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Municipal changes in Slovakia. The evidence from spatial data.

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Abstract

The main objective of the paper is to examine the evolution of spatial patterns of settlement network in Slovakia as a result of population rearrangement among municipalities based on time series data of 1993 - 2017. The objects of the research are municipalities, which during the searched period recorded unusual fast population growth or decline, far exceeding the chosen parameter of the population sample. The primary population sample consists of 2919 municipalities. The experimental samples consist of 563 of fast-growing municipalities and 413 of fast-declining municipalities, based on the chosen statistical criteria, what is the compound annual growth rate. The results have shown that fast-growing municipalities are predominantly situated on the West, surrounding the Bratislava agglomeration, on the North and the East surrounding the Kosice metropolis. Generally, they tend to cluster around the cities on the district and regional levels. Fast-declining municipalities predominantly situated in the Middle, along the Hungarian, Polish, and Ukrainian border on the South and the East of the country, respectively.



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1. INTRODUCTION

Slovak municipalities have been going through profound spatial changes, which had shaken its traditional settlement fabrics since the Velvet revolution in 1989. This still ongoing process leads to redistribution of population among municipalities and to the exchange of population between city and hinterland. In consequence, some areas are gaining population whereas others permanently losing population, thereby challenging its population and material base and underscoring deepening disparities on a regional level.

(Falt'an and Pašiak, 2004) characterize urban development of Slovakia after 1990, like as typical in the transformation of urban and rural settlements, in human potential, in the economic base, in its internal structures and relations. In the development of the urban settlement network, we witness the apparent counter urbanization process and more significant suburbanization and decentralization process, which has, however, markedly selective character.

The primary cause of the processes mentioned above, we might consider an internal migration. (Bezák, 2006) distinguishes four types of internal migration on the perceived axis of urban-rural dichotomy. During the 1980s, a decisive part of migration flows had been made by emigration flows from the countryside to cities; after 1990, the counter urbanization tendencies prevailed. Other types of internal migration represent the migration between the cities and the countryside.

(Tóth, 2014; Bezák, 2014) considers the so-called functional urban regions, as a better spatial framework for studying the processes of growth and redistribution of the population, migration mobility a regional dimension of settlement systems, than the traditional administrative-territorial units. The functional urban region characterizes the distinct regional urban hierarchy between the urban cores and its satellites braced by the intensive urban-rural relations. The significant role in this pattern plays short-distance commuting.

The first signs of the modern suburbanization in Slovakia can be visible on an example of Bratislava city and its hinterland, which we might observe in the 1980s years of the twentieth century. Its character, architecturally or socially, was significantly affected by the urbanization process with a strong dependence on the city of Bratislava. Another commonly visible pattern was a transformation of until then gardening colonies located on the city periphery on permanent habituated objects. This trend had had reportedly shifted to city suburbs or the countryside and gradually to other Slovakian cities (Falt'an, 2019).

Development of regional economics in Slovakia followed patterns suggested by regional polarization theories. Polarization approaches incorporating factors of infrastructure development, stock of human capital, and agglomeration probably were the best models to describe processes of regional divergence in Slovakia and resembled those in other European countries (Baláž, 2007).

2. BACKGROUND

2.1 Literature review

Most people tend to move for economic reasons. The causes of migration can be generally divided into the push and pull factors. As a push factor, we might consider high unemployment, low wages, war, land shortages, famine, or poverty. As pull factors, we consider higher wages, job and educational opportunities, or the 'bright lights' of cities. (Stutz and Warf, 2012).

Migration on the country level over time could lead to the permanent reallocation of the population between the cities and the countryside. Then we can speak about urbanization processes. There are several theories explaining the main drivers of urbanization, in the past and present, including both demographic transition and economic development (Zelinsky, 1971; Dyson, 2011).

Urbanization and commonly related processes of a city changes became an object of the interest from various fields of expertise and science (Tzaninis & Boterman, 2018; Hilal et al., 2018; Taubenböck, et al., 2019; Tsenkova & Nedovic-Budic, 2006). Also, many authors had investigated the impact of urbanization and suburbanization processes on the development of so-called satellite cities, which incorporate settlements located within the area of gravity of some cities on a higher level of the centrality (Falt'an, 2019). Some authors also concern by the depopulation of certain, mainly rural areas in favor of more urbanized and centralized ones (Makra et al., 2018).

The migration transition model (Zelinsky, 1971) links the urbanization with migration in several phases. The first phase is before the beginning of the urbanization, and actually, there is only little migration. In the second phase, a huge movement from the countryside to cities is in place. During phase three and phase four, urban migration outpaces rural to urban migration, where rural to urban migration continues but diminishes absolute or relative rates. Finally, during phase five, nearly all domestic migration may be of the interurban variety.

The stylized sector-specific model of urbanization concerns mortality. Because of a drop in infectious disease mortality over time, the urban death rate falls more rapidly than the rural death rate. A crucial stage occurred when the urban death rate dropped below the urban birth rate resulting in the urban population growth, further stimulated by rural to urban migration (Dyson, 2011).

(Collantes et al., 2013) studied the spatial distribution of immigration in rural areas in Spain. At the first settlement of relatively high-income migrants from Northern Europe in tourist areas along the Mediterranean coast and the islands, the pattern had shown. Secondly, Madrid and Barcelona's metropolitan areas became centers of gravity for large numbers of skilled and unskilled migrants. Finally, the labor-intensive and export-oriented agriculture found in provinces such as Almeria and Murcia in south-eastern Spain also became attractive for migrants with other labor skills.

(Tzaninis and Boterman, 2018) in its resumé point on suburbanization as a prevalent process of post-war, capitalist urban growth, conditioning to a majority of citizens in many advanced capitalist economies to live in the suburbs. (Hilal et al., 2018) explain above mentioned processes as a result of the gradual saturation of the central areas, improvements in infrastructure level, and steady growth in urban real estate prices, as

well as by push factors (city intrusions) and pull factors (peripheral amenities). Also, the high cost of housing in city cores led to the outflow of the less affluent households and families with children from central districts to settle the outskirts.

The post-socialist urban restructuring has resulted in a change in land use patterns similar to Western Europe since the late 1950s. Suburbanization has made a substantial increase in urbanized land as well as to a decrease in urban density. Cities and city-regions demonstrate a sign of convergent adaptation and path dependency at the same time (Taubenböck et al., 2019).

(Tsenkova & Nedovic-Budic, 2006) perceive urbanization and conventional related processes in the former Soviet Union and the Central and Eastern European countries in the light of the transformation phase. Political and fiscal decentralization transfer power and responsibilities to local governments. Policies affecting urban areas and land gentrification, and central area refurbishment, dwelling, transportation, and provision of infrastructure have significant ramifications for both the economic efficiency and the social wellbeing of local communities.

(Lukic et al., 2012) investigated depopulation trends in Western Balkan countries. There are two factors that affect depopulation: negative natural increase, which is the result of wrong age structure, and migration. Migrations were provoked by civil conflict, which was guided by an increase in mortality rates and decrease fertility. However, nowadays, the emigration from the region is no longer primarily related to the war, conflict, and human rights abuses, but in consequence of a worsening of the economy and a lack of appropriate jobs, especially for medium to highly skilled workers.

(Zborowski, Soja & Lobodzińska, 2012) list a number of factors, which have been playing the pivotal role in population redistributions in Poland by the motive, direction of move, geographical range, and specific nature. Wage migrants belong to citizens occupying medium-sized post-industrial urban centers or small towns. The next group are citizens of large and medium-sized cities, who move to the urban-rural fringe thanks to suburbanization processes—migration within functional urban regions. Warszawa has an especially large migrant gravity area. centers, like Kraków, Wrocław, Poznań, and Gdańsk, have smaller catchment areas.

Above mentioned processes often result finally to regional polarization. The concept of polarized development is already well observed. It is an integral part of theories based on the polarized approach to regional development. In this relation, the theory of growth poles (Perroux, Boudeville) and the theory of cumulative causations (Myrdal, Hirschmann) are most known. However, Perroux (1955), within its theory, understands the space rather abstractive as a sphere of influence in economics, where distinguishes propulsive and being propulsive industries. Perroux theory was substantially extended by the Boudeville (1966) and Lasuén (1969), who linked Perroux inductive theory with Christaller's (1933) and Lösch's (1940) deductive theory of central cities (Blažek & Uhlíř, 2011). The study of relations between the central cities and its hinterlands concerns Christaller, as well as Lösch. Christaller enriched the picture represented by Lösch by considering different functions or types of production. The optimal configuration of cities on the featureless plain now includes an urban geographical hierarchy, in which higher-order cities (those containing functions that require more centralization) are fewer and farther apart than lower-order cities. There are a large number of market towns; every group of market towns is focused on a larger administrative center. The theory seems to offer an answer to the question of how the economics of scale and

transport costs interact to produce a spatial economy (Geltner et al., 2014; Fujita et al., 1999).

Myrdal (1957), as Hirschman (1958), incorporates interactions between the regions in two counter effects. Myrdal recognizes 'spread' and 'backwash' effects, Hirschman denotes them as 'trickling down effects' and 'polarization effects.' These effects include mechanisms, which are leading to spatial expansion of development impulses. On the opposite, backwash effects and polarization effects include effects that manifest on neighboring regions negatively; economic activity is being sucked into one center (Maier & Tödling, 1996).

There are many assumed causes of regional growth and decline. (Polèse, 2009) for instance, mentions negative clusters as a part of the historical legacy of regional development, which has turned into decline. The negative clusters are term, which was coined to industries, whose early dominated in the regional landscape, however, now are the principal source of the regional decline. The coal-mining region, centered on the Borinage district and cities of Mons and Charleroi in Belgium, metal-bashing industries of Birmingham, or great blast-furnaces of the English Midlands, are examples of particularly debilitating effect of negative clusters on the local economy. In turn, scale economies in production, trade, transportation, and distribution related to the local area might serve as a basis for growth and development.

(Benedek & Koczisky, 2015) analyzed polarization and peripheralization on the case of Vysehrad countries. On the level of Vységrad countries, any evidence about the sigma-convergence, either in economic or in multi-dimensional terms, was not found. The regional gap among these countries has increased, which indicates an evident process of spatial polarization. These divergences are very rapid in Hungary and Slovakia. Generally, results underline the fact of nation-wide convergence to the EU mean level of development has been achieved at the cost of increasing internal polarization and peripheralization.

3. ANALYSIS

Primarily, the paper investigates the spatial rearrangement of the population across the region and country, resulting in a population of specific areas and, in turn, depopulation of other ones over Slovakia. The objects of the research are municipalities, which during the searched period recorded unusual fast population growth or decline, far exceeding the chosen parameter of the population sample, what is the compound annual growth rate.

The whole process we observe on long term time series data plotting is the compound annual growth rate, incorporating natural and migration changes over the years 1993 – 2017, counting all municipalities (settlements) located in Slovakia.

Secondly, the paper investigates, if long term population changes and redistributions between municipalities would show some systematical pattern, like clustering or dispersing pattern of growing /declining municipalities in some particular areas over Slovakia. At the conclusion, results might indicate regional polarization affecting growth and development.

For our research we introduce is compound annual growth rate, V_i , calculated per every municipality as:

$$V_i = \left(\frac{t_b - t_a}{\sqrt{\frac{P_{it_b}}{P_{it_a}}}} - 1 \right) * 100\% \quad (1.0)$$

Where P_{it_b} and P_{it_a} are population levels for i -th municipality, $i = 1, 2, \dots, n$; in the year t_b and t_a , respectively. The time interval during the measurement period was expressed by $t_b - t_a$.

Next, we collect evidence about possible systematical spatial changes in terms of growing and declining municipalities. For this purpose, we divide our primary population sample into two subsamples. The primary population sample consists of 2 919 units, municipalities, thus all settlements in Slovakia. The first population subsample includes all municipalities, which in explored period show population growth, so it is 1 656 (56,7%) of growing municipalities. The second population subsample includes all municipalities, which in explored period show population decline, so it is 1 263 (43,3%) of declining municipalities..

Furthermore, on population subsamples (growing and declining municipalities), we further apply binary division for each subsample; thus, we make two experimental population subsamples, consisting of statistically significant, i.e. fast-growing and fast-declining municipalities.

In the case of growing municipalities, we are showing a variation range of 0,001% to 7,76% on average per annum. Standard confidence interval 95% (CI) for the sample mean was set on [0,747; 0,824] level, so in further sampling, we incorporate only those municipalities which exceeded the upper confidence bound of this interval; thus, we consider them as statistically significant, i.e., fast-growing municipalities.

In the case of declining municipalities, we are showing a variation range of -0,003% to -7,43% per annum. Standard confidence interval 95% (CI) for the sample mean was set on [-0,715; -0,639] level, so in the further sampling, we incorporate only those municipalities which exceeded the upper confidence bound of this interval; thus we consider them as statistically significant, i.e., fast-declining municipalities.

The reason is straightforward; by experience, we find out that a large number of the municipalities recorded values of (population growth/decline) very near (above/below) the zero, what suggests the presence of a random component in the trend, what it does not contribute on showing some systematical pattern.

Finally, we introduce the methodology for the examination of spatial patterns of municipalities based on researched statistical character relative population change. Purposely, we are looking for some evidence about systematical clustering or dispersing patterns of growing and declining municipalities over the area of Slovakia.

Initially, sourcing as a method of study from the plant ecology, Quadrat analysis embraces a variety of mathematical and statistical techniques that are designed to measure properties of point patterns. These techniques are of inherent interest to geographers because they provide answers to fundamental questions about the relationships between points in space (Thomas,1977).

Quadrat sampling involves collecting counts of the number of events in subsets of the study region A . Traditionally, these subsets are rectangular, although any shape is possible. So, we assume about the realization of a point process $\{Z(s): s \in H \subset \mathbb{R}^2\}$ consisting of points in the random set H . The random set represents H all municipalities located in Slovakia. A point pattern is noted as a completely random pattern if the following criteria are met. The average number of

events per unit area; the intensity (s); is homogeneous throughout H , the number of events in two non-overlapping subregions A_1 and A_2 are independent, and the number of events in any subregion is Poisson distributed. The mathematical manifestation of complete spatial randomness is the homogeneous Poisson process pattern (Schabenberger & Gotway, 2005).

Based upon the distribution of points across the quadrats and the frequency capturing the distribution, one can determine if the point distribution under study is closer to a clustered, a random, or a dispersed pattern. Observed point patterns are tested initially against the hypothesis of a complete spatial random pattern. The last issue that requires careful consideration when applying Quadrat analysis is the size of quadrats. Optimal size of quadrat according to the (Taylor, 1977; and Griffith & Amrhein, 1991 in Wong & Lee, 2005) can be calculated by

$$\text{Quadrat size} = \frac{2A}{r} \quad (1.1)$$

Where A is the area of the study, i.e. the area of Slovakia, which is 49 036 km^2 .

r is the number of points in the distribution, i.e. number of cities, which is 2919.

This suggests that a quadrat of the appropriate size has a width of $\sqrt{2A/r}$ in case of square quadrats or a radius of $\sqrt{2A/\pi r}$ in the case of circular quadrats. Once the quadrat size for a point distribution is determined, Quadrat analysis can proceed to establish the frequency distribution of the number of points for all quadrats that cover the entire study area systematically. In our searched area we examined the difference between an observed point pattern to a point pattern generated by a random process. A parameter in the Poisson distribution is the average number of occurrences, λ , which in the context of our research means the average number of points (municipalities) in a quadrat. Assume that we have n quadrats and r points in the entire study area.

We are assuming as the null hypothesis, that all statistical samples follow a Poisson distribution, which we might approximate as a random distribution pattern, expressing formally as

$$H_0: \mu = X \sim Po(s\lambda)$$

And as alternative hypothesis

$$H_1: \mu \neq X \sim Po(s\lambda)$$

Where μ means the average number of points (municipalities) in a quadrat.

An estimate of $\lambda = \frac{r}{n}$, means the average number of points in a quadrat. Using the Poisson distribution, the probability of having x points in a quadrat is then defined as

$$p(x) = \frac{e^{-\lambda} \lambda^x}{x!} \quad (1.2)$$

Where e is the natural logarithm and $x!$ is the factorial of x , which can be defined as

$$x! = x * (x - 1) * (x - 2) * \dots * 1 \quad (1.3)$$

Using various values for x (e.g., 0, 1, 2,..., r) in the above equation computing the Poisson distribution, the probabilities of having x points in a quadrat can be derived.

The observed frequency distribution derived by tabulating the number of quadrats containing different numbers of points must be compared to the expected frequency

distribution describing a random point pattern. The observed and expected frequency distributions can be compared using the Kolmogorov – Smirnov (K-S) statistical test. This test is being used to test if the observed frequency distribution and the frequency distribution of a theoretical pattern are statistically different or not.

$$D = \text{Max } |O_i - E_i| \quad (1.4)$$

Where O_i and E_i are the observed and expected cumulative proportions, respectively, of the i th category in the two distributions. Calculating a critical value as the basis for comparison. In the one sample case

$$D_{\alpha=0.05} = \frac{1.36}{\sqrt{n}} \quad (1.5)$$

Where n is the number of points. Besides using K – S statistics to test if the observed pattern is different from a random pattern, one may perform the Variance-Mean Ratio Test by taking advantage of a specific statistical property of the Poisson distribution.

$$\sigma = \frac{\sum n_i (x_i - \lambda)^2}{n} \quad (1.6)$$

Where x_i is the number of points (cities) in a quadrat, n_i is the number of quadrats with x_i points, and n is the total number of quadrats. With this ratio, given an observed point pattern and the frequency distribution of points by quadrats, we can compare the pattern's observed variance-mean ratio to 1, the expected variance-mean ratio, to see if they are significantly different or not.

The test statistics, which is a t – statistics, is defined as

$$t_{(df=n-1)} = \frac{\left| \left(\frac{\sigma}{\lambda} \right) - 1 \right|}{\sqrt{\frac{2}{(n-1)}}} \quad (1.7)$$

With a degree of freedom = $n - 1$, where n is the number of quadrats. The numerator is the absolute difference between the observed variance-mean ratio and the expected ratio. If the observed pattern is not statistically significantly different from a random pattern, then we can expect that the observed variance-mean ratio, $\frac{\sigma}{\lambda}$, will be close to 1, the theoretical variance-mean ratio for a Poisson distribution, where σ and λ are the same. If $\frac{\sigma}{\lambda} > 1$, this indicates that the pattern may be more clustered, as that the relatively large variance implies that some quadrats have many points and others have very few. On the other hand, $\frac{\sigma}{\lambda} < 1$ is an indication of a dispersed pattern as σ is quite small and all quadrats have similar number of points (Wong & Lee, 2005).

As noted in methodology, the primary population sample consists of 2 919 municipalities, including growing and also declining ones. On the first classification level, we divided the primary population sample on two population subsamples. The first subsample includes only growing municipalities in terms of population, and the second subsample records only declining municipalities.

On the second classification level, we separated from the subsamples those municipalities, which complied chosen criteria: exceeded CI [0,747; 0,824] of the population subsample of growing municipalities, as same for CI [-0,715; -0,639] of the population subsample of declining municipalities. Thus, we created two experimental population subsamples. The first experimental population subsample includes only

statistically significant, i.e. fast-growing municipalities, which consists of 564 units. The second experimental population subsample includes only statistically significant, i.e. fast-declining municipalities, which consists of 413 units. Further, we proceed only with experimental population subsamples, including fast-growing and fast-declining municipalities, and with primary population sample, including all municipalities in Slovakia, we consider as a control variable.

Next, according to the eq.(1.1), we set the appropriate size of the quadrat (square shape) via using the GIS application. The primary population sample, including all municipalities, the area of the square quadrat, was set at $5,79 \text{ km}^2$. Experimental population subsample of fast-growing municipalities, the area of square quadrat was set at $13,18 \text{ km}^2$, and in case of population subsample of fast-declining municipalities, the area of square quadrat was set at $15,4 \text{ km}^2$. Distinguishing number of quadrats was assigned with respect to the size of the country and the size of experimental population samples, respectively.

Figure 1a displays the spatial distribution of all municipalities across Slovakia embedded into the assembled grid according to the eq.(1.1) via using the 'fishnet' tool provided by the GIS. Figure 1b displays the spatial distribution of those municipalities which recorded unusually fast growth, thereby outpacing the confidence interval of the sample mean computed based on all municipalities, which had shown population growth in the given period. Figure 1c displays the spatial distribution of those municipalities which recorded unusually fast declines, thereby outpacing the confidence interval of the sample mean computed based on all municipalities, which had shown a population decline in the given period.

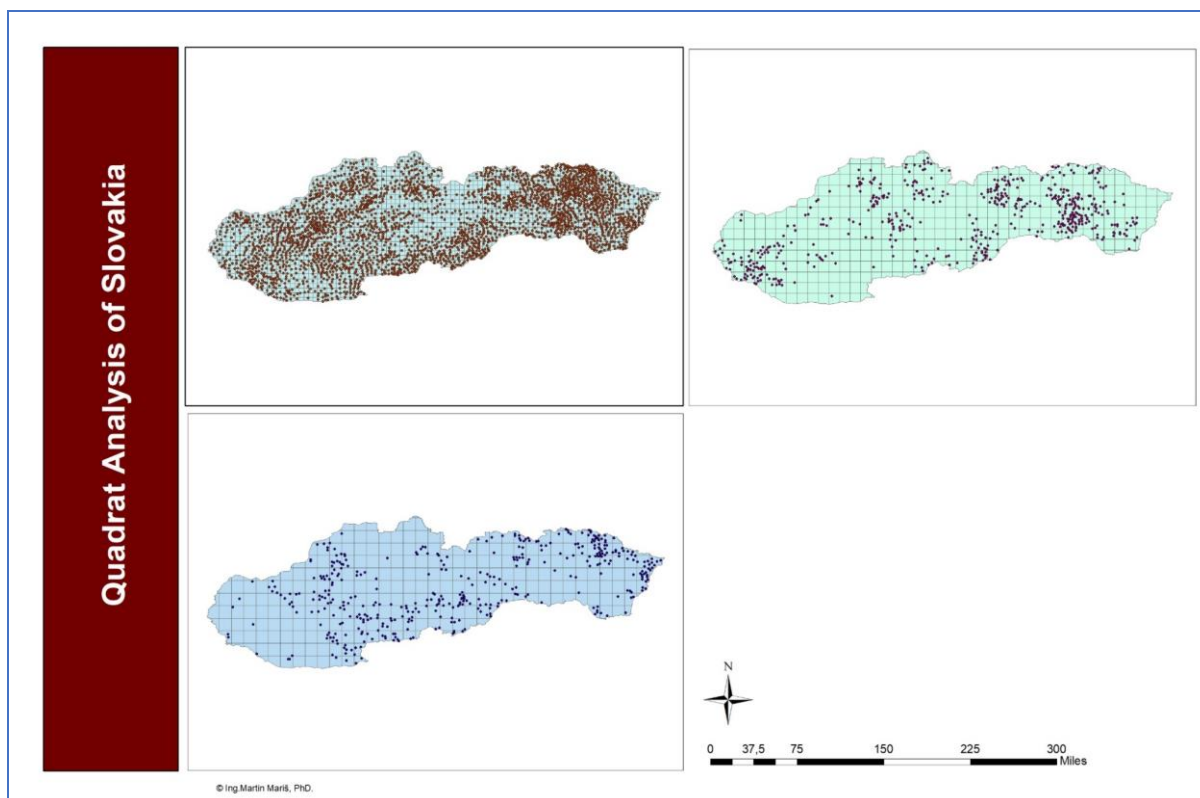


Figure 1. Spatial deployment of municipalities within the quadrats by sample

Table 1 is a numerical reproduction of Fig 1a).; it includes 2 919 municipalities grouped in 1 946 quadrats. The leftmost column of Table 1 lists the number of municipalities per one quadrat; the second column relates a number of quadrats to the respective number of municipalities in each class; the third column displays actually observed share of quadrats in each respective class on the total number of quadrats and the fourth column displays cumulative proportions of observed shares of quadrats on the total number of quadrats.

The fifth column displays computed expected shares of quadrats in each class, according to the eq. (1.2), the sixth column displays its cumulative proportions, and the seventh column displays absolute differences in proportions, computed as the difference between both cumulated proportions (col.4 and col.6), which is a basis for K-S D statistics.

Table 1: Computed cumulated proportions from Observed and Expected patterns to derive the absolute differences for the K-S Statistic, D

No. of municipalities in each Quadrat	Observed no.of Quadrats	Observed Proportion	Cummulated Observed Proportion	Expected (Poisson) Proportion	Cumulated Expected (Poisson) Proportion	Absolute Differences in Proportion
0	415	0,2133	0,2133	0,2231	0,2231	-0,0098
1	648	0,3330	0,5462	0,3346	0,5577	-0,0115
2	534	0,2744	0,8207	0,2510	0,8087	0,0120
3	234	0,1202	0,9409	0,1255	0,9342	0,0067
4	86	0,0442	0,9851	0,0471	0,9812	0,0039
5	23	0,0118	0,9969	0,0141	0,9954	0,0016
6	3	0,0015	0,9985	0,0035	0,9989	-0,0004
7	2	0,0010	0,9995	0,0008	0,9996	-0,0002
8	1	0,0005	1	0,0001	1	0
	$\Sigma 1946$					

Source: Own calculations

Table 2: Computed cumulated proportions from Observed and Expected patterns to derive the absolute differences for the K-S Statistic, D

No. of municipalities in each Quadrat	Observed no.of Quadrats	Observed Proportion	Cummulated Observed Proportion	Expected (Poisson) Proportion	Cumulated Expected (Poisson) Proportion	Absolute Differences in Proportion
0	209	0,5036	0,5036	0,2576	0,2576	0,2460
1	76	0,1831	0,6867	0,3493	0,6069	0,0798
2	51	0,1229	0,8096	0,2368	0,8437	-0,0341
3	26	0,0627	0,8723	0,1070	0,9508	-0,0785
4	20	0,0482	0,9205	0,0363	0,9871	-0,0666
5	11	0,0265	0,9470	0,0098	0,9969	-0,0499
6	7	0,0169	0,9639	0,0022	0,9991	-0,0353
7	2	0,0048	0,9687	0,0004	0,9996	-0,0309
8	5	0,0120	0,9807	0,0001	0,9996	-0,0189
9	4	0,0096	0,9904	0,0001	0,9997	-0,0093
10	1	0,0024	0,9928	0,0001	0,9997	-0,0069

11	1	0,0024	0,9952	0,0001	0,9997	-0,0045
12	1	0,0024	0,9976	0,0001	0,9997	-0,0021
15	1	0,0024	1,0000	0,0001	1,0000	0,0000
	$\Sigma 415$					

Source: Own calculations

Table 3 is a numerical reproduction of Fig1b).; it includes 563 municipalities grouped in 415 quadrats. The same way computes the content of the columns as previously in Table 1.

Table 3 is a numerical reproduction of Fig 1c)., it includes 413 municipalities grouped in 308 quadrats. The same way computes the content of the columns as previously in Table 2 and Table 3.

The Table 4 displays parameters of each sample, all municipalities (displayed on Fig.1a), fast-growing municipalities (displayed on Fig.1b) and fast-declining municipalities (displayed on Fig.1c).

Table 3: Computed cumulated proportions from Observed and Expected patterns to derive the absolute differences for the K-S Statistic, D

No. of municipalities in each Quadrat	Observed no. of Quadrats	Observed Proportion	Cummulated Observed Proportion	Expected (Poisson) Proportion	Cummulated Expected (Poisson) Proportion	Absolute Differences in Proportion
0	151	0,4903	0,4903	0,2618	0,2618	0,2285
1	64	0,2078	0,6981	0,3508	0,6126	0,0854
2	32	0,1039	0,8019	0,2350	0,8477	-0,0457
3	22	0,0714	0,8734	0,1050	0,9526	-0,0793
4	15	0,0487	0,9221	0,0352	0,9878	-0,0657
5	6	0,0195	0,9416	0,0094	0,9972	-0,0557
6	10	0,0325	0,9740	0,0021	0,9993	-0,0253
7	4	0,0130	0,9870	0,0004	0,9997	-0,0127
8	1	0,0032	0,9903	0,0001	0,9998	-0,0096
10	1	0,0032	0,9935	0,0000	0,9998	-0,0063
11	1	0,0032	0,9968	0,0000	0,9998	-0,0031
12	1	0,0032	1	1,8E-08	1	0
	$\Sigma 308$					

Source: Own calculations

Table 4: The parameters of the researched samples

Parameter	Primary pop. sample	1 st exp. pop. subsample	2 nd exp. pop. subsample
Λ	1,5	1,356	1,34
K-S D	0,0308>0,0119	0,0667<0,246	0,0774<0,2284
	0,9382	3,3881	2,9327
t	11,68	21,56	14,72

Source: Own calculations

The first row of Table 4 represents computed statistics for Poisson distribution for each searched sample; the second one compares the Observed and Expected distribution

using the K-S D test according to the eq. (1.4) and eq. (1.5), (the computation of the K-S D statistics is based on the greatest value of absolute differences in proportion, col.7 of tables 1, 2 and 3).

The third row represents the variance-mean ratio computed per each sample, and the fourth row represents – statistics for testing the null hypothesis that the observed variance mean ratio is not significantly different for the expected variance-mean ratio, which is 1, according to the eq. (1.7)

The K-S D statistics show that the primary population sample (Fig.1a) is not statistically different from the Poisson distribution, so we might conclude that the spatial pattern of distribution follows the Poisson process; thus, municipalities are distributed over the space randomly. However, in case of the first (fast-growing municipalities) and the second (fast-declining municipalities) experimental population subsample of the observed pattern is statistically different from the Poisson distribution, so we might conclude that there are some systematical factors which affect as such distribution of the municipalities in a searched sample. Finally, computed variance mean-ratio and subsequent - statistics confirm statistically significant clustering pattern in case of the first and the second searched population subsample, which represent a fast growing and declining municipalities.

4. CONCLUSIONS

The main objective of the paper has been investigation of spatial population rearrangement among the municipalities over Slovakia. Secondly, the paper observes whether the processes mentioned above have been leading to clustering and dispersing patterns, where municipalities gain population or lose it and thus shake the traditional urban-rural fabric of the Slovakian settlement network. Furthermore, we suppose that this does not might be viewed as an isolated local pattern in some region, but rather a systematic pattern visible in the entire regional structure of Slovakia.

The primary population sample includes all municipalities in Slovakia and statistically does not show any pattern; thus, we might conclude that such distribution is approximated with Poisson distribution and is following random patterns on choosing a statistical significance level. This conclusion is also in line with our expectations. Partly, results seem to contradict with Christaller's and Lösch's theory that central places are equidistant. (Mevedkov, 1967) argues, that any settlement pattern is a composite of two superimposed sub-patterns, one random and the other uniform.

However, in the case of municipalities, which have experienced, according to set criteria unusual fast growth or decline, we find results quite impressive. Both statistical samples show significantly clustered patterns on a choosing statistical significance level, which represents exciting implications for the economic and regional policy. Fast-growing municipalities are predominantly located on the West surrounding the Bratislava agglomeration, on the North, and the East surrounding the Kosice metropolis. The results are consistent with similar findings in OECD countries, where the acceleration of population growth in commuting zones was particularly high in the largest functional urban areas (FUA's), which in OECD FUA's account for 44% of the total urban population (Veneri, 2015).

In the case of fast-declining municipalities, we found that also they tend to cluster in several areas over Slovakia, which makes the implications for the regional policy even

more difficult. We might observe clustered pockets of these municipalities, mainly on the Southern and North-Eastern periphery of Slovakia, along the Hungarian, Polish and Ukrainian border. (Dická et al., 2019) have confirmed similar conclusions, about so-called 'extremely rural' areas, predominantly occupying the North-East and South parts of Slovakia. Similar results were found in Hungary, where clusters of critically endangered villages are on South-Western periphery (Zala), along the Slovakia border (Borsod-Abaúj Zemplén) and South (Baranya) of the country (Makra et al., 2018).

Also in Slovakian case, these areas traditionally belong to the most lagging regions in Slovakia. A number of studies have already confirmed a long-lasting regional gap, either in terms of migration, income, employment, wages, etc., between the West and East of the country, and along the Hungarian and Ukrainian border. (Maris et al., 2019; Uramová & Kožiak, 2008; Pašiak, Gajdoš & Falt'an, 2001; Michálek, Podolák & Madajová, 2018).

The paper concerns spatial changes of the municipalities resulting from population redistribution between them, which eventually transforms the traditional fabrics of the settlement network in Slovakia. Both experimental subsamples, which were the primary objects of the concern, have shown significant clustering patterns, which suggest eventually serious consequences for the future development of Slovakian's municipalities. The clustering of urban settlements leads to disorganization in the urban system. Obtained results suggest that they are somewhat in line with other earlier studies. (Morill, 1962) showed the development of disorganization in the urban system of Sweden. The same suggestion was indicated in the Polish urban system (Dziewonski, 1973).

In the case of fast-growing municipalities, it suggests that the gravity of the future development has shifted toward cities and their respective satellites on the regional or district level. In the case of declining municipalities, the findings suggest a more grim picture. Their unfavorable location, number of internal problems, and their 'spatial mass' due to their clustering, grossly worsens the solution possibilities for these municipalities.

However, all these results need to be interpreted with caution. There are several shortages of this paper resulting from the used samples and also a method. Some other methods are aiming at point pattern analysis. All these methods have some pros and cons; Quadrat analysis is one of the basic, however still widely accepted and used. Next, applying the criteria for forming the statistical samples from secondary data, lead to significant shrinkage of the samples in order to reduce distortions, however still maintaining the evidence.

Generally, the paper results suggest continuation of this trend at the expense of small and remote municipalities. The government on central, regional, and local levels should pursue policies aiming at thwarting of this trend of turning some areas of Slovakia to the empty quarters. Policies should be oriented on the local economy, supporting jobs and employment growth, exploiting the natural potential of the countryside, mainly. Also, the formation of local partnerships and cooperation between the public and private sector seems to be inevitable for launching the development. However, despite the effort, the gradual extinction of some municipalities in the future cannot be ruled out in the future.

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