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Reviewed by: Pavel Soukup (Czech National Bank)
Vratislav Izák (Prague School of Economics)
Pablo Antolin (OECD)

Project Coordinator: Vladimír Bezděk

Fiscal Sustainability – Definition, Indicators and Assessment of Czech Public Finance Sustainability

Aleš Krejdl *

Abstract

The aim of this paper is to shed some light on what fiscal sustainability actually means. In doing so, it looks in the literature for a definition of fiscal sustainability that not only is theoretically sound, but can also be used for setting fiscal targets in practice. Sustainability is defined in a rather standard way – fiscal policy is said to be sustainable if the present value of future primary surpluses equals the current level of debt. This definition enables various sustainability indicators to be constructed. A good indicator of fiscal sustainability should signal, with a sufficient lead, excessive debt accumulation. The paper introduces several sustainability indicators varying in how closely they are related to the sustainability definition (the infinite and finite horizon gaps), whether they take account of the future evolution of spending (the primary gap and the tax gap) and what target value of debt is set at the end of a finite horizon. While the indicators can be used for different time horizons – from one year to an infinite horizon, the paper is by and large focused on long-term sustainability. When combined with long-term projections the indicators gauge the resilience of public finances to population ageing. The indicators are used to assess the sustainability of Czech fiscal policy. The sustainable revenue ratio, enabling the future surge in age-related spending to be financed, is estimated at 48% of GDP in the Czech Republic. It is some 7 percentage points higher than the current revenue-to-GDP ratio. The sustainable primary balance stands at 0.4% of GDP. By observing this primary surplus, governments would stabilise the debt ratio in the long run. However, compliance with this target would require immediately raising taxes or cutting spending by almost 3.0% of GDP and containing any future spending pressures (projected at 7.3% of GDP) either by systemic reforms preventing age-related spending from rising or by annual discretionary spending cuts and tax increases.

JEL Codes: E61, E62, H30, H62, H63.

Keywords: Fiscal sustainability, population ageing, primary gap, sustainability indicators, tax gap.

* Aleš Krejdl, Delloite & Touche (akrejdl@deloittece.com).

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Nontechnical Summary

Sustainability has become one of the most widely used terms in the assessment of fiscal policy. However, it is hardly ever explained what sustainability actually means. We define sustainability in a rather standard way – fiscal policy is called sustainable if the present value of future primary surpluses equals the current level of debt (the so-called intertemporal budget constraint). If this condition is met, the government avoids excessive debt accumulation, is able to roll over its debt and there is no risk of insolvency.

Sustainability indicators should help detect unsustainable policies with a sufficient lead so that policy-makers have time to act and to mitigate the costs ensuing from the fiscal correction. The paper introduces several sustainability indicators varying in how closely they are related to the intertemporal budget constraint (the infinite and finite horizon gaps), whether they take account of the future evolution of spending (the primary gap and the tax gap) and, in the case of the finite horizon indicators, what target value of debt is set at the end of the given horizon.

The *primary gap* measures the distance from the sustainable primary balance. It is an attractive indicator, since budgetary balance is usually the ultimate object of policy-makers' interest. However, this indicator overlooks the tensions that may come from the expenditure side (e.g. as a result of population ageing) and does not provide a full picture of the correction needed. The *tax gap* expresses the difference between the actual and the sustainable revenue-to-GDP ratio. The sustainable revenue ratio is such that enables future spending to be financed. In terms of signalling the magnitude of the required fiscal correction, the tax gap is a more appropriate indicator. The primary gap and the tax gap can be calculated for different time horizons – from one year to an infinite horizon.

All fiscal indicators point to unsustainable fiscal policy in the Czech Republic. The current fiscal targets laid down in the Convergence Programme (2005) are not ambitious enough to prevent the debt ratio from increasing in both the short and long run. The medium-term fiscal targets envisaged in the Convergence Programme somewhat alleviate the existing imbalances. Nevertheless, the consolidation is far from restoring sustainability and the situation deteriorates even further beyond 2008.

The sustainable revenue ratio is estimated at 48% of GDP, as compared to an observed revenue ratio of around 41%. The government would have to increase taxes by 7 percentage points in order to be able to provide the same extent of public transfers and services (namely pensions and health care) to future generations. The resulting tax gap is very large, but it will increase even further beyond 2008. The fiscal imbalance is large even from an international perspective. In the light of population ageing, governments should create substantial primary surpluses and reduce public debt in order to pre-fund the future steep rise in age-related spending.

Governments can choose an alternative way towards sustainability. They can set a primary surplus target consistent with the sustainable primary balance. Currently, the sustainable primary balance stands at 0.4% of GDP. By observing this target, governments would stabilise the debt ratio in the long run. However, compliance with this target would require immediately raising taxes or cutting spending by almost 3.0% of GDP and containing any future spending pressures (projected at 7.3% of GDP) either by systemic reforms preventing age-related spending from rising or by annual discretionary spending cuts and tax increases. This strategy is more realistic. But it postpones the necessary adjustment further, and delaying the adjustment is costly in terms of foregone spending.

1. Introduction

A fiscal imbalance accompanied by large fiscal deficits and growing debt ratios will lead, sooner or later, to adjustment. The necessity to adjust the current fiscal policy is a sign of unsustainable public finances. The costs of the adjustment depend on whether the adjustment is pre-emptive, initiated by the government soon enough before the markets shatter the confidence of the country, or on whether the financial markets force the hesitant government to bring in unpopular measures. An adjustment triggered by a loss of confidence of financial market participants is generally much more costly. Thus, it is important to detect any unsustainable policies with a sufficient lead so that policy-makers have time to act and to mitigate the costs ensuing from the fiscal correction.

The high costs of spontaneous adjustment call for the development of indicators enabling unsustainable fiscal policy to be recognised. This explains why economists have spent so much time trying to define fiscal sustainability and to develop various sustainability indicators. At the same time, the sustainability of fiscal policy has become one of the most widely used terms in economic country surveys and reports of international organisations and rating agencies. Fiscal policy is often said to be sustainable or unsustainable for different reasons, but it is hardly ever explained what the word "sustainable" actually refers to. This should not be surprising, as the economic theory has not yet managed to derive a definition that is widely accepted without reservations. In theory, different definitions and conditions of sustainability have been proposed, while in practice, various indicators – not always grounded in economic theory – have been applied.

The aim of the paper is to describe the notion of fiscal sustainability that is currently accepted by the mainstream literature. Indicators of fiscal sustainability will be presented and the extent to which they draw upon the theoretical definition will be evaluated. While the indicators can be used for different time horizons – from one year to an infinite horizon, the paper is by and large focused on long-term sustainability. When combined with long-term projections the indicators gauge the resilience of public finances to population ageing. The indicators will be used to assess the sustainability of Czech fiscal policy.

The paper consists of three sections and is organised as follows. In the first section the concept of fiscal sustainability is described. This section provides a definition of fiscal sustainability and introduces various sustainability indicators that have been developed in recent years and applied in the assessment of fiscal policy. In these parts we draw on the existing literature dealing with the problem of defining and measuring fiscal sustainability. The first section also demonstrates the use of the indicators mainly by international organisations when analysing fiscal policy. In the second section, sustainability indicators are calculated for the Czech Republic, which makes it possible to evaluate the sustainability of Czech fiscal policy. The last part concludes.

2. Fiscal Sustainability – Definition and Indicators in Theory and Practice

Definition of Fiscal Sustainability

At first sight it may seem easy to define what a sustainable fiscal policy is. A sustainable fiscal policy is a policy that can be pursued however long without any major interventions in tax and spending patterns. To put it differently current policy, as defined by the current legislation and policy decisions determining the evolution of tax and spending ratios, can be maintained indefinitely without resulting in excessive debt accumulation. This definition may seem sufficiently clear. However, as soon as we want to adopt such a definition to assess the sustainability of current fiscal policy we are confronted with questions such as: What is excessive (which is only a synonym for unsustainable) debt accumulation and what is current policy? In this section we will leave the issue of defining current policy aside and we will try to shed light on how the contemporary economic literature defines sustainable fiscal policy.

In the literature we encounter various definitions of fiscal sustainability. A good survey is provided in Balassone and Franco (2000). According to them, the theory has proposed different conditions for sustainability – from a non ever-rising tax rate to an intertemporal discounted budget constraint. The requirement that the tax rate should not rise forever is one of the first definitions of sustainable fiscal policy. On the basis of Domar's model, Balassone and Franco derive a necessary condition for sustainability: an ever-growing tax ratio cannot be sustainable, i.e. sustainability requires a non ever-rising tax ratio.

According to Blanchard (1990a) sustainability is about whether, based on current fiscal policy, a government is headed towards excessive debt accumulation. To make this rather general statement operational, Blanchard defines sustainable fiscal policy as a policy that ensures that the ratio of debt to GDP converges back towards its initial level. A similar definition is provided in Buiter (1985), who calls a fiscal policy sustainable if it maintains the ratio of government net worth to GDP at the present level. These definitions are essentially the same. They differ only from the statistical point of view. By focusing on net worth, Buiter explicitly recognises that the government may temporarily keep its gross debt from rising by using its assets to finance the deficits. But the fact that gross debt does not rise immediately by no means signifies sustainability, since the government will sooner or later deplete its assets and the debt will start growing again. Blanchard was well aware of the complexities involved in measuring the asset/liability position of the government, but in his definition he paid attention to debt dynamics rather than to the precise content of the word debt.

The major problem with defining sustainable policy as a policy under which the debt-to-GDP ratio converges back towards the initial level is the apparent arbitrariness of such a definition. The definition is arbitrary in at least two ways. Firstly, there is no theoretical reason why the debt ratio should be required to return to its initial level and not to any other stable level, be it lower or higher. Secondly, one can easily conceive of a policy under which the debt ratio initially rises to levels that are likely to be perceived as excessive by market participants and it is only later when the debt comes down and returns to "safe" levels.

The former strand of criticism was resolved by making the definition of sustainability more general. The requirement of convergence of the debt ratio towards its initial level is only a special

case of a more general definition which states that fiscal policy is sustainable if the present value of future primary surpluses is equal to the current level of debt. This definition is derived from the intertemporal budget constraint. The latter strand of criticism led some authors (e.g. Artis and Marcellino, 2000; IMF, 2002) to distinguish between solvency and sustainability. The government is said to be solvent[1] if it is capable, over an *infinite* time horizon, of paying its debt via future primary surpluses. In other words, the government is solvent if the intertemporal budget constraint is fulfilled. On the other hand, according to Artis and Marcellino sustainability is a somewhat more imprecise concept referring to the possibility of the government under *current policies* achieving a pre-specified debt ratio in a *finite* time horizon. The distinction between finite and infinite horizon will be important when it comes to defining the various sustainability indicators. We will not attempt to draw such a sharp distinction between solvency and sustainability, and the term sustainability will be preferred in the rest of the paper.

As the definition based on the intertemporal budget constraint is the most widely acceptable and as it is the starting point for derivation of indicators of fiscal sustainability, we will formalise it in the next paragraphs. Neglecting stock-flow adjustment, a simple relationship between deficit and debt holds. The debt (B) at time t can be expressed as the sum of the debt in the previous period (t-1) and the deficit at time t. The deficit can be further decomposed into the primary deficit (PD) and interest payments (IP), and interest payments are a function of the interest rate (r) and the previous period debt level.

$$B_t = B_{t-1} + PD_t + IP_t = B_{t-1} + PD_t + r \cdot B_{t-1} \tag{1}$$

$$B_t = B_{t-1}(1+r) + PD_t \tag{2}$$

Assuming that all the variables are expressed in real terms, r is an implicit real interest rate. The primary deficit (surplus) is indicated by a positive (negative) value. It is convenient to rewrite equation (2) in terms of GDP ratios, as economies expand over time and, consequently, the government's capacity to repay its debt increases. What matters, then, is the evolution of the debt ratio rather than the debt in absolute terms. Dividing equation (2) by real GDP (Y) yields:

$$\frac{B_t}{Y_t} = \frac{B_{t-1}}{Y_{t-1}} \cdot \frac{1+r}{1+y} + \frac{PD_t}{Y_t} \tag{3a}$$

Where y stands for the real GDP growth rate. Simplifying the notation we obtain:

$$b_t = b_{t-1} \cdot \frac{1+r}{1+y} + pd_t \tag{3b}$$

[1] Solvency is often referred to as no Ponzi game financing.

Equation (3b) can be solved backwards to an initial period *0* and the debt ratio at time *T* (b_T) can be written as the sum of the present value of the initial debt and the present value of all past primary deficits:

$$b_T = b_0\left(\frac{1+r}{1+y}\right)^T + \sum_{t=1}^{T} pd_t\left(\frac{1+r}{1+y}\right)^{T-t} \tag{4}$$

We can divide both sides of equation (4) by the expression $\{(1+r)/(1+y)\}^T$. In other words we discount[2] equation (4) back to the initial period *0*:

$$b_T\left(\frac{1+r}{1+y}\right)^{-T} = b_0 + \sum_{t=1}^{T} pd_t\left(\frac{1+r}{1+y}\right)^{-t} \tag{5}$$

Assuming an infinite time horizon ($T\rightarrow\infty$) we obtain:

$$\lim_{T\to\infty}\left[b_T\left(\frac{1+r}{1+y}\right)^{-T}\right] = b_0 + \lim_{T\to\infty}\left[\sum_{t=1}^{T} pd_t\left(\frac{1+r}{1+y}\right)^{-t}\right] \tag{6}$$

We can further assume that the present discounted value of the debt from a very distant time in the future is equal to zero[3]:

$$\lim_{T\to\infty}\left[b_T\left(\frac{1+r}{1+y}\right)^{-T}\right] = 0 \tag{7}$$

If (7) holds, equation (6) becomes:

$$\lim_{T\to\infty}\left[\sum_{t=1}^{T} pd_t\left(\frac{1+r}{1+y}\right)^{-t}\right] = -b_0 \tag{8}$$

Equation (8) is a condition for sustainability. It says that the present discounted value of future primary surpluses must be equal to the initial value of debt. It should be borne in mind under what assumptions equation (8) was derived. The main assumption that was adopted is convergence of the

[2] The discounting factor can also be approximated by the following expression:

$$\left(\frac{1+r}{1+y}\right)^{-T} \cong \left(\frac{1}{1+r-y}\right)^{T}$$

where *r-y* is the growth adjusted real interest rate.

[3] This is valid under the assumption of b_T taking a finite value. In other words, the government is not playing a Ponzi game.

discounted value of the debt at infinity towards zero. It is obvious that dividing any finite value of debt by an infinitely large discounting factor[4] satisfies equation (7). This means that sustainability is consistent with the debt ratio converging towards its initial level or to any other finite level. However, sustainability defined in this way is ensured even if the debt ratio diverges but its growth rate is lower[5] than the difference between the real interest rate and the real GDP growth rate (r-y). This implies that the definition of fiscal sustainability based on the intertemporal budget constraint is the broadest one, as it not only covers the definition requiring the debt ratio to converge towards its initial level, but it also admits a diverging debt ratio (expanding at a pace lower than *r-y*).

Although Blanchard's definition based on the intertemporal budget constraint is nowadays widely accepted in the economic literature, there are still some unresolved issues relating to it. The intertemporal budget constraint only formalises the long-held belief in the economic profession that the government cannot expand its indebtedness forever. However, it leaves aside interactions between budgetary variables and the economy and as such it is based on the partial equilibrium approach. The advantage of the partial equilibrium approach to fiscal sustainability is that it highlights the constraint imposed on fiscal policy. On the other hand, neglecting the simultaneity between budgetary variables and the economy may lead to inappropriate conclusions. The evolution of the debt ratio is a result of budgetary policy, i.e. decisions about the volume and structure of taxes and primary expenditures. Public revenues, expenditures, deficit and debt have an impact on other macroeconomic variables, of which the interest rate and the growth rate of GDP are of utmost interest for sustainability. Unfortunately, economists have not reached agreement about the theory governing the interaction between the public budget and the economy. Thus, the common practice in assessing fiscal sustainability is to assume that the interest rate and the growth rate of GDP are exogenous to fiscal policy and the possible interactions are only analysed outside the model.

It is apparent from the definition of sustainability (equation 8) that sustainability is a forward-looking concept. Past fiscal data may provide some clue for assessing fiscal sustainability, but they are clearly not sufficient. There are many papers (e.g. Hamilton and Flavin, 1985; Banca d'Italia, 2000) testing econometrically the sustainability of fiscal policy. However, analysis based on investigation of time series does not seem to be a suitable instrument, since it completely neglects predictable future trends of government spending and revenues. In order to assess the long-term sustainability of public finances a researcher has to project the future path of revenues, expenditures and deficits. Long-term projections are necessarily subject to wide margins of uncertainty, which become wider the further into the future the projections go. This should not, however, lead researchers and analysts to refrain from assessing and judging the sustainability of the government's policies in a forward-looking manner.

[4] It should be satisfied that $(1+r)/(1+y)>1$, i.e. $r>y$.

[5] This is apparent from the following relationship: $\lim_{T\to\infty}\left[b_0\left(\frac{(1+\dot{b})(1+y)}{1+r}\right)^T\right]=0 \quad \Leftrightarrow \quad \frac{(1+\dot{b})(1+y)}{1+r}<1$

The relationship was obtained from equation (7) by substituting for the debt ratio b_T the initial debt ratio b_0 multiplied by the growth factor $(1+\dot{b})$, where $\dot{b}$ stands for the growth rate of the debt ratio. It is assumed that $\dot{b}$, r and y are non-negative.

Indicators of Fiscal Sustainability

The accounting identities introduced in the previous subsection represent the starting point for the derivation of fiscal sustainability indicators. A good indicator of fiscal sustainability is one that sends clear and easily interpretable signals when current policy appears to be leading to a rapidly growing debt-to-GDP ratio (Blanchard, 1990a). Sustainability indicators not only signal a need for readjustment, but also indicate the magnitude of the adjustment needed.

The most widely used indicators of sustainability are the primary gap and the tax gap. The construction of the two indicators is based on the same approach. Firstly, the sustainable level of the fiscal variable at hand is calculated. Secondly, the gap is defined as the difference between the sustainable and the current level of the primary deficit or the tax ratio. The sustainable level of the fiscal variable is such that ensures convergence of the debt ratio towards a finite value and its calculation is governed by the condition of sustainability (8).

If we are looking for a constant primary deficit satisfying the condition of sustainability, the infinite geometric series of discounted primary deficits in (8) can be summed up and the sustainable primary deficit can be expressed as follows:

$$pd^* = -b_0 \frac{r-y}{1+y}; \qquad \text{or neglecting (1+y):} \quad pd^* = -b_0(r-y) \tag{9}$$

And the primary gap becomes:

$$pd^* - pd_t = -b_t(r-y) - pd_t \tag{10}$$

When calculating the primary gap, we only need to know the current primary deficit and the debt and we have to make assumptions about the long-run expected average values of the interest rate and the growth rate of real GDP. If the current primary deficit is higher than the sustainable one (pd^*-$pd<0$), the debt ratio will rise without any limits and fiscal policy can be called unsustainable. The sustainable primary deficit (pd^*) can be used directly as a target guiding the government towards a sustainable deficit path. It is an attractive indicator, since budgetary balance is usually the ultimate object of policy-makers' interest. The primary gap is then a measure of the adjustment that is needed in order to return the fiscal balance to its sustainable level.

However, today's primary gap of zero does not mean that fiscal policy is automatically sustainable without any need for future adjustment. In future the spending ratio may rise (e.g. as a result of ageing) and maintaining the primary deficit at the sustainable level (pd^*) will require an adjustment of revenues or expenditures. To take account of future spending pressures the assumption of a constant primary deficit has to be relaxed.

The primary deficit can be expressed as the difference between spending and revenues:

$$pd_t = g_t + h_t - \tau_t \tag{11}$$

where τ is the tax ratio, g consumption (including investment) and h transfers. All variables are measured in terms of GDP shares.

Substituting (11) into (8) and solving for constant τ we obtain the sustainable tax ratio[6]:

$$\tau^* = \frac{r-y}{1+y} \cdot \left\{ \sum_{t=1}^{\infty} \left[\left(g_t + h_t \right) \cdot \left(\frac{1+r}{1+y} \right)^{-t} \right] + b_0 \right\} \tag{12}$$

By subtracting the current tax ratio from the sustainable level (12) we get the so-called tax gap indicator:

$$tax\_gap = \tau^* - \tau \tag{13}$$

If the sustainable tax ratio (τ^*) exceeds the current tax ratio (τ), i.e. the tax gap is positive, fiscal policy will have to be adjusted in order to avoid excessive debt accumulation. The name of the indicator should not lead one to conclude that the right way to correct the current policy would be to increase taxes.[7] The indicator only suggests that the current tax ratio is not high enough to finance future spending and to service the debt. In order to satisfy the intertemporal budget constraint it will be necessary to reduce spending and/or increase taxes, and the magnitude of the adjustment is given by the value of the indicator.

Both the primary gap (10) and the tax gap (13) were derived from the condition of sustainability and thus are fully compatible with the definition of fiscal sustainability as proposed by Blanchard. Both indicators should be calculated for the infinite time horizon, which does not pose a major obstacle in the case of the primary gap. However, computation of the tax gap requires spending to be projected over an infinite time horizon – in practice assumptions have to be adopted about the evolution of spending beyond the horizon of the projection. As a result it can be convenient to limit the computation of the gap indicators to a finite horizon and modify the derivation of the indicators correspondingly. On the other hand, we are deviating from the theoretical definition, as the construction of finite gap indicators necessitates determining the target value of debt at the end of the period (equation 5). This target value of debt is unavoidably arbitrary, and the present discounted value of debt is non-zero and condition (7) is not met.

Sustainability indicators for a finite horizon can be derived from equation (5) for both the primary gap and the tax gap indicator. As in the previous paragraphs we will start with the derivation of the sustainable primary deficit. Since we are interested in a constant value of *pd* satisfying the identity

[6] For the sake of simplicity it is assumed that the interest rate (r) and the growth rate of GDP (y) are constant. This assumption makes it possible to write the sustainable level of the fiscal variable in a simpler way. From the economic point of view, y and r should then be interpreted as long-run equilibrium values. If we were to be accurate and consider the evolution of variables y and r over time, the expression for discounting any variable x (in the text x takes the form of *pb*, $g+h$ or $g+h-\tau$) would have to be re-written in the following way: $\sum_{t=1}^{T} \left[x_t \left(\frac{1+r}{1+y} \right)^{-t} \right] \rightarrow \sum_{t=1}^{T} \left[x_t \prod_{i=1}^{t} \left(\frac{1+y_i}{1+r_i} \right) \right]$

[7] While the name "tax gap" is common in the theoretical literature, alternative names have been proposed in policy oriented papers (e.g. financing, sustainability or budgetary gap) to prevent policy-makers from drawing inappropriate conclusions about the best way to correct the fiscal imbalances identified. We stick to the original terminology introduced by Blanchard (1990a).

(5), (5) can be solved for *pd* by summing up the finite geometric series of primary deficits. Isolating *pd* on the left-hand side yields:

$$pd^* = \frac{r-y}{1+y} \cdot \left[1 - \left(\frac{1+r}{1+y} \right)^{-T} \right]^{-1} \cdot \left[b_T \left(\frac{1+r}{1+y} \right)^{-T} - b_0 \right] \tag{14}$$

The interpretation of the sustainable primary deficit has changed somewhat. pd^* now stands for the value of the primary deficit that will, given the initial debt level (b_0), ensure that the debt ratio reaches the value of b_T at time T. Again, the primary gap indicator can be expressed on the basis of the definition (10) as the difference between the sustainable and current level of the primary deficit (pd^*-pd).

If we are looking for the primary deficit that will stabilise the debt ratio at the initial level ($b_T = b_0$) at time T, (14) can be simplified as follows:

$$pd^* = \frac{r-y}{1+y} \cdot \left[1 - \left(\frac{1+r}{1+y} \right)^{-T} \right]^{-1} \cdot \left(-b_0 \right) \left[1 - \left(\frac{1+r}{1+y} \right)^{-T} \right] = -b_0 \frac{r-y}{1+y} \tag{15}$$

It is apparent that from the formal point of view the expression for the primary deficit stabilising the debt ratio at a finite horizon (15) does not differ from the sustainable primary deficit satisfying the intertemporal budget constraint (9). However, the difference rests in what will be substituted for r and y when calculating the primary gap indicator. If one wants to calculate the primary deficit that will stabilise the debt ratio at the initial level within, for example, 3 years, the forecasted values of r and y for the next 3 years will be applied. Nevertheless, such a primary deficit will not automatically ensure that the intertemporal budget constraint is met at the infinite horizon, since the long-run expected values of r and y may vary substantially from their short-run forecasted values.

To derive the sustainable tax ratio for a finite horizon the definition of the primary deficit (11) has to be substituted into (5):

$$b_T \left(\frac{1+r}{1+y} \right)^{-T} = b_0 + \sum_{t=1}^{T} \left(g_t + h_t - \tau_t \right) \left(\frac{1+r}{1+y} \right)^{-t} \tag{16}$$

As in the case of the finite horizon sustainable primary deficit, equation (16) can be solved for τ by summing the finite geometric series of the discounted tax ratios, which yields:

$$\tau^* = \frac{r-y}{1+y} \cdot \left[1 - \left(\frac{1+r}{1+y} \right)^{-T} \right]^{-1} \cdot \left[b_0 - b_T \left(\frac{1+r}{1+y} \right)^{-T} + \sum_{t=1}^{T} \left(g_t + h_t \right) \left(\frac{1+r}{1+y} \right)^{-t} \right] \tag{17}$$

If the debt-to-GDP ratio at time T is required to equal the initial level, (17) becomes:

$$\tau^* = \frac{r-y}{1+y} \cdot \left\{ b_0 + \left[1 - \left(\frac{1+r}{1+y} \right)^{-T} \right]^{-1} \cdot \left[\sum_{t=1}^{T} \left(g_t + h_t \right) \left(\frac{1+r}{1+y} \right)^{-t} \right] \right\} \tag{18}$$

As can be seen from (17) and (18) a projection of future spending is necessary in order to compute the sustainable tax ratio. The formulas for the sustainable tax ratio have often been used in long-term projections to capture the magnitude of adjustment needed to cope with the impact of population ageing on future spending ratios. In such a case, h stands for age related spending and g stands for other non-age related expenses.

In all the finite horizon sustainability indicators, the target value of debt (b_T) and the time horizon (T) have to be determined. The choice of the target value of debt is necessarily arbitrary, which may explain the preference for (15) and (18) over (14) and (17) in empirical research. The gap indicators corresponding to (15) and (18) are easier to interpret, as they express the adjustment needed to prevent the debt ratio from deteriorating and do not require an explicit debt target to be set. As for the choice of T, Blanchard (1990a) proposes to use three indicators of fiscal sustainability. Each of the indicators should be associated with a different time horizon, equal to 1, 3–5 and 30–50 years.

Blanchard justifies the choice of T equal to one year by the fact that such an indicator does not require a forecast as the budget data are widely available. As a result such an indicator can easily be constructed from published data. On the other hand, the one-period gap[8] is very primitive. If the forecast of r and y is used, this indicator should just be equal to the projected change in the debt-to-GDP ratio (neglecting stock-flow adjustment). The one-period gap may give a distorted picture of the amount of adjustment that would reasonably be required. Firstly, the actual primary deficit or tax ratio may be affected by transitory events (a hike in non-interest spending or short-lived spending cuts, one-off revenues) or by cyclical factors. Secondly, it does not take account of predictable changes in spending trends resulting from events such as population ageing. Thirdly, the real interest rate and the growth rate of real GDP may be unrepresentative of their long-run expected average values.

To diminish the influence of transitory and cyclical factors it is appropriate to construct medium-term indicators (T of three to five years). The application of gap indicators may, however, be limited by data availability. But these days, three- to five-year projections are often made by national fiscal authorities or international organisations. As in the case of the one-period gaps, the forecast of y and r may point to a situation in which the growth rate of GDP temporarily exceeds the real interest rate ($r<y$). During such periods, the debt may grow temporarily faster than would otherwise be required to keep the debt ratio at the initial level.

Although the medium-term gaps are more comprehensive than the one-period gaps, they are still not capable of reflecting all the predictable changes in future expenditure trends. The very fact that short- and medium-term indicators do not capture the long-term spending trends calls for construction of long-term indicators. As population ageing will undoubtedly be the most important driver of future spending, it is advisable to compute gap indicators for a very long time horizon of 30 to 50 or even 70 years. Calculation of long-term gaps is fairly ambitious because very long forecasts have to be made and these are necessarily subject to wide margins of uncertainty. Despite all the uncertainties, international organisations (OECD, EU, IMF), most of the national authorities of developed countries and independent researchers publish long-term fiscal projections.

[8] The one-year tax gap equals the one-year primary gap.

Even if sustainability indicators point to a significant fiscal gap, policy-makers tend to be hesitant to adopt corrective measures and are often tempted to postpone adjustment. However, the decision to postpone adjustment is not costless and it is important to know the costs before such a decision is made. The costs of delayed adjustment can be quantified as the difference between the fiscal gaps (e.g. tax gaps) prevailing at two distinct points in time. Delaying adjustment results in a more rapid accumulation of debt, which goes hand in hand with rising debt servicing costs and ultimately leads to lower primary spending (or higher taxes). In fact, the broadening of the fiscal gap indicates the volume of spending that will be foregone in future in exchange for temporarily higher spending. We will derive the costs of delay for an infinite tax gap, which is the most comprehensive and theoretically sound indicator.

Delaying fiscal adjustment by a year is, due to higher debt servicing costs, translated into a higher sustainable tax ratio. On the basis of equation (12) we can write:

$$\tau_1^* = \frac{r-y}{1+y} \cdot \left\{ \sum_{t=2}^{\infty} \left[\left(g_t + h_t\right) \cdot \left(\frac{1+r}{1+y} \right)^{-t+1} \right] + b_1 \right\} \tag{19}$$

Substituting for the debt ratio b_1 the expression from equation (3b) and expressing the primary deficit as the difference between primary spending (g+h) and revenues (τ) yields:

$$\tau_1^* = \frac{r-y}{1+y} \cdot \left\{ \sum_{t=2}^{\infty} \left[\left(g_t + h_t\right) \cdot \left(\frac{1+r}{1+y} \right)^{-t+1} \right] + b_0 \cdot \frac{1+r}{1+y} + \left(g_1 + h_1\right) - \tau_1 \right\} \tag{20}$$

After some manipulation and assuming a constant revenue ratio ($\tau_1 = \tau_0$) we obtain the following relationship between the sustainable tax ratio at time *1* and the sustainable tax ratio at time *0*:

$$\begin{aligned} \tau_1^* &= \frac{r-y}{1+y} \cdot \frac{1+r}{1+y} \cdot \left\{ \sum_{t=1}^{\infty} \left[\left(g_t + h_t\right) \cdot \left(\frac{1+r}{1+y} \right)^{-t} \right] + b_0 - \tau_1 \cdot \left(\frac{1+r}{1+y} \right)^{-1} \right\} \\ &= \frac{1+r}{1+y} \cdot \tau_0^* - \frac{r-y}{1+y} \cdot \tau_0 \end{aligned} \tag{21}$$

If (21) holds, the tax gap at any future point in time can be derived on the basis of the tax gap in the initial period and the interest rate/growth rate differential:

$$tax\_gap_1 = \tau_1^* - \tau_1 = \frac{1+r}{1+y} \cdot tax\_gap_0 \tag{22}$$

$$tax\_gap_{t+n} = \tau_{t+n}^* - \tau_{t+n} = \left(\frac{1+r}{1+y} \right)^n \cdot tax\_gap_t \tag{23}$$

Correspondingly, the change in the tax gap takes the following form:

$$\Delta tax\_gap = \left(\tau_1^* - \tau_1\right) - \left(\tau_0^* - \tau_0\right) = \frac{r-y}{1+y} \cdot tax\_gap_0 \tag{24}$$

Sustainability Indicators in Practice

Blanchard (1990b) was one of the first authors to systematically investigate the sustainability of public finances with the assistance of quantitative indicators. He computed indicators for 18 OECD countries and reported values of short-term, medium-term and long-term tax gaps. Since this paper is predominantly focused on long-term sustainability, it is important to note that the projection of age-related spending was rather simplistic. It comprised pension spending and health care spending, and the evolution of pension spending was projected on the basis of changes in the demographic dependency ratio only.

The first comprehensive report analysing the long-term sustainability of public finances from the international perspective was prepared and published by OECD in 2001. It covers most of the spending items deemed dependent on the age structure of the population, e.g. pensions, health care, long-term care, child-related programmes and education. The results are based on national models using an agreed upon set of assumptions about macroeconomic and demographic developments. Long-term sustainability is evaluated on the basis of the evolution of the primary balance and debt throughout the projection horizon (OECD, 2001) and by calculating the "primary balance needed to offset the impact of ageing" (Dang, 2001). The latter is in fact the primary balance in the given initial year, observance of which would ensure achieving a predetermined debt ratio[9] at the end of the year 2050. It essentially corresponds, after subtracting the initial primary balance, to the tax gap indicator obtained from equation (17). The OECD work became an inspiration for the sustainability analysis that is now carried out by the European Commission.

At present the European Commission (EC) undoubtedly seems to be the most active player in the field of analysing and evaluating the long-term fiscal sustainability of its member states. It systematically develops, calculates and applies indicators for assessment of public finance sustainability. The sustainability indicators make use of the information from long-term budgetary projections calculated on the basis of commonly agreed coverage, methodology and underlying assumptions. EC (2001, 2003) supplemented its projections of the fiscal implications of ageing populations with long-term gap indicators denoted *T1*, *T2* and *T3*, later replaced by the acronyms *S1*, *S2* and *S3*.

S3 has the strongest theoretical foundation, since it is fully compatible with the intertemporal budget constraint and the sustainable tax ratio (equation 12). It is an infinite horizon tax gap calculated on the basis of projected fiscal trends up to 2050 and extended beyond 2050 under the assumption of preserving the tax and spending ratios[10] at the levels achieved in 2050. *S1* and *S2* are the finite horizon tax gaps gauging the magnitude of adjustment needed to reach the pre-defined debt level in 2050, given the projections up to 2050. *S2* assumes that the 2050 debt ratio will amount to 40% of GDP. The arbitrariness of this debt target, which is used for countries with very different starting positions, has led the EC to abandon this indicator. Construction of the *S1* indicator was motivated by the provisions of the pre-reform Stability and Growth Pact (SGP), which required the member states to achieve balanced budgets in the medium term. Under a

[9] Two debt targets approximating sustainable fiscal policies were set: (i) the debt ratio reaching its initial level by 2050 and (ii) the debt ratio declining to zero by 2050.

[10] This is the only way of coping with the infinite horizon, because assuming constant ratios with respect to GDP makes it possible to sum up the infinite geometric series.

balanced budget the nominal value of debt does not change ($B_T = B_0$) and the target value of debt can be expressed as follows:

$$b_T = \frac{B_T}{Y_T} = \frac{B_0}{Y_0} \cdot \frac{1}{(1+y)^T} = b_0 (1+y)^{-T} \tag{25}$$

The SGP reform triggered changes in the assessment of public finance sustainability. The currently used quantitative indicators comprise *S1*, *S2* and *RPB*. The former *S2* indicator has been renamed *S1* and its definition has changed. *S1* currently measures the required change in the tax ratio that guarantees a debt-to-GDP ratio of 60% in 2050. The redefinition of *S1* reflects the intention to have an indicator consistent with the Maastricht targets. The current *S2* indicator is the old *S3* based on observance of the government intertemporal budget constraint. To make the indicators more understandable for policy-makers, the EC will calculate and publish the Required Primary Balance (*RPB*). The *RPB* should facilitate transformation of the quantitative indicators into policy prescriptions, since it indicates the required structural primary balance (in terms of GDP) over the five-year horizon respecting the intertemporal budget constraint. It is obtained by subtracting the *S2* indicator from the current primary deficit. Policy-makers can use the *RPB* directly as a fiscal target in their medium-term fiscal frameworks.

The assessment of public finance sustainability carried out by the EC does not rest on quantitative indicators only. The EC is well aware of the fact that the information given by the quantitative indicators is conditional upon the results of uncertain long-term projections. The uncertainty is partially circumvented by qualitative judgement. When pursuing sustainability analysis, the EC takes into account information on the current level of the debt ratio, the current level of the tax burden, the impact of structural reforms and the reliability of the projections. Sustainability analysis is not a mere exercise. It results in concrete recommendations and guidelines for the member states.

Assessment of fiscal (together with external) sustainability is an important part of the IMF's analysis carried out in the context of Article IV surveillance and Fund-supported programmes (IMF, 2002). The IMF is preoccupied with medium-term projections, usually not exceeding 5–10 years. Due to the timeframe covered, the sustainability assessments abstract from the impact of the evolution of age-related spending on sustainability. They consist in projecting revenues, expenditures and the resulting evolution of the fiscal balance and debt under alternative macroeconomic assumptions. Apart from baseline projections, several stress tests are usually performed in order to evaluate the resilience of the fiscal position to adverse shocks. The debt-stabilising primary surplus is often calculated and compared with the existing primary balance to show whether the current fiscal policy is, in the medium term, consistent with a stable debt ratio. The application of the IMF's framework to the Czech Republic was described in detail in Bulíř (2004).

3. Assessing the Sustainability of Czech Fiscal Policy

In this section we compute sustainability indicators for the Czech Republic. We start with short-term and medium-term indicators and conclude with long-term indicators taking account of the future spending pressures resulting from the changing population structure. Since forecasts are needed to assess the sustainability of current fiscal policy, it may be important to shed some light on what current policy actually refers to.

Box 1: Net Debt or Gross Debt Figures?

Economic theory is unambiguous as to whether net debt or gross debt should be looked at when assessing public finance sustainability. Since government assets can be used to finance future deficits and pay back principal and interest on outstanding debt, proper account should be taken of all assets held by the government. From the viewpoint of economic theory, net debt (or rather net worth) is the proper concept for sustainability assessments.

However, in practice important questions arise: should all government assets be taken into account in calculation of net debt, and if there are reasons for not including some assets, where should the dividing line be drawn through the spectrum of assets? Broadly speaking, government assets consist of financial assets (such as deposits, shares and equities) and non-financial assets (such as roads, buildings etc.). Liquid and marketable financial assets are easy to value and can be used for repaying debt without any major obstacles. Nevertheless, liquid and negotiable financial assets may account for only a fraction of financial assets. Non-negotiable financial assets (equities) and non-financial assets (such as roads) are difficult to value. On top of that, it may be questionable to what extent some of these assets can be used to redeem outstanding debt (without generating a future rise in debt). For instance, buildings and roads owned by the government could be sold, but expenditures would immediately rise, since the government would have to lease the buildings back to house government employees and it would have to pay for the use of roads, should the level of public services be kept unchanged. Non-financial assets account for the prevailing part of government assets, and government net worth (total assets minus total liabilities) may reach a high value (Figure 1) and bias the sustainability indicators. As a result the precise content of net debt can differ considerably across studies.

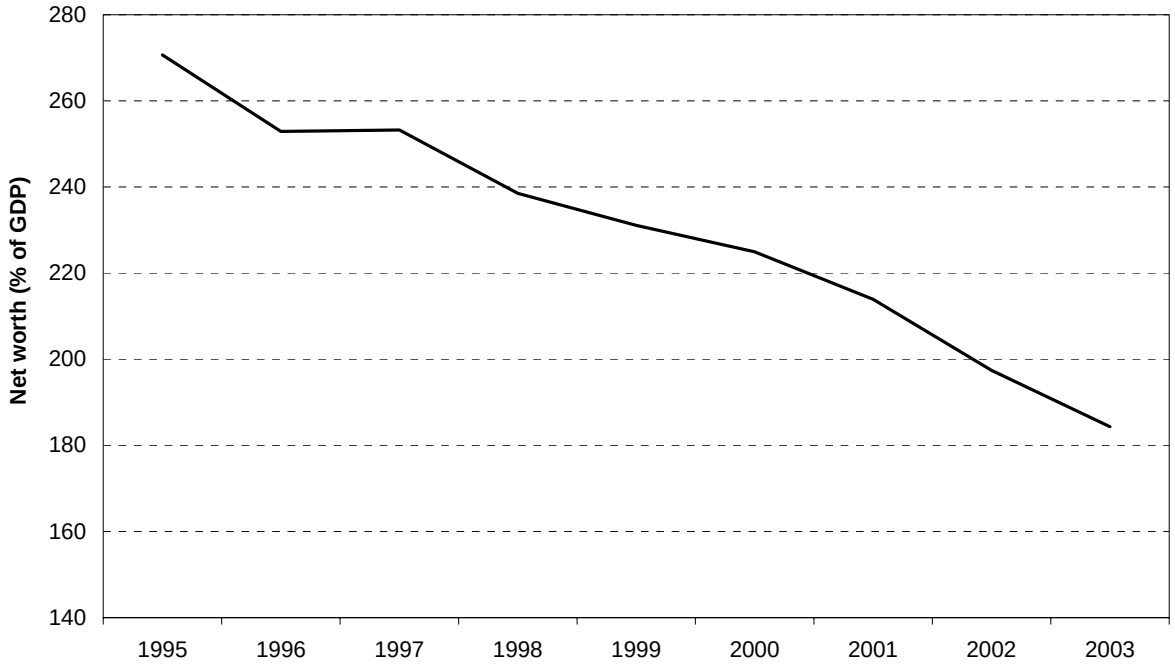
The concept used in some empirical studies (especially by the European Commission) is consolidated general government gross debt. Assets are taken into account insofar as a government unit holds assets in the form of debt of another government unit. These debts are consolidated, i.e. reduce the sum of outstanding debts of all government units. Other financial and non-financial assets are disregarded and do not contribute to reduction of the recorded level of debt. To avoid measurement problems and subjective judgement about which assets to include, we adopted the same approach.

The short-term and medium-term indicators are based on the official forecasts of the Ministry of Finance, which incorporate all the legislated changes on both the revenue and expenditure sides. The long-term indicators also use official projections, but in this regard it may be more appropriate to use the term prevailing policy. Making long-term projections requires adopting assumptions, and these assumptions do not always accord with the current legal prescriptions but anticipate future

changes in key parameters, as it is advisable to assume that some ratios will be preserved (e.g. per capita spending profiles, ratio of minimum subsistence level to average wage, replacement ratios for social benefits etc.). Such assumptions are warranted by the fact that policy-makers in real life are made to adjust benefit levels in accordance with economic developments in order to keep the relative living standards of various social groups broadly in line.

The primary source of data is the Convergence Programme of the Czech Republic (December 2005). It contains a medium-term fiscal framework comprising forecasts of revenues, expenditure and the deficit from 2004 to 2008. It also reports long-term fiscal projections up to 2050. The projections were complemented by the most up-to-date macroeconomic and fiscal forecast published by the Ministry of Finance (Macroeconomic Forecast, April 2006 and spring deficit and debt notification). All the reported data are in the ESA 95 statistical standard. The debt figures correspond to consolidated gross debt (Box 1).

Figure 1: Net worth (per cent of GDP)



Source: Czech Statistical Office, National Accounts 1995–2003.

Short-Term and Medium-Term Sustainability Indicators

The Czech Republic is an excessive deficit country. In 2003 it reported a deficit of 6.7% of GDP (a primary deficit of 5.5% of GDP) and gross debt of 30.3% of GDP.[11] In 2004 a consolidation package was implemented and the deficit shrank to 2.9% of GDP. However, the deficits are still too high to ensure a non-increasing debt ratio.

The question then arises of what adjustment to current policy would be needed in order to prevent the government debt from rising. To answer this question we calculate the sustainable tax ratio

[11] At the end of 2005, the Czech Statistical Office decided, on the basis of a Eurostat recommendation, to exclude a special guarantee issued in relation to the IPB rescue operation from the 2003 deficit and debt.

according to equation 17 for the periods of one year and three years. Abstracting from stock-flow adjustment[12] the one-period tax gap is equal to 1.3% of GDP in 2006, under the given interest rate and growth forecast (Table 1). This means that the government would have to reduce spending or raise taxes by 1.3% of GDP, should the debt ratio remain constant. The one-period tax gap should, by definition, equal the increase in the debt ratio. However, the official forecast of the Ministry of Finance reports a rise in the debt ratio of 0.3 percentage points only (Table 1). This does not mean that any of the figures is flawed. The difference is attributable to large asset sales (privatisation revenues) used for financing the deficit in 2005 and 2006.

Table 1: Main Fiscal and Macroeconomic Variables

	2003	**2004**	**2005**	**2006**	**2007**	**2008**
			fiscal variables			
t	41,1	41,7	41,5	40,3	39,8	40,9
g+h	46,6	43,4	42,9	42,7	41,8	42,1
pd	5,5	1,7	1,4	2,4	2,0	1,2
d	30,3	30,6	30,5	30,8	31,6	31,5
			macroeconomic vaiables			
y	3,2	4,7	6,0	5,6	5,0	4,8
r	3,1	1,9	1,3	1,6	1,4	1,3

Source: Convergence Programme of the Czech Republic, Ministry of Finance, December 2005; Macroeconomic Forecast, April 2006 and spring deficit and debt notification.

Note: *r* stands for the real interest rate computed from the yield to maturity on 10-year state bonds (5-year bonds up to 2000) adjusted for CPI inflation. The 2005–2008 values are forecasts.

The medium-term tax gap (3 years) amounts to 0.9% of GDP in 2006. A fiscal adjustment of 0.9% of GDP would be necessary to achieve the debt level from the initial period (2005) at the end of year 2008. The medium-term gap was obtained as the difference between the revenue-to-GDP ratio observed in 2006 and the sustainable revenue ratio. Given the medium-term fiscal and macroeconomic forecast (Table 1) the sustainable revenue ratio stands at 41.1% of GDP in 2006. Table 2 reports the evolution of the primary deficit and debt providing that the tax ratio is increased to the sustainable level. It is apparent from the results that the debt ratio rises in 2006 but subsequently falls to the initial level observed in 2005. The primary deficit is substantially reduced and hovers around 1.0% of GDP at the end of the projection horizon.

Table 2: Evolution of Primary Deficit and Debt under Sustainable Tax Ratio

	2005	**2006**	**2007**	**2008**
t*	41,5	41,1	41,1	41,1
g+h	42,9	42,7	41,8	42,1
pd*	1,4	1,6	0,7	1,0
d*	30,5	30,9	30,5	30,5

Source: Authors' calculations.

The three-year tax gap is lower than the one-period gap. The difference is as large as 0.4% of GDP. It can be explained by the fact that the one-period gap completely ignores the developments beyond

[12] In all the calculations we assume that the so-called stock-flow adjustment is zero. We abstract from changes in the debt level stemming from exchange rate fluctuations (exposure to exchange rate risk is negligible in the Czech Republic), debt assumption etc.

2006. Since the government intends to gradually reduce the deficit below the Maastricht level by 2008, the three-year tax gap is lower by the adjustment planned for the years 2007–2008.

The above reported calculations take the forecast for the interest rate and GDP growth rate as given. The forecast for economic growth and the real interest rate is conducive to stabilising the debt ratio, since the rate of economic growth exceeds the real interest rate by a large margin. This points to dynamic inefficiency, which is not likely to persist in the future. Moreover, any forecast is subject to wide margins of uncertainty. Putting these two arguments together leads us to investigate how sensitive the results are with respect to alternative assumptions. If the real interest rate and economic growth were set at their historical values[13] of 2.7% and 2.5% respectively (recorded over the period of 1996–2004), the one-period and three-year gaps would be some 1.1–1.2 percentage points larger, amounting to 2.5% of GDP for the one-period gap and 2.0% of GDP for the three-year gap. Thus, keeping the debt at its initial level would require substantially larger government intervention, be it through tax increases or spending cuts. An increase in the interest-growth differential of one percentage point adds some 0.3 percentage points to the required fiscal adjustment.

Table 3: One-Period and Three-Year Tax Gap under Alternative Interest-Growth Differentials

r / y	**MoF**	**2,7 / 2,5**	**4,0 / 3,0**	**5,0 / 3,0**	**6,0 / 3,0**
TG - 1Y	1,3	2,5	2,7	3,0	3,3
TG - 3Y	0,9	2,0	2,2	2,5	2,8

Source: Authors' calculations.
Note: MoF stands for the Ministry of Finance forecast (as reported in the Convergence Programme and Macroeconomic Forecast).

Long-Term Sustainability Indicators

We begin to investigate the long-term indicators by focusing on the primary gap indicator. Computation of the primary gap indicator (equation 10) does not require a long-term projection of budgetary spending. It only necessitates adopting assumptions about the long-term values of the real interest rate and economic growth.

Projections of economic growth usually assume labour productivity convergence towards the average historical values of a technological leader (in most cases the United States or some developed European country). Most studies by international organisations (OECD, 2001; EC, 2001) take the value of 1.75% as representing long-run equilibrium labour productivity growth. This leads, under a stationary population and a constant population structure, to long-run real GDP growth of 1.75%. The labour productivity growth in the Czech Republic is likely to be temporarily higher due to the real convergence process. This is reflected in the long-run macroeconomic scenario of the European Commission, upon which the Ministry of Finance based its long-term budgetary projections and which assumes average real GDP growth of 2.0% over 2005–2050

[13] Historical values do not always provide the best clue for making assumptions about future developments. The average growth rate observed over the past 10 years is substantially lower than the growth rate projected for the next three years. However, the growth rate itself is less important, since what matters for the sustainability analysis is the interest rate/growth rate differential. The sensitivity analysis indicates what might happen if the differential got closer to the historical average of 0.2.

(Table 4), and the baseline projection of the Expert Team for Pension Reform[14], in which the real GDP growth rate is 2.1% on average between 2005 and 2050. However, the OECD baseline scenario (OECD, 2001) shows a modest real GDP growth rate of 1.7% in the corresponding period, due to a less favourable employment projection.

Table 4: Long-Term Macroeconomic Assumptions (average growth rates over given period)

	2000-2005	2005-2010	2010-2015	2015-2020	2020-2025	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050	2005-2050
Real GDP	3,6	3,8	3,3	2,6	2,4	2,1	1,3	0,6	0,6	0,8	2,0
Employment	0,2	0,6	0,0	-0,6	-0,5	-0,7	-0,9	-1,3	-1,3	-1,0	-0,6
Labour productivity	3,3	3,1	3,3	3,1	2,9	2,8	2,3	1,9	1,8	1,7	2,6

Source: Convergence Programme 2005, Ministry of Finance.

Since we are looking at sustainability over an infinite horizon, we can for the time being abstract from the temporary dynamics and assume a long-term real GDP growth rate of 1.75%.

The choice of the real interest rate (r) is somewhat more arbitrary. The assumption regarding the real interest rate is usually derived from past observations as the average interest rate on long-term government bonds over the last several decades. In its projections, OECD (2001) used a real interest rate of 4%. This assumption was adopted by EC (2001). However, in its latest projection round EC (2005) lowered the interest rate assumption to 3% on the grounds of an observed decline in interest rates in the last decade. An interest rate of 3% will be considered the baseline assumption in our analysis. However, we will not use a single assumption on the interest rate, but instead the sensitivity of the primary gap with respect to the interest rate will be examined.

Figures 2 and 3 plot the sustainable primary balance for various combinations of real GDP growth and the real interest rate and also for different debt levels. Under the debt level of 30.8% of GDP reported at the end of 2005 the sustainable primary balance stands at 0.4% of GDP, assuming a real interest rate of 3% and real GDP growth of 1.75%. The primary gap then equals 2.8% of GDP. To make public finances sustainable the government would have to target a primary surplus of 0.4% of GDP, which would be achieved by reducing spending or increasing taxes by 2.8% of GDP. If we assume a more optimistic interest rate of 2%, the sustainable primary balance declines to 0.1% of GDP and the primary gap is reduced by 0.4 percentage points. It can be seen from Figure 2 that an increase in the interest rate of 1 percentage point raises the primary gap by approximately 0.3% of GDP. On the basis of Figure 2 we can also derive the sustainable primary balance (and corresponding primary gap) for any relevant growth rate assumptions simply by moving along the curve drawn for the given debt level and real interest rate.

[14] The macroeconomic scenario used by the Expert Team to project pension spending can be found at: http://www.reformaduchodu.cz/prilohy/makro/makro_vt.xls.

Figure 2: Sustainable Pimary Balance for Various Combinations of r and y

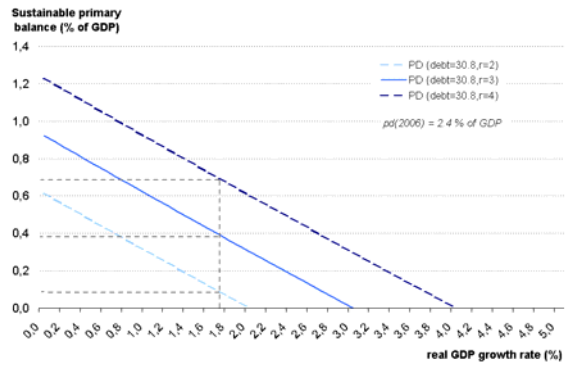
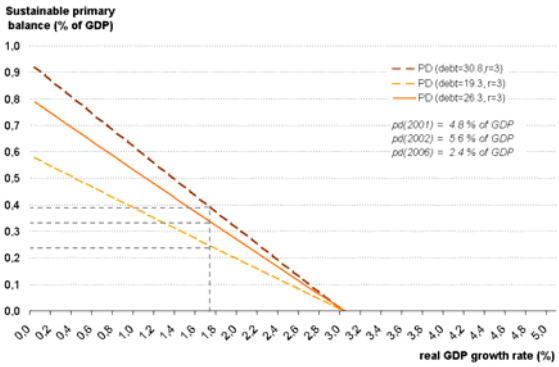


Figure 3: Sustainable Primary Balance for Different Debt Levels (b)



Delaying fiscal consolidation is costly, since the debt ratio rises and the primary gap widens, as illustrated by Figure 3. It shows the sustainable primary balance for debt levels of 19.3, 26.3 and 30.8% of GDP (reported at the end of 2000, 2001 and 2005 respectively). An increase in debt level results in a more demanding fiscal target as expressed by the sustainable primary balance. Again it is possible to determine the sustainable primary balance for different debt levels and growth rates from the lines drawn in Figure 3.

Table 5 summarises the sustainable primary balance for different combinations of debt level, growth rate and the interest rate. It complements the information that can be read from the previous figures. If the debt ratio increased by 10 percentage points, the government would have to permanently reduce spending by 0.1–0.3% of GDP to make public finances sustainable. The cost of delaying fiscal consolidation depends on the growth adjusted interest rate. Under our baseline assumptions (an interest rate of 3% and a growth rate of 1.75%) a 10 percentage point increase in the debt ratio leads to an additional fiscal effort of 0.1% of GDP.

Table 5: Sustainable Primary Balance for Various Combinations of r, y and d

	d = 20.0			d = 30.0			d = 40.0		
r / y	1,25	1,75	2,25	1,25	1,75	2,25	1,25	1,75	2,25
2	0,1	0,0	0,0	0,2	0,1	-0,1	0,3	0,1	-0,1
3	0,3	0,2	0,1	0,5	0,4	0,2	0,7	0,5	0,3
4	0,5	0,4	0,3	0,8	0,7	0,5	1,1	0,9	0,7
5	0,7	0,6	0,5	1,1	1,0	0,8	1,5	1,3	1,1

Source: Authors' calculations.

In the above calculations we have assumed a constant real GDP growth rate. It is apparent from Table 4 that economic growth is likely to change over time and may deviate significantly from the assumed long-run equilibrium value of 1.75%. To account for changes in the real GDP growth rate we relax the assumption of constant *y* and calculate the sustainable primary balance and resulting primary gap for an infinite horizon and a finite period (up to 2050). We carry out these calculations in order to arrive at a primary gap indicator that is comparable with the tax gap indicators that will be examined in subsequent paragraphs.

Table 6: Sustainable Primary Balance and Primary Gap (per cent of GDP)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Projected primary balance	-2,4	-2,0	-1,2	-1,1	-1,0	-0,9	-0,8	-0,6	-0,6	-0,6
Sustainable primary balance										
Infinite horizon	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,5	0,5	0,5
Finite horizon ($d_T = 60\%$)	-0,2	-0,2	-0,1	-0,1	-0,1	0,0	0,0	0,0	0,0	0,0
Finite horizon ($d_T = d_0$)	0,3	0,3	0,3	0,3	0,4	0,4	0,4	0,4	0,5	0,5
Primary gap										
Infinite horizon	2,8	2,3	1,6	1,5	1,4	1,3	1,2	1,1	1,1	1,0
Finite horizon ($d_T = 60\%$)	2,3	1,8	1,1	1,0	0,9	0,9	0,7	0,6	0,6	0,6
Finite horizon ($d_T = d_0$)	2,7	2,3	1,6	1,5	1,4	1,3	1,2	1,1	1,1	1,1

Source: Projected primary balance taken from Convergence Programme (2005); authors' calculations.

Assuming a time varying growth adjusted interest rate requires the formulae for calculation of the sustainable primary balance to be adapted slightly[15] along the lines indicated in footnote 6. Table 6 shows the results for the period 2006–2015. It conveys that the government should be targeting a primary balance of approximately 0.4% of GDP from 2006 onwards to ensure observance of the intertemporal budget constraint. Delaying the adjustment is translated into a stricter fiscal target (a rise in the sustainable primary balance of 0.1 percentage points by 2015) due to an increase in the debt ratio and higher debt servicing costs. Similar results are obtained in the case of the finite horizon sustainable primary balance guaranteeing that the debt ratio amounts to its initial level at the end of 2050. If the debt ratio is to reach 60% of GDP at the end of 2050, the primary balance has to be stabilised at -0.2% of GDP from 2006 onwards. Under these circumstances the fiscal target is the least strict, since it allows the debt ratio to rise from its initial level of 30% of GDP by an additional 30 percentage points to 60% of GDP.

Under all three measures, the primary gap declines from less than 3.0% of GDP in 2006 to around 1.0% of GDP in 2015. This is a result of the declining projected primary balance ensuing from fiscal consolidation plans that reduce the primary deficit from 2.4% in 2005 to 1.2% of GDP in 2008 and from the projected decrease in age-related spending in the medium term. It may seem that the fiscal imbalance is limited and disappearing over time. However, it should be kept in mind that the sustainable primary balance is a target, observance of which is not ensured under current policies. It does not provide a full measure of the adjustment needed, since the future increase in spending is not taken into account. Achieving a sustainable primary balance presupposes a policy action (spending cuts/tax increases) once the surge in age-related expenditures emerges. This additional fiscal correction stemming from the future rise in spending is not reflected in the primary gap indicator.

The tax gap, unlike the primary gap, intrinsically takes account of the future evolution of public spending. It follows that the computation of the long-term tax gaps rests on the availability of long-term fiscal projections. Public spending has to be projected over a long-term horizon covering several decades. The most important driver of public spending in the long run is demographic development. Non-demographic factors (e.g. the evolution of relative prices, efficiency gains in the provision of public spending, the income elasticity of demand for public goods, etc.) may also play

[15] Adapting the formulae does not make it possible to isolate the sustainable primary balance on the left-hand side of equation 8 and the solution has to be found by iteration algorithm (we used the solver option in the Excel application). The same applies to the sustainable tax gap under the time varying interest rate/growth rate differential evaluated in the next paragraphs.

a significant role. However, their role is usually suppressed, since the direction and magnitude of their impact are highly uncertain. The methodology of long-term budgetary projections is beyond the scope of this paper. It has been described elsewhere (EC, 2005; Krejdl, 2003; Krejdl and Štork, 2005).

We employ the long-term budgetary projections carried out by the Ministry of Finance (Convergence Programme 2005) on the basis of the macroeconomic assumptions shown in Table 4. It is the most up-to-date, comprehensive and currently one of the few available long-term projections analysing the impact of ageing on Czech public finances.[16] It covers most age-related spending (pensions, health care, long-term care, education and child/family benefits) and extends over 45 years.

Table 7: Long-Term Budgetary Projection (per cent of GDP)

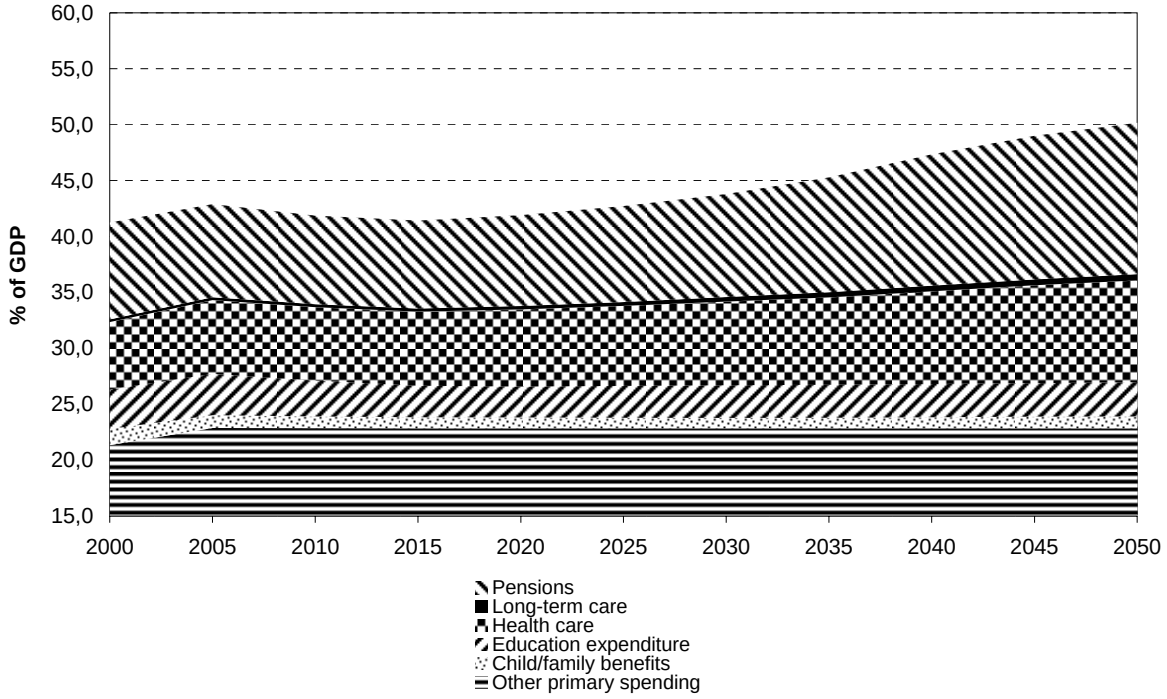
	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050	Change 2005-2050 (p.p.)	Change 2005-2050 (%)
Old age pension expenditure													
Old-age and early pensions (55+)	7,7	7,5	7,2	7,1	7,4	7,8	8,4	9,5	11,0	12,1	12,8	5,3	70,2
Other pensions (54-)	1,0	0,8	0,7	0,7	0,8	0,8	0,8	0,8	0,8	0,8	0,7	-0,1	-8,5
Pensions	8,7	8,3	7,9	7,9	8,1	8,6	9,2	10,3	11,8	12,9	13,5	5,2	62,5
Other age-related expenditure													
Health care	6,0	6,6	6,5	6,6	6,9	7,1	7,5	7,8	8,3	8,7	9,1	2,5	37,9
Long-term care	0,2	0,3	0,3	0,3	0,3	0,3	0,4	0,5	0,5	0,5	0,6	0,3	118,1
Education expenditure	3,5	3,7	3,2	2,8	2,8	2,8	2,9	3,0	3,0	3,0	3,1	-0,6	-16,9
Child/family benefits	1,4	1,1	1,0	1,0	1,0	0,9	0,9	0,9	1,0	1,0	1,1	-0,1	-6,5
Other age-related tranfers	11,2	11,7	11,1	10,7	10,9	11,3	11,7	12,2	12,8	13,3	13,8	2,1	18,0
Primary expenditure													
Age-related expenditure	19,9	20,0	19,0	18,6	19,1	19,9	21,0	22,4	24,5	26,2	27,3	7,3	36,5
Other primary spending	21,3	22,9	22,9	22,8	22,8	22,8	22,8	22,8	22,8	22,8	22,8	0,0	-0,2
Total primary expenditure	41,3	42,9	41,9	41,4	41,9	42,7	43,8	45,3	47,4	49,0	50,2	7,3	17,0
Revenues													
Total revenue	38,5	41,5	40,9	40,9	40,9	40,9	40,9	40,9	40,9	40,9	40,9	-0,6	-1,4
Primary balance	-2,8	-1,4	-1,0	-0,6	-1,1	-1,9	-2,9	-4,4	-6,5	-8,2	-9,3	-7,9	543,4
Interest payments	0,9	1,2	1,0	1,1	1,2	1,4	1,8	2,5	3,7	5,3	7,2	6,0	515,9
Net lending/borrowing	-3,7	-2,6	-2,0	-1,6	-2,3	-3,3	-4,8	-7,0	-10,2	-13,4	-16,5	-13,9	531,1
Debt	19,3	30,8	34,4	37,4	42,2	51,2	66,2	91,3	132,4	188,8	257,0	226,2	735,7

Source: Convergence Programme 2005, Ministry of Finance.

The exposure of Czech public finances to population ageing is summarised in Figure 4 and Table 7. They show that primary expenditure will, under the prevailing policies, increase by 7.3 percentage points of GDP, or by 17.0%. The increase in public spending is driven by pension and health care spending, which will deepen the primary deficit by as much as 7.7 percentage points. However, the largest increase in relative terms is reported in the area of long-term care, which will more than double over the next 45 years. The decline in spending on education and child/family benefits will offset the hike in pension and health care spending to a very limited extent only. Due to an assumed fall of the revenue ratio over the medium term (up to 2008) the primary balance is projected to deteriorate by 7.9 percentage points.

[16] At the beginning of 2006 the European Commission finalised its age-related public expenditure projections for all EU-25 member states, including the Czech Republic. The coverage of the projections is similar to that published in the Convergence Programme of the Czech Republic. Due to a similar methodology and the same data inputs and assumptions, the differences between the national and EC projections are really marginal (a rise in age-related spending of 7.2 percentage points in the EC projection compared to 7.3 in the national projection). IMF (2005) also carried out a long-term fiscal projection as part of the Article IV mission, but the projection methodology and assumptions employed are different.

Figure 4: Long-Term Budgetary Projection of Public Spending



Source: Convergence Programme 2005, Ministry of Finance.

It is obvious from the long-term projection of the primary balance and public debt (Table 7) that the current level of taxation is clearly not sufficient to finance public spending under the prevailing policies. The question then arises how much the government would have to raise taxes and/or curtail spending to preserve solvency in the long run. Table 8 reports sustainable revenue ratios and corresponding gaps under three situations: (i) consistent with the intertemporal budget constraint (based on equation 12), (ii) ensuring that the debt ratio equals 60% of GDP at the end of the year 2050 (equation 17) and (iii) ensuring that the debt ratio at the end of the year 2050 is the same as the initial debt ratio (equation 18). All three indicators reveal a substantial fiscal imbalance in 2006, ranging from 3.6% of GDP in the case of a finite horizon tax gap with a target debt level of 60% of GDP to 7.3% of GDP in the case of an infinite horizon tax gap. The finite horizon tax gaps are substantially smaller, since they disregard the fiscal situation beyond 2050 and in this way understate the adjustment needed. On the contrary, the computation of the infinite horizon tax gap rests on the assumption that spending beyond 2050 will remain constant at the high level achieved in 2050.[17] The long-run deficit deterioration of 7.9 percentage points has to be financed by a tax hike or spending retrenchment of 7.3% of GDP in 2006.

Sustainable tax ratios and tax gaps were calculated for the individual years from 2006 to 2015 so as to show the costs of delaying fiscal adjustment. In the given period the sustainable tax ratio rises by 0.6 percentage points, which is transformed, due to the projected rise in the revenue ratio, into a widening of the tax gap by around 0.3 percentage points only. The earlier the fiscal correction is

[17] This assumption (together with the assumption of constant y and r beyond 2050) makes it possible to calculate the present value of spending beyond 2050 (in mathematical terms to sum up the infinite geometric series). The assumption of keeping the spending ratio constant at the 2050 level seems to be prudent, since the demographic dependency ratio as the main driver of public spending is gradually converging towards its steady state level at the end of the projection horizon.

embarked on, the lower are the permanent tax hikes and/or spending cuts required. It has been demonstrated (equation 23) that the costs of delayed adjustment depend on the long-term interest/growth rate differential, which can, under the variable growth rate embedded in the projection, be approximated by a factor of 1.013. This means that postponing the fiscal correction by a year raises the infinite horizon tax gap by around 1.3% (or 0.1 percentage points).

Table 8: Sustainable Tax Ratio and Tax Gap (per cent of GDP)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Projected revenue ratio	40,3	39,8	40,9	40,9	40,9	40,9	40,9	40,9	40,9	40,9
Sustainable tax ratio										
Infinite horizon	47,6	47,7	47,8	47,9	48,0	48,1	48,2	48,3	48,4	48,5
Finite horizon ($d_T = 60\%$)	43,9	43,9	44,0	44,1	44,2	44,3	44,4	44,5	44,6	44,7
Finite horizon ($d_T = d_0$)	44,3	44,4	44,5	44,5	44,6	44,7	44,8	44,9	45,1	45,2
Tax gap										
Infinite horizon	7,3	7,9	6,9	7,0	7,1	7,2	7,3	7,4	7,5	7,6
Finite horizon ($d_T = 60\%$)	3,6	4,1	3,2	3,2	3,3	3,4	3,5	3,6	3,7	3,9
Finite horizon ($d_T = d_0$)	4,0	4,6	3,6	3,7	3,8	3,9	4,0	4,1	4,2	4,3

Source: Authors' calculations.

It is interesting to compare the two indicators of long-term sustainability – the tax gap and the primary gap. There are two striking differences between the two indicators. Firstly, the tax gap is substantially larger than the primary gap, pointing to more demanding fiscal adjustment. Secondly, while the tax gap is rising throughout the given period, the primary gap is falling (compare Tables 6 and 8). However, these differences should not be surprising, since they simply reflect differences in the construction of the indicators. The primary gap gauges the difference between the actual/projected primary balance and the sustainable primary balance. It does not indicate the adjustment needed, but only measures the distance from the fiscal target ensuring long-term sustainability. If spending rises (e.g. due to an ageing population), observance of the sustainable primary balance will necessitate a policy action – either spending cuts or tax increases. If the government is reducing the primary deficit, which is the case in the Czech Republic, the distance from the fiscal target is shortening and the primary gap automatically tapers off. To put it differently, a zero primary gap does not mean that no fiscal adjustment will ever be needed. It only indicates that at a given point in time the primary balance happens to coincide with the sustainable primary balance and if it is kept at that particular level no sustainability problems will arise. This stands in stark contrast with the tax gap indicator. If the tax gap equals zero, no more fiscal correction will be needed and sustaining the given revenue ratio constitutes sustainable public finances.

The tax gap for the infinite horizon amounts to 6.9% of GDP in 2008. If the government raised the tax ratio by 6.9 percentage points in 2008, the intertemporal budget constraint would be satisfied and no more policy action would be required to stabilise the debt ratio in the future. The adjustment is very large, since the rise in taxes (or cut in spending) has to pre-fund the future rise in spending, projected to reach 7.3 percentage points. The finite horizon tax gaps are substantially smaller, since only the deficits resulting from the rise in spending up to 2050 have to be pre-funded and no account is taken of the deficits beyond 2050. The primary gap for the infinite horizon is estimated at 1.6% of GDP in 2008, i.e. some 5.3 percentage points lower than the corresponding tax gap. It states that the government would have to make an adjustment of 1.6% of GDP in 2008 in order to achieve the sustainable primary balance. However, this figure does not represent the total adjustment needed, since the government will have to offset future increases in age-related

spending by tax increases or spending containments so that the primary balance is in line with the sustainable primary balance, estimated at 0.4% of GDP. In the case of the primary gap there is no pre-funding of future spending pressures and therefore the gap is much smaller.

It may be of some interest to compare our results with those found by IMF (2005). The IMF estimates the infinite horizon tax gap[18] at 11.6% of GDP in 2005 under its baseline scenario, and the finite horizon tax gap with a debt target of 60% in 2050 amounts to 6.1% of GDP. Thus, the magnitude of the fiscal imbalance is found to be more than 4 percentage points higher for the infinite horizon tax gap and more than 2 percentage points higher for the finite horizon gap. The discrepancy results from the different projection methodology applied[19], different population projection and macroeconomic assumptions and last but not least from a different base year for which the tax gap is calculated. Despite the discrepancies in magnitude the message conveyed by the sustainability indicators remains the same: Czech public finances will have to undergo a substantial consolidation so as to prevent excessive debt accumulation.

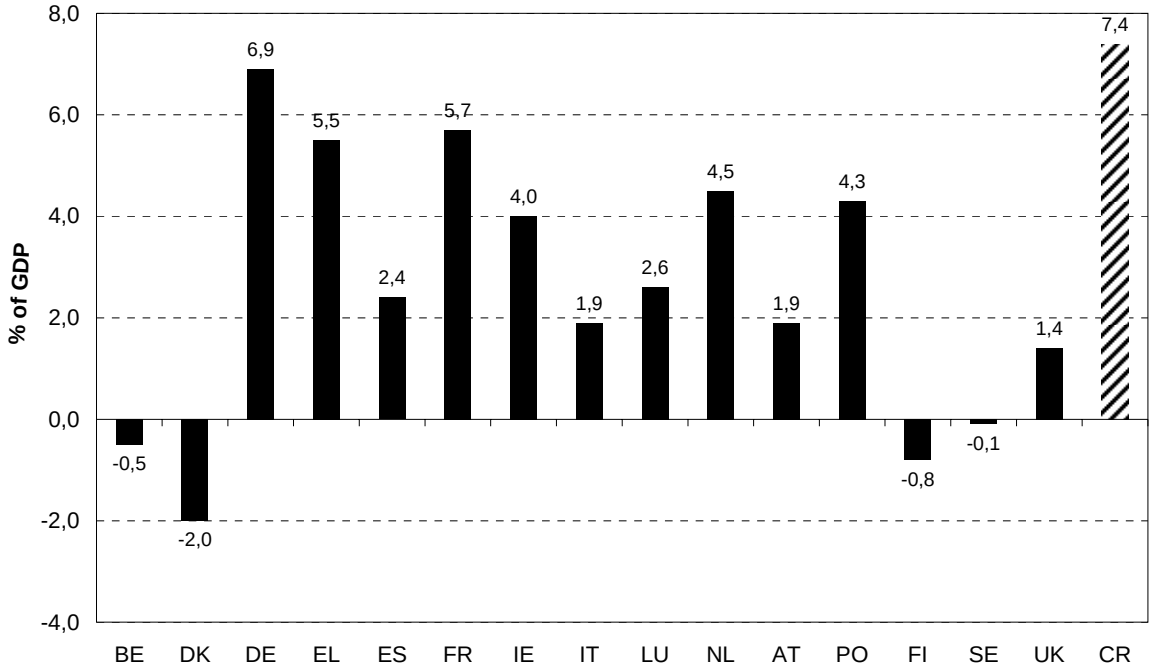
The existing fiscal gap, as measured by the infinite horizon tax gap, is high even from an international perspective. If we compare the results obtained for the Czech Republic with the tax gaps in some EU countries reported in an earlier study by EC (2003), we find that Czech public finances face a considerable challenge. The fiscal imbalance is the largest in comparison with the old EU-15 countries.[20] To prevent excessive debt accumulation it will be necessary to remove the primary deficit and contain the future surge in age-related spending.

[18] The IMF uses a somewhat different terminology. The infinite horizon tax gap is called the intertemporal fiscal gap and the finite horizon tax gap is termed the intertemporal fiscal gap with an explicit debt/GDP target.

[19] The IMF's approach rests on a generational accounting framework that uses age and gender specific profiles to project public revenues and spending. In the case of revenues the use of this approach may lead to inconsistency between the assumed overall productivity growth and the average productivity growth implied by the tax projections relying on age and gender specific profiles. This appears to be the case, since, for instance, the projected social security contributions as a percentage of GDP are not constant.

[20] The long-term fiscal position of the EU-15 countries may have changed, since the results portrayed in Figure 5 are based on the 2002 budgetary position and projections carried out in 2001/2002. As a result the underlying budgetary balance may have changed and also the future evolution of spending may be different due to recently approved and implemented reforms. The comparison is indicative only.

Figure 5: Comparison of Infinite Horizon Tax Gap



Source: EC (2003), authors' calculations.

4. Conclusion

The paper looks in the literature for a definition of fiscal sustainability that not only is theoretically sound, but can also be used for setting fiscal targets in practice. Sustainable fiscal policy can be defined as a policy that can be pursued however long without any major interventions in tax and spending patterns needed to prevent excessive debt accumulation. To make this definition operational a condition of sustainability is derived. It states that the present discounted value of future primary surpluses must be equal to the initial value of debt. Under such setting the debt ratio converges towards a finite level. This definition is sufficiently straightforward and operational, but its disadvantage is that it is based on the partial equilibrium approach, neglecting interrelationships between fiscal variables, economic growth and interest rates.

We have introduced several indicators of fiscal sustainability, varying in how closely they are related to the sustainability condition (the infinite and finite horizon gaps), whether they take account of the future evolution of spending (the primary gap and the tax gap) and what target value of debt is set at the end of a finite horizon. Finite horizon indicators are easier to interpret, since they are constructed under explicitly given time horizon and debt targets. On the other hand they are not directly related to the sustainability condition and completely disregard developments beyond the given horizon, which leads to underestimation of the required fiscal correction if the primary deficit is likely to persist. The primary gap may be more attractive than the tax gap, since it concentrates on the budgetary balance, which is usually the object of policy-makers' interest. However, it may substantially underestimate the adjustment needed if a surge in spending is

expected. Thus, the superior sustainability indicator in terms of signalling the magnitude of the required fiscal correction is the infinite horizon tax gap.

The sustainable revenue ratio, enabling the future surge in spending (mainly pensions and health care) to be financed, is estimated to hover around 48% of GDP in the Czech Republic. It is some 7 percentage points higher than the current revenue-to-GDP ratio. If governments wished to continue their current spending policies, they would have to increase taxes by 7% of GDP to avoid accumulating excessive debt and becoming insolvent in the future. The infinite horizon tax gap is currently very large and it will increase further beyond 2008 unless the government sets ambitious fiscal targets. In the light of population ageing governments should create substantial primary surpluses and reduce public debt in order to pre-fund the future steep rise in spending.

Governments can choose an alternative way towards sustainability. They can set a primary surplus target consistent with the sustainable primary balance. Currently, the sustainable primary balance stands at 0.4% of GDP. By observing this target governments would stabilise the debt ratio in the long run. However, compliance with this target would require immediately raising taxes or cutting spending by almost 3.0% of GDP and containing any future spending pressures (projected at 7.3% of GDP) either by systemic reforms preventing age-related spending from rising or by annual discretionary spending cuts and tax increases. This strategy is more expensive, since it postpones the necessary adjustment further and we have demonstrated that delaying the adjustment is costly in terms of foregone spending.

The finite horizon fiscal gaps (primary and tax) are substantially smaller, since only the deficits resulting from the rise in spending up to a given year (2050 in the case of long-term projections) are considered in the calculations and no account is taken of the developments beyond 2050. These indicators somewhat understate the required fiscal adjustment.

The importance of the sustainability indicators rests on their ability to signal future fiscal imbalances and the need to correct them. On the other hand the indicators do not answer the question of what adjustment is desirable from the economic point of view – cuts in spending or increases in taxes; cuts in public consumption, social transfers or investments; increases in direct or indirect taxation. In spite of the fact that "gap indicators" should never be mechanically translated into policy prescriptions, they gauge directly the size of the adjustment by the difference between the sustainable level of a given fiscal variable (be it the primary balance or the tax ratio) and its current or projected level. As a result, gap indicators are highly relevant to policy-makers, since they help them properly set fiscal targets and adapt public finances to future spending pressures such as those resulting from population ageing.

References

ARTIS, M. AND M. MARCELLINO (2000): "The Solvency of Government Finances in Europe", in Banca d'Italia.

BALASSONE, F. AND D. FRANCO (2000): "Assessing Fiscal Sustainability: A Review of Methods with a View to EMU", in Banca d'Italia.

BANCA D'ITALIA (2000): "Fiscal Sustainability", Essays presented at the Bank of Italy workshop held in Perugia, 20–22 January.

BLANCHARD, O., J. C. CHOURAQUI, R. P. HAGEMANN, AND N. SARTOR (1990a): "The Sustainability of Fiscal Policy: New Answers to an Old Question", *OECD Economic Studies*, No. 15, pp. 7–36.

BUITER, W. H. (1985): "Guide to Public Sector Debt and Deficits", Economic Policy: A European Forum 1.

BLANCHARD, O. (1990b): "Suggestions for a New Set of Fiscal Indicators", OECD Working Paper No. 79.

BUITER, W. H. (2004): "Fiscal Sustainability", Paper presented at the Egyptian Centre for Economic Studies in Cairo.

BULÍŘ, A. (2004): "External and Fiscal Sustainability of the Czech Economy: A Quick Look Through the IMF's Night-Vision Goggles", CNB Research and Policy Notes.

CHALK, N. AND R. HEMMING (2000): "Assessing Fiscal Sustainability in Theory and Practice", in Banca d'Italia.

DANG, T. T., P. ANTOLIN, P., AND H. OXLEY (2001): "Fiscal Implications of Ageing: Projections of Age-related Spending", Economics Department Working Paper No. 305, OECD Paris.

EUROPEAN COMMISSION (2001): "Budgetary Challenges Posed by Ageing Populations: The Impact on Public Spending on Pensions, Health and Long-term Care for the Elderly and Possible Indicators of the Long-term Sustainability of Public Finances", Economic Policy Committee, EPC/ECFIN/655/01.

EUROPEAN COMMISSION (2003): "Progress Report – The Impact of Ageing Populations on Public Finances: Overview of Analysis Carried out at EU Level and Proposals for a Future Work Programme", EPC/ECFIN/435/03 final.

EUROPEAN COMMISSION (2005): "The 2005 EPC Projections of Age-related Expenditure (2004–2050): Underlying Assumptions and Projection Methodologies to be Used for EU25 Member States", Economic Policy Committee.

HAMILTON, J. D. AND M. A. FLAVIN (1985): "On the Limitation of Government Borrowing: A Framework for Empirical Testing", NBER Working Paper No. 1632, Cambridge.

INTERNATIONAL MONETARY FUND (2002): "Assessing Sustainability", International Monetary Fund, Washington, DC. Also available at: http://www.imf.org/external/np/pdr/sus/2002/eng/052802.pdf.

INTERNATIONAL MONETARY FUND (2003): "Sustainability Assessments – Review of Application and Methodological Refinements", International Monetary Fund, Washington, DC. Also available at: http://www.imf.org/external/np/pdr/sustain/2003/061003.pdf .

INTERNATIONAL MONETARY FUND (2005): "Czech Republic – Selected Issues", Chapter III: Impact of Aging on Fiscal Sustainability, International Monetary Fund, Washington, DC. Also available at: http://www.imf.org/external/pubs/ft/scr/2005/cr05275.pdf.

KREJDL, A., V. BEZDĚK, AND K. DYBCZAK (2003): "Fiscal Implications of Population Ageing", *Finance a úvěr*, No. 53, pp. 562–591.

KREJDL, A. AND Z. ŠTORK (2005): "Modelling the Czech Pension System", Ministry of Finance, Working Paper No. 3.

MINISTRY OF FINANCE OF THE CZECH REPUBLIC (2005): "Convergence Programme of the Czech Republic", December.

MINISTRY OF FINANCE OF THE CZECH REPUBLIC (2006): "Macroeconomic Forecast", April.

OECD (2001): "Fiscal Implications of Ageing: Projections of Age-related Spending", The Ad Hoc Working Group on the Fiscal Implications of Ageing, ECO/CPE/WP1(2001)1.

OECD (2002): "Policies for an Ageing Society: Recent Measures and Areas for Further Reform", ECO/CPE/WP1(2002)7.

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Czech National Bank
Economic Research Department
Na Příkopě 28, 115 03 Praha 1
Czech Republic
phone: +420 2 244 12 321
fax: +420 2 244 14 278
http://www.cnb.cz
e-mail: research@cnb.cz