Sustainability of Government Debt in the EU

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This paper addresses the sustainability of government debt in Europe and is motivated by the recent debt increases following the crisis. We evaluate the sustainability in a time frame of ten years in which governments will be able to implement budget rules to get budget deficits under control. We develop a fiscal sustainability model for selected EMU member states that uses stochastic inputs based on historic data, closely following van Wijnbergen's (van Wijnbergen and Budina, 2008) approach. We simulate the development of government debt as a percentage of GDP and show its expectation value including a confidence interval for a member state conditional on deficit reduction scenarios and the behaviour of other EMU member states. Using OECD projections as a baseline, we find that without additional fiscal consolidation and taking into account the public costs of ageing until the end of the projection period, budget deficits in all selected EMU countries will rise and sovereign debt is not sustainable, apart from Belgium. Even ignoring the cost of ageing, consolidation of sovereign debt is necessary for nearly all EMU countries. The consolidation proposed by the OECD would eliminate the doubts on sustainability of Belgium, Dutch, German, Italian, Portuguese and French bonds. For Ireland, Greece and Spain additional actions are required on top of the consolidation in the OECD projections. Together with a review of spillovers and stress-tests performed with our model we conclude that coordination of fiscal policies in the EMU is necessary.

Key words: EU, government debt, cross border spillovers, euro
JEL code: E52, E6, H63, H71

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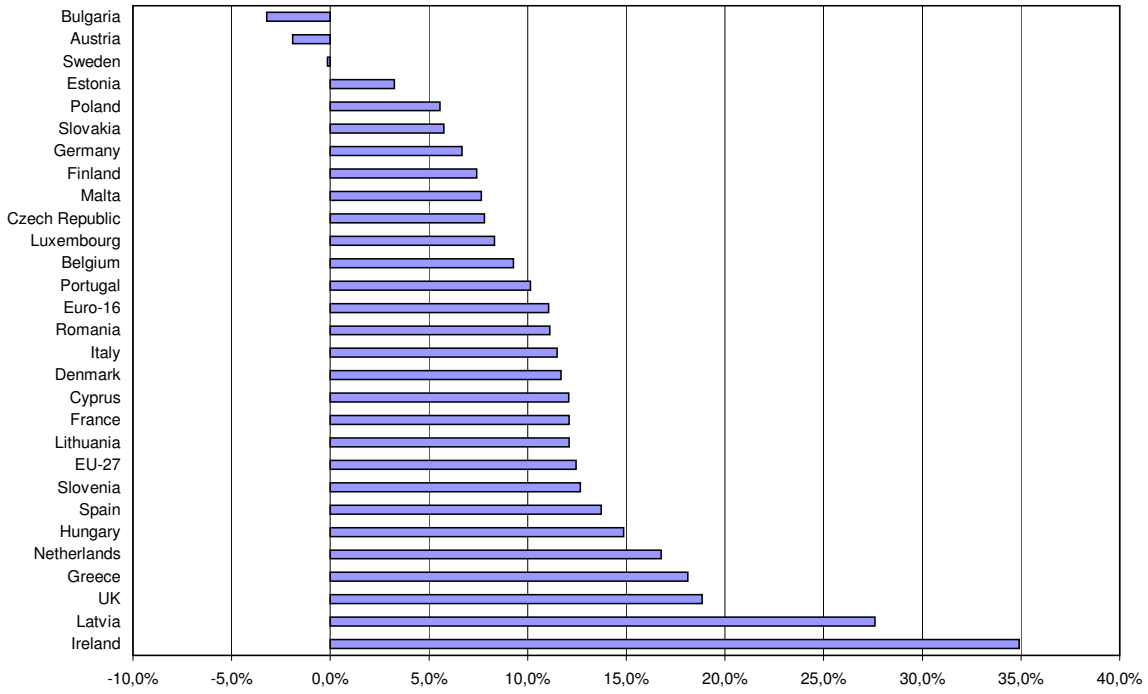
1 Introduction

Government debts have surged in Europe and other western countries in response to the worldwide financial crisis which forced several EU member states to support financial institutions and to stimulate the economy while tax revenues dwindled. On average debt increased from 66.0%, end of 2007, to 78.7% of GDP, end of 2009 in the Euro-16. Debt increases as a percentage of GDP were most pronounced in Ireland, Latvia, the United Kingdom, Greece, The Netherlands and Hungary (see Figure 1.1.).

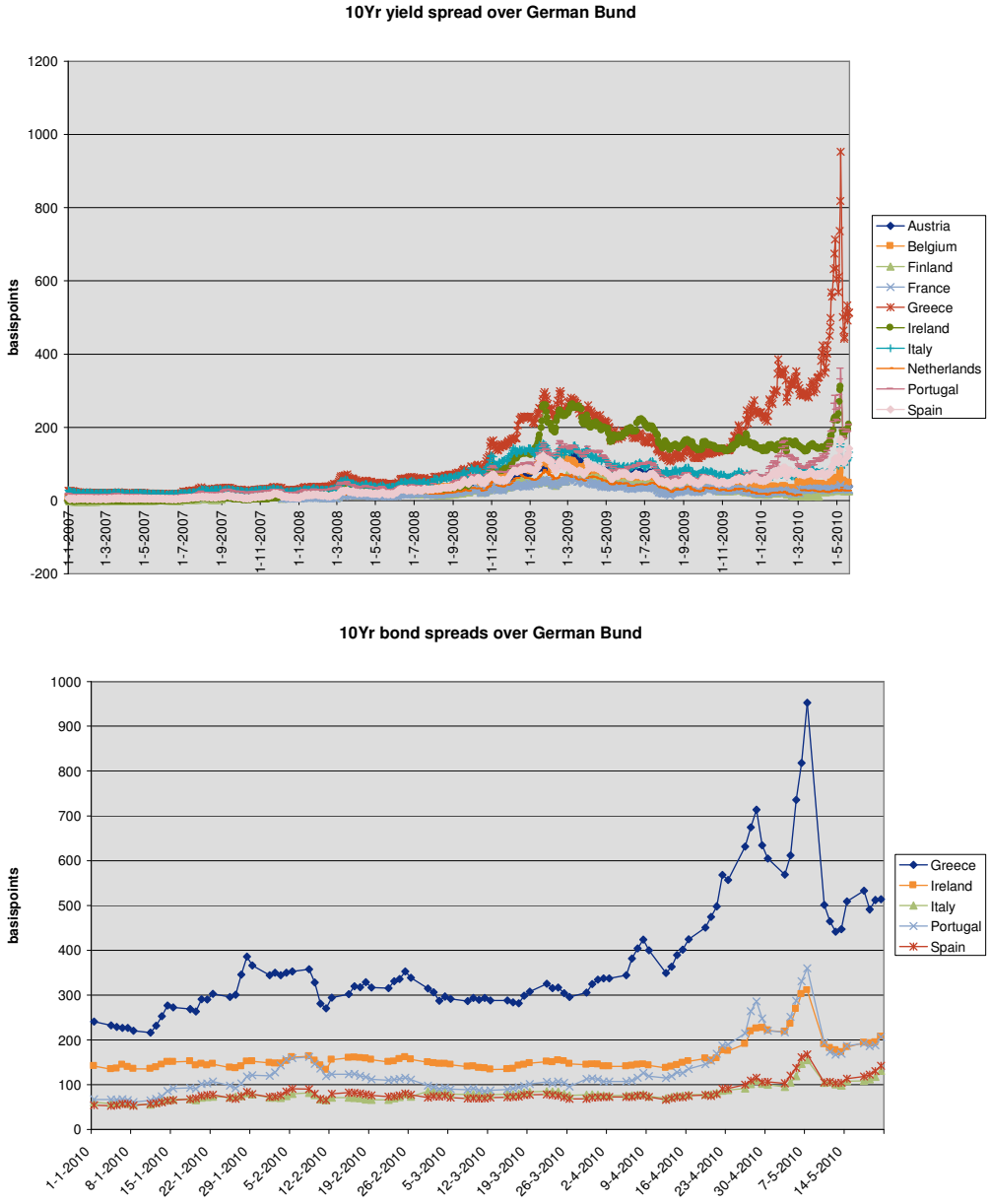
Figure 1.1 Change in government debt as a percentage of GDP third quarter 2007 to third quarter 2009, EU member states



Source: Eurostat

Apart from rising debt levels sovereign bonds have experienced unprecedented volatility. In 2009 sovereign bond spreads between the most default-free German Bund and less default-free government bonds of other Eurozone member states have risen and fallen again. Recently some southern Eurozone member states, in particular Greece, Spain and Portugal have experienced additional volatility again and are dealing with much higher bond spreads. At the date of writing, May 20th, Greek 10 year government bonds quote at 531 basis points over German Bunds. Also credit default swap ("CDS") spreads (number of basis points an owner pays for insurance against the default risk of the bond) are volatile to more or less the same extent.

Figure 1.1 Sovereign euro bond spreads, 2007-2009, in basis points



For some time the recent rise in government budget deficits and debts worried mainly academics, policy makers and politicians. In the beginning of 2010 the financial markets questioned the solvability of some member states, leading again rising to sovereign bonds spreads and finally to urgent and drastic actions of the EU and IMF to support Greece and other threatened member states.

These developments lead to several questions. First, are government debts in Europe indeed unsustainable and – if they are – for which countries is this case? Second, why do developments in one member states affect the situation in other countries? The issue of medium term sustainability is dependent on the notion of what a sustainable level of government debt is

and on the necessary EU framework and national policies that will be crafted and implemented to attain such sustainable levels.

To answer these questions we first survey the literature on sustainable government debt and on cross-border spillovers of government debt. This literature consists of a theoretical and empirical part. The theoretical literature provides insights in the determinants of government debt and spillovers. We use the empirical literature to judge the relevance of these determinants. With respect to sustainability various measures are developed to address this issue. Moreover, many countries have experienced government debt defaults. From these experiences some common determinants threatening sustainability can be derived. These issues are extensively discussed in section 2. The empirical literature on spillovers of government debt indicates the relevance of some of the spillover channels. Section 3 provides an overview.

Second, we develop a sustainable debt model based on van Wijnbergen and Budina (van Wijnbergen and Budina, 2008). This model allows us to assess the expected development and confidence interval of government debts using stochastic simulations based on historic inputs. We make use of the standard relation that the government debt-to-gdp-ratio depends on last year's debt-ratio, the primary surplus (including seigniorage revenue), the real interest rate, real GDP growth and other exogenous factors affecting the budget, like the costs of ageing and of the bailout of banks. The model allows for impacts that are conditional on the inputs of other countries with respect to economic growth and the interest rate. The stochastic simulations provide some indications on the possible bandwidth of outcomes due to uncertainty. We apply 'stress-tests' along several scenarios. Combining the outcomes with the criteria derived form the literature allows us to assess the sustainability of sovereign debt in selected EMU countries.

From the literature review on sustainable debt levels we derive four indicators that appear to be useful for the assessment of sovereign debt sustainability. First, the forward looking sustainability gap indicator which shows the distance in terms of primary surplus as a percentage of GDP from a stable debt-ratio. Second, the backward looking sustainability gap indicator which indicates whether the current debt level is commensurate with the debt-ratio that would be sustainable if augmented primary surpluses, interest rates and GDP growth rates would remain at their average level of the recent past. Third, the debt-to-government revenue indicator that was on average 350% for emerging market economies that defaulted since 1998 and 250% for non-defaulting countries (Callen et al., 2003). And finally the debt-to-GDP ratio for which a threshold value of 90% can be associated with below-median GDP-growth (Reinhart and Rogoff, 2010); hence, it is likely that maintaining debt-ratio's around 90% or higher is more difficult and thus less sustainable than debt-ratio's at a more modest level.

From the literature survey on cross-border spillovers from sovereign debts we conclude that the magnitudes of most spillovers are small. There are no empirical indications that inflation expectations are modified nor that in the longer term economic performance in other countries is affected via the various channels of cross-border transactions. There may be modest effects on interest rates from high budget deficits and high government debts in other countries but

their magnitude is small. However, once contagion occurs the spillovers can suddenly be large. These financial spillovers are larger if cross-holding of government bonds is more significant. With a weak and fragile banking system the contagion mechanism could disrupt economies across borders. This is the main argument for some coordination of fiscal policies.

Our assessments of sovereign debt developments depart from recent OECD projections. We apply an OECD baseline and consider two OECD variants that reflect a) extra consolidation of government budgets (raising primary surpluses) and b) the additional costs of ageing (reducing primary surpluses). Moreover, we apply two stress tests on the baseline projection. The first of these reflects higher than baseline interest rates. The second reflects a prolonged recession by maintaining the output gap. Using the four indicators for sustainability we conclude that a wide variety of scenarios is conceivable in which in a single case (baseline + consolidation) only a few of the member states considered are in a difficult sovereign debt position while in other cases (baseline + ageing; prolonged recession) most countries under consideration are potentially heading for unsustainable debts.

Thus, our assessment of the sustainability of sovereign debts within EMU and our mixed results over miscellaneous scenario assumptions provide an important background for judging current policy actions by the EU and Member States to raise primary surpluses. Are these actions sufficient to stabilize government debt and to reduce debt levels whenever reduction is needed? From this perspective we indicate that it is vitally important to strengthen the SGP and to put other mechanisms in place that can serve as guidelines for crisis management. EMU definitely should become prepared to prevent future sovereign debt crises.

2 Sustainable debt levels in the literature

2.1 No Ponzi-finance scheme

From the literature (*e.g.* Bohn, 2005, Buiter, 2009, van Wijnbergen and Budina, 2008) the basic requirement for the sustainability of public debt, is that governments should not engage in a Ponzi-finance scheme. In such a scheme existing debt is serviced forever by issuing additional debt to cover both interest payments and principal repayments. Instead governments should stay within their intertemporal budget constraints. This implies that the discounted value of current and future income plus initial wealth should at least be equal to the discounted value of all current and future non-interest expenditure (van Wijnbergen and Budina, 2008). Formally this comes down to:

$$\sum_{i=t+1}^{\infty} \frac{g_i}{(1+r)^{i-t}} \leq -b_t + \sum_{i=t+1}^{\infty} \frac{t_i + s_i}{(1+r)^{i-t}} \tag{2.1}$$

(2.1) states that the discounted value of all non-interest expenditure g_i should at most equal initial sovereign wealth (which is negative due to government debt) plus the discounted value of all public sector non-interest income, here summarized as the sum of tax revenues t_i and seigniorage revenues s_i. Seigniorage is the net income the public sector derives from issuing money. Note that b_t represents government debt at the end of year t. We assume the interest rate r to be constant over time, merely to simplify the equations. Defining the net receipts of the government with the augmented primary surplus $p_i = t_i - g_i + s_i$ (where the augmentation refers to the addition of seigniorage to primary surplus) we obtain

$$b_t \leq \sum_{i=t+1}^{\infty} \frac{p_i}{(1+r)^{i-t}} \tag{2.2}$$

or: initial (net) debt should at most equal the discounted value of all future augmented primary surpluses. In the sequel we will often for simplicity call p_i the primary surplus although it always has the wider meaning of primary surplus augmented with seigniorage.

To understand the implications of (2.2), it is useful to write down a simpler construct, the so called flow budget constraint:

$$b_t = b_{t-1}(1+r) - p_t \tag{2.3}$$

which states that the new level of debt equals initial debt plus interest payments minus the augmented primary surplus. It shows that government policy will only affect the debt level in as far as it influences the primary surplus p_t and possibly the interest rate r via the adjustment of primary surplus. Rewriting the flow budget constraint as an expression for initial debt,

$$b_t = \frac{p_{t+1}}{1+r} + \frac{b_{t+1}}{1+r} \tag{2.4}$$

we see that initial debt equals the discounted sum of the primary surplus and end of period debt. Substituting (2.4) repeatedly into itself, from *t+1* onwards, yields

$$b_t = \sum_{i=t+1}^{\infty} \frac{p_i}{(1+r)^{i-t}} + \underset{i\to\infty}{Lim} \frac{b_i}{(1+r)^{i-t}} \tag{2.5}$$

Equation (2.5) indicates that initial debt equals the present value of future primary surpluses if and only if discounted future debt converges to zero

$$\underset{i\to\infty}{Lim} \frac{b_i}{(1+r)^{i-t}} = 0 \tag{2.6}$$

or: the growth of debt should ultimately be smaller than the rate of interest. (2.6) is known as the 'transversality condition'. If this condition is met, current debt will not exceed the present value of all future augmented primary surpluses (as in the intertemporal budget constraint (2.2)).

Some authors (*e.g.* Kremers, 1989) have argued that this constraint should be modified to account for an upper bound on the size of the primary surplus because the government can not raise more revenue than the economy generates as income. Hence, the condition $t_t - g_t < \phi Y_t$ should be added, where Y_t is output and $\phi < 1$.

Advantage of the no-Ponzi scheme criterion is that it translates the fact the debt has to be repaid eventually into a mathematical formula. Disadvantage however is that the criterion is very soft and not of immediate use: it states no more than that one has to pay eventually, which could be in the (very) distant future.

2.2 Sustainability gap indicators

Many authors have focused on indicators of how far fiscal policy departs from sustainability (e.g. Chalk and Hemming, 2000). It should be noted that such indicators are not formally backed by a definition of sustainability. Instead, they rely on a more intuitive notion of what distinguishes sustainable from unsustainable fiscal policy.

One may express the flow budget constraint condition (2.3) relative to GDP as

$$\tilde{b}_t = \tilde{b}_{t-1}\frac{1+r}{1+\gamma} - \tilde{p}_t \approx \tilde{b}_{t-1}(1+r-\gamma) - \tilde{p}_t \tag{2.7}$$

where $\tilde{b}_t$ denotes end of period government debt as a share of GDP, γ the GDP growth rate and $\tilde{p}_t$ the augmented primary surplus as a share of GDP. Note that in (2.7) we have approximated the term $(1+r)/(1+\gamma)$ with $1+r-\gamma$. This is merely done to shorten notation. In our calculations we always use the precise expressions.

If $r > \gamma$ freezing the debt-to-gdp ratio will obviously leave the government within the intertemporal budget constraint because the growth rate of debt will be less than the rate of interest. If $r < \gamma$ the government would have the opportunity to engage in a Ponzi scheme, maintaining the primary surplus at zero and issuing forever new debt to service existing debts while the debt ratio would decline over time. However, an excess of the growth rate over the interest rate implies that the economy is dynamically inefficient and saving and investing too much. Thus, a Ponzi scheme for government funding could then be seen as a corrective action to absorb excess savings of the private sector (Romer, 2006). In an uncertain world the growth rate of gdp may temporarily exceed the rate of interest on government bonds. Bohn (1998) shows that under uncertainty an attempt to issue debt and roll it over forever without ever running a positive primary surplus has a positive probability. Conversely, if there is a positive probability that future interest rates will exceed the growth rate, a zero primary surplus is not sustainable.

If the government wants to prevent debt as a percentage of GDP to grow, a lower bound on the augmented primary surplus is implied

$$\tilde{p}_t \geq (r-\gamma)\tilde{b}_t \tag{2.8}$$

From (2.8) it follows immediately why it may be impossible to stabilize the debt ratio if a country is heading at a sovereign debt crisis. First, in such a situation γ is likely to be small or negative. Second, the interest rate on new roll-over debt may rise quite substantially. Thus, the (2.8) target for primary surplus may easily become infeasible, in particular – as within EMU – if simply expanding the money supply is not an option.

Buiter (2009) argues that the *permanent share* of the state's augmented primary surplus in GDP ($\overline{p}$) should not fall short of the outstanding stock of sovereign net debt as a share of GDP ($\overline{b}$) times the difference of the long term real interest rate on sovereign debt ($\overline{r}$) and the long term growth rate of real GDP ($\overline{\gamma}$)

$$\overline{p} \geq (\overline{r}-\overline{\gamma})\overline{b} \tag{2.9}$$

Deviations of the actual augmented primary surplus and its target value in (2.9) would then indicate how sustainable the fiscal policy is. In this formulation the net government debt is perhaps the best-known variable (though it may not be at all trivial to assess its level). Appropriate assessments of the long term development of the real interest and GDP-growth rates may be much more difficult to arrive at. Hence, this indicator may not be a very practical approach for the assessment of sustainability.
Blanchard (1990) proposes to start from (2.8) and to evaluate sustainability with the gap indicator

$$\tilde{p}_t - (r - \gamma)\tilde{b}_t \tag{2.10}$$

A negative value for this indicator would then suggest that the current augmented primary surplus falls short of the target level that would stabilize the debt ratio and that fiscal policy is 'thus' unsustainable.
Callen et al. (2003) propose the so-called 'overborrowing ratio' as an indicator of fiscal sustainability. This indicator expresses the current debt-to-gdp ratio as a fraction of the debt-to-gdp ratio that would emerge from past averages in primary surpluses, real interest rates and real gdp-growth rates.

$$o_t = \frac{\tilde{b}_t}{\frac{\tilde{p}_{av}}{r_{av} - \gamma_{av}}} \tag{2.11}$$

If the indicator exceeds 1 the current debt level is considered too high relatively to the debt-ratio that would be sustainable if the augmented primary surplus, interest rates and growth rates would remain at their average level of the recent past.
Note that we can also express the information of the overborrowing ratio in terms of a backward-looking sustainability gap, as in

$$\tilde{p}_{av} - (r_{av} - \gamma_{av})\tilde{b}_t \tag{2.12}$$

A negative value of this indicator shows that the current debt-ratio could not be maintained at past values of primary surplus, interest rates and growth rates while a positive value implies an overborrowing ratio that is less than unity.

2.3 Benchmark indicators for default

Another approach would be to construct a benchmark of defaulting countries analogous to an IMF study [Callen et al., 2003]. The IMF compared the characteristics of emerging market economies that defaulted since 1998 with the characteristics of non-defaulting countries. In general, defaulting countries had higher debt-to-gdp ratios, a higher share of foreign government debt funding, a higher debt to government receipts ratio and a smaller ratio of the broad money base to gdp than non-defaulting countries.

This benchmark would likely consist of parameters as (debt/GDP, debt/government revenue, foreign debt / total debt, broad money base/GDP, etc.). From these characteristics we might construct a range that could be considered to indicate fiscal unsustainability. Any member state venturing towards this range might be heading for default.

Limitations of this method are that they are dependent on historical data and that no OECD country has defaulted since the Second World War. It might therefore not be appropriate to use these criteria as the current circumstances originate from other factors than the historical circumstances in countries leading to default. A different debt level might therefore be acceptable.

2.4 Economic growth and high debts

A third approach would be to examine the effects of a high debt burden on the real economy. Reinhart and Rogoff [2010] show for example that countries with a debt/GDP level higher than 90% have a median GPD growth that is 1% lower. The effect is stronger for countries with a lot of external public debt.

The main characteristic of this threshhold is that it indicates the effects on the economy of a country as a whole. It links debt (potential problem in a part of the economy) to the functioning of the economy as a whole.

2.5 Primary surplus to debt feedback

Finally, one may estimate econometrically how the primary surplus ratio responds to the debt ratio. Thus we could estimate ρ in

$$\tilde{p}_t = \rho \tilde{b}_{t-1} + x_t \tag{2.13}$$

where x_t represents the impact of regressors other than $\tilde{b}_{t-1}$ on the relative augmented primary surplus. Then we can rewrite (2.7) as

$$\tilde{b}_t = \tilde{b}_{t-1}(1 + r - \rho - \gamma) - x_t \tag{2.14}$$

If x_t is 'stationary' and the coefficient of the lagged debt-ratio is positive and less than unity, relative debts will converge to a finite level that is determined by the average of x_t .
Hence, if the non-debt impacts on the relative augmented primary surpluses are stationary and

$$r - \rho - \gamma < 0 \tag{2.15}$$

relative debts will stabilize.
Bohn (1998) obtained an estimate for ρ of 0.05 for the US over the period 1916-1995 while Bohn (2005) obtained a larger US estimate of 0.12 over the much longer period 1702-2003. Callen et al. (2003) identify the relationship between primary surplus and public debt separately for industrial countries and emerging economies over the period 1990-2002. For both groups they find a positive feedback. Their estimates of ρ range from 0.039 till 0.134 for emerging market economies and from 0.057 till 0.060 in industrial countries. The feedback in industrial countries increases substantially when debt ratios exceed 80%. In emerging market economies the feedback weakens considerably when the debt ratio exceeds 50%.

2.6 Assessing fiscal sustainability in Europe

From our survey of the literature we conclude that four methods are available to assess sustainability of government debt:

a) the sustainability gap indicators (Blanchard gap, overborrowing ratio)
b) benchmark indicator set of defaulting countries
c) consideration of debt-to-gdp ratios in view of underperformance of gdp-growth once they exceed 90%
d) primary surplus to debt feedback rule (mean reversion apparent in past fiscal behaviour or not and –if so– what is the speed of convergence and what is the level of convergence?)

In this paper we will focus on a)-c) only. In particular, we will consider the following indicators to assess sovereign debt sustainability in selected EMU-countries:

- the sustainability gap indicator (2.10); the sustainability gap indicator shows the distance in terms of primary surplus as a percentage of GDP from a stable debt-ratio. A negative value indicates a shortfall from the primary surplus that would stabilize the debt ratio and a positive value indicates an excess over primary surplus that would stabilize relative debt. This sustainability gap indicator is forward looking as it uses projections of the primary surplus,

interest rate and GDP growth. We present the indicators for the average projected development between 2010 and 2019 and the end year 2019.

- the sustainability gap indicator (2.12); the sustainability gap indicator shows the distance in terms of primary surplus as a percentage of GDP from a stable debt-ratio, using realised values for primary surplus, interest and growth rates from the recent past. A negative value indicates overborrowing. This sustainability gap indicator is backward looking as it uses average past values of the primary surplus, interest rate and GDP growth. We calculate these averages for the period 1995-2009.
- the debt-to-government revenue indicator; this is the only indicator (in addition to the debt-to-GDP ratio below) that we consider from the benchmark set approach for emerging market economies; thus, we don't consider foreign currency denominated debts or base money as a percentage of GDP as sustainability indicators in the euro area; Callen et al. (2003) show that the average debt-to-revenue indicator was 350% for defaulting emerging market economies and 250% for non-defaulting countries; for the EMU-countries we consider a ratio below 350% as sustainable.
- the debt-to-GDP ratio; with the threshold value of 90% we associate below-median growth; hence, it is likely that maintaining debt-ratio's around 90% or higher is more difficult and less sustainable than debt-ratio's at a more modest level

As we will see in chapter 4 these indicators lead to diverging outcomes for the selected euro countries for which we have projected sovereign debts.

3 The coordination of government debt in Europe

In Europe government debt and budget deficits are not only considered as a national issue, but also as a European matter. This chapter discusses the international dimensions of government debt in particular in the EMU countries. Many of the spillover channels between countries are also apparent between countries outside the Eurozone, but they are more intensive in a common currency area. We review the theoretical and empirical arguments pro and contra coordination. These arguments are splits in two parts: cross-border spillover arguments and other arguments.

Cross-border spillovers

What are the spillovers of national government debt and budget deficits between the Eurozone countries? With that question this paragraph is concerned.

Identifying these spillover channels is also a first step to assess the probability of a debt crisis and to understand the mechanisms of such a crisis. The discussion stems from the massive literature on the formation of optimal currency areas which goes back to Mundell (1961) and the formation of the Economic and Monetary Union (EMU) in Europe. This event triggered an extensive debate on the relevance of the Maastricht (1991) criteria which define the entry conditions to the EMU and the Stability and Growth pact (SGP). We do not review this debate.[1] We concentrate on the possible spillovers from the steep rise in government deficits and debt in some EMU countries on the economic performance and on the sustainability of government debt in other countries.[2] The literature discusses various cross-border spillovers[3] and other arguments for coordinating fiscal policies.

The first externality is higher inflation expectations in the euro zone. The argument is that high debt in one country could only be recovered with inflation such that the central bank is urged to raise the overall inflation rate in the union and affecting price stability in other EMU countries. Fischer et al. (2002) show that larger budget deficits exert an upward pressure on inflation in developing countries in cross sections and panel regressions. However, these effects are insignificant in developed countries. Canzoneri et al. (2001) confirm these results by showing that government debt in Europe and the US is not a significant determinant of the price level. We conclude that the spillovers of national budget deficits on the inflation rates are negligible because the EMU countries are low inflation countries with a targeted inflation rate of the ECB

[1] Recently, Beetsma and Giuliodori (2010) provided a survey of the cost and benefits of the EMU based on this literature. The European Commission (2008) has presented an extensive overview on ten years EMU including the successes and challenges ahead.

[2] Note that we ignore private debts here.

[3] Other potential spillovers are labour mobility and fiscal transfers. These spillover channels are often discussed with the US in mind and do not apply for the EU due to the low mobility of labour and very limited fiscal transfers.

of at most 2%. The European Commission (2004) reaches a similar conclusion, but it has to be acknowledged that the recent ECB interventions by buying threatened government bonds suggest that this externality is not just a theoretical possibility.

The second externality is a higher rate of interest on government debt[4]. Every Eurozone country issues its own bonds with a national rate of interest. However, the high interest rate of a particular country could exert an upward pressure on the interest rates in other countries (perceptions of investors).[5] This could even be the case for non-EMU countries, in particular if they have plans to join. This is closely connected to contagion and reputation issues which played a role in the Latino debt crisis and the Asia crisis. Ardagna et al. (2007) estimate for 16 OECD countries the effect of primary deficits and government debt on the nominal interest rate on 10-year government bonds in the period 1960 to 2002. In their preferred specification a one percentage point increase in the primary deficit to GDP ratio leads to a 10-basis point rise in the nominal interest rate.[6] On the longer term a permanent increase in the primary deficit ratio has much larger effects: the nominal interest rate could increase by 70 basis points after five years and 150 basis points after ten years. The European Commission (2004) reports in its literature overview a 20 to 100 basis points increase in the long-tern nominal interest rates of government bonds, after having removed the insignificant results, suggesting that the Ardagna results are at the lower range. However they include the deficit and government debt simultaneously as explanatory variables while others do not. Faini (2006) focuses exclusively on the EMU countries between 1979 and 2002 and distinguishes an EMU and national interest rates. An increase in the budget surplus of the EMU lowers the EMU interest rate with 41 basis points. The analogous effect at the country level is much smaller, only 3 basis points. The latter effect corresponds to the results of Codogno et al. (2003). Gale and Orzsag (2002) found similar effects on the EMU interest rate for the US. This suggests that the quantitative impact of an expansionary fiscal policy in a member states on the EMU interest rates is much bigger than on the country spreads. Faini (2006) concludes that there are substantial spillovers of national fiscal policies on the interest rate. The literature provides however a broad range of estimates on the size of the spillovers.

The effect of higher government debt (as ratio of GDP) on the interest rate is nonlinear. If debt increases, bonds become more risky. Ardagna et al. (2007) conclude that if government debt is lower than (about) 60% of GDP an increase in debt could exert a downward pressure on the interest rate, but the direction of this effects switches if the debt is larger. If government debt is 141% (maximum in the sample) the interest rates increase by 114 basis points if debt increases by one standard deviation (is 26% government debt). This is considerable, but a 26% increase in debt/GDP is also quite dramatic. On the other hand, Faini (2006) does not find strong

[4] This literature mainly concentrates on long-term interest rates (real or nominal). The effects on short term interest rates are much smaller or even negligible because short term interest rates are often set by the central bank based on inflation and other targets.

[5] For some commentators this is a good reason to issue national bonds (see Issing (2009) among others).

[6] In other specifications the rise varies between 7 and 14 basis points.

evidence that the spillover effects of high debts on the interest rate and the country spread are larger than for low debts. Note that the time series are relatively short after the introduction of the euro.

A third externality is that many European financial institutions hold bonds of other EU members. The data of the Bank of International Settlement (BIS) show that these cross-border holdings have increased substantially in the last decades. If there is a chance that the high debt country (partially) defaults, the assets of government bond holders will plummet. In uncertain times this could trigger a chain reaction. Currently banks hold a significant share of Eurozone debt and it is uncertain whether a breach in bank balance sheets caused by a sovereign default will lead to a chain reaction in the form of another banking crisis. Assessing the impact of such an event is crucial in determining whether such a spillover is significant. The formation of the EMU has probably stimulated the cross holdings of government bonds, because the exchange rate risk is reduced, but these relations do also exist between countries with national currencies.

A fourth externality is the stability of the euro vis-à-vis non-euro countries. Exporters benefit from a weaker euro, but imports become more expensive. The net economic effect is not always clear and depends on the economic structure of a country. A deterioration of the euro in response to high debts in one or two member states has certainly an effect on the trading behaviour of euro members with non members.[7] Moreover, financial markets interpret depreciation of currencies often as a sign of weakness of the economic development having adverse effects on stocks markets.

A fifth externality is the transmission via the real economy due to budgetary decisions on the economies in other countries. Reinhart and Rogoff (2010) argue that high government debt is often related to poor economic performance, although the causality is not heavily discussed. Subsequently, poor economic performance affects other EMU economies, in particular via trade, FDI and R&D spillovers. The empirical literature estimates the spillover effects of trade (export and import) with VAR regression techniques. As an example, Giuliodori and Beetsma (2005) estimate that a net tax reduction of 1% of GDP in Germany leads to a maximum 0.7% GDP increase in the Netherlands after seven quarters. After about four years the effect dies out. That is not only the case for the Netherlands, but also often for other countries. Simulations of CPB (2004) illustrate that a 1% increase in German government spending (measured as share of GDP) raises Dutch GDP about 0.3% in the first two years and that this effect dies out two years later. The size of the spillovers depends on the bilateral trade relations, which are very tight between Germany and the Netherlands but much looser between other EMU countries. We conclude that the long term effects are small although the short term effects are larger.

[7] Outside a currency union, one country could simply devaluate its currency in response to difficult economic circumstances. Beetsma and Guiliodori (2010) describe some examples. These devaluations had serious negative effects on other countries due to less exports and more imports. This externality is eliminated by introducing a common currency. This fourth externality is probably much weaker than the eliminated one.

Other arguments

Here we review other arguments than spillovers on other countries for centralization or coordination. An argument is economies of scale; issuing government bonds at the EMU level could provide economies of scale compared to issuing government bonds at a national level. In particular, the liquidity of the market could be larger at the EMU level, making it easier to attract money. This argument is often mentioned for issuing Eurobonds with EMU interest rates. In particular smaller EMU member states would benefit from a liquidity premium resulting in a lower rate of interest.[8] A counter argument is the so called common pool problem. Countries with high debt could benefit from the good reputation of low debt countries at the capital market. They could attract money against lower interest rates. However, the interest rates for low debt countries rise. Moreover, it could be the case that individual member states become more relaxed in applying sound national budget policies. They may not face the consequences and the effect of their policies on the EU fiscal position may be limited. This argument pleas for national bonds or EMU bonds with stringent limits on the fiscal behaviour of member states that could jeopardize the common goals.

Another argument for centralizing fiscal policy is solidarity with other Member States. To some extent the Lisbon treaty already covers this. Bail outs within the EMU are possible in exceptional circumstances related to natural disasters etc. Moreover, the structural and cohesion funds in the EU are partly based on solidarity for helping the poorer member states. There is also self interest here, because all countries benefit from the increase of purchasing power in the poorer member states. Some commentators use the solidarity argument for helping the new member states with the sharp decline of their economies and others use the same argument for Greece.

Conclusions on the reasons for coordination

We conclude that the magnitudes of most spillovers are weak. There are no empirical indications that inflation expectations are affected or economic performance in other countries via trade, FDI etc. in the longer term. There are modest effects on the interest rates from high budget deficits and high government debts but these are not overwhelming. Only in case contagion occurs, the spillovers are large. Contagion can occur in financial spillovers and these financial spillovers are larger if the cross ownership of government bonds holdings is larger. With a weak and fragile banking system, the contagion mechanism could lead to disruptive effects on the economy in the form of higher interest rates or banks getting into trouble in case of a (partial) government default. This is the main argument for coordinating fiscal policies to some extent and should also be the main target of fiscal policy coordination. The economies of scale of euro bonds by a larger market and solidarity between member states could be additional reasons for intervention, but are not the prime motivation.

[8] See De Grauwe and Moesen (2009) and Depla and von Weisäcker (2010).

4 Medium term sustainability analysis

We assess the sustainability of government debt in the EMU countries using the Fiscal Sustainability Simulation model ("FSS") as an analytical tool. The model is described in some detail in section 4.1. The baseline projections underlying the FSS are OECD projections and are described in section 4.2. Some variants of the projections also impose the fiscal burden of ageing on the government budget. The outcomes of the FSS using these baseline projections are presented in section 4.3. In section 4.4 we comment on debt sustainability and the appropriateness of fiscal consolidation measures.

4.1 The model

The FSS generates a stochastic forecast for the development of government debt over GDP. Our approach closely follows van Wijnbergen's approach for the assessment of sovereign debt sustainability. Van Wijnbergen and Budina (2008) repetitively apply the following central flow budget equation for the development of government debt as a percentage of GDP:

$$\tilde{b}_t = (1 + r^d - \gamma)\tilde{b}^d_{t-1} + (1 + r^f + \delta e - \gamma)\tilde{b}^f_{t-1}e_{t-1} - \tilde{p}_t + OF \qquad (4.1)$$

Here $\tilde{b}_t$ is government debt as a percentage of GDP at the end of year *t* (superscript *d* means domestic currency denominated, superscript *f* means foreign currency denominated), $\tilde{p}_t$ the augmented primary surplus as a percentage of GDP, *r* the real interest rate, γ the real GDP growth rate, e_{t-1} the real exchange rate and δe the percentage change in the real exchange rate. Finally, OF stands for other, exogenous factors that influence the debt-ratio.

Within the Eurozone most government debt is euro-denominated and we assume that the exchange rate risk of the non euro-denominated part of government debt is hedged. Therefore we drop the foreign currency part. Furthermore we consider monetary policy to be an externality within the Eurozone (set by the ECB) and take seigniorage revenue as part of the primary surplus. Unlike van Wijnbergen we do not calculate the seigniorage revenue maximizing inflation rate, as this would be against the ECB policy goal to limit the annual inflation rate to 2%. This simplifies our central equation to:

$$\tilde{b}_t = (1 + r - \gamma)\tilde{b}_{t-1} - \tilde{p}_t + OF \qquad (4.2)$$

To obtain a debt path we need a forecast for the development of the primary surplus, the long-term interest and GDP growth rate. Note that we can take either both *r* and γ real or nominal

for small levels of inflation. To obtain a stochastic debt forecast we must make either some or all of the forecast variables stochastic.

We obtain a quarterly projection for the primary surplus, long-term interest rate and nominal GDP growth rate from the OECD Economic Outlook no.87, preliminary edition (OECD, 2010). We use OECD projections as a baseline because they are available for all Eurozone member states and follow the same methodology for all countries.
Stochastic features are added to these projections in the following way. For the primary surplus we calculate the variance of the primary surplus at the country level from historical data from Eurostat. We use annual figures from 2001 until 2008 and convert the annual variance into a quarterly variance. In this way we avoid large seasonal fluctuations. For GDP growth and the interest rates we take the intercountry dependencies or spillover effects into account in the stochastical part by using a covariance matrix obtained by the following Vector Auto Regression.

$$\Phi_t = C + A\Phi_{t-1} + \varepsilon_t, \quad \text{var}(\varepsilon_t) = \Omega \tag{4.3}$$

Here Φ is a vector containing GDP growth and interest rates per country. We use quarterly historical data from Eurostat from 2000Q2 until 2009Q3 to estimate C, A and Ω.
The stochastic parts are generated by multiplying the variance for the primary surplus and the (Cholesky decomposed) covariance matrix for GDP growth and long-term interest rates by a set of IID(0,1) drawings. These results are added to the projections of primary surplus, GDP growth and long-term interest rates and used to calculate the debt in the next period.

A debt path in our model is 40 periods, or 10 years, long (from 2010Q1-2019Q4). In our model we repeat this calculation 5000 times, such that we obtain 5000 debt paths.[9] The expected debt path and its expected standard deviation are then calculated and plotted. The results can be used to assess sustainability.

4.2 OECD baseline forecasts

As stated before we use the OECD Economic Outlook no.87, preliminary edition (OECD, 2010) to obtain our baseline. We discuss the main features of these projections in this section.

GDP growth

Real GDP growth rates and expected inflation rates are given in the table below. The OECD projections assume that the output gap is closed over the period 2012-2015, which explains the

[9] The model is written in Octave, an open-source version of Matlab.

relative high real GDP growth in this time period. The growth rates after 2015 are the expected long term growth rates. Inflation is assumed to be lower than the ECB target of 2% until 2015 due to the current economic crisis. Except for Ireland this will however not lead to deflation.

OECD projections / GDP growth

%	real GDP-growth					inflation			
	2009	2010	2011	2012-2015	2016-2025	2009	2010	2011	2015
Belgium	-3.0	1.4	1.9	3.2	1.7	0.9	1.6	1.3	2.0
Germany	-4.9	1.9	2.1	2.3	1.2	1.5	0.1	0.6	2.0
Ireland	-7.1	-0.7	3.0	2.9	3.2	-3.2	-2.5	0.2	2.1
Greece	-2.0	-3.7	-2.5	3.3	1.7	1.3	0.8	0.3	2.0
Spain	-3.6	-0.2	0.9	2.4	2.2	0.2	0.0	0.3	2.0
France	-2.5	1.7	2.1	2.1	1.5	0.8	0.7	1.0	2.0
Italy	-5.1	1.1	1.5	1.9	1.7	2.1	1.0	0.8	2.0
Netherlands	-4.0	1.2	2.0	1.9	1.7	-0.3	0.5	1.4	2.0
Portugal	-2.7	1.0	0.8	1.6	1.6	1.2	0.7	1.2	2.0

After 2015 inflation is expected to be at the ECB target.

Primary surplus

Primary surplus for 2010 and 2011 is determined by subtracting the implied interest expenses from the financial government balance. After 2011 the primary surplus is expected to improve automatically because of the closure of the output gap. The OECD assumes the output gap is closed in 4 years (2012-2015). Even with a closed output gap, the OECD concludes some countries to be on an unsustainable debt path and projects additional fiscal consolidation. The OECD assumes such countries will realize ½% of GDP improvement of their primary balance per year of consolidation starting in 2012.

OECD projections / primary surplus

% of GDP	primary surplus			output gap	years of	EMU debt	Gov revenue
	2009	2010	2011	2011	consolidation	2009	2009
Belgium	-2.4	-1.4	-0.5	-3.5	0	98	48
Germany	-1.0	-3.1	-2.1	-1.6	3	73	44
Ireland	-13.8	-10.6	-9.0	-3.0	14	64	34
Greece	-8.8	-2.8	-1.3	-5.0	1	115	37
Spain	-9.9	-8.0	-5.5	-2.2	6	55	35
France	-5.3	-5.5	-4.3	-2.0	8	76	48
Italy	-0.8	-0.7	-0.1	-2.0	1	115	47
Netherlands	-3.7	-4.7	-3.6	-2.2	4	61	46
Portugal	-6.6	-4.2	-1.8	-1.2	4	77	42

Government debt

In our analysis we examine the sustainability of the EMU Debt as defined by Eurostat, because it is the most widely used definition and it is a definition that is consistently applied among member states.

Maturity structure of government debt

In the medium term governments have some liberty to adjust the maturity structure of their debt such that it fits their desired maturity structure. With a normal yield curve the interest rate required by the market is lower for shorter maturities and the interest rate volatility risk and

liquidity risk are lower for longer maturities. We use the simplifying assumption that in the average maturity time the entire debt will be rolled over with equal parts being due in every period. This may imply that interest rate volatility is extended over a longer time period than actually is the case. Furthermore we also assume that all debt is financed against this average maturity and that the interest rate due is the long-term interest rate. We have obtained the average maturities of outstanding government debt from the websites of the debt management offices. For the countries under consideration the average maturity of the government debt ranges between 6 and 8 years.

Long-term interest rates

The OECD expects the long term interest rates to rise from the historic low rates of the 2000s to their historical average of 5.4% for the Eurozone. Intercountry differences are explained by an interest rate premium of 4 basis points for every 1% debt/GDP above 75%. This is consistent with OECD estimates (Egert, 2010).

OECD projections / long-term interest rates

%	long-term interest rates			
	2009	2010	2011	2025
Belgium	3.8	3.5	4.5	5.9
Germany	3.2	3.3	4.4	5.2
Ireland	5.2	4.9	5.7	6.7
Greece	5.2	7.3	6.9	7.4
Spain	4.0	4.0	4.8	5.3
France	3.6	3.6	4.7	5.9
Italy	4.3	4.1	5.1	5.2
Netherlands	3.7	3.5	4.5	5.1
Portugal	4.2	4.7	5.2	5.9

Externalities

We assume a budget neutral effect of the current and possible future bailouts of the banking sector. This means we neglect externalities of this type. The ageing of the European population will add considerable cost to Eurozone primary surpluses. The ideal approach assesses the extra implications for primary surpluses and is given in appendix A. To be consistent with the other projections we use the OECD projections for these costs (OECD, 2010) however. The increase in costs due to ageing assumes unchanged policy and structural trends. In the ageing scenario below we assume the costs of ageing are included in the primary surplus projections up to 2011 and assume that from 2012 onward additional costs apply.

We realize that these aging costs reach only to the end of the projection period and do not take further future costs into account. They will be useful however in showing that even these modest amounts of additional costs can make government debts unsustainable.

OECD projections / age-related public spending increase				
% of GDP	Change 2005-2025			
	Health care	Long-term care	Pensions	Total
Belgium	1.0	0.4	2.7	4.1
Germany	1.1	0.6	0.8	2.5
Ireland	1.2	1.1	1.5	3.9
Greece	1.2	1.0	3.2	5.4
Spain	1.2	0.8	1.2	3.2
France	1.1	0.3	0.4	1.8
Italy	1.2	1.0	0.3	2.5
Netherlands	1.3	0.5	1.9	3.7
Portugal	1.2	0.5	0.7	2.4

4.3 Government debt forecasts

Forecasts with OECD baselines

We have run the stochastic simulation model four times:

- OECD baseline forecasts without additional consolidation and without ageing costs:
  this simulation uses the GDP growth, long-term interest rate and primary surplus OECD projection as described in section 4.2, without the additional ageing costs and without the additional years of fiscal consolidation
- OECD baseline forecasts with additional consolidation and without ageing costs:
  here the same projections as in the previous simulation are used, with a difference to the primary surplus projections which are adjusted for additional fiscal consolidation. For every year of fiscal consolidation, starting in 2012, it is assumed that the primary surplus improves by ½%. It is important to note here that according to the OECD for some countries additional fiscal consolidation continues to take place after the end of our forecast period.
- OECD baseline forecasts without additional consolidation and with ageing costs:
  here we use again the baseline projections as described in the first simulation and simply add the aging costs as an externality.
- OECD baseline forecasts with additional consolidation and with ageing costs:
  this simulation combines the two previous additions to the first simulation.

In the 4 figures below we plot the results of these four scenarios. We present the results for nine EMU countries: Belgium, Germany, Ireland, Greece, Spain, France, Italy, the Netherlands and Portugal. We have neglected some small countries and new EMU members.[10] The model runs

[10] The results for Austria, Finland and Luxembourg are available upon request. The outcomes are not presented due to space limitations. In all scenarios these countries do not seem to have any sustainability problem.

from 2009 to 2019. The results are plotted for each quarter, “1” implies the last quarter of 2009 and is our starting point, “41” on the horizontal axis implies the last quarter of 2019. The vertical axis presents the sovereign debt to GDP ratio. The line in the middle represents the average debt development according to the FSS model. The other lines reflect the uncertainty with one or two standard deviations above or below the average debt development per country.

Figure 4.1 OECD baseline forecasts without additional consolidation and without ageing costs

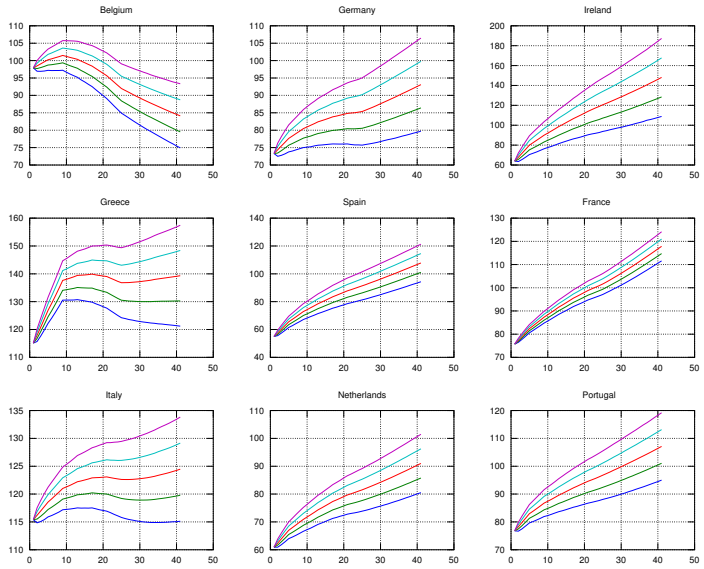


Figure 4.2 OECD baseline forecasts with additional consolidation and without ageing costs

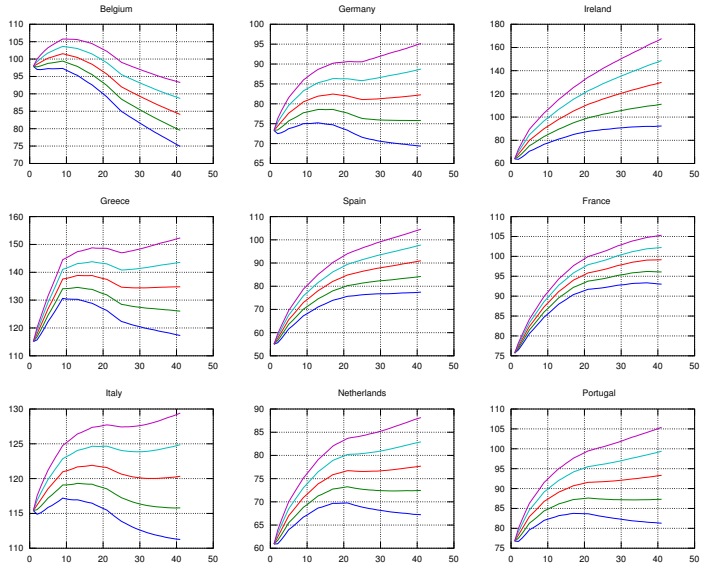


Figure 4.3 OECD baseline forecasts without additional consolidation and with ageing costs

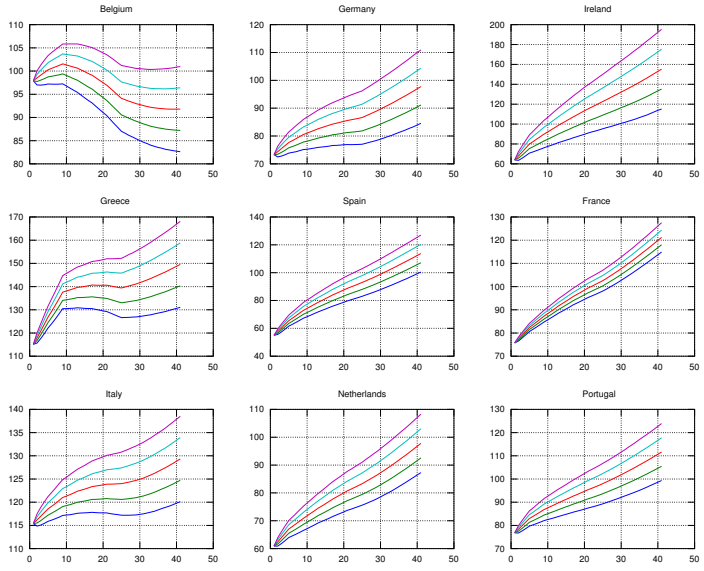
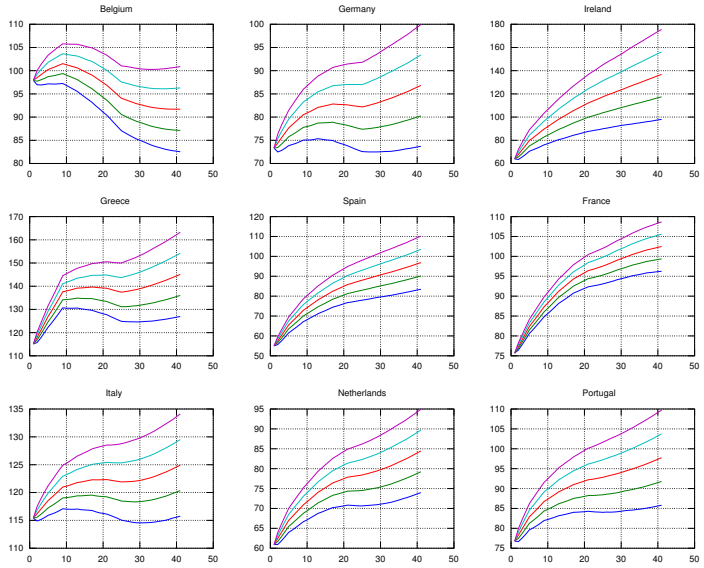


Figure 4.4 OECD baseline forecasts with additional consolidation and with ageing costs



The results have been summarized in the table below.

OECD projections / baseline outcomes						
% of GDP	EMU government debt					
	09Q4	19Q4 base	19Q4 cons	19Q4 age	19Q4 cons&age	19 stddev
Belgium	97.9	84.2	84.2	91.8	91.8	4.5
Germany	73.3	93.2	82.1	97.8	86.8	6.7
Ireland	64.0	148.1	129.8	155.3	136.9	16.3
Greece	115.1	139.1	134.7	149.6	145.2	7.8
Spain	55.0	107.8	90.9	113.7	96.8	6.7
France	75.7	117.9	99.1	121.3	102.5	3.5
Italy	115.4	124.6	120.3	129.3	125.0	5.0
Netherlands	60.9	91.0	77.5	97.9	84.4	5.2
Portugal	76.8	107.1	93.3	111.6	97.8	6.5
Weighted average	80.4	108.5	96.4	113.5	101.5	

Simulation outcomes

A first conclusion from the projections is that government debt will continue to rise almost everywhere in the medium term. Without consolidation the GDP weighted average government debt rises by 28.1% points. Additional budget consolidation reduces the debt/GDP ratio by 12.1% points on average. The burden of ageing on the government budget worsens the budgetary positions of all EMU countries. The average effect of ageing is an increase of 5.0% of debt/GDP ratio. This demonstrates that a significant rise in primary surplus is required in most member states in order to offset the additional ageing costs, even when these only pertain to the projection period. Including the costs of ageing and debt consolidation, sovereign debt only stabilizes in Belgium. We therefore conclude in line with other studies that structural

reforms will be necessary to address the ageing issue in the projection period and further beyond.

Next, we recognize that there are not only significant differences in inter-country starting positions, but also in inter-country development paths. These paths strongly depend on the initial starting position, the projections for GDP growth, long-term interest rates, primary surpluses and the feasibility of fiscal consolidation and of incurring the costs of ageing. Furthermore historic volatility in interest and GDP growth rates as well as primary surplus causes the standard deviation in mean debt paths to be different.

Here we describe the outcomes per country:

Italy: Government debt is more or less stabilized after an increase of 9.2% points, however the ageing issue needs to be addressed in order to obtain a stable debt / GDP ratio. Furthermore the level at which government debt is stabilized is relatively high.

Spain, France, Portugal: Government debt is stabilized only in case of additional consolidation and dealing with the ageing issue. Even then debt levels stabilize only after an increase of 16.5% points (Portugal), 23.4% points (France) or 35.9% points (Spain) Again the levels of government debt at which stabilization occurs are relatively high.

Ireland: Debt levels in Ireland have not stabilized after 8 years of fiscal consolidation and addressing the ageing issue. In the time frame under consideration they have risen by 65.8% points to relatively high levels.

Belgium: In Belgium government debt ratios decline after a small hump due to a sturdy primary surplus and closure of the output gap. Even without fiscal consolidation and tackling of additional ageing costs debt ratios do not become unstable.

Greece: In Greece government debt ratios stabilize after a significant increase in 2010 and 2011 due to a closure of the output gap. However, if the ageing issue is not dealt with, debt levels will rise again and become unstable. Again debt levels remain high here throughout the projection period.

Germany, Netherlands: With consolidation debt also stabilizes in Germany and the Netherlands after an increase of 8.8% points (Germany) or 16.6% points (Netherlands). This is no longer true however if the costs of ageing are also taken into account.

Stress tests

Two stress-test scenarios are developed on top of the baseline consolidation scenario. In stress-test scenario 1 (S1) the Eurozone is not able to win back the financial markets trust and Portugal, Italy, Ireland, Spain and Greece have to pay 250 basis points additional interest spread on their debt in 2011 and 2012. This leads to a higher interest payment in 2011 until 2018 due to the assumed maturity structure of debt. The precise end date is country dependent.

In stress-test scenario 2 we assume the current economic recession turns into a Japan style lost decade. Here the output gap persists; resulting in lower real GDP growth in the period 2012-

2015 and lower improvement of the primary surplus from 2012 (the member states have permanent lower tax revenue and higher social security expenditures). The outcomes of the stress-tests are displayed in the table in the next section.

4.4 Conclusions on fiscal sustainability

In this section we apply the sustainability indicators described in section 2.6 on the simulations performed in section 4.3 and conclude on the outcomes. First, we state how we apply the indicators on the simulation outcomes; subsequently we show and discuss the indicator outcomes. After that we elaborate on a way to reconcile the different test outcomes with each other and conclude on sustainability after reconciliation.

Definition of the indicators

We have one simulation independent indicator, which is the current over-borrowing ratio expressed as a sustainability gap. This can be seen as an indicator for the current state of government finances as it confronts realised values in the recent past of primary surplus, interest and growth rates with debt-over-GDP.

We present three sustainability indicators: the forward looking sustainability gap, the debt/government revenue ratio and the debt/GDP ratio. We calculate the sustainability gap using equation 2.10 and use for the debt/government revenue and debt/GDP sustainability indicator a simple Yes/No sustainability indicator.

As sustainability gap indicator we display the average sustainability gap in our simulation period (2010-2019) and the end-of-period sustainability gap (2019Q4), which functions as a proxy for the sustainability of government debt after our forecast period. The debt/government revenue indicator is positive if this ratio is smaller than 350% in 2019. The 350% benchmark is the average debt/government revenue ratio of defaulting developing countries according to the IMF (Callen et al, 2003). As a proxy for 2019 government revenue we use 2009 government revenue, which is displayed in the table on government primary surplus and debt in section 4.2. The debt/GDP indicator is positive if debt/GDP is smaller than 90% in 2019, because above 90% their might be a negative impact on economic growth (Reinhart & Rogoff 2010).

Indicator results

We have applied the 4 criteria described in section 2.6 on the baseline forecasts and the stress tests and display the results in the table below:

OECD projections / test outcomes													
		baseline				ageing				consolidation			
	SG hist	SG av	SG 19	/ GDP	/Rev	SG av	SG 19	/ GDP	/Rev	SG av	SG 19	/ GDP	/Rev
Belgium	-8.0	0.9	1.5	Y	Y	0.1	-0.2	N	Y	0.9	1.5	Y	Y
Germany	-5.9	-2.3	-2.2	N	Y	-2.8	-3.2	N	Y	-1.2	-0.5	Y	Y
Ireland	-20.7	-9.2	-7.6	N	N	-10.0	-9.2	N	N	-7.4	-3.4	N	N
Greece	-14.3	-3.7	-1.1	N	N	-4.8	-3.6	N	N	-3.3	-0.4	N	N
Spain	-13.0	-5.6	-4.4	N	Y	-6.2	-5.7	N	Y	-3.9	-1.2	N	Y
France	-8.7	-4.7	-4.7	N	Y	-5.1	-5.5	N	Y	-2.8	-0.3	N	Y
Italy	-8.7	-1.6	-1.2	N	Y	-2.1	-2.3	N	Y	-1.2	-0.6	N	Y
Netherlands	-7.8	-3.3	-2.6	N	Y	-4.0	-4.2	N	Y	-1.9	-0.4	Y	Y
Portugal	-10.7	-3.4	-2.9	N	Y	-3.9	-3.9	N	Y	-2.0	-0.6	N	Y
		ageing & consolidation				S1: extra interest				S2: output gap			
		SG av	SG 19	/ GDP	/Rev	SG av	SG 19	/ GDP	/Rev	SG av	SG 19	/ GDP	/Rev
Belgium		0.1	-0.2	N	Y	0.9	1.5	Y	Y	-2.1	-2.5	N	Y
Germany		-1.7	-1.5	Y	Y	-1.2	-0.5	Y	Y	-2.7	-2.3	N	Y
Ireland		-8.1	-5.0	N	N	-9.3	-5.1	N	N	-9.3	-6.6	N	N
Greece		-4.3	-2.9	N	N	-5.8	-2.6	N	N	-8.0	-7.0	N	N
Spain		-4.5	-2.5	N	Y	-5.4	-2.4	N	Y	-5.5	-3.6	N	Y
France		-3.2	-1.1	N	Y	-2.8	-0.3	N	Y	-4.5	-2.6	N	Y
Italy		-1.7	-1.7	N	Y	-3.4	-2.4	N	Y	-2.7	-3.0	N	Y
Netherlands		-2.6	-2.0	Y	Y	-1.9	-0.4	Y	Y	-3.5	-2.9	N	Y
Portugal		-2.5	-1.6	N	Y	-3.7	-2.0	N	Y	-2.9	-2.0	N	Y

Here “SG av” denotes the average sustainability gap in the simulation period 2010-2019, “SG 19” denotes the sustainability gap at the end of the period, “/GDP” the outcome of the debt/GDP test and “/Rev” the outcome of the debt/government revenue test.

These test outcomes clarify the conclusions based on visual inspection of the FSS debt path graphs in section 4.3. The average sustainability gap being negative in almost all scenarios for all countries implies that average debt levels must be rising in the projection period. Furthermore a negative sustainability gap in 2019 implies government debt to be unsustainable if unattended. We will now reconcile the test outcomes in order to conclude.

Assessing simulation outcomes

We draw conclusions from these outcomes, using a constructed relative rating of the importance of the outcomes. We realize that these assessments are debatable, determining them as follows.

- **No issues:** Declining government debt and no sustainability issues in the projection period. This means: 2019 sustainability gap is positive (long-run declining debt) and either the average sustainability gap is positive (on average a declining debt throughout the projection period) or the average sustainability gap is negative and the debt/GDP and debt/government revenue tests are passed (meaning that although there is a temporary increase in debt in the projection period, debt stays within reasonable bounds and debt levels will be decreasing after 2019).
- **Relatively stable:** Stable government debt and no sustainability issues in the projection period or declining debt and sustainability issues in the projection period. This means either the 2019 sustainability gap is not smaller than -1% of GDP and debt/GDP and debt/government revenue tests are passed (small sustainability gap at most, which could be bridged by two years of fiscal

consolidation, while debt levels are reasonable) or 2019 sustainability gap is positive, but the average sustainability gap is negative and debt/GDP or debt/government revenue tests are failed (implying a sustainable long term outlook, but possible issues in the medium term).

- **Action required:** Significantly rising government debt levels combined with some ability to repay. The 2019 sustainability gap is not smaller than -3% of GDP (6 years of fiscal consolidation) and either the debt/GDP or debt/government revenue test is passed such that there is some capacity to repay in the long run. In this case action is required by policy makers as government debt won't stabilize. Furthermore, depending on the average sustainability gap, there might be debt issues in the medium term, because financial markets might loose confidence in the light of continuing fiscal deficits without a positive long-term outlook.
- **Potentially dangerous:** All tests failed. Without further action government debt is likely to spiral out of control as both the medium term and long term outlook are negative.

Outcomes and conclusion

The test outcomes are displayed in the table below:

Sustainability assessment						
	baseline	ageing	consolidation	age & cons	S1: extra interest	S2: output gap
No Issues	Belgium		Belgium		Belgium	
Relatively stable		Belgium	Netherlands Germany France Italy Portugal	Belgium	Netherlands Germany France	
Action required	Germany Italy Netherlands Portugal	Italy	Greece Spain	Germany Netherlands Spain Italy Portugal France	Portugal Spain Italy	Belgium Netherlands Portugal Germany France
Potentially dangerous	Ireland Spain France Greede	Greece Germany Ireland Spain France Italy Netherlands Portugal	Ireland	Greece Ireland	Ireland Greece	Greece Ireland Spain Italy

- **Baseline:** Belgium shows a solid debt development. Action is required in Germany, Italy, the Netherlands and Portugal. Other countries need significant additional fiscal consolidation or structural reforms to prevent their debt from spiralling out of control.
- **Ageing:** Without additional consolidation or measures to address the ageing problem only the Belgium government debt is manageable, in Italy additional fiscal consolidation is required and all other countries need to take extra measures over and above the projected additional fiscal consolidation.
- **Consolidation:** With fiscal consolidation Belgium has no debt issues, Germany, the Netherlands, France, Italy and Portugal have a stable debt outlook and Greece and Spain still

need to take additional action. For Ireland debt is still not under control and additional measures must be taken.

- **Ageing and consolidation:** When the costs of ageing are added to the fiscal consolidation scenario, debt developments worsen for all countries. Belgian debt is still relatively stable. Additional action is needed in Germany, France, the Netherlands, Spain, Italy and Portugal. In Greece and Ireland larger efforts are needed to maintain debt sustainability.
- **S1:** When applying a 250 basis points interest shock to Italy, Ireland, Greece, Spain and Portugal (compared to the consolidation scenario), Greece's debt sustainability becomes potentially dangerous, the Irish debt stays that way, Portugal and Italy migrate to the 'Action required' category and Spain remains there. The fact that Greece and Italy are more hit by an interest rate shock than Portugal and Spain is caused by their higher initial debt and thus higher interest rate commitments.
- **S2:** In the most severe stress-test S2, which is essentially a lasting depression, Belgium, the Netherlands, Germany, France and Portugal need to undertake action like additional fiscal consolidation, whereas the other member states need to make structural adjustments and fiscal consolidation.

Concluding on a country basis for the 'consolidation' scenario, which implies additional fiscal consolidation for most member states, it turns out that extra measures over and above the OECD consolidation scenario are required in Greece and Spain. Ireland has to tackle its debt issues even further and may not be able to avoid painful policy measures.

Finally the reader needs to note that not the full cost of ageing is taken into account, hence implying the possible need for additional reforms and that member states have all announced or are currently working on fiscal consolidation plans, which will in some cases be stricter than the fiscal consolidation assumed by the OECD. However these plans are not yet implemented. Implementation depends on the state of the Eurozone economy, the political situation in a country and the effectiveness of the Eurozone fiscal framework that is currently being developed.

5 Conclusions

Government debt in de EMU countries has increased by about 13% points in 2008 and 2009 and is expected to rise further in 2010 and 2011. Sovereign debt exceeds the 60% maximum according to the Maastricht treaty and worries exist that government debts may not be sustainable, at least in some countries. The credit crisis seems to have evolved into a debt crisis in Europe. This paper discusses the sustainability of debt in selected EMU countries (Germany, France, Italy, Spain, Netherlands, Belgium, Ireland, Greece and Portugal). Using a stochastic sustainability model and OECD projections, we conjecture the development of government debt until 2019. The stochastic simulations provide a bandwidth of outcomes reflecting the uncertainty. Moreover, we have performed various stress tests to address the robustness of the results. Four sustainability criteria are used to evaluate the projected developments of government debt: a sustainability gap indicator during and after the projection period, a debt to GDP ratio and a debt to government revenue ratio. The model projections are run for four scenarios: the evolvement of debt given the present situation, reconsolidation of government budget, no reconsolidation and including the cost of ageing and including ageing costs and reconsolidation.

Without consolidation and taking into account the public costs of ageing until the end of the projection period, budget deficits in all EMU countries will rise and sovereign debt is not sustainable, apart from Belgium. Even ignoring the cost of ageing, in nearly all EMU countries consolidation of sovereign debt is necessary. This would eliminate doubts on the sustainability of Belgium, Dutch, French, Italian, Portuguese and German sovereign debts. For Greece, Spain and Ireland additional actions are required on top of the consolidation in the OECD projections. If the costs of ageing are included extra efforts to improve government finances are required for all countries except Belgium. If the current output cap can not be closed (the recession is turning into a depression), government debts will reach dangerously high levels by the end of 2019.

Our assessments indicate mixed results under miscellaneous assumptions. Thus, recurrent sovereign debt crises within EMU are not at all inconceivable the coming decade. This calls for a quick realignment of policy rules and institutions that would enable to prevent crisis development and would install an authority with the capacity to manage crisis situations (if they nevertheless occur) efficiently and proficiently. In order to prevent contagion this authority should oversee fiscal consolidation programs of member states that are in trouble, organise a bail-out when necessary and organise a structured default when inevitable.

From past performance we know that:

a) crisis prevention measures (though indicated by the SGP) were not at all taken seriously
b) rules for crisis management were completely absent

c) a crisis management structure (who does what in times of emergencies) is not yet agreed upon. Such a structure should have the means to support countries with problems financing their sovereign debt and should have the means to arrange and to coordinate proper restructuring of debt and defaults

If anything, the results of our sustainability assessments point to an undiminished necessity to quickly make progress in all three of these fields. After all, our analysis shows that the possibility of sovereign debt crises in Europe is not at all behind us yet. Even if the growth of government debt in Europe due to the current economic crisis can be reversed, new fiscal challenges are ahead, in particular covering the public cost of ageing beyond the projection period.

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Appendix A: The costs of ageing and sustainability of sovereign debt

It is well-known that for the next decades the costs of ageing populations will be soaring unless current arrangements taking care of the elderly will be modified. Calculations of the 'sustainable deficit as a share of GDP' due to ageing typically depart from the intertemporal budget equation (2.3) where debt and the augmented primary surplus are expressed as shares of GDP.

$$\tilde{b}_t \leq \sum_{i=t+1}^{\infty} \frac{\tilde{p}_i}{(1+r-\gamma)^{i-t}} \tag{A.1}$$

For a long-term baseline projection (up till t+T) the intertemporal budget equation is forced to hold by adding a constant, $\tilde{h}$, to the augmented primary surplus, as in (A.2).

$$\tilde{b}_t = \sum_{i=t+1}^{t+T} \frac{\tilde{p}_i + \tilde{h}}{(1+r-\gamma)^{i-t}} \tag{A.2}$$

At CPB the Gamma-model (Draper et al., 2005) is used to calculate the sustainable deficit $\tilde{h}$. At DG ECFIN the sustainable deficit is simply calculated for each member state given an exogenous long-term projection. For T large enough one can approximate (A.2) with

$$\tilde{b}_t = \sum_{i=t+1}^{t+T} \frac{\tilde{p}_i}{(1+r-\gamma)^{i-t}} + \frac{\tilde{h}}{r-\gamma} \tag{A.3}$$

and thus

$$\tilde{h} = (r-\gamma)(\tilde{b}_t - \sum_{i=t+1}^{t+T} \frac{\tilde{p}_i}{(1+r-\gamma)^{i-t}}) \tag{A.4}$$

This indicator is called S2 in DG ECFIN's 'Sustainability Report' (DG ECFIN, 2009) and shows adjustment of primary surpluses required to fulfil the intertemporal budget constraint when the full costs of ageing are also taken into account. The sustainability indicator thus quantifies the required permanent adjustment of the primary surplus to ensure the sustainability of public finance.