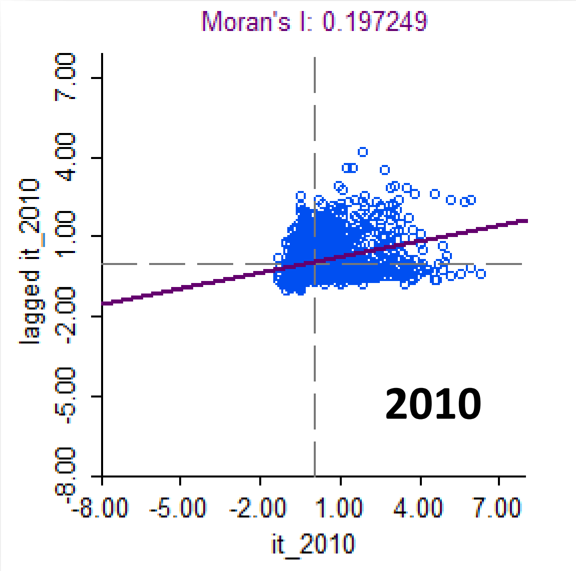
→The lower right and upper left quadrants represent negative spatial autocorrelation or spatial outliers.

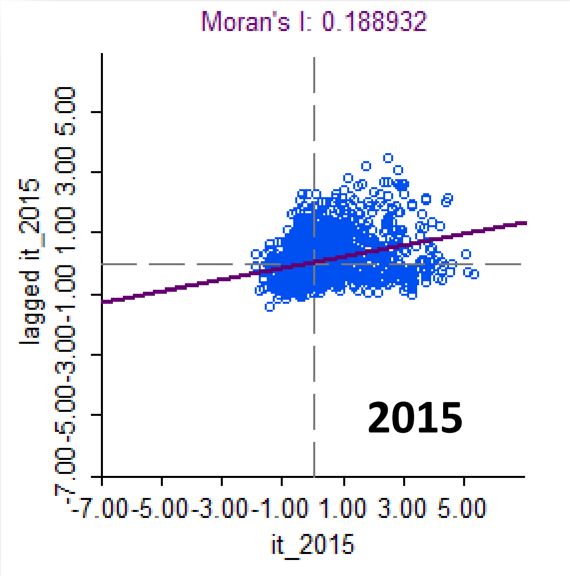
→ One can visually check whether there appear to be more clusters or outliers by inspecting points that fall into the upper right or lower left quadrants.

- Univariate Moran's I is a global statistic that tells whether there is clustering or dispersion, **but it does not inform of the location of a cluster**.
- **Local Moran's I** is a local spatial autocorrelation statistic developed by Anselin (1995) as a local indicator of spatial association (LISA)
- It decomposes the global Moran's I down to its components thus constructing a map with regions that have high values of the variable and have neighbors with high values (high-high), low-low in the same scheme and alternatively low-high and high-low units.
- The former regions are therefore those that contribute significantly to a positive global spatial autocorrelation outcome, while latter contribute significantly to a negative autocorrelation outcome.

Results



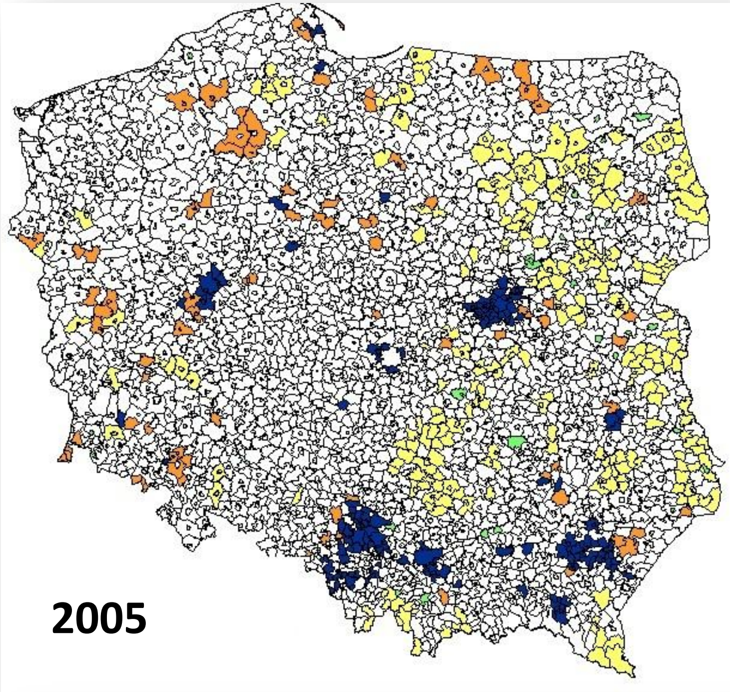


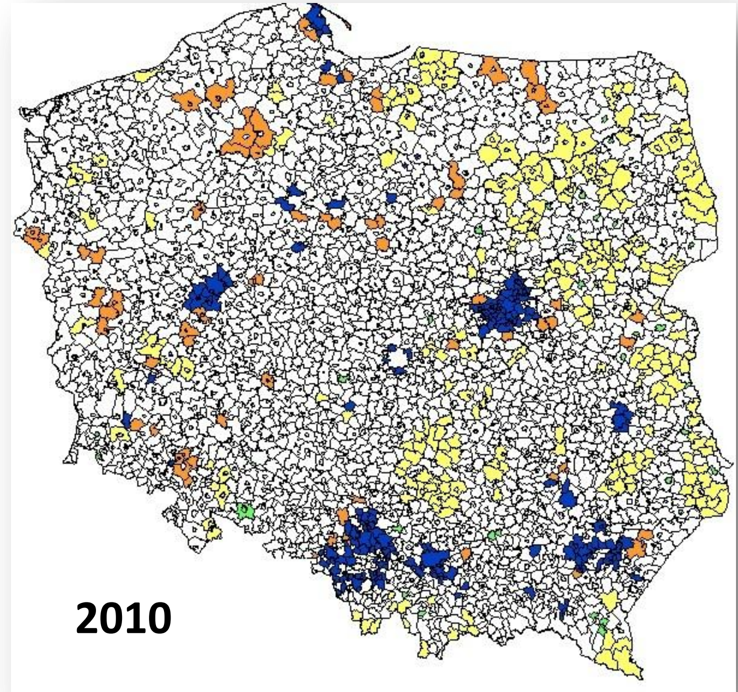


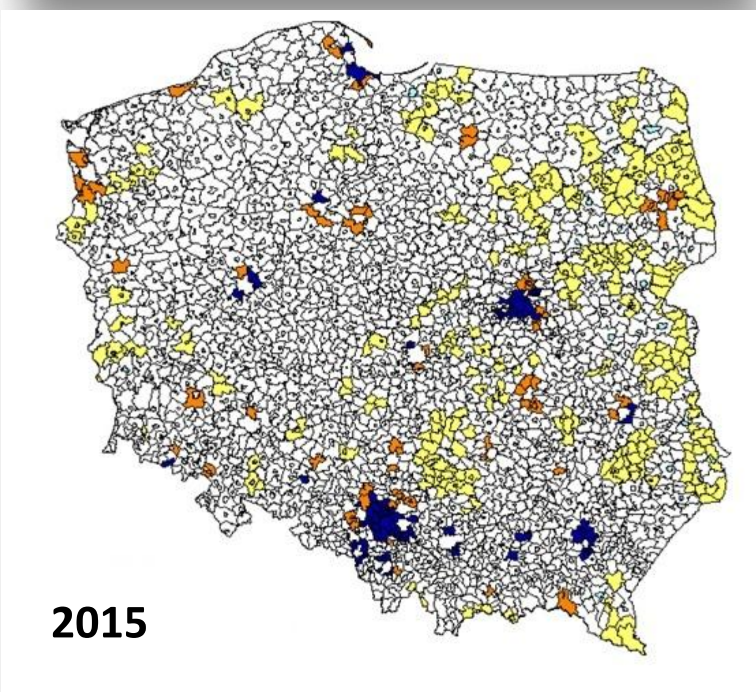
Moran's I statistics – spatial autocorrelation → technical infrastructure, communities of Poland

Year	Moran's I statistics
2005	0,169
2010	0,197
2015	0,189

It is positive → there is an overall pattern of clustering in technical infrastructure







LISA – local spatial autocorrelation → technical infrastructure, communities of Poland

Type	Description	Color	Year/#		
			2005	2010	2015
Clusters	High surrounded by high (HH)		136	150	142
	Low surrouded by low (LL)		233	242	202
Outliers (Hot-spots)	Low surrouded by high (LH)		75	68	78
	High surrounded by low (HL)		39	40	47

Conclusions

- Results show that increased level of technical infrastructure development polarization indicates that this is not an accidental and transient phenomenon but a continuing development trend.
- In the period under review, territorial cohesion in technical infrastructure was weakened.
- The delimitation of infrastructure diffusion areas using the spatial correlation method at the municipal level has revealed that big cities are the strongest centers of regional diffusion of development.
- Particularly unfavorable in terms of development prospects is the situation of communes located in the periphery of large area regions. These municipalities do not have strong functional links with metropolitan areas.