DE GRUYTER OPEN

Regions for Servicing Old People: Case study of Slovenia

Samo Drobne
Faculty of Civil and Geodetic Engineering, University of Ljubljana, Slovenia
Marija Bogataj
Mediterranean Institute for Advanced Studies, Šempeter pri Gorici, Slovenia

Abstract

Background: Aging is one of the most serious problems that most developed countries are facing in the 21st century. In the European Union, Member States are responsible for the planning, funding and administration of health care and social protection systems. Local authorities and state governments should undertake research toward developing an appropriate array of community-based care services for old people. **Objectives:** This study analyses the regions of Slovenia for servicing old people in the 2000–2010 time horizon. **Methods/Approach:** Sets of functional regions were modelled for each year in the analysed period using the Intramax method. Functional regions were evaluated based on the attractiveness of central places for labour commuters and the propensity to commute between regions. **Results:** The results show that in addition to the nominally declared regional centres of Slovenia, there are also some other local centres that should be potentially included in the functional areas for servicing old people. **Conclusions**: The results suggest that the regionalization into seven functional regions is the most convenient for servicing old people in the region. Furthermore, some additional functional regions at a lower level are suggested.

Keywords: population aging, servicing old people, functional region, commuting, SIM, Slovenia

JEL main category: C
JEL classification: C01, H40, J14, J21, R15, R23, R58
Paper type: Research article, Case Study

Received: 16 January, 2014
Accepted: 30 June, 2014

Acknowledgments: The research was partly financed by the Slovenian Research Agency, research project "The impact of recession on the interaction of regions in the global supply chain and land use", No. J5-4279-0792 2011–2014.

Citation: Drobne, S., Bogataj, M. (2014). "Regions for Servicing Old People: Case Study of Slovenia", Business Systems Research, Vol. 5 No 3, pp. 19-36.
DOI: 10.2478/bsrj-2014-0017

Introduction

Aging of the population is one of the most serious challenges that Europe, particularly Southern Europe, Central and Eastern Europe, is facing in the 21st century (Gavrilov and Heuveline, 2003). According to Kovács (2010), by 2050 the number of older persons will be more than twice the number of children in most European countries, and, according to the UN Population Aging and Development (2012), Europe will have more than 241 million people aged 60 and above by 2050. This will present 34% of European population (in 2012, it was 22%). The most problematic area is, and will continue to be, Southern Europe (especially the Mediterranean region), where this percentage will exceed 38% (ibid).

In Slovenia, by 2050 there will be 37% of those aged 60 and above (ibid). According to Kerbler (2011a, b) and Bogataj and Aver (2013), nearly one third of the housing stock needs to be transformed to homes and service facilities for old people. This could be achieved in two ways (Bogataj, Temeljotov Salaj and Aver, 2012): by segregation of seniors in senior cities or by universality of cities including adaptability of central places and suburbs. A careful introduction of universality and adaptability in the towns will allow for a greater mobility of old people that will enable them to stay in their homes longer and postpone reallocation to long-term care facilities (ibid).

According to Wikipedia (2014), there are several terms for old people including, "old people" (worldwide usage), "seniors" (American usage), "senior citizens" (British and American usage), "older adults" (in the social sciences), "the elderly" and "elders" (in many cultures including the cultures of aboriginal people). In this paper we use the term "old people" along with other generally accepted professional terminology, such as "aging index" and "old-age dependency ratio". But, when we cite other authors, we leave the original term.

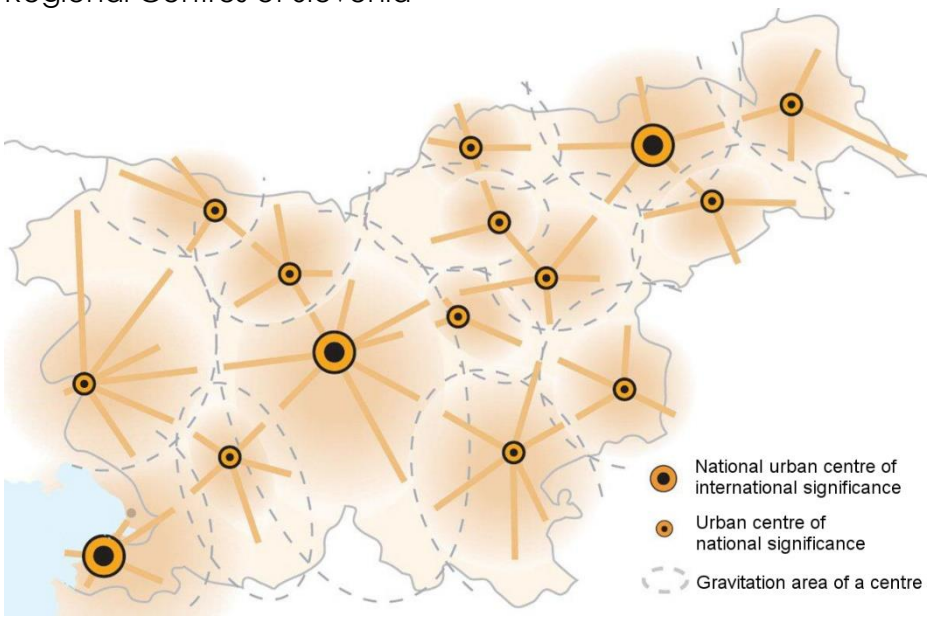
In the European Union, Member States are responsible for the planning, funding and administration of health care and social protection systems. Local authorities and state governments should undertake research toward developing an appropriate array of community-based care services for old people. Moving toward consumer-centred services for old people would require appropriate infrastructure and a mix of changes in consumer and provider attitudes. Therefore, new business practices and public policies are needed. It is expected that new care processes and management structures will be introduced in the future. According to Pogačnik, Zavodnik Lamovšek and Drobne (2009), such activities should be organised in the regional centres of Slovenia, while allowing for the inclusion of some central places on a lower level of the network of settlements in the region.

In Slovenia, there are 12 statistical regions of which the first version dates back to the mid-1970s. The first regionalization of statistical regions was supported by exhaustive gravity analysis of labour markets, education areas and supply markets in twelve regional centres (SURS, 2013a). However, labour and supply markets etc. are changing all the time, especially during the crisis that emerged in Slovenia in 2008 (Drobne and Bogataj, 2013a; Drobne, Rajar and Lisec, 2013). For that purpose, we modelled and analysed the functional regions of Slovenia.

A functional region is a region characterised by its agglomeration of activities and by its intra-regional transport infrastructure. 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). According to OECD (2002), the border of a labour market region is a good approximation of the border of a functional region.

The concept of Slovenia's urban system is defined in the Spatial Development Strategy of Slovenia (SPRS, 2004). The most important regional centres, or "urban centres of national significance", are (ibid): Ljubljana, Maribor, conurbation Koper–Izola–Piran, Celje, Kranj, Novo mesto, Nova Gorica, Murska Sobota, Velenje, Postojna, Ptuj, and conurbations Slovenj Gradec–Ravne na Koroškem–Dravograd, Jesenice–Radovljica, Zagorje ob Savi–Trbovlje–Hrastnik, and Krško–Brežice–Sevnica. On the other hand, the most workplaces and economic activities in Slovenia are concentrated in the (wider) urban areas of Ljubljana, Maribor, Celje, coastal conurbation Koper–Izola–Piran, followed by Kranj, Novo mesto, Velenje, and Nova Gorica. As it is noted (ibid), their gravitation areas are not clearly defined and may overlap; see Figure 1.

Figure 1
Regional Centres of Slovenia



Notes: (a) urban centres of national significance ≡ regional centres, (b) the three national urban centres of international significance are regional centres as well.
Source: SPRS (2004, 22) and author's illustration

Drobne and Bogataj (2013b) showed that the regional centres defined in (SPRS, 2004), and illustrated on Figure 1, could provide hubs for supply chains for servicing old people. Consequently, the pertinent questions emerge: *What would be the most convenient regionalization of Slovenia considering the aging population? How to evaluate functional areas for supply networks needed for old persons?* Recently, Drobne and Bogataj (2013c) suggested a method to delimitate and evaluate regions for servicing old people. In this paper, we improved the method and tested it for a longer period of eleven years, i.e. between 2000 and 2010. We based our research on the following hypothesis: "*The functional regions modelled by inter-municipal commuters of the working-age population are, in most cases, the best choice as regions for servicing old persons. The agglomeration effect which is different for aging cohorts regarding working cohorts can be corrected using the aging index*". The reason is in the criterion of the minimum time spending distance from settlements to the central places of higher level, i.e. where workers travel, which is at the same time the minimum time spending distance for offering services from a central place to the agglomerations on a lower level. The aging structure can differ,

therefore the agglomeration effect, which is different for aging cohorts regarding working cohorts, was corrected using the aging index.

The paper consists of four parts. After the introduction, the research methodology is presented. The data analysis and the main research findings are provided in the third part. Finally, research results are discussed and directions for future research are given.

Methodology

In the research, we first analyse the spatial distribution of the aging population in relation to the regional centres of Slovenia. Old people economically, socially and, sometimes, physically, depend on the working-age population in the state and/or in the region. For that reason we suggest that the functional regions as the regions for servicing old persons are modelled by considering the inter-municipal commuters of the working-age population. We suggest two methods: one to delimitate and another one to evaluate such regions. The suggested methods were applied for the case study of Slovenia for the period between 2000 and 2010.

Material

All data used in our research refer to the municipalities of Slovenia. However, the number of municipalities has been changed from 192 municipalities in 2000–2001 to 193 municipalities in 2003–2006 and to 210 municipalities in the last part of the analysed period in 2007–2010. The spatial data on the municipalities were acquired from the "Free Access Database" of the Surveying and Mapping Authority of the Republic of Slovenia (GURS, 2013a).

All statistical data analysed in the research and used in the modelling of functional regions were acquired from the "SI-Stat Data Portal" of the Statistical Office of the Republic of Slovenia (SURS, 2013b). These are the data on population, age structure of Slovenian population, employment, gross earning, useful floor space of dwellings, and labour commuting. The data on inter-municipal labour commuting were acquired from the Statistical Register of Employment (in Slovene "Statistični register delovno aktivnega prebivalstva" – SRDAP), which keeps the data on the place of residence and place of work of the persons in employment (SURS, 2013c). SRDAP contains the data on persons in paid employment and self-employed persons who are at least 15 years old and who are employed in the territory of the Republic of Slovenia (with the exception of farmers).

Functional regions were evaluated using the aforementioned statistical data and the data on municipal budget, real-estate price, and time-spending distances between municipal centres. The data on municipal budget were acquired from the Ministry of Finance of the Republic of Slovenia (MF, 2013), and the data on the average price of dwellings in the municipality were acquired from the Database for Mass Appraisal of Real-Estates of the Surveying and Mapping Authority of the Republic of Slovenia (GURS, 2013b). The data on time-spending distances between the municipal centres of Slovenia were calculated in the geographical information system ArcMap using data on state roads in Slovenia and their changes in the period between 2000 and 2010 (DRSC, 2013). Time-spending distances were calculated as travel times by car considering the state road system and the public road toll system in each analysed year.

Method

The spatial distribution of the aging population in relation to the regional centres of Slovenia was analysed using two well-known indicators of the age structure of

population: the aging index and the old-age dependency ratio. The aging index (also referred to as the elder–child ratio) is defined as the number of people aged 65 and over per 100 youths under age 15. The old-age dependency ratio is the ratio between the number of older population (aged 65 years or more) and the number of working-age population (aged 15 to 64), multiplied by 100. The old-age dependency ratio measures how many older people are age-dependent per 100 working-age population.

The functional regions of Slovenia have been modelled by the Intramax method (Masser and Brown, 1975, 1977; Masser and Scheurwater, 1980), using the Flowmap software (Breukelman, Brink, de Jong and Floor, 2009). The objective of the Intramax procedure is to maximise the proportion within the group interaction, in our case within the group of all inter-municipal labour commuters in Slovenia, 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 municipalities were grouped together for which the objective function C was maximised (Masser and Brown, 1975):

$$\max C, \quad C = \frac{C_{ij}}{O_i D_j} + \frac{C_{ji}}{O_j D_i} \tag{1}$$

where C_{ij} is the number of commuters from municipality i to municipality j, $O_i = \sum_j C_{ij}$ is the total of interactions originating from origin i, $D_j = \sum_i C_{ij}$ is the total of interactions coming to destination j, similarly C_{ji}, O_j, D_i, and $O_i, O_j, D_i, D_j > 0$.

Slovenia has been divided into sets of 2 to 30 functional regions for each analysed year between 2000 and 2010. The sets of regions have been evaluated following two characteristics: the propensity to commute between functional regions, and the attractiveness of the aging population for the labour commuters in the region. The propensity to commute between functional regions was measured by the cumulative intra-regional commuters, and the attractiveness of the aging population in the region for intra-regional commuters was estimated in the spatial interaction model.

Our presumptions (P) are: If the urban centres of functional regions should provide the hubs for servicing old persons in the region, then:

- (P1) the attractiveness of old people in a destination for intra-regional labour commuting should define a local maximum, and
- (P2) cumulative intra-regional interactions should be relatively high.

The number of intra-regional commuters (P2) was measured by summing labour commuters staying in the functional regions. The impact of the aging population in a destination on commuting flows in functional regions (P2) was estimated in the spatial interaction model (SIM; Cesario, 1973, 1974; Fotheringham and O'Kelly, 1989) that was adapted to

$$C_{ij} = k \cdot K\big(d(t)\big)_{ij}^{\gamma} \prod_{s \in S} K(s)_i^{\alpha(s)} K(s)_j^{\beta(s)} \quad \text{for } i \in MFR_g,\ j \in MFR_h \ \ and\ MFR_g \equiv MFR_h \tag{2}$$

where k is the constant of proportionality, $K\big(d(t)\big)_{ij}^{\gamma}$ is the coefficient of the time-spending distance from the centre of municipality of origin i to the centre of municipality of destination j, $K(s)_i$ and $K(s)_j$ are the coefficients of the analysed factor S in the municipality of origin i or in the municipality of destination j, MFR_g is

the set of municipalities in the functional region of origin g, and MFR_h denotes the set of municipalities in the functional region of destination h.

The coefficient of the analysed factor is the proportion between the factor in the municipality and the factor at the state level. The variables analysed in model (2) are explained in Table 1. The impacts of *stickiness* in the origin, the impacts of *attractiveness* in the destination, and the impact of the time-spending distance between the origin and the destination on the commuting were analysed in the regression analysis using regression coefficients γ, $\alpha(s)$ and $\beta(s)$.

Table 1
Variables Analysed in Model (2)

Sign in model (2)	Variable
C_{ij}	commuting flow (number of commuters) from the municipality of origin i to the municipality of destination j
$K(d(t))_{ij}$	coefficient of the time-spending distance by car from the centre of the municipality of origin i to the municipality of destination j, $K\,(d(t))_{ij} = d(t)_{ij}/\overline{d(t)}$, where $d(t)_{ij}$ is the time-spending distance by car from the centre of municipality of origin i to the centre of municipality of destination j and $\overline{d(t)}$ is an average time-spending distance between all municipal centres in Slovenia
$K(P).$	the coefficient of population in the municipality, $K(P). = P. / \overline{P}$, where $P.$ is the population in the municipality and $\overline{P}$ is the average population in the municipality in Slovenia,
$K(EMP).$	the coefficient of employment in the municipality, $K(EMP). = (EMP. / AP.) / (EMP_{SI} / AP_{SI})$, where $EMP.$ is the number of employed persons in the municipality, $AP.$ is the number of active population in the municipality, EMP_{SI} is the number of employed persons in Slovenia, and AP_{SI} is the number of active population in Slovenia
$K(GEAR).$	the coefficient of gross earning per capita in the municipality, $K(GEAR). = GEAR. / GEAR_{SI}$, where $GEAR.$ is the gross earning per capita in the municipality and $GEAR_{SI}$ is the gross earning per capita in Slovenia
$K(UFSP).$	the coefficient of useful floor space of dwellings per capita in the municipality, $K(UFSP). = UFSP. / UFSP_{SI}$, where $UFSP.$ is the useful floor space of dwellings per capita in the municipality and $UFSP_{SI}$ is the useful floor space of dwellings per capita in Slovenia
$K(BUDG).$	the coefficient of the budget of the municipality, $K(POPC). = POPC. / POPC_{SI}$, where $POPC.$ is the budget of the municipality, and $POPC_{SI}$ is the average budget of municipalities in Slovenia
$K(APF).$	the coefficient of the average price per m² of flat in the municipality, $K(APF). = APF. / APF_{SI}$, where $APF.$ is the average price per m² of flat in the municipality and APF_{SI} is the average price per m² of flat in Slovenia
$K(A).$	the coefficient of aging, $K(A). = AG. / AG_{SI}$, where $AG.$ is the aging index in the municipality and AG_{SI} is the aging index in Slovenia

Note: · denotes the separate consideration of the variable in the municipality of origin i and in the municipality of destination j.
Source: Authors' notes

In our application of the case study of Slovenia, we focused most on the results regarding the stickiness of the aging population in origin i, which was measured by $\alpha(A)$, and especially on the attractiveness of the aging population in destination j, measured by $\beta(A)$.

Results

Figure 2 shows the linear trend of the aging index (LTA) in Slovenian municipalities for 2000–2012. It is obvious that the linear trend of the aging index is positive for all regional centres. The most critical centres with a very high linear trend ($LTA > 4$) are (from a higher to a smaller trend): Murska Sobota, Ptuj, Ravne na Koroškem, Trbovlje, Maribor, Dravograd, Piran, Hrastnik, and Sevnica. Other regional centres also with a high positive linear trend of the aging index ($2 < LTA \leq 4$) are: Velenje, Radovljica, Slovenj Gradec, Novo mesto, Celje, Jesenice, Brežice, Zagorje ob Savi, Izola, Kranj, and Nova Gorica. The lowest – but still positive – dynamics of the aging index is shown for Postojna ($LTA = 0.90$), while in Ljubljana ($LTA = 1.99$), Krško ($LTA = 1.85$) and Koper ($LTA = 1.53$) the dynamics of the aging population is somewhat higher.

Figure 3 shows the linear trend of the old-age dependency ratio ($LTAD$) in the municipality for 2000–2012. The linear trend of the old-age dependency ratio is positive for all regional centres. The most critical centres with a relatively high linear trend of the old-age dependency ratio ($LTAD > 0.5$) are (from higher to smaller): Murska Sobota, Ptuj, Dravograd, Ravne na Koroškem, Velenje, Radovljica, Maribor, Nova Gorica, Novo mesto, Hrastnik, and Trbovlje. The most of other regional centres have a relatively low linear trend of the old-age dependency ratio ($0.25 < LTAD \leq 0.5$): Celje, Slovenj Gradec, Jesenice, Kranj, Sevnica, Izola, Piran, Ljubljana, Brežice, Zagorje ob Savi, Koper. The lowest $LTAD$ is in Krško ($LTAD = 0.19$) and Postojna ($LTAD = 0.17$).

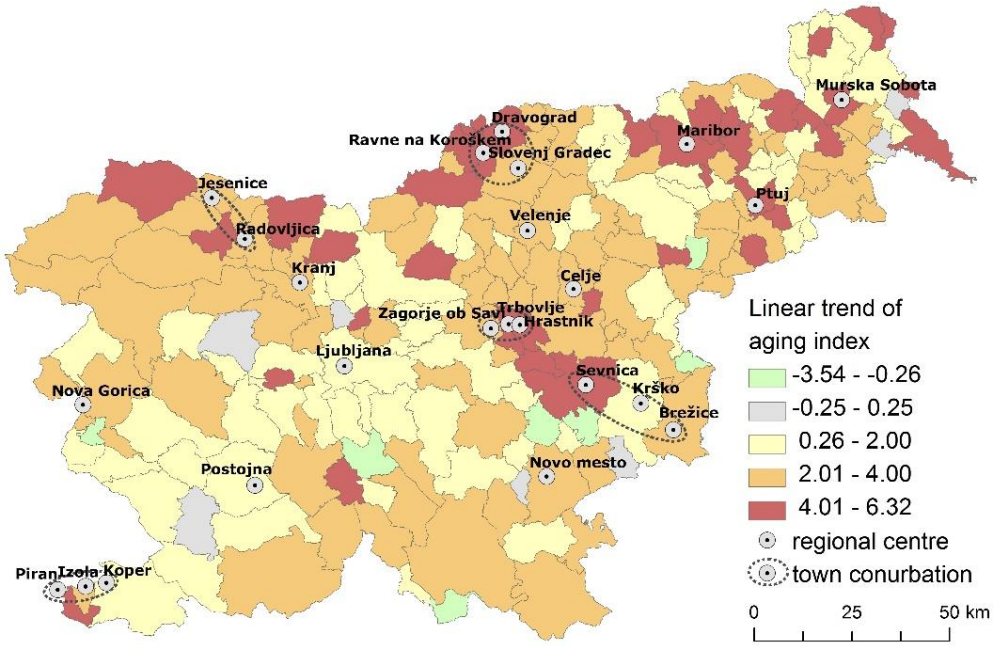
Figure 4 shows the cumulative intra-regional labour commuters and regression coefficients for aging indexes in spatial interaction model (2) according to the functional regionalization into 2 to 30 regions in Slovenia for representative years in the analysed period of 2000–2010. Note that eleven years have been analysed; however, due to limitations of space in this paper, we show only the most typical results for 2000, 2002, 2007 and 2010.

Considering the attractiveness of the aging population for labour commuters in the functional region, the most convenient regionalization would be in local maximums of $\beta(A)$. Comparing the results for $\beta(A)$ for the whole set of all eleven analysed years (2000–2010), it becomes clear that the local maximum of attractiveness of the aging population is very stable for delimitation into 7 functional regions for the last ten years (2001–2010). It was stable for delimitation into 15 functional regions before the crisis in 2008, but, in the crisis, the urban centres in Postojna's functional region have lost their relative position in the country: the population in Postojna and in neighbouring municipalities is getting older much slower than that in the municipalities of neighbouring functional regions. Considering the regionalization of Slovenia into a higher number of smaller regions, the regionalization into 29 and 30 regions play an important role for the last nine years (2002–2010). On the other hand, the regionalization into 12 functional regions would be the least convenient regionalization in relation to the attractiveness of the aging population for labour commuters in the region. This is the case for the last ten years (2001–2010).

Considering the inter-regional commuting flows, which should be relatively low in the case of functional regions (while intra-regional flows should be relatively high), the most convenient regionalization is the regionalization into only 2 functional regions. But, when a higher number of functional regions is considered, more convenient regionalization into functional regions would be the ones where the cumulative intra-regional labour commuting flows are much higher than those where a higher number of functional regions is taken into consideration. For example, from Figure 4 it is evident that regionalization into 5, 6, 7 or 8 functional

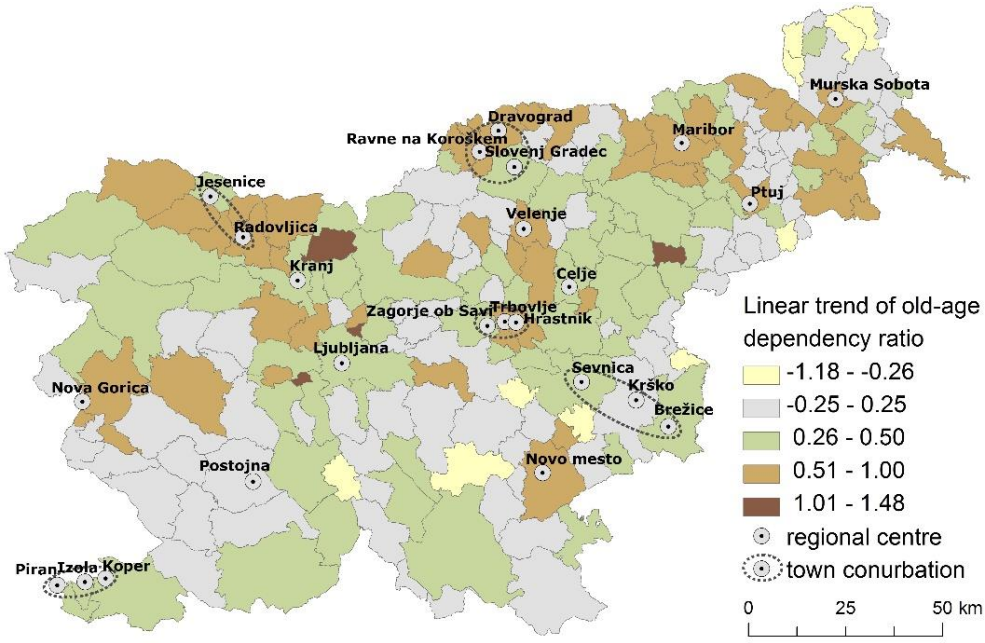
regions were more convenient than those into 9 or 10 regions for 2000 and 2002, but in 2007 and 2010 only the regionalization into 5, 6 or 7 functional regions remain more convenient than those of 8, 9 or 10 regions for the case of Slovenia.

Figure 2
Linear Trend of the Aging Index in the Municipality for 2000–2012



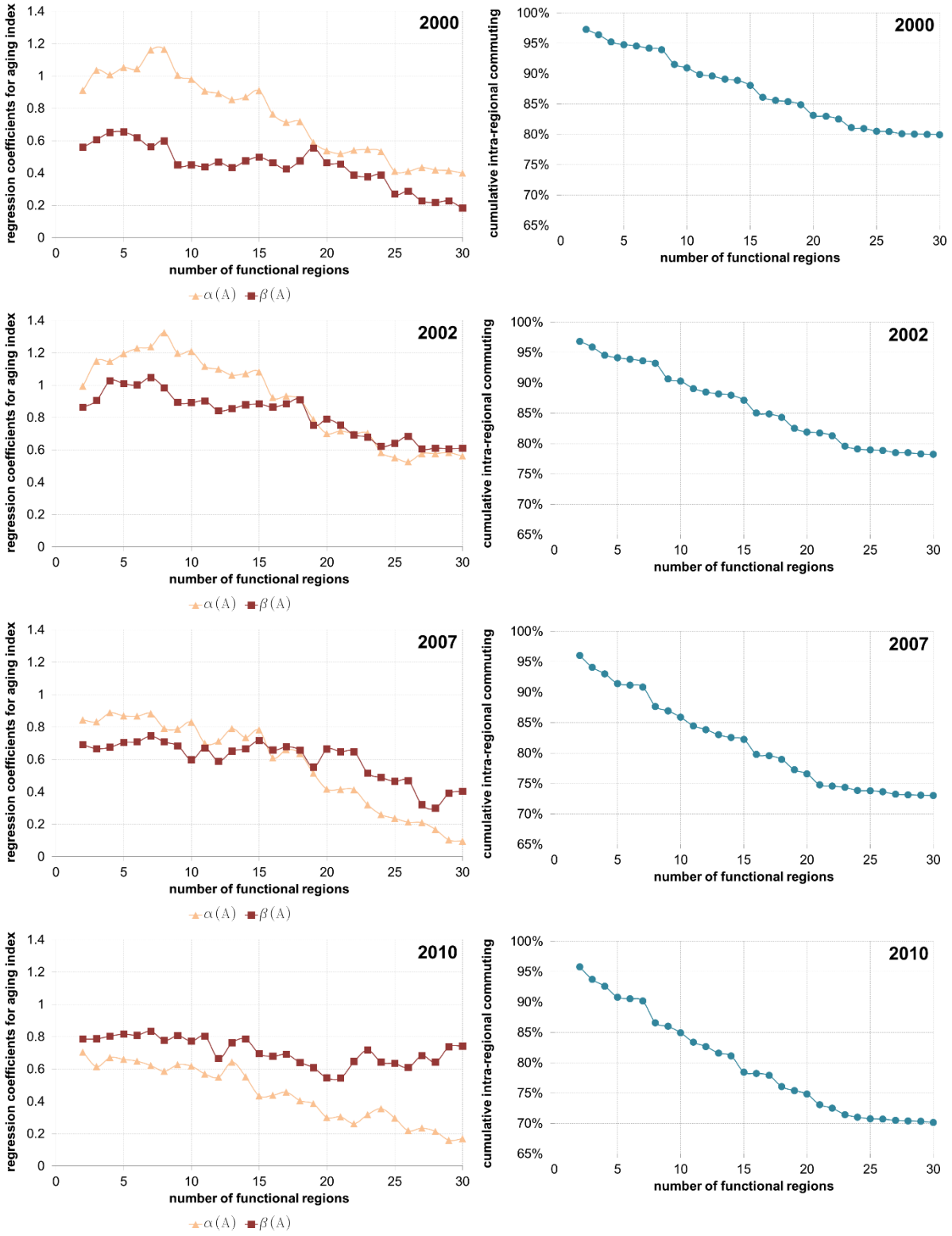
Source: SURS (2013b) and author's calculation

Figure 3
Linear Trend of the Old-Age Dependency Ratio in the Municipality for 2000–2012



Source: SURS (2013b) and author's calculation

Figure 4
Regression Coefficients for Aging Indexes in Model (2) (left) and Cumulative Intra-Regional Labour Commuting in Relation to the Sets of Functional Regions in Slovenia (right) in Four Representative Years of the Period 2000–2010



Source: Author's calculation

Considering the stability (unchangeability) of functional regions in the analysed period, only the regionalization into 7 functional regions remained the same all along (2000–2010).

Comparing the results on the attractiveness of the aging population for labour commuters in the functional region in relation to the cumulative inter-regional commuting flows and in relation to the stability of functional regions in the analysed period, the regionalization into 7 functional regions has been identified as the most convenient regionalization for servicing old people in 2000–2010. Figure 5 shows the regionalization of Slovenia into 7 regions using the Intramax method.

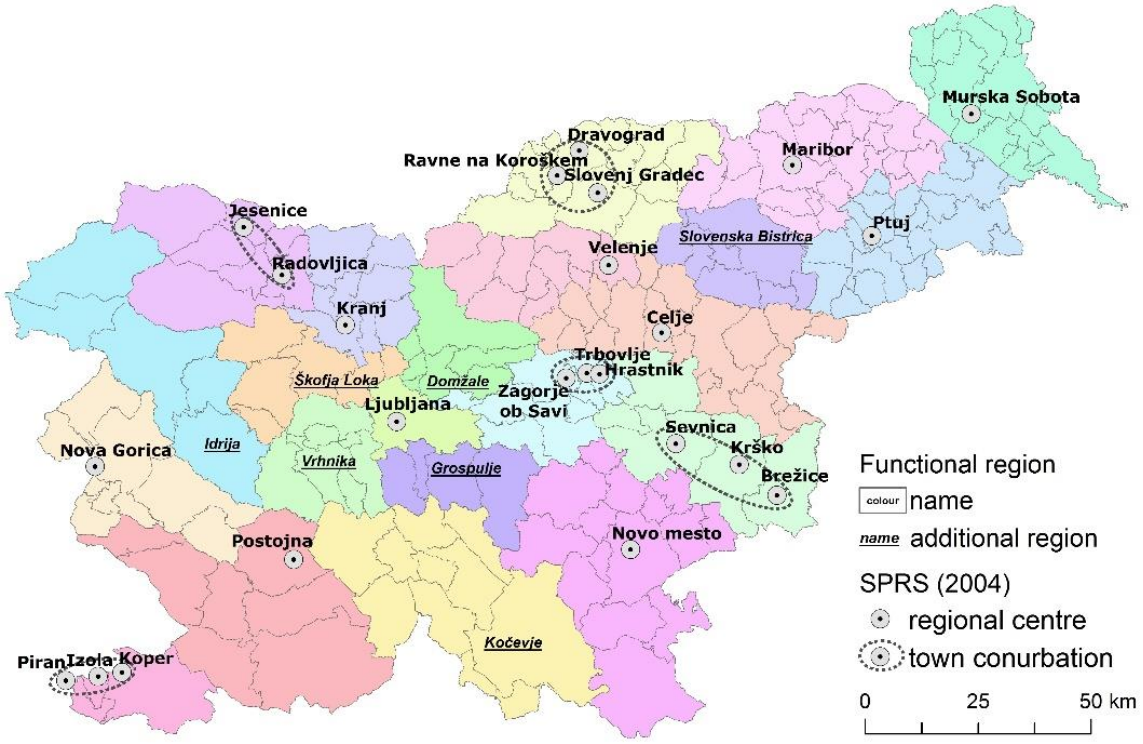
But, from Figure 5 it is evident that not all regional centres (i.e. urban centres of national significance) have their own functional region. If the government decided that all regional centres, as declared in the Spatial Development Strategy of Slovenia (SPRS, 2004), had their own region, it would be necessary to introduce 7 additional functional regions before the last regional centre, i.e. conurbation Jesenice–Radovljica, would get its own region in the north-west side of Slovenia (otherwise the functional area of Jesenice would be coupled with the functional region of Kranj due to the intensity labour commuting). The 7 additional functional regions where intra-regional labour commuting flows played a significant role in the last eleven years were (see Figure 6): functional regions of Slovenska Bistrica, Grosuplje, Vrhnika and Škofja Loka where new business zones have been established, functional region of Domžale as an important employment centre near the capital, and functional regions of Kočevje and Idrija, which are geographically separated from other important employment centres of Slovenia.

Figures 5 and 6 show 7 and 22 functional regions of Slovenia, respectively, in the analysed period. Note that 7 functional regions have not changed at all in the eleven years, but the regionalization into 22 regions somewhat changed in 2004 and 2005.

Figure 5
Seven Functional Regions for Servicing Old People in Slovenia in 2000–2010

Source: Author's calculation

Figure 6
Twenty-Two Functional Regions for Servicing Old People in Slovenia in 2000–2003 and 2006–2010



Source: Author's calculation

The results of the regression analysis of commuting flows in model (2) are for both, 7 and 22 functional regions, in Tables 2 and 3. In all cases, adjusted R^2 is high, varying from 70.5% to 71.2% for 7 functional regions and from 71.9% to 73.9% for 22 functional regions.

The results of modelling the intra-regional labour commuting flows for the most stable regionalization of Slovenia into 7 functional regions and for regionalization into twenty-two regions that coincide with the government document on regional centres of Slovenia (SPRS, 2004) for the whole time horizon (2000–2010) show the following (see also Table 4):

- The impact of distance on labour commuting in the region is negative and it has decreased for both systems of functional regions: it means that the willingness to long-distance labour commuting has increased (a bit more inside 7 than in 22 functional regions). The same can be expected in relation to servicing old people.
- In general, the impact of population on interactions in the region is positive and it has increased – except for the population in destination for 7 functional regions: it means that bigger employment centres in 7 functional regions have lost on their attractiveness for local, intra-regional commuters.
- The impact of employment on intra-regional labour commuters is negative in the origin and positive in the destination. The negative impact of employment in the origin has been even stronger for commuters in 7 functional regions.
- The impact of useful floor space of dwellings per capita on intra-regional labour commuters is positive, but is has decreased in both the origin and the destination.

- The impact of municipal budget per capita on intra-regional labour commuters is positive, but is has decreased in the destination.
- The impact of the average price per m^2 of flat is negative in the origin and positive in the destination. It has lost its impact in the origin, but it has strengthened in the destination.
- The impact of the aging population on intra-regional labour commuters is positive: more commuters originate from municipalities where the aging index is high and work in municipalities with a high percentage of old people. The impact of the aging population has decreased in the origin, but it has increased in the destination (the most for regionalization into 22 functional regions).

Table 2
The Results of the Regression Analysis of Intra-Regional Commuting Flows in Model (2) in Seven Functional Regions of Slovenia (Fig. 5) for Four Representative Years of the Period 2000–2010

Parameter	Symbol	Year 2000	Year 2002	Year 2007
N		3651	3932	5039
adjusted R^2		0.712	0.693	0.700
constant	k	[1.072]	1.253	1.458
$d(t)_{ij}$	γ	-2.209	-2.159	-2.099
$K(P)_i$	$\alpha(P)$	0.615	0.576	0.631
$K(P)_j$	$\beta(P)$	0.851	0.734	0.774
$K(EMP)_i$	$\alpha(EMP)$	-0.367	-0.296	-0.357
$K(EMP)_j$	$\beta(EMP)$	1.654	1.492	1.502
$K(GEAR)_i$	$\alpha(GEAR)$	-0.365	-0.311	-0.485
$K(GEAR)_j$	$\beta(GEAR)$	0.424	0.505	0.601
$K(UFSP)_i$	$\alpha(UFSP)$	[0.222]	[0.301]	[0.215]
$K(UFSP)_j$	$\beta(UFSP)$	0.845	[-0.301]	0.369
$K(BUDG)_i$	$\alpha(BUDG)$	0.664	0.083	0.604
$K(BUDG)_j$	$\beta(BUDG)$	1.309	0.813	0.605
$K(APF)_i$	$\alpha(APF)$	-0.520	-0.388	-0.472
$K(APF)_j$	$\beta(APF)$	[0.045]	0.253	0.077
$K(A)_i$	$\alpha(A)$	1.160	1.238	0.883
$K(A)_j$	$\beta(A)$	0.562	1.047	0.744

Notes: Regression coefficients where P-values > 0.10 are in in square bracket [ ]. In the analysis, parameters for all eleven years have been estimated, but, here, the results for only four representative years are represented here.
Source: Authors' calculation

Discussion

The analyses of functional regions in Slovenia, modelled by the commuting zone approach, i.e. the Intramax method, have shown that the most convenient regionalization of functional regions for servicing old people is the regionalization into 7 functional regions. Such regionalization was stable in all analysed periods of the eleven years, i.e. from 2000 to 2010. The regionalization into 7 regions as suggested here is also attractive, while a relatively high percentage of commuters stays in the regions (from 94.2% in 2000 to 90.2% in 2010); so, less than 10% of labour commuters crossed regional "borders". Most of regional centres of 7 functional regions have also a high linear trend of the aging population ($LTA > 2$) in the last thirteen years (2000–2012), except Ljubljana.

Table 3

The Results of the Regression Analysis of Intra-Regional Commuting Flows in Model (2) in Twenty-Two Functional Regions of Slovenia (Fig. 6) for Four Representative Years of the Period 2000–2010

Parameter	Symbol	Year 2000	Year 2002	Year 2007
N		1537	1542	1963
adjusted R^2		0.730	0.719	0.728
constant	k	3.003	3.076	2.978
$d(t)_{ij}$	γ	-1.842	-1.815	-1.804
$K(P)_i$	$\alpha(P)$	0.653	0.636	0.651
$K(P)_j$	$\beta(P)$	0.953	0.846	0.898
$K(EMP)_i$	$\alpha(EMP)$	-0.305	-0.506	-0.352
$K(EMP)_j$	$\beta(EMP)$	1.845	1.787	1.651
$K(GEAR)_i$	$\alpha(GEAR)$	[-0.287]	-0.641	-0.709
$K(GEAR)_j$	$\beta(GEAR)$	0.495	0.545	[-0.072]
$K(UFSP)_i$	$\alpha(UFSP)$	0.852	0.914	0.599
$K(UFSP)_j$	$\beta(UFSP)$	0.826	[0.345]	[0.032]
$K(BUDG)_i$	$\alpha(BUDG)$	0.727	[0.101]	0.625
$K(BUDG)_j$	$\beta(BUDG)$	1.506	0.411	0.696
$K(APF)_i$	$\alpha(APF)$	-0.318	-0.266	-0.300
$K(APF)_j$	$\beta(APF)$	[-0.077]	0.200	0.152
$K(A)_i$	$\alpha(A)$	0.540	0.699	0.413
$K(A)_j$	$\beta(A)$	0.388	0.694	0.647

Notes: Regression coefficients where P-values > 0.10 are in square bracket [ ]. In the analysis, parameters for all eleven years have been estimated, but, here, the results for only four representative years are represented here; *Source*: Authors' calculation

Table 4

The Linear Trend of Impact of Analysed Parameters of Intra-Regional Commuting Flows in Model (2) for 7 and 22 Functional Regions of Slovenia, respectively, in the Period 2000–2010

Parameter	Symbol	General impact on intra-regional commuting in 2000–2010	Linear trend of impacts of parameter in 2000–2010	
			in 7 functional regions	in 22 functional regions
$d(t)_{ij}$	γ	-	0.009	0.008
$K(P)_i$	$\alpha(P)$	+	0.005	0.003
$K(P)_j$	$\beta(P)$	+	-0.004	0.004
$K(EMP)_i$	$\alpha(EMP)$	-	-0.009	0.010
$K(EMP)_j$	$\beta(EMP)$	+	-0.039	-0.053
$K(GEAR)_i$	$\alpha(GEAR)$	-	-0.003	0.010
$K(GEAR)_j$	$\beta(GEAR)$	+	0.040	-0.012
$K(UFSP)_i$	$\alpha(UFSP)$	+	-0.031	-0.031
$K(UFSP)_j$	$\beta(UFSP)$	+	-0.065	-0.054
$K(BUDG)_i$	$\alpha(BUDG)$	+	0.046	0.038
$K(BUDG)_j$	$\beta(BUDG)$	+	-0.029	-0.007
$K(APF)_i$	$\alpha(APF)$	-	0.014	0.010
$K(APF)_j$	$\beta(APF)$	+	0.012	0.013
$K(A)_i$	$\alpha(A)$	+	-0.054	-0.039
$K(A)_j$	$\beta(A)$	+	0.002	0.013

Note: A careful interpretation of the linear trend is needed: e.g., the negative linear trend for the negative impact leads to the increase in the impact of the observed parameter; *Source*: Authors' calculation

But, Ljubljana has other important characteristics to be considered as a regional centre of a functional region: it is the capital, it is the most important employment centre of Slovenia, and it is declared as a "national urban centre of international significance". Also, Ljubljana has a positive trend of the old-age dependency ratio. The important fact that postulates 7 functional regions is also the attractiveness of the aging population in urban centres in the region for intra-regional commuters. For the last ten years, it was the highest when comparing the attractiveness inside all observed functional regionalization into 2 to 30 functional regions.

The regionalization into 7 functional regions for servicing old people does not include all regional centres as declared in the Spatial Development Strategy of Slovenia (SPRS, 2004). If all 15 regional centres (and conurbations), i.e. the "urban centres of national significance", served as hubs for servicing old people, 7 additional functional regions, along with the 15 regional centres defined in (SPRS, 2004), should be included in the consideration. The attractiveness of the aging population in urban centres of 22 functional regions for labour commuters has been much lower than for any other regionalization where a smaller number of regions was considered, but it has had a high positive trend in the last eleven years. 22 hubs for servicing old people are also more compatible with the "polycentric urban system" of Slovenia defined in (SPRS, 2004) than the 7 hubs in 7 functional regions. However, the regionalization into 22 functional regions could be considered as a hierarchical structure of 7 functional regions for servicing old people in the region. This could be a good solution not only during the time of the economic crisis but in general.

Previous studies on the aging population and on servicing old people in Slovenia considered, simply and solely, the administratively defined regions, areas, urban centres and other settlements in Slovenia. But, there are no previous studies on functional regions for servicing old people. Drobne and Bogataj (2013a, b) showed that the aging population in the regional centres of Slovenia attracts labour commuters, and they suggested a method to evaluate functional regions for servicing old people (Drobne and Bogataj, 2013c). In this paper we improved the method and applied it to the whole territory of Slovenia for a longer period.

Practical implications of the method suggested here, tested on the case study of Slovenia for the time horizon of eleven years, have resulted in the following two main conclusions: (a) There is a regionalization of Slovenia that is, according to the methodology used here, the most convenient for servicing old people and assuring better contacts of working children with their parents, i.e. to benefit from the central place where they contributed during their working period, and very stable even for a longer time horizon. That is the regionalization into 7 functional regions consisting of functional regions of Maribor, Celje, Slovenj Gradec, Novo mesto, Ljubljana, Nova Gorica and Koper. This is the regionalization where old people have been and would stay closely connected with the labour commuters in the region. The attractiveness of the aging population in the urban centres of these 7 functional regions for labour commuters is also the highest comparing to all other analysed sets of functional regions. But, here we also mention all other important urban centres in the region, not only the centres of a functional region. According to the results of the case study of Slovenia and along with the urban centres of national significance as declared in (SPRS, 2004), 7 additional urban centres should be considered as important hubs at a lower level for servicing old people in Slovenia; here we find urban centres of regional significance (Škofja Loka, Kočevje, and Idrija) and urban centres of inter-municipal significance (Slovenska Bistrica, Grosuplje, Vrhnika and Domžale).

There are two important limitations of the methodology used: (a) the first one is related to the method of delimitation of functional regions, and (b) the second is related to the data capture methodology of labour commuting interactions in the statistical database. ad a) Besides the methods that delimitate the functional regions using solely the data on interactions, there are also methods that delimitate functional regions around predefined regional centres; see (Karlsson and Olsson, 2006). For more complex and verified results, other methods of modelling functional regions should be considered and tested. ad b) The problems arising from the data capture methodology into the SRDAP database are the following: (b1) incorrect data about the place of residence or place of work, (b2) changed methodology of data collection in 2009, and (b3) lack of data on the actual commuting of the employed persons. Those problems have been already discussed in (Bole, 2011; Drobne et al., 2013). In short: ad b1) the problem of incorrect data on the place of residence or place of work can only be solved by a simultaneous analysis of all data; ad b2) we may assume that the difference of registered commuters is evenly distributed nation-wide; ad b3) work from home may also be considered as a functional interaction.

Conclusion

It is predicted that in less than 35 years more than one third of the population in Slovenia will be older than 60 (UN, 2012). The future aging structure depends on today's aging and migration. Drobne and Bogataj (2013a, b) showed that the higher aging index in the origin and in the destination induces more intensive flows of migration. The flows to the regional centres of Slovenia are more intensive than those to local centres; therefore regional centres will probably provide the best hubs for the supply chains for old people. Therefore, access to properly equipped home and community-based services, including personal care for old people, will be needed, not necessarily uniformly available across state, but rather available in central places of national importance with a network across the region. An access to appropriate services is essential to the quality of life for old people and should be included in spatial development plans soon enough.

The health and social care administration at the (yet to be shaped) regional levels, i.e. functional regions for old people, and the state government should undertake research toward developing an appropriate array of community-based care services for old people. Moving toward meaningful consumer-centred services for old people would require a mix of changes of public policies and supply network management structures.

In this paper, we suggested a methodology to model and evaluate functional regions for servicing old people. The methodology has been tested for the case study of Slovenia for the last decade. But, to achieve the aforementioned changes research is necessary today – not only through the identification of regional centres, but also by predicting and evaluating the future functional areas for supply networks needed for old people.

References

1. Bogataj, D., Aver, B. (2013) Residential real estate investments from the perspective of Act on social security benefits. *Dignitas*, No. 57/58, pp. 252–276.

2. Bogataj, D., Temeljotov Salaj, A., Aver, B. (2012). "Urban Growth in Ageing Societies", in: Michell, K., Bowen, P., Cattel, K. (Eds.). Delivering Value to the Community. Cape Town: Department of Construction Economics and Management, pp. 437–446.
3. Breukelman, J., Brink, G., de Jong, T., Floor, H. (2009). Manual Flowmap 7.3. Faculty of Geographical Sciences, Utrecht University, The Netherlands, [online], available at http://flowmap.geo.uu.nl [August 15, 2011].
4. Cesario, F. J. (1973). "A Generalized Trip Distribution Model", Journal of Regional Science, Vol. 13, pp. 233–247.
5. Cesario, F. J. (1974). "More on the Generalized Trip Distribution Model", Journal of Regional Science, Vol. 14, pp. 389–397.
6. Drobne, S., Bogataj, M. (2013a). "Vpliv recesije na parametre kakovosti regionalnih središč in njihovo privlačnost" ("Impact of Recession on the Parameters of Quality of Regional Centres and their Attractiveness"), Revija za univerzalno odličnost, Vol. 2, No. 2, pp. A25–A42, [online], available at http://www.fos.unm.si/media/pdf/RUO_2013_22_Drobne_Bogataj1.pdf [December 30, 2013].
7. Drobne, S., Bogataj, M. (2013b). "Impact of Population Aging on Migration to Regional Centres of Slovenia", in Zadnik Stirn, L., Žerovnik, J., Povh, J., Drobne, S., Lisec, A. (2013). SOR '13 proceedings. Ljubljana: Slovenian Society Informatika, Section for Operational Research, pp. 325–330.
8. Drobne, S., Bogataj, M. (2013c). "Evaluating Functional Regions for Servicing the Elderly", in Zadnik Stirn, L., Žerovnik, J., Povh, J., Drobne, S., Lisec, A. (2013). SOR '13 proceedings. Ljubljana: Slovenian Society Informatika, Section for Operational Research, pp. 331–336.
9. Drobne, S., Rajar, T., Lisec, A. (2013). "Dynamics of migration and commuting to the urban centres of Slovenia, 2000–2011". Geodetski vestnik, Vol. 57, No. 2, pp. 333–353, [online], available at http://geodetski-vestnik.com/cms/images/57/2/gv57-2_drobne_eng.pdf [December 30, 2013].
10. DRSC (2013). Data on state roads in Slovenia, Slovenian Roads Agency.
11. Fotheringham, A. S., O'Kelly, M. E. (1989). Spatial Interaction Models: Formulations and Applications, Dordrecht, Kluwer Academic Publishers.
12. Gavrilov, L. A., Heuveline, P. (2003). "Aging of Population", in: Demeny, P., McNicoll, G. (Eds.). The Encyclopedia of Population. Macmillan, New York.
13. GURS (2013a), Free Access Database, The Surveying and Mapping Authority of the Republic of Slovenia, [online], available at http://www.gu.gov.si/en/services/free_access_database/ [November 8, 2013].
14. GURS (2013b), Data on average real-estate price in the municipality of Slovenia, The Surveying and Mapping Authority of the Republic of Slovenia.
15. Haynes, K. E., Fotheringham, S. (1984). Gravity and Spatial Interaction Models. SAGE publications, Inc.
16. Karlsson, C., Olsson, M. (2006). "The Identification of Functional Regions: Theory, Methods, and Applications", Ann Reg Sci, Vol. 40, pp. 1–18.
17. Kerbler, B. (2011a). "Prilagajanje grajenega bivalnega okolja za potrebe starejših ljudi" ("Adapting the Built Living Environment for the Needs of Older People"), Geodetski vestnik, Vol. 55, No. 1, pp. 57–69.
18. Kerbler, B. (2011b). "Pametni dom za samostojno in kakovostno bivanje starejših ljudi" ("Smart Homes for Independence and Quality of Life for the Elderly"), AR, Arhitektura raziskave, Architecture Research, Ljubljana, pp. 15–22.

19. Kovács, Z. (2010). Challenges of Ageing in Villages and Cities: the Central European Experience. Department of Economic and Social Geography, University of Szeged, Szeged.
20. Laan, L. V. D., Schalke, R. (2001). "Reality versus policy: The delineation and testing of local labour market and spatial policy areas", European Planning Studies, Vol. 9, pp. 201–221.
21. Masser, I., Brown, P. J. B. (1975). "Hierarchical aggregation procedures for interaction data", Environment and Planning A, Vol. 7, No. 5, pp. 509–523.
22. Masser, I., Brown, P. J. B. (1977). "Spatial representation and spatial interaction", Papers of the Regional Science Association, Vol. 38, pp. 71–92.
23. Masser, I., Scheurwater, J. (1980). "Functional regionalisation of spatial interaction data: an evaluation of some suggested strategies", Environment and Planning A, Vol. 12, No. 12, pp. 1357–1382.
24. MF (2013). Municipal budget ("Podatki občin o realiziranih prihodkih in drugih prejemkih ter odhodkih in drugih izdatkih splošnega dela proračuna ter o realiziranih odhodkih in drugih izdatkih posebnega dela proračuna"), The Ministry of Finance of the Republic of Slovenia, [online], available at http://www.mf.gov.si/si/delovna_podrocja/lokalne_skupnosti/statistika/podatki_obcin_o_realiziranih_prihodkih_in_drugih_prejemkih_ter_odhodkih_in_drugih_izdatkih_splosnega_dela_proracuna_ter_o_realiziranih_odhodkih_in_drugih_izdatkih_posebnega_dela_proracuna/ [November 8, 2013].
25. OECD (2002). Redefining Territories – The functional regions, Organisation for Economic Co-operation and Development, Paris, France.
26. Pogačnik, A., Zavodnik Lamovšek, A., Drobne, S. (2009). "A Proposal for Dividing Slovenia into Provinces". Lex localis, Vol. 7, No. 4, pp. 393–423.
27. SPRS (2004). Spatial Development Strategy of Slovenia. Ministry of the Environment, Spatial Planning and Energy, Ljubljana, [online], available at http://www.mop.gov.si/fileadmin/mop.gov.si/pageuploads/publikacije/drugo/en/sprs_eng.pdf [August 15, 2012].
28. SURS (2013a). Administrative-territorial division, Statistical Office of the Republic of Slovenia, Ljubljana, [online], available at http://www.stat.si/eng/tema_splosno_upravno.asp [March 25, 2013].
29. SURS (2013b). SI-Stat Data Portal, The Statistical Office of the Republic of Slovenia, Ljubljana, [online], available at http://pxweb.stat.si/pxweb/dialog/statfile1.asp [November 8, 2013].
30. SURS (2013c). Persons in employment (excluding farmers) by municipalities of residence and municipalities of workplace by sex, municipalities, Slovenia, annually, The Statistical Office of the Republic of Slovenia, Ljubljana, [online], available at http://pxweb.stat.si/pxweb/Dialog/varval.asp?ma=0723405E&ti=&path=../Database/Demographics/07_labour_force/05_labour_force_register/10_07234_working_migrations/&lang=1 [November 8, 2013].
31. UN (2012). Population Aging and Development 2012. United Nations, [online], available at: http://www.un.org/esa/population/publications/2012PopAgeingDev_Chart/2012AgeingWallchart.html [March 25, 2013].
32. Wikipedia (2014). Old age. [online], available at: http://en.wikipedia.org/wiki/Old_age [January 6, 2014].

About the authors

Samo Drobne is a Senior Lecturer at the Department of Geodetic Engineering, Faculty of Civil and Geodetic Engineering, University of Ljubljana. His main research fields include spatial systems, geographical information systems, and spatial analysis and statistics. The author can be contacted at: **samo.drobne@fgg.uni-lj.si**.

Marija Bogataj is a Full Professor of the University of Ljubljana. She is Head of CERRISK in MEDIFAS. Her main research fields include location theory, spatial systems, statistics and risk management, and supply chain modelling. The author can be contacted at: **marija.bogataj@guest.arnes.si**.