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Choosing the Pace of Fiscal Consolidation

Łukasz Rawdanowicz

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ABSTRACT/RÉSUMÉ

Choosing the pace of fiscal consolidation

In many OECD countries debt has soared to levels threatening fiscal sustainability, necessitating its reduction over the medium to longer term. This paper uses stylised simulations in a small, calibrated macroeconomic model which features endogenous interactions between fiscal policy, growth and financial markets. Simulations are done for a hypothetical economy, reflecting key characteristics of fiscally stressed OECD countries. Given the assumed objective to stabilise debt at a 60% of GDP target within 20 years, a consolidation path is chosen by maximising cumulative GDP growth and minimising cumulative squared output gaps. The simulations highlight four issues. First, lowering the debt-to-GDP ratio within a finite horizon requires big initial consolidation which can be largely unwound if debt is to be stabilised at a lower level. Second, some frontloading of the adjustment turns out to be optimal in case of an interest rate shock. Third, debt reduction with high fiscal multipliers, hysteresis effects and adverse market reactions involves protracted large negative output gaps and deflation. This stresses the importance of selecting reasonable fiscal targets consistent with market conditions. Fourth, delaying the attainment of the debt target by two years has generally little implications for initial consolidation, though under adverse conditions this would result in much higher debt and slower growth.

JEL Classification: E61, E62, H6
Keywords: fiscal consolidation, sovereign debt, government budget balance, fiscal rules

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Choisir le rythme de l'assainissement budgétaire

Dans de nombreux pays de l'OCDE, la dette a atteint des niveaux menaçant la viabilité budgétaire, nécessitant sa réduction à moyen et à long terme. Ce document utilise des simulations stylisées mises en œuvre avec un petit modèle macroéconomique calibré qui tient compte des interactions endogènes entre la politique budgétaire, la croissance et les marchés financiers. Les simulations sont réalisées pour une économie fictive reflétant les principales caractéristiques des pays de l'OCDE en difficulté budgétaire. Compte tenu de l'objectif de stabiliser la dette à 60% du PIB à horizon de 20 ans, le chemin de l'assainissement est choisi par la maximisation de la croissance cumulée du PIB et par la minimisation des carrés des écarts de production. Les simulations mettent en évidence quatre problèmes. Tout d'abord, l'abaissement du ratio dette sur PIB à horizon fini exige une grande consolidation initiale qui peut être largement annulée par la suite si la dette doit être stabilisée à un niveau inférieur. Deuxièmement, une montée en charge plus rapide de l'assainissement est optimale en cas de chocs de taux d'intérêt. Troisièmement, en cas de multiplicateurs fiscaux élevés, de phénomènes d'hystérèse et de réactions défavorables des marchés, la réduction de la dette implique des périodes prolongées d'écarts de production négatifs importants et de déflation. Cela souligne l'importance de choisir des objectifs budgétaires raisonnables et compatibles avec les conditions de marché. Quatrièmement, reporter l'assainissement et l'atteinte des objectifs de dette de deux ans a généralement des répercussions légères sur la consolidation initiale, mais dans des conditions défavorables, il en résulte une dette beaucoup plus élevée et une croissance beaucoup plus lente.

Codes JEL: E61, E62, H6
Mots Clés: l'assainissement budgétaire, dette souveraine, l'équilibre budgétaire du gouvernement, les règles budgétaires

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CHOOSING THE PACE OF FISCAL CONSOLIDATION

By

Łukasz Rawdanowicz[1]

1. 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,[2] 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.

2. 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 lower 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 markets' confidence in the solvency of a government, risking, in a benign scenario, sluggish growth due to pass through of higher sovereign risk to borrowing conditions in the broader economy and, in the worst case scenario, disruptive sovereign default.

3. 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.

4. 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 feedbacks among fiscal policy, growth and financial markets as well as a simple monetary policy rule

1. The author works at the OECD Economics Department. I would like to thank Sveinbjorn Blondal, Yvan Guillemette, Patrice Ollivaud, Jean-Luc Schneider, Stéphane Sorbe, Douglas Sutherland, David Turner and Eckhard Wurzel for valuable comments, and Isabelle Fakih for help in the final document preparation. The views expressed in this paper are those of the author and do not necessarily represent those of the OECD or its member countries.

2. 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; Reinhart and Rogoff, 2010; Cecchetti *et al.*, 2011), however the causality from debt to growth has been questioned (Panizza and Presbitero, 2012).

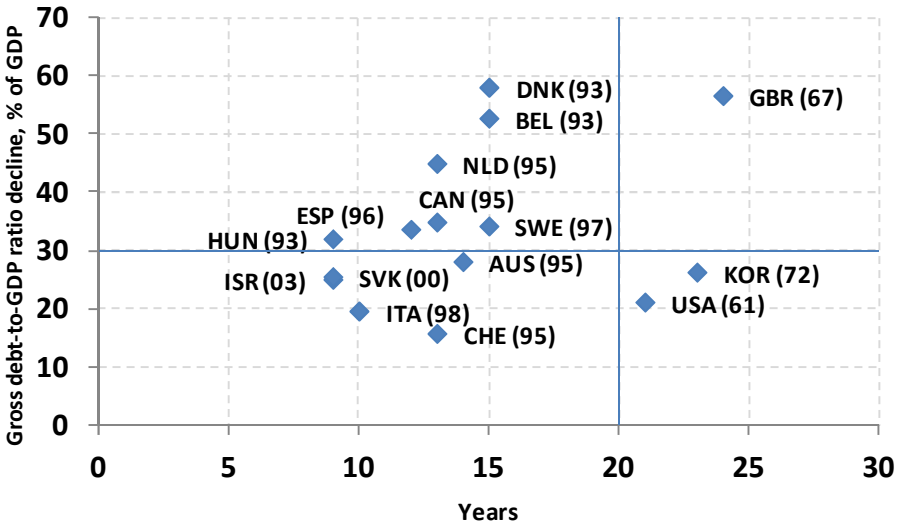
and debt maturity structure under a perfect foresight. The hypothetical economy is calibrated so as to reflect key characteristics of fiscally troubled OECD countries, including high debt, structural and headline budget deficits and initial large output gaps. The exercise, although only illustrative 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.

1. Model's framework

1.1. Consolidation objective

5. It is assumed that fiscal authorities are fully determined to reduce and stabilise the debt-to-GDP ratio at a lower and prudent level within a finite horizon. In particular, 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 (Section 1.3). The debt target and time needed to reach it are illustrative. The target is set in the vicinity of a level conventionally deemed as safe (Sutherland *et al.*, 2012),[3] 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 1).[4]

Figure 1. Past debt reductions



Note: Numbers in brackets after the country abbreviation refer to the year when debt reduction started.

Source: OECD Economic Outlook No. 91 database.

3. 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).

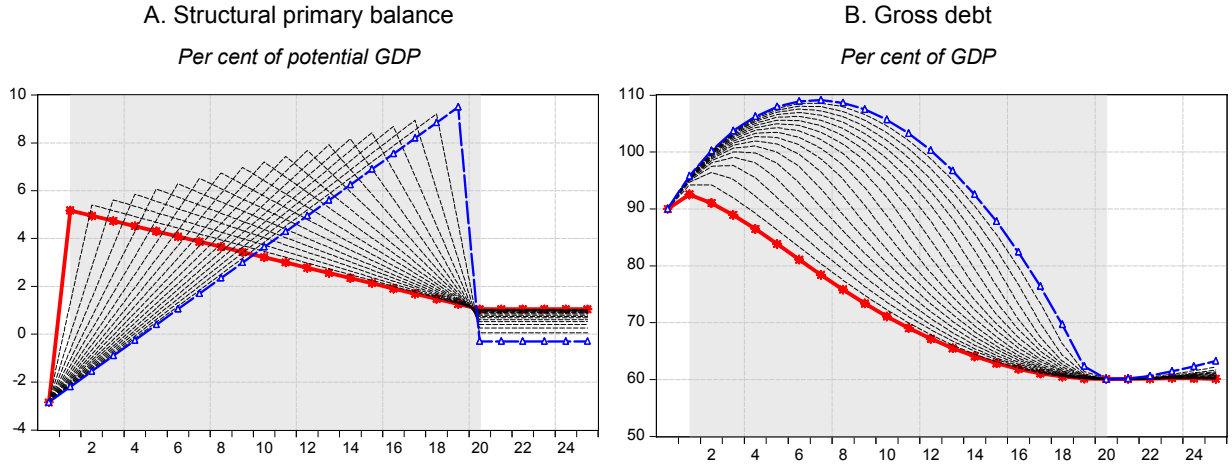
4. Past debt reductions were however not only driven by the improvement in the structural primary balance.

6. A fiscal adjustment aiming to reduce and then to stabilise the debt-to-GDP ratio at a level significantly below the initial one within a given finite period is likely to involve fiscal tightening followed by easing. With high initial debt and deficit ratios, a large improvement in the budget balance is needed to put debt on a downward path. However, sustained, large budget surpluses, which are likely to be above the debt stabilisation level (Annex 1), will continue to reduce debt. Thus, some reduction in the budget balance will be required to stabilise the debt-to-GDP ratio. This implies that not all consolidation measures have to be permanent.

7. The right level of the budget balance to stabilise debt at the end of the analysed sample has also implications for calculations of consolidation requirements. Any consolidation path that does not ensure debt stabilisation will result in biased estimates – overestimated for total consolidation (from the start to the end) and underestimated for initial cumulative consolidation (from the start to the maximum of the structural primary balance). This is the case for instance in calculations undertaken by European Commission (2009), Sutherland *et al.* (2012), and OECD (2011). Annex 1 demonstrates these biases and proposes two methods of calculating consolidation needs as an alternative to the optimisation framework discussed below.

8. There is a vast number of possible consolidation paths that are compatible with the debt ratio stabilisation 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 2). For this set of functions, there are *k-1* possible paths, where *k* is the number of years to reach the target, which differ with respect to the time of reaching the peak and the size of annual adjustment (*i.e.* the angles of slopes).

Figure 2. 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 effects in the model. The presented paths are derived in the baseline specification of the model (see Section 1.2).

Source: Author's calculations.

9. An optimal path can be selected by optimising a fiscal policy objective function. Several plausible objectives are possible.[5] In this paper, given the assumed objective to stabilise debt at the target within a finite period, a natural criterion for selecting a consolidation path is the minimisation of the consolidation impact on economic growth. Such an objective is appealing, especially when the effectiveness of monetary policy is reduced and there are large negative output gaps. It is, however, not meant to imply that fiscal authorities should be responsible for stabilising the economy over the cycle, which under normal circumstances is generally considered to be the task of monetary policy.

10. In particular, it is assumed that the government maximises a discounted sum of real GDP growth and minimises a discounted sum of squared output gaps. The second condition is added to ensure that the pursuit of high growth does not lead to undesirable large output gaps. Positive and negative gaps are treated symmetrically. 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. Thus, the government's loss function is given by:

$$LF = min \sum_{i=1}^{k+4} \beta^i (-w1 * r + w2 * gap^2) \qquad (1)$$

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 (assuming a 1% discount rate). The function ignores other possible important objectives of fiscal policy, like income redistribution.

11. 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,[6] 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

12. 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.[7] The description of the main equations focuses on baseline specifications – alternative scenarios are discussed in the next section.

Real GDP growth

13. Following the assumption adopted in Johansson *et al.* (2012), 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 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

5. 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).

6. The structural balance often corrects also for one-off measures.

7. The cyclical adjustment applies an aggregate elasticity (0.5 in the baseline scenario) to the level of the output gap.

can be followed by 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 2.3). 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).[8] 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, *FM* is the fiscal multiplier and *d(RIRL)* stands for changes in the real long-term interest rate.

Inflation

14. 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%.

Monetary policy

15. The monetary policy stance is driven by the standard Taylor rule.[9] 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%[10]

$$IRS_ss = 4 + 0.5*GAP + 1.5*(pi - infl_target) \quad (4)$$

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.

Long-term interest rates and implied cost of debt

16. Following the assumptions in Johansson *et al.* (2012), 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*):

$$IRL = Tprem + \sum_{i=0}^{9} IRS(i)/10 + Frisk \quad (6)$$

8 . This is somewhat lower than the estimated elasticity for the euro area of -0.19 by Guichard *et al.* (2009).

9 . 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.

10 . The nominal natural rate of 4% is assumed to be equal to the sum of real potential GDP growth (2%) and inflation target (2%).

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 (Johansson *et al.*, 2012).

17. 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 (Johansson *et al.,* 2012). In the baseline scenario, RFSH is set at 0.2, which is close to the 2011 average observed for selected OECD countries.[11]

1.3. Hypothetical economy

18. The model – as outlined above – is solved for a hypothetical economy which features many characteristics of OECD countries in difficult fiscal positions. In particular, the initial conditions involve the high overall budget deficit and gross debt, and the large negative output gap (Table 1). In addition, short and long-term interest and inflation rates are assumed to be initially low (only in the baseline scenario).

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. Loss function weights and baseline consolidation path

19. The choice of weights of the loss function has a significant impact on the consolidation path (Table2 and Table 3 – scenarios 1-3). Under the baseline specification of the model and initial conditions (Table 1), maximising cumulative GDP growth always favours a more gradual 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). In contrast, minimising the sum of squared output gaps tends to favour the path with the peak around the middle of the sample as large initial consolidation and large fiscal loosening at the end imply large output gaps. Consequently, increasing the weight of the first component prolongs consolidation, whereas raising the weight of the second component shortens it (to a minimum

11. The average maturity in G10 countries ranges from five years in the United States to 13 years in the United Kingdom (Rawdanowicz *et al*., 2011).

of 14 years). For equal weights, the optimal path of consolidation implies a peak of the structural primary balance after 19 years. For the baseline simulation, weights of 0.2 and 0.8 are selected.

20. 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 gross debt increase is more pronounced and protracted (Section 2.7).

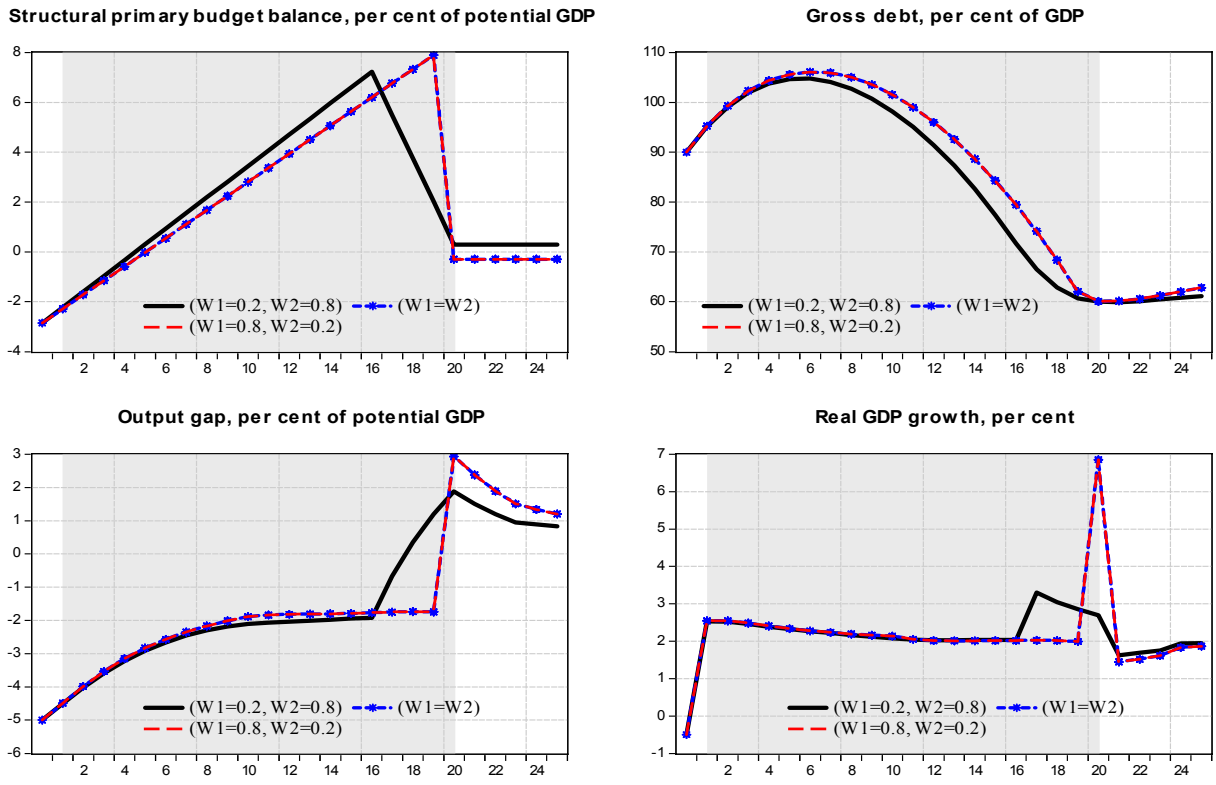
Table 2. Timing of the budget balance peak for different weights of the loss function

In years

		W2				
		0.00	0.20	0.50	0.80	1.00
W1	0.00		14	14	14	14
	0.20	19	19	18	16	16
	0.50	19	19	19	19	19
	0.80	19	19	19	19	19
	1.00	19	19	19	19	19

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

Figure 3. Consolidation under different weights of the loss function



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

2.2. Interest rate shocks

21. 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.

22. 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).[12] 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.

23. 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-load 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 3, scenario 4; Figure A2.1). 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 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 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 2.8).

Table 3. Summary of different consolidation scenarios

	Scenario	W1	W2	FM	RFSH	IR	Hyst.	AS	Initial consolidation			Fiscal easing			Structural budget balance			Total
									length	annual	total	length	annual	total	initial	max	end	consolid.
									years	% of GDP		years	% of GDP			% of GDP		
1	Baseline	0.25	0.75	0.5	0.2	0	0.0	0.5	16	0.6	10.1	4	-1.7	-6.9	-2.8	7.2	0.3	3.1
2	Alternative weights	0.50	0.50	0.5	0.2	0	0.0	0.5	19	0.6	10.7	1	-8.2	-8.2	-2.8	7.9	-0.3	2.5
3	Alternative weights	0.75	0.25	0.5	0.2	0	0.0	0.5	19	0.6	10.7	1	-8.2	-8.2	-2.8	7.9	-0.3	2.5
4	Interest rate shock	0.25	0.75	0.5	0.2	3	0.0	0.5	11	1.0	10.8	9	-0.8	-7.2	-2.8	7.9	0.7	3.5
5	Interest rate shock with higher debt turnover	0.25	0.75	0.5	0.4	3	0.0	0.5	11	1.0	10.8	9	-0.8	-7.0	-2.8	8.0	1.0	3.8
6	Hysteresis	0.25	0.75	0.5	0.2	3	0.0	0.5	16	0.6	10.4	4	-1.8	-7.3	-2.8	7.5	0.2	3.0
7	Lower automatic stabilisers	0.25	0.75	0.5	0.2	0	0.1	0.5	17	0.7	11.1	3	-2.3	-6.9	-3.8	7.3	0.4	4.2
8	Higher fiscal multiplier	0.25	0.75	1.5	0.2	0	0.0	0.3	17	0.7	11.3	3	-2.9	-8.7	-2.8	8.5	-0.3	2.5
9	Higher fiscal multiplier with hysteresis	0.25	0.75	1.5	0.2	0	0.1	0.5	17	0.7	12.4	3	-3.3	-9.9	-2.8	9.5	-0.4	2.4
10	Higher fiscal multiplier with hysteresis and interest rate shock	0.25	0.75	1.5	0.2	3	0.1	0.5	16	1.1	17.0	4	-3.6	-14.6	-2.8	14.2	-0.4	2.4
11	Delayed consolidation under baseline	0.25	0.75	0.5	0.2	0	0.0	0.5	14	0.7	10.4	6	-1.2	-7.1	-2.9	7.6	0.4	3.3
12	Delayed consolidation with interest rate shock	0.25	0.75	0.5	0.2	3	0.0	0.5	9	1.3	11.5	11	-0.7	-7.8	-2.9	8.6	0.8	3.7
13	Delayed consolidation with higher fiscal multiplier, hysteresis and interest rate shock	0.25	0.75	1.5	0.2	3	0.1	0.5	16	1.2	19.4	4	-4.3	-17.1	-2.9	16.5	-0.6	2.3

Notes: *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.

12. 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).

24. 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 A2.1).[13] 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).

2.3. Hysteresis

25. 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 affect much the optimal consolidation path compared to the baseline, but when it can affect the adjustment path when interacted with higher fiscal multipliers and interest rate shocks – see below (Table 3, scenario 6).

2.4. Automatic stabilisers

26. The presence of automatic stabilisers complicates consolidation as part of the structural adjustment is offset by the deterioration of fiscal balances due to 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 better 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).

27. It turns out the lowering automatic stabilisers has a very small impact on the optimal consolidation path (Table 3, 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.

2.5. Fiscal multipliers

28. 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 interest bound (Christiano *et al.*, 2009; Woodford, 2011),

13 . This low pass-through partly owes to the assumption that the government refinances short-term debt at the level of monetary policy rates

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 output gap is positive and monetary policy functions normally (*i.e.* monetary policy interest rates are significantly above zero).

29. The higher fiscal multiplier does not change much fiscal consolidation strategy (Table 3, scenario 8; and Figure A2.2). Under this scenario, initial consolidation is slightly longer (one extra year) and larger than in the baseline. This reflects a smaller improvement in the cyclical component of the budget balance and less favourable debt dynamics due to weaker growth. The GDP cost of such consolidation is very high, resulting in a large and persistent negative output gap, and in inflation and monetary policy rates close to zero for an extended period (Section 2.8).

2.6. Delayed consolidation

30. 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 rerun assuming that the start of consolidation and reaching the debt target are delayed for two years. This implies that the structural primary balanced 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 adjustment (Table 3, scenario 11-13; and Figure A2.3). The build-up of debt is however larger (Section 2.7).

2.7. Self-defeating consolidation

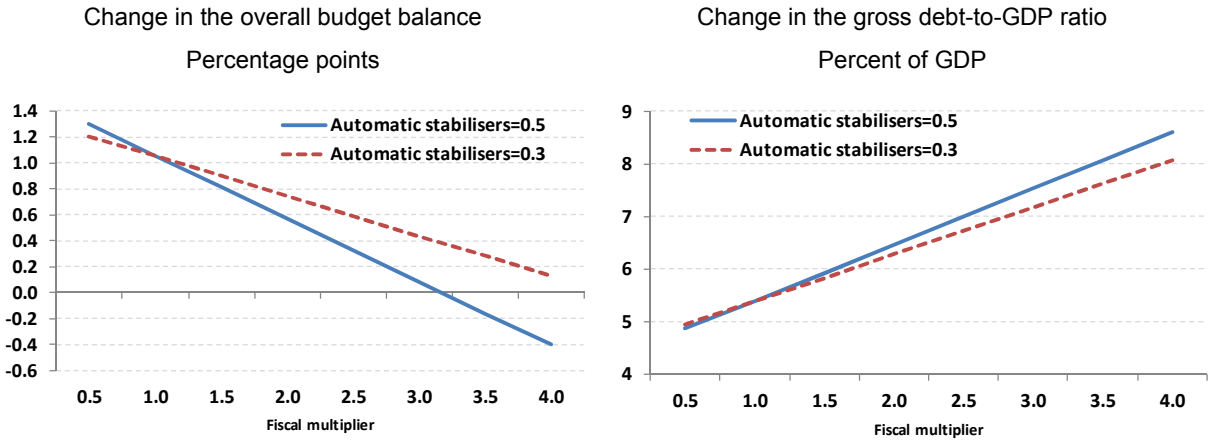
31. Recent announcements of consolidation plans in the OECD countries have caused concerns that fiscal adjustments may actually increase government budget deficits and debt (*i.e.* may result in a self-defeating consolidation). This may occur, for instance, when increased tax rates reduce economic activity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

32. In the logic of the presented model, 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.[14] The higher the fiscal multiplier for a given size of automatic stabilisers, the bigger the effect. Lowering automatic stabilisers' parameter weakens this relation. Model simulations under the baseline specification[15] shows that for reasonable ranges of automatic stabilisers and fiscal multipliers, a 1% of GDP structural fiscal adjustment is not likely to lead to a decline in the overall budget balance in the first year (Figure 4).

14. 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.

15 . 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 10 years.

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



Notes: Calculations are based on model simulations with the initial condition assumptions of 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 consoidation in		Gross debt	
	Structural primary balnce	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	3.8	3.1	116	7
13 Delayed consolidation with higher fiscal multiplier, hysteresis and interest rate shock	3.6	1.5	137	10

Notes: For specifications of scenarios see Table 3.

Source: Author's calculations.

33. 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.[16] 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).

16. 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).

34. 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 A1.2). 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 first three years, at most by half. This reflects raising net interest payments and 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.[17]

35. 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 result in a higher and longer debt build-up, in the worst case by up to 47% of GDP which lasts more than a decade.

36. By and large, the tested specifications of the parameters suggest that a fully-fledge 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 improvement in debt.

2.8. GDP costs of consolidation

37. 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). Given very weak GDP growth, a country would experience almost two decades of large and negative output gaps (Figures A2.2 and A2.3). 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. 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 percentage points lower than in the baseline. Inflation growth is even weaker when fiscal multipliers interact with hysteresis and the interest rate shock (by up to 20 percentage points compared with the baseline). In the latter case, the inflation rates are close or below zero for around a decade (Figures A2.2 and A2.3).

38. 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.

17 . 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.

Table 5. GDP costs of different consolidation scenarios

	Scenario	W1	W2	FM	RFSH	IR	Hyst.	AS	Real GDP	GDP deflator	Nominal GDP
									Level change after 20 years, in %		
1	Baseline	0.25	0.75	0.5	0.2	0	0.0	0.5	59.4	28.4	87.8
2	Alternative weights	0.50	0.50	0.5	0.2	0	0.0	0.5	61.0	27.6	88.6
3	Alternative weights	0.75	0.25	0.5	0.2	0	0.0	0.5	61.0	27.6	88.6
4	Interest rate shock	0.25	0.75	0.5	0.2	3	0.0	0.5	58.6	28.7	87.4
5	Interest rate shock with higher debt turnover	0.25	0.75	0.5	0.4	3	0.0	0.5	58.6	28.6	87.2
6	Hysteresis	0.25	0.75	0.5	0.2	3	0.0	0.5	52.4	28.3	80.7
7	Lower automatic stabilisers	0.25	0.75	0.5	0.2	0	0.1	0.5	59.4	27.6	87.0
8	Higher fiscal multiplier	0.25	0.75	1.5	0.2	0	0.0	0.3	60.9	16.0	76.9
9	Higher fiscal multiplier with hysteresis	0.25	0.75	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	0.25	0.75	1.5	0.2	3	0.1	0.5	45.1	7.8	52.9
11	Delayed consolidation under baseline	0.25	0.75	0.5	0.2	0	0.0	0.5	57.8	32.5	90.3
12	Delayed consolidation with interest rate shock	0.25	0.75	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	0.25	0.75	1.5	0.2	3	0.1	0.5	39.0	8.4	47.4

Notes: *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.

3. Conclusions

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

- First, 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 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 analysed in this paper, on average ¾ of initial budget tightening can be reversed. The method discussed in the paper as well as two alternative *ad-hoc* methods presented in Annex 1 do ensure that the budget balance is consistent with debt stabilisation. Methods of calculating consolidation needs that imply a higher budget balance than need for debt stabilisation at the end of calculation period result in biased estimates.

- Second, 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 to some extent the fiscal adjustment in case of an interest rate shock.

- Third, ambitious debt targets in the context of adverse circumstances (large fiscal multipliers, hysteresis effects and interest rate shocks) can result in a protracted spell of negative output

gaps and deflation. This highlights the need of selecting realistic fiscal targets within realistic deadlines consistent with prevailing market conditions.

- Fourth, delaying consolidation and 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.

40. The presented results 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 to an investigation of 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 current context of concerted consolidation in many OECD countries, accounting for international spillovers would be desirable.

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ANNEX 1. CALCULATING CONSOLIDATION NEEDS

41. 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 ongoing 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.

A1.1. Debt dynamics

42. Consolidation requirements are derived from the standard debt dynamics equation:[18]

$$d_t = \frac{1+i}{1+g} d_{t-1} - pb_t \qquad \text{(A1)}$$

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):

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

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

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

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

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 the initial primary balance.

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

$$d_t = \frac{1+i_t}{1+g_t} d_{t-1} - pb_t \qquad \text{(A1')}$$

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

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

18. 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.

A1.2. One-off and constant adjustment approaches

45. The magnitude of 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 A1.1.

46. 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 A1.1). 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).[19] The gradual consolidation implies a bigger total fiscal adjustment than under one-off consolidation (see Figure A1.1 and further below). Although, in most cases the pace of consolidation will be moderate, this method does not address the second problem.

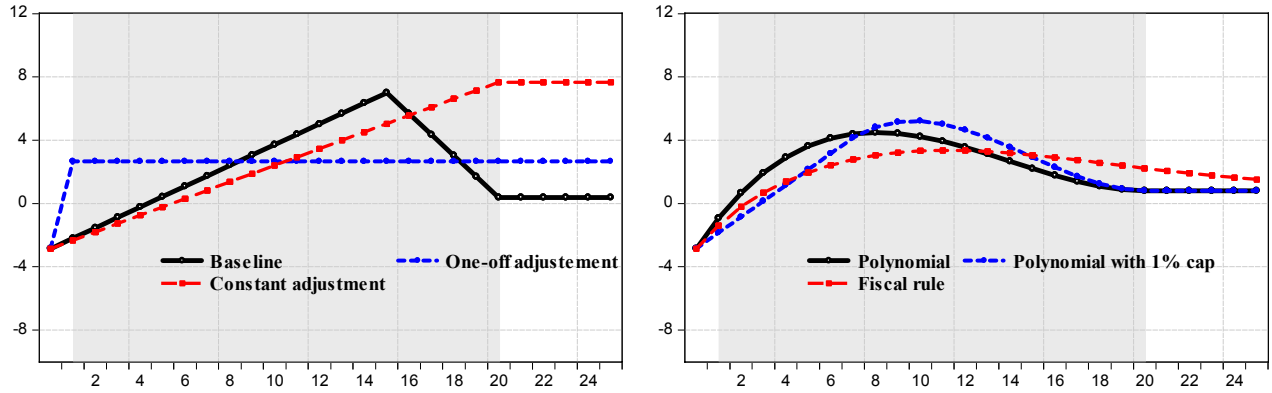
A1.3. Alternative approaches

47. 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.

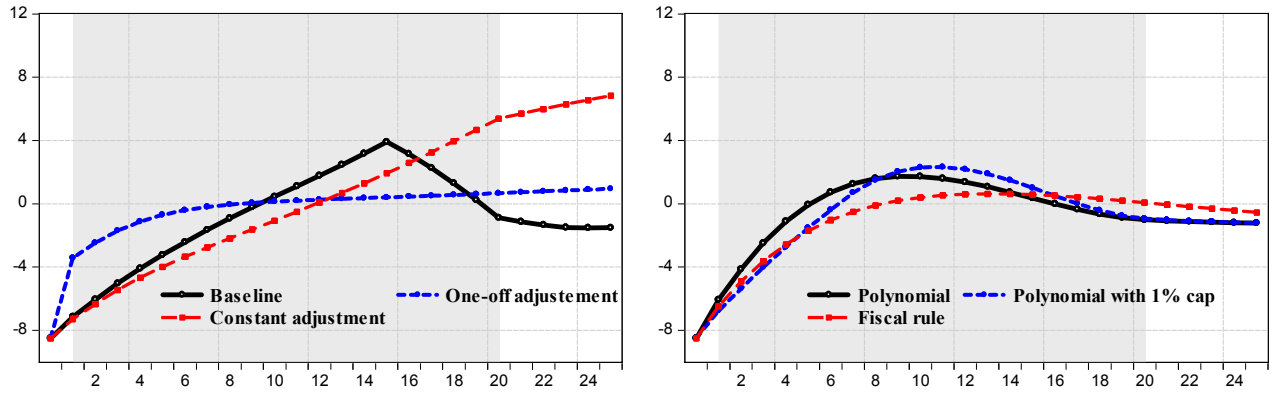
19. See Figure 4.2. The baseline calculations of consolidation needs in the Economic Outlook No. 89 assumed a constant consolidation of 0.5% of GDP per year until the primary balance reached a level consistent with debt stabilisation at its prevailing level, resulting in debt stabilisation in OECD countries 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.

Figure A1.1. Different consolidation paths

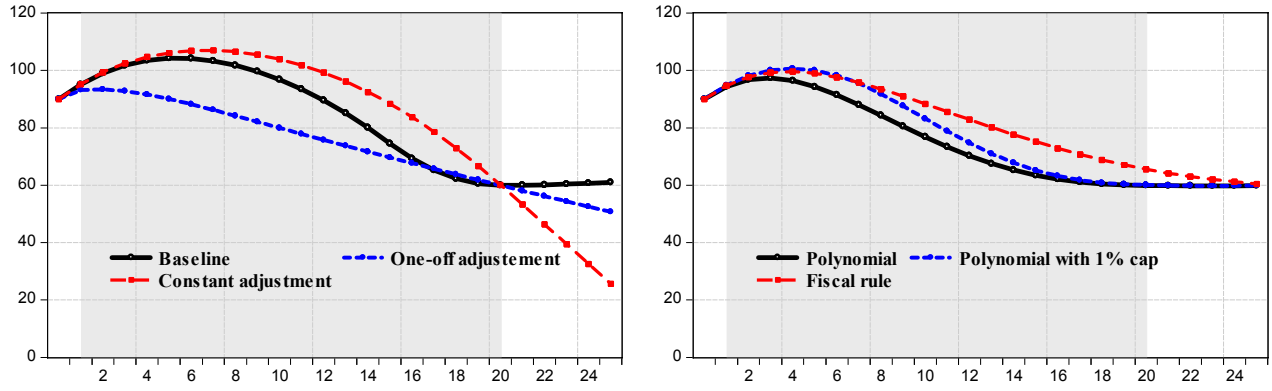
A. Structural primary balance, per cent of potential GDP



B. Overall budget balance, per cent of GDP



C. Gross debt, per cent of GDP



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.

Third-order polynomial approach

48. 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. For a given (finite) duration of consolidation, a third-order polynomial function ensures that initially 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 minimum (*i.e.* is convex), implying smooth primary balance convergence (see Figure A1.1 for the shape of such a function).

49. 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 model's assumptions and debt accounting identities:

$$pb_t = \beta_1 t^3 + \beta_2 t^2 + \beta_3 t + \beta_4 \qquad \text{(A4)}$$

where t stands for time (1...N).[20] 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 ($\mathrm{pb_N} = \frac{i_N - g_N}{1+g_N}\mathrm{d_N}$)[21] 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 to debt settles at its target in year N.

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

51. 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

20. 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.

21. With assets the condition becomes: $\mathrm{pb_N} = \frac{i_{pN} - g_N}{1+g_N}\mathrm{d_N} - \frac{i_{rN} - g_N}{1+g_N}\mathrm{a_N}$.

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.

52. 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 maximum level) is likely to be larger than total consolidation (*i.e.* a difference between initial and 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.[22] 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

53. 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).

54. The rule can thus be given by:

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

where b_t is 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 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.

55. 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.[23] 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

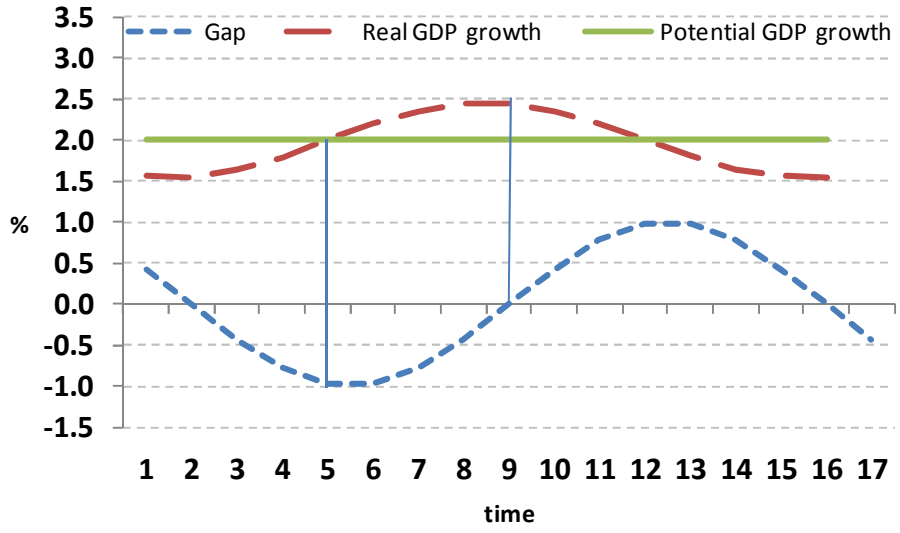
22. For these two approaches the last value of the primary balance is equal to its maximum, which is not the case with the polynomial approach.

23. If the adjustment is based on the change (not level) of the output gap – which is sometimes the case – than it is approximately equivalent to the one base on the difference between actual and potential GDP growth rates.

for the use of nominal growth, ensuring consistency with the calculation of b^* and requiring the authorities to implicitly reveal their inflation target.

56. 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 growth rate differential when the output gap is negative and closing as the actual GDP growth rate already exceeds the potential growth rate (Figure A1.2). Consequently, after a recession the former method would allow for larger and more prolonged automatic stabilisers than latter method. For this reason, the output gap proxy is chosen in this annex.

Figure A1.2. Relation between the output gap and the potential and actual GDP growth rates



Source: Author's calculations.

57. The complete rule is:

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

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.

58. 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 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.[24] Consequently, the rule can be used to measure fiscal policy room to accommodate negative shocks (the so-called fiscal space). The rule can

24. 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.

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.

59. 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 sizable 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).[25] Consequently, a consolidation cap can be applied to the fiscal rule similarly to the polynomial approach.

60. 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.

61. 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.

A1.4. Illustration

62. 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 feedbacks from consolidation to growth, from interest rates to growth and from debt to interest rates.

63. 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.[26] Parameter γ (0.5) equals to the OECD average size of automatic stabilisers (Girouard and André, 2005).

25. To avoid the latter problem, the fiscal rule could be defined in terms of net and not gross debt.

26. 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.

64. Figure A1.1 and Table A1.1 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 an optimised kinky-linear underlying balance path from the main paper.

Table A1.1. Consolidation requirements under different consolidation paths

	1st year	Consolidation initial % of GDP	total	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.

65. The one-off adjustment under the standard method is very large, in this example nearly 6% of GDP (Table A1.1, Figure A1.1). 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. 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 1% of GDP cap does not change much the results. Consolidation needs under the constant adjustment are the largest, double of that under the one-off adjustment.

66. As expected, the one-off and constant adjustment methods do not ensure stabilisation of debt at its target (Figure A1.1) 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.

Table A1.2. Changes in the structural primary balance, overall balance and debt in selected scenarios

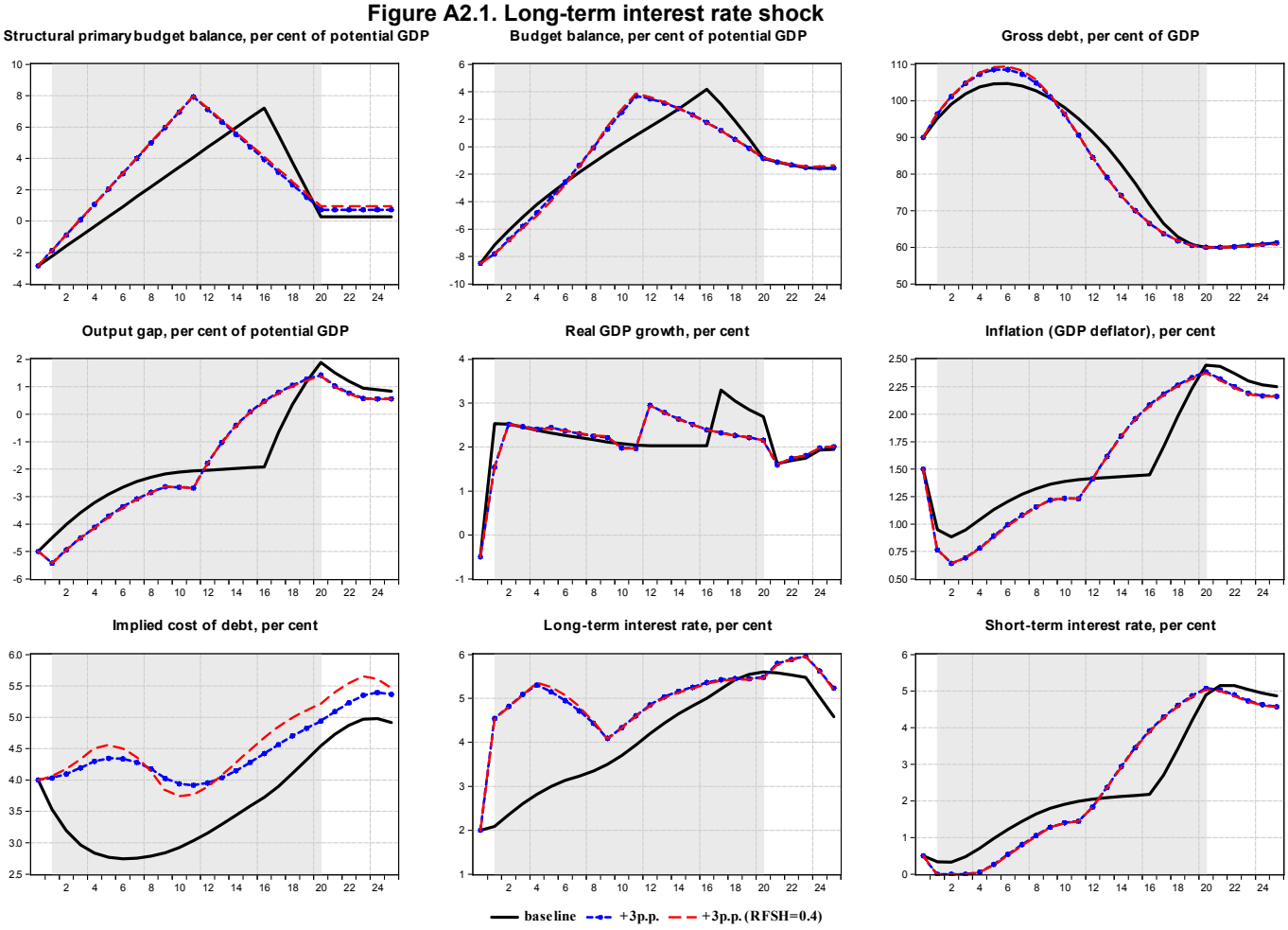
Per cent of (potential) GDP

	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

Notes: 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 3.

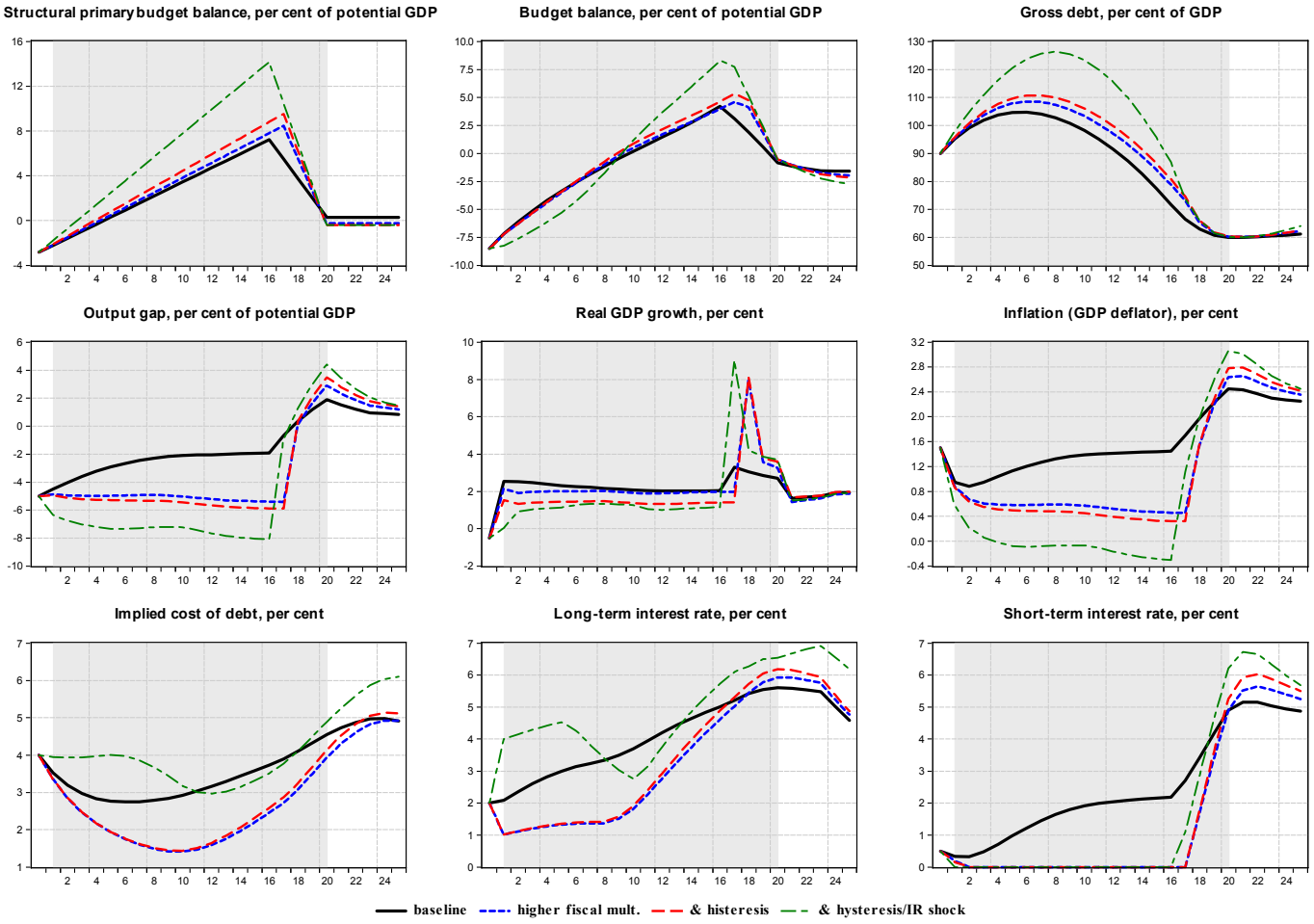
Source: Author's calculations.

Figure A2.1. Long-term interest rate shock



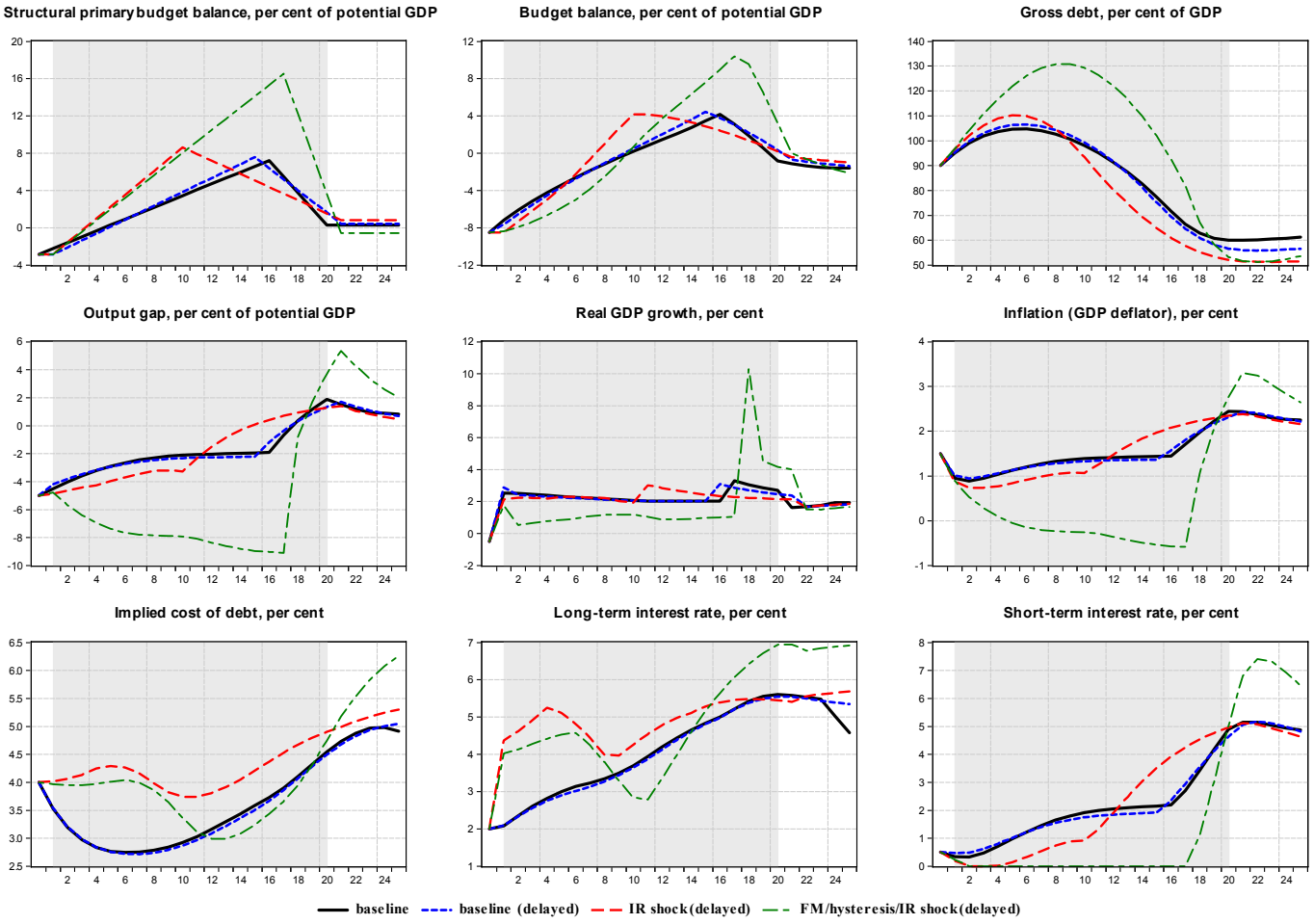
Source: Author's calculations.

Figure A2.2. Higher fiscal multipliers



Source: Author's calculations.

Figure A2.3. Delayed consolidation



Source: Author's calculations.

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