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EMU and the Renaissance of Sovereign Credit Risk Perception

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Abstract

What is the role of fiscal variables for the assessment of sovereign credit risk? Has this role changed over time? In the face of the financial crisis many OECD countries have experienced large increases of government debt relative to GDP. This has triggered a distinct response of financial markets reflected by a sharp rise of long-term interest on government bonds. We show that, in particular, within some member countries of the European Monetary Union the explanation of investors' recent reactions to these fiscal imbalances is twofold: first, it is the worsening of fiscal positions due to the financial crisis that has been taken into account. Second, and more striking, it is financial markets' reconsideration of the role of these fiscal fundamentals for the pricing of sovereign credit risk. We argue that, from a historical perspective, this recent re-evaluation of fiscal positions 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.

In our study we provide cross-country evidence for the impact of fiscal imbalances upon long-term interest rates. We use macroeconomic data from 1980 to 2012 and contrast a panel of 22 OECD countries with 11 EMU member countries and the so called GIIPS countries. This comparably long time span allows us to evaluate the changes in sovereign risk pricing that set in with the start of the EMU. In particular, we find that the relationship between the perceived default risk reflected by long-term interest rates and the public debt to GDP ratio as an indicator of fiscal sustainability is time regime as well as regional cluster specific. Our findings suggest that there is a strong connection of institutional aspects of EMU and the relationship between fiscal imbalances and changes in the pricing of sovereign credit risk.

Keywords: default risk, EMU, GIIPS, long-term interest rate, sovereign debt crisis
JEL-classification: E43, E44, E62

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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: first, the worsening of fiscal fundamentals since the beginning of the financial crisis has been taken into account. 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.

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 22 OECD countries, including 11 EMU member countries between 1980 and 2012.[2] Within the 11 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 observe a pronounced increase since the beginning of the financial crisis (2007/08). The latter also holds for EMU member countries, 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 converged nearly perfectly - staying together until 2008 when their development expanded again. The centered and lower panels in figure 1 exemplify this rather impressive phenomenon for the GIIPS countries as well as for 6 other EMU countries. Thereby, we identify two striking facts: 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 crisis seems to be an EMU-specific feature that is even more pronounced for the GIIPS countries. 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.

In the context of the EMU this convergence pattern of long-term interest rates has been explained in several ways. 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/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). 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

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

risks (see Bernoth et al. 2006). [3] Moreover, it is supposed that as a consequence of the ECB's collateral policy there has not been any adequate differentiation between the underlying credit risks in the periphery countries (Buiter/Sibert 2005).[4] However, this obvious, temporary disregard of country-specific macroeconomic performance (in particular of fiscal imbalances as we argue below) seems to have vanished with the onset of the financial crisis in the second half of 2007 (see Gärtner et al. 2011 as well as Sinn 2012). In this sense, the recent sharp increase of long-term interest rates is argued to be due to a shift in investors' default risk perception triggered by the onset of the financial crisis (see Arghyrou/Kontonikas 2009 as well as De Grauwe 2011). Besides this, some authors like Frömmel/Kruse (2009) notice that the strongly interconnected 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. According to this, a great part of the convergence in long-term interest rates is ascribed to declining inflation risk and exchange rate risk before the start of the EMU.

In the following we focus on our central research question: *what is the role of fiscal variables for the assessment of sovereign credit risk and has this role changed over time?* We argue that in the course of the institutional changes associated with the EMU long-term interest rates - and implicitly the sovereign default risk perception - were significantly lower than the "correct" long-term interest rates that would have been suggested by fiscal fundamentals. We demonstrate that this is reflected in two structural breaks - framing the time span starting with the EMU convergence period (1993/94) and lasting until the beginning of the financial crisis (2007/08) - that document the decline and reemergence of the relevance of fiscal variables in explaining sovereign default risk as a central component of long-term interest rates.

Our paper is structured as follows: section 2 gives a brief overview of related literature and highlights the relevance of our findings with regard to this branch of research. Sections 3 and 4 motivate and specify our empirical strategy and introduce our estimation setup. Section 5 discusses our findings and section 6 concludes.

[3] This is most probably due to the Maastricht treaty which was signed on 7 February 1992 and had its entry into force on 1st of November 1993.

[4] Related to this aspect one might argue that far 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.

2 Related Research

Corresponding research explains investors' assessment of sovereign credit risk by macroeconomic performance in general, and the role of fiscal variables, in particular. Over the last decade the macroeconomic

and financial literature has provided several empirical studies based on panel data linking government bond yields and fiscal imbalances.

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, squared debt and primary balance relative to GDP, interactions between level of debt and deficits as well as a set of macroeconomic control variables. The authors provide both statistically and economically significant evidence in favor of non-linear effects of fiscal deficits and public debt on interest rates in the sense that increasing public debt and a weakening of the fiscal balance lead to an increase of long-term interest rates.

Bernoth et al. (2006) base their analysis on yearly data for 14 EU countries covering the time-span from 1993-2005. The authors examine yield differentials between DM (euro) and US dollar denominated government bonds. Explanatory fiscal variables are the debt ratio and the deficit ratio (as well as the debt-service ratio for another specification), each measured as differences relative to the benchmark country (Germany, US). These fiscal variables are also considered in a squared form. Additionally, a set of control variables covering cyclical fluctuations, liquidity and maturity aspects as well as general risk aversion is considered. The authors find a significant impact of public debt on yield spreads; particularly squared deficits are significant. Besides this, interactions with an EMU dummy show a significant negative sign indicating that the average yield differentials of EMU member states have declined since the start of the EMU.

Haugh et al. (2009) explain the yield on ten-year sovereign bonds of ten EMU members against Germany using quarterly data covering the time span from December 2005 to June 2009. The authors approximate investors' assessment of sovereign credit risk by gross and net debt relative to GDP, the debt service ratio and medium term forecasts of future fiscal deficits. Moreover, a bivariate "fiscal track record"-indicator based on the history of running large fiscal deficits over a prolonged period and expected future public pension expenditures, the general degree of risk aversion and a liquidity proxy (the ratio of a country's outstanding euro denominated long-term government bonds to euro-area-wide total outstanding government bonds of the same type) are included. The authors find that differing fiscal policies exert a significant influence on bond yield spreads and their widening since the mid of the year 2007 in the euro area. In particular, the results for the interaction of fiscal variables with general risk aversion highlight the change in pricing behavior that set in with the beginning of the financial crisis.[5]

Besides this our analysis is most closely related to De Grauwe/Ji (2012). They 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

[5] Further work on sovereign spreads is provided by Attinasi, et al. 2009, Caceres et al. 2010, Caporale and Girardi 2011, Gibson et al. 2011 as well as Schuknecht et al. 2010.

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). In their econometric analysis the authors use 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 position as a proxy for net foreign debt. In addition, they consider the squared debt to GDP ratio and changes of the euro exchange rate for non-euro countries.

We contribute to this branch of literature by providing broad cross-country evidence for 22 OECD countries within the time-span from 1980 to 2012. We update and complete current research by a number of features: first, we cover two time regime breaks in the institutional context of the EMU, i.e., we contrast investors' assessment of sovereign credit risk based on fiscal information for the time-span before the Maastricht Treaty, since the start of the EMU and since the beginning of the financial crisis. Second, we provide evidence for the specific sovereign risk assessment of different regional clusters: the so-called GIIPS countries, 11 EMU member countries, and 22 OECD countries. Third, focusing on a range of fundamental macroeconomic variables, we use a panel fixed effects estimation framework that complements and qualifies many findings of previous empirical studies. Thereby, we are able to show that changes in the relevance of fiscal variables for sovereign default risk assessment differ significantly between time regimes and regional clusters. Most important, we highlight the fall and reemergence of the debt to GDP ratio in financial markets' pricing of sovereign credit risk in EMU member countries and in particular the GIIPS countries.

3 Empirical Strategy

To identify structural breaks (time regime shifts) in the relationship between sovereign credit risk and fiscal information, first of all, we derive an empirical proxy for financial markets' assessment of credit risk. Second, we specify a valid estimation setup explaining changes in sovereign credit risk by fiscal variables and macroeconomic control variables. Third, we identify appropriate subsamples by graphical analysis and test for structural breaks with the use of time regime-specific interaction terms. Fourth, to gain insights in investors' assessment of fiscal imbalances, we compare the stability of the relationship between sovereign credit risk and fiscal variables over time.

3.1 Measuring Sovereign Credit Risk

We want to assess changes in sovereign risk perception reflected by variations of long-term interest rates. 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 the

investors' assessment of a country's fiscal position and the sustainability of public debt, respectively. As credit risk premia 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, Frömmel/Kruse 2009).

The level of long-term interest rates not only reflects 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 liquidity premia. To examine the relevance of fiscal information for financial markets' risk perception, we isolate credit risk as a component of the long-term interest rate. For this purpose we subtract the short-term interest rate and the mean adjusted inflation rate from the long-term interest rate. We approximate the impact of expected inflation upon the long-term interest rate by the national above average rate of inflation rather than the inflation rate as such. We do this to correct for time varying country-specific inflation regimes.

With regard to the short-term nominal interest rate, from a theoretical point of view, it would be correct to subtract the geometric mean of current and expected future short-term interest rates instead of the current short-term interest rate only. However, we cannot easily measure expected future short-term interest rates and therefore implicitly assume an adaptive mechanism of the formation of expectations with regard to future short-term interest rates. Besides this, to control for the influence of exchange rate risk upon long-term interest rates we include the year on year change of the domestic currency US dollar exchange rate in our regressions. Finally, we do not 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 also consider a variety 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. The resulting inflation adjusted interest rate differential is likely to be a measure of sovereign default risk anticipated by financial markets. Thereby, the credit risk component may not perfectly reflect the "true" default risk but investors' perceptions of the latter.[6]

3.2 Data

To assess the evaluation of sovereign default risk by financial markets we examine the driving forces of the inflation adjusted interest rate differential (*SOVRISK*) which is based on the long-term nominal interest rate (rate on 10-year government bonds), the short-term interest rate (rate on 3-month treasury bills) and the

[6] In our basic specification we subtract the above national average current rate of inflation from the national nominal interest rate spread (adaptive formation of inflation expectations). In addition to this we run the respective regressions for the first lag as well as for the first lead of the above average inflation rate (the latter resembles the assumption of rational expectations). We find that estimation results do not vary considerably. We take this as an indicator for the robustness of our specification.

national above average rate of inflation (based on the year-on-year change of the Consumer Price Index). With regard to explanatory variables we focus on fiscal indicators: government debt relative to GDP (*DEBTGDP*), the primary balance to GDP ratio (*PRIMBALGDP*) as well as a set of macroeconomic control variables: yearly growth of real GDP (*GDPGR*), the growth rate of the exchange rate in US dollar per domestic currency (*EXCHGR*) and the current account surplus relative to GDP (*CASGDP*). Our choice of control variables is guided by existing literature in this field, see section 2.

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. Our sample covers the following 22 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), Island (ISL), Italy (ITA), Japan (JPN), Korea (KOR), the Netherlands (NLD), Norway (NOR), Portugal (PRT), Sweden (SWE), the United States (USA).

3.3 Time Regime Shifts and Regional Clusters

Against the background of the historical track record of long-term interest rates and the pricing of sovereign default risk suggested in above mentioned related research (see section 2), we implement the following sub-sample classification covering 3 time regimes and 3 regional clusters:

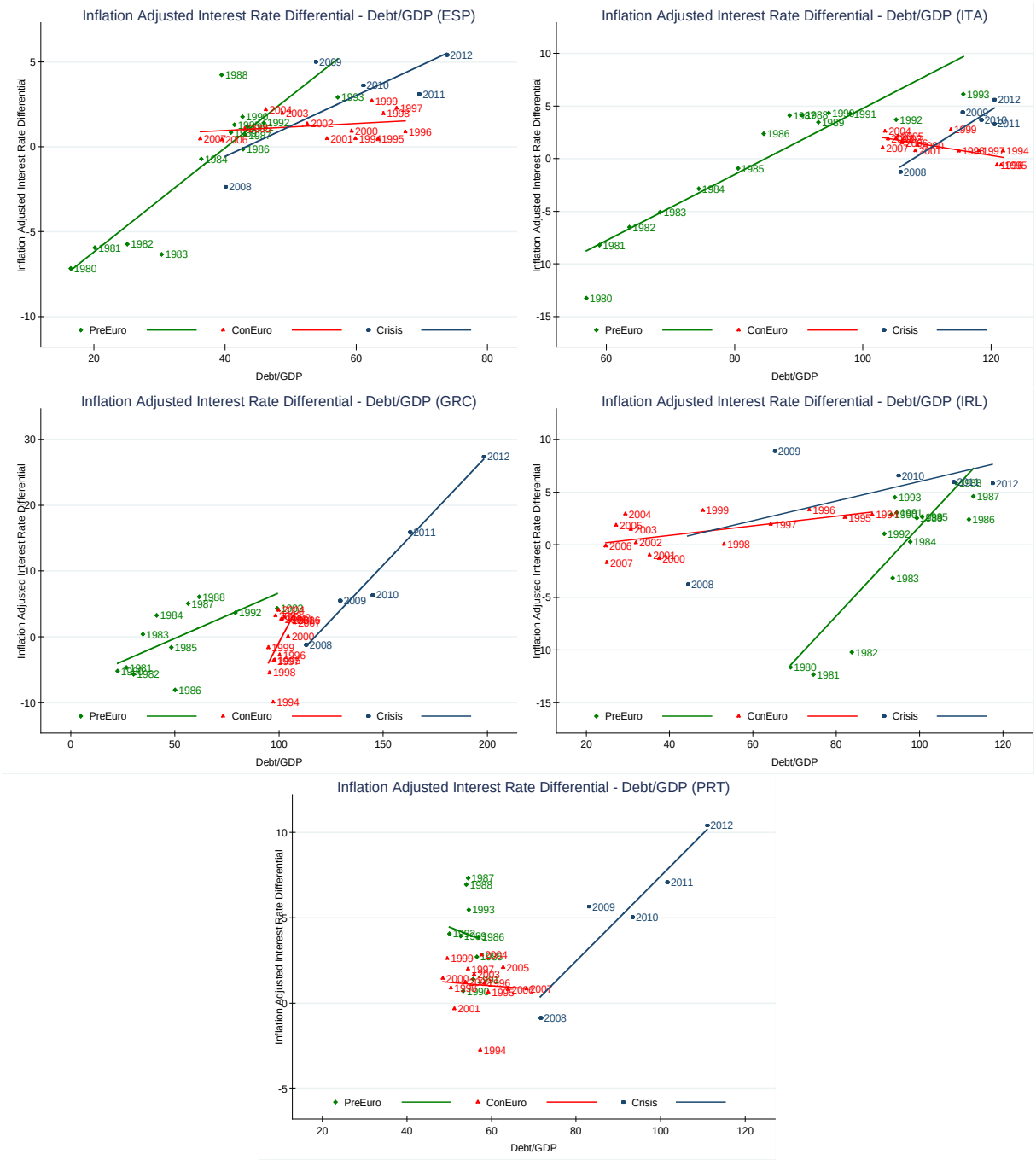
- Time regimes:
  - 1980-1993 (T = 14): “PreEuro”-period
  - 1994-2007 (T = 14): “ConEuro”-period (covering EMU and the pre EMU convergence era until financial crisis)
  - 2008-2012 (T = 5): “Crisis”-period
- Regional clusters:
  - GIIPS (N = 5; ESP, GRC, IRL, ITA, PRT)
  - EMU-11 (N = 11; GIIPS, AUT, BEL, GER, FIN, FRA, NLD)
  - OECD-22 (N=22; EMU-11, AUS, CAN, CHE, DNK, GBR, ISL, JPN, KOR, NOR, SWE, USA)

Basic summary statistics according to the resulting 3x3 subsample matrix are reported in table A1 in the appendix. In addition to this univariate information it is in particular the relationship between fiscal variables and interest rates on government bonds that motivates the abovementioned classification. Therefore, figures 2 and 3 contrast the inflation adjusted interest rate differential (vertical axis) with the debt to GDP ratio (horizontal axis).[7] Figure 2 gives an illustration on a single country but full time period basis while figure 3

[7] Besides this, pooled cross-correlations between our basic variables *SOVRISK*, *DEBTGDP*, *PRIMBALGDP*, *GDPGR*, *EXCHGR* and *CASGDP* according to our time regime and regional cluster classification are provided in table A2 in the appendix.

focuses on a single time regime, but regional cluster representation. In each graph, the respective years are reported for each observation.

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

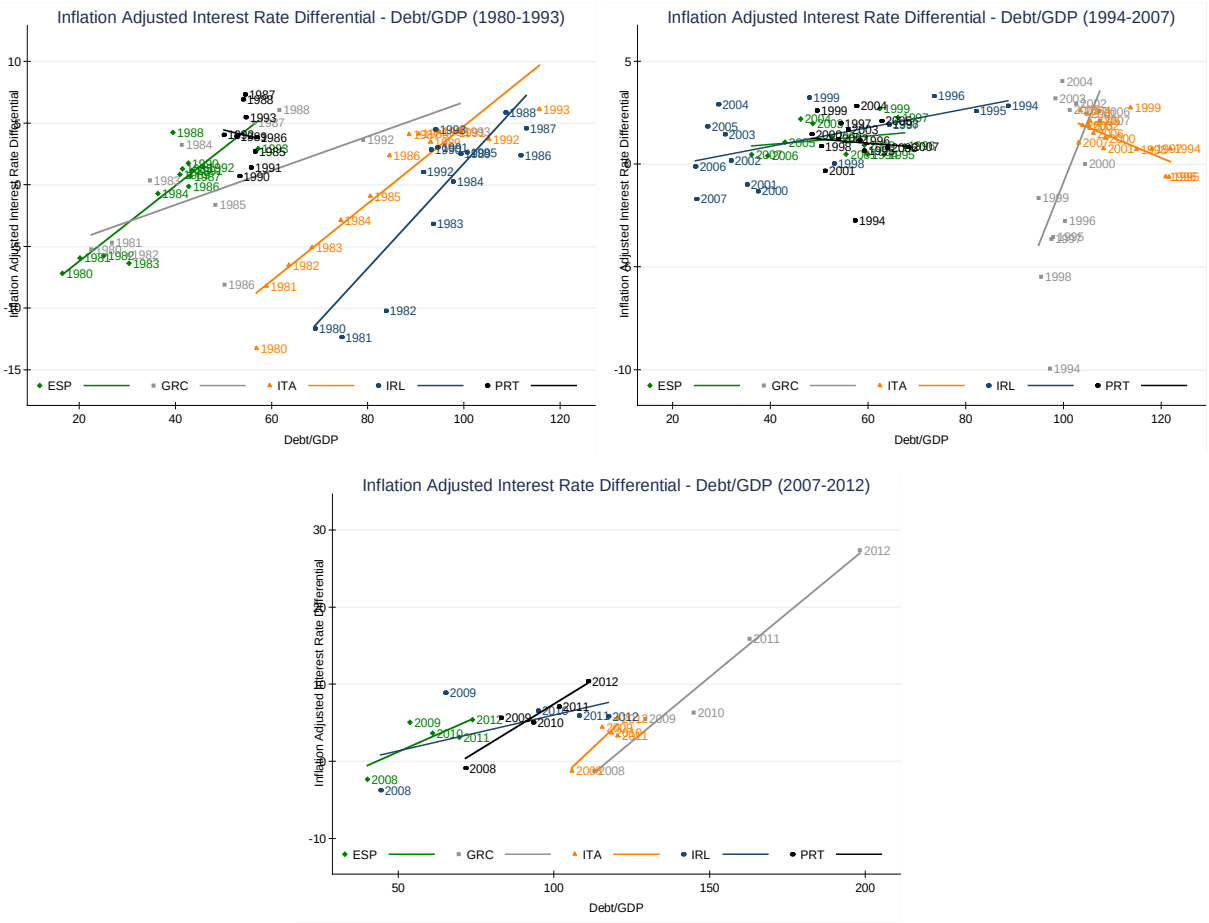


Data source: OECD Economic Outlook, AMECO Database.

Here, the slopes of the simple regression lines indicate investors' adjustment of default risk perception to changes in the debt to GDP ratio. The slope is comparably high in the "PreEuro"-period (1980-1993, green representation), while in the "ConEuro"-period (1994-2007, red representation) except in the case of Ireland,

the positive relationship disappears, i.e., there is no clear market anticipation of credit risk based on debt sustainability issues anymore. In particular for Spain and Italy we observe a pronounced break. In the case of Greece and Portugal, from 2008 onwards ("Crisis"-period, blue representation) the slopes of the simple regression lines are not just positive again, but even higher 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/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. With regard to Spain and Italy this does not hold. Compared to the "PreEuro"-period, the relationship seems far from extraordinary in these two countries.

Figure 3: Time regime-specific Pricing of Sovereign Default Risk (GIIPS).



Data source: OECD Economic Outlook, AMECO Database.

In addition to these graphical illustrations, we motivate the time regime shifts via a formal test for structural breaks in the coefficients. The Chow-test allows detecting breaks in the regression coefficients at particular dates. Therefore, we create a regime specific dummy as well as interaction terms and run a regression between the outcome variables and the explanatory variables along with the respective interactions and the

break-dummies. Finally, we run an F-test on coefficients for the interactions and the break-dummy. As we want to identify two breaks (1993/1994 and 2007/2008) we carry out this procedure twice.[8] The results of the Chow-test are presented in table 1. Results are based on the following equation, which corresponds to our basic estimation setup that will be presented in detail in the next section.

$$SOVRISK_t = \beta_0 + \beta_1\, DEBTGDP_t + \beta_2\, PBGDP_t + \beta_3\, GDPGR_t + \beta_4\, EXCHGR_t + \beta_5\, CASGDP_t + \varepsilon_t$$

Table 1: Chow-test for Structural Break.

	Break 1993/1994	Break 2007/2008
Region	F-stat	F-stat
AUT	8.9***	4.9**
BEL	2.5*	132.8***
ESP	32.3***	147.2***
FIN	3.0**	18.0***
FRA	13.6***	61.7***
GER	1.9	36.4***
GRC		213.4***
IRL	20.1***	242.7***
ITA	10.6***	141.5***
NLD	0.5	2.0
PRT	0.2	5.3**
OECD	1.6	5.2***
EMU	19.0***	11.9***
GIIPS	9.7**	27.8***

H0: There is no structural break in the coefficients. *** / ** / * denote 1/5/10-percent levels of significance. Note that for Greece the first break cannot be computed as we do not have suffiecient observations for the "PreEuro"-period.

We find that the null-hypothesis that there is no structural break can be rejected for all countries except the Netherlands for the 2007/2008 break. For the 1993/1994 break the null is rejected for most of the countries but not for the north and central European countries which might be due to a very low anticipated default risk for these countries even before the start of the EMU. The only outlier seems to be Portugal. Interestingly, the null cannot be rejected for the OECD-22 panel either. This suggests that the problem of under-evaluated default risk after the sign of the Maastricht treaty is an EMU-specific one.

[8] Note that, due to serial correlation we estimate the underlying equation using Newey-West standard errors (Newey/West 1987) for single countries and fixed effects with Driscoll and Kraay standard errors for the panel regional clusters (OECD-22, EMU-11, GIIPS). Formal tests for serial correlation are carried out for each country (see Breusch and Pagan 1980) as well as for panel serial correlation (see Wooldridge 2002 and Drukker 2003).

4 Estimation Setup

As we cover information for N = 22 countries and T = 33 years our (full-sample) dataset may be classified as a large N (number of countries), large T (length of the time series) panel setup. In principle, from a technical point of view this offers two perspectives: on the one hand, there are econometricians who might approach this macro dataset as a longitudinal panel focusing on time-series methodology and aspects such as stationarity and cointegration. On the other hand, some researchers stick to a (more traditional) large N, small T panel perspective that emphasizes the use of cross-sectional information (see Baltagi 2005: 237 f as well as the references cited therein). Against the background of the time regime shifts identified above we will stick to the second line of argument and estimate the 3 time regimes separately. Afterwards we will compare the changes of the estimated coefficients over time. Moreover, to gain a widespread and general impression of the regional differences, we contrast regional specific samples and apply regional dummy variables and interaction terms.[9]

The dependent variable in our (basic) specification is the inflation adjusted interest rate differential (*SOVRISK*). As described above, we suppose this variable to capture adequately sovereign default risk. The economic rationale with regard to explanatory variables is motivated as follows:[10] the debt to GDP ratio (*DEBTGDP*) is supposed to exert positive impact upon *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 position is reflected by a rising primary balance relative to GDP (*PRIMBALGDP*) we expect a negative sign for this regressor. The yearly growth rate of real GDP (*GDPGR*) is supposed to enter with a negative sign as production growth eases the national budget. For our measure of movements in the expected exchange rate (*EXCHGR*) - denoted in dollar per national currency - we expect a negative sign (controlling for investors' portfolio adjustments due to exchange rate re-valuation). Additional capital inflows should increase credit supply and ceteris paribus reduce the long-term interest rate. Finally, we consider the current account surplus relative to GDP (*CASGDP*) which may either be classified as a proxy for a country's net foreign liabilities (see, e.g., De Grauwe/Ji 2012) or be interpreted as a measure of competitiveness (Sinn 2012). In either case we expect a negative sign.

For our basic specification we estimate the following panel setup for 22 OECD countries (country *i, i* = 1, …, 22) for each time regime (year *t*, *t* = 1, …, 14 for the "PreEuro"-period, *t* = 1, …, 14 for the "ConEuro"-period and *t* = 1, …, 5 for the "Crisis"-period). Thereby, u_i denote country specific fixed effects, which are zero in the pooled regression. The component ε_{it} is a random error term. As mentioned above, the role of regional clusters is captured by regional dummies for EMU-11 and GIIPS countries (a detailed description is provided

[9] This approach is supposed to generate first reliable estimates in a simple and transparent manner. The results based on fixed effects panel estimation are presented within tables 2 to 4 and will be discussed below. Our next steps on this work will focus on estimation within one single sample controlling for time regime changes as well as regional differences simultaneously.

[10] Note that the respective signs are already (loosely) confirmed by the regional cluster specific cross-correlations (see table A2 in the appendix).

below). Note that regional cluster specific interactions that document the relationship within the EMU relative to the OECD-22 sample allow controlling for investors' overall shifts in risk aversion over time.[11]

$$
\begin{aligned}
SOVRISK_{it} = \beta_0 \quad & + \beta_1 DEBTGDP_{it} + \phi_1 RD \times DEBTGDP_{it} \\
& + \beta_2 PRIMBALGDP_{it} + \phi_2 RD \times PRIMBALGDP_{it} \\
& + \beta_3 GDPGR_{it} + \beta_4 EXCHGR_{it} + \beta_5 CASGDP_{it} + u_i + \varepsilon_{it}
\end{aligned}
$$

We apply serial correlation robust panel estimation using Driscoll and Kraay standard errors (Driscoll and Kraay 1998). Results of a Wooldridge Test for serial correlation in panel data and a Pesaran test for cross-sectional dependence are reported in table A3 in the appendix (see Wooldridge 2002, Drukker 2003 and Höchle 2007). Note that the null of no first-order serial correlation is rejected except for the GIIPS countries in the "ConEuro"-period.

5 Estimation Results

Tables 2 to 4 illustrate our first results based on fixed effects panel estimation.[12] Table 2 compares the three time-periods for the whole OECD sample. Analogously, table 3 contrasts EMU member countries with the OECD non-EMU countries. Table 4 compares GIIPS to the remaining EMU member countries. Within tables 3 and 4 estimated interaction terms (labelled ϕ_1 and ϕ_2) are reported below the respective reference cluster and are distinguished by a "Δ"-sign. Below the interaction terms we report the sum of the estimated coefficient and the interaction term to assess the impact of an explanatory variable within the respective subpopulation (i.e. EMU countries in table 3, GIIPS countries in table 4). Thereby, inference for these built-up coefficients is derived from the joint significance of the respective sum. While interaction terms indicate the magnitude and the statistical significance of regional differences the coefficient estimates itself suggest the following interpretation: in the row of the explanatory variable *X* the respective coefficient estimates correspond to the impact of a one unit change of the *X* variable on *SOVRISK* with regard to the respective regional cluster.

In general we see that the specification fits the data quite well. Within the "PreEuro"-period and the "Crisis"-period we report comparably high R^2 between 0.46 and 0.84. In contrast, we find a low R^2 during the "ConEuro"-period, reflecting the rather minor importance of macroeconomic fundamentals and in particular fiscal variables for the explanation of the sovereign credit risk perception.

[11] For example, the overall risk aversion may have increased since the crisis 2008. Figure A1 in the appendix illustrates that the re-evaluation pattern not only holds for the GIIPS but can also be found for the EMU-11 as well as for the OECD-22 sample. Besides this we are able to capture the impact of changes in the overall risk perception and credit supply that are associated with the reduced macroeconomic volatility during the Great Moderation period.

[12] Note that the regional clustering differs if compared with figure 2. We now do not preclude the EMU countries when looking at the OECD 22 sample.

Table 2: Estimation results - whole sample.

SOVRISK	1980-1993	1994-2007	2008-2012
DEBTGDP			
OECD	0.191***	0.028**	0.201***
PRIMBALGDP			
OECD	-0.235**	-0.211***	-0.118
GDPGR	0.387**	0.294***	-0.373**
EXCHGR	0.067***	0.027	0.024
CASGDP	0.195**	-0.014	0.159***
obs	239	310	115
R^2	0.46	0.22	0.60

*** / ** / * denote 1/5/10-percent levels of significance.

Table 3: Estimation results - OECDexEMU vs. EMU.

SOVRISK	1980-1993	1994-2007	2008-2012
DEBTGDP			
OECDexEMU	0.176***	0.024*	0.147***
Δ EMU [ϕ_1]	0.020	0.013	0.082**
EMU	0.196***	0.037**	0.229***
PRIMBALGDP			
OECDexEMU	-0.277**	-0.159***	-0.077
Δ EMU [ϕ_2]	0.102	-0.143**	-0.101
EMU	-0.175	-0.302***	-0.178**
GDPGR	0.386**	0.290***	-0.382**
EXCHGR	0.066***	0.023	0.042*
CASGDP	0.184**	-0.016	0.114**
obs	239	310	115
R^2	0.46	0.24	0.61

*** / ** / * denote 1/5/10-percent levels of significance.

Table 4: Estimation results - EMUexGIIPS vs. GIIPS.

SOVRISK	1980-1993	1994-2007	2008-2012
DEBTGDP			
EMUexGIIPS	0.116***	0.048***	0.184*
Δ GIIPS [ϕ_1]	0.099**	-0.012	0.105
GIIPS	0.215***	0.036**	0.289**
PRIMBALGDP			
EMUexGIIPS	-0.251**	-0.165	-0.098
Δ GIIPS [ϕ_2]	0.370***	-0.277**	0.069
GIIPS	0.120	-0.442***	-0.029
GDPGR	0.173	0.279**	-0.565***
EXCHGR	0.083***	0.029	-0.129
CASGDP	0.516***	-0.220**	-0.409
obs	133	154	55
R^2	0.64	0.37	0.84

*** / ** / * denote 1/5/10-percent levels of significance.

Within tables 2 to 4 the estimates for the debt to GDP ratio (*DEBTGDP*) illustrate how the sovereign risk measure (*SOVRISK*) is affected by a one percentage point change in the debt to GDP ratio during different time periods and within different country-samples. The observable pattern is exactly what we would expect from figures 2 and 3 as well as from related research mentioned above. There is a remarkable re-assessment of fiscal imbalances with the beginning of the crisis. While the coefficients for all regional clusters had substantially fallen with the EMU convergence and have risen again with the beginning of the crisis, the changes for GIIPS countries (table 4) are particularly pronounced (see also figures 2, 3 and A1).

In detail, first, the reaction of *SOVRISK* to changes in *DEBTGDP* was statistically and economically significant in the "PreEuro"-period for all country-samples. In the "ConEuro"-period the effect of a rising *DEBTGDP* does not exert an economically significant effect anymore. After the start of the financial crisis, however, the impact of *DEBTGDP* on *SOVRISK* is revived. Second, one can observe, that this "high-low-high"-pattern with regard to the economic significance of *DEBTGDP* is much more pronounced for GIIPS countries compared to the other EMU or the remaining OECD countries. Put differently, this means that the GIIPS countries benefitted enormously from an abnormally small risk premium during the "ConEuro"-period.

Moreover, we see that, opposed to the argumentation of De Grauwe/Ji (2012), it might be misleading to contrast recent increases in default risk premia to a so-called "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 2000-2011. 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 "overpricing" benchmark for the current

crisis. 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 premia, thereby, however, in the other direction.

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): many countries face significantly higher debt ratios as well as higher interest rates implying higher debt service. Moreover, in particular the GIIPS countries have lost competitiveness and have accumulated current account deficits associated with high levels of net foreign debt (see also Sinn 2012). Besides this it might also be the institutional setup of the EMU, i.e., its one central bank and the associated "debt in foreign currency"-issue, that intensifies financial markets pressure upon the debt of some EMU member countries (De Grauwe 2011). The illustrated differences of EMU countries compared to the OECDexEMU sample (stronger reaction of *SOVRISK* perception to *DBTGDP* as well as *PRIMBALGDP*) reflect this potential malus component of so called common currency countries in contrast to stand-alone countries in times of severe financial distress.[13]

Concerning the role of the primary balance relative to GDP (*PRIMBALGDP*) we find that irrespective of the regional cluster and the time period all coefficients (except the GIIPS countries within the "PreEuro"-period) show up with the expected sign. Within the "ConEuro"-period we observe economically and statistically significant coefficients for all regional clusters (except for the EMUexGIIPS cluster, table 4). This relationship is much more pronounced for the GIIPS countries. Here, a decline of the primary balance to GDP ratio of one percentage point resulted in a 0.442 percentage point increase in the SOVRISK. Moreover, for the GIIPS countries, in contrast to our findings with regard to *DEBTGDP*, the relevance of *PRIMBALGDP* increased in the "ConEuro"-period. According to Bernoth et al. (2006) with the installation of the Maastricht treaty the debt to GDP ratio may have "*become the object of highly politicized debates and is a subject to creative accounting as governments try to stay within the limits of the Maastricht Treaty*". Thus, one might conclude that financial markets shifted their focus towards the primary balance causing the weakening of the debt to GDP ratio as an indicator for fiscal soundness. However, with regard to economic significance the increase of the coefficient of the primary balance is far from offsetting the decrease of the coefficient of the debt to GDP ratio. In particular, the re-rise of the debt to GDP ratio since 2008 rather suggests the temporary neglect of fiscal information during the "ConEuro"-period, as we have argued above.

For our macroeconomic control variables, results are mixed. For example, the "PreEuro"-period *GDPGR* coefficients in most cases indicate a positive impact suggesting higher GDP growth to come along with higher *SOVRISK*. This effect is statistically significant; however, the economic significance is negligible.

[13] Note that the interaction term for the EMU-dummy in the "Crisis"-period (table 3) indicates a statistically significant difference between the EMU and the remaining OECD countries.

6 Conclusions

Covering the time-span from 1980 to 2012 we provide broad cross-country evidence for 22 OECD countries with regard to the role of fiscal variables 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 fiscal indicators for the assessment of credit risk within EMU countries and in particular within GIIPS countries compared to our OECD sample. The second shift is due to the onset of the financial crisis. Here, we observe the reestablishment 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 results suggest a reconsideration of the findings of De Grauwe/Ji (2012) who claim that since the start of the sovereign debt crisis due to negative market sentiments financial markets wrongly overestimated sovereign risks in the way that spreads of Greece, Ireland, Portugal and Spain increased disconnectedly from underlying fiscal indicators. Opposed to this view, the examination of a longer time-span (i.e. the "PreEuro"-period) suggests that recent adjustments of sovereign risk premia do not reflect "spectacular overpricing".

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.

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Appendix

Table A1: Summary statistics for time regimes and regional clusters.

		1980-1993			1994-2007			2008-2012		
Region	**Variable**	*mean*	*min*	*max*	*mean*	*min*	*max*	*mean*	*min*	*max*
	SOVRISK	0.16	-14.20	8.73	1.06	-9.94	4.82	2.12	-9.67	27.36
	ILONG	11.04	4.02	27.74	5.64	0.99	20.70	4.37	1.10	26.35
	ISHORT	11.36	3.01	31.02	4.58	0.05	24.56	2.25	0.11	15.82
	INFLATION	7.99	-0.20	84.28	2.27	-0.89	10.87	2.21	-4.49	12.42
OECD-22	*DEBTGDP*	56.28	11.33	134.06	65.41	14.42	175.27	78.84	13.74	210.00
	PRIMBALGDP	-0.59	-10.09	9.01	1.40	-9.70	16.19	-2.42	-28.17	16.03
	GDPGR	2.51	-6.19	13.04	3.08	-5.88	10.66	0.12	-8.58	5.98
	EXCHGR	-2.77	-71.95	34.59	0.86	-39.28	18.42	-0.07	-39.15	16.50
	CASGDP	-0.04	-18.61	10.50	1.95	-18.21	18.05	2.58	-14.41	22.54
	SOVRISK	0.21	-13.26	7.32	1.23	-9.94	4.31	3.37	-3.77	27.36
	ILONG	11.63	5.89	27.74	5.62	3.33	20.70	5.17	2.36	26.35
	ISHORT	12.04	3.99	23.54	4.39	2.11	24.56	1.80	0.81	4.63
	INFLATION	7.92	-0.20	28.89	2.51	0.18	10.87	1.91	-4.49	4.71
EMU-11	*DEBTGDP*	58.39	11.33	134.06	69.93	24.68	132.06	85.00	33.94	198.27
	PRIMBALGDP	-0.79	-8.82	5.40	1.44	-6.54	7.87	-2.85	-28.17	3.46
	GDPGR	2.20	-6.19	13.04	3.02	-0.94	10.66	-0.41	-8.58	3.62
	EXCHGR	-2.40	-32.83	30.05	0.91	-17.69	17.98	-0.10	-5.30	6.87
	CASGDP	-1.06	-18.61	10.50	1.52	-13.67	17.10	1.52	-14.41	22.54
	SOVRISK	0.17	-13.26	7.32	0.85	-9.94	4.05	5.41	-3.77	27.36
	ILONG	14.51	7.70	27.74	6.24	3.33	20.70	7.21	3.98	26.35
	ISHORT	15.37	8.08	23.54	5.39	2.11	24.56	1.80	0.81	4.63
	INFLATION	12.09	1.41	28.89	3.40	1.44	10.87	1.82	-4.49	4.71
GIIPS	*DEBTGDP*	63.90	16.45	115.66	73.86	24.68	121.84	100.71	40.07	198.27
	PRIMBALGDP	-1.42	-7.34	5.08	1.69	-3.43	6.72	-4.74	-28.17	3.46
	GDPGR	2.32	-2.28	7.57	3.56	-0.94	10.66	-1.44	-7.25	1.53
	EXCHGR	-5.73	-32.83	24.74	0.50	-17.69	17.98	-0.10	-5.30	6.87
	CASGDP	-3.51	-18.61	10.50	-1.30	-13.67	17.10	-0.27	-14.41	22.54

Table A2: Cross-correlations for regional and time regime clusters.

	1980-1993						1994-2007						2008-2012					
	SOVRISK	*DEBTGDP*	*PRIMBALGDP*	*GDPGR*	*EXCHGR*	*CASGDP*	*SOVRISK*	*DEBTGDP*	*PRIMBALGDP*	*GDPGR*	*EXCHGR*	*CASGDP*	*SOVRISK*	*DEBTGDP*	*PRIMBALGDP*	*GDPGR*	*EXCHGR*	*CASGDP*
OECD-22																		
SOVRISK	1						1						1					
DEBTGDP	0.27	1					0.10	1					0.35	1				
PRIMBALGDP	0.08	0.04	1				-0.22	-0.19	1				-0.15	-0.29	1			
GDPGR	0.19	0.05	0.31	1			0.04	-0.23	0.28	1			-0.29	-0.24	0.23	1		
EXCHGR	0.29	0.10	0.28	0.21	1		0.23	-0.10	-0.17	-0.09	1		-0.04	0.03	0.26	0.38	1	
CASGDP	0.15	0.14	0.16	0.03	0.16	1	0.17	-0.16	0.33	0.03	0.03	1	-0.11	-0.26	0.25	0.08	0.04	1
EMU-11																		
DEBTGDP	0.27	1					0.00	1					0.70	1				
PRIMBALGDP	0.28	0.14	1				-0.28	0.24	1				-0.20	0.02	1			
GDPGR	0.16	0.04	0.33	1			0.06	-0.21	0.32	1			-0.43	-0.20	0.25	1		
EXCHGR	0.45	0.10	0.28	0.35	1		0.20	-0.07	-0.36	-0.28	1		-0.41	-0.11	0.37	0.32	1	
CASGDP	0.24	0.24	0.19	0.00	0.23	1	0.12	-0.27	0.30	0.28	0.06	1	-0.07	-0.26	-0.22	0.11	-0.05	1
GIIPS																		
SOVRISK	1						1						1					
DEBTGDP	0.36	1					-0.05	1					0.71	1				
PRIMBALGDP	0.56	0.48	1				-0.28	0.12	1				0.03	0.28	1			
GDPGR	0.22	0.12	0.32	1			0.17	-0.33	0.39	1			-0.38	-0.18	0.12	1		
EXCHGR	0.38	0.18	0.14	0.59	1		0.31	-0.09	-0.32	-0.25	1		-0.36	-0.13	0.36	0.25	1	
CASGDP	0.19	0.47	0.11	0.03	0.20	1	0.06	-0.28	0.50	0.48	0.03	1	0.03	-0.16	-0.42	0.05	-0.09	1

Table A3: Wooldridge Tests for Serial Correlation and Cross-sectional Dependence.

Wooldridge Test for Serial Correlation

	1980-1993	**1994-2007**	**2008-2012**
Region	F-stat	F-stat	F-stat
OECD-22	**755.9**	**57.5**	**304.3**
	0.0000	0.0000	0.0000
EMU-11	**294.6**	**14.3**	**444.5**
	0.0000	0.0036	0.0000
GIIPS	**94.1**	**3.7**	**385.4**
	0.0006	0.1267	0.0000

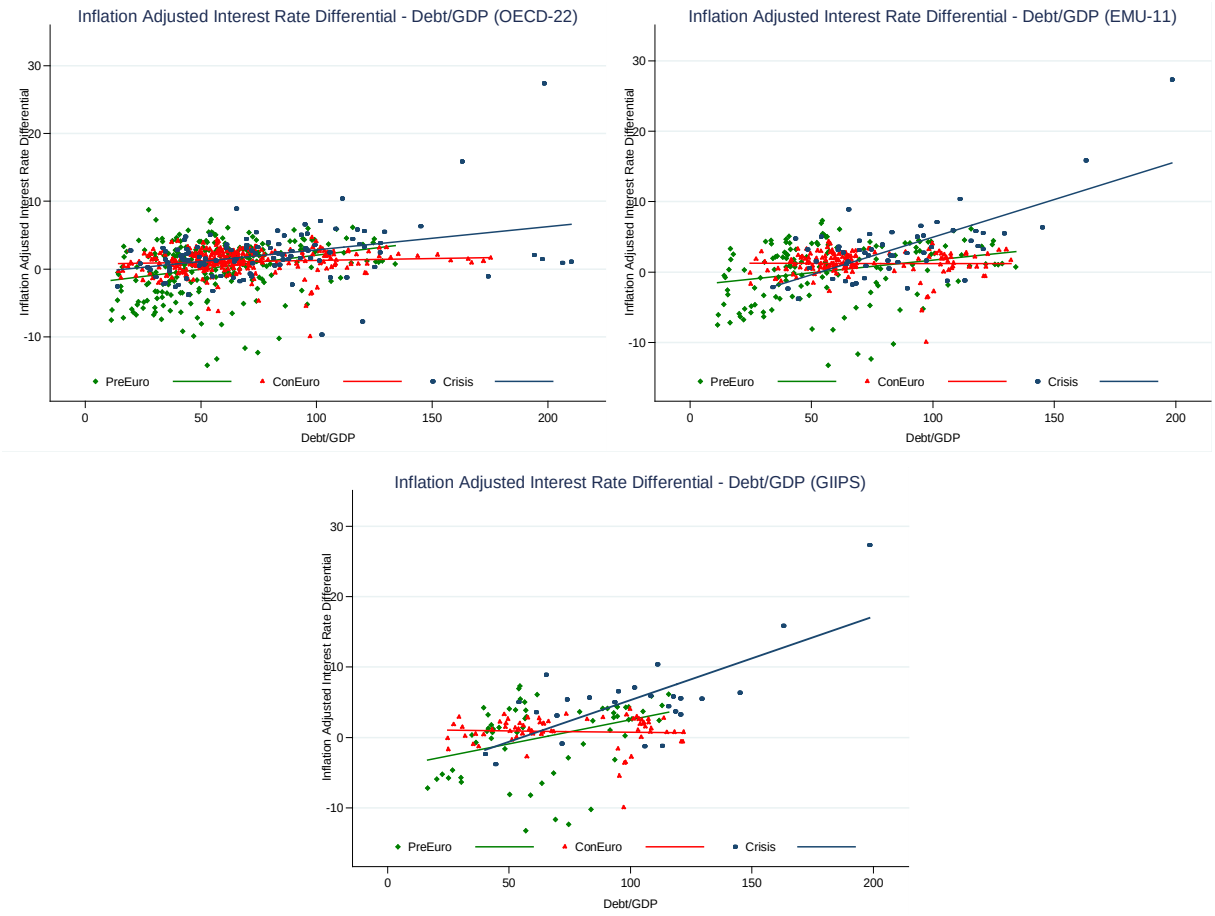
H0: No first-order autocorrelation.

Pesaran Test for Cross Sectional Dependence

	1980-1993	**1994-2007**	**2008-2012**
Region	Test-stat	Test-stat	Test-stat
OECD-22	**6.36**	**12.80**	**2.88**
#	0.41	0.35	0.49
	0.0000	0.0000	0.0040
EMU-11	**4.57**	**9.50**	**-0.77**
#	0.39	0.41	0.44
	0.0000	0.0000	0.4414
GIIPS	**-1.15**	**4.15**	**-0.93**
#	0.35	0.35	0.43
	0.2524	0.0000	0.3551

Average absolute value of the off-diagonal elements

Figure A1: Regional Cluster- and Time Regime-specific Pricing of Sovereign Credit Risk (pooled).



Data source: OECD Economic Outlook, AMECO Database.

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