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DETERMINANTS OF THE PORTUGUESE GOVERNMENT BOND YIELD SPREAD

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ABSTRACT

This paper seeks to find out the determinants of the 10 year Portuguese government bond yield spread for the period between the January of 2010 and December of 2012.

Fundamental factors (debt ratio and government balance in % of GDP) and contagion effects are the main drivers behind the surge of the yield spread during the first two years of the sample. Liquidity risk (measured by the bid-ask spread) and the size of the banking system are also significant determinants. These same factors however, have no significance in explaining the drop in the yield spread during the final seven months of the sample.

Keywords: yield spread, fundamentals, contagion

I. INTRODUCTION

From the inception of the European Monetary Union (EMU) until the 2008 financial crisis, government bond yields of member countries converged to very low levels. Almost no differentiation was made among different countries' bonds which resulted in very low yield spreads in relation to the perceived safest bond of any EMU country: Germany's. As recently as 2007 the Portuguese government bond yield spread was merely in the 10-30 basis points (bps) range.

With the outbreak of the 2008 financial crisis, however, this changed. Between the second semester of 2008 and the first semester of 2009 the yield spread increased to maximum levels since the inception of the EMU - the Portuguese yield spread reached almost 200 bps. The literature that focuses on this period concludes that the main determinant of this increase was the increase in investors' risk aversion.

After this turbulent period, the Portuguese yield spread came down again (during the second semester of 2009) to values near 50-75 bps. These are significantly higher than before but incomparably lower than those observed in the two subsequent years. Between 2010 and 2011 the Portuguese yield spread sky-rocketed and by the end of 2011 was already higher than 1100 bps.

What contributed to this sharp increase in the yield spread? Did investors finally start differentiating countries based on their fundamentals (debt ratio, government balance, growth, for example)? Or were more general factors such as the investors' risk aversion or their liquidity preferences those responsible for this surge of the yield spread? Were the frequent government interventions on the financial system perceived to harm its ability to fulfill its debt commitments? Finally, how significant were contagion effects among peripheral countries? These are some of the questions this

paper intends to answer in its mission to determine the main determinants of the Portuguese government bond yield spread between January of 2010 and December of 2012 (this sample is afterwards divided in two: the period of the rise of the yield spread – from January 2010 until December 2011 - and the period when the yield spread dropped – from March 2012 until December 2012).

Unlike most papers in the literature that use panel data to analyze the yield spread of several countries in an aggregated manner, this study only refers to Portugal. Gerlach, Schulz, Wolff (2010) show that the homogeneity assumption necessary use pooled data of several EMU countries does not hold meaning that doing so would yield inaccurate results.

The paper is organized as follows. Section II contains an overview of the literature on this topic. Section III provides a description of the data used. Section IV describes the model and methodology employed. Section V presents the estimation results and the discussion of said results (subsections V.1, V.2 and V.3 present the estimations results and discussions for the dynamic model, the cointegrating regression and the error correction model and for the period covering the drop of the yield spread, respectively). Finally, Section VI summarizes the main conclusions of the paper.

II. LITERATURE REVIEW[1]

A significant amount of studies on the determinants of yield spreads in the EMU have already been published most of which use panel data to assess them on an aggregate basis. Some factors such as the global risk aversion of investors, country-specific fundamentals and liquidity risk are broadly used regardless of author and sample period while others, for example, factors measuring the importance of the

[1] In order to put the forthcoming conclusions from the literature in perspective the sample periods used by the authors are presented in table 5 in Appendix 1.

financial system or the effects of contagion risk became more of a concern with the eruption of the 2008 financial crisis and the subsequent sovereign debt crisis. Below is presented an overview of some of the existing literature on the variables used in this study.

International risk aversion

As mentioned above, a variable measuring the risk aversion of investors at each point in time is frequently used in the literature. Usually, an increase in global risk aversion will drive down (up) the yields of the higher (lower) rated government bonds (flight to quality effect). We therefore expect this variable to have a positive sign (as the investors' risk aversion rises the higher rated German government will benefit from lower yields while the lower rated Portuguese government will see its yields increase).

The proxy used to measure this factor varies across studies. Bernoth, Erdogan (2010) evaluate risk aversion by taking the yield spread between BBB graded US corporate bonds and US government bonds. Attinasi, Checherita, Nickel (2009) employ a similar approach but use instead AAA graded US corporate bonds. Giordano, Linciano, Soccorso (2012), on the other hand, do not take into account yields of government bonds and simply take the yield spread between BBB and AAA graded US corporate bonds. Caceres, Guzzo, Segoviano (2010) do not take yield spreads but instead use an asset pricing model to create their risk aversion variable. Klepsch (2011) uses the VIX index to proxy this variable.

The conclusions regarding the impact of this variable are relatively unanimous and point to it being a significant determinant of the yield spread. Only Bernoth, Erdogan (2010) find that the international risk factor is insignificant from 2001 until 2007. But even in their paper it turns significant with the eruption of the crisis. Attinasi,

Checherita, Nickel (2009) and Caceres, Guzzo, Segoviano (2010) conclude that this variable is significant at the 1% level throughout their sample; Giordano, Linciano, Soccorso (2012) also find that the investors' risk aversion is significant in both their basic and time dependent models

Fundamentals

Another set of variables always employed in the literature are those measuring credit risk. Government bond yields include a risk premium which depends on the credit risk of the issuer. This credit risk corresponds to the ability of the issuer country to meet its obligations and is most often in the literature proxied by the debt to GDP ratio and the government balance in % of GDP with the growth rate of real GDP also being sometimes used. The debt to GDP ratio is expected to have a positive sign (an increase in this ratio augments the stock of debt relative to the resources available to repay them in the future thus increasing the credit risk premium). The government balance as well as the real GDP growth rate should exhibit negative signs (a deterioration of the government or current account balances or a contraction in the real GDP growth rate should drive government bond yields up).

Aßmann, Hogrefe (2009) conclude that the debt to GDP ratio is the most important factor before the crisis and remained significant after its outburst. De Grauwe, Ji (2012) and Schuknecht, von Hagen, Wolswijk (2010) find that the importance of this coefficient rose a lot after the crisis. Both of these papers also find non-linear effects for this variable which indicate that an increase of the debt-to-GDP ratio has a much higher impact on the yield spread when the ratio is high. Giordano, Linciano, Soccorso (2012) find that an important portion of the increase in the Italian yield spread can be explained by the debt to total tax revenues ratio.

Bernoth, von Hagen, Schuknecht (2004) determine that the government deficit in % of GDP is significant at the 1% level during their sample and also find significant non-linear effects for this variable. Schuknecht, von Hagen, Wolswijk (2010) also find a significant coefficient for the government balance in % of GDP since the beginning of their sample that gained a lot of magnitude after 15 September of 2008. Bernoth, Erdogan (2010) and Aßmann, Hogrefe (2009) conclude that this variable is insignificant over long periods but both agree that it turned significant around 2008-2009.

Giordano, Linciano, Soccorso (2012) find that the GDP growth is significant in explaining yield spreads in both their basic and time dependent models but has a low magnitude in explaining the rise in Italian yield spreads. Bernoth, von Hagen, Schuknecht (2004) conlude that their variable measuring the business cycle is highly significant. On the other hand, unlike both previous studies, Gerlach, Schulz, Wolff (2010) use the output gap as a measure of the economic cycle and do not find a significant effect for this variable.

Liquidity risk

A liquidity risk premium is demanded by investors to compensate them for the risk of not being able to promptly liquidate an asset when market conditions deteriorate. Potentially having to hold on to a devaluing asset is a burden faced by every investor that should therefore be compensated for this risk. A more (less) liquid security should, ceteris paribus, exhibit a lower (higher) yield.

Different proxies for this liquidity risk are used in the literature: bid-ask spreads (illiquid securities have higher bid-ask spreads which implies a positive relationship between yield spreads and bid-ask spreads), trading volumes, turnover ratios or market depth (proxied by the size of the debt market). Fleming (2003) compares different

liquidity proxies for the US treasury market and concludes that bid-ask spreads are the best performing.

The literature provides uncertain results about whether or not liquidity risk is a significant determinant of yield differentials. Bernoth, Erdogan (2010) and Schuknecht, von Hagen, Wolswijk (2010) use different liquidity proxies (bid-ask spread and the size of the debt issued, respectively) find that liquidity is never significant during their samples. Bernoth, von Hagen, Schuknecht (2004) conclude that liquidity risk is significant but its importance is reduced with the inception of the EMU. Finally, Aßmann, Hogrefe (2009) also conclude that this factor is not significant over long periods but turned significant and gained a lot of magnitude with the outburst of the crisis.

Financial system

The stability of the financial system has been one of the main concerns of EMU governments. They have frequently intervened in the financial system committing a lot of resources to ensure its stability. This puts a significant strain on a government's finances that increases with the size of the financial system. This means that governments of countries with large banking assets to GDP ratios have to commit more resources to ensure the stability of its financial system thereby weakening their finances (which drives bond yields up).

In the literature few authors control for this effect: Attinasi, Checherita, Nickel (2009) proxy the impact of the financial system in the yield spread by constructing dummy variable on the announcement of bank rescue packages. Gerlach, Schulz, Wolff (2010) use the banking assets in % of GDP and the equity to assets ratio. Both studies find that this financial system variable is significant.

Contagion risk

Contagion risk refers to the likelihood that economic/social/political events in one country will spillover to other countries. This effect is particularly important for vulnerable countries with similar characteristics.

In the literature not many authors account for this factor perhaps because it acquired more importance after the 2008 crisis. Caceres, Guzzo, Segoviano (2010) find that contagion risk is a crucial explanatory variable of yield spreads of EMU, first stemming from the countries most hard hit by the financial crisis of 2008 (Austria, Netherlands and Ireland) while, by the end of the sample Portugal, Spain and Greece were the main sources of contagion risk due to concerns regarding the long term sustainability of these governments. Giordano, Linciano, Soccorso (2012) reach similar conclusions regarding the importance of contagion risk in explaining yield spreads.

Conclusions specific to Portugal

All of the aforementioned papers work with a panel of EMU countries, providing aggregate conclusions for that group of countries. No paper works solely with Portugal which means that specific conclusions are scarce.

Nevertheless, some papers try to disentangle their conclusions and present country specific results: Attinasi, Checherita, Nickel (2009) conclude that for the period between 2007 and 2009 the main determinant of the Portuguese yield spread is the international risk aversion factor (explaining 69,5% of the change in the yield spread). Other factors play a minor role. Klepsch (2011) reaches a similar conclusion with a sample ranging from 2000 to September 2010.

Caceres, Guzzo, Segoviano (2010) find that peripheral countries (including Portugal) became the main sources of risk in the aftermath of the 2008 financial crisis

(October 09 – February 10) and that contagion was in fact the main driver of Portuguese sovereign yield spreads in comparison to fundamentals and global risk aversion. Fundamentals gain explanatory power in the second half of the sample (October 08 – February 10) while risk aversion is only more important than fundamentals in the first half of the sample (July 07 – September 08) having a residual effect in the second half.

Giordano, Linciano, Soccorso (2012) support Caceres et al (2010) findings in that contagion is a more important contributor than fundamentals for the Portuguese yield spread. Codogno, Favero, and Missale (2003) find that the US swap spread is significant in explaining the Portuguese while the bid-ask spread relative to Germany has no explanatory power during their sample (1996-October 2002).

III. DATA[2]

The dependent variable is the spread between the yield on the 10 year Portuguese government bond and the German government bond of the same maturity. Daily data for this variable was collected from Datastream.

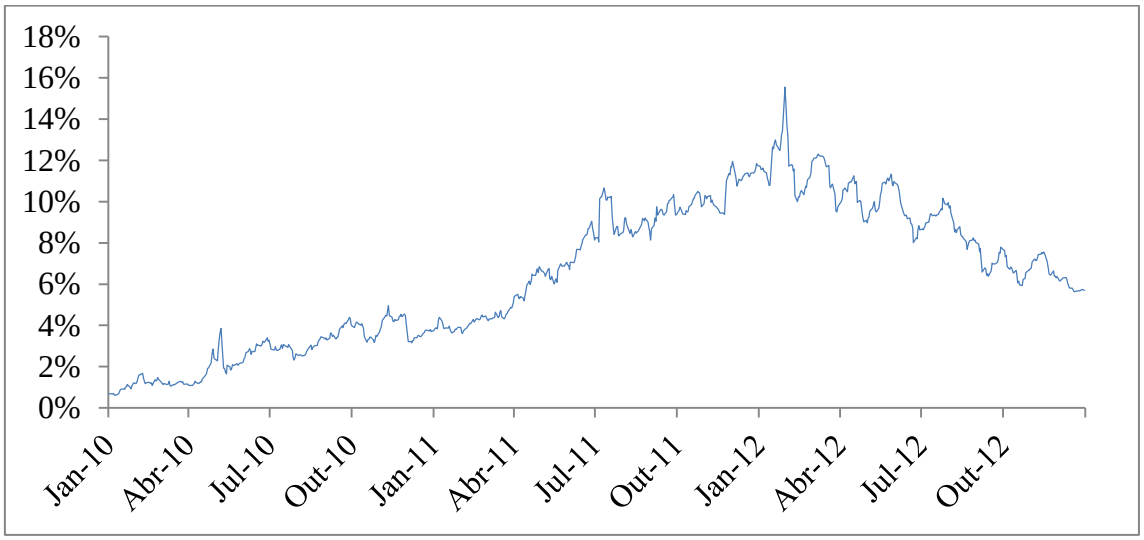

Figure 1: Yield spread between the 10 year Portuguese government bond and the German bond of the same maturity.

[2] Descriptive statistics of all variables are presented in table 6 in Appendix 2. Graphs for all explanatory variables are presented in figures 4a-j also in Appendix 2.

The proxy used to assess the international risk aversion factor is the spread between the yield on 10 year, AAA rated US corporate bonds and the 10 year US government bond yield. Daily data collected from Datastream.

To measure the credit risk of the Portuguese government three variables are used: the debt to GDP ratio, the government balance in % of GDP and the growth rate of real GDP. Quarterly data of the debt to GDP ratio is taken from Eurostat and then interpolated to higher frequency (monthly). Because the estimation is conducted using daily data observations for this variable and all other non-daily variables are updated whenever a new observation exists. Quarterly data of the government's revenues and expenses and GDP is collected from Eurostat. The government balance in % of GDP is then easily calculated. Finally, quarterly data on the annual level of real GDP is taken from the OECD website and then interpolated to higher frequency (monthly). The growth rate of real GDP is then easily calculated.

Bid-ask spreads are used as a proxy to gauge liquidity risk. Daily data is collected from Bloomberg.

The variable used to assess the impact of the financial system on the government yield spread is total banking assets in % of GDP. Monthly data of the aggregate banking assets is available on Datastream.

All three fundamental, the liquidity risk and the financial system variables are measured in differences to the corresponding German factor.

To measure contagion risk the probability of default[3] is extracted from the 5 year CDS spreads of four EMU governments (Greece, Ireland, Italy and Spain)[4]. Daily data is available on Datastream. This variable is not measured in differences compared to the

[3] Probability of default = CDS Spread/(1-Recovery Rate); Recovery rate assumed to be 40%.
[4] Two countries that asked for international help (Greece and Ireland) and two countries that posed the biggest systemic problems for the EMU (Italy and Spain).

German value which means that there is an implicit assumption that contagion effects stemming from these countries did not affect the German government bond yield. This does not seem that far-fetched since the German government was never considered to be in any kind of financial trouble during the crisis, even when the aforementioned countries were facing difficulties. Therefore, the contagion from the four countries mentioned above will impact the dependent variable solely through the Portuguese yield and the coefficient associated with each country are expected to be positive (the higher the probability of default of each of the other EMU countries the greater the risk their problems will spillover to Portugal and consequently the higher the Portuguese yield spread.

Finally, weekly dummy variables on important events[5] are also utilized to measure their specific impact on the Portuguese yield spread: (12/3/10) approval of the 2010 budget, the last with sustainable bond yields; (20/4/10) publication of an IMF report that puts Portugal as the second biggest source of financial distress in the EMU; (25/5/10) budget cuts undertaken in Italy and Spain; (23/3/11) Portuguese government resignation; (29/3/11) Portuguese government debt downgraded to one level above "junk" status by Moody's and Fitch; (6/4/11) Portugal asks for international help; (4/8/11) the ECB buys Portuguese and Irish government debt.

IV. THE MODEL

Due to the high persistence of the dependent variable a dynamic model specification is adopted to control for the past values of the yield spread. Taking into account the difference in explanatory variables the estimated model is similar to that estimated by Giordano, Linciano, Soccorso (2012):

[5] Dates collected from the website of the "Centro de Estudos Sociais da Universidade de Coimbra".

$$(1)\ \text{spread}_t = \text{intercept} + \beta_1 \text{spread}_{t-1} + \beta_2 \text{risk\_aversion}_t + \beta_3 \text{debt}_t + \beta_4 \text{balance}_t + \beta_5 \text{growth}_t + \beta_6 \text{liquidity}_t + \beta_7 \text{bank\_assets}_t + \sum_{i=1}^{4} \gamma_i \text{contagion}_{i,t} + \sum_{k=1}^{7} \delta_k \text{dummy}_{k,t} + \varepsilon_t$$

Spread refers to the spread between 10 year Portuguese government bonds and the German bond of similar maturity. *Risk_aversion* corresponds to the difference between the yields of US 10 year, AAA graded corporate bonds and the 10 year US government bond while *debt*, *balance* and *growth* represent the fundamental variables proxied by debt to GDP ratio, government balance in % of GDP and growth rate of real GDP, respectively (all measured in differences to the German values). *Liquidity* denotes the difference between the Portuguese and German bid-ask spreads and *bank_assets* designate the difference between the Portuguese and German banking assets in % of GDP. *Contagion* designates a set of variables measuring the contagion risk stemming from Greece, Ireland, Italy and Spain. Finally, *dummy* refers to the set of weekly dummy variables used to assess the impact of specific events during the sample period.

The estimation is conducted using the OLS methodology with heteroskedasticity and autocorrelation robust standard errors. Firstly, daily data ranging from January of 2010 to December of 2011 is used in the estimation. This sample period captures the massive increase in the yield spread as can be observed in Figure 1.

Before proceeding with the estimation, however, the possible nonstationarity of the variables must be taken into account to avoid a spurious regression. All variables are integrated of order 1[6] at the 5% significance level and cointegrated[7] at the 1% significance level. This means there is an equilibrium relationship between the variables which eliminates the spurious regression problem.

[6] Unit root tests conducted on the variables are presented on table 7 in Appendix 3.
[7] Cointegration tests are presented on table 8 in Appendix 3.

The cointegrating regression is presented below, in equation 2:

$$(2)\ \text{spread}_t = \text{intercept} + \beta_1 \text{risk\_aversion}_t + \beta_2 \text{debt}_t + \beta_3 \text{balance}_t + \beta_4 \text{growth}_t + \beta_5 \text{liquidity}_t + \beta_6 \text{bank\_assets}_t + \sum_{i=1}^{4} \gamma_i \text{contagion}_{i,t} + \varepsilon_t$$

The error correction model presented in equation 3, below, is estimated to gauge the short run dynamics of the variables and assess which are the biggest contributors for the variation of the yield spread in the short-run.

$$(3)\ \text{d}(\text{spread}_t) = \text{intercept} + \beta_1 \text{d}(\text{spread}_{t-1}) + \beta_2 \text{d}(\text{risk\_aversion}_{t-1}) + \beta_3 \text{d}(\text{debt}_{t-1}) + \beta_4 \text{d}(\text{balance}_{t-1}) + \beta_5 \text{d}(\text{growth}_{t-1}) + \beta_6 \text{d}(\text{liquidity}_{t-1}) + \beta_7 \text{d}(\text{bank\_assets}_{t-1}) + \sum_{i=1}^{4} \gamma_i \text{d}(\text{contagion}_{i,t-1}) + \text{resid}_{t-1} + \varepsilon_t$$

The *d(...)* refers to the first-difference of a series and *resid* refers to the residuals of the cointegrating regression 2.

Finally, regression 1 is re-estimated (without the dummy variables) for the period ranging from March of 2012 until December of 2012 to determine if the drop of the yield spread was driven (or not) by the same factors that previously led it to rise.

V.1 ESTIMATION RESULTS (Jan 10 – Dec 11)

In table 1 below, the results of the model specified in equation 1 are presented:

Table 1: Dynamic model (sample: January 2010 – December 2011)

Variables	*Coefficients*	*Dummy variables*	*Coefficients*
intercept	-0.00354 ***	**2010_budget_approval**	0.00087 ***
spread$_{t-1}$	0.78514 ***	**IMF_report**	0.00177 ***
risk_aversion	0.05155	**budget_cuts_Spain_Italy**	-0.00085 **
debt	0.02840 ***	**government_resignation**	0.00093 **
balance	-0.00681 **	**rating_cuts**	0.00144 ***
growth	-0.04729	**Portugal_help**	0.00088 **
liquidity	0.41419 **	**ECB_buys_debt**	-0.00167 ***
bank_assets	0.00588 ***		
contagion_Greece	0.00392 ***		
contagion_Ireland	0.04506 ***	N	520
contagion_Italy	0.00454	Sample	4/1/10 – 30/12/11
contagion_Spain	0.05685 *	R squared	0.996

Note: ***, **, * denote significance at 1, 5 and 10% levels, respectively.

The first lag of the dependent variable is extremely significant which is an indication of the high persistence of the series.

The international risk aversion factor is not significant meaning that the causes of the increase in the yield spread between 2010 and 2012 were not the same as those back in 2008-2009: according to Attinasi, Checherita, Nickel (2009) the risk factor was by far the main determinant of the rise in yield spreads during the 2008 financial crisis. This result, however, makes sense because the level of global risk aversion is higher during the 2008 financial crisis than afterwards during the Euro sovereign debt crisis (this can be observed in figure 4a in Appendix 2).

Of the three fundamental variables used to assess the state of the Portuguese government, two help to explain the rise in the yield spread: the debt to GDP ratio and the government balance in % of GDP. The investors' thus seem to place much more importance in these two variables than in the growth rate of the economy. This is not surprising since the reduction of the government budget deficit was top priority first for the Portuguese government and also afterwards for the troika. Also the vast increase of the debt to GDP ratio has naturally worried investors' regarding Portugal's long term ability to honor these commitments so it is no surprise that they placed great importance on this indicator. Finally, achieving GDP growth was never a priority of the Portuguese authorities during this period which means that the recessions experienced by Portugal were to be expected and did not overly concern investors.

Liquidity risk is also significant at the 5% significance level and positively correlated with the yield spread meaning that an increase in the bid-ask spread of the 10 year Portuguese government bond would, ceteris paribus, increase the yield spread.

The variable controlling for the size of the banking system is also highly significant and positively affects the yield spread, as would be expected. This may suggest that investors were in fact worried about the possibility that the Portuguese government would be forced to compromise its fiscal position in order to ensure the stability of the financial system.

Contagion risk is also highly significant: contagion effects stemming from Greece and Ireland are significant at the 1% significance level and those stemming from Spain are significant at the 10% significance level. Only Italy's coefficient is not significant. These results indicate that Portugal's yield spread was negatively affected primarily by the countries that requested international aid and by its neighboring country whose much speculated collapse would have generated very serious systemic problems for the EMU.

Finally, the dummies on specific events:

- 12nd of March 2010: the Portuguese Parliament approves the government budget proposal for the year that would decide if Portugal needed international help or if it could resolve its financial problems on its own. The markets reactions to the approval of the budget were not positive because in the subsequent week the yield spread of Portuguese government debt rose.
- 20th of April 2010: IMF report that puts Portugal as the second biggest source of financial distress in the EMU. As it can be easily deduced this to widen the Portuguese yield spread.
- 25th of May 2010: this dummy variable is useful for two reasons: it allows not only to capture the 24 thousand million euros budget cuts in Italy (approved by the parliament on the 25th of May) but also the 15 thousand million euros budget cuts in

Spain approved just 2 days later. This contributed to reduce the Portuguese yield spread through the reduction in contagion risk. The significant at the 10% level contagion effect obtained for Spain versus the insignificant Italian contagion effect indicates that it is likely that most of the influence of this variable comes from the Spanish austerity package.

- 23rd of March 2011: Portuguese prime-minister resigns creating a political crisis. Naturally, this political uncertainty and need for anticipated elections contributed to the expansion of the Portuguese yield spread.
- 29th of March 2011: this variable also captures two important events in the same week: rating agencies, Moody's (at the 29th) and Fitch (at the 1st of April) both downgrade the Portuguese rating in the same week to one level above "junk" status. This obviously led to an increase of the Portuguese yield spread.
- 6th of April 2011: Portugal asks for international help. This event also contributed to amplify the Portuguese yield spread. Investors may have interpreted this as an admission of the failure of the government measures and as a sign that the government's finances were actually in worse shape than had been described.
- 4th of August 2011: the ECB buys Portuguese and Irish government debt. The ECB stepped in to help distressed countries which was interpreted as an sign that the ECB would from then on adopt a more proactive stance in helping the countries in need. This obviously contributed for the lowering of the Portuguese government bond yield compared to Germany. This highlights the need for a wider, pan-European response to the crisis.

Relative contribution of factors

Having already determined which factors played a role in the increase of the Portuguese government bond yield in comparison to Germany it is now useful to determine the relative contribution of each factor individually. In order to calculate this, the methodology used in Attinasi, Checherita, Nickel (2009) is applied. As an example, the relative contribution of the debt to GDP ratio to the increase in the Portuguese yield spread is calculated in the following way:

(4) $Debt_{relative\ contribution} =$

$$\frac{|\beta_3| * |\overline{debt}|}{|\beta_3| * |\overline{debt}| + |\beta_4| * |\overline{bal}| + |\beta_6| * |\overline{liq}| + |\beta_7| * |\overline{bk\_ass}| + \sum_{i=1}^{4} |\gamma_i| * |\overline{contagion_i}|}$$

The results are presented in the following graph:

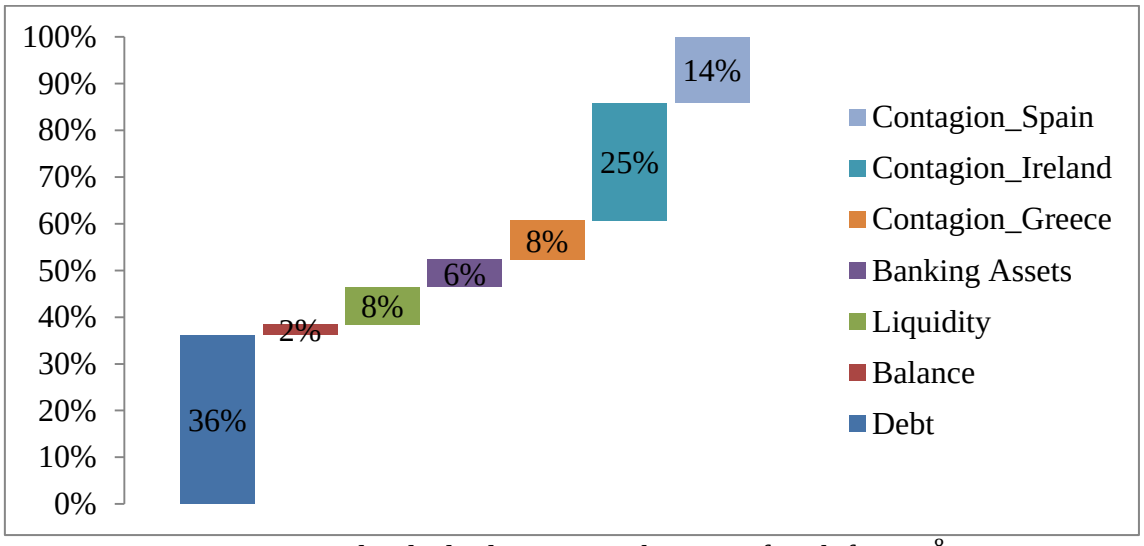

Figure 2: Individual relative contributions of each factor. [8]

As is apparent in the graph the greatest contributor for the increase in the yield spread was the deterioration of the debt to GDP ratio in comparison to Germany. This further supports the idea that investors are seriously worried with the accumulation of

[8] The lagged dependent variable is not included in this calculation because the objective is to discern among the other explanatory variables which were the most important and not analyze the persistence of the series.

debt by the Portuguese government. The government balance had a small magnitude in explaining changes in the yield spread.

Liquidity risk explained 8% of the evolution of the yield spread while banking assets account for 6% of the change in the yield spread during this period. This indicates that while investors were concerned about the financial capability of the Portuguese government to ensure the stability of the banking system, they never believed that the Portuguese banks would be sources of major problems.

Finally, the contagion effects: Ireland seems to be the biggest source of contagion to Portugal followed by Spain and Greece. While Spain is a peripheral country like Portugal and rumors were rampant at some point about a possible intervention in the country the fact is that Spain never requested international help which means that it makes sense that an intervened country (Ireland) is the one that most contributes to Portugal's contagion risk. The lower contagion risk stemming from Greece points to the fact that investors though the context of Greek and Portuguese situation was different. This makes sense since Portugal did not need a second rescue package, social upheaval in Portugal is much less significant than in Greece, fundamental data was not as bad to begin with and as bad as the political situation can be in Portugal it still is more stable than in Greece.

Figure 2 further demonstrates that, on an aggregate level, fundamentals and contagion risk were clearly the two main drivers of the increase of the Portuguese government bond yield spread. Some policy implications can be drawn from this:

- The austerity route seems to be justified: if the main goal of the intervention of the IMF/European Commission is to allow the Portuguese government to return to the financial markets as soon as possible an aggressive improvement of the fundamental

variables is the way to do it even if it compromises the growth rate of the economy - a variable investors did not seem to take into account.

- European wide action is key to resolve this problem: while these conclusions provide some support for the austerity route followed by the troika, contagion effects were still the main drivers of the increase of the yield spreads. This means that when one member country of the EMU faces problems the entire union must swiftly react to provide financial and political support in order to keep the problems from spreading. As this crisis demonstrated there are still a lot of deficiencies in the way the EMU is organized especially in the political front with national elections often getting in the way of what is in the best interest of the EMU.
- The implementation of Basel III, a tougher regulation for the banking system, is a step in the right direction if the objective is to limit the spreading of private sector risk to the public sector.

V.2 ESTIMATION RESULTS (Cointegrating Regression and EC Model)

In table 2 below, the results of the model specified in equation 2 are presented:

Table 2: Cointegrating regression (sample: January 2010 – December 2011)

Variables	*Coefficients*	*Variables*	*Coefficients*
intercept	-0.01162***	**contagion_Greece**	0.02230***
risk_aversion	0.01713	**contagion_Italy**	0.05877
debt	0.14801***	**contagion_Spain**	-0.04269
balance	-0.02581***		
growth	-0.50081***		
liquidity	1.26753***	**N**	521
bank_assets	0.02099***	**Sample**	1/1/10 - 30/12/11
contagion_Ireland	0.25789***	**R squared**	0.987

Note: ***, **, * denote significance at 1, 5 and 10% levels, respectively.

Table 2 presents the long run determinants of the Portuguese government bond yield spread. Results are very similar to those obtained in the dynamic model with only two differences: the growth rate of real GDP turns significant while the contagion risk

stemming from Spain becomes non-significant. Despite the few changes they could have strong implications on the conclusions taken in the previous section: if the growth rate of real GDP is a significant determinant of the Portuguese yield spread the austerity strategy may not be as appropriate as it seemed with the dynamic model.

Relative contribution of factors

Figure 4, however, shows that the previous section's conclusions are still accurate because despite turning significant, the relative contribution of the growth rate of real GDP for the change of the yield spread is residual.

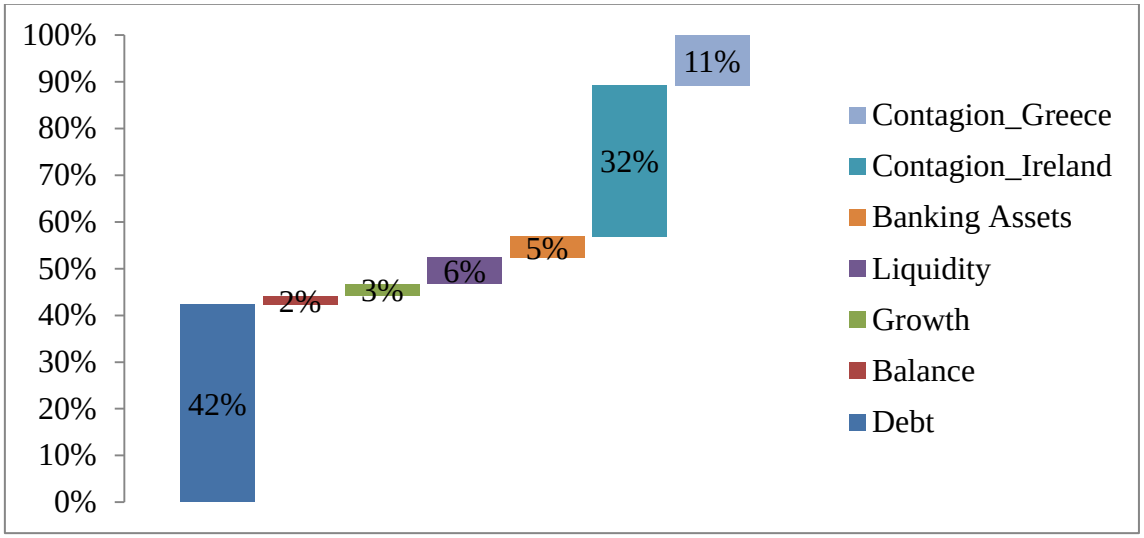

Figure 3: Individual relative contributions of each factor (cointegrating regression).

The main difference between this and figure 2, besides the different variables used, is the increased importance of the debt to GDP ratio and of the contagion effect stemming from Ireland. It also shows that in the long run the aggregate magnitude of fundamental variables is greater than that of contagion effects (47% vs 43% in the long run compared to 38% vs 47% in the dynamic model).

After assessing the long run effects of each variable, the ECM model specified in equation 3 is estimated below to determine their short run effects.

Table 3: Error Correction Model (sample: January 2010 – December 2011)

Variables	*Coefficients*	*Variables*	*Coefficients*
intercept	0.00020**	**d(contagion_Ire $_{t-1}$)**	0.08242**
d(spread $_{t-1}$)	0.01673	**d(contagion_Ita $_{t-1}$)**	-0.06697
d(risk_aversion $_{t-1}$)	0.14060	**d(contagion_Spa $_{t-1}$)**	0.18441*
d(debt $_{t-1}$)	-0.00234	**cointegration_eq_res $_{t-1}$**	-0.12249***
d(balance $_{t-1}$)	-0.00236		
d(growth $_{t-1}$)	-0.16810		
d(liquidity $_{t-1}$)	0.02232	**N**	519
d(bank_assets $_{t-1}$)	0.00429	**Sample**	5/1/10 - 30/12/11
d(contagion_Gre $_{t-1}$)	-0.00402	**R squared**	0.091

Note: ***, **, * denote significance at 1, 5 and 10% levels, respectively.

Error correction models are useful in order to determine the speed of convergence of the dependent variable after a shock. This model also allows us to understand the short term effects of the explanatory variables on the dependent variable. The estimated coefficient of the error correction term is negative and significant which means that deviations from the equilibrium value of the yield spread are corrected at 12% per day. Also the only significant explanatory variables are the Irish and Spanish contagion effects (at the 5 and 10% levels, respectively). This means that these are the two variables that significantly impact yield spreads in the short-run.

V.3 ESTIMATION RESULTS (Mar 12 – Dec 12)

At this point it makes sense to analyze if the drop of the Portuguese government bond yield spread is explained by the same factors that led to its increase. The estimation results are presented below, in table 3.

Firstly, it should be noted that two months were dropped from the estimation period one before and one after the highest value of the yield spread (30th of January 2012). The estimation results were too sensitive to these outliers so they were dropped to ensure the accuracy of the results.

Table 4: Dynamic model (sample: March 2012 – December 2012) [9]

Variables	*Coefficients*	*Variables*	*Coefficients*
c	0.02329*	**contagion_Ireland**	-0.07246
Spread$_{t-1}$	0.92572***	**contagion_Italy**	0.16692
risk_aversion	-0.27227	**contagion_Spain**	-0.07773
debt	-0.03526		
balance	-0.01353		
growth	0.40198	**N**	217
liquidity	0.45892	**Sample**	2/2/12 - 31/12/12
bank_assets	-0.01089	**R squared**	0.985

Note: ***, **, * denote significance at 1, 5 and 10% levels, respectively.

No previously significant variable is significant anymore. Table 4 proves that the great reduction of the 10 year Portuguese government bond yield spread in relation to Germany was not due to an improvement in any of the variables that drove yields sky high back in 2010-2011. This suggests that something other than these explanatory factors is driving the yield spread[10]. Perhaps, the fact that Portugal is currently under the tutelage of international institutions has lent credibility to its policies and thus assured investors that Portugal is on the right track. If this is the case, though, a serious problem will arise in 2014 when said international institutions are scheduled to leave the country.

VI. CONCLUSION

The Portuguese yield spread in relation to Germany sky rocketed in the period between 2010 and 2011. This paper finds that the main drivers of this sharp increase were fundamental variables (debt ratio and government balance), liquidity risk, the risk of a government intervention in the financial system in order to ensure its stability and contagion risk (stemming from Greece, Ireland and Spain). Fundamental variables and contagion risk are the variables that boast the highest relative contributions.

[9] There is no sovereign CDS data for Greece past end-February 2012 meaning that for this estimation the variable measuring the effect of contagion stemming from Greece is lost. This is not ideal but the estimated model below is still valid.

[10] This conclusion is further supported by analyzing table 8 in Appendix 3. This table shows that, in this period, the variables are no longer cointegrated which provides further proof of the lack of an equilibrium relationship between the explanatory variables and the drop of the yield spread.

Two interesting policy implications can be derived from this:

- If the goal is to get the Portuguese government to return to the market as soon as possible the austerity receipt was correct: fundamentals had a huge importance during the crisis and thus must be greatly improved for Portugal to have any hope to return to the markets.
- The EMU must be swifter in dealing with problems to one of its member countries: contagion effects were the main drivers of the increase in yield spreads and the only they can be minimized is if the EMU works quickly and as a unit to prevent these contagion effects. There are, however, still many national political barriers getting in the way for what is best for the EMU as a whole.

Finally, between March 2012 and the end of the year the yield spread dropped significantly. Nonetheless, this drop was not supported by the same explanatory factors that led it to increase dramatically in the previous two years. Non measurable factors may be the leading cause for this decrease of the yield spread, namely the heightened confidence that investors put in the international institutions that are currently overseeing the Portuguese government. If this is the case it is likely that when these institutions leave the country in 2014 the yield spread will increase again.

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APPENDIX 1

Table 5: Sample periods of the papers referenced

Paper	Sample period
Aßmann, C. and Boysen-Hogrefe, J. (2009)	From January 2001 until March 2009
Attinasi, M., Checherita, C. and Nickel, C. (2009)	From 31 July 2007 until 25 March 2009
Bernoth, K. and Erdogan, B. (2010)	From Q1-1999 until Q1-2010
Bernoth, K., von Hagen, J. and Schuknecht, L. (2004)	From 1991 until 2002
Caceres, C., Guzzo, V. and Segoviano, M. (2010)	From mid-2005 until early-2010
Codogno, L., Favero, C. and Missale, A. (2003)	From 1999 until 2002
De Grauwe, P. and Ji, Y. (2012)	From Q1-2000 until Q2-2011
Gerlach, S., Schulz, A. and Wolff, G. B. (2010)	From January 1999 until February 2009
Giordano, L., Linciano, N. and Soccorso, P. (2012)	From January 2002 until May 2012
Klepsch, C. (2011)	From January 2000 until September 2010
Schuknecht, L., von Hagen, J. and Wolswijk, G. (2010)	From 1991 until mid-May 2009

APPENDIX 2

Table 6: Descriptive statistics

	Sample: 1/1/10 – 31/12/11			
	Mean	St. dev.	Max	Min
Spread	5.1%	3.2%	12.0%	0.6%
Risk aversion	0.8%	0.1%	1.2%	0.4%
Debt	17.9%	7.5%	29.9%	9.7%
Balance	-4.6%	5.0%	3.2%	-10.1%
Growth	-0.3%	0.3%	0.3%	-0.8%
Liquidity	0.3%	0.3%	1.3%	0.0%
Banking assets	13.8%	10.1%	28.5%	-5.0%
Contagion_Greece	30.3%	35.4%	184.9%	3.8%
Contagion_Ireland	7.8%	4.1%	19.9%	1.6%
Contagion_Italy	3.2%	1.9%	8.3%	1.2%
Contagion_Spain	3.5%	1.2%	6.7%	1.2%
	Sample: 1/3/12 – 31/12/12			
	Mean	St. dev.	Max	Min
Spread	8.6%	1.8%	12.3%	5.6%
Risk aversion	0.9%	0.2%	1.3%	0.6%
Debt	37.9%	3.5%	43.1%	32.0%
Balance	-6.4%	2.8%	-2.4%	-9.5%
Growth	-0.4%	0.1%	-0.2%	-0.5%
Liquidity	0.4%	0.2%	1.0%	0.2%
Banking assets	24.2%	5.0%	35.8%	18.4%
Contagion_Greece		No data		
Contagion_Ireland	6.2%	2.8%	10.4%	1.9%
Contagion_Italy	5.3%	1.4%	7.9%	3.0%
Contagion_Spain	5.5%	1.4%	8.2%	3.2%

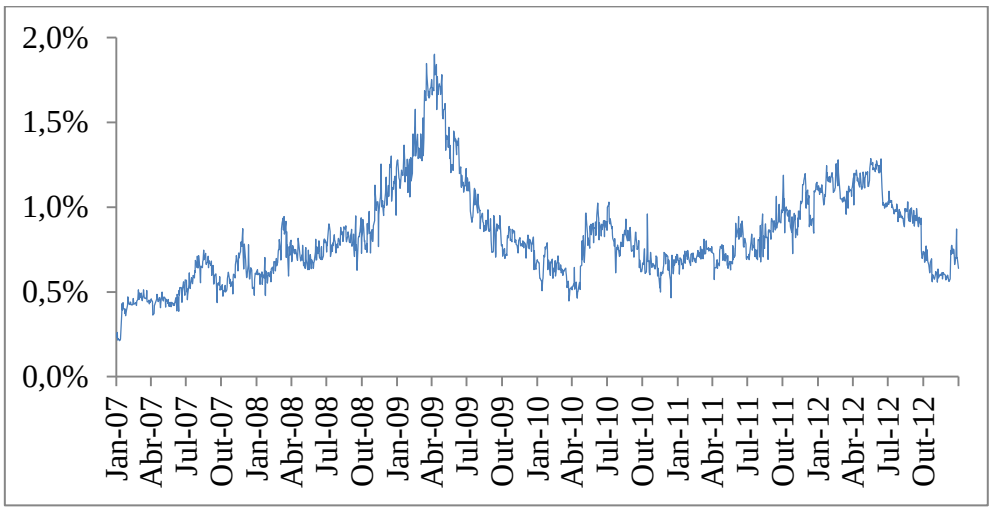

Figure 4a: Difference between US 10 year, AAA graded corporate bonds and the 10 year US government bond.

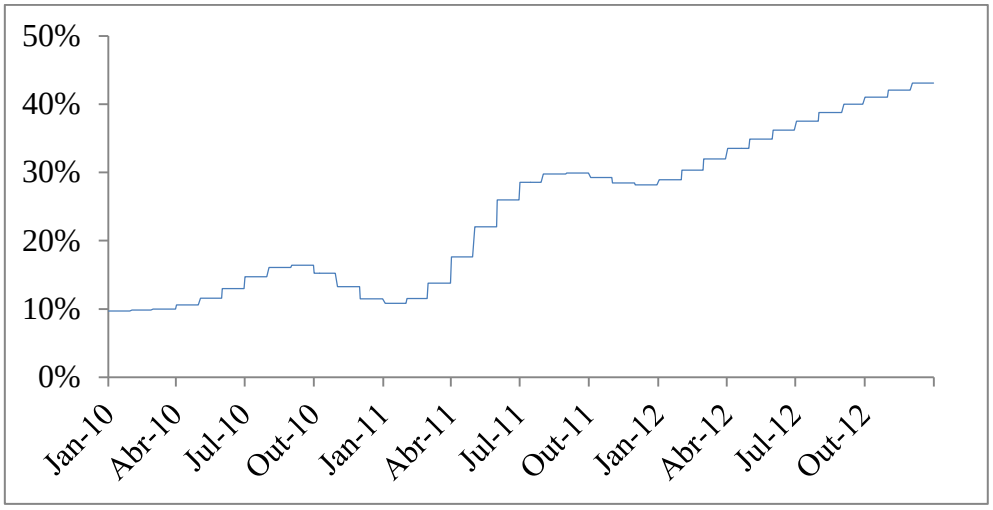

Figure 4b: Difference between the Portuguese and German debt to GDP ratios.

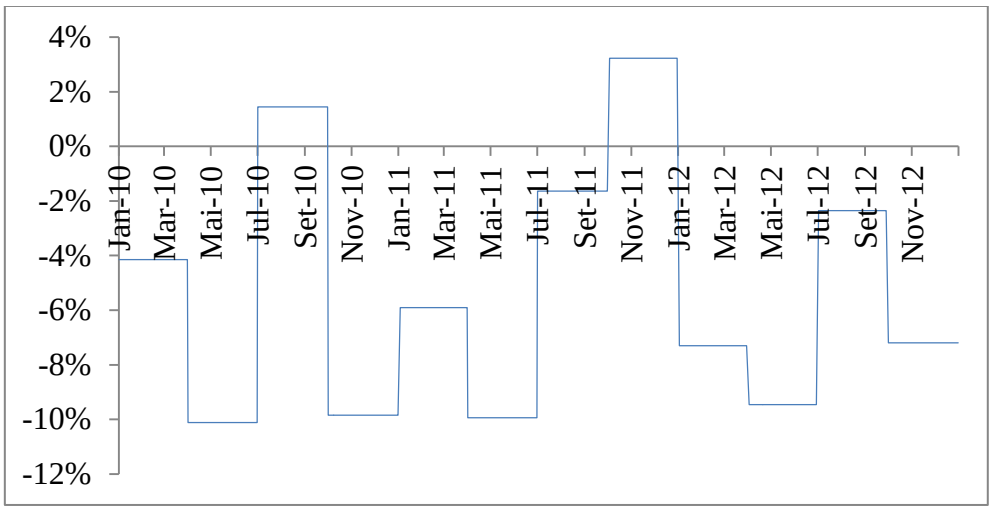

Figure 4c: Difference between the Portuguese and German government balances in % of GDP.

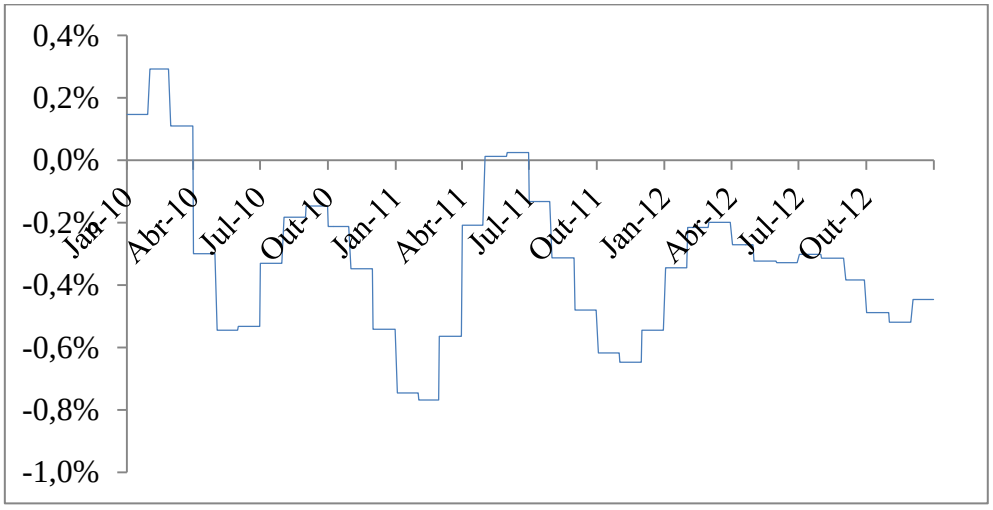

Figure 4d: Difference between the Portuguese and German growth rates of real GDP.

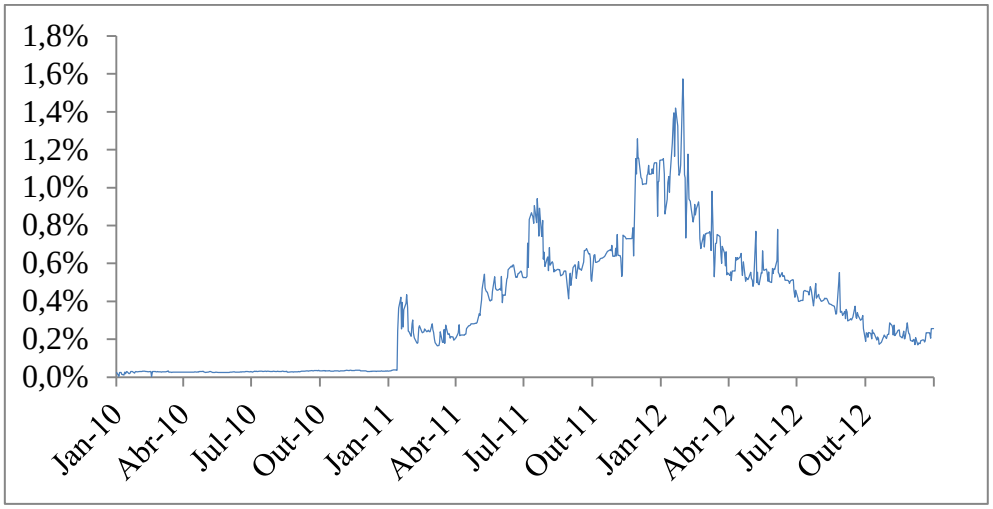

Figure 4e: Difference between the Portuguese and German bid-ask spreads.

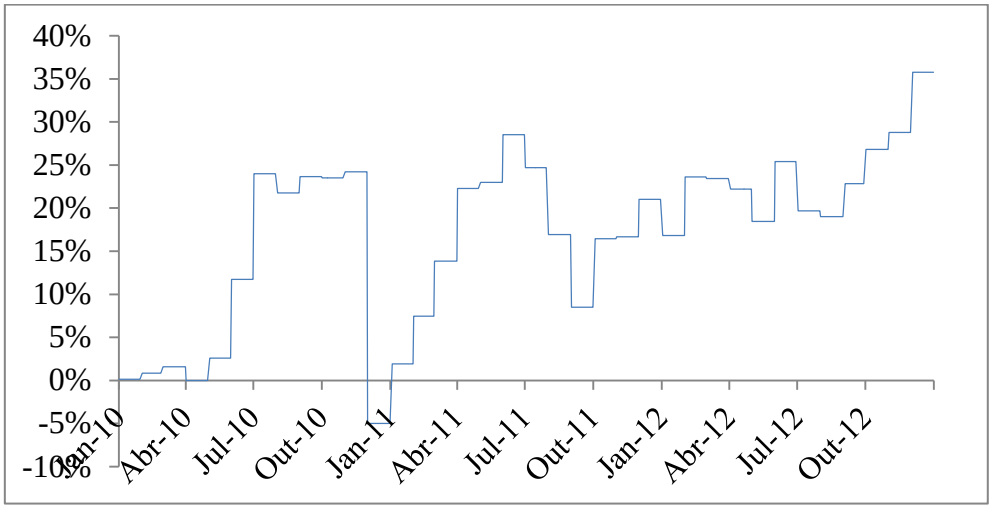

Figure 4f: Difference between the Portuguese and German banking assets in % of GDP.

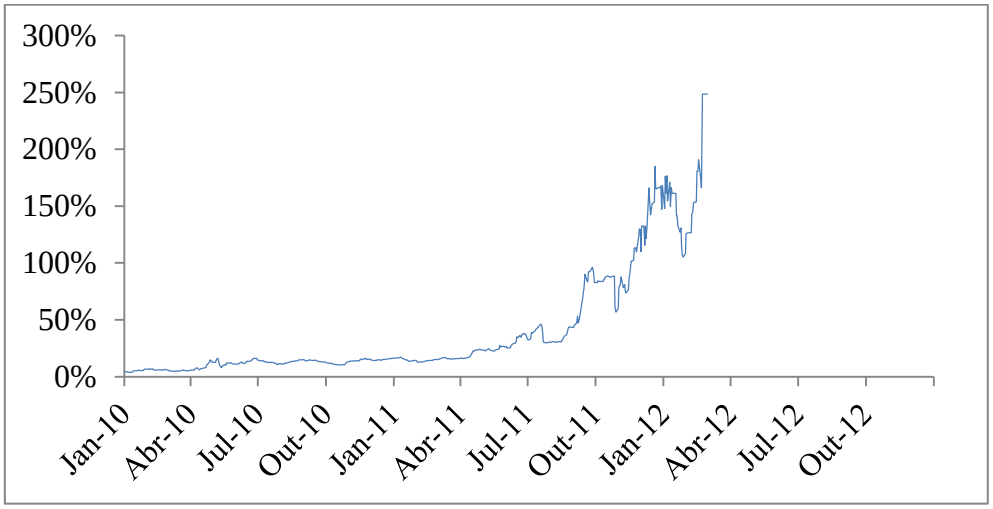

Figure 4g: Greek government's probability of default.

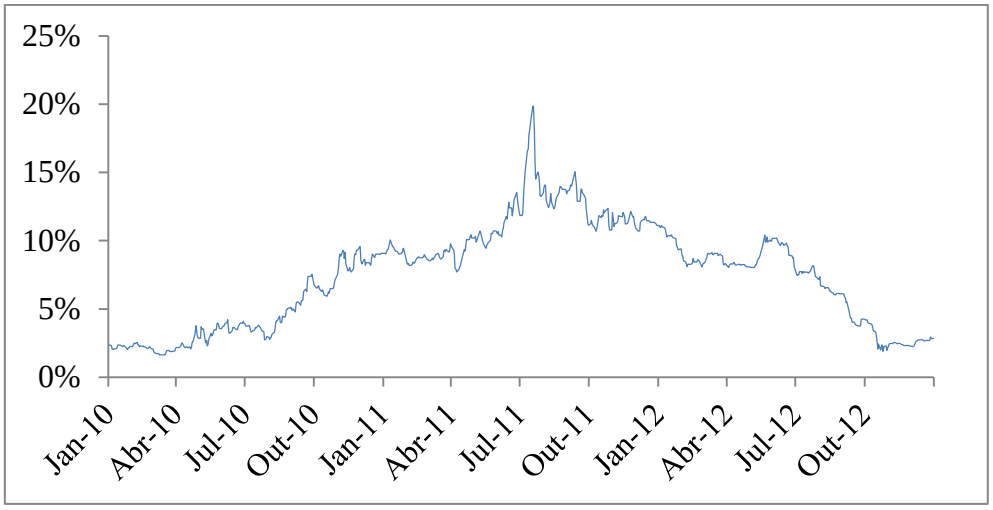

Figure 4h: Irish government's probability of default.

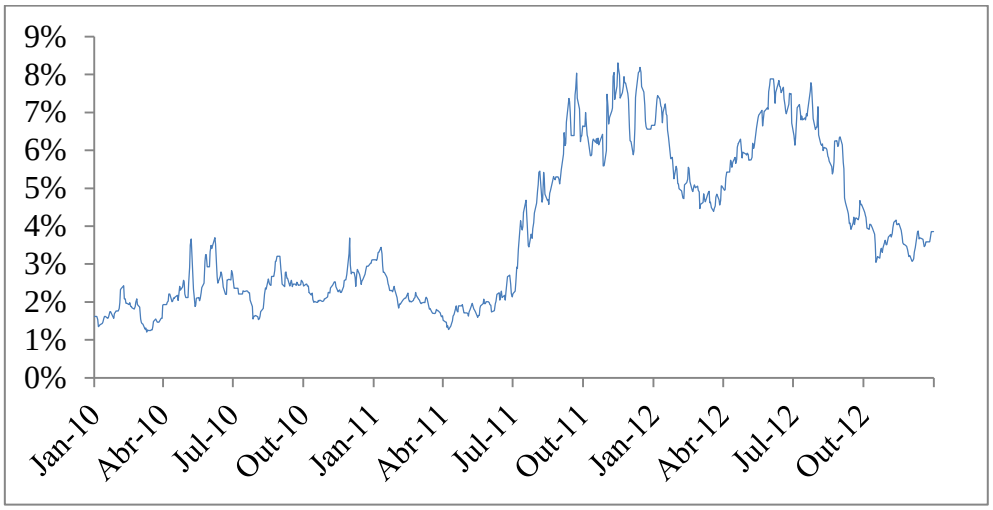

Figure 4i: Italian government's probability of default.

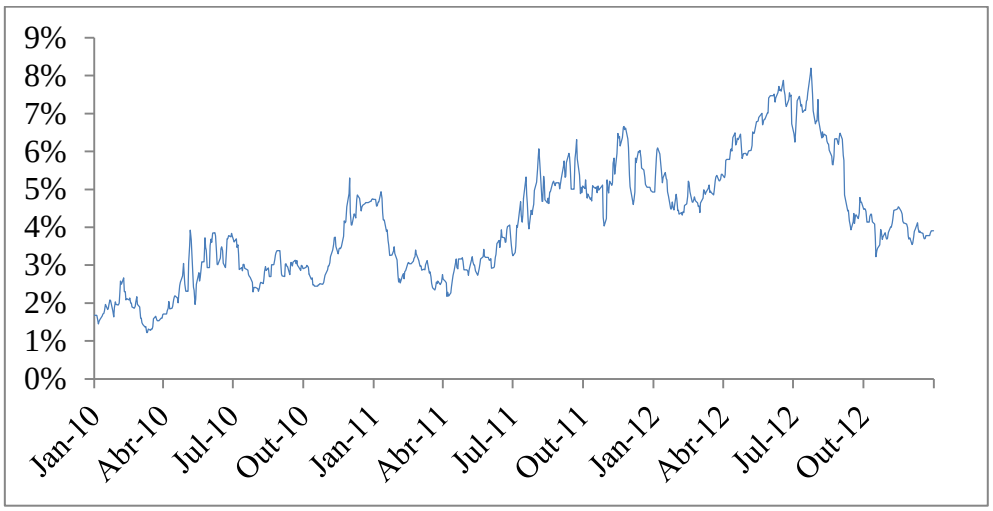

Figure 4j: Spanish government's probability of default.

APPENDIX 3

Table 7: P-values of the unit root tests conducted on each variable (Null hypothesis: series has a unit root).

	Sample: 1/1/10 – 31/12/11		Sample: 1/3/12 – 31/12/12	
	Levels	Differentiated	Levels	Differentiated
Spread	26%	0%	29%	0%
Risk aversion	11%	0%	19%	0%
Debt	98%	0%	0%	0%
Balance	12%	0%	44%	0%
Growth	42%	0%	91%	0%
Liquidity	52%	0%	0%	0%
Banking assets	23%	0%	76%	0%
Contagion_Greece	100%	0%	No data	No data
Contagion_Ireland	10%	0%	69%	0%
Contagion_Italy	83%	0%	50%	0%
Contagion_Spain	9.4%	0%	42%	0%

Table 8: Engle Granger two-step tests on the regressions in tables 1 and 3, respectively (Null hypothesis: residuals of the cointegrating regression have a unit root).

Sample: 1/1/10 – 31/12/11			
β_∞	-6.22103	**1% critical value**	-6.30147
β_1	-41.7154	**Test result**	-7.36611
β_2	-102.68	Null hypothesis is rejected at the 1% significance level ⇒ Residuals do not have a unit root ⇒ Series are cointegrated.	
β_3	389.33		
N	521		
Sample: 1/3/12 – 31/12/12			
β_∞	-4.696	**10% critical value**	-4.769
β_1	-15.732	**Test result**	-3.61302
β_2	-6.922	Null hypothesis cannot be rejected at the 10% significance level ⇒ Residuals have a unit root ⇒ Series are not cointegrated.	
β_3	67.721		
N	218		

Note: Critical value formula = $\beta_\infty + \beta_1/N + \beta_2/N^2 + \beta_3/N^3$, from MacKinnon (1990).