A METHOD TO DEFINE THE NUMBER OF FUNCTIONAL REGIONS: AN APPLICATION TO NUTS 2 AND NUTS 3 LEVELS IN SLOVENIA

METODA OPREDELITVE ŠTEVILA FUNKCIONALNIH REGIJ: APLIKACIJA NA RAVNEH NUTS 2 IN NUTS 3 V SLOVENIJI

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ABSTRACT

In the article, we suggest a method of decision-making about the number and composition of functional regions in the state. The method considers the economic variable of the average monthly gross earnings per capita in the functional region (the variability between regions should be minimal) as well as the guidelines for the population size of the regions. The method was applied to analyse regions at NUTS 2 and NUTS 3 levels in Slovenia in 2000–2010. In our application we are looking for equally developed regions (with the smallest disparities between regions possible).

KEY WORDS

region, functional region, commuting, decision-making, number of functional regions, NUTS 2, NUTS 3, Slovenia

IZVLEČEK

V prispevku predlagamo metodo za opredelitev števila in sestave funkcionalnih regij v državi. Pri metodi za odločanje glede števila funkcionalnih regij se upoštevata zahteva po bolj izenačeni vrednosti ekonomskih kazalnikov med regijami (povprečna variabilnost bruto plače na prebivalca med regijami naj bo minimalna) ter evropsko priporočilo glede števila prebivalcev v regiji. S predlagano metodo smo analizirali regije na ravneh NUTS 2 in NUTS 3 v Sloveniji v obdobju 2000–2010. V aplikaciji predlagane metode smo iskali podobno razvite regije (čim manjšo neenakost med regijami).

KLJUČNE BESEDE

regija, funkcionalna regija, vožnja na delo, odločanje, število funkcionalnih regij, NUTS 2, NUTS 3, Slovenija

1 INTRODUCTION

The concept of regions is anchored deep in the history of Europe. Before the transportation technology enabled to create and integrate national markets, most of Europe consisted of economically autonomous regions, whose size was limited by one-day accessibility of the regional centre on foot or by cattle-drawn cart. Only the most developed cities and city-regions, mostly maritime, were able to overcome the barrier of physical distance and become a part of higher-rank, Europe-wide, commercial and other power structures. It was only towards the end of the pre-industrial period when the growing power of bureaucracy-based central power replaced the medieval regions by centralised economy of states. Later, the process of etatisation had a different shape in different parts of Europe (Maier, 2005).

Nowadays, the idea of regions is often connected with the integration of the European Union (EU). However, different actors understand the very concept of a region quite differently. Administrative or statistic regions are defined by their borders and they are required to cover

whole the respective territory homogeneously and to be of comparable size. In comparison with rigid administrative regions, functional regions of economy and/or society are product of interrelations, they are changing all the time with development of technology and with the investments into the space, they are quite diverse in terms of their size and population, and they may overlap as well as not fully cover the territory.

Ball (1980), Casado-Diaz (2000), Andersen (2002), and Karlsson and Olsson (2006) denoted that the standard administrative regions used by governments for policy making, resource allocation, and research do not provide meaningful information on actual conditions of a particular place or region. As such, there has been a move towards the identification and delineation of functional regions. A functional region is a region characterised by its agglomeration of activities and by its intra-regional transport infrastructure, facilitating a large mobility of people, products, and inputs within its interaction borders. The basic characteristic of a functional region is the integrated labour market, in which intra-regional commuting as well as intra-regional job search and search for labour demand is much more intensive than the inter-regional counterparts (Laan and Schalke, 2001; Karlsson and Olsson, 2006). Consequently, the identification and delineation of functional regions are commonly based on the conditions of local labour markets, LLMs, (Smart, 1974; Coombes et al., 1986; Casado-Diaz, 2000; OECD, 2002; Karlsson and Olsson, 2006; Cörvers et al., 2009; Farmer, 2009), which can be changed by economic shocks like the nowadays' economic crises is.[1]

So, the aim of a functional regionalization is to define geographical units where the majority of the interactions between workers seeking jobs and employers recruiting labour occur (i.e. to define boundaries across which relatively few people travel between home and work). This is of obvious interest for labour economists who seek to carry out research at sub-national levels, and also for various parts of government for a number of reasons (Ball, 1980; Casado-Diaz, 2000). Commuting flows are of relevance for planning purposes in transport, housing and other infrastructure. Moreover, since LLMs (i.e. functional regions at local level) have been accepted as the main reference for measuring labour market conditions, they have also been used as ideal geographical areas for reporting disaggregated labour figures and for the identification of assisted areas for the purposes of regional industrial policy. They were also used for the reorganization of local government in the UK and for the delimitation of industrial districts in Italy (Casado-Diaz, 2000).

A number of regionalisation procedures have been suggested in the literature (e.g., Masser and Brown, 1975, 1977; Slater, 1981; Coombes et al., 1986; Florez-Revuelta et al., 2008; Farmer and Fotheringham, 2011). A recent review of different approaches to delineate functional regions is in (Karlsson and Olsson, 2006). However, Farmer and Fotheringham (2011) identified three general classes of functional regionalisation procedures defined in the literature: (1) hierarchical clustering, (2) multistage aggregation, and (3) central place aggregation. No matter how, the

[1] Some case studies of delineation of functional regions are in (Mitchell et al., 2007) for Australia, in (Persyn and Torfs, 2011) for Belgium, in (Tomaney and Ward, 2000; Feldman et al., 2006; Bond and Coombes, 2007) for England, Wales and Scotland, in (Papps and Newell, 2002) for New Zeeland, in (Laan, 1991; Van der Zwan et al., 2005; Cörvers et al., 2009) for The Netherlands, in (Karlsson and Olsson, 2006) for Sweden, in (Casado-Diaz, 2000) for Spain, in (Killian and Tolbert, 1993) for the United States of America, and, most recently, for Slovenia in (Drobne et al., 2009a, 2009b, 2010; Drobne and Konjar, 2011; Konjar, 2009; Konjar et al., 2010; Pogačnik et al., 2009, 2011; Bajt, 2010).

aim of regionalisation procedures is to define as many functional regions as possible, subject to certain statistical constraints which ensure that the regions remain statistically and operationally valid (Farmer, 2009).

A problem with many functional regionalisation procedures is that they cannot be used directly for selecting the number of functional regions, *k*. Most recently Farmer (2009) made a review of approaches to define the number of functional regions: (1) some procedures require the value of *k* to be specified *a priori* (e.g. Brown and Holmes, 1971; Masser and Scheurwater, 1980; Cörvers et al., 2009), (2) others determine *k* through the use of *ad hoc* assessments of the data, where the subjective assessments of the configuration of functional regions are often based on authors' perceptions of local environments and specific application contexts to determine the optimal number of functional regions (Farmer, 2009), and (3) the network based methods that are designed to find the community structure of a network.[2]

As already noted, there are several approaches to delineate functional regions. In this paper we analyse functional regions defined by hierarchical clustering using the Intramax method (Masser and Brown, 1975, 1977; Masser and Scheurwater, 1980) by original adding the socio-economic criteria, compare them with administrative regions on NUTS 2 and NUTS 3 levels in Slovenia and suggest a method for decision-making on the number of functional regions in the state. In their nature, functional regions are heterogeneous, while the workers are attracted from areas with fewer jobs to areas with more jobs. So, the method to define the "appropriate" number of functional regions is based on the search for (local) minimums of variation of socio-economic parameters - that influence the criterial function - between regions (that means maximums of variation of parameters in the regions). In the application of the introduced method, we analyse the regions at NUTS 2 and NUTS 3 levels in Slovenia. Slovenia joined the EU in 2004. For this reason, we chose the time periods of 2000–2001, 2004–2005 and, the last period for which data have been available, 2009–2010 to perform the application of the approach. The choice of such time-horizons allows us also to study the influence of economic crisis on the systems of functional regions in the state.

1.1 NUTS regions in Slovenia

The NUTS (Nomenclature of Territorial Units for Statistics) classification is a hierarchical system for dividing up the economic territory of the EU for the purpose of (a) the collection, development and harmonisation of EU regional statistics; (b) socio-economic analyses of the regions; and (c) framing of EU regional policies (EC, 2003; 2007). For the purpose of socio-economic analyses, three levels of regions have been established inside each EU member: (b1) major socio-economic regions at NUTS 1 level, (b2) basic regions for the application of regional policies at NUTS 2 level, and (b3) small regions for specific diagnoses at NUTS 3 level. For the purpose of framing of EU regional policies (c1) regions eligible for aid from the Structural Funds (Objective 1) have been classified at the NUTS 2 level; (c2) areas eligible under the

[2] *Community structure refers to the tendency for nodes in a network to form groups of high within group edge connections, and low between-group edge connections. In the network based methods, the goal function Q directly measures the quality of a particular cluster arrangement, providing a means to automatically select the optimal number of clusters (or functional regions) k, in a network by choosing the cluster arrangement where Q is maximised (Farmer, 2009; Farmer and Fotheringham, 2011) .*

other priority objectives have mainly been classified at the NUTS 3 level; and (c3) the Cohesion Report has so far mainly been prepared at the NUTS 2 level. The current NUTS classification valid from 1st of January 2008 until 31st of December 2011 lists 97 regions at NUTS 1, 271 regions at NUTS 2 and 1303 regions at NUTS 3 level (Eurostat, 2011). At NUTS 0 level, state borders of EU members are defined.

In Slovenia, there is only one region at NUTS 0 or NUTS 1 level, respectively: the whole state. There are two regions for the application of regional policies at NUTS 2 level also called "macro regions" or "cohesion regions", and there are twelve "statistical regions" at NUTS 3 level also called "development regions" (SORS, 2011a; see Figure 1). The East (SI01) and West (SI02) Cohesion Regions have been introduced with the Promotion of Balanced Regional Development Act and approved with the decision of the Government of the Republic of Slovenia in 2005. Eastern Slovenia includes development regions (at NUTS 3 level): Mura Region (SI011), Drava Region (SI012), Carinthia (SI013), Savinja Region (SI014), Lower Sava Region (SI016), Central Sava Region (SI015), Southeast Slovenia (SI017), and Notranjska-Karst Region (SI018). Western Slovenia includes development regions (at NUTS 3 level): Central Slovenia (SI021), Gorenjska Region (SI022), Goriška Region (SI023), and Coastal-Karst Region (SI024). While cohesion regions have existed only since 1st of January 2008, the first version of statistical regions dates back to mid-1970s. At that time, statistical regions were established for the purpose of regional planning and cooperation in various sectors. The first regionalization of statistical regions was supported by exhaustive gravity analysis of labour markets, education areas and supply markets in twelve regional, and their sub-regional, centres – that is the reason why Slovenian regions at NUTS 3 level are very stable (SORS, 2011a). Figure 1 shows two cohesion regions, twelve statistical regions and 210 municipalities of Slovenia in the beginning of 2011.

Figure 1: Two cohesion regions and twelve statistical regions of Slovenia in the beginning of 2011 (EC, 2003, 2007; Eurostat, 2010; SORS, 2011a).

2 MATERIALS AND METHODOLOGY

The labour commuter is a person in employment whose territorial unit of workplace is not the same as territorial unit of residence. In our application, we analysed inter-municipal labour commuters in Slovenia. The source of data for our application was the Statistical Register of Employment (SRDAP), which has been kept by Statistical Office of the Republic of Slovenia. SRDAP covers persons in paid employment and self-employed persons who are at least 15 years old and who have, on the basis of the employment contract, compulsory social insurance or are employed on the territory of the Republic of Slovenia. Employment can be permanent or temporary, full time or part time (SORS, 2011b).

Here, we should stress two points: first, in the analysed period of 2000–2010 the number of municipalities changed twice: in 2002 one new municipality was established, while in 2006 seventeen new municipalities were established. The number of analysed municipalities was: 192 municipalities in 2000–2001, 193 municipalities in 2002–2005, and 210 municipalities in 2006–2010. And, secondly, in data 2000–2008 for citizens of the Republic of Slovenia permanent residence was taken into account, while for foreigners only temporary residence was considered. From 2009 on for all persons temporary residence is taken into account first and only then his or her permanent residence.

To analyse normatively and functionally defined regions at NUTS 2 and NUTS 3 levels in Slovenia, a set of functional regions was modelled using the Intramax method, which belongs to the methods of hierarchical clustering. Regionalisation procedures based on hierarchical clustering were initially developed in the 1970s and 1980s, and were introduced as alternatives to the more *ad hoc* methods. Such methods include Markov chain analysis techniques of Brown and Holmes (1971), as well as the strategy of Masser and Brown (1975, 1977) and Masser and Schuerwater (1980), which is based on refinements to Ward's (1963) hierarchical aggregation procedures (Farmer, 2011).

The Intramax method, which was introduced by Masser and Brown (1975) and improved some years later (Masser and Brown, 1977; Masser and Schuerwater, 1980), carries out a regionalization of an interaction matrix. The objective of the Intramax procedure is to maximise the proportion within the group interaction at each stage of the grouping process, while taking account of the variations in the row and column totals of the matrix. In the grouping process, two areas, i.e. municipalities in our application, are grouped together for which the objective function T is maximised (Breukelman et al., 2009):

$$\max T,$$

$$T = \frac{T_{ij}}{O_i \cdot D_j} + \frac{T_{ji}}{O_j \cdot D_i}, \tag{1}$$

where T_{ij} is the interaction between origin location i and destination location j, $O_i = \sum_j T_{ij}$ is the total of interactions originating from origin i, $D_j = \sum_i T_{ij}$ is the total of interactions coming to destination j, and O_i and $D_i > 0$.

The Intramax analysis is a stepwise analysis. In each step two areas are grouped together and the interaction between the two municipalities becomes the internal interaction for the new resulting area. This new area takes the place of the two parent areas at the next step of the analyses. So with N areas after $N-1$ steps all areas are grouped together into one area (region) and all interactions become internal.

In our analysis, the Flowmap software (Breukelman et al., 2009), with implemented Intramax method, was used to delineate functional regions of Slovenia. In Flowmap, the outcome of an Intramax analysis is a report in table form and a dendrogram showing which municipalities are grouped and how. We modelled 29 systems of 2 to 30 functional regions for each analysed year (i.e. 2000, 2001, 2004, 2005, 2009, and 2010). These sets of functional regions were used to develop criteria on decision-making on the number of functional regions in Slovenia. Here we considered (a) the demographic criterion of the EU guidelines for the size of the region at NUTS 2 and NUTS 3 levels, and (b) the criterion of economic equality of regions.

In Table 1, EU guidelines for the size of regions on NUTS levels are indicated. The thresholds in the table are used as guidelines for establishing the regions, but they are not applied rigidly.

Level	*Minimum population in the region*	*Maximum population in the region*
NUTS 1	3,000,000	7,000,000
NUTS 2	800,000	3,000,000
NUTS 3	150,000	800,000

Table 1: Guidelines for establishing the regions at NUTS 1–3 levels (EC, 2003; Eurostat, 2011).

The most commonly used economic criterion in different regional development analyses is gross domestic product (GDP). Economic prosperity can be determined in three ways, all of which should, in principle, give the same result. These are the product (or output) approach, the income approach, and the expenditure approach. The income approach measures GDP by adding incomes that firms pay households for the factors of production they hire, wages for labour, interest for capital, rent for land and profits for entrepreneurship. Normally, GDP is measured only for regions at NUTS 3 level, or higher. There are no data for GDP at lower levels of regions. For this reason, we chose average monthly gross earnings per capita in paid employment in the municipality (SORS, 2011c) as a measure of economic prosperity. An average monthly gross earning per capita in the functional region is calculated as:

$$GEAR\_PC(fr) = \frac{\sum_{fr} GEAR\_PE(m) \cdot PPE(m)}{POP(fr)} \tag{2}$$

$$POP(fr) = \sum_{fr} POP(m)\,, \tag{3}$$

where *GEAR_PC(fr)* is the average monthly gross earning per person in paid employment in the municipality, *PPE(m)* is the number of persons in paid employment in the municipality *m*,

POP(fr) is population of a functional region, *POP(m)* is population of a municipality, and $\sum_{fr}$ denotes the sum by municipalities inside the functional region *fr*.

The model for decision-making on the number of functional regions at NUTS 2 and NUTS 3 levels is based on the variation of average monthly gross earnings per capita between the functional regions and deviation of population in the functional region regarding the EU guidelines:

$$\min_k f(k,w)$$
$$f = w \cdot CV_{GEAR\_PC(fr)} + (1-w) \cdot CD_{POP(fr)}, \tag{4}$$

where k is the number of functional regions in the state, $CV_{GEAR\_PC(fr)}$ is coefficient of variation of average monthly gross earnings per capita between functional regions, $CD_{POP(fr)}$ is coefficient of deviation of population in the region regarding the EU guidelines, w is the weight for economic criterion, $1-w$ is the weight for criterion of population size in the region, and

$$CV_{GEAR\_PC(fr)} = \frac{\sigma_{GEAR\_PC(fr)}}{\mu_{GEAR\_PC(fr)}} \tag{5}$$

$$CD_{POP(fr)} = \sqrt{\frac{1}{k}\sum_{i}^{k} D_i^2} \Bigg/ \frac{(POP(r)_{\min} + POP(r)_{\max})}{2} \tag{6}$$

$$D_i^2 = \begin{cases} POP(fr)_i < POP(r)_{\min} & \rightarrow & (POP(fr)_i - POP(r)_{\min})^2 \\ POP(fr)_i > POP(r)_{\max} & \rightarrow & (POP(fr)_i - POP(r)_{\max})^2 \\ sicer & \rightarrow & 0 \end{cases}, \tag{7}$$

where $\sigma_{GEAR\_PC(fr)}$ is standard deviation of average monthly gross earnings per capita between functional regions, $\mu_{GEAR\_PC(fr)}$ is the average of average monthly gross earnings per capita in the functional regions, $POP(r)_{min}$ is the minimum population in the region regarding the EU guidelines and $POP(r)_{max}$ is the maximum population in the region regarding the EU guidelines.

In the model (4), we presume that we wish regions that are socio-economically alike (the variation of average monthly gross earnings per capita is minimal between functional regions). Model (4) allows us to analyse the adaptable change of the impact of socio-economic and demographic parameters (through the change of weight w).

The review of all actual regions at NUTS 2 and NUTS 3 levels in EU and candidate states shows that EU guidelines for regions at different NUTS levels are not applied rigidly for EU members. For this reason, we also performed an analysis to define the number of functional regions considering only the "local" socio-economic criterion of economic equality of functional regions in the state.

3 RESULTS

In the application of the decision-making model on the number of functional regions at NUTS 2 and NUTS 3 levels in Slovenia (4), weight varied from 0 to 1 by 0.1. The results for the suggested number of functional regions at NUTS 2 and NUTS 3 levels are in Tables 2 and 3, respectively. The results show that the prevailing number of functional regions at NUTS 2 level is that of two functional regions ($k = 2$) in the case of using weak or mean weight for variation of average monthly gross earnings per capita between the functional regions ($0 \leq w \leq 0.7$), but the suggested number of functional regions at NUTS 2 level is also three functional regions ($k = 3$, if $w = 0.8$) in 2009 and 2010 and seven functional regions ($k = 7$, if $w = 1$) in 2001. However, at the end of the analysed period (2009–2010), the number of functional regions varied from $k = 2$ (for $0 \leq w \leq 0.7$) to $k = 3$ (for $w = 0.8$), and to $k = 4$ (for $w \geq 0.9$). It means that the EU criterion about the population in the region suggests a smaller number ($k = 2$) of larger functional regions, while the "local" economic criterion of homogeneous regions suggests a number higher than two functional regions ($k = 4$ or $k = 3$), i.e. of smaller, but socio-economically more balanced, functional regions at NUTS 2 level in Slovenia; see Table 2.

According to the model (4), the prevailing number of functional regions at NUTS 3 level is five functional regions in Slovenia ($k = 5$ for $0 \leq w \leq 0.8$) for 2000, 2001, 2009 and 2010. But the suggested maximum number of functional regions was seven ($k = 7$) in 2001 (for $w \geq 0.9$), and in 2009, 2010 (for $w = 0.9$); see Table 3.

min f(k=•,w=•)	*w*										
leto	**0**	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
2000	0,000 *(k = 2)*	0,022 *(k = 2)*	0,044 *(k = 2)*	0,066 *(k = 2)*	0,088 *(k = 2)*	0,110 *(k = 2)*	0,131 *(k = 2)*	0,153 *(k = 2)*	0,175 *(k = 2)*	0,170 *(k = 5)*	0,163 *(k = 5)*
2001	0,000 *(k = 2)*	0,024 *(k = 2)*	0,048 *(k = 2)*	0,072 *(k = 2)*	0,096 *(k = 2)*	0,121 *(k = 2)*	0,145 *(k = 2)*	0,169 *(k = 4)*	0,192 *(k = 4)*	0,183 *(k = 7)*	0,170 *(k = 7)*
2004	0,000 *(k = 2)*	0,025 *(k = 2)*	0,050 *(k = 2)*	0,075 *(k = 2)*	0,100 *(k = 2)*	0,125 *(k = 2)*	0,150 *(k = 2)*	0,175 *(k = 2)*	0,192 *(k = 6)*	0,181 *(k = 6)*	0,171 *(k = 6)*
2005	0,000 *(k = 2)*	0,024 *(k = 2)*	0,049 *(k = 2)*	0,073 *(k = 2)*	0,098 *(k = 2)*	0,122 *(k = 2)*	0,147 *(k = 2)*	0,171 *(k = 2)*	0,190 *(k = 6)*	0,180 *(k = 6)*	0,169 *(k = 6)*
2009	0,016 *(k = 2)*	0,036 *(k = 2)*	0,057 *(k = 2)*	0,077 *(k = 2)*	0,098 *(k = 2)*	0,118 *(k = 2)*	0,138 *(k = 2)*	0,159 *(k = 2)*	0,175 *(k = 3)*	0,176 *(k = 4)*	0,172 *(k = 5)*
2010	0,016 *(k = 2)*	0,036 *(k = 2)*	0,056 *(k = 2)*	0,075 *(k = 2)*	0,095 *(k = 2)*	0,115 *(k = 2)*	0,135 *(k = 2)*	0,155 *(k = 2)*	0,172 *(k = 3)*	0,172 *(k = 4)*	0,168 *(k = 4)*

Table 2: A suggested number of functional regions at NUTS 2 level in Slovenia according to the decision model (4) and different weights by analysed years.

The results of the decision model (4) show that laying (great) stress on EU guidelines about the number of population in NUTS regions leads us to consider the systems of a smaller number of functional regions, while pursuing more socio-economically similar developed regions (more even distribution of average monthly gross earnings per capita between the functional regions) the systems of a higher number of smaller functional regions in Slovenia are promoted. From Table 3 it is also evident that there were suggestion for higher number of smaller functional regions in the time of economic conjuncture in 2004 and 2005, but, when the economy crisis

come the bigger regions become more relevant. However, a review of all actual regions at NUTS 2 and NUTS 3 levels in EU and candidate states confirms the fact that EU guidelines for regions are not applied rigidly for EU members. For example, the smallest NUTS 2 region in EU was Aland (FI20) with an average of only 26,500 inhabitants in 2000–2009, and the largest NUTS 2 region was Ile-de-France (FR10) with more than 11 million inhabitants on average in 2000–2009 (see Figure 2). And, at NUTS 3 level – besides the Spanish small island in the Atlantic (El Hierro, ES703) and Swiss region Appenzell Innerrhoden (CH054) – the smallest region in EU was Evrytania (GR243) with an average of 19,500 inhabitants, while the largest region was – besides Istanbul (TR100) – Madrid (ES300) with approx. 5.8 million of inhabitants on average in 2000–2009 (see Figure 3).

min f(k=•,w=•)	***w***										
leto	**0**	**0,1**	**0,2**	**0,3**	**0,4**	**0,5**	**0,6**	**0,7**	**0,8**	**0,9**	**1**
2000	0,000 *(k = 5)*	0,016 *(k = 5)*	0,033 *(k = 5)*	0,049 *(k = 5)*	0,065 *(k = 5)*	0,081 *(k = 5)*	0,098 *(k = 5)*	0,114 *(k = 5)*	0,130 *(k = 5)*	0,146 *(k = 5)*	0,163 *(k = 5)*
2001	0,000 *(k = 5)*	0,018 *(k = 5)*	0,036 *(k = 5)*	0,055 *(k = 5)*	0,073 *(k = 5)*	0,091 *(k = 5)*	0,109 *(k = 5)*	0,127 *(k = 5)*	0,145 *(k = 5)*	0,160 *(k = 7)*	0,170 *(k = 7)*
2004	0,000 *(k = 5)*	0,019 *(k = 5)*	0,038 *(k = 5)*	0,057 *(k = 5)*	0,077 *(k = 5)*	0,096 *(k = 5)*	0,114 *(k = 6)*	0,128 *(k = 6)*	0,142 *(k = 6)*	0,157 *(k = 6)*	0,171 *(k = 6)*
2005	0,000 *(k = 5)*	0,019 *(k = 5)*	0,038 *(k = 5)*	0,057 *(k = 5)*	0,076 *(k = 5)*	0,095 *(k = 5)*	0,112 *(k = 6)*	0,127 *(k = 6)*	0,141 *(k = 6)*	0,155 *(k = 6)*	0,169 *(k = 6)*
2009	0,020 *(k = 5)*	0,037 *(k = 5)*	0,054 *(k = 5)*	0,071 *(k = 5)*	0,088 *(k = 5)*	0,104 *(k = 5)*	0,121 *(k = 5)*	0,138 *(k = 5)*	0,155 *(k = 5)*	0,168 *(k = 7)*	0,172 *(k = 4)*
2010	0,026 *(k = 5)*	0,042 *(k = 5)*	0,057 *(k = 5)*	0,073 *(k = 5)*	0,089 *(k = 5)*	0,105 *(k = 5)*	0,121 *(k = 5)*	0,137 *(k = 5)*	0,153 *(k = 5)*	0,167 *(k = 7)*	0,168 *(k = 4)*

Table 3: A suggested number of functional regions at NUTS 3 level in Slovenia according to the decision model (4) and different weights by analysed years.

At NUTS 2 level of Slovenia, there were approx. 1.1 million inhabitants in East Slovenia (SI01), and approx. 925,520 inhabitants in West Slovenia (SI02) on average in the period of 2000–2009. On NUTS 3 level of Slovenia, the smallest region was Central Sava Region (SI015) with only approx. 45,540 inhabitants, while Central Slovenia (SI021) was the largest region on NUTS 3 level of Slovenia with approx. 501,280 inhabitants on average in the period of 2000–2009 (see Table 4).

	NUTS 2		***NUTS 3***	
	minimum	***maximum***	***minimum***	***maximum***
Slovenia	app. 925,520	app. 1,080210	app. 45,540	app. 501,280
EU	app. 26,500	app. 11,390,600	app. 19,500	app. 5,803,570
Eurostat	800,000	3,000,000	150,000	800,000

Table 4: Minimum and maximum population in NUTS 2 and NUTS 3 regions in EU and in Slovenia on average in 2000–2009, and guidelines for establishing the regions at NUTS 2 and NUTS 3 (Eurostat, 2011; EC, 2003).

Figures 2 and 3 show the average population in 2000–2009 in regions at NUTS 2 and NUTS 3 levels in EU and candidate countries. From figures it is evident that there are many smaller and

larger regions according the area as well as regions with smaller and higher population at NUTS 2 and NUTS 3 levels in EU than those in Slovenia. It is a fact that the number of Slovenian regions at NUTS 2 and NUTS 3 levels, respectively, could be lower or higher than it is the case today. For this reason we investigated the economic criteria only, i.e. coefficient of variation of average monthly gross earnings per capita between the functional regions, and searched for the local minimums of the analysed economic parameter for the systems of 2 to 30 functional regions in Slovenia. The local minimums of the analysed parameter defined the systems of economically alike functional regions. Figures 4–6 show the coefficient of variation of average monthly gross earnings per capita between the functional regions according to 29 systems of 2 to 30 functional regions in Slovenia in 2000–2001, 2004–2005, and 2009–2010. On figures, the local minimums are denoted by a black circle or ellipse, while grey ellipses denote sets of systems of functional regions near the local minimums, which could also be considered as an "appropriate" system of functional regions (with a small variation of the analysed economic parameters between the functional regions).

In 2000 and 2001, the most economically alike functional regions were identified for the systems of 5, 14, 19, 21 and 25 functional regions in the state. Around the local minimums, there were several systems of functional regions with a similar homogeneity between regions; those were the systems of 4–6, 12–15, 17–19, 21–22, and 24–26 functional regions. In 2004 and 2005, when Slovenia joined the EU, there were changes in the inter-municipal commuting flows of Slovenia, which defined the functional regions – especially for the systems of 9, 18 and 19 functional regions. The most homogeneous regions were those in the systems of 5–7 (with the local minimum of 6) functional regions, of 12–15 (with the local minimum of 14) functional regions, and in the systems of 22–25 (with the local minimum of 22) functional regions. In the last analysed period of 2009–2010, the most stable systems of functional regions, according to the analysed economic parameter, were those of 3–4 (with the local minimum of 4), 7, 12–14 (with the local minimum of 14) functional regions, and the systems of 20 and 22 functional regions.

By combining the results (the curves of the coefficient of variation of average monthly gross earnings per capita between the functional regions) for all three analysed periods on the same graph (see Figure 7), we found the most stable systems of functional regions for the whole period of ten years; those were the systems of 7 and 12–14 (with the local minimum of 14) functional regions, while for the last analysed periods also the systems of 3–4 (with the local minimum of 4) functional regions, 19–20 (with the local minimum of 20) functional regions, and the system of 22 functional regions in Slovenia.

Figure 7 also shows that the system of 7 functional regions in Slovenia did not change much in the period of 2000–2010 – actually, it changed only from 2000 to 2001, while from 2001 to 2010 it remained the same. From here we concluded that the system of 7 functional regions is the most stable system of functional regions in Slovenia. Figures 16 and 17 show the system of 7 functional regions of Slovenia in 2001 and 2001–2010.

Figures 8–17 show the systems of functional regions modelled by the Intramax method; systems with the same number of functional regions as the number of regions at NUTS 2 and 3 levels

(Figures 8, 9, 12 and 13), systems of functional regions with the local minimum at NUTS 2 and 3 levels (Figures 10, 11, 14 and 15), and, finally, the system of 7 functional regions, which has proven as the most stable system of functional regions, in 2000 and 2001–2010, respectively (Figures 16 and 17).

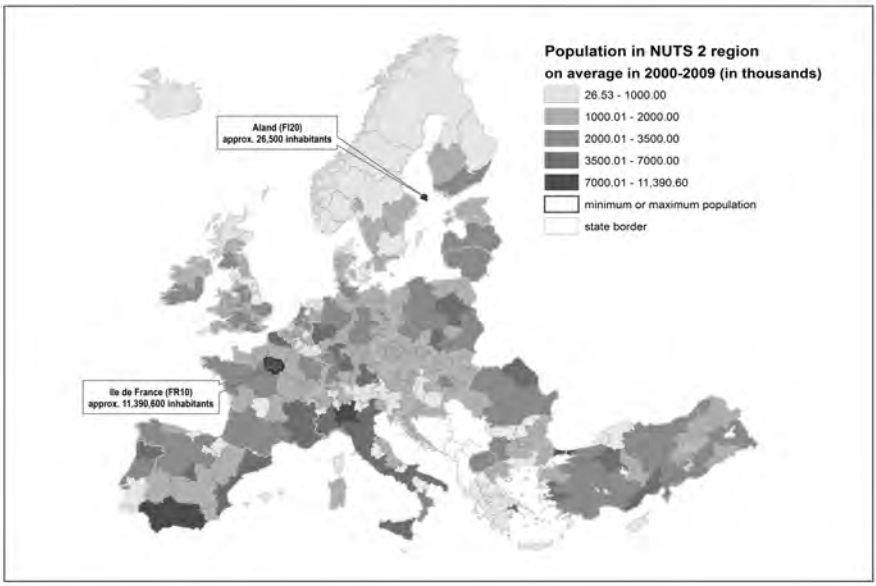

Figure 2: Population in NUTS 2-level regions in EU and candidate countries on average in 2000–2009 (in thousands).

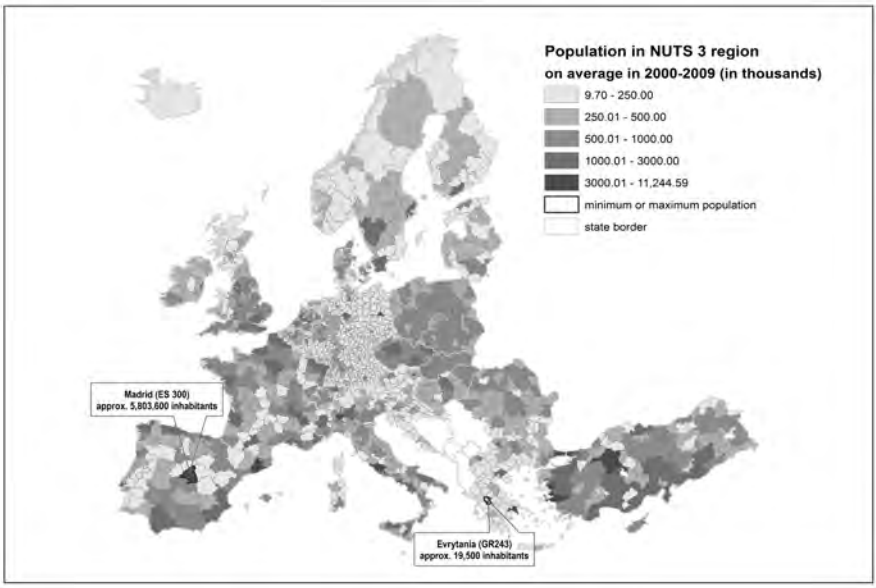

Figure 3: Population in NUTS 3-level regions in EU and candidate countries on average in 2000–2009 (in thousands).

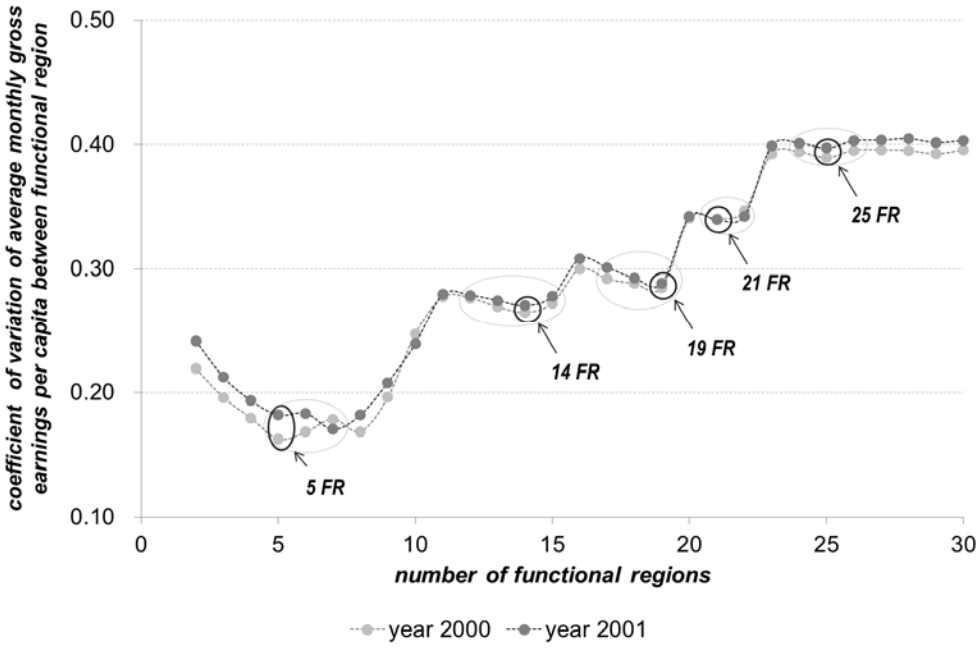

Figure 4: Coefficient of variation of average monthly gross earnings per capita between functional regions according to the system of functional regions in Slovenia in 2000 and 2001.

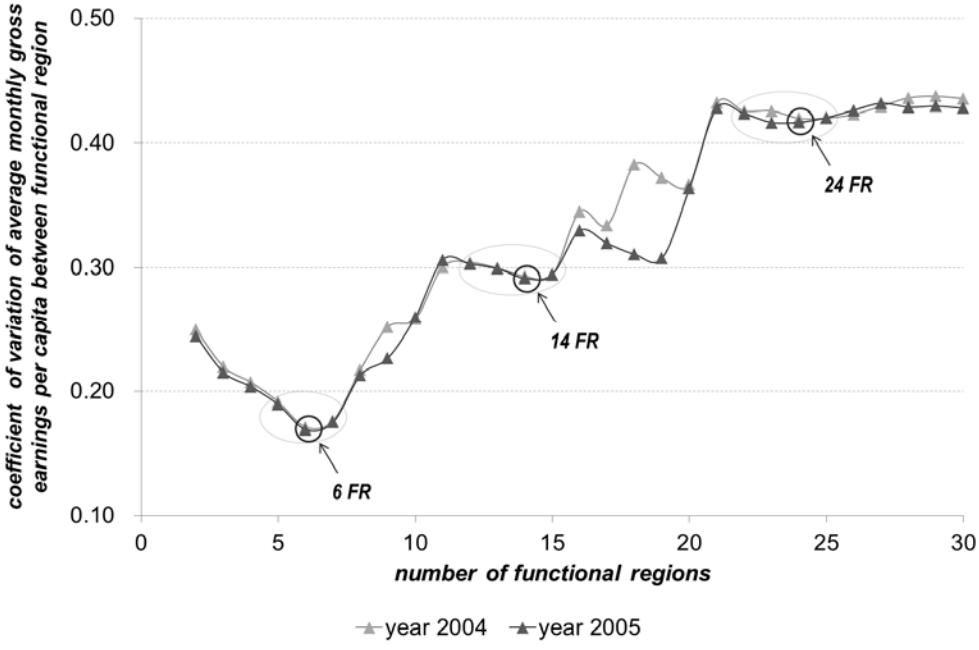

Figure 5: Coefficient of variation of average monthly gross earnings per capita between functional regions according to the system of functional regions in Slovenia in 2004 and 2005.

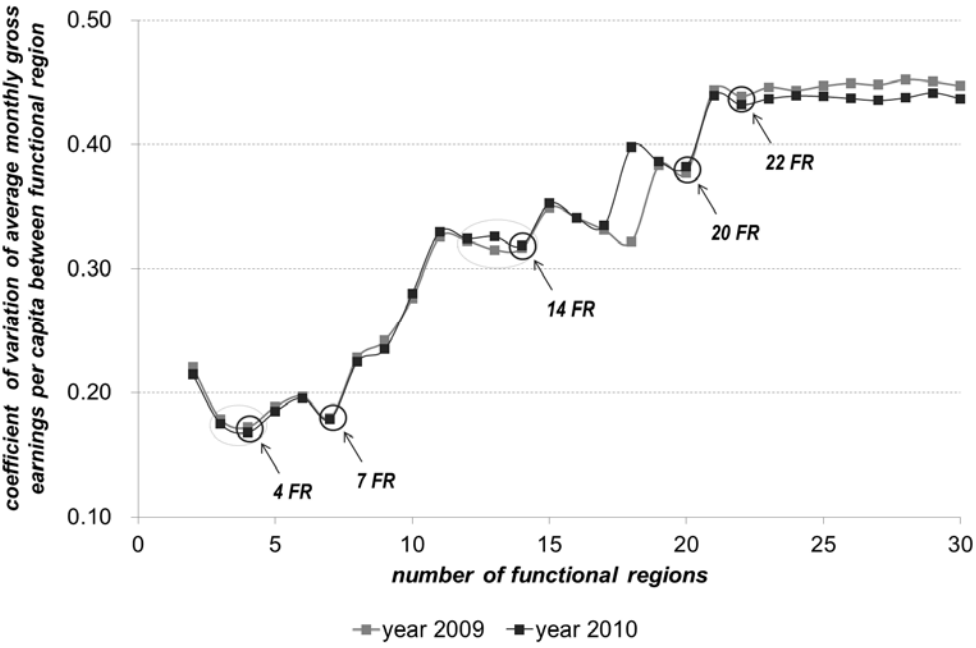

Figure 6: Coefficient of variation of average monthly gross earnings per capita between functional regions according to the systems of functional regions in Slovenia in 2009 and 2010.

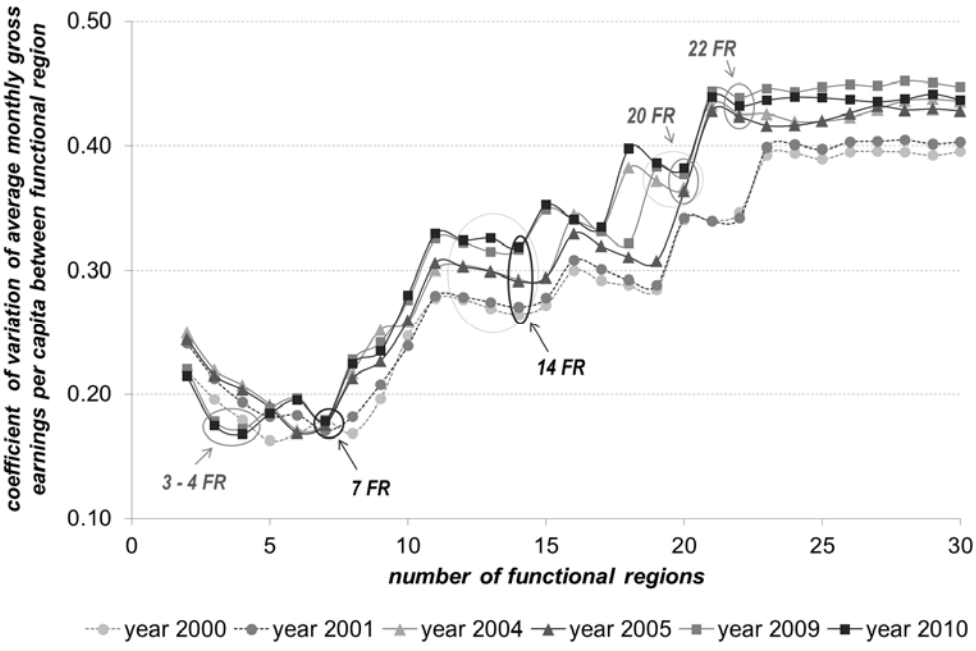

Figure 7: Coefficient of variation of average monthly gross earnings per capita between functional regions according to the systems of functional regions in Slovenia in 2000–2001, 2004–2005, and 2009–2010.

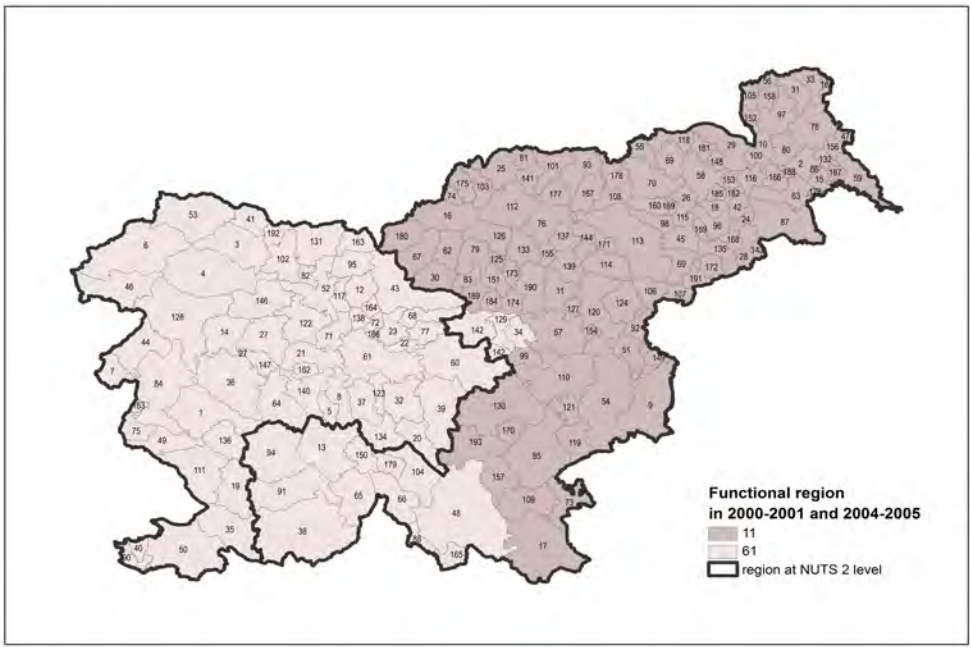

Figure 8: Two functional regions in 2000–2001, 2004–2005 and two regions at NUTS 2 level in Slovenia (codes for municipalities are in Annex 1).

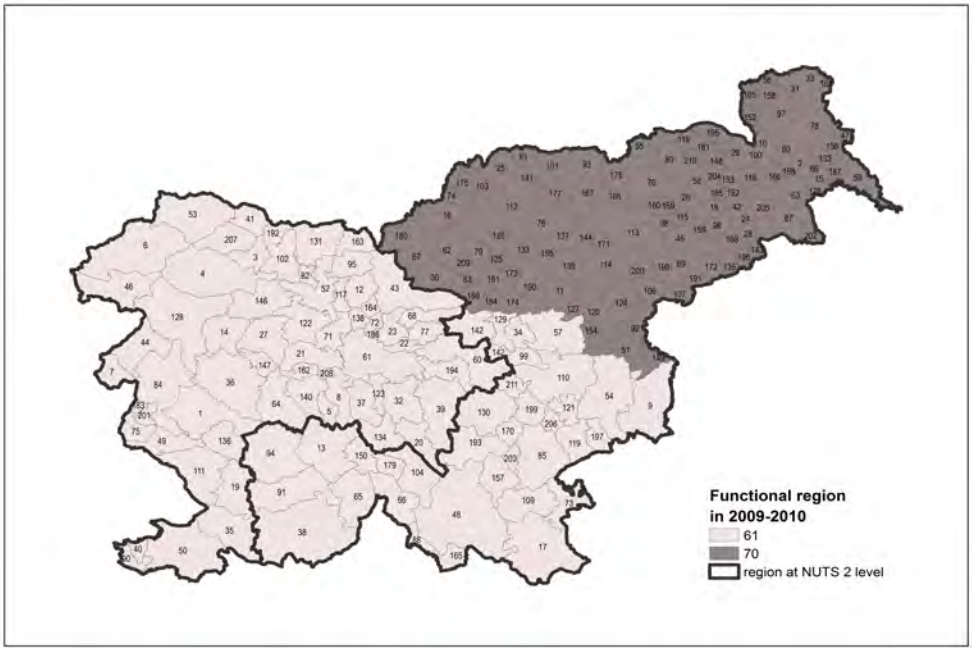

Figure 9: Two functional regions in 2009–2010 and two regions at NUTS 2 level in Slovenia (codes for municipalities are in Annex 1).

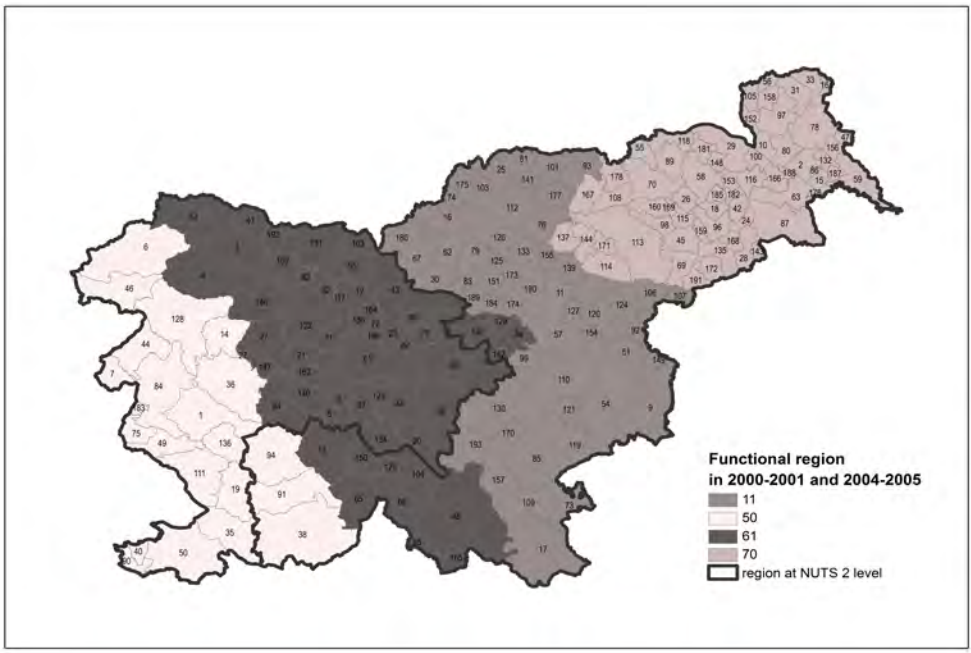

Figure 10: Four functional regions in 2000–2001, 2004–2005 and two regions at NUTS 2 level in Slovenia (codes for municipalities are in Annex 1).

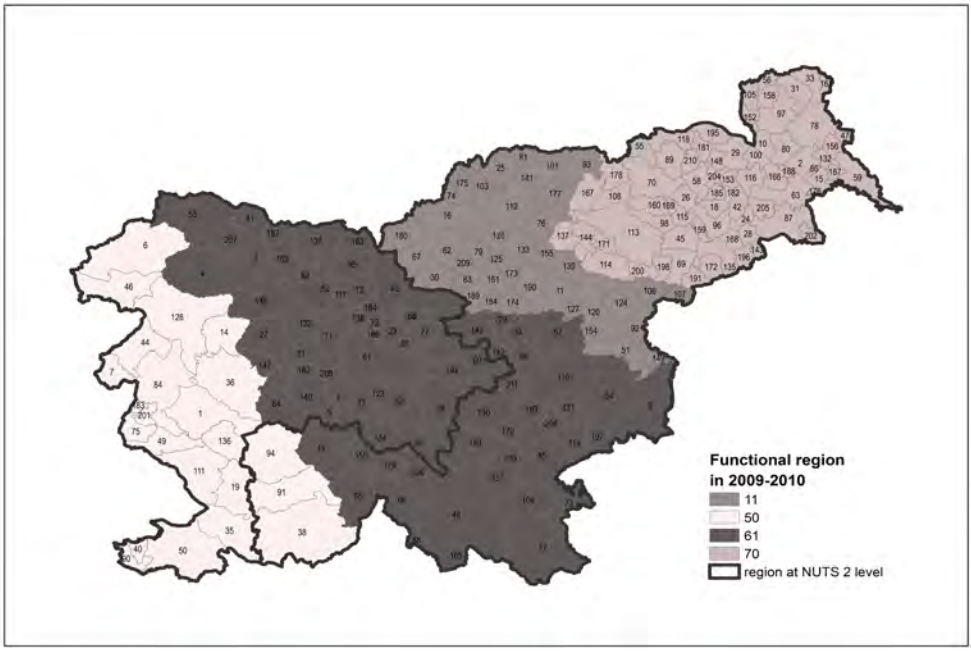

Figure 11: Four functional regions in 2009–2010 and two regions at NUTS 2 level in Slovenia (codes for municipalities are in Annex 1).

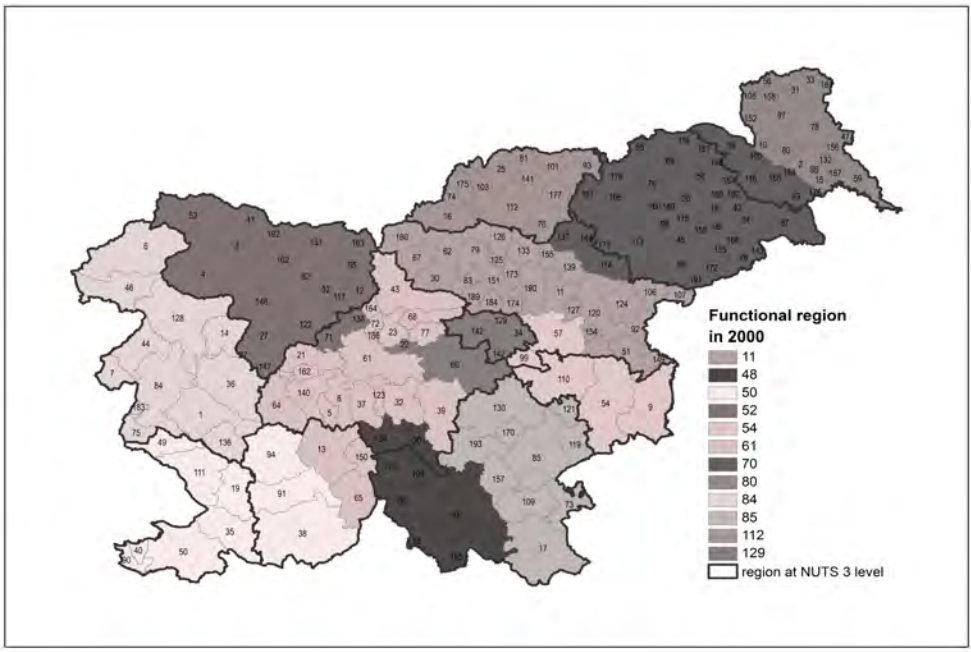

Figure 12: Twelve functional regions in 2000 and twelve regions at NUTS 3 level in Slovenia (codes for municipalities are in Annex 1).

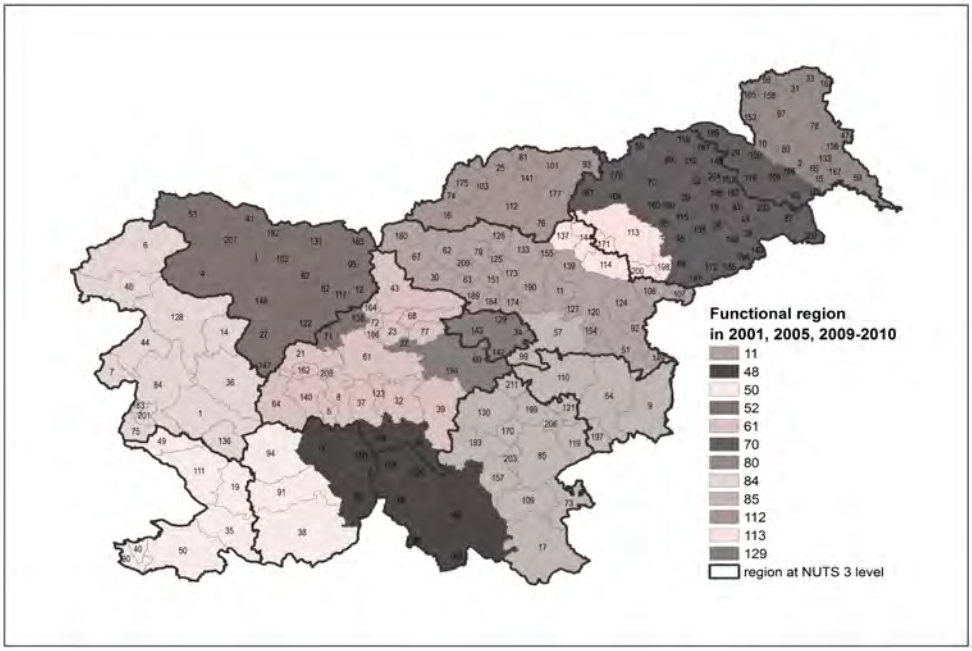

Figure 13: Twelve functional regions in 2001, 2005, 2009–2010 and twelve regions at NUTS 3 level in Slovenia (codes for municipalities are in Annex 1).

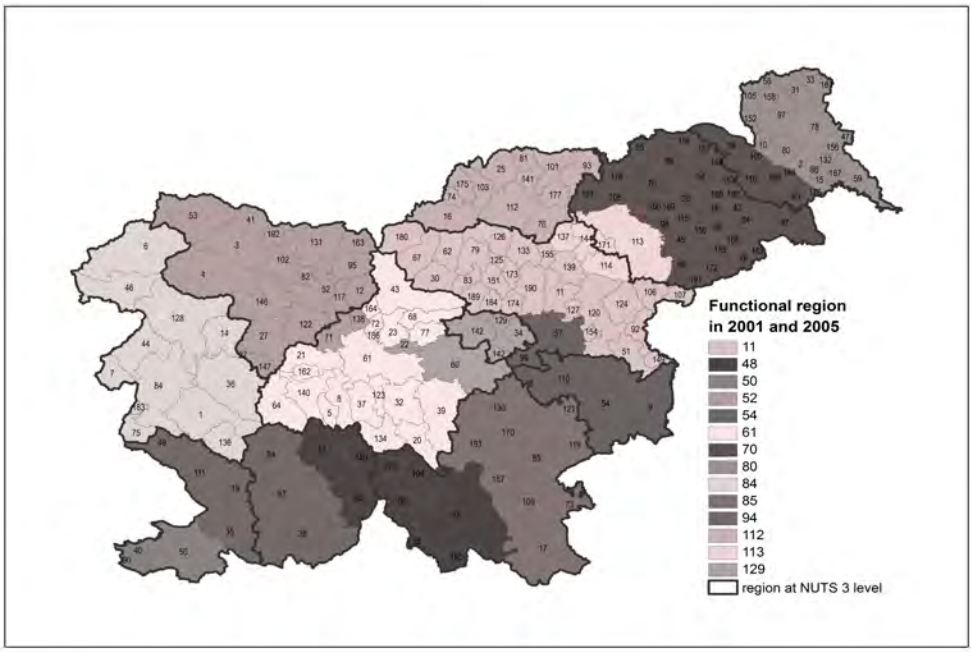

Figure 14: Fourteen functional regions in 2001 and 2005 and twelve regions at NUTS 3 level in Slovenia (codes for municipalities are in Annex 1).

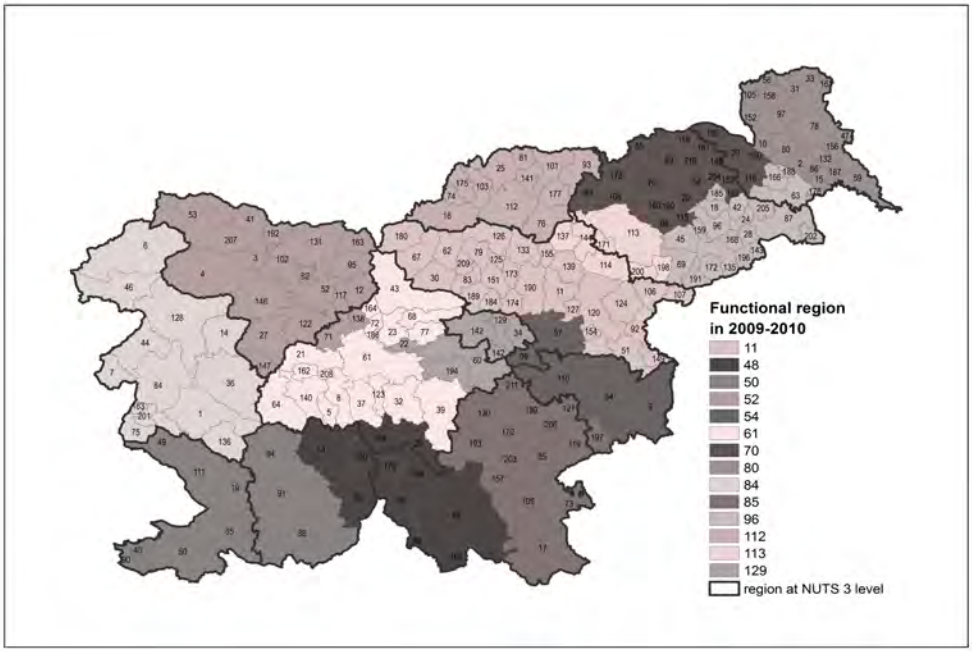

Figure 15: Fourteen functional regions in 2009–2010 and twelve regions at NUTS 3 level in Slovenia (codes for municipalities are in Annex 1).

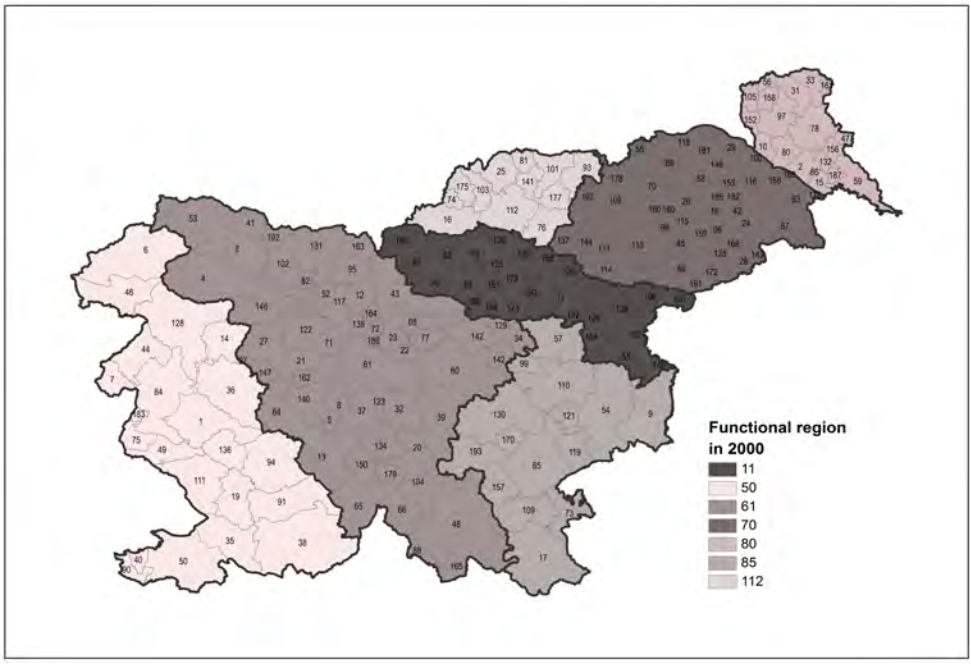

Figure 16: Seven functional regions in Slovenia in 2000 (codes for municipalities are in Annex 1).

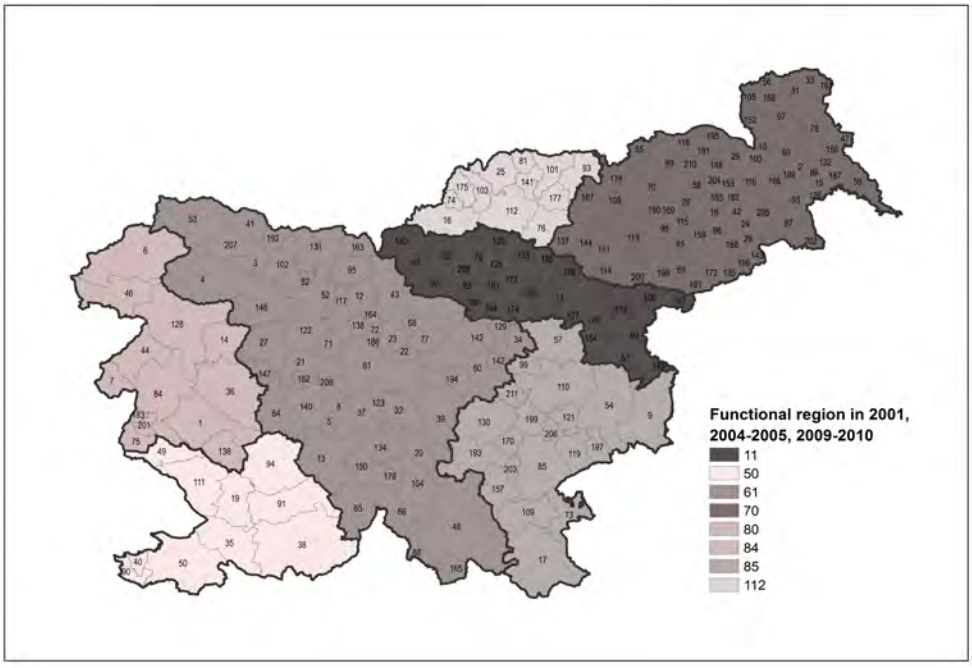

Figure 17: Seven functional regions in Slovenia in 2001, 2004–2005 and 2009–2010 (codes for municipalities are in Annex 1).

4 CONCLUSIONS

In the paper, we proposed a method for decision-making on the number of functional regions in a state. Software implementation of algorithms for delineation of functional regions enables modelling of several different systems of functional regions. So, the question about the "right" number of functional regions cannot be ignored. The suggested model for decision-making on the number of functional regions considers two criteria: that of the average monthly gross earnings per capita in the functional region, which can assure a more equal quality of life between regions, and, secondly, that of EU guidelines for the population in the region. The model could be improved by considering other more holistic economic parameters (i.e. GDP), by including another functional criterion in decision-making (e.g. travel costs in a functional region as a whole or to a regional centre as the future administrative centre) or by coupling the gravity approaches in the methods of delineation of functional regions, which is what we plan to investigate in the near future.

In the application of the model suggested here for the case study of Slovenia, functional regions were delineated by the Intramax method considering flows of labour commuters between the municipalities in Slovenia for three periods: 2000–2001, 2004–2005, and 2009–2010. The results of the model show that EU guidelines about the population in NUTS regions determine the systems of a smaller number of larger functional regions in the state, while the "local" economic criterion of socio-economically balanced functional regions determines the systems of a higher number of smaller functional regions – that is especially in the period of economic crisis.

The systems of functional regions modelled here also show that regions, defined by functional interrelations, do not necessarily coincide with the administratively defined (nominal) regions at different levels of the analysis. A major incompatibility is revealed not only for the smaller number of functional regions (e.g. at NUTS 2 level) but also for the higher number of functional regions in Slovenia (e.g. at NUTS 3 level). The suggestion is that the discrepancy between administrative and functional regions in Slovenia should be investigated deeper. The potentially new administrative regions in Slovenia could be defined by a further investigation into interrelations, and also by gravity analysis of labour markets, education areas and supply markets, not only in the most recent period, but also by studying their dynamics. It is difficult and costly to reorganize local government structure according to a particular functional division of regions. Therefore, a functional regionalization should have clear benefits over the administrative regionalization to make it really valuable for policy-makers (Cörvers et al., 2009).

The complex territorial organization of most EU members' political and administrative systems is rooted in the history and tradition as well as in a strong political will. Most parts of the provincial structure (states) and of the district structure of administration have been already inherited from the past and reflect the administrative entities of different social systems. But, for various motivations, the creation of a middle layer of regional government or administration should be established in those new member states of the EU where no intermediate level, except the state and municipality levels, of territorial organisation is present (Schrerrer, 2006; Drobne et al., 2009a, 2009b). In the last two decades, there has been an active debate over the establishment

of administrative regions (provinces) as an intermediate level of territorial organisation of Slovenia. The main goal of such (administrative) regionalization of Slovenia is decentralization of state functions and transfer of an important part of public affairs from the state to the regional (provincial) level. Besides, there are two more important goals of regionalization: harmonious regional development (polycentric development of the state) and international cooperation. The most recent OECD Territorial Reviews for Slovenia (OECD, 2011) suggest that "Slovenia should strengthen existing regional structure[3] and consider reducing their number in the medium term, rather than create a new administrative regional layer of government." The here suggested method to define the number of functionally living regions can help decision-makers to decide about the "appropriate" number of regions in Slovenia, that is, the system of seven functional regions, which has proven as the most stable system of regions in Slovenia in the last decade (see Figure 17).

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[3] *This refers to 12 statistical/development regions at NUTS 3 level in Slovenia.*

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Annex 1: Codes for municipalities (NUTS 5 regions) in Slovenia in 2000–2010

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Annex 1: Codes for municipalities (NUTS 5 regions) in Slovenia in 2000–2010

Code	Municipality
1	Ajdovščina
2	Beltinci
3	Bled
4	Bohinj
5	Borovnica
6	Bovec
7	Brda
8	Brezovica
9	Brežice
10	Tišina
11	Celje
12	Cerklje na Gorenjskem
13	Cerknica
14	Cerkno
15	Črenšovci
16	Črna na Koroškem
17	Črnomelj
18	Desternik
19	Divača
20	Dobrepolje
21	Dobrova-Polhov Gradec
22	Dol pri Ljubljani
23	Domžale
24	Dornava
25	Dravograd
26	Duplek
27	Gorenja vas-Poljane
28	Gorišnica
29	Gornja Radgona
30	Gornji Grad
31	Gornji Petrovci
32	Grosuplje
33	Šalovci
34	Hrastnik
35	Hrpelje-Kozina
36	Idrija
37	Ig
38	Ilirska Bistrica
39	Ivančna Gorica
40	Izola/Isola
41	Jesenice
42	Juršinci
43	Kamnik
44	Kanal
45	Kidričevo
46	Kobarid
47	Kobilje
48	Kočevje
49	Komen
50	Koper/Capodistria
51	Kozje
52	Kranj
53	Kranjska Gora
54	Krško
55	Kungota
56	Kuzma
57	Laško
58	Lenart
59	Lendava/Lendva
60	Litija
61	Ljubljana
62	Ljubno
63	Ljutomer
64	Logatec
65	Loška dolina
66	Loški potok
67	Luče
68	Lukovica
69	Majšperk
70	Maribor
71	Medvode
72	Mengeš
73	Metlika
74	Mežica
75	Miren-Kostanjevica
76	Mislinja
77	Moravče
78	Moravske Toplice
79	Mozirje
80	Murska Sobota
81	Muta

Code	Municipality
82	Naklo
83	Nazarje
84	Nova Gorica
85	Novo mesto
86	Odranci
87	Ormož
88	Osilnica
89	Pesnica
90	Piran/Pirano
91	Pivka
92	Podčetrtek
93	Podvelka
94	Postojna
95	Preddvor
96	Ptuj
97	Puconci
98	Rače-Fram
99	Radeče
100	Radenci
101	Radlje ob Dravi
102	Radovljica
103	Ravne na Koroškem
104	Ribnica
105	Rogašovci
106	Rogaška Slatina
107	Rogatec
108	Ruše
109	Semič
110	Sevnica
111	Sežana
112	Slovenj Gradec
113	Slovenska Bistrica
114	Slovenske Konjice
115	Starše
116	Sveti Jurij
117	Šenčur
118	Šentilj
119	Šentjernej
120	Šentjur pri Celju
121	Škocjan
122	Škofja Loka
123	Škofljica
124	Šmarje pri Jelšah
125	Šmartno ob Paki
126	Šoštanj
127	Štore
128	Tolmin
129	Trbovlje
130	Trebnje
131	Tržič
132	Turnišče
133	Velenje
134	Velike Lašče
135	Videm
136	Vipava
137	Vitanje
138	Vodice
139	Vojnik
140	Vrhnika
141	Vuzenica
142	Zagorje ob Savi
143	Zavrč
144	Zreče
146	Železniki
147	Žiri
148	Benedikt
149	Bistrica ob Sotli
150	Bloke
151	Braslovče
152	Cankova
153	Cerkvenjak
154	Dobje
155	Dobrna
156	Dobrovnik/Dobronak
157	Dolenjske Toplice
158	Grad
159	Hajdina
160	Hoče-Slivnica
161	Hodoš/Hodos
162	Horjul
163	Jezersko

Code	Municipality
164	Komenda
165	Kostel
166	Križevci
167	Lovrenc na Pohorju
168	Markovci
169	Miklavž na Dravskem polju
170	Mirna Peč
171	Oplotnica
172	Podlehnik
173	Polzela
174	Prebold
175	Prevalje
176	Razkrižje
177	Ribnica na Pohorju
178	Selnica ob Dravi
179	Sodražica
180	Solčava
181	Sveta Ana
182	Sveti Andraž v Slov. goricah
183	Šempeter-Vrtojba
184	Tabor
185	Trnovska vas
186	Trzin
187	Velika Polana
188	Veržej
189	Vransko
190	Žalec
191	Žetale
192	Žirovnica
193	Žužemberk
	New municipality in 2002
194	Šmartno pri Litiji
	New municipalities in 2006
195	Apače
196	Cirkulane
197	Kostanjevica na Krki
198	Makole
199	Mokronog-Trebelno
200	Poljčane
201	Renče-Vogrsko
202	Središče ob Dravi
203	Straža
204	Sveta Trojica v Slovenskih goricah
205	Sveti Tomaž
206	Šmarješke Toplice
207	Gorje
208	Log-Dragomer
209	Rečica ob Savinji
210	Sveti Jurij v Slovenskih goricah
211	Šentrupert