Fiscal Sustainability in Focus

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Summary

As regards the concept of fiscal sustainability, our study finds that in this area a variety of issues can be examined with very different tools. The issues may concern the achievement of fiscal constraints over an infinite horizon, the realisation of a specific target, or the fiscal policy response to indebtedness observed in the past. In some cases additional aspects of sustainability are considered too, such as the effects of ageing, although the consequences of rising inequality are mostly overlooked. The model may also include an estimate of the investment needed to mitigate the effects of climate change, but the impact of the impact of climate change is outside the model framework. To answer these questions, it may also be necessary to include uncertainty, in which case the discounting of future debt, tax revenue and expenditure with an intertemporal budget constraint in a stochastic environment depends on the probability distribution of these factors under different states. Our sustainability analysis, on the one hand, presents the best practice, complemented with the directions we have identified for further improvement. On the other hand, we have made the necessary corrections to avoid oversimplification in calculating debt dynamics.[1]

Key words: fiscal sustainability, intertemporal budget constraint, long-term fiscal projections

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Economic analyses should consider the aspects of sustainability (Baksay et al., 2022). The fundamental aim of our study is to examine fiscal policy, an important element of financial sustainability, as one of the four general areas of sustainability, i.e. financial, social, environmental and growth (Virág, 2019, Matolcsy, 2022). However, in our literature review we also look at interconnections with the other three pillars. Growth has been considered for a long time, as GDP determines both the numerator (primary balance) and the denominator of the public debt ratio. The role of the social pillar has also become apparent; the now regular long-term budget projections evaluate the fiscal impact of demography and ageing (OBR, 2018). Greater attention should be paid to income inequality as a social factor (Fanelli, 2018; Vanhuysse, 2021), since it is generally overlooked in long-term fiscal projections. Today, the financial and growth implications of environmental sustainability pose a spectacular challenge (IMF, 2020; Aligishiev, 2022).

A fundamental question regarding the current fiscal policy is whether it is sustainable, as 'the continued government borrowing leads to an ever-rising public debt' (Domar, 1944).

Based on the theory of sustainability, an entity's debt is sustainable if, with a specific level of return, the intertemporal budget constraint, i.e. the present discounted value (PDV) of current and future revenues less the present discounted value of current and future primary expenditure is met *without major revenue or expenditure adjustments.* The difference between them is sufficient to repay the current outstanding debt. The same can apply not only to debt, but it can be extended to net wealth, i.e. the assets that can be offset against the debt. Practically, a situation is also sustainable if the debt stock does not increase in the long run, or it increases in parallel with the assets. Tested empirically, however, it is sufficient if it can be proved from past behaviour that an appropriate revenue or expenditure response occurs when debt increases.

Next, we will review how the above questions are addressed in the literature, and what methods have been developed to answer them. Then we will ask the question whether best practice exists, or whether it can be improved further. Our second question is: what solutions can improve the calculation of simple debt dynamics? We will use these to do projections and to present the results for the EU countries, the United Kingdom and the United States.

LITERATURE REVIEW

In the deterministic case, the intertemporal constraint in a closed economy, and disregarding monetary policy, can be described as follows: (Chalk & Hemming, 2000)

$$b_{-1} \leq \sum_{i=0}^{+\infty} df_i\, pd_i + \lim_{\to\infty} df_t\, b_t$$

where the discount factor is $df_t = \frac{1+g_t}{1+r_t} df_{t-1}$, g_t is economic growth, r_t is the interest paid on government debt (b_t), and pd_i is the budget balance without interest payments, i.e. the primary balance. Since, in the long run, this requires the present value of debt to converge to zero, it follows that the debt ratio cannot grow faster than the difference in interest rate growth.

If the rate of growth exceeds the interest rate, the budget would follow a Ponzi scheme, meaning that at some point in the future private actors will hold government debt, and their consumption will be lower accordingly. Although the intertemporal constraint would be met, the condition for excluding the Ponzi game would not. For this the government would have to repay the debt from primary surpluses, in order to arrive at a broadly accepted definition of sustainability (Giammarioli et al. 2006):

$$b_{-1} \leq \sum_{i=0}^{+\infty} df_i \, pb_i$$

According to this, the fiscal policy is sustainable if the net present value of future primary surpluses is greater than or equal to the current public debt ratio.

Another important question of the theoretical approach is whether the examination of fiscal sustainability can be narrowed down to government debt. So far, we have been doing this, explicitly assuming that no other asset or liability has a dynamic in time, i.e. that they are constant. However, in some theoretical frameworks this cannot be assumed at all.

At the level of the national economy it can be observed that in a given period not all the income can be used, but that in an optimal case defined as the golden rule, a certain share is to be passed on to the next generation through investment that corresponds to savings. Under conditions of natural growth, this investment rate is equal to the rate of profit (Phelps, 1961). For public finances this appears as a golden rule, according to which the debt of the state must not exceed the size of its fixed assets. If we look not at the level but at the change, then it means that the maximum amount of government debt that can be accumulated equals the net increase in fixed assets above depreciation. The average lifespan of government fixed assets can be much longer than that of private fixed assets, due to the higher share of infrastructure assets. Consequently, the annual depreciation is lower because it is spread over a longer period of time, therefore intergenerational transfer is relevant, especially if infrastructure investment as a share of GDP is not constant, but is still growing, or already in a declining phase.

Buiter (2001) defines the intertemporal budget constraint as follows:

$$B = iB + P(G^C + G^I - \theta K^G - T)$$

where B is the stock of debt, i is the short-term nominal interest rate, P is the general price level, G^C and G^I are government consumption and investment in real terms, K^G is the real capital stock of the public sector, θ is the gross rate of return of this capital (receivable in cash revenue), and T is tax revenue net of transfers, expressed in real terms.

Let d be the balance as a share of GDP, r the short-term real interest rate, and δ the depreciation of capital. Assuming the discount rate to be constant in time, then the change in the net nominal stock of liability (L), where capital is recognised at current replacement value, can be expressed as:

$$L_t = \int_t^{\infty} P_s (T_s - G_s^C) e^{-i(s-t)} d_s + \int_t^{\infty} [r_s - (\theta - \delta)] P_s K_s^G e^{-i(s-t)} d_s$$

Arestis and Sawyer (2009) point out two implications of the above formula. On the one hand, depending on the sign of the net stock of liability, if the net value is positive, and the second element in the right-hand side of the formula is close to zero, then the sum of future fiscal balances may be negative. On the other hand, θ, i.e. the rate of return on capital as the second element in the right-hand side of the formula, includes not only revenue and income from fees, but also the positive impact on GDP. Consequently, the future output, and therefore tax revenue, is not independent of current government spending. As *Buiter* (2001) explains, government investment can improve (impair) solvency if the net present value of current and future investments is higher (lower) than the net present value of direct (fees) or indirect (tax) cash revenues realised on government fixed capital.

Returning to the models narrowed down to public debt, the literature suggests that in some cases a 'rational Ponzi scheme' may exist (O'Connel and Zeldes, 1988), where:

$$\lim_{T \to +\infty} df_t b_t \geq 0$$

This can be ensured by theoretical models where the population is constantly growing. Taking into account the other pillars of sustainability (especially the environmental one), this is not a feasible condition at present. If an infinite population growth is not a realistic assumption, then, it is concluded, a Ponzi scheme cannot exist (O'Connel and Zeldes, 1988, Buiter and Kletzer, 1992).

A common feature of the models that study Ponzi finance is that they assume overlapping generations of finitely-lived households with infinitely-lived government and economy (OLG model). They identify several potential channels; the budget and intergenerational bequests/gifts.

In the budget model (Buiter and Kletzer, 1992), lump-sum taxes are levied (this can be negative if government transfers exceed it), allowing intergenerational transfers, and thereby achieving Ponzi finance. If we exclude this transfer from our assumptions, i.e. each generation pays the same net tax (reduced by transfers) at any given time throughout their entire life cycle, then Ponzi finance – debt growing faster than the interest rate over an infinite time horizon – is only possible if the growth rate of labour productivity exceeds the interest rate.

Buiter (2003) treats the increase in the monetary base similarly to tax, as it does not pay interest, and it does not have to be repaid. Examining the monetary base and monetary equilibrium, O'Connel and Zeldes (1988) conclude that the equilibrium of the golden rule by population growth can be achieved with a Ponzi game equilibrium and positive coupon government bond without maturity.

Intergenerational gifts[2] can lead to excessive accumulation of capital; its level can exceed that of the golden rule (Carmichael, 1982). Therefore, the rate of interest can be greater than the rate of growth (dynamic inefficiency), and the government may roll over its debt by Ponzi finance. In contrast, O'Connel and Zeldes (1993) in their gift model find evidence of dynamic efficiency; if the gift function is linear, the equilibrium accumulation of capital is on the efficient side of the golden rule. The mechanism behind this is that if the older generation increases savings, the younger generation will respond by reducing its gifts. This reduces the actual rate of return on savings, thereby reducing the equilibrium accumulation of capital.

The immediate permanent change in tax (or expenditure) as a share of GDP that is necessary to meet the intertemporal budget constraint is expressed by the European Commission's S2 indicator:

$$ITGAP = \frac{(r-g)(b_t - \sum_{i=1}^{\infty}(df)^i pb_{t+i})}{1+g}$$

This indicator is regularly produced for all EU Member States, addressing the impact of the following factors:

- by providing a medium-term forecast, it removes the effects of the business or financial cycle;
- it also takes into account social security liabilities by extending the medium-term projection, however, this is not available over an infinite period of time but is projected over a horizon of approximately 50 years (currently until 2070).

So far sustainability has been interpreted in a deterministic way; the stochastic approach is an alternative where uncertainty is introduced and therefore no single output can be determined. Bohn (1995) explains that in a stochastic environment the discounting of future debt, tax revenue and expenditure with an intertemporal budget constraint depends on the probability distribution of these factors under different conditions. If we assume a stochastic model instead of a deterministic model, the budget constraint changes completely.

$$b_t + pb_t = \sum_{s_{t+1} \in S_{t+1}} p(s_{t+1} | h_t) + b(s_{t+1} | h_t)$$

Here the set of possible conditions is S_t, of which it assumes the value s_t at time '*t*'. The set of values taken by the economy until '*t*' is h_t=(s_t, s_{t-1}, ... s_0), where h_t is the set of values assumed in H_t, and $p(s_{t+1} | h_t)$ indicates the price paid for government bonds in period *t*, from which at *t*+1 a unit of consumer goods can be purchased under condition s_t+1. Consequently, the right-hand side of the equation represents the state-dependent market value of newly issued debt (Lukkezen and Rojas-Romagosa, 2013).

If we only look at the change in fiscal policy that is required to stabilise the current level of debt as a share of GDP rather than at the achievement of the budget constraint, simpler indicators of sustainability are received. *Blanchard's* (1990) primary gap indicator is such an indicator, as it takes into account only the debt ratio accumulated up to the present moment, and measures the distance from the primary balance required to stabilise it at its initial level. *Blanchard* (1990) also suggests a medium-term tax gap by extending the tax and expenditure ratios, which is practically based on available projections, i.e. over the next few years. This may address the problem that the current tax and expenditure also reflect the medium-term impact of the business cycle, so the primary gap and the tax gap fluctuate from year to year accordingly. This problem will be discussed in the chapter titled 'Sensitivity analysis of medium-term debt dynamics'.

According to *Buiter et al.*, (1985), sustainable fiscal policy is the one that can maintain the net wealth of the government sector at its current level. As *Bloch and Fall* (2015) explain in detail, there are several obstacles to defining net wealth, and therefore in practice it is often limited to the net wealth produced. However, even within this scope, it is a common problem that some fixed assets and equity are non-marketable and therefore have no market valuations. *Buiter et al.* (1985) solved this problem by disregarding the *level* of net wealth and focusing on the *change* in wealth instead, since, as we have seen, the sustainability requirement was defined by keeping this constant so that wealth should not decline. *Buiter* (1993) defined the net wealth of the government sector in an alternative way, consolidating it with the central bank. Accordingly, he considered foreign exchange reserve and the net present value of seigniorage revenue as assets, and consolidated debt and the monetary base (banknotes and deposits with the central bank) as liabilities. As *Buiter* (2001) notes, the intertemporal constraint defined for the budget can be extended not only to state-owned companies, but also to the government sector consolidated with the central bank.

If we depart from the principle of unchanging fiscal policy, then a government running a deficit for a longer period of time could in principle meet the intertemporal budget constraint by achieving a sufficiently large surplus in the future. This, however, cannot be a long-term valid commitment for future governments. Nevertheless, it is possible to examine whether governments have changed their fiscal policies in the past depending on how the debt ratio evolved. In this way the intertemporal budget constraint can be redefined, shifting from an unchanging fiscal policy to a fiscal policy responding to debt. This has been tested across various studies of the United States, and reviewed and formally explained by *Trehan and Walsh* (1991).

The intertemporal budget constraint interpreted in this way can be tested in a stochastic environment (Bohn, 1998). In this case the existence of a primary deficit with an economic growth exceeding the interest rate on government bonds is no evidence against sustainability. However, interest rate and growth can be omitted from the examination of sustainability if the starting point is not the unchanged current fiscal policy, but rather the manner in which the primary balance responded to changes in debt in the past. If there is a possibility of omitted variable, the regression will not be appropriate (Bohn, 1998). In this case *Bohn* proposes to use *Barro's* (1979) tax smoothing model.

Sustainability is also affected by interest rate sensitivity in relation to changes in the supply and demand for government bonds. Empirically the results fit well with the cases of heavily indebted countries, such as Japan and Greece (Yoshino & Miyamoto, 2020).

But even if public debt seems sustainable with the conventional factors, the impact of environmental change on fiscal policy now poses another question. Ignoring the issue of climate change would in itself create an impossible situation in the longer term through the other pillars of sustainability. This is why we need to reduce the negative environmental impacts and adapt here and now. Of these two channels, next we will discuss the second one.

The International Monetary Fund (IMF) defines the cost of adaptation as the difference between optimal investment levels with and without climate change (Aligishiev et al, 2022). Adaptation is necessary to minimise future losses (and maximise benefits from climate change). As total investment in adaptation increases, the benefits increase at a declining rate, and experience shows that the phenomenon of diminishing returns also occurs here. Accordingly, an investment level where marginal utility equals marginal cost can be defined. There can be significant differences between countries (e.g. island countries face a higher risk). Based on investment projections for 2021–2025, governments should spend an average of 0.25% of GDP per year on adaptation, and the private sector should spend twice as much. This has been extended to 2030 with different assumptions. However, it has been suggested that this rate of adaptation is largely sufficient for the current situation of climate change, but according to relevant studies the investment need could increase significantly by 2050, and there is a great deal of uncertainty as well. In the next decade the total cost of adaptation could reach as much as 3 percent of GDP per year in some countries of the Sub-Saharan, Middle East and Central Asia regions (IMF, 2020). The increase in investment and public debt could be offset by positive effects on economic growth. This transition can be estimated by using a variety of general equilibrium models (Aligishiev et al, 2022).

Excessive or rapidly rising income inequality can cause social problems and slowing economic growth. The question is how fiscal policy should respond to this challenge. The implications for fiscal sustainability are examined below. *Fanelli's* (2018) methodology modifies the conventional derivation of debt sustainability in several respects. On the one hand, the primary balance is broken down into several factors to reflect income redistribution: expenditure allocating public goods, government investment, tax revenue (including income from sales and fees), rents from public wealth and natural resources, and expenditure for redistributing income. On the other hand, the variables are expressed not as a share of GDP, but as a share of GDP per capita (y=y/x, where x is the size of the population), which may be justified in studies that include demography.

As it is shown, there is also a limit to redistribution, i.e. fiscal redistributions compete with other items in the budget, and this is true at any point in time. Transition is easier when the rate of growth exceeds the interest rate, and vice versa, the low growth rate and high interest rate limit the potential for fiscal policy to reduce income inequality (Fanelli, 2018).

THE BEST PRACTICE AND POTENTIALS FOR FURTHER IMPROVEMENT

Blanchard (1990) proposed a long-term debt gap with a 50-year projection to show the adjustment needed for debt stabilisation. As an example, he listed almost all the major items of *Table 1,* such as social security expenditure ($G_i^{Fs}+B_i^F$), future tax and revenue items diminishing over time (T^F+NT^F), and replacement needs for non-financial assets (A^{NF}). It can be established that the most comprehensive summary of the elements of sustainability is provided by the Office for Budget Responsibility (OBR) in the UK.

The most commonly used simple approach concerns liabilities accrued to date (B), possibly netting this gross debt with liquid financial assets (A^L). This implicitly assumes that all other elements in Table 1 are constant over time and therefore can be excluded from the sustainability analysis. In effect, this is not a realistic assumption, but extending the analysis to the other elements raises a number of practical issues, a detailed summary of which is provided by *Bloch and Fall* (2015). For example, the valuation of land and mineral deposits included among non-financial assets is difficult, but they may

Table 1

GENERAL GOVERNMENT ASSETS AND LIABILITIES

	PAST	FUTURE
Assets/ Revenues	Non-financial assets A^{NF} *(including land, mineral deposits: A^M)*	Future assets A^F
	Non-liquid financial assets A^{NL}	Future tax T^F and non-tax revenue NT^F
	Liquid financial assets A^L	
Liabilities/ Expenditures	Liabilities accrued to date *B*	Future liabilities G^F *(including social security: G^{Fs})*
		Future liabilities generated in the past B^F
		Contingent liabilities generated in the past CL^F

Source: OBR (2018)

have an impact on sustainability if revenues from extraction (which are currently very high in some countries) disappear in the long run. More reliable data are available for produced non-financial assets, but methodological differences in the depreciation of fixed assets, i.e. problems in measuring the current net stock mean that these data cannot be used for future projections in a fully reliable way. The net stock of government fixed assets tends to be inversely proportional to development, but it is difficult to estimate how much real wealth a country will have in 50 years with an unchanged fiscal policy, while the future path of investments can have a significant impact on the primary balance and debt.

From time to time, the OBR produces 50-year projections structured similarly to Table 1 as an extension of its medium-term forecast. However, such a broad examination of balances sheets ultimately aims to quantify public sector net debt by identifying the fiscal gaps necessary to achieve a net debt ratio of 20, 40 or 60 percent (OBR, 2018). This is more stringent than debt stabilization, as public sector net debt exceeded 80 percent of GDP at the time of calculation. The resulting fiscal gaps are determined in terms of an immediate permanent change in balance as a share of GDP, similar to the S2 indicator, alternatively examining the extent to which the situation would change in the event of gradual adjustment. Generally, it is also noted that the analysis of current items can be more intuitive, eliminating the uncertainty inherent in the choice of discount rate, which is necessary when future current items have to be converted into a present adjustment need (fiscal gap) expressed as a lump sum. The *OBR* (2018) emphasises that there exists a trade-off between completeness and certainty in the analysis of current items (flows) and stocks. The past stocks (debts and receivables) shown in Table 1 provide relatively reliable estimates. However, projections for the future provide a more complete but less certain picture sensitive to underlying assumptions.

However, despite its level of detail and transparency, the OBR method may be criticised on a number of points:

1 The long-term projection is highly sensitive to how the initial situation is judged. Cyclical adjustment could be a solution, however, in addition to the uncertainty of the output gap (P. Kiss, 2020), there are well-documented methodological problems concerning adjustment (P. Kiss & Vadas, 2006). From this point of view, the medium-term projection of initial revenue values may not be an ideal alternative (Blanchard 1990, OBR, 2018).

2 The projection of revenue from initial mineral wealth, including private property related taxes, such as mining royalties, is often neglected. Uncertainty in this respect is understandable, but for many countries with insignificant mineral assets this revenue would presumably disappear over a 50-year horizon.

3 Third, in the long run the convergence of EU transfers according to level of development makes a significant difference compared to the initial situation, with those of the contributor countries decreasing, and those of the catching-up member states possibly disappearing.

4 The future accumulation of fixed assets may be negative if stocks as a share of GDP converge in accordance with development.[3] This represents a significant saving in expenditure, and it also has to be netted due to non-refundable VAT (see next paragraph).

5 In the course of projecting expenditure on past or future liabilities conventional methods do not take into account the direct tax element of this expenditure, so grossing up can significantly overestimate the burden. For example, pensions are taxable in many countries, and public health care expenditure

contains a standard tax element as VAT on the purchase of goods and services is non-recoverable, while taxes and contributions are paid on the wages of employees too (P. Kiss G. et al, 2009; P. Kiss & Szemere, 2011; P. Kiss & Szemere, 2012, Adam et al., 2016).

6 Eurostat's projection (proj_19np) uses age-specific data that can be used to estimate age profiles (Vanhuysse et al., 2021) to specify not only future transfers from the state, but also taxes relating to income and consumption. Calculations here are made by the *OBR* (2018), but they predict only a minimal increase in VAT, while an increasing share of consumption belongs to the ageing population.[4]

7 The OBR (2018) calculation also makes explicit the assumption that the ending of the 50-year budget projections means nothing else than an extension with fixed GDP ratios because of the infinite horizon. But what would happen if the 50-year horizon was extended?

- uncertainty would clearly increase,
- the demographic waves triggered by baby boom would gradually diminish,
- the ageing of the population would continue,
- the impact of non-demographic factors on health care expenditure increase would continue.

SENSITIVITY ANALYSIS OF MEDIUM-TERM DEBT DYNAMICS

Let us look at a more easily quantifiable analytical framework. This calculation can be interpreted in the medium term, as there are several other factors influencing debt in the longer term. In this way, however, neither temporal projection nor determination of the net present value of future current items is necessary.

The increase in debt in a given year can be decomposed on the basis of *Domar's condition theory* (1944) as follows[5]:

$$\Delta b_t = \left(\frac{i_t - g_t}{1 + g_t}\right) b_{t-1} - pb_t$$

In Domar's model i_i, g_i and pb_i are constant; with a given constant growth target, the interest rate is constant because that is the aim of the monetary authority in order to achieve the necessary investment demand path. The planned public sector primary expenditure as a share of GDP and taxes as a share of revenue are also constant; in other words, the primary balance as a share of GDP is constant, too. (For a critique and alternatives see Mellár, 2002).

Next we will assume that the variables take constant values in the medium term, and we seek to determine whether, given the initial debt, there is a stabilizing debt ratio where:

$$b_{i-1} = b_i$$

Then, rearranging the above equation:

$$\left(\frac{i_t - g_t}{1 + g_t}\right) b_{i-1} - pb_i$$

With a positive potential growth rate (g), the sign of the debt dynamics element $\left(\frac{i_t - g_t}{1 + g_t}\right)$ depends on which value is larger: the medium-term interest rate or the potential growth rate.

If the growth rate exceeds the interest rate, then the initial debt is moving towards a stable equilibrium. In the case of a constant (cyclically adjusted) primary deficit this will be a specific amount of debt, and in the case of a constant (cyclically adjusted) primary surplus, a specific amount of deposit (negative debt) (top row of *Table 2*).

If the medium-term interest rate exceeds the potential growth rate, there is no stable equilibrium, but a steady shift towards infinite debt or infinite deposits, depending on the initial debt and the size of the constant (cyclically adjusted) primary balance (bottom row of Table 2).

In the event of crises, the question is whether the negative effects are temporary or permanent, and, in the latter case, whether they could pose a threat to debt sustainability. In the next part this will be examined for the EU Member States, the UK and the US.[6] In the best-case scenario, after the crisis starting in 2020 the pre-crisis medium-term interest rate, potential economic growth rate and cyclically-adjusted primary balance will recover in the medium term. Compared to this, we will consider the impact of some less favourable scenarios on debt.

The starting point is to determine the past medium-term values to which the best-case scenario could return. To eliminate individual fluctuations, a multi-year average up to 2019 has been defined with a different time horizon for each country.[7] The current estimate is taken from the European Commission's spring 2022 forecast. In principle, this eliminates the effect of fluctuations in the output gap, but the length of the period has been chosen to include the full economic cycle (the sum of the output gaps should be close to zero). This brings the averages of the adjusted and unadjusted data close together in a way that the length of the averaging period (3–9 years) reflects the current estimate for the cycle. This method can be suitable for determining the pre-crisis medium-term values.

For the averages of past values, both the potential growth rate and the interest rate have been defined in nominal terms, because while the effect of the deflator is reflected in growth immediately, it appears in the effective interest rate only with a delay, since repricing occurs gradually with the renewal of maturing debt. Assuming that the majority of the stock is repriced over a three year period, for the interest rate the averaging length of economic growth established at the level of the countries is shortened by three years.

With the baseline scenario determined, we have examined the potential impact of post-crisis persistent negative effects on debt dynamics.

For the interest rate paid on debt, a persistent negative effect can be expected. For the robustness test we have made a technical assumption that, following a gradual repricing, the interest rate could be permanently 0.5 percentage points higher than the pre-crisis medium-term value.[8]

As for potential growth, we have also considered a persistent negative risk of 0.5

Table 2

VARIATIONS OF SUSTAINABILITY

	$pb_i > 0$	$pb_i < 0$
Stable equilibrium: $i_i < g_i$	$b_t \rightarrow b_i$	$b_t \rightarrow b_i$
Unstable equilibrium: $i_i > g_i$	if $b_t < b_i$, then $b_t \rightarrow -\infty$ if $b_t > b_i$, then $b_t \rightarrow \infty$	if $b_t < b_i$, then $b_t \rightarrow \infty$ if $b_t > b_i$, then $b_t \rightarrow -\infty$

Source: own grouping, Mellár (2002)

percentage point as a technical assumption. On the one hand, the energy prices, the war and COVID-19 may have lasting economic effects, while, on the other hand, in times of major downturns a reassessment of the past and a downward revision of previous estimates for potential growth can be observed. These two factors could reduce the potential growth rate in our risk scenario by 0.5 percentage points.[9]

For the cyclically-adjusted primary balance a persistent negative risk can be assumed, similar to growth. A possible reason for this is that a decline in potential growth would also affect this indicator through tax revenues if expenditure failed to adjust at a similar pace. Another reason could be that some of the measures taken during the crises may become permanent, especially in countries with sufficient room for fiscal manoeuvre before the crisis. We have assumed a uniform risk level of 0.5% of GDP, considered on a technical basis.

Then we looked at the scenarios from a debt dynamics perspective, without examining how they might be related to each other. As a first step, in *Table 3* we highlight in green and red the straightforward cases where the combinations are positive in all circumstances (positive primary balance with a positive *g–r* difference) or on the contrary, they are negative.

In principle several combinations of the three shocks assumed in the baseline scenario can be produced. Practically, however, in *Table 4* we have presented a possible sequence where the first shock represents an increase in the interest rate, the second shock represents a decline in potential growth, and the third, additional shock represents deterioration in the cyclically adjusted primary balance.

As indicated in Table 4, the initial debt has a crucial role in addition to all of these. In this case we have used the European Commission's dept-to-GDP ratio projections for 2022, which can be estimated with relative certainty during the year. The equilibrium debt ratio is highlighted in bold type, while green indicates that it is lower than the initial debt, and grey indicates that it is higher. For the figures highlighted in bold, grey indicates that the debt will increase, but its level may not be unsustainably high (e.g. 50–60% for Poland and Lithuania). The strikethroughed italic figures cannot be interpreted, as there is no stable state (see Table 2).[10] Only the colours matter: green indicates a shift towards infinite negative debt, and red towards infinite debt.

While the debt parameters in Table 3 show that only 8 countries had a clearly positive or negative situation, adding the initial debt brings this number to 19. Within this, the public debt of Spain, France, Italy, Slovakia, the United Kingdom and the United States either converges to unsustainably high rates (exceeding 1300–1600% of GDP), or increases steadily in all scenarios.

For Belgium and Poland the baseline scenario is still favourable, but a single shock is enough to trigger an increase in debt. While Belgium has a steady increase, Poland has equilibrium rates, and in this case only the combined effect of the three shocks would result in an unsustainable rate (244 percent of GDP).

Croatia, Lithuania, Portugal and Finland are capable to withstand one shock, but with a second shock, the debt ratio would already increase. This being the case, only Lithuania would converge to an equilibrium state (more or less sustainable in the medium term), while the other countries would experience a steady increase.

The Czech Republic and Latvia would be able to cope with two additional shocks, but with a third one, the Czech debt would rise steadily, and Latvia's debt ratio would converge to a high but not unsustainable level exceeding 100% of GDP in the medium term.

Table 3

DEBT DYNAMICS FACTORS BY COUNTRY (GREEN IS POSITIVE, GREY IS NEGATIVE)

	Baseline scenario		Additional shocks		
	g–r (%)	*pb* (GDP %)	*r*	and *g* too	and *pb* too
Belgium	0.44	0.46	–0.06	–0.56	–0.04
Bulgaria	2.23	0.47	1.73	1.23	–0.03
Czechia	0.42	–0.01	–0.08	–0.58	–0.51
Denmark	0.49	2.92	–0.01	–0.51	2.42
Germany	1.64	2.03	1.14	0.64	1.53
Estonia	3.22	0.10	2.72	2.22	–0.40
Ireland	6.01	–3.79	5.51	5.01	–4.29
Spain	–0.58	–0.77	–1.08	–1.58	–1.27
France	0.10	–1.35	–0.40	–0.90	–1.85
Croatia	–1.13	1.35	–1.63	–2.13	0.85
Italy	–1.59	1.52	–2.09	–2.59	1.02
Cyprus	0.11	2.00	–0.39	–0.89	1.50
Latvia	1.66	–0.16	1.16	0.66	–0.66
Lithuania	1.52	–0.27	1.02	0.52	–0.77
Luxembourg	1.71	2.51	1.21	0.71	2.01
Hungary	0.96	0.85	0.46	–0.04	0.35
Netherlands	1.46	1.44	0.96	0.46	0.94
Austria	0.54	1.02	0.04	–0.46	0.52
Poland	1.46	–0.57	0.96	0.46	–1.07
Portugal	–0.23	0.99	–0.73	–1.23	0.49
Romania	4.74	–1.03	4.24	3.74	–1.53
Slovenia	0.29	1.79	–0.21	–0.71	1.29
Slovakia	–0.10	–0.43	–0.60	–1.10	–0.93
Finland	0.93	–0.10	0.43	–0.07	–0.60
Sweden	3.11	0.80	2.61	2.11	0.30
United Kingdom	0.23	–3.76	–0.27	–0.77	–4.26
United States	–0.13	–0.73	–0.63	–1.13	–1.23

Source: own editing

Table 4

DEBT DYNAMICS IN RELATION TO THE INITIAL STOCK (GREEN: DECREASING, GREY: INCREASING)

	Initial debt	Baseline scenario	*r*	and *g* too	and *pb* too
	b(2022) GDP%	*b(i)* (GDP%)			
Belgium	107.5	**–109.0**	~~726.9~~	~~83.5~~	~~–7.0~~
Bulgaria	25.3	**–22.3**	**–28.7**	**–40.3**	**2.3**
Czechia	42.8	**2.9**	~~–15.3~~	~~–2.1~~	~~–90.5~~
Denmark	34.9	**–617.4**	~~22 574.4~~	~~582.7~~	~~483.1~~
Germany	66.4	**–127.9**	**–183.0**	**–325.5**	**–245.5**
Estonia	20.9	**–3.4**	**–4.0**	**–4.9**	**18.4**
Ireland	50.3	**68.8**	**74.8**	**82.2**	**93.1**
Spain	115.1	~~–134.8~~	~~–72.1~~	~~–49.3~~	~~–81.3~~
France	111.2	1 335.9	~~–344.4~~	~~–152.5~~	~~–208.9~~
Croatia	75.3	122.9	~~84.7~~	~~64.8~~	~~40.8~~
Italy	147.9	96.9	~~73.3~~	~~59.1~~	~~39.7~~
Cyprus	93.9	**–1 948.2**	~~517.1~~	~~228.1~~	~~171.1~~
Latvia	47.0	**10.2**	**14.5**	**25.6**	**104.7**
Lithuania	42.7	**18.6**	**27.6**	**53.9**	**153.5**
Luxembourg	24.7	**–151.1**	**–212.3**	**–361.0**	**–289.0**
Hungary	76.4	**–93.7**	**–194.9**	~~2 176.1~~	~~901.5~~
Netherlands	51.4	**–102.0**	**–154.3**	**–322.2**	–210.6
Austria	80.0	**–196.2**	**–2 820.8**	226.7	116.0
Poland	50.8	**40.8**	**61.9**	**129.9**	**244.3**
Portugal	119.9	438.1	~~138.4~~	~~82.2~~	~~40.8~~
Romania	50.9	**23.6**	**26.2**	**29.8**	44.1
Slovenia	74.1	**–641.9**	~~867.5~~	~~258.3~~	~~186.2~~
Slovakia	61.7	–466.1	–74.1	~~–40.3~~	~~–87.0~~
Finland	65.9	**10.7**	**23.0**	~~–139.1~~	~~–856.9~~
Sweden	33.8	**–26.8**	**–31.8**	**–39.4**	**–14.8**
United Kingdom	100.2	**1 659.2**	~~–1 452.4~~	~~–504.4~~	~~–571.4~~
United States	123.4	~~–583.1~~	~~–118.9~~	~~–66.2~~	~~–111.9~~

Source: own editing

CONCLUSION

The issue of fiscal sustainability can be approached in a number of ways. One of the questions is whether we follow a theoretical approach and look at the achievement of the budget constraint over an infinite time horizon, or whether we are practically content with achieving a target, say the current stock of debt. Also, the concept of stock of liablility can be narrowed down to debt, or else broadened to net wealth. However, the results are very sensitive to the choice of discount factor that is necessary to calculate net present value.

While the projections provided by international organisations aim at cross-country comparisons (typically over a horizon of fifty years), some national institutions produce much more in-depth estimates focusing on a single country. The OBR's detailed, transparent approach is an example of best practice. The projections do not take into account the dynamics of several factors, such as public investment, or the dynamic increase in public expenditure due to ageing and health care development, which is considered in a gross way, not netted by its tax content. This may result in a higher estimation of the adjustment need for achieving sustainability. In addition to fiscal projections, it is clear that a comprehensive systemic approach to sustainability is needed in a way that allows for quantification of interactions between the financial, social, environmental and growth pillars. In this respect, *Virág* (2019) suggests a way forward for future research.

Looking at debt dynamics over a shorter horizon approaching medium term, the question is the extent to which, after the 2020–22 crises, the key parameters of the individual countries will return to the average values of the pre-crisis economic cycle. We have performed debt dynamics calculations by examining interest rates 0.5 percentage points higher than those, with lower potential growth rates and less favourable cyclically-adjusted primary balances as additional shocks. Our findings show that almost half of the 27 countries under review, altogether 13 states including Hungary, would be on a declining debt path both in the baseline scenario and with the additional shocks. ■

Notes

[1] The views expressed in this article are those of the authors and they do not purport to reflect the official position of the MNB.

[2] The model of bequest is different, as the bequesting generation moves before the previous one, and therefore its decisions are known. In the gift model, however, the younger generation determines the amount of gifts based on the savings of the older generation.

[3] Or they are independent of development and are determined by the size of the population (Fanelli, 2018). Projections established as a constant share of GDP are not justified in this case either.

[4] In addition to the age distribution of the population, projecting the income distribution is also necessary. As the growing income inequality cannot be sustained, fiscal instruments may be needed (see the final part of the literature review in this article).

[5] In practice there are some other factors affecting developments in debt and deficit, which we will disregard because of their dependence on non-

modellable elements. Examples include difference in taxes or expenditures on a cash and accruals basis, and equity sale or purchase.

[6] The exceptions include Greece and Malta, where the methodology discussed below could not be applied (the sum of the output gaps between the two crises was too far from zero for any period).

[7] The main problem may come from the fact that both the potential growth rate and the past values of the cyclically-adjusted primary balance are based on continuously updated estimates.

[8] The robustness test could have been performed on the basis of specific values, i.e. assuming a deterioration of 1 percentage point each, but if these were cumulative, the consequences for debt dynamics would have been so severe that they would have been difficult to interpret.

[9] By comparison, after two waves of crises the estimated potential growth rate in the more advanced EU countries has declined by almost half since 2000.

[10] The size of the figures is interesting for comparison with the initial debt, and it determines whether the debt is moving in a positive or negative direction towards infinity.

References

Ádám, J., Berta, D., Lovas, Zs., P. Kiss, G. (2016). The Impact of Fiscal Policy on Economic Performance, Palotai, D., Virág, B. (Ed.). Competitiveness and Growth, Magyar Nemzeti Bank, 2016

Aligishiev, Z., Bellon, M., Massetti, E. (2022). Macro-Fiscal Implications of Adaptation to Climate Change, IMF Staff Climate Note, 2

Arestis, P., M, Sawyer. (2009). The Intertemporal Budget Constraint and the Sustainability of Budget Deficits, http:// doi.org/10.1007/978-0-230-30604-2_6

Baksay, G., Matolcsy, Gy., Virág, B. (szerk.) (2022). New Sustainable Economics - Global Discussion Paper, Magyar Nemzeti Bank, Budapest 2022

Barro, R. J. (1979). On the Determination of Public Debt, *Journal of Political Economy,* 88, pp. 940–971

Blanchard, O. J. (1990). Suggestions for a New Set of Fiscal Indicators, OECD working paper

Bloch, D., Fall, F. (2015). Government Debt Indicators: Understanding the data, OECD Economics Department No. 1228 OECD Publishing, http://dx.doi.org/10.1787/5jrxv0ftbff2-en

Bohn, H. (1995). The Sustainability of Budget Deficits in a Stochastic Economy, *Journal of Money, Credit and Banking*, 23., pp. 257–271

Bohn, H. (1998). The Behavior of U. S. Public Debt and Deficits, *The Quarterly Journal of Economics*, August 1998

Buiter, W. H. (2001). Notes on "A Code for Fiscal Stability", *Oxford Economic Papers*, 53(1), pp 1–19

Buiter, W. H. (2003). Helicopter Money: Irredeemable Fiat Money and the Liquidity

Trap, *NBER Working paper No. 10163,* DOI 10.3386/w10163 December 2003

Buiter W. H., Persson, T., Minford, P. (1985). Guide to Public Sector Debt and Deficits, Economic Policy: A European Forum, 1., pp. 13–79, https://doi.org/10.2307/1344612

Buiter, W. H. (1993). Measurement of the Public Sector Deficit and Its Implication for Policy Evaluation and Design, IMF: How to Measure Fiscal Deficit

Buiter, W. H., K. Kletzer (1992). Government Solvency, Ponzi Finance and the Redundancy and Usefulness of Public Debt, *Working Paper from Yale – Economic Growth Center*

Carmichael, J. (1982). On Barro's Theorem of Debt Neutrality: The Irrelevance of Net Wealth, *American Economic Review*, 72(1), 202–13

Chalk, N., Hemming, R. (2000). Assessing Fiscal Sustainability in Theory and Practice, Perugia

Domar, E. D. (1944). The Burden of Debt and the National Income, *American Economic Review*, 34(4): pp. 798–827

Fanelli, J. M. (2018). Inter-temporal Sustainability of Fiscal Redistribution: a Methodological Framework, CEQ Institute, Tulane University, 77

Giammarioli, N., Nickel, C., Rother, P., Vidal, J. P. (2006). Assessing Fiscal Soundness: Theory and Practice, Fiscal Indicators, Banca D'Italia Research Department Public Finance Workshop, pp. 637–672

Lukkezen, J., Rojas-Romagosa, H. (2013). Stochastic Debt Sustainability Indicators, Revue de l'OFCE / Debates and policies – 127, https://www.ofce.sciences-po.fr/pdf/revue/5-127.pdf

Matolcsy, Gy. (2022). A gazdasági, a társadalmi, a pénzügyi és a környezeti fenntarthatósági szempontok megjelenése a Magyar Nemzeti Bank gyakorlatában [The Appearance of Economic, Social, Financial and Environmental Sustainability Aspects in the Practices of the Central Bank of Hungary], Public Finance Quarterly Issue 2022/3, pp. 319–337, https://doi.org/10.35551/PSZ_2022_3_1

Mellár T. (2002). Néhány megjegyzés az adósságdinamikához [Some remarks on debt dynamics], Economic Review Volume XLIV. Issue 6, pp. 474–487

O'Connel, Zeldes (1988). Rational Ponzi games *International Economic Review*, 29(3), pp. 431–450

O'Connel, Zeldes (1993). Dynamic Efficiency in the Gifts Economy *Journal of Monetary Economics,* 199331, pp. 363–79

Office for Budget Responsibility (2018). Fiscal sustainability report – July 2018

Phelps, E. (1961). The Golden Rule of Accumulation: A Fable for Growthmen Author(s), *The American Economic Review*, 51(4), pp. 638–643

P. Kiss, G., Vadas, G. (2006). Fill the Gap – Measurement of the Cyclical Effect on Budgets, Fiscal Indicators (Banca d'Italia)

P. Kiss, G., Jedrzejowicz, T., Jirsakova, J. (2009). How to measure tax burden in an internationally comparable way?" National Bank of Poland Working Papers, National Bank of Poland, Economic Institute

P. Kiss G. – Szemere R. (2012). Comparison of the Redistribution Level and Structure of Functional Expenditure in the Visegrád Countries, Public Finance Quarterly Issue 2012/1, pp. 112–134

P. Kiss, G., Szemere, R. (2011). Almát körtével? A négy visegrádi ország állami újraelosztásának összehasonlítása, 1995-2010 [Apple to oranges? A comparison of state redistribution in the four Visegrad countries, 1995-2010] MNB studies, 99

P. Kiss, G. (2020). Aggregate Fiscal Stabilisation Policy: Panacea or Scapegoat? *Financial and Economic Review,* 19(2), pp. 55–87, http://doi.org/10.25201/HSZ.19.2.5589

Trehan, B., Walsh, C. E. (1991). Testing Intertemporal Budget Constraints: Theory and Applications to U. S. Federal Budget and Current Account Deficits" *Journal of Money, Credit and Banking* 23(2), pp. 206–223, https://doi.org/10.2307/1992777

Vanhuysse, P., Medgyesi, M., Gal, R. I. (2021). Welfare states as lifecycle redistribution machines: Decomposing the roles of age and socio-economic status shows that European tax-and-benefit systems primarily redistribute across age groups. PLoS ONE 16(8), https://doi.org/10.1371/journal.pone.0255760

Virág, B. (Ed.) (2019). Sustainable Economics of the Future, Magyar Nemzeti Bank

Yoshino, N., Miyamoto, H. (2020). Revisiting the Public Debt Stability Condition: Rethinking the Domar Condition, ADBI Working Paper Series, 1141

Internet links

International Monetary Fund (2020). Adapting to Climate Change in Sub-Saharan Africa. Regional Economic Outlook: Sub-Saharan Africa – COVID-19: An Unprecedented Threat to Development. Online: https://www.imf.org/en/Publications/REO/SSA/Issues/2020/04/01/sreo0420#Chapter2