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Mispricing of Sovereign Risk and Multiple Equilibria in the Eurozone

Paul De Grauwe and Yuemei Ji*

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Abstract

This paper finds evidence that a significant part of the surge in the spreads of the PIGS countries (Portugal, Ireland, Greece and Spain) in the eurozone during 2010-11 was disconnected from underlying increases in the debt-to-GDP ratios, and was the result of negative market sentiments that became very strong since the end of 2010.

We also find evidence that after years of neglecting high government debt, investors became increasingly worried about this in the eurozone, and reacted by raising the spreads. No such worries developed in stand-alone countries despite the fact that debt-to-GDP ratios were equally high and increasing in these countries. We interpreted this evidence as validating the hypothesis formulated in De Grauwe (2011) according to which government bond markets in a monetary union are more fragile and more susceptible to self-fulfilling liquidity crises than in stand-alone countries.

We argue that the systematic mispricing of sovereign risk in the eurozone intensifies macroeconomic instability, leading to bubbles in good years and excessive austerity in bad years.

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Introduction

The sudden emergence of the government debt crisis in the eurozone in 2009 poses serious problems for the survival of the eurozone. It also poses serious problems for economic theories.

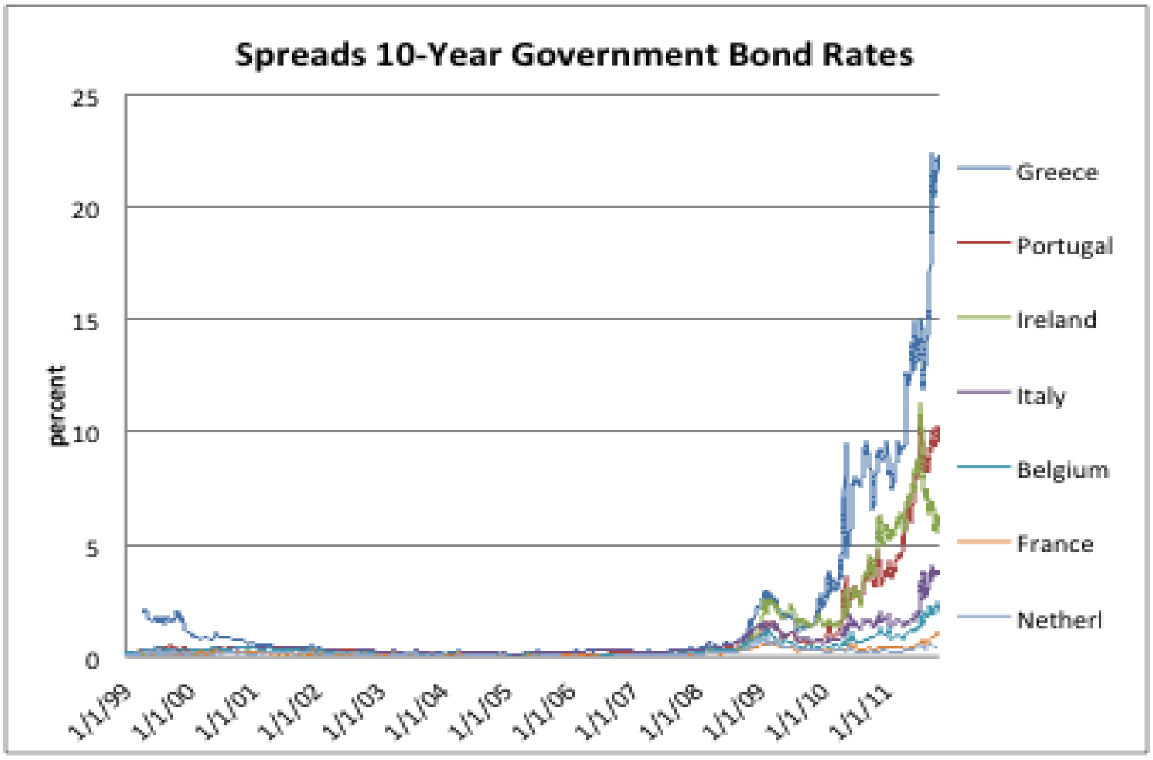
The common theory about the spreads in the government bond rates in a monetary union is that these spreads reflect default risks. The default risk in turn is determined by a number of fundamental variables. The most important of these fundamental variables is the government debt-to-GDP ratio which is a measure of the potential of a government to service its debt.

Figure 1 presents the 10-year government bond spreads in the eurozone since 1999. These spreads are defined as the difference of the government bond rates of each country with the German government bond rate. The latter is assumed to be free of default risk. The evidence of Figure 1 immediately poses serious empirical puzzles. First, during the period 2000-08 the spreads were very close to zero indicating that the default risks were perceived to be practically zero for all the eurozone countries. Yet, as will be shown, underlying fundamentals were widely different among these countries. Second, from 2008 there is a dramatic increase in the spreads. As will be made clear, these increases are significantly larger than the changes in the underlying fundamentals. These puzzles raise the question of whether financial markets may have mispriced risks either before or after the start of the crisis, or in both periods.

In this paper we analyze these puzzles and the mispricing question. This will lead us to develop the hypothesis that the spreads can be subject to 'bubbles', i.e. to movements that are dissociated from the underlying fundamentals. Note that underlying the increases in the spreads are the declines in the prices of the government bonds. Thus, the phenomena observed in Figure 1 could also be interpreted as being the result of negative 'bubbles' in the bond prices.

The analysis of such 'bubbles' is important because as argued in De Grauwe (2011) they can lead to multiple equilibria whereby countries are driven into a bad equilibrium characterized by self-fulfilling default crises and deep recessions. This potential for generating multiple equilibria makes the types of bubbles in the spreads different from the classical bubbles in the stock markets. The latter invariably lead to a crash in the stock prices whereby these prices are pushed back to their underlying fundamental values (see Kindleberger, 2005). It is not clear that the 'bubbles' in the spreads have this feature, i.e. it cannot be excluded that they push a country into a bad equilibrium that has the effect of changing the fundamentals in a self-fulfilling way. It is important therefore to find out whether such movements in the spreads that are disconnected from underlying fundamentals have occurred in the eurozone.

Figure 1. Spreads 10-year government bond rates



Source: Datastream.

There is a burgeoning literature analyzing the determinants of the spreads.[1] Most have concentrated on the eurozone. One of the novel features of our paper is to compare the eurozone countries with 'stand-alone' countries, i.e. countries that issue their own national currencies. It will be made clear that this comparison is quite revealing. In addition, more than the other existing papers we focus on the departures from the fundamentals, and the possible causes of these departures.[2]

The paper is organized as follows. Section 2 looks at the relation between spreads and the debt-to-GDP ratio so as to find out how close this relation is, and how it has changed over time. In section 3 a regression analysis is performed explaining the spreads in the eurozone by a number of fundamental variables. In section 4 we study structural breaks in these spreads. In section 5 we ask the question of whether the bubble-like developments in the spreads are also found in 'stand-alone' developed countries. In section 6 we develop a test allowing us to identify periods during which spreads become disconnected from fundamentals. Finally, in sections 7 and 8 we discuss theoretical and policy implications of our findings.

1. The facts about spreads and debt-to-GDP ratios

Before performing a rigorous econometric analysis explaining the spreads, it is useful to look at how the spreads and the debt-to-GDP ratios have evolved over time in the eurozone. We

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[1] Attinasi et al. (2009), Arghyrou Kontonikas (2010), Gerlach, et al. (2010), Schuknecht et al. (2010), Caceres et al. (2010), Caporale & Girardi (2011), Gibson et al. (2011).

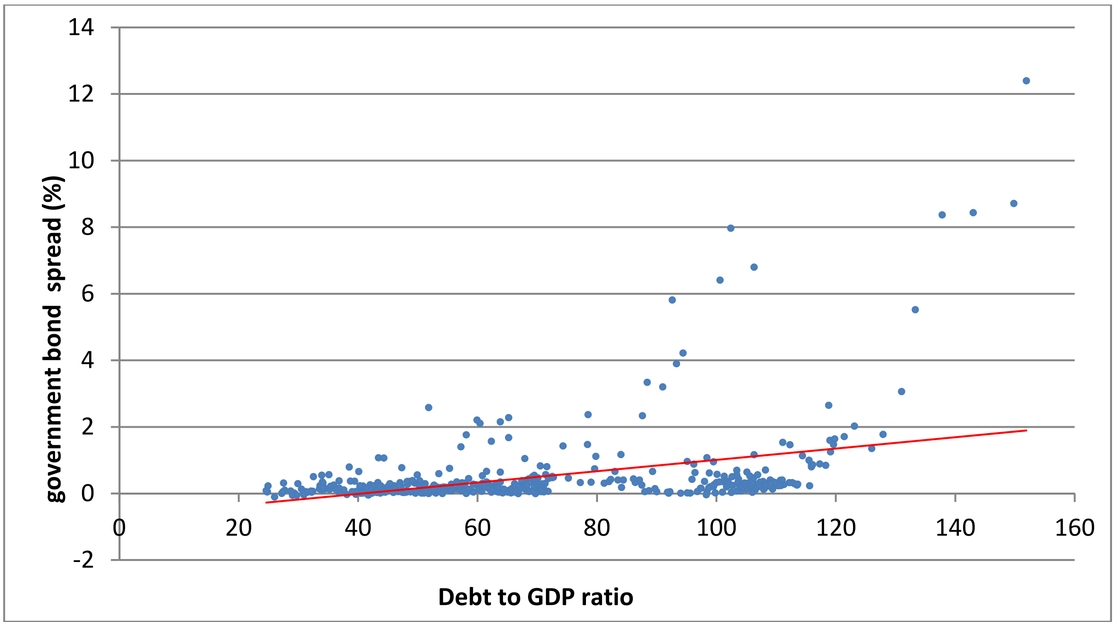
[2] Gibson et al. (2011) also focuses on such departures. As these departures have occurred msotly since 2010, the other studies mentioned in footnote 1 did not have sufficient data to detect these.

do this in Figure 2, which shows the spreads (vertical axis) as a function of the debt-to-GDP ratios (horizontal axis) in the eurozone countries. Each point is a particular observation of one of the countries in a particular quarter (sample period 2000Q1-2011Q2). We also draw a straight line obtained from a simple regression of the spread as a function of the debt-to-GDP ratio.

We observe first that there is a positive relation (represented by the positively sloped regression line) between the spread and the debt-to-GDP ratio, i.e. higher spreads are associated with higher debt-to-GDP ratios. We will return to this relationship and present more precise statistical results in the next section.

Second, it appears that only a small fraction of the total variation of the spreads can be accounted for by the debt-to-GDP ratio. While the debt-to-GDP ratio increases from approximately 20 to close to 160 across the sample, the simple regression line tells us that this should lead to an increase of the spread from 0 to approximately 2% (200 basis points). We observe, however, that the spreads increase to approximately 12% (1200 basis points). There is thus a lot of unexplained increase in the spread. The purpose of this paper will be to investigate how much of the spread can be explained by fundamental variables (such as the debt-to-GDP ratio) and how much is left unexplained?

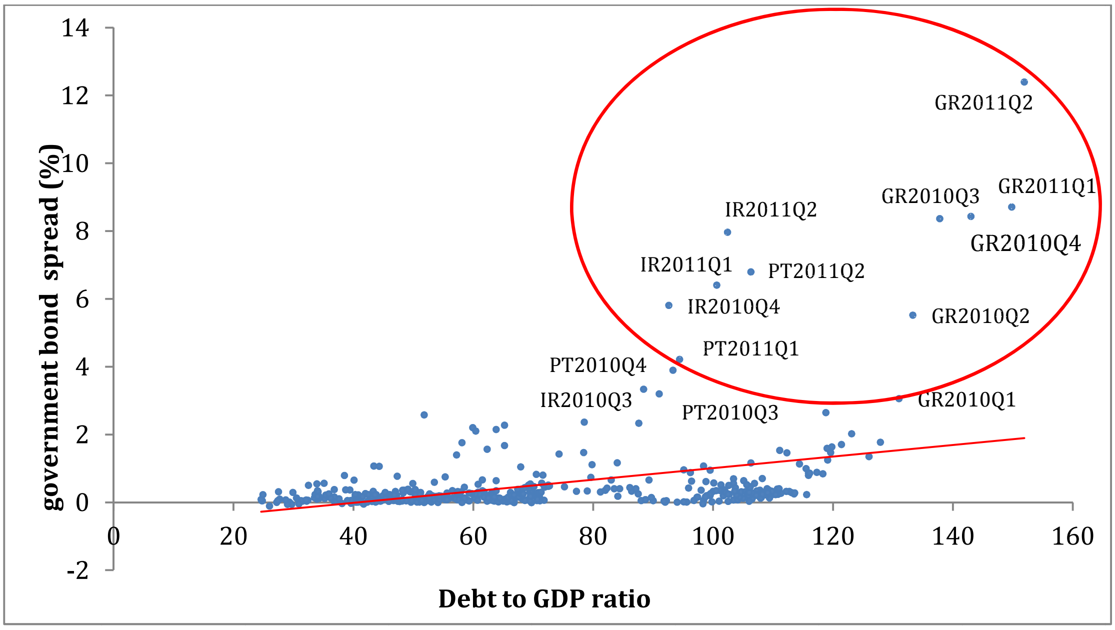
Figure 2. Spreads and debt-to-GDP ratio in eurozone (2000-11)



Sources: Eurostat and Datastream.

A third observation to be made from Figure 2 is that the deviations from the fundamental line (the regression line) appear to occur in bursts that are time dependent. We show this in Figure 3 which is the same as Figure 2 but where we have circled all observations that are more than 3 standard deviations from the fundamental line. It is striking to find that all these observations concern three countries (Greece, Portugal and Ireland) and that these observations are highly time dependent, i.e. the deviations start at one particular moment of time and then continue to increase in the next consecutive periods. It is as if 'bubbles' occurs in the spreads that lead to ever increasing deviations from the fundamental line. Put differently, the dramatic increases in the spreads that we observe in these countries from 2010 on do not appear to be much related to the increase in the debt-to-GDP ratios during the same period. Why do we observe this phenomenon that suggest that spreads increase in a way that appears disconnected from fundamentals?[3] This is another question we want to analyse in this paper.

Figure 3. Spreads and debt-to-GDP ratio in eurozone (2000-11)



Sources: Eurostat and Datastream.

2. The basic statistical model

In this section we specify an econometric model explaining the spreads by a number of fundamental variables. We have selected two fundamental variables, i.e. the government debt-to-GDP ratio and the current account position. The theory tells us that when the government debt-to-GDP ratio increases, the burden of the debt service increases leading to an increasing probability of default. This then in turn leads to an increase in the spread, which is a risk premium investors demand to compensate them for the increased default risk. The current account has a similar effect on the spreads. Current account deficits should be interpreted as increases in the net foreign debt of the country as a whole (private and official residents). This is also likely to increase the default risk of the government for the following reason. If the increase in net foreign debt arises from the private sector's overspending it will lead to default risk of the private sector. However, the government is likely to be affected because such defaults lead to a negative effect on economic activity, inducing a decline in government revenues and an increase in government budget deficits. If the increase in net foreign indebtedness arises from government overspending, it directly increases the government's debt service, and thus the default risk.

We specify the econometric equation both in a linear and a non-linear form. The reason why we also specify a non-linear relationship comes from the fact that every decision to default is a discontinuous one, and leads to high potential losses. Thus, as the debt-to-GDP ratio increases, investors realise that they come closer to the default decision making them more sensitive to a given increase in the debt-to-GDP ratio (Giavazzi & Pagano, 1996).

The linear equation is specified as follows:

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[3] Note that we will have to show this in a more formal way by introducing additional fundamental variables and by introducing possible non-linear relations between spreads and fundamentals.

$$I_{it} = \alpha + \delta * CA_{it} + \gamma * Debt_{it} + \alpha_i + u_{it}$$

where I_{it} is the interest rate spread of country i in period t, $CA_{it}$is the current account surplus of country i in period t, and $Debt_{it}$is the government debt-to-GDP ratio of country i in period t, α is the constant term and α_i is country i's fixed effect.

The non-linear specification is as follows:

$$I_{it} = \alpha + \delta * CA_{it} + \gamma_1 * Debt_{it} + \gamma_2 * (Debt_{it})^2 + \alpha_i + u_{it}$$

After having established by a Hausmann test that the random effect model is inappropriate, we used a fixed effect model. A fixed effect model helps to control for unobserved time-invariant variables and produces unbiased estimates of the 'fundamental variables'. The results of estimating the linear and non-linear models are shown in Tables 1 and 2. These results lead to the following interpretations.

First, the debt-to-GDP ratio has a significant effect on the spreads. The current account, however, although it has the right sign does not appear to be significant. Second, the non-linear specification improves the fit. This can be seen from the fact that the R-square increases from -0.60 (in the linear specification) to -0.74 (in the non-linear specification). In addition, the squared debt-to-GDP ratio is very significant. Thus, an increasing debt-to-GDP ratio has a non-linear effect on the spreads, i.e. a given increase of that ratio has a significantly higher impact on the spread when the ratio is high.

Table 1. Long-term government bond rate spread against Germany (%)

	(1)	(2)
Current account GDP ratio	-0.0380	-0.0064
	[0.0303]	[0.0439]
Debt to GDP ratio	0.0795***	-0.0454
	[0.0187]	[0.0420]
Debt to GDP ratio squared		0.0008**
		[0.0003]
Country fixed effect	Controlled	Controlled
Observations	460	460
R squared	0.60	0.74

Notes: Standard errors in brackets.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Cluster at the country level and robust standard error is shown in the brackets.

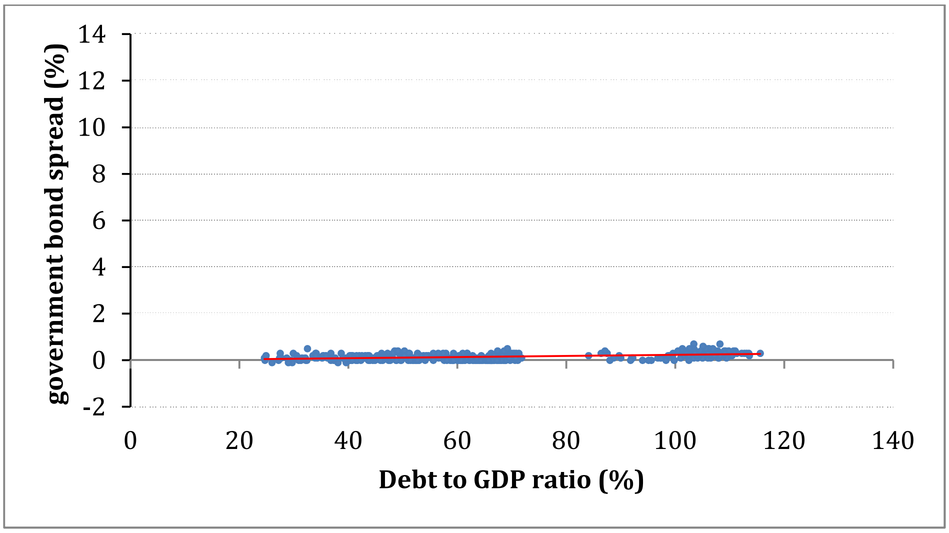
3. Structural breaks

Figures 1 and 2 suggest that a structural break has occurred since the start of the financial crisis. It is important to analyse the nature of that structural break.

As preliminary evidence we show in Figures 4 and 5 the plot of the spreads as a function of the debt-to-GDP ratio both before and after 2008. We also show, as in Figure 2, the simple regression line. The contrast between the periods is striking. Prior to the crisis the large differences in the debt-to-GDP ratios (ranging from about 20% to more than 100%) do not seem to have a visible effect on the spreads. Thus, during the pre-crisis period financial markets were saying that debt-to-GDP ratios do not matter for the solvency of countries. As a result, financial markets exerted no disciplinary effect on high debt governments.

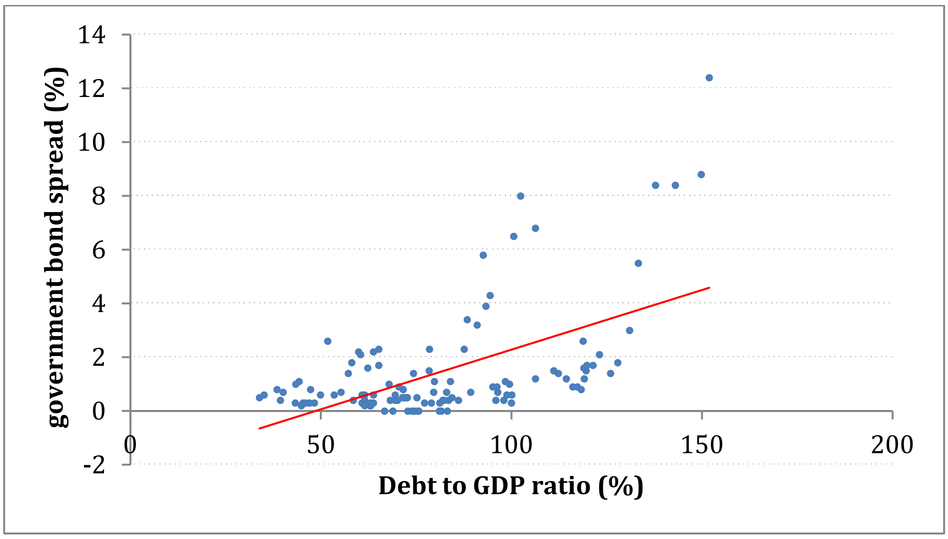
Things changed dramatically since the start of the financial crisis (see Figure 5). We now observe that the regression line is positively sloped (and significant) suggesting that suddenly financial markets started to look at the debt-to-GDP ratios in setting default risks. Why the markets suddenly changed their minds remains puzzling. It certainly suggests that they do not always use all available information to price government bonds, which goes against the efficient market theory. It also suggests that serious mispricing of risk occurred.

Figure 4. Spreads and debt-to-GDP ratios in eurozone prior to 2008



Sources: Eurostat and Datastream.

Figure 5. Spreads and debt-to-GDP ratios in eurozone after 2008



Sources: Eurostat and Datastream.

We also observe from Figure 5 that even in the post-crisis period there is a large unexplained component. We continue to observe large deviations of the spreads from their fundamental value as presented by the regression line. In addition, these deviations are strongly correlated over time, appearing at the same time and involving the countries mentioned earlier (Greece, Ireland, Portugal).

As in the previous section we applied a fixed effect model (both linear and non-linear) for the pre- and post-crisis periods. A Chow test revealed that indeed a structural break occurred around the year 2008, allowing us to treat the pre- and post crisis periods as separate. We show the results in Table 2

Table 2. Long-term government bond rate spread against Germany (%)

	(1) Pre-crisis_	(2) Post-crisis	(3) Pre-crisis	(4) Post-crisis
Current account GDP ratio	0.0011	-0.0033	0.0032	0.0210
	[0.0051]	[0.0457]	[0.0064]	[0.0384]
Debt to GDP ratio	0.0077*	0.1029***	-0.0031	-0.0865***
	[0.0037]	[0.0280]	[0.0107]	[0.0216]
Debt to GDP ratio squared			0.0001	0.0012***
			[0.0001]	[0.0001]
Country fixed effect	Controlled	Controlled	Controlled	Controlled
Observations	320	140	320	140
R squared	0.4848	0.7233	0.5056	0.8633

Notes: Standard errors in brackets.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.
Cluster at the country level and robust standard error is shown in the bracket.

The contrast between the pre- and post-crisis periods is striking. From Table 2 we observe that coefficient of the debt-to-GDP ratio prior to the crisis is low and only marginally significant, in the post-crisis period this coefficient becomes much larger and is statistically significant. Similar results are obtained by Schuknecht et al. (2010), Arghyrou & Kontonikas (2010), Borgy et al. (2011) and Gibson et al. (2011).

We obtain a similar result in the non-linear model. In fact, in the pre-crisis period, there does not seem to be a non-linear effect. The squared debt-to-GDP ratio is low and insignificant. After the crisis, however, the non-linearity is significant as can be seen from the highly significant coefficient of the squared debt-to-GDP ratio.

4. Stand-alone countries

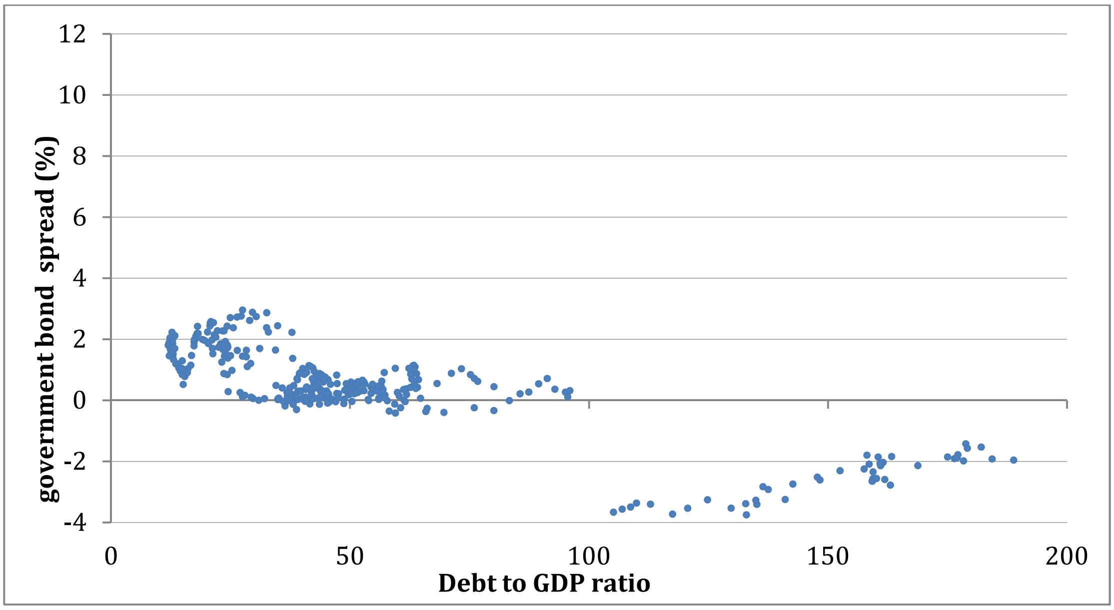
We have observed in the previous sections that there is a strong break in the data of the eurozone. Prior to 2008 financial markets were unconcerned about the large differences in debt-to-GDP ratios and vastly underestimated risks. Since 2008 the debt-to-GDP ratio became important in explaining the spreads. However, we also found out that there is a large unexplained component that is highly time dependent.

Do the same developments occur in ‘stand-alone’ countries, i.e. countries that are not part of a monetary union and issue debt in their own currencies? We analyse this question in the present section. We selected eight ‘stand-alone’ developed countries (Australia, Denmark, Japan, New Zealand, Norway, Sweden, US and UK) and computed the spreads of the 10-year government bond rates. In order to make the analysis comparable with our analysis of the eurozone countries, we selected the same default risk government bond, i.e. the German government bond. We could also have selected the US government bond. In fact doing so leads to very similar results.

It is important to stress that the spreads between 'stand-alone' countries reflect not only default risk but also exchange rate risk. It is even likely that the latter dominates the default risk, as exchange rates exhibit large fluctuations thereby creating large risks resulting from these fluctuations. In the econometric analysis we will therefore introduce exchange rate changes as an additional explanatory variable of the spreads. Before we do this, we present the plots of the spreads and the debt-to-GDP ratios in the same way as we did for the eurozone countries in section 2. The result is shown in Figure 6.

Comparing Figure 6 with Figure 2 of the eurozone countries, we find striking differences. First, the short-term volatility of the spreads is higher most of the time in the stand-alone countries. This probably has to do with the variability of the exchange rates. Second, one country, Japan, stands out with its negative spreads throughout the whole period. (The Japanese spreads are the points below the zero line and above the 100% debt-to-GDP ratio.) Thus, Japan seems to be a special case, which is probably related to the structural appreciation of the Yen (see McKinnon, 2003). This leads to ingrained expectations of appreciation creating expected future capital gains. These expectations, in turn allow the Japanese government to issue debt at a lower interest rate. In the econometric analysis, where we add the exchange rate changes and fixed effects for each country we will be able to take care of these problems.

Figure 6. Spreads of 10-year bond rates of 'stand-alone' countries, 2000-11



Sources: Eurostat and Datastream. The debt-to-GDP ratios of Australia, Japan, New Zealand and the US are calculated using data from their central banks.

A third difference with the eurozone countries is that the debt-to-GDP ratio seems to have a very weak effect on the spreads. Fourth, and most importantly, we observe the absence of 'bubble-like' behaviour of the spreads. That is, we do not detect sudden and time dependent large departures of the spreads from its fundamental. All the observations, although volatile in the short-run, cluster together around some constant number between 0% and 2% for the stand-alone countries without Japan, and between -2% and 4% for Japan.

A fifth difference is that there does not seem to be a structural break with the onset of the financial crisis in 2008. This is made clear from Figures 7 and 8. The financial crisis does not seem to have changed the relationship between spreads and debt-to-GDP ratios, i.e. it appears that since the financial crisis the link between spreads and debt-to-GDP ratios have remained equally weak for the stand-alone countries. This contrasts a great deal with the eurozone countries, where this link increased significantly in the post-crisis period. Thus, financial markets are not eager to impose more discipline on the stand-alone countries since the start of the financial crisis, while they are very much so in the eurozone. This striking difference is illustrated in Figure 9 where we combine the observations of the eurozone countries (Figure 5) and of the stand-alone countries (Figure 8).

Figure 7. Spreads of 10-year bond rates of 'stand-alone' countries, 2000-08

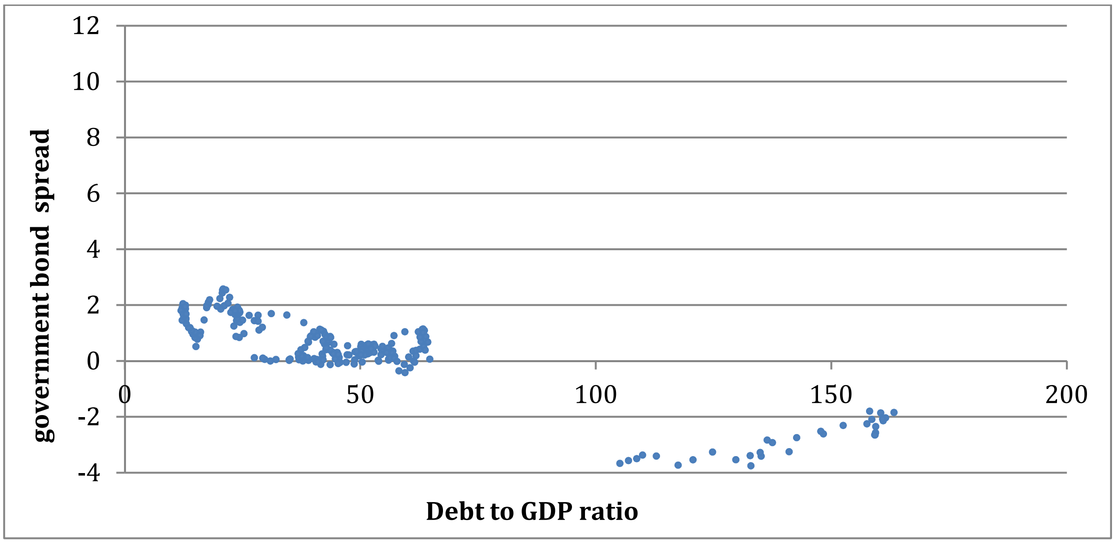
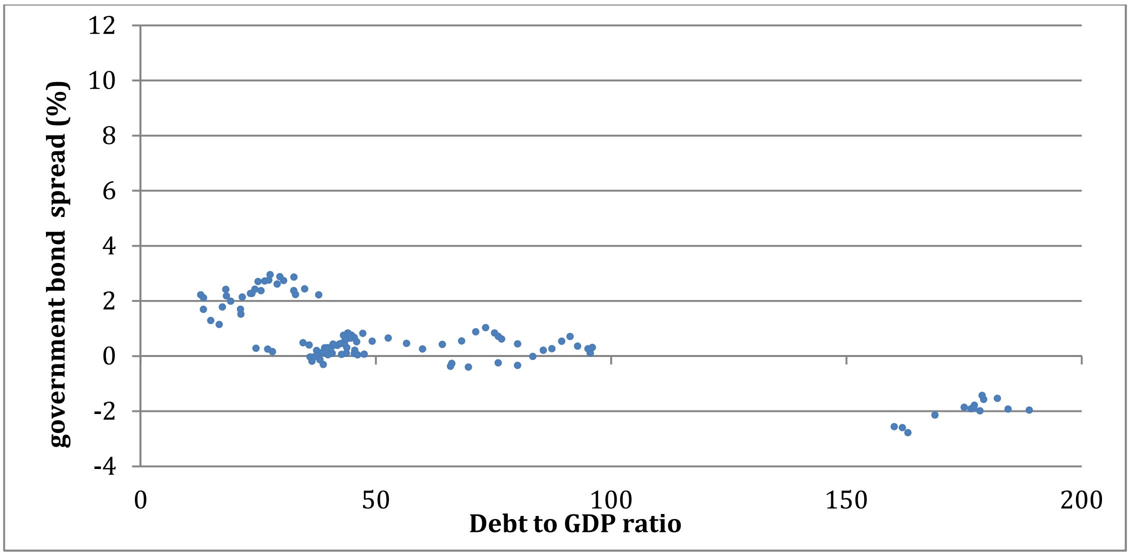
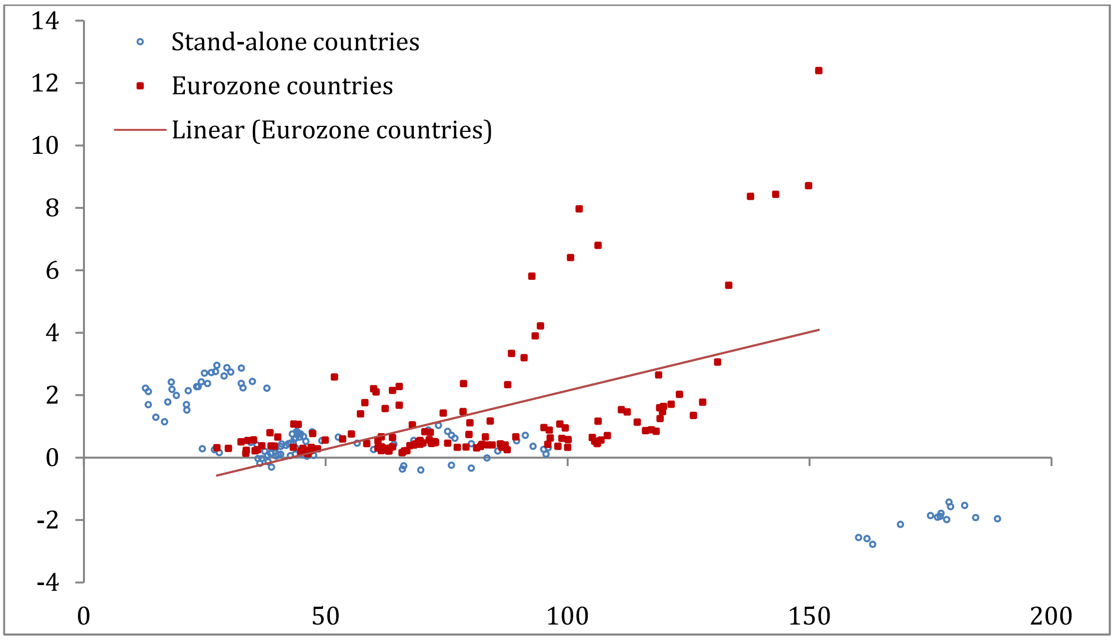


Figure 8. Spreads of 10-year bond rates of 'stand-alone' countries, 2008-11



Sources: Eurostat and Datastream. The debt-to-GDP ratios of Australia, Japan, New Zealand and the US are calculated using data from their central banks.

Figure 9. Spreads of 10-year bonds of eurozone and 'stand-alone' countries, 2000-11



Sources: Eurostat and Datastream. The debt-to-GDP ratios of Australia, Japan, New Zealand and the US are calculated using data from their central banks.

We now turn to an econometric analysis. We only present the results of a linear specification. The reason is that we could not detect any non-linearity in the effects of the debt-to-GDP ratios on the spreads. As mentioned earlier, we have now added the percentage change in the exchange rate of each stand-alone country against the euro. Ideally, we should use the expected future exchange rate changes. However, estimating future expected exchange rate changes is a perilous undertaking. Therefore, we use the observed changes, taking the view that the observed and forecasted exchange rate changes are highly correlated over a sufficiently long period of time.

The results of Table 3 lend themselves to the following interpretation. First, as could be guessed from the visual inspection of Figure 6, the debt-to-GDP ratio has no significant effect on the spreads. Financial markets do not seem to be concerned with the size of the government debt and its impact on the spreads of stand-alone countries, despite the fact that the variation of the debt-to-GDP ratio is of a similar order of magnitude as the one observed in the eurozone. In section 7 we interpret this paradox.

Second, the exchange rate changes have a significant effect on the spreads. This is no surprise given what we observed from Figures 6 to 8. Third, the current account has a significant effect on the spreads. This may be due to the Japanese phenomenon. The high current account surpluses of this country have the effect of reducing the spreads for any given level of debt-to-GDP ratio. Note that we could not find such a significant current account effect in the eurozone countries.

Table 3. Long-term government bond rate spread against Germany (%)

	(1)	(2)
Current account GDP ratio	-0.0469**	-0.0426**
	[0.0155]	[0.0135]
Debt to GDP ratio	0.0147	-0.0067
	[0.0081]	[0.0128]
Debt to GDP ratio squared		0.0001*
		[0.0000]
Exchange rate against euro	-0.0283***	-0.0279**
	[0.0071]	[0.0085]
Country fixed effect	controlled	controlled
Observations	368	368
R squared	0.9230	0.9312

Notes: Standard errors in brackets.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Cluster at the country level and robust standard error is shown in the bracket.

We also performed a Chow test for a structural break. In contrast with the results for the eurozone we could not detect a structural break in the effect of the debt-to-GDP ratio before and after the crisis. Thus, both before and after the emergence of the financial crisis the markets disregard the debt-to-GDP ratios of stand-alone countries as variables that can affect the solvency of countries. A very puzzling result, to which we return in section 7.

The contrast between the eurozone and stand-alone countries is also made clear by a pooled regression of the eurozone and the stand-alone countries. We do this in Table 4. We have added an interaction variable 'Debt to GDP*eurozone' which measure the degree to which the debt-to-GDP ratio affects the eurozone spreads differently from the stand-alone countries. The results of Table 4 confirm the previous results. The debt-to-GDP is a much stronger and significant variable in the eurozone than in the stand-alone countries. The latter seem to be able to 'get away with murder' and still not be disciplined by financial markets.

Table 4. Long-term government bond rate spread against Germany (%)

	(1)	(2)	(3)
	Total sample	Pre-crisis_	Post-crisis
Current account GDP ratio	-0.0408*	-0.0240*	-0.0092
	[0.0208]	[0.0134]	[0.0244]
Debt-to-GDP ratio	0.0146*	0.0164	0.0190**
	[0.0078]	[0.0133]	[0.0083]
Debt-to-GDP ratio*eurozone	0.0649***	-0.0069	0.0844***
	[0.0198]	[0.0141]	[0.0288]
Exchange rate against euro	-0.0283***	-0.0324***	-0.0200**
	[0.0067]	[0.0104]	[0.0076]
Country fixed effect	controlled	controlled	controlled
Observations	828	576	252
R squared	0.7669	0.9230	0.7981

Notes: Standard errors in brackets.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Cluster at the country level and robust standard error is shown in the bracket.

To summarise, we find a great contrast between the eurozone countries and the stand-alone countries. In the former, we detected a significant increase in the effect of the debt-to-GDP ratio on the spreads since 2008. Such an increase is completely absent in the stand-alone countries. Second, there appears to be significant departures of the spreads from their fundamental values in the eurozone countries after the start of the crisis, suggesting that time dependent movements in market sentiments become important. This does not seem to be observed in the stand-alone countries.

5. Introducing time dependency

In order to measure the importance of time dependent effects on the spreads, we introduce time dependency in the basic fixed effect model. In the non-linear specification this yields:

$$I_{it} = \alpha + \delta * CA_{it} + \gamma_1 * Debt_{it} + \gamma_2 * (Debt_{it})^2 + \alpha_i + \beta_t + u_{it}$$

where β_t is the time dummy variable. This measures the time effects that are unrelated to the fundamentals of the model or (by definition) to the fixed effects. If significant, it shows that the spreads move in time unrelated to the fundamentals forces driving the yields.

We estimated this model for both the stand-alone and the eurozone countries. In addition, we estimated the model separately for two subgroups of the eurozone, i.e. the core and the periphery. The results are shown in Table 5. The contrast between stand-alone and eurozone countries is striking. We could not detect significant effects of the time variable in the stand-alone countries. In the eurozone we detect significant time effects especially since 2008. Thus, during the post crisis period the spreads were gripped by surges that were independent from the underlying fundamentals. These time effects were especially strong in the periphery during 2010-11. Thus the disconnection of the spreads from their fundamentals seems to have been the most pronounced in the countries where the spreads surged most.

Finally we plot the time effects obtained from Table 5 in Figure 9. This suggests that especially in the periphery 'bubbles' occurred in the spreads, i.e. an increase in the spreads that cannot be accounted for by fundamental developments, in particular by the changes in the debt-to-GDP ratios during the crisis. Put differently, while before the crisis the markets did not see any risk in the peripheral countries' sovereign debt, after the crisis, they exaggerated these risks dramatically. Thus, mispricing of risks (in both directions) seems to have been an endemic feature in the eurozone.

Table 5. Long-term government bond rate spread against Germany (%)

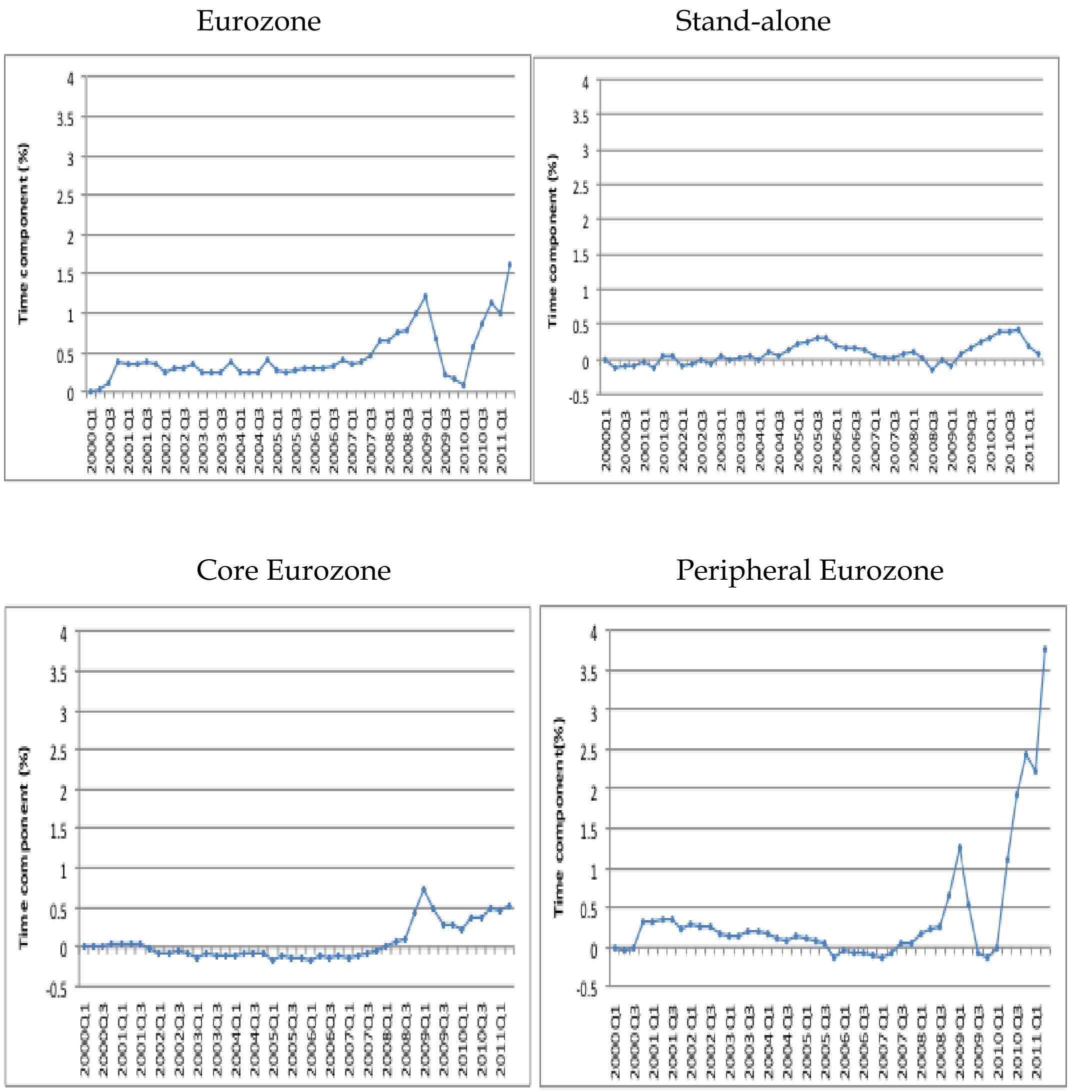
	(1) Stand-alone_	(2) Eurozone	(3) Core Eurozone	(4) Periphery
Current account GDP ratio	-0.0462**	0.0305	-0.0055	0.0063
Debt to GDP ratio	-0.0114	-0.0519	-0.0409	-0.0612
Debt to GDP ratio squared	0.0001	0.0008**	0.0003	0.0008**
2000Q2	-0.1084	0.0446	0.0017	-0.0283
2000Q3	-0.0876	0.1070*	0.0174	-0.0123
2000Q4	-0.0936	0.3910**	0.0383	0.3143
2001Q1	-0.0463	0.3432**	0.0315	0.3136
2001Q2	-0.1138	0.3548**	0.0335	0.3619
2001Q3	0.0626	0.3716**	0.0348	0.3556
2001Q4	0.0457	0.3635**	-0.0107	0.2453
2002Q1	-0.1017	0.2391	-0.0694	0.2775
2002Q2	-0.0622	0.3007	-0.0652	0.2638
2002Q3	-0.0032	0.2895	-0.0549	0.2726
2002Q4	-0.0547	0.3436	-0.0728	0.1673
2003Q1	0.0557	0.2524	-0.1288*	0.1539
2003Q2	0.0080	0.2385	-0.0720	0.1550
2003Q3	0.0328	0.2578	-0.1028	0.1921
2003Q4	0.0395	0.3747	-0.0982	0.1969
2004Q1	0.0051	0.2572	-0.1182	0.1573
2004Q2	0.1210	0.2341	-0.0798	0.1085
2004Q3	0.0612	0.2453	-0.0790	0.0797
2004Q4	0.1517	0.4176	-0.0694	0.1543
2005Q1	0.2223	0.2846	-0.1671*	0.1181
2005Q2	0.2450	0.2521	-0.1134	0.0673
2005Q3	0.3105	0.2871	-0.1265	0.0424
2005Q4	0.3235	0.3068	-0.1392	-0.1397
2006Q1	0.2059	0.2913	-0.1554	-0.0470
2006Q2	0.1669	0.3007	-0.1085	-0.0574
2006Q3	0.1607	0.3325	-0.1296	-0.0645
2006Q4	0.1443	0.3995	-0.1223	-0.1063
2007Q1	0.0407	0.3617	-0.1350	-0.1198
2007Q2	0.0108	0.3840	-0.1188	-0.0745
2007Q3	0.0357	0.4684	-0.0784	0.0399
2007Q4	0.0906	0.6486*	-0.0557	0.0513
2008Q1	0.1020	0.6512*	-0.0005	0.1629
2008Q2	0.0356	0.7457**	0.0644	0.2427
2008Q3	-0.1494	0.7902**	0.1008	0.2560
2008Q4	-0.0133	1.0087**	0.4403**	0.6465
2009Q1	-0.1046	1.2046***	0.7222***	1.2463*
2009Q2	0.0720	0.6873*	0.4808***	0.5392
2009Q3	0.1790	0.2078	0.2728**	-0.0722
2009Q4	0.2483	0.1645	0.2761**	-0.1206
2010Q1	0.3000	0.0964	0.2074*	-0.0067
2010Q2	0.3962	0.5582	0.3844**	1.1075
2010Q3	0.3993	0.8750	0.3861	1.9239
2010Q4	0.4151	1.1436*	0.4903*	2.4485**
2011Q1	0.1994	1.0117*	0.4693	2.2208**
2011Q2	0.0817	1.6274*	0.5345*	3.7585*
Exchange rate against euro	-0.0220**			
Country fixed effect	controlled	controlled	controlled	controlled
Observations	368	460	276	184
R squared	0.9409	0.8018	0.8351	0.9425

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Cluster at the country level and robust standard error is shown in the bracket. Chow test shows a split between the new and early members.

Core eurozone = Austria, Belgium, France, Germany, Finland, Italy, Spain.

Periphery: Ireland, Greece, Portugal.

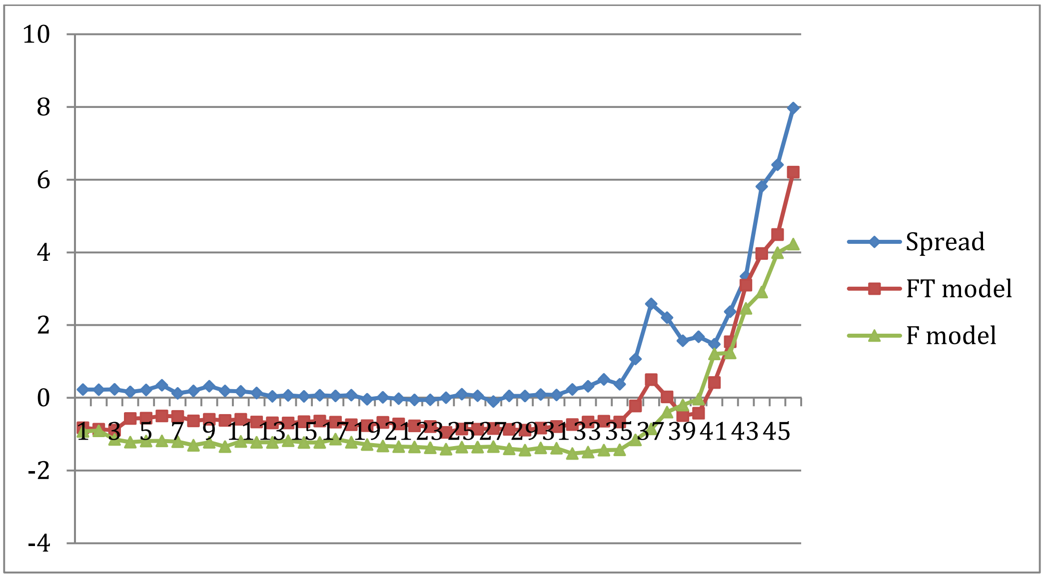
Figure 10. Time variable, eurozone and stand-alone



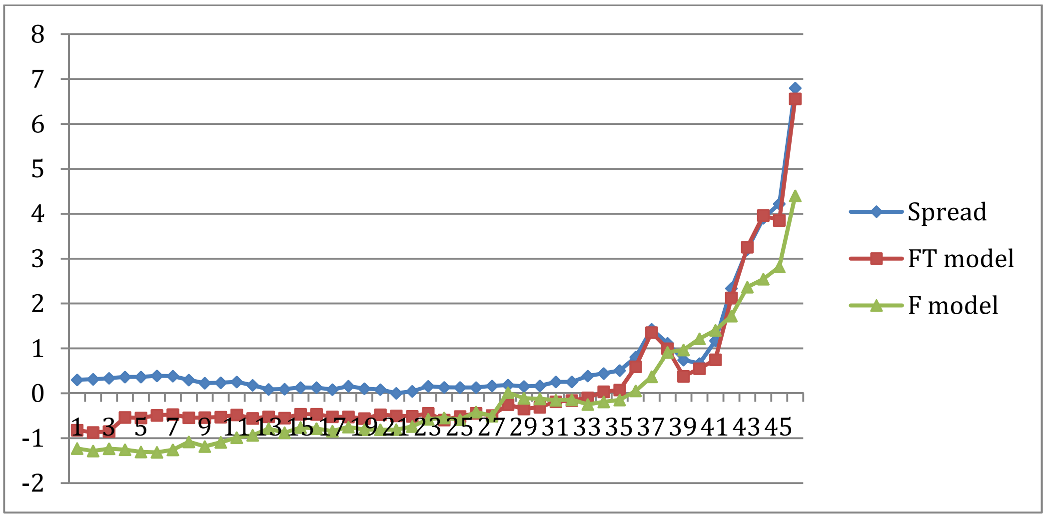
A final way to illustrate the importance of time dependent effects is to compare the observed spreads with the spreads as predicted by the model with and without the time effects. This is done in Figure 10. We observe that with the exception of Greece, the observed spreads at the end of the period are significantly higher than the spreads as predicted by the econometric model (F-model). The model with time effects (FT model) comes much closer in predicting the observed spreads at the end of the period. Greece is an exception, mainly because the model with fundamentals (F-model) tells us that the observed spreads should have been much higher prior to 2008. But markets then ignored fundamentals. As a result after 2008 spreads caught up with the fundamental model, after years of under-pricing the risk on Greek sovereign debt.

Figure 11. Observed spreads and estimated spreads using F-model and FT-model

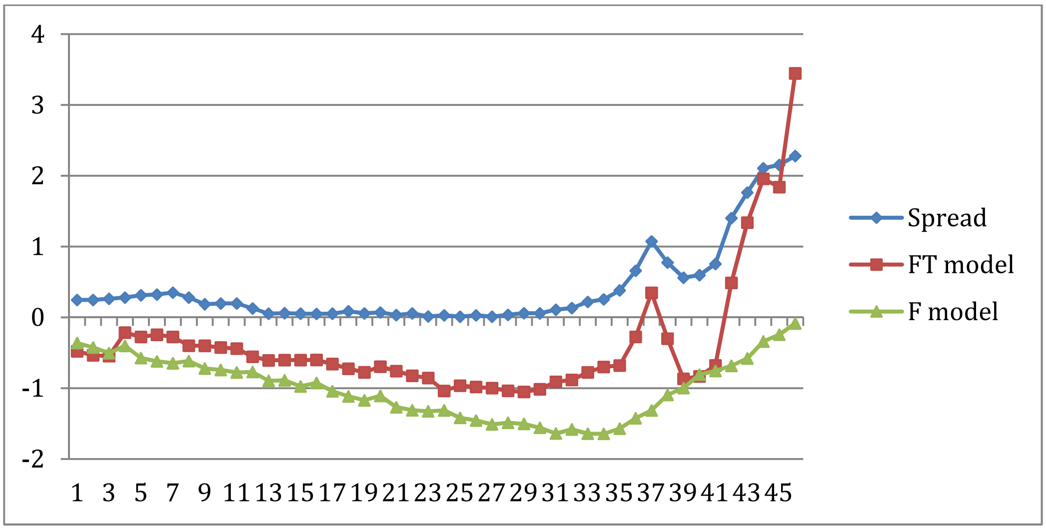
Ireland



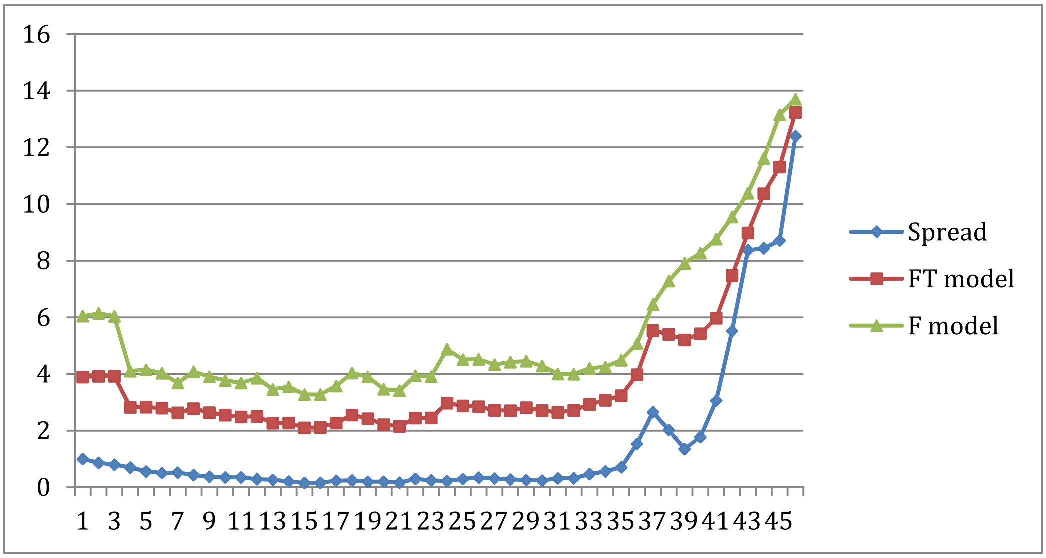
Portugal



Spain



Greece



6. Theoretical implications

In the previous sections we found two important pieces of evidence. First, since the start of the financial crisis, financial markets have started worrying about the high debt-to-GDP ratios in the eurozone, and have interpreted these high and increasing debt-to-GDP ratios as leading to default risk. No such worries have developed in stand-alone countries despite the fact that debt-to-GDP ratios were equally high and increasing in these countries. Second, we observed that in the eurozone the spreads can move away from underlying fundamentals (such as the debt-to-GDP ratio) in a 'bubble-like' fashion. No such 'bubbles' were observed in our sample of stand-alone countries.

How can these phenomena be explained? In De Grauwe (2011), a theoretical explanation was provided along the following lines.[4] Members of a monetary union issue government debt in a currency they do not control. As a result, the governments of these countries cannot guarantee that the cash will always be available to pay out the bondholders. This contrasts with stand-alone countries; which owing to the fact they have their own central bank, can always make sure that the cash will be there to pay out bondholders. The absence of a guarantee that the cash will always be available creates a situation in a monetary union in which a liquidity crisis arises. And because such a crisis leads to large increases in the interest rate on government debt it can drive governments of a monetary union into default. The important ingredient in this dynamics is its self-fulfilling nature: when investors start fearing default they will sell the bonds, creating a liquidity crisis that degenerates into a solvency crisis. The fear of insolvency creates conditions that make insolvency more likely.

This fragility has two effects. First, investors become more nervous when the debt-to-GDP ratios increase in member countries of a monetary union (as they did after 2008) than when similar increases occur in stand-alone countries. Put differently increases in the debt-to-GDP ratios lead to fears of default that in a monetary union can lead to default in a self-fulfilling way. This self-fulfilling dynamics is absent in stand-alone countries. As a result, the sensitivity of the spreads to the debt-to-GDP ratios is weak in the latter countries.

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[4] For a more formal model see also De Grauwe (2011). There exist many formal theoretical models that create self-fulfilling liquidity crises. Many of these have been developed for explaining crises in the foreign exchange markets (see Obstfeld (1986)). Other models have been applied to the government debt (Calvo (1988), Gros (2011) and Corsetti & Dedola (2011)).

Second, the fragility of a monetary union also implies that fears are enlarged and through contagion can take panic proportions, very much like one observes in banking systems that exhibit a similar fragility (Diamond & Dybvig, 1983). When fear and panic takes over sales of government bonds become massive creating increases in the interest rates (and the spreads) on government bonds in the absence of observable changes in the fundamentals. When such movements of distrust are triggered, the government bond rates tend to be driven away from their fundamentals. That is exactly what we observed in the data of the eurozone since 2010.

The potential for self-fulfilling liquidity and solvency crises in a monetary union also implies that countries can be driven into bad equilibria, that are characterized by high interest rates, a downturn in economic activity and a great pressure to apply budgetary austerity that because it intensifies the recession in the short run also has the tendency to raise the debt-to-GDP ratios further (Blanchard, 2011).

Thus when self-fulfilling crises occur that lead countries into a bad equilibrium, the fundamentals will tend to change over time. In particular, output declines so that the debt-to-GDP ratio tends to increase, thereby validating the increased spreads. Our empirical results suggest that this may have been a feature in the eurozone during the sovereign debt crisis. We observed that while the time component becomes very important during a crisis, the debt-to-GDP ratio continued to surge, and in addition, the sensitivity of the spreads to the debt-to-GDP ratio increased.

Conclusion

There is now a widespread consensus that financial markets in the eurozone have been systematically wrong when during 2001-08 they were charging the same risk premium on Greek and German government bonds despite huge differences in debt-to-GDP ratios of these countries. Today, the same markets apply huge spreads on Greek (and other) government bonds. Many economists today take the view that the spreads the markets now impose are correct. But why is it that if markets were systematically mispricing risks and failed to see any risk during 2001-08, these same markets suddenly found the truth?

In this paper we argued that financial markets did not suddenly find the truth. Since the start of the sovereign debt crisis they made errors in the other direction, i.e. they overestimated risks. We found evidence that a large part of the surge in the spreads of the PIGS countries during 2010-11 was disconnected from underlying increases in the debt-to-GDP ratios, and was the result of negative market sentiments that became very strong since the end of 2010.

We also found evidence that after years of neglecting high debt-to-GDP ratios, investors became increasingly worried about the high debt-to-GDP ratios in the eurozone, and reacted by raising the spreads. No such worries developed in stand-alone countries despite the fact that debt-to-GDP ratios were equally high and increasing in these countries. We interpreted this evidence as validating the hypothesis formulated in De Grauwe (2011) according to which government bond markets in a monetary union are more fragile and more susceptible to self-fulfilling liquidity crises. The stand-alone countries in our sample have been immune from these liquidity crises and weathered the storm without the increases in the spread.

The story of the eurozone is also a story of systematic mispricing of the sovereign debt, which in turn led to macroeconomic instability and multiple equilibria. During the 2001-08 period, the systematic under-pricing of the risk in the peripheral countries led to unsustainable booms in real estate and in consumption, until the crash occurred. The systematic overpricing of sovereign risk since 2010 had the effect of pushing these countries into bad equilibria characterised by solvency crises and deep recessions.

The systematic mispricing of sovereign debt observed in the eurozone also had the effect of giving wrong incentives to policymakers. During the boom years, when financial markets were blind to the sovereign risks, no incentives were given to policy makers to reduce their debts, as the latter were priced so favourably. Since the start of the financial crisis financial markets driven by panic overpriced risks and gave incentives to policymakers to introduce excessive austerity programmes.

In a world where spreads are tightly linked to the underlying fundamentals such as the debt-to-GDP ratio, the only option the policy makers have in reducing the spreads is to improve the fundamentals. This implies measures aimed at reducing the debt burden. If, however, there can be a disconnection between the spreads and the fundamentals, a policy geared exclusively towards affecting the fundamentals (i.e. reducing the debt burden) will not be sufficient. In that case policy makers should also try to stop countries from being driven into a bad equilibrium. This can be achieved by more active liquidity policies by the ECB that aim at preventing a liquidity crisis from leading to a self-fulfilling solvency crisis (Wyplosz, 2011 and De Grauwe, 2011).

It should be stressed that the policy aiming at improving the fundamentals through budgetary austerity and the policy of liquidity provision by the central bank are not substitutes, but complements. When a member-country of a monetary union is hit by a liquidity crisis that leads to a disconnection between the spreads and the fundamentals, both policies will in general be needed. All too often these two types of policies have been seen as 'either or'. In fact, as we have shown, in a monetary union conditions can arise in which both types of policies are required.

References

Arghyrou, M. and A. Kontonikas (2010), "The EMU sovereign-debt crisis: Fundamentals, expectations and contagion", Cardiff Economics Working Papers, E2010/9, University of Cardiff.

Attinasi, M., C. Checherita and C. Nickel (2009), "What explains the surge in Euro area sovereign spreads during the financial crisis of 2007-09?", ECB Working Paper, No. 1131, European Central Bank, Frankfurt, December.

Blanchard, O. (2011), "Four Hard Truths", VoxEU (http://www.voxeu.org/ index.php?q=node/7475).

Caceres, C., V. Guzzo and M. Segoviano (2010), "Sovereign Spreads: Global Risk Aversion, Contagion or Fundamentals?", IMF Working Paper, International Monetary Fund, Washington, D.C., May.

Calvo, Guillermo (1988), "Servicing the Public Debt: The Role of Expectations", *American Economic Review*, Vol. 78, No. 4, pp. 647□661.

Caporale, G. and A. Girardi (2011), "Fiscal Spillovers in the Euro Area", Discussion Paper, 1164, DIW, Berlin, October.

Corsetti, G.C. and L. Dedola (2011), "Fiscal Crises, Confidence and Default. A Bare-bones Model with Lessons for the Euro Area", unpublished, Cambridge.

De Grauwe, P. (2011), "The Governance of a Fragile Eurozone", CEPS Working Documents, CEPS, Brussels, May (http://www.ceps.eu/book/governance-fragile-eurozone).

De Grauwe, P. (2011), "The ECB as a lender of last resort", VoxEU, October, (http://www.voxeu.org/ index.php?q=node/6884).

Diamond, D.W. and P.H. Dybvig (1983), "Bank runs, deposit insurance and liquidity", *Journal of Political Economy* 91 (3): 401–419.

Eichengreen, B., R. Hausmann, U. Panizza (2005), "The Pain of Original Sin", in Eichengreen, B. and R. Hausmann, *Other people's money: Debt denomination and financial instability in emerging market economies*, Chicago, IL: Chicago University Press.

Gerlach, S., G. Schulz and W. Wolff (2010), "Banking and Sovereign Risk in the Euro Area", mimeo, Deutsche Bundesbank.

Gibson, H., G. Hall and G. Tavlas (2011), "The Greek Financial Crisis: Growing Imbalances and Sovereign Spreads", Working Paper, Bank of Greece, Athens, March.

Gros, D. (2011), "A simple model of multiple equilibria and default", mimeo, CEPS, Brussels.

Kindleberger, C. (2005), *Manias, Panics and Crashes: A History of Financial Crises*, Palgrave Macmillan, 5th edition.

McKinnon, R. and R. Goyal, (2003), "Japan's Negative Risk Premium in Interest Rates: The Liquidity Trap and Fall in Bank Lending", *The World Economy*, March, pp 339-364.

Obstfeld, M. (1986), "Rational and self-fulfilling balance-of-payments crises", *American Economic Review* 76 (1), pp. 72-81.

Schuknecht, L., J. von Hagen and G. Wolswijk (2010), "Government Bond Risk Premiums in the EU Revisited the impact of the financial crisis", ECB Working Paper No. 1152, European Central Bank, Frankfurt, February.

Wyplosz, C. (2011), "They still don't get it", VoxEU (http://www.voxeu.org/ index.php?q=node/6845).

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