Government bond yield spreads of PIIGS countries versus Germany

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The main objective of the paper is to study to what extent the evolution of government bond yield differentials of PIIGS countries versus Germany are driven from markets' perception of credit risk as it is captured by idiosyncratic risk factors or international risk ones. Mine empirical evidence suggests that the key determinant of yield spreads is changes in international risk factors as they measured by the US low rated corporate bonds relative to US Treasury bonds. Domestic risk factors play a minor role. However after the financial crisis idiosyncratic risk factors are highly associated with government bonds differentials. As a consequence of the augmented risk aversion observed the last years; international risk factors amplified their impact in evaluating yield spreads.

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Contents

1. Introduction

The last period for the European Monetary Union is a time of turbulence. The reason is the loss of market confidence for certain members of it. These members are Greece, Portugal, Italy, Spain, and Ireland; for the rest of the paper, the acronym PIIGS will be used. From the introduction of euro as a common currency in January 1999, there has been a question whether the market discipline will be advanced or obscured by financial integration and the fiscal rules of the Stability and Growth Pact. Financial integration set in motion a substantial convergence of spread differentials. It was a time when the investors were unwilling to discriminate the creditworthiness of different sovereign issuers among the states of the Union. Thus it can be concluded that the financial integration distorted the markets at that point. In the aftermath of the financial crisis of 2007 investors started to evaluate issuers with greater austerity taking into consideration the fiscal policies and other fundamentals of the economies in perspective (Wolswijk 2007).

The goal of this paper is to find out the origins of the difference of spreads of certain economies in the euro zone. The latter has been examined in an extent degree from a plethora of economists such as Gómez-Puig et al. (2009), Laopodis (2008), Wolswijk et al. (2007). However the economical environment has changed noticeably through the past years in the PIIGS block, in relation to fundamentals like external debt, fiscal and current budget deficits. Hence a reexamination of the evolution of yield differentials will shed light on the underlying disparities of these economies in comparison to the German economy.

The research will be based on the paper of Codogno *et al.* (2003) concerning the strategy and the methodology used to decompose and define the risks that are expressed by spreads differentials. In difference to the above paper, the present aims at a sub group of the EMU, specifically at Portugal, Italy, Ireland, Greece and Spain. The main issues that will be addressed are:

- The decomposition of determinants of yield differential between the PIIGS countries and Germany as well as to what extent these are driven by international risk factors or domestic risk factors.

- The evolution over the period from the introduction of the European Monetary Union.

- The policy implications.

The research procedure will be divided in two parts, the literature review and the empirical part. The literature review will be divided in four sections. First the financial integration that came as a consequence after the adoption of the common currency will be discussed. Moreover, certain benefits as well as caveats that stem from the above procedure will be presented.

Even though the financial integration reached a very high level, evidence from the differentials of the sovereign bond market suggest that there is still space for further unification. The second part of the literature review will present a number of papers that assess the reasons of that effect. First there will be a theoretical part concerning the various kinds of risks who dictate the market assessments. Finally a number of results and conclusions of several economists will be presented.

The literature review will proceed with a specific report of papers about the financial crisis of 2008 and how the previous affected the bond pricing. It is worthy to make this distinction since from that period and on there was a difference in the risk aversion. After the collapse of Lehman Brothers, an increase in risk aversion was observed. As a consequence markets have been more willing to discriminate issuers based on their fiscal policies and the fundamentals of the economies (Schuknecht et al. 2010). Finally the policy implications that stem from the study of government bond yield spreads for various agents will be discussed.

In terms of the empirical research the role of the international risks factors and idiosyncratic risk ones will be examined using monthly data. This data covers a period from January 1996 to December 2009. Moreover the source of the data is Datastream while the program that it is used to perform the econometric tests is Eviews.

The empirical evidence suggest that the driving factors behind the evolution of government bond yields of the PIIGS block are the international risk ones, as they are captured by the differential of Moody's Seasoned Baa corporate bonds relative to US Treasury bonds. The impact of the above variable is amplified during the sub period January 2007 to December 2009. The domestic risk factors are expressed through the deficit-to-GDP ratio for Portugal, Italy, Greece, Spain and Ireland. During the sub period the coefficient of deficit-to-GDP is augmented for Portugal and Italy, while for Spain the debt-to-GDP ratio is significant. Noticeably market's assessment does not take into account the deterioration of Ireland's fiscal fundamentals. Finally for Greece the outcome is in line with market rationality since its unsustainable fiscal position is captured by the proxies for domestic risk factors.

1.1 The historical path towards the Economic and Monetary Union

The German politician Gustav Stresemann introduced the first argument for a single European currency, on the 9th of September 1929, in his speech in the League of Nations. Specifically he asked 'where are the European currency and the European stamp that we need?', however due to the turmoil occurred by the 'Great Depression' the idea of a unique European currency was put aside. The French Foreign Minister, Robert Schuman, held the next initiative on The 9th of May 1950. He was the first to propose the establishment of a Community of Pacific Interests; nowadays the Day of Europe is celebrated in that date. The final introduction of the Economic and Monetary Union of the European Union was in 1999 but there were efforts towards this direction before that.

The first attempt was in 1969. In a summit in The Hague on December the Heads of State and Government decide that the Economic and Monetary Union will be an official objective in the process of European unification. A committee under the chairmanship of Pierre Wenner, Prime Minister of Luxemburg investigated the strategies needed to achieve a monetary integration, in a time frame of 10 years. A three stages approach was proposed. The uttermost objective was the full liberalization of capital flows, the final fixing of parities and the replacement of national currencies with a single European one. The above plan was put on hold after the collapse of Bretton Woods's system and the instability that was generated afterwards.

In March 1979 the efforts for a single monetary union renewed with the introduction of the European Monetary System (EMS), which was based on a system of floating exchange rates regime in certain intervals. The EMS system, over a period of ten years, stabilized the exchange rate variability. After the adoption of the Single Market Program in 1985, it became evident that in order to be fully integrated the European market a single currency should be introduced.

The Hanover European Council in 1988 decided to set a committee for the economic and monetary unification under the supervision of Jacques Delors. The report of this committee pointed out the need for greater coordination of economic policies, rules on fiscal policies, especially in terms of financing national budget deficits and finally an independent institution, which will be responsible for the implementation of monetary policy in EMU, the European Central Bank. On the fundamentals of this report the Heads of State and Government adopted the Treaty of European Union that was signed on the 7th of February 1992, in Maastricht. According to the Maastricht Treaty the economic and monetary union should be a reality at the end of the decade. The procedure would be divided into three stages with a strict time frame. The first step concerns the assessment of the monetary and economic convergence; the starting point was on the 1st of July 1990. As far as the second phase no formal decision was made. Individually member states had to adopt certain measures towards integration, while the predecessor of ECB, the European Monetary Institute (EMI), applied the convergence of the monetary policy. The main objective of EMI was the coordination of the national central banks, which were to be fully independent from that period and on.

The final stage of the monetary union concerned the convergence level of the member countries. At this stage certain criteria should be fulfilled by the candidate member in order to join the EMU. In addition the member states had to comply with certain budget rules such as the Stability and Growth Pact. In case members diverged, penalties would be posed. The European System of Central Banks (ESCB) will implement the single monetary policy. Finally the Treaty provided that the starting dates of the third stage will be in 1997, as long as the majority of member states will satisfy the convergence criteria. If this is not the case, then on the 1st of January 1999 any member states that realized the convergence criteria will form the EMU.

In the advent of EMU the member states that achieved the aforementioned criteria where Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxemburg, Netherlands, Portugal and Spain. The other members of Euro zone that joined the initial group of countries are Greece (2001), Slovenia (2007), Cyprus and Malta (2008) and Slovakia (2009).

1.2 The impact of the introduction of euro in euro area sovereign bond market and the evolution of government bond yields.

The supply side of public debt, the sovereign issuers, and the demand side, the investors, both believed that EMU could be the driving factor to lift up the euro government bonds into a major competitor to the US treasury securities. They based their reasoning in the common currency and the monetary unification. These factors would vanish the major components of differentiation of the domestic government bonds. Finally it was expected that the volume of outstanding issuances denominated the common currency would augment investors' preferences to them by the greater liquidity (Galati and Tsatsaronis, 2001).

Figure 1 shows that during the period of the implementation of the criteria established by the Maastricht treaty; the spreads of the government bonds yields started to converge before the introduction of EMU. After the initial diverge period in the beginning of the previous decade mostly related to a higher risk aversion as a result of the dotcom bubble in the United States and the terrorist attacks on the 9th of September 2001, there was the era of substantial differentials convergence until mid-2000s. From 2005 a modest divergence can be observed for low rated issuers as Greece, Portugal as well as Italy. After October 2007 and especially after the collapse of the Lehman Brothers in September 2008, the differentials between the benchmark German Bund and others government bonds in the euro area increased significantly (Manganelli and Wolsijk, 2009).
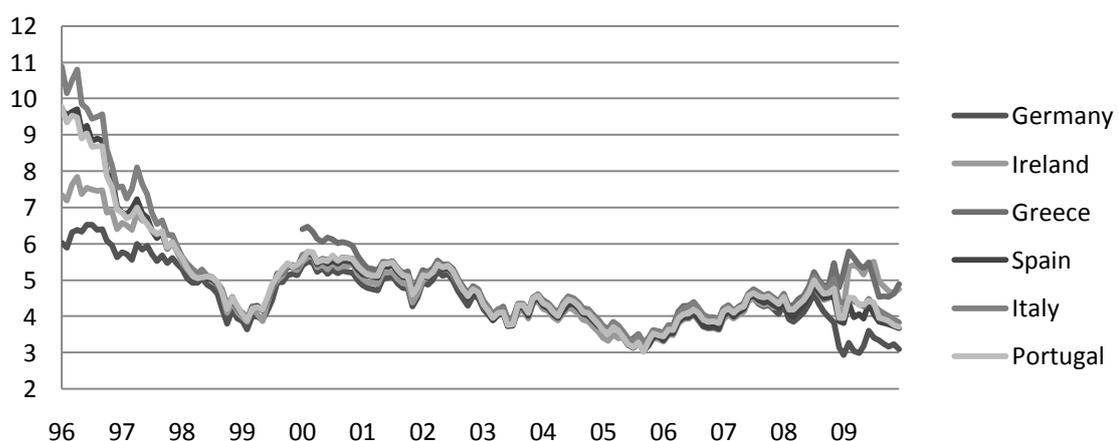

Figure 1. The evolution of government bond yield differentials of PIIGS and Germany
Note: Yields are in percentage annual terms.
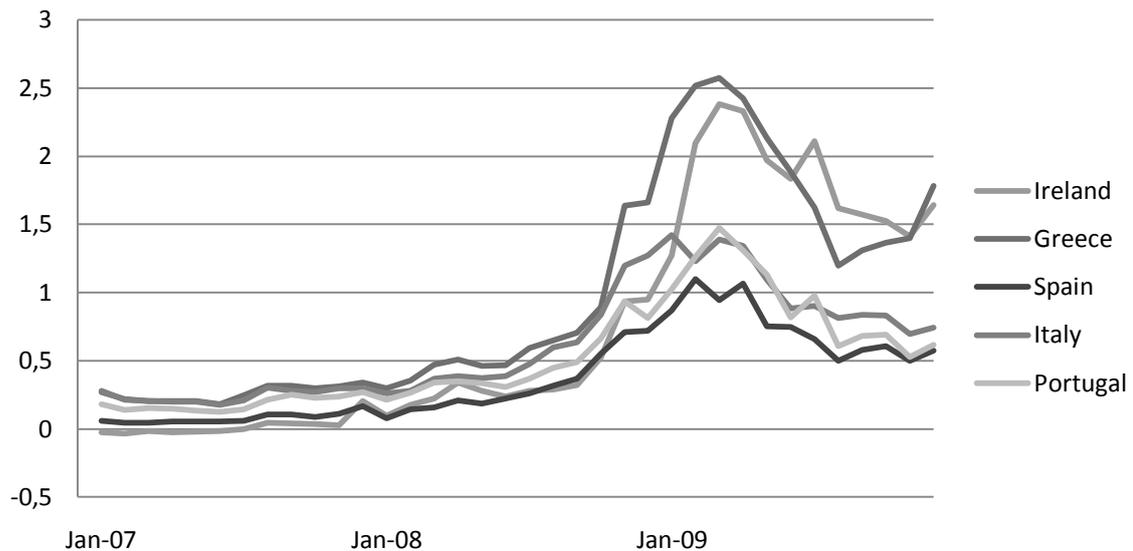*Source*: Datastream

Figure 2. The evolution of government bond yield differentials of PIIGS and Germany
Note: Yields are in percentage annual terms.
Source: Datastream

Italy and Greece are the two members of EMU of which the debt as a percentage to GDP is constantly over the threshold of 60%; the limit for sustainable debt service as this one is stated in the Stability and Growth Pact. While Ireland and Spain present clear downward sloping government debt from the beginning of EMU, there is a sharp increase after 2007 for Ireland and Spain's debt obligations increased substantially from 36% to 53% of GDP in the year 2009. It is straightforward the impact of the government stimulus packages into public debt. This trend is apparent for Portugal as well, while Germany presents the most moderate increase (figure 3).
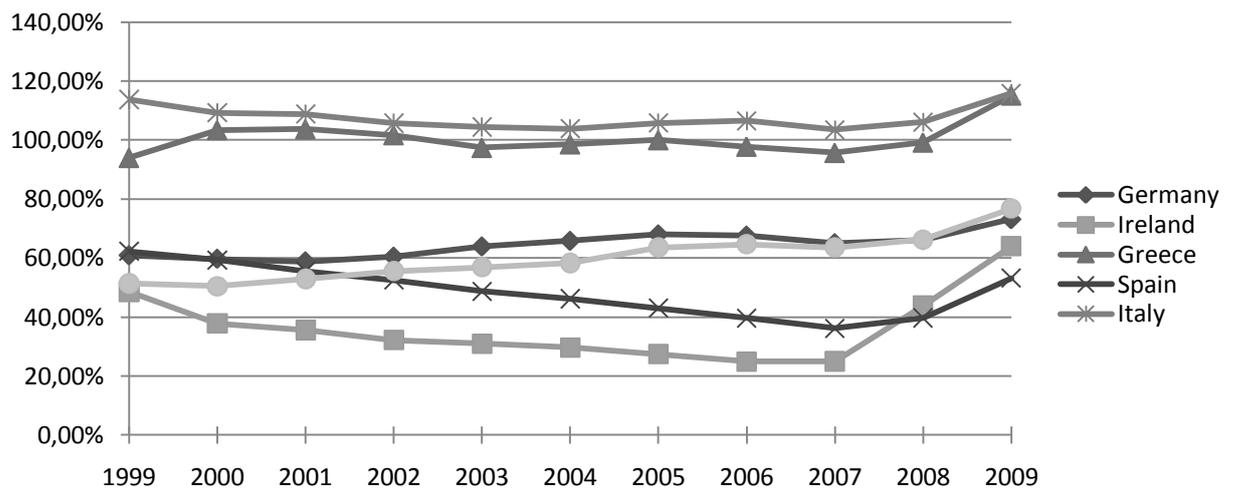

Figure 3. The evolution of government debt to GDP of PIIGS and Germany
Source: Eurostat

As far as the deficit to GDP, in the Stability and Growth Pact the upper limit is 3%.All countries the time they joined EMU presented deficits to GDP ratios below this threshold,

the only exception is Greece with 4.5 % in 2001. There is a twist in fiscal positions in 2002; member countries faced either higher deficit or lower, almost zero surpluses, for the case of Ireland. Until 2006 it is observed a reverse trend. All states downsized their deficits, while Ireland and Spain presented surpluses of 3% and 2%, respectively. However the crisis in 2007 and its escalation in 2008 resulted to higher deficits for all countries under consideration. In 2009 Ireland's deficit of 14.3% is the highest among the sample. In addition Greece and Spain appear a two digit deficit of 13.6% and 11.2% respectively. Portugal from a 2.8% deficit in 2008 reached the level of 9.4% in 2009. Last the increase in deficit for Germany and Italy was one of the modest among the group (figure 4).
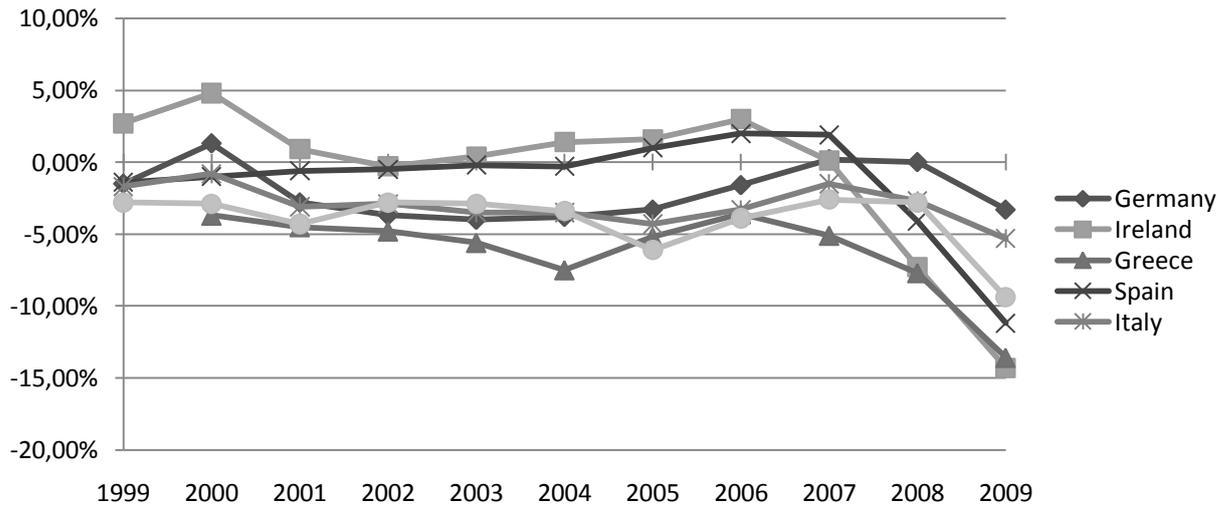

Figure 4. The evolution of government deficit/surplus to GDP of PIIGS and Germany
Source: Eurostat

2. Literature Review

There is high interest from researchers on the government bond yield spreads. The major part of papers deals with the essence of the driving factors underlying the evolution of government bond yield spreads. Moreover, economists evaluate the market integration of the European Monetary Union since the bond market appears to be one of the most integrated in the financial sector. Furthermore, the policy implications that stem from the study of the evolution of government bond yield spreads deserve specific mention. Taking the previous into perspective the following categorization is applied.

The first part provides the relevant evidence on the market integration of EMU and its consequence on the pricing of the government bond yield differentials. It is found that even though the degree of unification in the bond market is quite high there are still differences in the spreads of the sovereign bonds.

This part revises the relevant literature of the determinants of the government bonds yield spreads. This category of papers investigate to what extent the driving forces behind differentials are caused by the perception of the investors concerning the creditworthiness of the issuers, namely the credit risk, or if these differences are attributed to reasons such as the clearing procedures or the market size of the individuals issuing bonds, which is known as the liquidity premium.

After acquiring a well-rounded idea of the driving factors of the yield spreads, a number of papers are going to be reviewed concerning the changes in these determinants after the financial crisis of 2008.

From the start of the financial crisis and the intensification in September 2008 after the collapse of Lehman Brothers the international risk aversion increased. Investors were keener on discriminating issuers based on their fiscal sustainability. Thus it is worthy to re-examine topics such as the higher risk aversion and the impacts of it on the level of government bond yield differentials.

The final part will provide the policy implications that stem from the assessment of the government bond differentials. The policy implications concern different agents such as markets, investors and policy makers. The above are correlated with these policies in terms of portfolio diversification and sound fiscal policies.

2.1 Financial market integration

Financial integration in a single market is achieved when all economic agents in this, face identical rules and have equal access to financial instruments or services. The above operational definition is based on 'the law of one price', meaning that in an efficient market all identical goods must have identical price (Baele et al. 2004)

Investors benefit from a financial integrated economy through several channels. First financial integration provides them chances to mitigate risk. The reallocation of resources like capital becomes more efficient. Through financial development, unification can enhance growth, since more capital is flowing in an area. Besides the gains of the economy as a whole, specific advantages for the public debt market emerge. The most significant is the decline in the cost of serving public debt because of the improved liquidity. Investors demand less liquidity premium in case of a highly liquid market. Furthermore, homogeneity in market prices and transparency through the preannounced auctions lead to increased substitution between the sovereign bond issuers. At last, monetary policy is implemented through the financial system, too. Hence a further integrated market will offer a symmetric effect.

On the contrary as the integration proceeds a number of caveats appear. There might be signs of monopolies as financial institutions merge. The consolidation of the financial markets is the uttermost goal. However in the current phase additional financial instruments might distort the market. Consequently the welfare of the social agents may be reduced.

The first years of integration, from the supply side certain strategies were undertaken in order to overcome certain hurdles. The increased competition by the issuers led to significant harmonization of issuing practices. One of the main changes in euro area sovereign debt was the enlargement of the issue size, a minimum of 5 billion euro. Additionally, governments adopted new lines in issuance procedures to attract investors. An important measure was the enhancing of the secondary market through the EuroMTS. Moreover, policy makers focus on particular investors needs. Finally a lot of member states of the euro zone adopted the 'front loading' practice where they concentrate their issuance in the first few months of the year.

Besides the above policies, barriers still exist on the way to a fully integrated market. Most common barriers are the lack of standardized legal documentation for repos, the lack of same strategies about settlement procedures and the need of a unique clearing institution.

In addition to the above bureaucratic barriers, agents within the euro zone can be thought as obstacles in the way for integration. Specifically Adam et al. (2002) argue that the gains from the financial integration lay on the degree of development of the financial sector in the euro zone members. Countries with well-developed financial sector will benefit from the integration since investing risks are mitigated and new opportunities will be presented. The opposite counts for the financial sector of a country's that is underdeveloped. In this case, it is highly likely the financial institutes to witness their market share shrink due to the competition.

Furthermore, the authors assess the impacts on the manufacturing sector. In this case the benefits and losses are exactly the opposite. The manufacturing sector in the underdeveloped financially country will benefit from the decrease in the cost of borrowing. Firms from that member state will be more competitive while it is possible to expand their

market share. While the opposite stands for the manufacturing sector of the financially developed countries.

In this vain researchers examined empirically the degree of integration in the Economic and Monetary Union, after the introduction of the common currency. More specific Kim, Wu and Fariborz (2006) investigate the impact of the monetary union on the inter-stock-bond market. They argue that even though there is a strong trend of integration in both markets due to the introduction of the Euro and the convergence criteria that guided national economies into a same state, there might be signs of 'flight to quality'[1] phenomena.

Gómez-Puig (2008) investigates from another perspective the relationship between the monetary unification and the impact on the cost of borrowing of the sovereign issuers. She argues that the fall in adjusted spreads of the bonds of EMU members was less than expected, leading to a higher borrowing cost. She investigates if this increase may lay on the perception of the credit risk or to liquidity reasons. She concludes that it is the idiosyncratic factors that drive the evolution of the spreads rather than the international risks.

The researcher argues that a number of factors led to higher government bond yield differentials, especially for the smaller countries in terms of market size. Particularly she supports that after the elimination of the exchange risk factor with the introduction of euro, the smaller markets were penalized since they were more illiquid markets. At the same time, the 'too big to fail' theory seems to hold, meaning that the smaller the market size the higher the credibility of the 'no-bail out' clause. Hence the large differences between euro-area sovereign debt markets in addition to the removal of the exchange risk barrier led to an increase in the importance of market size and liquidity.

Last Gómez-Puig advocates that since the EMU denies the countries the right to print money to serve their debt combined with the credibility of 'no bail out' clause, the theory that the ECB is going to bail out a country only if its market size is beyond a threshold and there are risks of contagion, reinforce the theory of 'too big to fail'. Eventually this leads to higher adjusted spreads for the smaller sovereign issuers. Hence the monetary union and the market integration cause a penalization of the smaller issuers from the investors.

Laopodis (2008) examines the linkages between euro and non euro countries into two sub periods, pre EMU and post EMU. He performs a number of co integration tests in order to assess if the government bonds of the above issuers follow the same time pattern. His empirical results suggest that in the period before the EMU there is an absence of co integration for the euro zone countries, while there is weak evidence afterwards.

Abad, Chuliá, and Gómez-Puig (2009) assess the consequences of the introduction of euro in the European government bond market in terms of market integration. They divide two sub groups the EMU countries and the non EMU countries of the EU-15. They are the first to

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[1] 'Flight-to-quality' phenomena   observed when in economic distress, investors rebalance their portfolios towards less risky securities, especially in fixed-income markets.

adopt a CAPM model first based in that introduced by the Bekaert and Harvey (1995). The previous model was mainly used to assess a single factor of common systemic risk. In their research they divide each individual's country return to three effects in order to understand the participation of each factor on the above-mentioned return. They break it up into local effect, the idiosyncratic risk, the regional effect -Euro zone risk- and final the global effect that is related to the international risk factor. They use weekly data from Wednesday to Wednesday because they want to avoid the daily data problem of non-synchronous data. The time frame of their research starts from the beginning of EMU until the June of 2008.

The empirical results suggest that there is considerable integration in the EMU countries group, but still the European government bonds are treated as imperfect substitutes by the investors. That has its origins in domestic reasons either in creditworthiness either in liquidity risk. Furthermore the EMU government bond market presents a lower degree of integration than the US market. This is supported by the fact that the EMU bonds are influenced less from the international risk factor than the domestic risk factors. On the other hand the non EMU countries are more integrated with the US government bond market, proposing that they are more vulnerable to the international risk factor.

Adam et al. (2002) in order to measure the degree of convergence they adopt an indicator mainly used in the growth theory, namely the β-convergence and σ-convergence. The β-convergence measure counts the speed of adjustments of deviations of countries to the long run benchmark value. While the σ-convergence measures if countries tend to become similar over time in terms of deviations from the benchmark. In the government bond market there are signs of both indicators after January 1999. However the major part of the convergence in the differentials took place before the end of 1997. Finally they conclude that there is evidence that the convergence is higher in the Euro zone than in the EU as a whole.

Manganelli and Wolswijk (2007) treat the subject of financial integration from a different aspect. The authors point out the important linkages between integration, market discipline and fiscal rules. They indicate that even though there are differences in the fundamentals of the member states (deficits and public debt), the spreads of their government bonds are in historical lows. This implies that the markets are either unwilling or incapable to discriminate the creditworthiness of the national issuers. Some argue that this is a consequence of the process of financial integration .They advocate that market efficiency, through the financial integration, can be a tool for the markets to evaluate the assets more accurately. Thus impose higher borrowing costs for issuers with unsound fiscal policies, while reward the issuers that comply with the rules of the Stability and Growth Pact.

2.2 The determinants of government bond yield differentials

As it was stated above the 'law of one price' does not hold for the euro zone government bond market. The difference between the spreads of two assets with identical risk – return characteristics should be zero. Although history reveals that identical rating government bonds still present differences in their yield spreads (e.g. France, Netherlands and Germany

all are AAA rating but their spreads differ significantly). Hence the financial integration has not reached its full potentials. The logic behind these diversities lay in a number of reasons, such as differences in the fundamentals of the economy, the market size, the international risk averse and other factors.

One of the main risks is the exchange rate risk. It concerns the risk the investors face due to an insecure exchange rate environment. This risk contains the inflation risk whilst it can be related to the soundness of monetary and fiscal policy. However the previous risk has been eliminated in the euro area with the introduction of the common currency.

The credit risk can take three different forms. The first one is the default risk which is the possibility that the sovereign issuer will fail to pay back part of the interest payments or the principal. The credit spread risk which is related to the price of the bond performance. Credit spread risk is the probability of other analogous bonds to be market valued higher than the one invested. Finally the downgrade risk which is defined as the probability of a downgrade by credit rating agencies.

Another major component is the liquidity risk, which is broadly defined as the ability of market agents to perform large transactions while the price movements are not mainly affected. Liquidity in bond market relies on the issue size, the maturity and secondary market makers.

Finally, the international risk factor is one the main components of government bond yield spreads. The international risk factors usually are captured as the difference in spreads of the corporate sector to the ones with the same maturity to the government sector. A part of papers are using the US corporate bonds (Codogno et al., 2003, Favero et al., 2005) and other researchers take into account the euro area corporate bonds (Geyer et al., 2004, Manganelli and Wolsijk, 2007).

An important factor that in times of market stress can augment the effects of the above attributes is risk aversion. The interaction of risk aversion with variables used as proxies to capture credit risk multiplies their impact in the evaluation of government yield spreads (Haugh et al. 2009). While in times of low risk aversion the market assessment is abnormally low. The markets are either unwilling or incapable to measure accurately the true state of a sovereign issuer. (Manganelli and Wolsijk, 2007)

The relevant literature examines to what extent the above mentioned attributes are the causes of these diversities. The authors adopt different empirical methods, sample of countries and time frame. Different variables measuring credit risk, liquidity risk and the international risk factor.

The first attempt to investigate if and if so, in what degree the markets take into consideration the basic economic fundamentals of an issuer in their financial judgment was in 1984 from Edwards. In his paper he analyzes the determinants of the spread of the interest rate charged to a particular country over LIBOR by the international community. The

reasoning is that if a country presents higher probabilities of default then it should be charged a higher interest rate. If this probability reaches a certain level 'credit ceiling' then this country will not have access into the financial markets.

The author adopts a model to assess the default risk based on fundamental economic variables such as debt to output ratio, which will count for the solvency of the issuer. Another variable assessed is the debt service to exports ratio, which provides information regarding the possible liquidity problems faced by the country as well as other basic economic measures. The conclusions of the empirical analysis suggest that the international community, partially, takes into account the economical fundamentals of the country it finances.

Alesina et al. (1992) measure the price of default risk as the difference between the return from holding government debt and the return form holding 'safe' private debt of the corresponding maturity, denominated in the same currency. On average, in their sample of 12 countries in the period 1974 to 1989, the return on government debt is smaller than that on private assets, indicating that private assets are generally considered more risky than the government debt.

In their research they try to assess four statements.

- Firstly since the OECD governments have little changes of defaulting if they have the ability to roll-over the debt in 'reasonable' interest rates.

- Moreover, the highly indebted issuers may provoke a market confidence easier. If this crisis is characterized from elements of self-fulfillment, governments will have to compensate investors by offering them a higher return.

- The abovementioned return is augmented with the amount of the outstanding debt of the issuer and it is declined by the average age of its debt.

- The last matter is if during the deceleration of the business cycle the private sector interest rates are increased more than the public ones.

They come to the conclusion that public debt and interest rates charged by the markets are greatly correlated, however is applicable only for high indebt countries. Alessina et al. (1992) support that default risk is the origin of this premia. As well as the longer the maturity of the debt, the lower the premium is, though the evidence is quite feeble. Conclusively, the economic cycle is significantly correlated to spreads between the private and public interest rates.

Codogno, Favero and Missale (2003) examine the factors behind euro area countries bond yield spreads. Their results provide new evidence on the relative importance of the credit risk and liquidity by examining the role of macroeconomic fiscal fundamentals and liquidity indicators in explaining the movements in yield fluctuations.

They examine the EU 10 countries (without Luxemburg). Their data covers a period from December 1995 to October 2002, with monthly observations in order to capture the credit risk. They adopt this time frame because fiscal fundamentals fluctuate slowly during the time. While the data for the appropriate liquidity assessment model is daily covering a period of 8 months.

Their findings suggest that movements in the yield differentials in the euro zone government bonds are mostly explained by changes in international risk factors, as measured by the US Swap and the corporate bond spreads relative to US Treasury yields. The previous affects spreads through the perceived default risk of government bonds spreads in the euro zone. Finally liquidity factors play only minor role.

Geyer, Kossmeier and Pichler (2004) aim to explore the joined dynamics of yield spreads of euro area government bonds. They use weekly time series of yield differentials for selected countries, Austria, Belgium, Italy and Spain for maturities from 2 and 9 years. They find strong evidence for the presence of a global factor that captures the level of long term yield spreads. This leads to the conclusion that the joined variation of EMU spreads is driven by a set of common factors, rather than country specific reasons. In addition the above evidence props up the hypothesis of a small probability of failure of EMU and the reintroduction of the exchange risk. Moreover their results advocate that the differentials are related to euro corporate bond spreads and swap spreads. Finally there are no significant effects from the variables that capture liquidity risk such as market size or specialness.

Favero, Pagano and von Thassen (2005) implement a discrete-time general equilibrium model that combines the analysis of the Consumption Capital Asset Model (CCAPM) with the modeling of liquidity risk, where some consumers have to liquidate their assets permanently. Through this model they conclude that there is significant co movement to the German benchmark Bund.

Like other studies there is a common trend underlined which is highly correlated to international risk factors. The euro area yield differentials are mostly explained by a proxy of the international price of risk – the differential among high risk US corporate bonds and US government bonds at the corresponding maturity- something that it is in line with the relative literature. Meanwhile the liquidity spreads display high heterogeneity and cannot be explained by a common factor.

Bernoth, von Hagen and Schuknecht (2006) study the government bond yield spreads in a time frame from 1993 to 2005. Their contribution to the literature lies on the new data set which is made up from yields-at-issue spreads between German mark (DM) and US dollar denominated bonds issued by EU governments and Germany or the US government, respectively. In that way they treat euro denominated bonds of EMU states as a foreign currency debt. Hence they eliminate the exchange risk prior to EMU while the various tax regimes do not distort the evaluation.

Finally they adopt yields-at-issue in order to compare yields at different points in time. Their empirical findings suggest that there is significant relevance between spreads and the degree of indebtedness of the issuer. Moreover they conclude that after the introduction of the EMU the markets shifted their attention from government deficit and debt to debt to service ratio. They assume this turn occurred because the former had become highly politicized over the fiscal framework of EMU. Sovereign issuers with larger market in German mark or United States dollar pay significantly lower liquidity premiums that others with smaller size, however these differences in the euro denominated market have been vanished.

Manganelli and Wolswijk (2007) connect the market discipline, the financial integration and the fiscal rules. They decompose the spreads observed into the two main attributes the credit risk and the liquidity risk.

They conclude that the driving factor behind the evolution of spreads is one common international factor, just as most of the literature assess. This factor is related to the spreads of the corporate bonds over the government ones. They find evidence that these spreads are connected with the short term interest rates. According the compensation structure among the investor bankers, if the short interest rates are low, then the risk appetite increases, in search for better returns. Hence they prefer to invest more in bonds, consequently the spreads of the bonds decrease. Thus a positive correlation between short term interest rate and the spread of the corporate debt over the government one emerges.

According to the authors the diverge in spreads is caused either by credit risk which may be a result from market discipline, a signal for more sound fiscal policies, or by liquidity risk, as a consequence of market segmentation. If this is the case then there is a need for policies that will lead to higher integration.

Most researchers adopt the debt to or deficit to GDP as an appropriate proxy for default risk. However Manganelli and Wolswijk argue that the above measures are static, meaning that they do not capture the future sustainability of the economies. Instead the rating agencies take a more spherical aspect concerning the economy and its potentials.

Liquidity risk is identified through the AAA rating non benchmark bonds, since they have the same rating they will not include credit risk premiums. Credit risk premiums are identified by rating dummies and are measured by how much – in addition to the liquidity premium-countries with lower rating need to pay to attract risk averse investors. The authors use the evolution of the Credit Default Swap (CDS)[2] for the appropriate issue in order to robust checks for the credit risk.

Spreads have the tendency to be driven by the level of the short interest rate. Countries with lower ratings pay a higher credit premium. At the end both risks still exist meaning that the

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[2] As 'credit default swap' (CDS) is defined a contract between two counterparties. The 'protection buyer' makes periodic payments to the 'protection seller' and, in exchange receives a pay-off if the underlying entity defaults.

market discipline is still functioning , while there is further scope for financial integration in the euro area government bond market.

Schuknecht et al. (2009) examine the evolution of risk premium paid by central governments and sub national governments before and after the introduction of EMU. Sub central governments should pay higher risk premiums due to the small and the mobile tax bases. In Germany and in Canada applies the 'fiscal equalization scheme' this system is the transfer of funds from a state that has surplus to a state that has deficits. Hence the net recipients are paying a premium that does not respond to their true fiscal status. With the introduction of euro things changed, since more strict policies were implemented, such as the 'no bail out' clause of the Maastricht Treaty.

The data sample is 13 European countries and sub central governments of Germany, Spain and Canada. The time frame starts in 1991 and ends in 2005. As proxies for the credit risk are adopted fiscal balances and public debt. As far as the liquidity premium the authors take a different path from other researchers. The standard approach of bid ask spread is not applied since yields are yields-at-issue and in the first day of trading there are no bid ask spreads for such yields. Instead they make use of the market size; specifically they use the debt size of each issuer to proxy liquidity risk.

Their evidence suggests that yield spreads are correlated to indicators of fiscal performance. Before EMU the German states, under the 'fiscal equalization scheme' experienced lower risk premiums. After EMU and the introduction of the 'no-bail out' clause of the Stability and Growth Pact, the above changed. The market assessment of the credibility of the Spanish provinces did not changed over the examined period, since there is no equalization scheme as in Germany.

Beber,Brandt and Kavajecz (2008) assess if investors demand credit quality or liquidity. In times of turbulence does 'flight-to-quality' or 'flight-to-liquidity'[3] phenomena emerge? The answer is both at different times and for different reasons.

The data from EMU suggest that there is a negative correlation between quality and liquidity, while for US government the opposite holds. The intuition of the above is that fiscal discipline provides quality of credit, lower deficit or debt to GDP ratio. In the same time liquidity depends on the quantity of outstanding debt, which is decreased under the opposed fiscal discipline, holding the economy constant. A representative example is Italy, which even though it is treated as a relative high risk market is one of the most liquid ones. Hence the authors are based on the above to identify the two different phenomena.

Since there is no consensus on a single definition of liquidity, the authors use four different measures as proxies. They adopt the effective bid-ask spread, the average quoted path, the cumulative limit-order book depth and a liquidity index which equals the average quoted depth divided by the percentage bid ask spread.

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[3] 'Flight-to-liquidity' is defined when in economic distress; investors rebalance their portfolios towards more liquid securities.

Beber et al. (2008) conclude that when large movements observed in and out of the bond market, the explanatory power of liquidity is significant higher than quality. The previous dictates that investors during stressed periods prefer liquidity than credit quality.

Gomez-Puig (2006) studies the relative importance of domestic components of EMU sovereign yield spreads since the advent of EMU. The author, as others, uses credit ratings as a proxy for credit risk. The reason is that the previous may affect the credibility of the issuers and not the liquidity. Moreover is the best proxy in a model where the indebtedness is used as a proxy for market depth. The bid ask spread is applied to measure the trading costs of a typical investor and is an indicator of market tightness. The overall outstanding debt dictates the market depth. Last Gomez-Puig (2006) advocates that liquidity is self reinforcing while the size should play a key role since investors 'ex ante' prefer larger markets.

The adjusted spreads increased during the EMU, the reason may be a change in the market's evaluation of liquidity. In addition the credit premium is priced into the adjusted spreads and it is constant through the examined period i.e. before and after EMU. On the other hand the variable bid ask spread appears significant in both periods.

2.3 The impact of the financial crisis on the European government bond market

The European governments have successfully stabilized the financial system with the stimulus packages; however the issuers have undertaken substantial financial costs and credit risks. Through the stimulus packages a part of the credit risk from the financial sector transferred to the public one. This is observed in the evolution of the CDS premium and its evolution. Specifically CDS premia for insuring government debt was increased while the CDS premium for several European financial institutions was declined.

The strategies to overcome the financial crisis were similar over the members of the European Union. However there are differences in the assessment from the markets concerning the creditworthiness of the fiscal sustainability of different issuers. Before the escalation of the financial crisis government bond yield spreads were commoving, while after there is evidence of differentiation. By March 2009 the spreads for countries as Germany, France, the Netherlands, Belgium and Finland have fallen compared with January 2007, while there are constant for Austria, Spain, Italy and Portugal and increased for Greece and Ireland (ECB, Monthly Bulletin July 2009).

Schuknecht, von Hagen and Wolswijk (2010) examine the effects of the financial turmoil in the government bond yield differentials. First they investigate if the recent developments in public debt market are compatible with market rationality. Even though some support that markets acted not in the basis of economic principles, the authors support that before and after the crisis the markets evaluate sovereign issuers based on a set of macroeconomic variables, hence they function in a rational manner.

In addition, they assess while the increase in spreads is due to higher fiscal imbalances or if there is a change in the way the markets valuate credit risk. Their results suggest that the investors give more attention to the fiscal performance of an issuer than before. After the collapse of the Lehman Brothers the markets 'reward' sound fiscal policies while 'punish' countries with unsustainable fiscal strategies. Finally the German Bund has been characterized as a safe-haven investment which did not hold before the turmoil.

In the monthly bulletin of July 2009 the European Central Bank the authors decompose the yield spreads into three main attributes. The market's perception in credit risk is captured by the fiscal fundamentals of individual issuer. The liquidity risk is correlated to the market size and finally in the international risk aversion. In contrast to previous literature, authors capture credit risk by the expected fiscal positions of the countries rather than past and current states.

They come to the conclusion that after the crisis the bulk of the spreads are explained by higher expected budget deficits and debt ratios, higher international risk aversion and lower liquidity premium relative to Germany. Their evidence suggests that governments with more sound expected fiscal positions may gain from lower borrowing costs in times of economic crisis.

Attinasi, Checherita and Nickel (2009) adopt a dynamic panel approach to assess the driving factors behind the divergence among the sovereign issuers of euro zone. The data period starts in 31st of July 2007 and ends in 25th of March 2009. Hence it covers the beginning of the financial crisis and its escalation and its development to a fully economical crisis. As in other papers the credibility of the sovereign issuers is captured by the fiscal fundamentals while they focus on the impact of the announcements of the stimulus packages.

Their empirical evidence, in line with other researchers, dictates that countries with more favourable expected fiscal positions can benefit from lower borrowing costs. This leads to the idea of market discipline and the consolidation to the Stability and Growth Pact.

Moreover, 56% of the daily formation of spreads is attributed to variables that capture international risk aversion. The proportion for the expected budget balance and debt is up to 21% while the liquidity factors are responsible for 14%. Finally the announcements of stimulus packages contributed maximum up to 9%. Attinasi et al. (2009) advocate that the high percentage of risk aversion in explaining the government bond yield spreads can be related to the asperity of the financial crisis.

Furthermore, they conclude that credit reallocation from the private sector to the public one is not affected by the size of the stimulus package. The authors believe that the abovementioned has its origins in the evaluation by the markets of the credibility of sovereign commitment to provide support and not by the size of it.

Barrios, Iversen, Lewandowska and Setzer (2009) examine the evolution of the 10-years maturity government bond yield differentials from the dawn of the crisis in 2007. In the

same vain with the relevant literature they find that the international risk aversion is mostly responsible for the differences of the spreads of the sovereign issuers of euro zone. The idiosyncratic risks such as credit and liquidity risks still play a role but a minor one.

Their findings suggest that in times of growth and lower risk aversion, the cost of borrowing for the issuers will decrease substantially. In their model the fiscal variables have limited explanatory power, since for 1 percentage unit higher deficit, relative to Germany, a 2.4 base units increase will occur in the yield spreads. Finally the interaction between domestic factors and international risk aversion deserves special attention. In time of market stress investors are more willing to discriminate sovereign issuers based on their domestic factors.

During the period prior to the collapse of Lehman Brothers the interaction of unsound fiscal fundamentals and the international risk aversion was abnormally low. After the crisis there is evidence that they interact non-linear. Hence any potential distortions in the fiscal positions of sovereign issuers will lead to an even larger increase in the cost of borrowing (Haugh et al. 2009).

The estimation model of Haugh, Ollivaud and Turner (2009) is consisted by interaction terms that measure the effect from a difference of a fiscal variable and the increased impact this variable has to the level of spreads due to higher risk aversion. The authors decompose these effects and they conclude that for Ireland and Spain that the distortion of their fiscal positions was relatively higher, with risk constant, and played a major part in increasing the spreads. As far as the other countries of the sample their fiscal position did not change to a great extent, but the higher risk aversion rewarded or penalized the issuers significantly. For example countries such as Greece and Italy experienced increased spreads due to poor fiscal performance. On the contrary Finland was rewarded for its sound fiscal policy.

2.4 Policy implications

In this final part, the importance of the policy implications that stem from the assessment of government bond yield differentials is addressed. In general yield differentials are a good indicator of markets' assessment of fiscal sustainability of an issuer. Through higher spreads and consequently higher cost in debt service, markets impose discipline on sovereign fiscal strategies (Codogno et al., 2003). Moreover, taking into account the recent developments in the financial sectors, one can support that expansionary fiscal policies may impose higher debt service costs.

Public finances and financial markets are interconnected. Government debt plays a major part in the financial markets by setting a benchmark for interest rates. In addition the amount of government bonds traded in the capital markets outcomes other securities in terms of quantity. In parallel investors assess the fiscal position of an issuer and transform it to judgment. The previous affects the interest rates the sovereign issuers have to pay in order to finance expenses. Hence if investors' perception about the risk of the issuer increases the government will face a higher cost in serving their debt. Hence markets 'reward' or 'punish' by demanding diverse returns based on the fiscal position of the issuer.

Moreover, countries with excessive deficits and debts present higher potential risk of default, thus markets demand a higher return to overtake such an investment. In the extreme case if a country exceeds a certain threshold of unsound fiscal fundamentals, the markets can refuse to refinance it. In this case the possibilities of the above country to default are particularly high.

Taking the previous into consideration it can be stated that the markets through the process of valuation of debt can impose discipline in policy makers. Market discipline is implemented to ensure the fiscal sustainability[4] of governments.

In order for market discipline to be in place certain prerequisites must applied. First the governments must have equal access to markets as others agents. In addition there must not be any pressure from the government to financial institutions to buy their bonds. The avoidance of a bail out and sound information about the fiscal statistics of a governments. Precisely governments have to publish in time and accurate fiscal statistics, which will need to address medium term fiscal developments without a subjective behavior.

As far as policy makers they must react immediately to markets assessment concerning their fiscal strategies. It is straightforward that expansionary fiscal policies will eventually lead to increased deficits and debts. A number of strategies such as the issuance of long term bonds at fixed rates cuts off short term upsides; however it is considered costly. Furthermore, by adopting this strategy governments avoid the refinancing risk, the roll-over risk.

In terms of portfolio diversification the study of government bond yield spreads is intuitive. After the introduction of euro a vast reallocation of portfolios was observed. Though after the first year of the monetary union there were signs of 'passive diversification'. Several investors considering the high transaction costs decided to reinvest in coupons and redemptions.

The spreads of the government yield spreads converge substantially in the pre-EMU and after-EMU era, however not fully. Even issuers with the same ratings present differences in their differentials. The previous strongly supports the idea that the euro zone governments bonds are far from 'perfect substitutes', hence there is still room for portfolio diversification.

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[4] Fiscal sustainability is regarded the capability of an issuer to meet its debt obligations. The precondition is for the government to satisfy its intertemporal budget constrain. The outstanding debt of an issuer should be equal to the discounted present value of coming primary balances.

3. Empirical part

3.1 Data analysis

The lower interval of the sample period concerning Portugal, Italy, Spain and Germany is January 1996, while for Ireland is January 1997 and for Greece is January 2000. The upper interval is December 2009; it counts for all countries under consideration. The reason behind the choice of the time period is twofold. First the period provides a considerable amount of observations. Hence the explanatory power of the model is amplified. In addition the time period covers the economical turmoil of the financial system started in July 2007 and its escalation in September 2008 after the collapse of the Lehman Brothers. Through this sample period a number of different financial environments is covered and assessed.

Due to the fact that the proxies capturing domestic risk factors, debt-to-GDP ratio and deficit-to-GDP ratio, have low frequency, the best fit of observations is monthly. Annual observations can be adopted to assess the above risk but the number of observations will be limited. Consequently the obtained results will not be so representative. While daily observations can be qualified to capture liquidity risk which is a high frequency risk. Thus monthly observations seem to be the best choice for this research. The fiscal fundamentals, debt and deficit, were available only in quarterly and annually frequency respectively. So for the model to be coherent the values converted to monthly.[5] The data sources used for this examination are Datastream and Eurostat.

3.2 Model specification

As discussed above the timeframe of the sample period contains observations from pre EMU and after EMU era. For the sample to be consistent the exchange rate of the pre EMU period should be excluded. Favero et al. 1997 propose that a measure of the yield differentials irrelevant to exchange risk can be acquired by evaluating the differentials of assets from two issuers in their domestic currencies and the spreads in the above currencies , with the same maturity issued by the same subject. Three measures are the most appropriate for the above. First long term bonds issued by an international institution such as the European Investment Bank. Second measure could be the private sector's long term bonds and finally the fixed interest rates on swap contracts.

However the caveats of the differentials from the first two measures seem to be larger. Hence the differential on fixed interest rate swap contracts could be adopted as a measure of the exchange risk component of the yield spreads of government bonds. As an interest rate swap is defined a contract among two parties to exchange a number of interest payments but not the underlying debt. Hence the credit risk of the asset in not embodied into the level of the fixed interest rate on the swap contract. Indeed, figure 5, shows the

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[5] The values taken from Eurostat were quarterly for debt-to-GDP ratio and annually for deficit-to-GDP ratio. Thus an alteration to monthly took place. For example the deficit-to-GDP ratio for Greece in 2000 was -3.7; hence each monthly observation in 2000 has a value of -3.7.

evolution of the fixed interest rates on swap which is minimized as the process of convergence of EMU countries took place and becomes zero with the introduction of the common currency. Table 1 shows summary statistics on yield differentials, in which the exchange risk factor is excluded from the total yield spreads.
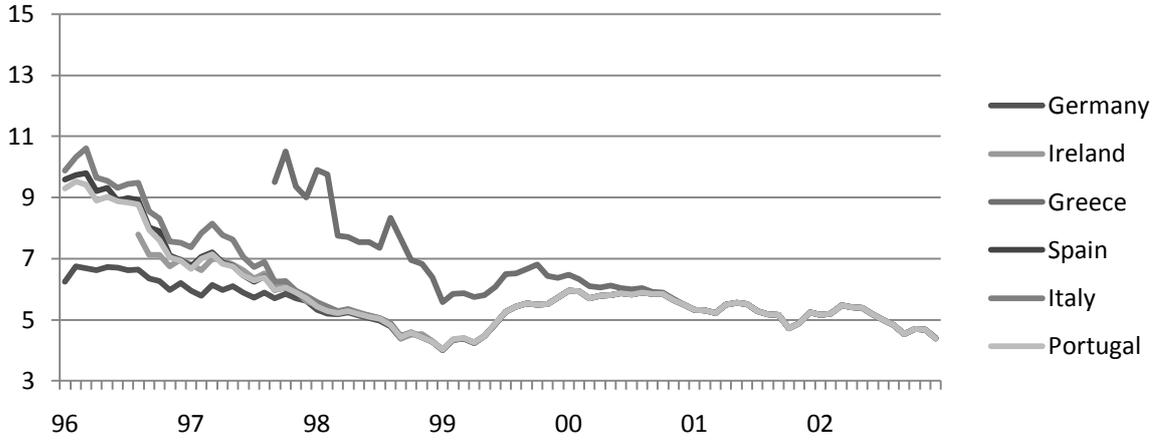

Figure 5. Fixed interest rate on swap of PIIGS countries and Germany
Note: Swap rates are in percentage annual terms.
Source: Datastream

In line with literature (Favero et al. 1997, Codogno et al. 2003), the measurement of the components of yield spreads irrelevant to exchange risk factors is constructed as

$$RAS_t^i = \left(R_t^i - R_t^{GER}\right) - \left(RSW_t^i - RSW_t^{GER}\right) \tag{1}$$

where RAS_t^i is the relative sset swap differential of country i, R_t^i and R_t^{GER} are the yields to maturity of 10-year government bonds of country i and Germany respectively, while the variables RSW_t^i and RSW_t^{GER} are the 10-year fixed interest rates on swaps denominated in currency i and deutschemarks respectively. The variable RAS_t^i will be the dependent variable of the empirical model. The empirical model that is going to be implemented is

$$RAS_t^i = \alpha + \beta_1 RAS_{t-1}^i + \beta_2\left(RDG_t^i - RDG_t^{GER}\right) + \beta_3\left(RDTG_t^i - RDTG_t^{GER}\right) + \beta_4\left(R_t^{SP,US} - R_t^{US}\right) + \beta_5\left(R_t^{C,US} - R_t^{US}\right) + u_t^i \tag{2}$$

where RAS_t^i is the relative asset swap for country i, $\left(RDG_t^i - RDG_t^{GER}\right)$ is the deviation of country i's deficit-to-GDP ratio from Germany's deficit-to-GDP ratio, $\left(RDTG_t^i - RDTG_t^{GER}\right)$ the deviation of country i's debt-to-GDP ratio from Germany's debt-to-GDP ratio, $\left(R_t^{SP,US} - R_t^{US}\right)$ is the spread between 10-year fixed interest rate on US swaps and the yield on 10-year US government bonds and $\left(R_t^{C,US} - R_t^{US}\right)$ is the spread between the yield on Moody's Seasoned BAA US corporate bonds and the yield on 10-year US government bonds. The debt-to-GDP and deficit-to-GDP are the most common measurements adopted by the researchers to identify the domestic risk factors of sovereign issuers. The differentials between the 10- year fixed interest rate on US swap and the yield on 10-year US government bonds as well as the spread between the yield on Moody's Seasoned BAA US

Table 1. Asset swap spreads and swap differentials

	Portugal	Italy	Ireland	Greece	Spain
Sample Jan 1996- December 1999					
Total yield differential	2.715	3.577	1.177	n. a.	2.854
Relative asset swap spread	0.234	0.707	4.703	n. a.	0.372
Swap differential	2.481	2.870	-3.525	n. a.	2.482
Sample Jan 1999- December 2002					
Total yield differential	0.394	0.609	0.298	0.474	0.247
Relative asset swap spread	0.394	0.609	0.298	0.405	0.247
Swap differential	0.000	0.000	0.000	0.069	0.000

Source: Datastream

corporate bonds and the yield on 10-year US government bonds are used as proxies to quantify banking and corporate risk premiums. In addition there is empirical evidence that the latter variables are appropriate proxies to measure international risk (Codogno et al. 2003).
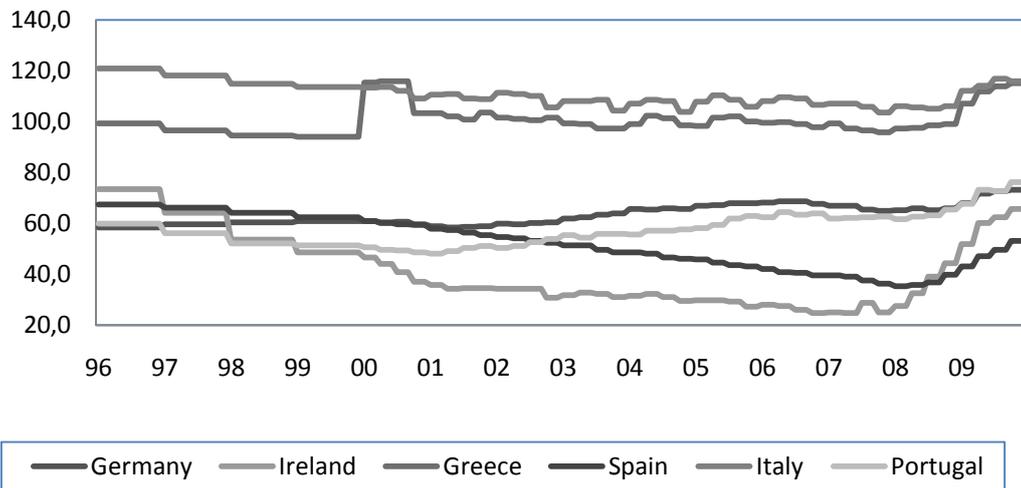

Figure 6. Debt to GDP ratios of PIIGS countries and Germany
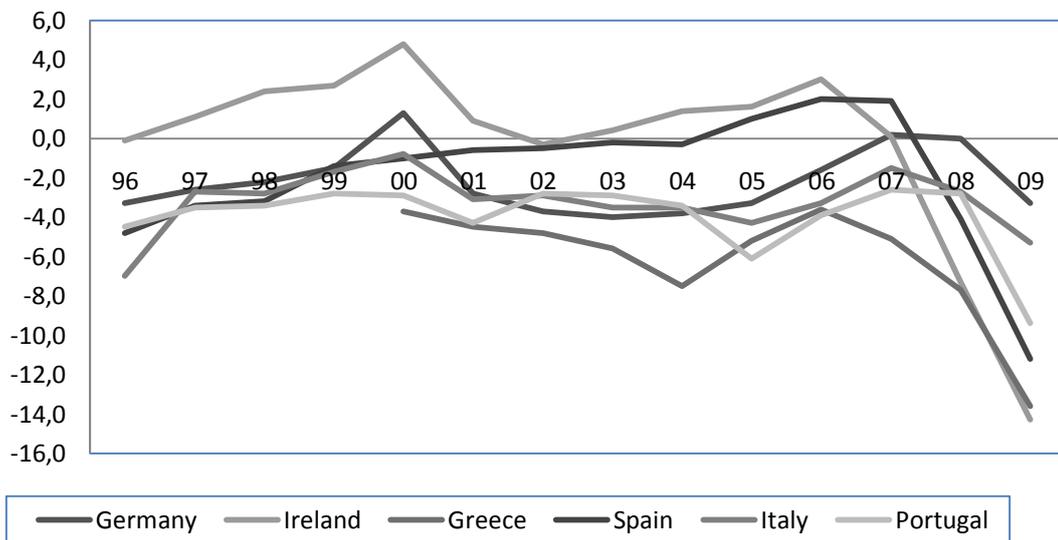*Source*: Eurostat

Figure 7. Deficit to GDP ratios of PIIGS countries and Germany
Source: Eurostat

Table 2. Model specification tests

	Test Hypothesis	Portugal	Italy	Ireland	Greece	Spain
Normality Test	H_0 : Errors normally distributed H_1 : not H_0	$P - value < a$ Rejected	$P - value < a$ Rejected	$P - value < a$ Rejected	$P - value < a$ Rejected	$P - value < a$ Rejected
Wald Test	$H_0 : \beta_1 = 0, \beta_2 = 0, \ \beta_3 = 0 \ \beta_4 = 0$ $\beta_5 = 0$ H_1: not H_0	$P - value < a$ Rejected	$P - value < a$ Rejected	$P - value < a$ Rejected	$P - value < a$ Rejected	$P - value < a$ Rejected
Homoskedasticity Test (White Test)	H_0 : Homoskedasticity H_1: Heteroskedasticity	$P - value < a$ Rejected	$P - value < a$ Rejected	$P - value < a$ Rejected	$P - value < a$ Rejected	$P - value < a$ Rejected
Serial Correlation Test (Breusch-Godfrey Test)	H_0 : No serial correlation H_1: not H_0	$P - value < a$ Rejected	$P - value > a$ Fail to reject	$P - value < a$ Rejected	$P - value < a$ Rejected	$P - value > a$ Fail to reject

Notes: Level of significance $a = 0.05$

Table 3 reports the results of certain model specification tests. The model lacks in terms of normal error distribution. Furthermore, there is significant evidence of heteroskedasticity in the paradigm specification as well as presence of serial correlation. Even though a lag variable of the depended one is added, serial correlation cannot be avoided. The above does not stand true for all countries. As the table presents there is evidence that there is no serial correlation for Italy and Spain. Thus the results obtained from this model specification should be treated with a certain level of prejudice.
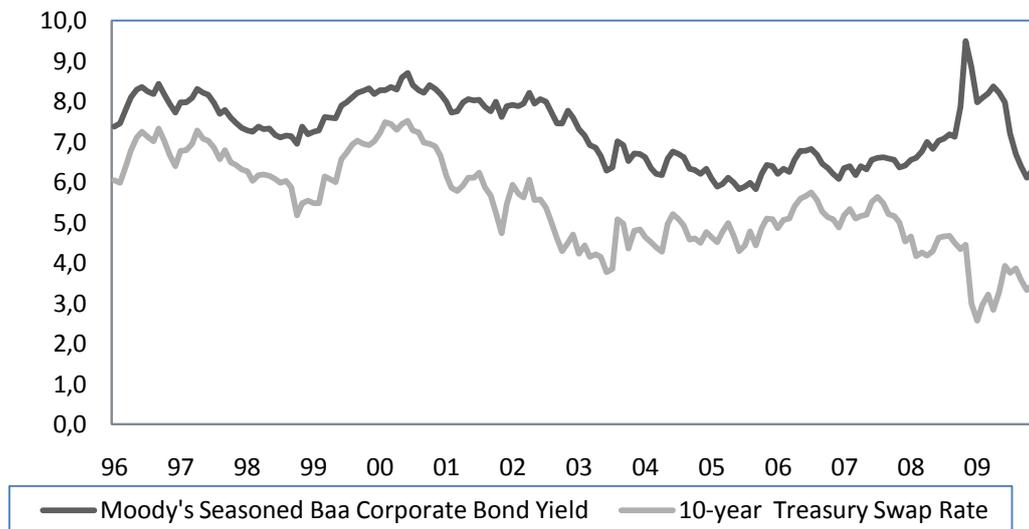

Figure 8. Exogenous measures of international risk premiums
Note: Yields are in percentage annual terms.
Source: Datastream

3.3 Results

In Figure 6, 7 and 8 the time series evolution of all regressors is reported. Table 2 reports the results obtained from the empirical assessment of the model while the coefficients that are not significant at 10% level are omitted.

For Portugal the proxies concerning domestic risks are both significant at a level of 5 %. It is apparent that equally the deficit-to-GDP ratio and debt-to-GDP ratio play a role in determining the yield differential of Portugal's 10-year maturity bonds. However the measures of international risk present higher coefficients. The above suggests that in the process of pricing the public debt of Portugal, international risk factors play a larger role than the idiosyncratic ones.

As far as Italy one should expect that the high debt-to-GDP ratio, over 105 % of GDP for all the period, would play an important role in determining the yield spreads. However as it is shown in table 2, only the variable of deficit is significant. The previous may has its origins in the fact that the debt of Italy even though it is extremely high and well above the threshold

of the Stability and Growth Pact, it appears quite constant over the period under examination, while the fluctuations of the deficit-to-GDP ratio are quite high. Thus one can conclude that investors take the previous into consideration when they determine the credit premium for holding Italian debt. Another finding that is in line with previous empirical research is the influence of international risk factors in pricing Italian government bonds.

Ireland is the country of the sample that its financial system was more integrated into the global one. As a result the consequences of the financial crisis were more severe than the others from the PIIGS block. This one is captured in the model by the coefficient as well as the high level of significance of the proxy about international risk factors. The latter coefficient is 5-6 times higher than the coefficient of deficit-to-GDP and considerable higher than the debt –to-GDP ratio. However the domestic risk proxies still play a part in determining the Irish debt by the financial markets. As in the case Portugal the driving factor behind capturing domestic risk is the deficit of general government and not the debt.

As above according to our results the main determinant of the yield spreads of 10-year government bond for Greece is the international risk factors as this one is captured by the difference of the Moody's Seasoned 10-year Baa corporate bonds to the 10-year maturity US Treasury bonds. The idiosyncratic reasons play a minor role. The above is reflected in the low coefficient of the variable deficit-to-GDP ratio, while the other proxy is significant at a level of 10 %.

Finally Spain follows the same outline concerning the driving factors behind the evolution of its cost of borrowing. As before the international risk factors are highly significant. In contrast to Greece and Italy both idiosyncratic risk proxies are significant at a level of 1 %. As it is shown in table 2 the variable deficit-to-GDP ratio is the one that affects mostly the investors' assessment about the fiscal position of Spain.

To sum up for all of the PIIGS countries the international risk factors play the major role in assessing their 10-year maturity government bond yield spreads. Additionally, for the entire sample the variable deficit-to-GDP ratio is the one that represents the idiosyncratic risk factors in contrast to debt-to-GDP ratio that is either less significant or insignificant at all. It is evident that the government bonds of these countries are treated as imperfect substitutes to other European sovereign issuers. Moreover, one can assume that during the sample period the markets where not so willing to discriminate issuers based on their fiscal performance. The above behaviour altered after the collapse of the Lehman Brothers in September 2008. Therefore, in order to assess the impact of the financial crisis in the way that markets determine the sovereign debt of the countries under consideration, a test is performed with different time frame. Specifically the sample period is changed and it covers a period from January 2007 up to December 2009. The reason is to examine if there are any differences in the driving factors behind the evolution of government bond yield spreads, the results are provided in table 3.

During this period two are the main determinants of Portuguese government bond yield spreads. As far as the domestic risk factors these are captured only by the deficit-to-GDP variable. In this timeframe this proxy is more significant than the whole sample period at a significant level of 1%. The coefficient is 8 times higher than the previous analysis. The

Table 3. Model estimates

	Portugal	Italy	Ireland	Greece	Spain
Sample	1996:1 2009:12	1996:1 2009:12	1997:1 2009:12	2000:1 2009:12	1996:1 2009:12
α	-0.09* (0.030)	-	-0.01*** (0.078)	-0.22** (0.098)	-
β_1	0.63* (0.056)	0.53* (0.059)	0.565* (0.053)	0.75* (0.052)	0.27* (0.076)
β_2	0.01** (0.004)	0.04* (0.009)	0.02* (0.005)	0.02* (0.007)	0.02* (0.003)
β_3	0.007** (0.003)	-	0.003* (0.001)	-	0.002* (0.0007)
β_4	0.09** (0.041)	-	-	-	-
β_5	0.06* (0.012)	0.11* (0.017)	0.13* (0.023)	0.08* (0.020)	0.06* (0.013)

Notes: Estimation method: OLS. Standard errors are in parentheses. *, **, ***, significance level 0.01, 0.05 and 0.1 respectively. The estimation model is

$RAS_t^i = \alpha + \beta_1 RAS_{t-1}^i + \beta_2\left(RDG_t^i - RDG_t^{GER}\right) + \beta_3\left(RDTG_t^i - RDTG_t^{GER}\right) + \beta_4\left(R_t^{SP,US} - R_t^{US}\right) + \beta_5\left(R_t^{C,US} - R_t^{US}\right) + u_t^i$, where RAS_t^i is the relative asset swap for country i, $\left(RDG_t^i - RDG_t^{GER}\right)$ is the deviation of country i's deficit-to-GDP ratio from Germany's deficit-to-GDP ratio, RAS_{t-1}^i is the relative asset swap for country i lagged 1 period, $\left(RDTG_t^i - RDTG_t^{GER}\right)$ the deviation of country i's debt-to-GDP ratio from Germany's debt-to-GDP ratio, $\left(R_t^{SP,US} - R_t^{US}\right)$ is the spread between 10-year fixed interest rate on US swaps and the yield on 10-year US government bonds and $\left(R_t^{C,US} - R_t^{US}\right)$ is the spread between the yield on Moody's Seasoned BAA US corporate bonds and the yield on 10-year US government bonds

deterioration of fiscal fundamentals, observed after the collapse of Lehman Brothers, is reflected in the latter attribute. The international risk factors play the important role in pricing the Portuguese government bonds. The coefficient is more than double than the previous sample period. This comes as a result of the increase in risk averse observed after the escalation of the financial turmoil in September 2008.

The same pattern for Italy is observed. The deficit-to-GDP component is significant and its effect on the determination of yield spreads is 4 times higher than before. The international risk factors still account for most part of the assessment of sustainability of public debt.

An interesting finding concerns Ireland. While in the previous time period idiosyncratic reasons played a significant part in the determination of the yield spreads, during the new period none of the proxies are significant. The only driving force behind the evolution of the Irish cost of borrowing is international risk factors and the coefficient is equal to the one before.

The results for Greece are as expected. During this period the deficit-to-GDP ratio presents a coefficient 4 times higher than the previous time. In this case the proxy debt-to-GDP ratio is significant in contrast to the previous one. It is apparent that idiosyncratic reasons of the Greek fiscal position play an important role in pricing Greek government bonds. A rational outcome if one takes into account the high deficit of Greece, more than 13,6% and a debt-to-GDP ratio equal to 119%. In addition, a finding similar to the other countries is the increased international risk components. Their coefficient is 3 times higher than before. As it was stated above this outcome is related to the increase in risk aversion the last years.

The last country of the sample is Spain. As in the previous test the international risk play a major role in evolution of the yield spreads of 10-year maturity government bonds. Specifically the coefficient regarding this component is double. In contrast to the whole sample period the deficit-to-GDP ratio is not significant while the debt-to-GDP is the representative component of the domestic risk factors.

All in all, it is evident that the increase in risk aversion influenced to a greater extent the evolution of yields spreads. For Portugal, Italy, Greece and Spain the coefficient of the proxy capturing the international risk factors has been amplified, while for Ireland is still the same. In contradiction to the previous results there are differences in how domestic risk factors are expressed.   As before for Portugal and Italy the independent variable deficit-to-GDP ratio is the one that captures the idiosyncratic risks. For Ireland during the period of the financial crisis none of the proxies capturing domestic risk factors are significant. The latter is not consistent with the fiscal position of Ireland, since the deficit-to-GDP ratio is quite high. Spain's debt seems to account more for markets in their procedure of assessing the credit risk. Furthermore, Greece's unsound fiscal fundamentals play a more central role in the second period, a finding which is consistent with market rationality. Finally for all countries the coefficients for all the proxies that are significant are augmented. A sign that markets were more keen on discriminating sovereign issuers based on their fiscal fundamentals as well as 'penalized' unsound fiscal positions more strictly.

Table 4. Model estimates

	Portugal	Italy	Ireland	Greece	Spain
Sample	2007:1 2009:12	2007:1 2009:12	2007:1 2009:12	2007:1 2009:12	2007:1 2009:12
α	-0.49* (0.158)	-	-	-2.21** (0.874)	1.28** (0.583)
β_1	0.27*** (0.136)	-	0.39** (0.145)	0.38* (0.103)	-
β_2	0.08* (0.027)	0.17** (0.079)	-	0.09** (0.044)	-
β_3	-	-	-	0.07** (0.029)	0.05** (0.027)
β_4	-	-0.36** (0.178)	-	-	-
β_5	0.14* (0.027)	0.27* (0.042)	0.13** (0.053)	0.27* (0.046)	0.13* (0.039)

Notes: Estimation method: OLS. Standard errors are in parentheses. *, **, ***, significance level 0.01, 0.05 and 0.1 respectively.

$RAS_t^i = \alpha + \beta_1 RAS_{t-1}^i + \beta_2\left(RDG_t^i - RDG_t^{GER}\right) + \beta_3\left(RDTG_t^i - RDTG_t^{GER}\right) + \beta_4\left(R_t^{SP,US} - R_t^{US}\right) + \beta_5\left(R_t^{C,US} - R_t^{US}\right) + u_t^i$, where RAS_t^i is the relative asset swap for country i, $\left(RDG_t^i - RDG_t^{GER}\right)$ is the deviation of country i's deficit-to-GDP ratio from Germany's deficit-to-GDP ratio, RAS_{t-1}^i is the relative asset swap for country i lagged 1 period, $\left(RDTG_t^i - RDTG_t^{GER}\right)$ the deviation of country i's debt-to-GDP ratio from Germany's debt-to-GDP ratio, $\left(R_t^{SP,US} - R_t^{US}\right)$ is the spread between 10-year fixed interest rate on US swaps and the yield on 10-year US government bonds and $\left(R_t^{C,US} - R_t^{US}\right)$ is the spread between the yield on Moody's Seasoned BAA US corporate bonds and the yield on 10-year US government bonds

4. Concluding remarks

The main driving factor behind the evolution of government bond yield spreads are the international risk factors as they are captured by the difference of Moody's Seasoned BAA corporate bonds relative to US Treasury bond yields. The proxies who represent idiosyncratic risk factors in the model, namely deficit-to-GDP ratio and debt-to-GDP ratio, affect the assessment of yield spreads, especially the deficit-to-GDP ratio, however in a smaller degree.

There is evidence that the impact of the international risk factors and the domestic risk factors magnified during the period from January 2007 to December 2009. Specifically the idiosyncratic risk factors as measured by fiscal fundamentals account multiple times more than in the period of economic prosperity. The latter is applicable for Greece, Italy, Portugal and Spain. For Ireland the domestic risk factors are not significant at a level of 10% which comes into contrast to the fiscal position of the country.

In general the results are in line with literature concerning the change in behavior of markets in assessing the fiscal positions of sovereign issuers (Manganelli and Wolswijk 2009). In the years before and just after the introduction of EMU an enormous convergence in yield spreads took place. Financial markets were either unwilling or incapable to discriminate issuers based on their fiscal performance. The previous mentality changed during the financial crisis of 2007. The increase in risk averse led investors to assess sovereign fiscal position in a stricter manner. From that point and on markets 'reward' sound fiscal policies while they 'penalize' countries with irresponsible fiscal policies.

The previous dictate the need of consolidation of member states of EMU, especially members of the PIIGS block to the Stability and Growth Pact. In this vein Greece and Ireland have implemented stability packages in order to manage their unsound fiscal position. Through these policies these countries will gain again the market confidence. Consequently their cost of borrowing will return to levels which will guarantee their fiscal sustainability.

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