Effects of Population Ageing on the Pension System in Belarus

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Abstract: Belarus currently has a relatively generous pay-as-you-go pension system, but population aging coupled with recent problems with economic growth will soon make it unsustainable. We build a rich OLG model of Belarusian economy, which shows that without reform the Pension Fund will run into persistent and growing deficit, which will reach 9 per cent of GDP by 2055. We also compute the fiscal projections of several parametric pension reforms. To avoid a deficit without reform, pension benefits would have to be substantially reduced. The increase of retirement age to 65 for both genders has a strong positive effect on sustainability of the pension system and keeps the deficit below 2 per cent of GDP.

JEL codes: C68, H55, J26

Keywords: Belarus, pension system, demography, retirement age, pension reform

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1. Introduction

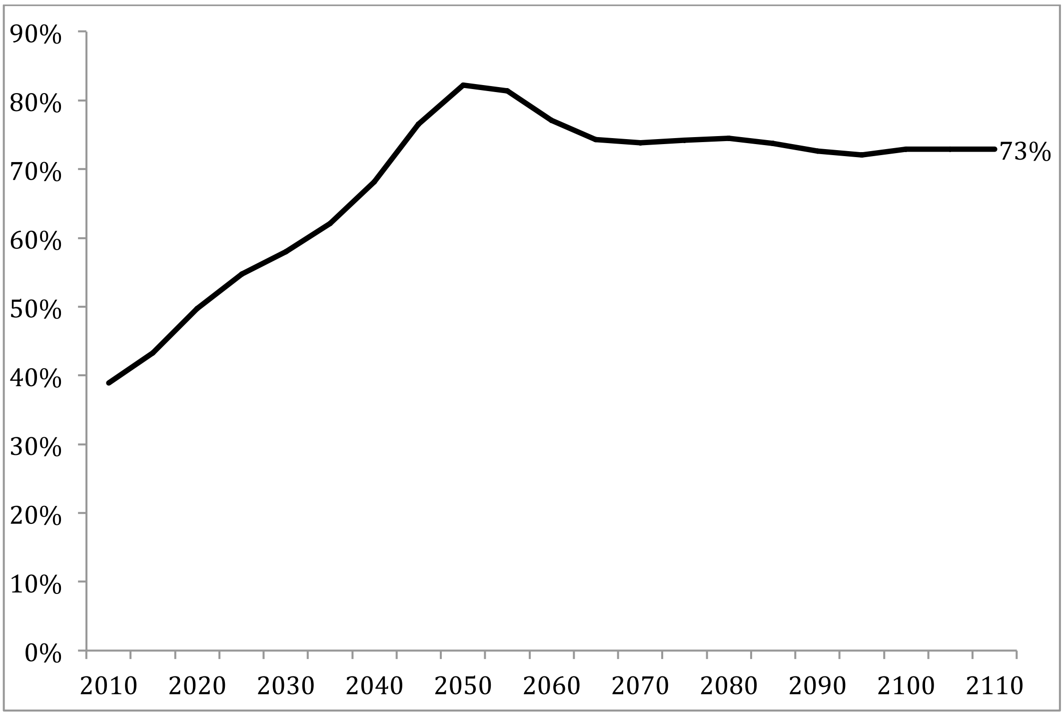
After the dissolution of the USSR, the majority of former Soviet Union states experienced increases in mortality (Ellman, 1994; Brainerd and Cutler, 2005) and sharp drops in birth rates (Adsera, 2004; Perelli-Harris, 2008). Belarus was not an exception, although the increase in mortality was less pronounced than in other newly independent states, as the socio-economic changes were less drastic (Grigoriev et al., 2010; Shakhotska, 2007). The health crisis of the 90s contributed to the decline in the life expectancy, especially among males (Cockerham, 1997). In 1999 the male life expectancy at birth was only 62.2 years (WDI, World Bank), the lowest for the past 50 years.

In 2000s, economic growth in Belarus picked up. It was pro-poor (Haiduk and Chubrik, 2007), and living standards improved rapidly. As economic uncertainty subdued and incomes grew, both life expectancy and fertility increased. The government also introduced maternity and child benefits, and these policies contributed to an increase in fertility (Amialchuk et al., 2011). But these positive developments were not enough to reverse the negative trend in population growth. According to the World Bank, the Belarusian population decreased from 10.2 million in 1991 to 9.5 million people in 2014. According to the UN population projections it is expected to contract to 8.1 million people by 2050. More importantly for the pension system, the old-age dependency ratio (number of persons of retirement age per 100 workers) will almost double from 43 in 2015 to 82 in 2050 (see Figure 1).

The current pension system in Belarus is a standard one-pillar pay-as-you-go scheme. The retirement ages in Belarus are among the lowest in the region: 55 years for females and 60 for males. The contribution rate of 29 per cent, on the other hand, is among the highest in Eastern Europe (Zviniene and Biletsky, 2011). In 2013 the average pension benefit exceeded the poverty level 2.54 times, and constituted 38 per cent of an average wage (Belstat, 2014).

Low post-war birth rates implied that in the 2000s the cohorts entering retirement were relatively small. This favourable demographic environment allowed for a surplus in the Pension Fund. As old-age dependency worsened, 2013 became the first year with registered Pension Fund deficit. UN population projections suggest that age dependency will continue worsening until 2050 when it stabilizes, and Pension Fund deficits might become unsustainable.

Figure 1. Old-age dependency ratio



Source: 2010-based UN population projections (medium scenario)

Many developed countries face similar challenges as their populations are ageing. A growing body of literature is analysing public pension systems with general equilibrium overlapping generation (OLG) models. De Nardi, Imrohoroglu, and Sargent (1999), for instance, study social security reform in the U.S. economy; Diaz-Gimenez and Diaz-Saavedra study the effects of an increase in retirement age in Spain (2009).

Zviniene and Biletsky (2011) build fiscal projections for the pension system of Belarus using the World Bank PROST accounting model. To the best of our knowledge, this paper is the first attempt to model the Belarusian pension system in an OLG framework, taking into account general equilibrium effects of possible reforms and macroeconomic consequences of decreasing working-age population.

We find that under the current arrangements of the public pension scheme with the current replacement rate (average pensions at around 40 per cent of average wage) the Pension Fund deficits increase up to the year 2050. We also show that it will be necessary to either decrease the replacement rate or increase contributions to keep the Pension Fund afloat. Delaying retirement, in particular for women, is another option, which not only improves the sustainability of the Pension Fund, but also benefits GDP growth by increasing the labour supply.

The rest of the paper is structured as follows. In Section 2 we give an overview of the pension system in Belarus. In Section 3 we briefly describe the model. In Section 4 we describe the calibration of the model to Belarusian macro and micro data. Simulation results and possible reform projections are described in Section 5. Section 6 concludes.

2. The Pension system in Belarus today

The current pension system in Belarus was inherited from the Soviet Union. The pension system is redistributive or pay-as-you-go (current generations of workers pay contributions, which are used in the same period to pay pensions to the current retirees).

The pension age is 60 years for men and 55 years for women. These are the lowest pension ages in Europe (see Table 1 for details), comparable only to those in Russia (Ukraine has already started raising the pension age for women). The only reforms of the pension system during the years of the independence in Belarus were the restrictions of access to work pensions , which are now paid only for those who contributed to the Pension Fund for at least 15 years (still very low). If the person does not meet this criteria, she/he is only entitled to the social pension, paid after the age 65 for men and 60 for women. As most developed countries have moved towards the same pension ages for both sexes, Belarus remains among the group of transition countries which still cling to the outdated policy of earlier retirement ages for women.

The social security contributions are paid to the Fund of the Social Protection of the Population (here the Pension Fund). Total pension contributions are 29 per cent of gross wages, of which only 1 per cent is paid directly by the employee, while the employer pays the rest.

In 2013, the total amount of pensions paid out by the Pension Fund constituted 9.4 per cent of GDP. This level of expenditure is similar to many European and transition countries. 2013 was also the first year of the Pension Fund deficit in Belarus – the deficit was quite small, amounting to 0.08 per cent of GDP.

Table 1. Statutory retirement ages across countries

Transition countries		Developed countries	
Armenia	63	Australia	67
Azerbaijan	58/63	Austria	65
Belarus	55/60	Belgium	65
Bulgaria	60/63	Canada	65
Croatia	60/65	Denmark	67
Czech Republic	55-61/62.5	Finland	65
Estonia	60.5/63	France	65
Georgia	60/65	Germany	67
Hungary	62	Greece	65
Kazakhstan	58/63	Iceland	67
Kyrgyz Republic	58/63	Ireland	65/66
Latvia	62	Israel	67
Lithuania	60/62.5	Italy	60/65
Moldova	57/62	Japan	65
Poland	60/65	Netherlands	65
Romania	59/64	New Zealand	65
Russian Federation	55/60	Norway	67
Serbia	60/65	Portugal	65
Slovak Republic	59.5/62	Spain	65
Slovenia	56.3/63	Sweden	65
Turkmenistan	57/62	Switzerland	64/65
Ukraine	55-60/60	United Kingdom	68
Uzbekistan	55/60	United States	67

Source: Pallares-Miralles et al., 2012

The replacement rate (the ratio of the average pension to average wage) in Belarus is not high compared to OECD countries. The OECD average is 54.5 per cent, while the Belarusian replacement rate was only 43 per cent in 2013. The average pension in Belarus in 2013 was 2.21 mln Belarusian roubles, or 249USD.

Given the demographic challenges ahead, Belarus needs to reform its pension system. These changes can be parametric – changing only the features of the current pay-as-you-go system – or structural. In this paper we focus on the sustainability of the current system and the possible parametric reforms.

3. The Model

The model used in this paper is designed to analyse the long-term economic implications of demographic change. The exogenous demographic process is superimposed on the model and provides the shock or driving force behind the simulation results. The model is calibrated on the Belarusian data. Below we describe the demographic structure of the model and outline the main features of the production, household and government sectors.

3.1 Demographic Structure

The population is divided into 21 generations or age groups (i.e., 0-4, 5-9, 10-14, 15-19, …, 100-104). Demographic variables, fertility, mortality and net-migration rates are assumed to be exogenous. Every cohort is described by two indices. The first is *t*, which denotes time. The second is *g*, which denotes a specific generation or age group.

The size of the cohort belonging to generation *g+k* in any period *t* is given by the following two laws of motion:

$$Pop_{t,g+k} = \begin{cases} Pop_{t-1,g+k+5}\, fr_{t-1} & for \quad k = 0 \\ Pop_{t-1,g+k-1}\left(sr_{t-1,g+k-1} + mr_{t-1,g+k-1}\right) & for \quad k \in [1,20] \end{cases} \tag{1}$$

The first equation simply implies that the number of children born at time *t* (age group *g+k = g*, i.e. age group 0-4) is equal to the size of the first adult age group (*g+k+5=g+5*, i.e. age group 20-24) at time *t-1* multiplied by the “fertility rate”, *fr*, in that period. If every couple has two children on average, the fertility rate is approximately equal to 1 and the size of the youngest generation *g* at time *t* is approximately equal to the size of the first adult generation *g+5* one year before. A period in the model corresponds to five years and a unit increment in the index *k* represents both the next period, *t+k,* and, for an individual, and a shift to the next age group, *g+k*.

The second law of motion gives the size at time *t* of any age group, *g+k,* beyond the first generation, as the size of this generation a year ago times the sum of the age specific conditional survival rate, *sr,* and the net migration rate, *mr,* at time *t-1.* In this model the fertility rates vary across time, while the survival and net migration rates vary across time and age. For the final generation (i.e., the age group 100-104 (*k*=20)), the conditional survival rate is zero. This means that everyone belonging to the oldest age group in any period dies with certainty at the end of the period.

Time variable fertility and time/age-variable net migration and conditional survival rates are calibrated based on exogenous population projections. This permits a precise modelling of the demographic scenarios of any configuration within the model.

3.2 Production

At any time *t*, a representative firm hires labour and rents physical capital to produce a single good using a Cobb-Douglas technology. The production function thus reads:

$$Y_t = AK_t^{\alpha} L_t^{1-\alpha} \tag{2}$$

where *Y* denotes output, *K* is physical capital, *L* denotes effective units of labour, *A* is a scaling factor and α represents the share of physical capital in output. The market in which the representative firm operates is assumed to be perfectly competitive. Factor demands thus follow from the solution to the profit maximization problem:

$$re_t = \alpha A \left(\frac{K_t}{L_t} \right)^{\alpha - 1} \tag{3}$$

$$w_t = (1-\alpha) A \left(\frac{K_t}{L_t} \right)^{\alpha} \tag{4}$$

where re and w denote, respectively, the rental rate of capital and the wage rate.

3.3 Household sector

Household behaviour is captured by 21 representative households that interact in an Allais-Samuelson overlapping generations structure representing each of the age groups. Individuals enter the labour market at the age of 20, retire at the age of 65, and die at the latest by the age of 104. Younger generations (i.e. 0-4, 5-9, 10-14 and 15-19) are fully dependent on their parents and play no active role in the model. However, they do influence the public expenditure. An exogenous age/time-variable survival rate determines life expectancy.

Adult generations (i.e. age groups 20-24, 25-29, …, 100-104) optimise their consumption-saving patterns over time. The household's optimization problem consists of choosing a profile of consumption over the life cycle that maximizes a CES type inter-temporal utility function, subject to the lifetime budget constraint.

The inter-temporal preferences of an individual born at time *t* are given by:

$$U = \frac{1}{1-\theta} \sum_{k=4}^{20} \left\{ \Pi_{l=4}^{k} \left[\frac{1}{1+\rho_{g+l}} \right] \Pi_{m=0}^{k} sr_{t+m,g+m} \left((C_{t+k,g+k})^{1-\theta} \right) \right\} \tag{5}$$

where *C* denotes consumption and θ represents the inverse of the constant inter-temporal elasticity of substitution. Parameter ρ is the pure rate of time preference, and is age-variable. Future consumption is also discounted at the unconditional survival rate, $\prod_k sr_{t+k,g+k}$, which is the probability of survival up to the age *g+k* and period *t+k.* It is the product of the age/time-variable conditional survival rate, $sr_{t+k,g+k}$, between periods *t+k* and *t+k+1* and ages *g+k* and *g+k+1*.

The household is not altruistic, i.e. it does not leave intentional bequests to children. It insures its future via a perfect annuity market, as described theoretically by Yaari (1965, case C) and implemented in an OLG context by Borsch-Supan et al (2006).

The household's dynamic budget constraint takes the following form:

$$HA_{t+1,g+1} = \frac{1}{sr_{t.g}} \times \left[Y_{t,g}^{L} \left(1-\tau_{t}^{L} - Ctr_{t}\right) + Pens_{t,g} + \left(1+r_{t}\left[1-\tau^{K}\right]\right) HA_{t,g} - \left[1+\tau^{C}\right] C_{t,g} \right] \tag{6}$$

where *HA* is the level of household assets, *r* is the rate of return on physical assets, τ^K is the effective tax rate on capital, τ^L the effective tax rate on labour, τ^C the effective tax rate on consumption, *Ctr* is the contribution rate to the public pension system, Y^L is the labour income, *Pens* is the level of pension benefits.

The intuition behind the term *1/sr* is that the assets of those who die during period *t* are distributed equally between their surviving peers. Therefore, if the survival rate at time *t* in age group *g* is less than one, then at time *t+1* everyone in their group has more assets. This is the mathematical description of the perfect annuity market.

Labour income is defined as:

$$Y_{t,g}^{L} = w_t EP_g LS_g \tag{7}$$

where *LS* is the exogenously given supply of labour. It is assumed that labour income depends on the individual's age-specific productivity. In turn, it is assumed that these age-specific productivity differences are captured in age-earnings profiles. These productivity profiles are quadratic functions of age:

$$EP = \gamma + (\lambda_t)g - (\psi)g^2, \qquad \gamma, \lambda, \psi \geq 0 \tag{8}$$

with parametric values estimated from micro-data (as discussed in the calibration section). Differentiating the household utility function, subject to its lifetime budget constraint, with respect to consumption yields the following first-order condition for consumption, commonly known as Euler equation:

$$C_{t+1,g+1} = \left[\frac{\left[1 + \left[1 - \tau^K\right] r_{t+1}\right]}{(1+\rho_t)} \right]^{\frac{1}{\theta}} C_{t,g} \tag{9}$$

It is important to note that, since survival probabilities are present in both the utility function and the budget constraint, they cancel each other out and are not present in the Euler equation.

3.4 Investment and Asset Returns

The law of motion for the capital stock, *Kstock*, is:

$$Kstock_{t+1} = Inv_t + (1-\delta)Kstock_t \tag{10}$$

where *Inv* represents investment, *δ* is the depreciation rate of capital.

Capital markets are assumed to be fully integrated. This implies that financial capital is undifferentiated from physical capital, so that the interest rate parity holds:

$$1 + r_t = re_t + (1 - \delta) \tag{11}$$

where *r* and *re* denote the net and gross rates of return to physical capital, respectively.

3.5 Government Sector

The Government's budget constraint reads:

$$\begin{aligned} &\sum_g Pop_{t,g} \left\{ \left(\tau_t^L + Ctr_t \right) w_t EP_{t,g} LS_{t,g} + \tau^C C_{t,g} + \tau^K r_t HA_{t,g} \right\} \\ &= Gov_t + \sum_g Pop_{t,g} Pens_{t,g} \end{aligned} \tag{12}$$

where Gov is public consumption. The left-hand side of the constraint contains the government revenues. The right-hand side represents different categories of government expenditure including transfers to households and pension benefits. Note that the pension program is a part of the overall government budget.

Public expenditures per person, *GEPC,* are fixed per-person and hence total expenditure, *Gov,* depends only on the size of the total population, *TPop*.

$$Gov_t = TPop_t GEPC \tag{13}$$

In the simulations presented in this paper we use the wage tax rate, τ_t^L, as the only endogenous policy variable that adjusts in every period to achieve a balanced government budget. Wage tax does not generate efficiency distortions, given the absence of an endogenous labour-leisure decision.

3.6 Market and Aggregation Equilibrium Conditions

Perfect competition is assumed in all markets. The equilibrium condition in the goods market requires that the Belarus' output be equal to aggregate absorption, which is the sum of aggregate consumption, investment and government spending:

$$Y_t = \sum_g Pop_{t,g} C_{t,g} + Inv_t + Gov_t + GovH_t + GovE_t \quad (14)$$

Labour market clearing requires that the demand for labour be equal to the supply:

$$L_t = \sum_g Pop_{t,g} LS_g EP_g \quad (15)$$

Similarly, the units of capital accumulated up to period *t* must equal the units of capital demanded by the representative firm in that period:

$$Kstock_t = K_t \quad (16)$$

In the same vein, equilibrium in the financial market requires total stock of private wealth accumulated at the end of period *t* to be equal to the value of the total stock of capital accumulated at the end of period *t*:

$$\sum_g Pop_g HA_{t,g} = Kstock_t \quad (17)$$

4. Calibration

The model is calibrated using 2013 data for Belarus where available. The data for the demographic baseline shock is taken from the 2010-based medium population projections produced by the United Nations Population Division (UNPD). Population projections are used for the calibration of the fertility and survival rates used in the model.

The data on public finances and GDP components are taken from the National Accounts. The effective labour income, capital and consumption tax rates are calculated from the corresponding government revenue categories and calibrated tax bases. Data on total amount of pensions are taken from the Pension Fund budget. Based on this information, the effective pension contribution rate and the average size of pension benefits can be calculated. The average pension per person is obtained by dividing the total amount of pension benefits by the total number of people of pension age. In a baseline scenario, males start receiving pension benefits at the age of 60 and females at the age of 55.

The source of the labour market data is the Belarusian Household Budget Survey 2013 (BHBS). Two labour market characteristics are derived from the data: age-specific employment rates and age-specific productivity profiles. The latter are estimated via the use of quadratic age-earning regressions.

Figure 2. Employment rates by age and sex

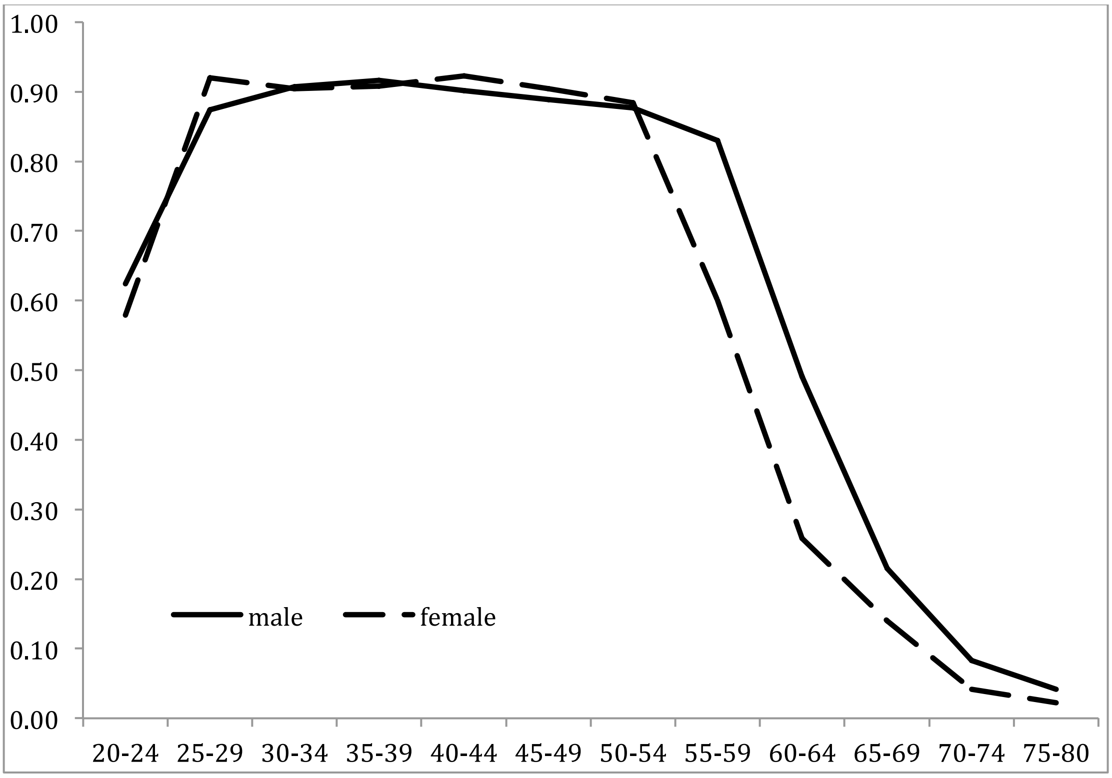


Figure 2 shows employment rates by age and sex. Employment is very high – in the region of 90 per cent – until the pension age, at which point it plummets. As expected female employment rates begin to fall 5 years earlier than male because of lower state pension age.

In the baseline scenario we assume that there is total factor productivity growth of 1.5 per cent per year for the next 100 years. The (5-year) inter-temporal elasticity of substitution is set to 1.25. The wage rate is a numerare. Other model parameters are calibrated.

The calibration procedure is a sequence of three steps.

In the *first step* using the information on GDP, capital and labour earnings we calculate the scaling parameter in the production function and the capital income share.

The *second step* is the most challenging one since it involves equations describing the household's optimisation problem, the equilibrium conditions in the assets and goods markets and the government budget constraint. In particular, the rate of time preference is solved endogenously during the calibration procedure in order to generate plausible consumption and capital ownership profiles for each age group. Capital ownership profiles must also satisfy the equilibrium condition on the asset market.

The *third and final step* uses the calibration results of the first three steps to verify that the model is able to replicate the observed data corresponding to the initial equilibrium. Only when the initial equilibrium is perfectly replicated by the calibration solution can the model be used to evaluate the consequences of exogenous shocks/policy experiments.

5. Simulations and results

In all scenarios presented below, population projections provide the main shock to the model. In addition we make assumptions about the pace of economic growth and the configuration of the pension system.

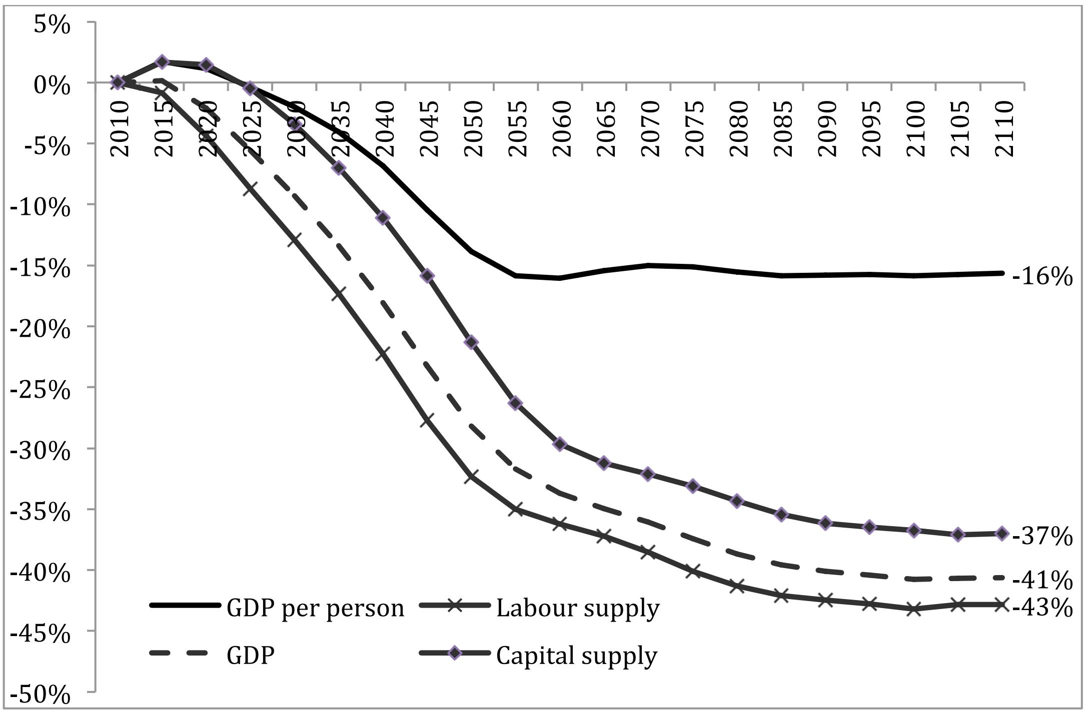
Pay-as-you-go pension systems can be described by three broadly defined characteristics: level of contributions, level of benefits and number of retired. Our model inevitably has to simplify many complexities of the Belarusian pension system. We use three parameters as proxies for the above mentioned characteristics of the pension system: contribution rate, replacement rate (ratio of average pension to average wage) and state pension age. By adjusting them we can see what effect this will have on the future stability of the pension system. Since the current contribution rate at 29 per cent of labour income is already one of the highest in the world, we do not consider any scenarios that require a further increase.

5.1. Baseline scenario

For the baseline scenario, we use the UN medium population projections for Belarus for 2010-2110. After 2110 population size and age-sex structure are assumed to stay constant. We assume total factor productivity (TFP) growth of 1.5 per cent per year over the next 100 years and 0 per cent thereafter. Pension age for females/males stays at 55/60 years. This can be thought of as a *status quo* scenario, as we do not change the current parameters of the pension system.

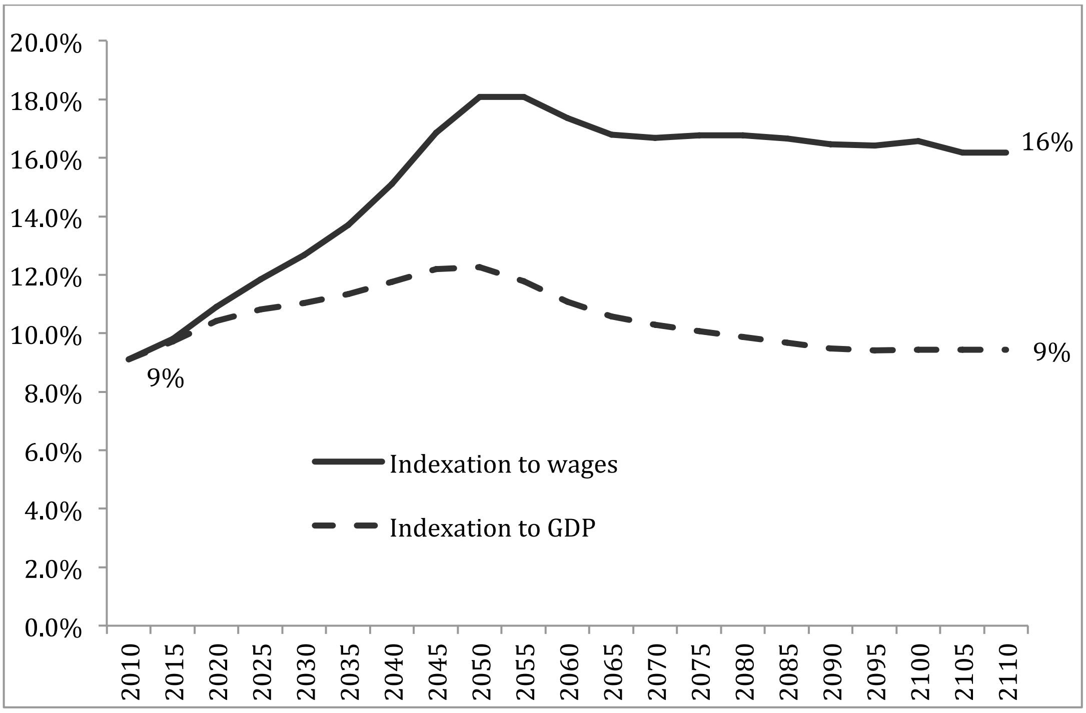
Due to assumed technological progress, in the baseline scenario GDP in Belarus increases almost 2 times over the next 50 years. To illustrate the effect of population ageing, Figure 3 shows GDP, GDP per person and inputs of production relative to the scenario with the same TFP growth but without ageing. Due to the changes in age structure by 2060, GDP, labour and capital supply decline by 41, 43 and 37 per cent correspondingly. GDP per person during the same period declines by 16 per cent and stabilises after that.

Figure 3. GDP and inputs of production, relative to scenario without ageing



Projecting the level of pension benefits into the future requires making certain assumptions. Pension benefits are usually indexed to take into account improvements in standards of living. Indexation rules can be very elaborate, but two that are often used are indexation to wages or GDP growth. They produce drastically different outcomes in terms of sustainability of the pension system and living standards of the retired. Figure 4 illustrates the difference between the two types of indexation by showing the amount of total pension benefits as a share of GDP. In 2013 total pension benefits amounted to 9 per cent of GDP. If pensions are indexed to wages, then by 2050 the total pension bill would reach 18 per cent of GDP. But if pensions are indexed to GDP, they would increase to only 12 per cent of GDP.

Figure 4. Total pensions as a share of GDP



If contributions are not increased in line with the pension bill, this leads to a corresponding deficit in the Pension Fund (Figure 5). If pension benefits are indexed to wages, by 2050 the deficit reaches 9 per cent of GDP. If, on the other hand, pensions are indexed to GDP, deficit peaks at 3 per cent of GDP in 2050 and by the end of the century almost disappears.

Figure 5. Pension Fund deficit

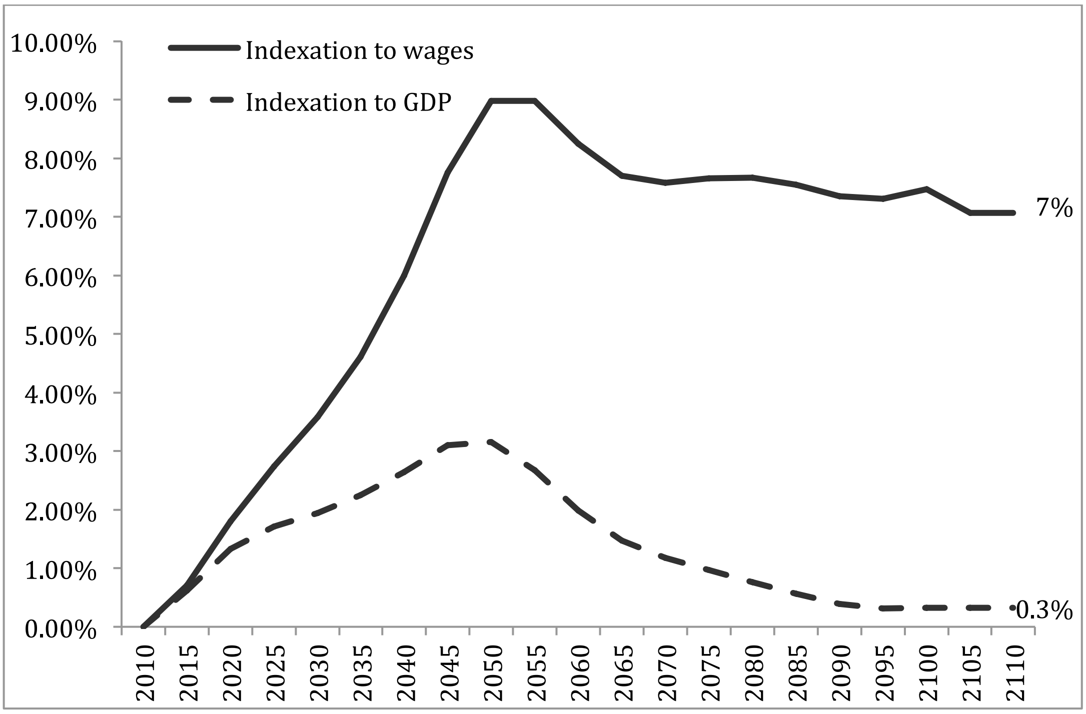
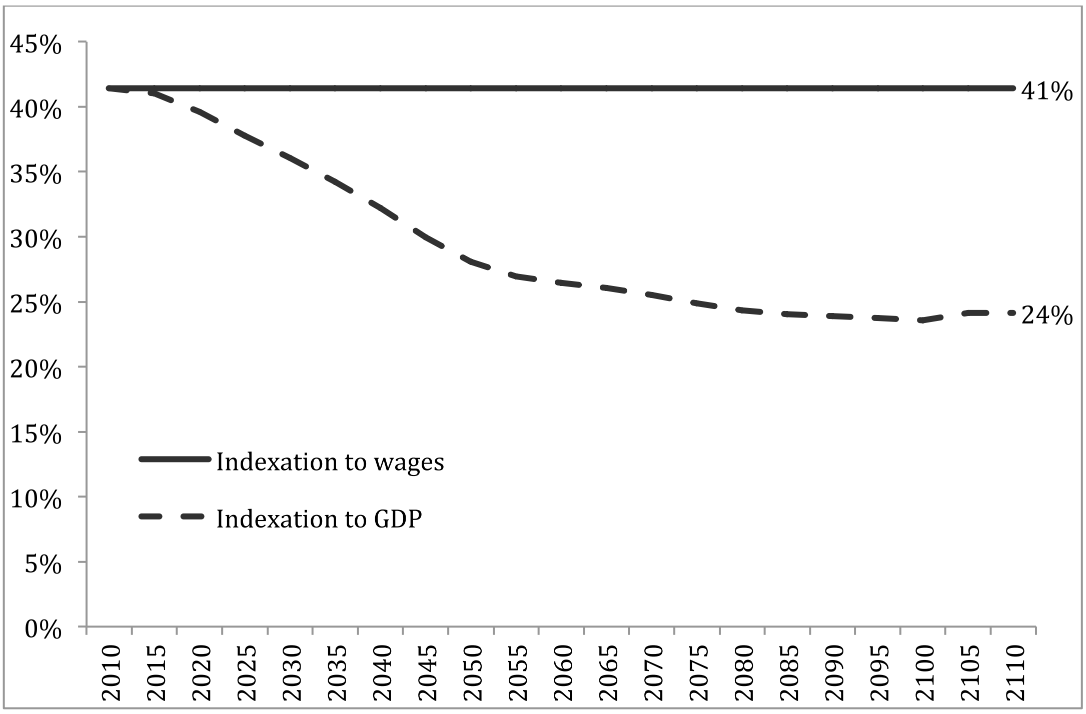


Figure 6. Replacement rate



Different indexation rules have consequences not only for the financing of the pension system, but also for the relative living standards for the retired. Figure 6 shows changes in replacement rate – ratio of average pension to average wage – under different indexation rules. If pensions are indexed to wages it essentially means that replacement rate stays constant. If they are indexed to the growth rate of GDP, however, this means that relative living standards of pensioners are deteriorating – replacement rate decreases from 43 per cent in 2013, to just 28 per cent in 2050.

5.2. Increase in the state pension age

The previous section demonstrated that the status quo will result in a large Pension Fund deficit. This can be mitigated by using different indexation rules, but at a cost of a significant reduction in the living standards of the retirees. In this section we will explore the effect of another policy option – an increase in the state pension age. Currently Belarus has one of the lowest state pension ages in the world – 55 years for females and 60 for males. We look at two scenarios of state pension age increase. The first one is increase of female state pension age from 55 to 60 by 2025 (by half a year every year). The second scenario is increase in the state pension age for both sexes to 65 by 2035.

Figure 7 demonstrates the effect of these changes on old-age dependency ratio. The dependency ratio changes in the case of an increase in the state pension age for two reasons: the number of working people increases, and the number of pensioners decreases due to later retirement.

With falling dependency ratio, funding the pension system becomes much easier. Figure 8 shows the size of the Pension Fund deficit. If pension age is not increased, by 2055 the deficit reaches 9 per cent of GDP. If pension age for women is increased to 60 years, the deficit in 2055 decreases to 7 per cent of GDP. If the state pension age for both sexes is increased to 65 years, the deficit at its peak in 2060 is only 3 per cent of GDP and later converges to 2 per cent of GDP.

Figure 7. Old-age dependency ratio

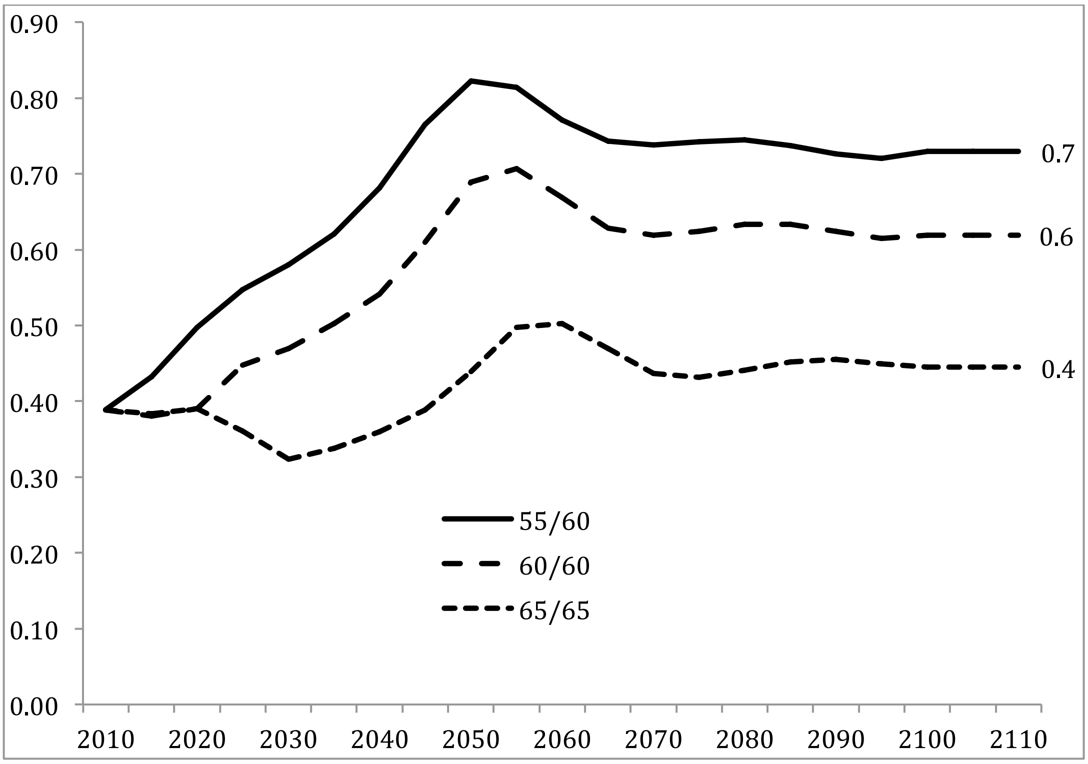
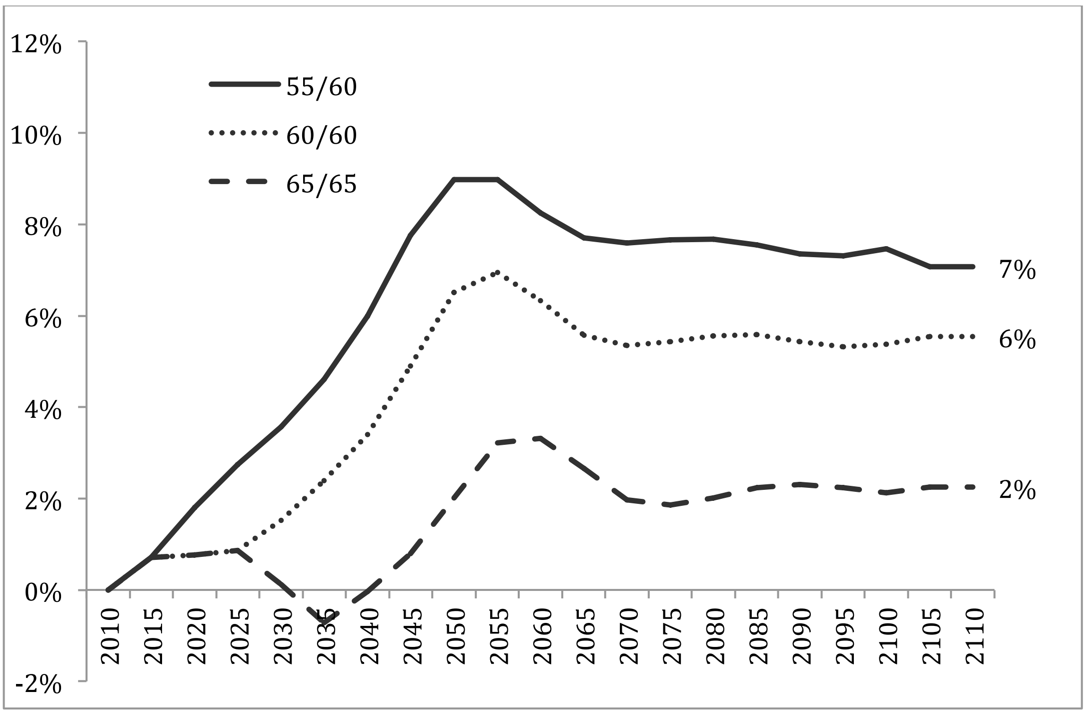


Figure 8. Pension Fund deficit, % of GDP



6. Concluding Remarks

The process of population ageing presents a serious challenge for the Belarusian economy. Our estimates suggest that it will result in a 16 per cent drop from potential per capita GDP by 2050. But one of the most urgent consequences of population ageing is the persistent deficit in the pension system.

The Pension Fund has ran into deficit in 2013 for the first time, but our results suggest that deficits will grow in the future, and under the current pension system will reach 9 per cent of GDP annually by 2055. We estimate the possible effects of two parametric reforms: decreases in replacement rate and increases in retirement age.

We find that retirement age increase would be very effective, as it works not only through the decrease in pension payments, but also increases the labour supply and GDP. If retirement age for both males and females is increased to 65 years, the Pension Fund deficit will not exceed 3 per cent of GDP. Increasing only the female retirement age to 60 will keep the deficit below 7 per cent of GDP.

We did not look at the scenarios that involve an increase in pension contribution rate, because it is already one of the highest in the world. Without a substantial increase in retirement ages or an increase in contributions, the replacement rate will have to decrease. This will result in 34 per cent reduction in the living stands of retirees relative to workers by 2055.

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