UDC 331.556.4

M. Grešš

University of Economis in Bratislava, Slovakia, Bratislava
E-mail: martin.gress@euba.sk

State of population in countries of the Commonwealth of Independent States in the beginning of 21st century[1]

In recent decades, we witnessed a dynamic evolution of the population not only at the global level, but also in different regions and countries. The aim of this article is to explore the populations in member countries of Commonwealth of Independent States (CIS). We then formulate recommendations to ensure convergence not only among the studied countries, but also between them and the developed countries of the West. In conclusion, we note that state of some demographic variables is not at a sufficient level, which implies the necessity to take measures to ensure a positive demographic trend, together with measures to ensure the effective functioning of the economies of the countries in the CIS region.
Keywords: population, CIS, cluster analysis, demographic variables, recommendations.

M. Grešš

XXI ғасырдағы Тәуелсіз Мемлекеттер Достастығындағы демографиялық жағдай

Соңғы он жылдықтарда біз халықтың динамикалық дамуының тек ғаламдық деңгейде ғана емес сонымен қатар бөлек аймақтардада болып жатқанынакуә болдық. Қазіргіуақытта біз жаңа демографиялық үрдістерді байқаудамыз: халықтың қартаюын,дамыған және дамып келе жатқанелдердегіхалықтардың туып-көбею деңгейінің төмендеуін, өндірістік еңбекпен айналысқан жалпы халық жастарының санының азаюын,өмірдің ұзақтығыныңұлғаюын, алғашқы кездермен салыстырғанда нәрестелік және балалар өлім-жітімлігінің төмендеуін, және т.б. Осы мақаланың мақсаты-Тәуелсіз МемлекеттіңДостастығыелдеріхалықтарының жағдайын зерттеу.Біз конвергенцияменқамтамасыз етуге арналғантек қана зерттелген елдердің арасында ғана емес, солармен бірге дамыған Батыс елдеріне деарналғанұсыныстарымызды тұжырымдаймыз. Кейбір елдердің демографиялық өзгерістеріжеткілікті деңгейде емес, сол себептен демографиялықүрдісі ілгері басу үшінжәнеТМД елдерінің аймақтарындағы экономикалары да тиімді қызмет ету үшінқажетті шара қолдануын қажет етеді.
Түйін сөздер: халық саны, ТМД, кластер талдауы, демографиялық өзгеріс, ұсыныстар.

M. Grešš

Состояние демографии в странах Содружества Независимых Государств в начале XXI века

В последние десятилетия мы стали свидетелями динамичного развития населения не только на глобальном уровне, но и в разных регионах и странах. В настоящее время мы наблюдаем новые демографические тенденции – старение населения, снижение уровня рождаемости в развитых и развивающихся странах, уменьшениедоли молодежи в общей численности занятых производственным трудом, увеличение продолжительности жизни, снижение младенческой и детской смертности и смертности в целом по сравнению с предыдущими периодами, и другие.Цель этой статьи заключается в изучении населения в странах-членах Содружества Независимых Государств (СНГ). Мы сформулируем рекомендации по обеспечению конвергенции не только среди исследованных стран, но и между ними и развитыми странами Запада. В заключении отметим, что состояние некоторых демографических переменных не на достаточном уровне, что предполагает необходимость принятия мер по обеспечению положительной демографической тенденции, наряду с мерами по обеспечению эффективного функционирования экономик стран в регионе СНГ.
Ключевые слова: население, СНГ, анализ кластера, демографические изменения, рекомендации.

[1] This article has been composed within the project VEGA no. 1/1326/12, Neoregionalizáciasvetovejekonomiky a spoločnosti, supervisor: LadislavLysák.

In the second half of the 20thcentury, there has been a significant change in dynamics of the world's population. We are currently witnessing new demographic trends– population aging, decline in fertility rates in developed and developing countries, decline in the young population to the total productive population, longer life expectancy, reduced infant and child mortality and overall mortality compared with previous periods, and others. [7], [8] and [4] elaborate the development of the demographic variables in the global economy. At the end of the article, we present the link between the demographic variables and government economic policy. [2]highlights the necessity of using the results of population projections for the creation of state economic policy.

In addition to basic demographic variables that we used in our analysis there are other variables that may have some impact on population dynamics, as expressed in [1]. An important issue is the study of "population momentum" in [3]. Certain recommendations regarding the development of demographic variables at the beginning of the 21st century can be found in [6, p. 693]. In the regional dynamics of the population, importance plays an analysis of the dynamics of employment in different sectors of the economy as presented in [5]. Trends in population may have an impact on the environment; its development and changes may in turn affect the economic development of the state.[10] deals with the impact of population on climate change.[12] is significant in terms of the impact of population growth on economic growth. It is devoted to empirical analysis of effects of age structure on economic growth in Vietnam.[14]addresses the impact of the level of wealth and age structure on aggregate consumption.

Based on data from Table 1, we can conclude that the total population in CIS countries varies considerably around the average, which stands at 25 million. Of the eleven countries, only three countries (27.3 % of all surveyed countries) have a population higher than average (Russia 143 million; Ukraine 45.7 million; and Uzbekistan 29.3 million). Rest of the countries (72.7 %) have a lower population, while seven countries (63.6 %) have populations of less than 10 million.We observe minor differences at the level of absolute volume of GNI expressed in current prices in USD. Five countries have GNI p. c. higher than average, the remaining six countries have lower levels. Low levels of GNI p. c. indicate possible problems within economies of CIS countries, mainly in the area of public expenditures on education and health care, which may result in higher values of certain demographic variables compared to more developed countries with higher levels of GNI p. c.

Table1– Population and economic performance in CIS countries, 2011

Country	Population (mil.)	GNI p.c. (current USD)	Country	Population (mil.)	GNI p. c. (current USD)
Armenia	3,0	3 490	Russian Federation	143,0	10 810
Azerbaijan	9,2	5 140	Tajikistan	7,8	780
Belarus	9,5	6 270	Turkmenistan	5,1	4 920
Kazakhstan	16,6	8 250	Ukraine	45,7	3 150
Kyrgyz Rep.	5,5	900	Uzbekistan	29,3	1 500
Moldova	3,6	2 150	***CIS Average:***	***25,3***	***4 305***

Source: author's calculations based on Health Nutrition and Population Statistics

The aim of this paper is to divide the CIS countriesbased on their demographic characteristics into groupswith different characteristics among the groups and similar characteristics within the groupsusing cluster analysis, and to outline possible measures that may change the status of the population in these countries in coming years and decades.

Methodology and data

In determining the objects of analysis (CIS countries), we used the definition of this group according to [15]. As a basis for the analysis served variables derived from [9]. All data for individual countries come from this database. We selected the year 2011 as a base year for the analysis. For this year, we were able to obtain complete data for all CIS countries, allowing sufficient analysis of the state of population in CIS countries.

We applied cluster analysis while analyzing the evolution of the population. Cluster analysis allows us to create several groups of observed units (in our case CIS countries). Individual groups (clusters) contain units (countries) with the most similar demographic characteristics (in terms of selected and analyzed variables). On the other hand, we observe different characteristics among groups. We used Ward's clustering method in the analysis. We expressed the distance between objects by squared Euclidean distance.Based on results of the analysis, we identified five major clusters of observed countries. We notice similar demographic characteristics within the clusters and different characteristics among the clusters.

We divided individual variables for the analysis into six basic groups (Table 2). In the group "Population status", we analyzed basic demographic variables – total population and annual population growth. We included four variables that are particularly relevant to national economies in the group "Age structure". The first two relate to the proportion of non-productive part of the population in the total population. The other two (dependency ratio)relate with the evolution of the main macroeconomic indicators, especially with the formation of GDP, the level of household final consumption and income and expenditure of the national budget (impact on direct and indirect taxes and transfer payments). "Fertility" is an important group, which tracks the total fertility of women of childbearing age (15-49 years) and adolescent fertility (15-19 years). The level of total fertility is particularly important for maintaining the stable population; theoretical minimum for stable population is two children per woman. Adolescent fertility rate is important for the state budget. On the revenue side, the state loses to direct taxes, because young mothers stay at home with children, on the expenditure side, there is upward pressure on expenses related to the provision of basic needs of children. The group "Natality and mortality" includes also four variables. The first two – crude birth rate and crude death rate are important to natural increase or decrease of population. In addition, we also included in the analysis variables on infant and child mortality, which may reflect the state of health in observed countries to some extent. The penultimate group "Life expectancy" comprises of two variables – life expectancy at birth separately for men and women. The development of these variables over time is important for the economy of the state for the correct settings of retirement age, which has an impact on the expenditure side of the state budget in the absence of population's pension savings in the private sector. The last group "Urban population" is important in terms of urban planning. We analyzed total urban population as a proportion of total population as well as the growth rate of the urban population.

In the second part of the article we analyze the observed countries grouped based on the variables in Table 2. For the purposes of identifying the different characteristics among clusters, we used the centroids of the variables for all clusters in the studied period. Table 3 summarizes basic information on individual clusters. Table 4 presents the summary of each cluster based on the analyzed variables.

Table 2– Summary of analyzed variables

Group	Variable	Unit	Name
Population status	Total population	Million	POP_t
	Population growth (annual)	%	POP_g
Age structure	Population 0 – 14 (on total)	%	POP_y
	Population 65+ (on total)	%	POP_o
	Dependency ratio 0 – 14 (on population 15 – 64)	%	AGE_y
	Dependency ratio 65+ (on population 15 – 64)	%	AGE_o

Fertility	Total fertility (woman aged 15 – 49)	Births per woman	FER_t
	Adolescent fertility (woman aged 15 – 19)	Births per 1,000 women	FER_a
Natality and mortality	Crude rate of births	Per 1,000 people	CBR
	Crude rate of deaths	Per 1,000 people	CDR
	Infant mortality (children under 1 year of age)	Per 1,000 live births	MR_i
	Child mortality (children under 5 years of age)	Per 1,000	MR_u5
Life expectancy	Life expectancy at birth (males)	Years	LE_m
	Life expectancy at birth (females)	Years	LE_f
Urban population	Total urban population (on total population)	%	URB_%
	Urban population growth (annual)	%	URB_g

Source: author

Table 3– Summary of clusters

Cluster	Members	Percent	Countries
1	1	9,09	Armenia
2	3	27,27	Azerbaijan, Kazakhstan, Kyrgyz Rep.
3	3	27,27	Belarus, Moldova, Ukraine
4	1	9,09	Russian Federation
5	3	27,27	Tajikistan, Turkmenistan, Uzbekistan
Sum:	***11***	***100***	

Source: author's calculations

utput analysis

Cluster structure

Table 3 shows summary characteristics of each cluster identified by analysis. Figure 1 demonstrates geographical structure of individual clusters. We observesignificant geographical proximity of units within clusters. The structure of each cluster is geographically homogeneous, with one exception. Azerbaijan, in cluster 2, has no common border with other units of the cluster.

In the first group of variables, we see that cluster 4 (Russian Federation) reached the highest absolute number of people. Russian Federation is the most populous country in the CIS with a share of the total population in the CIS in 2011 of 51.4 %. Conversely,cluster 1 (Armenia) was the least populous cluster. Armenia is country with the lowest overall population with a share of the total population of CIS of 1.1 %. As for population growth, cluster 3 reached the lowest value (population decline). Members of this cluster were the only three countries, which witnessed a population declinein 2011, with the strongest decline in Ukraine (-0.4 %).Cluster 5 reached the highest rate of population growth. We register two members in this cluster with the highest population growth in the CIS (Uzbekistan 2.7 % and Tajikistan 2.4 %).

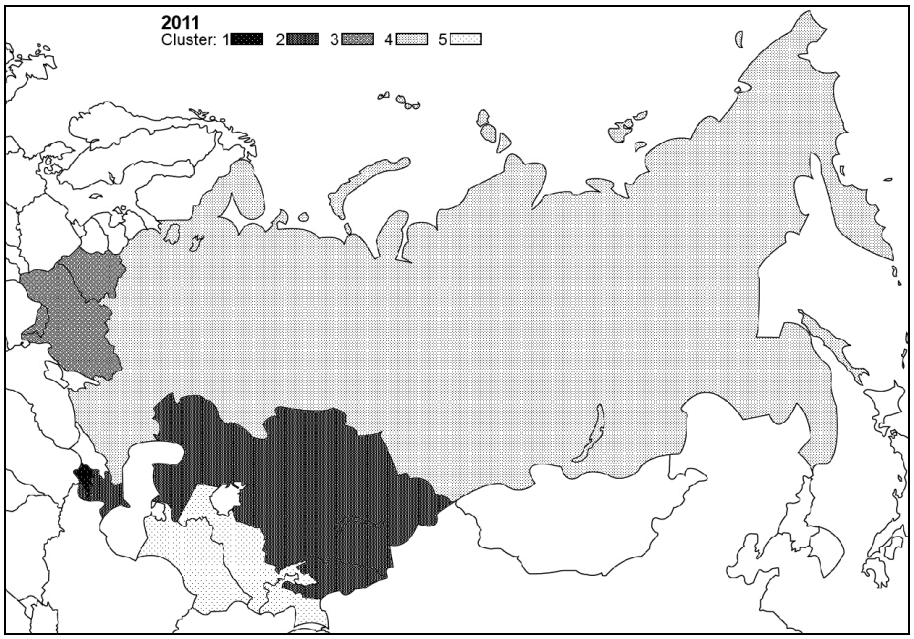

Figure 1 Geographic structure of clusters

Source: author

Cluster differences

Table 4 – Cluster characteristics based on input variables

Cluster	POP_t	POP_g	POP_y	POP_o	AGE_y	AGE_o	FER_t	FER_a
1	**2 964 120**	0,02	20,41	10,39	29,50	15,02	1,74	**33,71**
2	10 415 500	1,32	25,89	5,55	37,98	8,07	2,52	30,50
3	19 580 000	**-0,19**	**15,16**	**13,53**	21,25	**19,00**	**1,48**	25,99
4	**142 960 000**	0,40	15,15	13,00	**21,09**	18,10	1,54	24,58
5	14 087 600	**2,13**	**31,32**	**3,88**	**48,63**	**5,97**	**2,70**	**18,88**
Cluster	**CBR**	**CDR**	**MR_i**	**MR_u5**	**LE_m**	**LE_f**	**URB_%**	**URB_g**
1	15,20	8,99	15,60	17,50	**70,80**	**77,19**	64,11	**0,10**
2	22,93	7,04	30,17	34,53	65,91	73,71	47,56	1,49
3	**11,59**	**14,02**	**8,80**	**10,57**	65,42	75,27	63,85	0,59
4	12,60	13,50	9,80	11,90	**63,20**	75,10	**73,82**	0,63
5	**23,53**	**6,28**	**46,30**	**54,80**	63,53	**70,51**	**37,18**	**2,47**

Source: author's calculations

Note: highlighted are highest and lowest values of variables

The second group of variables relate to the age structure of the population.In the age structure, we consider as positive values high proportion of young people (0-14 years) and a low proportion of elderly (65+ years). In the case of young people, they regard as potential workforce that will, in the future development,have a positive impact on the economy (GDP formation). In the case of the

elderly, there may be an impact and pressure on state's social spending and population aging. This may require re-evaluation and change or creation of demographic policy in observed countries in order to eliminate the effects of aging. Looking at Table 4, we can clearly identify clusters with the highest and lowest values of the variables in this group. These are clusters 3 and 5, which have also reached the highest and lowest values in case of population growth. We note that in the case of a high proportion of the age group of 0-14 years in the total population there is also a high value in dependency ratio in this age group. Vice versa, in the case of the low proportion of the age group 65+ years in the total population there is also a low value of dependency ratio in this age group. Correlation between the share of the population in a certain age group (in our case 0-14 years and 65+ years) in the total population and the dependency ratio in these age groups on the productive part of the population (in our case 15 to 64 years) shows a very high correlation between these variables. The correlation coefficient for the two groups of variables is 0.995 (for the age group 0-14) and 0.999 (for the age group 65+), indicating a direct linear relationship between these variables. The only exception to the outputs of the analysis consists of dependency ratio of the young population, which is lowest in cluster 4. However, we observe only a minimal difference between clusters 3 and 4 (21.25 % and 21.09 % with a difference of 0, 17).

In case of fertility,of interest is the value of total fertility from which we may infer whether the individual clusters are capable of achieving at least replacement level fertility (for details see 11]). We note that from all observed groups only clusters 5 and 2 reached a level higher than the theoretical minimum needed to maintain the population, with cluster 5 reaching the highest level of total fertility rate (2.7). On the contrary, clusters 3, 4 and 1 reached lower values than theoretical minimum, with cluster 3 recordingthe lowest value at 1.48. Interestingly, the level of adolescent fertility rate in cluster 5 is the lowest despite the high level of total fertility. On average, almost 19 children are born per thousand women aged 15-19 years in cluster 5. On the other hand, cluster 1 has the highest average of adolescent fertility of almost 34 children per thousand women aged 15-19 years.

We analyzed four variables in the group "Natality and mortality". Looking at crude birth rate and crude mortality rate,we observe (abstracting from migration) relatively high natural increase of population in clusters 5, 2 and 1. In the case of cluster 5, assuming unchanged development in further years, the population will double in 4 years. Conversely,unchanged value of decrease in population in cluster 4 (natural decrease -0.9)entails the decrease of the population to half in 78 years.Cluster 3 reached the highest population decline (-2.43), which is comprised of the only countries with negative population growth. In this case, there would be a decline to half of the population in approximately 29 years.Mortality rate is an important indicator of health, education and welfare in the state. In this indicator, we included infant mortality (children under 1 year of age) and child mortality (children under 5 years of age).Cluster 5 reached the highest levels of both variables, with values high in excess of the values in the other clusters.Cluster 3 reached the lowest values of these variables.

Life expectancy is especially important for planning social spending and the retirement age. In case of its growth (which is the trend in recent decades in almost all countries of the world), there will be a need to review state expendituresfor elderly as well as the possibility of changing upper age limit for retirement of the productive part of total population in each country. We focused specifically on the analysis of the life expectancy of men and women. Compared to other variables there is a change in clusters showing the highest and lowest values. For men, cluster 1 reached the highest average (70.8 years) and cluster 4 the lowest value (63.2 years). For women, cluster 1 again reached the highest value (77.19 years) and cluster 5the lowest value (70.51 years).

The last group of variables was "Urban population". We analyzed proportion of urban population to total population and the growth rate of the urban population. We note significant heterogeneity between clusters and countries concerning the share of the population living in cities. Three clusters have reached values higher than 50 %,cluster 4 reached the highest value (73.82 %), although the considering individual countries, Belarus (cluster 3) reached the highest value (75%). Regarding the growth of urban population, with the exception of Ukraine (-0.07 %) all countriesachieved positive numbers. The highest growth rate occurred in cluster 5 (2.47 %), where three countries with the highest rate of

growth of the urban population are located (more than 2 % per year).

We conclude that cluster 5 (Tajikistan, Turkmenistan, Uzbekistan) shows the worst average values of analyzed variables, especially in the group "Natality and mortality".

Discussion and conclusion

If we look at the absolute volume of GNI p. c. for 2011 at current prices (Table 1), we see that clusters containing more than onecountryare composed of countries with dissimilar volumes of GNI p. c. Based on the above, we can conclude that the countries grouped in each cluster have similar demographic characteristics, but different volumes of GNI p. c. This would indicate a possible low correlation between demographic characteristics of observed countries and the volumes of their GNI p. c.Based on correlation coefficients between GNI p. c. and analyzed demographic variables (Table 5) we can conclude that chosen demographic characteristics are characterized by rather weak to very weak correlation on GNI p. c. Of the sixteen variables only two variables show strong dependence (POP_t and URB_ %). None of the variables reaches very high correlation values. On the other hand, there are fourteen variables with weak or very weak correlation. In terms of economic theory postulates, we can conclude that the correlation coefficients are consistent with their conclusions.The growth of economic welfare (GNI p. c. growth) leads to an inverse relationship between GNI p. c. and population growth (POP_g), proportion of young people in the total population (POP_y),dendency ration of young (AGE_y), total and adolescent fertility (FER_t and FER_a), birth rate (CBR), rate of infant and child mortality (MR_i and MR_u5) and the growth rate of urban population (URB_g).

Table 5 –Correlation of input variables and GNI p. c. (2011, current USD)

Variable	Correlation coefficient	Variable	Correlation coefficient
POP_t*	0,64	CBR	-0,40
POP_g	-0,30	CDR	0,42
POP_y	-0,49	MR_i	-0,41
POP_o	0,39	MR_u5	-0,41
AGE_y	-0,51	LE_m	-0,29
AGE_o	0,38	LE_f	0,32
FER_t	-0,42	URB_%*	0,70
FER_a	-0,11	URB_g	-0,42

Source: author's calculations
*Note: * strong correlation*

Based on the results of analysis we can identify problematic demographic characteristics of the observedcountries:

- Population growth – low level, even decrease in population growth in individual clusters, but also in individual countries based on unfavorable development of other demographic variables,and also economic and social characteristics of the countries.
- Total fertility – in spite of gradual growth in other clusters, it is decreasing in cluster 5 (however, it is highest in this cluster and is above level of replacement fertility); in six countriesit is below the minimum theoretical value of replacement fertility, which in the future may cause a problematic development of other demographic variables affecting individual economies.
- Infant and child mortality – despite the declining trend in all clusters, these variables are still at a high level compared with developed countries; higher levels of these variables can have a negative effect both on the demographic characteristics of

the CIS countries and on their economic potential.

- Life expectancy for men – reaching lower values than for women (in average 8.58 years).

Due to these problem areas,it is necessary to formulate recommendations for decision-makers in the field of demographic and economic policies that can help to improve the demographic characteristics of the CIS countries and subsequently increase their level of economic well-being in order to converge with the level of advanced countries of the world:

- Population growth –to ensure population growth in CIS countries is a prerequisite for further economic growth, which will depend on the development of individual economies as well as the development of other demographic variables.Countries should ensure, through economic policy,such degree of population growth, which is consistent with the development of the economy (especially in terms of generating economic growth and increasing welfare at both state and household and individual level). Research shows ([13]) that in recent years there is an increase in the total fertility in countries with a high Human Development Index. Therefore, we proposemeasures to be takenfor efficient functioning of economies in CIS countries, which will subsequently lead to an increase in population growth, which may be further positively reflected in the development of individual economies.
- Total fertility rate – the social policy measures should be taken to ensure that the right conditions for families are created so that the CIS countries reach at least level of replacement fertility. In countries that already achieve this value, create the conditions for maintaining the state of the population at least at the current level so that the population in these countries are able to reproduce without increased migration. Otherwise, it will be necessary to take measures in the field of migration policy. Even though,CIS countries deal with the opposite problem as more advanced EU countries. Namely, the need to create conditions that will restrict emigration.
- Infant and child mortality –it is necessary for CIS countries to increase the well-being of individual economies and households (ensure growth of GDP p. c.), so that households can afford higher expenditures on providing adequate health care of children under 5 years of age. On the other hand, it is necessary to increase public expenditure on health care in order to improve these indicators in order to fall to the level of more developed countries.
- Life expectancy for men – social policy measures are required to ensure the creation of conditions for faster convergence in life expectancy between men and women. In particular, we propose the implementation of health care beyond legal obligations, which wouldcontribute to the improvement and extension of life expectancy for menin our view. However,it will require growth of state budget expenditures.

In conclusion, we can say that despite the different status of individual demographic characteristics of the CIS countries there is a negative and unsatisfactory development of certain variables, especially infant and child mortality, which may adversely affect the future demographic and economic developments in these countries.Therefore,CIS countries should take measures in economic and social policies so that they succeed as soon as possible in eliminating the negative developments of examined demographic characteristics.

Refernces

1. Belkin, V. – Storozhenko, V. (2010). Housing Construction as a Factor in Demographic Dynamics. Problems of Economic Transition, 52 (11), 71-79.
2. Bleha, B. (2006). Terminologickéšpecifiká a vybranéteoretickéotázkyregionálnehopopulačnéhoprognózovania. Geografickýčasopis, 58, 61-71.
3. Blue, L. – Espenshade, T. J. (2011). Population Momentum across the Demographic Transition. Population and Development Review, 37, 721-747.
4. Chi, G. – Ventura, S. J. (2011). An Integrated Framework of Population Change: Influential Factors, Spatial Dynamics, and Temporal Variation. Growth and Change, 42, 549-570.
5. De Graaff, T. – van Oort, F. G. – Florax, R. J. G. M. (2012). Regional Population-Employment Dynamics across Different Sectors of the Economy. Journal of Regional Science, 52, 60-84.
6. Demeny, P. (2012). Geopolitical Aspects of Population in the Twenty-First Century. Population and Development Review, 38, 685-705.
7. Grešš, M. (2006). Populáciavosvetovejekonomike. Medzinárodnévzťahy, 4 (1), 92-103.

8. Grešš, M. (2008). Demograficképremennéaichvývoj v rozvojovýchkrajinách. Article presented at VII. Annual international scientific conference of PhD. students and young research scholars, Bratislava, June 6th2008.
9. Health Nutrition and Population Statistics. Dostupné online na: http://databank.worldbank.org/data/views/variableSelection/selectvariables.aspx?source=health-nutrition-and-population-statistics.
10. Jiang, L. – Hardee, K. (2011). How Do Recent Population Trends Matter to Climate Change? Population Research and Policy Review, 30, 287-312.
11. McFalls, J. A., Jr. (2007). „Lively Introduction“, Population Bulletin, 62 (5).
12. Minh, N. T. (2009). Dynamic Demographics and Economic Growth in Vietnam. Journal of the Asia Pacific Economy, 14, 389-398.
13. Myrskylä, M. – Kohler, H.-P. – Billari, F. C. (2009). Advances in development reverse fertility declines. Nature, 460, 741-743.
14. Senesi, P. (2003). Population Dynamics and Life-Cycle Consumption. Journal of Population Economics, 16, 389-394.
15. United Nations (2013). World Economic Situation and Prospects 2013. UN: New York. ISBN 978-92-1-109166-3.