Macroeconomic and Fiscal Implications of Population Aging in Bulgaria

Harun Onder

Pierre Pestieau

Eduardo Ley

The World Bank
Poverty Reduction and Economic Management Network
Economic Policy and Debt Unit
February 2014

Abstract

Bulgaria is in the midst of a serious demographic transition that will shrink its population at one of the highest rates in the world within the next few decades. This study analyzes the macroeconomic and fiscal implications of this demographic transition by using a long-term model, which integrates the demographic projections with social security, fiscal and real economy dimensions in a consistent manner. The simulations suggest that, even under fairly optimistic assumptions, Bulgaria's demographic transition will exert significant

fiscal pressures and depress the economic growth in the medium and long term. However, the results also demonstrate that the Government of Bulgaria can play a significant role in mitigating some of these effects. Policies that induce higher labor force participation, promote productivity and technological improvement, and provide better education outcomes are found to counteract the negative consequences of the demographic shift.

This paper is a product of the Economic Policy and Debt Unit, Poverty Reduction and Economic Management Network. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at <http://econ.worldbank.org>. The authors may be contacted at honder@worldbank.org.

The Policy Research Working Paper Series disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be cited accordingly. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

Macroeconomic and Fiscal Implications of Population Aging in Bulgaria*

Harun Onder, Pierre Pestieau, and Eduardo Ley[†]

JEL Classification: E66, H55, H68, J11

Keywords: Aging, Fiscal Sustainability, Growth

Sector Board: Economic Policy (EPOL).

*This study served as a background paper for the World Bank Report “Mitigating the Economic Impact of an Aging Population: Options for Bulgaria”. Comments from Jeffrey D. Lewis, Leonardo Hernandez, Doerte Doemeland, Stefanie Sieber, Julia Burr Oliver; and from peer reviewers for the report Jorge Araujo, William Maloney, and Luigi Giamboni as well as the decision meeting participants including Mamta Murthi and Satu Kristiina Kahkonen are gratefully acknowledged. We would also like to thank Doerte Doemeland, Stella Iliyeva, Miglena Abels, Johannes Koettl, and Agnes Couffinhall for providing the data and inputs for our projections.

[†]Harun Onder is an Economist in Economic Policy and Debt Unit of the World Bank; Pierre Pestieau is a Professor in University of Liege, CORE, PSE and CEPR; Eduardo Ley was a Lead Economist in Economic Policy and Debt Unit of the World Bank when this paper was prepared.

1 Introduction

Bulgaria is in the midst of a significant demographic transition. Total population is estimated to decrease from 7.4 million in 2012 to 5.5 million by 2050, which accounts for a total loss of 26.7 percent of the current population. In annual terms, such a reduction in size is equivalent to a negative 0.78 percent growth rate on average. According to United Nations estimations, this constitutes the highest rate of decrease in population in the world within the next half century (United Nations, 2011). In comparison, the population in Europe is expected to shrink by 0.12 percent per year, whereas the world population is expected to grow by a 0.78 percent annually in the same period.

The reduction in Bulgarian population is expected to be more pronounced for economically productive age groups (Figure 1). The working age population (individuals who are aged between 15 and 64) is expected to shrink by 35 percent in the same period, reaching to 3.3 million from about 5 million. As a result, the old age dependency ratio, which is defined as the ratio of elderly population (aged 65 and above) to the working age population, will increase from 27 percent in 2012 to 51 percent by 2050.

What are the implications of shrinking population and increasing old age dependency ratio for GDP growth and fiscal balances in Bulgaria? This paper develops a macro-fiscal projection model in order to provide an answer to this question within a medium and long term perspective. A novel aspect of the model is its ability to bring together the demographic projections with other aspects of the economy in a consistent manner. These aspects include the real economy, fiscal balances, and the social security system. On the real economy side, a decreasing population depresses the growth of economic output by constraining the factors of production. Labor input decreases directly as a result of demographics. In an open economy framework, which is pursued by this study, other things being equal, this leads to a reduction in capital stock. This is mainly because the capital flows respond to returns to investment. In a market equilibrium, where factors of production are imperfect substitutes and they are paid their marginal contributions, a reduction in the labor force reduces the equilibrium interest rate; thus, restricting the capital input as well. Together, these lead to a smaller output. Our simulations suggest that, even after reaching the long term unemployment levels which is substantially lower than the currently high levels, the number of employed individuals will gradually shrink to near 2 million by 2050. This reduction, which is nearly the fifty percent of the current level, is projected to cause the GDP growth to decrease to near 1 percent per year in the long term.

The demographic transformation is also expected to affect the public finances through both

revenue and expenditure channels. On the revenue side, the impact is transmitted from the real economy through changing tax base and social security contributions. Public expenditures, on the other hand, are mainly affected through the social commitments of the Bulgarian Government. These include the provision of public services in healthcare, long term care, and education, as well as the implicit guarantees on maintaining the social security system. The simulations show that, given projections for the demographic dynamics and associated changes in the real economy, public expenditures for healthcare will increase from 4.1 percent of GDP to 5.1 percent from 2012 to 2050. The transfers from the general budget to the pension system is expected to decrease from 6.1 percent of GDP to 4.9 percent in the medium term; then, increase to about 5.6 percent by 2050.¹In contrast, public expenditures for education decrease from about 4.6 percent of GDP in 2012 to about 3.1 percent as a result of decreasing numbers of school enrollment.

These aging related projections for revenues and expenditures are then incorporated into a debt dynamics framework along with other components of the fiscal budget. This enables us to quantify the aggregate dynamic implications. The simulation results show that, in the absence of any changes in policies, the projected demographic transition will lead to a net deterioration in public finances in the medium and long term. Under the baseline scenario, the debt to GDP ratio is projected to increase from about 18 percent to 51 percent by the end of projection period.

The analysis also considers alternative scenarios in order to investigate the extent to which different policies can counteract the negative consequences of unfavorable demographic dynamics. To this effect, alternative scenarios in Total Factor Productivity (TFP) growth, Labor Force Participation (LFP), and education are considered. The results show that, in comparison to the baseline scenario, policies that promote higher productivity growth, higher labor force participation, and better education for the work force can play a significant role in mitigating some of the macroeconomic and fiscal problems borne by demographics.

This paper proceeds as follows. The next section describes the main characteristics and components of the projection model. The third section discusses the simulation results under the baseline and alternative scenarios. The last section concludes.

¹In Bulgaria, pension contributions of employees are directly collected in the pension fund, where benefits are also financed from. In addition to these contributions, a pre-committed share of them, e.g. “a matching fund” are transferred from the general budget to the fund in the same fiscal year as enacted by law. After these transfers, any remaining deficits are also financed by the general tax revenues via a secondary transfer.

Figure 1: Demographic Transition in Bulgaria

(a) Population by Age Group

(b) Composition of Population by Age Group

2 A Long-Term Model to Investigate the Macro-Fiscal Implications of Aging

This section introduces a simple modeling framework where demographic changes affect the fiscal balances through both revenue and expenditure channels. On the revenue side, aging and shrinking population change the scale and composition of the labor force. As a result, the supply of efficiency labor changes over time, which has a direct impact on output, thus, on tax revenues. On the expenditure side, public expenditures on education, healthcare and long term care adjust to accommodate the changing needs of an aging society. Moreover, the benefit-contribution deficits in the Pay-as-You-Go (PAYG) pension system, which emerge from rising imbalances between number of beneficiaries and contributors, is also financed by transfers from the fiscal budget. These transfers, therefore, also adjust as the relative sizes of working age population and dependent population changes.

One of the objectives of this projection model is to bring together the independent estimations of population, labor force, pension system and fiscal aspects of the economy in a consistent manner. Figure 2 shows the overall structure of the model and its sub-modules which serve this purpose. In order to facilitate consistency, the model incorporates a number of assumptions that aim to simplify this integration. First, we assume that the labor supply is exogenously determined by the forces of demographics. An increasing rate of labor force participation over time can be imposed, however, this does not arise endogenously as a reaction to wages or lifetime income expectations. Policies designed to provide further labor force participation (LFP), such as changes in the statutory retirement age and/or establishment of daycare facilities, have an impact on the aggregate supply of labor, which are incorporated through different scenarios. However, we abstract from analyzing the optimization problem at the individual level, which would involve decision making on the basis of labor-leisure choice. As the share of population in the older age cohorts increase, the aggregate LFP decreases. This structure enables us to use the demographic projections that are prepared outside the model in the simulations, such as the UN population projections or the projections by the authorities in the country.

The second simplification is about the public services. The model abstracts from characterizing the impact of government expenditures on welfare of the households. Provisions of public services are determined by a simple projection methodology, e.g. indexed to per capita income through income elasticities, which may be unitary, or greater. A unitary elasticity case can be considered as a result of an underlying structure with homothetic household preferences and responsive government policies. However, we do not characterize them for-

Figure 2: The Projection Model

mally in the model. This approach enables the model to have the necessary granularity to capture the aging related subcategories of the public finances, and to match the macro-fiscal projections of the authorities in the short-term at the same time.

Figure 3 shows a visual description of the real economy in the projection model. This structure considers an open economy environment, where capital is the mobile factor, and labor is not.² A discussion about the openness of the Bulgarian economy is provided in the Box 1. The output in period t is given by a standard Cobb-Douglas production function with constant returns to scale:

$$Y_t = F(K_t, L_t) = A_t K_t^\alpha L_t^{1-\alpha} \quad (1)$$

where $\alpha \in (0, 1)$ is capital's share in income. L_t denotes the supply of efficiency labor at time t , which is assumed to be exogenously determined as discussed above. Total factor productivity, A , grows at an equilibrium rate $\bar{g}_t^a$, however, it also carries permanent shocks:

$$A_t = A_{t-1} \times (1 + g_t^a) = A_0 \prod_{i=1}^t (1 + g_i^a) \quad (2)$$

where,

²This approach does not exclude the migration prospects, however, the migration estimations are exogenous to the model like the labor force projections. An estimate for the movement of labor across the border, e.g. out-migration or immigration, are incorporated in the baseline projections, and different magnitudes are investigated by alternative labor force scenarios. However, these provide a number of discrete cases only, where the labor supply is inelastic within each scenario.

[illegible]

where $\epsilon_i^a \sim iid(0, \sigma^a)$ is the shock to the productivity growth in period t . Capital stock at a given point in time is determined by the capital flows that respond to the interest rate differentials between the domestic and foreign economies. Let's denote the rest of the world interest rate by r_t^f , then, the equilibrium capital stock in the domestic economy will implicitly be defined by:

where λ_t denotes the risk premium in the domestic economy, and hat shows the equilibrium level of capital, which equalizes the domestic and international returns on investment. Given the exogenous labor supply, this equation uniquely defines the capital stock at time t . Following a productivity shock, or change in the labor force, capital inflows or outflows adjusts to equalize the risk adjusted returns to investment in the domestic economy with the rest of the world. We also consider case where this adjustment takes time, e.g. following a shock the economy moves in the direction of equilibrium without necessarily re-establishing the

interest rate parity in the short-term. However, this aspect is not central to the long term projections.

Note that because domestic savings are not explicitly characterized in the open economy model, the exact magnitudes of capital flows across the border are not identified. Box 1 discusses this and other implications of openness assumption. We also abstract from analyzing possible differentiation between the domestic and foreign taxation on capital over the the projection horizon, therefore, capital flow dynamics respond similarly to both gross and net returns to investment.

Box 1. On the Openness of the Bulgarian Economy

The long term macro-fiscal model presented here considers Bulgaria a small and open economy, where capital is the mobile factor. This means that the agents in Bulgarian economy take global prices as given, and whenever there are differences between the domestic and foreign returns to investment, capital will flow out or flow in to equalize the risk adjusted expected returns. For many developing countries this assumptions would not hold. However, Bulgaria demonstrates characteristics of an open economy to a large extent. In addition to the EU membership status, historically large foreign capital flows across the border imply that this assumption is not unrealistic. The following figure shows that capital flows has been more responsive to changes in the economic environment in Bulgaria than the averages of EU-10 and EU-15 countries within the last decade.

Box-Figure 1. Capital Flows as a Share of GDP

However, the open economy environment, along with no effort to solve the households' maximization problem, prevents us from tracing the source of investment in the domestic economy. Investments only respond to risk adjusted interest rate differentials between the domestic and global economies, and these investments are not necessarily financed by the Bulgarian household. In comparison, in a closed economy, all investment would need to be financed by domestic savings. Therefore, a closed economy would face an additional channel through which the demographic dynamics affect the macro-fiscal outcome in the economy. More broadly, the impact of aging on domestic savings and, hence, on investment and capital accumulation, is not uniform across countries. The magnitude of the impact, and even the direction of it, depends on the determinants of aging and the prevailing social security system. As shown by Dedry, Onder, and Pestieau (2014), a decline in fertility unambiguously fosters savings, whereas an increase in longevity in a society with flexible retirement age and pay-as-you go social security has an ambiguous effect on saving. Even though an increase in savings would be expected under reasonable assumptions, if the pensions system is rather generous, then a decrease in savings is also possible.

Figure 4: Labor Force Dynamics

2.1 Labor Force Dynamics

Total population is classified under 5 year age groups except the category of very old (80+ year old are aggregated into a single category). Let n_t^j be the number of Bulgarian citizens in the age category j in year t , where $j \in \{0-4, 5-9, \dots, 75-79, 80+\}$. Total population (N_t) is, then, composed of individuals that are employed (E_t), unemployed (U_t), and out of labor force R_t :

$$\underbrace{\sum_{j=0-4}^{80+} n_t^j}_{N_t} = \overbrace{\sum_{j=0-4}^{80+} e_t^j + \sum_{j=0-4}^{80+} u_t^j + \sum_{j=0-4}^{80+} r_t^j}^{\text{labor force}} \quad (5)$$

As shown in Figure 4, population in i 'th age group (n_t^i) also is composed of individuals that are employed (e_t^i), unemployed (u_t^i), and out of labor force r_t^i . Labor force participation and unemployment rates for each age group is given exogenously by the demographic projections from outside the model. Physical units of labor that are employed in a given year are, then, converted to efficiency units by incorporating the impact of schooling.

$$L_t = \exp(\lambda\phi_t) \sum_{j=0-4}^{80+} e_t^j \quad (6)$$

where, we denote the average years of schooling among the employed by ϕ_t in year t . The average years of schooling is magnified by the coefficient λ , which is conventionally inter-

preted as returns to education in a Mincerian framework. Therefore, L_t represents labor as a factor of production with embedded human capital.

2.2 Public Sector

Government collects taxes, receives non-tax revenues and grants, and provides public services in the model (Figure 5). For tractability, we do not explicitly model the impact of government expenditures on output apart from education expenditures, which increase the efficiency of labor.

Tax revenues comprise indirect taxes, τ^i , capital income taxes, τ^K , and labor income taxes, τ^L :

$$R_t = \tau^i Y_t + \tau^K r_t K_t + \tau^L w_t L_t \quad (7)$$

where, τ denotes the tax rate, and the superscripts i, K, L assign the type of tax, e.g. indirect, capital income, and labor income taxes, respectively. Factor prices, r and w are determined according to their marginal productivities:

$$r = MP_K = (1 - \tau^i) \alpha A K^{\alpha-1} L^{1-\alpha} \quad (8)$$

$$w = MP_L = (1 - \tau^i)(1 - \alpha) A K^\alpha L^{-\alpha} \quad (9)$$

The following government budget identity holds in all periods:

$$R_t + \Upsilon_t + \Delta D_t \equiv G_t + TR_t + iD_{t-1}$$

where the left hand side shows the revenues as a sum of tax revenues (R_t), non-tax revenues (Υ_t) that includes social security contributions, and net borrowings (ΔD_t) in period t . The right hand side, on the other hand, shows the government outlays as sum of government consumption including the education and health expenditures (G_t), transfers including the pensions (TR_t), and interest payments on outstanding debt iD_{t-1} . Box 2 and Box 3 discuss the methodology we use to calculate the age-related components of revenues and expenditures in more detail.

Figure 5: Public Sector and Debt Dynamics

(a) Public Sector

(b) Debt Dynamics

Box 2. Expenditure Projections

Projecting the healthcare expenditures is a challenging task. Demographic factors such as longevity and life expectancy are at the core of the analysis. However, several other factors including technological change and “health distribution” across age groups have substantial implications as well. In this study, we employ a simple technique to estimate the long-term changes in public healthcare expenditures. Total public healthcare expenditures at time t is given by:

$$G_t^H = \sum_{i=0-4}^{80+} \mu^i n_t^i y_t$$

where μ^i denotes the per person public expenditures as a share of income per capita in age group i . In order to calculate the total public healthcare expenditures, this share is multiplied by the average per capita income and the number of individuals in each cohort within the respective year. The μ 's for each cohort are estimated by using their share in public hospital care expenditures. The group shares are then converted to individual shares by dividing the number of individuals in each cohort, and then calculating the ratio of these shares in GDP per capita. This “pure demographic” approach relies on a number of implicit assumptions. First, the pattern of healthcare consumption remains constant as a share of income in all age groups over the projection horizon. This implies that health deterioration follows the same pattern as it does now. Second, technological progress in healthcare industry does not affect the demand for services. In the past, it was shown that technology is a major determinant of healthcare demand. However, as forecasting such technological change in a convincing way is not within the scope of this study, we abstract from this factor.

Education expenditures are also estimated using a similar methodology. First, per student public expenditures are calculated for each education level (primary, secondary, and tertiary) for the base year. Then, using the enrollment projections and per capita income growth, future expenditures are projected.

The transfers to the pension system are projected by using the PROST model of the World Bank. PROST estimates the pension fund deficit by using the demographic projections and a number of estimates from the real economy including the real wage growth rates. Therefore, in our simulations, demographic dynamics feed into the macro-fiscal model and PROST at the same time, and the results from the real economy component is used to feed into the PROST. Finally, the estimates from the PROST are fed back in our model for fiscal projections. This procedure is repeated for each scenario.

Box 3. Revenue Projections

Indirect taxes are held constant throughout the projection horizon with the exception of a small adjustment in the short term. In contrast, the direct tax revenues are assumed to exhibit a small and gradual increase as a share of GDP. This is to represent the effect of growth in per capita income, and not a change in the tax policy. Intuitively, as income grows more individuals pay taxes at a higher bracket, therefore tax revenues increase even in the absence of a change in the tax rates. However, in a model with homogenous agents and single tax bracket, this assumption necessarily translates into an increase in the tax rates over the long term. In order to see this, suppose tax revenues, both direct (DTR) and indirect (ITR), are given as:

$$DTR + ITR = \tau^i Y + \tau^K MP_K K + \tau^L MP_L L$$

Using the definitions of marginal products from equations 8 and 9, and rearranging, we get:

$$= \tau^i Y + (1 - \tau^i) Y [\alpha \tau^K + (1 - \alpha) \tau^L]$$

Finally, dividing by the output level, we get:

$$Y^{-1}(DTR + ITR) = \tau^i + (1 - \tau^i) [\alpha \tau^K + (1 - \alpha) \tau^L]$$

This result suggests that the share of direct and indirect tax revenues in GDP, together or separated, depends only on the corresponding tax rates and the factor's share in income. Therefore, increasing the direct tax revenues as a share of GDP in fiscal projections requires an adjustment in tax rates on the right hand side. However, this outcome is sensitive to the selection of the production function and assumption of homogenous agents in the economy.

Overall, this study does not consider the implications of tax policy issues in depth; however, it highlights the importance of tax reform over a demographic transition period for future studies.

3 Simulations

This section presents an overview of our numerical estimations. We first discuss the issues under the baseline assumptions, which reflect the outcomes in the absence of policy adjustments. Then, we compare three groups of scenarios in terms of their impact on macroeconomic and fiscal implications of demographic dynamics. At this point, before we proceed with the main results, it will be useful to summarize the underlying parameter calibrations.

Table 1 shows the values of parameters used in the model. These values are assigned according to conventions in the literature: the capital share in income is 30 percent, and returns to education within a Mincerian framework are 7 percent. Capital stock in the base year is,

Table 1: Parameter Values

Definition	Parameter	Value	Units
Capitals Share in Income	α	0.3	-
Standard Deviation of the Productivity Shock	σ^a	0.75	Percent
Returns to Education	λ	0.07	-
Base Year Capital Stock	K_0	0.2	Trillion US \$

on the other hand, calculated by using a capital output ratio of 2.55, which is close to the estimations of IMF Article IV Staff Appraisal Report.

Table 2 shows the macroeconomic and fiscal assumptions that apply throughout the projections with the exception of the baseline TFP growth. In the medium term, the TFP growth picks up from the current low levels as the economy recovers from the ongoing economic slowdown. In the longer term, as capacity utilization approaches its equilibrium level, the TFP growth also converges to its long-term level of 1.2 percent.

The open economy modeling environment makes it necessary to specify global rates of return to capital in the long run. We assume that gross returns to capital remain stable in the long term. In the meantime, the interest rate differential between the Bulgarian and global economy decreases from about 2.5 percentage points in the 2012 to about 0.1 percent by the end of projection horizon. This transition is determined by several factors including the current risk aversion of global investors, and economic and institutional convergence of Bulgarian economy with the rest of the EU, which should reduce the risk premium. Finally, we assume that the current unemployment rate will gradually converge to its long-term level of 5 percent just before 2040.

On the fiscal side, we impose a unitary elasticity of non-tax revenues, therefore, their share remains constant in GDP in the medium and long term. The only adjustment comes from a reduction from 4.8 percent in 2012 to 3.6 in 2015, which represents the expectations of the authorities as reported in the Medium Term Fiscal Framework of Government of Bulgaria (2012). Direct tax revenues are, on the other hand, projected to exhibit a gradual and modest improvement over time, increasing from 5.4 percent of GDP in 2012 to 6.5 percent in 2050. This improvement is in line with a progressive tax system: as the average income increases, tax payments will be made at higher brackets. Finally, the share of grants, which mainly comprises the EU grants, is estimated to first increase in the medium term, then decrease to about 3 percent as Bulgaria moves up the per capita income ladder.

Table 2: Assumptions Table

	2012	2015	2020	2025	2030	2035	2040	2045	2050
	<i>(Percent)</i>								
Baseline TFP Growth Rate	0.0	2.0	1.3	1.2	1.2	1.2	1.2	1.2	1.2
Global Interest Rate (Before Tax)	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5	4.5
Interest Rate Differential	2.5	2.5	2.3	2.2	1.7	1.2	0.6	0.3	0.1
Unemployment Rate	12.4	11.1	9.1	7.1	5.8	5.3	5.0	5.0	5.0
	<i>(Percent of GDP)</i>								
Direct Tax Revenues	5.4	5.5	5.9	6.1	6.3	6.4	6.4	6.5	6.5
Indirect Tax Revenues	17.2	16.4	16.2	16.2	16.2	16.2	16.2	16.2	16.2
Non-Tax Revenues	4.8	3.8	3.6	3.6	3.6	3.6	3.6	3.6	3.6
Grants	3.1	3.8	3.4	3.3	3.2	3.1	3.1	3.0	3.0
Contribution to EU Budget	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Other Expenditures	18.6	19.5	19.4	19.2	19.1	19.1	19.0	19.0	19.0

3.1 Baseline Projections

In this section, we present and discuss the baseline simulation results using the assumptions summarized above. Figure 6 displays the main characteristics of medium and long-term GDP growth. As TFP growth gradually slows down toward its long-term level, so does GDP growth. On average, the latter is expected to reach to about 2.6 percent in 2016, and then gradually decrease to about 1 percent in early 2040's, and 0.7 percent towards the end of the projection horizon. A Monte Carlo experiment shows that, in the long term, the growth rates are expected to remain within the band of 2.2 percent and 0.2 percent with a 90 percent degree of confidence.³ As a result, the GDP level is projected to grow from about US\$ 77 billion in 2012, to US\$ 126 billion in 2050, in real terms.

Panel (c) in Figure 6 decomposes GDP per capita growth into its main determinants. There are two interesting observations here. First, as the economy recovers from the current downturn, contributions from TFP growth also become positive and increase until reaching the long term level. Second, while the labor force diminishes during the entire projection period because of demographic transition, the falling employment ratio does not always reduce the growth rate in our projections. This is mainly driven by our unemployment rate assumptions. In the medium term, there are two opposing effects determining the net impact of the employment ratio on the GDP per capita growth rate. The reductions in labor force reduce the number of employed, whereas reductions in the unemployment rate increase it. In the medium term the latter effect dominates the former one. Therefore, employment ratio

³These simulations characterize TFP growth shocks that are identically and independently distributed with zero mean, and 0.75 percent standard deviations

contributes positively to the GDP per capita growth. However, once the unemployment rate reaches to its long term equilibrium, there is only the negative effect due to decreasing labor force, therefore, the impact on the growth becomes negative as well.

Given the macroeconomic estimates above, we now investigate the implications for fiscal balances. Figure 7 summarizes the fiscal outcomes under the baseline assumptions. As Panel (a) shows, the share of indirect revenues are kept constant at 16.2 percent of GDP in the long term, whereas the share of direct tax revenues increase from 5.4 percent in 2012 to 6.5 percent by 2050 as we discussed before. The shares of non-pension social security contributions and healthcare contributions exhibit a small decrease in the medium term, but by the end of the projection period they both reach back to their original levels of about 2 percent of GDP. On the expenditure side, the categories that are not related to population dynamics are kept constant as a share of GDP.

The evolution of aging-related public expenditures are displayed in Panel (c). Public expenditures for education decreases from 4.6 percent of GDP in 2012 to about 3.2 percent by 2050. This is mainly because of a reductions in the number of students. Total numbers of students in all levels of education were 1.03 million in 2012, however, this number is projected to decline to 527 thousand in 2050. Although per student education expenditures are assumed to grow at the same rate as GDP per capita, the reduction in student enrollment trickles down public education expenditures. However, this outcome implicitly assumes that the government will not face serious obstacles in reducing the public expenditures for education, hence there is no “political ratchet effect”. This may does not necessarily hold as public expenditures are generally rigid downwards.

In comparison, public healthcare expenditures demonstrate an upward trend throughout the projection period. Starting from about 4.1 percent in 2012, the share of public healthcare expenditures in GDP reaches to a little more than 5.1 percent by 2050. This increase arises from a combination of factors. First, the share of elderly people increases from about 25 percent of population in 2012 to about 38 percent by the end of projection horizon. Since the elderly population spend a larger share of their income for healthcare consumption, an increase in the average age of society increases the share of aggregate income spent for healthcare. Second, the healthcare consumption is assumed to have an elasticity higher than unitary with respect to per capita income (1.15). In this case, GDP per capita grows faster than GDP itself because of negative population growth rate. Therefore, even after controlling for the change in age composition, public healthcare expenditures still increase as a share of GDP. However, it is useful to remind ourselves that there are certain shortcomings in this approach. These include ignoring the impact of longevity on the health distribution

Figure 6: Macroeconomic Projections under the Baseline Assumptions

Table 3: Debt Dynamics Decomposition under the Baseline Scenario (Percentage Points)

	2015	2020	2025	2030	2035	2040	2045	2050
	<i>(percentage points)</i>							
Change in Debt to GDP Ratio	1.18	0.80	0.73	0.63	0.56	0.69	0.97	1.12
Growth Effect	-0.49	-0.48	-0.40	-0.43	-0.43	-0.39	-0.36	-0.33
Interest Payments	0.76	0.42	0.33	0.37	0.40	0.43	0.47	0.53
Primary Balance	0.85	0.86	0.80	0.68	0.59	0.65	0.86	0.91

across ages, and the impact of technological improvements in health services production on expenditures.

The next aging-related expenditure category in Panel (c) is the budget transfers to the pension fund. These transfers are comprised of two components. First, an amount that is proportional to the total current pension contributions from employee payrolls is transferred from the general budget to the pension fund, as enacted by law. Second, if the pension fund runs a current (accounting) deficit within a year, then the gap is closed by a second tier transfers from the general government budget within the same year. As shown in the graph, the sum of these two types of transfers exhibits a small decrease from about 6.1 percent of GDP in 2012 to about 4.9 percent in medium term, and then bounces back to reach about 5.6 percent by the end of projection horizon.

As demographic transition leads to a shift in both the composition and size of fiscal revenues and outlays, the next question is whether these changes pose a threat to fiscal sustainability. To this effect, we present simulation results that trace the evolution of primary balances, as well as the share of debt in the economy, which takes the debt dynamics into consideration. Panel (d) in Figure 7 shows that the fiscal budget continues to incur primary deficits throughout the projection horizon. Although there is a modest improvement in the medium term, it changes direction quickly, and the deficit remains close to 1 percent of GDP. As a result, the debt-to-GDP ratio increases from its current level of about 18 percent to about 51 percent by 2050. Even though this shows a substantial deterioration, this indicator, in itself, does not breach the common debt distress threshold identified in the literature, and it is also within the limits defined by Maastricht criteria. However, the protracted upward trend indicates that a breach of these thresholds is likely in a longer time span.

Table 3 shows the debt dynamics decomposition for the projection period. Protracted primary deficits, which follow the U-shape pattern in the transfers from general budget to the pension system, are the main driver of the change in debt-to-GDP ratio. The growth effect is large enough to counteract the burden imposed by the interest payments, however, in the long run it falls short of doing this.

Figure 7: Fiscal Projections under the Baseline Scenario

3.2 Alternative Scenarios

In this section, we consider alternative formulations of the main assumptions in the model. This exercise not only provides a robustness check for the baseline results, but also enables a comparison of policy options in terms of their impact on macroeconomic and fiscal outcomes in the medium and long term. We investigate three classes of scenarios: total factor productivity scenarios, labor force participation scenarios, and school enrollment scenarios.

Total Factor Productivity Scenarios

Total factor productivity growth is a particularly important determinant of the macro-fiscal outcomes in a situation where one or both factors of production shrink over time. Therefore, we include a robustness check where TFP growth rates either exceed or remain short of the levels characterized by the baseline. Panel (a) in Figure 8 displays the trajectories of these alternative TFP growth rates in comparison to the baseline.

The low TFP growth series are 0.15 percent smaller than the ones in the baseline case in the long-term. In the medium term, however, the differences change from 0.8 percent in 2016 at the largest, to 0.18 percent in 2021 at the smallest. The low TFP growth is similar to the averages of EU-27 countries projected by the European Commission (2012), and provides a useful benchmark. Minor differences between the two mainly lie in medium term dynamics, where the EU study employs a relatively stable TFP growth trajectory, whereas our estimates incorporate the current economic downturn and a projects a recovery in the medium term. These additions are reflected as lower TFP growth rates than the EU-27 average in the short term, and higher than those in the medium term.

The high TFP growth scenario assumes a TFP growth rate that is about 0.3 percentage point higher than the baseline scenario in the long term. With the exception of certain short and medium term dynamics as described above, the TFP growth projections in this scenario are similar to the Bulgaria specific projections by the same EC report.

Panel (b) in the same figure shows the associated GDP growth rates. Obviously, higher TFP growth rates translates into higher GDP growth rates as well. However, we should keep in mind that, the differences cannot be attributed solely to TFP. When TFP increases, marginal productivities of both production factors increase, which increase the real wages and interest earnings. In response, there will be capital inflows into an open economy. Therefore, a portion of the additional GDP growth is due to higher investment. As labor supply is assumed to be inelastic in our model, there is no additional contribution from that channel.

Figure 8: Total Factor Productivity Growth Scenarios

In the long run, high TFP growth scenario reduces the primary deficit as displayed in panel (e) of Figure 8, whereas a lower TFP growth scenario increases the deficit. As a result, the debt to GDP ratio decrease to about 45 percent in 2050 under the former scenario, whereas it increases to about 64 percent under the latter. In the absence of a policy change, this result suggests that if the Bulgarian economy does not outperform the EU27 average in terms of TFP growth, then, there is a substantial risk of breaching the Maastricht criterion in the long run, which limits the public debt to 60 percent of GDP.

In order to see what drives the impact on public finances under different TFP growth scenarios, we investigate the changes in the expenditure categories. Panel (c) that shows the evolution of public healthcare expenditures under each scenario. An interesting observation here is that higher productivity growth brings about greater expenditures for public health even as a share of GDP. To see the reason behind this, remember that public healthcare expenditures are assumed to grow by a rate proportional to the GDP per capita growth. In an economy with a shrinking population, other things being equal, GDP per capita grows faster than the GDP itself. In addition, when the income elasticity of public health expenditures is greater than unitary, the difference between GDP growth and GDP growth is carried onto the public expenditures in a more pronounced way. Higher TFP growth magnifies this effect, thus, boosting the public expenditures even as a share of GDP.

Next, we compare the budget transfers to the pension fund. As panel (d) shows, scenarios are sorted differently in this case. High TFP growth scenario generates a nominally greater pension fund deficit that needs to be financed by the transfers from the tax revenues of the general budget. This is because benefits are indexed to the real wage growth, and higher productivity growth increases the real wages faster. However, higher productivity growth also increases GDP faster, and in this case its contribution to the level of GDP at a point in time is comparatively larger than its effect on the pension fund deficit . Therefore, the amount of transfers as a share of GDP becomes smaller in the high TFP growth scenario *vis-a-vis* the baseline scenario. A similar logic explains why a lower TFP growth implies a greater burden for the fiscal budget levied by the social security system.

Labor Force Participation Scenarios

The size of population going forward is largely determined by exogenous factors including the changes in fertility and longevity. There is some scope for policy makers to have an impact on this, such as reforms in migration policies and incentives to increase fertility rates. However, these typically have a limited impact when the demographic pressures are strong. In comparison, labor force participation is potentially more responsive to changes in policies,

especially in countries with a sizable public pension system. Changing the statutory retirement age, encouraging beyond retirement work, and promoting further female participation in the labor force may all work to mitigate the adverse implications of aging to a certain extent. However, the degree of this impact depends on country specific characteristics.

This section introduces a number of alternative labor force participation scenarios to investigate the boundaries of policy impact in this area. The baseline labor force projections assume that the LFP rate for both men and women remain constant after 2020. This structure is in line with the current ILO projections. Here we introduce three alternative labor force trajectories, which reflect the likely impact of different policy combinations.

First, we discuss a “retirement age scenario”, where the statutory retirement ages are increased from 63 to 65 for men, and from 60 to 63 for women by 2017. This measure changes the LFP rates, especially of those between the old and new statutory retirement ages. Second, we consider a “high LFP scenario”, where, LFP rates are assumed to increase substantially in order to provide an upper bound of the analysis. To this effect, we build on the first scenario, and assume that in addition to the increasing retirement ages, the LFP rates converge to those of high LFP rate countries such as Iceland, Norway, Sweden, and Switzerland including all ages and both genders. Moreover, the average length of work life is assumed to be 10 years longer than the baseline case. Overall, this scenario implies LFP rates that exceed 80 percent even in the age group of 70 to 74. Finally, we consider the labor force projections of EuroStat along with the population projections for comparison.

Panel (a) in Figure 9 shows the labor force projections under each scenario. As expected, the high LFP scenario generates a labor force that is substantially larger than the baseline scenario, where the difference is more pronounced towards the end of our projection horizon. By 2050, the former scenario assumes about 470,000 more participants than the latter one. In comparison, the retirement age scenario generates a more modest contribution to the labor force. The additional labor force generated by increasing the retirement age reaches to a peak of 50,000 in 2024, which gradually decreases to about 38,000 in 2050. Finally, the Eurostat labor projections also exhibit an increasing difference over time, which reaches to about 171,000 by 2050.

The differences between these scenarios in terms of the labor force dynamics also reflect in the GDP growth trajectories in the medium and long term. Panel (b) in Figure 9 shows that, compared to other scenarios, the high labor force scenario brings about the greatest boost to GDP growth rate in the medium and long run. On average, the difference between the growth rates under the baseline and high LFP scenarios is about 0.5 percentage points per year. This eventually increases the GDP per capita from about 22,200 under the baseline to

Figure 9: Labor Force Scenarios

about 26.4 thousand in 2050. In comparison, the Eurostat LFP scenario contributes about 0.18 percent to the growth rate per year. In terms of income per capita, the results under the Eurostat is similar to the baseline case, mainly because the differences in the population size estimations towards the end of the projection horizon. The GDP growth impact of the retirement age scenario is an interesting case. Between 2020 and 2025, which is the time frame where the transition from the old retirement age to new retirement age actively increases the number of workers due to the reform, there is a substantial boost to the GDP growth, about 0.3 percentage point per year. However, once the reform is completed, the growth rate of the labor force is solely determined by the demographic dynamics again. Therefore, the GDP growth, in this case, is very similar to the ones under the baseline for the remaining projection period.

To see the fiscal implications of alternative labor force dynamics and associated differences in the real economy, we first investigate the impacts on public expenditures. As Panel (c) of Figure 9 shows, the high labor force scenario leads to a small increase in public expenditures for healthcare when compared to the baseline scenario. This is mainly because per capita GDP grows faster under this scenario; and this effect is magnified under greater than unitary elasticity of healthcare expenditures with respect to per capita income. Other alternative scenarios, retirement age and Eurostat labor force, also increase the healthcare expenditures, however, these impacts are small compared to the high labor force scenario. A similar outcome is observed in the case of budget transfers to the pension fund. Panel (d) shows that the higher labor force participation significantly reduces the transfers budget transfers to the pension fund as a share of GDP. There are several factors behind this outcome including the addition to the number of contributors, and relatively smaller rate of growth in real wages, which is used as a base for pension benefits, and higher GDP levels in the denominator. In comparison, retirement age scenario has a very small impact on transfers, whereas the Eurostat labor force projections have a moderate negative impact which is more pronounced towards the end of our projection horizon.

Panel (e) in the same figure shows the evolution of primary deficits over the projection horizon. As expected, the dynamics under high labor force scenario provide a relatively strong improvement in the primary balances. By the end of the projection horizon, the primary deficit is projected to be 0.75 percent of GDP under this scenario. Compared to 0.83 percent under the Eurostat LFP scenario, and about 0.91 under the baseline and retirement age scenarios, this presents a more favorable case. Differences across these cases mainly arise from the expenditure side. As shown in the Panel (f), these primary deficit projections are translated into lower debt to GDP ratio for the high LFP scenario (43.7 percent), and the Eurostat LFP scenario (49.4 percent) in comparison to the baseline and

retirement age scenarios (51.3 percent and 50.8 percent, respectively).

Our results in this section suggest that policies aimed at increasing the labor force participation can play a significant role in reducing the fiscal pressures arising from the aging demographics. It should also be noted that the higher labor force participation generates more income per person, hence better living standards, for the current and forthcoming generations of Bulgarian citizens. Moreover, it also enables the Government of Bulgaria to allocate more resources for education and healthcare services for its constituents without creating an additional burden on public finances. Therefore, boosting the labor force participation, as a policy option, has an advantage of both stimulating the economy and helping the public finances; a characteristic that is not true for many policy tools available to the government.

Education Scenarios

Human capital enters the production process directly via the efficiency labor. An interesting question is, then, to what extent can the Bulgarian policy makers compensate for the reduction in the physical labor by boosting the skill intensity of the remaining work force? In this section we consider such an option by running an education scenario.

As the Panel (a) in Figure 10 shows, school enrollment ratios in secondary and tertiary levels of education are assumed to increase over time, as opposed to the constant enrollment ratios under the baseline scenario. As a result, by 2050, the number of students graduating with a tertiary school diploma will increase from 88,000 under the baseline to 204,000 under the high education scenario. Similarly, the number of students graduating with a secondary school diploma will increase from 265,000 to 440,000. As a result, the average years of schooling of the current workforce will increase from about 11 years in 2012 to 12.2 years by 2050. In addition, we allow the labor force to respond to these changes considering the fact that labor force participation is higher among the higher educated segments of the society. The results of this flexibility is displayed in Panel (b), where the physical labor force under the high education scenarios is about 97,000 workers larger than the baseline scenario in addition to the human capital differences.

Panel (c) shows the estimated increase in public education expenditures that comes with an increase in the number of students. Education expenditures no longer decrease as a share of GDP as in the baseline case. On the contrary, it increases from a little above 4.6 percent in 2012 to near 5.1 percent in the medium term; and, then, decreases back to 4.5 percent by 2050. On the positive side, GDP growth is also boosted by the additional workers and human

capital. On average, this scenario generates an additional 0.23 percentage point growth rate after becoming effective around 2020. This effect becomes stronger towards the end of the projection horizon, and reaches nearly 0.4 percentage points in 2050. However, is this sufficient to offset the increase in education expenditures? The increase in public education expenditures does not deteriorate the public finances if a highly educated workforce enables the government to save from other public services. This is likely when a highly educated workforce enables the government to save on other public expenditures such as policing and hospital care. Empirical evidence shows that higher education is correlated with lower crime rates and more frequent practice of preventive care. Giving some credibility to this argument, our assessment is that a better educated workforce can help to make the public finances more sustainable in Bulgaria. Panel (e) shows that, on average, a more educated and productive workforce leads to a reduction in the primary deficit by about 0.15 percentage points per year. As a result, the debt to GDP ratio decreases from 51 percent in 2050 under the baseline to near 41 percent. It should also be noted that, there are also benefits in terms of higher living standards of the households as public services other than the education also increase because of higher per capita income.

There are, however, two issues that require further analysis in education: bringing more students to school may prove to be costly, and more schooling does not guarantee higher productivity. The education scenarios characterized here are based on certain assumptions. First, the projected increase in the school attainment is assumed to be feasible, e.g. not too costly. We assumed that bringing an additional child to school in the high education scenario will cost the same amount as an incumbent (children that would already be registered in the baseline scenario). In the case of Bulgaria, this assumption may be difficult to justify in the future. Certain minorities, especially Roma population, have high fertility but low school attainment rates. If this profile persists in the future, expanding school attainment may become increasingly costly. Second, we assume that school attainment in itself increases the productivity of the workforce. Again, this assumption may not hold in the case of a skill mismatch, e.g. the education system does not serve the business needs. Finally, the quality of education is at least as important as the quantity of graduates.

4 Conclusions

The findings in this paper suggest that an aging and shrinking population threatens the living standards and sustainability of the fiscal policies in Bulgaria. The reductions in the work force are estimated to depress economic growth in the long run. In the mean time,

Figure 10: School Enrollment Scenarios

an increasing old age dependency will lead to additional pressures on fiscal balances. These results will be magnified if productivity growth stalls. Our simulations show that if the Total Factor Productivity (TFP) growth in Bulgarian economy does not outperform the EU27 average, there is a substantial risk of breaching the Maastricht criterion in the long run, which limits the public debt to 60 percent of GDP. However, an essential point here is that, maintaining a high productivity growth is not an automatic process. It will require active policies and planning.

The Government of Bulgaria has access to policy instruments that can be effective in mitigating some of the consequences of demographic transition. Our analysis shows that policies that promote further labor force participation, boost productivity and technological progress, and increase the quality and coverage of education can help to reduce the negative impacts of demographic trends. Moreover, some of these policies, such as measures to induce higher labor force participation, have the advantage of stimulating the economy and helping the public finances at the same time. Therefore, with a carefully designed strategy, policies that have a long-term perspective can avoid the common short-term trade-offs.

The results also suggest that the timing of the policy actions are important as well. Demographic transition is a structural challenge that accumulates over generations. Therefore, more effective solutions also carry structural characteristics. Our simulations show that one-off measures, such as increasing the statutory female retirement age to match the male retirement age, provide some temporary relief from the burden of demographics in the medium term. However, in the long term, they are not as effective compared to measures that lead to an across-the board increase in labor force participation. Moreover, many effective measures entail early and continuing action. An important case is building human capital to compensate for the shrinking physical labor force, which involves better education outcomes over current and future generations. This report acknowledges the difficulty of implementing certain policy measures, especially when the economy is in downturn. To this effect, the analysis suggests that the forthcoming period of medium-term recovery provides an excellent opportunity to address critical structural issues in the economy. However, this requires developing a strategy with contingency plans, and sustained efforts to build up the capacity and coordination among the implementing agencies and institutions.

References

- [1] Dedry, A., Onder, H., and Pestieau, P. (2014), Aging, Social Security Design, and Capital Accumulation, unpublished.

- [2] European Commission (2012), The 2012 Ageing Report, Brussels: EC.
- [3] International Monetary Fund (2012), Article IV Consultation-Staff report, Washington, DC: IMF
- [4] Ministry of Finance of the Republic of Bulgaria (2012), Budget Forecast for the 2013-2015 Period, Sofia.
- [5] United Nations (2011), World Population Prospects: 2012 Revision, New York: UN.