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Item 10 – Small population and sub-national population projections

How to deal with sub-national forecasts in spatially very heterogeneous countries? Towards using some spatial theories and models

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1. INTRODUCTION

Our intention here is to comment on the position and significance of local and regional population forecasts. At a glimpse at the variety of practical regional forecasts and methodological studies focused on the forecasts it seems that they are in the shade of national forecasts. New methods are logically applied and verified mostly at national levels, too. Demographers and statisticians dealing with the forecasts tend to use the national level. Geographers preferring territorial aspects are rarely immersed in prognostic methods. Demographic (economic) method and methods of spatial research are seldom used jointly, although an efficient methodology for this field of research was well developed in the past. We can mention e. g. Rogers (1975, 1995), Rees (1983), Willekens – Drewe (1984), Rees – Convey (1984), Plane – Rogerson (1985) and others.

We refer to the latest two worksessions on population projections. During the Bucharest worksession in 2007, out of the multiple presentations only two or three were focused explicitly on lower-than-national territorial level. The current Lisbon worksession seems to pay more attention to sub-national forecasts (with a special session reserved for them), however, they will be covered by only a few papers. Thus, structure of papers presumably reflects the interest of demographers in particular topics.

Since the term „sub-national“ is probably too wide, we will strictly differ between regional and local forecasts. The local forecasts correspond to those of cities, municipalities or very small regions, while those projected for European NUTS II, III and IV units can be considered as regional ones, although in each country the size and population of the units might be considerably different.

Not only the authors of the forecasts (from scientific point of view), but also practical users (supreme decision making authorities such as central governments) are far more interested at the national level. Figures presenting EU population decrease by millions or tens of millions or increasing number of seniors by millions are crucial for central measurements and seem to be „frightening“ as presented by media. These are the reasons why the data projected for lower territorial units are in the shade of the national ones. The EUROSTAT have issued a regional forecast, too, however we dare to estimate that the national forecasts for individual countries are much more in centre of attention.

Thus, the public as well as prognosticators themselves pay less attention to subnational forecasts and it would be inaccurate to believe that they should attract as much attention as the national ones. On the other hand, we suppose that regional and local development will be gaining importance hand in hand with regional population change. Using Slovakia as an example we will briefly show how diverse can be the national societal development at both regional and local levels. This is not only the case of the Slovak Republic, one may find similar trends when comparing data on NUTS III regional units in the EUROSTAT forecast, variations of natural increase and predicted migration attractiveness are sometimes immense. No doubt that a „healthy“ population development is a primary precondition for regional development. Vice versa, a low natality rate and emigration can indicate economic problems of the region. Our intention is not to discuss comprehensively all aspects of relationship between demographic trends, human capital and regional development. In the paper we will focus on elementary research methods of demography, geography and related disciplines.

2. SOME PRIMARY QUESTIONS TO BE SOLVED

In this part of the paper we will consider only forecasts by age and sex. Significance of derived forecasts is growing, sooner or later also the „beyond age and sex“ forecasts will become more relevant at the subnational territorial level. Nevertheless, categories of age and sex will stay in the centre of attention of local and regional authorities. In the following part we will discuss on the forecasts by age and sex. Primary questions to be solved before we start calibrating detailed parameters of the model are stated here, too.

2.1 What would be the most suitable territorial units? (delimitation of a reproductive system)

This seems to be a wide and complex issue. It is one of the input steps in the overall multi-step forecast process. Administrative and statistical units are not autonomous populations from the aspect of demographic reproduction, moreover, they are often socially and ethnically heterogeneous. These facts can potentially increase uncertainty of the forecasts. Migration openness and occurrence of stochastic elements are the other reasons for this uncertainty. Issues of other potentially exploitable units were discussed by Bleha (2007) concluding that absence of available data and a low consistency of these „scientific“ units in relationship with the official units would considerably lower the possibilities of their practical use. That is why demographers will have to settle for the official units being more suitable for practical utilisation in decision-making. In spite of that, a further search for „pure“ demographic territorial units should carry on. We can show an example. There are several NUTS IV regions in Slovakia, which might be divided into small homogeneous units based dominantly on their ethnic structure. The region as a whole shows a more or less zero population growth, while the smaller units within may display completely divergent population trends. There are multiple subregions in Slovakia with fertility of minority population exceeding the value of 5, thus the strength of this minority in the whole population will be increasing. Nonetheless, the recent data do not allow to make an accurate estimation on this.

We can also show an example of an intensive suburbanization processes having been well reported in multiple studies after 1989 (such as Spišiak – Kulla 2008, Slavík – Kurta 2009). The adjacent parts of the districts located in neighbourhood of the capital city of Bratislava partly form the city´s suburbanization zone, while remoter parts of the districts have not been hit by the intensive suburbanization inflow yet. In this case, we make a forecast for a territorial unit which is markedly heterogeneous considering the migration aspect. With the absence of sufficient data enabling us to gain data representing the whole region by combining the data on NUTS V units (bottom-up approach), one cannot avoid consequential defects.

2.2 Issue of appropriate method

In one of the initial parts of the paper we mentioned some authors who had elaborated various methods of multi-regional forecasting, demographic accounting and others. We can also name other methods, such as Bayesian model utilization presented by Bijak (2007) and used it for estimation of international migration. It is inevitable to develop and verify these scientific methods. On the other hand, likewise in question 1, it is quite realistic to believe that the official regional forecasts will be continuously created by a conventional cohort-component method using age-specific net migration or possibly emigration rates. Apart from not always comparable character and extent of the data for member states, we should highlight the issue of overall arduousness of a regular forecast release for all EU regions realized by these methods. Even if we stay realistic, resign and use the conventional methods, there is still a need to search for the best way how to increase the quality and credibility of both general and detailed assumptions. As shown by Keilman and Kučera (1991), a methodological progress is not always the only way. Czechoslovak forecasts reviewed by them were as precise as Dutch ones, despite of the fact that Dutch methods were more progressive. We really suppose that a quality forecast can be made only by considering as wide and multidisciplinary theoretical knowledge as possible. This is extremely important in case of the regional forecasts where spatial aspect must be respected.

3. GENERAL ASSUMPTIONS – THE KEY PROBLEM

There is no doubt about the fact that the sources of errors in forecasts made for developed and stable European countries lie predominantly in inaccurate hypotheses. Inaccuracy of starting age structure can be sometimes the reason for errors, too, although because of the insufficient system of migration recording we can hardly find accurate population size estimations either for source territories or for target ones. Inaccuracy rate depends mostly on migration attractiveness of a region and vice versa. In case of Slovakia´s international migration, this was clearly shown by Divinský (2007). For example, any forecast made for the capital city of Bratislava will be biased by the missing population represented by those working and living in Austria. On the other hand, there are ten-thousands of residents of central and eastern Slovakia living and working long-term in Bratislava, yet being registered (so called permanent residence) elsewhere. And lastly, thousands of Bratislava´s residents have moved to the suburban zone of the city but they are still registered in the core city. The starting age structure (at both regional or local levels) is biased by a specific error, then. Let us pay attention to the general assumptions again. In accordance with the conclusions of previous chapter, we will operate with

the cohort-component method. We will use some detections and outcomes of recent official regional forecast by Bleha and Vaňo (2008), having been published also as a scientific monograph including detailed comments on the assumptions. *Although principally, the best way is to create assumptions individually for each region, yet we decided to use Ward´s cluster method to group the districts into clusters and then make forecasts for these clusters (we have identified different clusters for fertility, mortality and migration). Needless to say that we took the aspect of development (i. e. potential future stability of the clusters) into consideration, too (see Figure 1 of fertility clusters).*

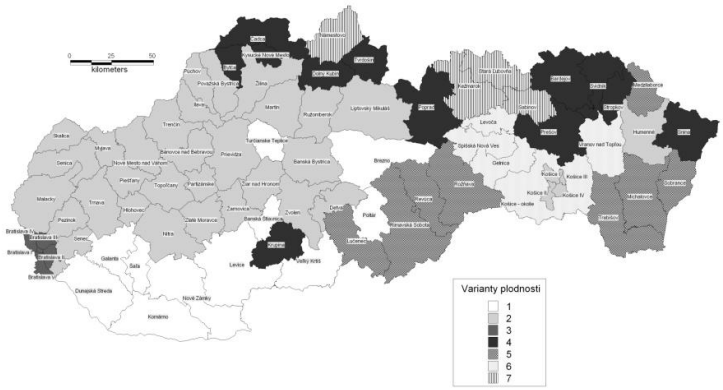
3.1. Fertility assumptions

In scale of Slovakia as a whole, the fertility development will remain the key factor affecting the general population change trajectory. This is evidently a result of the fact that Slovakia´s population is now in the stage of realization of postponed childbirths related to a specific 1970s generation of women. Identification of the rate of the childbirths postponed to higher age at birth was one of the crucial issues enabling to outline the fertility assumptions. Thus, it was necessary to incorporate some estimations on the postponed childbirths and their relevance (or even their absolute dominance) in recent boost. If so, then corrections of the optimism rate on future population development will be necessary and time-modelling of future development will have to be done with expectations of a turbulent (non-linear) population growth for the entire projected time period.

The above stated lines represent only a very general vision of future development of fertility in the Slovak Republic. *However, can we anticipate a uniform development line in all regions?* We certainly cannot. Now, the main issue is to determine the individual fertility rate development trajectories for each region. *Are the regions of Slovakia heading towards convergence?* An answer to this question supported by scientific arguments is the clue to solve this problem. This is where various spatially oriented theories may apply. All in all, a convergence is projected in the EUROSTAT´s convergence scenario, too. *Can such general idea be applied to a subnational level, even in the highly heterogeneous territory of Slovakia?*

To create assumptions for fertility development, we have delimited 7 clusters being not always spatially coherent, but this was not a precondition for the cluster analysis output. In spite of that, a certain degree of territorial autocorrelation has been confirmed. *Identification of spatial autocorrelation (e. g. Getis – Ord 1996, Anselin 2003) and utilization of some other quantitative geographical methods represent one of the ways how to compile assumptions in a preliminary phase for subnational forecasts. They should be combined with demographic theories and regional development theories, mentioned below.* For our purposes, we delimited 7 clusters, embracing groups of districts with more or less equal levels and structure of fertility, also respecting its development trends. Afterwards, using statistical indicators a decrease of variability in the 7 clusters was identified. *During the recent 10 years, the variation range and standard deviation have been in decline, the clusters seem to converge. However, this cannot be used as a determining and cogent argument declaring that this tendency will persist in future.*

Figure 1: Clusters of NUTS IV regions by fertility



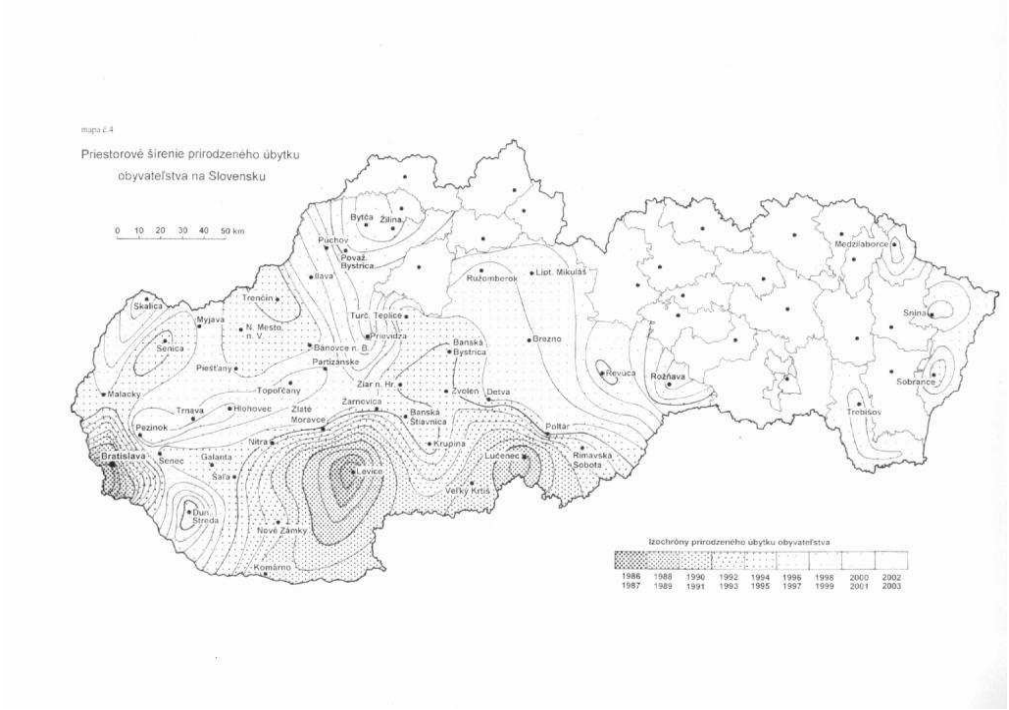
Source: Bleha – Vaňo (2008)

Apart from the quantitative methods, we should consider the effect of particular fertility determinants. We suppose that ideological and cultural changes are becoming more and more decisive at the expense of economic determinants. We suppose that they will be spread diffusively. Although the relative role of economic determinants will be generally decreasing, their actual importance will be growing, in case of proceeding growth of regional differences. As proved by Korec (2005) and Džupinová et. al. (2008), regional disparities and spatial polarization of the territory of Slovakia were accelerated during the transformation period. This may act to the contrary with the above mentioned relative decrease of role of economic determinants. *Unfortunately, Slovak demographers are not offered a satisfactory forecast on regional differentiation by regionalists, who have not concluded whether the regional differences will keep on growing, or if they are to decelerate or even decrease in future.* Unluckily, this is one of the fundamental input determinants which should be used at least intuitively.

Let us give a short comment on the ideological and cultural changes again. Diffusion and developmental idealism in post-socialist countries has been considered and presumed in a theory released by Thornton – Philipov (2007). In our attempt to verify, if this kind of diffusion has ever been present in the territory of Slovakia, we can use an indirect evidence, but still a supportive one. Figure 2 shows a diffusion of natural decrease as a virtual continuous phenomenon expressed by isochrons. In this case, the isochron is a line displaying the year with the first record of natural decrease in the relevant region.

Figure 2 displays location of primary cores of reproduction changes resulting in natural decrease and the way these changes were successively spread further from highly urbanized areas (mostly in western part of the country) towards the more conservative and less secularized north and east, or from non-Catholic (Calvinist especially) territories with traditionally lower fertility rate, respectively. Similar territorial pattern would be observed in case of other phenomena, such as total fertility rate, mean age at birth, etc. This clearly supports our hypothesis that the timing and intensity of fertility in the lagging and pioneer regions (mainly Bratislava) will be more similar in future, though some differences will remain visible. *We suppose that in Slovakia as well as other transforming post-socialist countries a gradual weakening of religious and similar cultural determinants affecting fertility will appear.* For example, Orava – a traditionally conservative region in northern Slovakia with above-average TFR – did not answer to the transformation-related changes after 1989, there was almost no postponement recorded but it is highly visible today. *In other words, Orava and some parts of eastern Slovakia only recently witness the postponement of first births and births, but also higher parity ratios decreasing. It seems that following the patterns of more developed regions is happening but the conservative regions need their role models – something like „driving“ regions.*

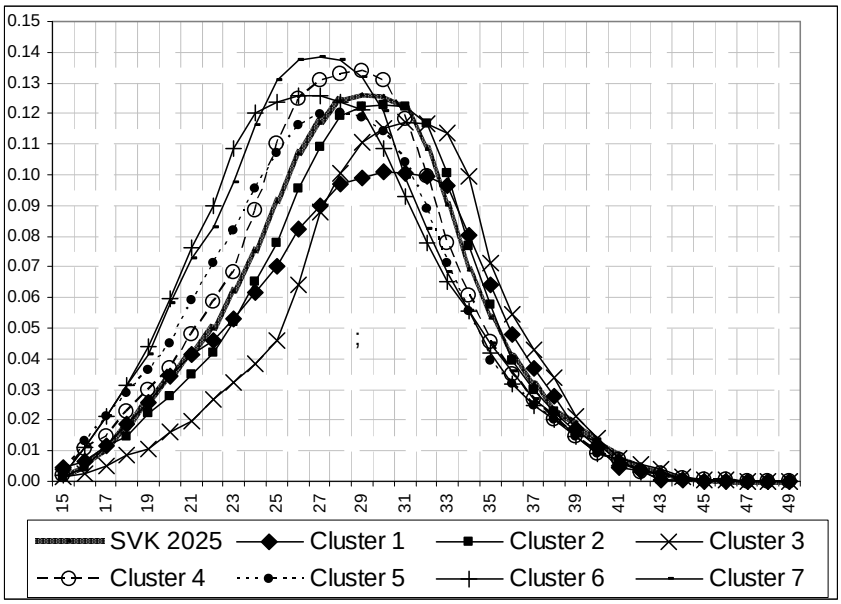
Figure 2. Spatial spread of natural decrease using isochrons



Source: originally published in Mládek - Bleha (2001)
Note: The isolines depict the first year the surplus of deaths occurred

Results are shown in Figure 3. A thorough cohort analysis finally led to modelling of the timing of transversal fertility in the individual clusters. Also a recent analysis demonstrated that the spatial spread visible in geographical space would be roughly indicated by curves, too. Populations of conservative clusters of districts are represented by curves that appeared 20 or 30 years ago in the urbanized areas. *Timing of the pioneer regions can partly serve as a pattern for modelling of timing of conservative regions.*

Figure 3. Fertility timing in clusters in 2025



Source: Bleha – Vaňo (2008)

Concluding the debate on fertility we would like to mention two mutually related sources of uncertainty. The first of them is represented by a scarcely assessable long-term development of supportive measurements in the field of population and family policies which might affect the fertility in future. For example, a one-off paid family allowance for higher-parity-ratios children can preserve a state of higher fertility rate for these ratios, or lower the mean age at birth in some regions, being extremely low anyway.

Population surveys could perhaps be very helpful for the regional overview of fertility and its prediction. These surveys would cover also spatial aspect. A question of ideal or intended number of children is also very important. In Europe, this issue is often a matter of research (for example, see Thomson 1997, Testa – Grilli 2004). *It would be very interesting to map the differences between the desired and realized number of children in families in various regions of country, it is not clear whether there would be any differences at all or at least in comparison between highly urbanized and traditional regions (Bratislava vs Northern Slovakia, etc.).* We can only assume that the contrasts between wanted and realized numbers of children would be higher in „poor“ traditional territories due to economic situation. Or is the power of tradition the decisive factor? Without a detailed research, it is difficult to conclude. Our contemplation might serve as a demontration of this factor´s importance and encourage to realize this kind of research.

The second source of uncertainty is related to the phenomenon of Romany population and its fertility rate. As suggested by Šprocha (2009), in selected segregated Romany settlements average TFR (1994-2004) reached nearly 5. According to our estimation, in some regions of eastern Slovakia, these births accounts for approximately half of all children to be born in region. Development of fertility of this ethnic group is difficult to predict, moreover, the statistics on the Roma population and its structure are not reliable.

3.2. Mortality assumptions

Due to limited extent of the paper, we can touch upon the issue of mortality only briefly. Generally, mortality development results from parallel operation of two groups of determinants: exogenous and endogenous factors (Casselli – Vallin – Wunsch 2006). In principle, the endogenous factors are fixed, they act spontaneously and do not fluctuate in time. Shifts in mortality course are mostly caused by exogenous factors that can be (unlike the former ones) easily suggestible and thus enable us to control the mortality processes directly. The map of life expectancy in districts of Slovakia indicates a mosaic territorial pattern and it is difficult to give a simple explanation of it, since it is a result of multiple factors. This forced us to use also extrapolation methods and naturally, we discussed the issue of causes of death with medical doctors. Although potential errors in the mortality prediction do not affect excessively the national level of forecasts, they can act so at the sub-national level. *Nevertheless, we are quite sure that the mortality rate will be*

in decline within a long-term time-horizon in all transition societies of central Europe and that no isolated poles of life expectancy decrease will appear in these countries. We can add that the accuracy of specific mortality estimation will probably become more decisive, with respect to the intensive and unavoidable population ageing of the transition territories in transitional countries.

3.3. Migration assumptions

As indicated above using example of suburbanization, the trends of intra-regional migration are not immanently included as a determinant, in spite of the fact that these processes contribute to redistribution of population, especially if we consider population flows between rural space and urban cores within a district (region). This kind of migration flow influences indirectly the inter-regional migration, too. We can mention a diffusion of suburbanization processes across the urban hinterland as an example.

Depopulation in some regions of southern and eastern Slovakia can be perceived as a certain "anti-pole" of the suburbanization processes in this scale. This problem afflicts also territories with scattered settlement, which is primarily a result of emigration from these areas. Petrovič (2007) observes that some qualitative and quantitative changes indicate gradual dying-out of these territories. Deducing from available statistical data, the same processes appear in some peripheral regions in transitive societies. *In Slovakia, we will probably witness extinction of some rural communities as a result of demographic development for the first time in history.* This must be respected in the process of hypotheses creation for regions where these depopulation processes have been detected. *First, the general assumption for migration development should be solved.*

The analysis of all geographical factors must be very comprehensive. We would highlight the macro-position factor above all. Korec (2005) supposes that this determinant is the key one responsible for west-east polarization of the country. Western Slovakia benefits from its position bordering on the „old" EU. We have already mentioned a certain diffusion of reproductive behaviour from the west towards the east. Recent migration trends show a reverse east-west gradient. This indicates that net migration flows are heading from the east to the west, albeit the migration effectiveness is not too high. This clearly copies Korec´s division of Slovakia into a „wealthy" south-west and a „poor" north-east. This fact supports the macro-economic neo-classical theory which seems to be applicable on the transitive societies. At the same time, the Slovak population mobility (as far as labour migration is concerned) can be considered as below-average, if compared to the Czech Republic, for example.

The above mentioned fact is closely related to regional development perceived in the aspect of spatial polarization – being a very frequent topic of geographical, sociological and economic studies (see for example Woodward 1995, Badcock 1997 and some others). If we agree with recent studies on regional development based on the theory of polarization in Slovakia (Gajdoš – Pašiak 2006, Halás 2008), we might assume the impact of this regional polarization on future migration trends and vice versa. Migration as a manifestation of polarization can even deepen the polarization trends (by migration of young and qualified population towards the growth poles). Research of migration and polarization from hierarchical point of view deserves a particular attention. Two facts are decisive here. According to our analysis of empirical data on migration registration, it seems that at sub-national level smaller districts with smaller nodal centres in central and eastern Slovakia are losing residents while the nearest big district and regional urban centres prove population gains, although there are many exceptions. For migration trends, the following two dichotomous polarizations are crucial: a) west-east (north-west – south-east) polarization, and b) peripheral mezo-regions – cores of these regions (centres of regions with over 50,000 residents and their broad hinterland). The major cities (in Slovakia covered principally by centres of regions and cities over 50,000 inhabitants) should gain population from their broad nodal regions, even from neighbouring districts with smaller nodal centres. The net volumes of these migration flows are probably low, but they can still significantly affect the net migration of the big regional centres (and their districts). On the other hand, the residential suburbanization and deconcentration (outward migration) will probably decrease the effectiveness of the centripetal migration. A serious forecast at sub-national territorial level for the system of nodal or administrative regions will require finding answers to the following questions: will the volume of inner migration be increasing or decreasing? which regions of the country will be affected by migration effectiveness change? These questions have to be answered by regionalists dealing with the increasing social and macro-economic spatial disparities.

Therefore, a serious cross-impact analysis of various system-related geographical factors and theories is inevitable for calibration of any type of forecast model (multiregional, classic models, etc.). In this chapter, we could not present our premises comprehensively, we have only tried to outline the determinants that demographers should take into consideration. *We dare to claim that the migration assumptions should not be realized by experts from one or two scientific disciplines only, as this field of research is considerably multidisciplinary.*

4. SPATIAL CONVERGENCE – ASSUMPTIONS VS RESULTS

Decision makers sometimes ask us whether the regional differences in demographic development within a country will be growing or decreasing. Apart from expected uncertainty of any regional prediction, the answer to this question must be presented as following. Our estimations show that a certain confluence (divergence) of reproductive behaviour will be observed sooner or later. Extreme migration gains or decreases will not be frequent. But, the age structure of regional populations varies a lot. *Lowering disparities between calibrated parameters will not necessarily result in low disparities between results*. This fact has been analysed using the model forecasts. In Table 1, some modelling scenarios are presented. These are based on our not real conditioned presumptions, therefore we cannot introduce them as real forecasts (we prefer distinguishing between „forecast“ and „projection“). Four scenarios are related to fertility, the last one associates with migration. For every scenario, mortality is considered the same as in medium scenario of original forecast. Immediately, we can observe that our expectations have been confirmed. Respecting the age-structural momentum, these model presumptions do not stand for any significant change of results as far as spatial differentiation is concerned. After doing calculations, we made an evaluation of the following four values: number of births, population size, ageing index and mean age of population.

Table 1: Projection scenarios

	Fertility – development until 2025	*Mortality until 2025*	*Migration until 2025*
projection I	fixed 2007 value	likewise in medium scenario	likewise in medium scenario
projection II	the TFR increase higher (by 30%) than in medium scenario	likewise in medium scenario	likewise in medium scenario
projection III	differentiation growth – significant differences in TFR	likewise in medium scenario	likewise in medium scenario
projection IV	homogenization – the fertility rate in all districts equal to the one stated in national forecast	likewise in medium scenario	likewise in medium scenario
projection V	likewise in medium scenario	likewise in medium scenario	no migration

Source: Own assumptions

If we use the fixed 2007 fertility level, the number of births in 2007 - 2025 would decline by 30 per cent (average decline within group of all NUTS-IV regions calculated by geometric mean), while the original forecast estimated the decline by 10 per cent only. The variation coefficient of the total number of births in the group would reach up to 585.9 (549 in the original forecast and 553 in 2007). *Fixating the recent character and level of fertility would mean a sharper decrease of number of births, but also a (moderate) increase of variability of values.*

If a rapid growth of TFR is detected (scenario II), the number of births would be higher than in 2007, with its decrease only in case of urban districts of Bratislava and Košice characterised by extremely unbalanced age structured. On the other hand, the number of births would turn higher in districts with high percentage of children who would reach reproduction age in the forthcoming years. Variability of number of births would stay more or less the same as in the original forecast.

Scenario III represents bigger differences among TFR values, that means increasing changes in reproductive behaviour across regions. An extreme growth of variability of births will not occur, though. The variation coefficient would be as high as 595. *This fact indicates, that most of the future variability can be explained by the age-structural momentum effect.* According to scenario IV, all regional populations would record identical values of fertility. In spite of this, the variation coefficient of number of births would drop down to 541, which is almost equal to the national forecast value (549). Scenario V deals with migration only, its relevance for the number of births should be marginal. Nevertheless, its effects are remarkable, as we can demonstrate on the example of districts that are considerably formed by principal suburbia. *Number of births in the districts of Senec (in the hinterland of the city of Bratislava) would decrease (in comparison with the original forecast) only by 4 per cent till 2025. However, if there is no migration surplus (scenario V), the number of births would decrease by 30 per cent in the 2007-2025 period. Neither an extreme fertility growth (according to scenario II) would be sufficient to compensate the modelled loss of reproductive cohort within the suburban migration.*

Similarly, we have made an appraisal of demographic ageing. If we fixed the current lowest-low-fertility values, the average ageing index would grow 1.86 times instead of 1.6 times. However, if we took scenario II (high TFR growth) into consideration, the ageing index would increase 1.35 times on average. These differences seem to be quite significant, neither the unrealistic high fertility growth at sub-national level would not stop the ageing process.

Respecting the ageing index sensitivity, we decided to use mean age of population for verification purposes. *This procedure has confirmed that the mean age oscillates less. Relevant model „interventions“ are necessary in order to change the indicator significantly. While in accordance with scenario II, the mean age would increase by 8.8 per cent on average, it would grow by 13.3 per cent within scenario I.*

5. CONCLUSION

Although sub-national forecasts are not as frequently discussed in Europe as the national ones, we can expect that their relevance is high and will be growing in future. Regional demographic differences are too high, we can illustrate them by referring to maps of the total population growth of particular regions of Germany, Italy or Slovakia.

In our opinion, elaboration of a quality sub-national population forecast with a high feasibility is an extraordinarily ambitious process from methodological point of view. In the paper we are trying to give arguments that improvement of methods is not the only way, and perfect methods should be combined with determinants of high quality, respectively. To assemble excellent determinants of fertility, mortality and migration trends, one must make use of many more pieces of information and a lot of partial analyses. Demographer cannot do without spatial sciences, mostly geography and regional analysis. A harmonization of „pure“ demography and geographical approach can be a suitable prerequisite for a feasible sub-national forecast. That is why we are trying to imply what should the input analyses be focused on, which spatial theories and methods should be utilized, mainly when considering determinants of fertility and migration. Although we have applied the case of Slovakia, we are absolutely certain that our approach (perhaps with small modifications) can be applied to other transitive societies, with similar processes of polarization, suburbanization, selective growth of regional disparities, etc.

In the final part of the paper, using the model calculations we have tried to point at the fact that most of future differences between individual NUTS IV regions of Slovakia stem from the recent significant disparities in age structure. A total homogenization (identical fertilities applied) would deliver only a mild decrease of variability of the number of births and other demographic events, and the variability would be even lower in case of ageing indicators.

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7. REFERENCES

BIJAK, J. (2007).Bayesian model selection in forecasting international migration: Simple time series models and their extensions. Work session on demographic projections, Eurostat, Methodologies and working papers, pp. 309-318.

BLEHA, B. (2007). Conception of spatial units appropriate for regional popualtion forecasts. Work session on demographic projections, Eurostat, Methodologies and working papers, pp. 319-326.

BLEHA, B., VAŇO, B. (2008). Population development in Slovak districts until 2025. Convergence or divergence?, Infostat, Bratislava. 82 p. (originally in Slovak)

CASELLI, G., VALLIN, J., WUNSCH, G. (2006). Demography: Analysis and Synthesis. Elsevier, London.

DIVINSKÝ, B. (2007). Labor market – migration nexus in Slovakia: time to act in a comprehensive way, IOM, Bratislava, 229 p.

DŽUPINOVÁ, E., et. al. (2008). Peripheriality a spatial polarisation in Slovakia, Geografika, Bratislava. 186 p.

GAJDOŠ, P. – PAŠIAK, J. (2006). Regionálny rozvoj Slovenska z pohľadu priestorovej sociológie. Sociologický ústav SAV, 320 s. (originally in Slovak)

GETIS, A., ORD, J.K. (1996). Local spatial statistics: an overview. In: Longley, P., Batty, M. (eds.) Spatial analysis: Modelling in a GIS enviroment, Cambridge, pp. 261-227.

HALÁS, M. (2008). The spatial polarisation of society with a detailed review of peripheral region of Slovakia. Czech sociological review, Vol. 44, No. 2., pp. 349-369.

KEILMAN, N., KUČERA, T. (1991). The impact of methodology on accuracy of population forecasts. Evidence from the Netherlands and Czechoslovakia. Journal of Forecasting 10. pp. 371-398.

KOREC, P. (2005). Regional development in Slovakia during 1989-2004. Geografika, Bratislava, 228 p. (originally in Slovak)

MLÁDEK, J., BLEHA, B. (2001). Spatial spread of natural decrease in Slovakia. Slovak demographic conference, Rajecké Teplice. (originally in Slovak)

PETROVIČ, F. (2007). Prognóza krajiny s rozptýlením osídlením. In: Kraft, S., Mičková, K., Rypl, J. - Švec, P. - Vančura, M. (eds.): Česká geografie v europském prostoru. PF Jihočeská univerzita v Českých Budějovicích, s. 474-480.

PLANE, D.A., ROGERSON, P.A. (1985). Economic-demographic models for forecasting interregional migration. Enviroment and Planning, A 17, pp. 185-198.

REES, P.H.(1983). Multiregional mathematical demography. themes and issues. Enviroment and Planning No.15. pp. 1571-1583.

REES P. H., CONVEY, A. (1984) Spatial population accounting. In: Clarke, J. (ed.) Geography and population: approaches and applications. Pergamon Press, Oxford. pp.51-59.

ROGERS, A. (1975). Introduction to Multiregional Mathematical Demography. John Wiley and s. (interscience publications).

ROGERS, A. (1995). Multiregional Demography. Principles, Methods and Extensions. John Wiley and Sons. New York.

SLAVÍK, V., KURTA, T. (2009). Selected manifestations of suburbanization in the hinterland of Bratislava, In: Global changes: Their regional and local aspects, Ed. Wilk, W., University of Warsaw.

SPIŠIAK, P., KULLA, M. (2008). Suburbanization in the Košice hinterland, Masaryk University, Brno, In. Svatoňová, H. et. al. Geography in Czechia and Slovakia, pp. 370-374.

ŠPROCHA, B., PUKAČOVÁ, J. (2009). Specifics of Roma population in Slovakia, pp. 166-186. In: Bleha, B. (ed.) Population development in Slovakia at the milleniums ´ breakthrough: Continuum or the new era?, Bratislava, Geografika. 336 p. (originally in Slovak)

TESTA, M.R., GRILLI, L. (2004). The effects of Childbearing Regional Contexts on Ideal Family Size in Europe: A Multilevel Analysis, European Demographic Research Papers, Vol. 4, 46 p.

THOMSON, E. (1997). Couple Childbearing Desires, Intensions and Births, Demography, Vol. 34, pp. 343-354.

THORTNON, A. – PHILIPOV, D. (2007). Developmental Idealism and Family and Demographic Change in Central and Eastern Europe. European Demographic Research Papers, Vol. 3., 85 p.

WILLEKENS, F.J., DREWE, P. (1984). A multiregional model for regional demographic projection. In: Demographic research and spatial policy, eds.Willekens, F.J. ,Heide, T.H. Academic press.

WOODWARD, R. (1995). Approaches towards the study of social polarization in the UK. Pro-. gress in Human Geography, Vol. 19, pp. 75-89.