The Czech Fiscal Council

REPORT ON THE LONG-TERM SUSTAINABILITY OF PUBLIC FINANCES

June 2019
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Introduction

Public finance sustainability is a fundamental condition for economic and social development in any economy. To assess the degree to which this condition is met in Czech Republic, the Czech Fiscal Council (CFC) regularly issues a *Report on the Long-Term Sustainability of Public Finances* (the "Report"). Preparing the Report and submitting it to the Chamber of Deputies of the Parliament of the Czech Republic is one of the CFC's principal duties under Act No. 23/2017 Coll., on the rules of budgetary responsibility (the "Act").

The main objective of the Report is to evaluate how public finances are likely to develop over the next 50 years if the current government policies are maintained. At first glance, the 50-year timescale may seem very long and subject to considerable uncertainty as regards future trends. However, the CFC chose it not only because it is commonly used in similar documents published elsewhere around the world, but also because the Czech Republic will face the most unfavourable demographic structure – with all its negative impacts on public finances – in 40 years' time. The full scale of the problem of long-term public finance sustainability, caused primarily by population ageing, is only revealed when a 50-year projection is used. Choosing a shorter timescale would distort the situation considerably.

This, the second *Report on the Long-Term Sustainability of Public Finances* examines the issues opened in the first Report roughly six months on. The autumn 2018 timing of the publication of the first Report was determined by the objective of fulfilling the CFC's legal mandate "to submit regular reports on the long-term sustainability of public finances" in its first year of existence. However, the CFC does not regard the autumn publication date as optimal, as such reports should ideally reflect the current public finance and national accounts data for the previous year with the shortest possible delay. These data are published in March and April. The Convergence Programme of the Czech Republic, the General Government Budgetary Strategy of the Czech Republic and other key public finance documents are also published in this period. The CFC has therefore decided to publish the annual Report in the first half of June.

This *Report on the Long-Term Sustainability of Public Finances* contains a number of changes in content and methodology by comparison with last year's edition. The current demographic projection of the Czech Statistical Office (CZSO), published in November 2018, is a major new source of information. The new demographic projection is reflected on both the revenue and expenditure sides of public finances in various structurally crosscutting ways. When preparing this report, the CFC also endeavoured as much as possible to incorporate the suggestions, comments and recommendations it has gathered during the public debate that has been going on over the past six months on various platforms.

The objective of the Report is to test the implications of the current public finance revenue and expenditure parameters for future decades, as determined by demographic trends and as affected by expected economic growth. The Report is again based on the assumption of no policy change, the general approach used to assess public finance sustainability. The Report therefore describes the potential consequences of not making changes to public finance revenue and expenditure policy. It differs from the previous Report in that a larger number of scenarios have been created. Different variants of the demographic projection published by the CZSO are quantified. Another scenario links the retirement age to rising life expectancy (an option already considered in the current legislation). Lastly, the effects of the upward trend in productivity growth that would hypothetically occur as a result of ongoing digitalisation and robotisation are tested.

The Report sets out to provide timely identification of weaknesses that could result in a serious imbalance in the public finance sector and to map out their time profile. The main common denominator of these weaknesses is population ageing. The public is aware of this problem, and the solution must be sought in the public arena too. This Report plots the size of the potential public finance imbalance over the coming decades. Given the long timescale of the projection, the results are subject to uncertainty, but the trend in, and estimates of, the imbalance between public finance revenue and expenditure are beyond dispute. Playing down the future problems (either by directly rejecting the projections without giving clear counterarguments, or by making more sophisticated reference to potential "adjustment mechanisms" without providing further quantification) would merely lead to a harder landing at a time of economically unfavourable demographic trends.

The CFC does not have a mandate to table solutions itself, but it does have the mandate and the ability to assess the impacts of proposed solutions. It is in the interests of all of society to debate how to face the increasing pressure on public expenditure stemming from population ageing. It will not be easy to reach a consensus, as the meetings of the new Fair Pensions Committee have shown. These aspects – contrasting with the currently sound condition of public finances – should be taken into consideration when reading the Report. The longer the problem is put off, the narrower the room for manoeuvre will be. With each year of delay in preparing for demographic change we not only lose valuable time, we also increase the cost of future action.

1 Summary

The second Report prepared by the CFC shows that despite a slight improvement on last year due to a more favourable demographic projection, Czech public finances remain unsustainable in the long term. Compared with last year, a new Czech Statistical Office (CZSO) demographic projection was available to the CFC for the preparation of the Report. This projection is updated every five years and the latest version was published at the end of November 2018. However, the new CZSO data do not indicate any major change in the long-term trends.

The Czech population continues to age. The share of people aged 65+ in the total population is currently 19% and will increase to 30% over the next 50 years. Given current revenue and expenditure policies, this will lead to a significant increase in pension and health and long-term care expenditure. Education and defence spending will increase as well.

Real convergence to more developed countries and economic growth accompanied by a growing share of wages in GDP (leading to increased collection of personal income taxes and social security contributions relative to GDP) will not suffice to offset such trends on the expenditure side.

The general government primary balance, which is positive in the early years of the projection, will drop into marked deficits after 2030 as the baby-boom cohorts begin to retire and will peak at just below 7% of GDP around 2060.

According to the baseline scenario of the projection, the “debt brake” threshold, which is legally set at 55% of GDP, will be breached around the year 2047. The general government debt will, however, continue to increase, due not only to growing pension system deficits, but also to an increase in interest rates spurred by the country’s growing indebtedness. At the end of the projection’s 50-year horizon in 2069, the debt in our simulation will reach some 222% of GDP. Even if financial markets were not to react to the increasing debt, leaving the rate of return on bonds at the level prior to the debt brake breach, the debt-to-GDP ratio would amount to 175% of GDP at the end of the projection.

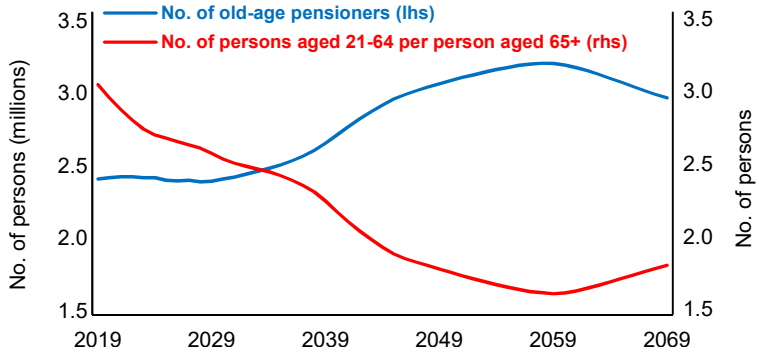
Alternative scenarios that count, for example, on linking the retirement age to expected life expectancy or on favourable effects of digitalisation, automation and robotisation on labour productivity, show that the debt in relation to GDP would be lower than in the baseline scenario at the end of the 50-year projection horizon. However, the Czech Republic would not achieve long-term sustainability of public finances even under such favourable scenarios.

It is obvious that the public finance trends described in the Report will require a response from political representatives. The political representation will need to adjust tax and expenditure policies at the latest when the limits set by law are reached (1% of GDP in the case of the structural deficit and 55% of GDP in the case of the general government debt). The considerable increase in projected debt in the simulated period, indicating the size of the long-term imbalances, at the same time implies that the adjustments will have to be very strong and not merely cosmetic.

Although the period over which the deficit and the debt reach the limits defined by law seems to be long enough to find a consensual solution to the long-term unsustainability of Czech public finances, the opposite is true. Neither politicians nor the general public should be lulled into a false sense of security by the developments expected over the next few years, in which Czech public finances may seem at first sight to be in good condition in terms of debt to GDP and by international comparison. The projection clearly shows that the unfavourable trend will accelerate after 2030. The costs increase with each year of postponement of the necessary changes. The later reforms are adopted, the more painful they will be for society.

It is therefore clear that it is necessary to start a serious debate that will lead to concrete measures as soon as possible. Such debate would help distribute the burden of demographic change over more generations and at the same time provide economic agents with more time to adapt.

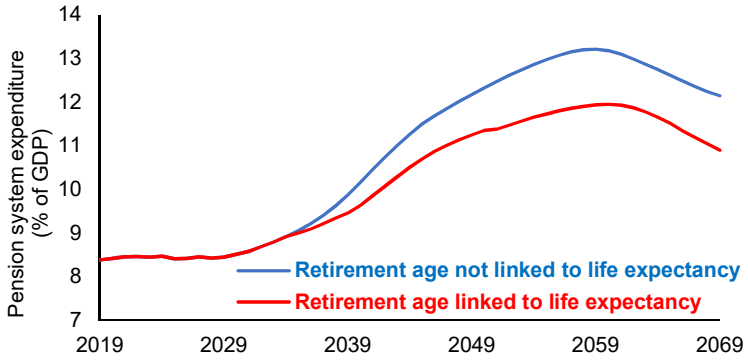
KEY FINDINGS in the baseline scenario



The number of old-age pensioners will peak around 2059 at about

3.2 million

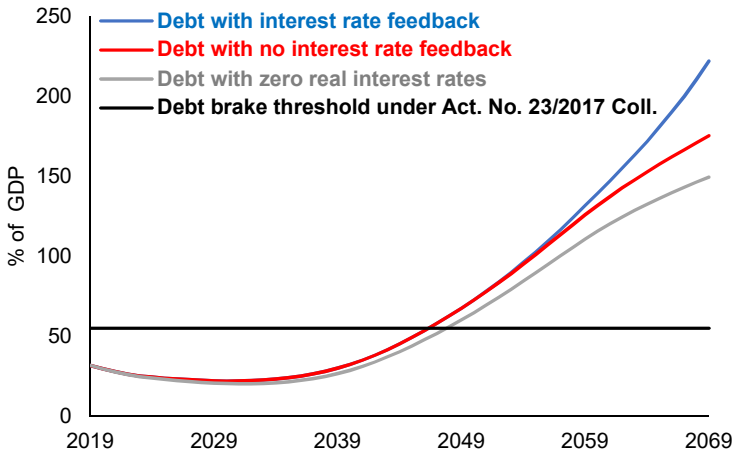
i.e. about a third more than today. The working age population will decline.



Linking the retirement age to life expectancy does not lead to long-term sustainability of public finances. However, pension system spending would be reduced by up to

1.3% of GDP

from 2059.



If the current tax and expenditure policies were maintained, the breach of the debt limit would probably take place in

2047

The general government debt-to-GDP ratio could reach

222% of GDP

by the end of the projection's 50-year horizon.

2.79% of GDP

is the amount by which the primary structural balance would have to be better from 2019 until 2069 for the debt not to exceed the debt brake in 2069.

2 Starting point and medium-term outlook

In the medium-term outlook, fiscal policy is assessed primarily in the context of the current and expected evolution of the business cycle. By medium-term outlook, we mean the outlook for the whole of 2019 and for the period that coincides with the time frame for which the General Government Budgetary Strategy is approved (three years), i.e. currently 2020–2022.

2.1 Starting point and fiscal effort

In 2018, the Czech Republic recorded annual GDP growth of 2.9% and its output gap reached 1.7% of GDP. Potential output grew at approximately the same pace as GDP in the same period. Total factor productivity was the main driver of potential output growth (contributing 1.9 pp).[1]

The dominant demand-side contributor to GDP growth was gross fixed capital formation (2.6 pp). Final consumption expenditure of households and government also contributed to the growth (1.5 pp and 0.7 pp respectively). By contrast, the trade balance and change in inventories made negative contributions.[2]

This favourable economic environment was reflected in the finances of the general government sector. In 2018, the sector achieved a surplus of 0.9% of GDP. Central government contributed a surplus of 0.2% of GDP, local government a surplus of 0.4% of GDP and social security funds a surplus of 0.3% of GDP to the overall figure.[3] The structural balance was 0.4% of GDP. Fiscal effort recorded a negative figure of –0.7% of GDP, as the surplus was smaller last year than in 2017. General government debt stood at 32.7% of GDP.[4]

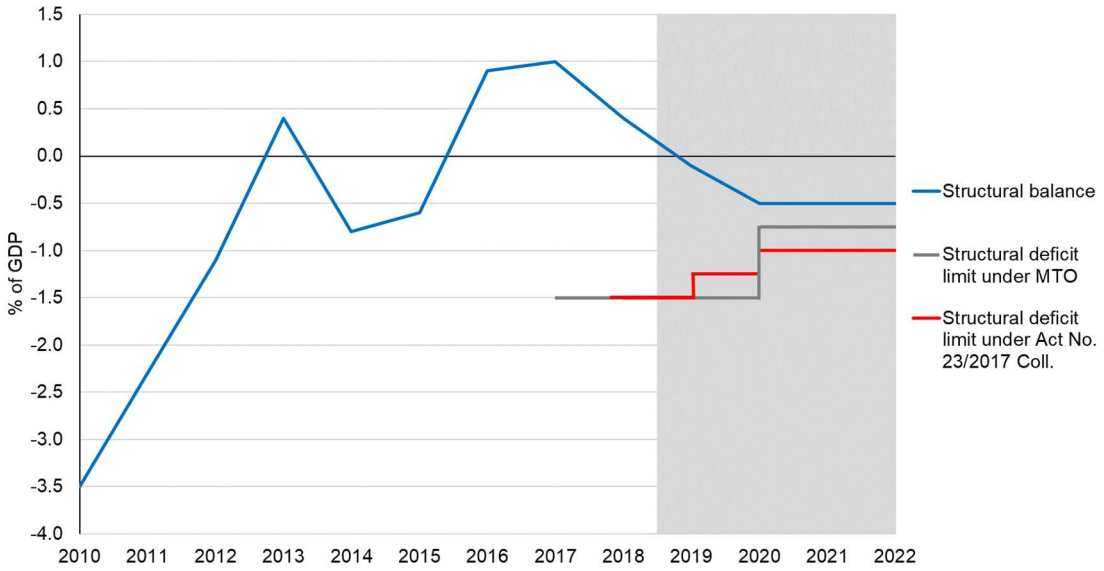
In its current forecast in the April 2019 Convergence Programme of the Czech Republic, the Ministry of Finance of the Czech Republic (MF CR) predicts positive, albeit slowing, real GDP growth for 2019–2022. The positive output gap is also expected to close over the coming period of 2020–2022. The year 2018 can therefore be regarded as the peak of the business cycle. This path of the economy and the reduction in the positive output gap are reflected in a fall in the general government cyclical balance from 0.4% of GDP to zero in the final year of the forecast (2022). As a result of expansionary fiscal policy this year and the next, the structural balance will meanwhile decrease from a surplus of 0.4% of GDP in 2018 to a deficit of 0.5% of GDP in 2020 (see Chart 2.1.1). Over the following two years of the forecast it is expected to stay constant.[5]

According to MF CR projections,[6] the ratio of general government debt to GDP will drop from 31.5% to 29.7%. However, the relatively large declines in the ratio seen in previous years (such as the decrease of 2 pp between 2017 and 2018) are unlikely to be repeated, mainly because of lower GDP growth and lower primary balances.

The financial results planned for the general government sector for 2019–2022 continue to assume adherence to the limits defined in the Act. Consequently, neither the structural deficit limit of 1% of GDP arising from the mechanism for deriving total general government expenditure (see Section 10 of the Act), nor the general government debt limit of 55% of GDP set forth in Section 14 of the Act will be exceeded (see Charts 2.1.1 and 2.1.2). At the same time, however, a deterioration in the cost of ageing component of the S2 sustainability indicator[7] will cause the Medium-Term Budgetary Objective (MTO) for the Czech Republic (see Box 2.1) to be tightened from –1.5% of GDP to –0.75% of GDP, limiting the room for any future fiscal expansion. So, if the general government structural balance reaches the expected –0.5% of GDP in 2020, the room left for any fiscal expansion will be only 0.25% of GDP.

[1] MF CR: Macroeconomic Forecast of the Czech Republic, April 2019, pp. 2 and 23.
[2] MF CR: Macroeconomic Forecast of the Czech Republic, April 2019, p. 28.
[3] MF CR: Convergence Programme of the Czech Republic, April 2019, p. 47.
[4] MF CR: Macroeconomic Forecast of the Czech Republic, April 2019, p. 14.
[5] MF CR: Convergence Programme of the Czech Republic, April 2019, p. 49.
[6] MF CR: Convergence Programme of the Czech Republic, April 2019, pp. 18 and 48.
[7] The S2 indicator shows by how many per cent of GDP the primary structural balance must be permanently improved (from a given year) to make the general government debt remain stable over an infinite horizon.

Chart 2.1.1 The general government structural balance 2010–2022



Source: MF CR: Macroeconomic Forecast of the Czech Republic (April 2019), MF CR: Convergence Programme of the Czech Republic (April 2019), CZSO (2019); CFC calculations.
Note: MF CR outlook for 2020–2022 (structural balance).

Box 2.1 Calculation of the Medium-Term Budgetary Objective for the Czech Republic

Each EU Member State has its own Medium-Term Budgetary Objective (MTO) under the Stability and Growth Pact. It is expressed as a minimum structural balance reflecting the normal volatility of public revenues and expenditure and the country's debt and future liabilities. Despite its name, the MTO is a limit, not an objective. Adherence to the MTO should allow Member States to maintain a sufficient reserve against the reference value (a deficit of 3% of GDP) in ordinary cyclical situations and to improve the sustainability of public finances while leaving room for automatic stabilisers to act.[8]

The MTO calculation is set out in an implementing document published by the Economic and Financial Committee of the Council (EU) on the Stability and Growth Pact.[9] At national level, the MTO will be applied under the methodology for deriving expenditure frameworks of the state budget and state funds[10] if it is stricter than the 1% structural deficit limit defined in the Act.

The MTO for the Czech Republic for the periods 2017–2019 and 2020–2022 is set equal to MTO^{ILD}, a variant of the MTO that takes into account implicit liabilities and debt. Under the current European Commission methodology[11] it is determined according to the following equation:

$$MTO^{ILD} = -0.6 \cdot nominal\ GDP\ growth + 0.33 \cdot ageing\ cost + debt\text{–}reduction\ effort$$

The first term is calculated as the product of –0.6 and projected average nominal GDP growth until 2060 (for MTOs over the period 2017–2019) and until 2070 (for MTOs over the period 2020–2022). The second term represents the budgetary adjustment that would cover a fraction (0.33) of the projected increase in the cost of ageing, calculated to an infinite horizon. The third term reflects the debt-reduction effort specific to Member States with debt above 60% of GDP, which is not currently the case of the Czech Republic. Table B2.1.1 presents the figures used to calculate the Czech MTO^{ILD} over the periods 2017–2019 and 2020–2022. These figures are then substituted into the equation and the result is rounded to a quarter of a percentage point.[12]

[8] MF CR: Convergence Programme of the Czech Republic, April 2019, p. 37.
[9] EFC: Specifications on the Implementation of the Stability and Growth Pact and Guidelines on the Format and Content of Stability and Convergence Programmes, 15 May 2017.
[10] Methodology of Deriving Expenditure Frameworks of the State Budget and State Funds. Prague, MF CR and CFC, April 2018.
[11] European Commission: Vade Mecum on the Stability and Growth Pact – 2019 Edition, Institutional Paper 101, April 2019.
[12] The value of the MTO is rounded towards zero when it is positive (a lower required surplus) and away from zero when it is negative (a higher permitted deficit).

Table B2.1.1 Figures for the calculation of *MTO^{ILD}*

Components of MTO^{ILD} calculation	MTO$_{2017–2019}$	MTO $_{2020–2022}$
Projected nominal GDP growth (%)	3.6	3.5
Projected increase in cost of ageing (% of GDP)	2.4	4.7

Source: European Commission: Ageing Report 2015 and 2018, European Commission: Fiscal Sustainability Report 2015 and 2018
Note: 2% inflation assumed.

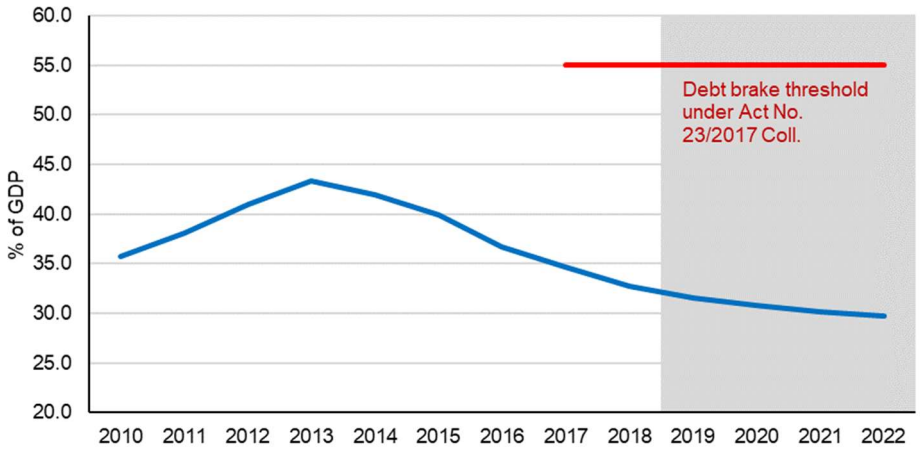
$$MTO^{ILD}_{2017-} = -0.6 \cdot 3.6 + 0.33 \cdot 2.4 + 0 = -2.2 + 0.79 = -1.41 \cong 1.50$$

$$MTO^{ILD}_{2020-} = -0.6 \cdot 3.5 + 0.33 \cdot 4.7 + 0 = -2.1 + 1.55 = -0.55 \cong -0.75$$

The revision of the increase in the cost of ageing from 2.4% to 4.7% of GDP had a key effect on the tightening of the MTO from –1.50% to –0.75% of GDP by the European Commission. *MTO^{ILD}* assumes coverage of one-third of the cost of ageing, so the increase in that cost of 2.3 pp results in a tightening of 0.76 pp. The revision (reduction) of the growth estimate has only a minor effect on the MTO (a tightening of 0.1 pp).

The cost of ageing primarily reflects growth in the costs of pensions, health care and long-term care due to population ageing. The costs of pensions and long-term care were revised upwards significantly (from 0.6% to 2.2% of GDP and from 0.5% to 1.1% of GDP respectively).[13]

Chart 2.1.2 General government debt net of the state debt financing reserve 2010–2022



Source: MF CR: Draft State Final Accounts of the Czech Republic for 2014, section E. State Debt Management Report; MF CR: Convergence Programme of the Czech Republic (2017–2019), CNB: Government Financial Statistics; CFC calculations.
Note: MF CR forecast for 2019–2022.

The structure of public debt as regards holdings by residents and non-residents shifted slightly towards residents. At the end of 2017 domestic owners held 54.5% of public debt, whereas by the end of 2018 the figure had risen to 60.4% (see Chart 2.1.3). The domestic public debt held by foreign investors thus decreased during 2018. This was due to repayments of short-term bonds and T-bills to non-residents by the Ministry of Finance. Non-residents' persisting exposure to the Czech koruna is gradually turning them into long-term investors in Czech government bonds.

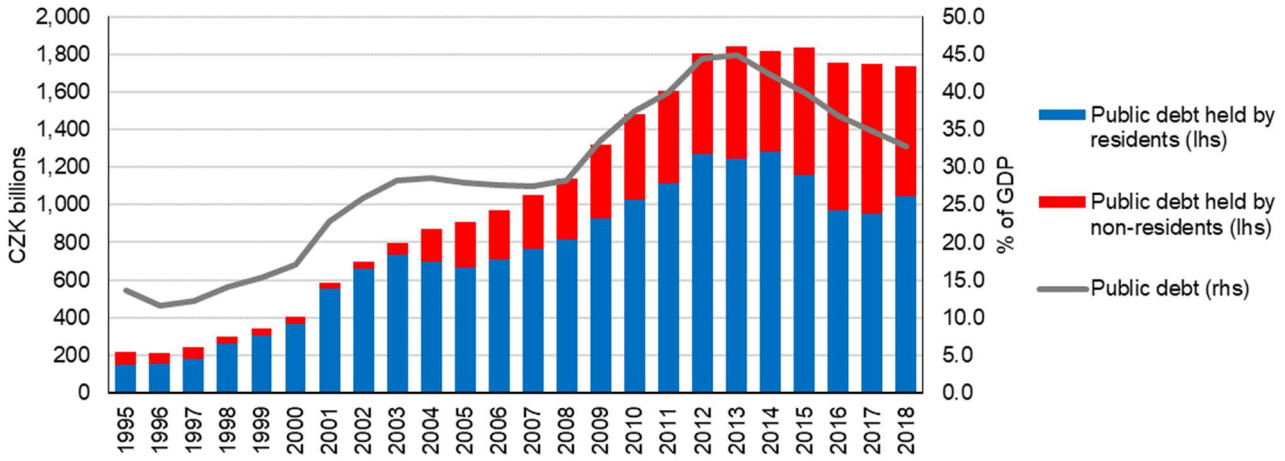
The biggest buyers of Czech government bonds were domestic financial institutions, which increased their domestic public debt holdings by CZK 94.4 billion. Banks accounted for CZK 44.2 billion of this figure, while other financial institutions – primarily insurance companies and capital market funds – recorded the dominant increase in holdings of CZK 87.1 billion. Other residents, by contrast, saw a decrease in debt holdings of CZK 36.9 billion (see Chart 2.1.4). From the risk assessment perspective, this change is generally favourable, as it reduces the risk of external shocks spilling over to the domestic financial

[13] Figures from European Commission 2018 and 2015: Fiscal Sustainability Report. The majority of countries saw an increase in the projected cost of pensions, but the growth for the Czech Republic is the second-highest behind Luxembourg. The situation is similar as regards the costs of long-term care. In this case, the Czech Republic is in equal third place (together with the UK) behind Luxembourg and Ireland (European Commission: The 2018 Ageing Report: Economic and Budgetary Projections).

system, where a sell-off of domestic debt by foreign investors would probably trigger high volatility in market prices of Czech government bonds. In line with international practice, the CNB considers 35% as the critical threshold for the proportion of public debt held by foreign entities.[14] This threshold has been constantly exceeded in the Czech Republic since 2015.

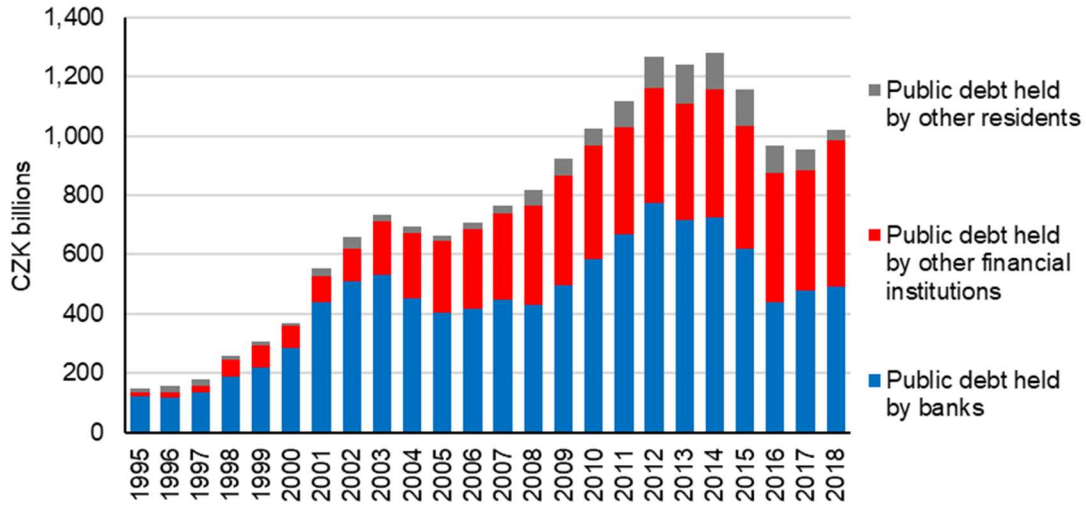
At the end of 2019, domestic banks held 30% of public debt, up 3 pp on a year earlier. The share of domestic government bonds in bank assets dropped modestly to 7% in 2018, slightly reducing the interconnectedness of the risks of the domestic banking and government sectors.

Chart 2.1.3 Public debt held by residents and non-residents



Source: CNB (2019): ARAD; CFC calculations.

Chart 2.1.4 Public debt held by domestic residents



Source: CNB (2019): ARAD; CFC calculations.

2.2 Fiscal policy stance relative to the position in the business cycle

One of the functions of fiscal policy at the macroeconomic level is to stabilise the rate of growth of the economy. The stabilisation function of fiscal policy is implemented through two types of instruments: automatic stabilisers and discretionary measures. Automatic stabilisers consist mainly of income taxes and some social transfers. These stabilisers activate automatically, i.e. without any direct government inter-

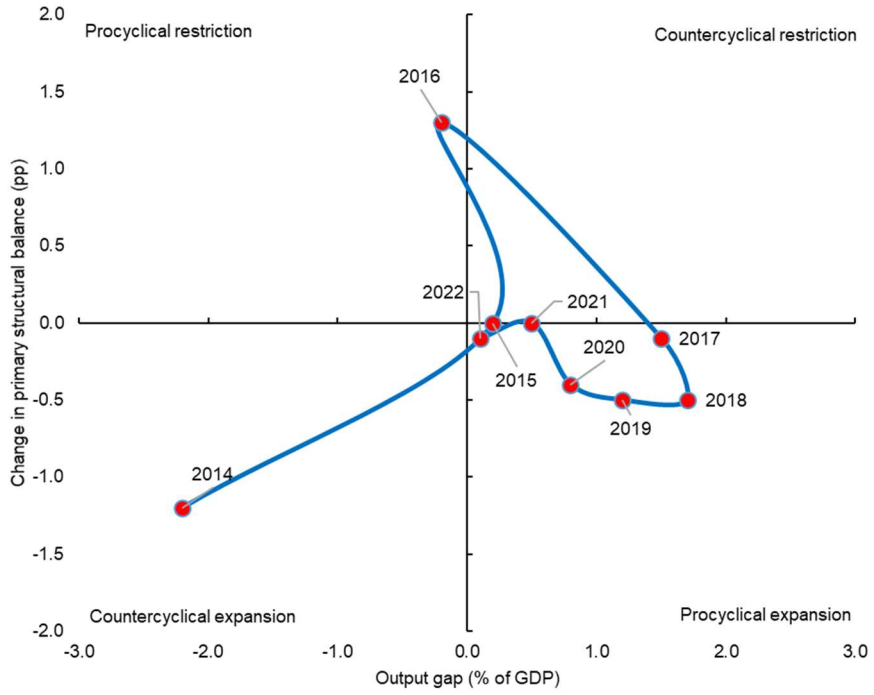
[14] See, for example, CNB (2018): Financial Stability Report 2017/2018.

vention, in the course of the economic cycle. Discretionary measures, which we discuss in subsection 2.3, are deliberate government measures that change tax rates, social transfers and government purchases, including capital purchases.

The nature of discretionary fiscal policy measures can be analysed by means of the change in the primary structural balance. If this balance is increasing (decreasing), the government is taking action to reduce (increase) aggregate demand. For fiscal policy to fulfil its stabilisation function, therefore, the primary structural balance should increase (decrease) when the output gap is positive (negative). From the longer-term perspective, it is vital to pursue restrictive fiscal policy when the output gap is significantly positive. This on the one hand will reduce the volatility of economic growth and on the other will ensure that the general government sector creates sufficient room for fiscal expansion when the output gap is negative (countercyclical expansion).

Chart 2.2.1 illustrates the relationship between the output gap and the change in the primary structural balance. It shows clearly that last year and, according to the forecast, 2019 and 2020 are characterised by procyclical fiscal expansion. This will result in there being limited room for active expansionary fiscal policy in the future. As a consequence, fiscal policy will not fully perform its stabilisation function this year and in the subsequent years of the forecast.

Chart 2.2.1 Relationship between the output gap and the change in the primary structural balance 2014–2022



Source: MF CR: Macroeconomic Forecast of the Czech Republic (April 2019), MF CR: Convergence Programme of the Czech Republic (April 2019), CZSO (2019); CFC calculations.
Note: MF CR outlook for 2020–2022 (primary structural balance).

2.3 Decomposition of the fiscal effort

The fiscal effort is the year-on-year change in the structural balance expressed in percentage points. It is an indicator of year-on-year fiscal policy tightening (if the fiscal effort is positive) or loosening (if it is negative). The main categories of factors affecting the fiscal effort are:

1. **Autonomous developments** – as a result of higher taxation of labour than capital, for example, a higher ratio of wages and salaries to GDP will lead to higher general government sector revenue from personal income tax and insurance premiums.
2. **Discretionary government measures** – see Table 2.3.1 and the text below the table.
3. **Factors depending on other determinants** – the investment activity of municipalities, for example, is often dependent to some extent on the implementation of operational programmes.

Table 2.3.1 Decomposition of the fiscal effort 2014–2022 (pp)

	2014	2015	2016	2017	2018	2019	2020	2021	2022
Taxes and social contributions	*–1.7*	*–0.7*	*0.9*	*0.0*	*0.7*	*0.3*	*0.1*	*0.2*	*0.2*
Other revenue	*0.0*	*0.6*	*–1.6*	*–0.3*	*0.4*	*–0.3*	*–0.2*	*–0.1*	*0.0*
REVENUE	–1.7	–0.1	–0.7	–0.3	1.1	0.0	–0.1	0.1	0.1
Compensation of employees and intermediate consumption	*0.4*	*0.3*	*–0.1*	*–0.1*	*–0.9*	*–0.2*	*–0.1*	*–0.1*	*–0.1*
Social transfers and social transfers in kind	*0.4*	*0.7*	*0.2*	*0.4*	*–0.1*	*–0.3*	*–0.3*	*0.0*	*0.1*
Interest	*0.0*	*0.2*	*0.1*	*0.2*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Investment	*–0.4*	*–1.0*	*1.9*	*–0.1*	*–0.7*	*0.0*	*–0.1*	*–0.1*	*–0.2*
Other expenditures	*–0.3*	*0.5*	*0.1*	*0.2*	*–0.1*	*0.1*	*0.2*	*0.1*	*0.1*
One-off measures	*0.4*	*–0.5*	*0.1*	*–0.1*	*0.1*	*–0.1*	*0.0*	*0.0*	*0.0*
EXPENDITURE	0.6	0.3	2.3	0.4	–1.7	–0.5	–0.3	–0.1	–0.1
FISCAL EFFORT	–1.2	0.2	1.5	0.1	–0.7	–0.5	–0.4	0.0	0.0

Source: CNB (2019): Government Financial Statistics, MF CR: Convergence Programme of the Czech Republic (April 2019), MF CR: Macroeconomic Forecast of the Czech Republic (April 2019), CZSO (2019); CFC calculations.
Note: Taxes and social contributions are cyclically adjusted but the other items are not. Outlook data for 2020–2022 (Convergence Programme). The subtotals may not add up to the total difference due to rounding.

Table 2.3.1 presents the decomposition of the fiscal effort using the indirect method (i.e. as the year-on-year change in the general government structural balance and its subsequent decomposition) for the period 2014–2022. The fiscal effort was significantly affected in 2018 by an increase in revenue from taxes and social contributions and, from the expenditure perspective, an increase in compensation of employees and growth in investment. In the text below the table we give the most significant discretionary measures in terms of volume for 2018 as presented by the Ministry of Finance in the 2018 and 2019 Convergence Programmes.[15]

Discretionary measures were implemented on both the revenue and expenditure sides of the budgets in 2018. The most significant (i.e. those exceeding CZK 1 billion) are presented below.

An increase in the minimum and guaranteed wage under personal income tax collection had a **positive impact on the revenue side** (i.e. an increase in revenues) in the general government sector in 2018. In addition to the aforementioned increase in revenues due to growth in wages and salaries, there was a rise in revenues of CZK 3.1 billion under social security contributions due to an increase in payments for state-insured persons (cash social benefit expenditure increased to the same extent). According to the Ministry of Finance, VAT revenues were increased by CZK 3 billion by control statements[16] and CZK 1 billion by electronic sales registration.[17] An increase in the rate of excise duty on tobacco products increased excise duty revenues by CZK 1.5 billion.[18]

An increase in the tax credit on the first child under personal income tax had a **negative effect on the revenue side** (i.e. a reduction in revenues) totalling CZK 2.4 billion in 2018.[19]

None of the discretionary measures introduced in 2018 had a significant **positive effect on the expenditure side** (i.e. a reduction in expenditure) in the general government sector.

Several discretionary measures had an **upward effect on expenditure**. The more significant ones included an increase in compensation of employees, which in 2018 alone lifted spending by approximately CZK 31 billion. Expenditure on social transfers in kind rose by CZK 2 billion as a result of the introduction of a 75% fare discount for the under 26s and over 65s.[20] Pension benefits had the largest upward effect on expenditure in the area of cash social benefits. Spending on this item increased by CZK 2.5 billion due to a change in the indexation formula[21] in addition to growth in the price level and real wages leading also to an increase in pensions. Expenditure

[15] MF CR: Convergence Programme of the Czech Republic, April 2018 and 2019.
[16] Amendment to Act No. 360/2014 Coll., amending Act No. 235/2004 Coll., on Value-Added Tax, as amended, and other related acts.
[17] Act No. 112/2016 Coll., on Registration of Sales.
[18] Act No. 315/2015 Coll., amending Act No. 353/2003 Coll., on Excise Duties, as amended.
[19] Act No. 200/2017 Coll., amending Act No. 117/1995 Coll., on State Social Support, as amended, and other related acts.
[20] Government Resolution No. 206/2018.
[21] The indexation formula is the sum of consumer price index growth or pensioner cost of living index growth (whichever is the higher) and one half of real wage growth (Act No. 203/2017 Coll.). Previously, the indexation formula was the sum of consumer price index growth and one third of real wage growth. If the increase in the average pension is lower than 2.7% under the current indexation formula, pensions will be increased by that percentage figure (Act No. 212/2016 Coll.).

was also increased by family policy measures[22] and measures to support people with disabilities[23] and people with long-term illnesses or their carers.[24] The measures in the area of family policy and support for people with disabilities and long-term illnesses increased expenditure by CZK 9 billion overall in 2018. The state's payment for state-insured persons went up by CZK 3.1 billion.

Box 2.2 Sustainability in the medium term

Medium-term sustainability is derived from the initial level of general government debt and is determined going forward by nominal GDP growth, the implicit (average) nominal interest rate on general government debt, and the general government primary deficit, according to the following fundamental debt dynamics equation:

$$d_t = d_{t-1} \cdot \frac{1+r}{1+g_t} - \frac{PB_t}{GDP_t},$$

where d_t and d_{t-1} are the debt-to-GDP ratios in years *t* and *t*–1 respectively, r is the implicit (average) nominal interest rate paid on the debt, g_t is annual nominal GDP growth between years *t* and *t*–1, PB_t is the general government primary balance in year *t*, and GDP_t is nominal GDP in year *t*.

When assessing medium-term sustainability, the main issue is how the level of debt would change in the event of an economic downturn as simulated by a stress scenario. The stress scenario also incorporates refinancing risk, i.e. the risk that the cost of refinancing the part of the debt that would mature during the scenario will increase by comparison with current market interest rates.

As general government debt is made up predominantly of state debt (central government debt: CZK 1,741 billion; local government debt: CZK 79 billion),[25] we focus primarily on this item.

We calculated two stress scenarios (see Table B2.2.1):

a) A *severe stress scenario* assuming flat nominal GDP over the next three years, i.e. in 2020, 2021 and 2022. On the basis of the flat nominal GDP, we also assume flat nominal state budget revenues, while we still expect expenditure to be in line with the figures published in the Draft Medium-Term Outlook for 2020–2021. The dynamics of state budget expenditure in 2022 are derived from the General Government Budgetary Strategy of the Czech Republic for 2020–2022.

b) A *moderate stress scenario* assuming annual nominal GDP growth of 2% over the next three years. The same rate of growth is assumed for nominal revenues. The expenditure side in the moderate stress scenario is the same as that in the severe stress scenario.

In both scenarios, we additionally simulate the response of financial markets to the downturn in the domestic economy. Based on the post-2008 experience, this response is estimated by revaluing the interest rate to 4.5% in the first year of the scenarios and 4.0% in the following two years. Bonds maturing in each year of the scenarios (based on the current stock of bonds actually issued) will thus be refinanced under these interest rate conditions. The same financing conditions will apply to the additional state budget deficits generated over the three-year period. The initial state debt level for 2019 of 31.9% of GDP was taken from the Ministry of Finance's central government debt projection published in the April 2019 Convergence Programme of the Czech Republic.

The results are rather more favourable than those of the 2018 stress scenarios. There are several reasons for this. The initial implicit interest rate is lower because of favourable state debt management conditions in 2018 and early 2019. The three-year outlook for 2020–2022 is also relatively comfortable from the perspective of the average interest rate paid on the general government debt. The increase in interest rates from their current levels under the stress scenarios would not lead to any dramatic increase in debt service. The refinanced debt tranches of previous years are also subject to a higher interest rate and the amount of bonds with the lowest coupons maturing over the next three years is relatively low.

[22] Act No. 148/2017 Coll. and Act No. 200/2017 Coll.
[23] Act No. 301/2017 Coll., Act No. 93/2017 Coll. and Act No. 327/2017 Coll.
[24] Act No. 259/2017 Coll., amending Act No. 589/1992 Coll., on Social Security Insurance and State Employment Policy Contributions, as amended, and other related acts; Act No. 200/2017 Coll., amending Act No. 117/1995 Coll., on State Social Support, as amended, and other related acts.
[25] MF CR: Fiscal Outlook of the Czech Republic (November 2018), p. 17.

Table B2.2.1 State debt stress scenarios

	2020	2021	2022	2020	2021	2022
	Flat nominal GDP (severe stress)			2% nominal GDP growth (moderate stress)		
Total state budget balance (CZK billions)	-100.0	-164.0	-228.0	-73.0	-109.0	-144.0
Total balance (% of GDP)	-1.8	-2.9	-4.1	-1.3	-1.9	-2.4
Primary state budget balance (CZK billions)	-53.0	-111.0	-169.0	-27.0	-59.0	-91.0
Primary balance (% of GDP)	-1.0	-2.0	-3.0	-0.5	-1.0	-1.5
Implicit interest rate (%)	2.9	3.0	3.1	2.9	3.0	3.0
Government debt (% of GDP)	33.7	36.8	41.0	32.7	34.0	35.9

Source: MF CR: Convergence Programme (April 2019), MF CR: Macroeconomic Forecast of the Czech Republic (April 2019), MF CR: Government Debt Management Report 2018; CFC calculations.

Under the severe stress scenario, the state debt would rise by almost 10 pp – from 31.9% of GDP in 2019 to 41% of GDP in 2022. Even the moderate stress of a three-year stagnation of real GDP (given 2% nominal GDP growth and 2% inflation) would generate a rise in the state debt-to-GDP ratio from 31.9% to 36% (see Table B2.2.1).

In the event of economic problems, however, the budgets of municipalities and regions, which are currently in surplus, would also probably worsen. This could cause the overall general government debt to reach a higher level than the simulations presented above indicate.

The debt dynamics relationship can also be used to determine the maximum permissible general government debt level ensuring that the debt brake would not have to be activated over the three-year horizon of the severe stress scenario. The ratio of state debt to general government debt is assumed to stay at the present level. With a debt brake of 55% of GDP, the current limit is a state debt of 40% of GDP and a total general government debt of 42% of GDP. The maximum relative permissible limit is not constant over time, as it depends on the current government bond market situation and on the three-year public finance outlooks.

2.4 Effect of monetary factors

The economy is affected by monetary factors as well as fiscal policy. The CNB's main monetary policy interest rate (the two-week repo rate) was raised five times in 2018, from 0.5% at the start of the year to 1.75% at the end. The CNB Bank Board increased the rate by a further 25 basis points at its May meeting.[26] The main reason for tightening monetary policy in spite of uncertainty stemming from the external environment, was strong inflationary pressure in the domestic economy reflecting, among other things, robust growth in wages and salaries.[27] The gradual rise in the two-week repo rate was reflected with varying intensity along practically the entire length of the yield curve, with the three-month PRIBOR rising from an average of 0.77% in January 2018 to 2.02% in April 2019.[28] The 10-year government bond yield went up from 1.77% to 1.82% in the same period.[29] Despite a large interest rate differential between the Czech Republic and the euro area, the Czech currency did not strengthen against the euro – in April 2019 the exchange rate was 25.68 CZK/EUR, representing a year-on-year weakening of the koruna of approximately 1.2%.[30]

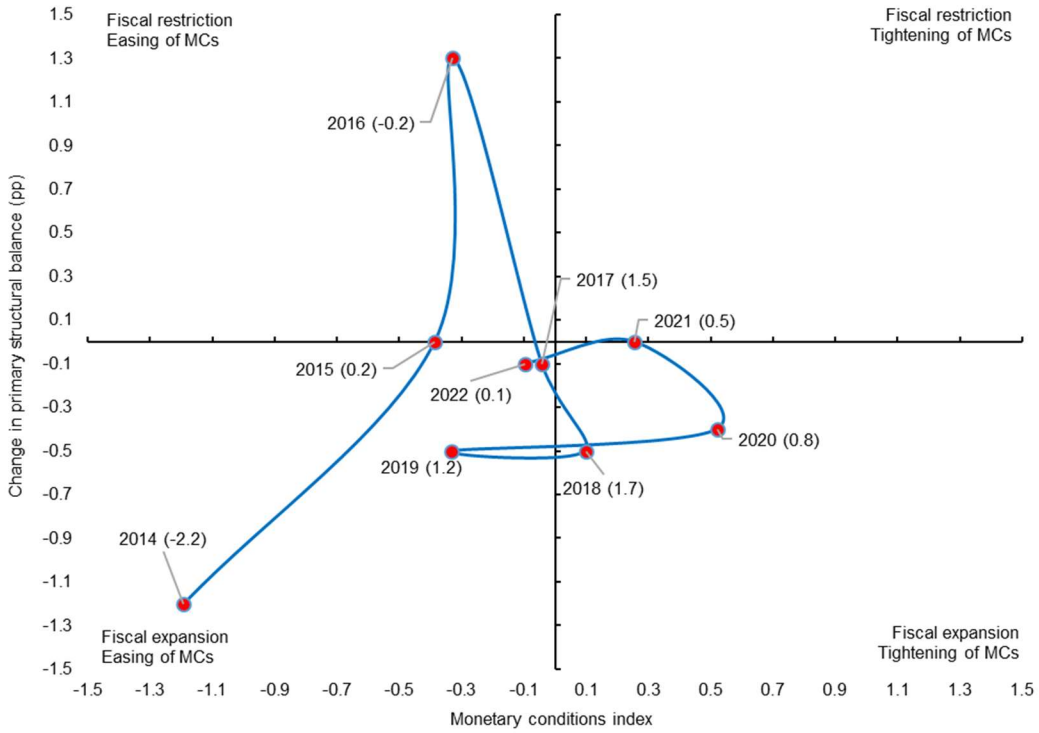
For 2019, the Ministry of Finance forecast[31] assumes a modest increase in the three-month PRIBOR to 2.1%. For the following two years (2020–2022), it expects the rate to stagnate at 2.3%. The yield to maturity of ten-year government bonds is expected to rise from 2.2% this year to 2.4% in the subsequent years of the forecast. The CZK/EUR exchange rate is expected to strengthen gradually from an estimated average of 25.5 CZK/EUR this year to 24.2 CZK/EUR at the end of the forecast horizon in 2022.

[26] CNB: Summary – Inflation Report II/2019.
[27] Besides raising interest rates, the CNB implemented some macroprudential policy instruments (an increase in the countercyclical capital buffer and a tightening of the rules applying to the provision of housing loans). Macroprudential policy instruments respond mainly to the financial cycle, which is longer than the business cycle.
[28] CNB (2019): ARAD.
[29] CNB (2019): ARAD. In March 2017, the last full calendar month of application of the CNB's exchange rate commitment, the yield was 0.87%.
[30] CNB (2019): ARAD.
[31] MF CR: Convergence Programme of the Czech Republic, April 2019, p. 4.

Chart 2.4.1 illustrates the interaction of monetary and fiscal policy for the period of 2014–2022 (the output gap in % of GDP is given in parentheses after the years). For these purposes, we calculated a monetary conditions index characterising the tightness/easiness of monetary policy in simple terms.[32] Monetary policy is getting tighter if the index is rising and easier if it is falling. The chart shows that in some years monetary and fiscal policy do not affect the business cycle in the same direction (see, for example, 2018 in Chart 2.4.1).

For 2019, our calculations indicate an easing of the monetary conditions, primarily as a result of a lower real three-month PRIBOR. According to Ministry of Finance figures,[33] growth in the real three-month PRIBOR and a strengthening of the real effective exchange rate can be expected in the period ahead.

Chart 2.4.1 Monetary and fiscal policy in the context of the business cycle 2014–2022



Source: MF CR: Macroeconomic Forecast of the Czech Republic (April 2019), MF CR: Convergence Programme of the Czech Republic (April 2019), CNB (2019): ARAD, Eurostat (2019), International Monetary Fund (World Economic Outlook, April 2019), CZSO (2019); CFC calculations.
Note: MCs = monetary conditions. The output gap in % of GDP is given in parentheses after the year. MF CR outlook for 2020–2022 (primary structural balance).

[32] The monetary conditions index comprises an interest rate component and an exchange rate component in a 3:1 ratio. The nominal three-month PRIBOR, the GDP deflator and the real effective exchange rate deflated by the industrial producer price index enter the calculation. The time series of the trend real interest rate and the real effective exchange rate were obtained using the Hodrick-Prescott filter and the (standard) deviations from this trend were then used.
[33] MF CR: Convergence Programme of the Czech Republic, April 2019, p. 4; MF CR: Macroeconomic Forecast of the Czech Republic, April 2019, pp. 19 and 36.

3 Long-term macroeconomic projection

The long-term projection of general government revenues, expenditure and balance over a 50-year timescale is based on the long-term projections for the main macroeconomic variables relevant to the fiscal projection. These variables include GDP growth, labour productivity, employment, the volume of wages and the related distribution of gross value added between labour and capital. As we relate our fiscal projection systematically to GDP and other real variables, nominal variables such as the inflation rate, nominal wages and nominal interest rates are less important. Unlike the medium-term outlook, the long-term projection abstracts from the business cycle. Although we assume that cyclical fluctuations of the economy will continue to occur, their timing cannot be predicted in the long run, hence their size cannot be reliably quantified either. We therefore simulate the paths of potential GDP and other corresponding macroeconomic variables.[34]

3.1 Real convergence

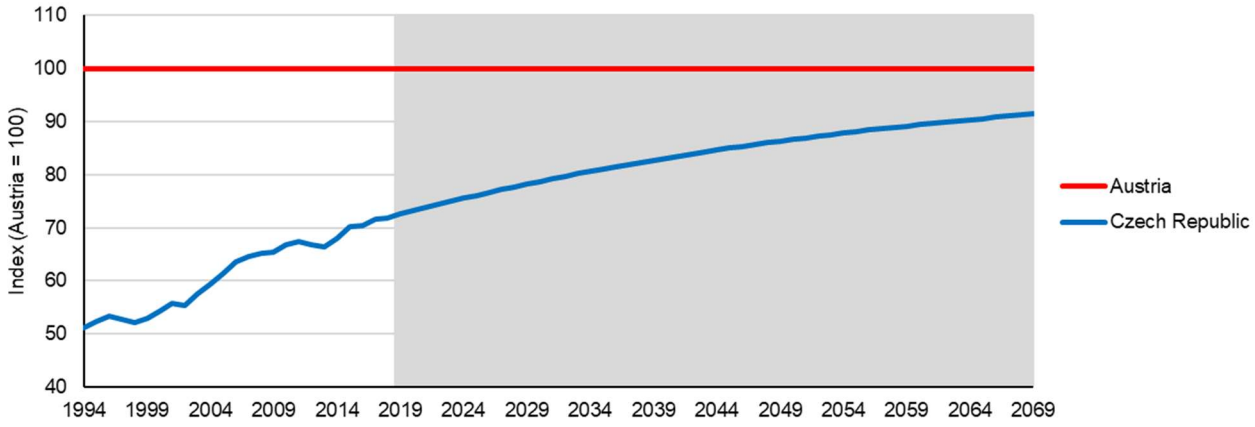
We chose neoclassical growth theory as the theoretical basis for our long-term macroeconomic projection. The basic building block of this theory is the aggregate production function, which describes how various inputs (such as capital, labour and technological change) affect the volume of production. According to this theory, one can differentiate between economies that are in their steady state and those that are still converging to their steady state. The Czech economy is a converging economy. This is the starting point for our macroeconomic projection. According to economic theory one can estimate the size of the steady state towards which the Czech Republic should converge. However, this estimate is conditional on the ratio of investment to GDP, the rate of growth of the labour force and other variables remaining constant over the entire projection period. These are very strong assumptions, so we chose an alternative approach in which a real-world economy, specifically that of Austria, is assumed to represent the steady state of the Czech economy (i.e. some sort of convergence target). We opted for the Austrian economy because – despite having some structural differences – it is a standard mixed economy of an EU Member State that is similar in size to the Czech Republic and because the difficult-to-quantify factors that potentially influence the economy and its steady state (such as cultural habits, the legal environment and informal rules) in Austria are, in our opinion, similar enough to those in the Czech Republic.

The convergence process can be modelled in several ways. For example, one can assume convergence of GDP per capita, convergence of GDP per worker (which would be closest to the theory) or convergence of output per hour worked. As the last mentioned option is subject to considerable data problems, and as our projection is for a period in which demographic changes are going to occur, we base our projections on convergence of GDP per worker. According to the theory, economies should converge to their steady states such that the difference between the steady state and the actual state of the economy shrinks by a constant percentage each year. The gap between the Austrian and Czech GDP per worker levels (estimated at 28% of the Austrian level in purchasing power parity in 2018[35]) has narrowed by roughly 2.3% a year on average over the last 20 years (currently by approximately 0.6 pp of the gap a year). This rate is similar as in other transition countries and is also in line with the usual empirical convergence results, so we use it to simulate the convergence of whole-economy labour productivity (see Chart 3.1.1).[36]

However, the shrinking gap between the steady state and the converging economy is only one component of long-run growth. An economy that is in the steady state and in which the labour force is not expanding grows at the rate of growth of technology (i.e. the rate of growth of aggregate factor productivity). This growth must therefore be added to the convergence component when estimating the long-run rate of growth of the Czech economy. In our simulation we use a figure of 1.5% a year as the rate of growth of output per worker in the steady state resulting from growth in technology. This is the long-run average for developed countries if we eliminate the effect of the financial crisis in 2008 and 2009, when many European countries saw a sustained decline in whole-economy productivity. In our simulation, the rate of growth of GDP per worker thus falls steadily from 2.4% at present to 1.6% at the end of the projection as a result of the convergence component of growth gradually being exhausted. With the given parameter settings, this implies that whole-economy labour productivity will be at 91% of the future Austrian level at the end of the projection in 2069.

[34] A more detailed explanation of the procedure and parameters used for the long-term macroeconomic projection is given in OCFC (2019): Dlouhodobá makroekonomická projekce ČR [Long-term Macroeconomic Projection of the Czech Republic, available in Czech only].
[35] According to OECD statistics.
[36] For details, again see OCFC (2019): Dlouhodobá makroekonomická projekce ČR.

Chart 3.1.1: Process of convergence of output per worker to the Austrian level (Austria = 100)



Source: OECD and CFC calculations.

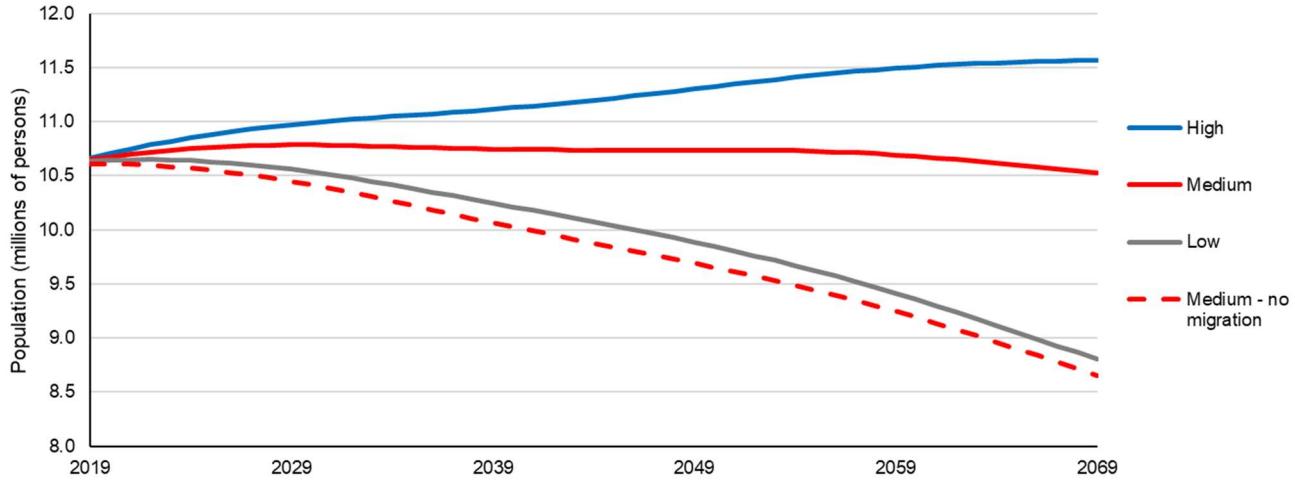
Productivity growth will be affected by, among other things, the ongoing wave of robotisation and digitalisation. However, we do not explicitly model these phenomena, because in our opinion they are merely new forms of technological progress, which the neoclassical growth theory works with routinely. We are not saying that robotisation and digitalisation will not affect economic variables, we just believe that they will neither fundamentally change the functioning of the market economy, nor be quantitatively significant enough to necessitate a change to the current theoretical framework.[37] In alternative scenarios (see section 6.2), however, we nonetheless test the impact of a productivity growth acceleration of 1 pp a year over the entire projection period. As we demonstrate, the impacts of such an acceleration on the fiscal projection do not change our fundamental conclusions.

3.2 Demographic projection

While growth in GDP per worker is modelled independently of population growth in the long-run projection, total GDP will clearly be affected by both the number of citizens and the age structure of the population. The demographic projection is therefore one of the main inputs to the macroeconomic projection, as the simulation of the number of workers is based upon it. For our purposes, we use the CZSO's November 2018 demographic projection, which is drawn up in three variants: medium, high and low. A no-migration version (i.e. with zero net migration for each year of the projection) is additionally calculated for the medium variant.[38] We opted for the medium variant as the default baseline scenario for our projections and prepared alternative scenarios based on the other variants where it was possible and relevant to do so. The latest projection has undergone many changes by comparison with the original 2013 CZSO demographic projection used in last year's Report on the Long-Term Sustainability of Public Finances.[39] That said, the most important feature of all the variants of the demographic projection is still a rising share of people aged 65+, which should reach roughly 30% (or higher for the low variant and the no-migration variant) around 2059. This will be aided by, among other things, an increase in life expectancy of 8.3 years for men and 6.6 years for women by 2069. Population ageing is common to all the projection variants, though there are significant differences in other indicators between the variants. For example, the difference in the total population between the high variant and the medium no-migration variant is almost three million at the end of our projection (see Chart 3.2.1).[40]

[37] For more details on the possible consequences and problems associated with automation and robotisation, see Hindls, R., Hronová, S. (2019): Robotizace, rozvoj umělé inteligence a jejich dopad na ekonomiku, ÚNRR [Robotisation and the Development of Artificial Intelligence and their Impact on the Economy, OCFC, available in Czech only]. However, we should also point out that labour productivity growth has yet to accelerate perceptibly in developed countries. On the contrary, statistically measured labour productivity has been lagging behind the long-run growth trend in many developed countries over the last 10 years.
[38] CZSO (2018): Projekce obyvatelstva České republiky 2018–2100 [Population Projection of the Czech Republic 2018–2100, available in Czech only].
[39] See section 6 for a more detailed comparison of the current demographic projection and that used in the preparation of the Report in 2018.
[40] CZSO (2018): Projekce obyvatelstva České republiky 2018–2100.

Chart 3.2.1: Population paths in the variants of the demographic projection



Source: CZSO (2018): Population Projection of the Czech Republic 2018–2100.

Using the demographic projection, we estimate the growth in the number of workers based on the growth in the number of people aged 21+ minus the projected number of old-age pensioners and level-3 disability pensioners. We estimate the numbers of beneficiaries of such pensions according to the statutory retirement age and other parameters.[41] We assume that the rate of economic activity is constant in this population category and that the natural rate of unemployment likewise remains constant. If we combine the rate of growth/decline in the labour force obtained in this way with the projection of GDP per worker, we get the growth paths for total GDP and GDP per capita (see Table 3.3.1).

3.3 Real wages and the primary income distribution

Wage growth plays a major role in the projections for the pension system, education and health care and other areas. In our projection, we derive the evolution of real wages from the long-run growth projection for GDP per worker. In contrast to the other projections, however, we do not assume that real wages will grow at the same rate as GDP per worker, because the ratio of compensation of workers to gross value added (GVA) was and to a large extent still is low in the Czech economy compared with other countries.[42] Nevertheless, this indicator has been increasing steadily over the years.[43] Such change in the distribution of GVA is important for, among other things, the level and structure of future tax revenues. As we see no reason a priori why this ratio should be systematically lower in the Czech economy than in developed countries in the long run, we assume a process of convergence here as well. In this case, however, economic theory does not offer a clear guide to the speed of convergence of the ratio of compensation of workers to GVA, so we use the same rate at which GDP per worker converges. This means that the gap between the ratio of compensation of workers to GVA in the selected developed countries and the same ratio in the Czech Republic also narrows by 2.3% a year in our simulation.[44]

As with long-run productivity growth, we do not explicitly consider the impact of digitalisation and robotisation on the primary income distribution (i.e. the distribution of income between labour and capital). While the effect of this phenomenon on the data is imperceptible in the case of productivity, there is some doubt whether the labour share of output is declining in developed countries due to technological

[41] The methodology and projection for the number of pension beneficiaries is described in more detail in section 4.
[42] For better international comparability, we work with the ratio of compensation of workers, which we define analogously to compensation of employees except that we include an estimate of compensation of entrepreneurs (the self-employed). The figure we use per self-employed person is equal to the average per employee.
[43] See Box 3.1 for a more detailed explanation of the evolution of the ratio of compensation of workers to GVA in the Czech Republic.
[44] The selected developed countries are Austria, Germany, Sweden, Denmark, Belgium, the Netherlands and Finland. For details, see OCFC (2019): Dlouhodobá makroekonomická projekce ČR [Long-term Macroeconomic Projection of the Czech Republic, available in Czech only].

change (i.e. whether it is moving in the opposite direction to that assumed in our simulation).[45] For now, however, the changes in the primary income distribution in developed countries are not large and systematic enough to enable their cause to be identified.

Technological progress, however, can also change the inequality in the distribution of income among workers (i.e. within the share for labour) without significantly changing the aggregate primary income distribution. Some research suggests that this is indeed the case. While some occupations are complementary to the current technological progress (and are therefore enjoying rapidly rising real wages), others are being substituted by it.[46] However, we do not explicitly include this effect in the simulation either, as it is difficult to quantify and it is not even clear in which direction it would affect the fiscal balance.

The increasing ratio of compensation of workers (and hence also employees) to GDP in our projection means that the volume of wages and salaries is growing faster than GDP in the long term, at the expense of the gross operating surplus of firms. Regardless of the variant of the demographic projection chosen, real wages are rising more quickly than labour productivity. Overall, then, we assume in our projection that real wages will grow by 2.1% a year on average (see Table 3.3.1). This is about 0.2 pp higher than per worker GDP growth. We fully abstract from the effect of the terms of trade, which could also affect the gap between real wage growth and productivity growth in the long run. Such a gap between productivity growth and wage growth over a period of 50 years may seem to be a discrepancy, but note that this gap averaged 0.6 pp between 1995 and 2017 (average real wage growth of 3% and average growth in GDP per worker of 2.4%), and even that was not enough to offset the unusually low ratio of wages to GDP in the Czech economy.[47]

In order to calculate the interest paid on general government debt, we still need to make an assumption about the rate of inflation, because the latter affects nominal interest rates. Over the entire period of our projection, we assume that the rate of consumer price inflation is equal to the rate of growth of the GDP deflator, namely 2% a year. This inflation rate is in line with the CNB's current inflation target.

Table 3.3.1 Average annual growth rates based on the long-term projection (%)

	2019–2030	2031–2040	2041–2050	2051–2060	2061–2069	Entire period
GDP per capita	2.3	1.8	1.2	1.5	2.2	1.8
GDP total	2.4	1.7	1.2	1.4	2.0	1.8
Average real wage	2.5	2.2	2.1	1.9	1.8	2.1

Source: CFC calculations.

Box 3.1 Sector analysis of the share of compensation of workers in gross value added

Compensation of workers naturally differs from sector to sector – some sectors (such as energy and network industries) are capital intensive and compensation of workers in them has a relatively small share in gross value added (GVA). By contrast, other sectors (such as education, health and social care and public administration) use little capital per unit of labour and can thus be expected to display a high share of compensation of workers in GVA. However, the shares of the various sectors in total GVA in the economy are changing steadily over time. The question is, therefore, to what extent the past growth in the share of compensation of workers in the Czech economy has been due to change in the structure of the economy and to what extent it has been due to changes in the shares of compensation of workers in individual sectors.

The total share of compensation of workers α is a weighted average of the shares of compensation of workers in the individual sectors α_i, where the weights are the shares of GVA created in the various sectors in total GVA. We can decompose these weights into two components – a relative labour productivity component indicating the value added per worker in the sector relative to the average value added per worker in the economy as a whole, and a component describing the share of the sector in total employment in the national economy. If we denote productivity per worker as gva and the number of workers as L (or, where relevant, as L with the relevant sector index), we can break down the share of compensation of workers as follows:

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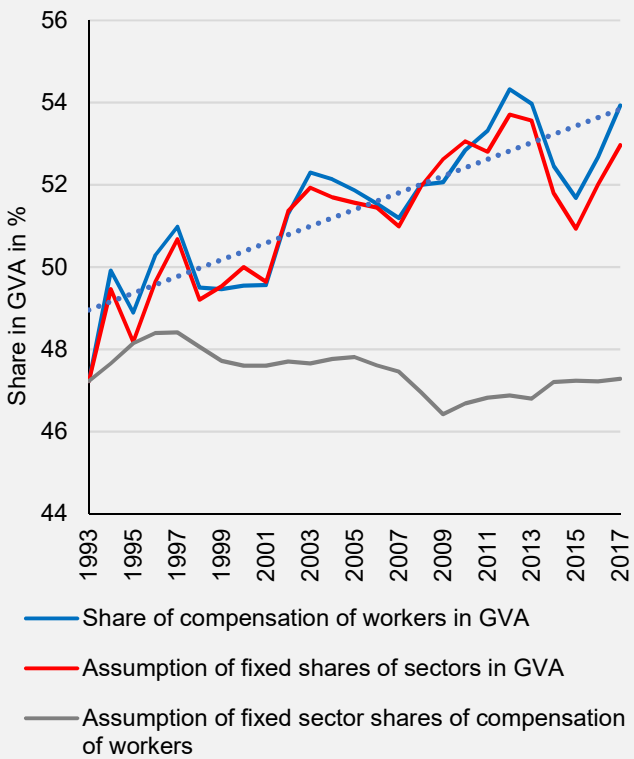
[45] See, for example, the survey of empirical findings in Mai Chi Dao et al.: Understanding the Downward Trend in Labor Income Shares, in IMF: World Economic Outlook, April 2017.
[46] Ibid.
[47] OECD figures.

$$\alpha = \sum_i \alpha_i \cdot \frac{GVA_i}{GVA} = \sum_i \alpha_i \cdot \frac{gva_i}{gva} \cdot \frac{L_i}{L}.$$

To determine whether the observed growth in α is caused by increasing weights of sectors with higher shares of compensation of workers or by the fact that the share of compensation in some sectors is rising, we calculated two hypothetical series of α. In the first hypothetical series, we abstracted from sectoral change – we assumed that the sectors' shares in total GVA stay at the 1993 level but the sectoral α_i change in the same way as they changed in reality. If the change in the actual α is primarily a result of the fact that the sectoral α_i changed, this hypothetical series of α must be similar to the historical series. In the second hypothetical series, by contrast, we abstract from changes in the sectoral α_i – we assume that sectors keep their sectoral α_i at the 1993 level but the weights of the sectors in the value added produced in the economy change as they changed in reality. If the change in the actual α is primarily a result of changes in the sector structure of the economy, this second hypothetical series should be similar to the actual historical series of α.

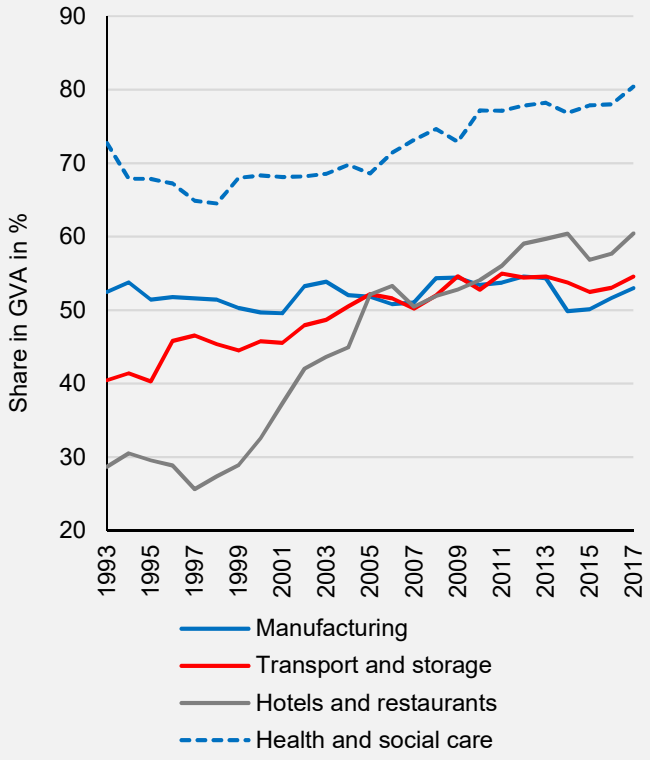
A comparison of the historical pattern and the hypothetical series shows clearly that the growth in the GVA share of compensation of workers in the Czech Republic over the past quarter of a century was not a result of structural shifts in the economy (see Chart B3.1.1). On the contrary, it was caused predominantly by the fact that the sectoral shares of compensation of workers grew in certain sectors. The data reveal that the sectoral shares of compensation of workers increased primarily in services (transport, hotels and restaurants, finance, public administration, education and health care). By contrast, manufacturing – the sector most strongly affected by technological advancement – surprisingly displays no clear trend in the share of compensation of workers (see Chart B3.1.2).

Chart B3.1.1 Share of compensation of workers in GVA



Source: CZSO (2019); CFC calculations.

Chart B3.1.2 Share of compensation of workers in GVA in selected sectors



Source: CZSO (2019); CFC calculations.

4 Revenue and expenditure in the long-term projection

The macroeconomic projection contained in the previous section forms the basis for the projection of general government revenue and expenditure. We split these into two categories: first, revenue and expenditure that will be directly affected by demographic change, and second, revenue and expenditure that will be affected by convergence effects, i.e. effects caused by the very fact of the Czech economy expanding and converging in the long run towards the level of advanced countries. In reality, the demographic and convergence effects will be more or less intertwined, but demographic effects will prevail in the pension system, health care, social benefits and long-term care. Convergence effects will have more weight in the case of expenditure on public investment and public employees' pay and in the case of revenue from certain taxes and social security contributions. We will start by looking at the areas affected by demographic change.

4.1 Pension system

The pension system consists of old-age pensions, disability pensions and survivors' (widows', widowers' and orphans') pensions. The system is managed and administered by the Czech Social Security Administration (CSSA), with the exception of the armed forces, for which the system is managed by the relevant ministries (the Ministry of the Interior, the Ministry of Defence and the Ministry of Justice). However, the terms for members of the armed forces are the same as those for the insured falling under the CSSA, so in the simulation we treat the entire pension system as a single entity. We initially focus on the expenditure side of the system, modelling first the number of recipients of each type of pension and then the levels of those pensions. The revenue side of the system is modelled directly on the basis of our macroeconomic projection, as pension insurance contributions constitute taxation of labour income.

4.1.1 Old-age pensions

Old-age pensions are quantitatively the most important component of the pension system. They are currently drawn by approximately 2.4 million people, and their number will be determined predominantly by demographic change and changes to the statutory retirement age (which is currently rising at different rates for men and women in accordance with an annex to Act No. 155/1995 Coll., on Pension Insurance, and will gradually move to 65 years for both men and women by 2030).[48]

We start by looking at the number of old-age pension beneficiaries and in the next step we estimate the level of newly granted and average old-age pensions. The number of old-age pension beneficiaries cannot be derived simply from the demographic projection and the statutory retirement age alone. A substantial role is played by the option of retiring early or, conversely, by the option of working beyond retirement age and thus enhancing the old-age pension. For these reasons, we use the "rate of retirement" (i.e. the ratios of the number of pensioners to groups of people defined in terms of age or otherwise – see later for more details) for the simulation of the number of old-age pensioners. However, we first need to take into account the fact that the number of old-age pension beneficiaries interacts with disability pensions. This is because these two types of pensions are mutually exclusive – disability pension beneficiaries cannot simultaneously be old-age pension beneficiaries. However, it is also the case that disability pensions are converted into old-age pensions when the beneficiary reaches the age of 65 (see section 4.1.2 on disability pensions for more details). For these reasons, we work with rates of retirement that relate not to the entire population of a given age, but only to the section of the population that is not drawing a disability pension. It turns out that when this approach is applied, the empirical rates of retirement are smoother and not subject to volatility caused by the changing share of disability pensioners.

Another fact we need to consider for projection purposes is the raising of the statutory retirement age. Not surprisingly, the retirement age is the variable that underpins the decision on the timing of old-age retirement. We therefore construct the rates of retirement as a function of time to the statutory retirement age, not of biological age. The rate of retirement thus tells us, for example, what per cent of those who are, say, two years short of the statutory retirement age

[48] Although Section 4a of the Act on Organisation and Implementation of Social Security (No. 582/1991 Coll., as amended) indicates that the statutory age may change in the future depending on the development of life expectancy, the actual statutory retirement age is governed by an annex to the Act on Pension Insurance (No. 155/1995 Coll.) currently in force, so this statutory age enters the baseline scenario of our projection. We consider the linking of the retirement age to life expectancy under Act No. 582/1991 Coll. as an alternative scenario in section 6. For a more detailed comparison of the Czech pension system with those in selected European countries, see Lakotová, L. (2019): Komparativní analýza penzijních systémů, ÚNRR [Comparative Analysis of Pension Systems, OCFC, available in Czech only].

(and are not disability pension beneficiaries) are already pension beneficiaries, or what per cent of those who reached the statutory retirement age, say, a year ago are now receiving a pension.

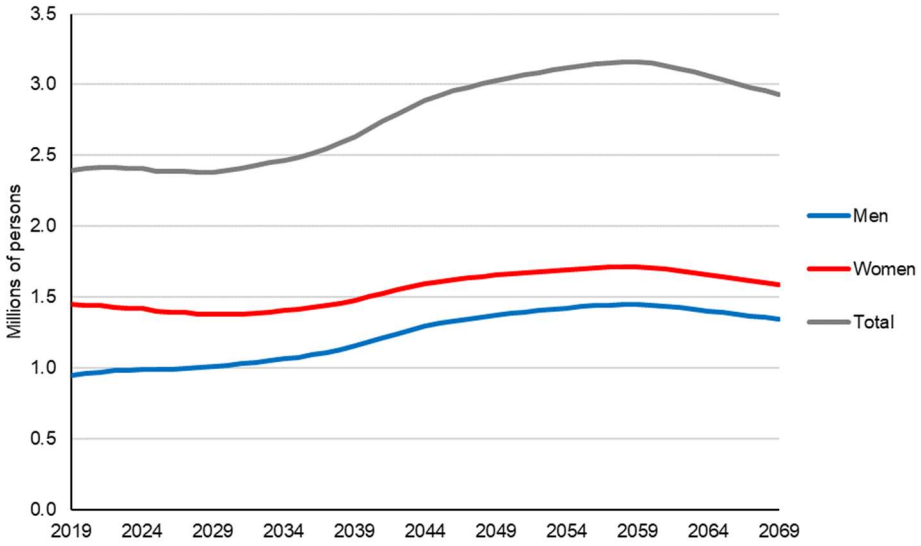
We derived the rates of retirement used in the simulation of the number of old-age pensioners separately for men and women as the average empirical retirement rates recorded in 2013–2017.[49] The empirical retirement rate curves seem stable enough, but for the long-run projection we also need to take into account the fact that they are derived on the basis of a period in which the retirement age was rising. So if, when calculating the rate of retirement, we are comparing the number of people whose age is now, say, two years lower than the current retirement age, we are not using the rate of retirement that is actually relevant to people of that age, because after those two years have passed, the actual retirement age for them will be higher as a result of the rising retirement age. As soon as the retirement age stops rising after 2030 in the baseline scenario, it is therefore logically consistent to use slightly modified rates of retirement (with more moderately sloped curves, differentiating between men and women). We use similarly modified retirement rates when estimating an alternative scenario in which the retirement age is linked to life expectancy and will be increased at a rate dependent on increasing life expectancy (the alternative scenario quantified in section 6).[50]

When simulating the number of old-age pension beneficiaries, we thus start by deducting the number of disability pension recipients of a given age (which is also simulated – see the next subsection) from the size of the individual cohorts projected by the demographic projection. In the next step, we apply the relevant rate of retirement to the resulting number and obtain the projected number of old-age pensioners.

The baseline projection scenario initially indicates a broadly constant number of old-age pensioners followed by steady growth in the latter 2030s and the 2040s. This is caused primarily by the 1970s baby-boomers starting to retire. The fact that the retirement age will stop rising also plays a role. According to the simulation, the number of old-age pensioners will peak around the year 2059 at around 3.2 million, i.e. roughly one-third higher than today. It will then begin to fall as the baby-bust cohorts born in the 1990s reach retirement age (see Chart 4.1.1).

Besides the change in the number of pensioners, there will be a change in gender structure, as the equalisation of the statutory retirement ages for men and women will lead to a rise in the proportion of men in the total number of old-age pensioners. The persisting predominance of women in the future will be due solely to higher life expectancy among women, whereas today the fact that women reach statutory retirement age earlier also plays a major role.

Chart 4.1.1 Projection of the number of old-age pensioners (medium variant of the demographic projection)



Source: CFC calculations.

[49] For women, we considered a single aggregated retirement rate only. The model scenario involved a woman with two children.
[50] For a more detailed description and discussion of rates of retirement and modifications thereof as a result of different rates of increase in the retirement age, see OCFC (2019): Projekce důchodového systému [Pension System Projection, available in Czech only].

In order to project old-age pension expenditure, we also need to estimate the average old-age pension level. It is affected both by the level of newly granted pensions and by the level of pensions already in existence and thus granted at various times in the past. Let's focus first on the level of newly granted pensions. A pension consists firstly of a "basic assessment", which is tied to the average wage in the economy. In our simulation we assume that the basic assessment will stay at the current level 10% of the average wage. The second component of the pension is a "percentage assessment", which is derived from the insured person's past earnings indexed according to the average wage and the number of years of insurance (including credited periods and other adjustments). The calculation also contains two "reduction limits", which are a redistributive element reducing the differences in newly assessed pensions. These reduction limits change every year on the basis of average wage growth.

We simulate all pension levels as a percentage of the average wage. As the starting point for our projection of the level of newly granted pensions we use the latest known figures, according to which the replacement ratio was 46.6% of the average wage for men and 39.6% for women.[51] The lower newly assessed pensions of women are due both to lower wages during their careers and to their lower statutory retirement age and thus shorter insurance period. Following the equalisation of the statutory retirement ages for men and women (i.e. after 2030), and assuming that the gender wage gap is maintained, the difference between the newly granted pensions of men and women will therefore drop (because the insurance period will be extended more for women). For men we assume a broadly constant ratio of newly granted pensions to the average wage (46.6%), while for women we gradually raise the ratio in our simulation so that it reaches 44.0% of the average wage in 2030. Such ratios correspond to an insurance period (including credited periods) of 41 years, which, given the future retirement age, we regard as a conservative estimate. In addition, we slightly reduce the ratio of newly granted pensions to the average wage between 2050 and 2055 (and keep it reduced to the end of the projection) to take account of the fact that periods of university education will no longer be recognised as credited periods.[52]

To calculate the overall average pension, however, we also need to model already granted pensions. The indexation scheme currently in place assumes full indexation to inflation (with some modifications – see below) and semi-indexation to real wage growth. Though current pensions are fully indexed to the inflation rate, the current indexation system additionally allows for indexation based on the costs of living of households of pensioners. In any given year, the index that will be more favourable for pensioners will be used to index pensions.

We take this rule into consideration in our simulation, as we believe there are reasons for the inflation rate determined from the consumption basket of households of pensioners to be systematically higher than the inflation rate based on the overall consumer price index. This is mainly because of the higher share of services in the consumption basket of households of pensioners. In a growing economy, prices of services rise faster than prices of industrial goods in the long run, due to slower growth in labour productivity in the service sector than in tradable goods-producing sectors (a phenomenon analogous to the Balassa-Samuelson effect). In our simulation, we therefore assume a 0.3 pp difference over the entire projection horizon and we add this figure to the real wage-based indexation of pensions every year.

In addition to newly granted pensions and indexation, the average old-age pension is affected by the demographic structure of pensioners. Each year, pensioners with newly granted (and hence above-average) pensions will swell the total pensioner count. On the other hand, a proportion of pensions will cease to be paid. The change in the average pension thus reflects the change in existing pensions (i.e. their indexation to inflation and real wage growth), the number and level of newly granted pensions and, finally, the number and level of terminated pensions. However, the average level of terminated pensions is not captured in any available statistics. For simulation purposes, we therefore simply assume that the ratio of the average terminated pension to the average old-age pension is constant.[53]

Integrating all these assumptions into our demographic projection implies an average pension to average wage ratio that fluctuates in a range of 38% to 40.4% (see Chart 4.1.2). Its course is determined by a combination of effects, although the sizeable growth in the ratio in the 2030s and 2040s is caused by a rapid rise in new pensioners and a simultaneous increase in the share of men in the total number of pensioners (both groups have higher pensions in relative terms). The two last-mentioned factors, i.e. the higher rate of inflation for households of pensioners and the lower level of terminated pensions, also increase the simulated average replacement ratio. In

[51] MoLSA (2018): Statistická ročenka z oblasti práce a sociálních věcí 2017 [Statistical Yearbook in the Area of Labour and Social Affairs 2017, available in Czech only], CZSO 2019.
[52] For a more detailed description, see OCFC (2019): Projekce důchodového systému [Pension System Projection, available in Czech only].
[53] Payment of pensions is more likely to be terminated for older pensioners, who have lower pensions on average. We therefore set the level of terminated old-age pensions at 95% of the average old-age pension.

their absence, it would probably be 3.6 pp lower at the end of the projection (see Chart 4.1.2).

From our knowledge of the path of the ratio of pensions to the average wage and the path of the number of old-age pensioners, we can easily derive the path of old-age pension expenditure expressed as a percentage of GDP. The expenditure peaks at 11.7% of GDP around 2059 (see Chart 4.1.3). The rise in expenditure compared with the present is due partly to the assumed increase in the ratio of compensation of employees to GDP (which feeds through to growth in pensions via indexation) and partly to an increase in newly granted pensions (especially those granted to women) stemming from a lengthening insurance period. However, the most important factor is naturally growth in the number of pensioners.

Chart 4.1.2 Average old-age pension to average wage ratio

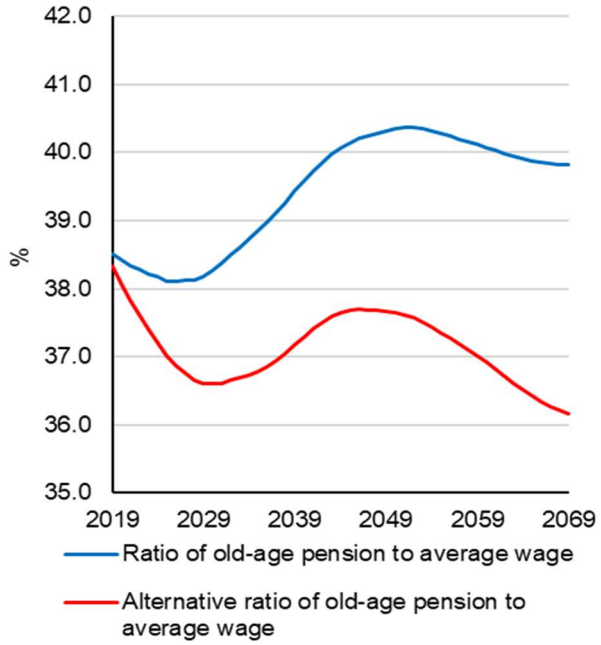
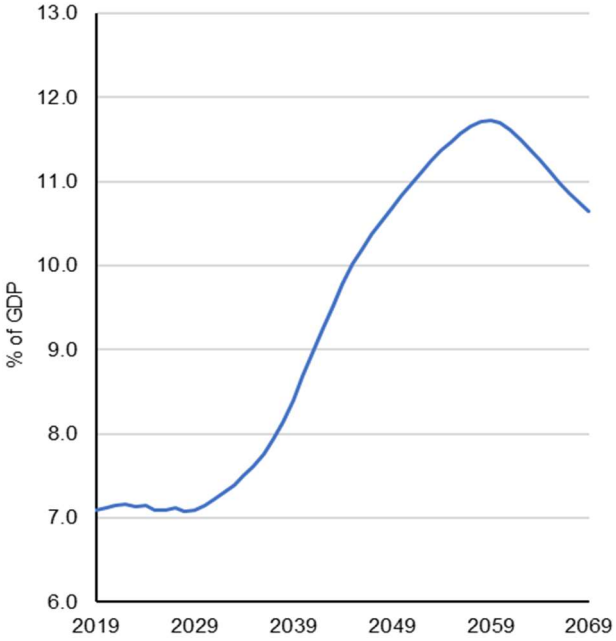


Chart 4.1.3 Share of old-age pension expenditure in GDP (%)



Source: CFC calculations.
Note: The alternative average pension to average wage ratio is that which would apply if we were to abstract from the higher growth in the living costs of households of pensioners and the lower level of terminated pensions.

4.1.2 Disability pensions

When projecting disability pensions, we again project first the number of beneficiaries and then the average disability pension. The projection of the number of disability pensioners is based on assumptions about the proportion of persons receiving a disability pension in each age cohort (the rate of disability). In the past, the rates of disability for given age categories were fairly stable, allowing us to project them into the future.[54] Generally speaking, the rate of disability increases with age. In the past it peaked at the ages of 60–61 among men and 56–58 among women. For higher ages, the age-specific disability rates are currently lower than they were in the past, especially for men. This a manifestation of the healthy ageing hypothesis and possibly also of a stricter approach applied by medical examiners.[55] The rates of disability fall close to retirement age. This is because disability pensioners who reach the age of eligibility for an old-age pension (including in the case of early retirement) and whose calculated old-age pension is higher than their disability pension will start to draw that higher old-age pension and are taken off the disability pensioner register. On the other hand, some disability pensioners, mostly those with the highest degree of disability, receive a disability pension that is higher than their calculated old-

[54] For a more detailed description of the method for projecting the number of disability pensioners, see OCFC (2019): Projekce důchodového systému [Pension System Projection, available in Czech only].
[55] See Report on the Long-Term Sustainability of Public Finances 2018, Box 4.1.

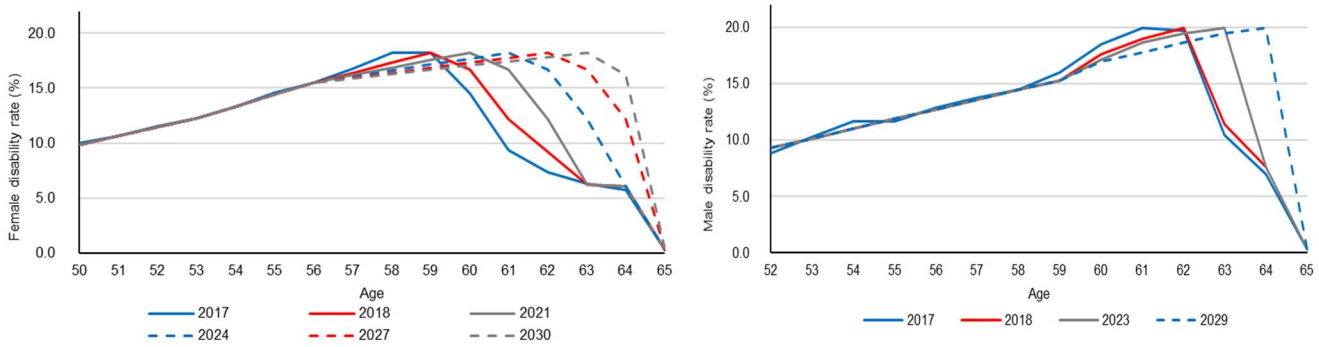
age pension would be, and do so until the age of 65, when their disability pension is converted into an old-age pension of the same amount. The rate of disability in the population aged 65+ is thus zero.

When projecting age-specific disability rates (see Chart 4.1.4) we need to take the rising retirement age into account. We assume that the disability rates for under-55 cohorts will be equal to the average for 2015–2017 or the rate for 2017 if the latter was lower. We also assume that the disability rate curve will peak two years before retirement age and that the disability rate will rise steadily to this peak from the age of 55. We thus project lower disability rates as the peak of the disability rate curve shifts to a higher age, which we interpret as a manifestation of the healthy ageing hypothesis. For the age of 64, we assume a disability rate equal to the average for 2013–2017 and we again assume an even decline in the disability rate from its peak until the age of 64. For the medium demographic projection we also consider an alternative in which the retirement age is tied to life expectancy.

In all the projection variants[56] the number of disability pensioners rises by 14.6–17.4% compared with the present and peaks in 2036–2038. The share of disability pensioners in the total population increases by 0.5–0.8 pp from the current 4% in the same period. The highest share of disability pensions occurs in the medium demographic projection with no migration. In the most likely medium variant of the projection, the share of disability pensioners in the population peaks at 4.6%. The growth in the number of disability pensioners is linked on the one hand with population ageing and on the other hand with the raising of the statutory retirement age, especially in the case of women. In 2039–2060, the number and share of disability pensioners in the population will both fall as disability pensioners switch to old-age pensions. In 2060, the share of disability pensioners in the population will be lower than 4% in all variants of the projection (0.4 pp lower in the medium one). It will then rise modestly at the projection horizon.

Due to the structural similarity in the calculations of disability pensions and old-age pensions, we can easily model the average disability pension (separately for each degree of disability) by assuming a constant ratio between the average disability pension for a given degree of disability and the average old-age pension. These ratios have fallen modestly in past years as the share of new disability pensions in the total number of disability pensions has dropped. Overall, according to the simulation there will be a slight increase in expenditure on these pensions, from the current roughly 0.8% of GDP to more than 1% of GDP around 2040, primarily due to the assumed growth in the number of disability pension beneficiaries and to growth in average disability pensions (see Table 4.1.1). The share of spending on disability pensions will subsequently fall just below 1% in 2060 and then rise to 1% at the end of the projection.

Chart 4.1.4 Projected female and male disability rates



Source: CSSA (2019); CFC calculations.

4.1.3 Survivors' pensions

Survivors' pensions comprise widows', widowers' and orphans' pensions. Again, we first simulate the number of recipients of each type of pension. For orphans' pensions, we will assume a constant ratio of beneficiaries to the population of new-born to 21-year-old persons.[57]

[56] The medium, high and low demographic projections. The medium demographic projection additionally considers a no-migration variant and a variant in which the retirement age is tied to life expectancy.
[57] An orphan's pension can be drawn by a beneficiary of up to 26 years of age (if studying at university).

In the case of widows' and widowers' pensions, however, we still need to distinguish between pensions paid out individually (solo) and pensions paid out in combination with old-age (or disability) pensions, as there is a substantial difference in the levels and durations of these pensions. For solo widows' and widowers' pensions, we assume an approximately constant share in the part of the adult population (i.e. for our purposes the over-21s) not receiving an old-age or disability pension.[58] This projection method abstracts from the fact that the probability of being widowed is higher in cohorts who are already of retirement age today but will not yet be retired in the future due to the rising retirement age than it is in younger cohorts. As a result, the chosen method may underestimate the projected number. On the other hand, for this part of the population we do not take into account rising life expectancy, which reduces the probability of being widowed at this age.

According to the simulation, there will be a slight decline in the number of beneficiaries of orphans' pensions and solo widows'/ widowers' pensions, as both demographic groups used as the basis for the projection shrink slightly.

We use a more complicated approach to simulate the number of widows' and widowers' pensions paid out in combination with old-age or disability pensions. For the projection, we use age-specific widows'/widowers' pension rates. These indicate what proportion of women/men of a given age receive a combination widows'/widowers' pension. The curve of these age-specific rates rises with rising age and converges to a value of less than one (because a proportion of women/men remain unmarried or are widowed at too young an age to be entitled to a combination survivor's pension). We additionally adjust these age-specific combination survivor's pension rates in the projection to account for two important facts: the rise in the statutory retirement age up to 2030 and the rise in life expectancy (for widows' pensions we take into account the rise in male life expectancy and for widowers' pensions we take into account female life expectancy).[59] Both these facts reduce the projected number of beneficiaries. Ceteris paribus, the increasing statutory retirement age reduces the number of persons gaining entitlement to a combination survivor's pension. In the case of growth in life expectancy, the event of being widowed (and hence gaining entitlement) moves to a higher age. The fact that according to the demographic projection the difference in female and male life expectancy will decrease also plays a role, as it is relevant to the number of widows. So, despite the increasing number of senior citizens in the population, there is a slight decline in the number of combination survivors' pensions in our projection.

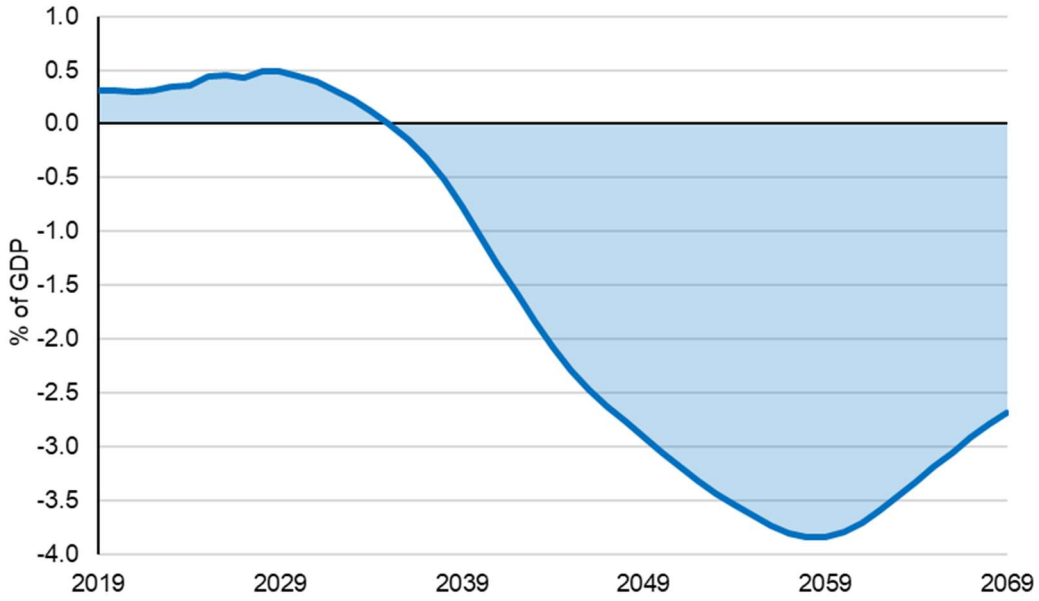
As regards the level of each type of survivor's pension, we will again take advantage of the structural similarity between the determination of survivors' pensions and the calculation of old-age pensions. We will thus model the level of survivors' pensions as a fixed proportion of the old-age pension according to the average for the past three years. The simulation of survivors' pensions generally indicates a fairly insignificant figure of around 0.5% of GDP for all types of survivors' pensions combined over the entire projection period (see Table 4.1.1).

4.1.4 Total revenue, expenditure and balance of the pension system

We model pension system revenue on the basis of the expected evolution of compensation of employees.[60] Recall that in the macroeconomic projection we expect the ratio of such compensation to GDP to increase as a result of convergence. The ratio of pension system revenue to GDP will thus rise proportionately as well. Overall, the revenue of the system under the current legislation will thus go up from the present 8.7% of GDP to approximately 9.5% of GDP at the end of the projection period. However, it is apparent that such growth in the revenue of the system cannot cover the sharp rise in expenditure that will occur in the 2030s. Under unchanged policies, the pension system will thus switch from the current modest surpluses to substantial deficits. The deficits of the system as a whole will peak around 2059 at approximately 3.8% of GDP a year according to the simulation (see Chart 4.1.5). The subsequent drop in expenditure and improvement in the balance of the pension system will be due to a reduction in the number of old-age pensioners.

[58] We use the empirical shares in the defined population group for 2015–2017.
[59] For details again see OCFC (2019): Projekce důchodového systému [Pension System Projection, available in Czech only].
[60] In addition to compensation of employees, compensation of workers comprises compensation of entrepreneurs, estimated as part of mixed income (see section 3).

Chart 4.1.5 Annual balances of the pension system



Source: CFC calculations.

Table 4.1.1 Summary of pension system projections for selected years (% of GDP)

	2020	2030	2040	2050	2060	2069
Old-age pensions	*7.1*	*7.2*	*8.7*	*10.8*	*11.7*	*10.6*
Disability pensions	*0.8*	*1.0*	*1.1*	*1.0*	*1.0*	*1.0*
Survivors' pensions	*0.5*	*0.4*	*0.4*	*0.5*	*0.5*	*0.5*
Total expenditure	8.4	8.5	10.2	12.3	13.2	12.1
Total revenue	8.7	9.0	9.1	9.3	9.4	9.5
BALANCE	0.3	0.4	-1.0	-3.1	-3.8	-2.7

Source: CFC calculations.
Note: The totals in the table may be subject to inaccuracies due to rounding.

Box 4.1 Pension liabilities and how they relate to the estimate of pension system sustainability

The CZSO published a pension liabilities indicator for the first time in 2018. According to the CZSO, pension liabilities amounted to 237% of GDP at the end of 2015.[61] This is below the EU average.[62] The question is, what does this indicator mean and how does it relate to the above estimates of the balances of the pension system? Put simply, it expresses the value of the liabilities arising from the state-run pay-as-you-go pension system. The pension system has an obligation to people who are already receiving pensions (old-age, survivors', orphans' and disability pensions) to keep paying pensions in the future. This obligation has a value equal to all the future payments the state has still to pay pensioners over their lifetimes under the regulations in force. However, the pension system also has an obligation to people who are not yet eligible to receive some type of pension. Most of these people are actively contributing to the pension system and thus in some sense have a claim on it, the value of which is linked to the size and duration of their contributions. The estimate of the value of pension liabilities is subject to many uncertainties regarding, for example, the number, size and duration of payments. These factors are additionally associated with demographic uncertainties. The value of the liabilities is not the simple sum of all future payments, but the sum of the present value of those payments. However, the discount rate used to convert future payments into their present value is set using expert judgement, so the numerical value of the estimates of

[61] See CZSO (2018): National Accounts Database.
[62] According to Eurostat data, the ratio of pension liabilities to GDP in 2015 stood at 370% in France, 348% in Italy, 404% in the UK and 291% in Germany, for example.

total pension liabilities is highly sensitive to the discount rate chosen.[63] Despite all the methodological difficulties, however, this indicator gives at least a broad idea of the size of the pension system's liabilities.

It is clear from the construction of the indicator that it is completely different to the estimate of the future balances of the pension system. Estimating the balances involves quantifying the match or mismatch between the revenue and expenditure side of the system. If, for example, the revenue side of the pension system was set so as to cover the expenditure side exactly at every moment in time, the balance (including the cumulative balance) would always be zero, but the value of pension liabilities could be the same as it is today if the liabilities to the system participants were not affected in any way. The pension liabilities indicator therefore tells us nothing about the balance or sustainability of the pension system. Rather, it indicates the costs that would be associated with hypothetically terminating the pay-as-you-go system while respecting the existing obligations to its participants.

4.2 Health care

A significant item of public expenditure that is very sensitive to demographic changes is health care. Health care expenditure is covered by both public and private sources. In the Czech Republic, expenditure covered by public sources, which will be the sole subject of our projection, traditionally has a very high weight. Public expenditure is mainly covered by public health insurance (approximately 80% coverage in the long term).[64] Other funding includes investment in health care facilities, ad hoc subsidies from public budgets and certain social benefits. Health care expenditure from public sources other than health insurance is therefore already contained in, for example, government investment, social benefits and other general government expenditure items, so we will focus here solely on expenditure covered by health insurance.

The basis for projecting the expenditure side of public health insurance is the profile of the cost of health care per person of a given age. This age-specific (and gender-specific) health care cost curve is then used to calculate the total cost of public health insurance given ongoing demographic change. The crucial question for the reliability of the projection is therefore whether the age-specific health care cost curve is sufficiently stable over time or at least predictable. It is clear that a growing economy will record long-run growth in costs due to growth in the price level and growth in real wages, which (if they are not offset by growth in productivity) also increase the cost of health care. It is therefore appropriate to express age-specific health care costs in relation to either the average wage in the economy or GDP per capita/worker.

It is more common to use the second approach, i.e. to use the cost curve where health care costs are expressed in each age category as a percentage of annual GDP per capita. However, even this cost curve changes over time, reflecting natural variability and, in time, long-run trends.

From the long-term perspective it is the effect of changes in trend that introduces the most uncertainty into the estimate. The long-run income elasticity of demand for health care services is not clear in advance. If, for example, it was above unity, consumption of health care services would increase more than proportionately as a consequence of GDP growth and the entire age-specific health care cost curve would gradually go up along its entire length.[65] As well as shifting in its entirety, however, the curve can also change shape – for some age categories the costs can fall (relative to GDP per capita), while for others they can rise. This can be caused by, for example, rising life expectancy accompanied by healthy ageing (for more details, see Report on the Long-Term Sustainability of Public Finances 2018, Box 4.1) or technological progress.

Long-term shifts in the curve can also be caused by factors linked with real convergence of the economy. In our macroeconomic projection, we assume that real wage growth will outpace productivity growth or GDP per capita. If we assume that wages in health care will maintain their current level relative to wages in the rest of the economy, growth in the share of wages in GDP will lead, ceteris paribus, to an upward shift in the cost curve, because wage costs are a significant part of health care expenditure.[66] On the other hand, the relative price of some non-wage cost items (such as imported medicines and health care equipment) can fall due to real convergence (because real convergence causes, among other things, convergence of the domestic price level to the level abroad and hence real exchange rate appreciation). This can effect the health care cost curve in

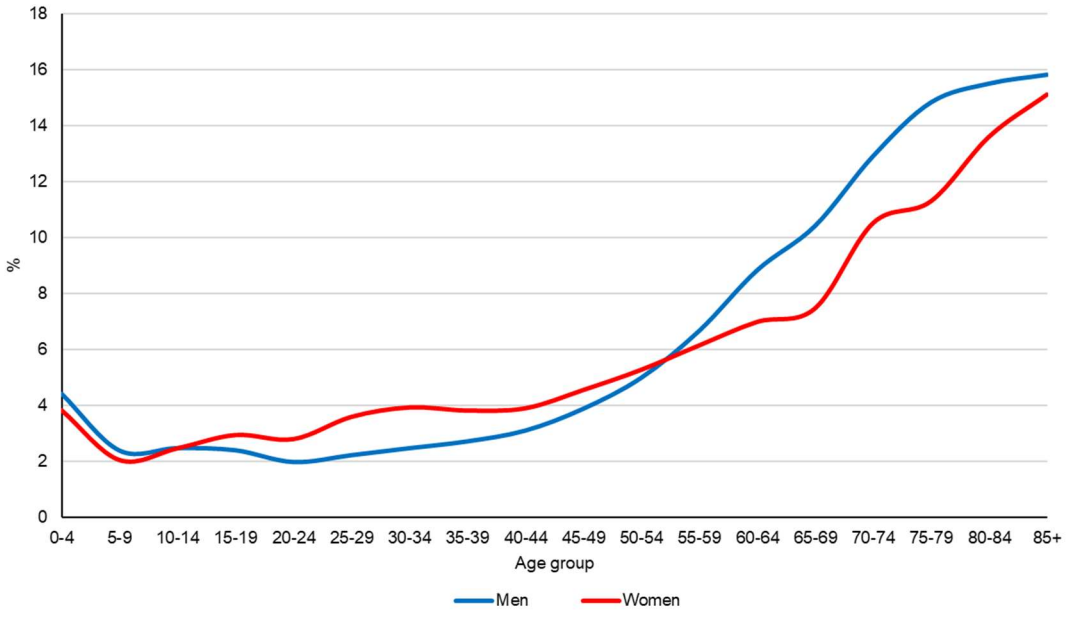
[63] For a more detailed description of the calculation method and a discussion, see Skalák, Z., Rybáček, V. (2018): Pension Liabilities in the Czech Republic, Statistika: Statistics and Economy Journal, 3/2018, pp. 209–222.
[64] See CZSO (2019): Výsledky zdravotnických účtů ČR 2010–2017 [Health Accounts of the Czech Republic 2010–2017, available in Czech only].
[65] An income elasticity of greater than one is characteristic of luxury goods. However, some authors (for example De la Maisonneuve, C., Martins, J. O. (2013): Public Spending on Health and Long-Term Care, OECD Economic Policy Papers, No. 06, June) argue that the elasticity of demand for health services should be lower than unity, which could conversely lower the curve over time.
[66] See also Box 3.1 for the share of compensation of workers in gross value added in the health care sector.

the opposite direction than real wage growth. Given the aforementioned uncertainty about the direction in which the age-specific health care cost curve will change, in our simulation we use a stable curve derived empirically as the average of the relevant curves for the last five years (we use separate curves for men and women and also project the costs separately for men and women).

However, the assumed stability of the age-specific cost curve means that the costs covered by public health insurance would change proportionately with GDP if there were no change in demographic structure. In other words, if the curve is stable (which we assume in the simulation), all changes in the share of health care expenditure are necessarily a sole result of the changing age structure of the population. Given the shape of the age-specific health care cost curve (see Chart 4.2.1) it is clear that population ageing gradually leads to growth in health care expenditure. If the medium variant of the demographic projection were to materialise, the costs covered by public health insurance would peak at 6.6% of GDP approximately in the first half of the 2060s and would be roughly 1.3 pp higher than they are now.

The revenue side of the public health insurance system relies on contributions paid by employees, employers, the self-employed and individuals with no taxable income and on contributions paid by the state for “state insurees” (children, students, old-age and disability pensioners, the unemployed etc.). We will estimate the contributions collected from the first group as a constant ratio to compensation of workers. As in the case of pension insurance contributions, our outlook foresees growth in revenue due to the assumed rise in the ratio of wages to output. The state-funded contributions for state insurees will increase even more significantly, as we assume that the assessment base for state insurees will rise at the same pace as the average wage in the economy and their number will simultaneously increase (mainly because of growth in the number of old-age pensioners). The state will thus gradually increase its payments for state insurees from 1.3% of GDP to almost 1.9% of GDP around 2060. The total revenue of the system will thus gradually rise from its current level of 5.6% of GDP to around 6.8% of GDP at the end of the period. **If the medium variant of the demographic projection materialises, the public health insurance system will be in a modest surplus falling steadily from 0.3% of GDP at present to 0.1% of GDP at the end of the projection. The current configuration of the system thus seems sustainable. The growth in costs connected with population ageing in the projection is 50% covered by growth in contributions collected from workers and employers and 50% covered by growth in payments for state insurees.**

Chart 4.2.1 Costs covered by health insurance by age group (% of GDP per capita)



Source: CZSO (2019) and CFC calculations.
Note: Average for 2013–2017.

4.3 Non-pension social benefits in cash and long-term care

Another expenditure item that will be affected by demographic changes is spending on certain non-pension social benefits in cash. In the model we simulated expenditure on maternity benefit, parental allowance, care allowance and housing allowance, i.e. expenditure on non-pension social benefits in cash that are both sufficiently fiscally significant (amounting to at least 0.1% of GDP) and identifiably linked to demographics. For benefits that do not meet these two criteria (sickness benefit excluding maternity benefit, unemployment benefit, child allowance, foster care benefit, birth grants, funeral grants and social assistance/need benefit), we assume that they maintain their current share of GDP. In the projection they are classed as "other".

We simulated expenditure on fiscally significant social benefits separately using the demographic projection. The link to demographics was tested on the basis of the past evolution of the benefit (e.g. housing allowance) or arises directly from how the benefit itself is constructed (e.g. maternity benefit). For the purposes of the projection, we assume that the current average benefit to average wage ratio and likewise the current non-take-up rates of some benefits will be maintained. Table 4.3.1 summarises the projection methodology.

The simulation of **maternity benefit** is based on the construction of that benefit. It is determined by the ratio of the average benefit to the average wage and is also shaped by the duration of the benefit. The projection of this benefit is related to the projection of the number of new-borns.

We simulated **parental allowance** on the basis of the projection of the number of children aged 0–3. We drew on data[67] on the structure of parental allowance recipients by child age. Using information on the number of benefits paid, we calculated the number of persons with children in the various age cohorts drawing parental allowance. Based on the number of such persons and the actual number of children in the various age cohorts we determined the numbers of discontinued parental allowances[68] and used them to obtain the structure of recipients according to the child's age when the allowance was discontinued for the various age cohorts of children aged 0–3. From this we derived the average monthly benefit and the share of recipients in each age cohort. This makes it possible to refine the projection of expenditure on parental allowance. We incorporated into the estimate the government-approved increase in the total parental allowance benefit from CZK 220,000 to CZK 300,000 effective 1 January 2020.

Our estimate of the **care allowance** is based on the shares of individuals receiving an allowance in the given age categories and in the given dependence category in 2018 (Czech Labour Office data).[69] Under the assumption of a constant share of the number of individuals drawing an allowance at a given age, we then use the demographic projection to determine the total number of individuals drawing an allowance in the various dependence categories. The care allowance amount for 2019 and 2020 is set according to the laws that have been passed.[70] From 2021 onwards we then assume a constant allowance to average wage ratio. The total volume of allowances paid will rise to 1.4% of GDP, mainly due to population ageing and an increasing share of people aged 75+ in the total Czech population.

We project **housing allowance** on the basis of past developments. We use CZSO information[71] that people aged 65+ account for around 25% of the number of housing allowance benefits paid.[72] Roughly three-quarters of the recipients are thus aged 18–64.

[67] Höhne, S. (2017): Změny v čerpání rodičovského příspěvku v demografických souvislostech [Changes in Parental Allowance Take-up in a Demographic Context, full article available in Czech only]. Demografie. 2017. 59: 5–22., MoLSA database.
[68] The child's age when the parental allowance was discontinued enables us to determine the recipient's average monthly parental allowance.
[69] The share of individuals receiving care allowance is negligible until retirement age but starts to rise quite sharply after the age of 75, reaching one-third of the population at the age of roughly 85 and a full two-thirds above the age of 90. A shift to higher forms of dependence meanwhile occurs with increasing age. For a detailed description of the calculation method, see OCFC (2019): Odhady nákladů příspěvku na péči v návaznosti na stárnutí populace [Estimates of the Costs of Care Allowance in the Context of Population Ageing, available in Czech only].
[70] In April 2019, the care allowance in the highest dependence category – level 4 – was raised from CZK 13,200 to CZK 19,200 a month. In July 2019, the allowance in the level 3 category will go up from CZK 9,900 to CZK 13,900 a month (the allowance for persons older than 18 is CZK 1,100 lower). However, the increase in the allowance only applies to those who do not use residential social services.
[71] CZSO (2014). Kdo pobírá příspěvky na bydlení v České republice [Who Receives Housing Allowance in the Czech Republic, available in Czech only at https://www.czso.cz/csu/czso/0b00513f9e].
[72] We checked this figure using EU-SILC data for the Czech Republic for 2015, according to which the share of people aged 65+ receiving housing allowance is 22%.

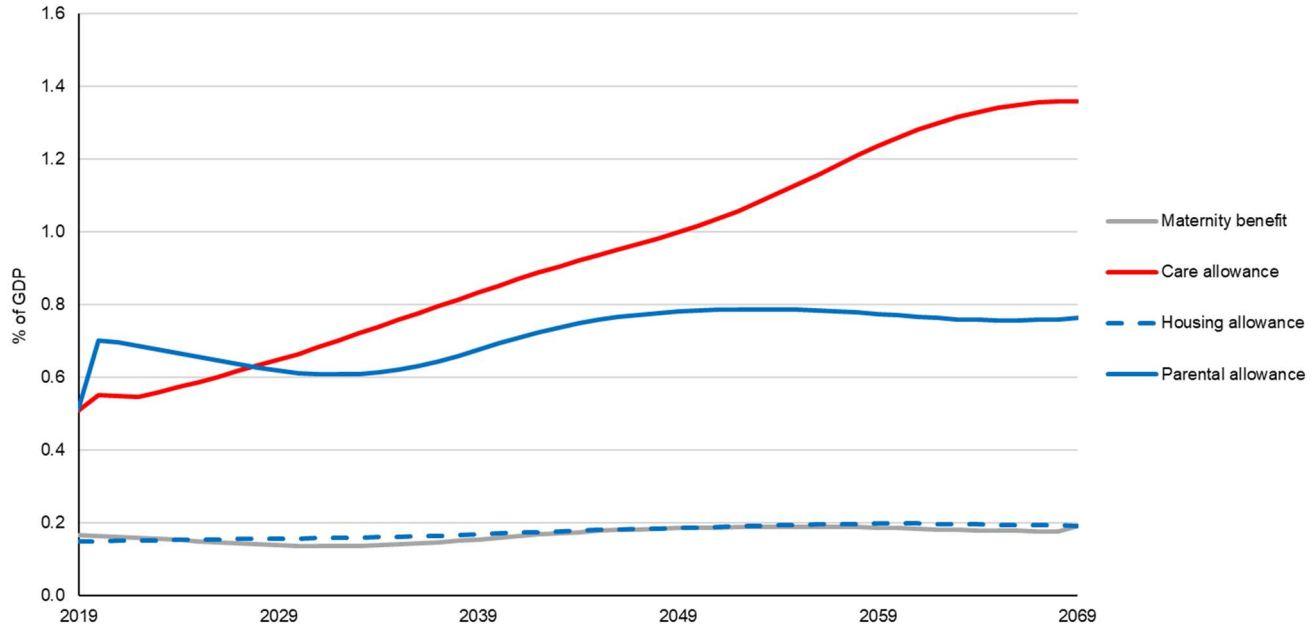
Table 4.3.1 Demographic variables used to predict expenditure on individual social benefits

Benefit	Input variable for projection of number of benefits
Maternity benefit	Number of new-borns
Parental allowance	Number of children aged 0–3
Care allowance	Age structure of population
Housing allowance	25% share of number of persons aged 65+
	75% share of number of persons aged 18–64

Source: CFC.

The expenditure projections for each of the benefits are shown in Chart 4.3.1. In 2020 there is a one-off increase in the ratio of parental allowance expenditure to GDP caused by the government-approved increase in this benefit. Parental allowance expenditure subsequently declines until 2030 and then gradually rises. The ratio of care allowance expenditure to GDP grows over the whole period of interest. This growth does not start to slow until the late 2060s. Non-pension social benefits in cash peak in the 2060s, by which time expenditure on those benefits will have gone up by a total of around 1.3 pp of GDP compared with the current situation according to the projection. Care allowance expenditure will account for almost 1 pp and parental allowance expenditure for almost 0.3 pp of that increase.

Chart 4.3.1 Projections of non-pension social benefits in cash



Source: CZSO (2019), MoLSA (2019); CFC calculations.

4.4 Education

Education expenditure has long stood at about 4% of GDP in the Czech Republic.[73] The share of public education expenditure in total state budget expenditure has been fluctuating constantly in the range of 14–15% over the past 20 years or so. The average registered converted number of employees in the education sector exceeds 7% of all employees in the Czech Republic.[74] It is therefore evident that growth in education expenditure (including rising pay levels)

[73] Education expenditure is defined as the consolidated education expenditure of the MoEYS and municipalities and regions. See MoEYS: Statistická ročenka školství – Soubor ekonomických ukazatelů 2017, Souhrnné informace [Education Statistical Yearbook – Set of Economic Indicators 2017, Aggregate Information, available in Czech only].
[74] CFC calculation using data from the MoEYS (Statistická ročenka školství – Soubor ekonomických ukazatelů 2016 [Education Statistical Yearbook – Set of Economic Indicators 2016, available in Czech only]) and the CZSO.

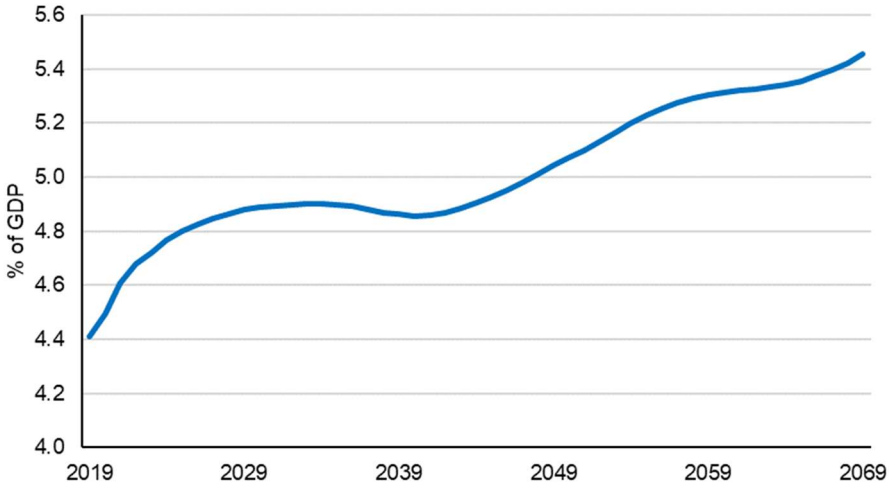
will be one of the factors affecting general government spending in the long-term projection to 2069.[75]

In the long-term projection we consider public education expenditure under the following assumptions:

1) for the number of persons entering and passing through the education system, we use the CZSO's official demographic projection (medium variant[76]);
2) we set the shares of persons who are participants in the educational process provided by public education institutions parametrically as follows:[77]
   a) in the 1–5 age cohorts we assume that 63% of persons will enter public pre-school facilities,
   b) in the 6–14 age group we assume that 92% of persons will pass through the public primary education system,
   c) in the 15–19 age group we assume that 77% of persons will enter secondary public education institutions,
   d) in the 20–26 age group we assume that 42% of persons will enter public universities (we include post-secondary and tertiary education and do not consider university students of higher age).
3) for the period 2019–2021 we choose the level of wage growth that ensures that the average wage in the education sector in 2021 is 1.5 times the average wage in the Czech Republic in 2017.[78] For 2019 we assume that wages will account for just under 50% of public education expenditure; in the subsequent years up to 2069 we assume that wage growth in public education will follow the same path as the overall wage growth index.

Higher wage growth in public education will play a crucial role in state budget expenditure. The share of wages in public education expenditure will gradually rise from its current level of 50% to approximately 55% by around 2060. This will lead to an increase in the ratio of public education expenditure to GDP from the current level of around 4.4%[79] to almost 5.5% in 2069, as shown in Chart 4.4.1. The share of public education expenditure in total state budget expenditure will increase proportionately from the current one-seventh to about one-sixth.

Chart 4.4.1 Ratio of public education expenditure to GDP



Source: CFC calculations.

[75] Public research, development and innovation expenditure is linked primarily with university education. For more details, see Hronová, S. (2019): Výzkum, vývoj a inovace, ÚNRR [Research, Development and Innovation, OCFC, available in Czech only].
[76] In addition to the medium variant, we calculated the other variants of the demographic projection (low and high) in our simulation. Logically, however, these two variants produced practically identical results for the share of education expenditure in GDP as the medium variant, because the education department cannot react instantly to changes in the size of an age cohort but has to track the long-term transitions between the different levels of education (primary, secondary and tertiary).
[77] CZSO (2018): Školy a školská zařízení – školní rok 2017/18 [Schools and education facilities – school year 2017/18, available in Czech only] and Eurostat (2019): Pupils and students enrolled by education level, sex, type of institution and intensity of participation.
[78] See Policy Statement of the Government of the Czech Republic of 27 June 2018.
[79] Information from the Treasury of the Ministry of Finance of the Czech Republic, CFC calculation.

4.5 Expenditure associated with convergence effects and other expenditure

So far, we have focused on expenditure that we expect to be associated more or less with demographic changes. For the remaining general government expenditure, we could assume that its share in GDP will be approximately stable. Nevertheless, irrespective of demographic trends, the mere fact that the Czech economy is a converging economy will, in the long run, systematically affect some other expenditures. It is not our goal, however, to simulate the shares and evolution of individual expenditure categories in detail. Rather, we are concerned with capturing the systematic and long-term changes that, in our opinion, will result from convergence. Therefore, with regard to convergence effects we will focus on their contribution to the growth or decline in total expenditure (expressed in per cent of GDP).

The first group of expenditures where convergence effects may arise is **public investment**. The projection assumes a gradual reduction in the contribution of public investment to GDP. This relationship is based on analyses carried out on a sample of EU countries indicating an inversely proportional relationship between a country's level of economic development and the ratio of public investment to GDP. Less developed countries generally spend a higher percentage of their GDP on public investment. There are clearly a variety of reasons for this. First, in the case of less advanced but converging countries, a role may be played by efforts to upgrade infrastructure (such as motorways, railways and urban infrastructure) and the ensuing higher level of public investment. Another possible reason is the higher relative price level of investment goods in less developed countries, which leads directly to a higher investment rate. The higher relative price of investment may be due to the laws of economics (the different capital, labour and technology positions of less developed economies), but the cause may also be a lower standard of public administration, as indicated by quality of governance indexes, for example.[80] The CNC projection foresees both of these effects fading away as the level of economic development rises. In the case of the Czech Republic, this will lead to a decline in the share of public investment of 0.3 pp of GDP at the projection horizon (see Table 4.5.1).

In the case of **defence expenditure**, there are no convergence effects in the sense of such expenditure increasing as a result of the convergence of the Czech economy, but our projection nevertheless assumes that the Czech Republic will, in accordance with the Medium-Term Development Plan for the Department and the Armed Forces up to 2025, approved by the Government on 22 June 2018, honour its NATO commitments and thus be spending 2% of GDP on defence over the next several years. The medium-term plan for the Ministry of Defence budget heading envisages expenditure of around 1.4% of GDP in 2021, rising by 0.2% of GDP a year over the following three years to 2% of GDP in 2024.

The convergence of the Czech economy will also affect the **remuneration of employees in the general government sector**, which will be another source of expenditure pressure. This is due to an assumed gradual increase in the costs of activities performed by organisations in the general government sector. Growth in labour productivity and a rise in the share of compensation of employees in the private sector will give rise to wage pressures, which will inevitably spill over to the general government sector. However, the activities in this sector are mostly services, moreover services of such a kind that the wage growth cannot be entirely offset by growth in labour productivity (public administration, justice, internal security and so on). As a result, the costs will rise even if the services produced by general government sector employees are kept on the same scale, so their relative share in GDP will also increase. This is a manifestation of the Baumol-Bowen effect: goods which are produced with no increase in labour productivity in the long run (if they are to be provided in the same quality) necessarily become relatively more expensive due to wage growth in other sectors.

The impacts of this effect on health, education and defence spending are not simulated in this section, since they are already contained in the partial projections presented in previous sections. In the remaining areas, our simulation assumes that this effect will gradually increase and will represent an additional 0.5 pp of GDP on the expenditure side at the end of the projection period.

Likewise, besides convergence effects we assume growth in **payments to the EU**, which would foster a rise in expenditure of 0.1% of GDP compared with the present as from 2028 (see Box 4.3 for more detailed information on payments to/from the EU).

We assume that the remaining expenditure of 17% of GDP is sensitive neither to demographic change, nor to convergence or other effects and we therefore keep it constant until the end of the projection horizon. Its size is derived from the evolution of general

[80] See, for example, World Economic Forum (2018): Global Competitiveness Report 2017–2018.

government sector finances in 2013–2018 and the Ministry of Finance's predictions for 2019–2022.[81]

Table 4.5.1 Expenditure associated with convergence effects and other expenditure (% of GDP)

	2020	2030	2040	2050	2060	2069
Other expenditure – baseline scenario	17.0	17.0	17.0	17.0	17.0	17.0
Convergence-related changes in other expenditure	0.0	0.8	0.8	0.9	0.9	0.8
public investment	*0.0*	*0.0*	*–0.1*	*–0.2*	*–0.2*	*–0.3*
defence expenditure	*0.0*	*0.6*	*0.6*	*0.6*	*0.6*	*0.6*
growth in costs of general government sector	*0.0*	*0.2*	*0.3*	*0.3*	*0.4*	*0.5*
growth in payments to EU	*0.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
OTHER EXPENDITURE INCLUDING CHANGES	17.0	17.8	17.8	17.9	17.9	17.8

Source: CFC calculations.
Note: The figures in the table may be subject to inaccuracies due to rounding.

4.6 Revenue in the long-term projection

General government revenues will be subject to interlinked demographic and convergence effects in the long-term projection. For the purposes of this Report, government revenues are split into the following categories: revenue from personal and corporate income taxes, statutory social security contributions, revenue from consumption taxes and other revenue (e.g. property income, income from the sale of goods and services and income from the EU).

In the projection of **personal income tax** revenue, we assume that such revenue depends mainly on compensation of workers. For this reason, the convergence effect will manifest itself here, since according to our assumptions the ratio of compensation of employees to GDP will gradually increase (see section 3) and so, proportionately, will the share of this tax in GDP. This effect will thus outweigh the fact that the share of employees (and the share of workers) in the overall population will decline for demographic reasons. According to our macroeconomic projection, wages will grow fast enough to more than offset the drop in the number of workers.[82] The projected growth in personal income tax revenue from the current 4.6% of GDP to 5.0% of GDP at the end of the projection is thus the result of convergence alone (see Table 4.6.1).

Corporate income tax revenue is quite sensitive to the business cycle and therefore fluctuates. Also, the construction of the tax base makes this tax hard to predict. However, in the long-term projection we abstract from cyclical effects and for reasons of logical consistency we project such revenue on the basis of net operating surplus. It should explain this tax revenue better than GDP, because it is net operating surplus that is the macroeconomic counterpart of net operating profit before tax.[83] As with personal income tax, convergence effects will be apparent, but this time with the opposite consequence. Growth in the ratio of compensation of employees to GDP will necessarily lead to a decline in the share of gross operating surplus in GDP. The share of net operating surplus (i.e. after consumption of fixed capital is taken into account) in GDP will in turn decline even more significantly, as we assume that the share of fixed capital consumption in GDP will remain constant.[84] As a result, the ratio of corporate income tax revenue to GDP will fall by from 3.3% at the beginning of the projection to 2.5% at the end. The digital taxation currently under discussion would have to be imposed either on net operating surplus, or on consumption. In both cases, however, it is unclear whether it would be possible simply to define the tax base and thus prevent international tax optimisation. As with the introduction of sectoral taxes in the financial industry, it is also unclear whether such measures would affect firms' owners or be reflected in increased prices for consumers. The additional public sector revenues from these taxes are not quantified.

We assume a fixed share in GDP for **other current taxes**. Their share in GDP has long been stable, and with the given tax policy setup we are not aware of any reasons for it to change.

[81] MF CR: Convergence Programme of the Czech Republic (April 2019).
[82] Note that here we deviate partially from making our projection strictly in accordance with the current legislation. Tax regulations often include deductions and discounts or thresholds in nominal terms. Growth in nominal wages and other income can thus, ceteris paribus, lead to an increase in the average rate of taxation. This means that without any changes to the legislation, there is erosion of the real value of deductible items, migration into higher tax bands and related taxation at higher rates, and so on. However, we abstract from this and similar effects in our projection.
[83] We again abstract from the effects of inflation (these would manifest here in erosion of the real value of tax depreciation of the fixed capital of firms and in the valuation of inventories).
[84] We assume a constant share of fixed capital consumption of 21.24% of GDP (equal to the average for 2013–2017).

Mandatory social security contributions comprise pension contributions (including the systems of the Ministry of Defence, the Ministry of Interior and the Ministry of Finance), public health insurance contributions excluding state insurees, payments for state insurees and other mandatory social security contributions (sickness insurance and state employment policy contributions). As in the case of personal income tax, all these payments are linked by construction to compensation of employees in our projection. Here again, the convergence effect is present – the ratio of these payments to GDP grows in equal proportion to the ratio of compensation of employees. In the case of revenue for state insurees (see section 4.2), we took into account the demographics of the categories that state insurees form (especially growth in the number of old-age pensioners). We linked the payment per state insuree to the average wage. If the average wage rises (falls) in the estimates, the ratio of the contributions to GDP also increases (decreases). Recall that in the general government sector, payments for state insurees are both a revenue (to health insurance companies) and an expenditure (for the state budget). As a result, they do not have any impact on the sector's balance. We nevertheless present them separately, since they affect the data on the structure and size of the general government sector.

Taxation of consumption (**taxes on production and imports**) consists primarily of revenue from VAT and selective excise duties. This tax revenue is simulated by the share of the final consumption expenditure of households in GDP, which represents an approximation of the largest part of the tax base for consumption taxes. According to our macroeconomic projection, this share is constant (a change in the structure of pensions in favour of compensation of employees does not necessarily translate into a change in the structure of use of pensions), so consumption taxation revenue will maintain a constant share in GDP.[85]

Table 4.6.1 General government revenues in selected years (% of GDP)

	2020	2030	2040	2050	2060	2069
Personal income taxes	4.6	4.7	4.8	4.9	5.0	5.0
Corporate income taxes	3.3	3.0	2.8	2.7	2.6	2.5
Other income taxes and taxes on property transactions	0.2	0.2	0.2	0.2	0.2	0.2
Social security contributions	16.0	16.5	16.9	17.3	17.6	17.7
pension insurance	*8.7*	*9.0*	*9.1*	*9.3*	*9.4*	*9.5*
public health insurance (excluding SIs)	*4.6*	*4.7*	*4.8*	*4.9*	*5.0*	*5.0*
payment for state insurees (SIs)	*1.4*	*1.4*	*1.5*	*1.7*	*1.9*	*1.8*
other	*1.3*	*1.3*	*1.4*	*1.4*	*1.4*	*1.4*
Taxes on production and imports	11.9	11.9	11.9	11.9	11.9	11.9
Property income	0.5	0.5	0.5	0.5	0.5	0.5
Other revenue	4.7	4.7	4.7	4.7	4.7	4.7
TOTAL REVENUE	41.2	41.5	41.8	42.2	42.4	42.4

Source: CFC calculations.

Box 4.2 Expected evolution of excise duty revenue

Excise duty on selected products (selective excise duty) brings in revenue of more than 3% of GDP to general government budgets (OECD, CZSO).[86] It comprises duty on mineral oils, tobacco products, alcohol and liquor, beer, wine and semi-products. Energy and environmental duties – levied on electricity, natural gas and solid fuels – are very similar in terms of construction. As regards budgets, revenues from duty on mineral oils and tobacco products are dominant, accounting for around 55% and 35% of selective excise duty revenue respectively.[87]

[85] Again, we diverge slightly here from strict conformity with the legislation, as some excise duties are constructed as a nominal figure for a given amount of goods. We therefore assume that the legislation will change over the long term in such a way that the revenue from this class of taxes evolves as if all the rates were constructed as ad valorem.
[86] OECD, Details of Tax Revenue – Czech Republic; CZSO, National Accounts Database.
[87] OECD, Details of Tax Revenue – Czech Republic.

Excise duty on mineral oils

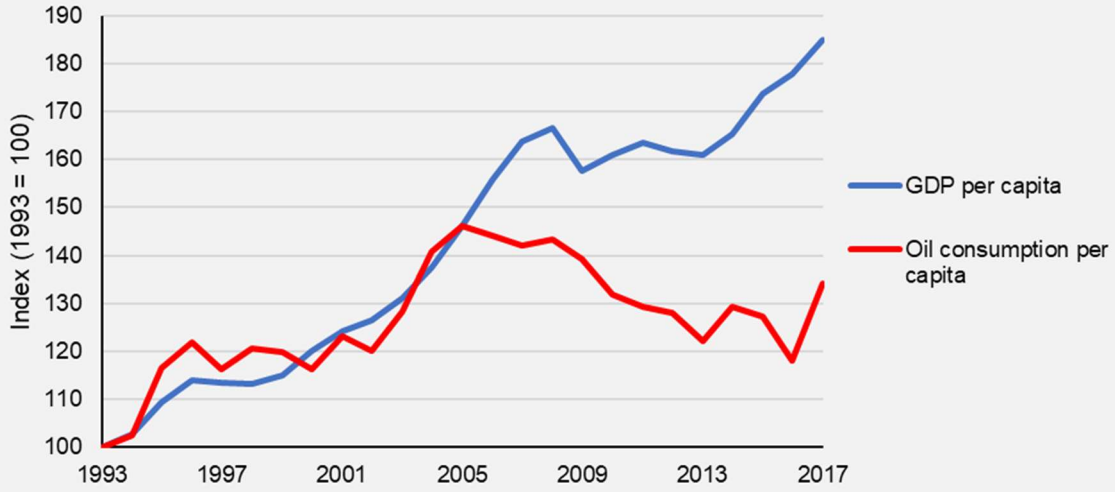
Over recent years, excise revenue on mineral oils has been fluctuating above CZK 80 billion a year[88] and rising from year to year. Such revenue is made up predominantly of revenue from excise duty on fuels. We therefore assume that future revenue will depend primarily on fuel consumption. Although nominal revenue from excise duty on mineral oils is increasing over time, the relative revenue as a percentage of GDP is falling. This is due to GDP growth outpacing excise revenue. Given convergence effects, the revenue relative to GDP can be expected to be lower in the future than it is now, because revenue in Austria, for example, has long been more than 0.5 pp of GDP lower despite similar rates of duty.[89]

According to OPEC figures (World Oil Outlook, 2018), oil consumption will fall by around one-fifth – and by more than 30% in road transport – in developed OECD states in Europe over the coming two decades. The energy market in this region will be strongly affected by government regulation of automobile transport and the potential development of electromobility.

As an economy becomes more developed, its consumption of oil rises, though only to a certain extent and with decreasing dynamics. An income elasticity of oil demand of less than unity is consistent with in-depth studies – see Havránek and Kokeš (2015).[90] Based on a meta-analysis of other studies, the authors estimate the income elasticity of oil demand at 0.1 for the short run and 0.23 for the long run. Developing countries with low GDP per capita levels initially record extensive economic growth. Such growth is reflected in the use of large quantities of resources in production processes and private consumption. The marginal rate of oil consumption decreases as the level of economic development increases. This is caused by intensive economic growth, which is accompanied by growing technological development and rising productivity and efficiency (including energy efficiency).

Chart B4.2.1 shows economic development (as measured by GDP per capita) and oil consumption per capita in the Czech Republic. While GDP per capital has risen by more than 85% since 1993, oil consumption per capita has gone up by only 34%.

Chart B4.2.1 Oil consumption and economic development in the Czech Republic



Source: OECD (2019), IEA (2019); CFC calculations.

In the absence of rate increases, the unit-rate construction of excise duty is causing the importance of such taxation in the tax structure and in relation to GDP to fall. Electromobility and EU regulatory pressure to increase the energy efficiency of fuel combustion will simultaneously negatively affect fuel consumption. These are all risk factors from the perspective of the long-term sustainability of public finances in the Czech Republic, so the assumption of fixed excise revenue may be mildly optimistic for the purposes of projecting tax revenue.

[88] OECD, Details of Tax Revenue – Czech Republic.
[89] Ibid.
[90] Havránek, T. and Kokeš, O. (2015): Income Elasticity of Gasoline Demand: A Meta-Analysis. Energy Economics, 2015, 47(C).

Excise duty on tobacco products

This duty is levied on tobacco (smoking tobacco, cut tobacco, tobacco refuse and raw tobacco) and tobacco products (cigarettes, cigars and cigarillos and, since 1 April 2019, heated tobacco products). Cigarettes are the most important as regards revenue. Duty on cigarettes is calculated as the sum of two parts. The first is the product of a unit rate (2019: CZK 1.46 per cigarette) and the number of cigarettes. The second part is the product of the rate of duty (2019: 27%) and the price of cigarettes. If the sum of these two parts is less than the minimum rate of duty (2019: CZK 2.63 Kč per cigarette), the minimum rate is applied. Consumption of tobacco in the form of smokeless and heated tobacco products is currently taxed as much as 50% less than classic cigarettes when adjusted for tobacco content.[91] Smoking tobacco and other non-cigarette tobacco products are taxed at unit rates (for example, tobacco at CZK 2,236/kg in 2019).[92]

Per capita cigarette consumption has been stable over the last 10 years despite having dropped by 13% in the previous 15 years.[93] This, coupled with a rising share of novel forms of smoking not covered by these statistics (e-cigarettes and smokeless and heated tobacco products), points to stabilised consumption in the medium term. The prevalence of smoking among the adult population in the Czech Republic has been slightly volatile in recent years, ranging between 28% and 32%.[94]

A comparison with other countries reveals a different situation. According to Tobacco Atlas data for 2016, the number of cigarettes consumed per capita among those aged 15 or over was 2,428 in the Czech Republic, 1,927 in Austria, 1,600 in Germany, 2,060 in Hungary and 1,501 in Slovakia. Due to a different methodology, the figures do not match those from the CZSO and are affected by the intensity of illegally produced or imported cigarettes. If we assume convergence towards consumption in Austria, we can expect a fall in consumption of classic cigarettes of at least 20% in the long term.

The key factors in the long run, however, will be changes in consumer behaviour and changes to tax policy in the area of non-traditional smoking. Given the lower effective taxation of smokeless and heated tobacco products, gradual substitution of classic cigarettes with heated tobacco (in the absence of changes to the taxation system) would lead to fall in such taxation of up to 50% (around 0.6% of GDP)[95] assuming the same taxation of e-cigarettes and heated tobacco (i.e. the introduction of taxation of e-cigarettes with liquid refills). This would bring the share of taxation of tobacco products closer to the current Austrian level (which, however, does not yet include the expected change in structure towards non-traditional smoking).

The demographic sensitivity of tobacco product consumption according to the National Institute of Public Health study cited above points to a risk of a long-term decline in revenues from this tax channel due to population ageing: the prevalence of smoking tobacco products is highest in the 15–24 age group (35.6%), falls to 27.4% in the 25–44 group and 26.2% in the 45–64 group, and is lowest among those aged 64+ (14.9%). Janda and Strobl (2019),[96] who model tobacco consumption over a 60-year period based on changes in demographic structure, on an assumption of constant prices and tax policy, and on equations of adolescent behaviour, arrive at a similar conclusion. Tobacco consumption and tax revenues increase until the late 2030s, then stabilise and subsequently start falling sharply in the 2050s. Moreover, the smoking rate is lower among the university-educated, which, given the long-run growth in the share of the university-educated in the population, will autonomously reduce smoking activity.

Property income is made up mainly of dividends and shares in the profits generated by state-owned enterprises. In this case again, we assume a constant share in GDP, as we have no information indicating that the share of profit in GDP will change. We also assume that the state will not change its holdings in the major firms it (co-)owns. Overall, therefore, we assume that the share of property income in GDP will remain constant at 0.5%.

Other revenue consists mostly of income from the sale of goods and services and income from the EU. Given the way the Treasury operates, interest revenue on investment of surplus liquidity is not considered. The ratio of income from the sale of goods and services to GDP is essentially constant, so its ratio is fixed for the long-term projection. We assume that income from the EU will form a constant percentage of GDP as well. However, this only concerns general

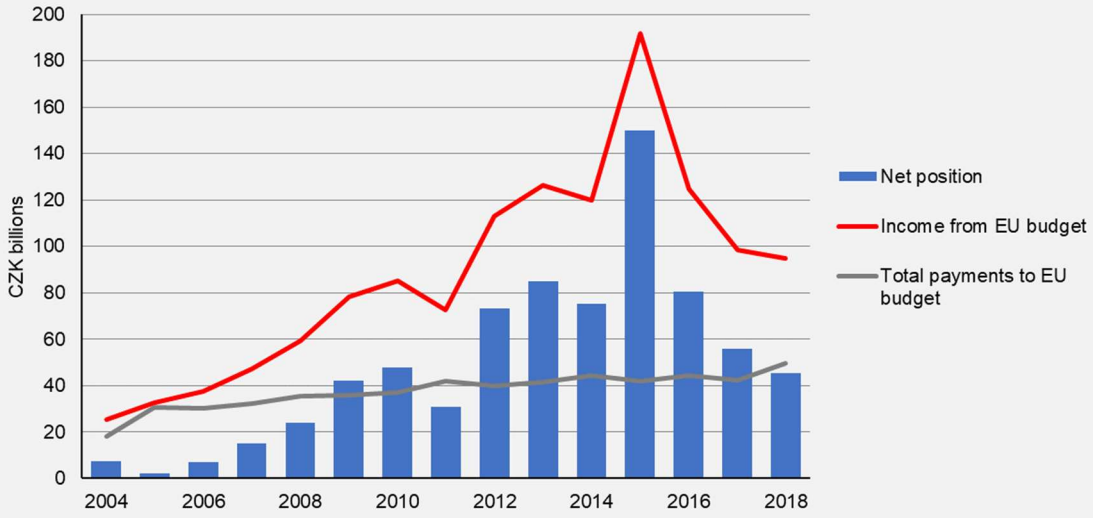
[91] Miltáková, L., Stavjaňová, J. (2016): Nepoměr zdanění tabákových výrobků v ČR a vybraných okolních zemích [Disproportion in Taxation of Tobacco Products in the Czech Republic and Selected Neighbouring Countries; full article available in Czech only]. Acta Oeconomica Pragensia 2016/3.
[92] Rates as per Act No. 353/2003 Coll., on Excise Duties.
[93] Váňová, A., Skývová, M., Malý, M. (2018): The Use of Tobacco in the Czech Republic 2017. National Institute of Public Health. 2018.
[94] Ibid.
[95] CNC calculation based on OECD data.
[96] Janda, K., Strobl, M. (2019): Smoking Czechs: Modelling Tobacco Consumption and Taxation. Prague Economic Papers. 2019, 28(1).

government income from the EU, not the total income from the EU for all entities in the Czech Republic. The unresolved incorporation of some elements (such as flexibility and conditionality) makes it difficult to quantify such income. Total income from the EU will decline as a percentage of GDP (see Box 4.3 for more details).

Box 4.3 Income from and payments to the EU

The Czech Republic has been a net recipient of EU budget funds ever since 2004. Payments to the EU budget include traditional own resources (customs duties), the VAT-based resource and the resource based on gross national income (GNI). Payments from the EU budget include, or have included, payments for structural projects, agriculture and payments from EU programmes. Between 2004 and the end of 2018, the Czech Republic paid more than CZK 565 billion into the EU budget and received more than CZK 1,306 billion from the EU. The Czech Republic's net position – the difference between income from and payments to the EU budget – thus exceeded CZK 741 billion in cumulative terms at the end of 2018 (see Chart B4.3.1).

Chart B4.3.1 Total income from and payments to the EU



Source: MF CR (2019)[97]

The uncertainty surrounding Brexit and the limited progress in the Multiannual Financial Framework (MFF) negotiations currently make it impossible to refine the medium-term estimate of total Czech public budget income and payments from/to the EU. As in the previous Report, we therefore base our medium-term and long-term estimates of Czech public budget income and payments from/to the EU on an increase in payments to about 1.1% of GNI starting from 2028.[98] In the Czech Republic, however, GNI has long been lower than GDP, because a large part of the economy is under foreign control and, for example, the profits of foreign owners do not fall under GNI. Given the difference between GDP and GNI in the Czech Republic over the past three years, we can estimate payments to the EU at around 1.0% of GDP from 2028 onwards.

The exact amount of planned expenditure from EU budgets and funds for the next MFF period, including the national pre-allocations, will not be known until 2020. The preliminary proposals suggest the following commitment structure and volumes for the new MFF 2021–2027 (commitments totalling EUR 1,134 billion at current prices):[99]

1) Single Market, Innovation and Digital (EUR 166 billion),
2) Cohesion and Values (EUR 391 billion),
3) Natural Resources and Environment (EUR 336 billion),
4) Migration and Border Management (EUR 30 billion),
5) Security and Defence (EUR 24 billion),
6) Neighbourhood and the World (EUR 108 billion),
7) European Public Administration (EUR 75 billion).

[97] MF CR (2019): Position of the Czech Republic vis-à-vis the EU budget.
[98] See, for example, European Commission (2018): EU Budget for the Future, 2018, Vol. 1: Proposal of the Commission for the Multiannual Financial Framework 2021–2027 and Vol. 3: Factsheets.
[99] Proposal for a Council Regulation COM (2018) 322 final of 2 May 2018, Annex to the Proposal, p. 2.

The Czech Republic's total income from the EU expressed as a percentage of GDP will probably fall in the future for several reasons. First, there may be Brexit-related effects (pressure for an overall reduction of the budget or for cuts in "non-priority" areas). We also assume that the long-running decline in the share of Common Agriculture Policy funds will continue, implying a reduction in the "automatically" calculated payments for the Czech Republic. Other potential reasons include a gradual decrease in the share of expenditure on economic, social and territorial cohesion policy and, conversely, an increase in the size of spending programmes under which the Member States will have to compete for funds rather than receiving amounts fixed in advance. Among other things, this is already reflected in the proposed MFF 2021+, which contains a large new chapter (Single Market, Innovation and Digital) where the option of pre-allocation for individual countries will probably be very limited. In the case of these programmes, however, entities from the Czech Republic are already lagging behind in their ability to come up with potential projects, and in this respect we do not foresee any major change going forward. Another reason why the Czech Republic can expect to record a decreasing net position vis-à-vis the EU budget in the future is its gradual increase in wealth relative to the other Member States (Czech per capita GDP at current prices in purchasing power parity stood at around 90% of the EU average in 2018[100]). This will limit the ability of some regions to obtain funds in the longer run. The Czech Republic's net position may also be worsened in the future by other new criteria being reflected in the pre-allocation of expenditures for individual Member States.

Nevertheless, we assume structural changes in the use of income from the EU (such as increasing expenditure on strategic public transport investment, R&D, education, migration and security) that will lead to the general government sector maintaining its current level of income from the EU as a percentage of GDP over the entire period despite the decline in total income from the EU. However, other entities that do not come under the general government sector will have to expect a correspondingly larger relative decrease in EU funding.

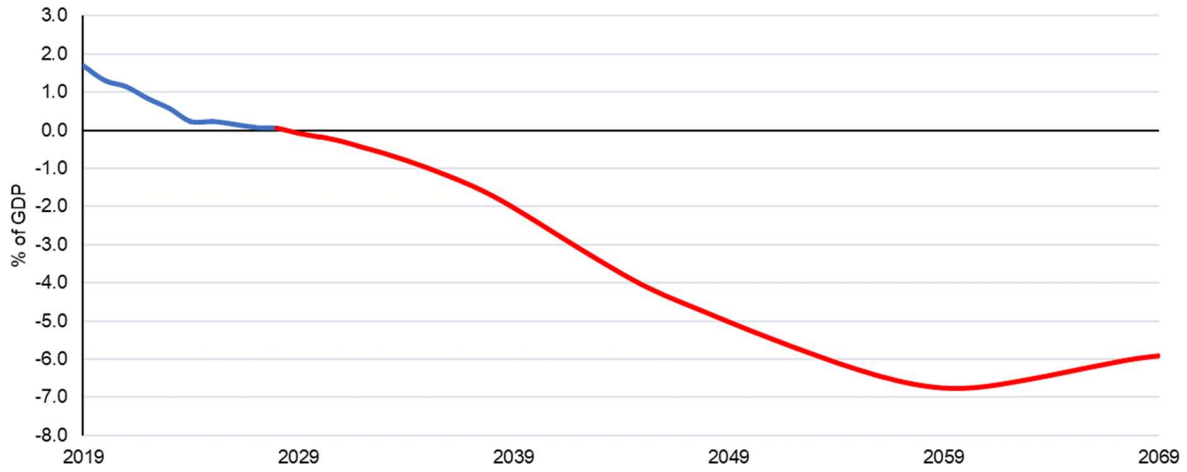
[100] MF CR (2019): Convergence Programme of the Czech Republic, April 2019.

5 Overall general government balance and debt

5.1 Primary balance

The projections of the individual revenue and expenditure items allow us to prepare a projection of the primary structural balance of the general government sector. Two periods can be distinguished for this balance. During the first period, which begins with the present and lasts approximately until 2028, the balance is positive. Beyond that year, though, it gets into a deficit and, according to our projection, remains there permanently (see Chart 5.1.1). The reason for the switch from surplus to deficit is unequivocally the expenditure side, which grows mainly for demographic reasons, although defence and education spending also plays a role. The declines accelerate further in the 2040s and 2050s. After 2060, the primary deficits will fall, because by then the baby-bust cohorts will have started to enter old-age retirement, but the annual deficits will remain significant until the end of the projection period. The budget revenue side will increase only moderately over the projection period, as a result of growth in the ratio of compensation of employees to GDP, which is taxed more heavily than net operating surpluses. However, the growth on the revenue side is far from able to offset the growth on the expenditure side.

Chart 5.1.1: Primary general government balance



Source: CFC calculations.

5.2 Interest costs

To obtain a comprehensive picture of the general government balance, we still need to complement the path of the primary balance with interest expenditure related to the general government debt. So far, we have expressed both expenditure and revenue items as a share of GDP, so the rate of inflation has been irrelevant to them. In the case of interest expenditure, however, this is no longer possible. Interest expenditure is generally determined by the nominal interest rate, which already contains the inflation rate (in the long run, in which we work). This is because the nominal interest rate is the sum of the real interest rate and the inflation rate, with the real interest rate itself being determined by real factors such as the marginal productivity of capital and the time preferences of economic agents. The long-run inflation rate thus has an effect, via the nominal interest rate, on the share of interest expenditure in GDP and hence also on the total share of general government expenditure in GDP. Recall that in section 3 on macroeconomic developments we assumed 2% inflation. It is this value that enters our simulation of nominal interest expenditure. If we were to work with a higher (lower) inflation rate, the share of interest expenditure in GDP would be permanently higher (lower), although this would (apparently paradoxically) have no effect per se on the debt-to-GDP ratio.[101]

[101] This is because of the debt dynamics equation. Higher interest expenditure resulting from higher inflation leads to higher annual deficits, but the higher inflation leads, ceteris paribus, to higher nominal GDP growth, so the debt-to-GDP ratio is not affected by inflation per se.

The general government debt of the Czech Republic consists mainly of the state debt (which has long accounted for more than 90% of the total), and we will focus on it in our simulation. We will assume that the interest costs on the remaining part of the general government debt (e.g. municipal debts) will behave similarly. In reality, the state debt is financed by a whole range of instruments, ranging from non-marketable borrowings to a wide palette of debt securities with various maturities, coupon yields and denominations.[102] In the simulation, we are therefore forced to simplify and split the total general government debt into two parts – short-term debt (i.e. debt maturing within one year) and long-term debt. We assume that the short-term debt is financed at the short-term rate and has to be refinanced each year at the current rate. By contrast, we assume that the long-term debt is financed using bonds with a ten-year original maturity and a coupon that equals the ten-year nominal interest rate (ten-year maturity was chosen because it is the longest maturity for which we have a sufficiently long time series and which is internationally comparable). We keep the shares of short-term and long-term debt in the total debt constant at 20% and 80% respectively. This is approximately equal to the present distribution of the state debt in terms of time structure and is also in line with the Ministry of Finance's current plans for the term structure of the state debt.[103]

We model total interest costs as the product of general government debt and the implicit nominal interest rate, which is de facto a weighted average of the nominal interest rates paid on the short-term and long-term portions of the debt. The weight of the short-term interest rate in the implicit interest rate is identical to the share of the short-term debt, i.e. 20%. We will consider the short-term interest rate in our projection to be constant at 2.1% p.a. This figure corresponds to a real short-term interest rate of 0.1% p.a. (the average real three-month interest rate over the period 2004–2018) plus inflation of 2%.[104] The interest rate on the long-term portion of the debt analogously has a weight of 80% in the implicit interest rate. In this case, however, we assume for the sake of simplicity that the interest rate on the long-term portion of the debt is equal to the ten-year moving average of the ten-year interest rates in individual years.[105] In the baseline version, we simulate the ten-year nominal interest rate at 3.2% p.a., 1.2 pp of which is the real interest rate (again, the average for the period 2004–2018) and the rest is the expected rate of inflation. These assumptions together lead to a gradual increase in the modelled implicit interest rate over ten years to 3% p.a., where it will stay constant until the interest rates start to rise due to the breach of the debt brake (see below).[106] Although this procedure is only approximate, we verified on the data for the past ten years that it led to a satisfactory simulation of actual interest costs.

5.3 Debt

Interest costs enter the calculation of the overall general government balance on the expenditure side and thus increase the annual deficits. Those deficits accumulate further in the general government debt, and the growing debt in turn again generates rising interest costs (see Table 5.3.1 for data for selected years). We regard the simulation of interest expenditure in this form as moderate, as international institutions recommend using higher real interest rates, which would make the results even worse.[107] Even so, over the 50-year horizon the cumulative general government debt is heading towards approximately 175% of GDP by 2069. However, this is due mainly to the evolution of the primary balances in the second part of the projection period, not to our model of interest costs. Even if we were to assume (unrealistically) that both the short-term and long-term real interest rates were zero over the whole projection period, the debt would still head towards roughly 150% of GDP (see Chart 5.3.1).

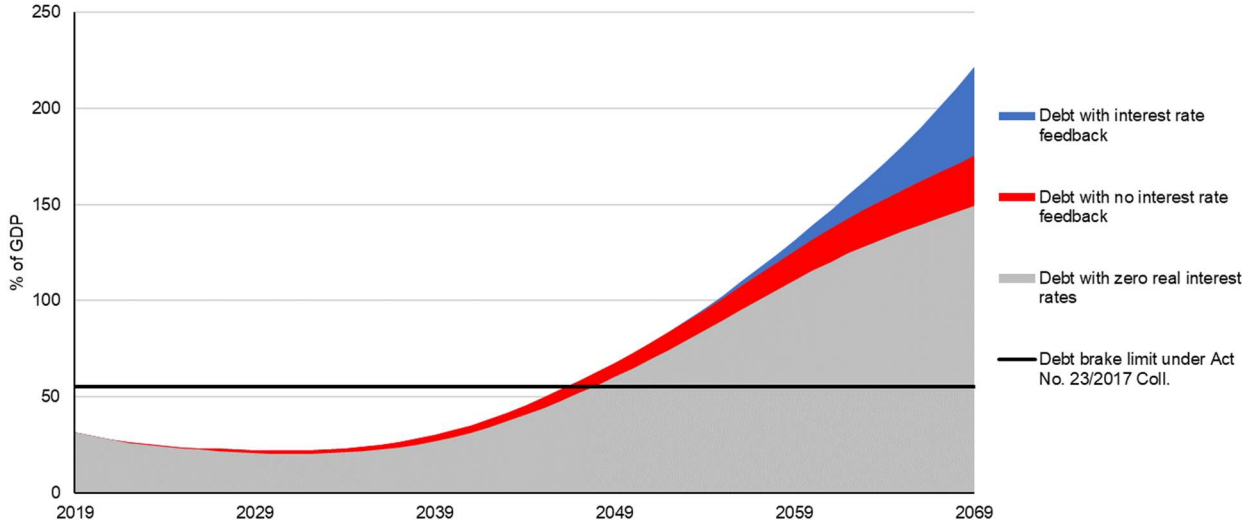
Besides this version of the interest expenditure simulation, we also carried out a projection in which we take into account the relationship between the size of the debt relative to GDP on the one hand and the level of real interest on the other. If the debt-to-GDP ratio rises significantly, it is likely that investors will require a risk premium for being willing to hold such a large volume of debt paper and to further increase the share of such paper in their portfolios and thus

[102] For more details, see MF CR (2019): State Debt Management Report of the Czech Republic in 2018 and Morda, P. (2019): Vývoj státního dluhu České republiky, ÚNRR [Evolution of the State Debt of the Czech Republic, available in Czech only].
[103] See, for example, MF CR (2018): Strategy for the Financing and Management of the State Debt of the Czech Republic 2019.
[104] CNB nominal interest rate data. We used the GDP deflator from CZSO data to convert to the real interest rate.
[105] We use this approach to account for the fact that the current interest rate is not relevant to the servicing costs of ten-year bonds already issued; all that matters is the interest rate at the time of issue.
[106] The only gradual increase in the implicit interest rate is due to the fact that for the long-term portion of the debt we apply the moving average of actual long-term rates over the last ten years, so until 2026 this average includes some of the actual rates prior to 2018.
[107] See, for example, European Commission: The 2018 Ageing Report: Underlying Assumptions and Projection Methodologies, which recommends a real interest rate of 3%.

expose themselves to a rising risk of borrower default. Interest rate feedback thus arises between the debt and interest expenditure above a certain debt level. This is a loop in which a high level of debt leads to growth in the real interest rate; that in turn increases interest expenditure, fostering growth in the debt, which further increases the real interest rate, and so it continues.

Of course, there remains the question of the debt level at which this feedback begins to emerge. In the projection, we opted for a threshold of 55% of GDP, because this is the value of the debt brake.[108] According to the simulation, this threshold would be breached sometime around 2047. If the general government debt were to break through this threshold and continue to rise, it would undoubtedly be a signal for investors that the deficit reduction measures referred to in the law are insufficient, and market interest rates would very likely increase.[109] Another question is how intensely the real interest rate would respond to the growth in debt. Given that in modern history the debt-to-GDP ratio in the Czech Republic has never reached the aforementioned threshold, we used a sensitivity level derived from the differences in yields on the ten-year government bonds of euro area countries.[110] In the simulation, we assume that each percentage point of the debt-to-GDP ratio above the 55% threshold leads to an increase in the current ten-year real interest rate of 0.039 pp (we leave the interest rate on the short-term portion of the debt unchanged). Under these assumptions, the debt growth will accelerate at the end of the projection period compared with the no-feedback scenario (see Chart 5.3.1). The implicit nominal interest rate in our projection with interest rate feedback will exceed 6% and the debt-to-GDP ratio heads towards 222%

Chart 5.3.1 General government debt (% of GDP)



Source: CFC calculations.

Table 5.3.1 Interest costs and total budget balances (in % of GDP) in selected years

	2020	2030	2040	2050	2060	2069
Interest costs with no interest rate feedback	0.6	0.6	0.9	2.0	3.7	5.0
Interest costs with interest rate feedback	0.6	0.6	0.9	2.1	5.8	13.6
Total balance with no interest rate feedback	0.7	–0.8	–3.3	–7.3	–10.5	–10.9
Total balance with interest rate feedback	0.7	–0.8	–3.3	–7.3	–12.5	–19.5

Source: CFC calculations.

[108] See Section 14 of Act No. 23/2017 Coll., on the rules of budgetary responsibility.
[109] However, the change in market interest rates would also depend on the fiscal situation in other countries, since bonds are to some extent substitutes for each other – a sharp increase (decrease) in the indebtedness of other countries would probably reduce (increase) the growth in Czech interest rates.
[110] We derived the sensitivity of the interest rate on the basis of the relationship between the debt-to-GDP ratios of the 12 euro area member states as the explanatory variable and the ten-year government bond yield as the explained variable. We used a panel regression for the period 2009–2017 for the estimation. The lower bound of the estimate is an increase in the interest rate of 0.039 pp for each additional percentage point in the debt-to-GDP ratio. We favour the lower estimate for our purposes because the link between the debt is more intensive in euro area countries than in non-euro area countries, as the single monetary policy makes it impossible for individual euro area countries to react to rising debt by increasing the money supply ("printing money", in lay terms). See, for example, Turner, D. Spinelli, F. 2012. Interest-Rate-Growth Differentials and Government Debt Dynamics, OECD Journal: Economic Studies, Vol. 2012/1.

5.4 Public finance sustainability indicator

The S1 indicator is used as an overall indicator of the sustainability/unsustainability of public finances. It is generally defined as the number of per cent of GDP by which the primary structural balance would have to change (by the same number of per cent of GDP every year) over an entire given period for the debt to reach a given level by the end of that period.[111]

In our case, we will therefore select a 50-year period and ask how many per cent of GDP the primary balance would have to be less in deficit or more in surplus each year relative to our projection for the general government debt to be at 55% of GDP, i.e. the debt brake level, at the end of the projection period. The S1 indicator constructed this way describes the **public finance sustainability gap**. However, let us emphasise that this merely an indicator, one intended primarily to allow for a quick comparison in the future of whether public finance sustainability is improving or worsening. It is **not** a recommendation that the balance should improve by the given figure each year in reality.

According to our simulation, the public finance sustainability gap currently stands at 2.79 (the figure last year was 2.86). This means that if the primary deficit was 2.79% of GDP lower (or the primary surplus was the same amount higher) from 2019 onwards over the entire projection period, the debt would head towards 55% of GDP in 2069. Given that in such case the debt path would never exceed the debt brake, there would be no feedback between the real interest rate and the debt.

If measures to reduce the long-term public finance imbalance are put off, the changes to tax and expenditure policies needed to ensure that the debt will not exceed 55% of GDP in 2069 will have to be larger than that expressed by the sustainability gap indicator value presented above. If solutions are delayed until the general government structural deficit hits the legal limit of 1% of GDP (sometime around 2032 according to our simulation), the sustainability gap will grow to 3.51.[112] If the solution is postponed until the debt brake threshold is reached (sometime around 2047 according to the simulation), the gap will widen further to 5.36.[113]

Note that the similar indicator constructed by the European Commission, which, however, works with an infinite horizon instead of a 50-year projection period and gives the fiscal effort needed to achieve **equality** of discounted revenue and expenditure (the S2 indicator), stands at 4.1 for the Czech Republic.[114] This is higher than the figure based on the Czech Fiscal Council's projection.

[111] For a more detailed description, see European Commission: Debt Sustainability Monitor 2017. Institutional Paper 071.
[112] This means that for the debt to head towards 55% of GDP in 2069, the primary deficit would have to be 3.51 pp of GDP lower from 2032 to 2069.
[113] So, for the debt to head towards 55% of GDP in 2069, the primary deficit would have to be 5.36 pp of GDP lower from 2047 to 2069.
[114] European Commission (2019): Fiscal Sustainability Report 2018. The requirement for balanced revenue and expenditure makes S2 stricter than our sustainability gap.

6 Alternative scenarios and comparison with the previous Report

We calculated the baseline scenario on the assumption that the medium variant of the CZSO's demographic projection will materialise. With the same demographic projection, however, there is a multitude of other possible scenarios, of which we choose two that we regard as important, either because they ensue directly from the current legislation, or because they were frequently discussed in reaction to the 2018 Report. We also conduct a simulation for the other variants of the demographic projection so that we can assess the sensitivity of the resulting projections to different assumptions about the size and structure of the population.

6.1 Linking of the retirement age to life expectancy

In the first alternative scenario, instead of using the current retirement age we assume that the retirement age is linked to life expectancy as per Section 4(a) of Act No. 582/1991 Coll. In such case, the retirement age (the same for men and women) would be set so that the remaining life expectancy of those who reach it (i.e. the time they will spend retired) equalled one-quarter of their overall life expectancy. To simulate this alternative scenario, we used the CZSO's retirement age projection, which we prolonged to allow us to perform the simulation up to the end of our projection period (i.e. up to 2069).[115] We assume that until 2030 the retirement age would increase in the same way as in the baseline scenario and that from 2034 onwards it would be gradually extended to 67.7 years at the end of the projection so that the expected time spent retired would remain equal to one-quarter of the individual's life.

The gradual increase in the statutory retirement age will be felt in a number of areas. First, it will slightly raise the projected GDP level, because later retirement will gradually increase the number of workers in the economy (by about 5% by the end of the projection). There will be a proportionate increase in general government revenue, but the ratio of revenue to GDP will remain unchanged. The expenditure side will see a modest rise in expenditure on disability pensions, but there will be a fall in spending on old-age pensions and, to a lesser extent, on widows' and widowers' pensions. The fall in spending is due predominantly to a decline in the number of pensioners (of up to 11% in 2069 by comparison with the baseline scenario in the case of old-age pensioners). Conversely, newly granted pensions and the pension-to-wage ratio will rise modestly in the long run due to a longer insurance period. The balance of the pension system will be around 1.4% of GDP better from 2059 until the end of the projection as a result of the gradual increase in the retirement age. The reduction in pension system deficits will lead to a commensurate decrease in primary deficits and, together with the slightly higher GDP level and lower interest payments, to a debt level that is 60 pp lower than in the baseline scenario in 2069. **This scenario therefore has a large impact on the future debt level. It is nonetheless apparent that linking the retirement age to life expectancy does not in itself lead to long-term public finance sustainability.** Despite the reduction in spending on the pension system, at the end of the projection the sector is generating high primary deficits and the debt path is showing no signs of slowing (see Chart 6.2.1).

6.2 Faster productivity growth due to technological progress

The next alternative scenario tries to capture the effects of robotisation and digitalisation and their impact on labour productivity. Although we believe that this impact will not be as dramatic as it might seem today,[116] to assess this factor we calculate a scenario in which labour productivity rises 1 pp faster than in the baseline scenario every year. This means we increase the rate at which, under our assumption, labour productivity rises in the steady state in developed countries (the rise of digitalisation and robotisation would certainly not be limited to the Czech Republic). We do not regard such an increase in the rate of growth as realistic in the long term, because past waves of technological innovation (such as the rise of personal computers and the development of the internet) were not reflected too strongly in productivity growth. However, we are interested in determining the sensitivity of the projection to an acceleration in labour productivity growth.

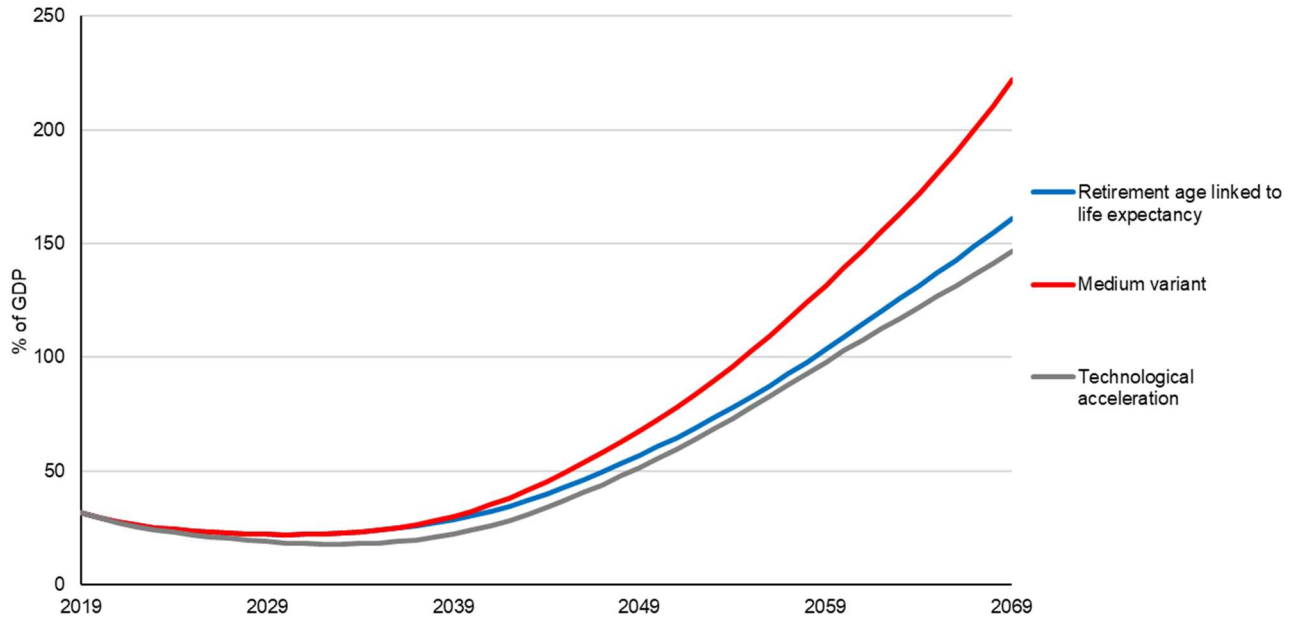
In this technological acceleration scenario, we keep the other parameters, such as the rate of convergence of the Czech economy to the steady state and

[115] See CZSO (2018): Zpráva o očekávaném vývoji úmrtnosti, plodnosti a migrace v České republice [Report on Expected Mortality, Fertility and Migration in the Czech Republic, available in Czech only]. According to this report, the longest retirement age is calculated for the cohort born in 1994, which should reach retirement age in 2061. In the years 2062 to 2069 we gradually increased the retirement age by approximately one month in order to have a retirement age for simulation purposes for the entire projection period.
[116] See Section 3.

the ratio of compensation of workers to GVA, the same as in the baseline scenario. However, this means that thanks to an increase in GDP growth per worker there will be an equal increase in real wage growth. This is therefore an optimistic scenario for the impact of technological acceleration – one could alternatively assume a stagnation or decline in the ratio of compensation of workers to GVA, which we do not consider here. Note that we are preparing a long-run scenario, which means we can assume that structural unemployment (which could arise temporarily as a result of the deployment of new technology) is eliminated by economic adjustment mechanisms. The number of workers in this scenario is therefore equal to that in the baseline scenario, but the rate of growth of GDP is 1 pp higher every year.

The budget revenue side measure as a percentage of GDP is not affected. The expenditure side sees an improvement in the pension system area through the following mechanism: permanently higher real wage growth causes pensions granted in previous years to lag further behind real wages than in the baseline scenario (because the indexation of pensions only recognises half of the real growth in wages). The average pension to average wage ratio thus falls. This in turn reduces pension system expenditure (relative to GDP) and improves the sector's primary balance by up to 0.9 pp a year at the end of the projection. Another key factor as regards general government debt is that the volume of GDP rises quickly given the permanent increase in productivity growth, so the debt carried over from previous years is smaller in relation to GDP than in the baseline scenario. The public sector debt ratio is as much as 75 pp lower than in the baseline scenario, but even this very optimistic scenario does not lead to a sustainable public finance path (see Chart 6.2.1).

Chart 6.2.1 Comparison of alternative scenarios with the medium variant – debt in % of GDP

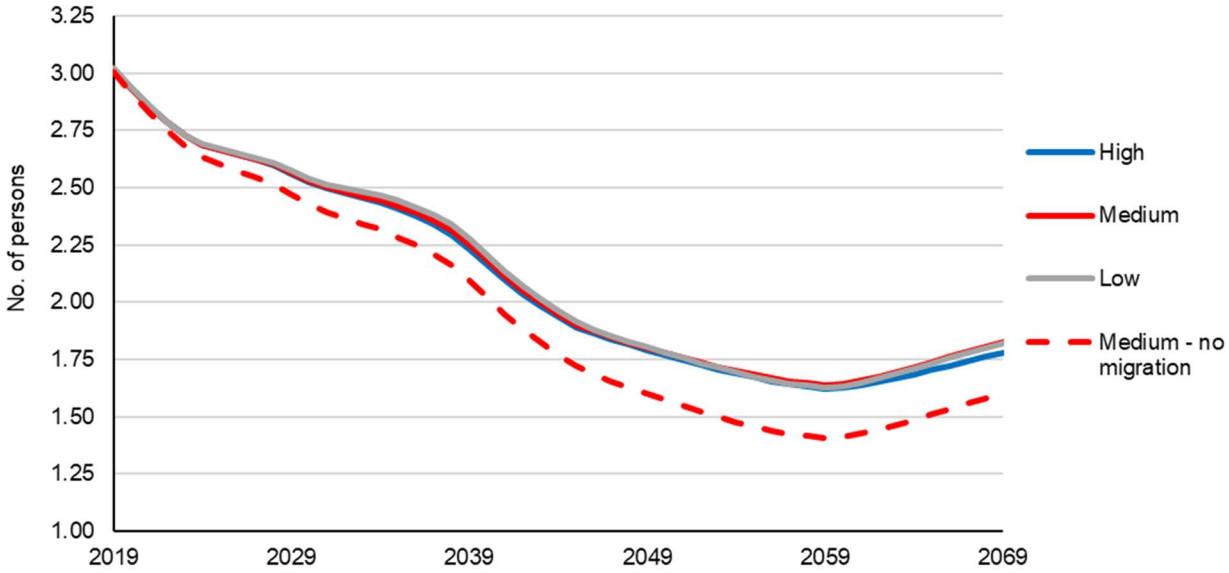


Source: CFC calculations.

6.3 Different variants of the demographic projection

The next scenario can be regarded as an analysis of the sensitivity of the baseline scenario to different assumptions about population growth. If, instead of the medium variant of the demographic projection, we use the high, low or no-migration medium variant, we obtain modifications of the baseline scenario caused by different population growth. Generally, we can divide the results of the different population growth variants into those caused by differences in the age structure of the population and those caused by different population size. The results associated with different age structure manifest themselves mainly in the pension system area, whereas population size co-determines the size of the economy itself and therefore has an impact on the debt-to-GDP ratio via its effect on the absolute size of GDP. Although the variants of the demographic projection differ in many respects, the medium, high and low variants are quite similar as regards the population structure they project. This is apparent, for example, from the ratio of the working-age population (for our purposes those aged 21–64 inclusive) to the population aged 65+ (see Chart 6.3.1).

Chart 6.3.1 Number of persons aged 21–64 (inclusive) per person aged 65+



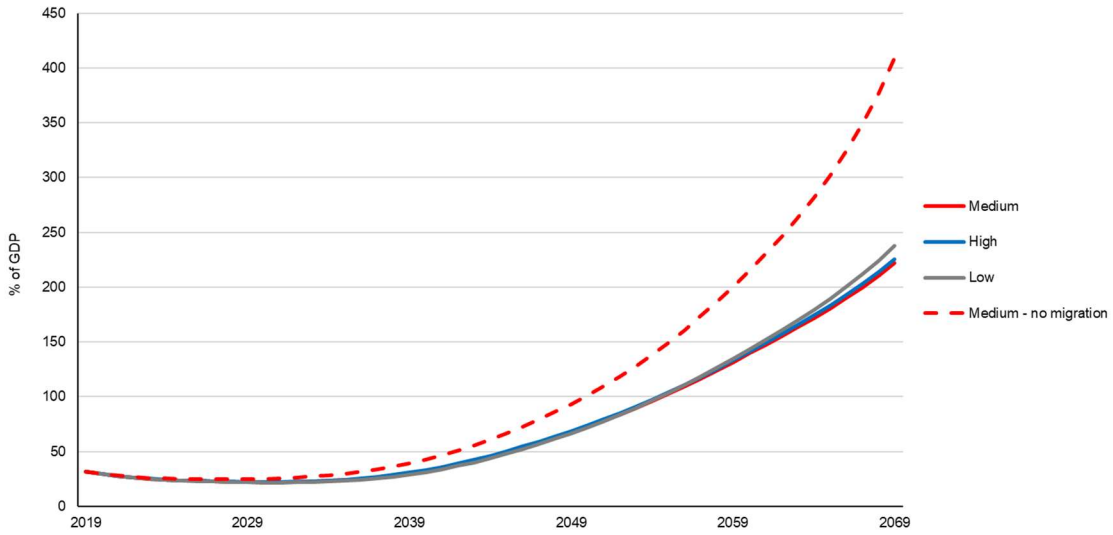
Source: CFC calculations.

The surprising similarity in structure of these demographic variants leads to similar projections of the debt-to-GDP ratio (see Chart 6.3.2). In the case of the high variant, the higher volume of GDP reduces the debt-to-GDP ratio. This effect, however, is roughly offset by the higher assumed life expectancy and hence by higher pension system costs. The opposite is true of the low variant. Although the simulation results are not identical across the variants, in broad terms **the results of the fiscal projection are robust to the demographic variants due to mutually offsetting effects**.

Among the demographic variants considered, however, the no-migration medium variant stands out in terms of structure.[117] In this case, the effect of population structure is very strong: the pension system falls into deficits of more than 5% of GDP a year as a result of an adverse age structure of the population. Coupled with higher primary deficits, the volume factor would affect the size of the debt as well, because under the assumption of zero net migration the size of GDP at the end of the projection is more than 20% lower than in the medium variant. Partly as a result of this, the simulation heads above the hypothetical figure of 400% of GDP at the end of the projection period (see Chart 6.3.2). This is therefore the worst debt path of all the variants simulated.

[117] The medium variant of the demographic projection assumes constant positive net migration of 26,000 persons a year. The cumulative net migration shortfall (and the related birth rate) therefore has a substantial impact on the projected population structure.

Chart 6.3.2 Comparison of the different variants of the demographic projection – debt in % of GDP



Source: CFC calculations.

6.4 Comparison with the previous Report on the Long-Term Sustainability of Public Finances

We have made several changes in this year's Report by comparison with the 2018 one. These can be split into methodological changes, by means of which we have tried to refine and supplement our projections, and quantitative changes to input parameters, which, together with the methodological changes, modify our original quantitative conclusions.

The biggest parametric change concerns the input demographic projection. In the previous Report we used the expert-adjusted high variant of the CZSO's 2013 demographic projection,[118] whereas in the current one we have been able to use the demographic projection issued by the CZSO in November 2018. As the demographic projection is updated only once every five years, and given the importance of the demographic projection as an input parameter for projecting revenues and expenditure, let's compare the current and original demographic inputs in more detail.

The current demographic projection is prepared in four main variants: high, medium, low and, for the first time, no-migration medium. In all its variants, the new demographic projection assumes a higher population of the Czech Republic relative to the variants of the 2013 projection (1.6 million higher in the medium variant, 1.7 million higher in the high variant, and 1 million higher in the low variant in 2069). The future population assumed in the medium variant is nevertheless similar to the population in the adjusted projection used for last year's Report, which assumes an essentially stable Czech population up to 2069.

As regards the structure of the population, the new projection again assumes an ageing population, as reflected in an increase in the proportion of persons aged 65+ to 30% in the medium variant. By comparison with the projection in last year's Report, the new demographic projection nonetheless indicates a 1.4–2.7 pp lower share of persons aged 65+ in the total population for 2069 in all its variants. The exception is the no-migration medium variant, which is close to the projection in last year's Report.

The smaller impacts of population ageing relative to the projection in last year's Report arise from a combination of three main changes in the demographic projection. First, the projection assumes a higher total fertility rate,[119] as reflected in a higher birth rate. Following a sharp drop in the 1990s, renewed growth before the financial crisis and a stagnation after the financial crisis, the fertility rate has risen to 1.7 in recent years and is now at its highest level in the history of the independent Czech Republic (although it is still below 2 and will not be enough in itself to restore the population). The medium and high variants of the demographic projection assume that this fertility rate will be maintained and gradually rise.

[118] For the purposes of last year's Report, the high variant of the 2013 projection was adjusted to reflect the actual demographic data. A higher fertility rate, a slightly lower mortality rate and slightly lower net migration were also used.
[119] The average number of live births per woman.

The second factor reducing the share of the elderly in the total population is a higher assumed international migration rate. The medium variant of the projection assumes constant positive net migration of 26,000 persons a year, whereas the projection in last year's Report assumed a gradual rise from around 20,000 to 24,000. The foreign migrants arriving in the Czech Republic are mostly of productive age, have a low unemployment rate and thus reduce the burden on the pension system. Higher population growth should also be fostered by a changing structure of migration flows. Until now, migration from other countries to the Czech Republic has been dominated by men of working age, whereas the CZSO projection expects the shares of men and women to equalise. In addition to its direct effect, the higher proportion of women in migration will give rise to an increase in the birth rate (given the fertility rate, the number of women of reproductive age will be higher). One risk to the demographic projection is the potential dependence of migration flows on economic convergence, which will also be going on in the countries from which migrants have traditionally flowed into the Czech Republic (Slovakia, Ukraine and the Balkan countries). This is because convergence may cause the difference between wages in those countries and the Czech Republic to narrow and thus reduce the incentive to migrate. Moreover, part of these migration flows may be redirected to wealthier European countries (such as Germany), which could potentially open their labour markets to non-EU countries in the future.

The third change fostering a lower proportion of pensioners is the revised mortality assumptions, which are also reflected in assumed life expectancy. The projection assumes a decline in mortality, which will be driven by older age cohorts and will follow similar trends to those seen in developed European countries in the past. The projection also assumes a decrease in the life expectancy of men and women and greater concentration of the age of death around the modal age of death. These assumed declines in mortality, however, are lower than assumed in the projection contained in last year's Report. The current medium variant of the projection assumes there will be up to 277,000 fewer people aged 65+ around the year 2060 than the projection in last year's Report did. This reduces the number of old age pensioners and pension system expenditure in our projection.

While the new demographic projection was the most important parametric change, the most important methodological change was the separation of education expenditure from the originally non-differentiated other expenditure aggregate, which we modelled as a constant per cent of GDP. We now model education separately on the basis of demographic and wage input parameters. The separation of education is in line with the established practice for tracking the costs of population ageing.[120] Another specific input parameter for our projection of education expenditure is growth in teachers' wages – a significant government policy with a broad political consensus behind it. The separate projection of education expenditure from other expenditure leads to total general government expenditure being up to 1.1% of GDP higher at the end of the projection than in the previous Report.

The remaining part of the other expenditure item has also been increased. This is due to a significant change in public expenditure cause by growth in general government expenditure on compensation of employees and intermediate consumption.[121]

The other methodological and parametric changes are refinements and we present them below in order of the sections of the Report.

The main methodological change to the long-term macroeconomic projection is that the default indicator is GDP per worker (as compared to GDP per capita in the previous Report) and the average real wage is determined as a percentage of GDP per worker (in the previous Report wages were determined by spreading compensation of workers across all workers). These changes slightly affect the paths of productivity, total GDP and real wages but do not fundamentally affect the average rates of growth. The rate of decrease of the gap between Austrian and Czech labour productivity is now set at 2.3% (as compared to 1.9% for the rate of closure of the gap between Austrian and Czech GDP per capita in the previous Report).

In the pension area, we made a methodological change in the case of disability pensions and survivors' pensions paid in combination with a direct pension. The new methodology[122] uses age-specific disability rates. This makes it possible to link the estimate of the number of disability pensioners more accurately to demographic change. In the previous Reports, the number of disability pensioners was estimated solely on the basis of the population aged between 18 and retirement age. In addition, disability rates are now linked to the (gradually changing) retirement age. Likewise, survivors' pensions paid in

[120] See, for example, European Commission (2018): Ageing Report: Economic and Budgetary Projections for the EU Member States, Brussels 2018.
[121] The April 2018 Convergence Programme assumed that these two items would equal 15.2% of GDP on average in the period 2017–2021, whereas the April 2019 Convergence Programme assumes that the figure will be 1.05 pp higher in the period 2018–2022.
[122] For a more detailed description of the method used to project the number of disability pensioners, see OCFC (2019): Projekce důchodového systému [Pension System Projection, available in Czech only].

combination are based on age-specific rates, whereas in the previous Report they were modelled using the difference in the numbers of men and women above certain age thresholds. As a result of these changes, our estimates of the number of disability pensioners have increased slightly. In the case of survivors' pensions, the changes are not quantitatively significant.

In the projection of non-pension social benefits in cash, we have changed the methods for calculating parental allowance expenditure and long-term care allowance expenditure. Using data on the structure of parental allowance recipients, we have refined the expenditure projections by including the number of discontinued parental allowances by child age. This has enabled us to determine the average benefit for the various age cohorts of children. We have also incorporated into the estimate the government-approved change in the total sum of the parental allowance, which will increase this sum from CZK 220,000 to CZK 300,000 with effect from 2020, so we now use this amount as the default level. The main methodological difference for the simulation of care allowance expenditure is a refinement of the projection of the number of persons drawing it according to age categories. In the previous Report the number of care allowance recipients was related to the population aged 65+, whereas in this year's Report we take into account the entire age profile of persons drawing the allowance. The projection depends mainly on the population aged 75+. Another difference is that in this year's Report we consider the new allowance amount that started to be paid during 2019. As a result of the changes to the methodology and input parameters, peak care allowance expenditure is up to 0.3% of GDP higher than in the previous Report.

We leave the revenue-side projection methodology unchanged. An important parametric change is an increase in the ratio of compensation of workers to GDP. We counted on a rise in this ratio in the previous Report, but the rate of growth in 2018 was faster than we had assumed. We have therefore amended the default position of the ratio of compensation of workers to GDP according to the present values. This has resulted in a slight change in the structure and level of revenues.

We have left the total debt projection methodology unchanged and have merely made a parametric adjustment to the real interest rate on the long-term portion of the debt based on the lengthening of the historical data series (a reduction of the real interest rate from 1.3% p.a. to 1.2% p.a.). This has resulted in a slight decrease in the projected debt level at the end of the projection period.

Conclusion and assessment

Czech public finances are not sustainable in the long term under the current government revenue and expenditure policies. Note again, however, that our simulation is not a prediction of the actual path of public finances. It is a simulation of what would occur without changes to tax and spending policies. Although the projection results contain many factors that cannot be entirely separated from one another in a reliable way, in this case we can still conclude that the main cause of the long-term unsustainability of Czech public finances is the mismatch between the current legislation on the one hand and the expected demographic trends on the other.

According to the simulation, under the assumption of no policy change general government debt would be broadly stabilised until the mid-2030s and later start to increase in the baseline scenario of our simulation. Around 2047 it would breach the debt brake of 55% of GDP. If changes to the fiscal settings still did not follow, the debt would grow at an accelerating pace with no prospect of stabilising, and do so right up the end of our projection horizon. In such case, the general government debt ratio would head towards approximately 222% of GDP in 2069.

In addition, the general government structural balance would first hit the currently applicable limit given by the Medium-Term Budgetary Objective (approximately around 2030) and would subsequently also breach the limit set by law (around 2032).

In the main, the projection results are insensitive to the variant of the demographic projection chosen. The exception is the variant that assumes zero net migration, in which the debt rises very sharply in the medium term.

An alternative scenario in which the retirement age is linked to life expectancy such that people spend approximately one-quarter of their life retired indicates a substantial reduction in the debt to GDP ratio by comparison with the currently applicable changes to the retirement age. Even in this scenario, however, the general government sector does not get onto a sustainable path. We can therefore conclude that **linking the retirement age to life expectancy cannot fully solve the problem of population ageing-related growth in general government expenditure on its own**, although it could be a useful part of a comprehensive solution. The simulation therefore shows, among other things, that the current revenue and expenditure policies are such that a realistic change to only one (albeit significant) parameter, such as the retirement age, cannot in itself steer Czech public finances onto a sustainable path.

Appendices

D.1 Summary of general government expenditure and revenue in selected years (% of GDP) – medium variant of demographic projection

	2020	2030	2040	2050	2060	2069
REVENUE						
Personal income taxes	4.6	4.7	4.8	4.9	5.0	5.0
Corporate income taxes	3.3	3.0	2.8	2.7	2.5	2.5
Other income taxes and taxes on property transactions	0.2	0.2	0.2	0.2	0.2	0.2
Social security contributions	16.0	16.5	16.9	17.3	17.6	17.7
pension insurance premiums	*8.7*	*9.0*	*9.1*	*9.3*	9.4	*9.5*
public health insurance premiums (excluding SIs)	*4.6*	*4.7*	*4.8*	*4.9*	5.0	*5.0*
payments for state insurees (SIs)	*1.4*	*1.4*	*1.5*	*1.7*	1.9	*1.8*
others	*1.3*	*1.3*	*1.4*	*1.4*	1.4	*1.4*
Taxes on production and imports	11.9	11.9	11.9	11.9	11.9	11.9
Property income	0.5	0.5	0.5	0.5	0.5	0.5
Other revenue	4.7	4.7	4.7	4.7	4.7	4.7
TOTAL REVENUE	41.2	41.5	41.8	42.2	42.4	42.4
EXPENDITURE						
Pensions	8.4	8.5	10.2	12.3	13.2	12.1
Health care (public health insurance system only)	5.5	5.9	6.2	6.4	6.6	6.6
Other social benefits in cash	2.4	2.5	2.8	3.1	3.3	3.4
Payments for state insurees	1.4	1.4	1.5	1.7	1.9	1.8
Long-term care outside the public health insurance system	0.6	0.7	0.8	0.9	1.1	1.1
Education	4.5	4.9	4.9	5.1	5.3	5.5
Other expenditure – baseline scenario	17.0	17.0	17.0	17.0	17.0	17.0
Changes related to convergence	0.0	0.8	0.8	0.9	0.9	0.8
public investment	*0.0*	*0.0*	*-0.1*	*-0.2*	*-0.2*	*-0.3*
defence expenditure	*0.0*	*0.6*	*0.6*	*0.6*	*0.6*	*0.6*
growth in general government costs (wages)	*0.0*	*0.2*	*0.3*	*0.3*	*0.4*	*0.5*
growth in payments to the EU	*0.0*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
Total expenditure excluding interest	39.9	41.7	44.2	47.4	49.2	48.3
Primary balance	1.3	-0.2	-2.4	-5.2	-6.8	-5.9
Interest – baseline scenario	0.6	0.6	0.9	2.0	3.7	5.0
Interest with interest rate feedback	0.6	0.6	0.9	2.1	5.8	13.6
TOTAL EXPENDITURE – NO INTEREST RATE FEEDBACK	40.5	42.3	45.1	49.5	52.9	53.4
TOTAL EXPENDITURE – INTEREST RATE FEEDBACK	40.5	42.3	45.1	49.5	55.0	61.9
TOTAL BALANCE – NO INTEREST RATE FEEDBACK	0.7	-0.8	-3.3	-7.3	-10.5	-10.9
TOTAL BALANCE – INTEREST RATE FEEDBACK	0.7	-0.8	-3.3	-7.3	-12.5	-19.5
DEBT – NO INTEREST RATE FEEDBACK	29.6	22.0	32.3	72.6	131.7	175.2
DEBT – INTEREST RATE FEEDBACK	29.6	22.0	32.3	72.7	139.3	221.8