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RESEARCH AND POLICY NOTES 2

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CNB CZECH NATIONAL BANK

RESEARCH AND POLICY NOTES

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2/2017

CNB RESEARCH AND POLICY NOTES

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Róbert Ambriško, Vilma Dingová, Michal Dvořák, Dana Hájková, Eva Hromádková, Kamila Kulhavá, Radka Štiková

Assessing the Fiscal Sustainability of the Czech Republic

Róbert Ambriško, Vilma Dingová, Michal Dvořák, Dana Hájková, Eva Hromádková, Kamila Kulhavá, and Radka Štiková*

Abstract

We present a model of public finance for the Czech Republic that addresses the main sources of risks to long-term fiscal sustainability: ageing-related expenditures and revenues, and the corresponding evolution of government debt. The baseline model is based on recent demographic projections issued by the Czech Statistical Office that forecast a shrinking share of the working-age population. Along with regulations and microeconomic incentives embedded in the tax and expenditure systems, demographic developments will affect economic growth and government expenditure and revenues in the long run. Population ageing is found to have a significant impact on future government expenditure via spending on old-age pensions and health care, where the cost profiles are modelled to reflect technological progress in the treatment of ageing-related illnesses. The analysis shows that under the current policy settings, a compound demographic effect will cause the primary government balance to turn negative at the beginning of the 2030s. The growing primary deficits, along with interest payments, which react to debt dynamics, will lead to a rapid escalation of government debt. While the outcome of the model is dependent on the specific settings of macroeconomic trends and policy variables, our wide range of sensitivity analyses show that without a policy response, even the most optimistic population scenario delivers an unsustainable path for public finances.

Abstrakt

V tomto článku popisujeme model veřejných financí České republiky, v rámci kterého se zaměřujeme na modelování hlavních zdrojů rizika pro dlouhodobou fiskální udržitelnost, tedy výdajů souvisejících se stárnutím populace a souvisejícím vývojem vládního dluhu. Základní model se odvíjí od aktuální demografické projekce Českého statistického úřadu, která předpovídá klesající podíl populace v produktivním věku. Demografický vývoj ovlivňuje ekonomický růst, vládní výdaje a příjmy v dlouhodobém horizontu v součinnosti s regulací a mikroekonomickými pobídkami vestavěnými v daňovém systému, resp. v systému vyplácení dávek. Stárnutí populace tak výrazně dopadá na budoucí vládní výdaje skrze starobní penze a výdaje na zdravotnictví, kde jsou náklady modelovány tak, aby odrážely technologický pokrok v léčbě nemocí spojených se stárnutím. Naše analýza ukazuje, že za předpokladu zachování současného nastavení parametrů fiskální politiky bude demografický vývoj od

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začátku 30. let 21. století implikovat záporné saldo primární bilance. Rostoucí primární deficity a související nárůst úrokových plateb pak povedou k rychlé eskalaci vládního dluhu. I když jsou kvantitativní výsledky modelu závislé na specifickém nastavení parametrů popisujících makroekonomický vývoj a fiskální politiku, široké spektrum našich citlivostních analýz ukazuje, že bez reakce hospodářské politiky i nejoptimističtější populační scénář implikuje neudržitelný vývoj veřejných financí.

JEL Codes: B6, B12, B52, Z80.

Keywords: Ageing, debt, demographics, fiscal sustainability, health care expenditure, old-age pension expenditure.

Nontechnical Summary

Population ageing will put pressures on public finance sustainability. The main channels of these pressures will be on both the expenditure and revenue sides of the general government balance. Government expenditures on old-age pensions and health care are those most influenced by ageing. At the same time, the increasing share of the beyond-working-age population will lead to an economic slowdown due to a shrinking labour force, and to lower tax receipts.

In this research note, we model the effects of these developments on Czech public finance sustainability. The model is built from several interconnected modules that result in a projection of the government debt path up to 2060. The key factor driving the long-term trends in Czech public finance is demographic developments. Therefore, great emphasis is put on the modelling of gender-age categories of the population relevant to the development of the labour force, which will influence the tax receipts of the government, and of the various recipient groups of government expenditure.

Demographic developments are linked to changes in the working population – and thus the productivity of the economy – in the GDP module of our model. The resulting GDP growth forecast then enters the modules for government revenues and expenditure.

Among government expenditures, old-age pension expenditure and health care expenditure will be crucially influenced by demographic developments. Ageing of the population will result in increasing numbers of old-age-pension-eligible people and increasing numbers of beneficiaries of the health care system whose health care cost profiles are the highest. This will lead to significantly increasing expenditure. The model is then closed by a module modelling interest payments. Interest paid on government debt reflects both the conditions on financial markets and the level of government debt.

In the baseline setting of our model, we evaluate the long-term sustainability of Czech public finance under the assumption of no policy change, which means the current settings of taxation and expenditure items. Given these conditions, and thanks to an advantageous initial debt level, the ratio of Czech government debt to GDP in our baseline outcome is predicted to decrease in the next 15 years. However, after that, from the early 2030s onwards, it will start increasing again as a result of growing expenditure linked primarily to population ageing and also to decelerating economic growth. In our baseline scenario, general government debt will reach 93% of GDP in 2060, with annual growth in terms of GDP of almost 4 percentage points. The general government deficit is expected to constantly exceed 3% of GDP as from 2044 and to reach more than 6% of GDP at the end of the period analysed.

Given the many assumptions and the static nature of our policy settings, we conduct several sensitivity analyses to demonstrate the effects of other trajectories in the underlying economic and demographic trends, and policy choices. Our sensitivity analyses show that even in the most optimistic demographic scenario, the debt/GDP ratio ultimately deteriorates beyond acceptable levels.

Public finance sustainability can have important repercussions for the monetary policy and financial stability goals pursued by the central bank. Since yields on government bonds continue to be anchored to monetary policy rates in our baseline scenario, monetary policy transmission

remains unaffected even when public finances deteriorate in the predicted way. However, this might change if further steps deepening the unsustainability problem lead to financial markets penalising the government via increases in government bond yields.

As regards financial stability, the projected unsustainable path of public finance constitutes a potential risk for bondholding financial institutions, a risk that might turn systemic. The dependence between financial stability and fiscal stability grows with increasing intensity of interaction between the financial sector and the government sector. The high share of government bonds in Czech financial institutions' balance sheets, both in absolute terms and in international comparison, therefore implies a need to closely monitor and evaluate the significance of sovereign risk, especially in the medium and long term.

1. Introduction

There is a clear need for the central bank to understand the impacts of fiscal policy on long-term developments in the real economy and the financial system. The central bank's main goals in terms of price and financial stability and smooth functioning of financial markets might be affected if the domestic fiscal setting is unsustainable. It is hence of high importance for monetary, macroprudential and regulatory policies to follow both the short- and long-term implications of fiscal policy.

Monetary policy considerations must cover the short-run effects of fiscal policy directly on the business cycle and its influence on transmission mechanisms, and, in the medium and long term, the impact of fiscal sustainability on the yield curve and, possibly, the threat of fiscal dominance. One key risk for monetary policy to follow is that of unsustainable public finance altering the functioning of monetary policy transmission through the lending channel. Higher and volatile yields on government debt might affect long-term interest rates in an unpredictable way, blurring the transmission to client rates, and/or influence profits and capital in the banking sector and thus the lending behaviour of commercial banks.

Central banks rely heavily on macroeconomic projections in achieving their goals, and behavioural changes and structural breaks might constitute a risk to their forecasts. An important factor that might alter economic mechanisms is that at certain levels of general government debt, the government might need to adjust its spending and investment habits either to comply with the legislation or to avoid increasing the risk premia on its securities. In the European Union context, fiscal discipline and sustainability is defined by simultaneous fulfilment of the deficit and debt limits under the Stability and Growth Pact. If government debt exceeds 60% of GDP, a country is expected to reduce its relative debt level at a satisfactory pace. In the Czech case, a change in government spending behaviour might be induced by the newly passed acts on budgetary responsibility, which entered into force in February 2017 and which introduce debt limits starting at 55% of GDP, after which the behaviour of government spending must be controlled.[1]

From the point of view of financial stability, it is important to monitor the link between government debt and banking portfolios. Government bonds issued to finance government debt are for sound economic reasons considered to be assets of high quality and high liquidity, and thus banks are important holders of government debt. The evidence of recent increases in government indebtedness in developed countries does not necessarily mean that debt tolerance has permanently increased, though. From the macroprudential perspective, debt sustainability is an area to monitor for sources of systemic risk, which is of crucial importance for financial systems where there is a high share of government bonds in financial institutions' balance sheets. Fiscal unsustainability may both reflect and cause banking crises. On the one hand, a financial bust may eventually lead to a sharp deterioration in public finances, as the government is the ultimate source of guarantees and support for the financial sector. On the other hand, a deterioration in fiscal sustainability and a fall in market confidence in the government's debt service ability can

[1] Act No. 23/2017 Coll., on fiscal responsibility rules, and the amending Act No. 24/2017 Coll., amending certain laws in connection with the adoption of fiscal responsibility regulations. The legislation introduces operative fiscal rules that will function permanently and a "backstop" rule regulating the situation if the ratio of general government debt to GDP increases above the defined limit of 55%. An Independent Budgetary Council will be established to evaluate whether or not the numerical fiscal rules have been complied with.

cause revaluation losses, increase financial institutions' funding costs, limit their access to domestic or foreign credit markets and/or lead to them defaulting. Political pressures can result in distressed banks being bailed out using public resources, aggravating the budgetary strain.

As regards fiscal sustainability in the Czech Republic, the obvious factor that will increasingly influence the balance between government revenues and expenditure is demographics. The Czech Republic will, like many other economies, face population ageing, which will gradually shift the balance between the working-age and non-working-age population towards an increase in the share of older people and thus in the old-age dependency ratio. The currently available demographic projections of the Czech Statistical Office imply a significant decline in the total population in all scenarios, with the share of elderly people increasing dramatically in the following decades. Such developments have impact on the size and composition of the labour force and consequently on GDP growth and corresponding tax revenues, as well as on selected types of government expenditure, such as pensions and health care and long-term care costs. Population ageing will bring about an increasing number of recipients of old-age pensions, rising health care costs and a decreasing number of people contributing to financing these systems. Without an adequate policy adjustment, this might lead to government debt increasing beyond sustainable levels. It is therefore necessary to look at the systematic and predictable trends in public finances that will influence the fiscal space in the Czech Republic in the future. By inspecting the problematic trends and sources of unsustainability, areas where further analytical focus is needed are identified.

In this research note, we design a model for evaluating the long-run sustainability of fiscal policy in the Czech Republic, reflecting demographic projections. The model has a structure of interconnected modules for the major macroeconomic and fiscal variables affecting long-term debt sustainability: (i) the labour force and economic growth, (ii) the primary balance as a result of government revenues and government primary expenditure, where the main focus is on spending on old-age pensions and health care, and (iii) interest payments. Since the baseline results of the model will clearly be conditional on more or less discretional assumptions about long-term macroeconomic developments, about the settings of policy variables and, importantly, about behavioural characteristics of the Czech population, we also present a range of scenarios that show the sensitivity of the model to selected assumptions.

The research note is structured in the following way. This introduction is followed in Section 2 by a summary of the analytical groundwork and findings in the field of fiscal implications of ageing. Then, in Section 3, the structure of the model of long-term fiscal sustainability and its building blocks are described, along with the main baseline results. Section 4 introduces several sensitivity scenarios, and Section 5 concludes.

2. Fiscal Sustainability in the Light of Population Ageing – What We Know So Far

The demographic risks to fiscal sustainability stemming from the population-ageing process have been at the forefront of the policy debate for the last decade. Although sustainability calculations in general require knowledge of the future evolution of debt and can therefore only be assessed with a high degree of uncertainty (Wyplosz, 2007), both international institutions and national

governments have been working on macroeconomic and microeconomic models to inform this debate.

On the global level, standards for analysing general government debt sustainability are set by the IMF (2013). In a recent paper, Clements et al. (2013) spell out the need for public pension reforms in the context of fiscal sustainability, singling out the importance of an increase in the retirement age. Their analysis, however, consists of an evaluation of a series of predefined risk scenarios and is focused more on the medium-term outlook, thus not allowing for full propagation of the impact of ageing.

In the European context, the most elaborate framework for the analysis of fiscal sustainability is provided by the European Commission in its Fiscal Sustainability Report (European Commission, 2015). It builds on a detailed analysis of demographic developments in the Ageing Report (European Commission, 2015). Its approach is based on the extrapolation and adjustment of current trends using detailed data from national sources. We rely heavily on its methodology in the development of our model; nevertheless, by focusing on the particularities of the Czech policy settings we are able to more accurately capture specific aspects of ageing in the Czech economy.

There are several links through which population ageing can affect economic growth and, consequently, the public finance of the economy. As reviewed in Bloom et al. (2010), the rationale for the negative effects of ageing on growth is based on the growth accounting calculation, where labour supply and savings (capital) decline with an increase in the elderly (and less productive) population. As Futagami and Nakajima (2002) point out, this implies that postponement of the retirement age may actually lower economic growth through the offsetting effect of ageing on the savings rate (Stoever, 2013). The structure of the economy also changes, as the service sector (especially health-related services) gains importance over industries providing consumer durables due to the different consumption demand of the elderly population. Finally, an older population also puts high pressure on social support systems (pensions, unemployment benefits) as well as health care costs (long-term and palliative care, new technologies), which, combined with lowered productivity, leads to a higher fiscal imbalance and an increase in debt.

One of the most interesting aspects of debt sustainability is the possibility of reverse causality leading from increasing debt to depressed growth. Rogoff and Reinhart (2010) find adverse effects of debt on growth for countries with debt of over 90% of GDP, while for "normal" debt levels they do not find a strong link. Similarly to other authors (Baum et al., 2013, among others) they confirm a non-linear empirical relationship between an economy's debt burden and its rate of growth. Based on these findings, growth-maximising general government debt ratios for euro area countries are found to be at about 50% of GDP (Checherita-Westphal et al., 2014). On the other hand, a recent paper by Pescatori et al. (2014) finds no evidence of a particular debt threshold above which medium-term growth prospects are compromised. The authors do, however, point out the importance of the debt trajectory, as countries with higher but declining debt seem to grow as fast as countries with lower debt.

Our model is developed for the purposes of evaluating the debt sustainability of fiscal policy in the Czech Republic. According to the assessment contained in the seminal study for our approach, the European Commission's Fiscal Sustainability Report (2016), the Czech Republic does not face a risk of fiscal stress in the short or medium term. On the other hand, the study warns that the Czech Republic is at medium risk in the long run, mainly due to the projected impact of age-

related public spending (health care and pensions), compounded by a slightly unfavourable initial budgetary position.[2] The conclusions of the European Commission's study thus validate the development of analytical tools focusing specifically on ageing-related issues. The Czech Republic, like other states in the CEE region, faces a rather gloomy outlook for its old-age dependency ratio. This is an important argument for analysing the sustainability of the public old-age pension system and of public finances as a whole.

There have been several analyses focused specifically on the Czech Republic, each having a different level of comprehensiveness of the factors considered.

Demographic developments and public old-age-related expenditures are explicitly analysed in Bezděk et al. (2005, 2010). The authors provide a projection of the state pension system in the Czech Republic up to the year 2100 and analyse the impact of possible reforms. The revenues of the pension system are based on the number of employed people and the implicit rate of pension contributions, while expenditures are derived from the number of pensioners and relevant pensions. The results reveal the weaknesses of the current system, in which a low degree of diversification combined with a high degree of solidarity lead to long-term unsustainability. The follow-up paper by Bezděk et al. (2010) restates the previous findings and proposes several reform steps to achieve fiscal sustainability and a fairer distribution of the inter-generational burden over time. On the other hand, Janský and Schneider (2012) point out that the Czech government debt is unsustainable even after significant parametric changes are made to the pension system. They estimate that for government debt to be at 40% of GDP in 2050 (i.e. to remain at the current level), the size of the fiscal gap is 2.2% of GDP. This is the size of the immediate permanent fiscal measures required to stabilise the ratio of debt to GDP. Obviously, any postponement of the fiscal adjustment increases the required size in the future.

The Ministry of Finance of the Czech Republic comments regularly on public finance sustainability in its Fiscal Outlook. In addition, it has published two informative studies about pension projections (Marval and Štork, 2012 and 2015). The latter study shows the public pension account deficit and the outlook for its further deterioration up to 2060. Further detailed information about the economics of the Czech pension system is provided in Ministry of Finance (2014), while Ministry of Finance (2016a) provides a detailed long-term projection of health care expenditure. The no-policy-change baseline scenario in Ministry of Finance (2016a) implies that general government expenditure on health care in the Czech Republic will increase from 5.5% of GDP in 2014 to 6.7% of GDP in 2060.

A comprehensive approach is presented by Kamenik et al. (2013), who developed a DSGE-type model with endogenous fiscal policy and applied it to data from Austria, the Czech Republic and Germany. Their model contains fiscal rules linking the structural deficit to deviation from debt targets and allows for interlinkages between fiscal and monetary policy. The authors find that the fiscal behaviour in the Czech Republic during 1999–2010 corresponded to an implicit debt target of around 50% of GDP and that the Czech Republic faces a serious risk of divergent interest payments. Their model, however, does not account for demographic change.

[2] European Commission (2016) works with 2015 data.

Babecký and Dybczak (2009), on the other hand, are able to account for ageing effects in their calibrated overlapping generations model. They consider various fiscal policy set-ups and, in a structural framework, analyse the effect on aggregate economic variables such as employment, the real interest rate and domestic assets (which, in the case of the Czech Republic, accrue to government bonds). The sustainability of the system is evaluated implicitly by estimating the amendments needed to keep the current system financially balanced. With this objective, the authors focus on the design of the most efficient pension system.

The current study puts detailed modelling of old-age pension and health care expenditure into the context of macroeconomic growth, which is simultaneously influenced by demographic developments, and the resulting evolution of the general government balance and debt. The aim is to create a workhorse model that can be repeatedly used to easily and schematically analyse the sustainability of Czech public finances and its risk factors.

3. Fiscal Sustainability Model

In this section, we describe a simplified model of the Czech economy that will serve as a benchmark tool for the evaluation of the long-term fiscal sustainability of public finance. Our model starts with the evolution of government debt:

$$D_t = D_{t-1} - PB_t + IP_t + SFA_t \tag{3.1}$$

where D_t is the level of government debt, PB_t is the primary balance, IP_t are interest payments on government debt and SFA_t are stock-flow adjustments[3] between the government budget balance and the change in government debt. This equation can be expressed in GDP ratios:

$$\frac{D_t}{Y_t} = \frac{D_{t-1}}{Y_{t-1}} - \frac{PB_t}{Y_t} + \frac{D_{t-1}}{Y_{t-1}} \frac{i_t - y_t}{1 + y_t} + \frac{SFA_t}{Y_t} \tag{3.2}$$

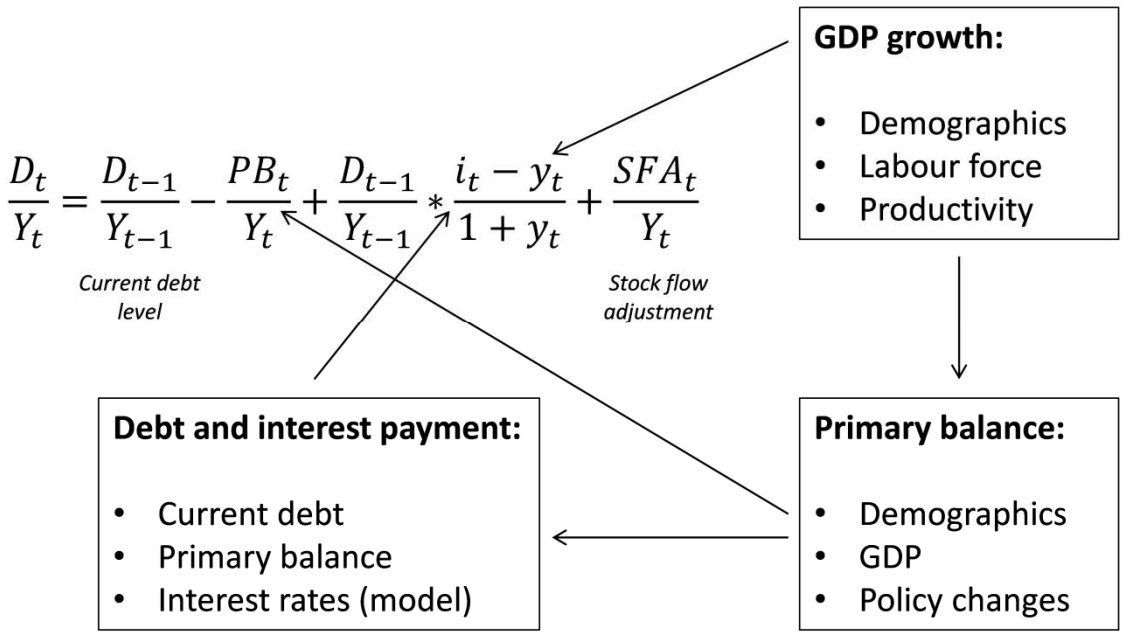
where Y_t is the nominal GDP level, y_t is the nominal GDP growth rate and i_t is the implicit interest rate paid on government debt. So, the debt ratio is a function of the debt ratio in the previous period, the primary balance, the interest rate growth differential and stock-flow adjustments.[4]

The model has a structure of interconnected modules for several macroeconomic and fiscal variables affecting long-term debt sustainability, as stated in Equation 3.2 and Figure 1.

[3] Stock-flow adjustment (SFA) is the difference between the change in government debt and the government deficit/surplus for a given period and reflects net acquisition of financial assets and valuation effects.

[4] The role of stock-flow adjustments is neglected in our long-term model, because they are often associated with one-off transactions such as privatisation proceeds, which are hard to predict.

Figure 1: Structure of the Model



In the GDP module, we link demographic developments to changes in the working population and thus the productivity of the economy. The resulting GDP growth forecast enters the government primary balance module, which sums government revenues and expenditures to create annual fiscal balances. Government debt, debt service and the corresponding fiscal balance close the model, with the main variable of interest being the debt/GDP ratio. Monetary policy is exogenous and neutral in the model. While this structure does not allow for a fully endogenised model in the sense of Kamenik et al. (2013), we are able to explicitly model the effect of demographic change at the cohort level. This type of model is primarily designed to capture long-term trends and/or the long-term implications of economic shocks or policy changes.

To ensure that our long-term analysis is not influenced by the business cycle dynamics at the starting point, we use the medium-term CNB macroeconomic forecast to account for these dynamics and apply the long-term trends and structural developments thereafter. Therefore, in our projection of macroeconomic and fiscal variables, we methodologically distinguish two periods: the forecasting period (covering the years 2016–2018), where we incorporate the detailed medium-term macroeconomic forecast of the Czech National Bank, and the projection period (2019–2060), where long-term trends and relations prevail.

We describe the key model variables and the interactions between them in the next subsections.

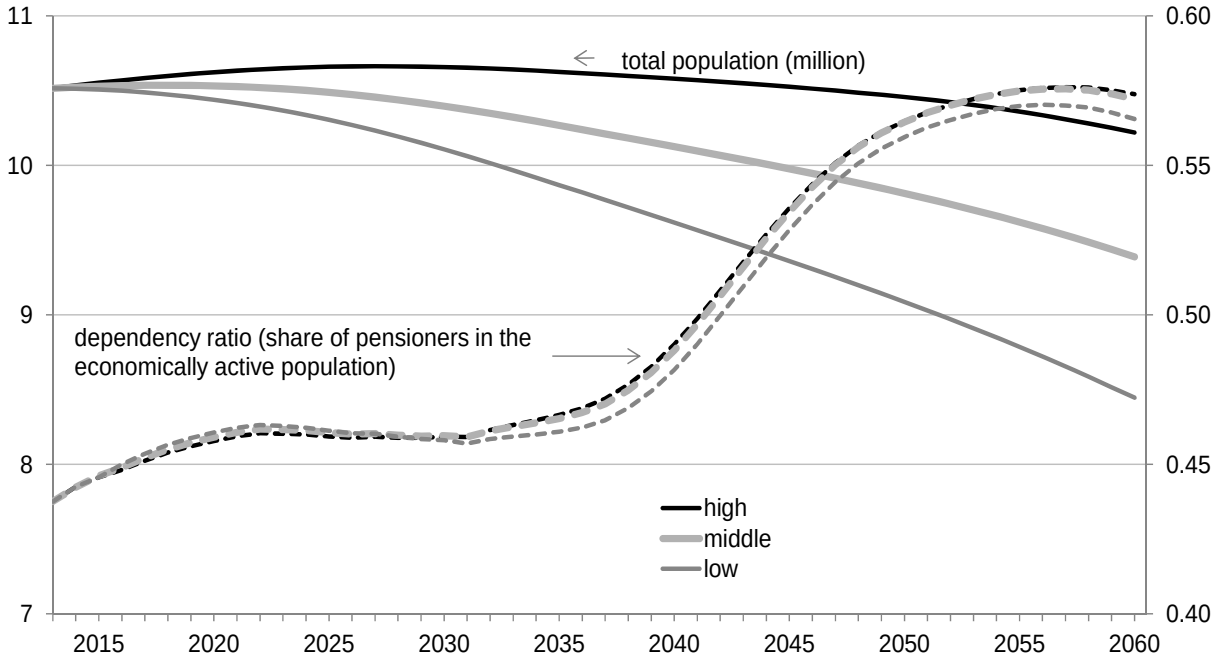
3.1 Demographics and Economic Growth

In the long run, according to the Solow (1956) model, the economy reaches its balanced growth path, where capital per worker grows at the same pace as the labour-augmenting process. Thus,

real GDP growth in our model is determined by two factors only – the size and the productivity of the labour force.

When predicting the size of the labour force, we work with the demographic projections created for all age/gender categories by the Czech Statistical Office.[5] These predictions come in three alternative scenarios for population growth (low, middle and high), based on three defining assumptions – fertility, life expectancy and migration. The implications of the alternative population scenarios for the total population and the old-age dependency ratio are depicted in Figure 2. For the baseline model, we decided to use the middle scenario, which operates with fertility slightly increasing over time and with an 8-year increase in life expectancy between 2015 and 2060.[6] In this scenario, the size of the population gradually shrinks from 10.5 million people in 2013 to 9.3 million in 2060, and the old-age dependency ratio (defined as the share of pensioners in the economically active population) rises from 0.44 in 2013 to 0.57 in 2060, mainly due to a relatively rapid increase in the share of citizens older than 65 years.

Figure 2: Population Projection Scenarios – Total Population and the Dependency Ratio (right-hand scale)



Source: Czech National Bank (CNB), Czech Statistical Office (CZSO).

From the population projection, we derive projections of the size of the labour force and the number of pensioners. The economic theory predicts that labour force participation depends on several factors, including social ones (length of schooling, length of maternity leave), economic ones (substitution and income effects of labour taxation, take-up rates for part-time employment) and institutional ones (changes in the effective age of retirement). In the baseline model, we primarily focus on institutional factors by incorporating the adjustment of current labour force

[5] The projections and their assumptions are available at https://www.czso.cz/csu/czso/projekce-obyvatelstva-ceske-republiky-do-roku-2100-n-fu4s64b8h4.

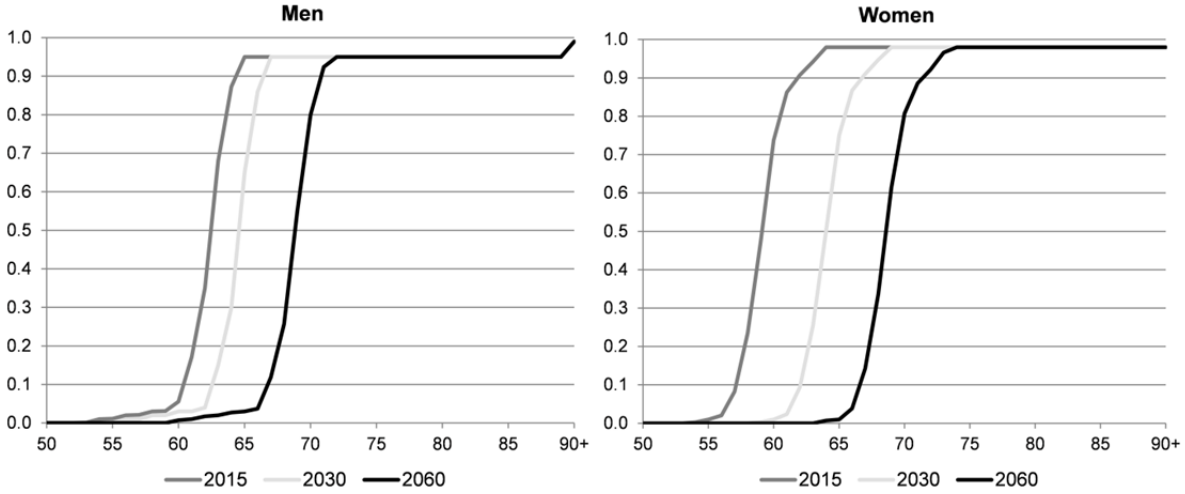
[6] The migration balance is unimportant in the case of the Czech Republic.

participation rates due to the increase in the statutory retirement age as implied by the current legislation.[7]

We model the number of pensioners in different age/gender categories separately for men and women, since their legal retirement ages and their effective retirement patterns are different. The current legislation also differentiates the retirement age for women according to the number of children raised. For the sake of simplicity, it is assumed that the legal retirement age for women equals the representative profile valid for a woman who raised two children. The legal retirement age is expected to be unified for women and men as of the year 2030.

The data show that some workers retire early and some choose to retire later than the official legal retirement age. These retirement patterns are reflected in our prediction of the number of pensioners, where a continuous probabilistic profile around the legal retirement age is assumed according to the type of retiring person (see Figure 3). For instance, in 2015, out of the women who turned 60 years of age, i.e. who reached the official legal retirement age, only 74% entered retirement; the rest of them remained in the labour force. In 2015, out of the women aged 58 years, 24% of them had opted for earlier retirement. The probabilistic profiles are somewhat steeper for men than for women, since men have a higher probability of retiring early.[8] Age-gender probabilistic profiles are then applied to our population projection to estimate the number of pensioners over time. In each year, it is also possible to estimate newcomers in the pension system.

Figure 3: Probability of Exit from the Labour Force around the Retirement Age



Note: People retired from the armed forces are not covered.
Source: CNB, Czech Social Security Administration (CSSA).

In order to project the size of the labour force, we combine our projection of retirement patterns with the current economic activity profile to predict its evolution over time, as depicted in Figure 4. For younger age groups, we assume that the labour force participation profile remains as in

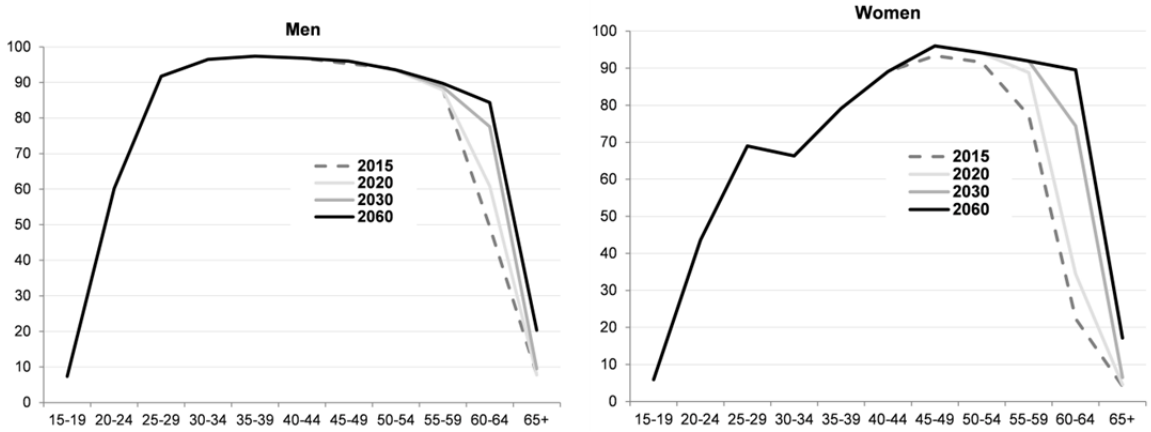
[7] Described in Article 32 of Act No. 155/1995 Coll., on pension insurance.

[8] The probability of exit from the labour force is slightly undervalued for men around the retirement age in Figure 3 because of no coverage of army employment. However, this does not have implications for the sustainability analysis.

2015, i.e. a relatively small share at younger age as a reflection of increased enrolment into education, and a sharp decline in economic activity for women in their thirties as a result of maternity leave. At older ages, the share of people that remain in the labour force increases in line with the current retirement age legislation. We also account for exit from the labour force due to disability.[9]

Turning to labour force productivity, we employ its forecasted development as used for the Czech Republic in European Commission (2014). It implies gradual convergence from the currently observed yearly labour productivity growth of around 3% to the long-term historical averages in the EU. We do not adjust labour productivity for the effect of ageing; this equates to assuming that productivity remains the same during the productive part of the life of every person.

Figure 4: Economic Activity by Age Group (% of the population)

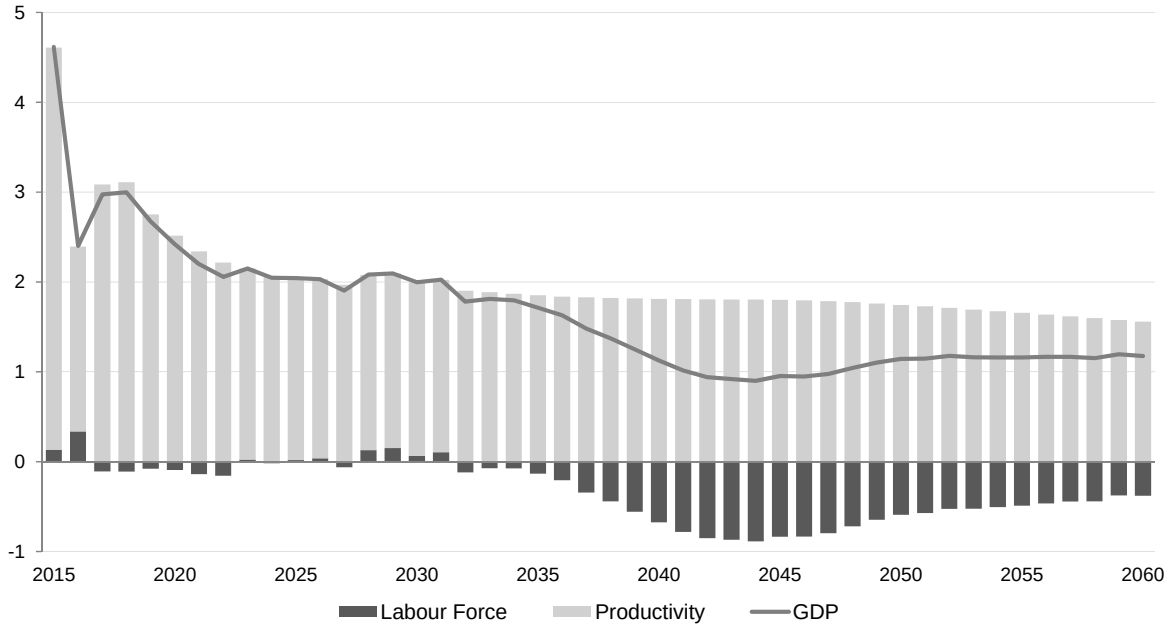


Source: CZSO – Labour Force Survey.

The projection of real GDP growth is shown in Figure 5. In the coming years, slowing labour productivity will gradually reduce real GDP growth to 2%, where it will stay until 2030. Afterwards, real GDP growth decelerates further to approximately 1% in 2040–2045, mainly due to a shrinking labour force, and then rises slightly. For the computation of nominal GDP growth, the GDP deflator is taken from the CNB's forecast, and in the projection period (2019 onwards) it is assumed to gradually converge to the inflation target of 2%.

[9] Data from the Czech Social Security Administration suggest that starting from 50 years of age, the probability of getting a disability pension is a linear function of age.

Figure 5: Productivity, the Labour Force and Real GDP (annual change in %, contributions in percentage points)

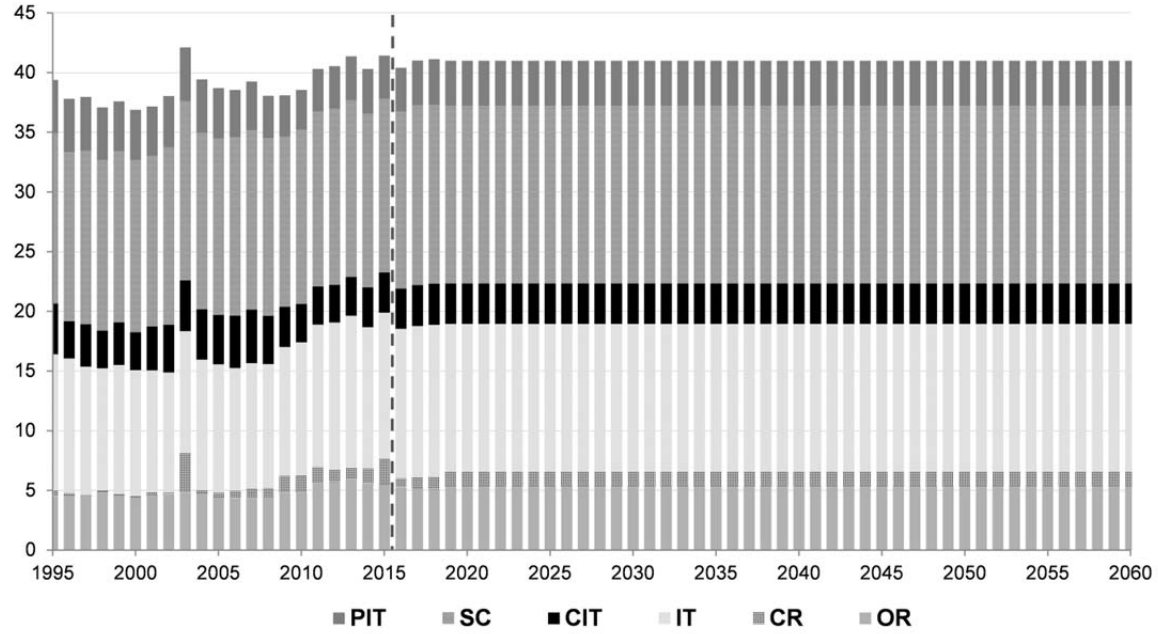


Source: CNB, European Commission.

3.2 Government Revenues

Government revenues are closely linked to the economic cycle. In the forecasting period (2016–2018), government revenues are consistent with the CNB's current forecast and reflect the parameters of the current legislation and other assumptions about future developments (e.g. the drawdown of European funds). In the projection period that follows, government revenues grow in line with nominal GDP, as the capital and labour shares in GDP remain constant, as do the marginal tax rates. The other categories of tax revenues, including indirect taxes, are assumed to maintain a constant share of GDP in the projection period. Their long-term shares in GDP are set at the average over the period 2014–2018, which reflects the initial conditions and planned tax changes by 2018. No changes in tax policy are assumed in the projection period. The projection of main government revenues, depicted in Figure 6, shows that total government revenues remain at about 41% of GDP.

Figure 6: Government Revenues (% of nominal GDP)



Note: Personal income tax (PIT), social security contributions (SC), corporate income tax (CIT), indirect taxes (IT), capital revenue (CR), other revenues (OR).

Source: CNB, CZSO.

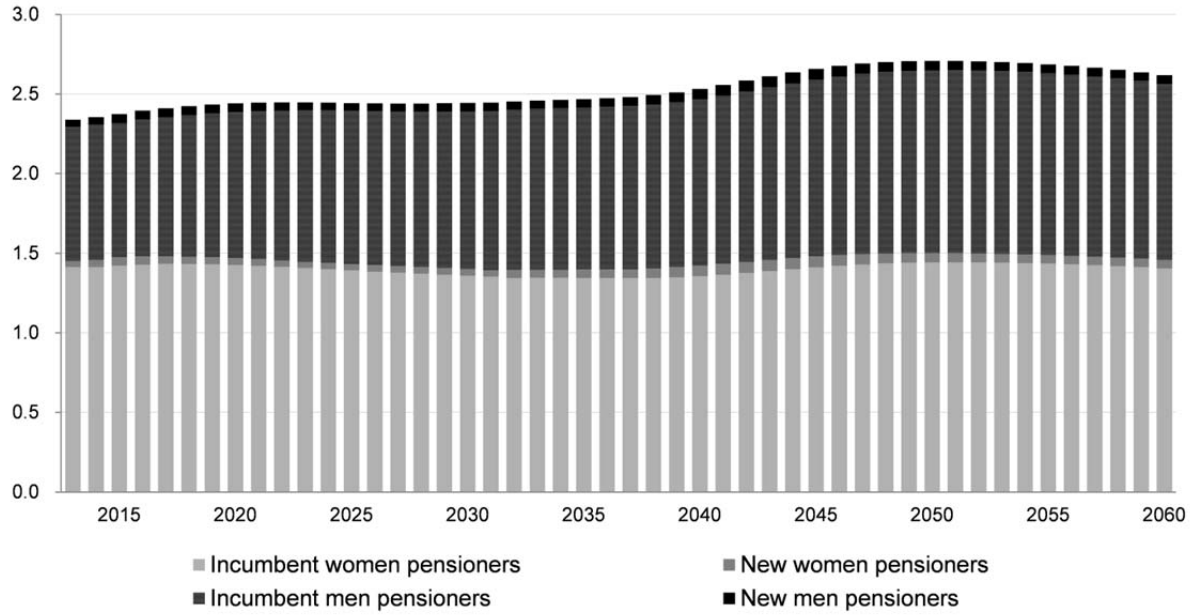
3.3 Government Primary Expenditure

As regards government primary expenditure (government expenditure excluding interest payments), our modelling focus is on two categories that are affected mostly by demographic change: old-age pensions and health care costs.

The total volume of disbursed old-age pensions in our prediction depends on the predicted number of pensioners, as estimated from the demographic projection and described earlier, and on the evolution of the average pension paid to new pensioners and the valorisation of outstanding pensions.

The expected number of pensioners ensues from the different age/gender categories obtained alongside the prediction of the labour force, divided into new and incumbent pensioners (Figure 7). The number of pensioners is projected to be stable over the period 2020–2035; afterwards it rises, peaking at 2.7 million in 2050, and then decreases slightly.

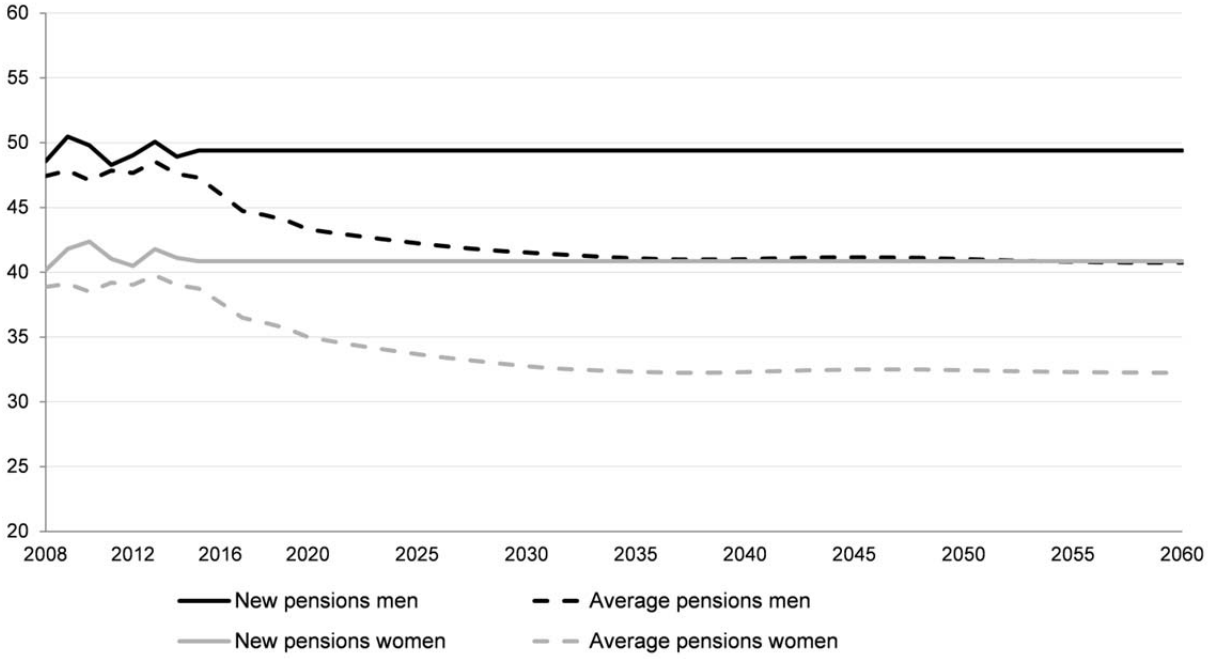
Figure 7: Number of Pensioners (millions)



Source: CNB, CSSA, CZSO.

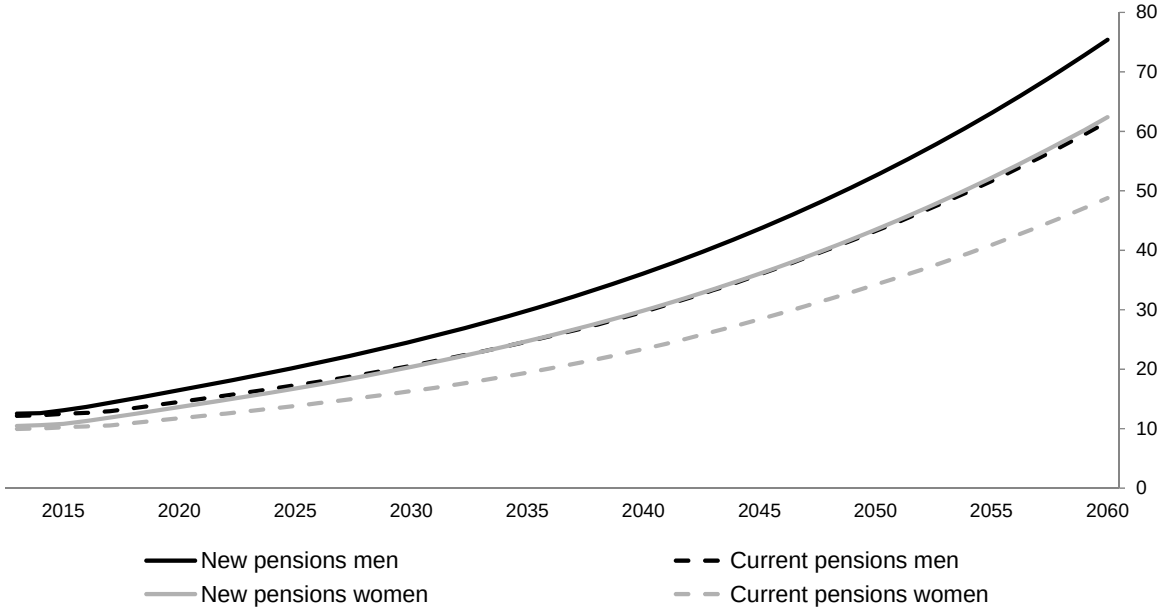
The valorisation scheme assumed for incumbent pensioners follows the current legislative parameters, which assumes yearly adjustment of the average outstanding old-age pension for the sum of observed inflation and 1/3 of the growth in the real wage. New pensions are set based on the assumed replacement rate, which is a policy variable that equals the level of the average newly granted pension as a share of the worker's pre-retirement gross income. In the projection it is assumed that the gender-specific replacement rate will stay constant at its historical average over the period 2000–2014, which is approximately 49.4% of the average wage in the economy for men and 40.9% for women (see Figure 8). The scenario assumed for the valorisation scheme and the replacement rate leads to the ratio of the average pension to the gross wage decreasing until 2035 and being broadly stable thereafter. The stabilisation of the ratio results from the combination of demographic developments and the valorisation scheme. The projected average monthly pensions for new and incumbent pensioners and for women and men are depicted in Figure 9.

Figure 8: Replacement Rate (%)



Source: CNB, CSSA, CZSO.

Figure 9: Average Monthly Pension (CZK thousands)

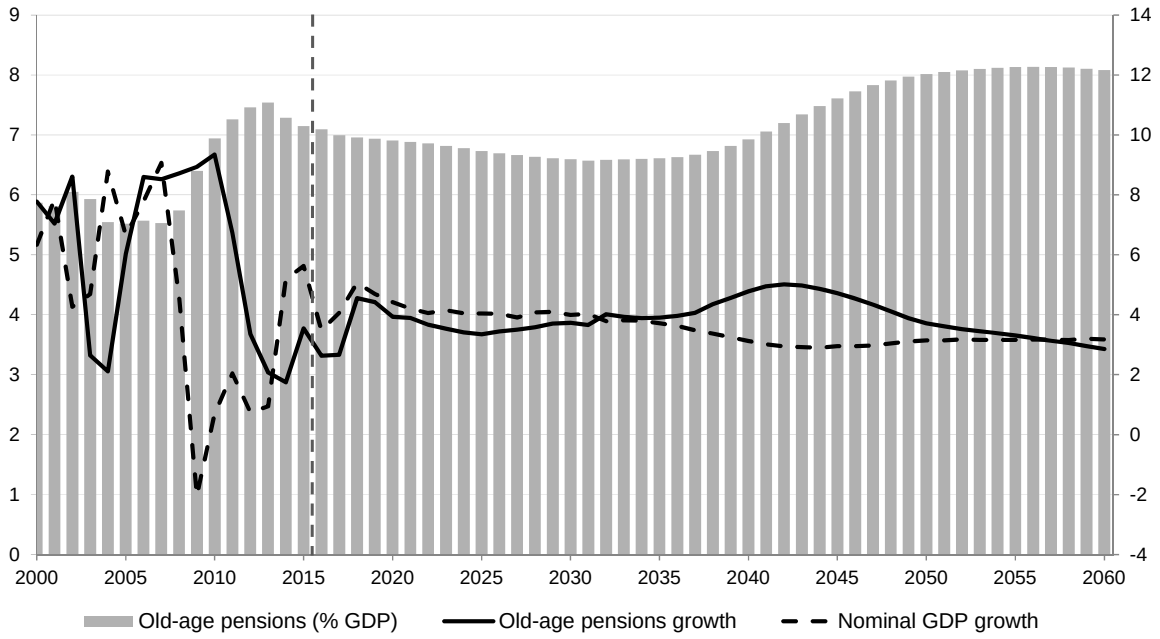


Source: CNB, CSSA, CZSO.

Having predicted the number of pensioners and average monthly pensions, expenditure on old-age pensions is calculated, which is shown in Figure 10. The ratio of old-age pensions to GDP is slightly decreasing from current levels until around 2030, due to nominal GDP growth outpacing growth in old-age pensions. As of 2035, this ratio starts to rise significantly, due to both an increased number of pensioners and a slowdown in nominal GDP growth. Old-age pensions as a share of GDP are expected to peak at 8.1% around the 2050s. Between 2030 and 2050, the

volume of old-age pensions will increase by 1.4% of GDP, which will put considerable pressure on Czech public finance.

Figure 10: Old-age Pensions (% of nominal GDP), Annual Growth of Old-age Pensions and Nominal GDP (%, right-hand scale)



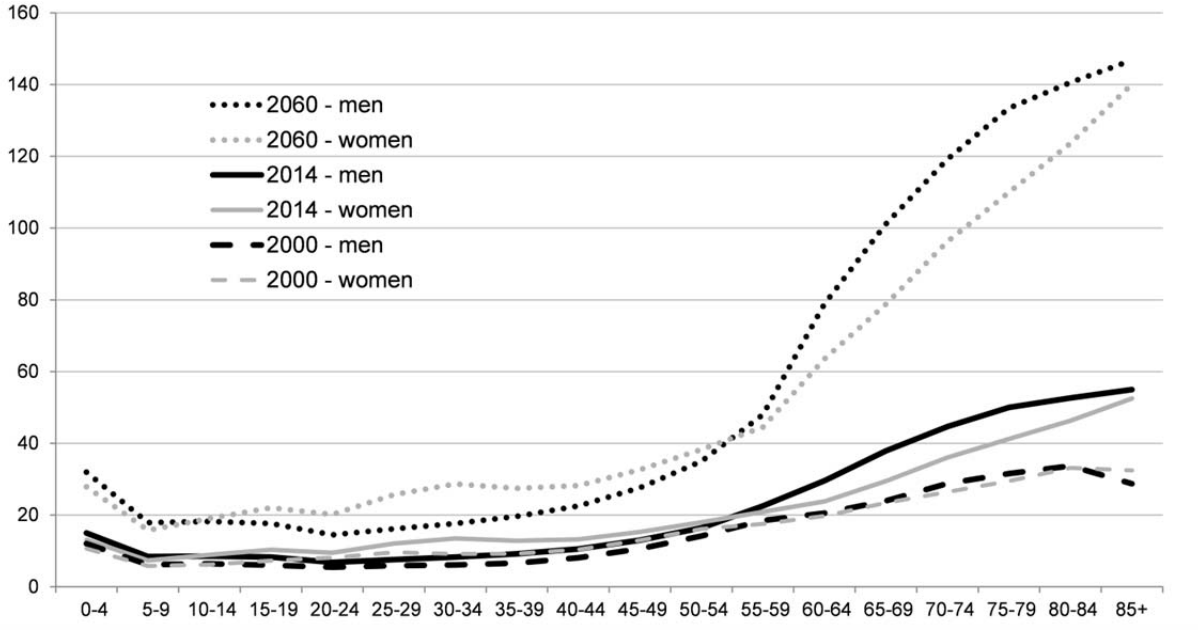
Source: CNB, CSSA, CZSO.

Health care costs are calculated as the product of the predicted number of people in each age/gender group and their respective cost profiles. The current values of health care costs per person in the public insurance system are based on CZSO Health Accounts data.[10] The assumptions underlying their prediction reflect a plausible scenario of future developments in the health care sector. In the baseline, we assume that health care costs grow at the same rate as GDP in the younger age categories and faster in the 60+ age category (1.5 times the GDP growth rate) due to technological progress in the treatment of ageing-related illnesses. Moreover, this mirrors the actual trend in the Czech data, which is summarised in Figure 11. Here, we can also see differences in utilisation patterns between genders – women tend to have higher costs at younger age (related to pregnancy), whereas men incur higher costs at older age, mainly due to a higher prevalence of cardiovascular problems. The rise in health care costs will gradually lead to a significant increase in public health care expenditure and to a dominant weight of older people in public health care expenditure (Figure 12). The share of health care expenditure in GDP gradually increases to just below 10% in 2060.[11]

[10] Available (in Czech) in Czech Statistical Office (2015).

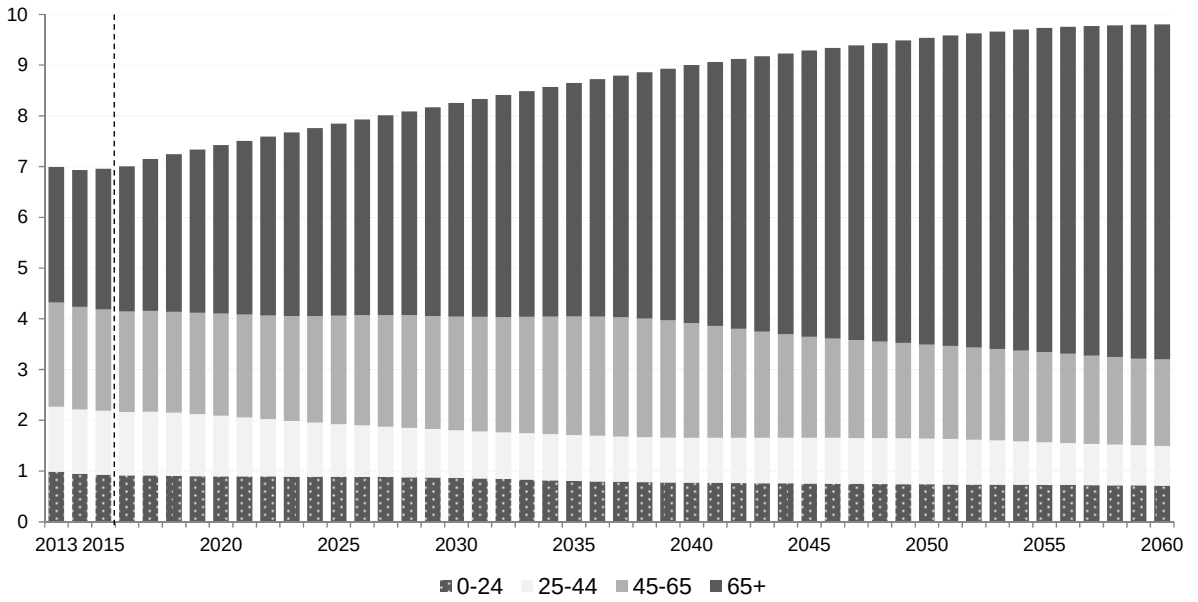
[11] Our results are somewhat more pessimistic than those in European Commission (2015), where health care costs vary between 6.1% and 8.6% of GDP in various scenarios. The difference is caused by different population scenarios (the EUROPOP prediction used in European Commission, 2015, assumes higher fertility) and by different cost profiles in health care.

Figure 11: Health Care Cost Profile by Age-gender Category (CZK thousands, 2005 prices)



Source: CZSO, Integrated Health Information Systems (IHIS).

Figure 12: Government Expenditure on Health Care by Age Category (% of nominal GDP)



Source: CZSO, IHIS.

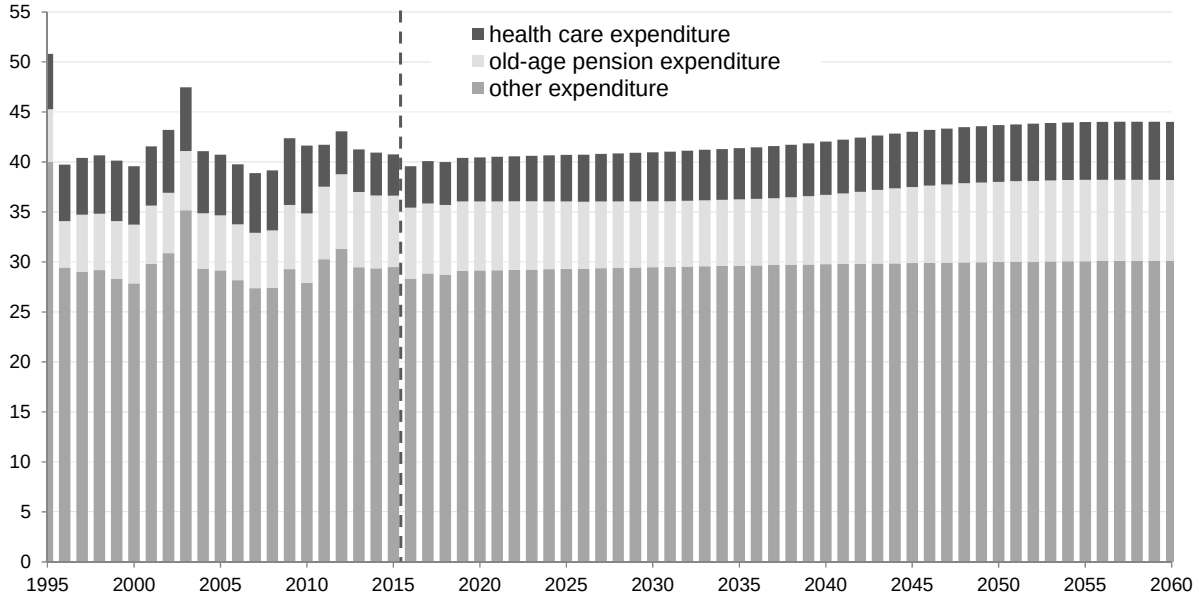
Besides expenditure on old-age pensions and health care, social payments in the Czech Republic also comprise illness benefits, invalidity pensions and survivors' pensions. The ratio of illness benefits and invalidity pensions to GDP was 2% in 2014 (the most up-to-date information) and is assumed to stay the same in the following years. Survivors' pensions represented approximately 0.7% of GDP throughout 2012–2014 and are expected to remain at this level from 2015 onwards. For unemployment benefits, which stood at 0.2% of GDP in 2014–2015, we use the CNB's current forecast for the period up to 2018; after that, a constant share in GDP is also assumed. In a similar way, other social payments and capital expenditure during the forecasting period are taken

from the CNB's forecast, whereas in the projection period they are assumed to maintain a constant share of GDP, which is set as the average over the period 2014–2018.[12]

Several categories of government expenditure – subsidies, compensation of employees, intermediate consumption and other current expenditure – involve a health care component. Examples include subsidies payable to hospitals, wages and salaries of doctors, intermediate consumption and other expenditure made by hospitals. Therefore, the predictions of these types of government expenditure are set in a manner that accounts for their specificity. In the forecasting period up to 2018, these expenditures are taken from the CNB's forecast. Thereafter, the health care component of these government expenditures is assumed to grow in line with health care costs. In other words, higher expenditure on hospitals is warranted with rising expenditure on health care. The non-health care component of selected government expenditures maintains a constant share of GDP in the projection period, proceeding from the average shares over 2014–2018.[13]

The projection of the main categories of government primary expenditure is shown in Figure 13. Total government expenditure excluding interest payments is expected to rise from 39.6% of GDP in 2016 to 44.0% of GDP in 2060, driven mainly by increasing expenditure on old-age pensions and health care. There is also some increase in the share of other expenditure, since subsidies and other current expenditure, compensation of employees and intermediate consumption involve a rising health care component.

Figure 13: Government Expenditure Excluding Interest Payments (% of nominal GDP)



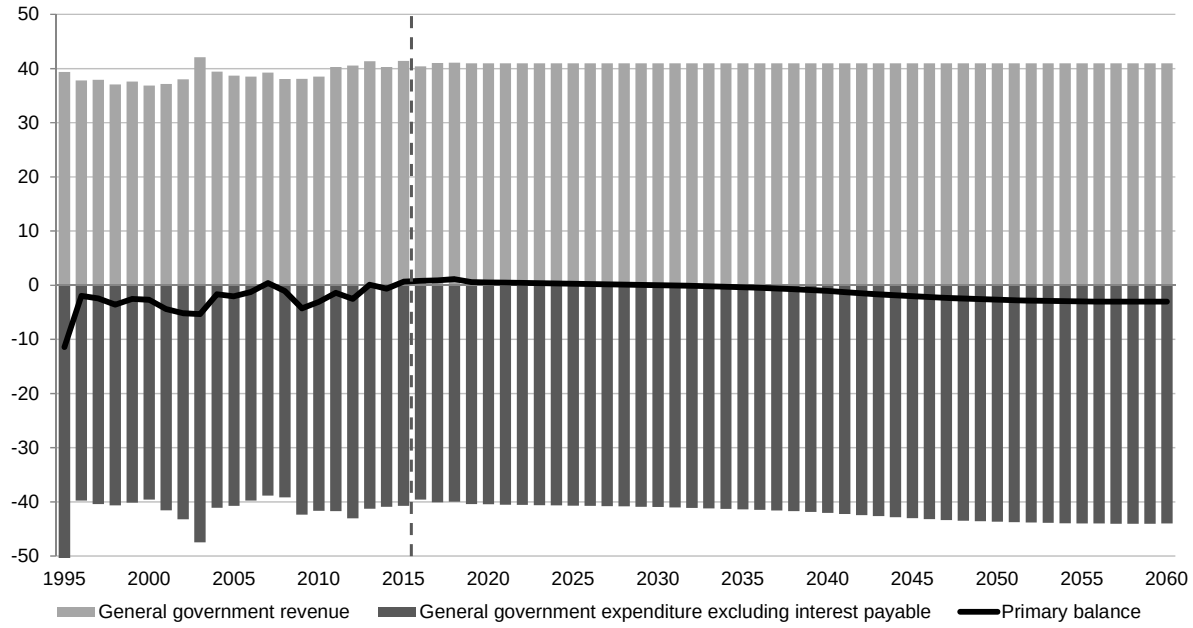
Source: CNB, CSSA, CZSO.

[12] This assumption implicitly means that capital expenditure involves continued drawdown of EU funds in the future, with Czech co-financing needs amounting to approximately 0.2% of GDP.

[13] The statistics on the health care component are available from the CZSO. In October 2015, government data were revised to include all hospitals, irrespective of their legal form, in the general government sector.

The projection of the primary government budget balance (government revenues minus government expenditures excluding interest payments) is depicted in Figure 14. In the near future, moderate primary surpluses are expected, but the primary balance turns into a primary deficit from 2030 onwards, reaching 3.0% of GDP by the end of the projection period. The worsening of the primary balance is caused mainly by rising expenditure on old-age pensions and health care.

Figure 14: Primary Government Budget Balance (% of nominal GDP)



Source: CNB, CZSO.

3.4 Interest Payments

Government debt service costs (interest payments) depend on the amount and maturity structure of the government debt and the vintage yields at which different tranches are issued.

In each period, the amount of government debt is established as a function of the outstanding part of previously issued debt and the debt issued in the current year. The amount of new debt issued in any year must cover the borrowing requirement, i.e. the debt maturing in the given year that needs to be refinanced, adjusted for the government budget balance arising in the relevant year, with regard to stock-flow adjustments.

The maturity structure of the Czech debt at the start of the projection period is known.[14] The pool of government debt is divided into fifteen annual maturity baskets. All debt with maturity 15 years or longer is treated as 15-year debt. In our forecast, we need to assume the maturity structure of the new issues of government debt. Since this cannot be reasonably estimated,[15] we start with the latest observed maturity structure of new issues and use expert judgement to align it with the objectives set in the ministry's issuance strategy documents until 2018 (Ministry of Finance, 2016b). After that, the structure of new issuance is expected to remain unchanged. The amount

[14] The data on central government bond issuance are available from the websites of the Ministry of Finance and the Czech National Bank.

[15] This might be an interesting area for future research.

and maturity structure of the total debt is then, naturally, the result of the amount and structure of old and newly issued debt.

The yield on the debt issued before the start of the forecast is computed as the average yield at issue for bonds falling to each maturity bucket. The yield on new debt is expected to reflect the market conditions at the time of issuance. To gauge the relevant weights of these factors, we turn to international evidence on yield determinants. The yield on new debt is, therefore, modelled as a function of the relevant macro-financial and fiscal variables: government debt growth, issuer rating, money market interest rates, expected inflation and the dollar yield curve. Since we assume that the expectations of market participants are partially adaptive, we also include the lagged dependent variable. The dynamic model is estimated using the Arellano-Bond (1991) dynamic panel regression method. The data sample covers 35 developed countries over the past 24 years; this includes several countries which experienced a debt crisis in this period. The credit risk of the sovereign issuer and the monetary conditions are therefore both taken into account. The analysis was conducted on government bond yields at three maturities: one-year, five-year and ten-year. Yields at other maturities of up to ten years are derived from these three by non-linear interpolation; longer yields are extrapolated using the spread between five- and ten-year yields. The estimated parameters and the indicative sensitivity of the yield to each explanatory variable are given in Table 1. An important feature of the yield model is that it captures the adverse spiral between the yield and amount of government debt. It assumes that financial markets will treat an increase in debt in relation to GDP as an increase in sovereign risk and will demand a higher nominal yield for each subsequent new debt issue. This will lead to a rise in government debt service costs and a further increase in the debt ratio.

Table 1: Variables and Parameters of the Yield Model

	Parameter	Standard error	Change ensuring growth of the yield by 0.5 p.p.
One-year yield			
One-year yield of previous year	0.40	0.1227 (***)	1.24
Government debt/GDP ratio[a]	0.03	0.0159 (**)	15.33
Credit rating[b]	0.44	0.1696 (***)	1.13
3M PRIBOR	0.41	0.1472 (***)	1.23
Inflation	0.09	0.0524 (*)	5.53
1Y US government bond yield	0.24	0.0650 (***)	2.07
Constant	-1.14	0.4370 (***)	-
Five-year yield			
Five-year yield of previous year	0.47	0.0439 (***)	1.06
Government debt/GDP ratio[a]	0.01	0.0105 ()	35.49
Credit rating[b]	0.20	0.0360 (***)	2.46
3M PRIBOR	0.32	0.0440 (***)	1.57
Inflation	0.07	0.0457 (*)	6.74
5Y US government bond yield	0.17	0.0402 (***)	2.91
Constant	-0.25	0.1304 (***)	-
Ten-year yield			
Ten-year yield of previous year	0.61	0.0539 (***)	0.82
Government debt/GDP ratio[a]	0.02	0.0112 ()	30.81
Credit rating[b]	0.31	0.1366 (**)	1.62
Real GDP growth (%)	-0.05	0.0406 ()	-9.29
3M PRIBOR	0.14	0.0312 (***)	3.64
Inflation	0.05	0.0660 ()	9.96
10Y US government bond yield	0.29	0.1047 (***)	1.70
Constant	-0.69	0.3661 (*)	-

Note: [a] change in past two years (p.p.), [b] AAA = 1, AA = 2, A = 3, etc., *** significant at 1% level, ** significant at 5% level, * significant at 10% level.

Source: CNB.

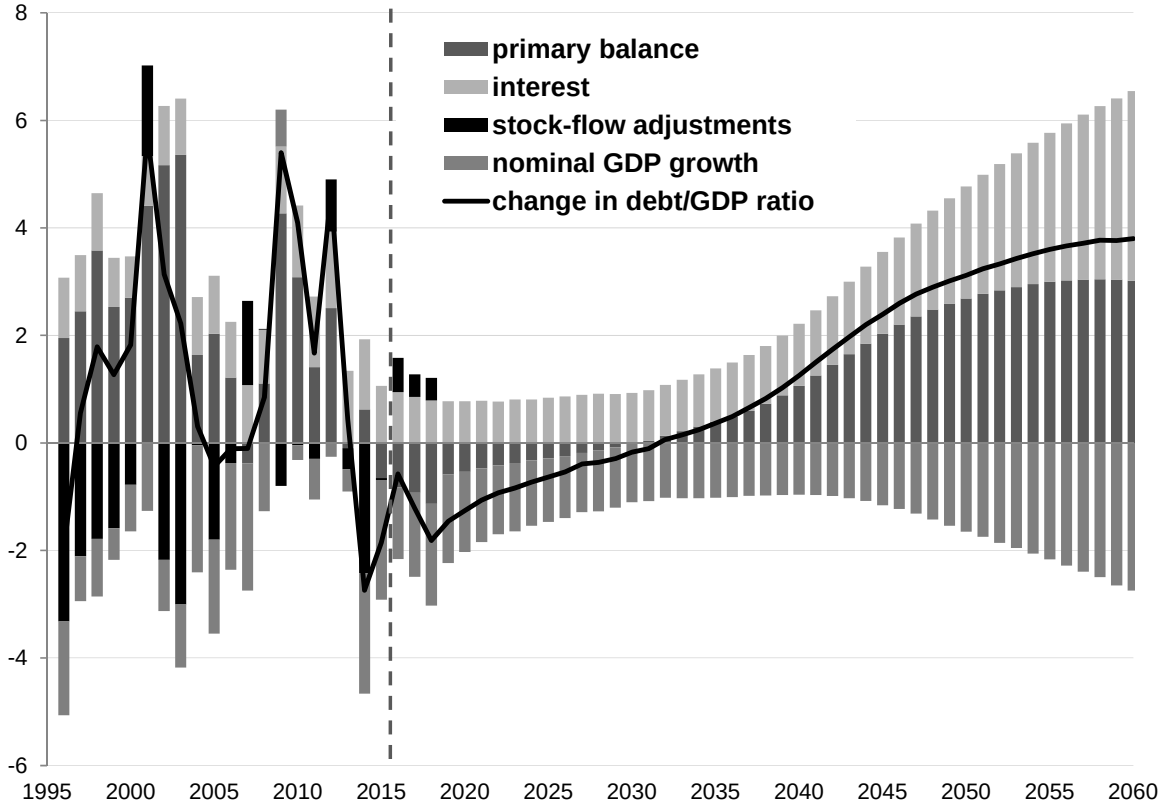
To arrive at the total interest payments for each year, we first compute the yields for each of the fifteen maturity baskets which apply in the given year. These are given by the weighted average of the yield on previously created debt of that residual maturity and the market yield for that maturity assumed in the given period, where the weights are the amounts of previously and newly issued debt. The interest payment in each basket is calculated by multiplying the average value of the debt by the average yield for the maturity basket. The sum of the interest payments in each of the fifteen annual maturity baskets finally gives the total amount of interest payments.

3.5 Government Debt

The resulting evolution of general government debt in the baseline scenario is depicted in Figures 15 and 16. Figure 15 shows the contributions of the primary balance, debt service costs and GDP growth from the perspective of Figure 1. The chart shows that while the ratio of Czech government debt to GDP is saved from increasing until the 2030s by positive primary balances,

the sheer effects of ageing – which will tip the primary balance over into deficit – will ultimately cause a sustained gradual increase in debt. Around the mid-2030s, the shielding effect of GDP growth exceeding the effective rate of interest paid on government debt (the interest rate – growth differential) vanishes, and interest payments also start to be an increasing burden on debt. As a result, government debt is predicted to start increasing in the early 2030s, and the annual change in the debt/GDP ratio is predicted to rise, reaching 3.8 percentage points of GDP in 2060.

Figure 15: Contributions to Change in the Debt/GDP Ratio (percentage points)

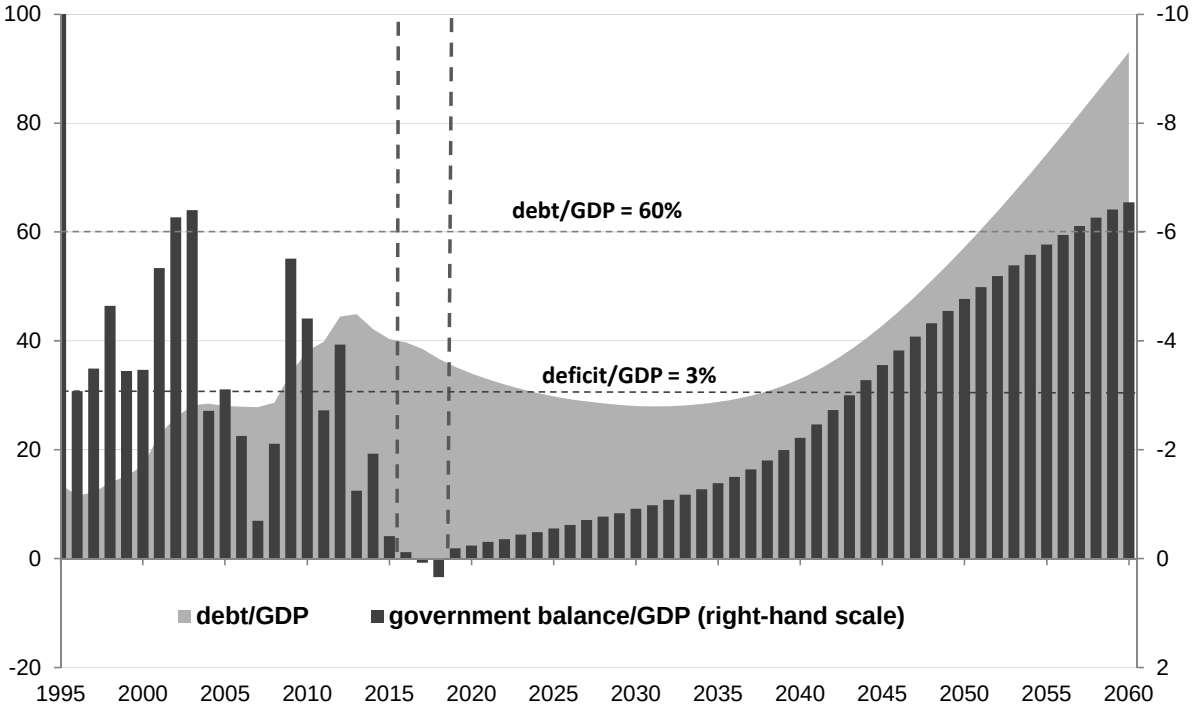


Source: CNB, CZSO.

Government debt increases from 40.3% of GDP in 2015 to 60% of GDP between 2050 and 2051[16] and is predicted to reach 93% of GDP in 2060 (Figure 16), and, as a result of the dynamics described above, it is bound to continue rising after this date. The total general government deficit is expected to exceed 3% of GDP in 2044 and to reach almost 7% of GDP at the end of the period analysed.

[16] A debt of around 60% of GDP is often referred as the tipping point for an elevated risk of debt unsustainability, so we specifically refer to when the 60% of GDP threshold is breached.

Figure 16: General Government Balance and Debt (% of nominal GDP)



Source: CNB, CZSO.

4. Sensitivity Scenarios

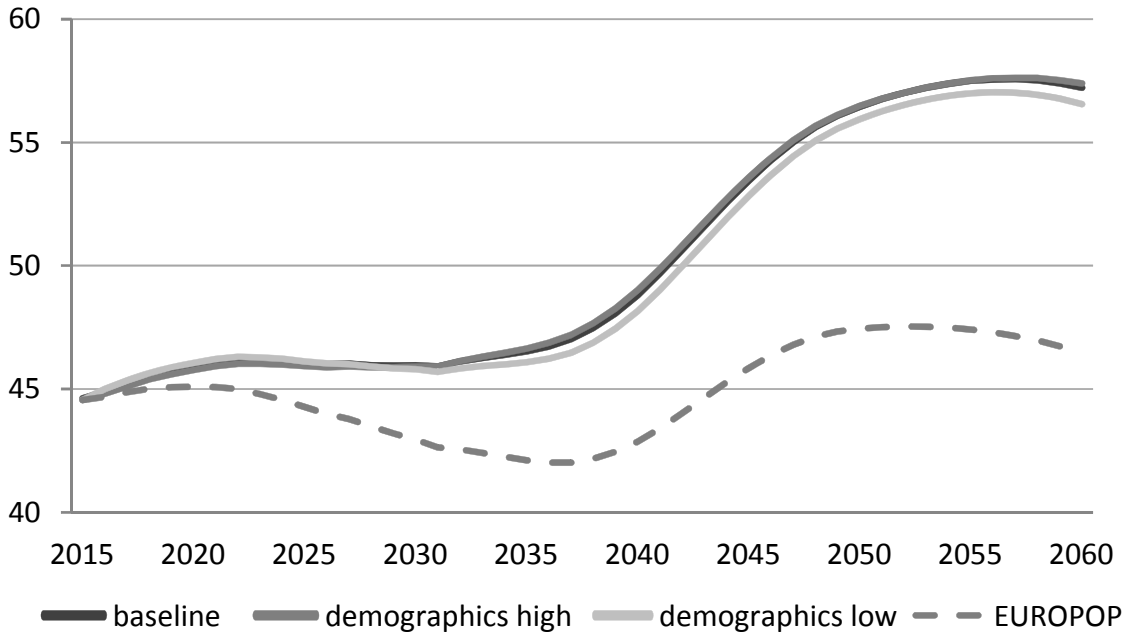
The results of the baseline setting of our model are clearly conditional on the assumptions we have made about long-term macroeconomic developments, about the settings of policy variables and, importantly, about the unchanged behavioural characteristics of the Czech population. It is important to assess the sensitivity of the results to changes in assumptions. Our analysis shows that particular uncertainties stem from population projections. Therefore, we present results that are consistent with alternative demographic assumptions. Further obvious targets for sensitivity tests are the parameters for policy variables in the old-age pension system, since they are the policy parameters. The other sensitivity scenarios include different health care assumptions, productivity developments, the impacts of a protracted economic crisis and sensitivity to variant yield trajectories. The figures and charts in this part depict the basic impacts of alternative assumptions about the evolution of the Czech government deficit and debt. Detailed results are presented in the Annex.

4.1 Assumptions about the Population and Labour Productivity

In the baseline model, we work with the middle scenario of the CZSO demographic projection. This implies a relatively sharp increase in the share of older citizens due to the combined effect of a small increase in the fertility rate and a relatively big increase in life expectancy. To test the sensitivity of our results to the choice of demographic assumptions, we use two other CZSO population scenarios (LOW and HIGH) to model the effect of alternative assumptions about lifespan and reproduction. The adjustments to fertility and life expectancy are relatively

proportional in both scenarios (i.e. both are lower in the LOW scenario and higher in the HIGH scenario). This implies a very slightly higher old-age dependency ratio for the HIGH scenario and a somewhat lower ratio for the LOW scenario as compared to our baseline (Figure 17). The patterns for the evolution of pensions remain very similar to the baseline (range 8.6%–8.8% of GDP in 2060), but those for health care spending are more dispersed (range 8.8% of GDP in 2016 in the LOW scenario and 10.7% of GDP in 2060 in the HIGH scenario). The ratios of debt to GDP in the different scenarios will start to diverge around 2025 and grow to 70.7% in 2060 for the LOW scenario and 110.3% in the HIGH scenario (Figure 18).

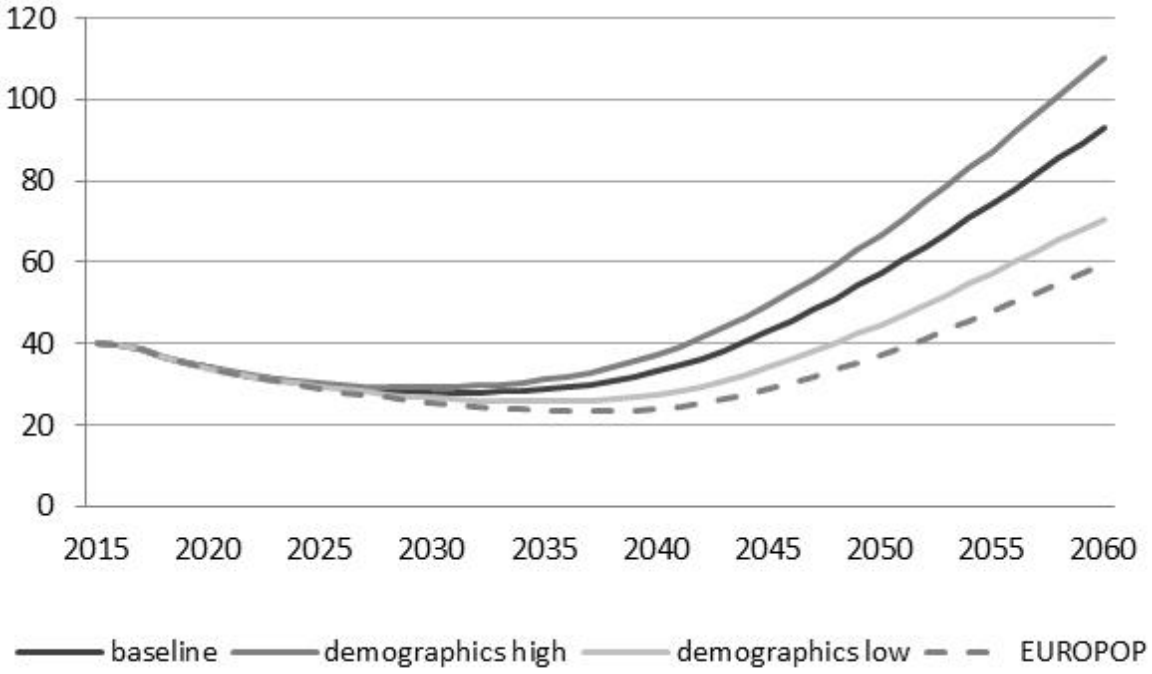
Figure 17: Population Scenarios – Old-age Dependency Ratio (%)



Sources: CZSO, European Commission, CNB.

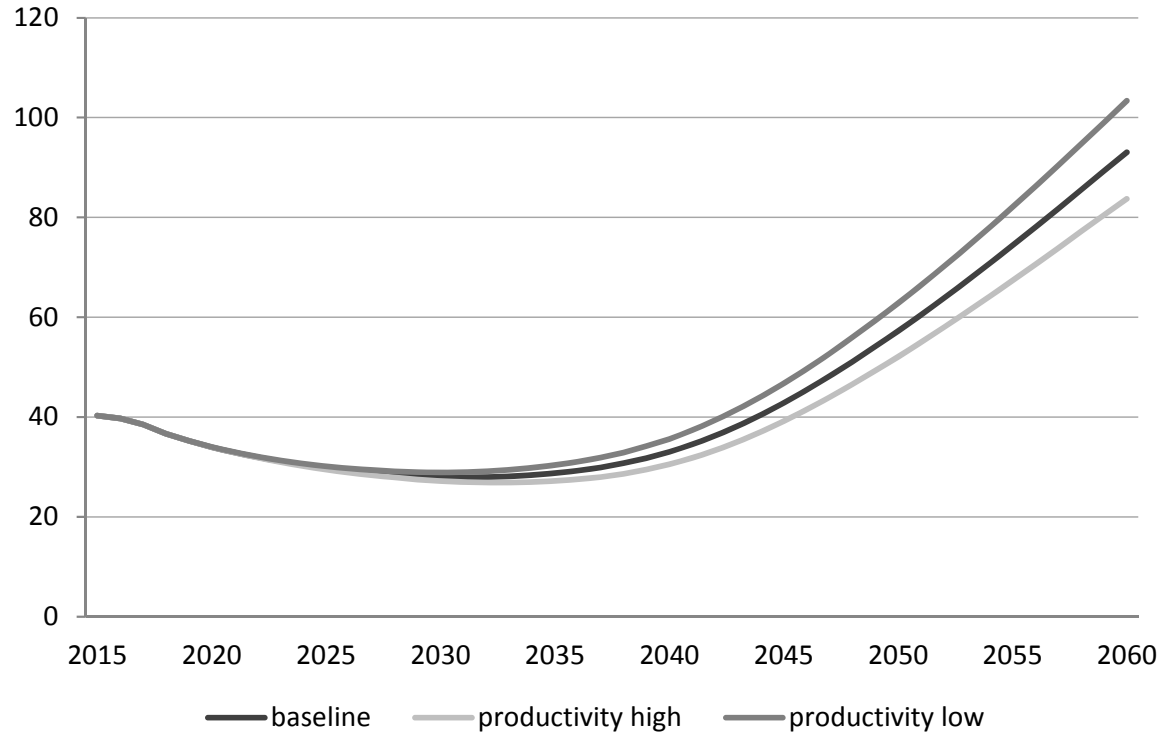
In addition to the demographic projections of the Czech Statistical Office, we implement a scenario for the Czech Republic using the EU-wide EUROPOP 2013 population projection. In this scenario, a much steeper increase in the fertility rate is assumed than in our HIGH scenario (from the current 1.52 to 1.8 children per fertile woman by 2060), while life expectancy follows a similar path to the baseline scenario. This assumption implies faster growth of the labour force in the next 25 years, with the effects of ageing entering much later in the future (Figure 17). The model thus projects much lower growth in the share of pensions in GDP, mainly due to a bigger labour force and a lower old-age dependency ratio. On the other hand, health care expenditure is higher, due to a larger population size. In sum, this scenario generates a lower level of indebtedness, which reaches 60% of GDP in 2060, mainly through the effect of the larger labour force (Figure 18). It is obvious that even though the latter, more advantageous demographic development postpones the problem of escalating general government debt further to the future, the path for public finances remains unsustainable.

Figure 18: Population Scenarios – Government Debt (% of nominal GDP)



An important determinant of future economic growth is labour productivity. In the baseline, we assume that, due to economic convergence, labour productivity decelerates gradually from its current growth of around 4.5% yearly to 1.6% in 2060. To explore the effects of variation in the productivity of the labour force, we introduce high/low productivity scenarios in which productivity growth is assumed to converge to a rate that is 0.25 p.p. higher/lower than in baseline scenario. This increase/decrease is introduced linearly during the period 2016–2025 and translates into a gradual change in real GDP growth. The differences in indebtedness start to be pronounced only after 2035, with the projection for 2060 ranging from 83.8% of GDP in the high productivity scenario to 103.3% of GDP in the low productivity scenario (Figure 19). This is mainly due to a difference in patterns of pensions, where higher/lower GDP growth translates only partially into the aggregate level of retirement payments.

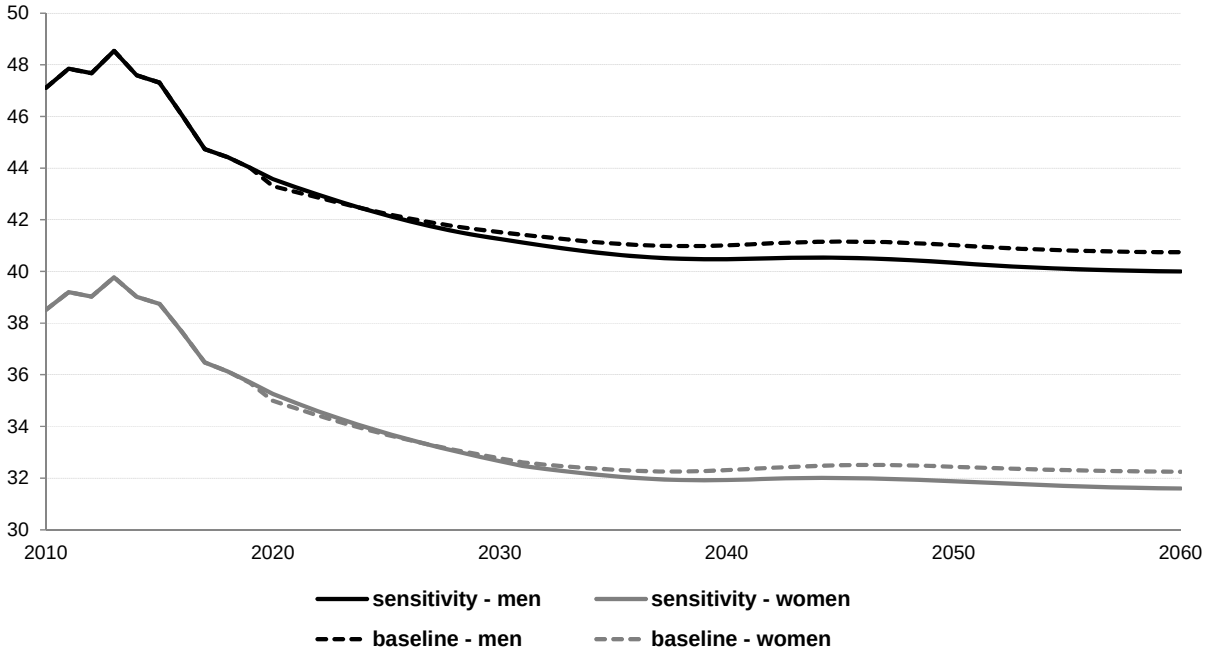
Figure 19: Productivity Scenarios – Government Debt (% of nominal GDP)



4.2 The Parameters of the Pension System

In the baseline projection it is assumed that the replacement rate for new old-age pensions will stay constant in the future. With this setting, Czech public finance is unsustainable and the debt/GDP ratio continuously increases at the end of our modelling period. We are therefore interested in determining which parametrical changes would help bring the system towards sustainability. In the first sensitivity scenario, we simulate a one percentage point drop in the replacement rate for new pensions, arbitrarily chosen to become effective in the year 2019. A one percentage point decrease in the replacement rate (Figure 20) translates into lower old-age pensions; the average pension is about 2% lower in 2060 compared to the baseline projection. In this sensitivity scenario, government debt reaches 88.4% of GDP in 2060, which is 4.6 percentage points less than in the baseline. In order to keep the government debt at 60% of GDP in 2060, the replacement rate would have to decrease substantially by 7.2 percentage points from 2019. In such case, the average pensions for men and women would drop by roughly 14% and 15% in 2060 respectively compared to the baseline projection.

Figure 20: Comparison of Average Replacement Rates (% of average wage)



An alternative way to keep the government deficits in check would be to strengthen the revenue side. In the baseline projection, the social security contributions rate is set constant at 45%, which is the current official statutory rate.[17] A one percentage point increase in the social security contributions rate starting in 2019 would bolster the government budget balance, and the debt would amount to 76.9% of GDP in 2060. This is a 16.1 percentage points better outcome than in the baseline. In order to keep government debt at 60% of GDP in 2060, the social security contributions rate would have to rise by 2.1 percentage points as from 2019. It is important to note here that this sensitivity scenario is only a partial analysis and neglects the possible effects of tax changes on macroeconomic variables (e.g. the behavioural responses of participation rates) and the possible nonlinearity between the tax rate and tax collection (e.g. movements along the Laffer curve).

Given the recently introduced cap on the statutory retirement age at 65 years,[18] we also model the impacts of this policy setting. In this sensitivity scenario, it is assumed for simplicity that the official statutory retirement age will be capped at 65 years indefinitely. The ceiling will become effective for those who are about to retire after 2030, unlike in the baseline scenario, where the retirement age is not capped and reaches 69 years in 2060.

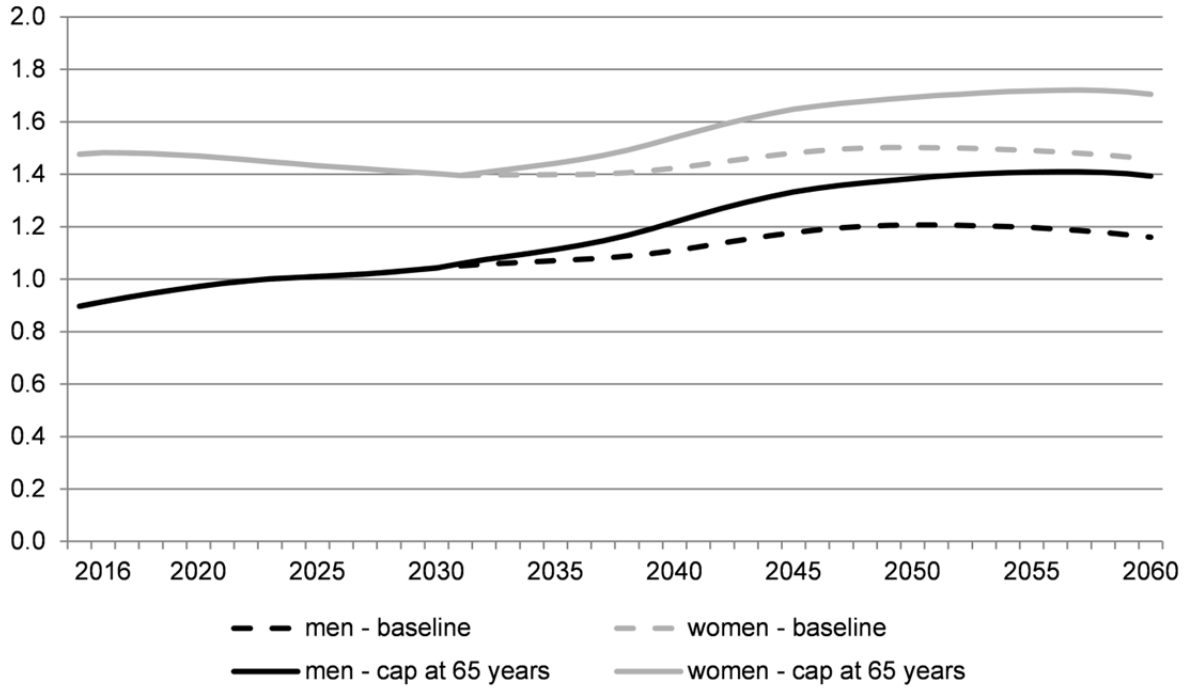
Such a change in the statutory retirement age would significantly increase the number of pensioners starting in 2030 (Figure 21). By the end of the projection horizon, there are about 0.5 million (20%) more pensioners than in the baseline scenario. Earlier retirement slows down the growth of the labour force, which turns into slower GDP growth compared to the baseline. After 2030, the gap between the growth of old-age pensions and nominal GDP growth widens. The ratio of old-age pensions to nominal GDP peaks at 10.4%, as opposed to 8.1% in the baseline. In this sensitivity scenario, government debt is projected to grow to 146% of GDP in 2060. Therefore,

[17] Of that, 28 percentage points are attributed to the Pension Account. Social security contributions also include health contributions.

[18] With a regular review mechanism for its subsequent change.

maintaining the ceiling for the statutory retirement age at 65 years goes against the sustainability of Czech public finance.[19]

Figure 21: Comparison of Number of Pensioners (millions)



4.3 Health Care Expenditure

In the baseline, we assume that health care expenditure is significantly influenced by technological progress and that increasing availability and improvement of treatment of ageing-related illnesses leads to growth in health care costs for the 65+ age category surpassing GDP growth. Therefore, in this sensitivity scenario, we try to disentangle the pure effects of ageing from technological progress in the health sector by setting the growth of health care costs at the same rate as GDP growth for all age categories. This would lead to more subdued growth in health care expenditure (Figure 22: 8.3% of GDP in 2060, as against 9.8% in the baseline scenario) and a corresponding drop in the country's indebtedness (Figure 23). This is mainly due to the disproportionately high share of expenditure on patients in the 65+ age category in general (currently 38% of expenditure on 18% of the population).

[19] Another recent change to the pension system rules is the discretionary power for the government to increase the old-age pension by more than what the standard rule would imply, up to 2.7%. Nevertheless, in our baseline, the expected rate of valorisation is higher than this value throughout the entire projection. Furthermore, the government has recently approved more generous valorisation of pensions from 2018, with the indexing increased to 1/2 of the growth in the real wage. Incorporating this change into the baseline, government debt would reach 106.3% of GDP in 2060, which is 13.3 percentage points higher than in the baseline.

Figure 22: Health Care Expenditure as a Share of Nominal GDP and Expenditure on Elderly Citizens as a Share of the Total (right-hand scale)

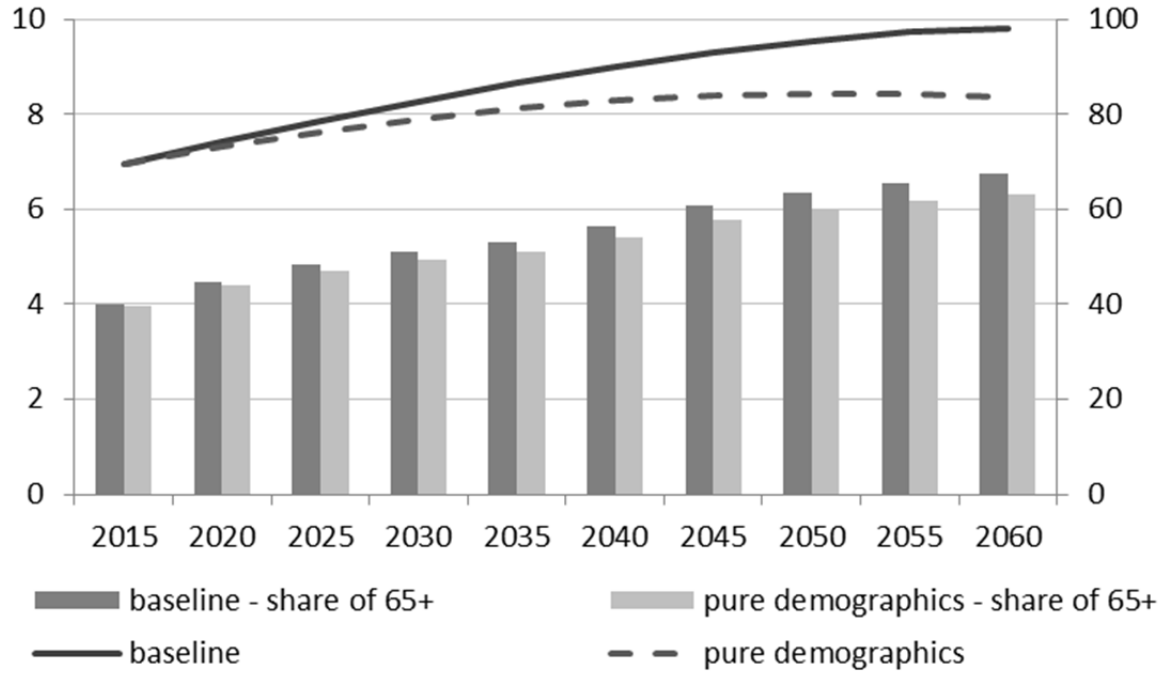
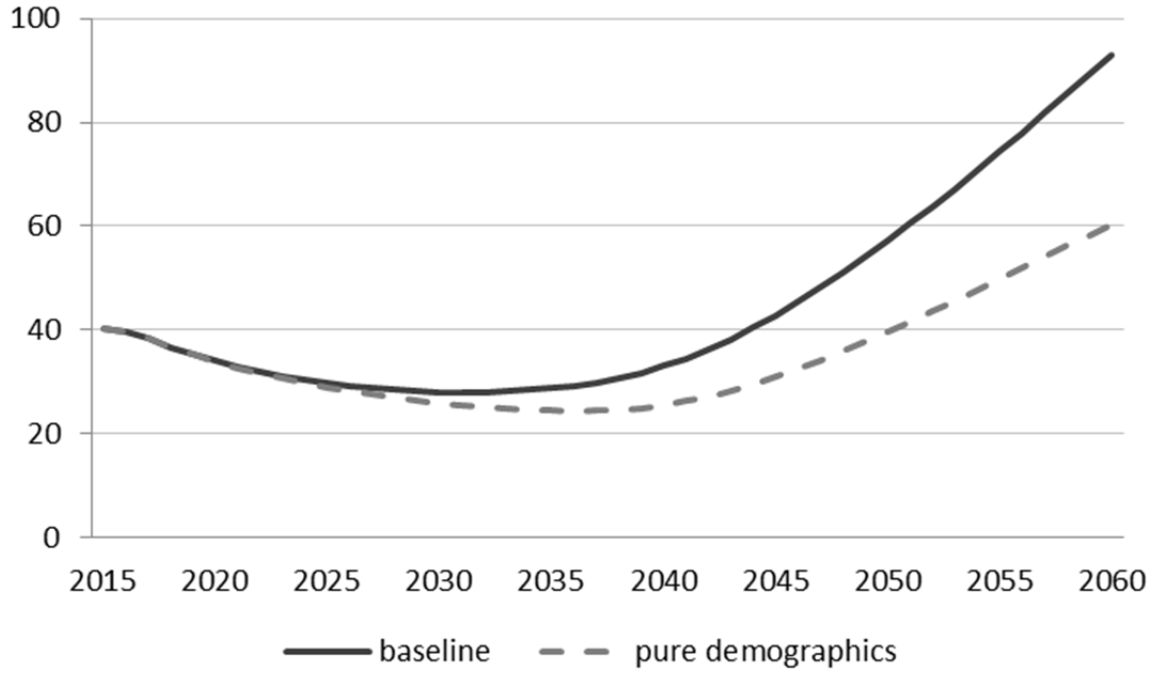


Figure 23: Effects of Technological Progress in Health Care – Government Debt (% of nominal GDP)



4.4 Economic Crisis Scenario

The baseline projection assumes organic developments in the Czech economy. The economic crisis scenario investigates how the debt trajectory evolves if the economy experiences a severe macroeconomic shock with a relatively sluggish recovery.

We model the impact of a sizeable decline of the Czech economy originating from adverse economic developments in the European Union. The hypothetical three-year recession would arrive in 2017 and peak in 2018 and would manifest itself in a sizeable decline in economic activity in the Czech Republic, a surge in unemployment and, in 2018 and 2019, a period of deflation (Table 2).[20] From 2019 onwards, the economy gradually converges back to the growth rates assumed in the baseline scenario. From 2022, the economy is back on the growth path of the baseline scenario. Since the assumed slowdown of the economy is not offset by higher post-crisis growth compared to the baseline scenario, the crisis leaves a permanent output loss of about 20% of nominal GDP.

Table 2: Macroeconomic Developments in the Economic Crisis Sensitivity Scenario

	Actual	Baseline scenario				Economic crisis scenario			
	2015	2016	2017	2018	2019	2016	2017	2018	2019
GDP (y-o-y %)	4.6	2.4	3.0	3.0	2.7	2.4	-2.3	-2.5	-1.1
Inflation (%)	0.3	0.6	2.1	2.3	2.2	0.6	1.0	-2.4	-0.2
Unemployment (%)	5.1	4.1	3.8	3.7	4.6	4.1	4.8	6.9	9.0
Nominal wage growth (%)	2.7	4.5	5.1	4.8	5.1	4.5	-2.1	-7.2	-0.6

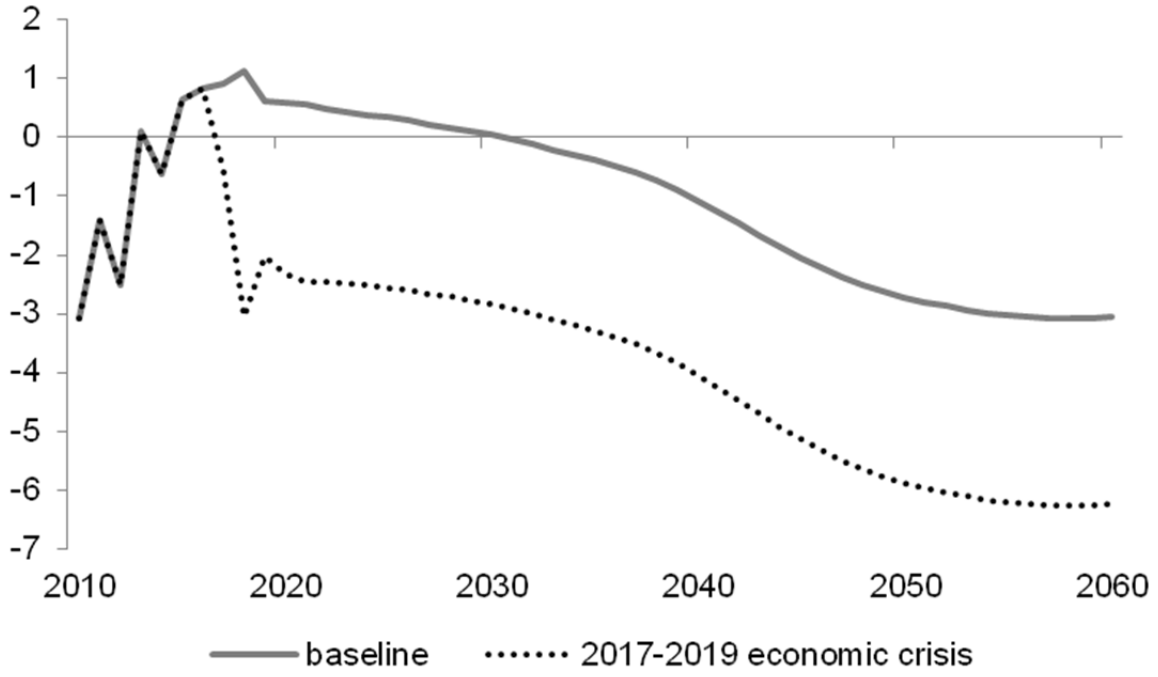
The crisis leads to much lower tax receipts and larger disbursement of unemployment benefits than under the baseline scenario. Although some expenditure items (e.g. state employee compensation) are modelled as a fixed percentage of GDP and thus decline as GDP shrinks, pension expenditure and most health care expenditures are assumed not to be influenced by the crisis,[21] adding to the budgetary stress during the crisis. We do not assume any fiscal policy response, which means that there is no fiscal consolidation possibly induced by the deteriorating budget balance and no fiscal policy stimulus to counteract the recession. Similarly, there is no fiscal cost of having to support banking sector solvency.[22]

[20] The macroeconomic scenario employed in this sensitivity analysis corresponds to the stress test scenario in the CNB's banking stress test featured in the 2016/2017 Financial Stability Report. This macroeconomic scenario also entered the 2017 Czech public finance stress test (Czech National Bank, 2017). Czech National Bank (2017) designs this scenario to be "severe but plausible". This scenario thus has a low probability but a large impact.

[21] Valorisation of pensions is assumed to be limited during the crisis, but pension entitlements cannot fall in absolute terms to follow the reduced tax receipts.

[22] According to the stress test in the 2016/2017 Financial Stability Report, the capital injections required by the banking sector as a consequence of such an economic crisis would be very limited anyway thanks to the resilience and capital adequacy of the Czech banking sector.

Figure 24: Economic Crisis Scenario – Primary Government Balance (% of nominal GDP)



As a consequence of the crisis, the primary balance surplus expected in 2016 is quickly followed by primary deficits as soon as 2017 (Figure 24). As the turmoil unfolds, bond yields increase from 0.5% to 1.9% in 2017 for 10-year maturity and increase further to 4.0% when the Czech government is downgraded in the midst of the crisis. The permanent output loss is reflected in a permanent loss of tax receipts. Given the steadily rising expenditure, mostly connected with ageing, the primary balance never recovers to positive values.

As a reflection of the prompt advent of primary deficits and the increase in the cost of funding, the government debt accelerates. In 2033 it exceeds 90% of GDP, which triggers another rating downgrade and a further increase in interest expenses. Three years later, the debt is larger than the country's annual economic output and it quickly gets onto an explosive path. At the 2060 projection-end, the government debt escalates to more than 360% of GDP as a consequence of the severe economic crisis in the first projection years.

Figure 25: Economic Crisis Scenario – Government Debt (% of nominal GDP)

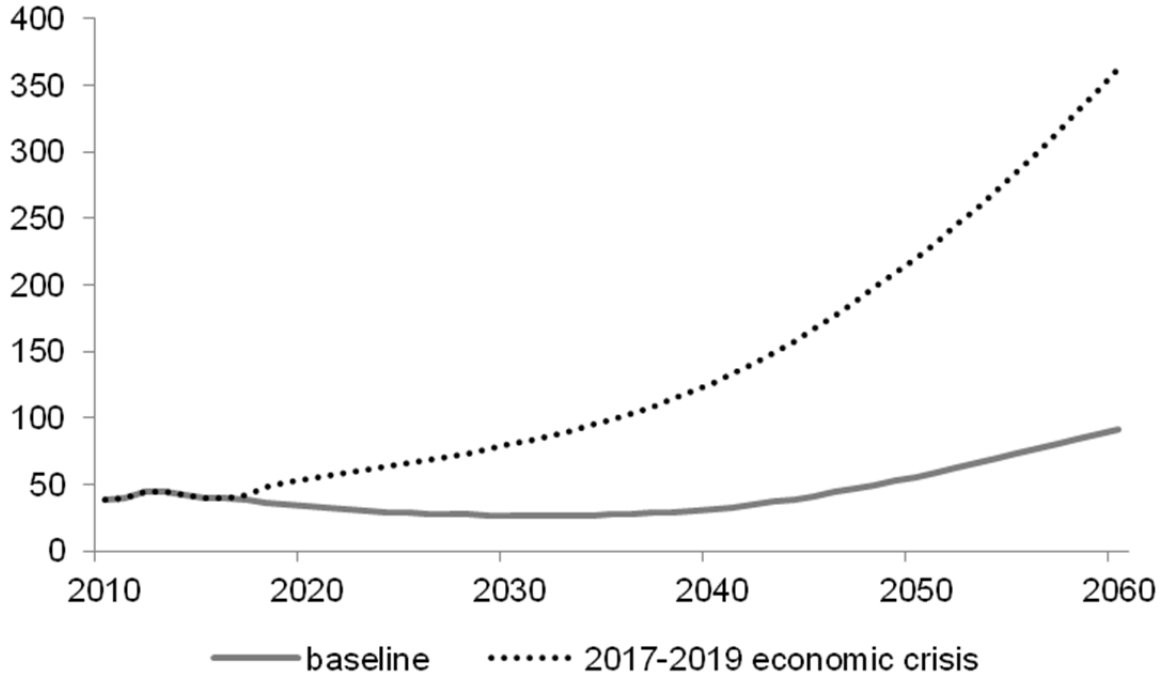
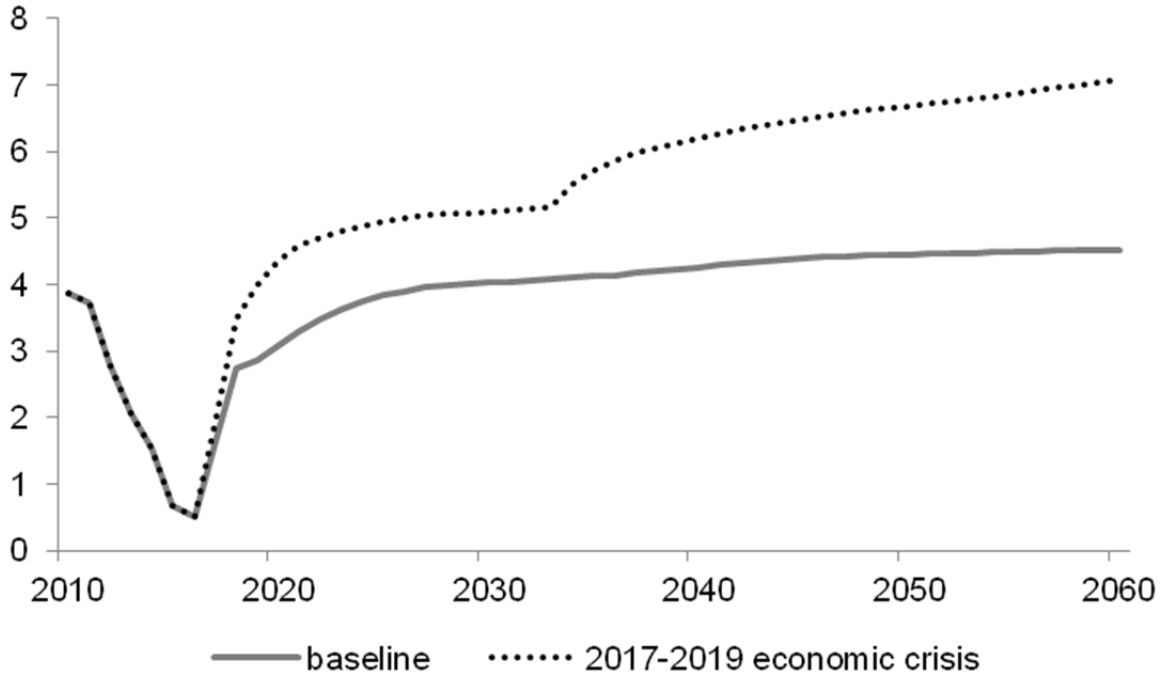


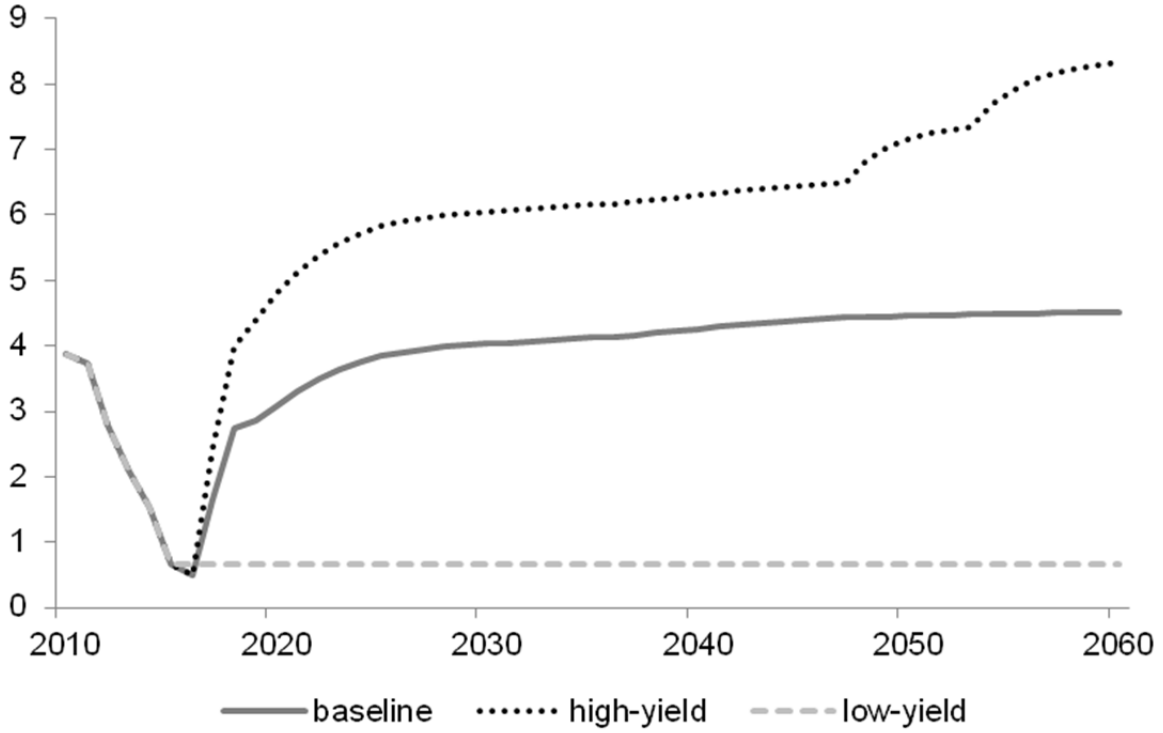
Figure 26: Economic Crisis Scenario – Cost of Funding (10-year government bond yield, %)



4.5 Cost of Funding

The current low-yield environment allows the Czech government to fund itself under very favourable conditions.[23] We will demonstrate the sensitivity of the debt outlook to two extreme developments in the cost of funding (Figure 27). The first (low-yield) scenario keeps the yields at the extremely low end-2015 levels over the whole projection horizon.[24] The second (high-yield) scenario expects the yields to increase very markedly as from 2017, exceeding the levels in the baseline scenario. The yield level is ultimately increased by 200 bps. In order to achieve this while keeping the feedback loop between the debt level and yields, we increase the intercept terms in the interest model by 78 bps, which works via the 0.6 autoregression coefficient in the 10-year yield model (cf. Table 1).

Figure 27: Cost of Funding Scenarios – 10-year Government Bond Yield (%)



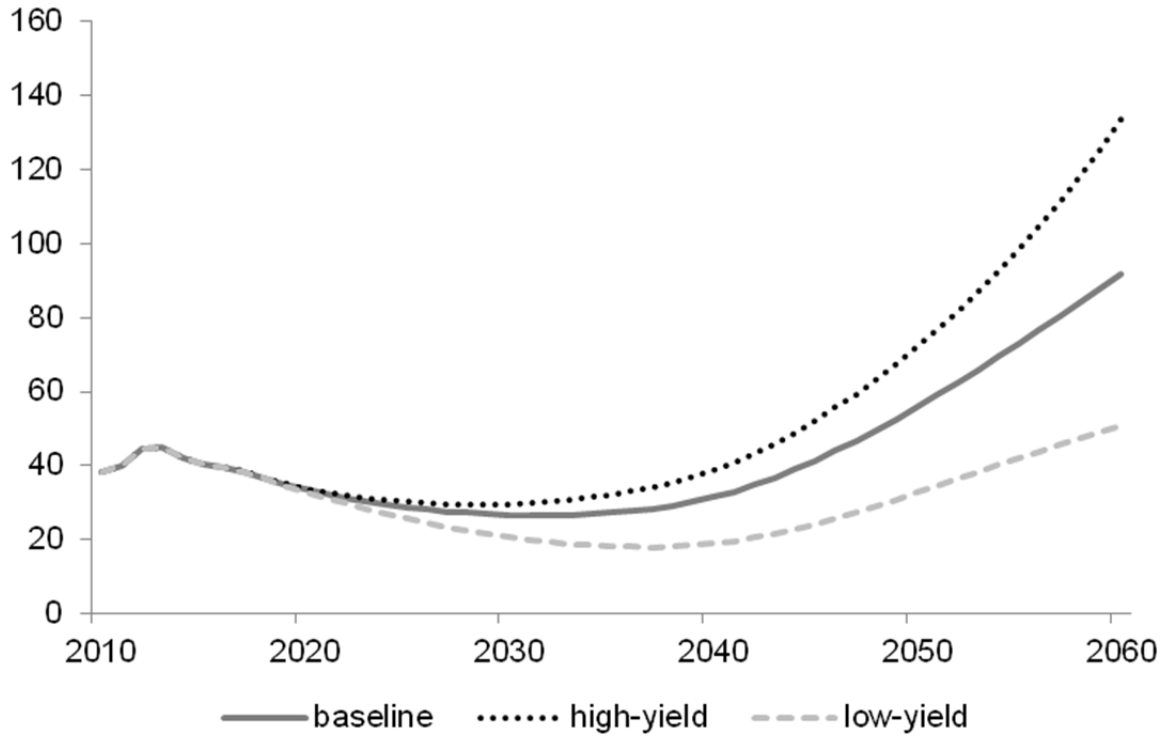
The debt trajectories in the scenarios are illustrated in Figure 28. In the low-yield scenario, the government's ability to access cheap credit allows the debt/GDP ratio to remain below 60% throughout the projection horizon despite sizeable primary balance deficits. The favourable issuing conditions move the turning point at which the debt ratio starts to increase from 2032 in the baseline scenario to 2038. However, the likelihood of the debt trajectory at the far end of the projection is low, since the yield conditions assumption does not reflect the pace of growth of the debt.

[23] For an evaluation, see the CNB Financial Stability Report 2015/2016.

[24] The first of the two scenarios might be taken to correspond to the situation of a decrease in long-term rates that might be linked to demographic developments and decreasing productivity.

In the high-yield scenario, the initial marked rise in yields at issue contributes to deepening indebtedness. We assume a credit rating downgrade by one notch in 2048, when the debt exceeds the 60% threshold, and another in 2054, when the debt stands at more than 90% of GDP. These downgrades further escalate the debt growth. This scenario shows that yields have little effect when the debt level is low, which is until about 2040. Then, when the primary balance deficits start piling up, the interest effect is large – the soaring yields cause the debt/GDP ratio to be more than 40 p.p. larger in 2060 relative to the baseline case.

Figure 28: Government Debt in the Cost-of-funding Sensitivity Scenarios (% of nominal GDP)



5. Conclusion

In this research note, we create a simple model of Czech public finance to assess its sustainability with a focus on the effects of population ageing. Czech public finance enjoys a clearly advantageous initial condition thanks to a relatively low debt/GDP ratio and a positive primary balance to start with. This will provide Czech fiscal policy with a window of opportunity before this advantage wanes, when, first, in the early 2030s, the primary balance turns negative and then increasing interest payments contribute to a growing debt/GDP ratio.

Our model shows that given standard expectations about population growth and the present policy settings, Czech public finance is heading towards unsustainability. Population ageing will gradually bring about increasing expenditure on the old-age pension and health care systems and, at the same time, lower economic growth rates. In our baseline scenario, this will lead to a rise in

the ratio of government debt to GDP starting in the early 2030s, with the yearly increases predicted to grow. The recent capping of the official retirement age exacerbates the unsustainability of the system.

Since the outcome of the analysis is obviously determined by its assumptions about economic trends and about the current policies remaining in place, it is desirable to further investigate the results with alternative – yet reasonable – assumptions. Therefore, we run a wide range of sensitivity analyses. In the sensitivity analyses, we show that the current configuration of Czech public finance remains unsustainable even with alternative assumptions. It is important to stress that the demographic scenarios themselves have a large influence on the results; our baseline demographic scenario based on the medium scenario published by the Czech Statistical Office puts significantly greater pressure on public finances than that published by Eurostat in its EUROPOP 2013 projection. However, even under the latter scenario, which can be regarded as quite optimistic, the Czech government debt starts to grow markedly and, towards the end of our forecasting period, exceeds the sustainability limits envisaged by the Czech budgetary responsibility law, while the general government deficits violate the Maastricht convergence criteria. After it breaches these levels, the debt does not stabilise but tends to progressively escalate further.

At the same time, the results signal a good message for monetary policy. Government bond yields continue to be anchored to monetary policy rates in our baseline scenario, and monetary policy transmission remains unaffected even when public finances deteriorate in the predicted way. However, this might change if further steps deepening the unsustainability problem lead to financial markets penalising the government via increases in government bond yields.

As regards financial stability, the projected path of government debt reveals that – in the medium term – prudential policy must provide the right incentives to avoid excessive accumulation of sovereign debt in the balance sheets of financial institutions. Avoiding the risk of debt unsustainability and a sovereign crisis is primarily a fiscal policy concern, but it is also a concern for financial stability. The recent global financial crisis revealed the risks that specific developments in public finances might pose for financial stability through the interaction between the financial sector and the sovereign sector and its impacts on the real economy. From this point of view, macroprudential policy – with its focus on preventing systemic risks – can also send out a timely signal to the government about the need to stabilise public finance and coordinate economic policies. As shown by the experience of countries with high government debts, such coordination is vital for maintaining financial stability and achieving fiscal and monetary policy goals.

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Appendix: Economic Assumptions and Projections

Table A1: Baseline Scenario

	2015	2020	2030	2040	2050	2060
Population assumptions						
Population, in thousands	**10530**	10532	10397	10126	9813	9388
Working age population (15-64), in thousands	**7053**	6754	6557	6078	5390	5038
Dependency ratio	**0.45**	0.46	0.46	0.49	0.56	0.57
Macroeconomic and labour force assumptions						
Real GDP growth (y-o-y), in %	**4.6**	2.4	2.0	1.1	1.1	1.2
Inflation (y-o-y), in %	**0.3**	2.0	2.0	2.0	2.0	2.0
Yield of 10-year government bond, in %	**0.67**	3.12	4.04	4.26	4.45	4.51
Labour force productivity growth (y-o-y), in %	**4.5**	2.5	1.9	1.8	1.7	1.6
Labour force growth (y-o-y), in %	**0.1**	-0.1	0.1	-0.7	-0.6	-0.4
Participation rate (15-64) in % - Men	**81.3**	82.8	82.1	83.1	83.8	83.0
Participation rate (15-64) in % - Women	**66.3**	70.7	74.2	75.4	75.6	74.9
Age-related expenditures as % of GDP						
Pension expenditure	**7.8**	7.6	7.3	7.6	8.7	8.7
of which old age pensions	**7.1**	6.9	6.6	6.9	8.0	8.1
Health care and long-term care	**7.0**	7.4	8.3	9.0	9.5	9.8
of which health care social payments	**4.1**	4.4	4.9	5.3	5.7	5.8
Fiscal indicators as % of GDP						
General government balance	**-0.4**	-0.2	-0.9	-2.2	-4.8	-6.5
of which primary balance	**0.7**	0.5	0.0	-1.1	-2.7	-3.0
Interest expenditure	**1.1**	0.8	0.9	1.2	2.1	3.5
General government debt	**40.3**	34.0	28.1	33.0	57.2	93.0

Table A2: Sensitivity Scenario – Demographic Projection CZSO HIGH

	2015	2020	2030	2040	2050	2060
Population assumptions						
Population, in thousands	**10538**	10623	10658	10581	10457	10219
Working age population (15-64), in thousands	**7057**	6818	6713	6332	5740	5470
Dependency ratio	**0.45**	0.46	0.46	0.49	0.56	0.57
Macroeconomic and labour force assumptions						
Real GDP growth (y-o-y), in %	**4.6**	2.5	2.1	1.3	1.3	1.4
Inflation (y-o-y), in %	**0.3**	2.0	2.0	2.0	2.0	2.0
Yield of 10-year government bond, in %	**0.67**	3.11	4.03	4.26	4.47	4.56
Labour force productivity growth (y-o-y), in %	**4.3**	2.4	1.9	1.8	1.7	1.6
Labour force growth (y-o-y), in %	**0.3**	0.1	0.2	-0.5	-0.4	-0.2
Participation rate (15-64) in % - Men	**81.3**	82.9	82.3	83.2	83.9	83.0
Participation rate (15-64) in % - Women	**66.3**	70.6	74.1	75.3	75.4	74.7
Age-related expenditures as % of GDP						
Pension expenditure	**7.8**	7.6	7.3	7.7	8.7	8.8
of which old age pensions	**7.1**	6.9	6.6	7.0	8.1	8.2
Health care and long-term care	**7.0**	7.5	8.5	9.4	10.2	10.7
of which health care social payments	**4.1**	4.4	5.0	5.6	6.0	6.3
Fiscal indicators as % of GDP						
General government balance	**-0.4**	-0.3	-1.2	-2.8	-5.8	-8.2
of which primary balance	**0.7**	0.5	-0.2	-1.5	-3.3	-4.0
Interest expenditure	**1.1**	0.8	1.0	1.3	2.4	4.2
General government debt	**40.3**	34.1	29.2	37.3	66.8	110.3

Table A3: Sensitivity Scenario – Demographic Projection CZSO LOW

	2015	2020	2030	2040	2050	2060
Population assumptions						
Population, in thousands	**10534**	10492	10265	9893	9482	8956
Working age population (15-64), in thousands	**7057**	6689	6397	5813	5020	4573
Dependency ratio	**0.45**	0.46	0.46	0.48	0.56	0.57
Macroeconomic and labour force assumptions						
Real GDP growth (y-o-y), in %	**4.6**	2.3	1.8	0.9	0.9	0.9
Inflation (y-o-y), in %	**0.3**	2.0	2.0	2.0	2.0	2.0
Yield of 10-year government bond, in %	**0.67**	3.12	4.04	4.24	4.43	4.46
Labour force productivity growth (y-o-y), in %	**4.3**	2.6	1.9	1.8	1.7	1.6
Labour force growth (y-o-y), in %	**0.3**	-0.2	-0.1	-0.9	-0.8	-0.6
Participation rate (15-64) in % - Men	**81.3**	82.8	81.9	83.0	83.9	83.1
Participation rate (15-64) in % - Women	**66.3**	70.7	74.2	75.5	75.9	75.3
Age-related expenditures as % of GDP						
Pension expenditure	**7.8**	7.5	7.2	7.5	8.6	8.6
of which old age pensions	**7.1**	6.9	6.5	6.8	7.9	7.9
Health care and long-term care	**7.0**	7.4	8.0	8.5	8.8	8.8
of which health care social payments	**4.1**	4.4	4.8	5.1	5.2	5.2
Fiscal indicators as % of GDP						
General government balance	**-0.4**	-0.2	-0.6	-1.5	-3.5	-4.6
of which primary balance	**0.7**	0.6	0.3	-0.5	-1.9	-1.9
Interest expenditure	**1.1**	0.8	0.9	1.0	1.6	2.7
General government debt	**40.3**	33.9	26.7	27.5	44.7	70.7

Table A4: Sensitivity Scenario – Demographic Projection EUROPOP

	2015	2020	2030	2040	2050	2060
Population assumptions						
Population, in thousands	**10538**	10645	10778	10905	11073	11081
Working age population (15-64), in thousands	**7057**	6816	6798	6645	6293	6237
Dependency ratio	**0.45**	0.45	0.43	0.43	0.47	0.46
Macroeconomic and labour force assumptions						
Real GDP growth (y-o-y), in %	**4.6**	2.5	2.3	1.7	1.7	1.7
Inflation (y-o-y), in %	**0.3**	2.0	2.0	2.0	2.0	2.0
Yield of 10-year government bond, in %	**0.67**	3.11	3.97	4.13	4.28	4.33
Labour force productivity growth (y-o-y), in %	**4.3**	2.4	1.9	1.8	1.7	1.6
Labour force growth (y-o-y), in %	**0.3**	0.1	0.4	-0.1	-0.1	0.1
Participation rate (15-64) in % - Men	**81.3**	82.8	82.0	82.2	82.7	81.8
Participation rate (15-64) in % - Women	**66.3**	70.6	73.7	74.0	73.7	73.1
Age-related expenditures as % of GDP						
Pension expenditure	**7.8**	7.5	6.9	6.8	7.5	7.4
of which old age pensions	**7.1**	6.8	6.2	6.2	6.9	6.7
Health care and long-term care	**7.0**	7.4	8.3	9.1	9.8	10.4
of which health care social payments	**4.1**	4.4	4.9	5.4	5.8	6.2
Fiscal indicators as % of GDP						
General government balance	**-0.4**	-0.2	-0.5	-1.2	-3.2	-4.4
of which primary balance	**0.7**	0.6	0.4	-0.4	-1.9	-2.3
Interest expenditure	**1.1**	0.8	0.8	0.8	1.3	2.2
General government debt	**40.3**	33.9	25.4	23.9	37.2	59.6

Table A5: Sensitivity Scenario – Productivity HIGH

	2015	2020	2030	2040	2050	2060
Population assumptions						
Population, in thousands	**10530**	10532	10397	10126	9813	9388
Working age population (15-64), in thousands	**7053**	6754	6557	6078	5390	5038
Dependency ratio	**0.45**	0.46	0.46	0.49	0.56	0.57
Macroeconomic and labour force assumptions						
Real GDP growth (y-o-y), in %	**4.6**	2.5	2.2	1.4	1.4	1.4
Inflation (y-o-y), in %	**0.3**	2.0	2.0	2.0	2.0	2.0
Yield of 10-year government bond, in %	**0.67**	3.11	4.00	4.21	4.40	4.44
Labour force productivity growth (y-o-y), in %	**4.5**	2.6	2.2	2.1	2.0	1.8
Labour force growth (y-o-y), in %	**0.1**	-0.1	0.1	-0.7	-0.6	-0.4
Participation rate (15-64) in % - Men	**81.3**	82.8	82.1	83.1	83.8	83.0
Participation rate (15-64) in % - Women	**66.3**	70.7	74.2	75.4	75.6	74.9
Age-related expenditures as % of GDP						
Pension expenditure	**7.8**	7.6	7.2	7.5	8.5	8.6
of which old age pensions	**7.1**	6.9	6.5	6.8	7.9	7.9
Health care and long-term care	**7.0**	7.4	8.3	9.0	9.5	9.8
of which health care social payments	**4.1**	4.4	4.9	5.3	5.7	5.8
Fiscal indicators as % of GDP						
General government balance	**-0.4**	-0.2	-0.8	-2.0	-4.4	-6.0
of which primary balance	**0.7**	0.5	0.1	-1.0	-2.5	-2.9
Interest expenditure	**1.1**	0.8	0.9	1.1	1.9	3.1
General government debt	**40.3**	34.0	27.2	30.5	52.1	83.8

Table A6: Sensitivity Scenario – Productivity LOW

	2015	2020	2030	2040	2050	2060
Population assumptions						
Population, in thousands	**10530**	10532	10397	10126	9813	9388
Working age population (15-64), in thousands	**7053**	6754	6557	6078	5390	5038
Dependency ratio	**0.45**	0.46	0.46	0.49	0.56	0.57
Macroeconomic and labour force assumptions						
Real GDP growth (y-o-y), in %	**4.6**	2.4	1.8	0.9	0.9	0.9
Inflation (y-o-y), in %	**0.3**	2.0	2.0	2.0	2.0	2.0
Yield of 10-year government bond, in %	**0.67**	3.12	4.08	4.31	4.52	4.59
Labour force productivity growth (y-o-y), in %	**4.5**	2.5	1.7	1.6	1.5	1.3
Labour force growth (y-o-y), in %	**0.1**	-0.1	0.1	-0.7	-0.6	-0.4
Participation rate (15-64) in % - Men	**81.3**	82.8	82.1	83.1	83.8	83.0
Participation rate (15-64) in % - Women	**66.3**	70.7	74.2	75.4	75.6	74.9
Age-related expenditures as % of GDP						
Pension expenditure	**7.8**	7.6	7.3	7.7	8.8	8.9
of which old age pensions	**7.1**	6.9	6.7	7.0	8.2	8.3
Health care and long-term care	**7.0**	7.4	8.3	9.0	9.5	9.8
of which health care social payments	**4.1**	4.4	4.9	5.3	5.7	5.8
Fiscal indicators as % of GDP						
General government balance	**-0.4**	-0.2	-1.0	-2.4	-5.2	-7.2
of which primary balance	**0.7**	0.5	0.0	-1.2	-2.8	-3.2
Interest expenditure	**1.1**	0.8	1.0	1.3	2.3	4.0
General government debt	**40.3**	34.0	28.9	35.6	62.8	103.3

Table A7: Sensitivity Scenario – Replacement Rate Drop by 1 p.p. since 2019

	2015	2020	2030	2040	2050	2060
Population assumptions						
Population, in thousands	**10530**	10532	10397	10126	9813	9388
Working age population (15-64), in thousands	**7053**	6754	6557	6078	5390	5038
Dependency ratio	**0.45**	0.46	0.46	0.49	0.56	0.57
Macroeconomic and labour force assumptions						
Real GDP growth (y-o-y), in %	**4.6**	2.4	2.0	1.1	1.1	1.2
Inflation (y-o-y), in %	**0.3**	2.0	2.0	2.0	2.0	2.0
Yield of 10-year government bond, in %	**0.67**	3.12	4.03	4.25	4.44	4.50
Labour force productivity growth (y-o-y), in %	**4.5**	2.5	1.9	1.8	1.7	1.6
Labour force growth (y-o-y), in %	**0.1**	-0.1	0.1	-0.7	-0.6	-0.4
Participation rate (15-64) in % - Men	**81.3**	82.8	82.1	83.1	83.8	83.0
Participation rate (15-64) in % - Women	**66.3**	70.7	74.2	75.4	75.6	74.9
Age-related expenditures as % of GDP						
Pension expenditure	**7.8**	7.6	7.2	7.5	8.5	8.6
of which old age pensions	**7.1**	6.9	6.5	6.8	7.9	7.9
Health care and long-term care	**7.0**	7.4	8.3	9.0	9.5	9.8
of which health care social payments	**4.1**	4.4	4.9	5.3	5.7	5.8
Fiscal indicators as % of GDP						
General government balance	**-0.4**	-0.2	-0.8	-2.1	-4.5	-6.2
of which primary balance	**0.7**	0.6	0.1	-1.0	-2.5	-2.9
Interest expenditure	**1.1**	0.8	0.9	1.1	2.0	3.3
General government debt	**40.3**	34.0	27.6	31.8	54.5	88.4

Table A8: Sensitivity Scenario – Social Security Contributions Rate Increase by 1 p.p.

	2015	2020	2030	2040	2050	2060
Population assumptions						
Population, in thousands	**10530**	10532	10397	10126	9813	9388
Working age population (15-64), in thousands	**7053**	6754	6557	6078	5390	5038
Dependency ratio	**0.45**	0.46	0.46	0.49	0.56	0.57
Macroeconomic and labour force assumptions						
Real GDP growth (y-o-y), in %	**4.6**	2.4	2.0	1.1	1.1	1.2
Inflation (y-o-y), in %	**0.3**	2.0	2.0	2.0	2.0	2.0
Yield of 10-year government bond, in %	**0.67**	3.10	4.01	4.23	4.42	4.47
Labour force productivity growth (y-o-y), in %	**4.5**	2.5	1.9	1.8	1.7	1.6
Labour force growth (y-o-y), in %	**0.1**	-0.1	0.1	-0.7	-0.6	-0.4
Participation rate (15-64) in % - Men	**81.3**	82.8	82.1	83.1	83.8	83.0
Participation rate (15-64) in % - Women	**66.3**	70.7	74.2	75.4	75.6	74.9
Age-related expenditures as % of GDP						
Pension expenditure	**7.8**	7.6	7.3	7.6	8.7	8.7
of which old age pensions	**7.1**	6.9	6.6	6.9	8.0	8.1
Health care and long-term care	**7.0**	7.4	8.3	9.0	9.5	9.8
of which health care social payments	**4.1**	4.4	4.9	5.3	5.7	5.8
Fiscal indicators as % of GDP						
General government balance	**-0.4**	0.1	-0.5	-1.6	-4.0	-5.6
of which primary balance	**0.7**	0.9	0.3	-0.7	-2.4	-2.7
Interest expenditure	**1.1**	0.8	0.8	0.9	1.6	2.9
General government debt	**40.3**	33.3	24.2	25.7	45.8	76.9

Table A9: Sensitivity Scenario – Introduction of Retirement Age Cap at 65 Years

	2015	2020	2030	2040	2050	2060
Population assumptions						
Population, in thousands	**10530**	10532	10397	10126	9813	9388
Working age population (15-64), in thousands	**7053**	6754	6557	6078	5390	5038
Dependency ratio	**0.45**	0.46	0.46	0.55	0.69	0.74
Macroeconomic and labour force assumptions						
Real GDP growth (y-o-y), in %	**4.6**	2.4	2.0	0.6	0.9	1.1
Inflation (y-o-y), in %	**0.3**	2.0	2.0	2.0	2.0	2.0
Yield of 10-year government bond, in %	**0.67**	3.12	4.04	4.40	4.66	4.80
Labour force productivity growth (y-o-y), in %	**4.5**	2.5	1.9	1.8	1.7	1.6
Labour force growth (y-o-y), in %	**0.1**	-0.1	0.1	-1.2	-0.9	-0.4
Participation rate (15-64) in % - Men	**81.3**	82.8	82.1	82.4	83.0	82.2
Participation rate (15-64) in % - Women	**66.3**	70.7	74.2	74.2	74.2	73.8
Age-related expenditures as % of GDP						
Pension expenditure	**7.8**	7.6	7.3	8.6	10.4	11.1
of which old age pensions	**7.1**	6.9	6.6	7.9	9.8	10.4
Health care and long-term care	**7.0**	7.4	8.3	9.0	9.5	9.8
of which health care social payments	**4.1**	4.4	4.9	5.3	5.7	5.8
Fiscal indicators as % of GDP						
General government balance	**-0.4**	-0.2	-0.9	-3.4	-7.5	-11.2
of which primary balance	**0.7**	0.5	0.0	-2.0	-4.4	-5.4
Interest expenditure	**1.1**	0.8	0.9	1.4	3.0	5.8
General government debt	**40.3**	34.0	28.1	38.9	81.2	146.4

Table A10: Sensitivity Scenario – Health Care Costs without Technological Progress

	2015	2020	2030	2040	2050	2060
Population assumptions						
Population, in thousands	**10530**	10532	10397	10126	9813	9388
Working age population (15-64), in thousands	**7053**	6754	6557	6078	5390	5038
Dependency ratio	**0.45**	0.46	0.46	0.49	0.56	0.57
Macroeconomic and labour force assumptions						
Real GDP growth (y-o-y), in %	**4.6**	2.4	2.0	1.1	1.1	1.2
Inflation (y-o-y), in %	**0.3**	2.0	2.0	2.0	2.0	2.0
Yield of 10-year government bond, in %	**0.67**	3.11	4.01	4.20	4.36	4.38
Labour force productivity growth (y-o-y), in %	**4.5**	2.5	1.9	1.8	1.7	1.6
Labour force growth (y-o-y), in %	**0.1**	-0.1	0.1	-0.7	-0.6	-0.4
Participation rate (15-64) in % - Men	**81.3**	82.8	82.1	83.1	83.8	83.0
Participation rate (15-64) in % - Women	**66.3**	70.7	74.2	75.4	75.6	74.9
Age-related expenditures as % of GDP						
Pension expenditure	**7.8**	7.6	7.3	7.6	8.7	8.7
of which old age pensions	**7.1**	6.9	6.6	6.9	8.0	8.1
Health care and long-term care	**7.0**	7.3	7.9	8.3	8.4	8.3
of which health care social payments	**4.1**	4.3	4.7	4.9	5.0	5.0
Fiscal indicators as % of GDP						
General government balance	**-0.4**	-0.2	-0.5	-1.3	-3.0	-3.8
of which primary balance	**0.7**	0.6	0.3	-0.4	-1.6	-1.6
Interest expenditure	**1.1**	0.8	0.9	0.9	1.4	2.2
General government debt	**40.3**	33.9	25.8	25.5	39.6	60.3

Table A11: Sensitivity Scenario – Economic Crisis

	2015	2020	2030	2040	2050	2060
Population assumptions						
Population, in thousands	**10530**	10532	10397	10126	9813	9388
Working age population (15-64), in thousands	**7053**	6754	6557	6078	5390	5038
Dependency ratio	**0.45**	0.46	0.46	0.49	0.56	0.57
Macroeconomic and labour force assumptions						
Real GDP growth (y-o-y), in %	**4.6**	0.0	2.0	1.1	1.1	1.2
Inflation (y-o-y), in %	**0.3**	1.7	2.0	2.0	2.0	2.0
Yield of 10-year government bond, in %	**0.67**	4.36	5.10	6.20	6.68	7.09
Labour force productivity growth (y-o-y), in %	**4.5**	0.1	1.9	1.8	1.7	1.6
Labour force growth (y-o-y), in %	**0.1**	-0.1	0.1	-0.7	-0.6	-0.4
Participation rate (15-64) in % - Men	**81.3**	82.8	82.1	83.1	83.8	83.0
Participation rate (15-64) in % - Women	**66.3**	70.7	74.2	75.4	75.6	74.9
Age-related expenditures as % of GDP						
Pension expenditure	**7.8**	8.7	8.2	8.6	9.8	9.9
of which old age pensions	**7.1**	8.0	7.5	7.9	9.2	9.2
Health care and long-term care	**7.0**	8.5	9.2	9.7	10.1	10.3
of which health care social payments	**4.1**	5.4	6.1	6.6	7.0	7.2
Fiscal indicators as % of GDP						
General government balance	**-0.4**	-3.7	-6.1	-10.1	-17.8	-27.4
of which primary balance	**0.7**	-2.3	-2.8	-4.0	-5.9	-6.2
Interest expenditure	**1.1**	1.4	3.3	6.0	12.0	21.2
General government debt	**40.3**	54.4	80.1	126.1	220.3	363.2

Table A12: Sensitivity Scenario – Yields on Government Bonds LOW

	2015	2020	2030	2040	2050	2060
Population assumptions						
Population, in thousands	**10530**	10532	10397	10126	9813	9388
Working age population (15-64), in thousands	**7053**	6754	6557	6078	5390	5038
Dependency ratio	**0.45**	0.46	0.46	0.49	0.56	0.57
Macroeconomic and labour force assumptions						
Real GDP growth (y-o-y), in %	**4.6**	2.9	2.0	1.1	1.1	1.2
Inflation (y-o-y), in %	**0.3**	2.0	2.0	2.0	2.0	2.0
Yield of 10-year government bond, in %	**0.67**	0.67	0.67	0.67	0.67	0.67
Labour force productivity growth (y-o-y), in %	**4.5**	3.0	2.0	1.8	1.7	1.6
Labour force growth (y-o-y), in %	**0.1**	-0.1	0.1	-0.7	-0.6	-0.4
Participation rate (15-64) in % - Men	**0.1**	82.8	82.1	83.1	83.8	83.0
Participation rate (15-64) in % - Women	**0.1**	70.7	74.2	75.4	75.6	74.9
Age-related expenditures as % of GDP						
Pension expenditure	**7.8**	7.5	7.2	7.6	8.7	8.7
of which old age pensions	**7.1**	6.8	6.5	6.9	8.0	8.1
Health care and long-term care	**7.0**	7.4	8.2	8.9	9.4	9.7
of which health care social payments	**4.1**	4.4	4.9	5.3	5.6	5.8
Fiscal indicators as % of GDP						
General government balance	**-0.4**	0.1	0.0	-1.1	-2.7	-3.2
of which primary balance	**0.7**	0.6	0.2	-0.9	-2.6	-2.9
Interest expenditure	**1.1**	0.5	0.2	0.1	0.2	0.3
General government debt	**40.3**	32.9	20.7	19.0	32.8	51.0

Table A13: Sensitivity Scenario – Yields on Government Bonds HIGH

	2015	2020	2030	2040	2050	2060
Population assumptions						
Population, in thousands	**10530**	10532	10397	10126	9813	9388
Working age population (15-64), in thousands	**7053**	6754	6557	6078	5390	5038
Dependency ratio	**0.45**	0.46	0.46	0.49	0.56	0.57
Macroeconomic and labour force assumptions						
Real GDP growth (y-o-y), in %	**4.6**	2.9	2.0	1.1	1.1	1.2
Inflation (y-o-y), in %	**0.3**	2.0	2.0	2.0	2.0	2.0
Yield of 10-year government bond, in %	**0.67**	4.79	6.05	6.30	7.16	8.35
Labour force productivity growth (y-o-y), in %	**4.5**	3.0	2.0	1.8	1.7	1.6
Labour force growth (y-o-y), in %	**0.1**	-0.1	0.1	-0.7	-0.6	-0.4
Participation rate (15-64) in % - Men	**81.3**	82.8	82.1	83.1	83.8	83.0
Participation rate (15-64) in % - Women	**66.3**	70.7	74.2	75.4	75.6	74.9
Age-related expenditures as % of GDP						
Pension expenditure	**7.8**	7.5	7.2	7.6	8.7	8.7
of which old age pensions	**7.1**	6.8	6.5	6.9	8.0	8.1
Health care and long-term care	**7.0**	7.4	8.2	8.9	9.4	9.7
of which health care social payments	**4.1**	4.4	4.9	5.3	5.6	5.8
Fiscal indicators as % of GDP						
General government balance	**-0.4**	-0.3	-1.3	-2.9	-6.5	-11.6
of which primary balance	**0.7**	0.6	0.2	-0.9	-2.6	-2.9
Interest expenditure	**1.1**	1.0	1.4	2.0	3.9	8.7
General government debt	**40.3**	33.9	29.7	38.8	72.0	133.6

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