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EMU, the Changing Role of Public Debt and the Revival of Sovereign Credit Risk Perception

by

Kai Daniel Schmid & Michael Schmidt

Faculty of Economics and Social Sciences
www.wiwi.uni-tuebingen.de

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Kai Daniel Schmid – University of Tübingen, Macroeconomic Policy Institute Düsseldorf
Michael Schmidt – Graduate School of Economics, Finance, and Management, Frankfurt

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Abstract

Using annual data for 21 OECD countries we provide evidence of remarkable mispricing of sovereign bonds for the so-called GIIPS countries before the start of the financial crisis. Our results also qualify the view of pronounced overpricing in the crisis. In detail, we find:

(i) Since the 1980s the role of public debt for the pricing of government bonds has changed twice: First-time in the aftermath of the signing of the Maastricht treaty, and again with the wake-up call due to the onset of the financial crisis.

(ii) Before the financial crisis EMU member countries had de facto been perceived as a homogenous group with regard to the role of public debt for sovereign risk pricing.

(iii) With the reconsideration of country-specific fundamentals the role of public debt has not only been revived but its impact upon bond yield spreads has become comparable to the time before the Maastricht treaty.

Keywords: EMU, GIIPS, public debt, risk perception, sovereign bond yields
JEL-Classification: E43, E44, E62

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Corresponding Author: Kai Daniel Schmid, Kai-Daniel-Schmid@Boeckler.de. Macroeconomic Policy Institute, Düsseldorf.

1 Motivation

In the face of the financial crisis many OECD countries have experienced large increases of government debt relative to GDP. At the same time there has been a sharp rise of long-term interest rates on government bonds. Therefore, at first glance, falling bond prices might result from investors' consideration of rising sovereign credit risk. However, we argue that, in particular within some member countries of the European Monetary Union (EMU), the explanation of investors' recent reactions to public debt imbalances is twofold: (i) First, the worsening of fiscal fundamentals since the beginning of the financial crisis has been taken into account. (ii) Second, financial markets have reconsidered the role of these fiscal fundamentals for the pricing of government bonds. From a historical perspective this recent re-evaluation of sovereign debt seems little surprising. It is rather the re-establishment of the temporarily interrupted pricing of fiscal imbalances (as a central factor of sovereign credit risk) than the aggravation of fiscal imbalances itself.

To give a first graphical illustration figure 1 presents the development of long-term interest rates and the debt to GDP ratio for a sample of 21 OECD countries, including 11 EMU member countries, between 1980 and 2012.[1] Within the ten OECD countries that are not part of the EMU (upper panel) we observe a trend of falling long-term interest rates. For the debt to GDP ratio within these countries we see a pronounced increase since the beginning of the financial crisis (2007/08). The latter also holds for EMU member countries and in particular for the GIIPS countries. Since the start of the convergence ambitions in advance of the EMU (1993/94) long-term interest rates of designated euro member states had converged nearly perfectly - staying together until 2008 when their development expanded again. The centered and lower panels in figure 1 exemplify this phenomenon for the GIIPS countries as well as for six other EMU countries. Thereby, we recognize two important things: (i) First, the convergence and re-widening pattern of long-term interest rates that is often associated with the "Great Moderation" period and with the effects of the recent financial and sovereign debt crises seems to be an EMU-specific feature that is even more pronounced for the GIIPS countries. (ii) Second, throughout the examined time span and irrespective of the regional cluster there is no stable relationship between long-term interest rates and the debt to GDP ratio.

The observed convergence pattern of long-term interest rates has been explained in several ways. (i) On the one hand, the decrease and narrowing of long-term interest rates within the GIIPS countries is said to be due to an expected catching up of these countries with regard to real production. According to this, enhancing economic strength might have justified lower interest rates on sovereign bonds (see, e.g., Giavazzi and Spaventa 2010). Thereby, the expectation of fiscal sustainability might have been suggested by the belief that real economic growth exceeds the growth of public debt (Sinn 2012). (ii) On the other hand, the convergence has been discussed related to the meanwhile questionable credibility of the so-called "no-bailout" statement reflecting rather a joint and several accountability than country-specific default risks (see Bernoth et al. 2006). (iii) Besides this, exchange rate risk and the risk denoted to expected inflation have taken a back seat with regard to the level of long-term interest rates since the beginning of the EMU-convergence (Frömmel and Kruse 2009). Accordingly, a considerable part of the convergence in long-term interest rates has been ascribed to declining inflation risk and exchange rate risk within some countries before the start of the EMU. (iv) Finally, it is argued that the ECB's collateral policy might implicitly have promoted insufficient differentiation between credit risks in

[1] Basic summary statistics are presented in table A1 in the appendix.

some EMU countries (Buiter and Sibert 2005). Thereby, too low risk weights for bonds of periphery countries in regulation codes as well as the perception of high and low quality bonds as close substitutes might have stimulated the demand for sovereign bonds of periphery countries.

Figure 1: Long-term Interest Rates and Public Debt to GDP Ratio.

Data source: OECD Economic Outlook, AMECO Database.

However, with the start of the financial crisis in the second half of 2007, this obvious, temporary disregard of country-specific macroeconomic performance (in particular of fiscal imbalances as we illustrate below) seems to have vanished (see Gärtner et al. 2011 as well as Sinn 2012). In this sense, the recent sharp increase of long-term

interest rates is explained by a shift in investors' default risk perception (Arghyrou and Kontonikas 2009, De Grauwe 2011, IMF 2010, Schuknecht et al. 2010).

In the following we show that the role of public debt for the assessment of sovereign credit risk strongly depends on the regional cluster and that since the 1980s this role has changed *twice*. We suggest that in the course of the institutional changes associated with the EMU, long-term interest rates - and implicitly sovereign default risk perception - were significantly lower than the "correct" long-term interest rates which would have been suggested by fiscal fundamentals. We argue that this is reflected by two crucial break points - framing the time span starting with the EMU convergence period (1993/94)[2] and lasting until the beginning of the financial crisis (2007/08) - that document the decline and reemergence of the relevance of public debt in explaining sovereign default risk as a central component of long-term interest rates.

Our paper is structured as follows: Section 2 summarizes related literature and highlights the relevance of our findings with regard to this branch of research. Section 3 explains our empirical strategy. Section 4 introduces our estimation setup and discusses our findings. Section 5 concludes.

2 Related Research and Contribution

2.1 Literature Review

Our study complements and specifies current research on the changing dynamics of pricing public debt in the EMU carried out by, e.g., Arghyrou and Kontonikas (2009), Attinasi et al. (2009), Beirne and Fratzscher (2012), Caceres et al. (2010), De Grauwe and Ji (2012), Gärtner et al. (2011), and Haugh et al. (2009). These papers share the insight that with the beginning of the financial crisis expectations have changed considerably and that investors have returned to country-specific pricing of macroeconomic fundamentals. (i) Arghyrou and Kontonikas (2010) apply monthly data for ten EMU countries from 1999:1-2010:4 and examine sovereign spreads against German bonds. The authors find that while until the onset of the financial crisis markets had hardly priced macroeconomic fundamentals, the increasing fragility of the intensifying divergence of fundamentals within the EMU caused a change in market behavior. (ii) Attinasi et al. (2009) use daily data from end-July 2007 to end-March 2009 for ten EMU countries and explain bond spreads relative to Germany by expected fiscal information (the latter also calculated relative to Germany). The authors find increasing relevance of the fiscal deficit in shaping investors' expectations in the financial crisis. (iii) Beirne and Fratzscher (2012) use monthly data from 2000:4-2011:8 for 31 countries and show that the rise of public bond yield (and CDS) spreads during the sovereign debt crisis is not only caused by the worsening of macroeconomic fundamentals but also due to increasing risk perception. (iv) Caceres et al. (2010) apply daily data from mid-2005 to 2010 for 10 EMU countries and examine changes in the yield on a 10-year euro swap, as a measure of euro area spreads relative to a common numéraire. The authors observe that in the course of the crisis the perception of country-specific risks has increased and that this partly stems from worsening fiscal fundamentals. (v) Gärtner et al. (2011) use annual data for 26 OECD countries between 1999 and 2010. These authors illustrate that for some EMU countries with the start of the financial crisis the role of macroeconomic fundamentals for the explanation of sovereign credit ratings has changed significantly and that risk premiums, measured by credit spreads for government bonds, are affected not only by the systematic part of credit ratings, but by an arbitrary

[2] Note that the Maastricht treaty was signed on 7 February 1992 and had its entry into force on 1st of November 1993.

part (indicating expectations-led, cumulative pricing dynamics) as well. (vi) Haugh et al. (2009) explain the yield on ten-year sovereign bonds of ten EMU members against Germany using quarterly data from December 2005 to June 2009. The authors find that differing fiscal policies exert a significant influence on bond yield spreads as well as a widening of the latter since mid-2007 in the EMU. In particular, the results for an interaction of fiscal variables with a proxy for general risk aversion highlight the change in pricing behavior that set in with the beginning of the financial crisis.

Besides this research our approach is also motivated by panel studies linking government bond yields and fiscal imbalances that do not solely cover time periods that are characterized by a single monetary policy stance - see, e.g., Ardagna et al. (2004) as well as Bernoth et al. (2006). (i) Ardagna et al. (2004) explain the development of the nominal 10 year interest rate on government bonds of 16 OECD countries using yearly data for the samples 1960-2002 and 1975-2002. Explanatory variables in use are the 3-month T-bill rate, the inflation rate, the primary balance relative to GDP, public debt relative to GDP, interactions between debt levels and fiscal deficits as well as a set of macroeconomic control variables. The authors show that increasing public debt and a weakening of the fiscal balance lead to an increase of long-term interest rates. (ii) Bernoth et al. (2006) base their analysis on yearly data for 14 EU countries covering the time span from 1993-2005. The authors explain yield differentials between DM(Euro) and US-dollar denominated government bonds by the debt ratio, the deficit ratio (as well as the debt-service ratio for another specification) each measured as differences relative to the benchmark country (Germany, US). The authors find a significant impact of public debt on yield spreads and document that average yield differentials of EMU member countries have declined since the start of the EMU.

The implications of our findings are most closely related to the study by De Grauwe and Ji (2012). Their econometric analysis is based on quarterly data from 2000-2011 for EMU countries as well as for eight further OECD countries. The authors explain changes in the long-term interest rate relative to Germany by the government debt to GDP ratio as a measure for sovereign default risk and the current account balance to GDP ratio as a proxy for net foreign debt. In addition, they consider changes of the euro exchange rate for non-euro countries. The authors argue that due to the consequences of the financial crisis recent long-term interest rate spreads against Germany of some EMU countries (Greece, Ireland, and Portugal) reflect an overpricing of sovereign credit risk. Moreover, they find that the sudden awakening of sovereign credit risk assessment does not hold for non-EMU members. This lends support to the notion that government bond markets in a monetary union are more fragile and more susceptible to self-fulfilling liquidity crises (De Grauwe 2011).

2.2 Contribution to the Literature

We contribute to this literature by providing broad cross-country evidence for 21 OECD countries within the time span from 1980 to 2012. Especially the fact that we consider data before 1999 (which has, to our best knowledge, not been done so far) allows us to compare recent and historic time regime changes. Only in this way it is possible to distinguish the recent re-pricing of government bonds as a “fear-bubble” or the time between the signing of the Maastricht treaty and the recent crisis as a “risk-bubble”. Focusing on a range of fundamental macroeconomic variables, we use a panel fixed effects estimation framework (similarly applied by Beirne and Fratzscher 2012 and De Grauwe and Ji 2012). Our extensive dataset and our very general approach allow us to consider the relevance of institutional changes in the context of the EMU by contrasting different time regimes and regional subsamples: (i) We cover *two* time regime breaks in the institutional context of the EMU, i.e., we

contrast investors' assessment of sovereign credit risk for the time span before the Maastricht treaty, since the start of the EMU and since the beginning of the financial crisis. (ii) We provide evidence for the specific sovereign risk assessment of three regional clusters: The so-called GIIPS countries (Greece, Ireland, Italy, Portugal, and Spain), six other EMU member countries, and ten non-EMU OECD countries.

Our results update, complement and qualify many findings of previous empirical studies by a number of features: (i) We show that the relevance and changes in the relevance of public debt for sovereign default risk assessment have differed significantly between time regimes and regional clusters. (ii) In particular, in GIIPS countries there has been a clear fall and reemergence pattern of the debt to GDP ratio in financial markets' pricing of sovereign credit risk. (iii) In the aftermath of the Maastricht treaty EMU member countries had been perceived as a nearly homogenous group with regard to the impact of the debt to GDP ratio upon sovereign risk assessment. (iv) We illustrate that with the onset of the financial crisis the role of public debt for the pricing of government bonds has not only been revived but that the impact of the debt to GDP ratio upon public bond yield spreads has become comparable to the time before the Maastricht treaty. (v) This suggests severe mispricing before the start of the financial crisis and qualifies the view of pronounced overpricing in the crisis.

3 Empirical Strategy

Our empirical strategy is made up of four steps: (i) First of all, we introduce two empirical proxies for financial markets' assessment of credit risk. (ii) Second, we classify appropriate time and regional subsamples with regard to the relevance of public debt for our sovereign credit risk measures in the context of the EMU. (iii) Third, we specify a valid estimation setup explaining changes in sovereign credit risk by the debt to GDP ratio and a set of macroeconomic control variables. (iv) Fourth, to gain insights in investors' assessment of fiscal imbalances, we compare fiscal variables' total effects upon sovereign credit risk over time and between regional clusters.

3.1 Measuring Sovereign Credit Risk

We seek to quantify changes in sovereign risk perception reflected by variations of long-term interest rates. As credit risk premiums are sensitive to the scale of fiscal imbalances, fiscal information is a central determinant of long-term interest on sovereign bonds (see Haugh et al. 2009 and Frömmel and Kruse 2009). The underlying theoretical context suggests that the level of long-term interest rates does not only reflect the debtors' default risk but also comprises the level of short-term interest rates (and expected short-term interest rates) as well as exchange rate risk, expected inflation and a liquidity premium. Thereby, the credit risk component represents the inverse likelihood of full repayment - or, more precisely, the market assumption of the probability of default and the resulting loss given default - depending on investors' assessment of a country's fiscal position and the sustainability of public debt, respectively.

To examine the relevance of fiscal information for financial markets' risk perception empirically, we isolate credit risk as a component of the long-term interest rate.[3] For this purpose we apply two credit risk measures that approximate sovereign default risk anticipated by financial markets: (i) First, we consider an inflation adjusted interest rate differential that we call real interest rate spread (*REALSPREAD*). Thereby, for each country we subtract the expected short-term nominal interest rate (to control for term-structure effects) and the

[3] Thereby, the credit risk component may not perfectly reflect the "true" default risk but investors' perceptions of the latter.

expected rate of consumer price inflation (to address creditors' real compensation in the spirit of Fisher 1930) from the long-term nominal interest rate. This measure is comparable between countries with individual monetary policy stances and country-specific expectations with regard to consumer price inflation. (ii) Second, we use the long-term interest rate spread against Germany (*GERSPREAD*). Thereby, the German bond yield serves as a benchmark asset. Here, we consider the respective countries' expected short-term nominal interest rate (to capture individual monetary policy) and the expected rate of inflation as specific right-hand-side control variables in our regressions (see section 4).

For both measures we take care of exchange rate risk upon long-term interest rates and therefore include the expected effective nominal exchange rate as an explanatory variable. We do not explicitly control for liquidity effects upon the long-term interest rate because of the lack of appropriate data. The liquidity premium is often either measured with the help of bid-ask spreads reflecting trading costs in bonds markets or it is approximated by the ratio of a country's debt to the total debt issued in the respective currency (see Bernoth et al. 2006 with reference to Flemming 2003 and Gravelle 1999). As we cover data since 1980 and we also consider a number of non-EMU countries we are not able to consistently assess the total amount of outstanding debt relative to a country's securities and hence cannot implement such a strategy.

Ideally, the estimation results based on our two measures should be robust to changing monetary policy regimes as well as country-specific expectations of inflation and exchange rates. As we consider the term-structure of interest rates as well as expected inflation for both risk measures we expect similar regression results. However, from a theoretical point of view there are two delicate differences: (i) First, while regressions of *GERSPREAD* on macroeconomic fundamentals allow for a varying impact of the expected short-term nominal interest rate and the expected rate of inflation, *REALSPREAD* is subject to the restriction of the respective coefficients to unity. Hence, differing results for the two measures will indicate changes in the relevance of interest rate policy or expected inflation upon long-term nominal interest rates. (ii) Second, *REALSPREAD* varies due to shifts in global risk aversion or credit supply trends. In contrast, as the German bond yield may also react to these factors, *GERSPREAD* may capture these dynamics to a lesser extent. Therefore, differences between the two measures are expected to hint at changes with regard to overall risk aversion or global trends in credit supply.[4]

3.2 Data

We use annual data from 1980 to 2012 from the OECD Economic Outlook #90 as well as from the AMECO Database and from the IMF World Economic Outlook Database, September 2011.[5] Our sample covers the following 21 OECD countries: Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Switzerland (CHE), Denmark (DNK), Spain (ESP), Finland (FIN), France (FRA), Germany (GER), Great-Britain (GBR), Greece (GRC), Ireland (IRL), Italy (ITA), Japan (JPN), the Netherlands (NLD), Norway (NOR), New Zealand (NZL), Portugal (PRT), Sweden (SWE), and the United States (USA).

Our two risk measures (*REALSPREAD*, *GERSPREAD*) are derived from the respective national long-term nominal interest rate (rate on ten-year government bonds), the German long-term nominal interest rate, and

[4] However, within our regressions we address effects of changing overall risk aversion or global liquidity trends by the use of yearly dummy variables.

[5] We obtained all data that underlie the presented results in September 2012. Note that the time series' values for the year 2012 are forecasts provided by the respective databases.

national short-term nominal interest rates (rates on three-month treasury bills). With regard to explanatory variables we consider two fiscal indicators: Government debt relative to GDP (*DEBTGDP*) and the primary balance to GDP ratio (*PBGDP*) as well as a set of macroeconomic control variables: The expected short-term nominal interest rate (*ISHORT_FC*), the expected rate of consumer price inflation (*INFL_FC*), expected annual growth of real GDP (*GDP_FC*), the expected effective nominal exchange rate (*NEFX_FC*), and a forecast of the current account balance relative to GDP (*CABGDP_FC*). Our choice of control variables is guided by relevant literature in this field (see, e.g., the references mentioned in section 2).

3.3 Time Regimes and Regional Clusters

Our analysis points out the EMU-specific dynamics of risk assessment that largely may have emerged from the institutional framework of the Maastricht treaty. For this purpose we contrast the impact of public debt upon interest rate spreads for the following three regional clusters and three time regimes:[6]

- Regional clusters:
  - OECD-21 ex EMU-11 (N=10: AUS, CAN, CHE, DNK, GBR, JPN, NOR, NZL, SWE, USA)
  - EMU-11 ex GIIPS (N = 6: AUT, BEL, GER, FIN, FRA, NLD)
  - GIIPS (N = 5: ESP, GRC, IRL, ITA, PRT)
- Time regimes:
  - 1980-1993 (T = 14): "PreEuro"-period
  - 1994-2007 (T = 14): "ConEuro"-period (lasting from pre-EMU convergence until the financial crisis)
  - 2008-2012 (T = 5): "Crisis"-period

Our subsample selection is guided by the institutional changes due to the Maastricht treaty (that initiated the above mentioned convergence of long-term interest rates) and by the severe macroeconomic shock of the financial crisis. The classification is in line with the above mentioned literature (see section 2) and is consistent with the historical track record of long-term interest rates (see figure 1 as well as figure A1 in the appendix). The results of a formal test for structural break are presented in table A2 in the appendix. The break in coefficients for the suggested dates is widely confirmed.[7]

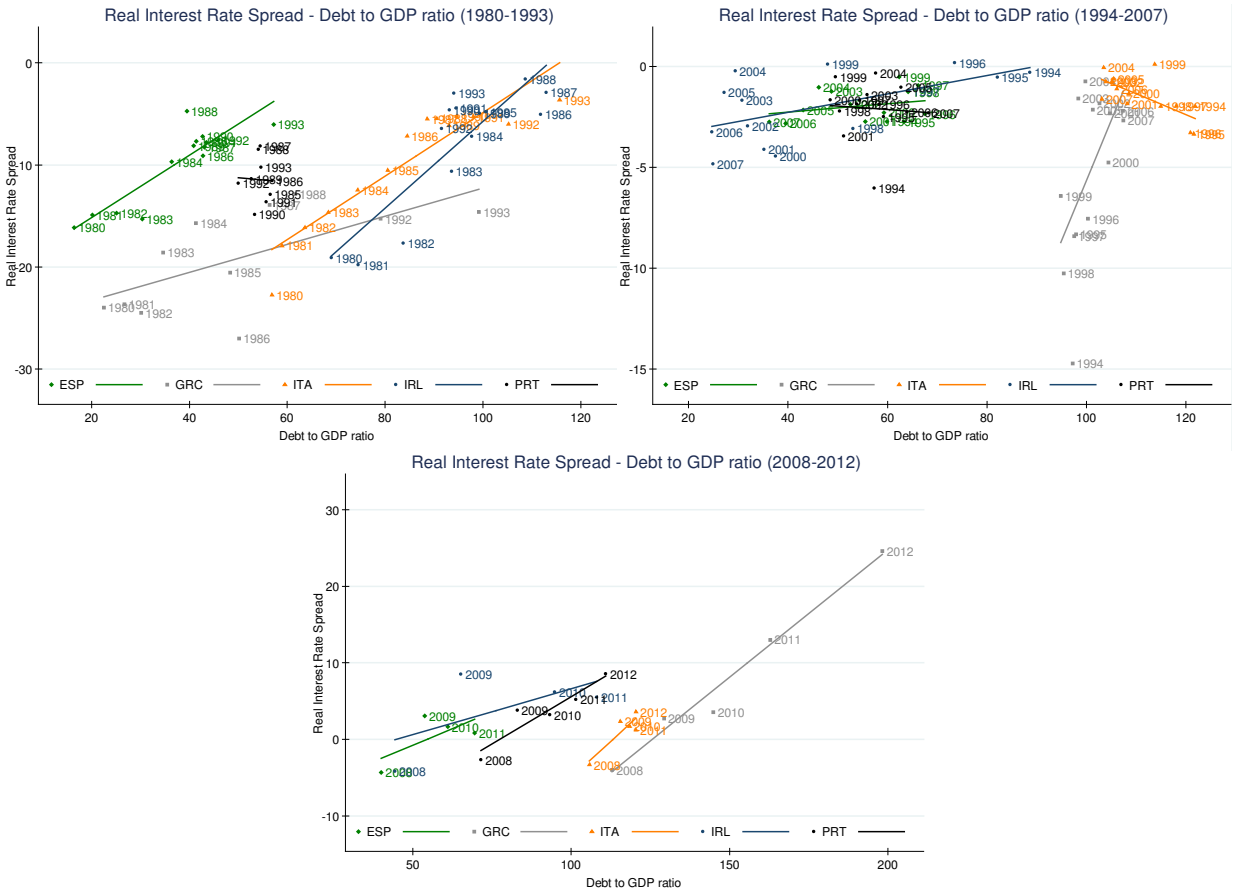
The comparison of the applied subsamples is supposed to trace regional and time period-specific differences within the relationship between public debt and interest rates on government bonds. Thereby, with regard to changes over time we observe an impressive pattern for the five GIIPS countries that is illustrated in figure 2. Here, the real interest rate spread (vertical axis) is contrasted with the debt to GDP ratio (horizontal axis) for each time regime. The respective years are reported for each observation. The slopes of the simple regression lines indicate investors' average adjustment of default risk perception to changes in the debt to GDP ratio. Except in the case of Portugal we observe a positive relationship in the "PreEuro"-period (1980-1993, upper left panel), while in the "ConEuro"-period (1994-2007, upper right panel) except for Ireland, the clear positive slopes disappear, i.e., there is no clear market anticipation of credit risk based on debt sustainability issues anymore. However, since the start of the financial crisis rising interest rate spreads have been associated

[6] Basic summary statistics of our data according to this 3x3 subsample matrix are reported in table A1 in the appendix.

[7] Alternatively, one might apply 2008/09 instead of 2007/08 as the second break date, and, indeed, a respective Chow-Test does not disqualify such a consideration. However, our results do not change qualitatively compared to the chosen time regime classification.

with increasing public debt to GDP ratios again ("Crisis"-period, lower panel). In particular for Spain and Italy we observe a pronounced change compared to the "ConEuro"-period.[8] In the case of Greece and Portugal, from 2008 onwards the slopes of the simple regression lines are not just positive again, but the relationship is even tighter compared to the "PreEuro"-period implying a pronounced re-assessment of fiscal soundness for the pricing of sovereign bonds. According to Gärtner et al. (2011) and De Grauwe and Ji (2012) this tightening might reflect a kind of overpricing of sovereign default risk after the financial crisis that even might have led to a self-fulfilling aggravation of the sovereign debt crisis.

Figure 2: Time regime-specific Pricing of Sovereign Default Risk (GIIPS).



Data source: OECD Economic Outlook, AMECO Database.

4 Econometric Methodology and Results

4.1 Explanatory Variables

The economic rationale with regard to explanatory variables is motivated as follows: The debt to GDP ratio (*DEBTGDP*) is supposed to exert a positive impact upon our two risk measures *REALSPREAD* and *GERSPREAD* (hereafter also referred to as *SOVRISK*) as increasing debt enhances both, the expected probability of default and the expected loss given default. Based on the assumption that an improvement of the government's fiscal

[8] A country-specific representation is provided in figure A2 in the appendix.

position is reflected by a rising primary balance relative to GDP (*PBGDP*) we expect a negative sign for this regressor. The expected short-term nominal interest rate (*ISHORT_FC*) and the expected national rate of inflation (*INFL_FC*) are assumed to exhibit a positive impact upon the long-term nominal interest rates.[9] The expected annual growth rate of real GDP (*GDP_FC*) is supposed to enter with a negative sign as an improvement of real economic performance eases the national budget. For the forecast of the effective nominal exchange rate (*NEFX_FC*) we expect a negative sign (controlling for investors' portfolio adjustments due to exchange rate re-evaluation expectations). Additional capital inflows should increase credit supply and ceteris paribus reduce the long-term interest rate. Finally, we consider the expected current account balance relative to GDP (*CABGDP_FC*) which may either be classified as a proxy for a country's net foreign liabilities (see, e.g., De Grauwe and Ji 2012) or be interpreted as a measure of competitiveness (Sinn 2012). In either case we expect a negative sign.[10]

4.2 Regression Setup

Our technical approach is similar to Beirne and Fratzscher (2012) and De Grauwe and Ji (2012) who also apply a panel fixed effects model. We estimate the following panel setup for 21 OECD countries (country *i*, $i = 1, \ldots, 21$) and 33 years (year *t*, $t = 1, \ldots, 33$) for each risk measure (*SOVRISK*).

$$
\begin{aligned}
SOVRISK_{it} \;=\; & \alpha\, TD_{PRE}\, X_{it} + \beta\, X_{it} + \gamma\, TD_{CRI}\, X_{it} \\
+\; & \delta\, TD_{PRE}\, RD_{ExG}\, X_{it} + \varepsilon\, RD_{ExG}\, X_{it} + \zeta\, TD_{CRI}\, RD_{ExG}\, X_{it} \\
+\; & \eta\, TD_{PRE}\, RD_{G}\, X_{it} + \theta\, RD_{G}\, X_{it} + \iota\, TD_{CRI}\, RD_{G}\, X_{it} \\
+\; & YD_t + u_i + e_{it}
\end{aligned}
$$

Thereby, X_{it} is a regressor-set of explanatory variables, YD_t are yearly dummy variables, u_i denote country-specific fixed effects, and e_{it} is a random error term.[11] The role of regional differences is captured by two regional dummy variables for six "EMU-11 ex GIIPS" countries (RD_{ExG}, $i = 11, \ldots, 16$) and for five GIIPS countries (RD_G, $i = 17, \ldots, 21$) as well as respective interactions to explanatory variables. Thereby, the "OECD-21 ex EMU-11" cluster ($i = 1, \ldots, 10$) serves as the benchmark region. To assess changes in the relevance of public debt for the pricing of sovereign bonds over time we separate effects within each time regime. For this purpose, we use time regime-specific dummy variables for the 14 years of the "PreEuro"-period (TD_{PRE}, $t = 1, \ldots, 14$) and the five years of the "Crisis"-period (TD_{CRI}, $t = 29, \ldots, 33$) as well as corresponding interactions to explanatory variables. Here, the "ConEuro"-period ($t = 15, \ldots, 28$) serves as the benchmark period.

We apply a serial correlation and cross sectional dependence robust panel estimation technique using Driscoll and Kraay standard errors (Driscoll and Kraay 1998, see also Höchle 2007). Test results for panel serial correlation and groupwise heteroskedasticity are reported in tables A2 and A3 in the appendix (see Drukker 2003, Greene 2000, Wooldridge 2002).

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[9] As our two risk measures differ in their information content with regard to effects of expected short-term nominal interest rates and expected inflation each measure is associated with a distinct set of regressors (see also subsection 3.1 as well as tables 1 and 2).

[10] For our macroeconomic control variables we use forecast data (provided by the databases reported in subsection 3.2) because investment decisions are assumed to be forward-looking. The only exception is *PBGDP* as we do not have enough forecast data for that variable.

[11] We include yearly dummy variables to consider changes in overall risk aversion (e.g., an increase of uncertainty due to the financial crisis) or global liquidity trends (e.g., rising credit supply associated with the reduced macroeconomic volatility during the "Great Moderation" period).

4.3 Estimation Results

Estimation results for the regime- and regional cluster-specific role of public debt are robust to a variety of specifications with regard to the choice of explanatory variables.[12] For example, the impact of *DEBTGDP* upon *SOVRISK* does neither depend qualitatively on the consideration of expected real GDP growth nor on the control for yearly dummy variables. Therefore, for the presentation of our findings we decided to report two setups that are very close to the specifications applied by Beirne and Fratzscher (2012) and by De Grauwe and Ji (2012). The former approach is presented in table 1, the latter is summarized in table 2. Both tables comprise three parts, each consisting of two major columns that contrast the results for our two risk measures. In part 1 of each table we report the explanatory variables' total effects upon *SOVRISK*. Part 2 summarizes the test results for regional differences of the impact of *DEBTGDP*. In part 3 we document the results of a test for time-varying total effects of *DEBTGDP*.

We report total effects for each country group. Coefficient estimates in the row of the explanatory variable *X* correspond to the impact of a one unit change of *X* on *SOVRISK* in the respective country group. The group "OECD-21 ex EMU-11" represents the benchmark cluster. Total effects for "EMU-11 ex GIIPS" as well as for GIIPS countries are calculated by adding the coefficients of the corresponding interactions and the coefficients of the respective *X* variable for the benchmark. For each regression we test for the significance of the sum of the respective interaction terms and the corresponding benchmark coefficient of the considered explanatory variable via an F-test. Reported inference in part 1 of each table corresponds to the P-values from this F-test.[13]

In the following we briefly summarize our findings. We proceed in four steps: (a) *DEBTGDP*'s total effects, (b) regional differences of these effects, (c) time-varying total effects of *DEBTGDP*, and finally (d) overall fit of the model.

a. Total Effects of DEBTGDP

The first three rows of part 1 in each table illustrate how *SOVRISK* is affected by a one percentage point change in *DEBTGDP* during different time periods and within different country groups. For the GIIPS countries the observable pattern is exactly what we would expect from figure 2 and from related research mentioned above. In detail, three aspects stand out: (i) First, for both EMU clusters the total effects of *DEBTGDP* indicate a remarkable reassessment of fiscal imbalances with the start of the financial crisis. For the "OECD-21 ex EMU-11" countries we do not observe a comparable shift. (ii) Second, while for the GIIPS countries total effects are statistically significant for both specifications and both risk measures, this does not hold for the remaining regional clusters. (iii) Third, and most important, the comparison of the "PreEuro"-period to the "ConEuro"-period for GIIPS countries reveals another shift of *DEBTGDP*'s total effects indicating a decline of the relevance of public debt for sovereign risk perception.

[12] Note that we do not apply the exact specifications of these authors as we use forecast data for most of our macroeconomic control variables. Besides this, in contrast to Beirne and Fratzscher (2012), we neither include the VIX-Index nor regional-specific bond yield spreads.

[13] Thereby, statistically and economically significant regional interaction terms indicate that the relation between *X* and *SOVRISK* differs in "EMU-11 ex GIIPS" countries (respectively in GIIPS countries) relative to non-EMU countries. Analogously, significant time interaction terms for the "PreEuro"-period (respectively for the "Crisis"-period) indicate changes of total effects relative to the "ConEuro"-period. These relationships are exploited in parts 2 and 3 in each table.

Table 1: Fixed Effects Estimation Results - Specification (1) – setup similar to Beirne and Fratzscher (2012).

(1) TOTAL EFFECTS UPON SOVRISK

SOVRISK	***REALSPREAD***			***GERSPREAD***		
	1980-1993	1994-2007	2008-2012	1980-1993	1994-2007	2008-2012
DEBTGDP						
OECD-21 ex EMU-11	0.059 ***	0.027 ***	0.012 **	0.015	0.004	0.002
EMU-11 ex GIIPS	0.040 ***	0.048 ***	0.075 ***	0.003	0.004	0.021 **
GIIPS	0.115 ***	0.082 ***	0.125 ***	0.056 ***	0.047 ***	0.072 ***
ΔPBGDP						
OECD-21 ex EMU-11	-0.390 **	-0.017	0.241	-0.157	-0.020	-0.072
EMU-11 ex GIIPS	-0.338 ***	0.083	-0.251 ***	-0.099 **	0.041 ***	-0.233 ***
GIIPS	-0.154	-0.346	-0.088	0.044	0.135 *	0.083 **
ISHORT_FC						
OECD-21 ex EMU-11				0.431 ***	0.371 ***	0.620 ***
EMU-11 ex GIIPS				0.507 ***	0.459 ***	0.730 ***
GIIPS				0.750 ***	0.354 ***	1.059 ***
INFL_FC						
OECD-21 ex EMU-11				0.269 ***	-0.052	-0.316 ***
EMU-11 ex GIIPS				0.259 ***	-0.111 *	-0.155
GIIPS				0.274 **	0.774 ***	0.252
NEFX_FC						
OECD-21 ex EMU-11	-0.038 ***	-0.016	-0.006	-0.011	-0.022 **	-0.023 ***
EMU-11 ex GIIPS	-0.153 ***	-0.152 ***	-0.173 ***	-0.002	-0.013	-0.031 **
GIIPS	0.003	0.041	0.015	0.065 **	0.071 ***	0.048 **
ΔCABGDP_FC						
OECD-21 ex EMU-11	0.339 **	-0.004	-0.064 **	-0.005	0.013	-0.017
EMU-11 ex GIIPS	-0.051	-0.074	0.042	-0.013	0.058 *	-0.072 *
GIIPS	-0.120	-0.263	-0.033	0.319 **	-0.011	0.406 **
GDP_FC						
OECD-21 ex EMU-11	0.737 ***	0.214 *	-0.358 **	0.145	0.060 *	-0.213 **
EMU-11 ex GIIPS	0.459 ***	0.029	-0.210 ***	0.041	-0.020	-0.188 ***
GIIPS	0.122	0.151	-0.889 ***	-0.022	0.092	-0.814 ***
Obs.		629			629	
R^2		0.84			0.91	

This part of the table reports total effects. *** / ** / * denote 1/5/10-percent levels of significance. The yearly dummy variables are considered in the regression but results are not reported in this table.

(2) TEST FOR HOMOGENEITY OF REGIONAL CLUSTERS

DEBTGDP	***REALSPREAD***			***GERSPREAD***		
	1980-1993	1994-2007	2008-2012	1980-1993	1994-2007	2008-2012
OECD-21 ex EMU-11 vs. EMU-11 ex GIIPS	1.09	1.99	7.43 **	0.87	0.01	3.02 *
EMU-11 vs. GIIPS	8.87 ***	1.55	5.70 **	10.87 ***	8.32 ***	10.73 ***
OECD-21 ex EMU-11 vs. GIIPS	5.96 **	7.83 ***	39.09 ***	3.77 *	10.58 ***	38.70 ***

This part of the table reports test-statistics and corresponding inference of an F-test for equality of *DEBTGDP*'s total effects between regional clusters. H0: Coefficients are equal. *** / ** / * denote 1/5/10-percent levels of significance.

(3) TEST FOR HOMOGENEITY OF TIME REGIMES

DEBTGDP	***REALSPREAD***			***GERSPREAD***		
	1980-1993 vs. 1994-2007	1994-2007 vs. 2008-2012	1980-1993 vs. 2008-2012	1980-1993 vs. 1994-2007	1994-2007 vs. 2008-2012	1980-1993 vs. 2008-2012
OECD-21 ex EMU-11	11.67 ***	8.28 ***	20.75 ***	0.92	0.31	1.08
EMU-11 ex GIIPS	4.77 **	3.53 *	5.42 **	0.08	7.79 ***	5.38 **
GIIPS	2.91 *	3.23 *	0.25	0.33	4.59 **	1.06

This part of the table reports test-statistics and corresponding inference of an F-test for equality of *DEBTGDP*'s total effects over time. H0: Coefficients do not change over time. *** / ** / * denote 1/5/10-percent levels of significance.

Table 2: Fixed Effects Estimation Results – Specification (2) – setup similar to De Grauwe and Ji (2012).

(1) TOTAL EFFECTS UPON SOVRISK

SOVRISK	***REALSPREAD***			***GERSPREAD***		
	1980-1993	1994-2007	2008-2012	1980-1993	1994-2007	2008-2012
DEBTGDP						
OECD-21 ex EMU-11	0.042 **	0.015 *	0.011 *	0.006	0.004	0.002
EMU-11 ex GIIPS	0.010	0.023 *	0.039 **	0.002	0.004	0.014
GIIPS	0.078 ***	0.101 ***	0.150 ***	0.064 ***	0.031 *	0.095 ***
ISHORT_FC						
OECD-21 ex EMU-11				0.420 ***	0.404 ***	0.546 ***
EMU-11 ex GIIPS				0.473 ***	0.474 ***	0.669 ***
GIIPS				0.702 ***	0.307 ***	0.885 ***
INFL_FC						
OECD-21 ex EMU-11				0.161 **	-0.021	-0.229 **
EMU-11 ex GIIPS				0.147 **	-0.010	-0.306 **
GIIPS				0.296 ***	0.677 ***	-0.036
NEFX_FC						
OECD-21 ex EMU-11	-0.041 ***	-0.005	-0.006	-0.010	-0.018 **	-0.016 ***
EMU-11 ex GIIPS	-0.124 ***	-0.103 ***	-0.113 ***	0.012	0.007	0.000
GIIPS	0.014 ***	0.032	0.014	0.000	0.037 *	0.010
CABGDP_FC						
OECD-21 ex EMU-11	0.099	0.148 *	0.094	-0.135 ***	-0.018 *	-0.051 ***
EMU-11 ex GIIPS	0.261 *	-0.048	-0.042	-0.024	-0.030	0.001
GIIPS	0.494 ***	-0.550 ***	-0.337 ***	0.216 *	0.189 **	0.193 **
Obs.		647			647	
R^2		0.85			0.88	

This part of the table reports total effects. *** / ** / * denote 1/5/10-percent levels of significance. The yearly dummy variables are considered in the regression but results are not reported in this table.

(2) TEST FOR HOMOGENEITY OF REGIONAL CLUSTERS

DEBTGDP	***REALSPREAD***			***GERSPREAD***		
	1980-1993	1994-2007	2008-2012	1980-1993	1994-2007	2008-2012
OECD-21 ex EMU-11 vs. EMU-11 ex GIIPS	5.19 **	0.33	2.65	0.12	0.00	0.82
EMU-11 vs. GIIPS	13.19 ***	13.48 ***	27.55 ***	13.68 ***	2.02	10.11 ***
OECD-21 ex EMU-11 vs. GIIPS	2.21	18.60 ***	27.11 ***	7.19 **	2.47	12.80 ***

This part of the table reports test-statistics and corresponding inference of an F-test for equality of *DEBTGDP*'s total effects between regional clusters. H0: Coefficients are equal. *** / ** / * denote 1/5/10-percent levels of significance.

(3) TEST FOR HOMOGENEITY OF TIME REGIMES

DEBTGDP	***REALSPREAD***			***GERSPREAD***		
	1980-1993 vs. 1994-2007	1994-2007 vs. 2008-2012	2008-2012 vs. 2008-2012	1980-1993 vs. 1994-2007	1994-2007 vs. 2008-2012	2008-2012 vs. 2008-2012
OECD-21 ex EMU-11	4.23 **	0.58	4.75 **	0.12	0.21	0.24
EMU-11 ex GIIPS	2.37	1.52	2.94 *	0.41	1.99	1.98
GIIPS	1.39	2.98 *	6.25 **	5.20 **	6.31 **	1.87

This part of the table reports test-statistics and corresponding inference of an F-test for equality of *DEBTGDP*'s total effects over time. H0: Coefficients do not change over time. *** / ** / * denote 1/5/10-percent levels of significance.

b. Regional-specific Effects

Results of a test for the regional-specific relevance of the debt to GDP ratio are presented in part 2 of each table. Thereby, we contrast the difference of total effects between "OECD-21 ex EMU-11" and "EMU-11 ex GIIPS" countries, between "EMU-11 ex GIIPS" and GIIPS countries, and between "OECD-21 ex EMU-11" and GIIPS countries. The results offer two insights: (i) First, while we find clear evidence that the impact of *DEBTGDP* in the

"PreEuro"-period and in the "Crisis"-period is significantly different in GIIPS countries compared to the two other groups, this does not hold during the "ConEuro"-period. (ii) Second, the outcome indicates that in the "Crisis"-period there is indeed regional-specific pricing of public debt that partly confirms the "single monetary policy markup" for some EMU countries as we will argue below.

c. Regional-specific Effects

Parts 3 in each table report our test results for the statistical significance of the changes of public debt's total effects over time. Here, for each regional cluster, we carry out a pairwise comparison of the total effects of *DEBTGDP* between our three time regimes. The results confirm the changes in total effects between the "ConEuro"-period and the "Crisis"-period, particularly for the GIIPS group. More striking, however, is the comparison of public debts' total effects in the "PreEuro"-period to the "Crisis"-period. Note that for the GIIPS countries the hypothesis of equality of coefficients can only be rejected for *REALSPREAD* in our second specification.

d. Overall Fit of the Model

Finally, with regard to total effects of our macroeconomic control variables we find that the expected short-term nominal interest rate (*ISHORT_FC*), the expected rate of inflation (*INFL_FC*) and the forecasts of the nominal effective exchange rate (*NEFX_FC*) show up with the expected signs and help considerably explaining changes in *SOVRISK*. The contributions of the primary balance to GDP ratio (*PBGDP*) in the first specification, the expected current account balance (*CABGDP_FC*) and the expected real GDP growth (*GDP_FC*) in the first specification are mixed. The yearly time dummy variables are highly significant (besides the time span 1989-1992 for *GERPREAD* in the first specification) and their changes do not vary across the different specifications. Starting at the beginning of the 1980s we observe rising values for the yearly time dummy variables that are followed by a decline in the late 1980s and a comparably sharp rise 1993/94. From then onwards until 2005 there is little variation. From 2008 onwards the values of the yearly time dummy variables increase again.

4.4 Economic Implications

Our results suggest that with the start of the financial crisis for both EMU clusters there has been a re-assessment of fiscal imbalances. Thereby, the changes for the GIIPS group are particularly pronounced. Put differently, this implies that the GIIPS countries benefitted from an abnormally small risk premium during the "ConEuro"-period. This mispricing is confirmed by the results of our test for regional differences that provides evidence in favor of perceived homogeneity of country-specific default risks before the crisis. Moreover, this is also supported by the fact that public debt's total effects do not differ significantly when comparing the "PreEuro"-period to the "Crisis"-period. Note that these findings are perfectly in line with the view that for some EMU countries markets did not assess adequate risk differentiation in the "ConEuro"-period (see IMF 2010, Kopf 2011, Sinn 2012). Therefore, we learn that it might be misleading to contrast recent increases of long-term interest rates associated with rising default risk premiums to a kind of fundamental relationship between the debt to GDP ratio and sovereign default risk reflected by long-term interest rates which is based on an average of the years 2000-2007. Due to the longer time span our analysis illustrates that in the medium run there is no stable structural relationship that might be exploited as some kind of benchmark for overpricing of sovereign

risk. In particular, against the background of the "PreEuro"-period it is rather the "ConEuro"-period that reflects a disconnection of fiscal fundamentals and sovereign risk premiums, however, in the other direction.[14]

Moreover, our results contribute to the so-called "debt in foreign currency"-issue intensifying financial markets pressure on common currency (one mutual central bank) in contrast to stand-alone countries in times of financial distress (see De Grauwe 2011 as well as Kopf 2011). For both EMU clusters we actually observe a markup for the total effects of *DEBTGDP* in the "Crisis"-period. However, while for the "EMU-11 ex GIIPS" cluster the corresponding total effects are generally higher compared to the "OECD-21 ex EMU-11" group the regional differences are only statistically significant for our first specification (see table 1, part 2). In contrast, the GIIPS countries show an economically and statistically significant markup compared to the "OECD-21 ex EMU-11" cluster in both specifications and for both risk measures.

5 Conclusion

Covering the time span from 1980 to 2012 we provide broad cross-country evidence for 21 OECD countries with regard to the role of public debt for investors' assessment of sovereign credit risk. We contrast the relative performance of different regional clusters in the context of two time regime breaks that indicate shifts in investors' weighting of fiscal information for the assessment of sovereign credit risk. The first shift is likely to be due to institutional changes in the course of the setup of the EMU. Here, we find a weakening of the debt to GDP ratio for the assessment of credit risk within GIIPS countries. The second shift is due to the onset of the financial crisis. Here, we observe the re-establishment of the temporarily interrupted pricing of debt sustainability as a central factor of sovereign credit risk. In particular, for GIIPS countries there has been a strong reassessment of financial markets' pricing decision.

Furthermore, our analysis specifies the findings of De Grauwe and Ji (2012) who argue that since the start of the sovereign debt crisis due to negative market sentiments financial markets wrongly overestimated sovereign risks in the way that bond yield spreads of some EMU countries (Greece, Ireland, and Portugal) increased disconnectedly from underlying fiscal indicators. Whereas we confirm the dramatic jump in the effect of public debt upon sovereign risk perception our results also call for a reconsideration of their overpricing view. This is because our examination of a longer time span reveals that there has been severe mispricing before the crisis as well as a shift in the role of public debt with the beginning of the EMU convergence. Hence, it is difficult to clearly assess an uncoupling effect of public bond yield spreads from fiscal fundamentals by comparing the dynamics of the crisis to any time span within the "ConEuro"-period.

Finally, with regard to financial markets regulation purposes our findings motivate further research focusing on the implications of such temporary mispricing for the evolution of financial sectors' portfolio structures and the consequences for financial stability. In particular, potential portfolio misallocation will certainly trigger the danger of contagion to foreign banking sectors as well as feedback to the respective sovereigns.

[14] Reasons for the pronounced adjustment that set in during the financial crisis may be a worsening of macroeconomic fundamentals relative to the late 1990s (see also table A1 in the appendix): At the present day, many countries face significantly higher debt to GDP ratios as well as higher interest rates implying higher debt service. Besides this, in particular the GIIPS countries have lost competitiveness and have accumulated current account deficits associated with high levels of net foreign debt (IMF 2010, Sinn 2012).

References

Ardagna, S.; Caselli, F.; Lane, T. (2004): Fiscal Discipline and the Cost of Public Debt Service. Some Estimates for OECD Countries. *European Central Bank Working Papers*, #411.

Arghyrou, M.; Kontonikas, A. (2009): The EMU Sovereign-Debt Crisis: Fundamentals, Expectations and Contagion. *Cardiff University, Cardiff Business School, Economics Section Working Papers*, #E2010/9.

Attinasi, M.; Checherita, C.; Nickel, C. (2009): What Explains the Surge in Euro area Sovereign Spreads during the Financial Crisis of 2007-09? *European Central Bank Working Papers*, #1131.

Basurto, M.A.S.; Caceres, C.; Guzzo, V. (2010): Sovereign Spreads: Global Risk Aversion, Contagion or Fundamentals? *International Monetary Fund Working Papers*, #10/120.

Beirne, J.; Fratzscher, M. (2012): The Pricing of Sovereign Risk and Contagion during the European Sovereign Debt Crisis. Mimeo.

Bernoth, K.; von Hagen, J.; Schuknecht, L. (2006): Sovereign Risk Premiums in the European Government Bond Market. *SFB/TR 15 Governance and the Efficiency of Economic Systems, Free University of Berlin, Humboldt University of Berlin, University of Bonn, University of Mannheim, University of Munich, Discussion Papers*, #151.

Buiter, W.; Sibert, A. (2005): How the Eurosystem's Treatment of Collateral in its Open Market Operations Weakens Fiscal Discipline in the Eurozone (and what to do about it). *CEPR Discussion Papers*, #5387.

Caceres, C.; Guzzo, V.; Segoviano, M. (2010): Sovereign Spreads: Global Risk Aversion, Contagion or Fundamentals? *International Monetary Fund Working Papers*, #10/120.

De Grauwe, P. (2011): The Governance of a Fragile Eurozone. *CEPS Working Documents*, #346.

De Grauwe, P.; Ji, Y. (2012): Mispricing of Sovereign Risk and Multiple Equilibria in the Eurozone. *CEPS Working Documents*, #361.

Driscoll, J.; Kraay, A. (1998): Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data. *Review of Economics and Statistics*, 80:549-560.

Drukker, D. (2003): Testing for Serial Correlation in Linear Panel-data Models. *The Stata Journal*, (3)2:168-177.

Fisher, I. (1930): The Theory of Interest. Macmillan, New York.

Flemming, M.J. (2003): Measuring Treasury Market Liquidity. *Federal Reserve Bank of New York Economic Policy Review*, 9:83-108.

Frömmel, M.; Kruse, R. (2009): Interest Rate Convergence in the EMS prior to European Monetary Union. *Ghent University Faculty of Economics and Business Administration Working Papers*, #610.

Gärtner, M.; Griesbach, B.; Jung, F. (2011): PIGS or Lambs? The European Sovereign Debt Crisis and the Role of Rating Agencies. *International Advances in Economic Research*, 17(3):288-299.

Giavazzi, F.; Spaventa, L. (2010): Why the Current Account may matter in a Monetary Union: Lessons from the Financial Crisis in the Euro area. *CEPR Discussion Papers*, #8008.

Gravelle, T. (1999): Liquidity of the Government of Canada Securities Market: Stylized Facts and Some Market Microstructure Comparisons to the United States Treasury Market. *Bank of Canada Working Paper*, 99-11.

Greene, W. (2000): Econometric Analysis. 4th ed. Upper Saddle River, New Jersey: Prentice Hall.

Haugh, D.; Ollivaud, P.; Turner, D. (2009): What Drives Sovereign Risk Premiums? An Analysis of Recent Evidence from the Euro Area. *OECD Economics Department Working Papers*, #718.

Hoechle, D. (2007): Robust Standard Errors for Panel Regressions with Cross-sectional Dependence. *The Stata Journal*, 7(3):281-312.

IMF (2010): Global Financial Stability Report - April 2010. International Monetary Fund, Washington DC.

Kopf, C. (2011): Restoring Financial Stability in the Euro Area. *CEPS Policy Brief*, #237.

Laubach, T. (2003): New Evidence on the Interest Rate Effects of Budget Deficits and Debt. *Federal Reserve Board Finance and Economics Discussion Series*, 12.

Sinn, H.-W. (2012): Die Target-Kredite der Deutschen Bundesbank. *ifo Schnelldienst 65*, Special Issue March, 2012.

Schuknecht, L.; von Hagen, J.; Wolswijk, G. (2010): Government Bond Risk Premiums in the EU revisited: The Impact of the Financial Crisis. *European Central Bank Working Papers*, #1152.

Wooldridge, J. (2002): Econometric Analysis of Cross Section and Panel Data, MIT Press.

Appendix

Table A1: Summary Statistics by Time Regimes and Regional Clusters.

		1980-1993			1994-2007			2008-2012		
Region	**Variable**	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*	*Mean*	*Min*	*Max*
OECD-21 ex EMU-11	*DEBTGDP*	53.36	21.80	96.32	59.26	14.42	175.27	68.37	13.74	210.00
	PBGDP	-0.34	-10.09	9.01	1.59	-9.70	16.19	-1.89	-10.06	16.03
	GDP_FC	2.34	-2.86	8.52	2.91	-2.11	6.21	0.64	-5.83	5.85
	NEFX_FC	102.46	32.10	216.40	102.82	75.80	137.00	111.62	76.70	144.00
	INFL_FC	5.97	0.05	17.97	1.73	-0.89	4.64	1.95	-1.35	4.45
	CABGDP_FC	-0.97	-8.90	7.73	1.54	-8.29	16.40	2.42	-8.83	16.92
	ISHORT_FC	10.61	2.98	23.31	4.22	0.03	9.30	2.09	0.11	8.02
	ILONG	10.35	4.02	20.50	5.20	0.99	10.24	3.35	1.10	6.08
EMU-11 ex GIIPS	*DEBTGDP*	53.79	11.33	134.06	66.65	35.16	132.06	71.91	33.94	99.19
	PBGDP	-0.36	-8.82	5.40	1.23	-6.54	7.87	-1.28	-5.37	3.32
	GDP_FC	2.02	-6.05	5.49	2.58	-0.06	5.82	0.30	-8.35	3.73
	NEFX_FC	93.19	66.00	125.10	105.81	99.70	114.30	111.82	106.20	117.40
	INFL_FC	4.42	-0.69	13.56	1.75	0.19	4.16	2.04	-0.05	4.49
	CABGDP_FC	0.46	-5.36	6.07	2.88	-2.89	9.28	2.32	-2.14	9.22
	ISHORT_FC	9.25	3.99	16.50	3.55	2.11	6.58	1.77	0.62	4.63
	ILONG	9.51	5.89	15.85	5.10	3.35	9.04	3.47	2.36	4.42
GIIPS	*DEBTGDP*	63.90	16.45	115.66	73.86	24.68	121.84	100.71	40.07	198.27
	PBGDP	-1.42	-7.34	5.08	1.69	-3.43	6.72	-4.74	-28.17	3.46
	GDP_FC	2.29	-2.26	7.64	3.68	-0.91	11.24	-1.77	-6.99	1.76
	NEFX_FC	153.83	100.90	511.80	106.49	93.50	117.00	113.51	106.80	122.50
	INFL_FC	12.09	1.41	28.88	3.41	1.44	10.87	1.89	-4.49	4.71
	CABGDP_FC	-2.38	-14.67	3.97	-3.41	-14.36	3.45	-5.63	-14.69	0.95
	ISHORT_FC	15.36	5.87	24.90	5.38	2.11	24.56	2.06	0.62	9.86
	ILONG	14.51	7.70	27.74	6.24	3.33	20.70	7.21	3.98	26.35

Table A2: Chow-Test for Structural Break.

Specification (1)

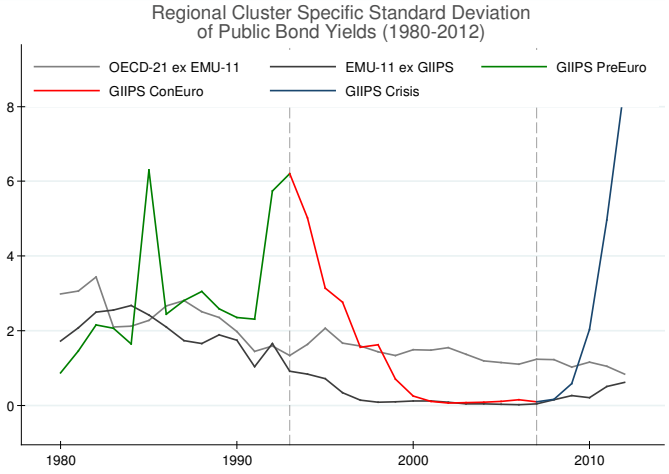
	REALSPREAD		***GERSPREAD***	
	1993/1994	2007/2008	1993/1994	2007/2008
OECD-21 ex EMU-11	4.39 ***	4.29 ***	5.04 ***	17.42 ***
EMU-11 ex GIIPS	12.26 ***	2.81 **	3.76 ***	4.37 ***
GIIPS	2.56 **	1.53	18.92 ***	12.07 ***

Specification (2)

	REALSPREAD		***GERSPREAD***	
	1993/1994	2007/2008	1993/1994	2007/2008
OECD-21 ex EMU-11	4.39 **	3.56 **	6.16 ***	11.49 ***
EMU-11 ex GIIPS	8.71 ***	1.84	1.98	1.33
GIIPS	11.88 ***	8.82 ***	6.09 ***	6.79 ***

This table reports F-statistics and corresponding inference of an F-test for joint significance of time-regime specific interaction terms (Chow-Test). H0: Time-regime interactions are zero, i.e., there is no structural break. *** / ** / * denote 1/5/10-percent levels of significance.

Figure A1: Convergence and Divergence of Long-term Interest Rates.



This figure illustrates the convergence of long-term interest rates for three country groups. Note that the sharp increase of the standard deviation of long-term interest rates for the GIIPS countries in 1985 is because Portugal enters the sample at that time. The pronounced rise of the standard deviation in 1992 is due to an extraordinarily strong increase of long-term interest rates in Greece at that time.

Data source: OECD Economic Outlook, own calculations.

Table A3: Wooldridge Test for Panel Serial Correlation.

Specification (1)

	REALSPREAD	***GERSPREAD***
F-Statistic	134.2 ***	30.1 ***

Specification (2)

	REALSPREAD	***GERSPREAD***
F-Statistic	60.95 ***	90.95 ***

H0: No first-order autocorrelation. *** / ** / * denote 1/5/10-percent levels of significance.

Table A4: Test for Groupwise Heteroskedasticity.

Specification (1)

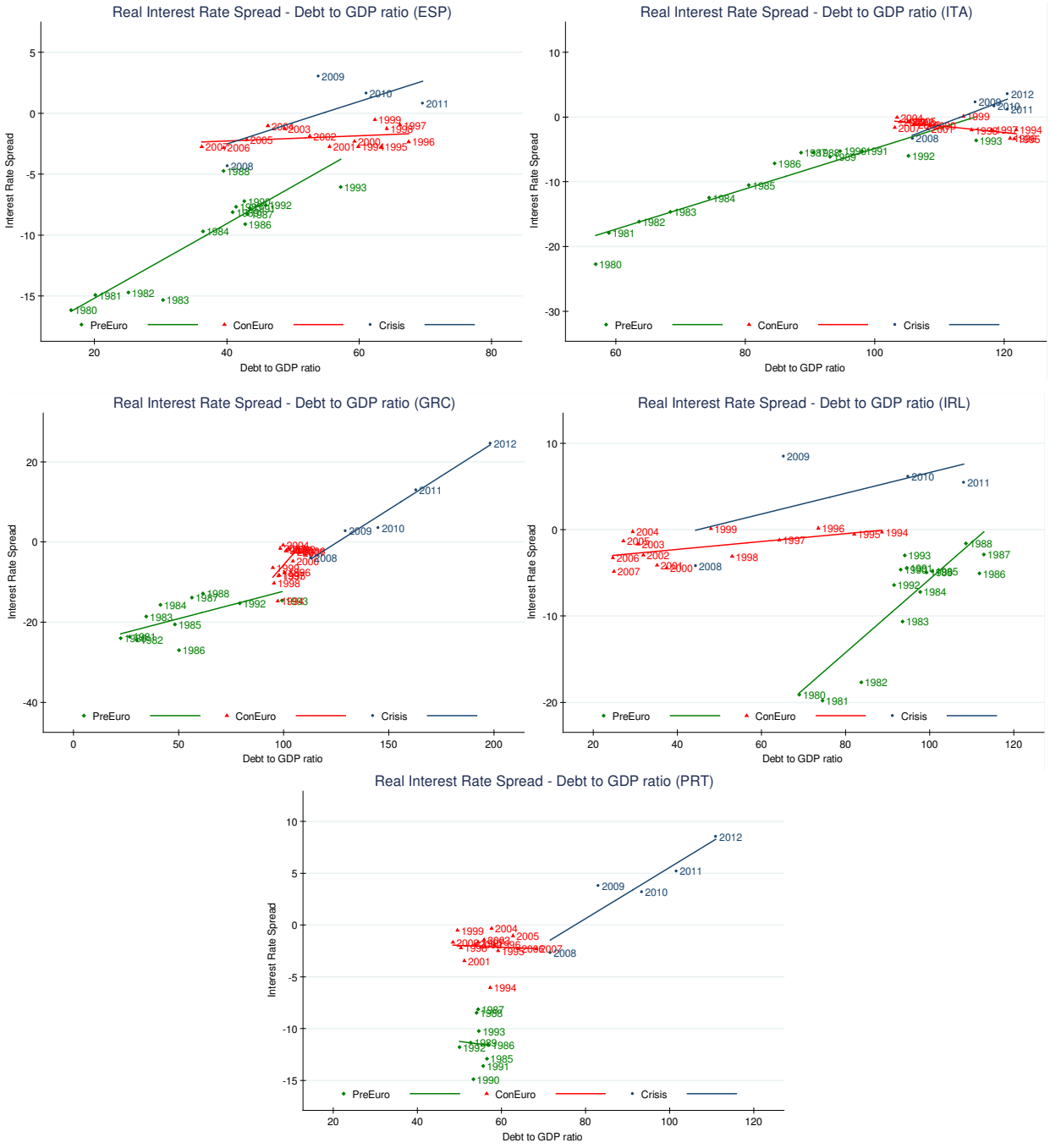
	REALSPREAD	***GERSPREAD***
Modified Wald Statistic	172.25 ***	851.98 ***

Specification (2)

	REALSPREAD	***GERSPREAD***
Modified Wald Statistic	101.46 ***	1698.55 ***

H0: Variances of countries' error terms are equal. *** / ** / * denote 1/5/10-percent levels of significance.

Figure A2: Country-specific Pricing of Sovereign Default Risk (GIIPS).



Data source: OECD Economic Outlook, AMECO Database.