The Dynamic relationship between long term interest rates and fiscal stances in the EMU

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Abstract

In this paper, we study the dynamics and drivers of sovereign bond yields in euro area countries, using a panel data and a time varying coefficient approach with GARCH volatility, which allows for capturing changes in the pricing mechanism of bond yields. Our key contribution is the inclusion of new fiscal variables as determinants of yields in the Eurozone all a whole, which were discarded by other methods and older data sets. Furthermore, our findings confirm that after the period of divergence in interest rates caused by a refocus on fundamentals, Eurozone interest rates converged again under the effect of a normalization of bond yield drivers back to pre-crisis levels. This implies that in times of economic uncertainty when default risk becomes an issue, interest rate effects of government policy can become significant leading to accentuated crowding out effects. Finally, our analysis provides a new methodological framework which discards panel data approaches to answer questions similar to ours.

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1 Introduction

The Eurozone debt crisis that occurred during the first half of the 2010's left a deep mark in minds of the European people and policy makers, as it brought the Eurozone on the verge of collapse. Not surprisingly, it was judged by the Organisation for Economic Co-operation and Development (OECD) to be the biggest threat to the global economy in 2011, and a breakup of the currency zone was not ruled out at the time. In the years that followed the situation remained critical and significant changes in government policies and in the role of the European Central Bank (ECB) were needed to end the divergence of European Monetary Union (EMU) spreads.

This crisis was caused by the increasing belief of investors that Greece and other euro area periphery countries were on unsustainable debt paths after the financial crisis of 2008, that could eventually lead to them defaulting on their debt. In a chained reaction of distrust by the markets, the spreads among EMU countries diverged greatly after 2009, as we can observe in figure 1. This occurred after over a decade of convergence which resulted in homogeneous borrowing rates amongst EMU countries, raising questions on whether these truly reflected fundamentals or if investors misconceived varying level of risk associated to state debt. Consequently, borrowing became prohibitively expensive for Greece, Ireland and Portugal, which required the interventions of the International Monetary Fund (IMF) and the ECB to make up for the lost support from private investors. Other countries such as Spain and Italy were also affected as their fiscal positions deteriorated and as investors feared contagion amongst Eurozone countries. In the meantime, liquidity streamed to the North European countries to which was attributed the status of "safe heaven", this, driving an even larger wedge between core and periphery borrowing rates (Poghosyan (2014)).

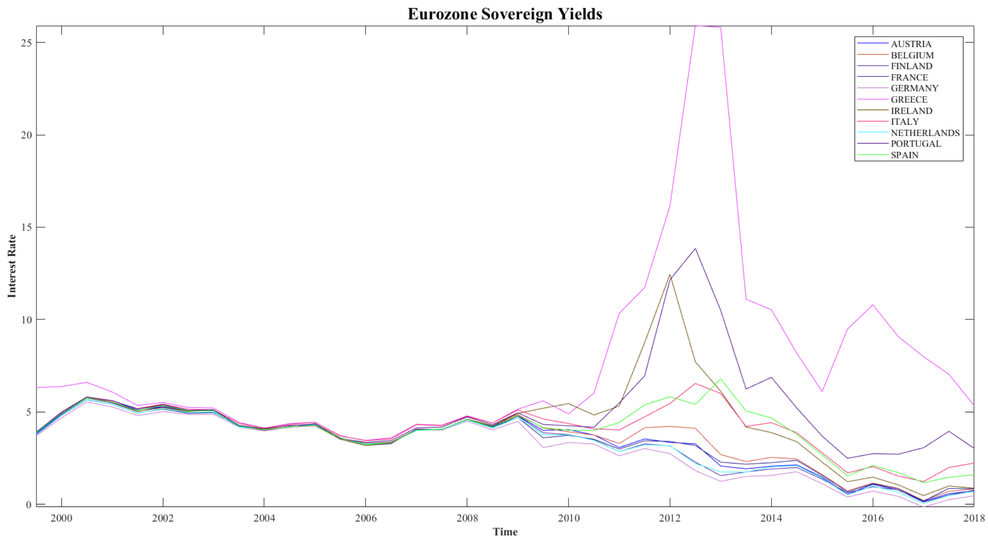


Figure 1. Eurozone Sovereign Yields

As such, understanding the pricing mechanism and the drivers of bond yields has become essential to monitor risks and formulate sound policies. As the Eurozone debt crisis has demonstrated, high borrowing rates, occurring when investors lose trust, can rapidly become unsustainable, leading states to effectively lose access to financial markets and making it impossible for them to fulfill their roles. Furthermore, long term interest rates act as benchmark financial instruments for the setting of other asset's prices such as bank loans and derivatives. This implies that bond yields have important implications for the general macro framework and the health of the economy as a whole. Sovereign bond markets have also attracted extra attention from the academic community because central banks have employed unconventional monetary policies to lower long term yields to boost the economy. In this context, understanding which are the determinants of yields and how they evolve over time has become a crucial question.

This study adds to this field of literature by looking at the dynamic relationship between fiscal variables reflective of the fundamentals, and the long-term interest rates of the Eurozone countries over the last 18 years. The method employed is twofold, first using a panel of 11 Eurozone countries we estimate the relationship between several fiscal and common factor variables, and long run interest rates. We proceed in analyzing the panel of 11 countries composed of data extracted from the OECD economic outlook forecasts, over the whole sample, two split samples and dynamically through the introduction of lags. Secondly, we compute time varying coefficient on a dynamic factor model, to study the dynamic relationship between bond yields and the variables found relevant in the first part of the analysis. The aim of our approach is to disentangle common euro area effects from the country specific ones in the setting of interest rates, and how this relationship changed over time. Specifically, evaluating the effect of the financial crisis on the pricing mechanisms in the euro zone bond market.

We place ourselves in the extensive literature on sovereign yields spreads by adding two contributions. First, we bring new evidence in the ongoing academic debate regarding which factors influence sovereign yields, and how they evolve over time given the economic conjecture. Our findings add to the evidence regarding different sub periods in European debt pricing and challenge the view that debt to GDP is the most important fundamental in pricing sovereign debt. Our findings confirm that during the financial crisis investors turned back to fundamentals in general, but not only debt as previous studies indicated but also current account balances and deficits. Second, we approach the question using innovative methods, taking into account non linearities in the data and different degrees of volatility over time. As such, we follow a logical procedure in which we adapt our methods to the challenges posed by the data we employ. This makes our analysis more complete since it looks at different forms of econometric evidence.

Our findings match our hypothesis identifying the crisis as a turning point during which investors increasingly pricing debt based on fiscal stances rather than common euro zone factors. The different methods we employed allow us to conclude that after 2009, the debt level, the deficits and the current account balances of the studied countries mattered more for the setting of long term interest rates. We also notice that after the divergence caused by the crisis, Eurozone countries seems to have entered a new phase of converge in their interest rates. This led us to our main conclusion, the crisis led investors to question the unity of EMU countries in times of economic hardship, causing them to pay closer attention to each member state's individual characteristics. This implies that when a crisis hits countries need to pay extra attention to their fiscal stances, or they face the risk of being exposed to fear movements in the financial market. Our paper is organized as follows: first we review the existing literature, we then introduce our methodology, followingly we present a time varying factor model, and then the evidence we obtained using panel data methods, finally we conclude.

2 Literature Review

The recent turmoil in the European government bond markets of 2011 reinvigorated the interest in investigating the determinants of bond yields and government spreads in last years, a topic largely treated in previous years. The recent literature in the field since 2010 has tried to explain why some European countries experienced a period of high interest rate, which led to adoption of austerity measures, after a period of strong convergence. Following, we will present a brief overview of the literature in the field, explaining the main motivations behind and emphasizing the studies which had a greater influence on our work.

The majority of studies look at fiscal fundamentals as determinants of sovereign bond yields and most of them agree on their pivotal role and how this link has changed during the crisis. Typically, the literature regarding the determinants of government bonds is modeled on three main variables: first an international risk factor capturing the level of perceived financial risk (see e.g. Acharya et al. (2014); Segoviano Basurto et al. (2010);Gerlach et al. (2010)). Second, credit risk, which has shifted considerably, with fiscal and other macro-imbalances now being more heavily penalized as compared to before the crisis (Zoli and Sgherri (2009), Schuknecht et al. (2010), Aßmann and Boysen-Hogrefe (2012)). Such a risk reflects the probability of default on behalf of a sovereign borrower, which is typically approximated using indicators of past or projections of future fiscal performance (Afonso (2010), Attinasi et al. (2009)) Indeed, existing evidence suggests that markets attach additional risks to the loosening of observed fiscal positions (see e.g. Ardagna (2004); Afonso and Rault (2015)). Third, liquidity risk has played a role, mainly in periphery countries during the crisis (De Grauwe and Ji (2013); Afonso et al. (2015)).

The literature referred to European government bonds is not always unanimous on the role of each of the three variables discussed above. We try to enter this discussion, by considering these three factors in our model. Specifically, we will use variables taking into account the international risk factor and credit risk, whereas we believe that liquidity risk is implicitly attached to the large movements of debt after 2008 in peripheral countries.

Prior the start of the financial crisis, the international risk factor was an important determinant of bond an yields (Favero et al. (2010);Zoli and Sgherri (2009); Dell'Erba and Sola (2013)). This effect was prominent in countries with high level of public debt. In particular, Dell'Erba and Sola (2013) captures the international risk factor by using a principal component approach and employing a factor augmented panel. In their analysis on OECD countries until 2012, they find that two global factors explain more than 60 percent of the variance in long-term interest rates, whereas the importance of domestic variables in explaining long-term interest rates is weakened. In our study we will follow their approach in order to construct international risk factor through principal components but considering additional fiscal variables .

Several studies tend to point out a significant impact of government debt and deficit on sovereign bonds yields.Faini (2006) finds a significant effect of fiscal deficit and debt levels on the aggregate EMU interest rate level, as well as on sovereign bond spreads in a model with identical slope coefficients across countries. Afonso (2010), using semi-annual vintages of growth and fiscal forecasts for a panel of 14 EU countries from 1988 to 2008, finds that nominal yields tend to lower with forecasts of higher GDP growth and with lower budget balance to-GDP ratio (primary deficit) a result in line with our findings. Similarly, Attinasi et al. (2009) use a dynamic panel approach from 2007 to 2009 on 10 Eurozone countries to show that sovereign bond yield spreads reflect concerns about a country's credit risk and liquidity risk. Higher expected budget deficit and/or greater expected government debt relative to Germany have led to an increase in bond yield spread in the countries under investigation. On the contrary, Dautovic (2017) exploiting a similar approach of Attanasi et al. on a panel data composed by projections over 14 countries from 1992 to 2008, shows that the correlation of fiscal fundamentals on bonds' interest rates is evident when static models are employed but they disappear with dynamic models. We performed an analysis similar to the last two papers in our panel data analysis, where we use both econometric models (static and dynamic), stressing the differences in results between the two approaches.

Finally, the effect of liquidity risk is disputed. Codogno et al. (2003), Bernoth et al. (2004), Pagano and Pagano and Von Thadden (2004), and Jankowitsch et al. (2006) find a limited and declining liquidity effect on EMU spreads. More recently, De Grauwe and Ji (2013) using a static panel data analysis over a set of European countries show that after years of neglecting high debt to GDP ratios, investors became increasingly worried about the high debt to GDP ratios in the Eurozone, and reacted by raising the spreads. They introduce the concept of self-fulfilling debt crises: when countries are hit by a liquidity crisis, they are forced to apply stringent austerity measures that force them into a recession, reducing the effectiveness of these austerity programs. Our findings are in line with De Grauwe and Ji (2013) when the static panel data model is employed.

In the last years, the literature presents a strong point of consensus in demonstrating how during the crisis period, markets have been penalizing fiscal and other macro-imbalances much more heavily than before. Despite that there is not a broad consensus in the literature regarding the econometric specification to use and on the right fiscal variables to employ. We will try to enter in this discussion by explaining our reasoning in selecting the model.
As we described before, many studies obtain their results by using panel data analysis, whereas there is another branch of literature focusing on dynamic model which had a large influence on our work. Bernoth and Erdogan (2012), analyze the determinants of sovereign bond yield spreads across 10 EMU countries from 1999 to 2010 applying a semiparametric time-varying coefficient model. They find that the impact of fiscal policy variables and general investors' risk aversion on sovereign yield spreads is not constant over time, coherently with our results. Indeed, before the financial crisis, financial markets paid no attention to government deficit ratios, while they almost continuously monitored the debt to GDP ratio of the individual countries, which is also the more relevant variable to assess fiscal sustainability. Afonso et al. (2015) use a dynamic multi path general-to-specific algorithm to capture structural instability in the relationship between Eurozone sovereign bond yield spreads against Germany, and their underlying de-

terminants over the period January 1999 until August 2011. Their findings suggest that the relationship between euro area sovereign risk and the underlying fundamentals is strongly time-varying. The authors show that the set of financial and macro spreads' determinants in the euro area is highly unstable but generally becomes richer and stronger in significance as the crisis evolves. Aßmann and Boysen-Hogrefe (2012) employ a time varying coefficient model to assess the government bonds yields of ten euro area countries relative to German government bond yields. Such a model illustrates that the evaluation of determinants of government bond spreads is highly volatile, indeed the relative and absolute importance of single determinants dramatically change over time , particularly during the crisis but also before. We will base our time-varying dynamic model on their specification, including additional fiscal variables and exploiting a greater availability of data.
Finally, we find the existence of different regimes in the relation between fiscal stances and interest rates. In line with this, it is worth to mention the contributions of Laubach (2011) and Adam and Lo Duca (2017) who both describe different phases in the evolution of the EMU bond market. More specifically, the latter study employs a factor model with time-varying coefficients finding three distinct stages in euro area sovereign bond markets, as in our analysis. First, an initial phase when bond markets were almost fully integrated. A second phase of dis-integration in bond markets when the crisis escalated. Lastly, a third phase of partial re-integration, when the pricing mechanism of bonds approached the pre-crisis conditions.

These studies strongly emphasize how the relationship between bond yields and macroeconomics' fundamentals is volatile over time, comparing outcomes before and after the crisis. Hence, according to the recent literature, time varying coefficient analysis would appear the most appropriate approach to follow in order to evaluate how the sovereign interest rates' determinants have evolved over time. We will try to shed light on this point by applying both a panel data and a time varying approach, showing that with the former method we are not completely able to draw general conclusions which are more evident with the latter specification.

3 Data and Principal Component analysis

3.1 Data

We use semi-annual forecasts of macroeconomic and fiscal variables we obtained from the December and June issues of the OECD's Economic Outlook, covering a period of 18 years, from December 1999 until December 2017, implying 38 observation per country. We have selected in our sample 11 countries, which are the original Eurozone countries abstracting from Luxembourg, leaving: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, The Netherlands, Portugal and Spain. This set of countries has been widely used in the literature to address similar questions to ours, examples for this are Attinasi et al. (2009) and Afonso et al. (2015).

We believe that OECD forecasts are more reflective of the information that investors take into account when judging the risk associated to sovereign debt, this method is also existent in the literature, Dell'Erba and Sola (2013) use OECD projections and Aßmann and Boysen-Hogrefe (2012) and Attinasi et al. (2009) use European Commission data. The June issue of the Economic Outlook has forecasts for the current year t, according to Beetsma et al. (2008), these reflect the implementation of the budget law, while the December release gives us a forecast for the next year $t+1$ and is reflective of the planning of the budget law. We have therefore every year one forecast for the current year and one for the year that follows. To this we associate 10 year rates that we extracted from Eurostat, we use the average of the July, 10 year interest rates collected at a daily frequency, as the interest rate related to the June projections, and the January interest rates for the December release. We selected this method based on the assumption that financial markets are forward looking and are able to incorporate rapidly all the available information, sampling interest rates after the release of the forecasts reduces the issue of reverse causality.

As measures of fiscal stances we extracted from the Economic Outlook projections for: debt to GDP, surplus to GDP, current account balance to GDP and GDP growth. In order to avoid issues related to reverse causality we use primary surplus rather than secondary surplus since interest payments are included in the latter. We choose this set of variables based on previous findings in this field of literature, most papers use debt to GDP ratios and public deficits to GDP as a measure of fiscal stances (eg: Kumar and Baldacci (2010); Dell'Erba and Sola (2013); Laubach (2011); Ardagna (2004); Attinasi et al. (2009)).

Table 1. Summary Statistics

	Ten year government bond yield				Debt to GDP				Surplus to GDP			
Country	Mean	St. dev	Min	Max	Mean	St. dev	Min	Max	Mean	St. dev	Min	Max
Austria	3.36	1.54	0.16	5.75	75.45	6.71	62.98	85.60	-2.01	1.26	-5.52	1.10
Belgium	3.51	1.50	0.20	5.79	104.98	6.75	90.10	116.50	-1.50	1.66	-5.63	1.15
Finland	3.26	1.57	0.12	5.75	45.87	9.60	28.80	64.20	0.68	2.76	-4.84	5.34
France	3.34	1.45	0.17	5.66	76.25	15.08	57.70	98.90	-3.38	1.83	-8.63	1.10
Germany	3.04	1.62	-0.15	5.54	67.97	6.87	57.60	80.00	-1.76	1.76	-5.38	1.03
Greece	7.63	5.10	3.46	25.91	130.39	30.84	99.90	178.90	-3.14	2.72	-9.84	1.58
Ireland	4.34	2.21	0.47	12.45	60.62	33.81	23.80	124.20	-2.35	4.80	-12.15	6.55
Italy	4.15	1.26	1.23	6.54	114.96	11.65	101.00	134.50	-2.72	1.27	-5.45	1.31
Netherlands	3.23	1.55	0.06	5.67	56.49	7.85	43.50	69.00	-1.66	1.96	-6.36	1.27
Portugal	5.06	2.36	2.49	13.85	86.56	31.52	50.10	133.00	-3.50	1.83	-7.59	1.43
Spain	4.08	1.33	1.17	6.79	64.36	22.61	34.79	100.77	-2.54	3.21	-9.44	1.53

Even if part of the literature uses one or the other, our reason for including both is that in theory the relationship between fiscal policy and interest rates can be described by one or the other variable. Textbook IS-LM accounts tend to emphasize the deficit, while microfounded general equilibrium models tend to place more weight on the stock of debt. Furthermore, even if one were specifically interested in the effects of only one of these variables, it would still make sense to control for the other.

To achieve correct identification we include relevant control variables to keep other factors constant. As such to control for monetary policy we include the short term interest rate and the inflation rate of each country in our analysis. Furthermore, we also include GDP growth as a control variable, even if it's effects on interest rates are already pricing in through the deficit, a country with high growth will find more ease in servicing it's debt due to high tax revenues (De Grauwe and Ji (2013)). We also control for the US Dollar to Euros exchange rate as a proxy for the monetary stance of the United States and changes in terms of trade. For example if the US tightens it's monetary policy, the dollar will appreciate, including this variable allows to control for these effects. Also it will reflect to some degree to competitiveness of the Eurozone with respect to the rest of the world which can have a long term impact on sovereign yields (Adam and Lo Duca (2017); De Grauwe and Ji (2013)). Finally, we include current account balances over GDP because increases in deficits can be interpreted as increases in net foreign debt, which can increase the risk of default of a country (De Grauwe and Ji (2013)).

In table 1 we present the summary statistics of our three main variables. We notice that countries in the south overall had higher average ten year yields, and that three countries, Greece, Portugal and Ireland, had large fluctuations in their yields, reflective of a confidence crisis. The same countries also have the highest standard deviations in their debt levels and the highest maximum levels as well, indicating that these countries faced the largest shocks during the Eurozone debt crisis.

3.2 Common component analysis

Being aware of the high integration among the Eurozone countries, stemming from the single market, the single currency and different common stances regarding fiscal policy included in the Maastricht Treaty, we decide to include common variables to all the Eurozone countries when trying to explain co-movements in all their interest rates.

The way in which we include these variables is through a Common Component Analysis. There are not many exercises in the literature where this approach is taken into account (common variables), and when it is, it is through already existing and available variables. Our aim is to create one or several variables that retrieve co-movements on the macroeconomic variables of the different Eurozone countries (surplus over GDP, debt over GDP, GDP growth...) that could explain at the same time co-movements in the different interest rates. There are some studies where this approach is taken into account, but either they use it in a panel data analysis (Dell'Erba and Sola (2013)), or use it in a time varying coefficient approach, where these co-movements are retrieved directly from the different interest rates of the Eurozone countries (Laubach (2011); Manganelli and Wolswijk (2009); Adam and Lo Duca (2017)), but without taking into account other macroeconomic and fiscal variables.

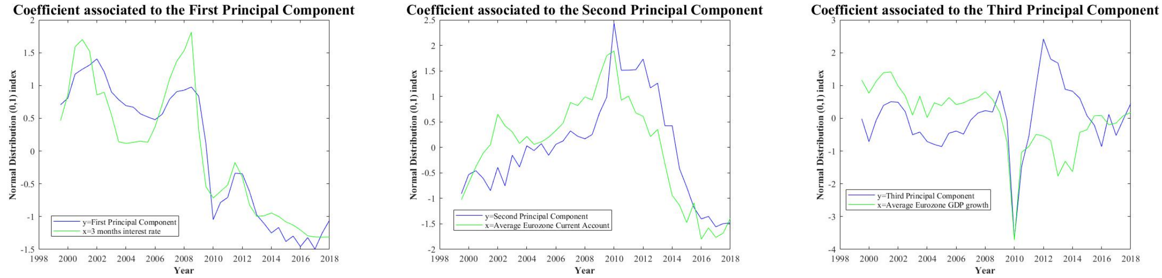


Figure 2. Common Components Variables

We extract our different common components following Dell'Erba and Sola (2013) approach. To do so we stack all the dependent and explanatory variables of each Eurozone country (namely, 10 year government bond interest rate, current account over GDP, surplus over GDP, inflation, GDP growth, debt over GDP, 3 months government bond interest rates) horizontally one after the other in a unique matrix. After creating a square variance-covariance matrix with all our sample variables (normalizing previously the data), we find that the first 3 eigenvectors resulting from the diagonalization this matrix explain roughly the 80% of all the variance present in our sample.

Because we introduce these self-created variables into the time-varying regression, we highly believe that it is necessary to give them an economic interpretation.For the first common component, after analyzing different Eurozone variables, we find that this variable closely follows the behavior of the 3 month Eurozone money market rate (after we have also normalized this variable). There are many different studies which, in order to control for the effect of short term interest rate on the long term ones, use this variable (e.g. Faini (2006), Attinasi et al. (2009) etc..). Therefore, in our case, without exogenously imposing it, we find that this variable is actually internally hidden in the performance of all the variables that we consider in our study for all the different Eurozone countries.

Moving to the second common component, we find that it follows the behavior of the average current account balance of the countries in our sample. This result is somewhat difficult to interpret. This variable reflects the periods in which this eleven Eurozone countries are net investors or net creditors as a whole, this could have effects on the level of the common part of the different interest rates that these countries share as a result of them co-existing in a common currency area. These effects would come from appreciatory/depreciatory pressures derived from trade flows. Therefore, we think it would be worth to control for this in our regression.

Finally, for the third common component, although it explains only 10% percent of the variance present in our sample, is included it as a proxy for the business cycle in the Eurozone, as it replicates moderately well the behavior of the Eurozone GDP growth. All these comparisons can be easily seen in figure 2.

4 Some Facts about 10-years bonds yields and fiscal stances

Before introducing the results, we are going to present some facts regarding the relationship between nominal interest rates and some fiscal stances in our data set. In particular, we will focus our investigation on two fiscal variables: debt over GDP ratio, which is crucial to understand the behavior of interest rates overtime and current account balance since it is not usually employed in the literature but it played a significant role in explaining the evolution of interest rates.

Figure 3 and figure 4 below show the relationship between dept over GDP and 10-years yields bond. This is done by plotting the nominal interest rates on vertical axis and the debt to GDP ratio on the horizontal axis in the EMU countries, over two intervals, namely, from 2000 to 2007 and from 2008 to 2017. We also draw a straight line obtained from a simple regression of the nominal interest rates as a function of the debt to GDP ratio. We observe that before 2007, there is no a clear trend in our data, in particular countries with high level of debt over GDP experienced the same nominal interest rates as their peers with a lower debt. This is the result of the convergence process in the EMU area, introduced in the previous section. After the crisis instead the divergence process is translated in an increasing pattern between dept and nominal interest rates (represented by the positively sloped regression line). Apparently, investors seem to punish more countries with a high level of debt over GDP, asking for higher interest rates in order to lend money. The relation looks quite steady after 2008 but for abnormal interest rates values requested by investors on Greek's Bonds in 2012, reaching a 25% level. This first evidence suggests that before the crisis investors did not weight countries according to their fiscal stances, there was the misconception that all the EMU area was facing the same risk. Another interesting element is highlighted by figure 5 and figure 6, where we present the same relation as before from 2008 until 2017 respectively for core and peripheral countries.

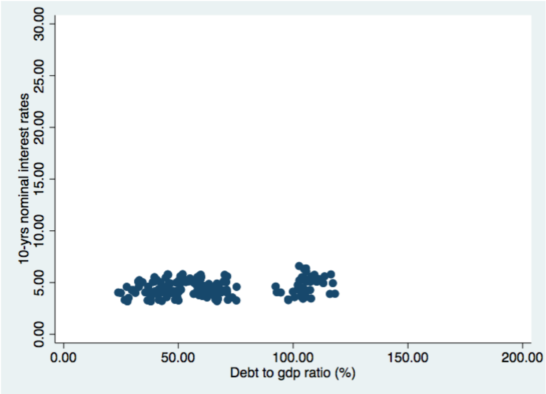


Figure 3. 10-yrs bonds and dept over gdp from 2000-2007

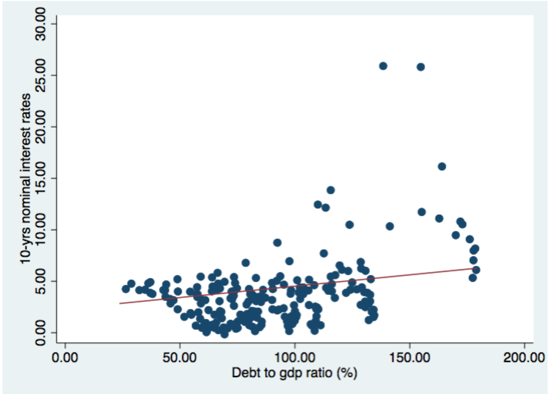


Figure 4. 10-yrs bonds and dept over gdp from 2008-2017

More specifically, with core countries we refer to: Austria, Belgium, Finland, France, Germany, Netherlands whereas we select as peripheral countries: Greek, Ireland, Italy, Portugal and Spain. It's immediately noticeable that when we consider just core countries a positive and increasing relation seems to disappear whereas it is still present when just periphery is considered. Therefore, we can conclude that the relation described before is mostly driven by peripheral countries. Nevertheless, this is mostly affected by outlier countries during the debt crisis, namely, Ireland, Greece and Portugal.

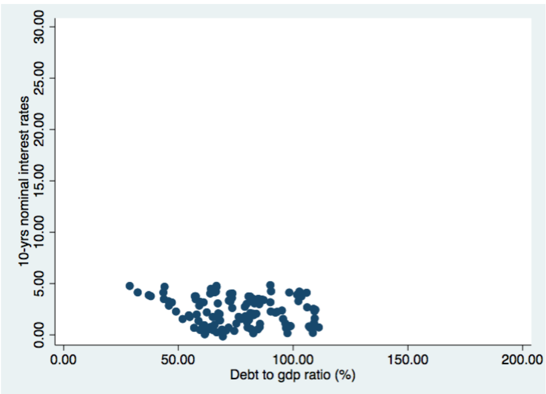


Figure 5. 10-yrs bonds and dept over gdp core countries 2008-2017

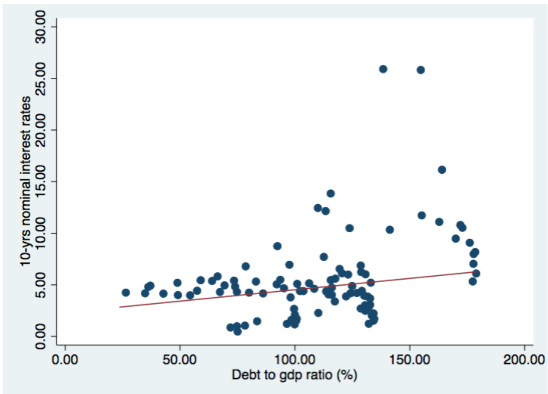


Figure 6. 10-yrs bonds and dept over gdp peripheral countries 2008-2017

Following, we will present a similar analysis but for current account forecasts. This variable is not usually employed in the literature which focuses its analysis on debt and deficit. There are two main reasons behind that. Firstly, it is believed that investors tend to focus their attention on the so called "Mastricht parameters" which refers to deficit and debt both over GDP. These are also the two variables under the attention of European Institutions which require to adapt budget policies in order to reach predetermined objectives. Secondly, current account is not unanimously considered to affect the fiscal solidity of a country, the United States could be an example in this sense. Nevertheless, in the EMU area current account deficit had a similar effects on nominal interest rates and on spread as deficit and debt. Indeed, as stated by De Grauwe and Ji (2013), current account should be interpreted as increases in the net foreign debt of the country as a whole and the explanation of such an effect goes in two directions.

On one hand, if this increase arises from the private sector's overspending, it could lead to a default risk in private sector which in turn has a negative effect on economic activity of a country as a whole and therefore on the government revenues. On the other hand, if this increase comes from government overspending it directly affects the government's debt service, and thus the default risk. The first two figures below present the relationship between nominal interest rates and current account forecast to GDP ratio respectively before and after the crisis. It's immediately observable by figure 8 how after the crisis there exist a positive relationship between negative current account values and 10-years bond. This relationship is instead quite inexistent before the crisis, which at this point is not anymore surprising being the effect of the convergence process in the EMU area. Therefore, our analysis seems to show that after the crisis investors posed additional attention to the balance of payments of countries.

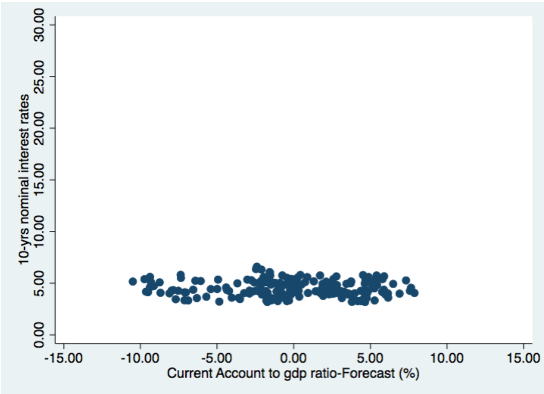


Figure 7. 10-yrs bonds and Current Account over gdp 2000-2007

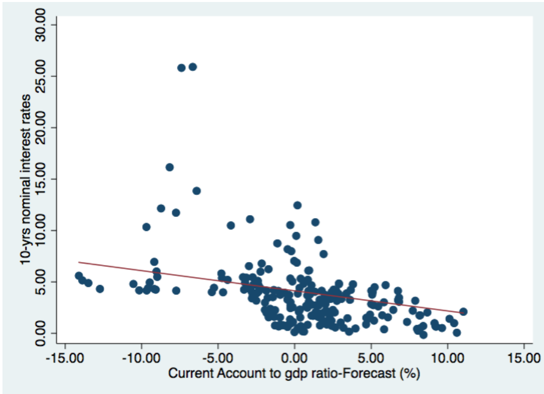


Figure 8. 10-yrs bonds and Current Account over gdp 2008-2017

As before, it's interesting to try to disentangle this effect among core and peripheral countries, we will perform this exercise in the subsequent set of figures. Again as shown by figure 10 the relationship is mostly driven by peripheral countries compared to core ones. Although some core countries like Belgium, France and Germany experienced very negative values of current account they were not perceived as risky by investors since probably it was linked with a sustainable level of debt. Therefore, what stands out from this analysis is that a deficit in current account was perceived as a factor of risk for countries' fiscal sustainability when it was combined with high level of debt and deficit over GDP.

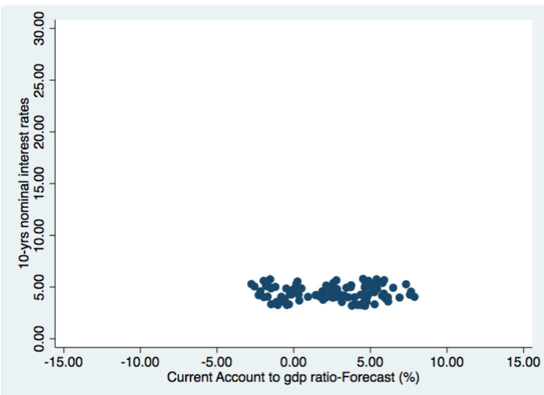


Figure 9. 10-yrs bonds and Current Account over gdp core countries 2008-2017

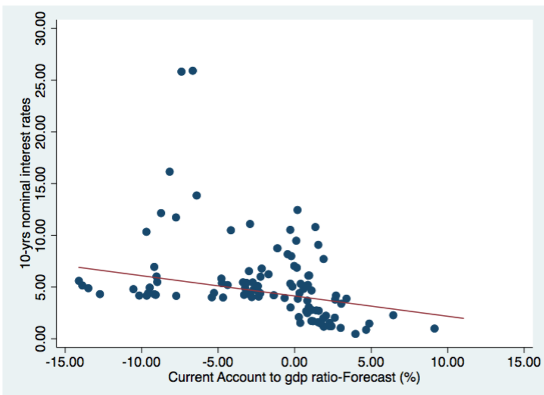


Figure 10. 10-yrs bonds and Current Account over gdp peripheral countries 2008-2017

5 Results

In order to study the relationship between fiscal policy and bond yields, we use a twofold approach, first we use a dynamic factor model to evaluate the changing relationship, between fiscal variables and ten year yields, for our sample of 11 Eurozone countries. We assume that changes in yields are driven by the variables presented above, and that their relationships change over time, given the conjecture and the state of the global economy. Second, we use panel data techniques following a very vast literature employing this method (e.g. Attinasi et al. (2009), De Grauwe and Ji (2013), Dautovic (2017)). This allows us to narrow down our approach and test our data set relative to similar studies.

5.1 Time Varying model analysis: Model Setup

Our model is designed to capture frequent decisions about the pricing of ten year bonds in the Eurozone, thus, it looks at the relationship between variables across countries and over time. We achieve this goal by creating a dynamic model based on the Kalman Filter that evaluates the effect of fiscal variables in the cross section and over time, treating every country's yield as a different variable. Hence we define our model as follows:

$$y_t^n = X_t^n \beta_t + \varepsilon_t^n \tag{1}$$

Where y_t^n denotes the bond yield of country n ($n = 1, ..., N$) at time t, X_t^n is a matrix of observable independent variables k ($k = 1, ..., K$) relevant for pricing the yields of country n at time t, β_t is a vector containing the coefficients associated to every independent variable, and is fixed across countries. Also, equation 3 does not contain any lagged values of the independent variables, this is because we assume that financial markets adjust quickly and that past information is already included in current variables. As such we assume that current long term yields are determined by current information only.
We assume that the time varying coefficients β_t follow a random walk and is defined as:

$$\beta_t = \beta_{t-1} + v_t \tag{2}$$

We presume that the effect of the independent variables on the interest rate evolves over time. Therefore, β_t is a non-observable latent variable that we will estimate through our dynamic factor model, specifically, the Kalman Filter.

We also think that the variance of our dependent variable, due to the financial crisis, is not constant over time. Indeed, in the years that followed 2008, volatility of the bond yields in the Eurozone increased substantially, and modeling this effect improves our results substantially. Therefore, we assume that the variance ($\overset{2}{\sigma_t}{}^n$) of our dependent variable follows a GARCH (1,1), based on the work of Harvey et al. (1992) and later on King et al. (1994) that introduce GARCH variances into state space models. Our process for the variances of the observables is of the form:

$$\overset{2}{\sigma_t}{}^n = \mathbb{E}[\overset{2}{\varepsilon_t}{}^n] = \varpi + \alpha \overset{2}{\varepsilon}{}^n_{t-1} + \phi \overset{2}{\sigma}{}^n_{t-1} + \xi_t \tag{3}$$

In the case of the time varying parameters, we assume that their variance is constant over time given that we have little information on it's behavior and assuming a process for it would lead to unjustified complications to our model. As a robustness check we modelise a GARCH(1,1) for the variances of the time varying parameters and conclude that our results do not improve with this addition, we will come back to this further in this paper. Thus, we will also model the variance ($\overset{2}{v_t}{}^n$) as:

$$\overset{2}{v_t}{}^n \sim N(0, \Sigma), \quad with\, \Sigma = diag(\sigma_1^2, ..., \sigma_K^2) \tag{4}$$

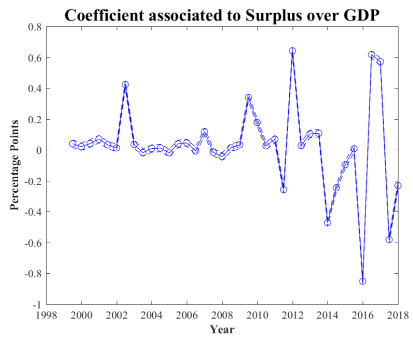
We define our model were we include the following set of variables in our regression Current Account Balance, Surplus over GDP, Inflation, GDP growth, Debt over GDP, Factor 1, Factor 2, Factor 3, US dollar/Euro Exchange rate Note that we refrain from using short term interest rates as this variable is captured in Factor 1.

5.1.1 Time Varying model without GARCH effects

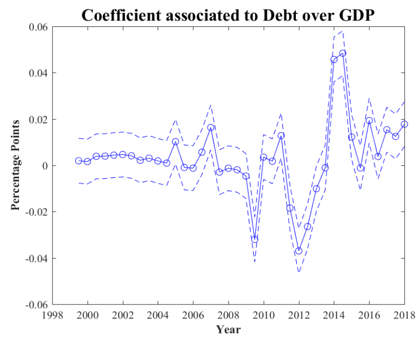
In this section we review the evidence obtained from our time varying model under different specifications without including GARCH effects on the variances of the observable variables.

Figure 11 displays the results of our model without considering time varying volatility. We find that whilst deficit did not play a role in determining sovereign yields prior to 2010, we observe a clear break thereafter. We find that after 2008 our model captures fluctuations in the coefficient associated to deficit, but the results are inconclusive as the coefficient varies at lot and is very noisy. Our other fiscal variables lead us to draw to the same conclusion, they all have no influence on bond yields prior to 2008 and become influential thereafter. Our model seems to capture an effect of fiscal variables after the crisis, but the coefficient are disturbed by the increased volatility associated with this period. Without GARCH variances our model is unable to properly capture the effect of our fiscal variables on interest rates, and we observe very noisy betas after the crisis, this is because the increased volatility of the dependent variables in that period which our model with fixed variances over the whole sample is unable to handle properly, by including GARCH effects in the next section we solve this problem.

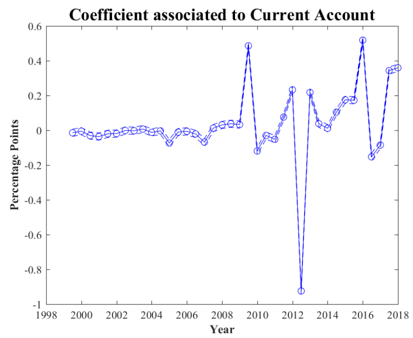
Figure 11



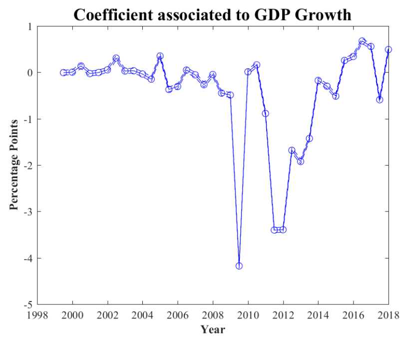
(a) Surplus over GDP



(b) Deficit over GDP



(c) Current Account

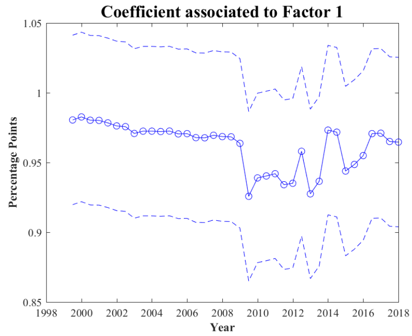


(d) GDP Growth

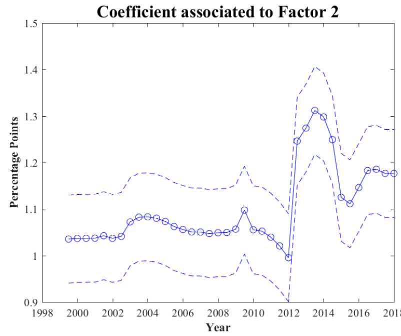
The results we obtained for the three factors are portrayed in figure 12. Under our model, the 3 factors indicate the existence of a structural break in the data. Factor 1, representative of the short term interest in the Eurozone financial markets, is largely stable and close to one over the period before the crisis and becomes noisy after 2008, this indicates that a one percent increase in the short term interest rate leads to a approximate 0.96 percent increase in long term interest rates. Factor 2, a proxy for the aggregate Eurozone current account balance, displays an interesting feature as well, we notice that between 2012 and 2015 the coefficient relating to current account balances jumps up and before decreasing again, afterwards it does not come back to it's pre crisis level. Factor 3, which is a proxy for the EMU's aggregate economic activity displays a similar result, it shows a structural break after the crisis, as it increases to a high level. We refrain from attaching economic meaning to the movements of the factors in the post crisis period since our model is unable to deal correctly with the increased volatility of that period as we argued before. However, it is noticeable that during the pre crisis period all factors had a significant effect on long term interest rates of the countries in our sample. This indicates that interest rates were mainly driven by aggregate variables for the whole of the EMU, and is reflective of a high degree of integration in the bond markets of the EMU. We believe that this could be the sign that investors assumed there to be some implicit guarantee between EMU countries in the period prior to the crisis.

Although some of the results obtained under the no GARCH effects specification are interesting, we acknowledge that assuming constant variances over the whole sample is incorrect and leads to flawed results during periods of high economic stress. Indeed, the increased volatility in our variables during the

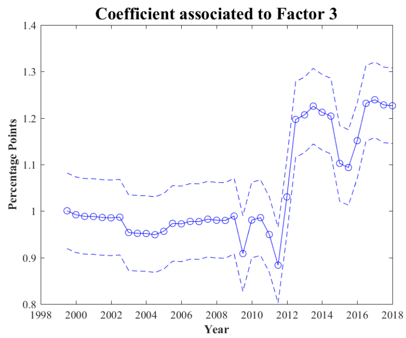
Figure 12



(a) Factor 1



(b) Factor 2



(c) Factor 3

crisis is reflected in our results by causing large fluctuations in the time varying betas that do not reflect the changing relationship between the variables. This is most apparent in the results of for the fiscal variables, we notice that the time varying betas are stable in the first half of the sample, but become very noisy as the economic crisis started and volatility increased. This makes any analysis impossible, and we refrain from making in depth interpretations of the results of our model assuming constant variances.

5.1.2 Time Varying model with GARCH effects

Given the noisy results we have obtained in the last specification of our model, we focus our analysis on our improved model. Namely, the time-varying coefficients model with time-varying variances computed using a dynamic factor model through the Kalman Filter. From the dynamic analysis we have carried out, several findings are noteworthy.

The first one is that, as well as in our previous specification, before the crisis started, the value of the coefficients associated to country specific variables that we think might determine interest rates remained quite stable around zero. This reaffirms previous suspicions that investors were not discriminating among fiscal and macroeconomic stances of the different Eurozone countries at the time of evaluating their risk via different interest rates. As we have pointed out in the introduction, there are several studies that explain this feature by the fact that once countries got into the European Monetary Union, exchange risks derived from deliberately inflating the economy, or from competitive devaluations, faded away, and investors stopped paying attention to fundamentals Sinn (2010). Other explanations come from the fact that once the Maastricht Treaty came into force, and nominal and real convergence took place, Eurozone countries bought somewhat the confidence that investors had previously in German fiscal discipline Klepsch and Wollmershäuser (2011). The only variables that seem to have an effect on setting of interest rates by that time are the different "common components" that we have extracted. However, this variables are common to all the countries, and therefore, explain co-movements among them, but are not able to explain differences. In fact, as we have seen in the graph that motivates our work, this difference was negligible before the crisis started.

The main finding that our time-varying coefficient analysis displays is that, what prior to the crisis had remained stable (namely the idiosyncratic economic characteristics of each Eurozone country) suffered a sudden deviation after the financial crisis outbreak. But in opposition to the results obtained in the previous section, our time varying parameters behaves in a much smoother way, supported by the fact that we are modeling and retrieving the volatility of our dependent variable through time, leaving our latent variable free from this feature.

In what follows, we comment on the results obtained from the same model that we have specified in the past section. To recapitulate, we regress in a panel data fashion (we let the parameters to vary over time) the 10 years bond interest rate of every country against it own Current Account, Deficit over GDP, Inflation, Deficit over GDP and debt over GDP, together with 4 common variables to all of them: Factor 1, Factor 2, Factor 3 and EUR/US exchange rate. This regression returns several interesting outcomes in the effect that several variables have had in determine movements in the 10 year bond interest rate in last times. In what follows, we are going to comment on them.

Firstly, the effect that an increase of debt had on the level of interest rates seems to have steadily increased since 2008, with an extraordinary peak in 2012. After this peak, this effect appears to have calmed down again, but it remained at a higher level than before the crisis. Regarding the fiscal balance, its effect started to gain importance since the begging of the the crisis. The value of the coefficient associated to this variable started to move towards values that implied that an improvement of one percentage point in the budgetary deficit, has as counterpart a lowering in the interest rate. Before the crisis, when debt sustainability issues did not play a role (look at the value of the coefficient associated to this variable) and when instead, negative fiscal balances were perhaps associated to productive investments, a worsening in the fiscal balance was not associated any increase in interest rates relative to countries with fiscal surpluses. We support this view in a recent communication dated November 2016 ("Towards a Positive Fiscal Stance for the Euro Area") where the European Commission advocates countries with budget surpluses and fiscal space (e.g. low levels of debt) to carry out expansionary fiscal policies that might also have expansionary effects in the rest of the Euro area. The Commission argues that these policies, carried out through productive investments (like infrastructures, from which some of this countries slightly lack of) would not have associated any impact in debt solvency (interest rates, debt level, budget balances) in the medium and long term because these impulse would turn self-financing. Since the value of this coefficient slumped in 2012, it has smoothly return to values previous to the financial crises. Thus, it seems that by 2012, sustainability concerns played a mayor role for investors instead of potential future productivity looses derived from a excessively strict austerity policy, something that can be the case in some European countries according to some of this last communications.

One of our most interesting findings is that, as we suspected, current account balances also played an important role in the divergence of interest rates after 2008. As we have commented before, according to De Grauwe and Ji (2013), this variable seems to have been retrieving the effect that a possible default of an over indebted private sector might have in the sustainability of government debt via tax revenues. Similarly to surplus over GDP, the effect of this variable is coming back to pre-crisis level since it plummeted to negative values in 2012, implying an extra risk compensation for every negative percentage point of the current account over GDP.

Another interesting finding is that the capacity of the European Central Bank in affecting long term interest rates through conventional monetary policy (the first "principal component") seems to have decreased since 2008. This is in line with a current stream of the literature that claims that mainly since the hitting of the zero lower bound, conventional monetary policy has seen weaken somewhat its ability to affect other nominal and real variables (Wright (2012)). This might be one of the explanations for the ECB's intervention in the sovereign debt markets in 2014.

If we turn to the effect of the Eurozone's financial liquidity (the second "common component") on the 10 year government bond interest rates, it suffered in this case another important level drop in 2008.

With respect to the Eurozone business cycle (or "third common component") it suffered another downwards level jump in 2008, to afterwards continue with a smooth negative trend, although still remaining in positive records. However, before this level jump, that might be associated to the crisis outbreak, this variable displayed a smooth negative path since the creation of the monetary union. This finding may be in line with the role that the slowdown in productivity, as some authors claim (Stolyarov (2016)). It means that for every extra one percentage point of Eurozone GDP growth, the extra compensation asked for possible inflation pressures (that seems weaker than previous decades) is lowering as time goes by.

In the same way, if we turn to idiosyncratic GDP growth, it suffered a level drop to negative values when the financial crisis broke out, meaning that the capacity of within-country GDP growth in lowering interest rates is larger after, compared to before the crisis. Therefore, the opposite applies to countries with negative GDP growth. These two interpretations between the Eurozone business cycle and the idiosyncratic GDP growth are not mutually exclusive. The second interpretation, that seems to be at odds with the first one, can be thought as the discrimination that investors make between the economic performance among the different Eurozones countries. The more a country is growing and the more sustainable their accounts are relative to their peers, the lower interest rate it is charged. However, when the Eurozone economy is performing well as a whole, and more returns are predicted in the private sector, the higher pricing that investors set to private assets claiming for a part of this greater production, has its reflection in the 10 years government bond interest rates. In the same way as the fiscal balance and the current account over GDP, the idiosyncratic GDP growth has started to come back to pre-crisis values since it reached its lowest point. These findings we have just described, might be able to explain part of the divergence in the ten year government bond interest rates the Eurozone countries have experienced during the crisis.

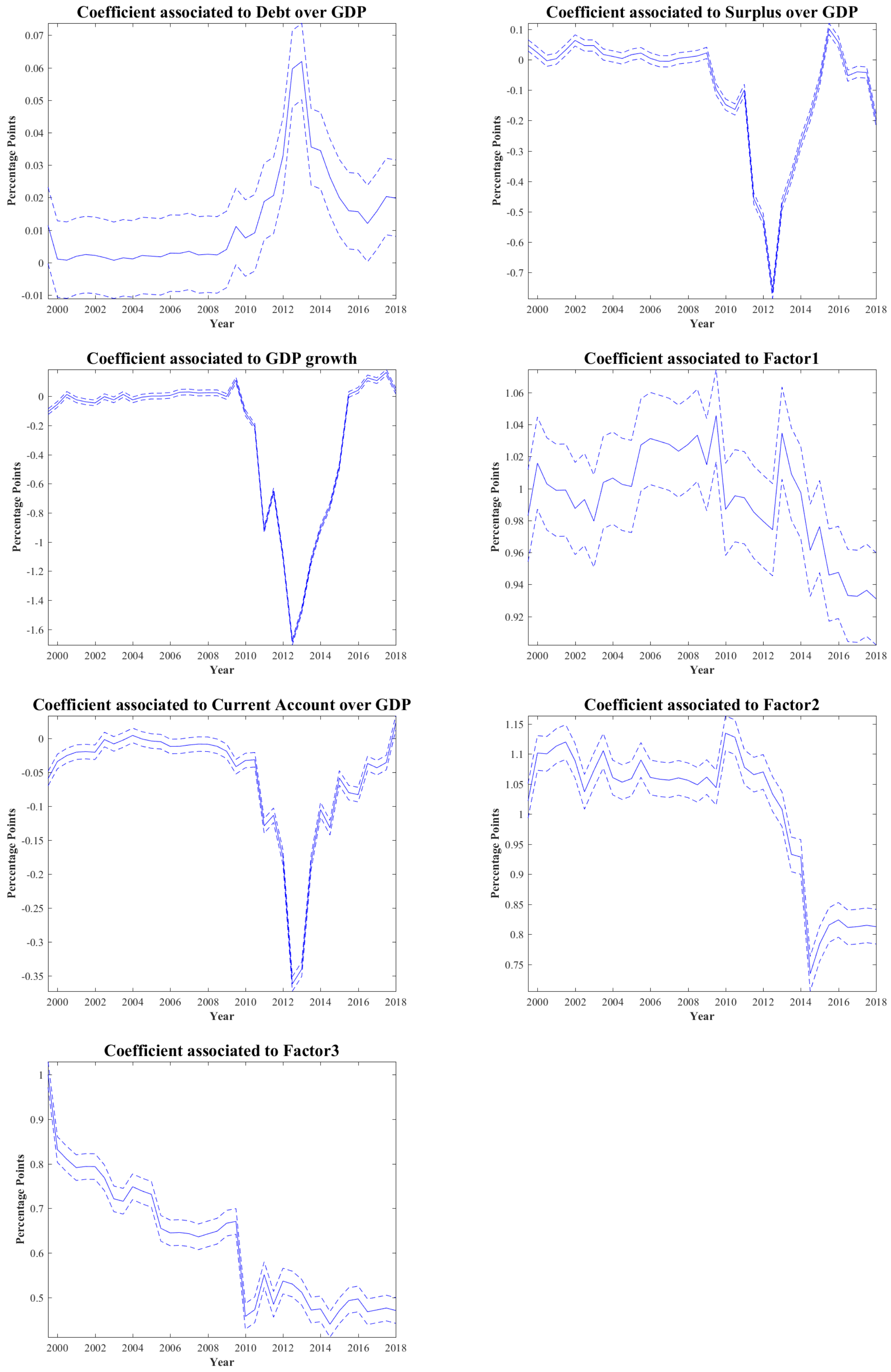


Figure 13. Coefficients associated to the explanatory variables

While northern countries recovered quickly from the global financial crisis in terms of GDP growth, southern countries kept on experiencing negative growth rates for some other years. Therefore, for every extra percentage point that countries were growing, the "forgiveness" in terms of interest rate level was now notable, whereas, before it was nonexistent. Thus, the opposite is true when a country collects negative growth rates. Furthermore, northern countries, as a consequence of their quick return to positive growth rates, witnessed a fast recovery leading to to primary surpluses in their budgets. Meanwhile, southern countries continued to experience negative fiscal balances in the aftermath of the crisis, caused by low fiscal revenues and high expenditures linked to the obligations implied by a situation of negative growth. This had a corresponding effect on the ten year yields of these countries, that we have observed in the evolution of the coefficient associated to this variable. Regarding the current account, it took a while for the southern countries to carry out the deleveraging process necessary to place this variable in positive records. This represents another burden with respect to the northern countries, whose already positive current account was not altered, which makes sense given that demand for imports and exports both decreased.

Finally, countries which were augmenting their debt over GDP more relative to other member states were witnessing a bigger increase in the interest rates if we consider the evolution of the coefficient associated to this variable.

On top of that, if we combine all these negative effects, together with the diminished ability of the ECB to affect the long term interest rates through conventional monetary policy (lower the short interest rates), it looks evident that there was a necessity for an unconventional or extraordinary monetary policy instrument if peripheral countries were to improve their financial conditions, and consequently, make their fiscal policy, sustainable. The effect of unconventional monetary policy is double sided. First, it directly lowers debt servicing costs of governments. Secondly, it boosts the economy as private agents find favorable financial conditions to invest and consume. As we have discussed before, 10 year bond interest rates pay a crucial role in pricing another financial indexes and assets, explaining, along with the default risks, explaining why it is crucial for a central bank to lower the 10 year bond interest rates by stepping in the debt market. Once an economy is growing or returning to sustained growth, it is easier to implement adjustment plans. This is because countries will have higher fiscal revenues and cuts in expenditures will be less painful, this provides these plans with the extra political stability and support they require for success.

This response as all of us know, came in two stages. Firstly, the still current president of the European Central Bank, Mario Draghi, gave a speech in which he reassured the market about the future of the monetary union. The effect of this communication reduced the exchange risk associated to a possible collapse of the euro, that would involve the EMU member states to return to their previous national currencies. The effect of this event can be noticed in the sudden drop on the value of the coefficient associated to debt in that year, just after the peak it had reached. After a period of relative stability in the Eurozone bond markets, the return of financial turmoil in 2014 was addressed by the ECB with the initiation of the Quantitative Easing (QE) program. This shock, associated with the global economic recovery, seems to also have had an effect on the coefficients associated to the remaining variables which explain the divergence in interest rates. We notice from our graphical analysis how since the start of QE, these coefficients have returned steadily to their previous pre-crisis levels. Namely, the idiosyncratic GDP growth, the surplus over GDP and the current account over GDP. Certainly, all the southern countries that by 2012 still were suffering from negative GDP growth started to move to positive growth rates in the following years.

Hence, from our analysis, we find clear evidence supporting the view that the ECB played an important role in calming the markets, and that along with the return to economic growth and fiscal sustainability, it's policies helped to bring back the influence of the variables that drove the divergence in spreads to pre crisis levels. Nevertheless, since the coefficient associated to the level of debt did not returned to its pre crisis levels, this variable could currently still be explaining the still considerable difference in Eurozone interest rate levels relative to the pre crisis level, regardless of the ECB's involvement in the debt market. Regarding this involvement, whether this is a correct policy, and whether effect of the idiosyncratic variables would become significant again once the ECB normalizes its monetary policy, we leave for further research. Lastly, another interesting outcome from our analysis that might be worth of mentioning is the lower effect of global variables in affecting all the interest rate of the Eurozone, perhaps another new explanation for the era of low interest rates that we are witnessing.

With regards to turmoil in the debt market we have mentioned previously, it's existence can easily be observed in the variance of our observables for the different countries in figure 14. As we have described in previous sections, one of the main implications of modeling a GARCH model on the variance the unobservables of interest rates is that we can retrieve the volatility every single period. As we see, financial markets had a low volatility from the start of our sample until 2008, at which time it started to increase, reaching its maximum in 2012. After the announcement of Mario Draghi, the turmoil decreased significantly, but did not recover its pre crisis level until the Quantitative Easing program implemented as response to the return of higher volatility.

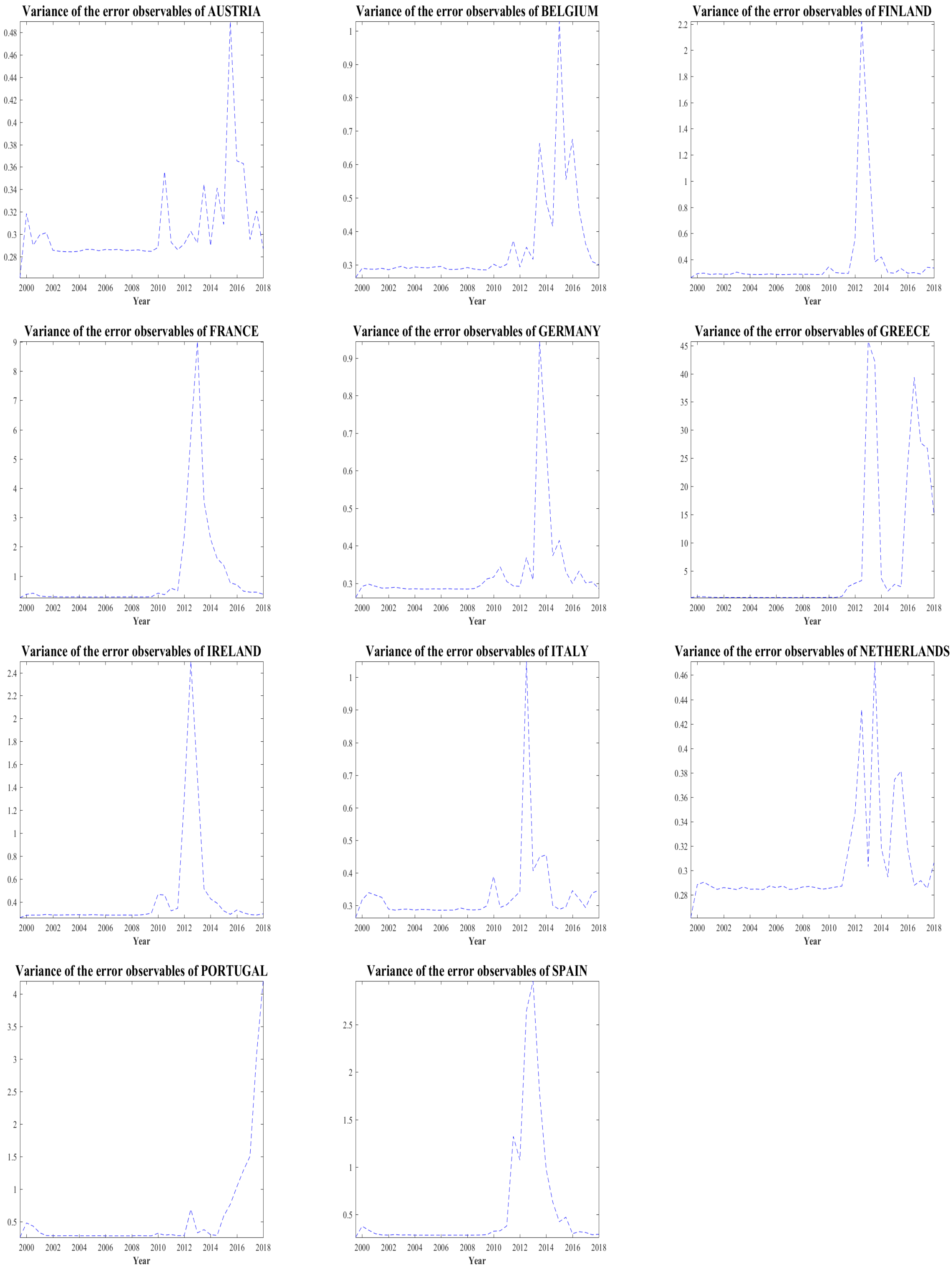


Figure 14. Variances of the unobservables associated to the interest rates of the Eurozone

5.2 Panel Data Analysis

In the following section the main question of how financial variables affect interest rates is addressed through panel data analysis, following the existing literature. We will show two different econometric specifications, static and dynamic model, arguing that the latter specification is the most appropriate in our framework, given the high persistence in our dependent variable. Nevertheless, we present both the analysis since they are both employed in the literature and will try to stress the differences between the two approaches.

5.2.1 Static Model

In our specification of the fundamentals model we rely on the existing literature, adding some other fiscal variables which have been not extensively analyzed so far. Our linear equation is specified as follows:

$$\begin{aligned} \mathrm{I}_{it} = \; & \alpha + \mathrm{Growth}_{it+1} + \mathrm{Inflation}_{it+1} + \mathrm{Deficit}_{it+1} + \mathrm{Debt}_{it} + \mathrm{CurrAcc}_{it+1} + \\ & \mathrm{Factor1}_t + \mathrm{Factor2}_t + \mathrm{Factor3}_t + \eta_i + \beta_t + u_{it} \end{aligned} \tag{5}$$

where α is the constant term, η_i is country i's fixed effect, β_t is a time variable in order to capture trend movements not explained by the regressors and all the other variables have been already presented in the previous section. As already mentioned before, we consider the interest rate in the months after (January and July) the biannual release of OECD and IMF forecasts for fiscal variables referred to the next December ($t + 1$ in our equation).

Table 2 reports our results for the static model following the specification of De Grauwe and Ji (2013). The first column reports the results for the whole sample whereas the second one refers to the case in which we split our sample between two time periods, before and after 2008, through the creation of a dummy variable. Therefore, in such a specification we are trying to capture the additional average effect, if any, of our regressors after 2008 compared to the previous interval. After having established by a Hausman test that the random effect model is inappropriate, we used a fixed effect model. A fixed effect model helps to control for unobserved time-invariant variables and produces consistent estimates of the "fundamental variables". By analyzing our results for the whole sample first, we notice that the coefficients associated to contemporaneous debt has a significant effects of the nominal interest rates in the Eurozone. A greater level of current debt over GDP tends on average to increase the interest rates requested by the investors. The opposite happens when growth of the GDP and inflation increase as economic theory suggests. The sign associated to deficit can result at a first glance unexpected but it mainly reflects the pre-crisis period. In fact, in this period of strong convergence, where fiscal sustainability was not perceived as a risk, most EMU countries have experienced a period of deficit in their fiscal balance, as introduced in the previous section. Regarding the three coefficients of integration generated through principal component, we observe that when factor 1 increases the interest rate tend to increase, and the coefficient is highly significant. As explained in the previous section factor 1 is associated with 3 month Eurozone money market rate, therefore this static model suggests that the ECB monetary policy tools are still effective in affecting the long term interest rate. Factor 2 which can be thought as the average current account balance present an unexpected sign, since it is positively correlated with interest rates. Factor 3 representing the Eurozone GDP growth, presents an expected sign although at a first glance could result counter intuitive if compared to the coefficient of GDP growth. Indeed, it's likely that when a global economy performs well, interests rates tend to increase as a response to high investments and to other factors.

Second column of table 2 presents an analysis for the splitted sample, where we try to investigate the effects on interest rates before and after the beginning of the recent crisis introducing a dummy. The coefficient associated to contemporaneous debt immediately captures our attention, because it becomes highly significant after 2008, with the expected sign whereas it's not significant before. When a sovereign debt crisis erupts in the Eurozone, investors become more reluctant to buy governments' bonds and as a result interest rates increased. In addition to that, it's noteworthy to comment the evolution of the current account forecast which was not significant in the whole sample analysis. As also witnessed by figure 8 after 2008 a worsening in the current account balance is associated on average with a higher interest rates. Nevertheless, before the crisis the opposite happens, although the coefficient is lower in magnitude, reflecting a trend similar to the fiscal balance deficit. Finally, the coefficient associated to factor 1 is also interesting to comment on. It is significant in both time periods with a very high coefficient before 2008 but it reverses his sign and his magnitude afterwards, explaining partially the reduced ECB power in affecting the long term interest rates. To conclude we observe that factor 2 and factor 3 show a significant, coefficient just after the crisis, whereas we would have expected a reduced importance when the divergence process started.

5.2.2 Dynamic Model

In this section we will present our results for the dynamic model specification, following the approach of Attinasi et al. (2009). Our specification is specified as follows:

$$\begin{aligned} \mathrm{I}_{it} = \quad & \alpha \ + \ \mathrm{I}_{it-1} \ + \ \mathrm{Growth}_{it+1} \ + \ \mathrm{Inflation}_{it+1} \ + \ \mathrm{Deficit}_{it+1} \ + \ \mathrm{Debt}_{it} \ + \\ & \mathrm{CurrAcc}_{it+1} \ + \mathrm{Factor1}_t \ + \ \mathrm{Factor2}_t + \ \mathrm{Factor3}_t \ + \\ & \eta_i \ + \ \beta_t \ + \ u_{it} \end{aligned} \tag{6}$$

It differs from equation 1 for the introduction of the first lag of interest rates as at regressor. Despite the choice to use a dynamic model comes as natural given the high persistence in our dependent variable, this model is not very employed in the literature. As stated by Dautovic (2017) the previous empirical literature in many circumstances has indeed failed to include the lagged long-term interest rate in the specification, failing to detect the real effect of fiscal policy on interest rates. Nevertheless, the introduction of a lagged dependent variable in our model dramatically change our results as explained later, leading in some circumstances to unexpected results. As well-known, the introduction of a lagged variable raises some issues regarding the consistency of our WG estimator, since the lagged variable is correlated with the error term and as such could bias the point estimate due to endogeneity. However, as explained by Alvarez and Arellano (2003) such a bias disappears when T goes to infinity. Although, there is no a convergence in the literature regarding the precise size of T, since we are dealing with a data set composed by 11 observations over 38 points in time, we believe that our T is large enough to make our bias disappear. Therefore, the results illustrated below refers to the usage of a WG estimator in a dynamic framework.

As for the static model we performed two analysis by considering the whole sample and the splitted one, namely, before and after the beginning of the crisis, through the employment of a dummy variable as shown by table 3. The whole sample analysis (first column) shows the high persistence of the interest rate, with the coefficient associated to the lag close to 0.650 and highly significant. Current account forecast and contemporaneous debt present the expected sign despite the one related to debt is very low in magnitude. The three factors present the same sign as in the static model and the same interpretation holds. When the sample is splitted before and after the crisis the change in results is remarkable. Before the crisis, all the coefficients associated to fiscal stances don't show up with a significant coefficient with the exception of inflation forecast which is slightly significant with the expected sign. A very interesting result derives from the lagged dependent variable which enters in the model just after the crisis, being not significant before. A plausible interpretation could be that possible jumps in interest rates before the crisis were not perceived as risky by investors, whereas after the crisis 10-years yields tend to be much more persistent even though for some countries they were steadily increasing. Regarding the fiscal variables, the only ones to present a significant and expected sign are the current account and the GDP forecast. The remarkable effect of contemporaneous debt observed in static model, disappears in this framework. This result is very informative since the previous empirical literature fail in many cases to include the lagged long-term interest rate in the specification, discovering a strong effect of fiscal variables such as debt and deficit on interest rates that disappears when the dynamic specification is employed. Moreover, it's noteworthy to highlight the presence in both the specifications of the effect of current account on interest rate, justifying our choice to introduce it.

The three factors associated to European integration are always significant before and after the crisis but they reverse their sign and their impact after 2008. Such a surprising behavior would require additional attention and in particular the possibility to further split our sample in order to obtain an evolution of this coefficients through time. Panel data setting, given the behind assumptions, doesn't allow us to do that, and we addressed this question in previous section.

Because of these results regarding debt under dynamic model, we perform another experiment by dividing the sample between peripheral and core countries, as specified in the previous section. The goal of this analysis is to verify whether northern countries are responsible for such outcomes and thus to re-establish the link between fiscal stances and interest rates which appear evident from a descriptive analysis of the data. Table 4 presents our results by comparing the two types of countries when the sample is further splitted before and after 2008 in order to capture the marginal additional average effect during the crisis. This analysis restores some meaningful results observed under static model, but still doesn't allow us to depict a clear and uni vocal picture. The coefficient associated to debt is positive and significant after 2008 both for core peripheral countries, despite the magnitude for the former group is basically close to zero. Therefore, the raise in debt partially explains the increase in 10-years bonds yields during the crisis, suggesting a greater risk perceived by the investors. Current account forecast, as in the two previous specifications, displays in periphery a significant effect and negatively correlated with the interest rates. Deficit forecast doesn't instead play any role in periphery whereas it's noteworthy to stress the effect on core countries before the crisis which is in line with our previous findings. An increase in deficit before 2008 was not perceived as an issue for fiscal sustainability, mainly in core countries, and therefore they experienced a reduction in interest rates. The coefficients related to the factors of integration instead present very dissimilar results across the two typologies of countries.

In conclusion, it is clear that the three analysis presented differ substantially in their outcomes. Although we strongly believe that the dynamic model should be the right specification to perform given the high persistence of interest rates, it does not enable us to clearly assess the effects of fiscal stances on interest rates and in some circumstances the results are counter-intuitive. This investigation suggests that the relationship between interest rates and fiscal stances is very volatile through time and requires a period to period analysis. Such an experiment can not be performed through panel data, given the lack of data in each period of time. Therefore, following the last findings in the literature, we have expanded our study exploiting another econometric specification, namely, dynamic time varying coefficient which has allowed us to draw more precise conclusions, as presented in previous section.

6 Conclusion

To conclude, our findings indicate that there has been a significant break in the way sovereign debt was priced after the crisis of 2008, indicating a return to fundamentals as main drivers of sovereign yields. We find that several factors reflective of fiscal stances became increasingly important during the crisis, after having been ignored in previous years. As such, debt to GDP, deficit to GDP, GDP growth and current account balances to GDP started playing an important role in the determination of long term interest rates for Eurozone government bonds. In line with previous research, our findings confirm the existence of of 3 distinct phases in the euro bond market, a period of high integration, a period of disintegration followed by a phase of partial reintegration (Adam and Lo Duca (2017)). Our findings suggest that during periods of economic uncertainty characterized by high volatility in the financial markets, investors tend to focus on fundamentals, as such we notice that bond markets behave differently than in calmer times. This finding has important policy implications since it suggests that during economic crises interest rates react much more to unsustainable fiscal policies, causing a greater private sector crowding out effect (Laubach (2011)). Therefore, out findings suggest that governments should pay closer attention to their fiscal stances during times of economic turbulence in order to avoid the detrimental effects of high interest rates. As argued before by De Grauwe and Ji (2013) this effect is exacerbated by the fact that Eurozone governments have no control over monetary policy making it impossible to reduce interest rates by other means than sound fiscal policies. In line with this result we notice that the ECB's unconventional monetary policy helped to bring down European bond yields after 2014, along with this, structural reforms and economic recovery helped countries to bring back their fiscal stances to sustainable levels.

Through our dual approach we were able to obtain robust results and determine which method was most appropriate to answer questions regarding the dynamic relationship between government bond yields and fiscal variables. We found that panel data approaches, which are widely used in the literature lead to unstable and unsatisfactory results causing us to attach little credibility to the outcomes of their analysis. However, the time varying coefficient approach seemed more appropriate and yielded robust and plausible results after we modeled the changes in volatility appropriately. We believe that having large samples would have allowed to us to obtain better results on this approach as well, a method to do so would be through mixed frequency modeling. Indeed, since we are limited by the number of yearly releases of macroeconomic forecasts by the OECD and the European Commission, in order to increase sample sizes an interpolation method could be used to combine monthly variables with biannual ones, as is done in Aßmann and Boysen-Hogrefe (2012) and Attinasi et al. (2009). This would also allow for better results in the panel data analysis perhaps, as the sample could be splitted more often making our analysis more precise. Another suggestion for further research would be to apply Bayesian techniques to estimate our model, indeed given the limited amount of data available and the complexity for our models, these methods seemed more appropriate. This improvement would have allowed for the including of the model specifications in which we modeled GARCH effects on the variances of the time varying parameters as well, we expect that allowing variances of the time varying parameters to change over time as well would have improved the quality of our estimation.

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7 Appendix

7.1 Principal Component method

We construct our factors following the approach of Giannone and Lenza (2010) that was later on also used by Sola and D'Ell Erba (2013).
First of all, we stack all the dependent and independent variables of our eleven different countries (our sample data) one after each other in different columns in the matrix W, and over time in different rows. Once we have this matrix, we normalized the data into a normal distribution with mean zero and variance 1. Having done that, the inner product of this matrix by his transpose returns as the sample variance-covariance matrix. This holds because, once we have normalized the data, we know that:

$\frac{1}{N}\left(\sum_{i=1}^{N} x_i\right)^2 = \bar{x_i} \simeq \mathbb{E}[x_i]^2 = 0$

...and

$\frac{1}{N}\left(\sum_{i=1}^{N} x_i\right)^2 \frac{1}{N}\left(\sum_{i=1}^{N} x_j\right)^2 = \bar{x_i}\bar{x_j} \simeq \mathbb{E}[x_i]\mathbb{E}[x_j] = 0$

Thereby, the inner product of the matrixes is the sample equivalent of the moment conditions

$cov(x_i, x_j) = \mathbb{E}[x_i x_i] - \mathbb{E}[x_i]\mathbb{E}[x_j] \simeq \frac{1}{N}\left(\sum_{i=1}^{N} x_i x_i\right)$

...and

$Var[x_i] = \mathbb{E}[x_i x_i] - \mathbb{E}[x_i]^2 \simeq \frac{1}{N}\left(\sum_{i,j=1}^{N} x_i x_j\right).$

$$W = \frac{1}{NxK}\begin{bmatrix} y_1^1 & x_{1,1}^1 & . & x_{K,1}^1 & . & . & . & y_1^N & x_{1,1}^N & . & x_{K,1}^N \\ . & . & . & . & . & . & . & . & . & . & . \\ y_T^1 & x_{1,T}^1 & . & x_{K,T}^N & . & . & . & y_T^N & x_{1,T}^N & . & x_{K,T}^N \end{bmatrix}\begin{bmatrix} y_1^1 & . & y_T^1 \\ x_{1,1}^1 & . & x_{1,T}^1 \\ . & . & . \\ x_{K,1}^1 & . & x_{K,T}^1 \\ . & . & . \\ . & . & . \\ . & . & . \\ y_1^N & . & y_T^N \\ x_{1,1}^N & . & x_{1,T}^N \\ . & . & . \\ x_{K,1}^N & . & x_{K,T}^N \end{bmatrix} = PDP^{-1} \quad (7)$$

After computing this variance covariance matrix, we diagonalize the matrix and we take the 3 first eigenvectors contained in the matrix P. This eigenvectors correspond to the 3 highest eigenvalues in the matrix D, or what it is the same, the 3 eigenvectors under our election are the three ones which explained the most part of the variance of the matrix W, it is, of our sample data. Specifically, as we have pointed out before, they explain roughly the 80% of the variance of our the data.

7.2 Time Varying Coefficients Model

Our initial model is the 10 year bond interest rates of the 12 original Eurozone countries (except Luxembourg) as a function of an array of independent and observable variables related to the monetary and fiscal stance of the different countries. Namely,

$$y_t^n = X_t^{'n}\beta_t + \varepsilon_t^n \quad (8)$$

where $X_t^i$is a vector "1xK" of observable independent variables. β_t is a vector "Kx1" containing the coefficients associated to every independent variable and ε_t^n is the innovations of the process, that we assume to follow a normal distribution with mean zero and $\sigma_t^{2^n}$ variance.

β_t is time-varying following the next process:

$$\beta_t = \beta_{t-1} + \upsilon_t \tag{9}$$

... where υ_t is the innovation of the time varying parameters that we assume follow also a stochastic process with mean zero and δ^{2^k} variance.

We presume that the effect of the independent variables on the interest rate have evolved over time. Therefore, β_t is a non-observable latent variable that we will estimate through a dynamic factor model, specifically, the Kalman Filter.

We also think that the variance of our dependent variable, due to the financial crises, has not a constant variance, something that could have held in the period previous to this unexpected shock. Therefore, we assume that the variance ($\sigma_t^{2^n}$) of our dependent variable follows a GARCH (1,1) process of the form:

$$\sigma^2_{n,t} = \mathbb{E}[\varepsilon^2_{n,t}] = \varpi + \alpha\varepsilon^2_{n,t-1} + \phi\sigma^2_{n,t-1} + \xi_t \tag{10}$$

Thus, the state space representation of the model aforementioned would be the following.

$$\begin{bmatrix} y_t^1 \\ \cdot \\ \cdot \\ \cdot \\ y_t^n \\ \cdot \\ \cdot \\ \cdot \\ y_t^N \end{bmatrix} = \begin{bmatrix} x_{1,1}^1 & \cdot & \cdot & \cdot & x_{k,t}^1 & \cdot & \cdot & \cdot & x_{K,t}^1 \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ x_{1,1}^n & \cdot & \cdot & \cdot & x_{k,t}^n & \cdot & \cdot & \cdot & x_{K,t}^n \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot & \cdot \\ x_{1,1}^N & \cdot & \cdot & \cdot & x_{k,t}^N & \cdot & \cdot & \cdot & x_{K,t}^N \end{bmatrix} \begin{bmatrix} \beta_t^1 \\ \cdot \\ \cdot \\ \cdot \\ \beta_t^k \\ \cdot \\ \cdot \\ \cdot \\ \beta_t^K \end{bmatrix} + \begin{bmatrix} \varepsilon_t^1 \\ \cdot \\ \cdot \\ \cdot \\ \varepsilon_t^n \\ \cdot \\ \cdot \\ \cdot \\ \varepsilon_t^N \end{bmatrix} \tag{11}$$

...where

$$R_t = \begin{bmatrix} \sigma^2_{1,t} & 0 & 0 \\ 0 & \sigma^2_{n,t} & 0 \\ 0 & 0 & \sigma^2_{N,t} \end{bmatrix} \tag{12}$$

...stands for the variance covariance matrix of the observables innovations, where every element of the diagonal follows the GARCH process we have aforementioned.

$$\begin{bmatrix} \beta_t^1 \\ \cdot \\ \cdot \\ \cdot \\ \beta_t^k \\ \cdot \\ \cdot \\ \cdot \\ \beta_t^K \end{bmatrix} = \begin{bmatrix} \beta_{t-1}^1 \\ \cdot \\ \cdot \\ \cdot \\ \beta_{t-1}^2 \\ \cdot \\ \cdot \\ \cdot \\ \beta_{t-1}^3 \end{bmatrix} + \begin{bmatrix} \nu_t^1 \\ \cdot \\ \cdot \\ \cdot \\ \nu_t^2 \\ \cdot \\ \cdot \\ \cdot \\ \nu_t^3 \end{bmatrix} \tag{13}$$

...where again

$$Q = \begin{bmatrix} \delta_1^2 & 0 & 0 \\ 0 & \delta_k^2 & 0 \\ 0 & 0 & \delta_K^2 \end{bmatrix} \tag{14}$$

...stands for the variance-covariance matrix of the time-varying parameters innovations.

"n" represents each country, "k" every independent variable and "t" every period of the sample.

In order to compute the coefficients common to all the countries in the state space representation, we first compute the log-likelihood as a function of the parameters we are interested in for for a given country every period . When we reach the last iteration and we compute the last log-likelihood, we sum up all the log-likelihoods for the selected country. We repeat this process for every country of the sample. Once we have computed the log-likelihood of the last country, we sum all them up and we maximize the function.

To illustrate how the algorithm we have computed works, we are going to detail the first iteration. This procedure would follow until the last iteration in time period "T".

For the first iteration, we have the following law of motion of the coefficients:

$$\begin{bmatrix} \beta_1^1 \\ . \\ . \\ . \\ \beta_1^k \\ . \\ . \\ . \\ \beta_1^K \end{bmatrix} = \begin{bmatrix} \beta_0^1 \\ . \\ . \\ . \\ \beta_0^2 \\ . \\ . \\ . \\ \beta_0^3 \end{bmatrix} + \begin{bmatrix} \nu_t^1 \\ . \\ . \\ . \\ \nu_t^2 \\ . \\ . \\ . \\ \nu_t^3 \end{bmatrix}$$

Thus, we compute the first estimation of our coefficients for the first period for a given country as:

$$\mathbb{E}\left[\beta_1/I_0\right] = \widehat{\beta}_{1/0} = \beta_0 \tag{15}$$

assuming as initial condition $\beta_0 = 1$, where β_0 is a vector "Kx1" of ones. Why do we assume that? By unconditional expectations, we have that:

$$\mathbb{E}\left[\beta_0\right] = \mathbb{E}\left[\beta_{-1}\right] + (\mathbb{E}\left[\nu_0\right] = 0)$$

Because there is not information available previous to period 0, and because by iterative substitution we know that the unconditional mean of a random walk is equal to the initial condition, we can assume freely what value is the one which is mot likely to us. For us, the one which makes most of the sense is to choose 1.
Just after this step, once we have observed y_1^i, and because β_t and y_t^i follow a bi variate normal distribution, we can update our estimate of $\widehat{\beta}_{1/0} = \mathbb{E}\left[\beta_{1/0}\right]$ applying the Kalman gain, which is not anything else that the conditional mean of $\beta_1$on y_1^i.
The update is a estimation of β_1 based on the information we have available until period 1.

$$\left(\mathbb{E}\left[\beta_{1/1}\right]\right) = \beta_1 = \left(\mathbb{E}[\beta_{1/0}] = \widehat{\beta}_{1/0}\right) + X_1^i P_{1/0}(P_{1/0} + R_{1/0}) * (y_1^i - \left\{\mathbb{E}[y_{1/0}^i] = X_1^{'i}\beta_{1/0}\right\}) \tag{16}$$

Equation (8) is not anymore than the conditional expectation of "z2" on "z1" when "z2" and "z1" are jointly normally distributed.

$$\begin{bmatrix} z1 \\ z2 \end{bmatrix} \sim \left(\begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix}; \begin{bmatrix} \Omega_{11} & \Omega_{12} \\ \Omega_{21} & \Omega_{22} \end{bmatrix} \right)$$

$$z2/z1 \sim N(m, \Sigma)$$

...where

$$m = \mu_2 + \Omega_{21}(\Omega_{11})^{-1}(z1 - \mu_1)$$

$$\Sigma = \Omega_{22} - \Omega_{21}(\Omega_{11})^{-1}\Omega_{12}$$

In our case, Ω_{11} is represented by

$$\Omega_{11} = X_t^i P_{1/0} X_t^i + R_t \tag{17}$$

where $P_{1/0}$ is the variance covariance matrix of $\widehat{\beta}_{1,0} = \mathbb{E}[\beta_{1/0}]$. It is, the variance-covariance matrix of β_1 conditional on the information available up to period 0.

$$P_{1/0} = V[\beta_{0/0}] + V[\nu^k_{1/0}] = P_{0/0} + Q \tag{18}$$

$P_{0/0}$ stays for the variance-covariance matrix of β_0 conditional on the information up to period 0. We assume for the initial variance-covariance matrix of β_0 the identity matrix.

Q is a diagonal matrix whose elements are the variances of every of the "k" parameters for all the period. Therefore, we assume that $\mathbb{E}[\beta^k_{1/0}\beta^s_{1/0}] \neq 0$ for $\forall$ "s"$\neq$ "k".

Regarding R_t (the variance of our dependent variable) we have modelized it in equation (3) as a GARCH(1,1) process.
To start the process, we assume as initial conditions:

- $\sigma_0^{2^i} = 0$
- $\varepsilon_0^{2^i} = 0$

...so

$\sigma_{1/0}^{2^k} = \mathbb{E}[\varepsilon_1^{2^k}/I_0] = \varpi + \alpha\varepsilon_0^{2^n} + \phi\sigma_0^{2^n} = \varpi$

For t=2, similar than before,

$\sigma_{2/1}^{2^n} = \mathbb{E}[\varepsilon_2^{2^n}/I_1] = \varpi + \alpha\varepsilon_1^{2^k} + \phi\sigma_1^{2^k}$

...where

$\varepsilon_1^{2^k} = \left(y_1^i - X_1^i\mathbb{E}\left[\beta_{1/0}\right]\right)^2$

Now we would have our algorithm completed.

We would have just to set the next initial condition β_1 for our estimation of:

$\mathbb{E}\left[\beta_2/I_1\right] = \widehat{\beta}_{2/1}$

... and $P_{1/1}$ for the estimation of:

$P_{2/1} = V[\beta_{1/1}] + V[\nu^k_{2/1}] = P_{1/1} + Q_{2/1}$

...and run this code until iteration "t"="TxN" number of periods, storing each time the log-likelihood, summing all them up, and maximizing the log likelihood as a function of our starting values for each one of the parameters we have in our equations.

In the same manner we updated the estimation of $\widehat{\beta}_{1/0}$ based on information up to period 1 with the Kalman gain, we can do the same for the estimation of the variance of $\widehat{\beta}_{1/0}$.
In this case,

$$P_{1,1} = P_{1/0} - P_{1/0}X_1^n\left(X_1^{'n}P_{1/0}X_{1/0}^n\right)^{-1}X_1^{'n}P_{1/0} \tag{19}$$

... which will be later use to compute $P_{2,1}$.

Therefore, the algorithm would work sequentially as follows:
- First, it is computed equation (9).
- Second, once we have the estimation of our parameter in the first period, we compute the variance-covariance matrix of the error of the estimated coefficients in the first period using equation (12).

• After having it, we have to compute the variance-covariance matrix of our estimated coefficients using equation (12) to get $P_{1/0}$and equation (4) to get the variance of our observables in every period of time.
• Once we have 12) and (4), we can compute equation (11). If we had had homoskedastic errors, equation (4) would not be necessary because the variance covariance-matrix of the errors would have been anything else than a matrix of constant parameters to be optimized in the likelihood function. It means, every iteration it would enter the same parameter in the likelihood function, while with heteroskedasticity this is not anymore a constant parameter but a function of another parameters and observations.
• After we have the last three estimations, we are now able to compute the update of our first period coefficient using equation (8).
• In the same way, we can now update the variance-covariance matrix of our updated estimation using equation (10).
• Finally, we would set up as initial parameters for the next iteration the last two updates we have computed and we would proceed alike until we reach the last iteration.

7.3 Panel Data Tables

Table 2

Panel Data WG static Model: Whole Sample (1)
vs Splitted Sample(2)

VARIABLES	(1) 10 years bond yields	(2) 10 years bond yields
GDP forecast	-0.639***	-0.210
	(0.070)	(0.130)
Inflation forecast	-0.775***	-0.329**
	(0.117)	(0.151)
Current Account forecast	-0.029	0.098**
	(0.032)	(0.042)
Deficit Forecast	0.097**	-0.092
	(0.047)	(0.080)
Contemporaneous debt	0.032***	-0.001
	(0.007)	(0.009)
Factor 1	1.872***	3.024***
	(0.168)	(0.578)
Factor 2	0.497***	-0.223
	(0.115)	(0.333)
Factor 3	0.786***	-0.430
	(0.096)	(0.387)
GDP Forecast 2008		-0.485***
		(0.144)
Inflation forecast 2008		-0.626***
		(0.222)
Time	0.005*	-0.010
	(0.003)	(0.008)
Current Account forecast 2008		-0.150***
		(0.040)
Deficit Forecast 2008		0.086
		(0.094)
Contemporaneous debt 2008		0.030***
		(0.006)
Factor 1 2008		-1.025*
		(0.607)
Factor 2 2008		0.602*
		(0.357)
Factor 3 2008		1.346***
		(0.393)
Observations	418	418
R-squared	0.596	0.678
Number of index	11	11
Country FE	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3

Panel Data WG Dynamic Model: Whole Sample (1)
vs Splitted Sample(2)

VARIABLES	(1) 10 years bond yields	(2) 10 years bond yields
I lag 10 years yields	0.641***	-0.161
	(0.022)	(0.088)
GDP forecast	-0.177**	-0.004
	(0.061)	(0.077)
Inflation forecast	-0.278***	-0.216*
	(0.072)	(0.102)
Current Account forecast	-0.040*	0.049
	(0.021)	(0.031)
Deficit Forecast	-0.008	-0.055
	(0.037)	(0.041)
Contemporaneous debt	0.010*	-0.004
	(0.005)	(0.010)
Time	0.001	0.003
	(0.001)	(0.007)
Factor 1	0.773***	3.820***
	(0.093)	(0.219)
Factor 2	0.203**	-0.440***
	(0.091)	(0.092)
Factor 3	0.296**	-1.079***
	(0.116)	(0.120)
I lag 10 years yields 2008		0.747***
		(0.101)
GDP Forecast 2008		-0.234***
		(0.067)
Inflation forecast 2008		-0.059
		(0.197)
Current Account forecast 2008		-0.090**
		(0.033)
Deficit Forecast 2008		-0.029
		(0.060)
Contemporaneous debt 2008		0.008
		(0.007)
Factor 1 2008		-3.005***
		(0.186)
Factor 2 2008		0.545***
		(0.083)
Factor 3 2008		1.484***
		(0.143)
Observations	407	407
R-squared	0.764	0.787
Number of index	11	11
Country FE	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4

Panel Data WG Dynamic Model: Core Countries (1)
vs Peripheral Countries (2)

VARIABLES	(1) 10 years bond yields	(2) 10 years bond yields
I lag 10 years yields	-0.244**	-0.157
	(0.097)	(0.442)
GDP forecast	0.143**	-0.254
	(0.070)	(0.202)
Inflation forecast	-0.056	-0.560
	(0.048)	(0.344)
Current Account forecast	0.011	0.120
	(0.017)	(0.100)
Deficit Forecast	-0.080***	0.016
	(0.029)	(0.148)
Contemporaneous debt	0.007*	-0.024
	(0.004)	(0.016)
Time	-0.003	0.026
	(0.004)	(0.018)
Factor 1	3.992***	4.044**
	(0.335)	(1.679)
Factor 2	-0.383**	-0.419
	(0.169)	(0.901)
Factor 3	-1.289***	-0.931
	(0.176)	(0.856)
I lag 10 years yields 2008	0.445***	0.609
	(0.113)	(0.443)
GDP Forecast 2008	-0.117	0.021
	(0.079)	(0.223)
Inflation forecast 2008	0.099	0.098
	(0.092)	(0.413)
Current Account forecast 2008	-0.002	-0.282***
	(0.020)	(0.089)
Deficit Forecast 2008	0.063*	-0.156
	(0.035)	(0.177)
Contemporaneous debt 2008	0.007**	0.019*
	(0.003)	(0.010)
Factor 1 2008	-2.916***	-3.988**
	(0.349)	(1.746)
Factor 2 2008	0.816***	0.577
	(0.179)	(0.925)
Factor 3 2008	1.075***	2.000**
	(0.182)	(0.868)
Observations	222	185
R-squared	0.966	0.770
Number of index	6	5
Country FE	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1