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Choosing the pace of fiscal consolidation

by
Łukasz Rawdanowicz*

In many OECD countries debt has soared to levels threatening fiscal sustainability, necessitating its reduction over the medium to longer term. This paper proposes a stylised model, featuring endogenous interactions between fiscal policy, growth and financial markets, to highlight how economic shocks and structural features of an economy can affect consolidation strategy and resulting growth and inflation developments. The fiscal authorities are assumed to choose a consolidation path from a predetermined set of possible paths by maximising cumulative GDP growth and minimising cumulative squared output gaps, with the objective to reach a given debt-to-GDP level within a finite horizon and stabilise debt afterwards under the assumption of the unchanged fiscal policy stance. Illustrative simulations for a hypothetical economy show, among other things, that by requiring debt to stabilise part of the initial adjustment can be reversed; some stepping up of the fiscal adjustment can be optimal if bond yields increase due to an exogenous shock; and for some debt reduction targets, high fiscal multipliers, hysteresis effects and higher government bond yields imply protracted deflation and large negative output gaps, stressing the need to select reasonable fiscal targets consistent with market conditions.

JEL classification: E61, E62, H6

Keywords: Fiscal consolidation, sovereign debt, government budget balance, fiscal rules

* Łukasz Rawdanowicz (e-mail: lukasz.rawdanowicz@oecd.org) works at the OECD Economics Department.
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Government deficits and debt increased in many OECD countries over recent years, often to record high levels. Such positions are not sustainable and fiscal consolidation has become a necessity. Merely stabilising debt at current high levels requires a substantial adjustment and even a larger and more protracted one is needed to reduce debt to lower, prudent levels (OECD, 2012). The latter option is desirable as high debt may weigh negatively on output growth,[1] expose a sovereign to market sentiment shifts, limit room for accommodation of future negative shocks and add to fiscal challenges resulting from the expected increase in government spending related to population ageing and health care.

While there is generally little controversy about the need of fiscal consolidation, its optimal pace is hotly debated (Corsetti, 2012), posing a key dilemma for policymakers in many OECD countries. Some argue for postponing consolidation as a large, frontloaded adjustment can reduce GDP growth with negative fallout for the fiscal situation. Such effects are more likely when – as is currently the case for several OECD countries – output and unemployment gaps are large, effectiveness of monetary policy is reduced with interest rates close to the zero bound, and credit constrains become more binding (Gali et al., 2007; Christiano et al., 2009; Woodford, 2011; Auerbach and Gorodnichenko, 2012). Consolidation-induced slowdowns may also reduce potential GDP via hysteresis effects and thus be counterproductive from a longer-term point of view (De Long and Summers, 2012). On the other hand, postponing consolidation may undermine market confidence in the solvency of a government, risking, in a benign scenario, sluggish growth due to the pass-through of higher sovereign risk to borrowing costs for the private sector and, in the worst case scenario, disruptive sovereign default.

The choice of optimal consolidation path depends crucially on the ultimate long-term objective of fiscal policy and market conditions. Estimating optimal consolidation pace is challenging given the nexus of interactions between fiscal policy, financial markets and economic growth. These interactions are likely to be non-linear and give rise to multiple equilibria. Consequently, their quantification is highly uncertain.

To shed some light on determinants of consolidation and their likely quantitative impact this paper uses stylised simulations of a small, calibrated model for a hypothetical economy where the fiscal adjustment is determined via an optimisation of a government loss function given the assumed objective of stabilising debt at the target at a finite horizon. The model accounts for endogenous feedback among fiscal policy, growth and financial markets as well as a simple monetary policy rule and debt maturity structure under a perfect foresight. The hypothetical economy is calibrated so as to reflect key characteristics of fiscally troubled OECD countries in 2011, including high debt, structural and headline budget deficits and initial large negative output gaps. The exercise, although only illustrative given its stylised nature, involves a number of sensitivity tests with respect to key parameters of the model and alternative scenarios. This is necessary given large uncertainty about interactions between fiscal, real and financial variables. The simulations investigate in particular how optimal consolidation changes with interest rates shocks, different fiscal multipliers, hysteresis effects and under delayed consolidation. In addition, conditions for a self-defeating fiscal adjustment are investigated. The model simulations are not meant to prescribe concrete policy recommendations – in particular regarding debt targets and the timing to reach them – but rather to offer a framework, that can be tailored to country-specific circumstances, to inform general policy choices.

1. Model's framework

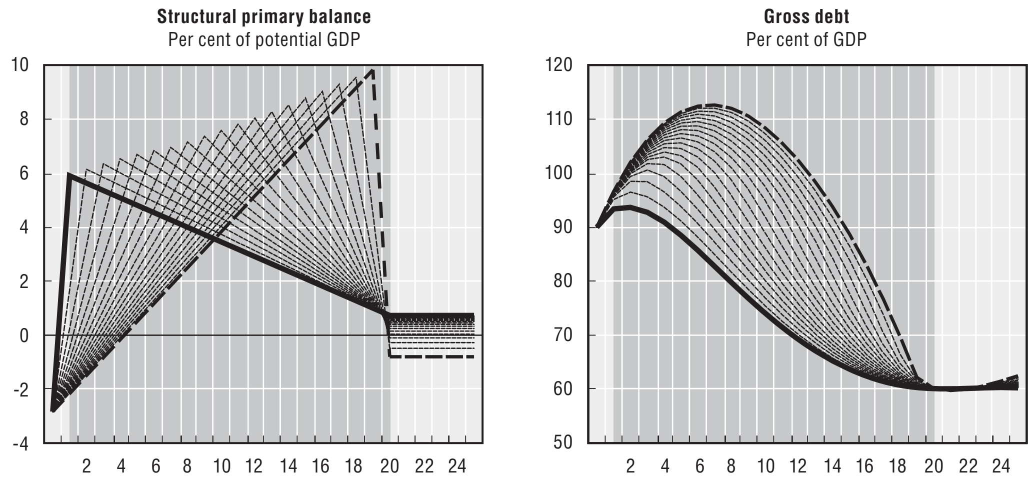
1.1. Consolidation objective

Given an initial high debt level, it is assumed that fiscal authorities are fully determined to reduce the debt-to-GDP ratio to a lower and prudent level within a finite horizon and then stabilise it at this level indefinitely with an unchanged fiscal policy stance. Debt stabilisation – around what is deemed a sustainable and prudent level – can be desirable as it creates room for absorbing future shocks and at the same time allows for a less stringent fiscal policy stance (see below). It also imposes a longer-term perspective, beyond the analysed period, requiring no further fiscal adjustment with unchanged fundamentals.

The requirement of debt stabilisation has implications for calculating consolidation needs. As explained in Annex A in greater detail, approaches adopted in the literature (assuming either a one-off adjustment in the first year or a gradual and equal in size adjustment over the entire period)[2] to reach a given debt target within a finite horizon, imply that with unchanged fiscal policy beyond the analysed horizon the debt-to-GDP ratio would continue to fall. This stems from the fact that with high initial debt and deficit ratios, a large improvement in the budget balance is needed to reduce debt within a given period, but debt stabilisation, once the lower debt level is achieved, requires a lower budget balance. Thus, consolidation needs derived from the methods employed in the literature imply that consolidation is permanent and they ignore debt evolution after the end of the period analysed. In contrast, consolidation aimed at debt stabilisation implies that some of the initial adjustment (i.e. a difference between the peak surplus and initial budget balances) can be reversed and total consolidation (i.e. a difference between the end and initial budget balances) will be lower (Annex A). There are numerous possible consolidation paths that are consistent with stabilising the debt ratio at a lower level within a finite horizon. The simulations in this paper focus on a subset of consolidation paths that involves a constant annual adjustment in the structural primary balance, both during fiscal tightening and easing, and assume an immediate start of consolidation. This implies a kinky, linear path of the structural primary balance (Figure 1). For this set of functions, there are $k - 1$ possible paths, where k is the number of years to reach the debt target, which differ with respect to the time of attaining the peak and the size of annual adjustment (i.e. slopes of the lines). Annex A proposes two alternative paths that ensure debt stabilisation.

Given the set of consolidation paths above, an optimal path can be selected by optimising a fiscal policy objective function. Several plausible objectives are possible.[3] In this paper, since the assumed objective is to stabilise debt at the target within a finite period, minimising the impact of consolidation on economic growth seems a natural criterion. Such an objective is appealing, especially when the effectiveness of monetary policy is reduced and there are large negative output gaps. The pursuit of growth objectives should not, however, lead to undesirable large output gaps. Thus, it is assumed that the government maximises a discounted sum of real GDP growth and minimises a discounted sum of squared output gaps (implying that positive and negative gaps are treated

Figure 1. **Possible consolidation paths to stabilise debt within a finite horizon**



Note: Different levels of the structural primary balance after reaching the debt target (non-shaded area) stem from differences in nominal GDP growth and in interest rates at the end of the simulation period as a result of endogenous feedback assumed in the baseline specification of the model (see Section 1.2).

Source: Author's calculations.

symmetrically).[4] Both components are summed from the start of the simulations until four years after the end of simulations. The extension of the sample is meant to capture possible large positive growth rates/output gaps resulting from fiscal easing at the end of the simulation period. The government's loss function is given by:

$$LF = min \sum_{i=1}^{k+4} \beta^i \left(-w1 * r_i + w2 * gap_i^2\right) \quad [1]$$

where $w1$ and $w2$ are weights attached to the first and second component, r is real GDP growth rate, gap is the output gap, and β is the time discount factor based on the 1% discount rate. The function ignores other possible important objectives of fiscal policy, like income redistribution or promoting potential growth.

Fiscal consolidation is defined as a change in the structural primary budget balance. The structural balance is corrected for cyclical effects and thus tends to capture discretionary fiscal measures,[5] and the primary balance eliminates effects of changes in interest rates on net costs of debt servicing, which may not always reflect government discretionary decisions.

1.2. The model

The fiscal simulations are based on a stylised, calibrated, small macroeconomic model. It consists of four main blocks determining real GDP growth, inflation, monetary policy and long-term interest rates. It also contains standard accounting identities for the budget balance and debt, and simplified calculation of structural (cyclically-adjusted) budget balances.[6] The description of the main equations focuses on baseline specifications – alternative scenarios are discussed in the next section.

1.2.1. Real GDP growth

Following the assumption adopted in Johansson et al. (2013), the cyclical component of real GDP growth is driven by the closure of the output gap. This implies that with a negative output gap, GDP grows faster than potential GDP, and when the output gap is closed it grows at the potential rate (equation [2]). The closing of the output gap is based on an error-correction specification with an elasticity of –0.2, implying that, all other things being equal, an output gap of 5% will be largely closed after 12 years. This relatively slow pace of convergence is selected to reflect the fact that financial crises can be followed by a prolonged period of slow economic growth (Reinhart and Rogoff, 2009). Potential real GDP growth is assumed exogenous in the baseline (this assumption is relaxed in a scenario with hysteresis – Section 2.4). In addition, real output growth is affected by fiscal policy via a short-term fiscal multiplier (0.5 in the baseline scenario), and by changes in real long-term interest rates with a short-term elasticity of –0.3. The latter draws on the long-term elasticity estimated by Cournède (2010).[7] The full GDP equation is given by:

$$dlog(GDPV) = dlog(GDPVTR) - 0.2 * log(GDPV[-1]/GDPVTR[-1]) + FM * d(NLGXQU) - 0.3 * d(RIRL)/100 \quad [2]$$

where *GDPV* and *GDPVTR* are real actual and potential GDP, *d(NLGXQU)* stands for the change in the structural primary balance as a per cent of GDP, *FM* is the fiscal multiplier and *d(RIRL)* stands for changes in the real long-term interest rate.

1.2.2. *Inflation*

Inflation, defined in terms of the GDP deflator, is modelled as an inflation expectations augmented Philips curve based on the output gap:

$$pi = 0.3 * pi(-1) + 0.7 * infl\_target + 0.2 * GAP \quad [3]$$

where *pi* is the rate of inflation and *GAP* is the output gap. Inflations expectations are assumed to be a weighted average of the past inflation rate and the inflation target (*infl_target*) which is set at 2%.

1.2.3. *Monetary policy*

The monetary policy stance is driven by the standard Taylor rule.[8] A target short-term interest rate (*IRS_ss*) is set in response to deviations of actual inflation (*pi*) from the target (*infl_target*) and the output gap (*GAP*), and the natural (nominal) short-term interest rate is assumed to be 4%:[9]

$$IRS\_ss = 4 + 0.5 * GAP + 1.5 * (pi - infl\_target) \quad [4]$$

Monetary policy is characterised by interest rate smoothing. Consequently, the actual policy interest rate adjusts only gradually to the Taylor rate:

$$IRS = 0.5 * IRS\_ss + 0.5 * IRS(-1) \quad [5]$$

It is assumed that the short-term interest rate cannot fall below zero.

1.2.4. *Long-term interest rates and implied cost of debt*

Following the assumptions in Johansson et al. (2013), the long-term interest rate is modelled as a 10-year average of future short-term policy rates (under a perfect foresight), a term premium (*Tprem*) fixed at 0.7%, and a fiscal risk premium (*Frisk*):

$$\mathrm{IRL} = \mathrm{Tprem} + \textstyle\sum_{i=0}^{9} \mathrm{IRS}_i/10 + \mathrm{Frisk_i} \quad [6]$$

The fiscal risk premium depends on gross debt. It increases by 0.02 percentage point for each percentage point of the excess of gross debt over 75% of GDP and by additional 0.02 percentage point when gross debt exceeds 125% of GDP.

The implied cost of debt (*IRP*) accounts, in a simplified way, for the maturity structure of outstanding debt. It is assumed that the cost of debt is a weighted average of the last period cost of debt and a weighted average of current market interest rates:

$$IRP = (1 - RFSH) * IRP(-1) + RFSH * (0.25 * IRS + 0.75 * IRL) \quad [7]$$

The weights (*RFSH*) are the shares of debt which matures within one year. In the baseline scenario, *RFSH* is set at 0.2, which is close to the 2011 average observed for selected OECD countries.[10]

1.3. Hypothetical economy

The model – as outlined above – is solved for a hypothetical economy which features many characteristics of OECD countries in difficult fiscal positions in 2011. In particular, the initial conditions involve the high overall budget deficit and gross debt, and the large negative output gap (Table 1).[11] In addition, short and long-term interest and inflation rates are assumed to be initially low (only in the baseline scenario). In an illustrative scenario, the policy objective is to reduce debt from 90% to 60% of GDP within 20 years and to ensure its stabilisation at 60% of GDP. The target is set in the vicinity of a level conventionally deemed as safe (Sutherland et al., 2012), and the length and the size of debt reductions are within the post-World War II historic averages of past big debt reductions in the OECD countries (Figure 2).[12] For the baseline simulation, weights of 0.2 and 0.8 in the government loss function are selected.

Table 1. **Main characteristics of the hypothetical economy**

Initial conditions		Constant assumptions over the entire simulation period	
Budget balance	–8.5% of GDP	Potential real GDP growth	2%
Primary budget balance	–5.5% of GDP	Government financial assets	30% of GDP
Structural budget balance	–5.7% of GDPTR	Interest rate earned on financial assets	2%
Structural primary budget balance	–2.9% of GDPTR		
Gross debt	90% of GDP		
Inflation rate	1.5%		
Short-term interest rate	0.5%		
Long-term interest rate	2%		
Output gap	–5% of GDPTR		

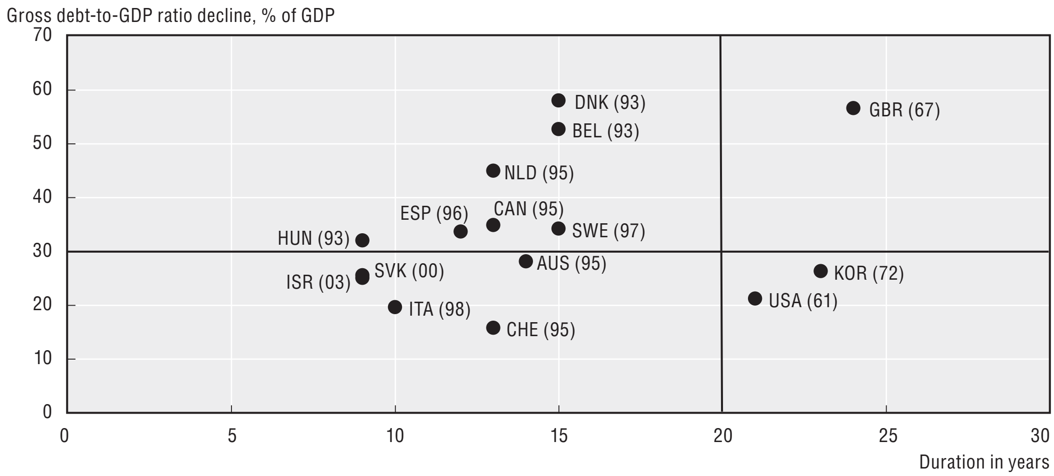
Note: GDPTR is nominal potential GDP.
Source: Author's calculations.

2. Simulation results

2.1. Baseline consolidation path

The parameters of the government loss function in the baseline scenario imply that initial consolidation is gradual and protracted, lasting 16 years (Table 2 and Figure 3). This stems from the dominance of the GDP growth maximisation objective since the paths with large fiscal easing at the end of the simulation period result in very high GDP growth rates (Section 2.2). The long duration of the consolidation phase makes the initial fiscal adjustment sizeable, nearly 10% of GDP. With shorter consolidation, the maximum adjustment would be smaller (Figure 1). As discussed above, initial consolidation is significantly higher than total consolidation of only around 3% of GDP, as it is followed by four years of fiscal easing. The baseline simulation demonstrates that, even with benign assumptions and a rather long period to stabilise debt, high budget deficit and debt make a significant reduction in debt challenging. Thus, unless helped by stronger GDP growth and lower interest rates, the process would be very difficult politically.

Figure 2. **Past debt reductions**



Note: Numbers in parentheses after the country abbreviation refer to the year when debt reduction started.
Source: *OECD Economic Outlook Database* No. 91.

Table 2. **Summary of different consolidation scenarios**

	Scenario	Model assumptions							Initial consolidation		Fiscal easing		Structural budget balance		
		W1	W2	FM	RFSH	IR	Hyst.	AS	Length	Size	Length	Size	Initial	Max.	End
									Years	% of GDP	Years	% of GDP	% of GDP		
1	Baseline	0.2	0.8	0.5	0.2	0	0.0	0.5	16	10.1	4	-6.9	-2.8	7.2	0.3
2	Alternative weights 1	1.0	0.0	0.5	0.2	0	0.0	0.5	19	10.7	1	-8.2	-2.8	7.9	-0.3
3	Alternative weights 2	0.0	1.0	0.5	0.2	0	0.0	0.5	14	9.6	6	-6.3	-2.8	6.8	0.5
4	Interest rate shock	0.2	0.8	0.5	0.2	3	0.0	0.5	11	10.8	9	-7.2	-2.8	7.9	0.7
5	Interest rate shock with higher debt turnover	0.2	0.8	0.5	0.4	3	0.0	0.5	11	10.8	9	-7.0	-2.8	8.0	1.0
6	Hysteresis	0.2	0.8	0.5	0.2	3	0.0	0.5	16	10.4	4	-7.3	-2.8	7.5	0.2
7	Lower automatic stabilisers	0.2	0.8	0.5	0.2	0	0.1	0.5	17	11.1	3	-6.9	-3.8	7.3	0.4
8	Higher fiscal multiplier	0.2	0.8	1.5	0.2	0	0.0	0.3	17	11.3	3	-8.7	-2.8	8.5	-0.3
9	Higher fiscal multiplier with hysteresis	0.2	0.8	1.5	0.2	0	0.1	0.5	17	12.4	3	-9.9	-2.8	9.5	-0.4
10	Higher fiscal multiplier with hysteresis and interest rate shock	0.2	0.8	1.5	0.2	3	0.1	0.5	16	17.0	4	-14.6	-2.8	14.2	-0.4
11	Delayed consolidation under baseline	0.2	0.8	0.5	0.2	0	0.0	0.5	14	10.4	6	- 7.1	-2.9	7.6	0.4
12	Delayed consolidation with interest rate shock	0.2	0.8	0.5	0.2	3	0.0	0.5	9	11.5	11	-7.8	-2.9	8.6	0.8
13	Delayed consolidation with higher fiscal multiplier, hysteresis and interest rate shock	0.2	0.8	1.5	0.2	3	0.1	0.5	16	19.4	4	-17.1	-2.9	16.5	-0.6

Note: *W1/W2* are weights of the government loss function, *FM* is the size of fiscal multiplier, *RFHS* is the share of government debt that matures within one year, *IR* indicates the size of interest rate shock, *Hyst.* is the size of the hysteresis effect, and *AS* is the size of automatic stabilisers.
Source: Author's calculations.

2.2. Alternative weights in the loss function

The choice of weights of the loss function affects the consolidation path (Table 2 – scenarios 1-3 – and Table 3). Under the baseline specification of the model and initial conditions (Table 1), maximising cumulative GDP growth always favours a more gradual

Table 3. **Timing of the budget balance peak for different weights of the loss function**

In years

	W2				
	0.00	0.20	0.50	0.80	1.00
W1 = 1 – W2	19	19	19	16	14

Note: The loss function is: $LF = min\sum_{i=1}^{k+4}\beta^i(-w1 * r_i + w2 * gap_i^2)$.

Source: Author's calculations.

and longer-lasting consolidation (i.e. a back-loaded consolidation). This is primarily due to very high GDP growth rate at the end of the simulation period, resulting from extremely large fiscal easing when implemented within one or two years (Figure 3).[13] In contrast, minimising the sum of squared output gaps tends to favour the path with the peak closer to the middle of the sample as large initial consolidation and large fiscal loosening at the end imply large output gaps, which are penalised. Consequently, increasing the weight of the first component prolongs consolidation, whereas raising the weight of the second component shortens it to a minimum of 14 years (Table 3).

Given the model's assumptions and initial conditions, a smaller annual adjustment implies a longer and larger cumulative fiscal adjustment (Figure 3). Back-loaded consolidation results in higher cumulative growth, but the closing of the output gap is very sluggish and there is a big change in the output gap at the end of the sample. In addition, the initial increase in gross debt is more pronounced and protracted (Section 2.8).

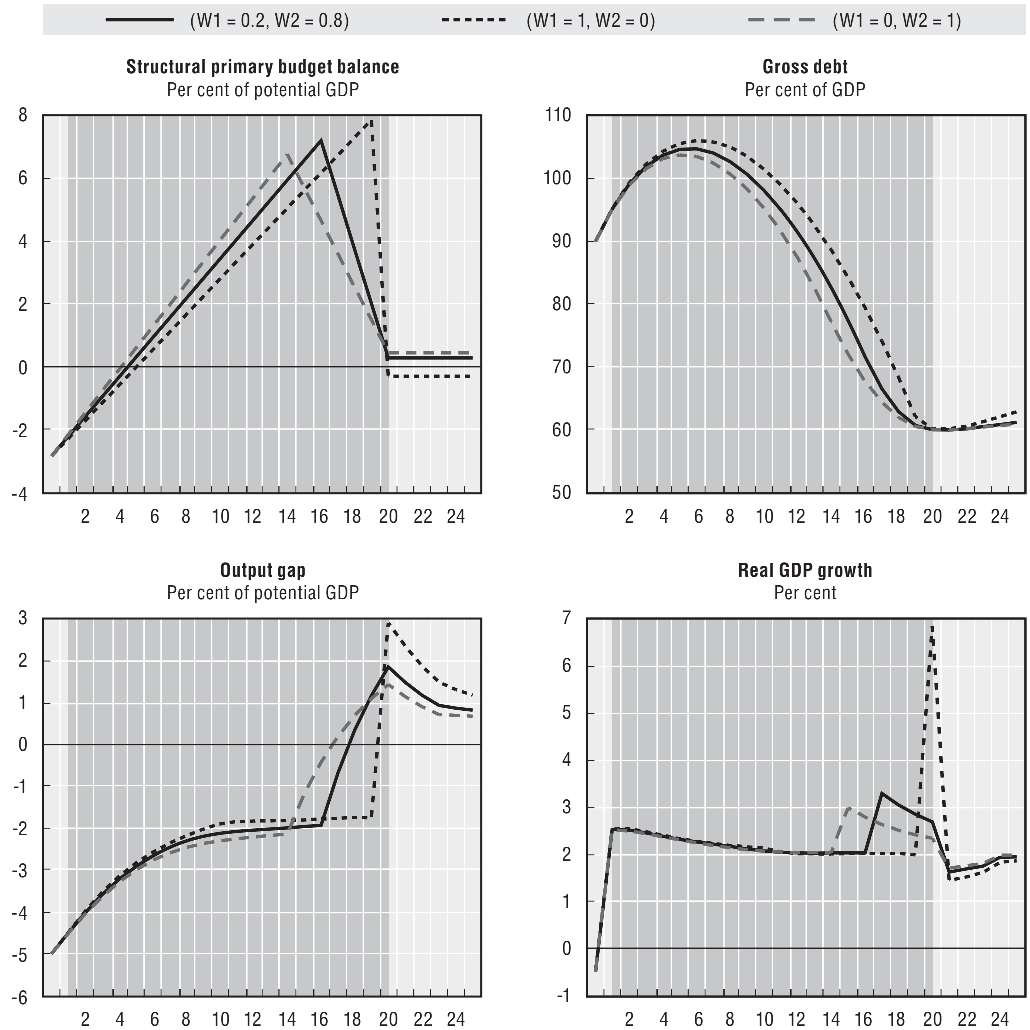
2.3. Interest rate shocks

Contrary to the baseline assumption, some OECD countries in difficult fiscal situations are faced with high market long-term interest rates. This section investigates how a long-term interest rate shock affects fiscal consolidation strategy.

Modelling market reactions is difficult. The model arbitrarily assumes a 3 percentage point increase in long-term interest rates. The shock persists at this level as long as the lagged overall budget deficit is above 6% of GDP and then it declines linearly to zero in line with narrowing of the deficit (it is zero when the budget is balanced).[14] The interest rate shock is transmitted to the implied cost of debt via long-term interest rates as explained in equation [7]. Monetary policy short-term interest rates are not affected by the interest rate shock.

The simulation results suggest that a country faced with adverse and protracted market reactions may find it optimal to shorten and steepen fiscal consolidation compared with the baseline (i.e. opt for front-loaded consolidation). Cumulative consolidation under the interest shock is marginally higher than in the baseline, but it is shorter by five years and the annual adjustment almost doubles (Table 2, scenario 4; Figure A.3). The interest rate shock necessitates larger annual consolidation for all possible paths due to higher debt servicing costs and, initially, a bigger cyclical deficit due to lower GDP growth resulting from higher interest rates and the larger fiscal adjustment (equation [2]). Given the criterion of minimising squared output gaps, very front-loaded and back-loaded consolidation strategies are increasingly penalised, leading to a selection of the structural primary budget balance path with the peak closer to the middle of the sample. Doubling the share of debt which matures within a year (RFSH) from 0.2 to 0.4 changes little the

Figure 3. **Consolidation under different weights of the loss function**



Note: The loss function is: $LF = min \sum_{i=1}^{k+4} \beta^i(-w1 * r_i + w2 * gap_i^2)$.
Source: Author's calculations.

consolidation path. The interest rate shock does not change much the level of real output and of prices at the end of simulation sample (Section 2.9).

It is worth noting that market interest rates pass through to the actual cost of debt with a lag. Even with a higher debt turnover the initial interest rate shock is not fully passed to the cost of debt and this takes around five years (Figure A.3).[15] To some extent this stems from endogenous decline in the short-term interest rate in the context of subdued growth and inflation. This implies that governments may have some time to take policy action when faced with adverse market reactions before debt financing becomes unsustainable. However, the interest rate shock which is limited by assumption to 3 percentage points and this may be viewed as a benign assumption given the observed sovereign risk premia in countries such as Greece and Portugal, and some evidence that the premia can increase nonlinearly with rising fiscal deficits and debt and negative real GDP growth (Haugh et al., 2009; and Cottarelli and Jaramillo, 2012).

2.4. Hysteresis

Prolonged negative output gaps can impact negatively the level of potential GDP, for instance, by discouraging labour participation or by depreciating human capital – the so-called hysteresis effects. Following De Long and Summers (2012), it is assumed that each percentage point of the (lagged) output gap reduces the growth rate of potential GDP by 0.1 percentage point (i.e. the level of potential GDP is permanently reduced). The hysteresis effect is assumed symmetric, i.e. positive output gaps increase the level of potential output. Under the assumed parameterisation, the presence of hysteresis does not change significantly the optimal consolidation path compared with the baseline (Table 2, scenario 6), but when it can affect the adjustment path when interacted with higher fiscal multipliers and interest rate shocks and have a considerable and permanent impact on the GDP level – see Section 2.9.

2.5. Automatic stabilisers

The presence of automatic stabilisers complicates consolidation as part of the structural adjustment is offset by the deterioration of fiscal balances due to the cycle. The size of automatic stabilisers also impacts the estimate of the initial structural balance. For a given overall budget deficit and a negative output gap, higher automatic stabilisers imply a higher structural balance. The opposite is true for lower values. Since the baseline assumption about the size of automatic stabilisers (0.5) corresponds to the upper range of estimates for the OECD countries observed mainly in western, continental European countries (Girouard and André, 2005), a sensitivity test assumes a lower value of 0.3 (which equals the estimates for Japan and the United States).

It turns out that lowering automatic stabilisers has a very small impact on the optimal consolidation path (Table 2, scenario 7). Total and initial consolidations are slightly larger than in the baseline since the initial level of the structural primary deficit is higher with lower automatic stabilisers.

2.6. Fiscal multipliers

The size of fiscal multipliers is at the centre of discussions about the pace of fiscal consolidation. The fiscal multiplier assumed in the baseline scenario of 0.5 is around the average of what is viewed as normal aggregate multipliers in the OECD countries (IMF, 2010; Barrell et al., 2012). However, there are several arguments that in current circumstances fiscal multipliers can be much higher. For instance, the multipliers tend to be larger during recessions as expansionary spending is less likely to crowd out private demand (Auerbach and Gorodnichenko, 2012), when monetary policy is constrained by the zero bound (Christiano et al., 2009; Woodford, 2011), or when consumers have no access to credit and are constrained to consume only out of their current income (Gali et al., 2007). Thus, this section investigates an alternative scenario where fiscal multiplier is increased to 1.5 as long as the output gap is below –3% of GDP. The latter condition is added to avoid a situation that fiscal easing excessively stimulates the economy when the output gap is positive and monetary policy functions normally (i.e. monetary policy interest rates are significantly above zero).

The higher fiscal multiplier does not change much fiscal consolidation strategy in terms of the duration and size of the fiscal effort, with initial consolidation longer by one year and slightly larger than in the baseline. This reflects the fixed deadline for reaching the debt target and the choice of loss function. However, the GDP cost of such consolidation is very high, resulting in large and persistent negative output gaps and in inflation and monetary policy rates close to zero for an extended period (Section 2.9).

2.7. Delayed consolidation

Given possible large negative consequences of consolidation on growth and weaker recovery, postponing consolidation (or even pursuing fiscal stimulus) has been suggested. To illustrate potential consequences of such a strategy, three scenarios (the baseline, interest rate shock and combined higher fiscal multiplier, hysteresis and the interest rate shock) are re-run assuming that the start of consolidation and the timing of reaching the debt target are delayed for two years. This implies that the structural primary balance is left unchanged for two initial years and consolidation starts only in the third year. The deadline to stabilise debt is kept unchanged at 20 years, so the total simulation sample is 22 years. Total consolidation is slightly higher with a shorter duration and a larger annual adjustment than in the respective scenarios with an immediate start of the adjustment (Table 2, scenarios 11-13; and Figure A.5). The build-up of debt is however larger (Section 2.8).

2.8. Self-defeating consolidation

Recent announcements of consolidation plans in the OECD countries caused concerns that fiscal adjustments may actually increase government budget deficits and debt (i.e. may result in a self-defeating consolidation). This may occur, for instance, when increased tax rates reduce economic activity and in turn the tax base, which – in contrast to the intentions – diminishes tax revenues and in turn – via higher deficit – increases debt.

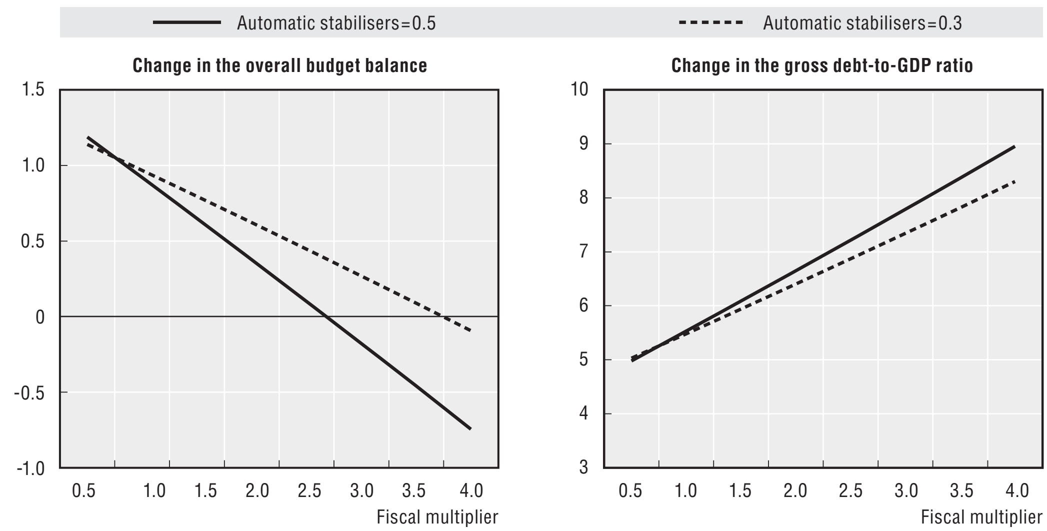
In the logic of the model presented, self-defeating consolidation arises when the improvement in the structural primary balance lowers GDP growth (via the fiscal multiplier), which in turn deteriorates the cyclical component of the budget balance (via automatic stabilisers) and results in no improvement or even a deterioration in the overall budget balance. This effect depends on the size of the fiscal multiplier and of automatic stabilisers.[16] The higher the fiscal multiplier for a given size of automatic stabilisers, the bigger the effect. Lowering the automatic stabilisers' parameter weakens this relation. Model simulations under the baseline specification[17] show that for reasonable ranges of automatic stabilisers and fiscal multipliers, a structural fiscal adjustment of 1% of GDP is not likely to lead to a decline in the overall budget balance in the first year (Figure 4).

The impact of structural consolidation on the debt-to-GDP ratio depends on the erosion in the ratio by nominal GDP growth and the resulting budget balance.[18] For a given structural adjustment, a higher fiscal multiplier dampens GDP growth by more and thus the gross debt ratio increase is larger (Figure 4).

Table 4 summarises changes in the overall budget balance, the primary structural balance and gross debt (all as ratios to GDP) for selected scenarios which differ largely from the baseline (detailed results are in Table A.2). In three scenarios involving the interest rate shock, especially when combined with the higher fiscal multiplier, the increase in the overall budget balance is indeed smaller than the structural improvement during the first three years, at most by half. This reflects raising net interest payments and the widening of the output gap (i.e. the increase in the cyclical deficit). In none of the scenarios, there is a full or negative offset though.[19]

Figure 4. **First-year change in the budget balance and debt following 1% of GDP structural consolidation**

Per cent of GDP



Note: Calculations are based on model simulations with the initial conditions as assumed in Table 1, the assumption that inflation and interest rates remain unchanged and GDP growth is determined as in equation [2].
Source: Author's calculations.

Table 4. **Changes in the structural primary balance, overall balance and debt in selected scenarios**

	Scenario	Cumulative change during first 3 years of consolidation in:		Gross debt	
		Structural primary balance	Overall balance	Maximum	Reached in year
		% of potential GDP	% of GDP	% of GDP	
1	Baseline	1.9	3.4	105	6
4	Interest rate shock	2.9	2.7	109	6
5	Interest rate shock with higher debt turnover	3.0	2.6	109	6
8	Higher fiscal multiplier	2.0	3.2	108	6
9	Higher fiscal multiplier with hysteresis	2.2	3.2	111	7
10	Higher fiscal multiplier with hysteresis and interest rate shock	3.2	1.6	126	8
11	Delayed consolidation under baseline	2.2	2.7	110	7
12	Delayed consolidation with interest rate shock	3.8	3.1	116	7
13	Delayed consolidation with higher fiscal multiplier, hysteresis and interest rate shock	3.6	1.5	137	10

Note: For specifications of scenarios, see Table 2.
Source: Author's calculations.

In case of the immediate start of consolidation, the debt-to-GDP ratio begins to decline only after seven or eight years and in most scenarios gross debt increases by around 15-20% of GDP, with the exception of the scenario involving the higher fiscal multiplier, hysteresis and the interest rate shock when debt increases initially by 36% of GDP. The continued increase in debt after the start of the consolidation was observed in the past consolidation episodes in the OECD countries (Blöchliger et al., 2012). Delaying the start of consolidation results in a higher and longer debt build-up, in the worst case by up to 47% of GDP, lasting more than a decade.

By and large, the tested specifications of the parameters suggest that a fully-fledged self-defeating consolidation is rather unlikely, but a large offset of the structural adjustment can be expected in initial years as well as only a delayed debt reduction.

2.9. GDP costs of consolidation

GDP growth and inflation vary among different consolidation paths of the alternative scenarios. Under the assumptions of the model, involving an endogenous reaction of the central bank, hysteresis is the main factor impacting negatively real growth. When combined with the higher fiscal multiplier and interest rate shock, real GDP can be lower after 20 years by 14% compared with the baseline scenario and even by 20% when this scenario involves delayed consolidation (Table 5). Most of these losses would be permanent due to the decline in potential output. Given very weak GDP growth, a country would experience almost two decades of large and negative output gaps (Figures A.4 and A.5). This is due to a combined effect of large and protracted consolidation (reflecting delayed consolidation and a weak cyclical improvement of the budget balance) and hysteresis magnified by the higher fiscal multiplier (as it results in larger output gaps). For scenarios without hysteresis, the differences in real GDP growth are small and will be ultimately eliminated with the closing of the output gap. The scenarios with the higher fiscal multiplier, and thus larger output gaps, have also much lower inflation – after 20 years, the price level would be by more than 12% lower than in the baseline. Inflation growth is even weaker when fiscal multipliers interact with hysteresis and the interest rate shock, resulting in the price level of up to 20% lower compared with the baseline. In the latter case, the inflation rates are close to or below zero for around a decade (Figures A.4 and A.5).

Table 5. **GDP costs of different consolidation scenarios**

	Scenario	Model assumptions							Real GDP	GDP deflator	Nominal GDP
		W1	W2	FM	RFSH	IR	Hyst.	AS	Level change after 20 years, in %		
1	Baseline	0.2	0.8	0.5	0.2	0	0.0	0.5	59.4	28.4	87.8
2	Alternative weights 1	1.0	0.0	0.5	0.2	0	0.0	0.5	61.0	27.6	88.6
3	Alternative weights 2	0.0	1.0	0.5	0.2	0	0.0	0.5	58.7	28.8	87.5
4	Interest rate shock	0.2	0.8	0.5	0.2	3	0.0	0.5	58.6	28.7	87.4
5	Interest rate shock with higher debt turnover	0.2	0.8	0.5	0.4	3	0.0	0.5	58.6	28.6	87.2
6	Hysteresis	0.2	0.8	0.5	0.2	3	0.0	0.5	52.4	28.3	80.7
7	Lower automatic stabilisers	0.2	0.8	0.5	0.2	0	0.1	0.5	59.4	27.6	87.0
8	Higher fiscal multiplier	0.2	0.8	1.5	0.2	0	0.0	0.3	60.9	16.0	76.9
9	Higher fiscal multiplier with hysteresis	0.2	0.8	1.5	0.2	0	0.1	0.5	47.3	14.5	61.8
10	Higher fiscal multiplier with hysteresis and interest rate shock	0.2	0.8	1.5	0.2	3	0.1	0.5	45.1	7.8	52.9
11	Delayed consolidation under baseline	0.2	0.8	0.5	0.2	0	0.0	0.5	57.8	32.5	90.3
12	Delayed consolidation with interest rate shock	0.2	0.8	0.5	0.2	3	0.0	0.5	58.2	32.7	90.9
13	Delayed consolidation with higher fiscal multiplier, hysteresis and interest rate shock	0.2	0.8	1.5	0.2	3	0.1	0.5	39.0	8.4	47.4

Note: *W1/W2* are weights of the government loss function, *FM* is the size of fiscal multiplier, *RFHS* is the share of government debt that matures within one year, *IR* indicates the size of interest rate shock, *Hyst.* is the size of the hysteresis effect and *AS* is the size of automatic stabilisers. For the sake of comparison, real GDP and price levels refer to the 20th year also for the scenarios with delayed consolidation, even though stabilisation of debt is achieved only in the 22nd year.
Source: Author's calculations.

Reaching the assumed debt target of 60% of GDP within 20 years in the presence of hysteresis and higher fiscal multipliers, especially in the case of delayed consolidation, can thus be very costly for the economy. This stresses the need of setting a realistic debt target within a realistic deadline. This also implies that lowering debt to prudent levels will likely be very long process in many OECD countries, since achieving high budget surpluses over many years, even under the benign baseline scenario, would be politically difficult unless debt dynamics is helped by the improvement in interest-growth differentials.

3. Conclusions

The main implications of the analysis of this paper are as follows:

- Lowering high debt requires large and protracted consolidation, but if the aim is to stabilise debt at a lower level not all consolidation has to be permanent. This stems from the fact that the budget balance needed to stabilise debt at a low target is usually smaller than the level of budget balance needed to reduce initial high debt. In the scenarios considered, on average three-quarters of initial budget tightening can be reversed. The method employed and the two alternative *ad hoc* methods presented in Annex A ensure that the budget balance is consistent with debt stabilisation and they imply lower overall consolidation needs than the methods adopted in the literature which do not meet this condition.
- If a government is fully committed to meeting the debt target within a finite horizon, it could be optimal, from the growth maximisation perspective subject to the minimisation of extreme output gaps, to front-load somewhat the fiscal adjustment in case of an exogenous shock which raises government bond yields.
- Delaying the start of consolidation and the timing of reaching the debt target by two years has generally little implications for the size of initial consolidation. However, with high fiscal multipliers, interest rate shocks and hysteresis effects, this strategy would result in much higher initial debt and much slower nominal GDP growth.
- Ambitious debt targets in the context of adverse circumstances (large fiscal multipliers, hysteresis effects and interest rate shocks) can lead to a protracted spell of negative output gaps and deflation. This highlights the need to select realistic fiscal targets within realistic deadlines consistent with prevailing market conditions.
- Under the model specifications, a fully-fledged self-defeating consolidation, when the improvement in the structural primary balance results in no improvement or even a deterioration in the overall budget balance, is rather unlikely, but a large offset of the structural adjustment can be expected in initial years. Moreover, consistent with past experience, debt usually starts to decline several years after the start of consolidation.

The results presented are specific to the model assumptions, especially GDP growth dynamics and market reactions, but the sensitivity analysis of key parameters can still be informative about the expected effects of fiscal consolidation. The analysis could be further extended by investigating the effects of particular consolidation instruments as fiscal multipliers and implications for potential growth are likely to differ across various instruments, as well as of uncertainty, for instance by applying stochastic simulations. Moreover, in the context of concerted consolidation in many OECD countries, accounting for international spillovers would be desirable.

Notes

1. Several studies find negative correlation between high government debt, above 80-90% of GDP, and real GDP growth (Caner et al., 2010; Checherita and Rother, 2010; Kumar and Woo, 2010; Cecchetti et al., 2011), however the causality from debt to growth has been questioned (Panizza and Presbitero, 2012) and the threshold effect and its level hotly debated (Égert, 2013).

2. See for instance European Commission (2009), Sutherland et al. (2012) and OECD (2011).
3. For instance, Kanda (2011) uses a loss function based on the squared output gap and the squared fiscal sustainability gap (the latter is measured as the European Commission's S2 sustainability indicator – European Commission, 2009).
4. An alternative specification could include a maximisation of potential growth. This would, however, require feedback from fiscal policy to potential growth. This is not the case in the baseline scenario of this paper, but one form of such a feedback is assumed in simulations with hysteresis effects – see Section 2.4.
5. Calculating structural primary balances in practice is challenging and there is large uncertainty about derived consolidation measures (Bi et al., 2013).
6. The cyclical adjustment applies an aggregate elasticity (0.5 in the baseline scenario) to the level of the output gap.
7. This is somewhat lower than the estimated elasticity for the euro area of –0.19 by Guichard et al. (2009).
8. An alternative assumption would have to be made to account for a situation when monetary policy is not tailored to a particular economy, for instance as in the case of members of the euro area. A simple solution would be to assume an exogenous path of policy interest rates.
9. The nominal natural rate of 4% is assumed to be equal to the sum of real potential GDP growth (2%) and an inflation target (2%).
10. The average maturity in G10 countries in 2011 ranged from five years in the United States to 13 years in the United Kingdom (Rawdanowicz et al., 2011).
11. For instance, the average of budget deficit in the top quartile of OECD countries was around 8.5% of GDP in 2011, while average gross debt was around 110% of GDP, i.e. higher than assumed for the hypothetical economy.
12. Prudent debt levels are often selected in pragmatic and somewhat arbitrary ways. They are likely to vary across countries, reflecting diversified fundamentals, current conditions, preferences and future contingent and contractual liabilities (like pension obligations). Past debt reductions were, however, not only driven by the improvement in the structural primary balance.
13. This result does not change even if the time discount rate is increased from 1% to 5%, reducing the weight of growth rates at the end of the 20-year period. However, the higher discount rate would imply more back-loaded consolidation, according to the output gap criterion, as positive output gaps driven by fiscal easing at the end of the period would be discounted by more and thus less penalised. Conversely, without any time discounting, the output gap criterion would pick consolidation lasting 13 years instead of 14 under the baseline assumptions.
14. The budget deficit is found empirically to be one of the determinants of sovereign risk premia, along with gross debt and real GDP growth (Haugh et al., 2009; and Cottarelli and Jaramillo, 2012).
15. This low pass-through partly owes to the assumption that the government refinances short-term debt at the level of monetary policy rates.
16. The assumed cyclical adjustment is based on the level of the output gap and thus it impacts the size of the offset as well. The offset increases as the negative output gap narrows.
17. The real interest rate effect in the GDP equation is omitted as it depends on the path of structural budget balance and monetary policy rates over the following ten years.
18. This stems from the debt dynamics equation: $\Delta gd_t = -g_t/(1 + g_t) * nd_{t-1} + \Delta a_t - b_t$, where *gd/nd* is gross/net debt, *g* is the real GDP growth rate, *a* is financial assets and *b* is the overall budget balance. The erosion of the debt ratio is a function of initial net debt and a given growth rate. Consequently, the increase in debt would be smaller for higher initial debt (higher erosion effect).
19. In fact, for four scenarios (the baseline and the scenario with the higher fiscal multiplier but without the interest rate shock) the overall balance even increases initially by more than the structural primary balance. This primarily stems from lower interest payments on debt, following the decline in long- and short-term market interest rates, and in the baseline scenario, also from a cyclical improvement of the budget balance as the negative output gap closes.

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ANNEX A

Calculating consolidation needs

Consolidation needs to achieve a given debt target can be calculated in several ways. The choice of a particular method has implications for the results and thus for the on-going policy debates on the size and pace of a fiscal adjustment. This annex highlights main determinants of such calculations, explains *pros* and *cons* of the existing methods and proposes two alternative solutions in addition to the approach discussed in the main paper.

Debt dynamics

Consolidation requirements are derived from the standard debt dynamics equation:[1]

$$\mathrm{d_t} = \frac{1+i}{1+g}\mathrm{d_{t-1}} - \mathrm{pb_t} \qquad \text{[A1]}$$

where d_t is the debt-to-GDP ratio, pb_t is the primary balance-to-GDP ratio, i is the nominal interest rate paid on debt, g is the growth rate of the nominal GDP; i and g are assumed not to vary over time. This assumption is relaxed below. Given equation [A1], the debt ratio in year $N(d_N)$ can be expressed as a function of initial debt (d_0):

$$\mathrm{d_N} = \mathrm{d_0}\left(\frac{1+i}{1+g}\right)^{\mathrm{N}} - \sum_{t=1}^{N}\mathrm{pb_t}\left(\frac{1+i}{1+g}\right)^{\mathrm{N-t}} \qquad \text{[A2]}$$

The equation implies that the debt level in year N is a sum of discounted initial debt and a discounted sum of primary budget balances between the initial year and year N.

The consolidation requirement to reach a certain debt level after N years (the so-called fiscal gap) can thus be given by:

$$\mathrm{pb_N} - \mathrm{pb_0} = \mathrm{d_0}\left(\frac{1+\mathrm{i}}{1+\mathrm{g}}\right)^{\mathrm{N}} - \sum_{\mathrm{t=1}}^{\mathrm{N-1}}\mathrm{pb_t}\left(\frac{1+\mathrm{i}}{1+\mathrm{g}}\right)^{\mathrm{N-t}} - \mathrm{d_N} - \mathrm{pb_0} \qquad \text{[A3]}$$

Hence, consolidation needs increase with higher initial debt and interest-growth rate differential ($\frac{1+i}{1+g} \cong 1 + i - g$), and with the lower debt target and initial primary balance.

With time-varying interest rates and nominal GDP growth rates, debt dynamics equations [A1]-[A3] become:

$$\mathrm{d_t} = \frac{1+i_t}{1+g_t}\mathrm{d_{t-1}} - \mathrm{pb_t} \qquad \text{[A1']}$$

$$\mathrm{d_N} = \mathrm{d_0}\prod_{\mathrm{t=1}}^{\mathrm{N}}\frac{1+i_t}{1+g_t} - \sum_{t=1}^{N-1}\mathrm{pb_t}\prod_{\mathrm{k=t+1}}^{\mathrm{N}}\frac{1+i_k}{1+g_k} - \mathrm{pb_N} \qquad \text{[A2']}$$

$$\mathrm{pb_N} - \mathrm{pb_0} = \mathrm{d_0}\prod_{\mathrm{t=1}}^{\mathrm{N}}\frac{1+i_t}{1+g_t} - \sum_{t=1}^{N-1}\mathrm{pb_t}\prod_{\mathrm{k=t+1}}^{\mathrm{N}}\frac{1+i_k}{1+g_k} - \mathrm{d_N} - \mathrm{pb_0} \qquad \text{[A3']}$$

One-off and constant adjustment approaches

The magnitude of the fiscal gap is usually analysed in terms of the starting and end conditions as well as the interest-growth rate differential, but less so in terms of the evolution of the primary balance over time. In particular, some studies assume that the entire consolidation takes place in the first year and the primary balance is kept constant at the level that ensures reaching the debt target at the end of the simulation period (European Commission, 2009; Sutherland et al., 2012) – the one-off adjustment in Figure A.1.

There are two problems with this fiscal gap measure. *First*, for certain values of d_N, N, and interest and GDP growth rates, consolidation can be very large, especially if initial debt is considerably above the target. Such an adjustment can be neither desirable due to possible strong recessionary effects, with knock-on effects on government finances in the short term, nor feasible due to political constraints. *Second*, the primary balance at the end of the period is likely to differ sizeably from the one that stabilises debt at the target, and keeping it unchanged will continue lowering debt instead of stabilising. To address the first problem a more gradual fiscal tightening would be required, implying larger and longer initial cumulative consolidation. One simple solution is to assume constant annual consolidation lasting over the entire simulation period with the size of the adjustment implied by the condition to reach the debt target at the end of the simulation period (the constant adjustment in Figure A.1). This form of the adjustment implies a linear path of the primary balance and was used in the *OECD Economic Outlook 89* to show consolidation requirements with alternative debt targets (OECD, 2011).[2] The gradual consolidation implies a bigger total fiscal adjustment than under one-off consolidation (see Figure A.1 and further below). Although, in most cases the pace of consolidation will be moderate, this method does not address the second problem.

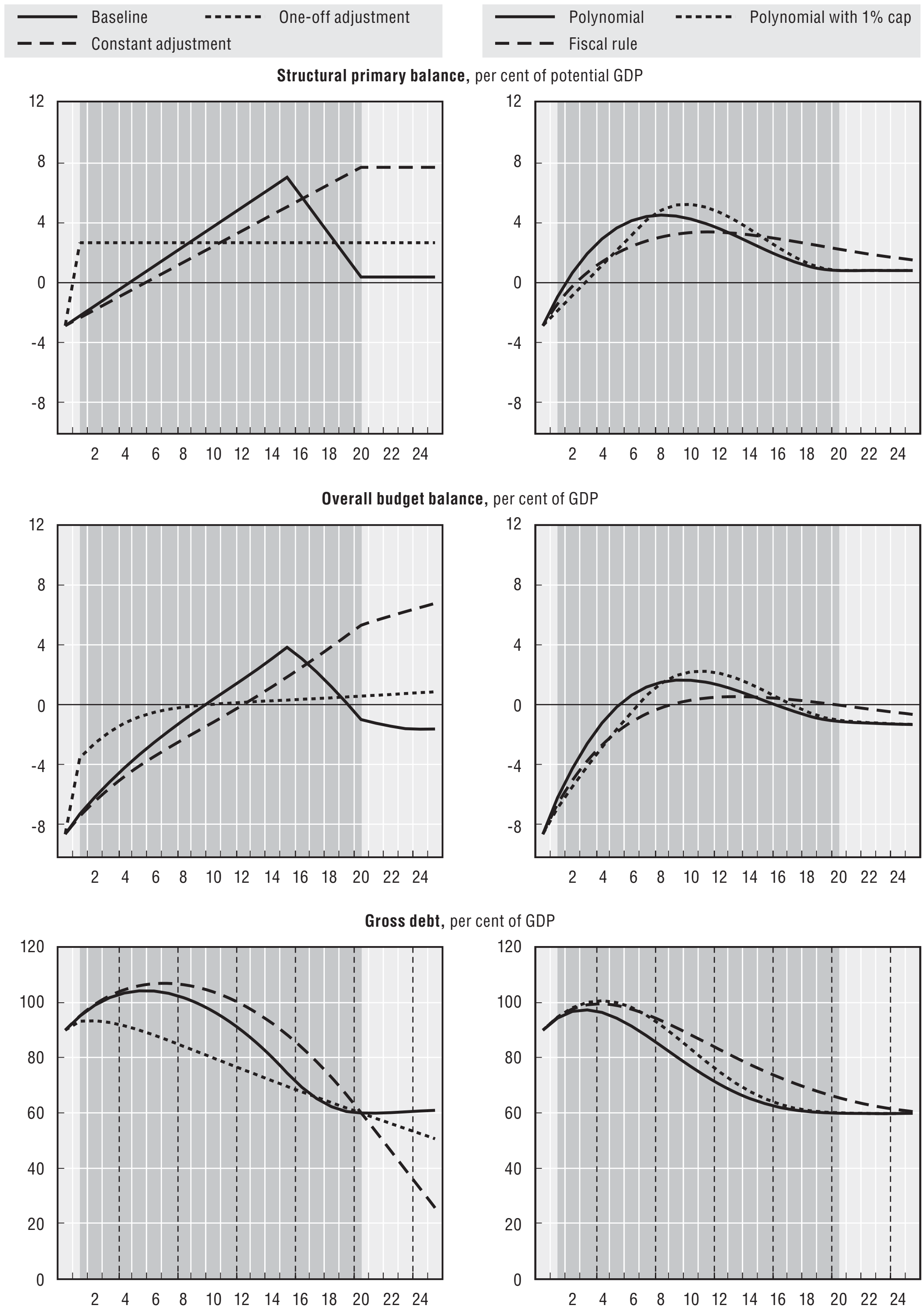
Alternative approaches

The consolidation path proposed in the main paper, which assumes constant annual adjustment during the consolidation and fiscal easing phase, ensures debt stabilisation at the end of that simulation period and avoids large swings in the fiscal policy stance. Other, more pragmatic and ad hoc approaches suited for simple illustrative calculations of consolidation needs are possible. Two of them are proposed in this annex. One adopts a mathematical approach based on a third-order polynomial and the other utilises a debt-stabilising fiscal rule. Both approaches address the two weaknesses of the fiscal gaps discussed above by imposing on the primary balance a gradual initial adjustment and convergence to a level guaranteeing debt stabilisation at the target.

Third-order polynomial approach

Many mathematical functions of the primary balance are possible to ensure its convergence to the level that stabilises debt at its target and to avoid large changes in the fiscal policy stance at the beginning and at the end of the adjustment period. In this annex, a third-order polynomial function is chosen. It not only meets these two conditions but also provides a plausible adjustment path which is easy to implement. In addition, it implies a smooth adjustment – a feature that is not essential from the policy point of view though. For a given (finite) duration of consolidation, a third-order polynomial function ensures that the primary balance improves at a diminishing rate (i.e. is concave), implying front-loaded consolidation, and that at the end it converges at a diminishing rate to a local

Figure A.1. **Different consolidation paths**



Note: Assumptions behind the presented adjustment paths are explained in the text. Baseline refers to the approach based on the optimisation of the policy loss function as described in the main paper (Section 1.2).
Source: Author's calculations.

minimum (i.e. is convex), implying smooth primary balance convergence (see Figure A.1 for the shape of such a function).

In practical terms, one has to find parameters of the following third-order polynomial so that the path of the primary balance guarantees reaching the debt target given the model's assumptions and debt accounting identities:

$$pb_t = \beta_1 t^3 + \beta_2 t^2 + \beta_3 t + \beta_4 \qquad [A4]$$

where t stands for time (1… N).[3] Given projections of interest rates (i_t) and nominal GDP growth (g_t), four unknown parameters of the polynomial can be obtained by solving a system of four equations requiring that: *i)* the primary balance equals its initial level (pb_1) in the first year ($t = 1$); *ii)* in year t_x the primary balance is at a level pb_x that ensures reaching the debt target in year N; *iii)* the primary balance equals its target ($pb_N = \frac{i_N - g_N}{1+g_N} d_N$)[4] in the last year ($t = N$); and *iv)* the last period's primary balance is a local minimum ($3\beta_1 N^2 + 2\beta_2 N + \beta_3 = 0$). pb_x is chosen iteratively by solving equation [A2'] so that debt settles at its target in year N.

The system is formally presented in a matrix form:

$$\begin{bmatrix} pb_1 \\ pb_x \\ pb_N \\ pb_N \end{bmatrix} = \begin{bmatrix} 1^3 & 1^2 & 1 & 1 \\ x^3 & x^2 & x & 1 \\ N^3 & N^2 & N & 1 \\ 3N^2 & 2N & 1 & 0 \end{bmatrix} * \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \\ \beta_4 \end{bmatrix}$$

Its solution is found as $\beta = X^{-1}PB$, where β is a vector of estimated parameters, X is a matrix of data points as given above, and PB is a vector of primary balances.

For given starting and end conditions and the time within which the debt target has to be reached, fitting equation [A4] does not ensure on its own that initial consolidation will not be very large (though it definitely avoids large fiscal loosening at the end). To this end, the polynomial has to be combined with a consolidation cap, limiting the annual adjustment to a certain threshold. The threshold can be selected based on past episodes of fiscal adjustments, taking into account a current state of the economy regarding the output gap, expected fiscal multipliers, etc. If the solution of the model implies a change in the primary balance in the first year which is bigger than the consolidation cap, the change is limited to the cap and equation [A2'] has to be solved again but starting from year 2 and with initial conditions as of the previous year. This process is repeated until the consolidation cap does not bind in any subsequent year.

The consolidation needs calculated by the polynomial method to be fully informative would be better presented by at least two numbers, expressing initial and total consolidation. For high starting values of debt relative to the target, initial cumulative consolidation (i.e. a cumulated improvement in the primary balance from its initial to the maximum level) is likely to be larger than total consolidation (i.e. a difference between initial and the last period's primary balance) – see the illustration below. This is in contrast to the fiscal gaps calculated based on the one-off and constant adjustments approaches, which can be summarised in one number.[5] In addition, in the polynomial method it could be instructive to provide information on the duration of fiscal tightening. In some cases, however, the smooth profile of the primary budget balance implies very small changes lasting several years which are not policy relevant. As a result the duration of fiscal tightening may be exaggerated.

Debt-stabilising fiscal rule

Gradual consolidation consistent with debt stabilisation at the target can also be worked out from a debt-stabilising fiscal rule. Given the aim to stabilise the debt-to-GDP ratio around a target, the fiscal rule has to be derived from the debt dynamics equation and consequently it has to simultaneously control for debt and the fiscal balance. After reaching the debt target, the debt ratio will stabilise only if the overall budget balance ratio settles at a particular level determined by nominal GDP growth and net debt: $b^* = -g/(1 + g)(d^* - a^*)$, where b^* is the debt-stabilising budget balance, g is the growth rate of nominal GDP, d^* is target gross debt and a^* is target financial assets (the last bracket shows net debt; all variables but g are expressed in per cent of GDP). This condition is equivalent to the debt stabilisation requirement for the primary balance of the polynomial approach (see requirement *iii)* above).

The rule can thus be given by:

$$\Delta b_t = \alpha(b^* - b_{t-1}) + \beta(d_{t-1} - d^*) \qquad [A5]$$

where b_t is the current year's overall budget balance, b^* is the debt-stabilising overall budget balance (which is a function of the projected GDP growth rate and debt and asset targets), d_{t-1} is previous year debt, d^* is the debt target (all expressed in per cent of GDP), α and β are positive parameters determining the speed of convergence of the budget balance and debt to their targets.

If the rule were to be used in a policy context, it should allow for cyclical fluctuations of fiscal balances. The adjustment for automatic stabilisers can be done based on the output gap (the standard practice) or, alternatively, based on the difference between actual and potential GDP growth rates.[6] The latter method avoids using output gaps, whose estimates are usually revised more than the estimates of actual and potential GDP growth rates (Koske and Pain, 2008; Bouis et al., 2012), and could facilitate monitoring of the rule and communication with the public. Moreover, it could allow for the use of nominal growth, ensuring consistency with the calculation of b^* and requiring the authorities to implicitly reveal their inflation target.

The two approaches of accounting for automatic stabilisers have different implications for the pace of consolidation over the cycle. For instance, the use of the output gap implies less fiscal tightening than the use of the growth rate differential when the output gap is negative and closing as the actual GDP growth rate already exceeds the potential growth rate (Figure A.2). Consequently, after a recession the former method would allow for larger and more prolonged automatic stabilisers than the latter method. For this reason, the output gap proxy is chosen in this annex.

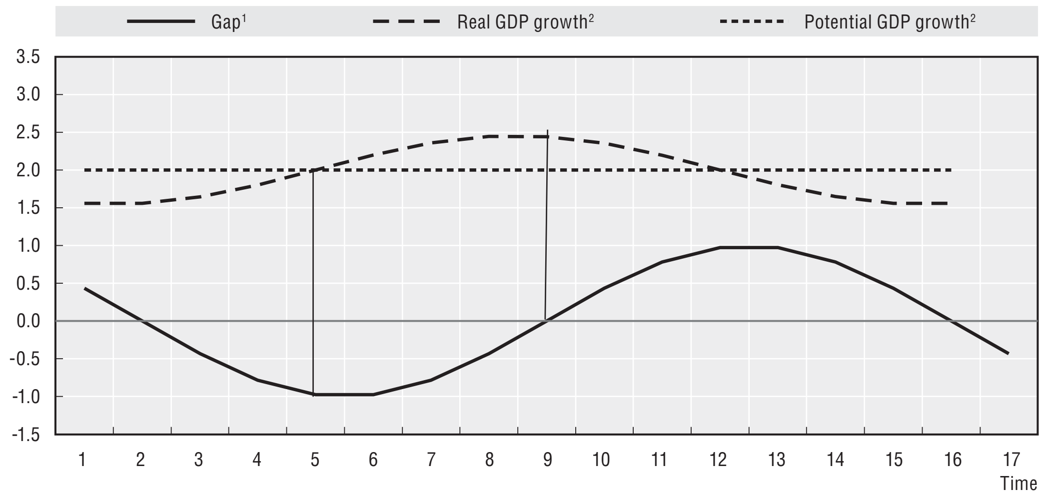
The complete rule is given by:

$$\Delta b_t = \alpha(b^* - b_{t-1}) + \beta(d_{t-1} - d^*) + \gamma gap_t \qquad [A6]$$

where gap_t is the output gap and γ is a positive parameter reflecting the size of automatic stabilisers. The rule refers to the overall balance, and not to the primary balance, as this makes the rule easier to monitor and more internally consistent. This is in contrast to the approaches discussed above, which focus on the structural primary balance.

The rule requires the overall budget balance to improve when, in the previous year, it was below its target, debt was above its target or when the (projected) output gap for the current year is positive. However, when the output gap is closed and the fiscal balance and

Figure A.2. **Relation between the output gap and the potential and actual GDP growth rates**



1. Per cent of potential GDP.
2. Per cent.
Source: Author's calculations.

debt are at their targets, the budget balance has to remain unchanged. When α and β are below 1, the adjustment to targets is gradual (see below). By construction, the rule would allow for a full operation of automatic stabilisers only when debt and the fiscal balance are at their targets.[7] Consequently, the rule can be used to measure fiscal policy room to accommodate negative shocks (the so-called fiscal space). The rule can be effective in preventing debt ratchet effects. No budgetary slippages would be forgotten, as deviating further from the targets will require more consolidation in the future. In contrast, a better budget outcome will lower the consolidation need in the following year.

Despite allowing for automatic stabilisers, the fiscal rule implies large initial consolidation when the budget balance and gross debt are far from their targets. This may not be desirable, especially when a large output gap persists or when there is a sizeable increase in gross debt resulting from the purchase of financial assets (without changing net debt as it can be the case after a financial crisis).[8] Consequently, a consolidation cap can be applied to the fiscal rule similarly to the polynomial approach.

The fiscal rule cannot however control precisely the timing of reaching a debt target and the size of initial consolidation, as these outcomes depend not only on parameters α and β but also on initial conditions. This may complicate comparing the size of consolidation requirements with other methods, but is less of a problem from the point of view of fiscal policy guidance.

Parameters α and β can be chosen pragmatically in model simulations under different assumptions (including starting and end values) as well as economic shocks so as to render reasonable and robust results. They could also be based on the existing fiscal rules. In the case of EU countries, for example, parameter β could be set at 0.05 in line with the new debt convergence rule, requiring the EU countries to reduce the excess of the gross debt ratio over the Treaty limit of 60% by 1/20th on average over three years (Barnes et al., 2012). Parameter γ could reflect existing estimates of the size of automatic stabilisers.

Illustration

To illustrate differences in the size of consolidation needs resulting from various possible adjustment paths, stylised calculations are done for the hypothetical economy under the baseline specification describe in Section 1.2 of the main paper. The country is expected to reach the debt target of 60% of GDP within 20 years. Simulations assume feedback from consolidation to growth, from interest rates to growth and from debt to interest rates.

The model specifications imply the following parameters of the polynomial:

$$pb_t = 0.004t^3 - 0.196t^2 + 2.481t - 5.139, \qquad t \in [1,21] \qquad \text{[A7]}$$

and the fiscal rule is parameterised as follows:

$$\Delta b_t = 0.4(b^* - b_{t-1}) + 0.05(d_{t-1} - d^*) + 0.5gap_t \qquad \text{[A8]}$$

Parameter β (0.05) is selected to reflect the new EU debt convergence rule. Parameter α (0.4) is set so as to ensure relative fast convergence to the debt-stabilising balance and thus to avoid debt undershooting.[9] Parameter γ (0.5) equals the OECD average size of automatic stabilisers (Girouard and André, 2005).

Figure A.1 and Table A.1 show consolidation paths and requirements under the one-off permanent fiscal adjustment, constant adjustment, gradual front-loaded consolidation without any cap (Polynomial), gradual front-loaded consolidation with an annual cap of 1.5% of GDP (Polynomial with 1% cap), the illustrative fiscal rule and the baseline specification with the optimised kinky-linear underlying balance path from the main paper.

Table A.1. **Consolidation requirements under different consolidation paths**

	Consolidation			
	1st year, % of GDP	Initial, % of GDP	Total, % of GDP	Duration, years
One-off adjustment	5.5	5.5	5.5	1
Constant adjustment	0.5	10.5	10.5	20
Polynomial	1.9	7.3	3.6	8
Polynomial with 1% cap	1.0	8.0	3.6	10
Fiscal rule	1.4	6.2	5.0	11
Baseline	0.7	9.8	3.2	15

Note: Initial consolidation is defined as the improvement in the structural primary budget balance between its initial and maximum level, whereas total consolidation refers to the difference between the initial and the final primary budget balance. Baseline refers to the approach based on the optimisation of the policy loss function as described in the main paper (Section 1.2).
Source: Author's calculations.

The one-off adjustment under the standard method is very large, in this example nearly 6% of GDP (Table A.1, Figure A.1). All other methods imply more gradual consolidation (the most gradual with the constant adjustment and the least gradual with the polynomial), resulting in a longer and larger initial but not total adjustment, respectively. The polynomial approach without the cap and the fiscal rule require 1.8 and 0.7% of GDP more of initial fiscal tightening which last 7 to 10 years longer than under the one-off adjustment. However, the total adjustment is lower by almost 2% of GDP (in the case of the fiscal rule the difference is only 0.5% of GDP but the rule does not stabilise debt at the target within 20 years). The cap of 1% of GDP does not change the results much. Consolidation needs under the constant adjustment are the largest, double those under the one-off adjustment.

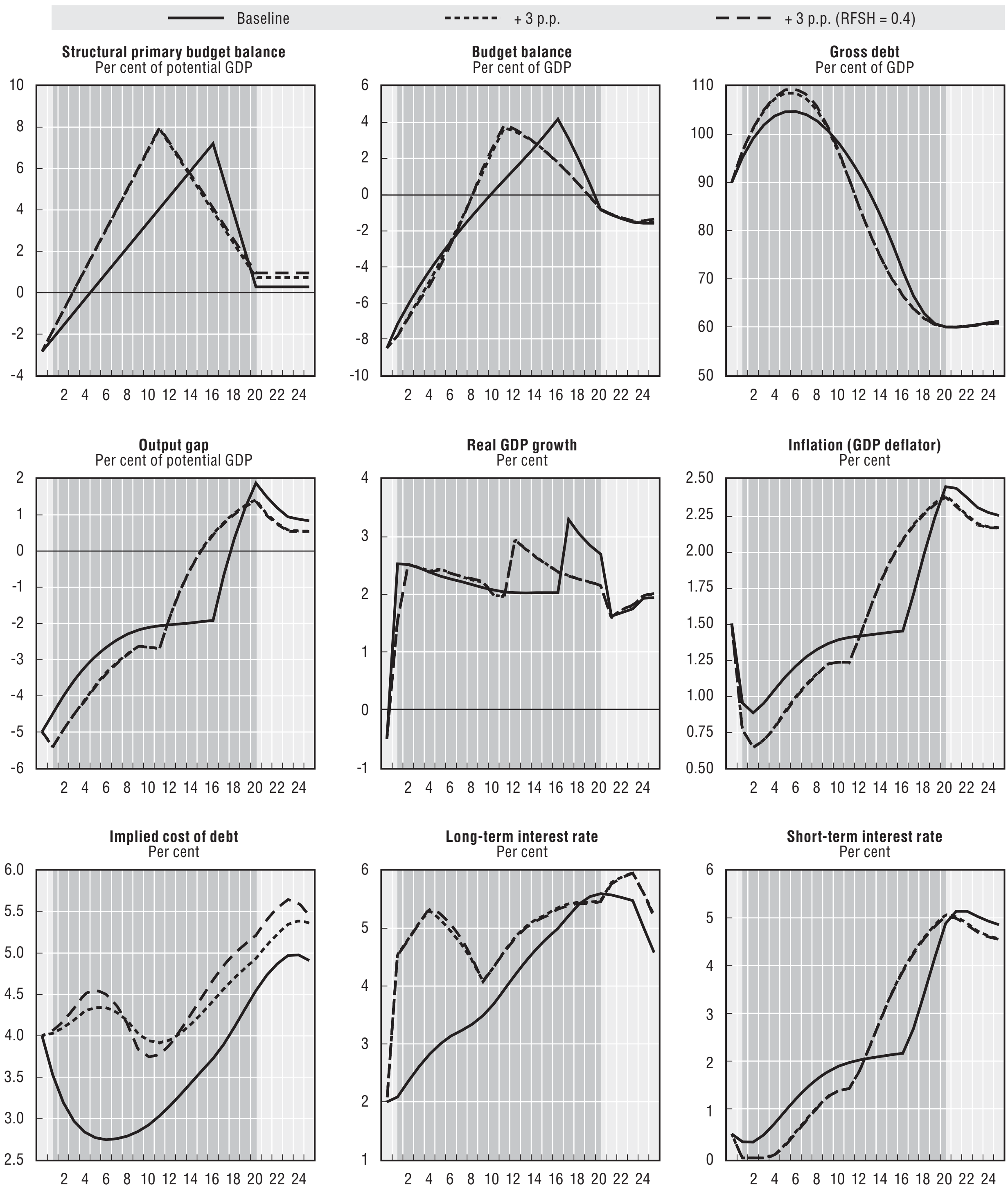
Table A.2. **Changes in the structural primary balance, overall balance and debt in selected scenarios**

Per cent of (potential) GDP

	Years									
	1	2	3	4	5	6	7	8	9	10
1. Baseline										
Structural primary balance	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Overall balance	1.3	1.1	1.0	0.9	0.8	0.8	0.7	0.7	0.7	0.7
Gross debt	5.1	4.0	2.8	1.8	0.9	0.1	-0.7	-1.4	-2.0	-2.6
Gross debt (level)	95	99	102	104	105	105	104	103	101	98
4. Interest rate shock										
Structural primary balance	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overall balance	0.7	1.0	1.0	1.0	1.1	1.1	1.2	1.3	1.4	1.2
Gross debt	6.4	4.7	3.6	2.5	1.2	0.0	-1.2	-2.5	-3.8	-4.7
Gross debt (level)	96	101	105	107	109	109	107	105	101	96
5. Interest rate shock with higher debt turnover										
Structural primary balance	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Overall balance	0.7	1.0	0.9	0.9	1.1	1.2	1.3	1.4	1.5	1.2
Gross debt	6.5	4.8	3.7	2.7	1.5	0.2	-1.1	-2.6	-4.0	-5.0
Gross debt (level)	96	101	105	108	109	109	108	106	102	97
8. Higher fiscal multiplier										
Structural primary balance	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overall balance	1.3	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.7
Gross debt	5.4	4.6	3.6	2.6	1.6	0.7	-0.2	-1.0	-1.7	-2.3
Gross debt (level)	95	100	104	106	108	108	108	107	106	103
9. Higher fiscal multiplier with hysteresis										
Structural primary balance	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overall balance	1.3	0.9	1.0	1.0	0.9	0.9	0.9	0.9	0.8	0.7
Gross debt	5.8	5.0	4.0	2.9	1.9	1.0	0.1	-0.8	-1.6	-2.3
Gross debt (level)	96	101	105	108	110	111	111	110	108	106
10. Higher fiscal multiplier with hysteresis and interest rate shock										
Structural primary balance	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1	1.1
Overall balance	0.3	0.6	0.7	0.8	0.8	1.0	1.2	1.3	1.4	1.5
Gross debt	7.9	6.9	6.1	5.3	4.4	3.2	1.9	0.6	-0.8	-2.3
Gross debt (level)	98	105	111	116	121	124	126	126	125	123
11. Delayed consolidation under baseline										
Structural primary balance	0.0	0.0	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Overall balance	0.8	0.5	1.0	0.9	0.9	0.8	0.8	0.8	0.8	0.8
Gross debt	5.5	4.7	3.9	2.9	1.9	1.0	0.1	-0.7	-1.4	-2.1
Gross debt (level)	95	100	104	107	109	110	110	109	108	106
12. Delayed consolidation with interest rate shock										
Structural primary balance	0.0	0.0	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Overall balance	0.0	0.2	1.0	1.0	1.0	1.2	1.3	1.5	1.6	1.7
Gross debt	6.8	5.9	5.2	4.0	2.8	1.5	0.0	-1.5	-3.1	-4.7
Gross debt (level)	97	103	108	112	115	116	116	115	112	107
13. Delayed consolidation with higher fiscal multiplier, hysteresis and interest rate shock										
Structural primary balance	0.0	0.0	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
Overall balance	0.1	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.2	1.4
Gross debt	6.9	5.9	6.9	6.5	5.9	5.2	4.4	3.2	1.9	0.4
Gross debt (level)	97	103	110	116	122	127	132	135	137	137

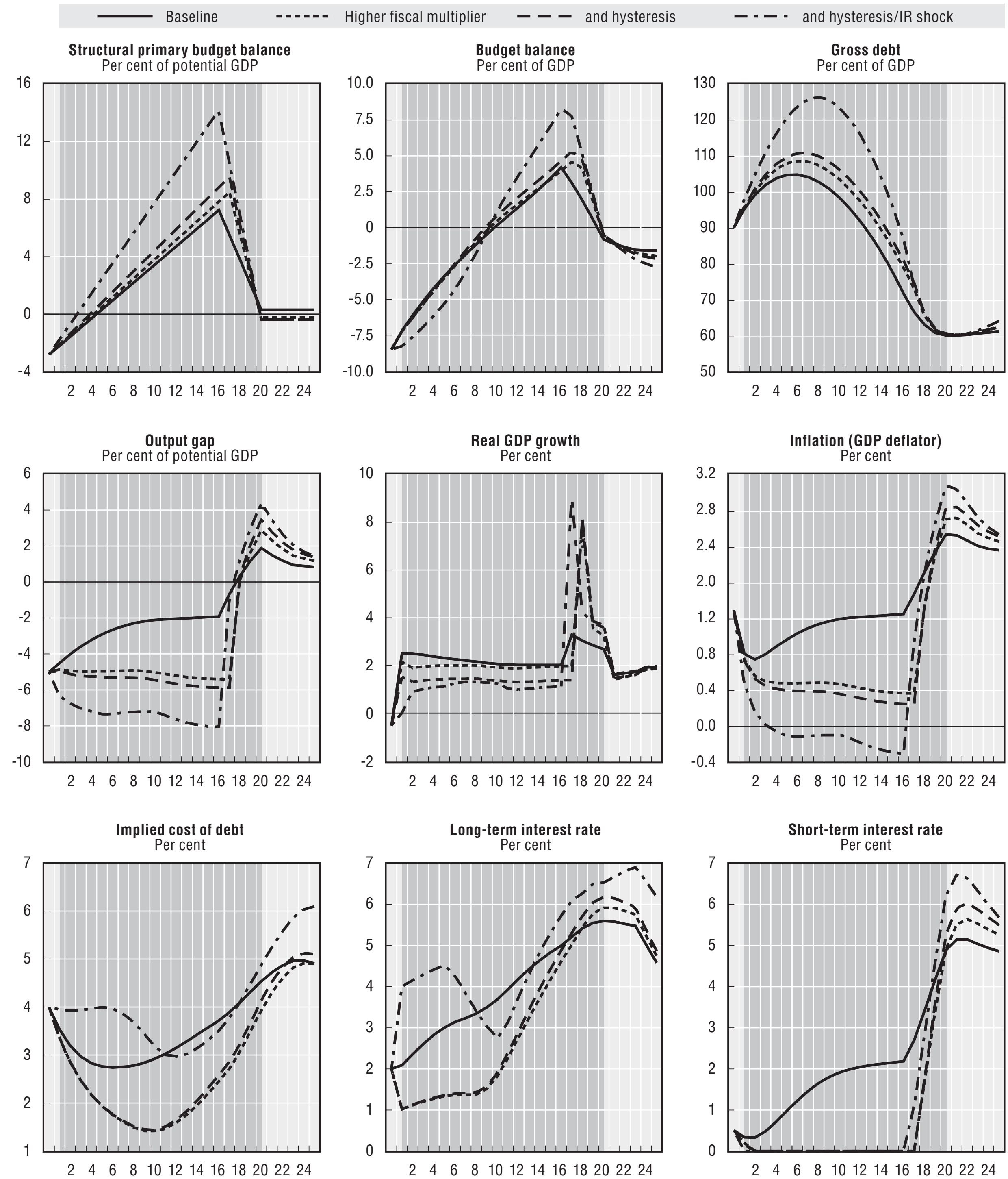
Note: Structural balances are expressed in per cent of potential GDP, whereas overall balances and gross debt as per cent of actual GDP. For specifications of scenarios see Table 2.
Source: Author's calculations.

Figure A.3. **Long-term interest rate shock**



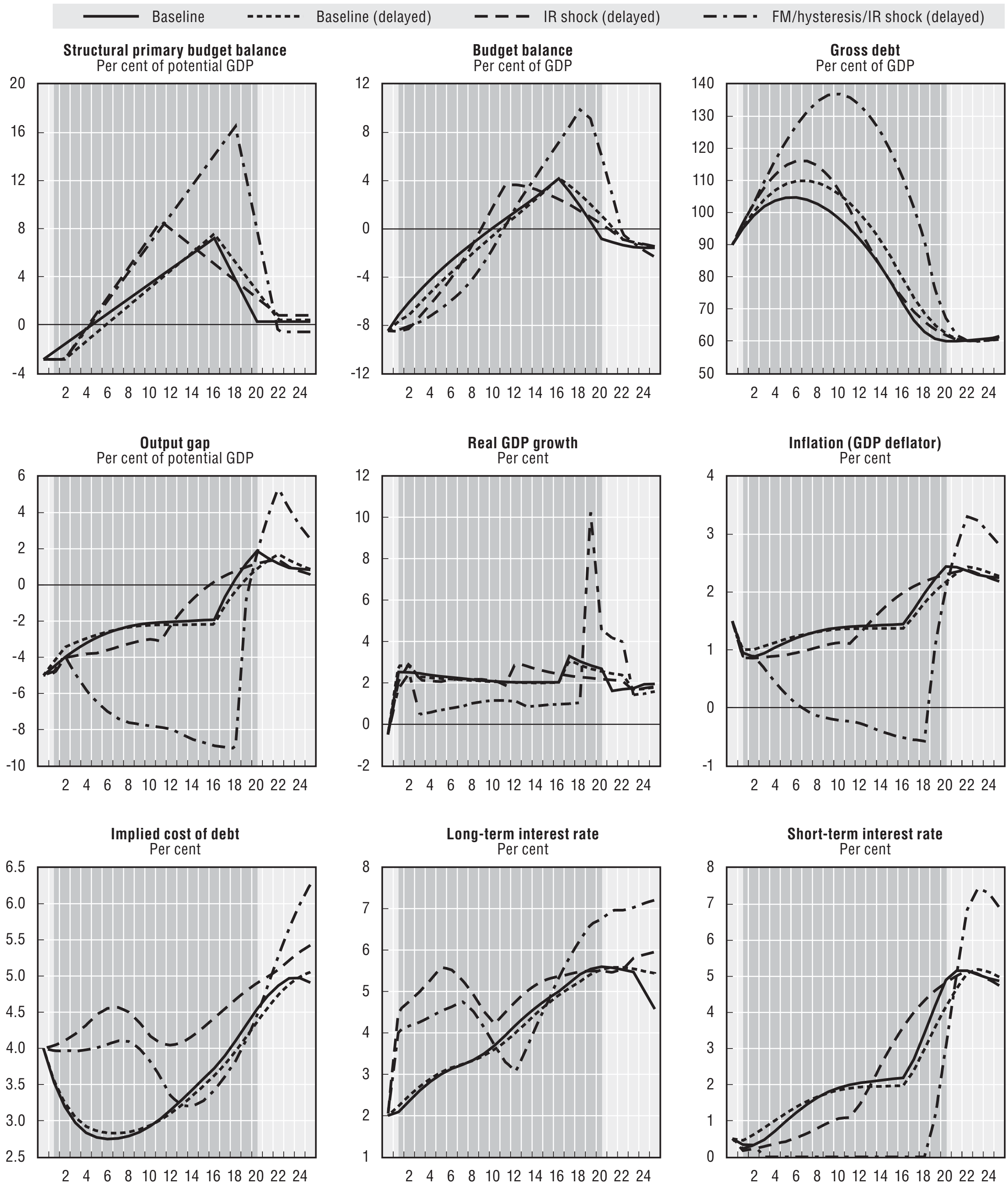
Source: Author's calculations.

Figure A.4. **Higher fiscal multipliers**



Source: Author's calculations.

Figure A.5. **Delayed consolidation**



Source: Author's calculations.

As expected, the one-off and constant adjustment methods do not ensure stabilisation of debt at its target (Figure A.1) and the primary budget balances are significantly higher than required to stabilise debt at the target (by between around 2% and 7% of GDP). Consequently, sustaining the balances at this level results in a continued decline in the debt ratio. In contrast, all other methods ensure debt stabilisation, though for the fiscal rule it takes more than 20 years.

Notes

1. Under the assumption of no government financial assets (i.e. when gross equals net debt). With financial assets, the gross debt equation becomes: $d_t = (1 + i_p)/(1 + g)d_{t-1} - (1 + i_r)/(1 + g)a_{t-1} - pb_t + a_t$, where a_t is the ratio of financial assets to GDP, i_p is the interest rate paid on debt, and i_r is the interest rate earned on assets.
2. See Figure A.2. The baseline calculations of consolidation needs in *OECD Economic Outlook* No. 89 assumed a constant consolidation of 0.5% of GDP per year until the primary balance reached a level consistent with debt stabilisation at its prevailing level, resulting in debt stabilisation in OECD countries at different points in time and at different levels. Thus, this method has a different objective (i.e. it does not require reaching a specific debt target within a common, finite horizon) and is not appropriate for a comparison here.
3. To ensure consistency with equations [A1]-[A3], *N* in equation [4] must be higher than *N* in equations [A1]-[A3] by 1, so that initial period 0 in equations [A1]-[A3] corresponds to year 1 in equation [A4], as the polynomial cannot be solved for $t = 0$.
4. With assets the condition becomes: $pb_N = \frac{i_{pN}-g_N}{1+g_N} d_N - \frac{i_{rN}-g_N}{1+g_N} a_N$.
5. For these two approaches, the last value of the primary balance is equal to its maximum, which is not the case with the polynomial approach.
6. If the adjustment is based on the change (not level) of the output gap – which is sometimes the case – then it is approximately equivalent to the one based on the difference between actual and potential GDP growth rates.
7. For certain values of parameters α and β and large negative shocks, almost a full operation will be possible even when debt and deficits diverge (within some limits) from their targets.
8. To avoid the latter problem, the fiscal rule could be defined in terms of net and not gross debt.
9. Very high initial debt relative to the target requires large budgetary surpluses and low α will bring the surplus down only slowly, potentially undershooting the debt target.