Economic Modelling xxx (2015) xxx–xxx

Contents lists available at ScienceDirect

Economic Modelling

journal homepage: www.elsevier.com/locate/ecmod

The effect of ageing on the European economies in a life-cycle model☆

Aleksandra Kolasa [a,b], Michał Rubaszek [a,c,*]

[a] National Bank of Poland, ul. Świetokrzyska 11/21, 00-919 Warsaw, Poland
[b] University of Warsaw, Krakowskie Przedmieście 26/28, 00-927 Warsaw, Poland
[c] Warsaw School of Economics, Al. Niepodległości 162, 02-554 Warsaw, Poland

ARTICLE INFO

Article history:
Accepted 22 June 2015
Available online xxxx

Keywords:
Aging
Life-cycle model
European Monetary Union

ABSTRACT

Aging is going to be an important factor affecting the functioning of European economies in the forthcoming decades. It is estimated that in most European countries the old-dependency ratio is going to increase significantly. The question arises about the effects of this process on the economy and what kind of policies would attenuate the potential problems. This paper addresses this issue by showing under "no-policy change" scenario one can expect a build-up of significant imbalances in four biggest euro area economies, which highlights a need of deeper reforms in the institutional design of the euro area.

1. Introduction

The demographic projections for European countries indicate that over the next fifty years both the share of older persons in total population and the ratio of pensioners to workers will increase substantially. In the debate on secular stagnation, Gordon (2014) indicates that these developments will constitute one of the major drags on growth in the forthcoming decades. Moreover, they will exert serious pressure on the sustainability of public finances (Diaz-Gimenez and Diaz-Saavedra, 2009; Lisenkova et al., 2013). The demographic developments in European countries under the assumption of "no policy change" are widely discussed the Aging Report (European Commission, 2012). The European Commission indicates that changes in the age structure are going to be an important driver of the future economic developments in the European Union (EU) and will require determined policy action in the EU, such as reducing the public debt, raising the employment rates, boosting productivity or reforming the pension, health care and long-term care systems. This is why aging issues have recently received a great deal of attention not only from academic circles but most of all from policymakers.

The aim of this study is to contribute to the above debate by highlighting the role of demographic changes on the stability of the European Monetary Union (EMU). In particular, we pose a question whether heterogeneous demographic developments combined with differences in the design of the pension systems will lead to a build-up of macroeconomic imbalances among major EMU economies: Germany, France, Italy and Spain over the next 50 years. For that purpose we develop a multi-country overlapping generations (OLG) model a-la Huggett (1996) in which heterogeneous households optimize their spending and savings decisions subject to individual income uncertainty and the equilibrium condition for the monetary union. Our main finding is that under a "no policy change scenario" demographic changes will lead to a build-up of significant imbalances within EMU, which should be addressed both at a national and pan-European level. The former would involve pension system reforms and policies targeted to boost productivity, whereas the latter the creation of the common fiscal capacity as well as partial harmonization of pension system regulations.

Our work is related to the strand of the literature that uses OLG-type models to analyze the economic effects of aging. In one of the first studies of this kind, Miles (2002) evaluates the impact of "greyer society" on savings, output, interest rates and the design of monetary policy to conclude that the influence of demographic changes on the economy depends critically on the way in which aging affects the structure of the pension system. The issue of pension system sustainability is also touched by Diaz-Gimenez and Diaz-Saavedra (2009), who analyze the consequences of delaying the retirement age in Spain. Within a general equilibrium OLG framework they study the transition dynamics under the reform and no-reform scenarios. The main conclusion is that in the no-reform scenario the current pay-as-you-go public pension system is completely unsustainable. However, delaying the retirement age for three years would alleviate the problem, at least in a horizon of 50 years. Similar conclusions are presented in Sanchez Martin (2001).

The question might arise, whether there are other options than reforming the pension system to ensure public debt sustainability in the face of aging process. This question is addressed by Fougere and Merette (1999), who examine the long term impact of aging in seven OECD countries. Their baseline, "no policy change" and exogenous technology growth scenario predicts a significant drop in aggregate output.

☆ "ISCEF2014 conference (www.iscef.com)".

* Corresponding author at: National Bank of Poland, ul. Swietokrzyska 11/21, 00-919 Warsaw, Poland.
E-mail addresses: aurbaniec@wne.uw.edu.pl (A. Kolasa), michal.rubaszek@nbp.pl (M. Rubaszek).

http://dx.doi.org/10.1016/j.econmod.2015.06.020
0264-9993/

However, they indicate that if one drops the assumption about exogenous growth and allows for investment in human capital, this will provide a boost to output and public finance sustainability. More recent studies using the OLG framework also point to the fact that human capital accumulation might mitigate welfare losses caused by demographic developments. Ludwig et al. (2012) quantify that welfare losses of older (and asset rich) persons driven by demographic changes can be halved by the process of human capital adjustments. Vogel et al. (2012) expand the Ludwig et al. framework for the opportunities of investing abroad and the possibility of delaying the retirement age. They find that openness has a negligible effect, but an increase in the retirement age can further reduce welfare losses of demographic changes. The mitigating effects of openness on welfare losses driven by aging are also investigated by Georges et al. (2013) with a multi-country OLG model, which consists of North and South countries. The former are developed but face aging problems, whereas the latter are emerging economies with a favorable age structure. The main conclusion is that North–South trade intensification should mitigate the consequences of population aging. The authors estimate that improper trade policy (North–North trade intensification rather than the exploration of the North–South trade possibilities) may cost Europe around 3% of real consumption per capita by 2060. However, none of the above studies focus on the effect of aging on the stability of the EMU.

The structure of the article is as follows. In Section 2 we present the structure of the model and discuss how we solve it. In Section 3 we provide a discussion on the choice of parameters. Section 4 presents the results and the last section concludes.

2. The model

We consider a model for J countries of differentiated structure that constitute a monetary union. These countries are inhabited by households that are heterogeneous in terms of age, wealth and productivity. The lifespan and individual productivity of households are stochastic, which affects their saving and consumption decisions.

Below we describe the structure of a single country, which is indexed by letter $j \in \mathcal{J} \equiv \{1, 2, \ldots, J\}$. For the purpose of presentation, in the first part of model description we omit subscript j both for variables and parameters. We return to indexing countries by j when describing aggregation for the monetary union.

2.1. International capital markets

The economy of country j can borrow and lend without any limits at the interest rate prevailing in the monetary union r_{MU} so that the level of the domestic real interest rate is:

$$r = r_{MU}. \tag{1}$$

Instead, for r_{MU} we assume that it is determined in imperfect international capital markets so that:

$$r_{MU} = r^* - \xi \frac{B_{MU}}{Y_{MU}}, \tag{2}$$

where r^* stands for the global interest rate and the parameter ξ measures the level of international financial markets imperfections: two special cases are autarky, in which $\xi \to \infty$, and perfect international financial markets, in which $\xi = 0$. The variables B_{MU} and Y_{MU} denote net foreign assets and output in the monetary union:

$$\begin{aligned} B_{MU} &= \sum_{j \in \mathcal{J}} B_j \\ Y_{MU} &= \sum_{j \in \mathcal{J}} Y_j, \end{aligned} \tag{3}$$

where B_j and Y_j stand for net foreign assets and output in country j, respectively.

2.2. Firms

The goods market is perfectly competitive and characterized by constant returns to scale. Identical firms of measure one are producing a homogeneous final good according to the Cobb-Douglas technology:

$$Y = ZK^{\alpha}L^{1-\alpha}, \tag{4}$$

where K and L denote the aggregate capital stock and effective labor, respectively. The aggregate productivity Z is assumed to increase at an annual pace g so that:

$$Z' = Z(1+g). \tag{5}$$

Factor prices are determined by profit maximization and are equal to their marginal products

$$\begin{aligned} \partial Y / \partial K &= r + \delta \\ \partial Y / \partial L &= w, \end{aligned} \tag{6}$$

where w is the real wage and δ stands for the depreciation rate.

2.3. Demographics and preferences

The economy is populated by an infinite number of households of different age $i \in \mathcal{I} \equiv \{1, 2, \ldots, I\}$. Their lifespan is uncertain: the probability of being alive next year at age i is equal to s_i. The unconditional probability of surviving till age $i > 1$ at time of birth is $S_i = \prod_{n=1}^{i-1} s_n$. Given the survival probabilities and the fact that population is assumed to grow at rate n, it is possible to compute the share of cohort i in population μ_i.

Households derive utility from consumption:

$$u(c) = \frac{c^{1-\eta}}{1-\eta}, \tag{7}$$

where η is the risk aversion parameter.

The economic activity of households consists of two distinct periods. During the initial $\tilde{I}$ years each household works by supplying one unit of time in the labor market. Individual productivity is equal to the product of age-dependent deterministic component z_i and a stochastic component $e \in \mathcal{E} \equiv \{e_1, e_2, \ldots, e_K\}$, i.e. $z(e, i) = z_i \times e$. The stochastic component follows a Markov process with the elements of the transition matrix $\pi_{kl} = P(e' = e_l | e = e_k)$, where $\pi_l > 0$ and $\sum_{l=1}^{K} \pi_{kl} = 1$ for every $k, l \in \{1, 2, \ldots, K\}$.[1] In the second part of their life households retire and receive a lump-sum pension $pen(e)$ that equals to a fraction $\chi(e)$ of the last wage, where the fraction depends on individual productivity and the generosity of the pension system.[2] The resulting income from labor is

$$y(e, i) = \begin{cases} (1-\tau) w z(e, i) & \text{for workers} \\ pen(e, i) & \text{for retirees.} \end{cases} \tag{8}$$

Here τ stands for the social contribution rate, which is set so that the pension system budget is balanced.

2.4. Timing and the budget constraint

A household of age i enters a period with financial assets a augmented by the interest rate r, and with idiosyncratic productivity e. Subsequently, she or he receives labor income $y(e, i)$ and transfers tr, and decides how to divide the resources on consumption c and savings a'.

[1] Throughout the paper we use x' to denote the next period value of a variable x.

[2] This assumption is equivalent with notation that the pension depends on individual productivity and the productivity is constant during the retirement so that $e' = e$.

Please cite this article as: Kolasa, A., Rubaszek, M., The effect of ageing on the European economies in a life-cycle model, Econ. Model. (2015), http://dx.doi.org/10.1016/j.econmod.2015.06.020