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Socio-economic Differences Among Slovenian Municipalities: A Cluster Analysis Approach

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Abstract

In this paper we are trying to form internally homogeneous groups of Slovenian municipalities on the basis of their socio-economic indicators. Because of the small size of municipalities only a limited number of indicators is available and beside that some of them are conceptually inappropriate.

The methodological approach is based on cluster analysis. In the first phase, Ward's hierarchical procedure has been used for identification of the number of clusters and definition of group centroids. In the second phase, centroids have been used as the initial seed points for the *K*-means non-hierarchical procedure, which has improved the formation of the clusters.

Four groups of municipalities are identified on the basis of all considered socio-economic indicators. The groups can be clearly ranked with regard to those socio-economic indicators that reflect their development characteristics. The latter confirms the well-known fact about the less developed eastern part and the more developed western part of Slovenia. There is a small group of municipalities where the situation is especially severe.

1 Introduction

The socio-economic differences among territorial units of a country are of primary interest of economists as well as politicians. There is a general belief that the difference in the level of the majority of economic indicators should be kept in sustainable limits for the welfare of the country as a whole. The analysis of these indicators can serve as the basis for the development policy on the regional or on the municipal level. Slovenia is not yet divided into regions with political authority, though many socio-economic analyses of statistical regions have been made in recent years (see for example Majcen et al. 2000; Natek, 2000). On the other hand, there is a belief that a thorough analysis must take into account smaller

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geographic units (with political authority) and a broad spectrum of socio-economic indicators (Soares et al., 2003). The advantage of such approach lies in the fact that large geographic units are not all of one kind, the geographical proximity between localities does not necessarily mean socio-economic proximity. In our opinion, this is particularly relevant for a small country like Slovenia.

So, in the present study we focus on the territorial level of municipalities. Our aim is to examine the socio-economic differences among municipalities and to classify them into relatively homogenous groups. When Slovenia gained independence in 1991 it was divided into 62 municipalities. Based on the 1994 law on the procedure for establishing new municipalities, 147 municipalities were formed. In the year 1998 their number increased to 192 with a strong tendency for further increase.

The methodology used in this work includes multivariate statistical method - cluster analysis. It is the standard approach for analysing socio-economic disparities between territories. Similar analyses were already done for some countries – see for example Ozimek (1993) for US, Openshaw (1995) for UK and Soares et al. (2003) for Portugal. If the number of disposable variables (socio-economic indicators) is large then a combination of factor and cluster analysis is applied (see Everitt, 1993). With factor analysis they summarise the information contained in a wide range of observed variables; on the basis of the formed factors cluster analysis is performed. However, in our case, where municipality data are analysed, we have only a small number of suitable variables, so there is no need for factor creation and we also do not want to lose information.

The paper is organised as follows: (1) Introduction (2) Description of variables (3) Short description of methodology, determination of the number of clusters and interpretation of the obtained results (4) Conclusions.

2 Variables

In the process of selection of socio-economic variables, we should take into account that some standard variables are not available at the municipalities' level and that some variables are not appropriate because of the small size of municipalities, although they are available. We were taking into consideration the variables used in similar analyses and we were also trying to balance the number of economic, demographic and social indicators as well as the indicators of the level of living. We shall present a short description of the variables used and the situation on Slovenian territory according to some of these variables.

2.1 Demographic variables

Aging index is defined as the ratio between the number of elderly people aged 65 years and above, and the number of children (0-14 years). High values usually indicate that the young people do not consider a certain territory attractive for living, there can also be a lack of communications, job opportunities etc. They (together with their children) emigrate from such areas, which makes the ratio higher.

Index of population growth in our analysis represents the population growth in the last decade (1991-2001). Let us comment on some of the most interesting changes in this period. In the *larger* metropolitan area of Ljubljana the number of inhabitants has increased by some 10 percent or even more. But in the municipality of Ljubljana itself the population has decreased by 1 percent. A plausible explanation of this phenomenon is the very high prices of dwellings in Ljubljana, therefore people rather have their residences in the city's *larger* metropolitan area and commute to work daily. On the other hand, some municipalities face strong depopulation. Most concerning is the situation in north-eastern part of Slovenia, where the population decreased by about 10 and even up to 20 percent.

Index of daily migration is the ratio between the number of jobs in a given municipality and the number of employed residents in this municipality. The more labour force one region attracts from the surrounding municipalities, the higher is the value of this variable. The municipality of Ljubljana attracts labour force from the whole territory of its region and also from some other regions. Four other regional centres of employment are Celje, Maribor, Murska Sobota and Novo mesto (see also Dolenc, 2000).

2.2 Economic variables

It is not easy to find appropriate economic variables when analysing municipalities. First of all, the most widely used economic indicator GDP per capita is not available on the municipal level. Next, if we consider earnings per person in paid employment – the criterion for assigning the values to the municipality is the residence of a company, not the residence of the employees. If we consider the value added per employed person the problem is even more severe[2].

Thus the most appropriate economic indicator is *the income tax base per capita* which does not underlie to the stated problems. The values are highest in the centre of Slovenia – municipality of Ljubljana. The values are high also in

[2] Not only that the whole value added of some company which has filials in many municipalities is assigned to the municipality where it has its headquarters, but also many organizational forms are not covered.

l*arger* metropolitan area and the municipalities in the west. In the East, in Slovenske gorice and in Goričko, the lowest values are concentrated. The gap between municipalities in the east and those in the west is very obvious.

High *share of agricultural population* reveals rural territories and it is the highest, as expected, in Pomurje and Kozjansko. This variable has certain deficiencies, but we still think it is an acceptable indicator and it is used in the majority of similar analyses.

We would like to have at least one more economic indicator; however none of them is available or appropriate for analysis.

2.3 Social variables

High level of *unemployment* has numerous negative effects. It is a serious social problem, a trauma for those who are unemployed, and a waste of resources with impedient effects on economic activity if we list only a few of them. Unemployment rates are clearly higher in the eastern part of Slovenia. The situation is most concerning in the *larger* metropolitan area of Maribor. In the socialist period, Maribor was an important industrial city. During the transition period, numerous large socialist companies went bankrupt. Obviously Maribor has not succeeded to transform yet. In some of those municipalities the registered unemployment rate is over 20 percent.[3]

The *number of students*[4] *per 1000 inhabitants* is often used as an indicator of the educational level of the population, which is an important current and future socio-economic characteristic of a certain territory. Municipalities with high values of this indicator are a little more concentrated around the centre of Slovenia and in southwestern part of Slovenia, but the differences among the territorial units are not very striking.

2.4 Variables of the level of living

Nowadays, the appropriate indicators of the level of living are the number of cars per 100 inhabitants, the number of telephone subscribers per 100 inhabitants or the number of internet users per 100 inhabitants etc. Unfortunately none of them is directly available on the municipality level. The *number of cars per 100 inhabitants* had to be aggregated with much effort by the user of data himself.[5]

[3] There are two unemployment rates calculated for Slovenia. On the level of municipalities only "registered unemployment rate" is available, which is much higher than international comparable "LFS (Labour Force Survey) unemployment rate". Their values for Slovenia for the year 2001 are 11.6 percent and 6.4 percent.

[4] Undergraduate students enrolled in the higher education institutions.

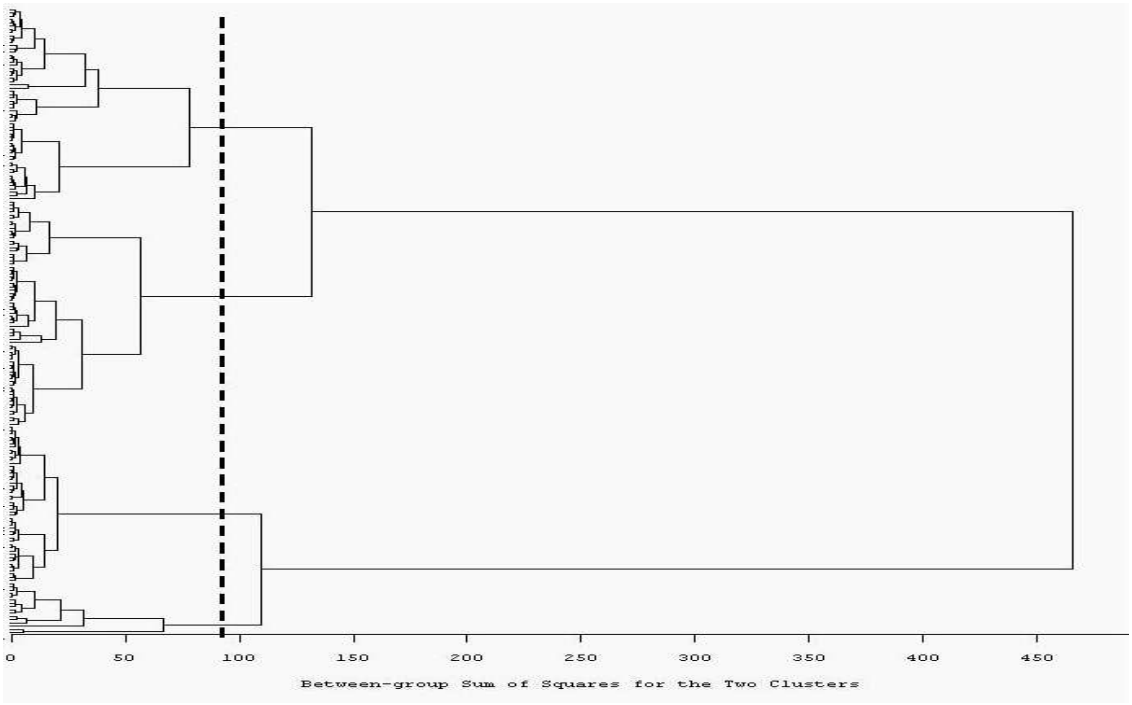
[5] Polona Grobler, 2002.

High values of this indicator are concentrated in the centre of Slovenia and southwestern part of Slovenia. Low values are more concentrated in the east part of Slovenia.

3 Analysis

On the basis of the variables described we will conduct cluster analysis to identify several groups of municipalities. For the purpose of this analysis all the variables considered have been standardised. The method employed in this study does not make any distributional assumptions, so no other transformation of the data has been performed.

Ward hierarchical procedure was first used to define the number of clusters, whereas the *K*-means non- hierarchical cluster procedure, using the cluster centres obtained with the Ward's method as the initial seed points, was used to improve the results.



Source: own calculations; SORS[6] data and IMAD[7] data.

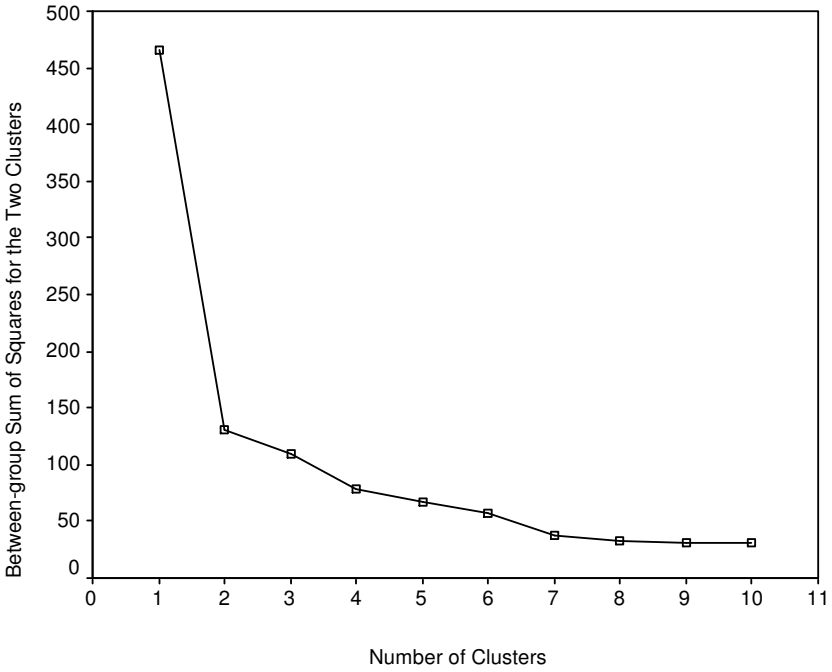
Figure 1: Dendrogram – Ward's method.

[6] Statistical Office of the Republic of Slovenia
[7] Institute of Macroeconomic Analysis and Development

3.1 Ward's hierarchical method

In the first step we have used Ward's hierarchical method. The graphical presentation of results with dendrogram (Figure 1) shows a fairly clear picture. On the horizontal axis we can easily notify two big jumps of the values of the between-group sum of squares – namely at two-group and at four-group level. The same conclusion can be made on the basis of the next plot (Figure 2), where the various cluster solutions are represented with the between-group sum of squares on the vertical axis and number of clusters on the horizontal axis (Sharma, 1996). We are looking for an elbow, it is clear that there is a change in the values when going from a one-cluster to a two-cluster solution and there is another change in the values when going from a three-cluster to a four-cluster solution.

The results of the Ward's method will be used as an input for the *K*-means method, so at this stage we will not comment on them into more details.



Source: own calculations; SORS data and IMAD data.

Figure 2: Plot of between-group sum of squares for the two clusters and the number of clusters.

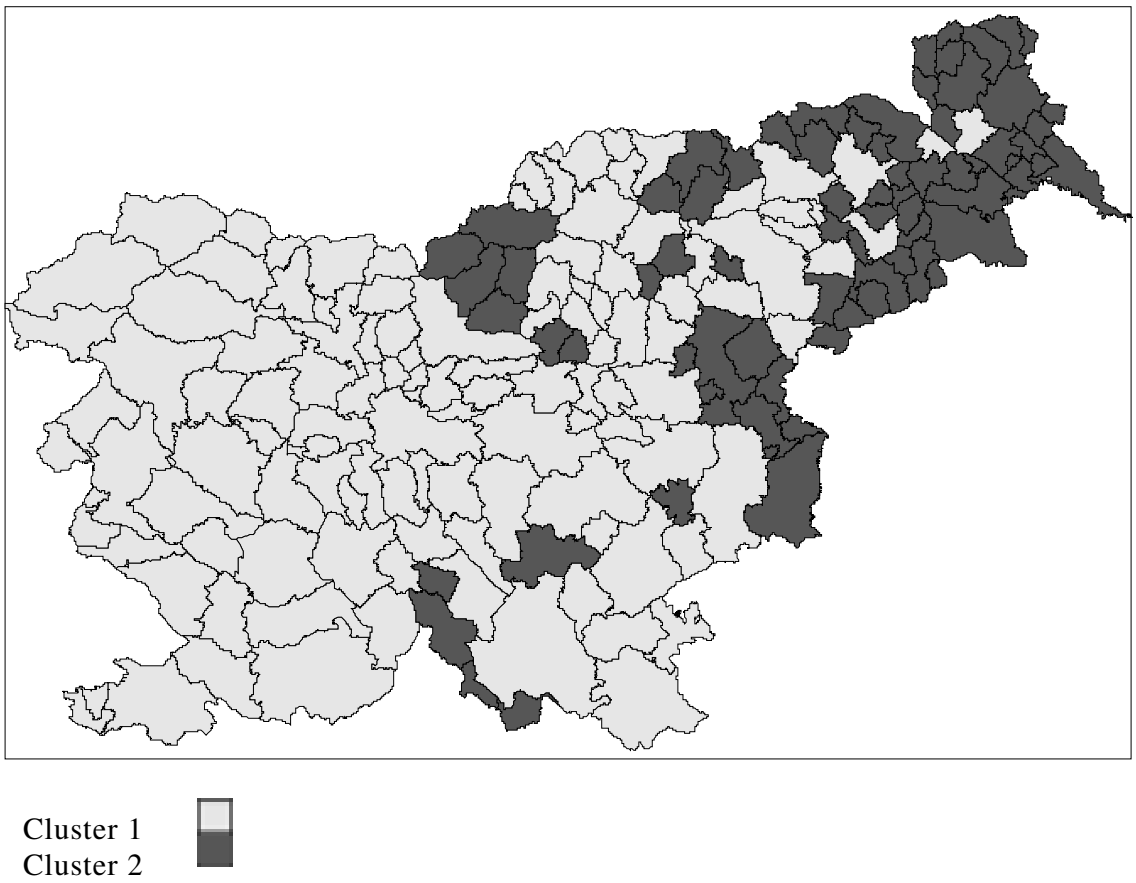
3.2 *K*-means method

Ward's hierarchical method has given us the number of groups (clusters) and the group centroids. In the second step we have used *K*-means method to improve the results of Ward's method. Namely, the main deficiency of the Ward's method (and

also of all other hierarchical method) is, that the allocation of units is final, with no possibility of reassignment to another (more appropriate) group during the procedure. *K*-means method, on the other hand, is sensitive to the initial value setting and if we are unfortunate we can trap into local optimum which can be far from global optimum. Empirical evidence suggests that we come very near to global optimum if we take centroids from hierarchical methods (Ferligoj, 1989: 88) as initial seed-points for the *K*-means method. In our case centroids from the Ward's method have been used.

3.3 Results for two groups of municipalities

We present the solution with two groups of municipalities because it is a very obvious first level result of a dendrogram.



Source: own calculations; SORS data and IMAD data.

Figure 3: Two groups of Slovenian municipalities.

Table 1: Mean values of variables for two groups of municipalities.

Variable	Cluster		Total
	1	2	
Ageing index	82.66736	95.85808	87.81999
Income tax base per capita	899759.4	605070.9	784646.7
Unemployment rate (registered)	9.446018	15.70116	11.88943
Number of students per 1000 inhabitants	34.48333	19.8384	28.76266
Number of cars per 100 inhabitants	56.17949	44.50667	51.61979
Index of daily migration	80.65983	48.82667	68.225
Index of population growth (1991-2001)	104.0641	97.43333	101.474
Share of agricultural population (percents)	2.45641	7.002667	4.232292

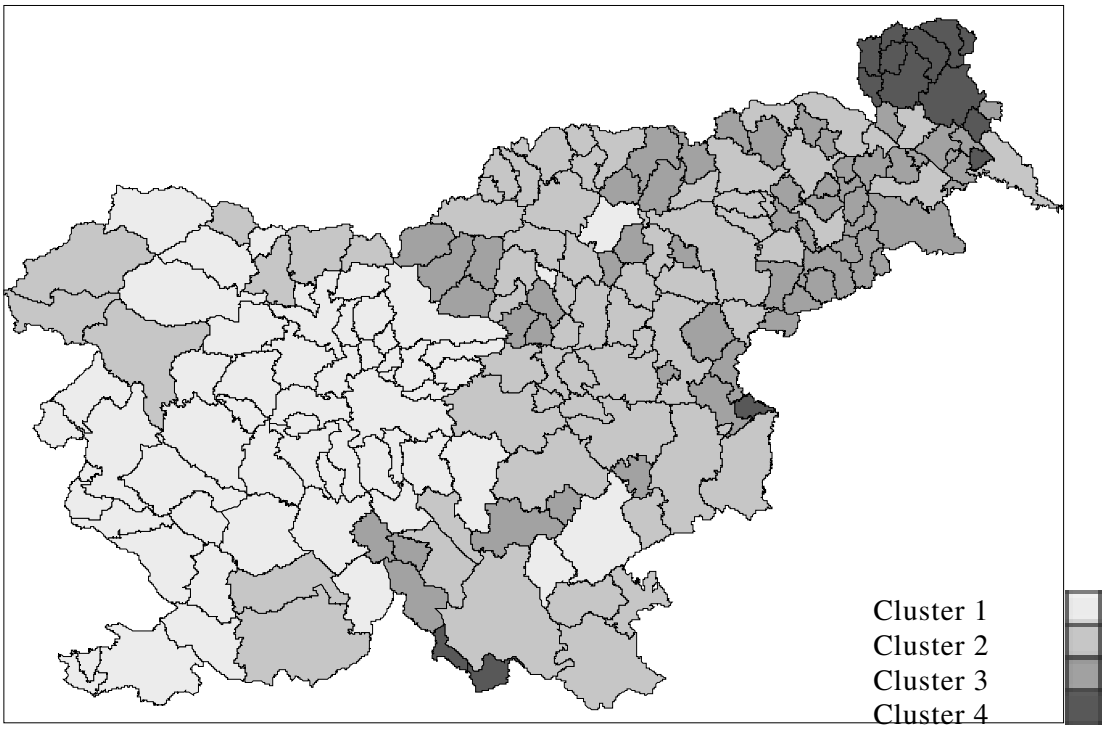
Source: own calculations; SORS data and IMAD data.

The differences between means of those two groups of municipalities are statistically significant for all variables (at 7 variables out of 8 at negligible level of significance). 75 municipalities which form second group of municipalities are located in the eastern part of Slovenia, often near the border. They have by almost one third lower income tax base per capita than municipalities in the first group and by two third higher unemployment rate. They have fewer cars per 100 inhabitants and much lower students share than municipalities in the first group. They face depopulation and their high ageing index suggests unattractiveness for young people. High share of agricultural population declares them as rural areas. Since most of these variables are also the indicators of socio-economic development and their average values are clearly more favourable in the first cluster, we name the first group of municipalities "more developed" areas and the second group of municipalities "less developed" areas.

3.4 Results for four groups of municipalities

We will focus on the solution with four groups of municipalities, because it offers a more detailed picture about socio-economic differences among Slovenian municipalities and because we believe that the results are logical and very informative (the list of municipalities by four groups is presented in Table 4).

In general, the differences between groups (clusters) are characterised by their unique combination of means of socio-economic indicators. Slovenian case is very special: for 6 out of 8 variables the mean values are monotonically increasing or decreasing from the first to fourth group and at the same time most of these variables are indicators of socio-economic development. For that reason the given groups can clearly be ranked with regard to the socio-economic development.



Source: own calculations; SORS data and IMAD data.

Figure 4: Four groups of Slovenian municipalities.

Table 2: Mean values of variables for four groups of municipalities.

Variable	Cluster				Total
	1	2	3	4	
Ageing index	81.94347	84.29367	82.93058	147.8435	87.81999
Income tax base per capita	982591.8	805136.8	617859	538069.5	784646.7
Unemployment rate (registered)	6.843336	12.82333	14.87456	16.58495	11.88943
Number of students per 1000 inhabitants	36.55121	33.49359	18.07589	17.61571	28.76266
Number of cars per 100 inhabitants	61.01724	51.04688	44.96429	41.92857	51.61979
Index of daily migration	73.04828	91.09531	42.25179	47.58571	68.225
Index of population growth (1991-2001)	106.9086	100.5875	99.65	90.30714	101.474
Share of agricultural population (percents)	2.043103	2.948438	6.005357	12.07857	4.232292

Source: own calculations; SORS data and IMAD data.

The first group consist of Ljubljana, and the municipalities from its larger metropolitan area, some municipalities from the western part of Slovenia and some other municipalities, which are mostly capitals of the regions. The income tax base per capita, the number of cars per 100 inhabitants and the index of population growth are significantly higher than in any other group of municipalities and the unemployment rate is significantly lower (results are based on Bonferroni's test, One-Way Anova: Post Hoc Multiple Comparison of Clusters). They also have the lowest value of ageing index, higher students share and lowest share of persons employed in agriculture. According to those characteristics we name them *most developed* municipalities.

The second group mainly consists of the municipalities from the eastern part of Slovenia; some of them are also in the south part and the north-west part of Slovenia. In most cases the mean values of variables for those municipalities are between the mean values of first and third group of municipalities. This "second place" is statistically significant for the income tax base per capita, the unemployment rate and the number of cars per 100 inhabitants. We name them *developed* municipalities, since there are two groups of municipalities which are less developed than this group.

Third group of municipalities are concentrated around Kozjansko, Haloze, Slovenske Gorice and the territory around Črna na Koroškem, Lovrenc na Pohorju and Goteniška gora. So they mainly cover less attractive territories in the eastern part of Slovenia. Income tax base per capita and students share are considerable lower than in the first and second group and the index of daily migration is the lowest of all groups. In the first two groups the low share of agricultural population suggested urban nature of municipalities, but now this share is considerably higher. They have higher unemployment rate and fewer cars per 100 inhabitants than the precedent two groups, so we name them *less developed* municipalities.

Table 3: Independent samples *t*-test for the group of less developed and the group of underdeveloped municipalities.

Variable	Mean difference	t	Sig. (1-tailed)
Ageing index	-64.913	-4.379	0.000
Income tax base per capita	79789.534	2.531	0.007
Unemployment rate (registered)	-1.710	-1.421	0.080
Number of students per 1000 inhabitants	0.4602	0.117	0.454
Number of cars per 100 inhabitants	3.0357	2.145	0.018
Index of daily migration	-5.3339	-0.945	0.826
Index of population growth (1991-2001)	9.3429	5.507	0.000
Share of agricultural population (percents)	-6.0732	-4.066	0.001

Source: own calculations; SORS data and IMAD data.

The fourth group consists of two municipalities from the south Slovenia (Osilnica and Kostel), one from territory of Kozjansko (Bistrica ob Sotli) and 11 municipalities from the north-east part of Slovenia, most of them from the hilly area, called "Goričko".

Before we describe this group into more details, we ask ourselves, whether these 14 municipalities are really so different that the formation of this separate group is justified or maybe they can be adjoined to the group of less developed municipalities? To answer this question, let us compare the mean values of the considered variables for these two groups of municipalities (Table 3), using independent samples *t*-test.

Group means of variables in the group of underdeveloped municipalities significantly differ from the group means of less developed municipalities at six out of eight variables. Thus independent samples t-test has confirmed substantial differences between the last two groups.

Municipalities in this fourth group are rural municipalities and they lie near the border. They have the lowest income base per capita, lowest number of cars per 100 inhabitants, lowest students share and highest unemployment rate. They face severe depopulation (the number of population decreased for almost 10 percent in just one decade), probably because of extensive emigration of young people with their children, since ageing index is extremely high. The situation looks really severe in this group, so we name them *underdeveloped* municipalities.

4 Conclusions

In this work we used cluster analysis to form the groups of Slovenian municipalities on the basis of their socio-economic characteristics. The procedure suggested two or four groups of municipalities. We concentrated on the result with four groups, since it presents far more detailed and informative picture. Most of used variables are also indicators of social-economic development and their mean values are increasing or decreasing (depends if indicator is positively or negatively correlated with socio-economic development) from the first to the last group. Therefore obtained groups of municipalities can also be clearly ranked in respect to their socio-economic development. Our typology for them is based on this finding. In both cases (two and four groups of municipalities) the study reinforces a well-known fact in Slovenia: more developed western part and less developed eastern part of Slovenia.

Table 4: List of Slovenian municipalities by four groups of development level.

#	Most developed	Developed	Less developed	Underdeveloped
1	Ajdovščina	Bovec	Beltinci	Bistrica ob Sotli
2	Bled	Brežice	Benedikt	Cankova
3	Bohinj	Celje	Bloke	Dobrovnik
4	Borovnica	Črna na Koroškem	Braslovče	Gornji Petrovci
5	Brda	Črnomelj	Cerkvenjak	Grad
6	Brezovica	Dobrepolje	Črenšovci	Hodoš
7	Cerklje na Gorenjskem	Dravograd	Destrnik	Kostel
8	Cerknica	Gornja Radgona	Dobje	Kuzma
9	Cerkno	Hoče-Slivnica	Dobrna	Moravske Toplice
10	Divača	Hrastnik	Dornava	Osilnica
11	Dobrova-Polhov Gradec	Ilirska Bistrica	Duplek	Puconci
12	Dol pri Ljubljani	Jesenice	Gorišnica	Rogašovci
13	Dolenjske Toplice	Jezersko	Gornji Grad	Šalovci
14	Domžale	Kidričevo	Hajdina	Velika Polana
15	Gorenja vas-Poljane	Kobarid	Juršinci	
16	Grosuplje	Kočevje	Kobilje	
17	Horjul	Krško	Kozje	
18	Hrpelje-Kozina	Laško	Križevci	
19	Idrija	Lenart	Kungota	
20	Ig	Lendava	Ljubno	
21	Ivančna Gorica	Litija	Loški Potok	
22	Izola	Ljutomer	Lovrenc na Pohorju	
23	Kamnik	Maribor	Luče	
24	Kanal	Metlika	Majšperk	
25	Komen	Mežica	Markovci	
26	Komenda	Miklavž na Drav. polju	Mirna Peč	
27	Koper	Mozirje	Odranci	
28	Kranj	Murska Sobota	Oplotnica	
29	Kranjska Gora	Muta	Ormož	
30	Ljubljana	Nazarje	Pesnica	
31	Logatec	Pivka	Podčetrtek	
32	Loška dolina	Polzela	Podlehnik	
33	Lukovica	Prebold	Podvelka	
34	Medvode	Prevalje	Razkrižje	
35	Mengeš	Ptuj	Ribnica na Pohorju	
36	Miren-Kostanjevica	Rače-Fram	Rogatec	
37	Mislinja	Radeče	Selnica ob Dravi	
38	Moravče	Radenci	Sodražica	
39	Naklo	Radlje ob Dravi	Solčava	
40	Nova Gorica	Radovljica	Starše	
41	Novo mesto	Ravne na Koroškem	Sveta Ana	
42	Piran	Ribnica	Sveti Andraž v Slov. goricah	
43	Postojna	Rogaška Slatina		
44	Preddvor	Ruše	Sveti Jurij	
45	Sežana	Semič	Škocjan	
46	Šempeter-Vrtojba	Sevnica	Šmarje pri Jelšah	
47	Šenčur	Slovenj Gradec	Tabor	
48	Škofja Loka	Slovenska Bistrica	Tišina	
49	Škofljica	Slovenske Konjice	Trnovska vas	
50	Šmartno ob Paki	Šentilj	Turnišče	
51	Trzin	Šentjernej	Veržej	
52	Velike Lašče	Šentjur pri Celju	Videm	
53	Vipava	Šoštanj	Vitanje	
54	Vodice	Štore	Vransko	
55	Vrhnika	Tolmin	Zavrč	
56	Železniki	Trbovlje	Žetale	
57	Žiri	Trebnje	Žužemberk	
58	Žirovnica	Tržič		
59		Velenje		
60		Vojnik		
61		Vuzenica		
62		Zagorje ob Savi		
63		Zreče		
64		Žalec		

Source: own calculations; SORS data and IMAD data.

The second conclusion is that there is a small group of municipalities where the situation is especially severe. This group of "underdeveloped" municipalities consists of only 14 municipalities, they cover only 3.45 percent of Slovenian territory and have only 1.64 percent of Slovenian inhabitants. Due to the small total size of this group the governmental support to those municipalities should not represent a too large financial burden for Slovenian budget. In this way Slovenia could reduce big differences in the level of development of its territory.

Finally, there exists an official methodology for identifying and classifying municipalities with "special developmental problems" into for groups. The method is quite simple, it was implemented in the year 2001 and it is one of the criteria for approval of project funds. The preferred list should be valid till the year 2006 if there will be no bigger changes in development level of municipalities. Our results can be useful information for this decision and guideline for eventual criteria adaptation. Also detailed statistical comparison of those two results could be done.

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