

Discussion Paper No. 11-080

**Fiscal Adjustment in Greece:  
In Search for  
Sustainable Public Finances**

Bas van Aarle and Marcus Kappler

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## **Non-technical summary**

This paper analyses Greek fiscal sustainability. This topic lies in the core of all discussions about a potential exit of the country from the euro area, and - more in general - about the design and long-run sustainability of the monetary union. We analyse Greek fiscal sustainability using empirical analysis and combine a retrospective and a prospective view.

In the retrospective part of the paper, econometric tests on solvency and sustainability of the Greek budget show that the Greek public finances were not on a sustainable path even before the global crisis broke out in 2009. Clearly, the ensuing economic and fiscal crisis that Greece experienced since that time has added additional pressure on the urge to regain fiscal sustainability. Thus, an important question is how Greece may regain fiscal stability.

In a next step, we therefore set out a forward-looking scenario-analysis to investigate how Greek public finances may evolve during the medium and long-run. Simulations for the period between 2011 and 2030, using a stylised model of the Greek public finances, provide a number of interesting insights and policy implications.

A first result is the importance of the interest rate versus growth factor for the dynamics of the fiscal variables in the longer run: a small reduction in interest rates or a small improvement of growth delivers important gains in limiting or even preventing the “debt snowball” effect that we still observe quite significantly in a status quo baseline scenario. Given that interest rates and economic growth are only very indirectly under control of policymakers, regaining long-run sustainability will require a long period of fiscal consolidation, resulting in substantial expenditure reductions with accompanying economic, political and social costs. Furthermore, fiscal prudence requires being very cautious regarding projections on interest rates and growth, and considering the possibility that both interest rates could get higher than projected and growth rates lower than expected.

In a “best case” scenario, the fiscal consolidation is significantly supported by growth, interest and primary balance improvements. At the same time, a “worst case” scenario where all these parameters turn adverse, imply a rapid derailment of Greek public finance and most likely a rapid default in practical terms. Debt-restructuring and debt forgiveness may have beneficial effects in the short-run; these effects are, however, temporary if not at the same time also the underlying structural determinants of fiscal sustainability are changed.

A final simulation points to the importance of the risk-premia dynamics in sustainability of public finances. A scenario where this risk-premia disappears (or is largely reduced) would provide strong support to fiscal sustainability as it mitigates the non-trivial adverse impact of speculation in international bond markets about a Greek default.

## **Das Wichtigste in Kürze**

Die Studie analysiert die Tragfähigkeit griechischer Staatsfinanzen, deren Krise im Mittelpunkt der Diskussionen um den Austritt des Landes aus der Eurozone und die generelle Debatte um die Ausgestaltung und den Zusammenhalt in der Währungsunion steht.

Auf Grundlage von ökonometrischen Tests wird im ersten Teil der Studie dargelegt, dass bereits vor dem Jahr 2009 die Solidität der öffentlichen Finanzen in Griechenland stark anzuzweifeln war. Seit Ausbruch der Wirtschafts- und Fiskalkrise hat sich die Situation für Griechenland weiter dramatisch verschlechtert und zusätzlichen Druck zur Herstellung fiskalischer Tragfähigkeit aufgebaut. Es stellt sich daher die Frage, unter welchen Voraussetzungen Griechenland mittel- bis langfristig wieder zu einem solventen Staat werden kann. Um dafür Orientierung zu geben, werden im zweiten Teil der Studie verschiedene Simulationen auf Grundlage eines stilisierten Modells zur Entwicklung der öffentlichen Finanzen in Griechenland über die Jahre 2011 und 2030 durchgeführt.

Ein Ergebnis verweist auf die hohe Sensitivität der fiskalischen Schlüsselgrößen bezüglich des Wirtschaftswachstums und der Schuldzinsen: Eine nur leichte Reduktion der Zinsen oder ein etwas höheres Wachstum des Bruttoinlandsprodukts als im Basisszenario unterstellt bringt entscheidende Vorteile und hilft, den schuldenstandserhöhenden "Schneeballeffekt" zu vermeiden. Dieser Schnellballeffekt gewinnt im Basisszenario, welches auf Status quo Annahmen baut und die Ausgangsreferenz der Simulationen darstellt, schnell die Überhand und würde zu einem unvermeidbaren Kollaps der öffentlichen Finanzen führen. Da die Stellgrößen „Wachstum“ und „Schuldzinsen“ nur bedingt der direkten politischen Steuerung unterliegen, kann die Herstellung der langfristigen fiskalischen Tragfähigkeit nur an einer aktiven Haushaltskonsolidierung ansetzen, verbunden durch eine starke Reduktion der Staatsausgaben. Außerdem sollten für die Planungen des künftigen Staatshaushalts vorsichtige Projektionen zugrunde gelegt werden und berücksichtigt werden, dass kleine Wachstums- und Zinsänderungen große Auswirkungen auf den Schuldenstand und den Schuldendienst haben werden.

Erreichbar wäre die mittel- bis langfristige Sanierung des Haushalts über eine günstige Zinsentwicklung, einem etwas stärkeren Wirtschaftswachstum als im Basisszenario sowie einem dauerhaften Überschuss des Primärsaldos. Darauf deuten unsere Ergebnisse eines „Best case“-Szenarios. Im „Worst case“-Szenario hingegen, welches eine simultane Verschlechterung dieser Faktoren unterstellt, wäre ein rascher Staatsbankrott unvermeidbar. Ein einmaliger Schuldenerlass hätte lediglich einen kurzfristigen Effekt und würde ohne weitere Konsolidierungsmaßnahmen die negative Dynamik der Staatsfinanzen zwar verzögern, aber langfristig nicht aufhalten.

In einer letzten Simulation betrachten wir die fiskalischen Wirkungen von Risikoaufschlägen auf die Schuldzinsen griechischer Staatsanleihen. Ein Wegfallen spekulativer Elemente der Risikoprämien würde die Schuldenfinanzierung erleichtern und eine vollständige Reduktion der Risikoaufschläge würde sogar substanziell helfen, den griechischen Staatshaushalt langfristig auf einen tragfähigen Pfad zu bringen.

# Fiscal adjustment in Greece: In search for sustainable public finances<sup>1</sup>

Bas van Aarle<sup>a</sup> and Marcus Kappler<sup>b</sup>

## *Abstract*

*This paper analyses Greek fiscal sustainability from a retrospective and a prospective view. Implications of Greek fiscal (un)sustainability are discussed. In the empirical analysis econometric testing of Greek government solvency during the period 1985-2008 is combined with a scenario analysis of budgetary adjustments during the period 2011-2030 under alternative hypotheses.*

JEL Codes: F31, F41, G15

Keywords: Greece, euro area, fiscal policy, policy rules, fiscal sustainability

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# 1 Introduction

Despite its relatively small size in the total euro area economy, economic and budgetary developments in Greece have played a major role in the euro area since 2009 when first signs of significant fiscal and macroeconomic challenges surfaced.<sup>2</sup> Since the beginning of 2010, global capital markets have sounded the alarm about the situation in Greece: increasing interest rate spreads on Greek bonds relative to German bonds and increasing spreads on Greek Credit Default Swaps (CDS) signalled diminishing investor confidence. On May 2 2010, Euro finance ministers, IMF and the Greek government agreed on a 110 billion euro rescue package for Greece -80 billion euro comes from the EU and 30 billion euro from the IMF- and supporting economic policies.<sup>3</sup> The former Greek Prime Minister George Papandreou announced that Greece will cut 30 billion euro in spending over the next three years. Greek bond prices recovered somewhat on this announcement, but this recovery was short-lived.

As a result of the continuing tensions and speculations about difficulties in Greece, as well as Portugal, Ireland and Spain, European Union finance ministers met in a 14 hour session in the weekend of May 8 and 9, 2010, and agreed on a 750 billion euro European-wide rescue package. The IMF was also involved again and the ECB announced to buy European public and private debt. Greek bond prices increased substantially on this announcement.

The continuing fiscal turmoil and social unrest in Greece, combined with continuing speculation in financial markets of a pending Greek default -with or without an exit from the Eurozone- led to a repeated downgrading of Greek government credit ratings by rating agencies to “junk status”. Risk premia on Greek debt and implied default probabilities in credit default swaps rose again. As a result, a further rescue program followed in July 2011 focusing on rescheduling of debt obligations and public and private debt-buyback schemes which taken together imply a significant reduction of the Greek debt burden in the shorter and longer run. Taken together, banks would accept a 21% “haircut” on their Greek debt holdings.

Notwithstanding these efforts, speculation about a Greek default continued. An extra Euro area summit on October 26 proposed new measures to support Greece and extend the EFSF to support banks that would be affected by the Greek debt problem, in an attempt to prevent further contagion of the Greek debt problem to other euro area countries. Banks would accept a 50% “haircut” on their Greek debt holdings. At the political front, the Greek government and its Prime Minister resigned to make way for a technocratic government that is to prevent further political stalemate in the implementation of structural reform and fiscal consolidation measures in the line of the EU/IMF proposals accompanying the rescue packages.

Whether or not the emergency measures constitute a “credit event”, de facto Greece has until so far not defaulted on its debt obligations, and its government has repeatedly vowed that budgetary and structural reforms will be implemented: These reforms are intended to restore long-run budgetary sustainability and economic growth, and thereby will support confidence in the viability of a Greek participation in the euro area.

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<sup>2</sup> The IMF (2009) e.g. noted in July 2009 on the Greek situation “Fiscal and external imbalances are high and competitiveness has weakened. Fiscal consolidation cannot be postponed. Reforms to bolster competitiveness and growth are essential to avoid slipping into stagnation. Greece needs a coherent fiscal adjustment path, based on durable measures, aimed at returning the debt ratio to a downward trajectory. Revenue enhancements are needed, but the main tasks are to address the wage bill and structurally worsening entitlement programs.”

<sup>3</sup> See EU Commission (2010a) for all details of the Greek adjustment program.

While not being a large euro area country, the interest and importance in the Greek case lies in the potential role of bond market contagion to other euro area countries, and related, the design and long-run sustainability of the euro area. Both issues have received ample speculation from policymakers and in financial markets.

This paper analyses Greek fiscal sustainability since it lies in the core of all discussions. Financial analysts and policymakers have made many claims about Greek fiscal sustainability and alternative solutions to improve it were proposed. We analyse Greek fiscal sustainability using empirical analysis and combine a retrospective and a prospective analysis. In the retrospective analysis in Section 2, econometric testing of Greek government solvency during the period from 1980 to 2008 is undertaken to assess fiscal sustainability during this period. In the prospective Section 3, a scenario analysis of budgetary adjustment in the medium- and long-run under alternative hypotheses is carried out. It considers the impact of deficit reduction, growth (e.g. resulting a pervasive restructuring and structural reform in the Greek economy), interest rate, debt restructuring (relating to the ‘haircuts’ on Greek debt), and financial market pressure. The final section discusses perspectives on how to regain long-run budget sustainability in Greece, given the results of the analytical parts.

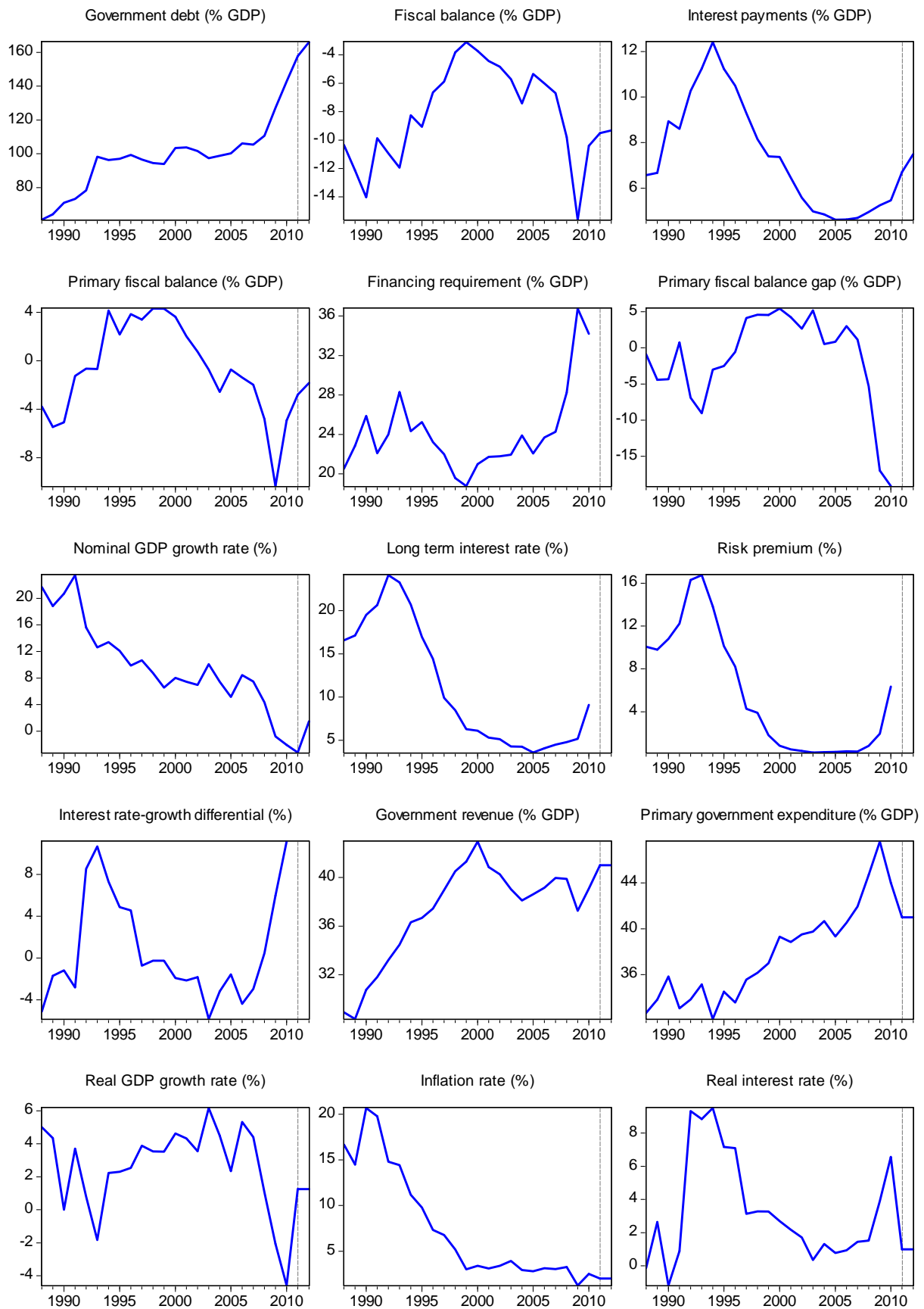
## **2 Budgetary (un)sustainability in Greece: Empirical testing**

### *Past budgetary and macroeconomic trends*

Figure 1 summarizes the main budgetary and macroeconomic trends that are observed during the period from 1990 to 2010. All data are from the European Commission’s AMECO database.<sup>4</sup> While being not very favourable already before, fiscal variables significantly deteriorate from 2007 onwards. Also the macroeconomic balance between growth and interest rate deteriorates around the same time. Both factors contribute to a rapid increasing government debt to GDP ratio, reflecting the ‘snow-ball’ effect. Underlying the fiscal balance deterioration is a combination of increasing government spending and declining revenues. We do not go into greater details of Figure 1 at this point (concepts will be discussed in due course), but rather point to the fact that the clear period of fiscal slippage from 2007 onwards is visible in nearly all fiscal and macroeconomic indicators.

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<sup>4</sup> Greek fiscal data and national income data have met repeated criticism on their consistency and adequacy. The European Commission (2010b) summarises the main problems and recommendations for improvement. We take the AMECO data as representing a reasonably adequate approximation of the actual Greek fiscal variables and output.



**Figure 1: Fiscal and macroeconomic variables, Greece, 1990-2010. Source: AMECO**



### ***Sustainability of the Greek budget before the crisis***

Unsustainable public finance, viz. government insolvency, implies the violation of the no-Ponzi game condition and hence, the intertemporal budget constraint. Following Bohn's seminal work (Bohn, 1995), empirical studies on government solvency have focused on estimating stationarity of fiscal balances and on finding cointegration between debt and the primary fiscal balance. Other studies such as Afonso (2005) apply the test of cointegration between government revenues and government expenditures in order to examine the sustainability hypothesis.

To test whether the Greek budget was sustainable before the fiscal crisis in 2009, we first conduct unit root tests on government gross debt, (primary) fiscal balances, government spending and government revenue.

**Table 1: Unit root tests**

	Deterministics	ADF	DF-GLS
Government gross debt	None	2.42 (0.99)	
	Intercept	-2.06 (0.26)	-0.26
	Intercept and trend	-1.26 (0.88)	-1.22
Fiscal balance	None	-0.59 (0.45)	
	Intercept	-1.43 (0.55)	-1.39
	Intercept and trend	-0.94 (0.94)	-1.34
Primary balance	None	-1.22 (0.20)	
	Intercept	-1.18 (0.66)	-1.16
	Intercept and trend	-1.05 (0.91)	-1.12
$\Delta$ Primary balance	None	-1.42 (0.14)	
	Intercept	-1.23 (0.64)	-1.61
	Intercept and trend	-2.35 (0.39)	-2.16
Government spending	None	1.66 (0.97)	
	Intercept	0.61 (0.99)	-0.16
	Intercept and trend	-1.57 (0.76)	-1.92
Government revenue	None	1.19 (0.93)	
	Intercept	-3.17 (0.04)	-1.61
	Intercept and trend	-0.90 (0.94)	-1.01

Sample: 1989-2008, for the ADF test p-values in parenthesis. Critical values for the DF-GLS test: -2.75, -1.97, -1.60 at the 1%, 5%, 10% level (intercept case) and -3.77, -3.19, -2.89 at the 1%, 5%, 10% level (intercept and trend case)

Government debt, total fiscal deficit, primary fiscal deficit, government spending and government revenues are all non-stationary in the sample period from 1989 to 2008 (Table 1). Even the change in the primary fiscal balance is found to be non-stationary during this period. That none of the tests rejects the null of a unit root in the (primary) fiscal balance is a first indication that intertemporal budget balance was not ensured in Greece even before the fiscal that erupted in 2009.

If the expected real interest rate is constant, for intertemporal budget balance to hold, the stock of debt and the primary deficit need to cointegrate (Trehan and Wlsh, 1991). To test for such a cointegrating relation between debt and primary deficit in the Greek case, we applied both the Johansen procedure –results provided in Table 2- and the Engle-Granger single equation cointegration tests for equations with different deterministic components - results are provided in Table 3.

**Table 2: Johansen cointegration test on Greek primary deficit and debt**

Data Trend	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	0	0	0	0	0
Max-Eig	0	0	0	0	0

\*Critical values based on MacKinnon-Haug-Michelis (1999)

**Table 3: Engle-Granger cointegration test on Greek primary deficit and debt**

Cointegrating equation deterministic: Constant				
Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
Government debt	-1.253965	0.8454	-3.432253	0.8408
Primary balance	-0.841305	0.9283	-3.006412	0.8729
Cointegrating equation deterministic: Constant and trend				
Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
Government debt	-3.372585	0.2087	-14.96438	0.1881
Primary balance	-2.648573	0.4953	-12.89425	0.3125
Cointegrating equation deterministic: Constant, trend and quadratic trend				
Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
Government debt	-2.752421	0.6830	-12.24238	0.6119
Primary balance	-4.363916	0.1106	-18.57582	0.1614

\*MacKinnon (1996) p-values, automatic lags specification based on Schwarz criterion

We do not find a cointegration relationship between the primary budget balance and the stock of debt. Trehan and Walsh (1991) show that the cointegration tests on government solvency do not generalize to the case where the expected real rate of interest is allowed to vary. Time-variation of interest rate expectations is likely given that the Greek economy underwent changes by preparing for the adaption of the Euro and implementing several convergence and stabilization programs that aimed at integrating into the European Monetary Union. A test of budget sustainability that rests on the assumption of a constant expected real interest rate may therefore be not very powerful. However, Trehan and Walsh (1991) argue that stationarity of the inclusive-of-interest deficit - the fiscal budget balance - is sufficient to imply that intertemporal budget balance holds, as long as the expected real rate of interest is positive.

Another prerequisite for a sustained budget is that revenues and expenditures move in parallel in the long-run. Only deviations of revenues from expenditures that are not mean-reverting violate restrictions on a sustainable budget balance. Consequently, if the budget process is balanced in the long-run, we expect revenues and expenditures being cointegrated.

Table 1 provided unit root tests of total expenditures (excluding interest payments) and total revenue. Both variables are non-stationary so that we indeed need to check whether a stationary linear combination between expenditures and revenues exist. Table 4 reports results of Johansen's cointegration test and Table 5 outcomes of the Engle-Granger cointegration test. The null of no cointegration is rejected by Johansen's trace and maximum eigenvalue statistic in almost all cases. The Engel-Granger procedure also rejects cointegration except in the very special case when a quadratic deterministic trend is included in the cointegration equation. We present outcomes for this specification for the sake of completeness, although the presence of a quadratic trend in the cointegration equation lacks any economic rationale and surely would not point to a healthy budget process in the long-run. We overall conclude that governmental revenues and expenditures in Greece did not co-move prior to the crisis in 2009. This finding implies non-sustainability of the Greek budget and confirms again the earlier finding using budget balance and debt stock data.

**Table 4: Johansen cointegration test of revenues and expenditures**

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	0	1	0	0	0
Max-Eig	0	0	0	0	0

\*Critical values based on MacKinnon-Haug-Michelis (1999)

**Table 5: Engle-Granger cointegration test of government revenues and spending**

Cointegrating equation deterministic: Constant				
Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
Govnt. spending	-0.565618	0.9590	-1.932556	0.9360
Govnt.revenues	-1.482438	0.7711	-3.421505	0.8416
Cointegrating equation deterministic: Constant and trend				
Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
Govnt. spending	-3.261304	0.2433	-15.54340	0.1606
Govnt. revenues	-1.716555	0.8879	-4.982806	0.9264
Cointegrating equation deterministic: Constant, trend and quadratic trend				
Dependent	tau-statistic	Prob.*	z-statistic	Prob.*
Govnt. spending	-4.088150	0.1640	-18.48348	0.1657
Govnt.revenues	-3.039170	0.5571	-57.47535	0.0001

\*MacKinnon (1996) p-values, automatic lags specification based on Schwarz criterion

Taken together, the unit-root and cointegration tests point strongly to unsustainability of Greek public finances during the period between 1989 and 2008. Clearly, the ensuing economic and fiscal crisis that Greece experienced has added additional pressure on the urge to regain fiscal sustainability. An important question is therefore how Greece may regain fiscal stability.

### **3 A forward-looking approach to fiscal sustainability in Greece: Simulating alternative scenarios for 2011-2030**

Fiscal sustainability can not only be defined in terms of observed behaviour of fiscal deficits, debt, expenditures and revenues in the past, but also in terms of a forward-looking approach by considering alternative scenarios for the near future and beyond and assess their implications in terms of budgetary sustainability. In this section, we analyse a number of budgetary scenarios that could be relevant from the perspective of sustainability of Greek consolidated public finances.

Underlying our analysis is a small simulation model that can be summarised by the equations that are shown in Table 6.<sup>5</sup>

<sup>5</sup> Our model deals with the general government fiscal variables and is therefore not further worked out into federal, regional, local government and social security accounts.

**Table 6: A small model of Greek public finances**

$$\left(\frac{B}{Y}\right)_{t+1} = (1 - gr_t^n) \left(\frac{B}{Y}\right)_t - \left(\frac{D}{Y}\right)_t + \left(\frac{SF}{Y}\right)_t \quad (1)$$

$$\left(\frac{D}{Y}\right)_t = \left(\frac{T}{Y}\right)_t - \left(\frac{G}{Y}\right)_t \quad (2)$$

$$\left(\frac{G}{Y}\right)_t = \left(\frac{G^P}{Y}\right)_t + int_t \quad (3)$$

$$\left(\frac{D^P}{Y}\right)_t = \left(\frac{T}{Y}\right)_t - \left(\frac{G^P}{Y}\right)_t \quad (4)$$

$$int_t = i_t^{avg} \left(\frac{B}{Y}\right)_t \quad (5)$$

$$i_t^{avg} = r_t^{avg} + \pi_t^{avg} + rp_t^{avg} \quad (6)$$

$$rp_t^{avg} = \alpha^{avg} \cdot finreq_t = \alpha^{avg} \left( \left(\frac{D}{Y}\right)_t + \frac{1}{avg} \left(\frac{B}{Y}\right)_t \right) \quad (7)$$

$$gr_t^n = gr_t^r + \pi_t \quad (8)$$

$$pfgap_t = (i_t^{avg} - gr_t^n) \left(\frac{B}{Y}\right)_{t-1} - \left(\frac{D^P}{Y}\right)_t \quad (9)$$

Equation (1) determines the dynamics of the next period debt-to-GDP ratio ( $B/Y$ ) as a result of debt in the previous period, the deficit to GDP ratio ( $D/Y$ ), the nominal GDP growth rate ( $gr^n$ ) and the stock-flow adjustment ( $SF/Y$ ). The stock-flow adjustment is the difference between the change in government debt and the government deficit/surplus for a given period. Stock-flow adjustments occur, for instance, through an acquisition of financial assets. The deficit in equation (2) equals revenues to GDP ( $T/Y$ ) minus expenditures to GDP ( $G/Y$ ). Total expenditures in equation (3) consist of primary expenditures ( $G^P/Y$ ) and interest expenditures ( $int$ ). Equation (4) defines the primary fiscal balance ( $D^P/Y$ ) by taking out the interest payments from the total deficit. Interest payments are approximated by the interest rate at the average maturity of the outstanding debt,  $i^{avg}$ . The nominal interest rate in equation (6) is defined as the sum of the real average interest rate ( $r^{avg}$ ), (expected) average inflation ( $\pi^{avg}$ ) and a risk premium ( $rp^{avg}$ ), all defined at the average maturity.<sup>6</sup>

We assume in equation (7) that the risk premium depends on the average financing requirement ( $finreq^{avg}$ ), with the sensitivity measured by the curvature parameter  $\alpha$ . The financing requirement is proxied by the fiscal deficit plus the amount of debt divided by the average maturity ( $avg$ ). Debt financed at a longer maturity has the advantage of reducing the financing requirement compared to debt with a shorter maturity. At the same time, financial markets typically increase the risk premium with longer maturity of bonds as the risk of default and interest rate changes increases with a longer maturity, the term premium. Note that equations (7), (6), (5) and (1) imply a non linearity (i.e. quadratic) in the debt dynamics.

<sup>6</sup> This implies that in the short-run interest payments are largely determined by past interest rates (given a debt evolution) and less by current market conditions bond yields, current speculations in financial markets, etc. The current interest rate at the average interest (6) is a somewhat rough proxy for the average interest rate on outstanding debt. In our simulations these current conditions and future expectations, speculations embedded in market interest rates, do need to get more attention as they will be gradually factored into future dynamics of interest payments as debt is rolled over.

Nominal GDP growth in equation (8) equals real growth ( $gr$ ) plus inflation.<sup>7</sup> Finally, equation (9) gives the primary fiscal gap ( $pfgap$ ), the difference between the primary fiscal balance that would stabilize debt at the level at the start of the current period and the actual primary fiscal balance.

### ***The baseline scenario***

We firstly set out a baseline scenario for the exogenous variables in the model for the period from 2011 to 2030 and then analyse the consequences for budgetary sustainability of several alternative scenarios. While this baseline scenario should not be considered necessarily as the most likely one, we give it a number of features that could be a useful benchmark.

In the baseline, we assume a real GDP growth rate of 1.25%, an inflation rate of 2% and a real interest rate of 1%. Primary government expenditures and government revenues are both set to 41% of GDP- close to their 2009-2010 values- implying a primary balance in equilibrium. In other words, we take a neutral stance on this aspect.<sup>8</sup> The average maturity of debt,  $avg$ , is set equal to its 2010 value of 6 years. The risk premium curvature coefficient  $\alpha$  is set to 0.07, based on a simple regression of the Greek interest rate differential w.r.t. Germany on the level of Greek debt. The stock-flow adjustment is set to 0% of GDP.

Simulating the model with these baseline assumptions results in the adjustments that are shown with a blue line in Figure 2. In this baseline scenario, government debt gradually rises from the starting value of close to 140% of GDP to over 250% by 2030. This growth is driven by a rising interest burden that contributes to deteriorating fiscal conditions –increasing debt, deficits, and risk premium. An average primary fiscal balance gap of around -5.5% of GDP over the projections from 2011 to 2030 suggests that throughout the period a sustained primary fiscal balance (improvement) of 5.5% -compared to the baseline- is needed to stabilise debt at its current level, other things being equal. That means that a primary fiscal surplus of 5.5% more than our (optimistic) baseline assumption of a 0% primary fiscal balance is necessary to retain sustainable debt levels. The persistent and rising risk premium to a value of around 4% at the end of 2030 reflects of course the high initial debt level and unfavourable debt dynamics.

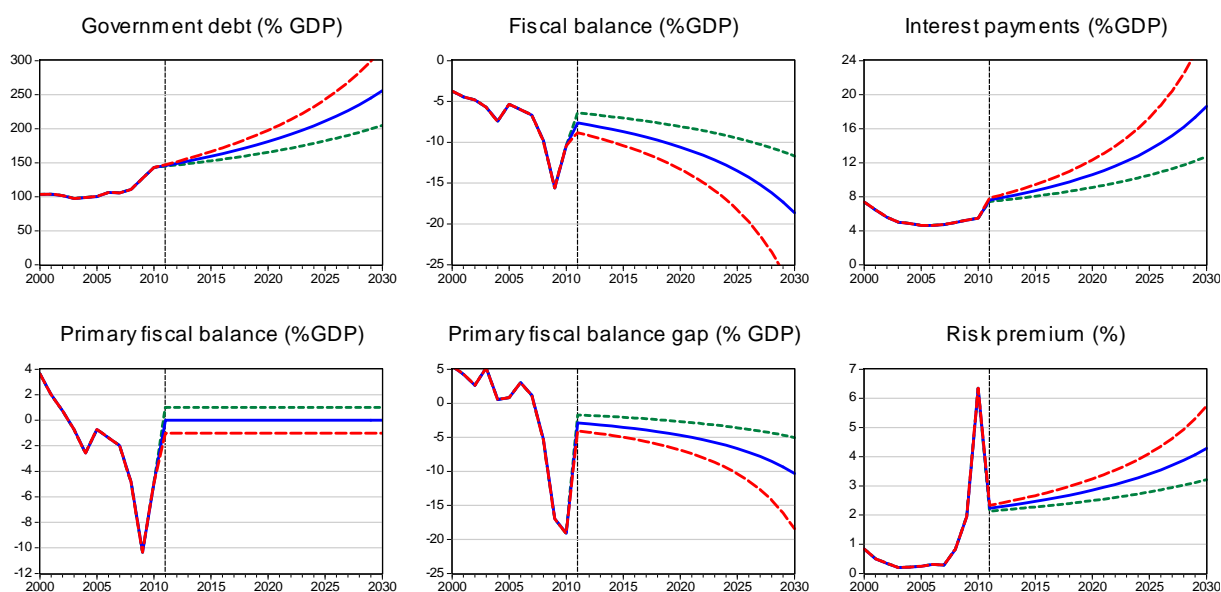
### ***Primary fiscal balance scenarios***

In the first case we consider the effects of a 1% GDP change in (net) government spending. Containing government spending, viz. raising tax revenues, improves the primary fiscal balance and has been advocated as crucial in regaining fiscal sustainability in Greece. Scenario 1 (2) therefore analyses the effects of a 1% decrease (increase) in primary government spending on the fiscal variables. Figure 2 compares the outcomes of scenario 1 (2) and the baseline scenario.

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<sup>7</sup> Note that our simple model ignores the effects of changes of government spending and government revenues on economic growth and inflation. There is considerable uncertainty about the size and even the sign of fiscal multipliers (think of the literature on the so-called non-Keynesian effects of fiscal adjustments) in the short and long-run, see Spilimbergo (2008).

<sup>8</sup> An example of more pessimistic baseline on the primary fiscal balance (-2% for the period 2010-2014) is taken by the IMF (2009). IMF (2010) considers an alternative, more optimistic scenario with the primary fiscal balance gradually improving from -2.5% of GDP in 2010 to +5% of GDP in 2015. In the even more optimistic scenarios of the European Commission (2010c), a positive primary fiscal balance of 5.5% of GDP is assumed from 2011 onwards, resulting in a gradual debt reduction from 137% to 125% to GDP in 2025.



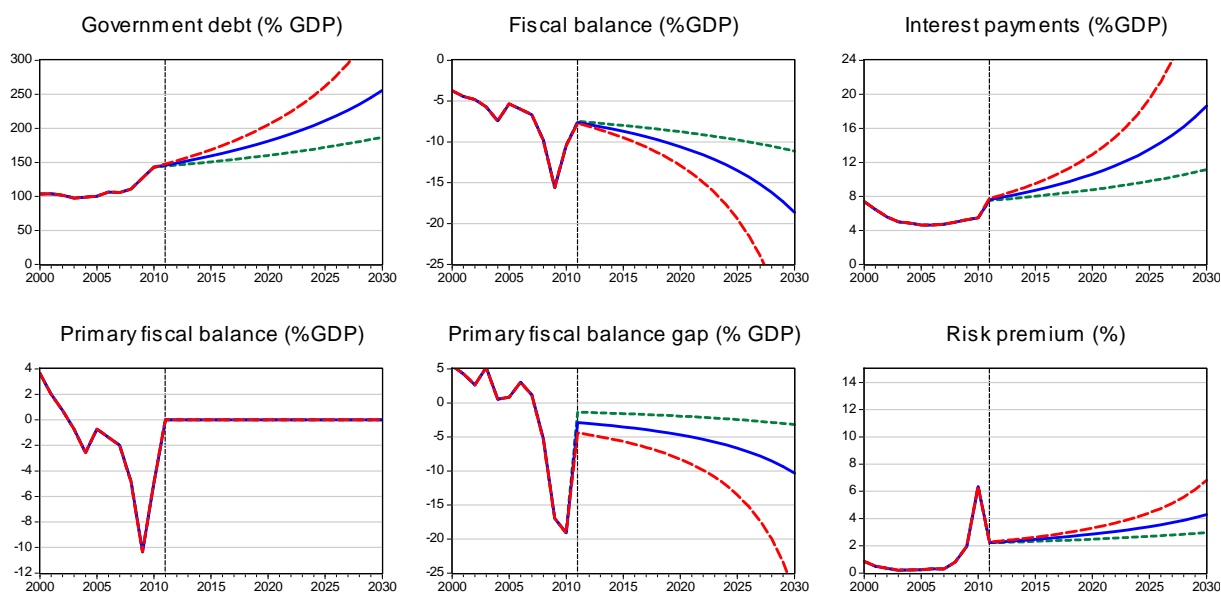
**Figure 2: Simulation of 1% lower (Scenario 1, red dashed line) or higher (Scenario 2, green dotted line) primary government spending compared to baseline (blue line), 2011-2030**

This scenario illustrates the relatively high sensitivity –especially in a longer-run perspective- of the Greek budgetary situation to small, permanent changes in the primary balance. Compared to the baseline, all fiscal variables gradually improve (deteriorate) from a reduction (increase) in primary government spending. Conversely, in case of a primary fiscal balance deterioration, fiscal sustainability is out-of-reach definitively. The simulation points in a quantitative manner to the obvious conclusion that cutting spending and/or increasing revenue, e.g. by reducing tax-evasion, is not easy and subject to political social resistance, but an important prerequisite for regaining fiscal sustainability in the Greek case.

Note that our simple framework ignores the effects that changes in government spending (and government revenue) may have on economic growth and inflation. Most empirical studies would point to small but positive fiscal multipliers in the short-run. The literature on non-Keynesian effects of fiscal adjustments would, however, point to the possibility of positive growth effects from fiscal consolidations –citing positive wealth effects, positive expectations effects and positive incentive effects-, especially under conditions of high government debt and high tax rates, a situation that would apply to the case of Greece. Taken together, this suggests that the short-run and long-run growth effects of such a fiscal consolidation are -while perhaps not zero- rather limited.

### ***Growth scenarios***

In the second case depicted in Figure 3, the effects of a 1% change in economic growth is considered: a crucial factor since economic growth determines the tax bases from which government spending, deficits and debt can be financed. Uncertainty over economic growth in the short and long-run is typically high. Thus, the following scenarios highlight the importance of assessing the impact of alternative growth hypotheses on public finances. Indeed, the Greek government has announced -and is seeking- to implement various measures that could contribute to reinvigorating growth of the Greek economy by restructuring and modernising the private and public sectors. Scenario 3 (4) displays the effects of an improvement (deterioration) of the real growth rate of 1% compared to the baseline.

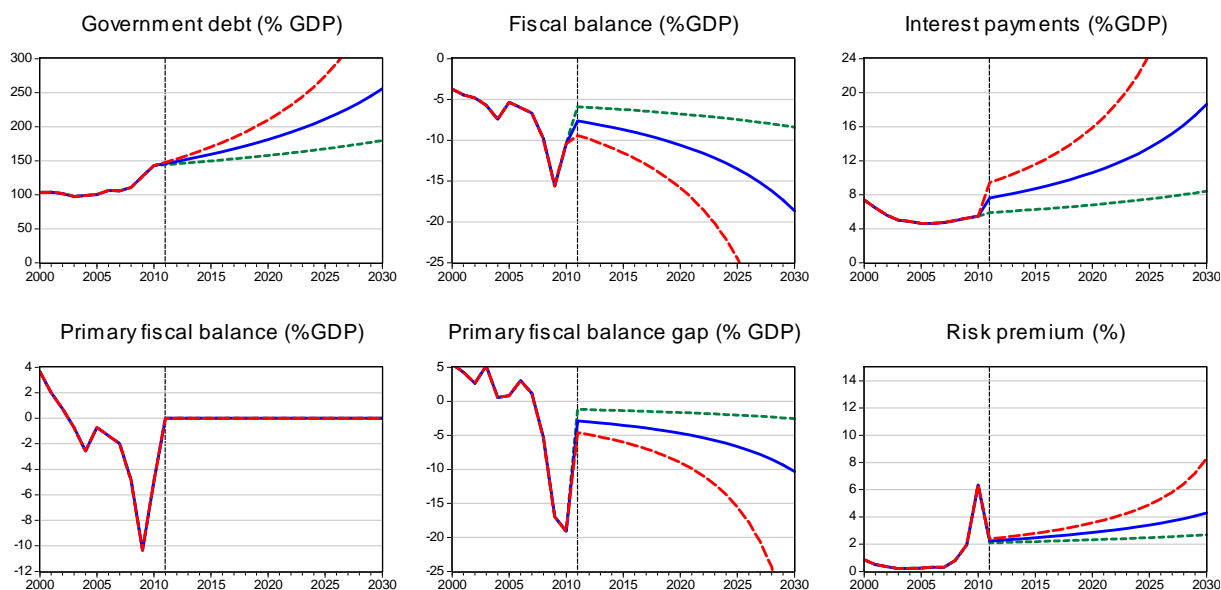


**Figure 3: Simulation of 1% higher (Scenario 3, green dotted line) and 1% lower (Scenario 4, red dashed line) economic growth compared to baseline (blue line), 2011-2030**

A small but sustained improvement of economic growth has strong effects on public finances. Compared to the baseline, debt dynamics get on a declining path and all fiscal variables improve markedly.

### ***Interest rate scenarios***

In the third case, the effects of a 1% change in the interest rate (risk premium) are analysed. We implement this interest rate shock by a change in the real interest rate,  $r$ . The same outcomes and interpretations would result if we implement the interest rate shock as a 1% shock to the risk premium. While economic growth is a stabilising factor, interest rates are a destabilising element in debt to GDP dynamics. The interest rate (risk premium) is obviously also one of the crucial driving forces in the dynamics of the Greek debt to GDP ratio. A higher interest rate (risk premium) not only implies a higher interest burden on outstanding debt, but we also consider the possibility that a higher debt stock itself in addition induces an increasing risk premium on government debt, leading to higher interest rates and reinforcing therefore the instability from high, increasing debt. Scenario 5 (6) considers the effects of a 1% lower (higher) interest rate on Greek debt, compared to the baseline.



**Figure 4: Simulation a 1% lower (Scenario 5, green dotted lines) and 1% higher (Scenario 6, red dashed lines) real interest rate compared to baseline (blue line), 2011-2030**

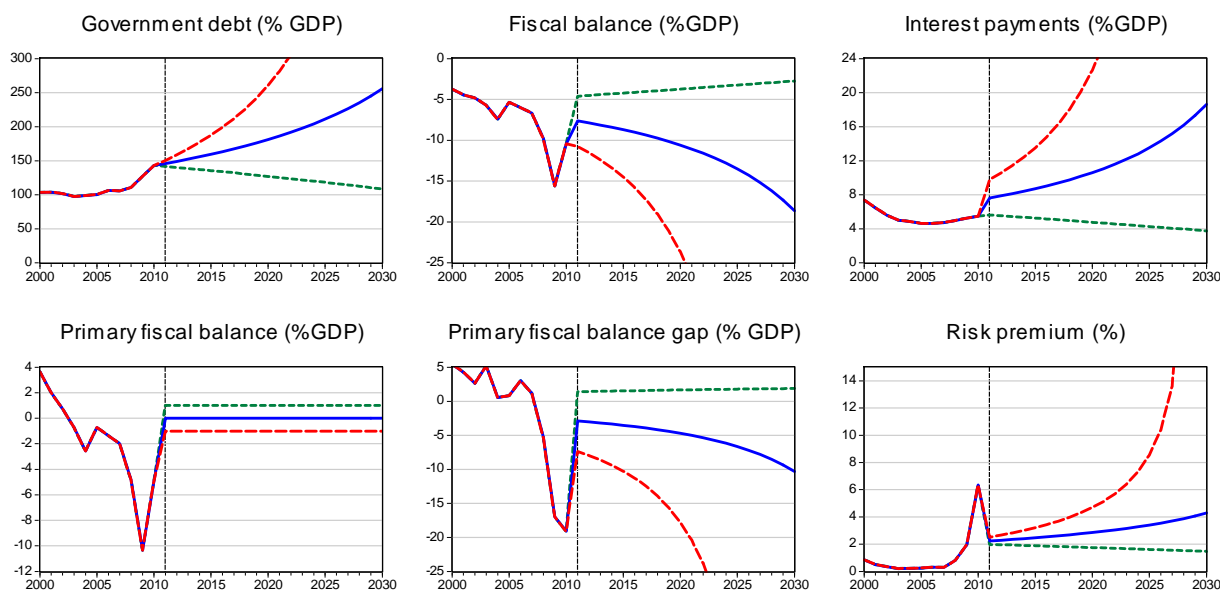
The results are similar to the 1% economic growth changes shown in Figure 3, the main differences lie of course in the interest burden and total deficit adjustment. A reduction of interest rates in Greek debt - whatever way achieved- is a crucial prerequisite for a lasting fiscal consolidation to be feasible. Note that the outcomes of the scenarios of Figure 4 would also occur from a permanent 1% reduction (increase) of the risk premium.

### ***Combined government spending, growth and interest rate scenarios***

In the fourth case we consider “best” (“worst”) case scenario that bring together the previous three cases, a 1% primary balance improvement (deterioration), 1% higher (lower) economic growth and a 1% lower (higher) interest rate. Figure 5 considers such a “best case” (Scenario 7) and a “worst case” (Scenario 8).

The “best case” scenario essentially restores Greek fiscal sustainability, even at a slow pace. The fiscal balance improves gradually as the interest burden recedes. Government debt starts to decline. In the “worst case” scenario, a rapid further decline in fiscal sustainability occurs. Note in particular the asymmetry between both cases due to the non-linearity in the risk-premium: in the “worst case” scenario, fiscal variables deteriorate faster than they improve in the “best-case” scenario.





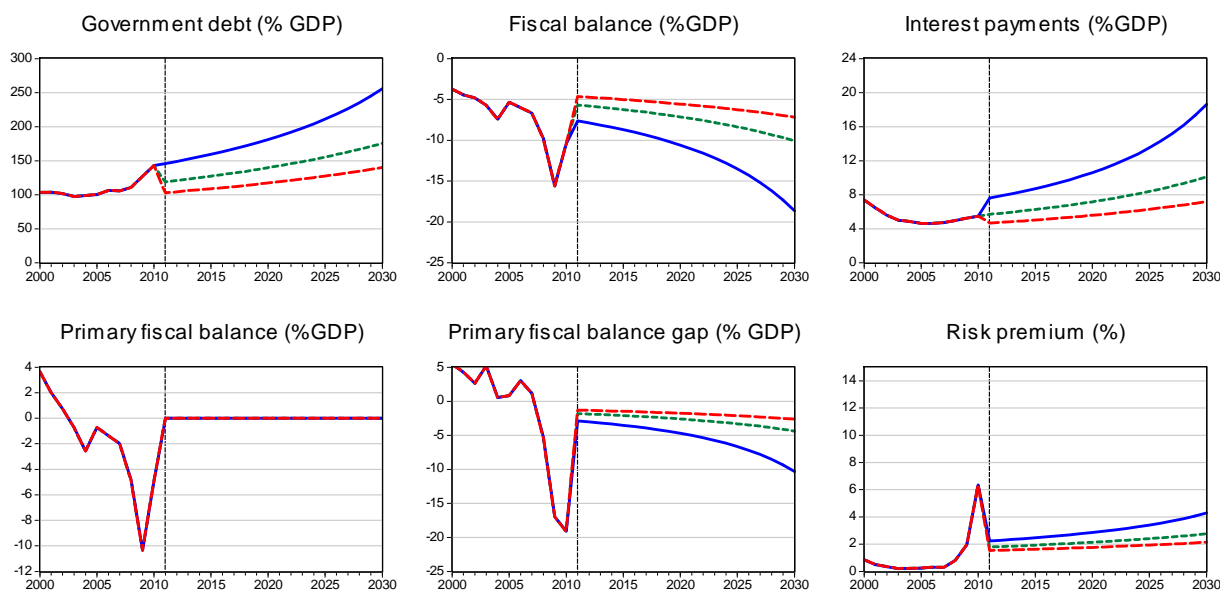
**Figure 5: Simulation of a “best case” (Scenario 7, green dotted lines) and “worst case” scenario (Scenario 8, red dashed lines) compared to baseline (blue line), 2011-2030**

### *Debt restructuring scenarios*

Other important factors that could contribute to the alleviation of the Greek debt crisis are measures to restructure debt. (In)voluntary debt forgiveness, increasing the maturity and refinancing at advantageous interest rates all contribute to a reduction of the debt and interest burden. Many variants of such debt restructuring packages have been discussed and proposed. Figure 6 studies the effects of a stock-flow adjustment of -25% of GDP (scenario 9) that could be considered as a rough approximation of the effects of the substantial Greek debt-rescheduling incorporated in the second rescue-package of July 2011. We also include a second, larger scenario of -40% debt to GDP (scenario 10) that could be considered as a rough approximation of the second Greek debt “haircut” agreed in the rescue package of October 27 and which would strip roughly 100 billion euro from the Greek debt where commercial banks would agree to write-off 50% of their Greek debt holdings.

In case of such a one-time debt-reducing effort from rescheduling/debt-buybacks and other measures in the order of 25% or even 40% of GDP, Greek public finances regain a more stable adjustment path over time, even if in the long-run again a small upward trend in debt remains, as the structural problem of low growth and insufficient fiscal stringency is not tackled by a one-time debt-relief. Nevertheless, considerably more budgetary “breath space” is provided from these debt-relief scenarios.<sup>9</sup>

<sup>9</sup> We ignore the possibility that financial markets, after a debt “haircut”, are likely to punish governments. Empirical evidence in Cruces and Trebesch (2011) suggests that higher haircuts are associated with higher subsequent bond yield spreads and limited capital market access for some time and that credit markets do not easily “forgive and forget” in other words.



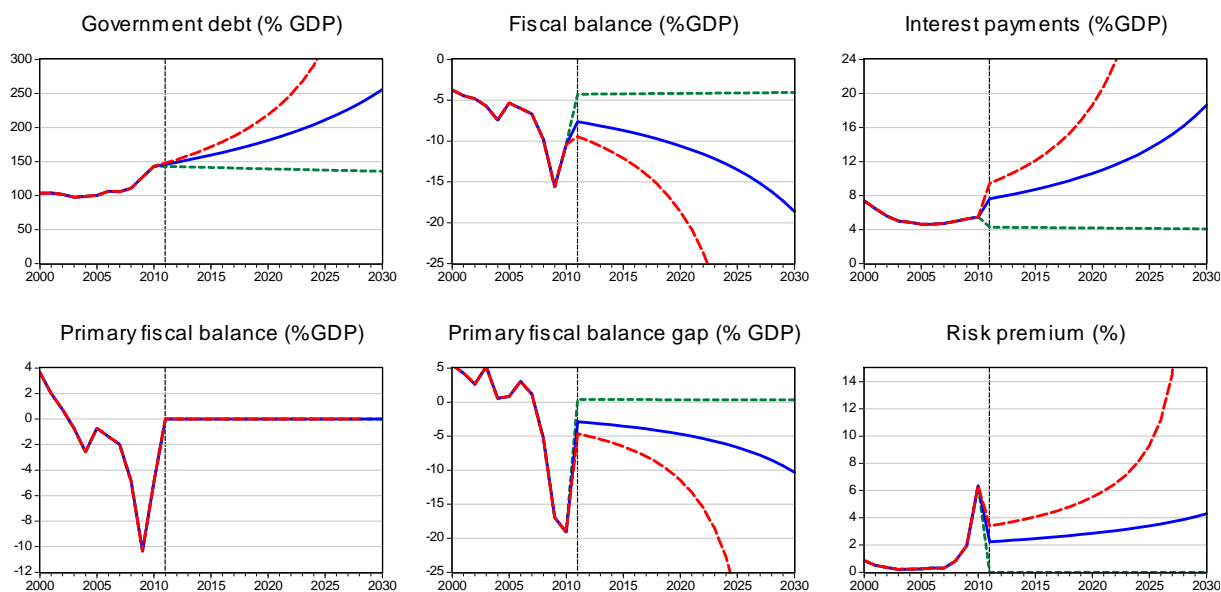
**Figure 6: Simulation of a -25% GDP (Scenario 9, green dotted line) and -40% GDP (Scenario 10, red dashed line) stock-flow adjustment compared to baseline (blue line), 2011-2030**

### *Risk premium scenarios*

In the last case we consider the effects of a stronger versus a lower risk-premium mechanism; the case of a lower risk premium mechanism is linked to the recent discussion of the possible introduction of ‘Eurobonds’ to stem the European debt crisis. As noted at various places, the risk-premium formation and dynamics play a significant role in the adjustment of fiscal variables. It is therefore interesting to examine this role further. We compare in Figure 7 the baseline scenario –based on the nonlinear (i.e. quadratic, as can be seen when combining equations (1), (5), (6) and (7)) risk premium mechanism, with  $\alpha = 0.07$ - with two alternatives. In Scenario 11,  $\alpha$  equals 0 implying no risk premium on Greek government bonds; in Scenario 12,  $\alpha$  equals 0.1 implying a stronger non-linearity in the risk-premium, and consequently in the entire adjustment of fiscal variables.

This scenario where risk-premia on Greek debt would disappear could result from the introduction of the so-called Eurobonds, a possibility that has been widely discussed. Figure 7 shows that this ‘Eurobonds’ scenario would restore fiscal sustainability: debt, fiscal deficit and the interest burden are stabilised and the primary fiscal gap closes entirely. The scenario where the link between risk-premia and government debt is tightened ( $\alpha = 0.1$ ) could be interpreted as a headwind scenario with stronger speculation on a Greek default in international financial markets<sup>10</sup>, speculative downgradings of Greek debt by rating agencies and a general lack of confidence on the Greek efforts to restructure public finance and the economy. This scenario with its stronger non-linearity in public finances from the risk-premia effect results in a situation where a Greek default is practically inevitable in the medium-term when this non-linearity start to “bite” more strongly than in the baseline.

<sup>10</sup> Such speculations can be fed e.g. by massive buying of Credit Default Swaps (CDS) on Greek debt. Instruments that have been described as “financial weapons of mass destruction”. While not necessarily fully adequate in case of sovereign debt, spreads on CDS are often used to derive an implied default probability and recovery rate, see Berndt e.a (2005) on such valuations using CDS. Arghyroua and Kontonikas (2011) analyse determinants of risk premia and CDS spreads in the Eurozone in the running-up and during the European debt crisis.



**Figure 7: Simulation of  $\alpha = 0$  (Scenario 11, green dotted line) and  $\alpha = 0.1$  (Scenario 12, red dashed line) compared to baseline (blue line), 2011-2030**

## 4 Conclusions

Recently, Greece found itself in the centre of the European debt crisis feeding speculations of a pending Greek sovereign default and an exit from the euro area. Policymakers of the European Union and the IMF responded by designing a Greek rescue programme to avert such a “worst-case scenario” on the near- and medium-term. Greek policymakers committed themselves to an extensive programme of fiscal and structural reforms. Given high vulnerabilities in growth, public finances and the financial sector, Greek policies need in particular to restore confidence and bolster sustainability.

This paper provided a more detailed look at the stability of public finance in Greece. Econometric tests on solvency showed that the Greek public finances were not on a sustainable path during the period between 1989 and 2008. During the period from 1990 to 2010, all Greek fiscal variables were found to be non-stationary and no cointegration was found between public debt and the primary fiscal balance and not between government revenue and (non-interest) government spending.

In a forward-looking scenario-analysis it was in a next step investigated how Greek public finances may evolve during the short- and medium-run. Simulations for the period between 2011 and 2030, using a simple model of the Greek public finances, provided a number of interesting insights and policy implications. A first result is the importance of the interest rate versus growth factor for the dynamics of the fiscal variables in the longer run: a small reduction in interest rate or a small improvement of growth delivers important gains in limiting or even preventing the “debt snowball” effect we still observe quite significantly in the baseline scenario. Given that interest rates and economic growth are only very indirectly under control of policymakers, fiscal prudence requires being very cautious regarding projections on interest rates and growth, and considering the possibility that both interest rates could get higher than projected and growth rates lower than expected.

Regaining long-run sustainability, in other words, will require a long period of fiscal consolidation, resulting in substantial expenditure reduction with accompanying economic,

political and social costs. In a “best case” scenario, the fiscal consolidation is significantly supported by growth and interest improvements and a significant debt-rescheduling package. At the same time, a “worst case” scenario where all these parameters turn adverse, imply a rapid derailment of Greek public finance and most likely a rapid default in practical terms. Debt-restructuring and debt forgiveness may have beneficial effects in the short-run; these effects are however temporary if not at the same time also the underlying structural determinants of fiscal sustainability are changed. A final simulation pointed to the importance of the risk-premia dynamics in sustainability of public finances. A scenario where this risk-premia disappears (or is largely reduced), for instance achieved through the implementation of “Eurobonds”, would provide strong support to fiscal sustainability as it mitigates the non-trivial adverse impact of speculation in international bond markets about a Greek default.

## References

- Afonso, A. (2005). Fiscal sustainability: The unpleasant European case, *FinanzArchiv*, 61 (1), p. 19-44.
- Arghyroua, M. and A. Ktononikas (2011). The EMU sovereign-debt crisis: Fundamentals, expectations and contagion, DG-ECFIN Economic Papers no.436, February 2011, Brussels.
- Berndt, A., R. Douglas, D. Duffie, M. Ferguson, and D. Schranz (2005). Measuring default risk premia from default swap rates and EDFs, mimeo.
- Bohn, H. (1995). The sustainability of budget deficits in a stochastic economy, *Journal of Money, Credit and Banking*, 27, p. 257-271.
- Cruces, J. and C. Trebesch (2011), Sovereign defaults: The price of haircuts, CESifo Working Paper No. 3604
- European Commission (2010a). The economic adjustment programme for Greece, Occasional Papers 61, May 2010, Brussels.
- European Commission (2010b). Report on Greek government deficit and debt statistics, COM\_2010 Brussels.
- European Commission (2010c). The economic adjustment programme for Greece, First review Summer 2010, Occasional Papers 68, August 2010, Brussels.
- IMF (2009). Greece: 2009 Article IV Consultation—Staff Report, IMF Country Report No. 09/244, August 2009.
- IMF (2010). Greece: First Review Under the Stand-By Arrangement, IMF Country Report No. 10/286, September 2010.
- Spilimbergo, A., S. Symansky, O. Blanchard, and C. Cottarelli (2008). Fiscal policy for the crisis, IMF Staff Position Note, SPN/08/01, December 29, 2008.
- Trehan, B. and C. Walsh (1991). Testing intertemporal budget constraints: Theory and applications to U.S. federal budget and current account deficits, *Journal of Money, Credit and Banking*, 23, p. 206-223.