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Sovereign yield spreads in the EMU: crisis and structural determinants*

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Abstract

We use a panel of 11 EMU countries in the period 2000-2014 to assess the importance of political and economic determinants as explanatory factors in sovereign bond yield spreads. According to the results, there is evidence that those spread determinants gained importance after the beginning of the financial crisis. Following the crisis, the debt ratio, fiscal balance, expenditure on pension funds, the level of liquidity, GDP growth rate, and structural reforms have become relevant determinants of sovereign spreads, while fiscal rules have reduced spreads.

Keywords: Public Debt, Sovereign Spreads, Fiscal Policy, Financial Crisis, EMU

JEL Codes: E43, E62, G01; H63

* The opinions expressed herein are those of the authors and do not reflect those of their employers.

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1. Introduction

In some of the Eurozone countries, high living standards and consumption were maintained through the accumulation of significant amounts of debt, benefiting from the creation of the EMU, with low interest rates, and the absence of exchange rate risk and inflation. However, despite the increase of domestic demand can stimulate the growth of GDP, if the production volume to be overcome by the debt service, the public debt dynamic could follow an unsustainable path, generating a risk default.

In 2009, during the financial crisis, the deterioration of the Greek public accounts prompted the markets to the risk of a possible default and to the consequent contagion to other European countries. Thus, with a significant increase in interest rates and reductions in the rating of the respective securities by the major rating agencies, Greece, Ireland and Portugal were forced in 2010 and 2011, to request external financial assistance, being supported by commonly called Troika (European Commission, European Central Bank and International Monetary Fund), under the then newly created European Financial Stability Facility (EFSF).

In this context, the control of public debt interest rates (and its determinants) has become a priority for the policy makers, to ensure the relative stabilization of public debt. According to the literature, there are indications that, after the beginning of the financial crisis, there was a significant change in the intensity of the interest rate reaction to different determinants, particularly in the EMU[3].

In this article, we pretend to investigate the change in the relative importance of the determinants of sovereign bonds spreads of EMU countries against Germany, before and after the bankruptcy of Lehman Brothers (October 2008), important date in the worsening of the financial and economic crisis, answering the question: How much the relative importance, magnitude and sign of the determinants of spreads changed following the crisis? To distinguish this work from other existing articles, this research aims to contribute to the literature by highlighting and analyzing the impact of some specific determinants, different than the traditional, related to political, institutional and structural factors. Then, we intend to investigate the relevance of factors such as the existence and rigidity of budgetary rules and political cycles to determine the spreads. Also, in a logic of sustainability, we intend to investigate the importance of expenditure on pension funds and the implementation of structural reform measures as determinants of sovereign

[3] See, for example, Heinemann *et al.* (2014).

spreads. Thus, we intend to realize how these determinants, and the others traditionally addressed in the literature, explain the evolution of spreads before and after the onset of the crisis.

According to the results, there is evidence that after the beginning of the international financial crisis, there was a significant change in the determinants of sovereign spreads, where political and budgetary determinants gained importance as explanatory factors.

Moreover, following the crisis, the debt ratio, fiscal balance, expenditure on pension funds, the level of liquidity, GDP growth rate, and the implementation of structural reforms have become determinants of sovereign spreads, and in turn, the FRI has a positive effect on the reduction of spreads, although the results are ambiguous with respect to the amplification or reduction of this effect following the crisis. In addition there is evidence that factors such as the implementation of structural reforms helped decreasing sovereign spreads.

The remainder of the paper is organized as follows. Section 2 reviews the literature. Section 3 explains the methodology. Section 4 reports and discusses the results. Section 5 concludes.

2. Literature

2.1. Cost of high levels of public debt

The literature shows that despite the short-term stimulus on economic activity that may result from the accumulation of public debt, based on Keynesian theory (Elmendorf and Mankiw, 1999; Dunayev, 2013), from a certain level of debt, its accumulation could deteriorate the economic and fiscal conditions, by increasing interest rates. On the other hand, the dynamics of debt increase could lead to a greater budgetary control, with increases in taxation and reductions in public spending, with recessionary impacts on the economy. This indicates that there may be a relationship of non-linearity between public debt and economic growth (Elmendorf and Mankiw, 1999; Baldacci and Kumar, 2010; Reinhart and Rogoff, 2010; Checherita-Westphal and Rother, 2012; Bowdler and Esteves, 2013).

The relationship between the accumulation of public debt and interest rates can be explained, according to the neoclassical model, by the fact that the interest rates increases because of the reduction of savings (especially public savings), and the increase in aggregate demand, generating deficits, and creating an oversupply of debt securities (Elmendorf and Mankiw, 1999). This relationship can also be explained by the crowding

out effect, which results from increased liquidity demand in financial markets by the government, which puts pressure on interest rates in the direction of ascent. Thus, the higher deficits and debt levels, the higher expected increase in long-term interest rate, with the magnitude of this variation depending on the budget level, the economic environment and the impact on financial markets (Baldacci and Kumar, 2010).

One of the most damaging macroeconomic consequences of high levels of public debt is the impact on sovereign bonds. In the case of debt accumulation can increase the distrust of investors in relation to any default risk, speculative movements may raise the interest rate on the bonds, thus increasing the probability of a debt crisis (Reinhart and Rogoff, 2013). In addition to the importance of interest rate on state financing, debt sustainability and the consequent risk of default (Tamborini, 2013; Apergis and Cooray, 2015), a rise in the price of the sovereign funding could also affect economic activity serving as a reference for the financing costs of families.

As stated Bowdler and Esteves (2013), the convergence of interest rates on debt securities since 1990, served as a catalyst for the sovereign debt crisis, and a major contributor to the excessive public deficits mainly recorded in the peripheral countries of Eurozone. Moreover, during the crisis, when were generated large differential in interest rates between economies, there were changes in capital flows caused by speculative movements that have guided investors to apply their funds, or in countries where interest rates were higher or in economies with lower risks (flight-to-quality and flight-to-safety phenomenon) (Bernoth *et al*., 2012; Ehmann and Fratzscher, 2015), leading in turn to greater volatility in interest rates, and consequently in the countries' economic activity.

Considering the incentives for the accumulation of debt, and the interdependence between the debts of countries that at the time, would come to join the EMU (Tamborini, 2013), at its formation, the EMU member states have implemented new fiscal rules. However, because of the heterogeneity of the initial debt conditions and of interest rates, which involved different speeds, budgetary enforces and convergence's rhythms, and despite the measures in corrective part of the SGP, not always the agreed limits have been met. Moreover, this heterogeneity amplified deviations during the international economic and financial crisis, due to the actions of discretionary fiscal policy and the automatic stabilizers (Tamborini, 2013).

2.2. Determinants of the behavior of sovereign bonds

According to the definition provided by Barbosa and Costa (2010, p 144), the risk premium of a bond will depend on idiosyncratic factors of each issuer and should correspond to "*return required by investors for the risk that future cash flows will be different from the agreed due to the occurrence of a default* ". Thus, the differences in the credit risk premium level should reflect the specific characteristics of each country, which will determine, with different amounts, changes in interest rates.

To study the behavior of sovereign bonds and the assessment of their risks, will be necessary name the importance of rating agencies in the context of the sovereign debt crisis, because their ratings and the information provided had responsibilities in felt mistrust on the quality of sovereign bonds (Afonso *et al*., 2012). Regarding other determinants of interest rates of sovereign bonds, studies indicate that most analyzed indicators by investors changed after the bankruptcy of Lehman Brothers and the start of the international financial crisis, where savers not only reassessed credit risks as the markets increased the risk aversion. Despite neglected the weight of public debt on GDP in the past, investors now pay close attention to indicators related to this variable and to the high recorded budget deficits, so that they have become the most analyzed indicators in the literature (Klepsch and Wollmershäuser 2011; De Grauwe and Ji, 2013; ECB, 2014; Afonso and Jalles, 2015; Esposito, 2015). This is supported by Baldacci and Kumar (2010) that highlight the importance of budget balance in the behavior of interest rates, with the magnitude of its variations depending on the initial conditions to the budgetary and cyclical level, and on the financial markets environment. Thus, the literature suggests that macroeconomic determinants, such as the public debt to GDP, budget balance and inflation rate to begin to explain much of the variation in interest rates of the bonds in the long term (Laubach, 2009; Poghosyan, 2014).

Thus, trust and expectations on budgetary performance of each country may trigger large changes in interest rates on debt, worsening again the budget indicators, and so on, culminating in a sovereign debt crisis (Reinhart and Rogoff, 2013). Afonso and Rault (2015) studding the behavior of sovereign bonds, found evidence supporting this perspective because the determinants of long-term (resulting from the fiscal position, the expectations of the dynamics and debt sustainability) are explanatory of changes on interest's behavior. According to the authors, investors tend to consider their investments according to expectations on inflation rate, current account balance and the exchange rate. As such, Constantini *et al.* (2014) point to the expectations of the value of the debt ratio

on GDP as the main indicator of budgetary imbalances and enabler of increases in risk premium.

Also, Afonso and Jalles (2015) make known the importance of economic stability for the control of interest rates, providing evidence that the volatility of macroeconomic determinants generates a worsening effect on the interest rates. Also, the importance of the characteristics of the securities has been referenced in the literature. Reportedly, the characteristics have great importance in explaining the interest rates, and have incentivized, over the past few years, researchers to provide a hefty amount of information about the stock, maturity, currency composition and contractual characteristics of sovereign debt to most countries of the world (Tomz and Wright, 2013). The literature says that debt with shorter maturities are more susceptible to distrust of investors. As argued Reinhart and Rogoff (2013), in addition to the fulfillment of obligations whose maturity matures possibly require high budget deficits, a high short-term debt may reflect difficulties the country may have to be financed in the long run, can foresee increases the tax burden and is more susceptible to distrust movements on debt sustainability.

2.3. The determinants of sovereign spreads in EMU

The interest paid by government bonds should highlight the differences both credit risk level (or default) as the liquidity risk of each country (Barbosa and Costa, 2010). The analysis performed in this article will have greater focus on credit risk, because it is this which shows the differences in the macroeconomic situation, political and structural view comparing to the German economy.

De Grauwe and Ji (2013), thinking about the weaknesses of the Eurozone, say that the key to the understanding of the sovereign debt crisis relates to the structure of economic and monetary union (EMU). Member countries, although they issue debt in its own currency (euro), cannot ensure that they will have sufficient liquidity to meet commitments, unlike other "stand-alone countries" that control monetary policy based on its currency. Thus, there is a susceptibility of EMU member countries to suffer distrust movements. Given the concerns about the payment of obligations, for example, from a new recession, investors sell debt securities of the countries with more difficulties, increasing interest rates and leading to a liquidity flight, with the creditors seeking countries where investments have lower risks (flight-to-quality). This "sudden stop" may have generated situations where governments find themselves forced to hire much higher rates than previously contracted to finance the public debt expenses.

Caporale and Girardi (2013) warn that interest rates on bonds of the Eurozone countries are strongly correlated (although the markets since 2008, discriminate against different issuers) and the percentage of resulting variability of domestic factors in long-term interest rates within the Eurozone is modest when compared to the result of external shocks.

According to Aizenman *et al.* (2013) and also De Grauwe and Ji (2013), the sovereign bond market is more fragile in a monetary union and more susceptible to self-generated crises that non-member countries. It is understood by self-generated crises (self-fulfilling crises), crises not motivated by macroeconomic fundamentals and political, but a dynamic "snowball" generated by pessimistic expectations of investors (Nakamura and Yagi, 2015).

With the onset of the 2008 financial crisis, the German economy has gained the status of "refuge", budgetary discipline stimulating within the union. Assigning the role of "risk-free zone" to Germany, the literature has been using the spread between its interest rate compared to other countries to help quantify the risk premium relatives to the titles of each country in analysis (Bernoth *et al.*, 2012). Thus, sovereign bonds spreads must be linked via the credit risk, with differences in the macroeconomic situation, via the sustainability of public finances, or via terms of risk indicators in international markets (Barbosa and Costa, 2010).

According to Barbosa and Costa (2010) and Klepsch and Wollmershäuser (2011), the spreads against Germany since 2007 can be explained by the decrease in risk appetite due to the financial crisis. As such, the spreads of sovereign bonds, as well as its determinants, have changed significantly over time, and in the pre-crisis period, the macroeconomic and fiscal fundamentals did not appear to be significant to determine the registered spreads (Afonso *et al.*, 2015). Thus, until the bankruptcy of Lehman Brothers in September 2008, the risk in financial markets explained about 70% of the difference between interest rates. After its bankruptcy, credit quality (incorporating fiscal vulnerabilities and the probability of default) and liquidity characteristics have increased their importance on the spread by 50% (Barbosa and Costa, 2010).

With the onset of the international financial crisis, there are many studies that try to explain the evolution of spreads. According Klepsh and Wollmershäuser (2011), not only investors reassessed credit risks, as risk aversion increased by markets, thus becoming one of the main determinants of the evolution of spreads. On the other hand, Klose and Weigert (2014) had presented empirical evidences that the sovereign bonds spreads

increased during the crisis due to the risk of collapse of the EMU or an exchange rate depreciation. Already Dewachter *et al.* (2015) state that fiscal fundamentals are now the main determinants of the existing gap in the interest rates, where the exogenous shocks on fiscal fundamentals have played an important role in the dynamics of rates since the start of the sovereign debt crisis of 2011. Santis (2014) also adds to the literature that liquidity flight is behind the determination of spreads across the euro area (the only explanatory factor in the case of the Netherlands and Finland), as well as spillovers from Greece contributed to its evolution.

As exemplified by Reinhart and Rogoff (2013; p lix), for a country that has a public debt level that seems manageable, given their current tax revenues, growth projections and market interest rates. If there are fears in the market, related to the possibility of a populist candidate win the next election and come to increase spending, so that the debt becomes hard to manage, investors can suddenly sell the short debt term, and ask for huge rates for the country. Thus, begins a crisis. This fear has been realized and referenced in the literature over the past decades, as the example of Hibbs (1977) that warned of the consequences of changes in macroeconomic policies from partisan changes. Also, Basevi (2013) argues that the effects coming from political uncertainty and desynchronization of political cycles (with consequent changes in the governing agents) is inhibiting effective policy responses, greater budgetary stabilization and the implementation of structural measures to promote the recovery of a trajectory of growth, representing a disincentive to investment in their debt.

3. Definitions and Methodology

Intending to study the changes in the impact of different determinants of sovereign bonds following the international financial crisis, through an application to the member countries of the Eurozone, this study uses the 2SLS methodology in order to analyze the evolution, the significance, the sign and magnitude of each of the explanatory variables of sovereign spreads. Initially, we divided the sample into two periods: the period between the beginning of the new millennium and the beginning of the financial crisis (2000-2007), and the period since then (2008-2014). In a second phase (Appendix 2), the first estimation robustness is tested, in contrast with the second estimation. In this, using an alternative procedure by including a dummy variable to identify the crisis years (taking as the beginning of the crisis reference, the bankruptcy of Lehman Brothers), we tried to study the changes in the impact of variables, public debt, budget balance, FRI and

implementation of structural reforms on sovereign spreads against Germany. In this way, we aim to explain the evolution of spreads on sovereign bonds of Eurozone countries against Germany, noting whether there was a change in the relevance of each of the determinants of spreads with the onset of the financial crisis.

Beyond the variables traditionally used in this type of approach, such as an indicator of liquidity, public debt, budget deficit, growth rate of GDP, inflation rate and the spread of the previous year, we also intend to verify the relevance of a set of factors political, institutional and structural, less explored: the existence and intensity of fiscal policy rules (which can be picked up by FRI-Fiscal Rule Index of the European Commission), the influence of political cycles (which can be picked up by the remaining time until the next elections), the prospects of future development of the public debt (which can be captured by the future evolution of pensions, presented by the OECD), and finally, an indicator of structural reforms implemented by different countries (which can be captured using an index published by the Fraser Institute).

Thus, we represent the explanatory spread equation as:

$$\begin{aligned} Spread_{it} = \propto & +\beta_1 Spread_{it-1} + \beta_2 Debt_{it} + \beta_3 Balance_{it} + \beta_4 FRI_{it} + \beta_5 Reforms_{it} \\ & + \beta_6 Pensions_{it} + \beta_7 Growth_{it} + \beta_8 Elections_{it} + \beta_9 Liquidity_{it} \\ & + \beta_{10} Inflation_{it} + \varepsilon_{it} \end{aligned}$$

According to the literature, there may be reverse causality problems between the spread and the explanatory variables, public debt and budget balance, making inconsistent the OLS estimator. Such suspicions were partially confirmed by conducting the Hausman test, where the budget balance presented principles of endogeneity. However, following a more secure way, preventing a possible endogeneity of debt that was not identified in the Hausman test, instrumental variables were used to correct the impact of both variables. Thus, it will be assumed as model assumptions, the equations of explanatory variables suspected of endogeneity (note that given the existing inertia in fiscal factors, variables were included lagged in two periods):

$$\begin{aligned} Debt_{it} = \delta & + \beta_1 Debt_{it-1} + \beta_2 Debt_{it-2} + \beta_3 Balance_{it} + \beta_4 FRI_{it} + \beta_5 Growth_{it} \\ & + \beta_6 Pensions_{it} + \beta_7 Inflation_{it} + u_{it} \end{aligned}$$

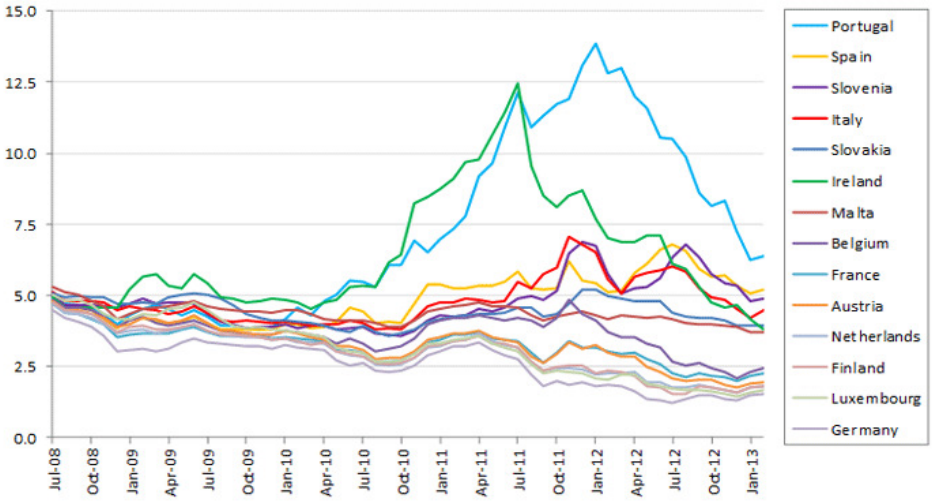
$$Balance_{it} = \theta + \beta_1 Balance_{it-1} + \beta_2 Balance_{it-2} + \beta_3 Debt_{it-1} + \beta_4 FRI_{it} + \beta_5 Growth_{it} + \beta_6 Pensions_{it} + \beta_7 Reforms_{it} + \beta_8 Inflation_{it} + v_{it}$$

Thus, the estimation is performed using as instrumental variables, $Debt_{it-1}$, $Debt_{it-2}$, $Balance_{it-1}$, e $Balance_{it-2}$, using the 2SLS method (Two Stage Least Squares) with panel data.

4. Empirical Analysis

In this section, through an application for eleven Eurozone countries (Austria, Belgium, Finland, France, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Spain) we evaluated the determinants of spreads (10 years bonds) before and after the beginning of the crisis, using annual data for two samples: 2000-2007 and 2008-2014 (data description at Appendix 1). The 2SLS methodology is applied to panel data and are considered fixed effects by country. Once the sample covers 11 countries with longer Eurozone accession and were not chosen from a random population, we opted for fixed effects (compared to random effects models). In addition, we consider only fixed effects by country because, in terms of time, we had already subdivided the sample between pre- and post-crisis.

Figure 1 - Evolution of interest rates on sovereign bonds of EMU countries (except Estonia, Greece and Cyprus) - monthly data from 2008 to 2013



Source: World Trade Organization.

2000-2007

According to the results for the period 2000-2007 (Table 1), the variables included in the model explains about 95% the sovereign spread behavior in the period between 2000 and 2007. However, only the spread in the previous year presents statistically significant (for 1 %), and expenditure on pension funds are also statistically significant, but only for a 13.5% level of significance.

Given the results presented, we are led to believe that the values of spreads followed an inertial logic, where the values observed in the previous period increase the spread by about 1.54 percentage points (pp), for each unit increase in percentage points.

Table 1 – Determinants of spreads (2SLS estimations): 2000-2007 vs. 2008-2014

	2000-2007	2008-2014
C	0.283854	11.71566
	(0.1289)	(0.7374)
SPREAD_1	1.543418***	0.629580**
	(5.8420)	(2.2825)
DEBT	-0.013673	0.072414**
	(-0.9776)	(-2.1542)
BALANCE	-0.018076	-0.357714**
	(-0.8008)	(2.1975)
FRI	-0.073782	0.059762
	(-0.5328)	(0.1526)
GROWTH	0.025792	-0.200076**
	(0.9650)	(-2.6869)
PENSIONS	0.076211	1.748444***
	(1.6283)	(3.7936)
REFORMS	-0.025086	-1.041635
	(-0.1230)	(-0.4756)
LIQUIDITY	0.04815	-0.556643***
	(0.4622)	(-3.5471)
ELECTIONS	-0.005367	-0.135805
	(-0.3975)	(-1.2478)
INFLATION	0.025742	0.456492
	(1.3094)	(1.1662)
Adj-R^2	0.954464	0.785291
F-Statistic	43.03406	26.82323

Note: Average increase (in basis points) in the spread of sovereign bonds resulting from unit percentage change in the variables indicated (except the constant C). The impacts are statistically significant at 1%, 5% and 10%, according to the classification ***, ** and * respectively (value of the t statistic in parentheses).

2008-2014

Studying the period 2008-2014, it is observed that the variables used in the regression explain the behavior of spreads on sovereign bonds at about 78.5%, where the FRI index,

the implementation of structural reforms, the electoral cycle and inflation does not to have statistically significant for a 5% significance level.

For the variables that are statistically significant, variations of one percentage point in the budget balance, in expenditure on pension funds and in public debt (as a percentage of GDP) generates average variations of -0.36, 1.75 and 0 07 pp on the difference between interest rates, respectively. In turn, it will also be expected to unitary variations in the GDP growth rate result in a reduction of 0.2 pp in the sovereign spread.

The value of the spread in the previous year is also significant at the 5% level, where each variation of one percentage point increase (on average) about 0.63 pp the spread of the following year. Finally, liquidity negatively influences the value of spreads: on average, an increase of one billion dollars traded (daily) in North American debt market may affect spreads in -0.56 pp.

Compared to the existing results in the literature, there is some agreement with the results obtained both in signal as the most significant variables. However, there was no statistical significance for the FRI variables, inflation, structural reforms and electoral cycle in the explanation of behavior of sovereign spreads.

Since many EMU member countries violated the limits laid down in certain budget rules (for example, the limits laid down in the SGP), where the pressure to promote the consolidation and budgetary discipline is made by lenders and the European institutions, the rigidity of the rules budget may have been become a key with little relevance to investors. Thus, it will be understandable the non-significance of the FRI index for the explanation of sovereign spreads.

Also, the non-significance of the proximity of elections can be explained by the high number of early elections in the Eurozone countries during the international crisis, causing governments, for example, to increase spending in the middle of the electoral cycle. Thus, the impact from the electoral cycle and the fears about the probability of the so-called populist parties come to assume government posts, as well as inversions in policies and reforms in progress may not have been captured by this indicator.

The fact that inflation was not statistically significant in explaining sovereign spreads may be due to the implementation of the single currency and central bank independence, where price stability and the maintenance of interest rates became the responsibility of an entity supranational. Despite the importance of this indicator for the management of public debt, as the conduct of monetary policy became the responsibility of the European Central Bank, it may no longer reflect the credibility of the national governing entities,

where politicians are unable to resort to monetary mechanisms to finance its economic activity, and generate high levels of inflation, which would reduce the public debt to GDP.

Finally, on structural reforms, although the estimates have the same sign mentioned in the literature, it is difficult to understand its non-significance. We suspect that this is due to its correlation with the budget balance. This result will be further revised in the analysis of the robustness of the estimation (Appendix 2).

Comparison between 2000-2007 and 2008-2014

On the level of significance of the variables, the public debt, budget balance, expenditure on pensions, as well as the liquidity level increased from insignificant to significant statistically in the post 2008 period.

The previous year's spread lost statistical significance in the post crisis period and there was a reduction in its coefficient (1.54 to 0.63). On the other hand, spending on pension funds become statistically significant, and with a positive sign in the spread explanation.

However, given that the budget balance is one of the explanatory variables of public debt dynamics, and considering the high correlation between these variables, the estimates were repeated using DEBT and BALANCE alternately, to assess the impact of this correlation results. In this way, we also hope to understand if the non-significance of structural reforms to the explanation of spreads in the crisis period is due or not, to its correlation with the budget balance and debt.

Through the estimates obtained in Table 2, for the period prior to the crisis, the results are consistent with those obtained in the estimations with DEBT and BALANCE (Table 1) on the significance of the explanatory variables, except for the GDP growth rate (which become significant to a level of 5%), the implementation of structural reforms (passed 5% significant), and expenditure on pension funds (became significant at 10%).

In the period 2008-2014, the results presented are consistent with those observed in Table 1 on the signal, magnitude and significance of most of the explanatory variables. However, the implementation of structural reforms and the FRI became significant to a level of 5%. Thus, the data indicates that a unit change in the value of implementing structural reforms index reduces the spread of sovereign bonds in 2.84 percentage points. In turn, a unit increase in the FRI reduce the spread in 0.66 percentage points.

Table 2 – Determinants of spreads (2SLS estimations): Debt

	2000-2007	2008-2014
C	3.876623*	24.16992**
	(1.7928)	(2.3456)
SPREAD_1	0.892237***	0.620705**
	(4.5991)	(2.3265)
DEBT	0.000730	0.065924**
	(0.1855)	(2.3911)
FRI	-0.194314	-0.660274**
	(0.9356)	(-2.3861)
GROWTH	0.050374**	-0.187822***
	(2.6520)	(-3.1613)
PENSIONS	-0.105987*	1.679091***
	(-1.7559)	(3.8275)
REFORMS	-0.379123**	-2.844008**
	(-2.1293)	(-2.0560)
LIQUIDITY	-0.092449	-0.398813***
	(-1.4961)	(-3.3449)
ELECTIONS	0.022169	-0.144867
	(1.5674)	(-1.3627)
INFLATION	0.006791	0.215761
	(0.3027)	(0.8787)
Adj-R^2	0.795256	0.874657
F-Statistic	13.64791	24.41555

Note: Average increase (in basis points) in the spread of sovereign bonds resulting from unit percentage change in the variables indicated (except the constant C). The impacts are statistically significant at 1%, 5% and 10%, according to the classification ***, ** and * respectively (value of the t statistic in parentheses).

Table 3 – Determinants of spreads (2SLS estimations): Balance

	2000-2007	2008-2014
C	2,610768*	6,374517*
	(1,9173)	(0,2879)
SPREAD_1	1,276692***	1,053369***
	(8,7012)	(4,6764)
BALANCE	-0,005612	-0,549787
	(-0,26049)	(-1,5112)
FRI	-0,027584	0,426919
	(-0,2209)	(0,4999)
GROWTH	0,028739*	-0,165755**
	(2,0879)	(-2,0305)
PENSIONS	0,003192	1,337249**
	(0,0673)	(2,6218)
REFORMS	-0,245352**	-0,078551
	(-2,3068)	(-0,0253)
LIQUIDITY	-0,053205	-0,431933**
	(-0,8973)	(-2,5329)
ELECTIONS	-0,000775	-0,178560
	(-0,0702)	(-1,3028)
INFLATION	0,028108	0,853495
	(1,5022)	(1,4616)
Adj-R^2	0,957088	0,758478
F-Statistic	37,95571	25,81763

Note: Average increase (in basis points) in the spread of sovereign bonds resulting from unit percentage change in the variables indicated (except the constant C). The impacts are statistically significant at 1%, 5% and 10%, according to the classification ***, ** and * respectively (value of the t statistic in parentheses).

Again, for the period prior to the international crisis, the results of Table 3 are consistent with those obtained in Table 1, but now, except for the GDP growth rate, which presents significant to a level of 10%, but with the sign contrary to expected according to the literature, and the implementation of structural reforms indicator that now features significant to a level of 5% and with the expected (negative) sign.

For the period 2008-2014, the results are approximate to those obtained in Table 1, but with a non-significant budget balance. This suggests that the impact of debt developments on the spread tends to be more robust than the budget balance.

Given that, for the period after the beginning of the international crisis, the level of significance of structural reforms varies depending on whether it is estimated including DEBT or BALANCE, there is evidence to support suspicions that the discrepancy between the results in Table 1 (where reforms are statistically non-significant) and the expected result given the literature, may result from the correlation between this variable and the budget balance or/and the public debt (Appendix 3).

The remaining discrepancies observed between the estimates with DEBT and BALANCE alternately, and the estimates with the two variables simultaneously, suggest that the correlation between public debt and the budget balance may influence the results of the regressions. Therefore, Appendix 2 shows the estimation results using DEBT and BALANCE alternately, but now considering the period 2000-2014 with the inclusion of a multiplicative dummy variable which takes the value 1 for observations between 2008 and 2014. The goal is to ensure a greater number of observations in the estimation and give robustness to the results already presented.

Observing this robustness test in Appendix 2, the results indicate that structural reforms, unlike previously presented, are now significant in explaining spreads, both before and after the crisis. However, the importance of implementing structural reforms has greater significance and impact on spreads after the crisis: we estimate that a unit change in the implementation of structural reforms indicator decrease 1.52 percentage points the sovereign spread in the pre-crisis period, and 2.03 pp in the post crisis period.

Analyzing the period 2008-2014 (Table A2), we conclude that the budget balance becomes statistically significant as a determinant of the spreads following the crisis. This may highlight the growing concerns about fiscal discipline and the management of public debt by investors. One of the justifications for such a change may be the fact that, before 2008, an expansionary policy could stimulate the economic activity and the profitability

of assets, without aggravating the spread, and after the start of the international crisis, concerns about the conditions for a country meet its debts overlapped this effect.

On the other hand, and despite the fact that structural reforms do not appear statistically significant in the first estimation, according to the robustness tests performed with alternating inclusion of public debt and the budget deficit, it is suspected that this may result from its correlation with the budget (Appendix 3). Thus, according to the estimation results (excluding the budget balance as an explanatory variable), the implementation of structural reforms is presented as statistically significant (5%), both pre and post the crisis began. However, the average impact of a unit change of this index on the spread increased from -0.38 (2000-2007) to -2.84 percentage points, after 2008.

According to the first estimation results, contrary to what would be expected given the literature, the rate of budgetary rules (FRI), the electoral cycle and the inflation wasn't statistically significant for a 5% significance level. However, the results, considering all the time sample shows that the FRI had a positive effect on the reduction of spreads, although this effect has diminished in the period after 2007. Also, the FRI has a negative impact on the spread (-1.47), which is lower in the post-crisis period (-0.44). This can be read as follows: fiscal rules reduce the risk of default, but since the rules were repeatedly violated, the credibility of these decreased following the crisis.

It is suspected that the fact that several of the EMU member countries have violated, often, the limits laid down in national and supranational fiscal rules, may have led to the formal restrictions imposed by the budgetary rules have lost importance in investors' decisions. Also, the non-significance of the proximity of elections can be explained by the high number of early elections in the EMU countries: the impact of the election cycle, representing the concerns about the probability of the so-called populist parties come to assume government posts, and of the inversions of the policies and reforms in progress, may not have been in these conditions captured by this indicator. In turn, the non-significance of the inflation could due to the implementation of the single currency and central bank independence, where price stability and the maintenance of interest rates were the responsibility of a supranational entity.

Considering all the results, and corroborating what is pointed out in the literature, they indicate, robustly, that following the crisis, the debt ratio, fiscal balance, expenditure on pension funds, the level of liquidity, GDP growth rate, and the implementation of structural reforms have become determinants of sovereign spreads, and in turn, the FRI

has a positive effect on the reduction of spreads, although the results are ambiguous with respect to the amplification or reduction of this effect following the crisis.

5. Conclusions

After the bankruptcy of Lehman Brothers and following the subsequent international economic and financial crisis, increased fears about the sustainability of public finances in Eurozone members. Such concerns have led to a substantial increase in the sovereign funding costs, leaving the EMU member countries in liquidity difficulties, and leading, in turn, that some of these requested it foreign aid to avoid default. This was due to the need for greater control of the debt interest rate for countries to be able to stabilize the public debt and to ensure the liquidity necessary to finance government expenditure, including the costs of the public debt.

As defended, for example, Heinemann *et al.* (2014), there are indications that, during the crisis, there has been a change in the relative importance of determinants (fiscal, macroeconomic and political-institutional framework) of the interest rates of sovereign bonds in the EMU.

This paper assessed the effects from the crisis on the relevance and magnitude of these determinants in the EMU, using a panel composed by a group of EMU countries and covering two periods: pre- crisis, 2000-2007, and post-crisis 2008-2014. According to the results, there are evidences that there was a significant change in the importance and magnitude of political and budgetary variables on the sovereign spread.

In the period prior to 2008, the spread of the previous year is the only determining factor (statistically significant at 1%) of the current spread. The fact that spreads are, largely explained by their values observed in previous years, can justify a low volatility of the same during the period between 2000 and 2007.

For the post-crisis period, public debt, budget balance, the GDP growth rate, spending on pensions, as well as the liquidity level become statistically significant (5%) and with the expected signal. Accruals of a percentage point in the ratios of the budget balance, the expenditure on pension funds and public debt to GDP ratio produces, on average, variations of -0.36, 1.75 and 0.07 (pp), respectively, in the sovereign spread. In turn, unit variations in the GDP growth rate result in the reduction of 0.2 percentage point on the sovereign spreads. The spreads in the previous year also keeps as a determinant: a variation of 1pp increase 0.63 pp the spread of the current year. Finally, the liquidity level has a negative impact on the spreads, where, on average, an increase of a billion dollars

transacted daily in the North American debt market reduces the differential analysis in 0.56 pp.

According to the results, political and economic determinants, as determinants of sovereign bond spreads, have gained importance in the post crisis period. In the previous period, apparently there seems to be evidences of an environment of trust generated by the creation of the euro area, in particular, by the public accounts control guarantees given by the existence of fiscal rules and the pursuit of a common monetary policy. In addition, structural reforms gained relevance in explaining sovereign spreads.

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Appendix 1 – Data description

Variables	Source	Period	Description
Spread	FMI	2000-2014	Difference between sovereign bonds (10 years - against Germany)
Public Debt	AMECO	2000-2014	% Of GDP - current prices (ESA 2010)
GDP Growth Rate	AMECO	2000-2014	Calculated based on GDP at Current Prices
Election Cycle	Comparative Political Data Set	2000-2013	Time (years) remaining until the next elections
Budget Balance	EUROSTAT	2003-2014	% of GDP
Expenditure on Pensions	EUROSTAT	2002-2013	% of GDP - current prices (difference against Germany)
FRI	European Commission	2000-2014	Compliance rate of budgetary rules
Structural Reforms	FRASER Institute	2000-2013	Regulation indicators in the labor market, credit and asset
Liquidity	SIFMA	2000-2014	Average existing daily transactions per year in sovereign debt markets (figures in billions of dollars)
Inflation	OECD	2000-2014	Percentage change from the same period last year

Appendix 2 - Robustness Analysis (Estimations with dummy CRISIS)

Table A1 – 2SLS estimation in 2000-2014 with dummy CRISIS (DEBT)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	16.04130	6.420312	2.498523	0.0141
SPREAD_1	0.887789	0.221868	4.001422	0.0001
DEBT	0.009691	0.019488	0.497285	0.6201
DEBT*CRISIS	0.035269	0.017705	1.992070	0.0490
REFORMS	-1.520461	0.781151	-1.946436	0.0544
REFORMS*CRISIS	-0.512573	0.220836	-2.321059	0.0223
FRI	-1.465487	0.557551	-2.628438	0.0099
FRI*CRISIS	1.026629	0.518671	1.979344	0.0505
PENSIONS	0.597690	0.218755	2.732236	0.0074
LIQUIDITY	-0.210590	0.070507	-2.986782	0.0035
GROWTH	-0.109244	0.052090	-2.097214	0.0384
ELECTIONS	-0.071074	0.065778	-1.080517	0.2825
INFLATION	0.184573	0.133111	1.386610	0.1686

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.879664	Mean dependent var	1.081120
Adjusted R-squared	0.853709	S.D. dependent var	2.640026
S.E. of regression	1.009758	Sum squared resid	104.0004
F-statistic	38.03802	Durbin-Watson stat	1.370614
Prob(F-statistic)	0.000000	Second-Stage SSR	93.89626
Instrument rank	26	Prob(J-statistic)	0.000035

Table A2 – 2SLS estimation in 2000-2014 with dummy CRISIS (BALANCE)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.186436	16.11731	-0.011567	0.9908
SPREAD_1	1.053970	0.184450	5.714119	0.0000
BALANCE	0.308248	0.211003	1.460868	0.1482
BALANCE*CRISIS	-0.725792	0.328595	-2.208774	0.0302
REFORMS	0.930085	2.274759	0.408872	0.6838
REFORMS*CRISIS	-0.407514	0.131780	-3.092387	0.0028
FRI	-1.367870	0.728722	-1.877081	0.0644
FRI*CRISIS	1.299616	0.793260	1.638322	0.1055
PENSIONS	0.758943	0.335745	2.260477	0.0267
LIQUIDITY	-0.263509	0.094524	-2.787755	0.0067
GROWTH	-0.117772	0.071938	-1.637142	0.1058
ELECTIONS	-0.154807	0.108007	-1.433309	0.1559
INFLATION	0.659953	0.396560	1.664193	0.1002

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.792727	Mean dependent var	1.375306
Adjusted R-squared	0.731927	S.D. dependent var	2.912292
S.E. of regression	1.507860	Sum squared resid	170.5232
F-statistic	37.30928	Durbin-Watson stat	2.104318
Prob(F-statistic)	0.000000	Second-Stage SSR	68.87945
Instrument rank	25	Prob(J-statistic)	0.492696

Appendix 3 - Correlation matrix

	SPREAD	SPREAD_1	DEBT	BALANCE	CRISIS	FRI	GROWTH	PENSIONS	REFORMS	LIQUIDITY	ELECTIONS	INFLATION
SPREAD	1.000000											
SPREAD_1	0.879345	1.000000										
DEBT	0.583780	0.578166	1.000000									
BALANCE	-0.420214	-0.350801	-0.515778	1.000000								
CRISIS	0.370893	0.378446	0.322680	-0.438284	1.000000							
FRI	-0.125583	-0.008098	-0.393663	0.269238	0.096866	1.000000						
GROWTH	-0.500441	-0.430380	-0.451888	0.509231	-0.590413	0.082656	1.000000					
PENSIONS	0.314839	0.301155	0.594037	-0.167797	0.340923	0.040205	-0.404560	1.000000				
REFORMS	-0.447809	-0.305104	-0.478376	0.543894	-0.239844	0.212395	0.443676	-0.396328	1.000000			
LIQUIDITY	0.372208	0.506574	0.321195	-0.312786	0.574340	0.240926	-0.381179	0.327913	-0.068764	1.000000		
ELECTIONS	-0.070151	-0.012752	-0.019856	-0.049742	0.016684	-0.045273	-0.058157	-0.070424	0.055379	-0.011356	1.000000	
INFLATION	-0.045412	-0.163938	-0.046613	0.232622	-0.113033	-0.165813	0.138450	-0.104832	-0.076458	-0.196652	0.015965	1.000000