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**Determinants of sovereign bond yields empirical
evidence from quantile regression**

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This study investigates the determinants of sovereign bond yields in some distinctive countries among the Eurozone. The methodology that is used to test the determinants of the sovereign bond yields is the quantile regression. The regression examines the relation between the below determinants and the 10th, 50th and 90th quantile. The tests are applied to volatility index, overnight index swap, debt to GDP and inflation for the time period from 2003 to 2014. The findings indicate various results for specific quantiles.

Keywords

Quantile, debt to GDP, inflation, OIS index, VIX index

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Introduction

Government bond is a bond issued by a national government with a promise to pay periodic interest payments and to repay the face value on the maturity date. Government bonds sometimes are similar to sovereign bonds but usually this term is used to refer to bonds issued in a currency other than the sovereign's currency. The foreign currency used will be a hard currency and may represent significantly more risk to the bondholder. That risk may be credit risk, currency risk or inflation risk. The currency risk may take place when the value of the currency that a bond pays out will decline compared to the holder's reference currency and the inflation risk is the risk that the value of the currency a bond pays out will decline over time. There are some ways to protect against the above risks. First of all is the research, by analyzing the country's ability to pay and deterring if it is likely to have the willingness to pay. Also by diversification we can reduce the sovereign credit risk. Sovereign bonds are among the safest investments in most countries because countries want to be able to continue borrowing, so they make a high priority of paying back debt. Another reason is that even if countries are not credit worthy their sovereign bonds are safer than other domestic alternatives.

When the European Monetary Union started, the spreads on the 10-year sovereign bond yields relative to German benchmark were small but when the sovereign debt crisis in the EMU escalated the Greek sovereign bond spread had reached about 1000 basis points from the previous 300 basis point. That led the investors to have doubts against certain EMU governments.

Previous literatures suggest as potential determinants of sovereign bond yields the time – varying factor (risk aversion) and country specific factor (liquidity). Also they separate them as long run (debt to GDP) and short run determinants (inflation, short term interest rates).

Estrada et al. (2012), notes that the persistent inflation differentials may be a good phenomenon if it is explained by a structural convergence process according to a Balassa–Samuelson type of argument, and the source of long-lasting and damaging

losses of competitiveness. But in order the previous argument to hold the inflation rates should be positively correlated with the difference between labor productivity growth in the traded versus non-tradable sectors. This effect can partially explain the inflation differentials in the euroarea because of Estrada et al. 2012. Especially he argues that the heterogeneous inertial components of price and wage-setting rules across the EMU, such as those caused by wage index action clauses, play a predominant role. De Grauwe and Ji (2012), as far the EMU fixed exchange rate regime, noted that if a country experiencing a real appreciation is likely to bump into problems of competitiveness which in turn may lead to current account deficits and debt problems. Faini, 2006, Laubach, 2009 find out that the effect of fiscal policy on interest rates is larger when the fiscal deficit rather than public debt is included as an explanatory variable. Laubach, 2009 supports that the effects of fiscal policy are larger when expectations of future fiscal policy rather than actual values of the debt and deficit are used. The impact on interest rates of a change of 1% of GDP in the fiscal deficit ranges from 10 basis points to 60 basis points Haugh et al. 2009. There are studies that have looked to the impact of external debt, debt service or current account Cantor and Packer, 1996, Edwards, 1984 fiscal variables, like fiscal debt and deficits Cantor and Packer, 1996; Rowland and Torres, 2004 or their composition Akitoby and Stratmann, 2008 and inflation, Min, 1998. McGuire and Schrijvers 2003 find that global risk aversion is a major factor driving spreads, Eichengreen and Mody (2000) and Bellas et al. (2010) show that changes in market sentiment also affect spreads. Gonzalez-Rozada and Levy-Yeyati (2008) find that besides to global risk aversion, global liquidity plays a key role. Hartelius et al. (2008) and Dailami et al. (2008) have found similar results for the U.S. interest rates. For sovereign bond yields Baldacci and Kumar (2010) find that in periods of financial distress, defined as periods of high levels of the VIX index, high inflationary pressures, and more adverse global liquidity conditions—fiscal deterioration has a larger impact on bond yields. The VIX threshold used in their analysis is chosen exogenously. Favero et al. (2010) relies on regressions of yield spreads on fundamental variables representing credit, liquidity, and international risks. Credit and liquidity risks are used to explain the differences in the Euro area bond spreads since the start of the debt crisis in 2009. Some papers have found evidence for the importance of the country's situation in determining the sovereign bond yields because they depend on the fiscal position and ability to honor its commitments. Bayoumi et al. (1995) find evidence of the impact of

the debt level on bond spreads for the U.S..There are also more papers for Eurozone that conclude to the same results (Hallerberg and Wolff (2006), Faini (2006). But there are also some other factors behind the movements in the sovereign bond yields spreads such as the international risk aversion and financial contagion. Manganeli and Wolswijk, 2009 identified as critical factors behind the level of sovereign bond spreads in the Eurozone the market liquidity, cyclical conditions and risk appetite (short-term rates). Attinasi et al. (2011), control for the effect of such factors on euro area sovereign bond spreads vis-à-vis German sovereign bonds and De Santis explores the impact of contagion from Greece to other Eurozone countries.

We try to contribute to the previous literature by performing an analysis based on the quantile regression among some main determinants of sovereign bond yields. We analyze the behavior on three different quantiles, specific in the 10th, 50th and 90th quantile for different maturities the time period of December 2003 until December 2014 in 4 EMU countries (Greece, Germany, Italy and Netherlands).

The remaining of the paper proceeds as follows; Section 2 is the literature review on the topic of determinants of sovereign bond yields, categorized based on which methodology is used, Section 3 describes the tests for these determinants, the data that have used and the descriptive statistics are presented, in Section 4 the results are analyzed, while Section 5 concludes.

Literature review

Debt crisis and affect on the countries

The European debt crisis means that Europe countries struggle to pay their debts as they rise in the recent decades. Especially Greece, Portugal, Ireland, Italy and Spain have failed to generate enough economic growth in order to pay back to the bondholders the guarantee.

Although these five countries encounter the immediate danger to default the crisis has its depths that extend beyond Europe borders to the whole world. Some said that it is the most serious financial crisis since the 1930s.

The financial crisis begins when the global economy experienced slow growth since the US financial crisis. That exposed the unsustainable fiscal policies of countries in Europe. Greece for example spends a lot for years and failed to undertake fiscal reforms. For that reason it was one of the first to have weaker growth and that leads to tax revenues which in turn lead to make high deficits unsustainable. Greece's debts where so large that exceed the size of the nation's entire economy, so the country can no longer hide their problem. Investors respond by demanding higher yields on Greece's bonds which raised the country's debt more. For that reason the European Union and the European Central Bank necessitate a series of bailouts. The markets began to drive up bond yields in other heavily indebted countries in the region.

The reason for rising bond yields is reflected by the following: If investors see higher risk associated with investing in a country's bonds they will require a higher return to compensate them from the risk. That leads to cycle. The demand for higher yields equates to higher borrowing costs for the country in crisis which leads to fiscal strain sand investors demand even higher yields and so on. When an investor loses his confidence it affects not only the country with bond yield but similarly weak finances (contagion).

The European Union tries to take action but it has moved slowly because it requires the consent of all nations in the union. Their primary action has been a series of

bailouts for Europe's trouble economies. But when Greece disburse 110 billion euro due to failed fiscal policies required more disburse with 157 billion. Portugal and Ireland also received bailouts. For that reason created the European Financial stability (EFSF) to provide emergency lending to countries with problematic economy. The European Central Bank (ECB) also involved. ECB announced a plan to purchase government bonds in order to keep yields from spiraling to a level Italy and Spain could no longer afford. In 2011 ECB made 489 billion euro in credit available to the troubled banks at very low rates and then followed with another round in 2012. They named that Long Term Refinancing Operation. Many institutions had debt coming due to 2012 and that cause them to hold on to their reserves rather than extend loans. That led to slower loan growth and made crisis worse. As a result ECB had to boost the bank's balance sheets to help forestall this potential issue. These actions help to stabilize the financial markets in the short term, but a larger issue was revealed. While smaller countries such as Greece are small enough to be rescued by the European Central Bank, Italy and Spain are too big to be saved. In 2012, the crisis reached a turning point when European Central Bank President Mario Draghi announced that the ECB would do "whatever it takes" to keep the Eurozone together. That led the yields in the troubled European countries fell sharply during the second half of the year. While that state didn't solve the problem, it made investors more comfortable buying bonds of the region's smaller nations. Lower yields, in turn, have bought time for the high-debt countries to address their broader issues.

Today, yields on European debt have plunged to very low levels. The high yields of 2010-2012 attracted buyers to markets such as Spain and Italy, driving prices up and bringing yields down. This indicates greater investor comfort with taking the risk of investing in the region's bond markets but the crisis lives on in the form of very slow economic growth and a growing risk that Europe will sink into deflation. The European Central Bank has responded by slashing interest rates, and it appears on track to initiate a quantitative easing program similar to that used by the U.S. Federal Reserve in the United States.

European banks remain one of the largest holders of region's government debt, although they reduced their positions. Banks are required to keep a certain amount of assets on their balance sheets relative to the amount of debt they hold. If a country defaults on its debt, the value of its bonds will plunge. For banks, this could mean a

sharp reduction in the amount of assets on their balance sheet – and possible insolvency. Due to the growing interconnectedness of the global financial system, a bank failure doesn't happen in a vacuum. Instead, there is the possibility that a series of bank failures will spiral into a more destructive contagion

The best example of this is the U.S. financial crisis, when a series of collapses by smaller financial institutions led to the failure of Lehman Brothers and the government bailouts or forced takeovers of many others. Since European governments are already struggling with their finances, there is less latitude for government backstopping of this crisis compared to the one that hit the United States.

The possibility of a contagion has made the European debt crisis a center point for the world financial markets in the 2010-2012 period. The investors usually sell anything risky, and buy the government bonds of the largest, most financially sound countries. European bank stocks performed much worse than their global counterparts during the times when the crisis was on center stage. The bond markets of the affected nations also performed poorly, as rising yields means that prices are falling. In the meantime U.S. Treasuries fell to historically low levels in a reflection of investors' flight to safety. When Draghi announced the ECB's commitment to preserving the eurozone, markets rallied worldwide bond and equity markets in the region have rise up

The political implications of the crisis were enormous. In the affected nations, the push toward austerity led to tensions between the fiscally sound countries, such as Germany, and the higher-debt countries such as Greece. Germany pushed for Greece and other affected countries to reform the budgets as a condition of providing aid, leading to elevated tensions within the European Union.

Germany's push for austerity was problematic because it leads to slower growth, which means lower tax revenues for countries to pay their bills. In turn, this made it more difficult for the high-debt nations to dig themselves out.

Germany

The Germany economy is the 16th economy in the 2015 index and 7th out of 43 countries in Europe region. Despite Germany had the largest fall of real GDP since World War II, their economy proved resistant against the recent crisis. Their supply-side reforms combined with traditional elements of their social market economy are responsible for their stability during the recent financial crisis while the most of the Euro area countries are struggling to overcome the crisis. Their member states had to renew and sustain balance between their national economic autonomy and the centralization of economic governance. In order to achieve that they had to get rid of their system weakness. Openness to global trade and investment has enabled Germany to become one of the world's most competitive and flexible economies. The government has held firm to policies emphasizing sound public finance.

Netherlands

The Netherlands economy is the 17th economy in the 2015 index and 8th out of 43 countries in Europe region. They have a long history of openness to global commerce and economic freedom. But their economy during the recent financial crisis has declined 1 point as a result of excessive government spending and increased corruption. Despite these negative facts their economy is still strong. The property rights and investment regimes are the second in the world. Business regulations are more efficient and they provide comparative advantage. However their fiscal policy does not remain a concern because the taxes are high, the government spending is even higher pushing up levels of public debt.

Greece

The Greek economy is the 130th economy in the 2015 index and 40th out of 43 countries in Europe region. Greek industry went into decline slightly before the country joined the EC, and this trend continued. Although worker productivity rose significantly in Greece, labor costs increased too fast for the Greek manufacturing

industry to remain competitive in Europe. There was also very little modernization in Greek industries due to a lack of financing

Italy

The Italian economy is the 80th economy in the 2015 index and 34th out of 43 countries in Europe region. Italy's economy has been mixed, experiencing both relative economic growth and stagnation, recession and stability. Italy is immobile, has an economic decline to productivity and thus to the loss of competitiveness, and to Italy's specialization in low capital-intensive sectors – a vocation in line with the peculiar small size of Italy's industrial enterprises.

Panel data

On their paper [MGomez-Puig,S.Sosvilla-Rivero,M.Ramos-Herrera](#) (2014) empirically investigate the determinants of EMU sovereign bond yield spreads with respect to the German bund. The sovereign risk has two domestic components: market liquidity and credit risk and an international risk factor which reflected investors' risk aversion. They focus on the analysis of the relative importance of systemic versus idiosyncratic risk factors in order to explain yield spreads in Europe after the introduction of the common currency. Firstly, they use an eclectic approach, a general to specific model strategy with panel data techniques so that they can empirically assess the relevance of the variables that they have used as drivers of EMU sovereign bond yield spreads. Secondly they go over the political relevance of the sample examined, both central (Austria, Belgium, Finland, France and The Netherlands) and peripheral (Greece, Ireland, Italy, Portugal and Spain) countries from January 1999 to December 2012. By doing that they can disentangle possible differences in the behavior between these two groups of countries within the EMU. Thirdly, they use an analysis of the time-varying pricing differences of the same spread drivers by market participants since the crisis outbreak. They adopt an eclectic approach using a general-to-specific modeling strategy with panel data techniques, so that empirically assess the relevance of the highest number of variables as potential drivers of EMU sovereign bond yield spreads. By doing that they allow the data to identify the variables that explain developments best for each of the three EMU groups of countries considered. Their main purpose is to gauge the effect of changes in market sentiment and risk aversion on yield spreads in the outbreak of the recent debt crisis. They also examine whether there are differences between peripheral and central countries and analyses the time-varying pricing of the same spread drivers by market participants after the onset of the crisis. They conclude that the rise in sovereign risk in central countries in the crisis period can only be partially explained by the evolution of local macroeconomic variables in those countries. The increase in the significance of the banking level of indebtedness and foreign bank's claims in the public sector (mainly in peripheral countries) along with the crisis unfolding, which highlights the interconnection between private(banking risk) and public debt(sovereign risk).They also notice that there has been a rise in their marginal effects after the start of the sovereign crisis, particularly in EMU peripheral countries. That shows an increase in the sensitivity of

the price of risk to fundamentals during the euro area debt crisis compared with the pre-crisis period. Their results indicate that the crisis had a significant impact on the markets reactions to macroeconomic and financial news, especially in the peripheral countries.

[L. Jaramillo, A. Weber](#) (2013) try to present a paper based on the determinants of long-term domestic bond yields in emerging markets, focusing on the impact of fiscal policy and global risk aversion. From previous literature they know that non-Ricardian features are instead incorporated, then an increase in the fiscal deficit and public debt would, all else equal, drive up long term bond-yields. and that an open economy fiscal policy will not affect interest rates except indirectly through its impact on the risk premium and the domestic bond yields in periods of financial distress (when VIX index increases) fiscal deterioration has a larger impact on bond yields. They use the VIX as exogenously. Their data are from 26 emerging economies between 2005 and 2011 and they include monthly vintages of one-year ahead market expectations for annual deficit-to-GDP ratios, debt-to-GDP ratios, inflation, and real GDP growth, which are expected to be more relevant than ex-post outcomes in driving bond yields. Also they borrow dataset from existing literature in order to explore the determinants of emerging market domestic bond yields, focusing on the role of fiscal variables. Then they extend the basic model specification using a panel threshold model to better account for the effect that a shift in global market sentiment can have on investors' assessment of credit risk. With that model the explanatory variables have differing regression slopes that are depending on whether global risk aversion is above or below a certain threshold, endogenously chosen to maximize the fit of the model. Their results show that it does matter what state you are in both in terms of the global environment as well as the health of a country's fiscal position. Once global risk aversion is low, domestic bond yields are mostly effected by inflation and real GDP growth expectations when high creditors' concern with default risk comes in front and expectations regarding fiscal deficits and government debt have a significant role in determining domestic bond yields. Moreover when the VIX crossed the model defined threshold in mid-2011, bond yields increased for those countries with weak fiscal position.

[A.Bardozzetti,D.Dottori](#) (2014) take an advantage of various lessons learned, related to methodology and datasets, and to give a wide range of approach for testing the relationship between the adoption of Collective action clauses (CACs) and bond yields. That dataset is from March 2007 to April 2011 with yields on 292 securities listed on major international markets. The sample is large enough to allow them to focus on sovereign bonds, enhancing comparability. Also they do not include corporate because that could give rise to spurious correlations. They examine a large number of countries at various stages of development and because of that they are not focus only on emerging market issuers. The long term period under scrutiny offers two advantages: (i) it renders the analysis less dependent on the idiosyncrasies in the data at any specific point in time and (ii) it allows them to check whether and how the link under examination has affect market developments. In conclusion that credit ratings matter for the impact of CACs on yields. For very good ratings, no statistically significant difference in yields is observed as a result from the use of CACs, while for bad ratings the yield discount is smaller than that for mid-range ratings, to the point of becoming insignificant for the lowest ratings. The ex-post beneficial effect of CACs for orderly restructuring is valued by the market, but it requires the probability of default to be non-negligible, the effectiveness of the ex-ante moral hazard channel is likely to be affected by the rating of the issuer, whose in the middle of the rating scale are afforded the largest discount by the market in the probability of default is concrete, but the incentive for the debtor country to meet its obligations and maintain access to international markets is sufficiently high and there is no evidence, irrespective of ratings, that use of CACs increases borrowing costs: even the worst rated issuers, we find that yield-increasing components never significantly overwhelm the yield decreasing components. That analysis suggests that the effect of CACs on yields may be different in a non-linear way according to the rating of the issuer's. The advantages of CACs are greater for the creditors of mid-rated issuers, because the probability of default is not negligible while there is less suspicion of opportunistic behavior on the part of the debtor. In contrast, the default is low for very well-rated issuers, thus reducing the value of ordered restructuring, while poorly rated issuers face lower reputational costs and are suspected of moral hazard to a greater degree if they choose to include CACs that favor debt restructuring.

[M.Costantini, M.Fragetta, G.Melina](#) (2014) identify that international time varying factor (as risk aversion) and country specific factors (as default and liquidity risk) are potential determinants of sovereign bond yields in the EMU. Additionally they add a long-run approach to the determinants of sovereign bond yield spreads in nine EMU economies (Austria, Belgium, Finland, France, Greece, Italy, Netherlands, Portugal and Spain) relative to Germany, when looking the matter from the point of view the theory of optimal currency areas (OCA). In particular they argue that long-run determinants of sovereign bond spreads are relevant for policy-makers when they decide whether, and to what extent, structural policy interventions are needed to reduce sovereign bond yield differentials and that investors take OCA issues, and in particular diverging competitiveness among EMU members, take into account when they have to assign and price sovereign default risk. At first they find out that there are fiscal imbalances (at expected government debt-to-GDP differentials) and liquidity risks as the main determinants of sovereign bond yield spreads in the long run. They found evidence for a level break in that relationship occurring during the sovereign debt crisis. That suggests that some EMU countries do need fiscal consolidation in order to remove imbalances and bring sovereign spreads to acceptable levels. On the other hand the usual debate between the appropriate timing and composition of fiscal consolidations and on whether high levels of public debt harm economic growth they estimate to the OCA theory and when it is able to establish that the above is only one important side of the coin. The other side of the coin suggests that is the extent, which EMU countries do form an OCA and, above all, whether investors take this information into account when they have to assess and prices sovereign default risk. Their empirical analysis finds that cumulated inflation differentials have non-negligible weights in sovereign bond yield spread determination. This suggests that policy-makers willing to reduce the burden of high sovereign spreads in the EMU should embrace structural policies aiming at a higher level of coordination of prices and wages across the union, besides well-designed consolidations programs.

[A.Afonso, S Nunes](#) (2014) assessing what is the impact of releasing economic forecasts on the sovereign yields. In particular the governments want to be aware of the consequences of forecast accuracy. They perform an econometric analysis of the linkages between different economic forecasts and sovereign yield spreads, using a

panel of 15 EU countries (Austria, Belgium, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal and Sweden), covering the period from 1999:1 until 2012:1. They conclude on that corrections in the EC's forecasts do impinge on the 10-year sovereign bond yield spreads, particularly the corrections in fiscal variables (public debt and budget balance), which is different across countries, being more pronounced in countries with less favorable economic conditions. They also find evidences that the sovereign debt crisis altered the variables to which investors pay attention.

B.Csonto (2014) discern between 'risk on' and 'risk off' periods and he suggests that it is essential of understanding the behavior of emerging market sovereign spreads since the relationship between spreads, country-specific fundamentals and global factors could differ across these periods. Several papers showed that regime shifts affect optimal asset allocation and risk management decisions. He suggests that it is important for policymakers to understand the possible consequences on financial assets of a shift in global market sentiment. The prevalence of favorable market conditions should not prevent them from focusing on reducing vulnerabilities, as weak fundamentals, which may be "overlooked" by investors during tranquil times. Amplify the negative effects on their economies of an adverse shift in global sentiment. His paper following the identification of low- medium- and high-volatility regimes, we investigate the behavior of emerging market sovereign bond spreads from three different angles. A cross-country correlations of EMBIG spreads increase substantially during medium- and high-volatility periods as compared to the low-volatility regime. This possibly emerging market bond spreads are mainly driven by external factors during periods of distress, thus they can only partially decouple from their peer countries when global sentiment deteriorates. Subsequently using the interactions of the regime probabilities with several country-specific and global variables as the determinants of spreads, his panel estimations showed that the role of both country-specific fundamentals and global factors differs across low-, medium- and high-volatility regimes. His finding leads that while country-specific fundamentals are important determinants of spreads in each regime, albeit at different significance level and with a different size of coefficient, important is that global factors increases during high-volatility periods. Also show that the switching regression slightly outperforms the non-switching model in terms of both the in-

sample explanatory power and the out-of-sample forecast accuracy. Finally, he found that such macroeconomic policies and strong fundamentals reduce the exposure of spreads to adverse shifts in global risk aversion. Specifically, based on the panel estimation results we can see that while a shift from low- to medium- and high-volatility regimes results in the substantial increase of fitted spreads of countries with weak fundamentals, the increase is much less pronounced in countries with stronger fundamentals.

[T. Poghosyan](#) (2014) intones that the long-run relationship between sovereign bond yields and macroeconomic fundamentals can break down in the short run, especially during periods of financial stress. He claims the need to distinguish between long-run and short-run determinants of borrowing costs and he attempts shed light on this issue for advanced economies. His conjecture is that sovereign bond yields can temporarily deviate from their long-run equilibrium level driven by short-run factors (such as monetary policy). He uses the panel co integration methodology, which has two main advantages over the fixed effects (FE) estimator employed in the vast majority of existing studies for the following two main reasons. First it allows the coefficients of short-run factors to differ across countries, while the impact of long-run factors remains the same and second it allows sovereign borrowing costs to deviate from their long-run equilibrium levels and evaluate the extent of this deviation during the global financial crisis in euro area countries. Also his assessment of the speed for adjustment of sovereign bond yields to their long run equilibrium level. He uses annual data for a sample of 22 advanced economies over the period 1980–2010. His findings suggest that in the long run, government bond yields increased about 2 basis points in response at 1 percentage point increase in the government debt-to-GDP ratio and by about 45 basis points in response at 1 percentage point increase in the potential growth rate. In the short run, changes in real bond yields deviate from their long-run equilibrium in response to changes in the debt-to-GDP ratio (positive effect), real money market rates (positive effect), and inflation (negative effect). The impact in the growth rate (negative effect) and the primary balance ratio (negative effect) is weaker. On average, about half of the deviation from the long-run equilibrium is corrected within one year. When applied to the current period, his model suggests that in some European periphery countries, bond yield spreads (relative to Germany) in the first half of 2012 exceeded the equilibrium value associated with long-run and short-run

fundamentals. On the other hand, emerges in the case of several core euro area countries (for example Finland), where “safe-haven” effects result in spreads undershooting their equilibrium value. After all, the model suggests that, in some members of the euro area, current sovereign borrowing costs deviate from the equilibrium level defined by macroeconomic fundamentals.

[L.Martinez,A.Terceno,M.Teruel](#) (2013) point out that the inclusion of developing countries into the globalization process has not been as expected as it was an obstacle to growth and a source of system instability and for that reason investing in emerging markets gave less diversification benefits than they did before. Many emerging markets have implemented some changes into the corporate financing sector. The main purpose is to avoid problems related to the original sin, which makes markets more vulnerable to external shocks since their debts are usually denominated in external currency, floated rate and short-term. These risky characteristics related to sovereign debt raise the economic vulnerability and the government probability of not being able to meet its obligations under changes in external and internal conditions. Securities of emerging markets were characterized by high country risk premiums and high domestic interest rates in detriment of growth and income distribution. The changes of country’s specific fundamentals and market sentiments drove fluctuations in spreads as a consequence of the financial contagion effect during the financial crisis. During the 1990s different financial crises took place in emerging economies. The Mexican crisis (1994), which also impacted the rest of Latin American countries, altered the issuance bond compositions mainly on the public sector. Later, the Asian crisis (1997) spread around the world, becoming a systemic crisis of confidence. Although the turmoil in Asian markets had little impact on Latin American trade, financial markets reacted with high volatility. The next year the burst of the Russian financial and economic crisis (1998), also involving Latin American countries, caused international financial changes. The last crisis that originated in emerging markets was the Argentine crisis in 2001, leading to a segmented integration among economies in the globalized system. The paper analysis identifies the main sovereign bond spreads determinants in Latin American countries and their vulnerability to the most recent global financial crisis. They select seven countries (Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela) from Q1 2003 to Q1 2012. They apply panel data econometric methodology and t-test is applied to explore the

homogeneity evolution of the EMBI Global (EMBIG) spread before and after the start of the crisis. And they consider financial and economic variables as key determinants of sovereign bond spreads in order to control liquidity, solvency and real variables as well as external shocks. Also analyze the impact of the financial crisis over sovereign bond spreads considering two dummy variables as indicators of the start of the financial crisis. Their result highlight the importance of domestic and external variables as spreads drivers. They found that inflation, the ratio of terms of trade, government effectiveness, external debt and international reserves that are key drivers of the sovereign bond spreads and they show that a high R2 which represent a good fit model including two dummy variables which indicate the start of the crisis as other explicative terms and both of them play an important role, given statistically significant results and improve the general fit. The contagion effect since 2008 seems to have been more explicative than the previous crisis date in 2007, since the contagion effect was not immediately propagated from the US to the rest of countries.

[D.Aristei,D.Martelli](#) (2014) point out that the recent financial crisis has drawn attention in Europe to an indicator of credit risk(the spread, the difference between the interest rate offered by securities and a benchmark). They use the term spread in reference to the market for bonds issued by sovereign states in the Economic and Monetary Union (EMU). Especially they use the term spread to indicate the difference between the yields on long-term (10 years) securities issued by individual countries that are part of the EMU, as compared to those on securities of equal residual maturity issued by the German government (the Bund), which represent the benchmark seems as a safe haven, as they have a low credit risk and high liquidity. The high interest rates offered by government bonds of some states were exchange rate risks and the fear of systematic devaluations and these differences continued to fall after that date which in return led to the hypothesis that the process of financial integration had finally eliminated the element of credit risk for Euro-zone countries, regardless of their individual national fiscal policies. But after the collapse of Lehman Brothers, and the intensification of the financial crisis, spreads began to widen. The interest rate differential against German bonds has affected all members of the EMU, beginning with those characterized by fundamental economic and fiscal weakness. Since then, the containment of the spread of individual national bonds against the German Bund has represented the biggest challenge facing the EMU, as the interest

rate differential also has repercussions in countries with strong fundamentals. In their paper they explore whether market sentiment and expectation indicators influence government bond yield spreads in the Euro area. They are using an unbalanced monthly dataset covering a 13-year period (from January 2000 to December 2012) and focusing on ten European countries. The results suggest that behavioral proxies included in the models are strongly statistically significant, they note that fundamental factors assume a primary role in explaining government bond spreads. But after they include market sentiment proxies, these additional variables become significant in affecting the spread behavior, especially in disfavor of liquidity risk determinants. The results are consistent independently of the behavioral variable tested and confirmed by several robustness checks. These effects are particularly evident during the crisis period, where sentiment and expectations factors increase their influence in determining sovereign bond yield spreads. The containment of the yield spreads of Euro area countries sovereign bonds against the German Bund represents one of the biggest challenges currently facing the EMU, as interest rate differentials have also repercussions in countries with strong fundamentals. An understanding of the forces underlying the variations of the spreads is therefore essential for both economists and policymakers. In the end they reach to two main conclusions. On the one hand, market authorities should take into consideration behavioral factors (besides the fundamental ones) while taking decisions to limit spread movements and thus non-conventional policies should be put in practice in order to manage and reduce investors' risk aversion; this is what monetary authorities (and the European Central Bank in particular) are trying to do last months. On the other hand, researchers should not focus only identifying new models to help policymakers in considering behavioral factors, but also on creating or testing new proxies of market sentiment and expectations since investors' risk perception is strongly influenced by several behavioral issues.

[S.Eichler](#) (2014) studies how various political aspects determine sovereign bond yield spreads in emerging markets. He identifies some variables as important drivers of sovereign default risk such as high levels of public debt, poor macroeconomic fundamentals, shortages of foreign exchange reserves and global risk factors. The meaning of sovereign bond yield spreads is the same for all countries while the classification of actual sovereign debt defaults requires finding suitable criteria for

such a debt crisis. Furthermore, sovereign bond yield spreads are forward-looking financial market data and therefore enable one to study investors' assessment of the impact of different aspects of politics on the risk of possible sovereign defaults in the future. He studies the political determinants of sovereign bond yield spreads for 27 emerging markets in the period 1996 to 2009. He concludes that presidential regimes face lower sovereign bond yield spreads than parliamentary regimes, stable and powerful governments are found to be important to reduce sovereign bond yield spreads, particularly in autocratic regimes, the relevance of political variables for the determination of sovereign bond yield spreads is much higher for autocratic and closed regimes than for democratic and open countries and the efficiency of the legal system, administration, and regulation should be increased.

Bayesian modeling averaging (BMA)

[D.Maltritz,A.Molchanov](#) (2013) contribute to the literature by applying Bayesian Model Averaging (BMA) – which explicitly accounts for model uncertainty – to analyze the determinants of country default risk. They were driven by the fact that high variation between the reported regression models and the determinants they include – variables are found to be significant in some papers, whereas in others they lack significance. This indicates a high degree of model uncertainty. Because credit ratings and yield spreads are highly correlated they argue that yield spreads are advantageous in capturing default risk to using default dummies because such dummies can provide very crude approximations of the “true” credit risk. They use yield spreads of emerging market bonds to assess default risk. They believe that political variables are equally with economic determinants and that suggest in their literature, leads to uncertainty about the determinants of emerging markets yield spreads, and, thus, country default risk. Because BMA explicitly acknowledges that the “true” model is not known, and, therefore, analyzes the entire model space the data mining concerns are mitigated, as the results are based on the entire model space, rather than on a single model. They use yield spreads for 35 emerging countries included in the EMBI+ index for the years 1996–2010. They also include political variables obtained from Heritage foundation besides the number of economic variables typically used in yield spread analysis. In order to include market sentiment as a determinant to sovereign yield spreads they include several measures of global and regional sentiment. They are interested in basic/fundamental and long-term

determinants of default risk so they perform their analysis using annual data (34 potential regressors using 374 observations). They document that total debt, history of recent default, currency depreciation, growth rate of foreign currency reserves and global market sentiment are among the most important variables determining credit risk and the variables that found to be significant in determining default risk, such as debt service ratio, budget balance, and inflation rate are found to have low influence on developing countries' default risk. Generally they analyze the determinants of default risk of developing countries reflected by their sovereign yield spreads and for that reason they apply BMA. The reason for the above is that there is no full theoretical guidance available regarding the determinant of default probability, alternative model specifications proposed in the literature have produced conflicting results and the ratio of the number of observations to the number of candidate independent variables is low. They measure the default risk of a country by EMBI+ sovereign yield spreads. So they include 34 candidate independent variables, and document that currency depreciation, growth rate of foreign currency reserves, market sentiment proxied by S&P 500 returns, default history and the ratio of external debt to GDP are the most important variables in determining yield spreads. But political and governance variables are shown to have low to medium probabilities of being included in the regression model. They believe that accounting for model uncertainty is especially important.

[D. Maltritz](#) (2012) aims to provide answer to the usual question of what drives sovereign yield spreads of EMU countries which is an important issue in the current political debate about the further development and even the survival of the Euro and the Eurozone. He analyzes determinants of sovereign yield spreads of EMU member states to German bond yields on secondary bond markets. He is focusing on the default risk component and tests a variety of variables related to that with respect to previous literatures. Because there is uncertainty about the "true" empirical model of the key determinants of sovereign yield spreads he is driven to use Bayesian Model Averaging (BMA). It explicitly accounts for the high model uncertainty by considering (approximately) the entire model space. By considering the entire model space BMA is supposed to provide more solid information about the determinants of spreads than classical regressions. He applies BMA in several settings and considers different time spans in order to carefully analyze the issue and provide robust results.

By considering 10 EMU member countries in the observation period 1999–2009, he finds that the most important country specific drivers of sovereign yield spreads in the Eurozone are budget balance to GDP, terms of trade, trade balance and countries' openness.

Autoregressions

In that study [I.C.Pragidis,G.P.Aielli,D.Chionis,P.Schizas \(2015\)](#) define contagion as the structural break in the linear transmission mechanism of financial shocks and the consequent possibility of a significant increase in the cross-market linkage between two countries. Firstly they estimate the adjusted correlation coefficient of the 10-year sovereign bond returns between seven European countries. With that that they avoid heteroskedasticity. They compute the adjusted correlation coefficient from the variance/covariance matrix of the residuals of a regression model of the return series. Then they estimate the correlation procedure modeled as a dynamic process. The dynamic correlation framework is detected by graphical inspection of the correlation output, but with that the contagion hypothesis cannot be explicitly tested. They tested for the possibility of structural breaks in the correlation dynamics by modeling this as a corrected dynamic conditional correlation (cDCC) process. After they show the superiority of the accuracy of the proposed method in terms of the estimation and inferences with respect to the CRM method. They concentrate on the part of the literature that tests the hypothesis of contagion in a correlation framework and try to correct some of the existing statistical issues. They performed a contagion analysis by employing the adjusted correlation coefficient of Forbes and Rigobon (2002), an EGARCH model extended for volatility spillovers, and an extension of the cDCC model allowing for non-linearities in the unconditional correlation of the bond yield rates of return. The results show that there is a decoupling in the correlation dynamics between the yields of the PIIGs and the yields of the core eurozone.

[D.Georgoutsos,P.Migiakis \(2013\)](#) focus on how market perceptions and states of uncertainty affect the euro-area sovereign bond spreads. Their analysis first focuses on the impact of different states of volatility since the monetary unification on the determinants of spreads. With that they provide information on the determinants of spreads and changes in their underlying specifications arising from changes in the degree of uncertainty and enable them to focus on the recent crisis and distinguish the

specification of spreads for this period. Their literature is concerned with issues related to financial integration. These are addressed by examining the homogeneity of the effects exercised by common, euro-area-wide variables and comparing their strength against the strength of the effects stemming from country-specific variables. Also they examine whether fiscal consolidation will suffice in order to restore stability and re-establish a high degree of integration in euro-area bond markets. Their empirical analysis has shown that even in the pre-2008 crisis period there was no uniform pattern in the determinants of spreads and their findings indicate that movements in the euro-area sovereign bond spreads, which are often perceived as reflections of fiscal fundamentals, are subject to market and economic sentiment conditions which, in their turn, may weigh on the formulation of perceptions for future developments related to economic activity. Also they find evidence of heterogeneity in the determinants of spreads across euro-area countries.

Personilized models

In that paper **H.Dewachter,L.Iania,M.Lyrrio,M.Perea** extend the approach that proposed from **Joslin et al. (2011)** to a multi market setting in order to decompose yield spreads of a set of euro area countries (Belgium,France,Germany,Italy and Spain) into a fundamental(set of country-specific factors, euro area economic fundamentals, and international factors) and a non-fundamental component(liquidity and political uncertainty effects, in addition to remaining common factors which might be proxying for redenomination risk).They use regressions of yield spreads on fundamental variables such as representing credit, liquidity, and international risks and on model that estimates multi-issuer, no-arbitrage, affine term structure models. They have found that contagion risk, international risk factors and country-specific credit risk are important in the determination of euro area sovereign bond spreads but on country-specific the effect of common risk factors is different in magnitude and has opposite effects on bond spreads. They classified the factors as economic, idiosyncratic, and related to non-fundamental risk. They find that economic fundamentals are the main drivers behind euro area sovereign bond spreads but non-fundamental risk shocks have a key role in the dynamics of yield spreads for all countries and maturities(since the summer of 2011).Credit risk, market volatility and liquidity tensions are responsible for the strong swings in bond yields but during periods of high market turmoil bond yields reflect risks associated with excessive risk

aversion that is out of sync with economic fundamentals and market conditions. The ECB announced Outright Monetary Transactions (OMTs) in secondary markets for sovereign bonds in the euro area because of the disruptions in the monetary transmission mechanism. OMTs are intended to stabilize the prices.

[L.Haan,J.Hessel,J.W.End \(2014\)](#) try to research the extent to which the large swings of sovereign yields of several euro area countries since 2010 can be attributed to fundamentals, given the inherent model uncertainty. Political risks affect bond yields also for various reasons. Also the reaction of bond yields to fundamentals is time-varying, due to fluctuations in global risk aversion(this is stronger in the euro area. They try to answer if bond yields are fairly priced with respect to macroeconomic fundamentals and market conditions. Their results show that sovereign yields cannot be fully explained by macroeconomic fundamentals alone and that sovereign yields react more strongly to economic growth prospects during the sovereign crisis than before. They show also that the extent of overpricing is affected by modeling choices with regard to the sample selection, the assumption whether the model coefficients are similar across countries or not, the use and calculation of confidence bands for the model prediction , the inclusion of financial variables and the usage of fixed or time-varying coefficients. Because of the fact that econometric models cannot fully solve the fundamental uncertainty about the fairness of bond yields some consequences are created. Their findings suggest for modesty, cautiousness and for more research.

[F. Comelli \(2012\)](#) suggests that sovereign debt securities have become a key method of funding for many emerging market economies as well as an increasingly important asset class for investors. His paper contributes to the debate of the role played by country-specific and global explanatory variables to explain emerging market sovereign bond spreads. He considers an index for political risk among the country-specific explanatory variables. He attempt to answer if the contribution of country specific variables change when the time and country dimensions of the panel change and if an empirical model – used to estimate sovereign bond spreads – generate in-sample predictions for sovereign bond spreads which are more informative than those obtained with random guessing. He estimates emerging economy sovereign bond spreads using a panel of 28 emerging economies, over the period January 1998–December 2011 and allow for the dimensions of the panel to change and then he back-test the model by generating bond spread in-sample predictions with linear

predictions and rolling regression routines. He tries to establish which of the methods is more successful at correctly predicting the direction of the monthly change in bond spreads, whether the forecasting accuracy of each method changes before and after the global financial turmoil of 2008, and to test whether the forecasting methods employed are more accurate than a random walk in predicting the monthly change in bond spreads. The results show that the coefficient estimates and statistical significance of country-specific and global explanatory variables on bond spreads may vary across time and regions. His model fails to fully explain the increase in sovereign bond spreads observed in 2010 and 2011 in some emerging economies. He also finds that during crisis times, good macroeconomic fundamentals are helpful in containing bond yield spreads, but less than in non-crisis times. Also he points out that changes in the degree of external vulnerability are estimated to cause the largest changes in the cost of external borrowing for emerging economies. His findings suggest that the rolling regression method can in some cases be more accurate than a random walk model to generate predictions for bond spreads. By contrast, the linear prediction method does not deliver more information compared to a random walk model.

[D.Chionis,I.Pragidis,P.Schizas \(2014\)](#) describe at first some reasons that led Greece to apply for an international bail-out and to accept fiscal austerity measures, which demand currency depreciation in order to be effective and successive. Under this spectrum they try to examine if the macro fundamentals were the main determinants of the Greek bond yields, during the pre- and post-crisis era. Then they present some facts that led the Greek economy to downgrade. On the one hand some literatures suggest that a country's macroeconomic fundamentals such as Debt to GDP ratio, deficit, current account deficit, and unemployment are the primary determinants of government bond yields. On the contrary other literatures find empirical evidences against country specific macroeconomic fundamentals and argue that common factors such as a generalized risk aversion factor affects government bond yields. During the time before memorandum, inflation and unemployment both seem significant determinants for the yield. Immediately after the burst of the Greek crisis in addition to the before mentioned factors a new factor seems to be significant, that is the fiscal deficit while growth rate has not any significant impact on the yield. This implies that the policy option of the fiscal consolidation is the appropriate road map for Greece to

come back to the international capital markets. On the contrary, a positive growth rate without any decrease in unemployment cannot lead the Greece to exit to the international markets. A quite interesting result is that during the crisis period half of the deviation of bond yields from their long-run equilibrium level adjusts during abnormal periods which adjustment well exceeds the before crisis relative coefficient. This increase, confirms the sell-off that took place in Greek fixed income market.

[A.Afonso,M.Arghyrou,G.Bagdatoglou,A.Kontonikas \(2015\)](#) review some previous literatures in regard the time varying slope coefficients that show that since the onset of the global financial crisis the market reaction to fiscal imbalances increased considerably. However they claim that these papers are subject to an important limitation. Their adopted panel-based econometric framework cannot uncover country-specific heterogeneity in the time-varying relationship between spreads and their determinants. Beyond the innovative feature of endogenous slope time-variation these studies are in line with previous panel-based studies that assume slope homogeneity across countries and common break points in time for all the countries in the panel. They have used a dynamic multipath general-to-specific algorithm to capture structural instability in the link between euro area sovereign bond yield spreads against Germany and their underlying determinants over the period January 1999–August 2011.They modeled spreads on proxies of international financial risk, liquidity risk and credit risk. That approach allow them to identify country-specific time-variation in the relationship between spreads and fundamentals. They have found that heterogeneity exists across countries, both in terms of the risk factors determining spreads over time as well as in terms of the size of their impact on national spreads. Their main implication of their findings is that given the recent market pricing behavior the European debt crisis will very likely not be fully resolved as a result of improved global risk conditions. For this purpose, a significant improvement in national fundamentals seems a necessary condition.

[C.McGee \(2007\)](#) points out the role of interest rates as a potential cause of sovereign default is well established. He explains that higher interest rates make it more costly to roll over existing debt or borrow additional funds and this in turn leads to acquisition of more debt to cover interest payments. Also the interest rates on sovereign debt will rise whenever the risk of default appears to increase and for that reason the causality runs in both directions between the interest rate and the chance of

default(vicious cycle).He presents a model that focuses on uncertainty about the degree of fiscal contraction which policy makers are willing endure. His model endogenizes the interaction between interest rates and political feasibility of repayment and illuminates a variety of short-term and long-term issues regarding sovereign debt. Also he point out that the multiple equilibria in the model are not problematic because the low interest equilibrium is stable. However when debt rises and the two loci become tangent the equilibrium is unstable on the right side and large shocks can force a default. He admits that his model has significant oversimplifications but he claims that it does capture an important real world feature that deserves attention for its policy implications. If it is true that moral hazard enables a persisting deficit bias and leads to a much larger interest burden and chronic crises, then IMF assistance should be scaled back, and fiscal conditionality should be more strict. Such solutions to the moral hazard problem will inevitably cause more defaults in the short term. However, the long-term benefits of a reform that prevents short-sighted leaders from generating a large debt burden on society should outweigh the costs.

[N. Antonakakis , K Vergos \(2013\)](#) point out that the reason of the financial crisis is that the debt crisis was accompanied by a slowdown in economic activity, thus many Euro zone countries faced risks to long-term sustainability. As a consequence, international markets are seeking greater sovereign risk premia. Their paper examine the directional linkages of government bond yield spreads (BYS) between Euro zone countries over the period March 3, 2007–June 18, 2012, and studies the features of BYS spillovers during the Eurozone debt crisis. They focus on the dynamics of sovereign bond yield spread spillovers in the Eurozone during the current crisis employing a VAR-based spillover index approach (Diebold and Yilmaz,2009, 2012), and impulse response function analyses. They found that on average, BYS shocks tend to increase future BYS, and are related to news announcements and policy changes and that BYS spillovers between Euro zone countries predominantly from the periphery (Greece, Ireland, Italy, Portugal and Spain (GIIPS)) and to a lesser extent from the core (Austria,Belgium, France and Netherlands (ABFN)). The within-effect of BYS spillovers is of greater magnitude within the periphery than that within the core and The between-effect (core vs periphery) of BYS spillovers suggests directional spillovers of greater magnitude from the periphery to the Euro zone core

than vice versa. Finally, the cumulative impulse responses of joint shocks in the periphery and the core reveal decoupling effects between these two groups of countries. Their findings highlight the increased vulnerability of the Euro zone from the destabilizing shocks originating from the Euro zone countries in the periphery, and to a lesser extent from the Euro zone core.

[K.Bernoth,B.Erdogan \(2012\)](#) suggest that bond yield differentials are significantly affected by both international and country-specific risk factors such as liquidity or default risk premia. They notify that the sharp increase of government bond yield spreads during the financial crisis cannot purely be attributed to changes in macroeconomic fundamentals, but also to the fact that the general pricing of risk has increased over time, in the sense that financial markets reacted more strongly to different risk variables than they did before. For that reason the relationship between the variables proxying default and liquidity risk and government bond yield spreads may be time-varying. In their literature they contribute by estimating time-varying coefficients in an additive non-parametric fixed-effects panel model framework. That allow them to identify to what extent an observed change in the yield spread is due to a shift in macroeconomic fundamentals such as a country's fiscal position and to what extent it reflects a change in markets' pricing of these fundamentals expressed by a shift in the model coefficients. They are able to endogenously identify the timing and patterns of any changes in the model coefficients. They find that the impact of fiscal policy variables and general investors' risk aversion on sovereign yield spreads is not constant over time, which confirms the need of time-varying coefficient models in this context. At the beginning of EMU in 1999, the debt level of a country and the general investors' risk aversion significantly explained interest differentials. In the subsequent years, however, the safe haven status of Germany diminished, while sovereign debt differentials continued to play an important role in explaining yield differentials. By the end of 2006, two years before the fall of Lehman Brothers, financial markets began to grant Germany a safe haven status again, which signals that financial markets started worrying about risk long before the start of the financial crisis. With the financial crisis, also the market reaction to fiscal loosening increased considerably. This indicates that financial markets have, at present, an important role in imposing fiscal discipline on governments and constitute an effective supplement to the Stability and Growth Pact (SGP).

[A.D'Agostino,M.Ehrmann \(2014\)](#) try to study the sovereign bond markets of the G7 countries over the last two decades. They try to understand to what extent market prices reflect fundamentals, and how this has changed over time and for that reason they use a model that allows for time variation in the coefficients, which evolve as random walks, and stochastic volatility in the error term. They suggest that market prices are likely to reflect expectations about the evolution of fundamentals much more than past realized values and they allow a relaxation of a commonly imposed assumption(when analyzing the determinants of sovereign bond spreads, the existing studies tend to use relative variables). They find that several risk factors have not been priced in the years preceding the financial crisis. They have estimated the determinants of sovereign bond spreads of the G7 countries, using time-varying parameter stochastic volatility models by studying the role of macroeconomic fundamentals in determining yield spreads. They identify three periods where actual spreads deviated substantially and persistently from those estimated by our model: the time of the scarcity premium on US bonds, where actual spreads were larger than estimated, the first decade of the millennium where spreads were lower than suggested by the model, and the sovereign debt crisis where Italian and French spreads were substantially larger than our model would have predicted.

Data and methodology

Data of determinants

As already mentioned, in our study we use a panel framework of four countries: Greece, Germany, Italy, Netherlands. Monthly data from December 2003 to December 2014. It is important to understand correctly the meaning of all variables. As the measure of sovereign bond yield (hereafter Y) we calculated monthly data of each country 10 year government bond which is act as benchmark and downloaded from Bloomberg.

We use the following country specific fundamentals which are described as follows. Public debt to GDP (hereafter DEBT), represents the ratio between the government debt and the Gross Domestic Product (GDP). It allows us to compare two different countries regardless of their size and allows us to compare debt levels of a country from different years.-Another factor is inflation (hereafter INFL) which measures the competitiveness among the countries.

Global factor

VIX: Obtained from Bloomberg, expresses the implied volatility of S&P 500 stock market index options which measures the global financial volatility or uncertainty of financial markets. It represents the risk aversion of the investors

OIS: Overnight Indexed Swap for different maturities of 1, 2, 3, 4 and 5 years obtained from Bloomberg. It expresses the evolution of the risk free interest rate for Euro countries. It also used to calculate the spreads of sovereign bonds at the respective maturities.

Inflation rate, debt to GDP ratio, VIX index and OIS index for maturities of 1,2,3,4 and 5 years are obtained from Bloomberg for Greece, Germany, Italy and Netherlands.

Unit root test

Consider a simple AR(1) process:

$$y_t = \rho y_{t-1} + x_t' \delta + \varepsilon_t$$

Where x_t are optional exogenous regressors which may consist of constant, or a constant and trend, ρ and δ are parameters to be estimated, and the ε_t are assumed to be white noise. If $|\rho| \geq 1$, y is a non-stationary series and the variance of y increases with time and approaches infinity. If $|\rho| < 1$, y is a (trend-)stationary series. Thus, the hypothesis of (trend-)stationarity can be evaluated by testing whether the absolute value of ρ is strictly less than one.

The unit root test generally tests the null hypothesis $H_0: \rho = 1$ against the one-sided alternative $H_1: \rho < 1$. In some cases, the null is tested against a point alternative. In contrast, the KPSS Lagrange Multiplier test evaluates the null of $H_0: \rho < 1$ against the alternative $H_1: \rho = 1$.

In our test in order to check for unit roots we perform the augmented Dickey-Fuller (ADF) test which is performed as follows:

We test for unit roots by level and by 1st difference and we include in test equation: Trend and intercept

The standard DF test is carried out by estimating:

$$\Delta y_t = \alpha y_{t-1} + x_t' \delta + \varepsilon_t$$

Where $\alpha = \rho - 1$. The null and alternative hypotheses may be written as,

$$H_0: \alpha = 0$$

$$H_1: \alpha < 0 \tag{1}$$

and evaluated using the conventional t-ratio for α :

$$t_\alpha = \hat{\alpha} / (se(\hat{\alpha})) \tag{2}$$

where $\hat{\alpha}$ is the estimate of α , and $se(\hat{\alpha})$ is the coefficient standard error.

Dickey and Fuller (1979) show that under the null hypothesis of a unit root, this statistic does not follow the conventional Student's t-distribution, and they derive asymptotic results and simulate critical values for various test and sample sizes. More recently, Mackinnon (1991, 1996) implements a much larger set of simulations than those tabulated by Dickey and Fuller. In addition Mackinnon estimates response surfaces for the simulation results, permitting the calculation of Dickey-Fuller critical values and p-values for arbitrary sample sizes.

The simple Dickey-Fuller unit root test described above is valid only if the series is an AR(1) process. If the series is correlated at higher order lags, the assumption of white noise disturbances ϵ_t is violated. The Augmented Dickey-Fuller (ADF) test constructs a parametric correction for higher-order correlation by assuming that the y series follows an AR(p) process and adding p lagged difference terms of the dependent variable y to the right-hand side of the test regression:

$$\Delta y_t = \alpha y_t + x'_t \delta + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + \dots + \beta_p \Delta y_{t-p} + v_t$$

This augmented specification is then used to test (1) using the t-ratio (2). An important result obtained by Fuller is that the asymptotic distribution of the t-ratio for α is independent of the number of lagged first differences included in the ADF regression. Moreover, while the assumption that y follows an autoregressive (AR)

The automatic bandwidth we are using is the Schwarz Info Criterion:

$$-2(I/T) + k \log(T)/T$$

Where the modification factor τ is computed as:

$$\tau = \alpha^2 \sum_t y_{t-1}^2 / \hat{\sigma}_u^2$$

For the information criterion selection methods, you must also specify an upper bound to the length. We choose a maximum lag of: 12

$$k_{max} = \text{int}(\min(T/3, 12) \cdot (T/100)^{1/4})$$

Cointegration test

The test we perform is based to Johansen Cointegration Test and is performed using a group object or an estimated Var object.

$$y_t = A_1 y_{t-1} + \dots + A_\rho y_{t-\rho} + Bx_t + \epsilon_t$$

Where y_t is a k-vector of non-stationary I(1) variables x_t is a d-vector of deterministic variables and ϵ_t is a vector of innovations. We may rewrite this VAR as,

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{\rho-1} \Gamma_i \Delta y_{t-i} + Bx_t + \epsilon_t$$

Where:

$$\Pi = \sum_{i=1}^{\rho} A_i - 1, \quad \Gamma_i = - \sum_{j=i+1}^{\rho} A_j$$

Granger's representation theorem asserts that if the coefficient matrix Π has reduced rank $r < k$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta'y_t$ is I(0). r is the number of co-integrating relations (the co-integrating rank) and each column of β is the co-integrating vector. As explained below, the elements of α are known as the adjustment parameters in the VEC model. Johansen's method is to estimate the Π matrix from an unrestricted VAR and to test whether we can reject the restrictions implied by the reduced rank of Π .

The deterministic trend specification that we are using is:

The 3: The level data y_t have linear trends but the cointegrating equation have only intercepts:

$$H_1(r): \Pi y_{t-1} + Bx_t = \alpha(\beta' y_{t-1} + \rho_0) + \alpha_\perp \gamma_0 \quad (\text{intercept (no trend) in CE and test VAR})$$

Or the 4: The level data y_t and the co-integrating equation have linear trends:

$H^*(r): IY_{T-1} + Bx_t = \alpha(\beta^{y_{t-1}} + \rho_0 + \rho_1 t) + \alpha_{\perp} \gamma_0$ (intercept and trend in CE –no intercept in VAR)

We choose 1 4 lag intervals which represented by the regression on VAR on Δy_t to $\Delta y_{t-1}, \Delta y_{t-2}, \Delta y_{t-3}, \Delta y_{t-4}$

Quantile regression

Quantile regression model is the relation between a set of predictor variables and specific percentiles (or quantiles) of the response variable. It specifies changes in the quantiles of the response. Quantile regression is desired if conditional quantile functions are of interest. One advantage of quantile regression, relative to the ordinary least squares regression, is that the quantile regression estimates are more robust against outliers in the response measurements. However, the main attraction of quantile regression goes beyond that. In practice we often prefer using different measures of central tendency and statistical dispersion to obtain a more comprehensive analysis of the relationship between variables.

The model of quantile regression

Suppose that we have a random variable Y with probability distribution function

$$F(y) = \text{Prob} (Y \leq y)$$

So that for $0 < \tau < 1$, the τ – th quantile of Y may be defined as the y satisfying $F(y) \geq \tau$:

$$Q(\tau) = \inf \{y: F(y) \geq \tau\}$$

Given a set of n observations on Y, the traditional empirical distribution function is given by:

$$F_n (y) = \sum_k 1(Y_i \leq y)$$

Where $1(z)$ is an indicator function that takes the value 1 if the argument z is true and 0 otherwise. The associated empirical quantile is given by,

$$Q_n(\tau) = \inf\{y: F_n(y) \geq \tau\}$$

Or equivalently, in the form of a simple optimization problem:

$$\begin{aligned}
 Q_n(\tau) &= \operatorname{argmin}_{\xi} \left\{ \sum_{i: Y_i \geq \xi} \tau |Y_i - \xi| + \sum_{i: Y_i < \xi} (1 - \tau) |Y_i - \xi| \right\} \\
 &= \operatorname{argmin}_{\xi} \left\{ \sum_i \rho_{\tau} |Y_i - \xi| \right\}
 \end{aligned}$$

Where $\rho_{\tau}(u) = u(\tau - 1(u < 0))$ is the so-called check function which weights positive and negative values asymmetrically.

Quantile regression extends the simple formulation to allow for regressors X . We assume a linear specification for the conditional quantile of the response variable Y given values for the p -vector of explanatory variables X :

$$Q(\tau | X_i, \beta(\tau)) = X_i' \beta(\tau)$$

Where $\beta(\tau)$ is the vector of coefficients associated with the τ -th quantile.

Then the analog to the unconditional quantile minimization above is the quantile regression estimator:

$$\widehat{\beta}_n(\tau) = \operatorname{argmin}_{\beta(\tau)} \left\{ \sum_i \rho_{(\tau)}(Y_i - X_i' \beta(\tau)) \right\}$$

Results

We perform unit root test for all the series of the determinants of sovereign bond yields and for the 10 year sovereign bond for all countries (Greece, Germany, Italy, Netherlands) and for all maturities ($i=1,2,3,4,5$). The results indicate that at the levels we don't have stationarity and for that reason we have unit root. On the other hand at first differences we have stationarity so we don't have unit root. After the unit root test we proceed to cointegration test for inflation, debt to GDP, VIX and OIS for maturities 1,2,3,4 and 5 years for all countries and we observe that all the series are cointegrated. Then we proceed to quantile regression test for each country and for all the different maturities. The quantiles that have used are the $\tau=0,1$, $\tau=0,5$ and $\tau=0,9$.

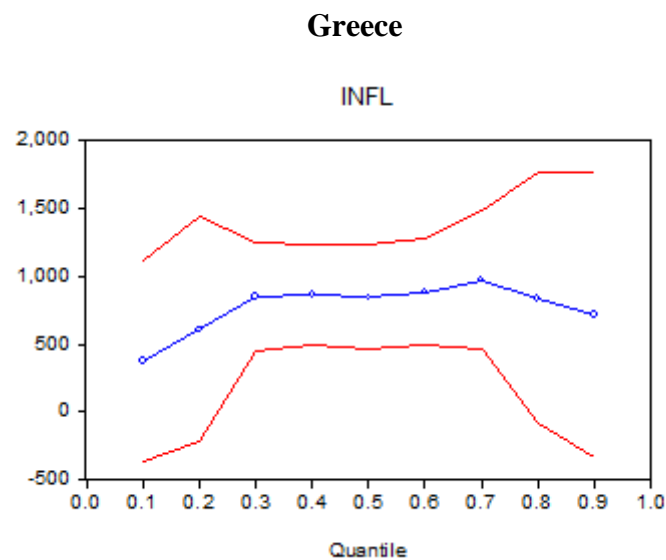


figure1

Figure 1 represents the inflation estimated from the quantile process for Greece

This plot helps us understand how variable an effect can be. It also highlights that a linear regression might not be an optimal solution to assess this relationship.

We start by analyzing the response of VIX, OIS, DEBT and INFL to sovereign bond yield. As it can be ascertained from table 2 for maturity 1 to 5 and for quantiles 0,1, 0,5 and 0,9, derives the following:

Maturity $i=1$

For quantile 0,1 we have DEBT with positive coefficient and it is statistically significant in level of 10% while OIS has negative coefficient and it is statistically significant in level of 5%

For quantile 0,5 we have INFL and DEBT with positive coefficient and they are statistically significant in level of 1%. OIS has negative coefficient and it is statistically significant in level of 5%. VIX is statistically non – significant.

For quantile 0,9 we have VIX, DEBT and OIS with positive coefficient and they are statistically significant in level of 10%, 1% and 1% respectively. INFL is statistically non – significant.

Maturity $i=2$

For quantile 0,1 we have INFL and DEBT with positive coefficient and they are statistically significant in level of 10% and 5% respectively. OIS has negative coefficient and it is statistically significant in level of 1%. VIX is statistically non – significant.

For quantile 0,5 we have INFL and DEBT with positive coefficient and they are statistically significant in level of 1%. OIS has negative coefficient and it is statistically significant in level of 1%. VIX is statistically non – significant.

For quantile 0,9 we have VIX, DEBT and OIS with positive coefficient and they are statistically significant in level of 10%, 1% and 5% respectively. INFL is statistically non – significant.

Maturity $i=3$

For quantile 0,1 we have INFL and DEBT with positive coefficient and they are statistically significant in level of 1%. OIS has negative coefficient and it is statistically significant in level of 1%. VIX is statistically non – significant.

For quantile 0,5 we have INFL and DEBT with positive coefficient and they are statistically significant in level of 1%. OIS has negative coefficient and it is statistically significant in level of 1%. VIX is statistically non – significant.

For quantile 0,9 we have VIX, DEBT and OIS with positive coefficient and they are statistically significant in level of 1% each. INFL is statistically non – significant.

Maturity $i=4$

For quantile 0,1 we have INFL and DEBT with positive coefficient and they are statistically significant in level of 5%.OIS has negative coefficient and it is statistically significant in level of 10%. VIX is statistically non – significant.

For quantile 0,5 we have INFL and DEBT with positive coefficient and they are statistically significant in level of 1%.OIS has negative coefficient and it is statistically significant in level of 1%. VIX is statistically non – significant.

For quantile 0,9 we have DEBT only with positive coefficient and it is statistically significant in level of 1%. VIX, INFL and OIS are statistically non – significant.

Maturity $i=5$

For quantile 0,1 we have INFL and DEBT with positive coefficient and they are statistically significant in level of 5% and 10% respectively.OIS has negative coefficient and it is statistically significant in level of 1%. VIX is statistically non – significant.

For quantile 0,5 we have INFL and DEBT with positive coefficient and they are statistically significant in level of 1%.OIS has negative coefficient and it is statistically significant in level of 1%. VIX is statistically non – significant.

For quantile 0,9 VIX,INFL,DEBT and OIS are statistically non – significant.

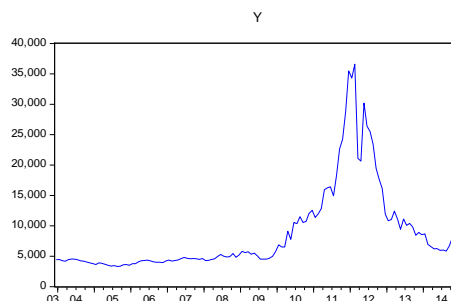


Figure 2

Where Y is the fluctuation of the Greek 10 year sovereign bond yield

Generally DEBT and INFL have positive coefficient for all maturities and they are statistically significant of a level 1%.OIS mostly has negative coefficient with statistical significant of level 1% while VIX in most cases is statistically non – significant.



Figure 3

Where Y is the fluctuation of the German 10 year sovereign bond yield

We start by analyzing the response of VIX, OIS, DEBT and INFL to sovereign bond yield. As it can be ascertained from table 2 for maturity 1 to 5 and for quantiles 0,1, 0,5 and 0,9, derives the following:

Maturity $i=1$

For quantile 0,1 we have INFL and DEBT with positive and negative coefficient respectively and they are statistically significant in level of 1%.OIS and VIX are not statistically significant

For quantile 0,5 we have VIX is not statistically significant, while INFL and DEBT have again positive and negative coefficient respectively and are statistically significant in level of 1 %.OIS has level 10%.

For quantile 0,9 INFL and DEBT have positive and negative coefficient respectively and are statistically significant in level of 1%.and OIS and VIX have level of 10%.

For maturity 1 year we observe that VIX is statistically significant only in the last quantile, DEBT has negative coefficient and INFL and OIS have positive

Maturity $i=2$

For quantile 0,1 we have that INFL and DEBT with positive and negative coefficient respectively and are statistically significant in level of 1%..OIS and VIX are statistically non – significant

For quantile 0,5 we have that OIS and INFL with positive coefficient while DEBT has again negative coefficient and all of them are statistically significant in level of 1%..VIX is statistically non – significant.

For quantile 0,9 we have that INFL and DEBT with positive and negative coefficient respectively and are statistically significant in level of 1%..VIX is statistically non – significant.OIS is statistically significant in level of 5%..

We obtain that in all quantiles, for the 2 year maturity, we examined VIX is non-statistically significant, INFL and OIS have a positive impact on sovereign bond yield and are statistically significant mostly in 1 % level while debt to GDP is negative.

Maturity $i=3$

For quantile 0,1 we have that INFL and DEBT with positive and negative coefficient respectively and are statistically significant in level of 1%..OIS and VIX are statistically non – significant

For quantile 0,5 we have that OIS and INFL with positive coefficient while DEBT has again negative coefficient and all of them are statistically significant in an 1 % level.VIX is statistically non – significant.

For quantile 0,9 we have that INFL and DEBT with positive and negative coefficient respectively and are statistically significant in level of 1%.VIX is statistically non – significant.OIS is statistically significant in a 5 % level.

Maturity $i=4$

For quantile 0,1 we have that INFL and DEBT with again positive and negative coefficient respectively and are statistically significant in level of 1%.OIS and VIX are statistically non – significant

For quantile 0,5 we have INFL,OIS and VIX with positive coefficient and they are statistically significant at level 1%,5% and 10 % respectively while DEBT has negative coefficient in level of 1%.

For quantile 0,9 we have INFL and OIS with positive coefficient and are statistically significant in level of 10% and 5% respectively. DEBT has negative coefficient and is statistically significant in level of 1% .VIX is statistically non – significant

Maturity $i=5$

For quantile 0,1 we have only the DEBT with positive coefficient and it is statistically significant in level of 1%.VIX,OIS and INFL are statistically non – significant.

For quantile 0,5 we have VIX,OIS and INFL with positive coefficient and they are statistically significant in level of 5%,1% and 10% respectively while DEBT has negative coefficient in a level of 1%

For quantile 0,9 we have OIS and INFL with positive coefficient and they are statistically significant in level of 1% and 5% respectively. INFL has negative coefficient and it is statistically significant in level of 5%. VIX is statistically non – significant

Public debt to GDP has a significantly negative coefficient in the same magnitude in each quantile and maturity. It can be observed that INFL has the same prospects as above only with positive coefficient. OIS generally has positive coefficient but not as strong as the INFL.

Table 4

	Quantile	Prob(i=1)	Prob(i=2)	Prob(i=3)	Prob(i=4)	Prob(i=5)
VIX	0.100	0.7377	0.4850	0.5041	0.5212	0.3123
	0.200	0.9139	0.9874	0.6611	0.6301	0.1256
	0.300	0.2636	0.2551	0.1454	0.0737	0.0619
	0.400	0.3544	0.0905	0.1153	0.0954	0.0324
	0.500	0.2910	0.2201	0.1892	0.0714	0.0418
	0.600	0.4590	0.3578	0.3493	0.2478	0.1573
	0.700	0.7384	0.2835	0.2492	0.2694	0.0811
	0.800	0.3708	0.4610	0.6382	0.6201	0.4666
	0.900	0.0999	0.1149	0.2367	0.3550	0.6628

$i=1, \dots, 5$ represents the maturity

Although VIX it is statistically non – significant in the most of previous cases we can observe in the table 4 that VIX can be statistically significant in specific quantiles.

Especially for maturity 2 we observe that VIX is statistically significant in level of 10%.

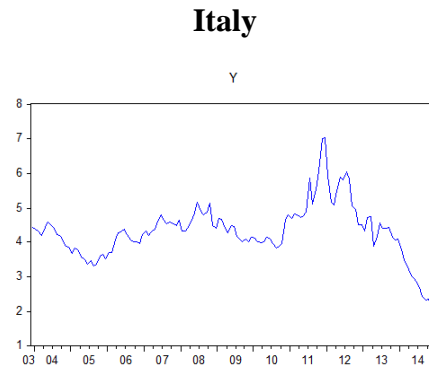


Figure 4

Where Y is the fluctuation of the Italian 10 year sovereign bond yield

We start by analyzing the response of VIX, OIS, DEBT and INFL to sovereign bond yield. As it can be ascertained from table 3 for maturity 1 to 5 and for quantiles 0,1, 0,5 and 0,9, derives the following:

For maturity $i=1$

For quantile 0,1 we have INFL and OIS with positive and negative coefficient respectively and they are statistically significant in level of 1% and 10% respectively. DEBT and VIX are statistically non – significant.

For quantile 0,5 we have VIX and INFL with positive coefficient and they are statistically significant in level of 5% and 1% respectively. DEBT and OIS are statistically non – significant.

For quantile 0,9 we have VIX,INFL and DEBT with positive coefficient and they are statistically significant in level of 5%,1% and 5% respectively.OIS is statistically non – significant.

For maturity $i=2$

For quantile 0,1 we have INFL with positive coefficient and it is statistically significant in level of 1%.VIX,DEBT and OIS are statistically non – significant.

For quantile 0,5 we have VIX and INFL with positive coefficient and they are statistically significant in level of 5% and 1% respectively. DEBT and OIS are statistically non – significant.

For quantile 0,9 we have INFL with positive coefficient and it is statistically significant in level of 1%. VIX, DEBT and OIS are statistically non – significant.

For maturity $i=3$

For quantile 0,1 we have INFL and OIS with positive and negative coefficient respectively and they are statistically significant in level of 1% and 10% respectively. DEBT and VIX are statistically non – significant.

For quantile 0,5 VIX, INFL and with positive coefficient and they are statistically significant in level of 10% and 1% respectively. OIS has negative coefficient in level of 10%. DEBT is statistically non – significant.

For quantile 0,9 we have INFL with positive coefficient and it is statistically significant in level of 1%. VIX, DEBT and OIS are statistically non – significant.

For maturity $i=4$

For quantile 0,1 we have INFL and OIS with positive and negative coefficient respectively and they are statistically significant in level of 1% and 10% respectively. DEBT and VIX are statistically non – significant.

For quantile 0,5 VIX, INFL and with positive coefficient and they are statistically significant in level of 10% and 1% respectively. OIS has negative coefficient in level of 10%. DEBT is statistically non – significant.

For quantile 0,9 we have INFL with positive coefficient and it is statistically significant in level of 1%. VIX, DEBT and OIS are statistically non – significant.

For maturity $i=5$

For quantile 0,1 we have INFL and OIS with positive and negative coefficient respectively and they are statistically significant in level of 1% and 10% respectively. DEBT and VIX are statistically non – significant.

For quantile 0,5 VIX,INFL and with positive coefficient and they are statistically significant in level of 10% and 1% respectively.OIS has negative coefficient in level of 10%.DEBT is statistically non – significant.

For quantile 0,9 we have INFL with positive coefficient and it is statistically significant in level of 1%.VIX,DEBT and OIS are statistically non – significant.

Generally INFL and VIX have a significantly positive coefficient in the same magnitude in each quantile and maturity while OIS has negative coefficient.

Table 5

	Quantile	Prob(i=1)	Prob(i=2)	Prob(i=3)	Prob(i=4)	Prob(i=5)
DEBT	0.100	0.5804	0.7601	0.7647	0.7731	0.8057
	0.200	0.5586	0.5543	0.7413	0.7611	0.9512
	0.300	0.8965	0.7121	0.4011	0.5651	0.4784
	0.400	0.4571	0.9397	0.9823	0.8886	0.9621
	0.500	0.1881	0.4533	0.6963	0.8301	0.9671
	0.600	0.2422	0.3789	0.6397	0.8531	0.5082
	0.700	0.0900	0.1991	0.4878	0.6065	0.6843
	0.800	0.0728	0.5232	0.7929	0.9723	0.9919
	0.900	0.0113	0.4466	0.9566	0.9510	0.9398

$i=1,\dots,5$ represents the maturity

DEBT it is statistically non – significant in the most of previous cases we can observe in the table 5 that DEBT can continues to be statistically non – significant in all quantiles for maturities 2 to 5.

Generally we observe that INFL has positive coefficient with significance of a level of 1%.VIX has positive coefficients but with significance of level 5% to 10%.DEBT is statistically non – significant while OIS has negative coefficient of a level 10%.

Netherlands

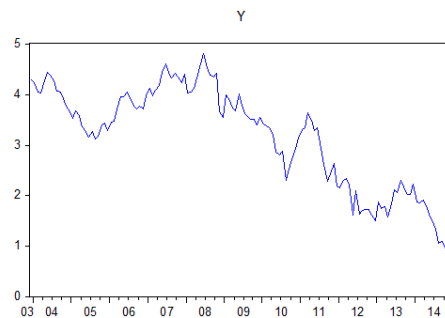


Figure 5

Where Y is the fluctuation of the Dutch 10 year sovereign bond yield

We start by analyzing the response of VIX, OIS, DEBT and INFL to sovereign bond yield. As it can be ascertained from table 2 for maturity 1 to 5 and for quantiles 0,1, 0,5 and 0,9, derives the following:

For maturity $i=1$

For quantile 0,1 we have DEBT with negative coefficient and it is statistically significant in level of 1%. VIX, INFL and OIS are statistically non– significant.

For quantile 0,5 we have INFL and DEBT with negative coefficient and they are statistically significant in level of 1%. VIX and OIS are statistically non– significant.

For quantile 0,9 we have DEBT and OIS with negative coefficient and they are statistically significant in level of 1% and 5% respectively. VIX and INFL are statistically non– significant.

For maturity $i=2$

For quantile 0,1 we have DEBT with negative coefficient and it is statistically significant in level of 1%. VIX, INFL and OIS are statistically non– significant.

For quantile 0,5 we have INFL and DEBT with negative coefficient and they are statistically significant in level of 1%. VIX and OIS are statistically non– significant.

For quantile 0,9 we have DEBT and OIS with negative coefficient and they are statistically significant in level of 1%. VIX and INFL are statistically non– significant.

For maturity $i=3$

For quantile 0,1 we have DEBT with negative coefficient and it is statistically significant in level of 1%. VIX, INFL and OIS are statistically non-significant.

For quantile 0,5 we have INFL and DEBT with negative coefficient and they are statistically significant in level of 1%. VIX and OIS are statistically non-significant.

For quantile 0,9 we have DEBT and OIS with negative coefficient and they are statistically significant in level of 1% and 5% respectively. VIX and INFL are statistically non-significant.

For maturity $i=4$

For quantile 0,1 we have VIX and OIS with positive coefficient and they are statistically significant in level of 10% and 5% respectively. DEBT with negative coefficient and it is statistically significant in level of 1%. VIX is statistically non-significant.

For quantile 0,5 we have INFL and DEBT with negative coefficient and they are statistically significant in level of 5% and 1% respectively. VIX and OIS are statistically non-significant.

For quantile 0,9 we have DEBT with negative coefficient and it is statistically significant in level of 1%. VIX, INFL and OIS are statistically non-significant.

For maturity $i=5$

For quantile 0,1 we have DEBT and OIS with negative coefficient and they are statistically significant in level of 1%. VIX and INFL are statistically non-significant.

For quantile 0,5 we have VIX and OIS with positive coefficient and they are statistically significant in level of 5% each. DEBT with negative coefficient and it is statistically significant in level of 1%. VIX is statistically non-significant.

For quantile 0,9 we have DEBT with negative coefficient and it is statistically significant in level of 5%. VIX, INFL and OIS are statistically non-significant.

	Quantile	Prob(i=1)	Prob(i=2)	Prob(i=3)	Prob(i=4)	Prob(i=5)
VIX	0.100	0.4686	0.6744	0.8933	0.0909	0.1272
	0.200	0.7272	0.3923	0.1046	0.0949	0.0812
	0.300	0.3507	0.7814	0.5290	0.5708	0.2432
	0.400	0.4491	0.7836	0.6672	0.2463	0.2621
	0.500	0.5792	0.6788	0.6860	0.2231	0.0109
	0.600	0.7930	0.6554	0.3080	0.1661	0.0296
	0.700	0.8400	0.8441	0.1362	0.0898	0.0021
	0.800	0.8395	0.7794	0.6483	0.4951	0.0653
	0.900	0.9033	0.8600	0.7793	0.5991	0.5634

Table 6

VIX is statistical non-significant for most of maturities. As we can observe from table 6 VIX is statistical significant only in maturity 4 at quantiles 0,1 and 0,2 but at level 10% and at maturity 5 at quantiles 0,2, 0,5, 0,6 , 0,7 and 0,8 at level 10%,5%,5%,1% and 10% respectively.

Generally DEBT has negative coefficient and it is statistically significant mostly at level 1% while INFL and OIS have negative coefficient with statistically significant mostly at level 1% and 5% respectively.

Conclusion

The present thesis sheds light on the determinants of sovereign bond yields in four countries from European Union. We make several contributions to the existing literature review, while we develop a dataset that contains inflation, debt to GDP, VIX index from S&P500 and OIS index for maturity 1 to 5 years. First, in line with the literature, we found that in Greece in the most of the examined cases the coefficients of VIX, inflation and debt to GDP ratio are positive and statistically significant, while OIS from maturity 1 to 5 years is negative and statistically significant. Furthermore, in the case concerned Germany, we conclude that the coefficients represent inflation and OIS are positive and statistically significant while the coefficients of debt to GDP ratio are negative and coefficients of VIX are in most cases non - statistically significant. In Italy the inflation and VIX are statistically significant with positive coefficients while the debt to GDP ratio is non - statistically significant and the OIS has negative coefficient which is however with 10 % level of significance. Lastly, in Netherlands the inflation, the debt to GDP ratio and the OIS have negative coefficient while VIX is non – statistically significant. The results show that it does matter in which country. We deduce from the tables that these findings have important policy implications and there are several directions for further research.

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Appendix

Greece

Table 1

		VIX	INFL	DEBT	OIS
i=1	$\tau=0,1$	21.95406 (1.009702)	375.8474 (0.993227)	37.65792* (1.691343)	-584.4252** (-2.464098)
	$\tau=0,5$	80.31592 (1.586941)	847.5551*** (4.317531)	139.9878*** (4.902623)	-416.7550* (-1.933810)
	$\tau=0,9$	404.5305* (1.947483)	718.3870 (1.333948)	373.7426*** (7.568123)	1855.291*** (3.013458)
i=2	$\tau=0,1$	13.51461 (0.642608)	631.3999* (1.792790)	42.74628** (2.213891)	-866.7005*** (-2.833720)
	$\tau=0,5$	53.69652 (1.286907)	867.2978*** (5.064076)	123.5400*** (4.732507)	-709.8967*** (-3.395567)
	$\tau=0,9$	429.7972* (1.697066)	830.4719 (1.476598)	394.6380*** (6.350621)	2261.022*** (2.391801)
i=3	$\tau=0,1$	-3.142901 (-0.145034)	632.8088* (1.966132)	35.63650** (2.131541)	-1087.851* (-2.984510)
	$\tau=0,5$	19.38064 (0.569634)	759.8697*** (5.080215)	98.78575*** (4.083722)	-966.2272 (-4.512525)
	$\tau=0,9$	268.3004* (1.814238)	850.7664 (1.470984)	383.8342*** (5.608688)	2023.866*** (1.996740)
i=4	$\tau=0,1$	-6.357330 (-0.275239)	642.0285** (2.151908)	33.23123** (2.124834)	-1284.669*** (-3.072554)
	$\tau=0,5$	7.891327 (0.253797)	745.0961*** (5.414668)	89.31788*** (3.847039)	-1163.538* (-5.172551)
	$\tau=0,9$	123.9669 (0.961017)	1269.127 (1.374290)	336.5586*** (3.826648)	960.8154*** (0.668759)
i=5	$\tau=0,1$	-14.02649 (-0.487104)	673.5257** (2.574754)	31.14098* (1.917676)	-1519.846*** (-3.431869)
	$\tau=0,5$	11.25448 (0.369448)	801.0381*** (5.936026)	88.90111*** (3.882248)	-1291.890*** (-5.345927)
	$\tau=0,9$	93.62373 (0.205271)	2023.874 (0.373271)	300.7469 (0.738562)	28.74337 (0.003378)

Notes: The dependent variable is the ten-year sovereign bond yield spread over Greece. *, **, and *** denote significance at 10, 5 and 1 percent level respectively. t-statistic is in parenthesis.

Germany

Table 2

		VIX	INFL	DEBT	OIS
i=1	$\tau=0,1$	0.004272 (0.335687)	0.436055*** (5.088343)	-0.129280*** (-3.649944)	0.057750 (0.419621)
	$\tau=0,5$	0.008727 (1.060388)	0.251242*** (4.049701)	-0.118834*** (-10.36269)	0.126921*** (3.289713)
	$\tau=0,9$	-0.010070* (-1.657475)	0.250144*** (4.242618)	-0.055815*** (-4.943066)	0.066794* (1.882042)
i=2	$\tau=0,1$	0.008279 (0.700251)	0.450186*** (4.801100)	-0.117646*** (-3.064714)	0.108674 (0.757223)
	$\tau=0,5$	0.012133 (1.232236)	0.234812*** (3.994802)	-0.108644*** (-8.588925)	0.164327*** (3.669594)
	$\tau=0,9$	-0.009560 (-1.587563)	0.253970*** (4.398499)	-0.051744*** (-4.850760)	0.085592* (1.866026)
i=3	$\tau=0,1$	0.007162 (0.670008)	0.457747*** (4.565134)	-0.116997*** (-2.913833)	0.118495 (0.775975)
	$\tau=0,5$	0.012178 (1.319910)	0.243418*** (4.225287)	-0.100416*** (-7.190508)	0.194542*** (3.823827)
	$\tau=0,9$	-0.006939 (-1.188951)	0.193839*** (3.248518)	-0.046014*** (-4.825182)	0.167139** (2.391891)
i=4	$\tau=0,1$	0.006142 (0.643251)	0.451105*** (4.339873)	-0.119011*** (-2.946307)	0.122364 (0.775481)
	$\tau=0,5$	0.015017* (1.818126)	0.015017*** (1.818126)	-0.085605*** (-5.594662)	0.266917*** (4.873629)
	$\tau=0,9$	-0.005616 (-0.928225)	0.127133* (1.943111)	-0.036268*** (-3.782473)	0.246825** (2.398156)
i=5	$\tau=0,1$	0.007579 (1.014424)	0.578161*** (2.676773)	-0.084836*** (-1.290860)	0.262087 (1.038473)
	$\tau=0,5$	0.017142** (2.056192)	0.265739*** (3.961268)	-0.068760*** (-4.065492)	0.351795*** (5.582662)
	$\tau=0,9$	-0.002574 (-0.436998)	0.138963** (2.199234)	-0.022443** (-2.168717)	0.390915*** (3.069322)

Notes: The dependent variable is the ten-year sovereign bond yield spread over Germany. *, **, and *** denote significance at 10, 5 and 1 percent level respectively. t-statistic is in parenthesis.

Italy

Table 3

		VIX	INFL	DEBT	OIS
i=1	$\tau=0,1$	0.002092 (0.276716)	0.588387*** (5.133673)	-0.013007 (-0.554255)	-0.190754* (-1.658308)
	$\tau=0,5$	0.021110** (2.185343)	0.465781*** (5.386453)	0.014439 (1.323381)	-0.048753 (-1.300290)
	$\tau=0,9$	0.079484** (2.021141)	0.618225*** (6.645672)	0.038374** (2.571797)	0.030067 (0.450610)
i=2	$\tau=0,1$	0.004409 (0.602879)	0.630430*** (5.271841)	-0.007958 (-0.305978)	-0.193973 (-1.543889)
	$\tau=0,5$	0.018677** (1.874434)	0.463136*** (5.442029)	0.009080 (0.752238)	-0.069674 (-1.551585)
	$\tau=0,9$	0.054188 (1.121385)	0.596565*** (5.152645)	0.021358 (0.763464)	-0.025442 (-0.278407)
i=3	$\tau=0,1$	0.005235 (0.832986)	0.650623*** (5.550921)	-0.007429 (-0.299906)	-0.205087* (-1.671119)
	$\tau=0,5$	0.017294* (1.686699)	0.453326*** (5.429161)	0.005219 (0.391220)	-0.091843* (-1.721713)
	$\tau=0,9$	0.037826 (0.659873)	0.600050*** (4.894622)	0.002346 (0.054523)	-0.086922 (-0.661636)
i=4	$\tau=0,1$	0.006271 (1.102612)	0.649209*** (5.716196)	-0.006701 (-0.288941)	-0.203060* (-1.748462)
	$\tau=0,5$	0.016499* (1.744022)	0.439748*** (5.498188)	0.002990 (0.215041)	-0.098812* (-1.707654)
	$\tau=0,9$	0.038432 (0.696584)	0.589592*** (4.480024)	0.002537 (0.061536)	-0.092454 (-0.687747)
i=5	$\tau=0,1$	0.006595 (1.160098)	0.652862*** (5.776110)	-0.005570 (-0.246493)	-0.205570* (-1.776502)
	$\tau=0,5$	0.015573* (1.725703)	0.443211*** (5.519564)	0.000599 (0.041291)	-0.114001* (-1.800952)
	$\tau=0,9$	0.038929 (0.722076)	0.581025*** (4.151706)	0.002994 (0.075680)	-0.097596 (-0.705721)

Notes: The dependent variable is the ten-year sovereign bond yield spread over Italy. *, **, and *** denote significance at 10, 5 and 1 percent level respectively. t-statistic is in parenthesis.

Netherlands

Table 4

		VIX	INFL	DEBT	OIS
i=1	$\tau=0,1$	-0.014360 (-0.726861)	-0.304770 (-1.270521)	-0.127392*** (-4.792122)	-0.041695 (-0.315118)
	$\tau=0,5$	-0.005138 (-0.556016)	-0.169177*** (-3.063961)	-0.115234*** (-10.57262)	-0.071047 (-1.538809)
	$\tau=0,9$	0.000682 (0.121729)	-0.012316 (-0.119162)	-0.126202*** (-12.74467)	-0.113552** (-3.584518)
i=2	$\tau=0,1$	-0.007741 (-0.421100)	-0.214952 (-0.902465)	-0.112484*** (-4.697125)	0.054605 (0.454994)
	$\tau=0,5$	-0.003965 (-0.415027)	-0.180296*** (-3.223606)	-0.114623*** (-9.117322)	-0.065248 (-1.171962)
	$\tau=0,9$	0.001059 (0.176720)	-0.056706 (-0.496057)	-0.127022*** (-10.01455)	-0.121628*** (-2.633961)
i=3	$\tau=0,1$	0.002282 (0.134363)	-0.112930 (-0.523149)	-0.102032*** (-5.390543)	0.110846 (1.085656)
	$\tau=0,5$	0.003878 (0.405239)	-0.187912*** (-3.068725)	-0.096078*** (-7.122916)	0.028877 (0.461995)
	$\tau=0,9$	0.001777 (0.280815)	-0.089959 (-0.739169)	-0.123759*** (-8.376383)	-0.132237** (-2.181469)
i=4	$\tau=0,1$	0.011658* (1.703312)	0.001425 (0.007597)	-0.091466*** (-7.013479)	0.170053** (2.482679)
	$\tau=0,5$	0.011643 (1.224181)	-0.170280** (-2.543554)	-0.081892*** (-6.094913)	0.095634 (1.429405)
	$\tau=0,9$	0.003611 (0.526952)	-0.090002 (-0.743509)	-0.116586*** (-6.147774)	-0.072702 (-0.722891)
i=5	$\tau=0,1$	0.010508 (1.535384)	0.027571 (0.140384)	-0.087249*** (-6.527970)	0.232909*** (3.296204)
	$\tau=0,5$	0.022379** (2.584799)	-0.106426 (-1.521432)	-0.073449*** (-5.844819)	0.172352** (2.416090)
	$\tau=0,9$	0.006216 (0.579373)	0.074905 (0.557592)	-0.085296** (-2.146531)	0.140664 (0.448740)

Notes: The dependent variable is the ten-year sovereign bond yield spread over Netherlands. *, **, and *** denote significance at 10, 5 and 1 percent level respectively. t-statistic is in parenthesis.