AN IMPACT OF MIGRATION ON THE SLOVAK PENSION SYSTEM: A DYNAMIC SIMULATION MODEL

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Abstract

Unprecedented demographic changes which require extensive reform in fiscal systems, social security systems, and other related policies belong to the most intensive research area. Due to conflicting interests between younger and older generations, reform of a pension system is usually politically difficult. The present paper models an impact of immigration in order to improve welfare of both current and future generations. The dynamic general equilibrium overlapping generations (DGE OLG) model of the Slovak pension system proposed by Farkašovský in 2016 includes several blocks: demographic, labour market, households, firms, and government. The aim of this contribution is to extend the demographic block of the original model by an impact of migration on the revenue of the Slovak pension insurance in order either to sustain current level of the replacement rate or to follow the replacement rate proposed by the European Commission in The ageing 2015 report. The result reveals that the demand for the net migration flows is so high, that in future the decrease of the participation rate, an increase of the levies, and many other measures will become reality.

Key words: *immigration, migration, pension system sustainability, overlapping generation model.*

1. Introduction

The demographic development in Slovakia is similar to the development in the other European countries. The population ageing and even de-population are central in discussions of the economists and politicians. Today, the Slovak system consists of a reformed pay-as-you-go (PAYG) pillar, a capitalization pillar (individual accounts) and a voluntary supplementary pension saving scheme. In our contribution we will primarily pay respect to the sustainability of the PAYG pillar.

In order to improve the sustainability of the pension pay-as-you-go system the government has the option of either reducing the benefits to the elderly expressed in the paper as the replacement rate or increasing the burden on the working generation. Obtaining agreement on reform by both generations is often too difficult to achieve. The aim of the paper is to quantify the impact of immigration on the Slovak economy and thus on pension system. The overlapping generations OLG models to fiscal impacts was pioneered by Auerbach and Kotlikoff (1987). Since then, OLG models have been used extensively to study the impact of population aging and to evaluate various policy changes, including tax, pension, and public debt policy (Shimasawa and Oguro, 2010; Lisenkova et al., 2013; Chen and Fang, 2013; Arltová and Langhamrová, 2010; Bezděk et al., 2003).

In the contribution, we use a large-scale general equilibrium model incorporating OLG introduced in the dissertation thesis by Farkašovský (2016). The core of the model is based on the research of de la Croix et al. (2013). The demographic block of the original model was extended by an impact of migration on the public pension expenditures.

The paper answers two research questions: (1) how many immigrants contributing over the analyzed period to the Slovak pension insurance would be necessary in order to keep benefits to the elderly at the current stage; (2) how many immigrants contributing over the analyzed period to the Slovak pension insurance would be necessary in order to keep benefits to the elderly at the level of prognoses projected in The 2015 ageing report (European Commission, 2015). The benefits to the elderly are expressed as the replacement rate at retirement that means the ratio of the first pension of those who retire in a given year over the average wage at retirement. Both research questions are answered by an application of two stochastic models (Lee and Carter, 1992; Hyndman and Ullah, 2007) and one deterministic model (Vaňo et al., 2013).

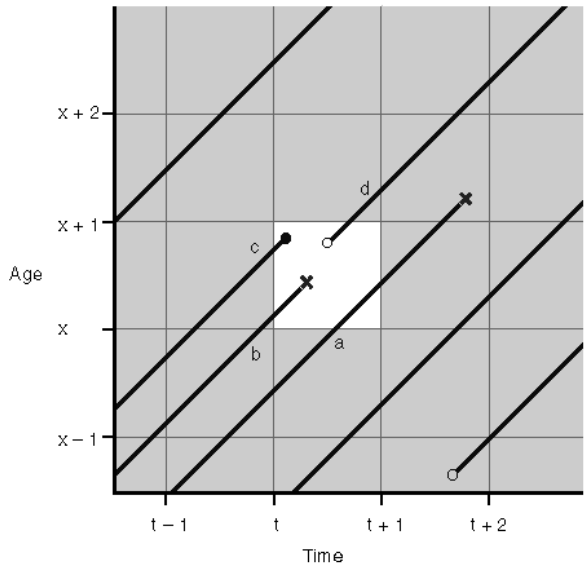
The paper is structured into 4 sections, the first of which is introductory and the last section is a conclusion. The introductory part contains a brief description of a motivation to study an impact of immigration on the Slovak pension system. The second part of the paper is devoted to the methodology and the data set. The OLG model by Farkašovský (2016) has five main parts: (1) demographic projection, (2) labor market and pension age, (3) household behavior, (4) firms behaviour, and (5) public pension. The research question is influencing especially the demographic projection and labor market block therefore the attention is on them. The third section brings results and discussion. From the gained results it comes out that substantial increase of inflows of (working-age) immigrants would be necessary. The current level of the benefits to the elderly in Slovak pension system as well as the level projected by the European Commission is not sustainable without the emigration reform.

2. Methodology and Data

The demographic projection is the main substance of the future stability and sustainability of the overlapping generation model. The live-cycle is derived into periods and the inhabitants (agents) are clustered into representative groups called cohorts. As time is passing by, the agents are shifting from one period to another. The majority of the research papers assumes only two periods: productive and non-productive. The model used in this paper contains in each moment thirteen five-years-cohorts. Starting with the cohort of 25-29 years old agents and ending-up with the cohort of 85 and more old agents. Those clusters of cohorts are notated as representative agents. Cohorts are shifting by ageing, and the demographic shifts of individual agents are displayed by the life lines depicted by the Lexis diagram (Figure 1).

Lexis diagram, named after economist and social scientist Wilhelm Lexis, is a two dimensional diagram that is used to represent events (such as births or deaths) that occur to individuals belonging to different cohorts. Calendar time is represented on the horizontal axis, while age is represented on the vertical axis. Generation shift enables to model demographic and socio-economic projections as a new cohort after shift has a different characteristics. Change of socio-economic characteristics usually includes a different propensity to save and to invest, changes in retirement-age, changes in early retirement share.

Figure 1: Lexis diagram



Source: Coughlan et al. (2007).

As stated by Romer (2006), due to generation shifts it is more convenient to use discrete time comparing to continuous one. Therefore all variables of the model are defined for the time $t = 0, 1, 2,\ldots$ The size of the population in the cohort in the time t can be denoted as $P_{a,t}$, while a represents an order of the cohort in the age sequence and t represents the current period. The generation which entered the labor market in period $t = 0$ is denoted as $P_{0,0.}$ In period $t = 5$ is denoted as $P_{0,5}$. A change of the population size between two analyzed periods can be characterized by coefficient $\beta_{a,t}$.

$$P_{a,t+1} = \beta_{a,t} P_{a,t} \,. \tag{1}$$

The projection of population is exogenous and therefore in the model real data on population and the projection of the Slovak population till 2060 published by Infostat (2012) and the Human Mortality Database (HMD) were used. Predicting population trends of the age groups are drawn from Vaňo et al. (2013).

The total size of the population in period t is denoted as PT_t and it can be expressed as a sum of population cohort size in particular year:

$$PT_t = \sum_{a=0}^{12} P_{a,t} \,. \tag{2}$$

The total size of the active population in the period t denoted as PAT_t can be derived by the similar procedure. As the pension age in the Slovakia is 62 years, the same for men and for women, in the seventh age cohort (representing 60-65 years old agents) the only 60-62 years old agents are taken into consideration. The equation (3) represents the size of active agents in the model, in which r is the rate of agents who receive the pension benefit from the pension system and λ represent share of those, who receive early retirement.

$$PAT_t = \sum_{a=0}^{6} P_{a,t} + (1 - r_{7,t} - \lambda_{7,t}) P_{7,t} \,. \tag{3}$$

The average wage *AWt* in the economy which determines amount of retirement benefits in the PAYG pension pillar is obtained as the following proportion, where $w_{a,t}$ is average wage at population group:

$$AW_t = \frac{\sum_{a=0}^{7} w_{a,t} PAT_{a,t}}{PAT_t}. \tag{4}$$

One of the most important blocks of the model describe development in the social security system. In the model we assume that old-age pension expenditure $\exp_t^e$ and expenditures on early retirement $\exp_t^r$ represents a proportion of the average wage in the national economy. Their amount is then defined as follows:

$$\exp_t^e = \rho_t^e AW_t (w_{6,t}\lambda_{6,t}P_{6,t} + w_{7,t}\lambda_{7,t}P_{7,t}), \tag{5}$$

$$\exp_t^r = \rho_t^r AW_t (PT_t - PAT_t), \tag{6}$$

where ρ_t^e is average early retirement replacement rate and ρ_t^r represents replacement rate in the old age. $\lambda_{a,t}$ stands for share of people in early retirement. Data on income replacement rates in retirement or early retirement was gained as a proportion of the average amount of retirement or early retirement pension to the average wage. Average amounts of old-age pensions are available in the management reports of the Social Insurance Agency. w_t - the total wages in the national economy and the rate of levy-tax burden was included to calculation in the form of implicit taxation of labor.

The following equation ensures the balance of the pension system in the Slovak Republic by increasing the number of inhabitants from other countries ($PAT_t img_t$):

$$PAT_t img_t = \frac{\exp_t^e + \exp_t^r}{E_t \tau_t^w AW_t} - PAT_t, \tag{7}$$

where E_t is average employment rate and τ_t^w is pension insurance rate.

In our paper, six scenarios which predict the future deficits of the Slovak pension insurance in horizon since 2014 till 2074 (60 years) were prepared. Those scenarios are classified into two clusters. The first cluster represents the "fix" models which assume that the replacement rate remains on the current level. The second cluster includes the models which assume that the replacement rate follows the predictions stated in The 2015 Ageing report for Slovakia (2015). Those models are denoted as "real".

Both, the "fix" and the "real" scenarios include the forecasted exogenous demographic variables estimated by the Lee-Carter model (Lee and Carter, 1992) denoted as "LC", the functional demographic model (Hyndman and Ullah, 2007) denoted as "FDM", and cohort-component model (Vaňo et al., 2013) denoted as "KK". It was proved by previous work of Farkašovský (2016) that the most suitable stochastic model to predict demografic development in Slovakia is FDM model.

The calibration of the model was predominantly based on the proper estimation of $\beta_{a,t}$. In the paper, a software platform Dynare for handling dynamic stochastic general equilibrium (DSGE) and overlapping generations (OLG) models was used.

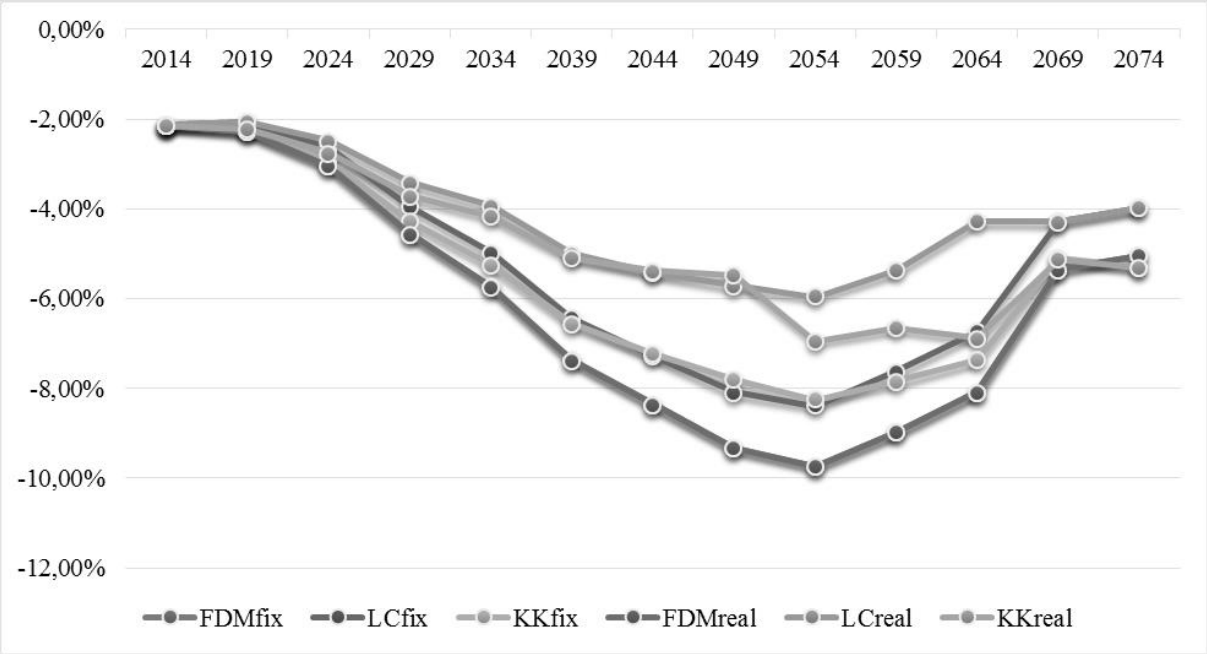
3. Results and Discussion

The revenues of the Slovak pension system are at the moment generated from the two sources: mainly revenues from the pay-as-you go (PAYG) system and from the state budget.

From PAYG revenues funding shortfalls connected to transfer to a capitalization pillar of the pension system have to be substracted. In the year 2014, the net asset value (NAV) of the capitalization pillar raise almost about 600 millions €. Considering almost zero outcome performance of the pension funds it means that it can be attributed to transfer from PAYG system. Taxation of work in the form of levies in the Slovak Republic is at the level of 24 % denoted pension insurance. In fact, even current revenues to the Slovak pension insurance are not sufficient and real implicit rate is higher. Moreover, the effectiveness of levies collecting is poor as in the year 2014 the rate of collection was 99.14 %. Therefore the revenue data were adjusted by this coefficient.

Based on this, the projection of future revenues and claims according to variant demographic and replacement rate scenarios is calculated. It results in pension system balance between 2014 – 2074.

Figure 2: Projection of future deficits of the Slovak pension insurance fund (in % of GDP)



Source: the authors.

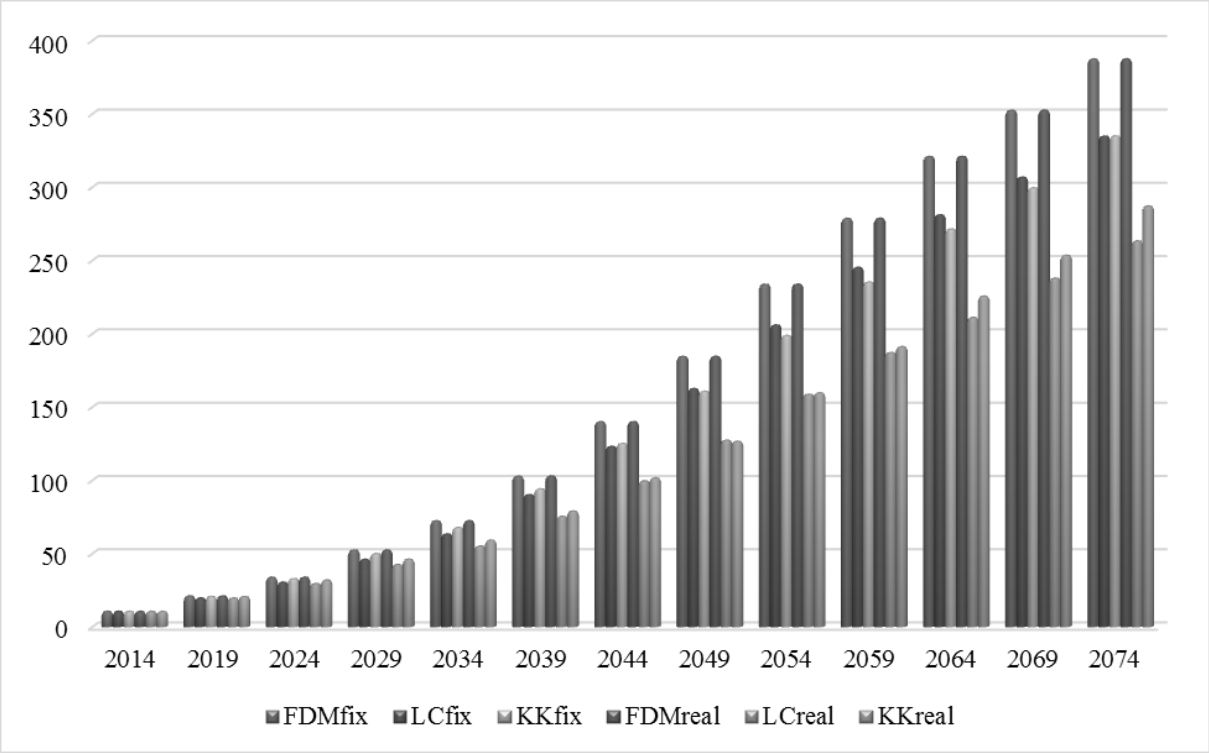
The Figure 2 demonstrates the projection of future deficits of the Slovak pension insurance over the period 2014 – 2074 as the percentage of gross domestic product. For each variant of the OLG models used, a gradual increase of pension system deficits from the year 2019 at the level of 1 % GDP is assumed. The least significant shortfalls are displayed in the case that the prediction models that take into account the a lower replacement rate for retirement income (comparing the current level) prognosed by the European Commission. The most significant drop is expected for prediction of demographic development on the basis of the model by FDM, which would deepen the deficit to below the eight percent of GDP in 2054. The model is based on the most pessimistic forecasts of demographic developments in relation to population ageing and its impact on the balance of the pension system. It intends highest share of people in post-productive age in the population of working age, while maintaining current levels of replacement income in old age. Since 2054 we are generally on the basis of all models assembled prerequisite for improving balance and the trend towards equilibrium between -2.5 % and -4 % of GDP. More positive prediction was calculated for KKfix and

LCfix model. In this case, the deficit will reach the worst value at around 7% of GDP. In the case of LCreal model it is about 4.5% of GDP.

However, an increase in pension expenditure in such levels is unsustainable in all scenarios. Even the most optimistic LCreal scenario presents that the cumulative deficit of the pension system as early as 2054 will attack the 100% of GDP. This ratio surely can not be considered sustainable, not to mention the current level of debt. Moreover, given the population ageing, the government budget during the coming decades will face to rising spending in other areas, particularly in the health care system.

The next Figure demonstrates development of the cumulative deficit of the pension system according to 6 variant scenarios assuming no other policy change.

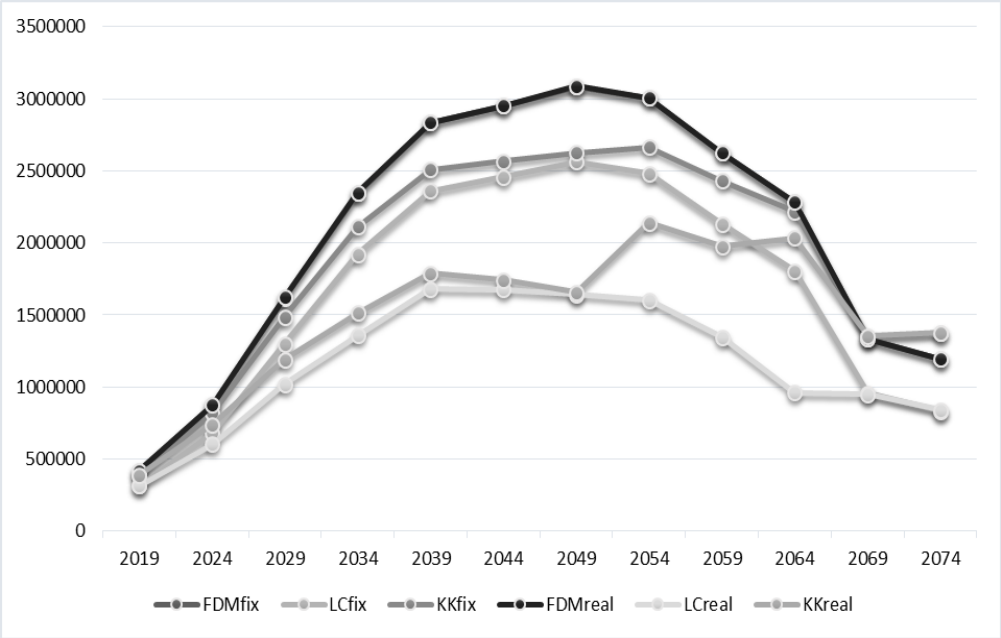
Figure 3: Cumulative deficit of the pension system according to variant scenarios between 2014-2074.



Source: the authors.

Figure 3 depicts, that the increasing deficit obviously leads to accelerating growth of accumulated deficit. To avoid this trend, there are several possibilities. One of them is raising immigration and decreasing emigration. Formula (7) exhibits how many citizens of foreign countries against current situation has to live and work in the Slovak Republic to achieve non-deficit financing of the pension system. The model assumes that the immigrants have the same socio-economic characteristics (age, employment rate, propensity to save…) as the domestic population. Quantity of foreigners ensuring non-deficit financing of the pension system is shown at the Figure 4.

Figure 4: Quantity of foreigners in the Slovak Republic ensuring non-deficit financing of the pension system according to the six variant scenarios.



Source: the authors.

The presented chart displays significant need of immigration in the case if it is decided that the immigration is the way to secure current replacement rate and no changes in the levies and the demography policy will be done. We can see similarities to the Figure 2 because raising immigration have to suppress deficit levels to zero. As it can be seen, the highest quantity of immigration is observed in the case, when the demography will develop according to the functional demographic model of Hyndman and Ullah (2007). In this most pessimistic case the number of immigrants increase very fast and in the year 2049 (that means at the peak of demographic crisis) it exceeds the 3 million inhabitants. Slightly modest quantity of emigration is predicted by KK model of Vaňo et al. (2013). In the case of fix variant of the KK model, where the current replacement rate is fixed, the need of immigrants is on the level of about two and half million in the years 2039-2059. Almost identical is prediction, when LC demographic development and fix replacement rates are assumed. The main difference is in equilibrium value. The most positive scenarios for public finance is LC real, which assume decreasing replacement rate in intentions of European Commission prediction. In this case the only one and half million immigrants will ensure balance of the Slovak pension system without any additional changes.

The equilibrium of quantity of immigrants for all models lies between 840 thousands and 1400 thousands. The minimum value is predicted for LC models (838,000 immigrants) and contrary maximum for the KK models (1,378,000 immigrants).

4. Conclusion

In this paper, a dynamic general equilibrium OLG simulation model in order to quantify the economic impacts of immigration on the Slovak pension system is presented. The paper answers the research questions, how many immigrants over the analyzed period would have to contribute actively to the Slovak pension scheme to enable to keep benefits to the elderly at the current stage or at the level prognosed by the European Commission (2015). The results

reveal, that that the balance of the Slovak pension system would be sustainable only by unrealistic migration flows. Specifically, the minimum value is predicted by LC models is 838 thousand of net migrants and maximum value predicted by the KK models is 1 378 thousand of net migrants.

This original contribution highlights an importance of an immigration reform, which has to take place in Slovakia. Even if this reform would be prepared and carried out soon, the demand for the net migration flows is too demanding. In future the decrease of the participation rate, an increase of the levies, and many other measures are expected.

Our study does not consider several points: (1) a strong anti-immigration perception of Slovak inhabitants supported by political representation, (2) structure of immigrants as to age, education, etc, (3) changes in taxation, (4) an impact of additional improvement of labour capital due to migration flow on gross domestic product increase. The current immigration policy of Slovakia belongs to most strict ones in the European Union. In fact, there is no relevant official document or strategy which would formulate the future priorities in immigration in the Slovak Republic. As the official document about immigration policy in the Slovakia does not exists, there is no aim and no list of desired policies which might focus on the entrance of foreign skilled workers (e.g. medical doctors, nurses for elderly assistance, employees in the motor industry, etc.). At the same time, the government is not promoting a program aimed at increasing the number of foreign students in the medium term. There is no strategy which might seek to expand the employment opportunities in Slovakia for those foreign students which graduate the universities at the moment. In many countries the attention is payed to the fact, that if foreign graduates have a smooth transition from graduation to employment in the country, the local companies can more easily recruit high quality foreign workers.

References

[1] ARLTOVÁ, M., LANGHAMROVÁ, J. 2010. Migration and ageing of the population of the Czech Republic and the EU countries. In Prague Economic Papers, 2010, vol. 20, pp. 54-73.

[2] AUERBACH, A. J., KOTLIKOFF, L. J. 1987. Dynamic fiscal policy. Cambridge : Cambridge University Press, 1987.

[3] BEZDĚK, V., DYBCZAK, K., KREJDL, A. 2003. Fiscal implications of population ageing. In Finance a úvěr - Czech Journal of Economics and Finance, 2003, vol. 53, pp. 562-591.

[4] COUGHLAN, G. et al. 2007. LifeMetrics – technical document. [online]. New York : JP Morgan Chase Bank, 2007. 106 pp. [cit. 2014-08-24] https://www.jpmorgan.com/ directdoc/lifemetrics_technical.pdf.

[5] EUROPEAN COMMISSION. 2015. The 2015 ageing report. 2015. Brusel : Economic Policy Committee and Directorate – General Economic and Financial Affairs of the European Commission, 2015. 470 pp.

[6] DE LA CROIX, D., PIERRARD, O, SNEESSENS, H. R. 2013. Aging and pensions in general equilibrium : Labor market imperfections matter. In Journal of Economic Dynamics and Control, 2013, vol. 37, pp. 104-124.

[7] FARKAŠOVSKÝ, V. 2016. Long-term sustainability of the pension system in Slovakia. Dissertation thesis. Faculty of Economics, Matej Bel University in Banská Bystrica. 151 pp.

[8] HYNDMAN, R. J., ULLAH, S. 2007. Robust forecasting of mortality and fertility rates : a functional data approach. In Computational Statistics and Data Analysis, 2007, vol. 51, pp. 4942-4956.

[9] CHEN, H., FANG, I. H. 2013. Migration, social security, and economic growth. In Economic Modelling, 2013, vol. 32, pp. 386-399.

[10] LEE, R. D., CARTER, L. R. 1992. Modeling and forecasting US mortality. In Journal of the American Statistical Association, 1992, vol. 87, pp. 659-671.

[11] SHIMASAWA, M., OGURO, K. 2010. Impact of immigration on the Japanese economy : A multi-country simulation model. In Journal of the Japanese and International Economies, 2010, vol. 24, iss. 4, pp. 586-602.

[12] INFOSTAT, 2002. Population projection of Slovakia until 2060. Bratislava : Demographic Research Centre. 74 pp.

[13] LISENKOVA, K., MÉRRETE, M., WRIGHT, R. 2013. Populaton ageing and the labour market : Modelling size and age-specific effects. In Economic Modelling, 2013, vol. 35, pp. 981-989.

[14] ROMER, D. 2006. Infinite-horizon and overlapping generation models. Advanced Macroeconomics. 3rd ed. New York : McGraw Hill, 2006. ISBN 0-07-287730-8.

[15] VAŇO, B. et al. 2013. Prognóza obyvateľstva SR do roku 2060. [online]. Bratislava : Výskumné demografické centrum INFOSTAT, 2013. 84 pp.