Rural and non-rural municipalities in the Slovak Republic

Janetta Nestorová Dická, Alena Gessert and Ivo Sninčák

Institute of Geography, Faculty of Science, Pavol Jozef Šafárik University, Košice, Slovakia

ABSTRACT

Identifying rural, non-rural or urban areas in Slovakia, Central Europe, is a complex task for extensive transformation of countryside during the last decades. The processes of suburbanization, which started in Slovakia in the 1990s after the change of the political regime, also contributed to this complexity. Therefore, the identification of rural / urban regions is even more difficult. Our research focuses on the application of a multidimensional approach to delimitation of rural and non-rural areas where the aim is to establish a rurality index that presents a more comprehensive definition of the rurality. We used the Factor Analysis of socio-economic data to show rural and non-rural transitional character of municipalities. The resulting data were assigned to spatial polygons of municipalities of the Slovak Republic and visualized as choropleth maps categorizing the spatial units based on the strength of the rurality. In this way, the spatial aspects of rural vs. non-rural character in Slovakia can be perceived and compared with other sources of spatial information.

1. Introduction

Slovakia is a Central European state where only 54% of the population lives in cities. This rate decreased by 2.7% in the last sixteen years which is attributed to powerful forces of suburbanization in the new millennium. Similar development and intensity of urbanization was observed in other countries of the Visegrad Four (Csachová & Nestorová-Dická 2011) or also in Romania and Kazakhstan (UN, 2018). Cities in the Slovak Republic make only 4.8% of all Slovak municipalities. The total population of Slovakia is 5.4 million which is distributed in 2887 municipalities (as for 31 December 2015 according to Statistical Office of the Slovak Republic). The detailed size structure of municipalities in the Slovak Republic presents Csachova and Nestorová Dická (2011). Officially, there are only 140 cities and towns but not each of the remaining 2747 municipalities has a rural character. Also the municipality officially declared as urban (town or city) does not necessarily imply an urban character. Given this specific situation of Slovakia, our aim was to uniquely determine which Slovak municipalities could be classified as rural.

The definition of a town/city varies in the surrounding countries. The population criterion is not crucial, and the administrative criteria prevail. Other criteria including administrative function, public utilities (schools, hospitals, employment services), population density and architecture are respected as well. The municipality can officially become a city upon request and after criteria established by the law NR SR Nr. 453/2001 Z.z. § 22 are met. The threshold population for a town in the Slovak Republic stands at 5000 inhabitants. However, a municipality can be declared a city, even if it does not qualify by the population criterion, if it is justified by the fulfilment of the other aforementioned assumptions by law.

After Novotný, Csachová, Kulla, Nestorová-Dická, and Pregi (2016) rural municipalities were first categorized officially as municipalities in the population census of 1961 and were assigned the category of ‘vidiecka obec’ (a rural village). This categorization of rural municipalities remained in use until 1991. Since that year, these rural and non-rural municipalities (with status given by NR-SR – National Council of Slovak republic) were excluded from the definition of cities. In the post-socialist period, the formerly very homogenous category of rural municipalities was further differentiated (Hampl, 1998) according to the structure of population and economic activities that are realized within the municipalities. The administrative structure of the Slovak Republic recognizes only cities (or towns) as specific types of municipalities. The rest of municipalities is not legally recognized in special sense; most of them has rural character.

After 1989, Slovakia has experienced a period of transformation which involved reprofiling of economy in rural regions (Pašiak & Falfan, 2004). While agricultural production dominated the rural economy before 1989, the importance of agriculture has been markedly
reduced during this transformation period. Other negative tendencies in the rural areas include depopulation, regression of human resources, stagnation and regression of cultural resources, deformation and decline of social capital, problems of insufficient personnel or infrastructural resources in small villages.

However, under the influence of the global transformation of society in Slovakia, rural areas have begun to change significantly in terms of their social structure, diversification of economic activities, and even the visual appearance of traditional rurality. Labrianidis (2004) pointed out that ‘at the dawn of a new millennium Europe’s rural areas are confronted with the task of reinventing themselves’ which emphasized the relevance of transformation of rural areas even more.

The changed meaning and interpretation of the term ‘rural’ refers to changes in agriculture and the rural economies transforming the social and demographic structure of rural areas, and to environmental changes as well. In this context, Woods (2005) points out that within the ongoing transformation and rural restructuring, the focus shifts from emphasizing the space as such to rather specific places. This reaffirms the great diversity and heterogeneity of rural areas (Woods, 2010).

The traditional and descriptive rural definition employed by the Organization for Economic Cooperation and Development (OECD, 1994, 2011) consists of two hierarchical territorial unit levels – local and regional. On the local level, a rural municipality is a municipality having a population density lower than 150 inhabitants per km². The regional level consists of inhabitants primarily living in rural municipalities. Following this approach, we distinguish three types of regions: (i) ‘sharp’ rural regions with more than 50% inhabitants living in rural municipalities, (ii) rural regions with 15–50% inhabitants living in rural municipalities, and (iii) mostly urban regions with less than 15% of inhabitants living in rural municipalities. The methodology of OECD became widely accepted on international scale for defining of rural areas, or at least it is the methodology which has been consistently used not only by OECD, but also by the European Commission (EC). On the Local Administrative Unit 1 (LAU 1) regional level of Slovakia according to the OECD definition, 70 of the 79 districts are rural (37 sharp rural and 33 rural). On level of the Slovak territorial structure, 2522 of rural communities on local level (87.3% of municipalities) have population density lower than 150 per km². Only 365 municipalities (12.7%) get over 150 inhabitants per km².

Based on the summarized facts, we perceive the requirement for demarcation of rural municipalities on factors beyond the number of inhabitants and population density. Definitions of rurality by population density provide too little information about the nature of the contemporary rural communities. The requirement of an alternative approach arises which is stimulated by several factors. The OECD methodology was not considered as imperfectly reflecting the rural character of areas (e.g. Hurbánek, 2008). Furthermore, the EU and the European Environment Agency (EEA) intensify their effort to implement sustainable economic and social development of rural areas by integrating environmental concerns into agricultural policy. New methodology (urban-rural typology) emerging from the EU is already based on population grids by the Statistical Office of the European Union (Eurostat, 2019). The European Commission published a new definition of urban and rural regions, which was similar to the OECD method but it relied on population grids instead of LAU2s (for more information see Eurostat, 2018). This definition introduced the concept of rural grid cells. They are used to define rural regions and rural LAU2s. This ensures that rural areas and rural regions are defined based on the same concept (rural grid cells). It also meant that rural areas and thinly populated areas were now identical (Dijkstra & Poelman, 2014).

A clear and accurate definition of rurality has long been discussed, so it is not surprising that discussions by researchers about representation of rural regions and their production have been so long-lasting (Blunden, Pryce, & Dreyer, 1998; Halfacree, 1993; Pratt, 1996). At present, there are many scientific studies available that discuss the meaning of ‘rural’ and where rural inhabitants are settled (Cloke, 2006; Dijkstra & Poelman, 2014; Gajić, Krunić, & Protić, 2018; Halfacree, 1993; Hart, Larson, & Lishner, 2005; Hruška, 2014; Paniagua, 2014; Paszto, Burian, Marek, Vozenílek, & Tucek, 2016; Prieto-Lara & Ocaña-Riola, 2010; Waldorf & Kim, 2015; Woods, 2015; etc.). The definition of rural area, i.e. countryside, could be approached from various points of view. One conceptualization of rural is from a functional definition, e.g. Halfacree (1993), Cloke (2006) and Woods (2005, 2011). Rural space is from this point of view defined by the following four functional elements: land use, small settlements, buildings and a life style. The definition of rural area as a locality is based on political-economic approaches (Hodge & Monk 2004). The introduction of the concept of locality marked an important breakthrough in rural studies. In line with Novotný, Mazur, and Egedy (2015), the definition of rural as a locality-conditioned rejection of both urban-rural dichotomy and urban-rural continuum concepts. This definition aims to define rural areas per se, not as the opposite to urban. Moreover, the concept of locality allows for relative openness of the definition because localities could be defined as an area which is constituted by actors and their groups or by a network of relations which transcends various scales and distances (Novotný et al., 2015), not as the opposite to urban. Rural areas (i.e. countryside) can
be perceived at least in two different ways. Murdoch and Marsden (1994), Halfacree (1993), Giddens (1984), Hoggart (1990), Hruška (2014) defined the countryside from the view of spatial unit, i.e. as a locality. Cloke and Goodwin (1992) emphasize also the imaginary dimension of rural area. Hence, the countryside as social representation is defined as an organizational mental construction which helps us to respond to what is visible. Therefore, the importance of rural region is situated in social, cultural and moral values that are related to rurality, rural space and rural life (Cloke, 2006). In addition, definitions, of what rural is and what rurality is, are ambiguous and vary among countries and scientific fields, approaches taken and even among researchers.

The most widely used criteria enabling an area to be defined as rural were based on univariate measures such as population size, population density, access to facilities or services and nearest-neighbour distance (Copus, 2003; Cromartie, Nulph, Hart & Dobis, 2013; Frideres, 2016; Martin, Brigham, Roderick, Barnett, & Diamond, 2000; Ocaña-Riola & Sánchez-Cantalejo, 2005; Prieto-Lara & Ocaña-Riola, 2010). The concept of rurality changes while the traditional interpretation of rurality as a geographically limited place remains in its understanding through a set of cultural and social constructs creating the rural space (Gregory, Johnston, Pratt, Watts, & Whatmore, 2009). Thus, a comprehensive understanding of rurality in its complexity, needs to be approached through different concepts in which rural space and its perception are shaping its current form (Máliková & Klobučník, 2017). However, Bryden (2008) or Hewitt (1989) argued that none of these simple indicators can hope to adequately capture a complex and multidimensional concept such as rurality.

The application of compound indices is a way how to avoid the aforementioned problems. Compound indices result from the sum of several standardized simple indicators. The weight assigned to each simple indicator can be decided subjectively according to the researcher’s criterion or objectively using multivariate analysis (Sánchez-Cantalejo, Ocaña-Riola, & Fernández-Ajuria, 2007). Multivariate statistical analysis is the most frequently used method for this purpose (Harrington & O’Donoghue, 1998; Pászto, Brychtová, Tuček, Marek, & Burian, 2015; Perlin, Kucerova, & Kucera, 2010; Pizzoli, 2017; Pizzoli & Xiaoning, 2007; Prieto-Lara & Ocaña-Riola, 2010; Vyas & Kumaranayake, 2006; Zhu, Deng, & Liang, 2017).

The model of a rural–urban continuum provided the conceptual framework within which rurality indices themselves were developed. Advantage of such indices is in measuring the diversity of rural environments, by identifying position of particular localities along a spectrum of index values between extreme urban and extreme rural instead of searching for areal units which in some way were uniquely urban or rural. The rurality index was mentioned for the first time in relation to the Great Britain at the beginning of the twentieth century, when it was used by the government for investigation of rural areas and small towns in England and Wales. Priority is given to the understanding of how rurality is constructed and deployed in a variety of contexts, rather than to the attempt to define the rural in a geographical sense though the formal use of statistical indices (Murdoch & Pratt, 1993). However, many attempts to identify and classify rural space were made in different countries considering a wide range of indicators and statistical data and in the application of quantitative methods and multidimensional statistical models.

The main aim of this paper is to delimit rural and non-rural municipalities. Objective measures of rurality can be applied in a spatial context of Slovakia applying the modified and improved rurality index used by Harrington and O’Donoghue (1998). This work used data to generate indices of rurality, which were used to track spatial change along an urban–rural continuum. Rurality index presents a rurality level, which is constructed by a set of variables and the Factor Analysis as a basis for rurality indices and quartiles of municipalities was created ranging from extreme rural to extreme non-rural categories. In addition, the paper identifies alternative factors affecting the spatial differentiation of rural municipalities in Slovakia.

The primary objective of the present paper is to create the rurality index from 2015 data for delimitation of rural typology municipalities and to develop alternative rurality indices, derived from quantitative analysis, which conceptualizes measures of rurality in the context of more than one dimension. Multidimensional approach is based on usage of different indicators from the section e.g. population, economy, land use, facilities, services and accessibility, that describing rural areas of the country. Municipalities are therefore classified as either rural, non-rural, or as their subtype. Rural typology can serve to give deeper knowledge on the present state of the residential system and rural development assumptions. Results of rural and non-rural determination analyses can be used as an instrument for political identification of most rural areas and to improve their exercisability. This paper fills the research gap by making available quantitative statements of rurality which might be used as the basis for classification and comparative studies in rural areas. We show that the rurality index makes an invaluable contribution to the debate on what is rural and what is not rural. Agreeing with Waldorf (2006), the rurality index is particularly beneficial for both research and policy: rurality is treated as a relative attribute, making it possible to investigate trajectories of rurality over time; sensitivity to small changes in one of the defining dimensions; applicability to different spatial scales.
Resulting ‘Main Map’ is useful for perceiving the spatial distribution and pattern of rural and non-rural municipalities. The ‘Main Map’ visualizes the rurality index as a degree of rurality for each municipality in the Slovak Republic. The dominant feature of the compound map is the ‘Main Map’ dedicated for the degree of rurality of the municipalities. Other two additional maps show the extension of the rurality index. While the rurality index is a useful and pragmatic measure its limitations are in that it is only a single quantitative parameter of rural–urban differences. The last two additional maps illustrate results of two-dimensional conceptualizations of rurality.

2. Methods

The rurality index is most frequently calculated by multivariate methods which employ the factor analysis. In this study, we opted for Factor Analysis in which Principal Component Analysis is used to extract the most significant factors. To ensure maximum efficacy, Factor Analysis should be based on an appropriate theoretical framework that enables the right variables to be selected. The included variables must be measurable, quantifiable, accessible at a reasonable cost–benefit ratio, easy to update and representative of the concept of rurality according to the theoretical framework studied (Ocaña-Riola & Sánchez-Cantalejo, 2005). The advantage of using factorial techniques is that no pre-judgement of the results is required, as the technique itself determines the importance of individual factors (dimensions) within any derived solution (Harrington & Dan O’Donoghue, 1998).

The selected rurality indices were drawn from variables describing rurality within the context of Slovakia. Determinants of rurality may vary among countries with different social backgrounds. Therefore, the selection of the variables used to construct the index should be based upon the context and social structure of the areas that are being studied (Hart et al., 2005; Ocaña-Riola & Sánchez-Cantalejo, 2005).

In the presented research, the concept of rurality in the form rurality index is defined by this final sub-set of fourteen variables comprising important demographic elements, employment and variables reflecting housing conditions and remoteness. This selection of variables is often influenced by the complex concept of rural environment. The rurality index applied in our study reflects the rural environment in Slovakia. However, defining the index in other countries could require different set of variables because the rural environment has different properties than in Slovakia.

To reduce the number of variables, we used the above mentioned Factor Analysis, allowing us to condense reciprocally related variables into a lower number of factors (Hendl, 2004). The inclusion of important demographic elements and variables reflecting housing conditions and remoteness achieves the concept of

| Variable name | Description | Source of data |
|---------------|-------------|----------------|
| Population    | Number of population | Statistical office (Datacube) |
| Density       | Number of inhabitants per square kilometre of built-up area | Statistical office (Datacube) |
| Age           | Mean age    | Statistical office (Datacube) |
| Ageing        | Number of people post-productive age per 100 person aged 0–14 | Statistical office (Datacube) |
| Senior        | Number of people over the age of 65 per 100 inhabitants | Statistical office (Datacube) |
| Fertility     | Number of women over the age of 14–49 per 100 inhabitants | Statistical office (Datacube) |
| Migration     | Net migration to migration turnover ratio | Statistical office (Datacube) |
| Unemployment  | Number of people no job per 100 person productive age | Statistical office (Datacube) |
| Work trips    | Number of outgoing inhab. per 100 economical active inhabitants | Census data from Statistical office |
| Occupation    | Number of inhabited housing per 100 all housing | Census data from Statistical office |
| New building-up | Number of new housing 2001–2011 per 100 all housing | Census data from Statistical office |
| Family houses | Number of family houses per 100 all houses | Census data from Statistical office |
| City 50 th.   | Time accessibility to City with 50 thousand and more inhabitants | Google maps |
| Hospital      | Time accessibility to Hospital | Google maps |

| Variable name | Minimum | Maximum | Mean  | Std. Deviation | Skewness | Kurtosis |
|---------------|---------|---------|-------|----------------|----------|----------|
| Population    | 7.00    | 422,932.00 | 1878.25 | 10,292.48 | 29.10 | 1074.05 |
| Density       | 31.30   | 16,737.92 | 1639.82 | 10,292.48 | 36.66 | 32.46 |
| Age           | 20.22   | 64.81    | 40.32  | 4.08          | 10.25   | 3.79    |
| Ageing        | 0.00    | 2800.00  | 123.08 | 127.76 | 11.18 | 187.87 |
| Senior        | 1.20    | 57.14    | 15.55  | 4.98         | 1.70    | 8.65    |
| Fertility     | 0.00    | 39.66    | 23.73  | 2.74         | 1.62    | 8.41    |
| Migration     | −100.00 | 89.89    | 7.69   | 19.12 | 0.40 | 1.71 |
| Unemployment  | 0.00    | 76.77    | 13.37  | 9.29         | 2.01    | 5.48    |
| Work trips    | 5.26    | 100.00   | 72.85  | 14.10        | 1.58    | 2.71    |
| Occupancy     | 23.58   | 100.00   | 82.85  | 10.70        | 1.56    | 3.32    |
| New building-up | 0.00  | 50.00    | 3.70   | 4.28         | 3.06    | 17.61   |
| Family houses | 0.32    | 139.00   | 49.06  | 2.53         | 0.58    | 0.23    |
| City 50 th.   | 0.00    | 62.00    | 17.64  | 8.11         | 0.66    | 1.03    |
| Hospital      | 0.00    | 62.00    | 17.64  | 8.11         | 0.66    | 1.03    |
variables for the rurality index present in Table 2 and correlation relations present correlation matrix in Table 3. The four categories were assigned with population above 50 thousand. Variables selected for the rurality index include the following terms: density, age, senior, ageing, fertility, population, city, new building-up, family houses, hospital, and city migration, unemployment, work trips, occupancy, population, age, senior, fertility, and age. The purpose of the paper was not in replicating the rurality index but in using them for defining the concept of rurality and addressing the complexity of rural environments. The purpose of the paper was not in replicating the rurality index but in using them for defining the concept of rurality and addressing the complexity of rural environments. The purpose of the paper was not in replicating the rurality index but in using them for defining the concept of rurality and addressing the complexity of rural environments. The purpose of the paper was not in replicating the rurality index but in using them for defining the concept of rurality and addressing the complexity of rural environments.
positive scores correspond with ‘non-rural characteristics’. Table 4 shows the results of this analysis in the form of loading scores on the principal component (also referred to as the first factor). The rurality index represents the variation in density, population, occupancy, fertility, new building-up and senior, age, ageing, city 50 th, family houses, hospital and index ranges from 4.0 to −4.9.

The rurality index is a useful and pragmatic research tool. It seems limited in that only one quantitative statement of rural–urban differentials is projected (Harrington and Dan O’Donoghue 1998). While recognizing that rurality can be measured, to some extent, along a single continuum from urban to rural, it is also appreciated that the use of only one continuum is rather limiting.

| Variable name     | Loading score |
|-------------------|---------------|
| Density           | 0.771         |
| Population        | 0.723         |
| Occupancy         | 0.697         |
| Fertility         | 0.638         |
| New building-up   | 0.612         |
| Migration         | 0.311         |
| Work trips        | 0.219         |
| Unemployment      | −0.227        |
| Hospital          | −0.408        |
| Family houses     | −0.466        |
| City 50 th.       | −0.495        |
| Ageing            | −0.683        |
| Age               | −0.727        |
| Senior            | −0.768        |
| % Explanation     | 34.3          |

Extension of the rurality index required because the single factor explained just 34.3% of the variation in the data set. The result was that almost two thirds of the variation in the data set remained unexplained. This suggests that the analysis could be extended to include additional factors to increase the degree of explanation. The analysis shows that the cumulative percentage of explanation increased by up to 58.4% (Table 5) if two factors were involved. With respect to the presented research, this value is not low but it just presents smaller variance of original data. As the variables used for calculation of the rural index represented various dimensions of rurality the variables are not strongly correlated. Not all information of original data was ultimately contained in the rural index, just the 58.4%. This implies that the loading scores from both factors will increase the extent to which rurality can be explained by the used variables.

The data from 2015 are used to create two separate rurality indices to see the performance of conceptualizing the dimensions of rurality. The purpose of a factorial technique is to disaggregate the generality of the solution in favour of a series of specific effects, so that each factor is associated as uniquely as possible with a distinct set of variables (Davies, 1984).

To make sure that the postulate of independence of the factors is fulfilled, the initial transformation of factor resulted into secondary factors. These new factors explain data to the same level as the initial estimates and they are not reciprocally correlated. Transformation of factors by orthogonal rotation was performed.
with, the varimax operation. Table 5 shows rotated factors loads with additional factors which can be interpreted by distinct clusters of variables. For this interpretation, variables with the rotated factor loads value more than 0.4 or less than −0.4 t were chosen.

Factor 1 represents the variation in senior, age, ageing, density, occupancy, population and fertility. Factor 2 represents the variation in work trips, construction of new buildings, migration, unemployment, city 50 th. and hospital. Two dimensions of rurality can now be observed based on these loading scores. In addition, both factors display bi-polar properties. Factor 1 represents what can be called demographic rurality, and factor 2 structural rurality.

Essentially, demographic rurality features an elderly population, with a high proportion of population older than 65 years. There are also changes in mean age, ageing index, fertile population (with low proportion of women aged 14–49), and low occupancy with family houses. The loading scores indicate that areas with elderly population are more rural, while more women in fertile age are found in more urban areas. The positive values on the demographic rurality indicate higher degree of rurality.

On the other hand, structural rurality is involved with the physical aspects of rurality. For example, the greater the distance from large urban nodes the more rural the area. Rurality increases also with increasing distance to the hospital, higher unemployment rate, low rate of development of new residential areas, lower rate of commuting and migration decline. Negative values on the structural rurality represent more rural areas.

The result of the rotated factor matrix is to provide researchers two possible approaches of further investigation, both of which measure rurality to varying extent. The results seem to indicate that based on 14 selected variables there are at least two urban–rural continua in existence, which in their own way represent different aspects of rurality. The demographic index ranges from 5.1 to −4.6, while the structural index ranges from −3.6 to 2.8. To understand the ways in which these two indices vary from the rurality index, it is necessary to compare each of them with the original index.

Both rural indices present disintegration of an original rurality index. Loading scores of two rurality indices was used for four typologies along the rural–urban continuum (Figure 2). After Harrington and O’Donoghue (1998), adoption of this two-dimensional conceptualization of the rurality could allow a new classification of rurality, or modifications that could be made (different divisions, not only quartiles, could be used). It allows for both factors of rurality to be used separately and together. The two-dimensional approach offers a direct method to follow change among districts. Only municipalities which were extreme rural or extreme non-rural along both dimensions should be considered as representing the two extremes of the spectrum rural–urban continuum.

### 3. Conclusion

The main aim of this paper was to measure and visualize the degree of rurality of municipalities in Slovakia by the means of modified and improved rurality index originally introduced by Harrington and O’Donoghue (1998). These generated maps visualize the spatial pattern of rurality based on rurality index which value determines how much rural or non-rural each municipality is. This index was derived in Factor Analysis in which principal Components Analysis was used to extract main components as factors. The quartile classification of municipalities was created ranging from ‘extreme rural’ to ‘extreme non-rural’ categories according to Harrington and Dan O’Donoghue (1998).

The initial rurality index confirmed a rural and non-rural municipalities distribution of Slovakia in 2015. Extremely rural areas, underdeveloped human potential, massive population ageing processes and hindered
accessibility, occupy the northeast and south parts of Slovakia. These areas are too distant from significant economic regions of Slovakia, they have insufficient transportation infrastructure and absence of bigger cities, which could stimulate their economy. On the other side, non-rural areas are represented by urban municipalities which is natural. But there are other municipalities with non-rural character where the high reproduction rate assigns them into this category. Such municipalities in the eastern part of the Slovakia seem to be associated with higher concentration of the Roma population having a specific demographic behaviour which assigns Roma communities to a progressive type of population (Mušínka, Škobla, Hurrle, Matlovičová & Kling, 2014). Such demography influences the values of the calculated rurality index so that the affected municipalities become non-rural despite being clearly rural from other points of view. Similar demographic properties are associated with the population of the north Slovakia region where many rural municipalities are mapped as non-rural. The reasons are in higher reproduction rate of population associated with typical culture, traditions and catholic religion in this part of the country (Ďurček & Šprocha, 2017). Non-rural areas of Slovakia have suitable human potential from the aging of the population aspects.

Additional information via secondary maps has been provided and it is now possible to evaluate the rurality or non-rurality of municipalities according to alternative dimensions of rurality. Degrees of rurality measured by these indices provided different results, and through using these indices, different aspects of rurality were explored representing different dimensions which often hold distinct geographical patterns. Finally, the two-dimensional approach offers a new classification of the rural districts of Slovakia, particularly with a view towards refining definitions at either end of the rural–urban continuum.

4. Data

Data for this study have been provided from different sources, Statistical authority of Slovak Republic databases (population census 2011, Balance of Slovak population movement 1996–2015) and using Google maps. Google maps was used for ascertaining distances between the municipalities and cities as a measure of accessibility the cities (with more than 50,000 population) and nearest hospitals were observed. Travel time was measured as a distance (travel time by car) between a municipality and a city with more than 50,000 inhabitants or the closest hospital. Fourteen indicators were included in the calculation and listed in Table 1. This study is based on the set of all 2889 Slovakian municipalities. Cities were included because of city municipalities’ heterogeneity. Some Slovakian cities have city status but they do not fulfil urban standard criterions.

The spatial framework of thematic data was mediated using a polygon data layer for the administrative areas of Slovak municipalities from The National Topographic Database Data200. The same database was a source for the topographic base of the map, which is represented by a point data layer of municipalities with city status. The status of Slovak municipalities was determined from a database published by Statistic Office of Slovak Republic (SOSR). This information is current as of 1/1/2015.

**Map design**

The attached map consists of one main map and four supplementary maps. The main map defines the rural and non-rural municipalities of Slovakia according to the intensity of the rurality index. These maps divide municipalities into rural or non-rural areas according to the Factor Analysis as the basis for these rurality indices. The map appendix also includes a rurality index calculation scheme. For visualization of the degree of rurality, choropleth maps (Kraak and Ormeling 2011) were used, in which areas are shaded proportionally to the value of the rurality index measured for each municipality. We used a bipolar color scheme where the intensity of the green color increases with increasing rurality of a particular municipality, and vice versa, the intensity of the red color increases with increasing non-rurality of a municipality. The adjacent four maps have the complementary character of Slovakia’s rurality. These two additional maps represent the extension of the rurality index, in the form of a demographic and structural rurality index. The last two additional maps illustrate outputs from two-dimensional conceptualizations of rurality. The choice of the green color reflects the extreme relationship to rurality on the demographic I structural rurality, and the red color reflects the extreme relationship to non-rurality on the demographic and structural rurality.

**Software**

A Factor Analysis was used to determine the degree of an affiliation of municipalities to the rural and non-rural areas. Its inference system was built using the open source software PASW Statistics 18.0. The map production was performed in in ArcMap 10.5 for Desktop by ESRI. Final desktop publishing and map sheet designing were performed using Adobe Illustrator CS4 and Adobe InDesign CS4.

**Disclosure statement**

No potential conflict of interest was reported by the authors.
References

Blunden, J. R., Pryce, W. T. R., & Dreyer, P. (1998). The classification of rural areas in the European context: An exploration of a typology using neural network applications. *Regional Studies*, 32(2), 149–160. doi:10.1080/0033430980123035

Box, G. E. P., & Cox, D. R. (1964). An Analysis of Transformations. *Journal of the Royal Statistical Society. Series B* (Methodological), 26(2), 211–252.

Bryden, J. (2008). Rural development indicators and diversity in the European Union. Retrieved from http://srdc.msstate.edu/measuring/bryden.pdf

Cloke, P. (2006). Conceptualizing rurality. In P. Cloke, T. Marsden, & P. Mooney (Eds.), *Handbook of rural studies* (pp. 18–28). London: Sage. doi:10.4135/9781847870824.n2

Couchová, S., & Nestorová-Dická, J. (2011). Territorial structure of local government in the Slovak Republic, the Czech Republic and the Hungarian Republic – A comparative view. *Geographical Journal*, 63(3), 209–225.

Clore, P., & Goodwin, M. (1992). Conceptualizing countryside: From post-fordism to rural structured coherence. *Transactions of the Institute of British Geographers*, 17, 321–336. doi:10.2307/622883

Copus, A. (2003). Socio-economic indicators for European regions, some thoughts on conceptual and practical issues. In IRENA expert meeting on land use/cover change, landscape state, and characterisation of rural areas, 23–24 June 2003 (pp. 38–40). Ispra: Joint Research Centre.

Cromartie, J., Nulph, D., Hart, G., & Dobis, E. (2013). Defining frontier areas in the United States. *Journal of Maps*, 9(2), 149–153. doi:10.1080/17445647.2013.773569

Davies, W. K. D. (1984). *Factorial ecology*. Aldershot: Gower. 409 p.

Dijkstra, L., & Poelman, H. (2014). “A harmonised definition of cities and rural areas: The new degree of urbanization.” Working paper 1. European Commission Urban and Regional Policy. Retrieved from http://ec.europa.eu/regional_policy/sources/docgener/work/2014_01_new_urban.pdf

Důrcěk, P., & Śroboća, B. (2017). Centrá a zázemí fungujících městských regií na Slovensku optikou kohortnej plodnosti. *Geografický časopis/Czech Sociological Review*, 50(4), 581–601. doi:10.13060/00380288.2014.50.4.109

Entrena-Durán, F. (1998). Cambiosen la construcción social de la ruralidad. De la autarquía a la globalización (p. 197). Madrid: Tecnos.

Eurostat (Statistical office of the European Union), (2018). *The Eurostat regional yearbook*. Luxembourg: Publications Office of the European Union, 2018. doi:10.2785/231975.

Eurostat (Statistical office of the European Union), (2019). *Methodological manual on territorial typologies – 2018 edition*. Luxembourg. Retrieved from https://ec.europa.eu/eurostat/web/products manuals-and-guidelines/-/KS-GQ-18-008

Fridel, E. (2016). The present state of rural territories in the EU: Evidence from ESPON. Joint EESC-CoR Conference “Cork+20: leaving rural areas behind is no longer an option!”. Brussels, November 9, Eson. Retrieved from http://cor.europa.eu/en/events/Documents/NAT/Agriculture%20and%20rural%20development/ESPON%20-%20Laurent%20KFRidler.pdf

Gajić, A., Krunić, N., & Protić, B. (2018). Towards a new methodological framework for the delimitation of rural and urban areas: A case study of Serbia. *Geografisk Tidsskrift-Danish Journal of Geography*, 118(2), 160–172.

Giddens, A. (1984). The constitution of society: Outline of a theory of structuration (p. 402). Cambridge: Polity Press.

Gregory, D., Johnston, R., Pratt, G., Watts, M., & Whatmore, S. (2009). *The dictionary of human geography* (5th ed., p. 1072). Oxford: Wiley-Blackwell.

Halfacre, K. (1993). Locality and social representation: Space, discourse and alternative definitions of the rural. *Journal of Rural Studies*, 9, 23–37. doi:10.1016/0743-0167(93)90003-3

Harrington, V., & O’Donoghue, D. (1998). Rurality in England and Wales 1991: a replication and extension of the 1981 rurality index. *Sociologia Ruralis*, 38(2), 179–203. doi:10.1111/1467-9523.00071

Hampl, M. (1998). *Realita, společnost a geografická organizace: hledání integrálního řádu*. Praha, DemoArt, 110 s.

Hart, L. G., Larson, E. H., Lishner, D. M. (2005). Rural definitions for health policy and research. American journal of public health, 95(7), 1149–1155. doi:10.2105/AJPH.2004.042432

Hendj, J. (2004). Přehled statistických metod zpracování dat. Portál, Praha, 583 s.

Hewitt, M. (1989). *Defining rural areas: Impact of health care policy and research*. Washington: US Government Printing Office. 60 p.

Hodge, I., & Monk, S. (2004). The economic diversity of rural areas: Impact of health care and urban areas: A case study of Serbia. *Geografisk Tidsskrift-Danish Journal of Geography*, 118(2), 160–172.

Hendl, J. (2004). Přehled statistických metod zpracování dat. Portál, Praha, 583 s.

Hewitt, M. (1989). *Defining rural areas: Impact of health care policy and research*. Washington: US Government Printing Office. 60 p.

Hodge, I., & Monk, S. (2004). The economic diversity of rural areas: Stylised fallacies and uncertain evidence. *Journal of Rural Studies*, 20(3), 263–272. doi:10.1016/j.jrurstud.2003.11.004

Hoggart, K. (1990). Let’s do away with rural. *Journal of Rural Studies*, 6, 245–257. doi:10.1016/0743-0167(90)90079-N

Hruška, V. (2014). Proměny přístupů ke konceptualizaci venkovského prostoru v rurálních studiích. *Sociologický časopis/Czech Sociological Review*, 50(4), 581–601. doi:10.13060/00380288.2014.50.4.109

Hurbánek, P. (2008). Recent developments in definitions of rurality/urbanity: Focus on spatial aspect and landcover composition and configuration. *Europa XXI*, 17, 9–27.

Kraak, M. J., & Ormeling, F. J. (2011). *Cartography visualization of spatial data*. New York: Guildford Press.

Labrianidis, L. (2004). The future of Europe’s rural peripheries. Aldershot: Ashgate.

Martin, D., Brigham, P., Roderrick, P., Barnett, S., & Diamond, I. (2000). The (mis)representation of rural deprivation. *Environment and Planning A*, 32, 735–751. doi:10.1068/a32130

Máliková, L., & Klobočník, M. (2017). Differences in the rural structure of Slovakia in the context of socio-spatial
polarisation. Quaestiones Geographicae, 36(2), 125–140. doi:10.1515/quageo-2017-0020
Murdoch, J., & Marsden, T. K. (1994). Reconstituting rurality: Class community and power in the development process. London: UCL press.
Murdoch, J., & Pratt, A. C. (1993). Rural studies: Modernism, postmodernism and the ‘post-rural’. Journal of Rural Studies, 9(4), 411–427. doi:10.1016/0743-0167(93)90053-M
Mušinka, A., Škobla, D., Hurle, J., Matlovičová, K., & Kling, J. (2014). Atlas of Romany communities in the Slovakia 2013. Bratislava, UNDP.
Novotný, L., Csachová, S., Kulla, M., Nestorová-Dická, J., & Pregi, L. (2016). Development trajectories of small towns in East Slovakia. European Countryside, 8(4), 373–394. doi:10.1515/euco-2016-0026
Novotný, L., Mazur, M., & Egedy, T. (2015). Definition and delimitation of peripheries of Visegrad countries. Studia Odborových Wieziek, 39, 35–48. doi:10.7163/SOW.39.7
Ocaña-Riola, R., & Sánchez–Cantalejo, C. (2005). Rurality index for small areas in Spain. Social Indicators Research, 73, 247–266. doi:10.1007/s11205-004-0987-3
OECD. (1994). Creating rural indicators for shaping territorial policies. Paris: OECD Publications. 31 p.
OECD. (2011). OECD regional typology. OECD – Directorate for Public Governance and Territorial Development. Retrieved from http://www.oecd.org/cef/regional-policy/OECD_regional_typology_Nov2012.pdf
Paniagua, A. (2014). Rurality, identity and morality in remote rural areas in northern Spain. Journal of Rural Studies, 35, 49–58.
Pászto, V., Burian, J., Marek, L., Vozenilek, V., & Tuček, P. (2016). Membership of Czech municipalities to rural and urban areas: A fuzzy-based approach. Geografie, 121(1), 156–186.
Pašík, J., & Falfán, I. (Eds.). (2004). Regionálny rozvoj Slovenska: Východisková a súčasný stav. Sociologický ústav. Bratislava: Slovenské akadémie vied.
Pászto, V., Brychtová, A., Tuček, P., Marek, L., & Burian, J. (2015). Using a fuzzy inference system to delimit rural and urban municipalities in the Czech Republic in 2010. Journal of Maps, 11(2), 231–239. doi:10.1080/17445647.2014.944942
Perlin, R., Kuceraova, S., & Kucera, Z. (2010). A typology of rural space in Czechia according to its potential for development. Geografie, 115(2), 161–187.
Pizzoli, E. (2017). Rural development indicators for regions with different degrees of “rurality”: A statistical study. Retrieved from http://jms.insee.fr/files/documents/2012/939_4-JMS2012_S24-2_PIZZOLI-ACTE.PDF
Pizzoli, E., & Xiaoing, G. (2007). How to best classify rural and urban? In Proceedings of the fourth international conference on agriculture statistics (ICAS-4), October, 22–24., Beijing. Retrieved from: http://www.stats.gov.cn/english/icas/papers/p020071114325747190208.pdf.
Pratt, A. C. (1996). Discourses of rurality: Loose talk or social struggle? Journal of Rural Studies, 12(1), 69–78. doi:10.1016/0743-0167(95)00046-1
Prieto-Lara, E., & Ocaña-Riola, R. (2010). Updating rurality index for small areas in Spain. Social Indicators Research, 95(2), 267. doi:10.1007/s11205-009-9459-0
Ritchie, J., Jacoby, A., & Bone, M. (1981). Access to primary healthcare. London: HMSO.
Sánchez-Cantalejo, C., Ocaña-Riola, R., & Fernández-Ajurua, A. (2007). Deprivation index for small areas in Spain. Social Indicators Research, 89, 259–273. doi:10.1007/s11205-007-9114-6
SO SR (Statistic Office of Slovak Republic), (1996-2015). Balance of Slovak population movement. Bratislava. Retrieved from http://datacube.statistics.sk
SO SR (Statistic Office of Slovak Republic), (2011). Štúnie obyvateľov, domov a bytov 2011 [Population census 2011]. Bratislava. Retrieved from http://datacube.statistics.sk
UN (2018). United nations demographic yearbook 2016: Sixty-seventh issue, UN, New York. doi: 10.18356/bad341b3-en-fr.
Vyas, S., & Kumaranyake, L. (2006). Constructing socioeconomic status indices: How to use principal components analysis. Health Policy and Planning, 21(6), 459–468. doi:10.1093/heapol/czl029
Waldorf, B. (2006, July). A continuous multi-dimensional measure of rurality: Moving beyond threshold measures. Paper selected for the Annual Meetings of the Association of Agricultural Economics, Long Beach, CA. Retrieved from http://ageconsearch.umn.edu/bitstream/21383/1/sp06wa02.pdf
Waldorf, B., & Kim, A. (2015). Defining and measuring rurality in the U.S.: From typologies to continuous indices. Paper presented at the Workshop on Rationalizing Rural Classifications, April, National Academies of Sciences, Engineering, and Medicine, Washington, DC. Retrieved from http://sites.nationalacademies.org/DBASSE/CNSTAT/DBASSE_160632
Woods, M. (2005). Rural geography. London: Sage.
Woods, M. (2010). Performing rurality and practising rural geography. Progress in Human Geography, 34, 835–846. doi:10.1177/0309132509357356
Woods, M. (2011). Rural. London: Routledge.
Woods, M. (2015). Conceptualizing rural areas in metropolitan society: A rural view. Paper presented at the Workshop on Rationalizing Rural Area Classifications, April, National Academies of Sciences, Engineering, and Medicine, Washington, DC. Retrieved from http://sites.nationalacademies.org/DBASSE/CNSTAT/DBASSE_160632
Zhu, H., Deng, F., & Liang, X. (2017). Overall urban–rural coordination measures—a case study in Sichuan Province, China. Sustainability, 9(2), 189. doi:10.3390/su9020189