SPATIAL CONCENTRATION OF POPULATION IN SERBIA 1981–2011 MEASURED WITH THE HOOVER INDEX

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ABSTRACT: Population distribution reflects the integrity of natural, social, economic and historical factors of the geospace, relevant both for fundamental and applied research. Complex spatial structure of the contemporary distribution of population in the world, and Serbia as well, during history was determined by human migrations of complex scope and determinants. The aim of this paper was to describe and analyze the geographical redistribution of the population by using the Hoover index as a measure of the redistribution. This measure was introduced by Edgar Hoover in 1936 and it has been widely used in geography. By computing this index, we can allocate the region of population concentration and deconcentration in Serbia. General conceptual framework of concentration and dispersion of population at different geographical levels is presented here. These differences in the achieved level of concentration in Serbia are correlated with the historical development of population, transition from an agrarian into industrial society, and process of urbanization and migration in the last sixty years.

KEYWORDS: Hoover index of concentration, population, distribution, Serbia

INTRODUCTION

The model of population distribution, as well as the factors that affect it, has been launched by the American school of regional science in the 50s and 60s, and it was first accepted by the geographers in Sweden and England. That caused the beginning of 'quantitative revolution' or the so called new geography [Grčić 1990]. Bunge [1962] points out that the processes of distribution and redistribution form a unified whole that reflects the spatial structure of the research phenomena. Redistribution, which arises from the spatial processes and spatial structure, represents different spatial properties of events. Hooson [1961] believes that knowledge of population distribution is the key to understand the individuality of geographic region. Old models of distribution
generally treated dispersion, and the newer models, mainly from the 70s, treated polarization, that is, clustering of the population through spatial concentration.

The questions of population concentration and dispersion are the core of geographic access to the condition and development of population systems that can be viewed by spatial-analytical approach [Ягельский 1980]. The aim is primarily to test the spatial aspects of population phenomena through distribution characteristics, forms of spatial structures, connections and relationships between demographic elements and other spatial systems as dynamic and temporal variable categories. Distribution is a result of the changes that have occurred in the past and transitional conditions of demographic and overall development. Development of the spatial-analytical approach in population science is correlated with the use of modern quantitative methods and technical research, and mathematical and statistical methods facilitate consideration of the flow and the determinants of population phenomena.

Great number of geographers agrees that the population has been an active factor of redistribution, especially in the last 200 years, due to the great territorial expansion, mass migration, and development of urban settlements. Therefore, due to the size, complexity and variability of the causes which determine it, the distribution should be perceived as a result of the process which involves systematic factors (technical, organizational, cultural progress) and the case factors, manifested in the specific distribution of certain human groups. By analyzing the characteristics of concentration and deconcentration, we can understand the impact of systematic or random factors and their role in the formation of a complex distribution of population at national, and even more importantly, at global level.

Proceeding from all foregoing, the studies on the spatial patterns of population distribution are very important. The redistribution of population has undergone several major phases during recent decades with a strong urbanization process, followed by the rural-urban migration, depopulation and population ageing. Therefore, it is not surprising that the population distribution has been among the most studied issues in the world, especially in response to new demographic developments in the 1980s. There have been numerous studies treating the spatial distribution of populations for various countries of the world, especially the United States [e.g. Hoover 1941; Vining and Strauss 1977; Lichter 1985; Long and De Are 1989; Otterstrom 2001; Roger and Plane 2013], China [Huang and Leung 2000], Malesia [Rainis and Shariff 2003], Switzerland [Kahsai and Schaeffer 2009], Sweeden [Borgegård and Håkansson 1997]. In Serbia, the subject of population concentration and dispersion can be found in the papers written in the second half of the XX century by the geographers: Radovanović, Nikolić, Spasovski, Grčić, Todorović, Ratkaj, Šantić and others [Šantić 2013].

In this paper, the analysis of the population distribution and redistribution was performed at different levels of the territorial structure of Serbia which demographic processes and population potentials were unevenly spatially distributed. The empirical analysis results in a spatial model of population redistribution in Serbia at different geographical levels. This study examines the
redistribution of Serbian population at the municipal level between 1981–2011. It is important to point out that population figures after 2000 are based on a different method than the one used in the previous censuses. This study did not analyze the causes of population deconcentration; it provides descriptive statistics which have allowed us to identify the regions where concentration, deconcentration and urbanization occurred.

The territory of Serbia is characterized by extreme polarization of demographic characteristics which is caused by distribution of elements and their spatial relations and links, as well as the relationships and connections with other territorial systems which determine the mode of functioning of the elements, as well as their spatial organization. Therefore, the application of quantitative analysis, which is comparable with the ratios of other structural characteristics of the studied territorial system, is essential.

**METHODOLOGY**

Various measures have been used in the study of population concentration and dispersion at global, regional, national and local levels. Duncan [1957], Nutenko [1971], Biraben and Duhourcau [1974], Ягельский [1980], Plane and Rogerson [1994] made the classification of those measures of spatial distribution according to certain characteristics. They can be combined as follows: population density, measures of distribution, measures of concentration, centrographic measures, and population potential. Various methods could be used to measure the distribution of population. These include the Hoover index, entropy index, Gini index. As population data is collected based on areal spatial unit, the level of spatial aggregation might affect the results by using such methods. However, so far, little study has been carried out to determine the sensitivity of data aggregation upon the uses of such methods, especially in the context of Serbia. This kind of analysis is important because data is usually collected at a specific areal unit (such as municipalities), but it can be used for various purposes at much broader level of spatial unit (such as state, region or at national level). This study has discovered that, in general, data aggregation affects the measure of spatial concentration of population distribution. The more aggregated the data is, the lower the measure of population concentration, and vice versa.

The Hoover Index [Hoover 1936, 1941] is the most widely used measure for assessing the concentration or deconcentration tendencies of a country’s evolving population distribution. This index is a timeworn measure which gives an easily comparable, relative value of concentration among various sizes of geographic units [Otterstrom 2001]. Hoover concentration index is the most widely used measure for assessing the (in) equality of distribution of the population over a given territory. It treats percentage of the total population to achieve an equal distribution of the population. It is based on an index and represents Gini version index of diversity (index dissimilarities). It compares the percentage of the population of each municipality with a proportional share of the municipality, and measures the degree of correspondence between the
population and territory. This measure can be calculated according to the following formula:

\[ H = \frac{1}{2} \sum_{i=1}^{n} \left| \frac{x_i}{X} - \frac{a_i}{A} \right| \times 100 \]

where \( x_i \) is the country’s population residing in region \( i \), \( X \) is total country population, \( a_i \) is country’s area covered by region \( i \) and \( A \) is total country’s area. \( n \) is the total number of districts, and \( i \) is the region. The index is 0 if, in every region \( i \), the share of the country’s population and country’s territory are identical. This indicates a perfectly dispersed pattern of population distribution. The measure approaches 1 or 100 if everyone lives in just one area which is small in size (perfect concentration). Thus, high values of \( H \) indicate highly uneven population distribution, and vice versa. Clearly, the choice of geographic unit of analysis affects the value of \( H \), as the index is 0 if the unit of analysis is the whole country. Neither extreme is likely, but the relative change in the value over time can be used to track spatial changes in the population. The increase of \( H \) indicates a pattern of increasing population concentration in time, whilst a decreasing \( H \) suggests the dispersal or deconcentration of population. A value of 50 would imply that 50% of the population would have to live elsewhere if the population is to be evenly distributed. A change from 50 to 40 shows that the population had increased more in more sparsely populated regions than in more densely populated regions. The following classification can be made based on the previously said: values of index more than 80 (0.8) suggest the highest concentration, values between 60 and 80 (0.6–0.8) suggest average concentration, values between 40 and 60 (0.4–0.6) suggest low level of concentration, and values below 40 (0.4) suggest population dispersion [Hoover 1936, 1941; Wright 1937; Grčić 1990; Plane and Rogerson 1994; Long and Nucci 1997; Rogerson and Plane 2012; Šantić 2013].

RESULTS

Depending on the spatial level of analysis, the concentration or dispersion of population is different. In Serbia, the concentration is at regional level, and dispersion at local level during the first phase, and then, dispersion on regional and local level during the second phase. Recently, the third phase could be recognized with concentration of population to some attractive regions such as the largest cities, in the first place. However, attention must be paid to the deviations from the national pattern within macro regions, and differences in the concentration/dispersion continuum with regard to the distance from major urban centers to central or peripheral location in the country.

The population redistribution among Serbian municipalities was characterized by an increased concentration between 1981–2011. When measured with the Hoover index, this increase was about 7%. The results of censuses in 1981 and 1991 indicated that it was necessary to redistribute 30% of the total population in order to obtain most appropriate correspondence between population and
area. In the first decade of the XXI century, it was necessary to redistribute 33% (2002) and 37.14% (2011) of the total population in Serbia [Šantić 2013].

Figure 1: Hoover index of concentration of total population in Serbia, 1981–2011

Taking into consideration the effects of migration and natural population change, it can be concluded that the concentration of the population in the XX century was primarily related to regional differences in migration processes and, at the beginning of the XXI century, it was related to the regional differences in fertility and mortality rates. It also implies that the natural population change has concentrated the population at a constant rate during the whole period, whereas the impact of migration on the Hoover index fluctuated over time. In the periods between 1971–1981 and 1988–1990 the migration contributed to the dispersion of the population. The concentration of the population in the second half of the XX century has high correlation with the changes in the migration patterns. However, an overall conclusion is that natural population change affects the long term trend towards concentration, and migration affects the short term fluctuations over time.

The data related to lower territorial units i.e. municipalities show the trend of population concentration in 29 municipalities in the period from 1981–2011. On the other hand, a trend of population dispersion was recorded in 132 municipalities. Increase in the population concentration due to natural population change is characteristic for the municipalities of Novi Pazar and Bujanovac; the population increase due to migration patterns is typical of Belgrade, Novi Sad and Niš regions, and the increase due to important functions of municipalities is typical of Vrnjačka Banja (tourism) (Table 1).

The highest index of concentration with values of more than 80 (or 0.8) was recorded in 17 municipalities in Serbia in 1981, and in 19 municipalities in 1991. The trend of increasing values of index of concentration was typical until the beginning of the XXI century. In the analyzed period, besides the Belgrade municipality, large concentration of population was in the municipalities with large regional and industrial centers such as Kragujevac, Niš,
Novi Sad, Majdanpek, Smederevo, Kuršumlija, Ivanjica, Knjaževac, Sjenica. In the period from 2002–2011 the value of this index significantly decreased, and this type of concentration was recorded only in 8 municipalities: Novi Beograd, Voždovac, Zemun, Palilula, Zvezdara, Čukarica, Niš and Novi Sad. The total share of population in those municipalities was much higher than total share of area. Average level of concentration (60–80) recorded constant decrease, from 11 (in 1981) to only two municipalities in 2011 (Kragujevac and Rakovica). The low level of concentration (40–60) according to the last census data was recorded in 10 municipalities, which is two times lower than in 1981. These municipalities are situated in the East (Knjaževac, Majdanpek, Negotin, Boljevac, etc.) and South West (Sjenica, Ivanjica). The increasing number of municipalities in the period from 1981–2011 was recorded only in the category under 40, which implies the population dispersion. In this category, 110 municipalities were registered in 1981, and 141 municipalities in 2011, which was 88% of total number of municipalities in Central Serbia and Vojvodina. That trend shows intensity of total depopulation process in Serbia in the last five decades (Table 1).

If we use the population concentration in Central Serbia and Vojvodina at the beginning of the XXI century as a standard size (37%), we can extract the contingents of the population with a concentration below and above that average. Concentration of population below average values have all categories of agricultural population, the population over 65 years of age, the population in the primary sector, the population with completed primary education, and non-migrant population. The smallest index of concentration in the analyzed period was recorded in the category of population with no education (20.5). That means that these contingents of the population are characterized by dispersive distribution, which is correlated with the distribution of the agricultural sector and its slow transformation, depopulation and cultural transformation in general.

The higher level of concentration is characteristic for the urban population, migrant population, and population active in the tertiary and quaternary sectors, and people with secondary and high education. It shows economic, demographic and social transformation strengthening trends of population redistribution and concentration in Serbia since the mid-twentieth century. The highest level of concentration in the analyzed period was recorded among dif-

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*Source: SORS, 1981–2011*
ferent ethnic groups: Albanians, Vlahs, Muslims (Bosnians), Hungarians, Roma people which was related to the historical development of population in Serbia, as well as differentiated demographic development by nationality [Šantić 2013].

Analyses at micro-regional, municipality level shows that the lowest concentration in almost all analyzed features was in the municipality of Crna Trava. The municipality of Čajetina recorded the lowest concentration of population in urban areas, and Ada municipality in villages; Trgovište municipality had the lowest concentration among retired people, Tutin in single-member and two-member households, and Sjenica municipality had the lowest concentration in the level of mortality. On the other hand, the largest value of Hoover index of concentration was recorded in the municipality of Zemun in almost all studied categories. In Grocka, the highest concentration of population was recorded in villages, and in Bogatić, the highest concentration was in total and active agricultural population. The highest concentration of natural increase was recorded in the municipality of Preševo [Šantić 2013].

DISCUSSION

Does Serbian population have a trend of concentration or deconcentration? What are the effects of regional differences? Do they represent a comparative advantage, or limiting factor for current and future sustainable development?

Republic of Serbia has undergone some sizable changes in its population geography since the Second World War. Major component of these population shifts was rapid migrations from rural to urban areas due to the processes of urbanization, industrialization and deagrarization. Since 1980, major demographic changes such as decreased fertility rates, increasing mortality, ageing populations and changed migration patterns have been often seen as the main ingredient of regional demographic change. They caused changes in the territorial distribution of the population as a result of differences in the achieved level of transition of natural change and migration, and spreading in the last 60 years, while on the other hand, in Kosovo and Metohija and its surrounding municipalities populated predominantly by ethnic Albanians and Muslim population, formed a homogenous areas of high fertility and expanded reproduction. So, the result of that process are areas of dispersion on the one hand (regions in the east), and areas of extreme concentration of population (Kosovo and Metohija and major river valleys) on the other.

The process of territorial and demographic polarization of Serbia was continued at the beginning of the XXI century. In general, with the decades of depopulation, regional and international migrations, the resources for further territorial redistribution of the population have been exhausted (particularly relating to the previous dominant trends of redistribution from rural to urban areas). Recent trends of population redistribution have been based on population movement from towns and cities toward regional centers – Belgrade, Novi Sad, Niš, Kragujevac, etc., and they affect further spatial redistribution of population in optimal working and reproductive age. This opens the door to demographic extinction of entire villages and regions in Serbia. Thus, there is
a need for revitalization and reverse of future demographic trends in the vulnerable areas and towns of Serbia. It is possible only in the circumstances of the overall transformation of economic and social environment necessary for survival, as well as with the return of the population with favorable demographic structural features (younger, more educated). Therefore, the process of redistribution of the population must be taken as one of the most important requirements which, along with the rehabilitation of birth, has to be the main factor of future sustainable demographic and overall development of Serbia.

The concept of the future population distribution of Serbia should be based on the comparative advantages of space, opportunities, potentials, limitations, and existing development and distribution of the population. The main criteria to direct the population concentration and deconcentration should result from goals described in spatial planning documentation, and the best use of areal potentials in accordance with their specific characteristics. So, desirable trends in the spatial distribution of the population should be consistent with estimates of costs and benefits for individuals, families, communities, regions and countries. The measures should lead to an increase in income and its efficient and equitable allocation, as well as to the protection and improvement of the quality of living standards in Serbia. For this purpose it is necessary to redefine the migration policy in order to achieve a continuous decline in mortality, as well as the balance in structural characteristics, particularly age and sex structure. With respect to this, the measures of population policy in the sphere of population redistribution in Serbia are of special importance for the future.

Modern scientific views on the phenomenon of urbanization and concentration of population in urban areas treat this segment as an important factor for sustainable development in the future. Distribution of population and urbanization are facing new challenges which have brought changes to the natural environment and will cause significant changes in the lifestyle of the population. Demographical issues have begun to regain important place in political agendas. That is why the study of population distribution may be useful to planners and decision makers as a guide in the selection of appropriate data level. In Serbia, no such study has been carried out so far, so it could be a subject of future research.

REFERENCES:


ОРИГИНАЛНИ НАУЧНИ РАД

ПРОСТОРНА КОНЦЕНТРАЦИЈА СТАНОВНИШТВА У СРБИЈИ 1981–2011. МЕРЕНА ХУВЕРОВИМ ИНДЕКСОМ

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САЖЕТАК: Разместај становништва одржава целовитост природних, друштвених, економских и историјских чинилаца геопростора, релевантних како за фундаментална, тако и за апли кативна истрживања. Сложену просторну структуру савременог разместаја популације у свету, као и у Србији, током историје су детерминисале људске миграције сложеног обима и детерминанти.

Просторна концентрација становништва представља важан сегмент организације географског простора, јер показује везе и односе елемената демографских
система у простору и нове релације са елементима осталих просторних система. За одређивање степена концентрације и дисперзије користе се различите статистичке мере, од којих у овом раду указујемо на Хуверов индекс концентрације. То је најшире коришћена мера за оцену (не)једнакости дистрибуције становништва на одређеној територији. Индекс третира процент укупне популације коју треба разместити да би се постигла једнака дистрибуција становништва. На основу овог индекса можемо издвојити регионе дисперзии и концентрације становништва Србије: изразито депопулациони простори југоисточне, источне и југозападне Србије, као и Баната, са једне, и региони Београда, Новог Сада, Ниша, као и долине великих река, с друге стране. Достигнуте разлике у нивоу концентрације становништва Србије су у корелацији са историјским развојем насељености, преласка из аграрног у индустријско друштво, као и са процесом урбанизације и миграцијама становништва у посљедњих 60 година.

КЉУЧНЕ РЕЧИ: Хуверов индекс концентрације, просторна дистрибуција, становништво, Србија