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APPRAISAL OF THE LOAD OF PRODUCTIVE POPULATION BY POST-PRODUCTIVE SEGMENT OF POPULATION WITH THE USAGE OF SAS

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Abstract

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The load of productive population by post-productive segment is an important indicator of human resources development. Relating to spatial aspect of the mentioned indicator we have used the methods of spatial statistics. The means of SAS have appeared as very advantageous tool for this kind of analysis. The results confirm the random location of the investigating indicator on the space of Slovak Republic in the years of 1993, 1997 and 2000, too.

population, Monte Carlo, centroid cluster analysis, Moran coefficient, Geary coefficient

Demographic researches and studies, which are concerned with the research of population development, cannot exist separately from social conditions because the reproduction process is closely joined with sociological, economic, geographic and enviromental conditions. It is not only the result of its influence and reflects its changes but on the other hand the level and intensity of demographic changes as a consequence of social changes influences the social development retrospectively. There is a backward bond.

Many authors from the field of management of human resources come out from analysis of population development. Koubek (1997) states that positive and also negative external factor is often population development ensuring the working resources and labour force reproduction together with spatial mobility and thus also the situation on the labour market. Similar opinion was expressed by Kachňáková (2001). Stýblo (1998) puts a stress on the fact that the importance of human resources rises in the global environment. There are some problems of ergonomics caused by rising number of older employees. The author appreciates their experience, discipline, honesty and quality. Višňovský (1998) connects human recources with labour analysis. Hrubý – Felsen (2000) describe the problems of the load of productive population.

The characteristic feature of the population development in Europe is the slowing speed of its reproduction. The marks of a new reproduction model with a low natality and mortality which take part in the Western Europe for a long period appear in Slovakia, too. The population starts getting older.

The population development in Slovakia has the following important characteristic features in the recent decade: the population is getting older, the age structure is worsening, the decrease of the number of new married couples and the wedding rate, the increase of the age of betrothed, the decrease of the number born children and the fertility of women, the increase of the average age of mother at the first childbirth, the increase of the population mortality, the decrease of natural growth of population.

According to Hrubý (1996) the future of every country is dependent on the population development as the basis of existence of every state. It is important to know the development of the child segment of population as a source of future labour force. Due to social and pension matters it is also important to pro-

gnosticate the development and structure of population in post-productive age. The family and household projections and other demographic prognosis are necessary for the future analyses. The knowledge about population development is crucial also for the analyses of agriculture which is important as a source of food.

THE GOAL, MATERIAL AND METHODS

Modern human resources management pays much attention to human resources which are in their quality structure the basis of highly-developed economy. One of the important indicators is the load of productive population by post-productive segment. The goal of the work is the appraisal of this indicator in Slovakia from a spatial and time point of view with an effective usage of SAS methods of spatial statistics and cluster analysis. The basic material was the age structure of inhabitants of Slovakia according to the Statistical bureau of Slovak Republic in the years 1993, 1997 and 2000. According to these data on the level of municipalities (NUTS 2) we calculated the coefficients X_i (i = 1, 2, …, 79) of the load of productive population by post-productive segment

$$X_i = \frac{P^i_{60+}}{P^i_{15-59}},$$

where i is the numerical order of the municipality (i = 1, 2, …, 79), is the number of inhabitants of post-productive age of i-th municipality, is the number of inhabitants of productive age of i-th municipality.

Many investigated factors have one common feature – they are more or less influenced by their near and also far environment. They do not exist separately from their environment. This fact is confirmed by the statement of the geographer Tobler who said that everything has a connection with everything else, but near things have more relations than far things. If the values of investigated mark for every couple of regions of the investigated space are not correlated, than we can express the statement that the spatial autocorrelation of the investigated factor does not exist. It means that the location of the investigated factor is random. Positive spatial autocorrelation means that similar values of the investigated variable are situated one next to the other in the space. In case of negative autocorrelation there are various values of the investigated factor alongside.

There are many measures of spatial autocorrelation. The most common are the Moran and Geary coefficients. We have used the Moran coefficient for the appraisal of the load of productive population by post-productive segment.

$$\mathbf{I} = \frac{n}{2A} \frac{\sum_{i=1}^{n} \sum_{j=1;j\neq i}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n}(x_i - \bar{x})},$$

where n is the number of regions, A is the number of boundaries, W is the neighbour matrix, x_i (i = 1, 2, …, n) is the value of the investigated factor in theregion i, $\bar{x}$ is the average value of the investigated factor.

The interpretation of the Moran coefficient is the following one. If the value I is approaching +1, the investigated factor is strongly positively autocorrelated. If the value I is approaching –1, the investigated factor is strongly negatively autocorrelated. If the value I is approaching 1/(n-1), the investigated factor is located in the space randomly.

For more detail reappraisal it is necessary to use statistical tests. When some moments (normality, randomization) are met, we know the moments of the Moran coefficient and we know that the testing statistic

$$Z = \frac{I - E(I)}{\sqrt{D(I)}},$$

where $E(I)$ is the average value and $D(I)$ is the dispersion of the coefficient I, has a asymptotically normal normalized distribution. It can be proved that the distribution of the statistic Z is not normal in case of specific arrangement of the investigated space. For example: Clif and Ord (1972) proved that it has a beta distribution for spaces of star type. Therefore we have used simulation MONTE CARLO for spaces of irregular shape or for small values of n. This attitude appeared as an effective method when considering the shape of Slovak Republic.

To identify similar municipalities we have used cluster analysis – centroid method.

RESULTS AND DISCUSSION

We have aggregated the results into tables.

I: *Spatial autocorrelation*

Year	N	Average values of the coefficients of the load	Variation coefficient	Dispersion	I
1993	79	0.25349	0.01450	0.00368	0.07081
1997	79	0.24693	0.01187	0.00293	0.04635
2000	79	0.24445	0.01032	0.00252	0.04197

II: *Tests – Moran coefficient*

Rok 1993	E(I)	D(I)	Z normality	P value	Sequence in Monte Carlo
Monte Carlo			1.22011	0.11121	
Test based on normality	–0.0128	0.0047	1.22011	0.11121	93
Test based on randomization	–0.0128	0.00443	1.22011	0.11121	

II: *Tests – Moran coefficient continuation*

Rok 1997	E(I)	D(I)	Z normality	P value	Sequence in Monte Carlo
Monte Carlo			0.86333	0.19398	
Test based on normality	–0.0128	0.00470	0.86333	0.19398	83
Test based on randomization	–0.0128	0.00448	0.86333	0.19398	

II: *Tests – Moran coefficient finished*

Rok 2000	E(I)	D(I)	Z normality	P value	Sequence in Monte Carlo
Monte Carlo			0.79939	0.21203	
Test based on normality	–0.0128	0.00470	0.79939	0.21203	84
Test based on randomization	–0.0128	0.00447	0.79939	0.21203	

According to the average values of the coefficients of the load of productive population by post-productive population we can see that it does not grow considerably. It means that the productive population of Slovakia is still loaded by post-productive population. The growth of the dispersion of values confirms the growing differentiation between municipalities. The values of the Moran coefficient are almost zero in every investigated year. *P*-values are more than the confidence level *alfa* = 0.05 in every case. Therefore we cannot refuse the hypothesis Ho about the random localization of the investigated factor. Similarly the results Monte Carlo confirm the random localization of the investigated factor.

From the point of view of human resources this result means that there is not a continuous group of municipalities in Slovakia with a considerably low or high load of productive population by post-productive one.

Optimal number of clusters was 3. We have had municipalities with a high coefficient of load over 0.3 (BA1, BA3, Medzilaborce, Sobrance) and very low coefficient of load (BA5, Košice 3). Other municipalities are in the third cluster.

A great advantage of SAS is the creation of HTML outputs. The values of index of load of productive population by the post-productive one in the year 2000, dendrogram and more detailed results including programs and outputs are situated at our web site www.fem.uniag.sk/priestorova_autokorelacia_v_SAS.

The present demographic situation in Europe is the result of long historic development. Europe belongs to such regions of the world in which the demographic development moved the most forward. Especially in the last century there were revolution changes in the character of demographic reproduction. It has appeared as a transition from the extensive to the intensive reproduction type. Demographic revolution led to the decrease of the birth rate and mortality.

The population development of the Slovak Republic is closely connected with the population development of the entire Europe in which the process of demographic revolution has been finished except some states like Turkey and Albania. In the western, north and part of middle Europe it was before the World War II and in other parts of Europe immediately after the World War II.

The age structure of the inhabitants of Slovakia is because of the previous development not well-proportioned. The irregularities can be best seen on the graph of the age pyramid.

In comparison to the age structure of inhabitants of the countries of EU the age structure is considerably more irregular although there are some similar features in some parts of the age pyramide (graph 1). The base of the age pyramide is sharply narrowing by the decresing of birth rate during the last 20 years. It means new irregularities of the structure of the inhabitants of Slovakia in the future.

Cluster analysis (program):

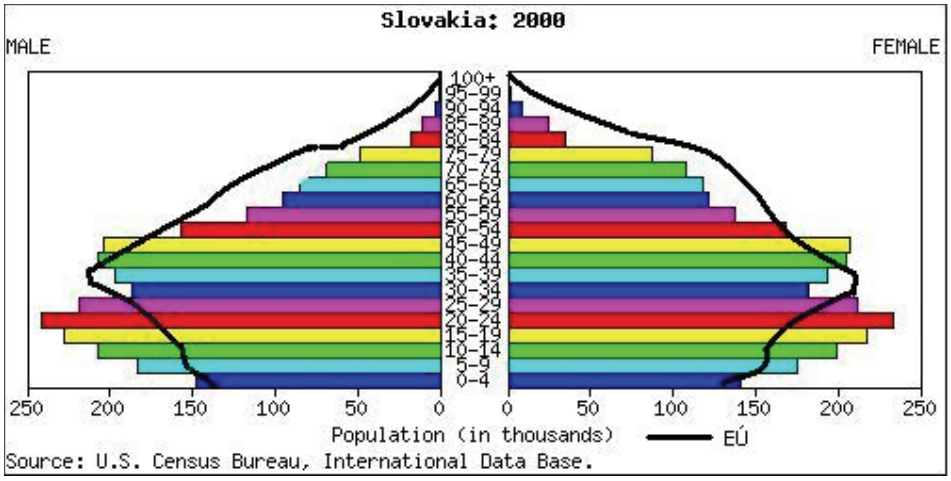
```
ODS HTML body=    "autocorr-body.html"
          contents="autocorr-contents.html"
          frame=   "autocorr-frame.html"
          page=    "autocorr-page.html"
          headtext="<title>Spatial Autocorrelation</title>"

TITLE1 'SPATIAL AUTOCORRELATION';
DATA RESPONSE;



options ls=80 ps=60 nocenter compress=yes  ;



proc cluster simple noeigen method=centroid rmsstd rsquare nonorm outtree=tree ;
id I;
var X;
copy X;
run;

proc tree data=tree out=clus3 nclusters=3;
id I;
copy X;
run;
```

1: *The output of clustering of municipalities by centroid cluster analysis*

The population getting older is the problem of not only Slovakia but also the whole Europe though this problem is much more perceptible in the Western Europe countries as in Slovakia. As the inhabitants of those countries achieve higher age these countries have a larger share of older inhabitants. The greatest share of inhabitants at the age of 65 years and more (in the year 2000) was in Italy (18.01%) and Greece (17.43%), then in Belgium (16.84%) and Germany (16.44%). In Slovak Republik the portion of inhabitants in this age group is one of the smallest ones (11.42%).

CONCLUSION

The present development in Slovakia is characteristic by considerable changes in many demographic variables while these changes are reflected in structure changes of inhabitants. The population getting older intensively influences the age structure of population. The numerous and relative growth of higher age groups and decrease of number of inhabitants in pre-productive age is the result of other demographic processes which after all form the age structure of population.



1: *Age pyramide Slovakia 2000*

Podstupka (1997) describes the situation relating the child component of population. The knowledge of this population segment is extremely important because this segment represents a potential labour force in the future, thus productive segment of population. The author deals with the decreasing reproduction as a result of present natality, mortality and reproduction processes from the past. The constantly decresing fertility in Slovakia has become one of the most discussed topics of the population development. The reasons cannot be found out easily. It is a complex of factors like a new way of life or the decreasing number of children in family. The population of the Eastern Europe type changes into the population of the Western Europe type with a low mortality and natality and the population which is visibly getting old. At present economic situation when there is a lack of flats it appears that young people consider the child birth much more rationally. They cannot count on the state help, a system of advantageous loans does not exist, thus they try to put off the parenthood to higher age. A part of population who originally planned a higher amount of people will remain at a two-children model, there will be a decrease of natality. The child birth is determined by the economic activity, young people want to have a child only when they have a job and housing. The tendencies of well considered wedding and parenthood must be welcomed. On the other hand a kindly climate has to be created in order people would want to have children.

Slovakia is approaching the Western Europe countries. There is a process of increase of average age of population joined with the decrease of the child segment and the growth of share of population in post-productive age. The demographic potential as well as the structure of inhabitants have an influence on the economic and social situation in the municipalities and regions as well as on their next development.

The portion of the parts of inhabitants has an intensive influence on the growth of life quality and the level of economic quality. According to our results we can state that the demographic development breeds many serious changes. The society has to prepare for the growing portion of old people. New approaches in the population, family, social, economic and migration policy will be necessary to manage this situation. The greatest changes are expected in the field of social care, health service, pensions and the labour force structure. The SAS tools have appeared as very advantageous for the appraisal of productive population by the post-productive one.

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SOUHRN

Hodnotenie zaťaženosti produktívnej populácie SR poproduktívnou zložkou populácie s využitím SASu

Zaťaženosť produktívnej populácie poproduktívnou zložkou je významným ukazovateľom z hľadiska rozvoja ľudských zdrojov. Vzhľadom na priestorový aspekt hodnoteného javu sme použili metódy priestorovej štatistiky. Prostriedky SASu sa ukázali ako veľmi výhodný nástroj pre túto analýzu. Výsledky potvrdzujú náhodné rozloženie skúmaného javu na území SR v rokoch 1993, 1997 aj 2000.

populácia, Monte Carlo, centroidná zhluková analýza, Moranov koeficient, Gearyho koeficient

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