

MULTIKRITERIJSKA ANALIZA KOT METODA ZA OPREDELJEVANJE SREDNJE VELIKIH MEST: PRIMER OSREDNJE SRBIJE

MULTIPLE-CRITERIA ANALYSIS AS A METHOD FOR DEFINING MEDIUM-SIZED CITIES: THE EXAMPLE OF CENTRAL SERBIA

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UDK: 911.37:519.23

Klasifikacija prispevka po COBISS.SI: 1.01

Prispelo: 3.6.2014

Sprejeto: 29.12.2014

DOI: 10.15292/geodetski-vestnik.2015.01.102-115

SCIENTIFIC ARTICLE

Received: 3.6.2014

Accepted: 29.12.2014

IZVLEČEK

Decentralizacija in usmerjenost k uravnoteženemu regionalnemu razvoju povzročata prerazporejanje funkcij mest: nekatere pristojnosti središč višje hierarhične ravni so prenesene na regionalna središča (predvsem na mesta srednje velikosti). V tem okviru je izvedena analiza o pomenu vloge srednje velikih mest v omrežju naselij in izpostavljena težava njihovega prepoznavanja v nacionalnem urbanem sistemu. Namen študije je opredelitev metode za prepoznavanje skupine srednje velikih mest v omrežju urbanih naselij, s posebnim poudarkom na osrednji Srbiji. Avtorji metodo primerjajo s slovenskim pristopom k reševanju te problematike ter opozorijo, da je pomen izraza »srednje veliko mesto« odvisen od konteksta, v katerem je opredeljen. Poleg demografske velikosti kot najpomembnejšega kazalnika pri opredelitvi srednje velikih mest so bila upoštevana tudi gospodarska, socialna, funkcijska, infrastrukturna in institucionalna merila.

ABSTRACT

Decentralization and the inclination towards a balanced regional development bring about a redistribution of cities' functions: certain responsibilities are transferred from centres at higher hierarchy levels to regional centres (mostly medium-sized cities). In this context, the authors have analysed the importance of medium-sized cities in the settlement network and discussed the issue of their identification within the national urban system. The purpose of this study is to establish a method for the identification of the set of medium-sized cities within the network of urban settlements, with particular reference to Central Serbia. The authors also compare the method with the one used in Slovenia in order to demonstrate that the phrase "medium-sized city" may have different meanings depending on the context in which it is defined. Along with the demographic size as the most important indicator in defining medium-sized cities, economic, social, functional, infrastructural and institutional criteria have also been taken into consideration.

KLJUČNE BESEDE

srednje velika mesta, omrežje naselij, policentrični razvoj, Srbija, Slovenija

KEY WORDS

medium-sized cities, settlement network, polycentric development, Serbia, Slovenia

1 INTRODUCTION

Medium-sized cities are described in various ways. In some national urban systems they are designated as a group of “immature”, poorly developed or stagnating urban entities which are in need of a radical political action intended to foster the economic dynamics. On the other hand, medium-sized cities are often “praised” as the last refuge of a genuinely urban atmosphere and idealized as the most natural link between the urban and the rural – as a potentially sustainable form of the urban structure (Uzelac, 1999).

Already in the mid-20th century the theory of the polarized (concentrated) development began to take shape. It relies on the logic of urban industrialization and postulates that the development within a region takes place through growth nodes – growth poles, i.e. development poles. Based on these principles, various authors devised the concept of the polarization process: e.g. Myrdal and Hirschman (Myrdal, 1957) in the theories related to circular cumulative causation; Friedmann (1972) in his theory of the dichotomy between the centre and the periphery; or Perroux (1955) in his theory related to growth poles, i.e. industrial focal points, etc. Since the mid-20th century various authors and modern European spatial development policy documents have been suggesting measures to mitigate the consequences of an unbalanced regional development. These measures seek to establish a regular hierarchy of urban centres based on a polycentric system of centres in order to counterbalance the intensive process of the population and capital concentration in large cities. This has been seen as a chance for lower-level centres. Such an approach confirms the significance and the role of medium-sized cities in regional development, i.e. in the process of balancing it according to the principles of polycentricity both in Europe (European Union) and worldwide (De Goei et al., 2010).

On the other hand, in accordance with the concept of a sustainable city (Capello et al., 1999), urban functions are analyzed in terms of a city's size and the thresholds of urban development. This approach basically brings into relation the size of a city and its sustainability. In other words, there is an optimal size of a city which implies that a certain range of urban functions corresponds to a certain population size and this is the precondition for an overall long-term balance. A balanced development of medium-sized cities is important for the overall social and economic development of a state for multiple reasons (Živanović, 2012): (1) by absorbing a portion of the population, medium-sized cities reduce the sources of those emigrants whose destination are large cities, i.e. they reduce the population pressure that is most commonly put on overpopulated large urban areas; (2) by ensuring links between rural and urban areas, medium-sized cities improve rural economy by developing non-agricultural activities in rural areas; (3) a dispersed population concentration increases the integration of the national territory; (4) by developing medium-sized cities a balanced regional development is promoted; (5) medium-sized cities may have good propensity for focusing on the development of individual functions that perform well in the national spatial economy, leading to a maximum employment of available resources.

The role of medium-sized cities in achieving a balanced regional development has also been confirmed in the solutions offered by relevant policy documents, such as the European Spatial Development Perspective (1999), Guiding Principles for Sustainable Spatial Development of the European Continent (2007), the Territorial Agenda (2007) etc. However, medium-sized cities have traditionally been rather neglected both by relevant international organizations and academic circles, i.e. among scholars and professionals. This is probably due to the rising interest in large cities or metropolises. Even statistical

and other information materials related to medium-sized cities available at a European level are rather limited and lacking conceptual comparability.

2 MEDIUM-SIZED CITIES WITHIN NATIONAL URBAN SYSTEMS

Having in mind that the phrase “a medium city”, just like “a large city” has various meanings in Europe, let alone worldwide¹, it is often difficult to discuss the demographic power of medium-sized cities. Nevertheless, the fact that about 52% of the world’s urban population lives in cities with less than 500,000 inhabitants is undoubtedly highly relevant. The discussion becomes all the less possible if we take into consideration a higher territorial level, up to the global level², where the differences in cities’ demographic weight are drastic. For example, in a number of Asian countries, cities with one to two million inhabitants are considered medium-sized (The Asian conference on population and development in medium-sized cities, 1987), which is unimaginable in Europe. Within the Urban Audit Project, initiated by DG REGIO and Eurostat (<http://epp.eurostat.ec.europa.eu>), cities are categorized based on population size. The lower limit of the basic demographic indicator for medium-sized cities has been determined to be 50,000 inhabitants, whereas the upper limit has been set at 250,000 inhabitants. According to a study conducted by UNESCO, cities with a population between 200,000 and 500,000 are considered medium-sized in America, while in Europe, according to the same study, cities with between 20,000 and 500,000 inhabitants are defined as medium-sized. A study on medium-sized cities has been conducted in the USA and it covers cities between 98,000 and 170,000 inhabitants, according to the 1990 Census (Vey and Forman, 2002). The first hundred cities in the list are considered large and the smallest among large cities has a population larger than 170,000. It is often impossible to find a generally accepted standardized definition of a medium-sized city at a continental and sometimes even at a national level. For example, in Italy, each region has an individual approach and a strategy for determining medium-sized cities and they depend on the specific territorial and functional context (ESPON Project 1.4.1., 2005).

Medium-sized cities may rank low on a global scale, which by no means diminishes their significance within a national urban system³. In European countries, there are significant differences in defining medium-sized cities based on their demographic size⁴. For example, in Sweden, the criteria for the identification of medium-sized cities are not limited only to their demographic size. Such cities include municipalities with a population between 20,000 and 50,000 where more than 70% of the total population live in the urban area and less than 40% of the population is employed in the secondary sector (ESPON Project 1.4.1., 2005). Furthermore, the share of medium-sized cities’ population in the total national population is different for various countries (Graph 1).

The following factors justify the mentioned conceptual differences related to medium-sized cities: the demographic size of a country; population density; urbanization level; general characteristics of the national urban system (the capital’s urban primacy, the number and density of urban settlements, etc.);

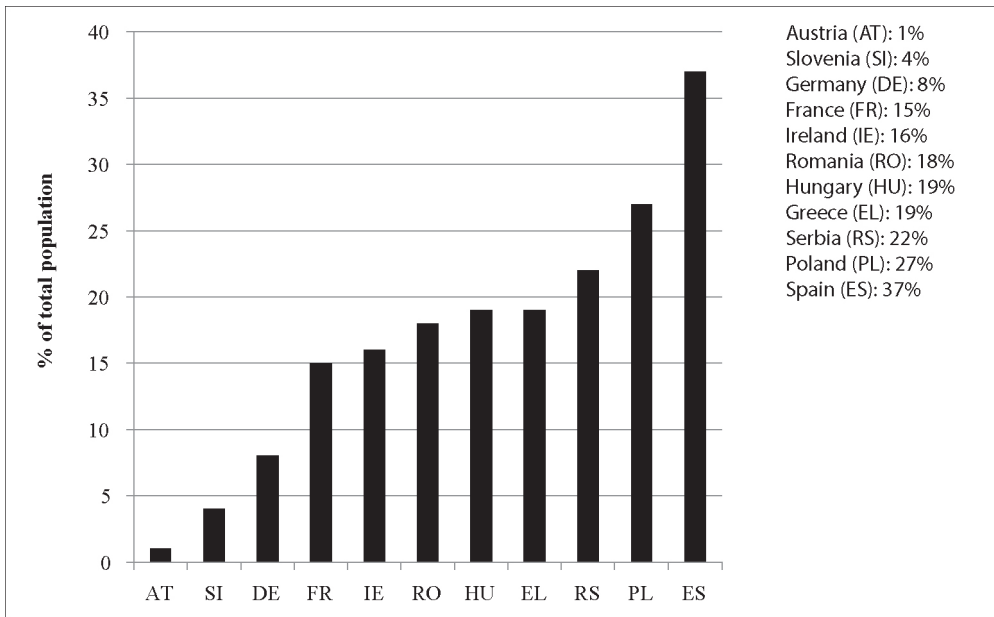
¹ *The studies on an optimal size of a city in Japan show that it would have a population of 18 million (Zheng, 2007).*

² *At a global level, the population of medium-sized cities ranges between 20,000 and two million (Medium-sized towns and world urbanisation, 2000).*

³ *Rondinelli suggests that medium-sized cities worldwide should include those with a population between 100,000 and a million (Rondinelli, 1983).*

⁴ *The population concentration in medium-sized cities primarily depends on the way in which this category of settlements is defined. If it is defined so as to include a wide range of population sizes, as it is the case in Greece (between 20,000 and 250,000), the population concentration will be large; on the contrary, if it is defined so as to include only a narrow range of population sizes, like e.g. in Austria, where the range covers populations between 45,000 and 50,000, the concentration is small.*

the political situation, the functional situation of territorial entities and geophysical factors.



Graph 1: The percentage of medium-sized cities' population in the total national population of selected European countries.

Within the scope of the ESPON Project 1.1.1. (2004), all countries have been classified according to the level of polycentricity. Slovenia is one of the countries where the value of this parameter is the highest. The settlement network of *Slovenia* is rather dispersed. A bit more than two million people live in about 6,000 settlements; less than one hundred of them have a population greater than 2,000. About 150 rural centres have between 500 and 2000 inhabitants and they have a crucial importance as local centres of services and employment. A half of the total number of settlements has less than 100 inhabitants. Compared to other countries of the European Union, Slovenia's urbanization level is rather low – it is not higher than 50.8% (the urban population is 998,000). Namely, though Slovenia's urban system comprises 80 cities, no more than seven have more than 20,000 inhabitants. The two largest cities in Slovenia: Ljubljana, which is the only large city according to these criteria, and Maribor, have together 352,720 inhabitants. This makes 40% of the urban population and 18% of the total national population. Cities with a population between 30,000 and 90,000 are considered medium-sized and there are no more than two such cities in Slovenia: Kranj and Celje (ESPON Project 1.4.1., 2005). They are located in different parts of the country, making its structure fairly balanced. Less than 4% of the total national population are located there. The percentage of those living in settlements with a population smaller than 30,000 is by far the highest, regardless the fact that the rather high percentage of population concentration in the capital makes the country's settlement network (which is by far the smallest among the analyzed countries in terms of the population) dispersed, i.e. highly polycentric.

In the paper “Small and Medium-Size Towns as the Basis of Polycentric Urban Development” (Zavodnik Lamovšek et al., 2008) the authors have identified medium-sized cities in the territory of Slovenia among 17 settlements with more than 10,000 inhabitants. The methodology devised for the identification of

medium-sized cities implies an analysis of urban entities based on 12 criteria divided into three categories:

- Formal Criteria: Number of inhabitants and Migration of inhabitants 2003–2005;
- Physiognomic/Morphological Criteria: Number of dwellings per building;
- Functional Criteria: Number of inhabitants per workplace; Share of active daily commuters to the town area; General hospital; Regional agencies and associations; Public cultural infrastructure of regional importance (cinema, museum); Institutions of higher education; Circuit court; Share of inhabitants employed in services; Share of inhabitants with higher and university education.

Having defined the average values for all of the mentioned indicators, urban settlements with six and more values above the average were selected. As opposed to the results in the ESPON Project (ESPO Project 1.4.1., 2005), these results indicate that there are ten medium-sized cities in the network of urban settlements in Slovenia.

The official statistics in Serbia do not categorize urban settlements as small, medium and large. In previous studies, the concept of medium-sized cities included urban settlements whose demographic size was between 20,000 and 100,000 inhabitants. Therefore, we may conditionally adopt the classification into large cities, with a population above 100,000 (Belgrade, Kragujevac, Niš and Novi Sad⁵), and medium-sized cities, including those with a population between 20,000 and 100,000 (there are 37 such cities: 24 in Central Serbia and 13 in Vojvodina). Apart from almost 15% of the national population concentrated in the capital, 6.82% of the population live in three large cities, while medium-sized cities are a permanent residence place for 21.73% of Serbia's total population⁶.

3 MULTIPLE-CRITERIA EVALUATION – AN APPLIED METHOD FOR DEFINING MEDIUM-SIZED CITIES IN CENTRAL SERBIA

Having in mind the complexity of the problems associated with the identification of medium-sized cities within the set of urban settlements, we believe that the method of multiple-criteria evaluation of the fundamental characteristics of urban settlements is the most appropriate for this purpose. The effectiveness and vitality of the method depends on the relevance of the selected, crucial evaluation criteria to the purpose of the analysis. What is also particularly important is the eligibility of indicators, which should be selected so as to represent the actual situation, i.e. to highlight possible deviations in individual cases (Figuera et al., 2005). The next step is to define parameters for each indicator, which is again a subjective procedure having in mind that it at least partially depends on the obtained results.

Based on the current body of knowledge on medium-sized cities, as well as the insight into the methods used in the identification of medium-sized cities in Slovenia, methods have been selected and a model for the determination of medium-sized cities (their identification in the territory of Central Serbia) has been established. The reasons to limit the area of the study to one of the three administrative macro-units in Serbia – namely *Central Serbia* – are the following: (1) physically geographic, historical, socio-economic and other factors have had diverse influences on the formation of a network of

⁵ *Priština has been excluded from the analysis due to the lack of data about the population of Kosovo and Metohija since 1981. For the same reason, the analyses related to Serbia as a whole were carried out not taking into consideration this autonomous region.*

⁶ *Along with the method used for defining medium-sized cities in the ESPON Project, there is a method similar to establishing the lower population threshold for medium-sized cities in Serbia: e.g. in France, cities with a population of 20,000 are considered medium-sized; however, the upper threshold is 200,000 inhabitants (Puissant and Lacour, 2011).*

urban centres and their gravity zones in the territory of Vojvodina, Central Serbia and Kosovo and Metohija; (2) the decades-long administrative division of the territory of the Republic of Serbia into three macro-units has further deepened differences in the development of cities and has fostered an uneven regional development; (3) the characteristics of the settlements within the network in Central Serbia are hardly comparable to their counterparts in Vojvodina; (4) as far as Kosovo and Metohija are concerned, the limitations are primarily due to inconsistencies in the statistical information basis since 1981 until the present day.

The set of urban settlements that will serve as the basis for the identification of medium-sized cities in the territory of Central Serbia includes 34 settlements with more than 15,000 inhabitants according to the 2011 Census (see Figure 1). Having been well acquainted with the situation within the settlement network and taking into consideration the presented opinions regarding the lowest population threshold for medium-sized cities (20,000), we deem that demographically weaker settlements (with less than 15,000 inhabitants) must be *a priori* excluded from the group of medium-sized cities. In our opinion, settlements with a population between 15,000 and 20,000 should be taken into consideration because the administrative boundaries of inhabited places in Serbia are not adequately defined due to the territorial amalgamation and physiognomic coalescence of nearby settlements with an urban centre. Although they are integrated into the urban centre's settlement matrix, these units do not lose the status of independent settlements. This could potentially result in the underassessment of the urban centre's role within a settlement network.

Furthermore, we deem it unmistakably apparent that, along with Belgrade, the group of large cities in the settlement network of Central Serbia also includes Niš and Kragujevac. These are the only two cities which each have a population two- or three-fold larger than that of the largest among other urban settlements – Čačak with 73,217 inhabitants. This opinion is further supported by the status of these cities that has repeatedly been confirmed in national scholarly studies and in practice: in the Spatial Plan of the Republic of Serbia adopted in 1996, these cities were recognized as macro-regional centres⁷; in the 2010–2014–2021 Spatial Plan of the Republic Serbia (2010), Niš is defined as the centre of a functional urban area of transnational importance, while Kragujevac is identified as a centre of a functional urban area of national importance (see Figure 1). The analyses of their characteristics have been presented in several studies (e.g., Živanović, 2006, 2007; Smiljanić, 2003). Studies related to the group of medium-sized cities in Serbia are scarce. Much more commonly, issues related to this type of cities are analyzed in studies primarily focused on other topics⁸.

Although the demographic size of a settlement bears important implications on the overall level of development, if used as an independent criterion, it is not sufficient for determining medium-sized cities. Accordingly, we believe that in order to establish a rational classification it is necessary to take into consideration other demographic, economic, social, functional, infrastructural and other criteria⁹,

⁷ According to this document, Užice has also been assigned the status of a macro-regional centre. However, having in mind that its population is only 54,717, it will not be *a priori* included in the group of large cities. The geographic and traffic position of Užice, i.e. its position within the national urban system and particularly in the specific settlement network of western Serbia have had a crucial role in defining it as a macro-regional centre.

⁸ Nevertheless, not even the group of settlements thereby defined as medium-sized cities were subject to separate analysis but were at best part of research related to the entire settlement network (e.g. Veljković et al., 1995; Vujošević, 1989). The most recent study dealing with this topic, authored by Spasić et al. (2007), is related to two categories of urban entities: small and medium-sized cities, which are defined *a priori*, solely based on the population size.

⁹ The fact that different countries use different criteria for the identification of medium-sized cities shows that there are numerous factors that can be relevant, i.e. it shows that the problem is very complex. However, there is a general agreement that the following basic indicators should be available for each

whose combination will contribute to the validity of conclusions.

Along with the population, the following criteria whose relevance we deem indisputable have been taken into consideration when defining medium-sized cities in the territory of Central Serbia:

- population growth rate,
- the share of newcomers in the overall population,
- daily commuting,
- the urbanization degree of the municipal territory,
- the share of the employed in the economically active population,
- income in the secondary and tertiary/quaternary sectors,
- the education structure of the population,
- the density of the traffic network,
- the status of urban settlements in planning documents,
- the administrative status of urban settlements,
- the minimal centrality degree of a settlement and
- the position of a settlement in the network of centres and within the national territory.

Settlements with parameters values above average in more than a half of the analysed parameters (according to the classification in planning and legal documents, settlements considered better than average have been assigned the status of a city) are identified as medium-sized cities.

Having in mind the character and intensity of development trends in Serbia in the period after World War II, the analysis of the growth rate covers the thirty-year period between 1971 and 2002. The criteria related to the **growth rate** raise the following dilemmas: (1) in the cities that have reached a certain demographic size, growth rates are often lower than those in demographically small cities; (2) the population growth in a city is not a positive trend unless it is accompanied by an overall qualitative development; (3) lower growth rates may be typical of urban settlements, particularly those characterized by narrow specialization, i.e. monostructural economy.

Population **migrations** are a reaction to particular socio-economic living conditions in various parts of the observed territory. Strong immigration centres are considered important in determining development lines and processes within the region. Accordingly, they are considered suitable candidates for the status of medium-sized cities. The analysis of the ratio between the indigenous and immigrant population is a relevant indicator of the centripetal force by which a city concentrates population in the immediate and wider surrounding area. It shows the average share of immigrants in the total population of a settlement.

Along with permanent migrations, daily commuting has also been included in the analysis. The percentage of workers, schoolchildren and students who make daily trips to and from the observed settlement (commuters) in the total active population is a clear indicator of the settlement's importance for the surrounding area. Divergent commuting in urban settlements is an indicator of the degree of self-sufficiency in terms of meeting the needs for jobs, as well as for acquiring higher levels of education.

The functional significance of an **urban settlement** largely depends on its demographic size. This further

medium-sized city: administrative status, demographic size, overall employment rate and employment rates within individual sectors, the unemployment rate and the available public services (ESPON Project 1.4.1., 2005).

highlights the importance of the urbanization degree of the municipal territory, i.e. the degree of population concentration in the municipal centre.

The size of the contingent of the **employed**¹⁰, as the most important segment of the economically active population and an important social category, clearly reflects the economic situation, as well as the situation in non-economic activities in the observed urban settlement.

The population's income, as an important economic criterion, is represented namely by the national income per capita. For the purpose of defining the set of medium-sized cities in the territory of Central Serbia, the income has been analysed within separate economic sectors – secondary and tertiary/quaternary. However, certain dilemmas have remained:

- for the first thing, due to the economic collapse that affected Serbia at the end of the previous century, which is primarily reflected in the decline of large industrial companies, the category of “fictitious employees” is observed; they are not considered unemployed, though they have no income. Consequently, a comparison of the percentages of the employed in the secondary sector based on official statistics yields a slightly distorted idea of the actual situation.
- secondly, though it is usually assumed that a structure of economic activities dominated by the tertiary/quaternary sector is an indicator of keeping up with processes in developed countries due to technological and information revolution (which puts end to the domination of massive industrial production), we cannot neglect the fact that in the Serbian context, an insufficiently diversified economic structure (due to the decline of the secondary sector) is the main reason for the relative employment growth in the tertiary/quaternary sector. Furthermore, the quality of services is far below the level typical for objectively highly developed urban settlements.
- thirdly, the income data are provided at the municipal level; this implies that the income from the primary sector (agriculture) is achieved in rural areas, i.e. outside the municipal centre. Accordingly, for the purpose of this analysis, only the income from the secondary and tertiary/quaternary sectors will be taken into consideration, in line with the assumption that it is mostly achieved in the municipal centre, i.e. in an urban settlement.

The analysis of European documents related to this topic shows that investment in research and development and the number of employees in these sectors (R&D) are frequently studied parameters. However, due to the scope of available data, we have been limited in the selection of criteria for determining the population's **education structure**. We could only establish the share of college- and university-educated people in the total population older than 15.

The criteria related to **infrastructure** are certainly essential when defining medium-sized cities, as the availability or accessibility of an urban settlement is considered to be the principal factor that determines the intensity of the utilization of its development potential. In this case, the selection of criteria has been significantly limited by available data. The density of the traffic network within a municipality is indicative for the analysis of traffic links among inhabited places and particularly between the municipal centre and minor settlements.

Along with demographic, economic, social and other criteria whose relevance is considered indisputable, we

¹⁰ *Although the official statistics of the Republic of Serbia do not record the employed population on the level of individual settlements, these data are provided on the municipal level.*

believe that the evaluation of the observed set of urban settlements with the aim of defining medium-sized cities in the territory of Central Serbia must also take into account solutions presented in the most important legal (planning) documents, the administrative status of urban settlements, the minimal centrality degree of a settlement and the position of a settlement in the network of centres and within the national territory.

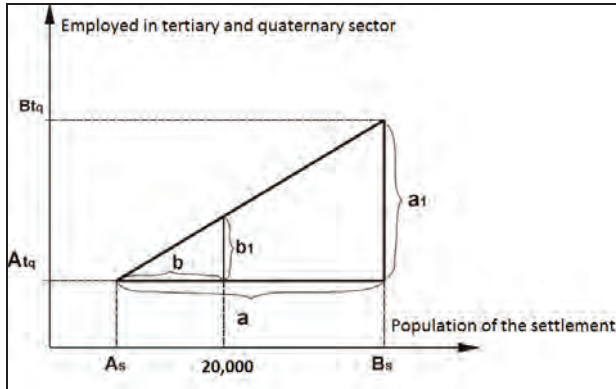
Among the analysed cities, 15 have the status of an administrative district centre according to the **Law on the State Administration (2005)**. In a way, this is an advantage and a relevant predisposition for development. The administrative role of a district suggests that a more efficient affirmation of regional centres could take place. Although they are rather far from the role fulfilled by regional centres in Western European countries with a well-developed regional level, the role of a district centre implies some importance and certain responsibilities in the areas of administration, health insurance, judiciary, education, etc.

According to the **Law on the Territorial Organization of the Republic of Serbia (2007)**, the city is defined as a territorial unit which is an economic, administrative, geographic and cultural centre of a wider area and has a population above 100,000. According to the Law, 24 urban settlements in Serbia have the status of a city. Among the 34 analyzed settlements in the territory of Central Serbia, 14 have the status of a city.

The **Spatial Plan of the Republic of Serbia (2010)** offers solutions related to Functional Urban Areas (FUA)¹¹. In 2009, Central Serbia had a single centre falling into the category of European MEGA territorial units: Belgrade belongs to the MEGA 4 (potentially MEGA 3) category. There was a single centre of transnational importance (FUA with a population above 250,000) – Niš. There were also eleven centres of national importance (FUA with populations between 100,000 and 250,000) and five centres of regional importance (FUA with less than 100,000 inhabitants). For the purpose of this analysis, all settlements that are defined at least as centres of regional importance in the mentioned document have been considered relevant development centres qualifying for the inclusion among medium-sized cities.

In the attempt to identify medium-sized cities one should not neglect the **functional criterion**. Some studies by authors from other countries postulate the functional importance, i.e. the **centrality or the importance of an urban settlement within a network**, as an essential criterion in the defining of medium-sized cities (ESPON 1.4.1 Programme, 2005). The centrality of a settlement is defined based on the share of the tertiary/quaternary sector in the structure of economic activities of its population. Such a decision is justified by the scope of the tertiary/quaternary sector, which encompasses all relevant functions of an urban settlement. Our points of departure have been the demographic size, as the most commonly used criterion in defining medium-sized cities, and the minimum population of 20,000, as the most common parameter. We have further tried to determine the minimum number of employees in the tertiary/quaternary sector. A group of cities whose demographic size is between 15,000 and 25,000 for Central Serbia have been taken into consideration. The following parameters have been defined: **A** is the average population, i.e. the average number of employees in the tertiary/quaternary sector for cities with a population between 20,000 and 25,000; **B** is the average population, i.e. the average number of employees in the tertiary/quaternary sector for cities with a population between 15,000 and 20,000; and **C** is the minimum number of employees in the tertiary/quaternary sector for a city with a population of 20,000 qualifying for the inclusion among medium-sized cities (Graph 2).

¹¹ *A Functional Urban Area includes a city of a certain size and its surroundings which has reached under its influence certain homogeneity of socio-economic transformation. A city with its functional region may have transnational importance ranking as MEGA 1–4 (Metropolitan European Growth Area) or a Functional Urban Area (FUA) of transnational, national or regional significance.*



Graph 2: The minimum centrality for medium-sized cities on the territory of Central Serbia.

$$\frac{a}{a_1} = \frac{b}{b_1} = \frac{c}{c_1} \tag{1}$$

A_s (average population) = 17,552; A_{tq} (average number of employees in the tertiary/quaternary sector) = 2,481; B_s (average population) = 22,923; B_{tq} (average number of employees in the tertiary/quaternary sector) = 3,723; $a = B_s - A_s = 22,923 - 17,552 = 5,371$; $a_1 = B_{tq} - A_{tq} = 3,723 - 2,481 = 1,242$; $b = 20,000 - A_s = 20,000 - 17,552 = 2,448$; $b_1 = a_1 * b / a = 1,242 * 2,448 / 5,371 = 566$; $C = b_1 + A_{tq} = 566 + 2,481 = 3,047$.

4 RESULTS OF THE MULTIPLE-CRITERIA EVALUATION

The application of the model, using the Thales' theorem, suggests that cities with more than 3,047 people employed in the tertiary/quaternary sector may be categorized as medium-sized. Finally, the obtained results suggest that in the observed set including 34 cities, 26 may be assigned the status of medium-sized cities. By applying the mentioned criteria on the set including 34 urban settlements in Central Serbia we have obtained the following results (Table 1):

- The average number of inhabitants in the 34 analysed urban settlements is 34,687. In the observed set of urban settlements, 15 have an above-average population, while values below the average for the analysed indicator have been observed in 19 settlements.
- The average growth rate in the analysed urban settlements during the observed period was 15.19%; out of 34 settlements, that criterion was met by 15.
- The average share of immigrants in the total population of a settlement, regardless of the time of immigration, is 49.95%. The above-average values of the indicator relating to the share of immigrants in the total population were observed in 18 urban settlements covered by the study.
- Approximately one quarter of the total urban population are employees who make daily trips to the city, i.e. they are **convergent commuters**. Compared to the average, 15 settlements show higher values of the indicator relating to convergent commuting. The average divergent commuting for the analysed set is 6.80%; the more favourable, below-average values of the indicator relating to divergent commuting were observed in 22 settlements.

- In the 34 municipalities covered by the study, an average of 44.67% of the total municipal population lives in the municipal centre. In a half of the analysed urban settlements, an above-average degree of urbanization is observed.
- The size of the contingent of the employed ranges between 59.53% and 82.97%. An above-average share of the employed in the total active population is observed 17 settlements covered by the study; these settlements are therefore assessed as important centres of employment for the surrounding area.
- The average share of income generated in the secondary sector in total income in the 34 analysed municipalities is 44.64%, while the average share of income achieved in the tertiary/quaternary sector amounts to 28.36%. The above-average values of the indicator relating to the share of income generated in the secondary sector is observed in 16 settlements, while those related to the tertiary/quaternary sector are observed in 17 settlements.
- The average density of the traffic network in the areas covered by this analysis is 0.59 km/km². An above-average density of the traffic network is observed in 15 urban settlements.

Table 1: Multiple-criteria evaluation of medium-sized cities in the territory of Central Serbia.

Criteria	Maximum value in 34 urban settlements	Minimum value in 34 urban settlements	Average value in 34 urban settlements	The number of cities that meet the criterion
<i>Population</i>	73,217	13,161	34,687	15
<i>Population growth rate (1971–2011) in %</i>	2.34	0.67	1.52	15
<i>The share of newcomers in the total population in %</i>	64.59	33.02	49.95	18
<i>The share of convergent commuters in the economically active population in</i>	61.70	7.06	25.37	15
<i>The share of divergent commuters in the economically active population in %</i>	15.50	0.79	6.80	22
<i>The urbanization degree of the municipal territory in %</i>	70.56	22.99	44.67	17
<i>The share of the employed in the economically active population¹² in %</i>	82.97	59.53	73.98	23
<i>The share of income in the secondary sector</i>	81.60	15.92	44.64	16
<i>The share of income in the tertiary/quaternary sector</i>	47.53	11.65	28.36	17
<i>The share of college- and university-educated people in the age group above 15</i>	19.02	8.32	13.26	15
<i>The density of the traffic network in km/km²</i>	1.49	0.19	0.59	14
<i>Administrative status of urban settlements</i>	District centre	-	-	15
<i>Law on Territorial Organization of the Republic of Serbia</i>	Status of a city	-	-	14
<i>2010-2014-2021 Spatial Plan of the Republic of Serbia</i>	Centre of a functional urban area	-	-	15
<i>Employed in the tertiary/quaternary sector</i>	-	3,047	-	26

¹² Although the official statistics do not record the employed on the level of individual settlements, for the purpose of this analysis, the number of the employed population was calculated by subtracting the actively employed agricultural population from the total actively employed population.

Based on the results of the analysis of relevant criteria (i.e. indispensable and sufficient for this study), we have come to the conclusion that 19 settlements have values above the average in more than a half of the analysed criteria. Therefore, an overall conclusion has been made that these 19 settlements make the set of medium-sized cities in the territory of Central Serbia. Most of them are cities of national importance according to the Spatial Plan of the Republic of Serbia (Figure 1). The departure of the analysed indicators from average values, expressed in the number of standard deviations, is the smallest in the settlements that fall into the category of medium-sized cities.



Figure 1: Medium-sized cities on the territory of Central Serbia in comparison to the hierarchy of centres given in Spatial Plan of the Republic of Serbia, 2010-2014-2021 (2010).

The position, as yet another criterion that has variously affected the defining of medium-sized cities, is also noteworthy. The position of cities within the settlement network, i.e. the vicinity of large cities, may have both positive and negative impact on the growth and development of medium-sized cities. For example, seven medium-sized cities in Central Serbia are located at a distance smaller than 50 km from large cities (those with more than 100,000 inhabitants). Furthermore, being a city in border zone was considered a drawback in the Socialist period. With the opening of national markets and the implementation of European policies related to trans-border collaboration, the position of such cities has become an advantage (there are four medium-sized cities in Central Serbia that are located at less than 20 km from the border).

5 CONCLUSION

The reliability of results obtained in the multiple-criteria evaluation (i.e. in an analysis using this method) aimed at identifying medium-sized cities in the territory of Central Serbia depends on various factors. We will point out the following ones: (1) the selection of the model to be used in determining the set of medium-sized cities; (2) the selection of criteria, indicators and parameters.

The selection of criteria is considerably limited by the availability, or rather the lack of data. The analysis of urban settlements in Slovenia covered a series of indicators related to the availability of public service facilities (hospitals, regional agencies and associations, cinemas, museums, higher education institutions, etc.). Under the circumstances, this was not considered relevant for Central Serbia because available data in Serbia are not up to date and they are very often collected using inadequate methods.

The population per job ratio is another indicator that was used in determining the set of medium-sized cities in Slovenia (Zavodnik Lamovšek et al., 2008) but could not be included in the analysis related to Central Serbia. In Serbia, no data about the number of jobs at the level of individual settlements are available.

Along with the mentioned criteria used to determine the set of medium-sized cities in the territory of Slovenia and Central Serbia, there are also a series of other criteria and indicators which are indisputably relevant for this analysis. Although they are very often used in studies carried out in other countries, in Serbia, they are either not monitored at all or this is not done in an integrated manner. These are principally the indicators relating to the development of information and communication technologies (the percentage of population employed in this sector), as well as: city's budget per capita; average price per square meter of construction area; business investment; poverty risk rate; workforce productivity; jobs to working-age population ratio; unemployment of the young (the number of unemployed young people under 25 per 1,000 people between 15 and 25); employment density (number of employed people per km²), etc.

It should also be borne in mind that the defining of medium-sized cities is relative, both in time and space. There are numerous examples showing that an advantageous feature in one city may be a drawback in another, placed in a different territorial or political context. Furthermore, what is currently considered a relevant predisposition for development may turn out to be a limiting factor to development in future (e.g. efficient economic specialization may be an agent of development in a medium-sized city as long as the industry ensuring the subsistence of the city does not collapse; once it collapses, the multistructurality of the city's economy becomes its greatest development problem). Therefore the classification of urban settlements cannot be static. It is liable to changes associated with urbanization and other development processes.

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