UNIVERSITA' DEGLI STUDI DI PADOVA

DIPARTIMENTO DI SCIENZE ECONOMICHE ED AZIENDALI "M.FANNO"

CORSO DI LAUREA MAGISTRALE IN ECONOMICS AND FINANCE

TESI DI LAUREA

"Eurobond and Fiscal Sustainability in the Eurozone: A Stochastic Analysis of Italy, Spain and France"

RELATORE:

CH.MO PROF. LUCIANO G. GRECO

LAUREANDO/A: FRANCESCA DI DIO

MATRICOLA N. 1081933

ANNO ACCADEMICO 2015 - 2016

Il candidato dichiara che il presente lavoro è originale e non è già stato sottoposto, in tutto o in parte, per il conseguimento di un titolo accademico in altre Università italiane o straniere.
Il candidato dichiara altresì che tutti i materiali utilizzati durante la preparazione dell'elaborato sono stati indicati nel testo e nella sezione "Riferimenti bibliografici" e che le eventuali citazioni testuali sono individuabili attraverso l'esplicito richiamo alla pubblicazione originale.

Firma dello studente

____

Contents

Introduction

The aim of this dissertation is to verify whether it is worth applying a certain form of Eurobond to the case of Italy, France and Spain. The analysis moves from the paper by Tielens and al. (2014) which claims that the Eurobond would bring about substantial benefits on the sovereign debt dynamics of Greece, Portugal and Ireland. Thus, we want to assess what could be the effects on the evolution of the debt-to-GDP ratio even for other countries belonging to the Eurozone (EZ). We want also to evaluate whether this common debt instrument is useful in insulating from shocks which originate in the macroeconomic variables affecting the debt dynamics. Thus, we compare two scenarios: one without and one with the common debt instrument. To perform this analysis we use a Vector Autoregressive (VAR) model.

The dissertation is structured as follows: in the first part, we summarize those which are considered by analysts the main causes of the euro crisis and we describe the arguments in favour and against the Eurobond proposal. In fact, it is common opinion that the root causes of the crisis have to be sought in the lack of fiscal union and in the absence of a lender of last resort in the European Monetary Union (EMU). According to economists these two elements have made the EMU prone and vulnerable to the willingness of the financial markets. Consequently the Eurobond has been considered by the literature as one of the possible resolution mechanisms to the crisis. Despite it presents a series of drawbacks, like a high moral hazard risk, it is supposed to help the EZ countries to minimize the risk of contagion and reduce the spill over effects.

In the second part we set up two VAR models to compare the two scenarios in order to assess whether there are benefits for the selected countries. The Eurobond design we use in our analysis is the simplest scheme among those presented by the literature: a bond with joint and several guarantee whose interest rate converges to that one of the German Bund.

The two VAR models are employed to compute the forecast of the macroeconomic variables affecting the debt dynamics: the GDP growth rate, the inflation rate, the variation of the interest rate of the government bond, the interest rate expenditure and the primary balance. For each country, we plot the fan charts of the debt-to-GDP evolution. The results we obtain for the three countries under analysis are the following: for Italy, which is the first country we analyse, the presence of Eurobond is effective. At the end of the forecast period (2023:Q4) the difference in debt-to-GDP ratio in the two scenarios is significant: 100 percent of debt-to-

GDP ratio in the no Eurobond scenario vs. 85 percent in the Eurobond scenario. Even France seems to benefit from the presence of the common debt instrument: under the Eurobond scenario its debt ratio declines up to the 83 percent, but considered its actual debt-to-GDP ratio (below but close the 100 percent), between the two countries it is Italy which would gain more from the implementation of the Eurobond. Finally, the Spanish debt-to-GDP ratio seems to present the major improvement: from the 97.8 percent it would be able to reach the 50 percent of GDP thanks to the Eurobond. But in our opinion these latter projections are overoptimistic. In fact, performing a probabilistic analysis, i.e. we ask ourselves what will be the probability to be above or below a given debt threshold, the results tell us that it would be more likely for Spain to reach a debt ratio between the 80 and 90 percent of GDP rather than the 60 percent, if the Eurobond scheme was implemented.

But, besides the simple analysis on the debt level, what is interesting is looking at the variability (captured through the fan charts) that surrounds the debt paths. In fact, the variability of the debt dynamics measures the riskiness of the debt itself. So, when we compare the two scenarios and we look at the degree of variability, we see that the presence of the Eurobond helps to reduce it. This is particularly true for Italy and to less extent for France and Spain, where this latter country presents the highest degree of variability compared to the other two countries. Nevertheless, the risk surrounding the debt path is high for all the three countries, especially at the end of the forecast period.

Thus, according to this analysis it seems to be worth introducing a common debt instrument, given the fact on one side, it would help to substantially reduce the debt level these countries are experiencing and on the other, it would help to lower the riskiness associated to it.

Then for each country, we perform the impulse response functions of debt dynamics in order to understand what could be the degree of insulation brought by the presence of Eurobond against specific shocks. Here, the results tell us that for Italy the Eurobond could perform its insulating role against all the shocks we have created, even if the difference with the no Eurobond case is not so remarkable. In particular, it is against the shocks stemming from the fiscal variables (interest expenditure and primary balance) that the Eurobond unfolds its risk hedging role. Instead, for France and Spain, a clear insulating role is not so evident. Only in the case of a shock to the variation of the nominal interest rate in the Spanish case, the Eurobond actually works containing the increase of the debt dynamics. Thus, we cannot say the Eurobond is completely ineffective: compared to the forecast analysis it only reduces its capability to bring about substantial benefits. In some sense, the impulse response functions are showing us that the risk hedging role of Eurobond might be limited if implemented.

Consequently, if on one side the forecast analysis induces us to believe the common debt instrument is a good solution, in light of the impulse response functions analysis we become more cautious about our conclusions.

1 The European Monetary Union: a brief overview

When the EMU was launched in 1999, it was the result of a long and thwarted path where the political effort and commitment, rather than the application of the economic theory, played a crucial role. There was in fact the widespread opinion the European member states "would have been able to reach agreement and cooperate on how to create the common currency institutions over time"[1], despite the differences. The idea was to create an area of macroeconomic stability based on a series of shared rules and common institutions which had to guarantee their enforcement.

The historical lessons of the failure both of the Werner Plan and of the European Monetary System, the original projects towards the creation of the EMU[2], did not induce politicians to give up the idea of a single market with a common currency. Not even the economic analysis demonstrating that the EMU would have been a sub-optimal currency area, stopped policy makers going on with their project. The idea that the benefits, both at micro and macro level would have outweighed the costs implied in losing sovereignty, was thought to be sufficient to overcome all the flaws presented by detractors of the economic union.

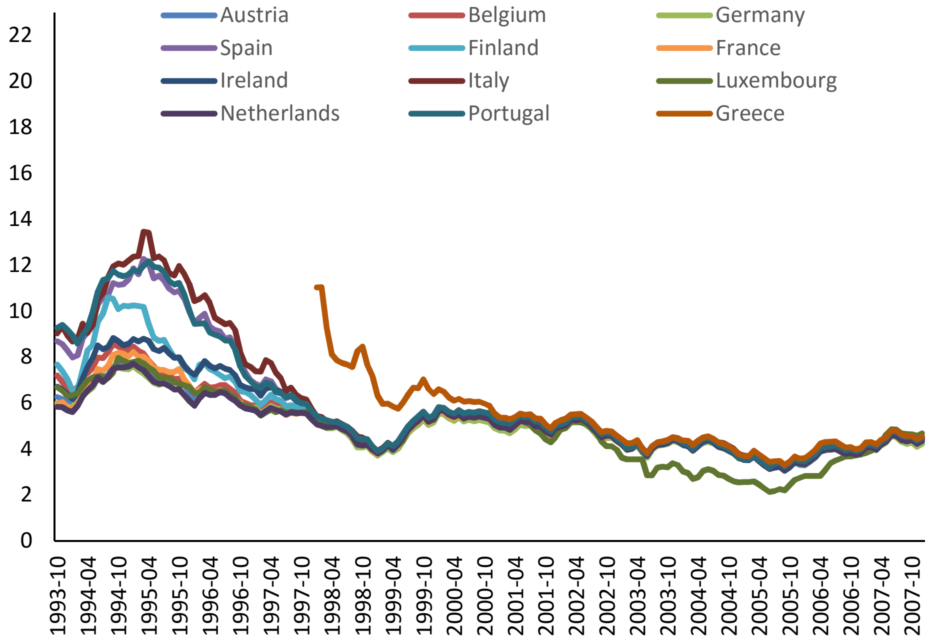
For the first decade after the introduction of the Euro, it seemed that the common currency in its original setup worked well: southern European countries experienced a convergence of the interest rate on government bonds towards the level of the northern European countries (Figure 1). Specifically, as Feld at al. (2015) pointed out there was a convergence towards the German rate that gave all the EZ countries the chance to cheaply access the financial markets, despite the differences in macroeconomic and fiscal policies. This was a striking result considered as a great achievement of the single currency and the main consequence was a credit expansion in the private and public sector which fostered an economic boom, in particular in some European countries, like Spain and Ireland. Moreover there was a capital flow from core European nations, like Germany, France, Belgium and the Netherlands whose investors were seeking higher returns, towards those nations (notably the southern ones) perceived to offer better investment opportunities. We can say that a classical catching up process was triggered by the implementation of the monetary union: another evidence of the success of the EMU project. This flow of capitals, result of the capital markets integration,

[1] R. Baldwin and F. Giavazzi (2015) quoting Corsetti (2015) "Roots of the EZ crisis: Incomplete development and imperfect credibility of institutions" in their e-book "The Eurozone crisis: A consensus view of the causes and few possible solutions".

[2] The main objective of both projects was to stabilize the exchange rate among the European countries. For further details about the road to the EMU see http://ec.europa.eu/economy_finance/euro/emu/road/index_en.htm or the European Commission publication (2007) "One currency for one Europe. The road to the euro".

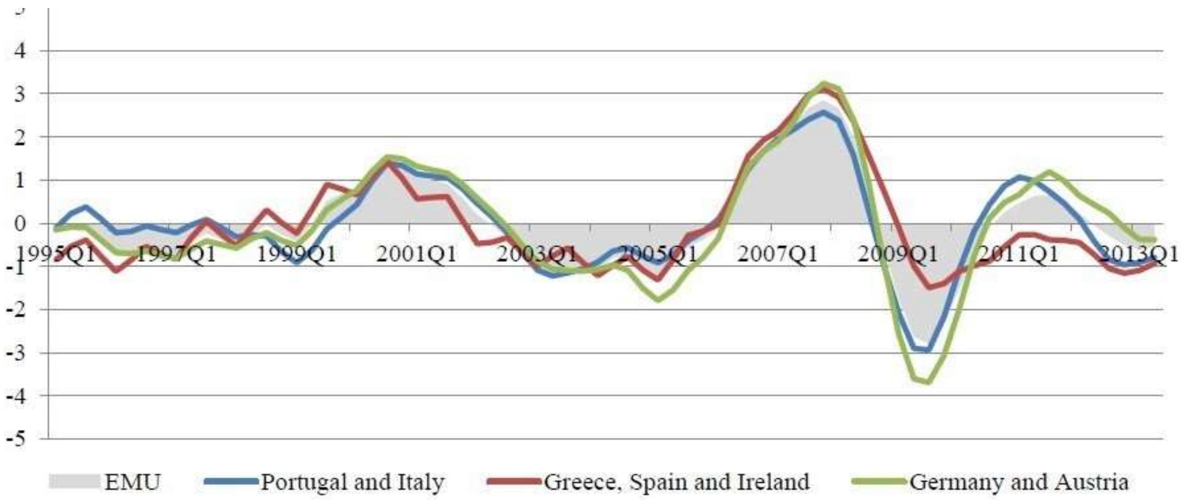
helped and sustained the synchronization of the business cycle already in place, as de Hall et al. (2014) highlighted in their work (Figure 2).

Figure 1: 10 year government bond yields (%) period 1993-2007



Source: http://sdw.ecb.europa.eu/ (monthly data)

Figure 2: EZ Business Cycle Fluctuations



Source: J. de Haan, J. Hessel and N. Gilbert (2014): elaborations of quarterly data for GDP filtered with HP-filter with λ = 1600

We know that together with the synchronization of the business cycles and price stability (the primary objective of the European Central Bank -ECB-), European policy makers thought that the "One Market, One Money"[3] framework would have brought about other benefits like the increase in competition and efficiency among European firms. The sources of these gains relied on the elimination of transaction costs and of the risk of uncertainty due to the exchange rate movements of national currencies. The former would have allowed the integration of the financial markets and of the banking system as well as the increase in price transparency. The latter would have let investors and firms invest their money abroad without the fear of losing it because of the fluctuations of the exchange rate. Moreover a unique, centralized and independent monetary policy would have promoted a better level of macroeconomic stability and a standardization of the labour market conditions, especially with respect the degree of flexibility of real wages. In fact without the instrument of the exchange rate, the governments (in particular the weaker ones) would not have had any more the possibility to devaluate the currency to gain competitiveness. Therefore, they would have been induced to eliminate the rigidities in their labour markets, so far masked thanks to the presence of the exchange rate tool.
This was what European institutions and markets thought would have happened.

Thus, before the eruption of the euro crisis in 2010, many economists tried to evaluate the impact of the euro to verify whether or not the alleged benefits had been achieved. Their assessment was ambivalent: on one side macroeconomic and price stability was reached, but the gains in GDP growth were less than those expected (Breuss, 2009). It was true that the absence of exchange rate volatility had a positive impact on trade and competitiveness, but the effects were far from those forecasted by European institutions. At the launch of the common currency, they were influenced by Andrew Rose's article[4] about the expectations on the positive outcomes stemming from the implementation of the EMU. According to Rose's view, the creation of the single monetary union would have expanded trade among European countries up to 200 percent. But this enormous effect was put under discussion by subsequent works: other researchers who considered different dataset and used different techniques for the analysis, claimed that the scope of an increase in trade was between 5 and 20 percent, far below the 200 percent foreseen by Rose[5].

[3] See the European Economic Report (1990).
[4] See Rose (2001).
[5] On this point see Angkinand et al. (2009).

Nevertheless, it was undoubted that the introduction of the common currency had increased the total amount of exports and imports within the EZ, in particular for those firms that before the euro based their production mainly on the internal demand. But at an aggregate level the increase was only moderate and this finding suggested that the use of the euro had only supported and confirmed long lasting commercial relationships already in place. Quoting Volker Nitsch and Mauro Pisu (2008), “the number of traded varieties remained largely unaffected by the adoption of a common currency”. Moreover, as regards the expected standardization in the labour market conditions, this was not achieved at all, despite the improvements taken in some countries, like Spain or Italy. Consequently, many rigidities in the labour market are still there.

Even though the trade and labour aspects were not as successful as assumed, economists stressed the positive effects of the financial integration and the use of the euro as reserve currency. Euro as reserve currency means that it is considered by investors and foreign governments as a strong and safe investment and it can be used as guarantee. During the first decade of the introduction of the euro, this feature of the common currency was widely exploited by governments that could easily issue treasury bonds (since the foreign reserves are usually held in government bonds) and get the financing for their deficit and projects at low cost. The presence of the Euro and the definition of fiscal rules were perceived as a sufficient guarantee to induce investors to eliminate the differences in the government bond markets: the sovereign bonds with the same maturity, even if issued by different governments, were considered as substitute and for a while financial markets stopped to perform their disciplining role, i.e. asking a risk premium according to the economic fundamentals. This led to the economic boom.

Thus, assessing the positive results achieved by the common currency in its first ten years of life, like the boost in intra-european trade of goods, services and capital flow, it seemed that the advocates of the EMU project were right. However, the Lehman Brother collapse and the subsequent global financial crisis revealed the major structural weaknesses of the EMU and shed light on economic problems, so far not perceived by policy makers and markets. The good outcomes achieved turned out to be misleading.

1.1 The flaws of the original project

At this point, we can ask ourselves: what were the arguments detractors of the EMU project used to highlight its downsides?

As stated at the very beginning, the majority of economists thought the EMU was a sub-optimal currency area. Their arguments against the creation of the EMU were based on the criteria defined by Mundell in 1961 and McKinnon in 1963 in their famous papers: "A Theory of Optimal Currency Area" and "Optimum Currency Areas". Following the reasoning by Mundell and McKinnon, economists said EMU could not be considered an optimal currency area because it did not fulfil two of the most important criteria at its basis: wage flexibility and labour mobility. According to Mundell and McKinnon, wage flexibility and labour mobility are the two main mechanisms through which equilibrium is restored when an asymmetric demand shock occurs in a monetary union: the higher the wage flexibility and the labour mobility, the faster the shock is smoothed. But in Europe, as M. Blomstrom (1998), a recent ECB working paper (2011)[6] and L. Andor (2014) pointed out, labour mobility has always been quite modest[7] and the presence of broadly regulated labour market institutions[8] slows down the wage adjustment process, especially during downturns. So it is clear why some economists were not in favour of the EMU. They highlighted the possibility that in case of an external shock in one region or country, the EMU would not have been able to handle it because of lack of flexibility, with negative repercussions for the European population affected by the shock, as for example high unemployment rate in case of a recession or inflationary pressure in case of a boom. In fact the rationale is that if workers can move freely from one country to another of the union, bearing low costs, and/or wages can fast adjust according to the economic conditions, booms and recessions presenting the features of a permanent shock produce a low social welfare loss and their consequences are contained.

These two theoretical points have always been considered not a big issue by the European politicians. They declared that asymmetric shocks in a monetary union had a low probability to occur and the introduction of the single currency would have induced the synchronization of the business cycle so that in case of distress, the shock would have been easier to manage, even with a low rate of flexibility. As we know the synchronization of the business cycle has

[6] See Heinz and Rusinova (2011).

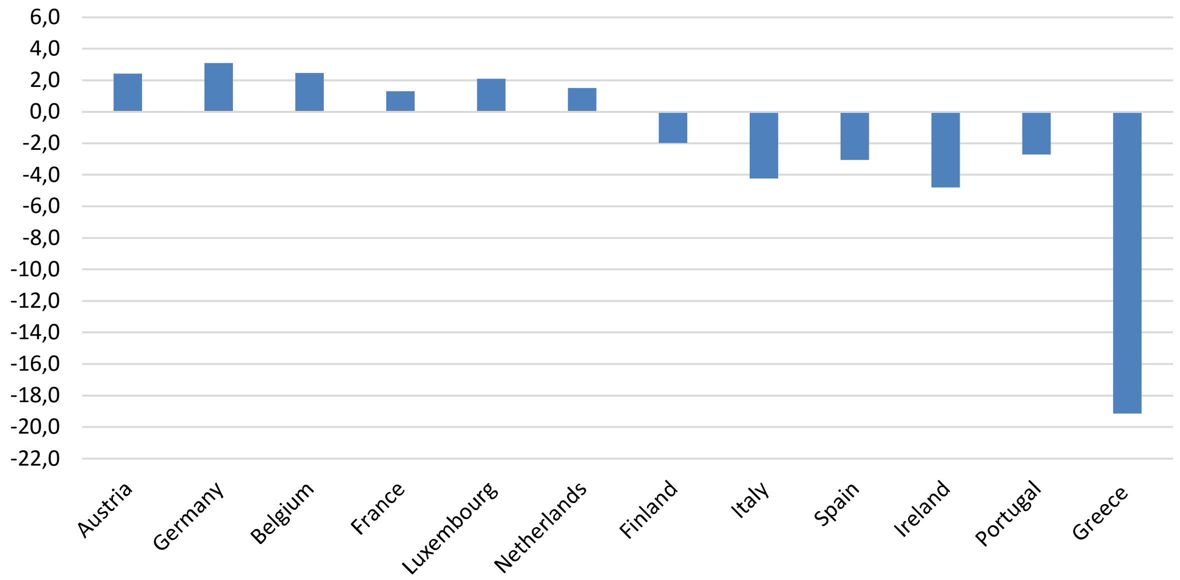
[7] To be fair, L. Andor (2014) explains that during the economic crisis labour mobility has slightly increased the movement of workers, with respect to the past. But this has not affected the overall picture about a labour mobility that in the European Union as a whole (and in the EZ for our purposes) has never been comparable to that one of US.

[8] Heinz and Rusinova (2011) define broadly regulated labour market institutions as "characterised by the existence of extension procedures and a high level of collective agreement coverage, a dominance of sectoral (and to a lesser extent firm level) wage bargaining and the general absence of coordination except through minimum wages (or trend setting sectors)".

been reached; however the recent financial crisis started in 2008 has shown us that even synchronized countries can be hit in highly different ways. From the chart of the cumulative growth of GDP (Figure 3) we can notice that in general Northern countries succeeded to cope with the crisis, while Southern European countries suffered a strong reduction in GDP growth. Moreover, to the consequences produced by the global financial crisis, we must not forget those stemming from the euro crisis broke up in 2010. Even in this case, peripheral nations were those more in distress. In fact, when the euro crisis turned into a sovereign debt crisis, analysts thought it was the outcome of the reckless management of debt held by the southern European countries, since the nations suffering the most were those which borrowed more during the preceding decade. But, this was not completely true, since among the countries mostly hit by the sovereign crisis there were even Spain and Ireland, two nations that had the parameters on public debt and deficit which were perfectly in line with those required by the regulation of the Stability and Growth Pact (SGP). Thus, not even the fiscal profligacy, although a relevant factor, could be considered the sole cause at the basis of the severe downturn these countries were experiencing. Moreover, further and deeper analysis demonstrated that the high debt-to-GDP ratio, blamed to be one of the main culprit, was in fact more a consequence rather than a cause of the crisis.

Thus, there had to be other sources of asymmetry that European policy makers did not take into account and that can explain better the reasons why some EZ countries dealt quite well with the crisis, while others are still struggling against its outcomes.

Figure 3: Cumulative growth of GDP (2008-2011)



Source: OECD Database

These sources of asymmetry have to be investigated within the entire architecture of the EMU. In fact, beside the low wage flexibility and low labour mobility, analysts have always highlighted that EMU lacked political union, fiscal integration and the stabilizing mechanisms proper of a monetary union which are useful in case of a shock, like the presence of a lender of last resort and of the automatic stabilizers in the government budgets. These drawbacks, which according to them would have made the structure of the EMU fragile and so prone to crisis, dated back to the Maastricht Treaty. The latter, as we know, created an independent central bank responsible for the monetary policy of the whole EZ and its main goal was to maintain the price stability, i.e. keep the inflation rate below but close to the 2 percent of the Harmonized Index of Consumer Prices (HICP). The fiscal policy instead remained a national responsibility, even if it had to follow the strict rules fixed by the SGP. The rationale behind this clear division of the macroeconomic policy instruments, was due to two elements: first ruling out the possibility that political pressures would induce the ECB to print money to finance governments' debt and deficit; to stress better this point a "no bail-out clause" was introduced[9]. Second, national governments were not keen on fiscal integration: the possibility of fiscal transfers made countries reluctant to lose sovereignty.

However, as De Grauwe (2011, 2014) and others[10] always stressed, design monetary union in such a way has as possible consequences the production of idiosyncratic movements, identified as boom and busts that once originated at a national level stay within the national borders. This makes the common monetary policy, i.e. the presence of a single interest rate, ineffective and self-defeating because it tends to exacerbate the asymmetries. This can clearly be proved analysing the economic imbalances that during the first ten years of the euro area have been produced between the North and the South of Europe, but that no one looked at since they were not considered a possible source of instability. But, when the crisis broke up, these imbalances that for a decade allowed peripheral countries to experience a great economic growth, unfolded all their harmful potential becoming the main drivers of the still lasting crisis.

Consequently, the euro crisis and its transformation into a sovereign debt crisis has its root causes in the flawed design of the EMU.

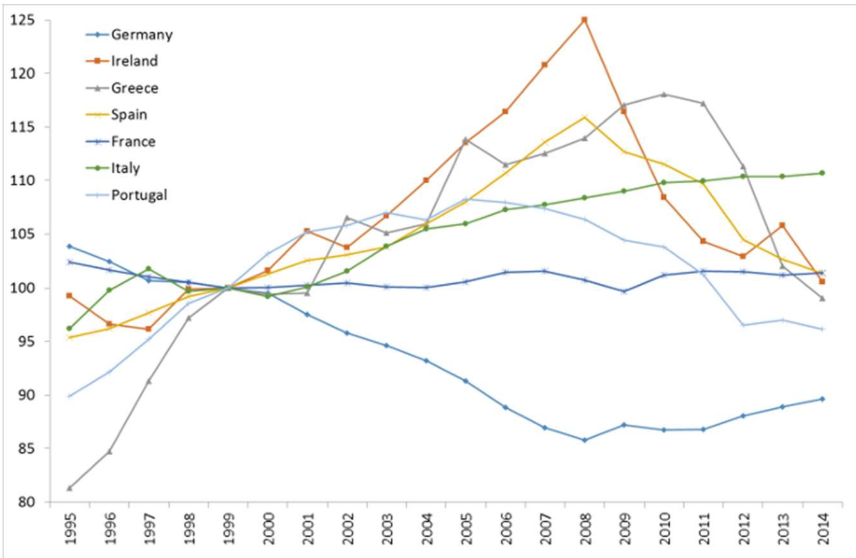
[9] We refer to Article 104b of the Maastricht treaty. See footnote 13.

[10] See de Hann et al. (2014) or Feld et al. (2015).

1.2 The consequences of the EMU flaws

The interest rate convergence towards a lower level brought about positive effects, but even side effects. In fact, on one hand the reduction of the lending rate provided by the market led southern European countries to experience a credit expansion that triggered an economic boom. But on the other hand, this credit boom resulted in a worsening of the current account of peripheral countries, while instead, northern European nations saw an improvement of their balance of payment account, given the fact that they did not borrow more than before but actually lent. Moreover this capital flow contributed to a worsening of the competitiveness in the southern labour market because of the increase of the labour unit costs (Figure 4). This loss in competitiveness due to the increase in real wages further contributed to the surplus of the North and to the deficit of the South. But, this increase in real wages, was not economically justified. In fact the capitals borrowed by Spain, Portugal, Greece, Ireland and Italy were largely invested in the non-traded sectors, notably housing and government services/consumption, i.e. in assets not associated to an increase in productivity or an improvement of the business environment that could explained the rise of wages[11]. All these imbalances had an impact within the EZ since they led to asymmetries in the financial cycle fluctuations (Figure 5): if European institutions hoped for a synchronization of the business cycles, they did not take into account the necessity of a symmetry condition in the financial sector as well to shelter the EZ from possible external shocks.

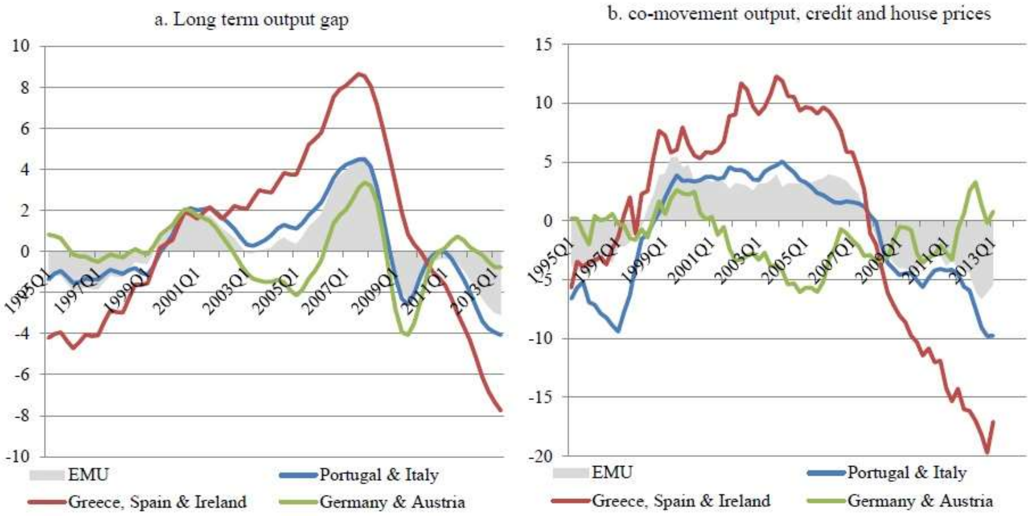
Figure 4: Nominal unit labour costs as percent of Eurozone 18 (100 in 1999)



Source: AMECO Database

[11] According to Lin et al. (2012) "the increase in wages was primarily driven by increases in public sector wages—aimed at swaying the electorate towards the ruling parties—which then also triggered increases in private sector wages".

Figure 5: Financial Cycle Fluctuations within the EA



See Comunale and Hessel (2014). Inspired by Alessi and Detken (2009) and Drehmann, Borio, Gambacorta, Jimenez and Trucharte (2010). Calculated as quarterly GDP filtered with an HP-filter with λ = 100.000 (frequency of the financial cycle).

See Comunale and Hessel (2014). Inspired by Borio, Disyatat and Juselius (2013, 2014). Calculated as principal component of the output gap (HP-filter λ = 1600), real credit growth and real house price growth.

Source: J. de Haan, J. Hessel and N. Gilbert (2014)

When the financial crisis moved to Europe the housing bubble, grown during the previous eight years thanks to cheap loans, crashed and a domino effect occurred. Since households were not able any more to repay their loans, banks were obliged to deleverage. Many banks were close to bankrupt, especially in Ireland, Portugal and Spain, where housing bubble grew more, so governments in order to avoid the collapse of the banking sector decided to rescue them. Banks found themselves in a liquidity crisis and governments acted as lender of last resort for their banks to prevent the diffusion of panic among depositors. In this way there was a transformation from private debt to public debt that led to an increase of the debt-to-GDP ratio. Rescuing the national banking sector was the right and logical thing to do but in some cases, like that one of Ireland, the banking system was larger than the national economy and its rescue required a huge amount of resources: governments of Ireland and Portugal asked for help and the first rescue packages were set up by the European institutions and the IMF. This solution restored the functioning of the interbank market, but the relief was not bound to last long.

Among the effects of the global financial crisis there was even the increase of the unemployment rate with the consequent increase of unemployment benefits provided by the welfare state that put a further burden on governments' debt. For this reason, all EZ countries experienced a surge in the debt-to-GDP ratio and since governments had not anymore the exchange rate instrument to boost the economy living in a monetary union, the only way to survive the crisis was through public expenditure cuts and through wage deflation. However, for countries with current account surpluses, these measures were not so harsh to sustain, while for countries with high deficit, these actions turned out to be particularly painful. Thus, the imbalances in the current account that for a decade were not perceived as a problems acted as amplifiers of the economic crisis. Moreover peripheral countries already in distress, where affected by the spill over effects stemming from the discovery of the Greek cheating on its financial statements.

In fact, when in December 2009 the Greek government declared that it had lied about the real value of its fiscal deficit and debt-to-GDP ratio, financial markets reacted with a "sudden stop", i.e. with a sudden withdrawal of capital and a massive sale of the Greek government bonds. This made the roll over process of debt more difficult, since investors started to require a higher risk premium and induced a self-fulfilling liquidity crisis that degenerated into a solvency crisis. However these refinancing problems were not confined at the Greek borders: contagion occurred and Portugal, Ireland, Spain and Italy, i.e. the countries that relied more on foreign borrowing to cover their savings-investment gap, saw an increase in their borrowing costs too.

1.3 The doom-loop spiral and the attempts to break it

Today, with the benefits of hindsight, we can say that the liquidity crisis and the subsequent sovereign debt crisis are the result of two EMU features combined together: the presence of a doom-loop mechanism and the absence of a lender of last resort.

In fact, the problem with the sovereign debt crisis was that it was not confined at the national level. The creation of the single currency had led to a strong financial integration, but as Brunemmeir et al. (2011) pointed out there was a lack of a euro denominated safe asset in the market, despite the euro had gained the role of reserve currency. Nevertheless, banks required substantial amount of safe assets to post as collateral, because of Basel regulation, so the governments bonds of all the sovereign states, rated as risk free assets, filled this lack. Given this situation, national policy makers had persuaded national banks to hold larger amounts of local debt than prudent diversification would have induced: the "home bias" phenomenon took place and the "doom loop" mechanism, i.e. the tight relationship between banks and governments, was created. Economists have deeply analyzed it and have claimed that this mechanism has been one of the reason why the euro crisis has been so severe, in particular in the peripheral nations.

At the same time, EZ government bondholders (i.e. financial institutions) bought something that had not the guarantee to be paid in future, since the single nations could not provide the necessary liquidity, given the fact they did not have any more the monetary policy tool at their disposal. In other words the EMU system relied on trust that the investors had on government's capabilities to fulfill their obligations. A system that largely parallels with the model on bank runs by Diamond and Dybvig (1983). In this model if depositors trust the banking system, they withdraw their money only when they need them. In this way, the banking system is in a "good" equilibrium. If instead they fear that a bank is insolvent and thus not able any more to repay its obligations, they start to withdraw their money at the same time and bank faces a liquidity crisis. Moreover, if a contagion effect occurs, i.e. a self-fulfilling prophecy mechanism takes place, the entire banking system is destabilized and even banks, which are illiquid but solvent, are pushed to bankruptcy. In this case, the banking system finds itself in a "bad" equilibrium. Thus, the banking system is characterized by multiple equilibria.
Now, if we tailor this model to the EMU architecture where the government takes place of banks and financial institutions play the role of the depositors, it is clear why these latter have such strong power to decide whether a country can stay solvent or not. In fact, until they are confident about the possibility of the nation to repay its obligations they are willing to buy government bonds, providing a low lending rate and the government is able to roll over. If instead, they change their mind about governments' abilities, they start to sell the government bonds leading to an increase of the lending rate. The good or the bad equilibrium of the government bond market becomes a matter of investors' expectations.
However, there is a way to rule out the possibility that the bad equilibrium occurs. It is creating a lender of last resort, i.e. an institution that provides the necessary liquidity in case of panic would spread among depositors/investors. Having an institution that has an unlimited capacity of fire, immediately stop the reactions associated to the realization of the self-fulfilling prophecy: people are sure the borrowers (whatever they are) will be always able to repay its obligations. In this way, the stability of the system is preserved.

Now, in the EMU the natural lender of last resort both for the banking system and the government bond market should be the ECB. In fact, when the banking sector was in trouble due to the deleverage process triggered by the burst of the real estate bubble, governments involved, like those of Ireland, Spain and Portugal, and the ECB decided to intervene providing the necessary liquidity. As De Grauwe (2011) pointed out the ECB discovered that price stability was not the only target to pursue, but even the stability of the banking system had to be an important goal to achieve. The fact that the European banking system could collapse was enough to induce the central bank to directly intervene and properly act as a lender of last resort. With the exceptional interventions, i.e. massive flows of liquidity lent at an interest rate close to zero, the ECB was able to manage the distress situation, but due to the "doom loop" mechanism the crisis was not stopped and the problem subsequently moved to the sovereign bonds. The economic imbalances plus the necessity to save the banks, which held the governments bonds, pushed countries to issue even more debt bought by the same institutions in shortage of liquidity. In a nutshell, "the rescue could require the rescuers [the governments] to borrow from the rescued [the banks]"[12].

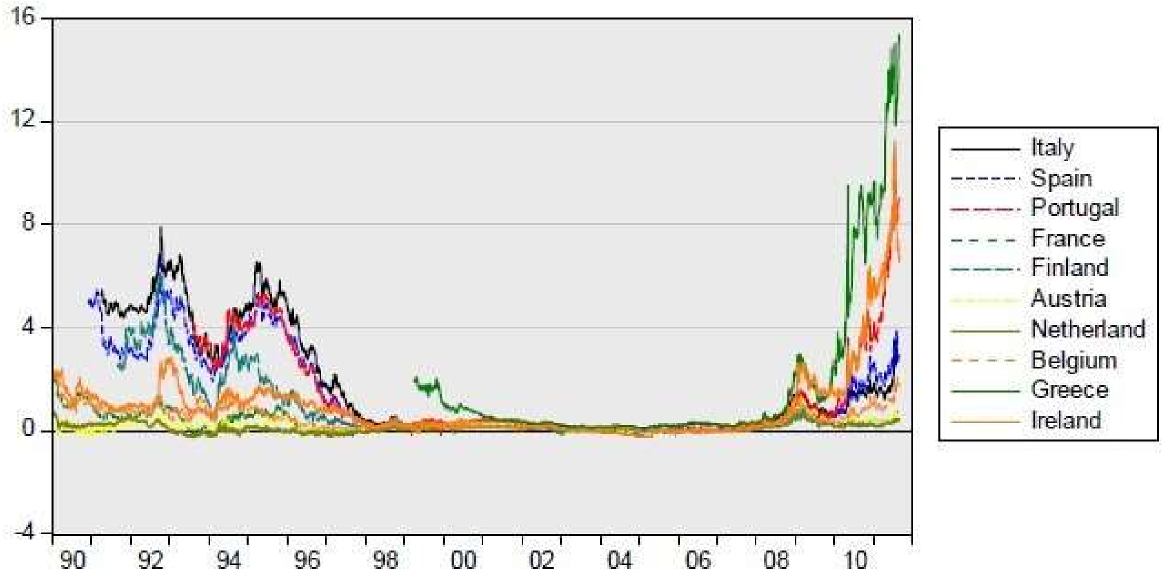
This "deadly embrace" weakened the economy and led investors to lose their confidence in the ability of less fiscally sound governments of repay their obligations. Thus, they started to sell the governments bonds considered unsafe triggering the mechanism of the self-fulfilling prophecy, given the fact the EZ countries, on the contrary of banks, were not backed by a lender of last resort. In fact, in the government bond market the ECB could not act as it did in the banking system, because of the "no bail out" clause defined by Article 125 of the Treaty on the Functioning of the European Union (TFEU)[13]. However, at the beginning of the crisis this clause was not credible enough to induce investors and governments to believe that European leaders would have let one country into default. The rescue packages for Ireland and Portugal confirmed this perception, but they did not help to stop the pessimistic wave. In fact the uncertainties, shown both by the ECB and the European institutions to find a credible and effective solution to the Greek problem, allowed investors' concerns to rise, since they did not know what could happen in the next future. The possibility that a member country could exit from the union became a real option, spreading panic among financial markets and bringing instability in the whole EZ.

It is in this moment that the interest rate spread between the southern European government bonds and the German Bund (perceived as the sole safe harbour remained within the EZ) increased a lot (Figure 6). Consequently, the weaker countries were pushed into what has been called the "bank-debt default vortex".

[12] Baldwin and Giavazzi (2015).

[13] The TFEU is the so called Lisbon Treaty, signed on 13th December 2007 and entered into force on 1st December 2009. It amends the previous Treaty on European Union, i.e. the Maastricht Treaty.

Figure 6: 10 years government bonds spread on German Bund (%)



Source: C. Favero, A. Missale (2012)

Thus, in an attempt to avoid this vicious circle and cool down the spread between the peripheral and the core nations, the ECB tried to intervene in the secondary market with a series of creative and non-conventional open market operations. They became particularly effective thanks to the "whatever it takes" famous speech held by the ECB President Mario Draghi in July 2012. With these words and the credible policy performed by the ECB through its subsequent actions, investors stopped selling the governments bonds of the problematic countries and left them the possibility to refinance their debt at reasonable interest rate again. However, the participation to these extraordinary programmes was conditioned to the implementation of a number of structural reforms and austerity plans, particularly concerning the labour market flexibility and the cutting of the government expenditures to reach fiscal consolidation. But, according to some economists the approach followed and consequently imposed by the European institutions, had negative outcomes since it was the consequence of a wrong diagnosis of the nature of the crisis. At the beginning, it was thought the sovereign debt crisis was linked to a mismanagement of the public finance rather than to the doom-loop mechanism, amplified by the financial market behaviour, and the absence of stabilizer elements proper to a monetary union. The shared opinion was that the reaction of financial markets was logical looking at the debt-to-GDP ratio of the countries hit by the crisis. The fact that investors required higher risk premia was only a natural consequence of the efficiency of the market, which was "acting as a disciplining force on bad governments"[14].

[14] De Grauwe (2011).

Thus, since these countries had been profligate, now they had to fix their own errors. This argument was particularly supported by the Northern European countries, but as De Grauwe (2014) remember us it must be that “for every foolish debtor there must be a foolish creditor”. Nevertheless, this was the chosen road, but its main result was a worsening of the recession, given the fact that these kind of actions turned out to be pro-cyclical.

Looking at the evolution of the euro crisis, it is clear enough that the absence of a lender of last resort is the main driver (not the only one though) of the weaknesses of the EMU project. So when the European politicians were designing the feature of the EMU, why did they prohibit the ECB to be a lender of last resort for the government bond market, tightening its policy to the achievement of price stability only?
The main rational explanation for the inaction of the ECB is the risk of moral hazard, i.e. the possibility that with the presence of a safety net which intervenes in case of distress, governments have an incentive to issue more debt and manage their finances unwisely. But, as De Grauwe underlines (2011), this is exactly the same risk the ECB faces in the banking system, where it acts as a lender of last resort within its mandate. In fact banks can lend more than the resources they have using the leverage tool or they can grant uncreditworthy borrowers a loan. These are risky activities from a bank’s point of view that if they fail, they require the action of the lender of last resort to avoid the bank runs phenomenon. The control of the risky activities and the consequent reduction of the moral hazard risk has been managed with the institution of a supervisory authority responsible for bank supervision, independent from the ECB and with stricter rules about the capital banks’ requirements. The same mechanism can be transferred to the government bond market, so that the moral hazard risk can be contained.

The moral hazard is the strongest argument used by politicians against the transformation of the ECB as lender of last resort. But, at the point in which today we are, many analysts are claiming for a change in policy followed by the central bank and new steps towards a new scenario have taken place through first the European Stability Mechanism (ESM) and Outright Monetary Transactions (OMTs) program and then with the quantitative easing (QE) program launched in January 2015. De facto, the ECB is already working as a lender of last resort. Furthermore comparing the dimension of the banks’ liabilities with those of the governments, for the ECB would be simpler and less costly intervening directly in the government bond market instead of providing the protection for the banking system.

There are other reasons economists opposed to the transformation of the ECB as safeguard of the government debt market: the risk of inflation and the fiscal consequences. As De Grauwe (2011) explains these are false arguments: in fact, the former can be contained since there exists, especially in crisis moments, a disconnection between the two main monetary aggregates, money stock and money base. Even if the central bank increases the money base, money stock could remain unaffected. This is because, during a financial crisis banks tend to keep liquidity for themselves instead of expand the credit. Moreover, the central bank can impose stricter rules in the credit conditions, so that it can control even better the level of inflation. In the author's view the fiscal consequences that the ECB should bear in case governments are not able to repay their debt servicing are reasonable but fail to recognise that the risk is embedded in all kind of open market operations, even in those ones performed in the banking sector. So, if this is true it means the ECB should abstain from any market operations but in this case its role will vanish.

1.4 Steps towards a stable EMU

From the eruption of the euro crisis until now many steps forward in order to reform, improve and fix the features and failures of the EMU architecture have been done.

Immediately after the first signals of instability, Europeans leaders pushed by the problem of a high debt level focused their attention on the Stability and Growth Pact. They found that some correlated problems to the euro crisis could derive from the weak enforcement of the rules defined within the European fiscal regulation. Leaving the fiscal policy completely in the hands of national governments, without a serious and effective mechanism of sanctions in case of breaches of the rules, resulted in an incentive for governments not to respect the targets they promised in their Stability Program submitted to European institutions. Governments were asked to present a document in which they shown the budgetary objectives needed to achieve the stability in public finances over the medium-long run and to prevent excessive deficit in the short run. European institutions were responsible for the supervision and the application of the "preventing arm" of the Pact, but since European institutions are constituted by representatives of the member states, it can easily be identified an opportunistic behaviour: there was no reason why a member state should prevent another member states from deviating from the objective to strive for a balanced budget in the medium term, as de Haal et al. (2014) pointed out. Moreover the French and the German breaches of the parameters during the first years of the monetary union undermined the credibility of the Pact letting other countries to do the same.

Thus, the Stability and Growth Pact has been made more restrictive and effective. In particular the “Six Pact”, the “Two Pact”, the “Fiscal Compact” and the “Macroeconomic Imbalance Procedure” have been introduced with the intent of achieving a greater macroeconomic coordination, but according to Agnès Benassy-Quéré (2015) they might create only complicated bureaucratic process.

Besides the improvement in fiscal regulation, the EMU has improved the banking union: specifically it has moved banking supervision at a European level. The main aim is providing more stability to the whole system and protecting the single currency from future crisis breaking up the doom-loop relationship between banks and governments. Moving the banking supervision to the ECB, through the Single Supervisory Mechanism, and introducing the “bail in” clause for banks, i.e. the intervention of shareholders and creditor in the rescue of the banks in case of losses, should “ensure financial stability and protect national governments from the need to intervene to rescue their banks” (Draghi 2014).

Then the ECB together with the European Commission (EC) have defined a series of extraordinary programs to use in case other financial crisis will occur. They are the ESM[15] and OTMs program. The first is a rescue fund directly created by the European States: it has a lending capacity up to €500 billion. It is thought to be “the permanent crisis resolution mechanism for the countries of the euro area”[16] and its main aim is to provide help in terms of loans, purchases of debt in the primary and in the secondary markets and recapitalization of the financial institutions in need. But, the financial assistance is subject to strict conditionality. The latter is the program conducted by the ECB after a Member State has asked for financial assistance to the ESM fund in order to promote and safeguard the appropriate monetary policy transmission. Through these rescuing plans, the ECB and European leaders think it will be possible to stabilize the expectations of the financial markets taking off the table the possibility that a member state would exit from the EZ. Nevertheless some analysts (De Grauwe 2011, Manasse 2011) are not convinced of the effectiveness of the solution: they highlight the attempt to substitute the possible infinite firepower capacity of the ECB with a limited capacity fund, a weaker funding system and a voting mechanism based on the unanimity principle that slows down the decision making process. They notice that its construction could spread the crisis to other high indebted member states rather than protect them from the shocks.

[15] The ESM is the evolution of the European Financial Stability Facility, the temporary crisis resolution mechanism that provided financial assistance to Ireland, Portugal and Greece.

[16] See http://www.esm.europa.eu/#

Finally a QE program has been set up to cool down the sovereign spreads and give countries in fiscal distress the chance to access the market at reasonable conditions. It started in January 2015 and its structure has been clearly described by Annunziata (2015): it provides substantial purchases (at least €60 billion per month) of asset-backed securities, covered bonds and investment grade bonds issued by governments until end-September 2016. In case the expected recovery will not be considered sufficient enough, the program will be extended beyond September 2016. The purchases will be proportional to the shares of EZ national central banks in the ECB's capital: this should help in particular Italy which holds the third largest fraction of ECB's capital and at the same time is the nation with the highest debt burden. The participation at the program is conditional for the countries (say Greece) under EC/ECB/IMF programs. The definition of the rules and the reason adduced for intervention, i.e. the necessity to restore the inflation rate to its target, since EZ as a whole is experiencing a deflationary pressure, have been used by ECB's president Mario Draghi to support and fight against the political opposition that have occurred during the setup phases. Notably criticism has come from Germany and other Northern nations which have claimed against the direct intervention of the ECB in the government bond markets for fears of fiscal transfers.
With this program ECB hopes that countries in distress will take the chance to make the right structural reforms and that growth will be lifted. Yet the scope for moral hazard is high.

Despite the efforts, EMU needs to further increase the degree of coordination in its economic policy. The "Five presidents' Report" of June 2015[17] set out four areas in which work is needed. The report focuses on the steps necessary to enhance an economic, political, financial and fiscal union. Assessments of three out of four areas are beyond the scope of this work, but fiscal union is of our interest: the crisis has revealed that more fiscal sustainability and fiscal stabilisation is required. In fact, the rules imposed through the Stability and Growth Pact and its updates are not sufficient enough to promote them. Furthermore the programs put in place by the ECB have a short run horizon. Achieving fiscal sustainability and fiscal stabilisation in a coordinated and credible way is quite difficult nowadays due to legal, economic and political reasons, but it is necessary to quickly find out a solution because a "currency without a state"[18] will not last in the long run.
Among the various solutions proposed and discussed by economists and policymakers, one has gained attention during the whole period of the crisis: it is the implementation of a Eurobond, i.e. of a common debt instrument. The aim of this instrument is to shield all

[17] See Juncker et al. (2015)
[18] Issing (2008).

member states from future speculative attacks, letting them to finance at reasonable lending rate and to restore the financial stability, reducing the scope of intervention of the ECB.

1.5 The Eurobond proposal

Considering all the facts above mentioned, it is evident that the absence of a fiscal union has brought about some negative implications on the functioning of the EZ. The weak enforcement of the SGP and its lack of automatism in the application of the "corrective arm" is to blame because it has led to an excessive level of debt and deficit for many countries. However, to be fair, as Boonstra (2011) has underlined the total amount of the EZ debt and deficit is quite small compared to other big advanced economies, like that of the US or Japan. Therefore, the main difference that has transformed the financial crisis into a sovereign debt crisis relies on the fact that the other advanced economies can exploit a monetary policy instrument and that in the EMU even a small country, like Greece, when enters into financial troubles could affect all the others because of the doom-loop mechanism.

Consequently, the euro crisis has revealed how much the architecture of the EMU is financially unstable and prone to speculative attacks and how much is necessary to find out a solution. The improvements in the SGP, the construction of rescue funds and the implementation of a QE program, are considered by economists short lived solutions and they present some limits too. Indeed a long run solution is required to provide stability to the EMU and shield it in the correct way from future crisis.

During the years of the crisis, the Eurobond analysis started with the introduction of the Euro and then abandoned, has been reviewed: the common debt instrument has been proposed as a possible mechanism to achieve the fiscal union in a way in which all the member states could benefit.

At the origins, as the Giovannini Group has presented it, the Eurobond had to be an instrument finalized to increase coordination of public debt issuance, with the ambition to become an alternative to the US Treasury Bond and gain the official status of reserve currency (Claessens et al., IMF 2012). The possibility to extend the liquidity dimension of the government bond market eliminating all the fragmentations stemming from national issuances, was considered a likely consequence of the presence of such an instrument. With the surge of the crisis, it was seen more as the necessary tool to cool down the sovereign spreads and break the doom-loop spiral rather than a liquidity provider.

The IMF analysts[19] have suggested in a detailed fashion what could be the possible objectives and motivations for the introduction of the Eurobond. In their analysis, the Eurobond is seen as a resolution tool both in the short run, as immediate response to the financial crisis, and in the long run, as a permanent feature of the EMU. In fact, it could be useful both to governments and investors since, on one side it could provide the right incentives to prudence (but also insurance against interest and liquidity shock) and on the other side it could improve stability, liquidity and reduce the probability of default. These targets are classified into three categories: fiscal risk sharing and fiscal discipline, financial stability and monetary policy transmission. However they present evident conflicts of interests and overlaps. Specifically, the fiscal risk sharing and the fiscal discipline would imply that a common debt instrument should have some degree of risk sharing, i.e. an ex ante transfer mechanism resulting in a reduction of the lending rate and an ex post default mechanism. As regard the financial stability, the help provided by a Eurobond is considered twofold: first the doom-loop mechanism and consequently the "home bias" phenomenon of the purchase of the sovereign bonds would be weakened; second the creation of a debt instrument guaranteed by all the member states would ensure an increase in safe assets and so a reduction in the flight to quality or safety phenomenon. Moreover there would be less scope for the ECB to directly intervene in the market. Finally the issuance of a common debt instrument would allow to reduce the fragmentation in the sovereign bond market restoring the correct functioning of the markets and giving the ECB the chance of using them as monetary policy transmission tool in a proper way.

Yet, all these possible benefits present non-negligible concerns, so that the proposal of the introduction of a Eurobond is not free of critics.

In order to identify the major concerns, we can use Gros' (2011) definition of a Eurobond: "a bond which has a 'joint and several' guarantee by all member states of the Eurozone. The 'joint and several' guarantee implies that if the issuing country cannot service its 'Eurobond' debt, the creditors can demand payment from all other Eurozone countries. This would imply that in extremis the creditors could demand that Finland or Estonia pay up for the (Eurobond) debt run up by, say, Greece or Italy if the other large Eurozone members are either unwilling or unable to pay". In other words, the "joint and several" guarantee implies that the Eurobond is an indivisible legal object whose total amount of obligations is guaranteed by each participating member state. Consequently with the "joint and several" guarantee provided by all the member states, there is a pooling of the credit risk.

[19] See Classens et al. (2012).

Given the definition, it is quite understandable why the Eurobond as long run tool is considered controversial. In fact, on one side if implemented it would imply a unique interest rate for all the countries. Considering the actual situation in which a differential exists among the interest rates because of country-specific elements, the presence of a single lending rate would be for sure a benefit for those nations which bear higher costs of borrowing than, for example, Germany or the Netherlands which already benefit of the favourable conditions that financial markets are providing them. Thus, according to critics, there would be a sort of subsidy from the financially sound member states to the financially unsound. So, this is why, some authors and think tanks (Issing, 2009; Gros, 2011; IFO, 2011) have claimed against the introduction of the Eurobond[20]. However, on the other hand, the Eurobond would reduce the incentive for fiscal discipline increasing the scope of moral hazard. In fact with the presence of a safety net represented by the "joint and several" guarantee these states could feel free to play again a disruptive fiscal policy without the fear that market forces push them into the bad equilibrium of the debt vortex. The market discipline, evoked by northern European nations as signal to promote strong fiscal adjustments, would be eroded.
Then, there are even more subtle issues that complicate the path towards a possible introduction of a common bond. They fall into the broad category of the political and legal issue. From the political side, Gros (2011) argues that a fiscal union requires first a certain degree of political union: for him the Eurobond would make sense only if the "United States of Europe" were already existing. Creating such a union would imply substantial changes in the TFEU: in particular the presence of a Eurobond would be against the "no bail out" clause. However as we have already discussed, this clause have never been completely credible and the recent actions taken by the ECB and the European Council have shown that a certain degree of debt mutualisation among the European countries has already been put in place. Furthermore, as Classens et al. (2012) suggest, a possibility to overcome this obstacle is making voluntary the participation at the program. But, as we will see, a voluntary participation could weaken the entire structure of the project. We must take into account even the way in which a possible scheme would be received at a national level and how it would comply with the national constitution and the budgetary legislation. This could become a major challenge in some EZ countries, like Germany, but the recent approval of the German participation to the ESM are positive signs for a possible future introduction of common debt program, although limited in amount and in time.

[20] In particular the IFO institute (2011) has calculated that for Germany the issuance of a common bond would cost €47 billion per year of additional interest expenses. This calculation is based on a series of specific assumptions: if changed they would lead to a different result. But the fundamental point would not change: the Eurobond would represent a huge burden for German taxpayers

In any case, everything seems depending on the way in which the Eurobond would be constructed.

Proponents of the instrument know well the main drawbacks that a Eurobond embodies in its structure once issued, but they know the benefits too. Thus, what they have done during the years of the crisis is not only highlighting the positive effects of the common debt instrument, but even trying to tackle the problem of the unique interest rate and of the moral hazard with a proper design in order to convince reluctant politicians of the validity of the solution. In other words, they have worked to find out solutions that could minimize or even eliminate these risks, but at the same time could provide a mechanism to enforce the fiscal discipline in a time-consistent manner (Claessens et al., IMF 2012).

One of the first proposals we analyse is that one by De Grauwe and Mosen (2009). In its naïve setup the Eurobond proposed has the following features: each euro government would participate in the issue on the basis of its equity shares in the European Investment Bank (EIB) and the debt instrument (i.e. the Eurobond) would have an interest rate calculated as a weighted average of the yields observed in each government bond market at the moment of the issue. The weights used in the computation of the Eurobond yield would be linked to the equity shares in the EIB. The proceeds of the bond issue would be channelled to each government using the same weights and each government would pay the yearly interest rate on its part of the bond, using the same national interest rates used to compute the average interest rate on the Eurobond. In order to rule out the possibility of moral hazard, each country would pay the same interest to the EIB as it would pay in the market. Thus, the fiscally sound nations would not see an increase in their borrowing costs and the weaker countries would have an easy access to financial markets. However, the scheme defined by the two authors is very limited and the way in which they tackle the problems of the interest rate and of the moral hazard comes from the fact in 2009 the differentials in spread were still narrow. Moreover, it does not address the market discipline issue at all. Thus, such proposal, if it had applied during the sovereign debt crisis, would not have been effective. Rather it would have worsened the distress situation because it would not have protected the weaker nations by the shift in market sentiment. Moreover, it would have increased the contagion effect, and it would made the interest rate bill to be paid to the EIB unsustainable (Boomstra, 2011).

A more structured proposal is that one by Delpla and von Weizsäcker (2010). In their famous “Blue-Red Bond Proposal” they sustain a debt mutualisation up to the 60 percent of GDP issued as senior tranche, i.e. the “blue bond”, which would be covered by joint and several liability. The amount of debt over the 60 percent threshold of the blue bond would be issued as junior tranche, i.e. the “red bond”, with sound procedures for an orderly default. The split between two tranches, where one is completely guaranteed at European level while the other is backed only at national level (so it is riskier), would be a way to differentiate the cost of borrowing, avoiding the convergence to a single interest rate, notably the German one. Moreover, it would induce countries to continue the path of the fiscal consolidation in order to reach the 60 percent threshold and obtain a discount on the lending rate associated to the remaining part of debt, still subject to market discipline.

As clarified in subsequent updates of the proposal, the transition to such a scheme, once adopted would require a period of three or four years. The authors try to stress the benefit stemming from the implementation of this kind of Eurobond. They emphasise the liquidity gains for smaller countries with relatively illiquid sovereign bonds and the fiscal incentive for high indebted countries. There would be substantial benefits for the stronger countries as well. The participation at the program would help to re-establish the credibility of the SGP and would reduce the risk that a bail out of weaker countries might become necessary.

However, this proposal has been partly criticised. In fact, Boonstra (2011) notices that the Blue and Red bond proposal still counts on market discipline that during the EMU first decade has demonstrated to be unreliable. Thus, countries would be still vulnerable to the swings in market sentiments, albeit for a limited part of their debt. Then, as Gros (2011) points out, the division into tranches could force the highly indebted countries into an immediate debt restructuring, since they could no longer find buyers for the “red bond”, which is the part guaranteed nationally. Moreover, in the Delpla and von Weizsäcker scheme the participation would be on a voluntary basis and the issuance of the common instrument would be at a national level. These two elements would have two main downsides: first if one country decided to step down from the project, the entire structure would be weakened and the riskiness of the entire program would increase, since it would be probable that the stronger countries are those that decide not to participate; second national issuance would mean a further fragmentation of the sovereign bond markets that could push countries into acute liquidity shortage, and this is exactly what a Eurobond would rule out.

Consequently Boonstra (2011) proposes to create a central agency, an EMU Fund which would raise the funding required on the behalf of the EMU as a whole and would assign it to the individual member states according to their requests. In such a scheme there would not be any tranche and there would not be a direct interest rate on the issuance: member states would pay a lending rate to the central agency for the funding received and this lending rate would be calculated on the basis of the financial position of the government. The larger the fiscal deficit or the higher the government debt, the higher the rate they would be charged. Thus, according to Boonstra, his proposal that is similar to an insurance scheme would reduce the scope of moral hazard, would contribute to the strengthening of the budgetary rules and would bring benefits for all countries, since they would be shielded from the market sentiment and potential spill overs coming from high indebted countries.

A similar proposal in which there is a central agency which would raise the funding for all the member states is that one by De Haan et al. (2012). The main difference stands in the way funds would be distributed: in Boonstra (2011) scheme, EZ countries can access the funds paying an interest rate; in De Haal et al. (2012) design, governments can obtain the funds only if they demonstrate to have sustainable fiscal policies as defined in the Maastricht Treaty or they implement a strictly monitored adjustment program. So first the countries would have to put their own effort in reaching a fiscal position in line with the SGP and Fiscal Compact rules and then they could benefit from the common debt instrument. Furthermore, the central budget authority would be fully independent and it could have the power to directly intervene to enforce the fiscal adjustments in case the debt ceiling of 60 percent of GDP would be overshot. Instead, countries below the 60 percent threshold would retain full autonomy to determine the size, composition and financing of their national budget, even if it would be the central authority to raise funds in the markets on their behalf.

Both proposals provide a valid solution for the moral hazard problem since they imply or impose the fiscal consolidation to the weaker nations to obtain the funds and at the same time enable stronger countries to maintain their positions without suffering for an increase in the borrowing costs. But they require long time to be implemented and a real fiscal union among member states, which would imply profound modifications in the TFEU.

Boonstra (2012) himself recognises these limits in his proposal, thus he presents another version of his Eurobond. He calls it "Conditional Euro-T bill" and he presents it as a transitional regime necessary to restore the financial stability in the Eurozone and help to create the circumstances under which a budget consolidation program can be implemented. In order to participate to the program, a member state must be solvent with an approved fiscal policy plan. Therefore, those countries in financial troubles must first resolve their problems. For those nations that participate to the temporary program, the Euro-T bill, which would have a short term maturity (no more than 2 years) and would be cross-country guaranteed, would cover the funding needs. Countries would be still allowed to issue long term maturity bonds, but these would not be jointly guaranteed. In case a country would fail to implement the agreed policies, it could be phase out of the program. There would be a supranational agency in charge of rising funds, called the EMU fund. This would be financed by the member states, which in case they would exceed the 3 percent deficit threshold or the 60 percent debt-to-GDP ratio would be obliged to pay a premium on top of the necessary costs to finance the agency. This premium would be calculated as follows:

$$R(i) = \alpha[DEF(i) - DEF(m)] + \beta[DEBT(i) - DEBT(m)]$$

where $R(i)$ is the size of the premium additional to the funding costs of the EMU fund, $DEF(i)$ is the budget deficit of country i, as a percentage of GDP, $DEBT(i)$ is the national debt of country i, as a percentage of GDP, $DEF(m)$ and $DEBT(m)$ are the maximum values for budget deficit and national debt described in the SGP, i.e. 3 percent and 60 percent of GDP respectively. Parameters α and β are coefficients determining the relative weight of national debt and the budget deficit in the formula. The problem with this formula is the calculation of the parameters α and β which would be the result of a bargain process rather than the outcome of transparent and credible decision making process. These premium would contribute to create a reserve buffer that would help to minimize the possibility of spill over effects.

Despite the complexity, according to the author, such a scheme would present the following advantages: first, it could be introduced quickly, given the temporary nature of the program. At the same time, this trial period would let "buy time" for those countries in need to stabilize and consolidate their budget: without the fear of sudden shifts in financial markets' sentiment, these countries would be able to put in place all the efforts required and it would provide a liquidity premium for the stronger countries. However, the author highlights even the disadvantages of such a scheme: for example in case a country would be phase out of the program, this would cause unrest, but the spill over effects would be contained thanks to the reserve buffers. Another drawback stem from the fact that the weaker participating countries, not yet being able to issue long term bond on their own, would have to finance their deficit and maturing debt with short term credit. This would mean the average maturity of their national debt would decrease. Consequently there would be an increase in their public finances' sensitivity to interest rates.

This conditional Euro-T Bill recalls the proposals by the European League of Economic Cooperation (ELEC 2012) and by the European Commission (2011). The latter in 2011 issued a "Green Paper" on the feasibility of introducing a certain form of debt mutualisation (Stability Bonds) providing different schemes on the basis of the degree of the guarantee provided. All the options are a mix of already existing proposals that the EC thought it was possible to implement in a future. The three approaches presented by the EC are the

following: (i) a full substitution of Stability Bond issuance for national issuance, with joint and several guarantees; (ii) a partial substitution of Stability Bond issuance for national issuance, with joint and several guarantees; and (iii) a partial substitution of Stability Bond issuance for national issuance, with several but not joint guarantees[21]. Among the three solutions proposed by the EC, the most effective in delivering the benefits would be scheme (i), but it would be that one with the high implied moral hazard risk. Instead, approach (ii) would be a remainder of the blue and red bond proposal by Delpla and von Weizsäcker (2010). Finally scheme (iii), although it would require few preconditions, it would bring about few benefits.
The EC has moved beyond the theoretical aspects, since it has launched a public consultation on the topic involving state representative, banks, think tanks, market stakeholders, etc. The result have been presented in a document (European Commission, 2012) in which the evidence is that the majority would be in favour of the introduction of a Eurobond in the form of approach (ii), even if they stress the need to simultaneously (some even see it as a prerequisite) addressing the issue of budgetary divergence in the euro area. Of course the document has reported the objections to the Eurobond as well: they relate to the classical topic of moral hazard and fiscal discipline.

All the main Eurobond proposals are based on a high degree of fiscal integration which embeds at the same time advantages and disadvantages. Since financial integration is even the main argument used to prevent the introduction of the common debt instrument, Brunnermeir et al. (2012) present a scheme which do not require more fiscal integration than today exists and creates the safe assets EMU is supposed to need[22]. They call it European Safe Bond (ESBies) and it works as follows: the EMU member states would create a European Debt Agency (EDA) which would buy the sovereign bonds according to some fixed weights. These weights would be set by strict rules representing the relative size of the different member states. In this way there would not be scope for a bail out. The sovereign bonds would be used by the EDA as collateral to issue two new securities: a senior tranche, i.e. the ESBies, and a junior tranche that would be sold to the willing investors in the market. Of course the senior tranche would be safer than the junior tranche and for this reason it would be acquired by the European banks, which would use it as collateral in the open market operations with the ECB,

[21] In this case there would be a pro-rata guarantee, i.e. each member state would retain liability for their respective share of Stability Bond issuance as well as for their national issuance.
[22] Until the eruption of the euro crisis, in the EMU all governments bonds were considered safe assets and used by banks as collateral, creating the doom-loop mechanism.

but even by pension funds or other institutional investors which are required to hold safe assets in their portfolios.
According to the authors, this structure would make the ESBies safer than the Eurobonds, since it would not rely on fiscal revenues, but on diversification and credit enhancement. Then, it would not require revision or changes of European treaties and at the same time EZ countries would receive some reliefs from their sovereign debt. Moreover, with the presence of the ESBies in the market, there would be a new "safe asset" that would capture the premium investors would be willing to pay in exchange of safety and the mispricing problem associated to the sovereign bonds would disappear.
For all these reasons, the authors believe their solution could be the right tool to be used to build a sustainable institutional framework for the Euro, without modifying the existing rules.

The majority of the proposals presented in the literature suggests the increase in liquidity in the market as potential direct or indirect gain. The gain would come from the fact that with the implementation of a common debt instrument, even if subject to conditionality in order to avoid a single lending rate that might hurt stronger countries and incentivise free riding, the fragmentation in the sovereign bond market would disappear and investors would have at their disposal a safe, stable and credible instrument jointly guaranteed. Yet, about the increase in the liquidity premium brought by the introduction of the Eurobond instruments, whatever the shape, some economists have shown some doubt. In particular Favero and Missale (2012), who try to identify the drivers of the sovereign spread in order to verify whether a Eurobond scheme is useful in the EMU, discover that the scope of a rise in liquidity dimension is very little. In their work, they claim that the rationale behind the introduction of a Eurobond is economically justified if the differential on spread depends more on the market sentiment than on the fundamental driver of the spread itself, i.e. the default risk that in turn depends on fiscal fundamentals like the debt or the deficit. Thus, their analysis tries to pin down what the relative weights of the fiscal fundamentals and of the market sentiment are in the determination of the yield spread. They use a Global VAR model for the spread on Bunds. They find out that fiscal fundamentals matter only if there is an interaction with other countries' yields spread, i.e. the global risk the market perceives. But this interaction is not constant over time, meaning that there is a market sentiment component to take into account when determining the yield spread. If this market sentiment component is strong enough, i.e. markets can stay irrational more than a country can stay solvent, then the yield spread as disciplinary force is weaken, since it is not a real economic indicator, but rather a result of market perceptions. In this case, it is worth trying to draw an instrument that can help to insulate all the member states of the EMU from the negative spill overs stemming from the default of one of them. Although the authors at the end of their work claim to be favourable to the introduction of a common debt instrument, they do not conceal their scepticism about a real possible implementation of it, considering all the political and legal obstacles such a tool would face.

Now, looking at the current structure of the EMU, no one of the solutions proposed has been implemented. Instead of Eurobond, European institutions are working on different crisis management tools, like the ESM, even for the long run. The reason behind this choice is probably more political than economical. The strong political opposition by the Northern and fiscally sound countries, like Germany, has halted the path for a construction of a common debt instrument, preferring the implementation of a rescue fund to be used only in case of financial distress. The fear for an increase in the borrowing costs and in the possibility of paying the bill in case of default of fiscal reckless nations have been sufficient deterrents to stop the Eurobond project, despite all the effort in design something that could rule out or at least minimize these major drawbacks.

2 The Model Framework for the Italian case

Despite the failure of the Eurobond project from a political point of view, economists and analysts continue to assess what could be the effects of this fiscal instrument on debt sustainability of the EZ countries.

It is worth noting the work by Tielens et al. (2014) on the impact of Eurobond on sovereign debt dynamics for selected European member states, specifically Greece, Ireland and Portugal. Their aim is to assess whether or not there are benefits and gains stemming from the introduction of such an instrument. The authors compare two scenarios: one in which there is not Eurobond protection (hereafter the baseline case), the other in which there is the introduction of the common debt instrument in the form Delpla and von Weizsäcker (2010) defined it[23]. They call this scenario the "full-fledged Eurobond scenario" where they assume sovereign country starts issuing Eurobond after a date of introduction so that old debt remains under national guarantee while new (Eurobond) debt is fully backed by participating member states.

They provide projections of sovereign debt, primary balance and long term interest rate of the selected countries in the two scenarios. In the baseline case they do not take into account the structural reforms implemented by the three nations in recent years, since they want to exclude any sort of cofounding effect between the evolution of the debt and the impact of those reforms on it. In other words they compare a "no policy change scenario" with a full-fledged Eurobond scenario to better assess the effects.

In order to compute their projections till 2020, they use a VAR Model and a fiscal reaction function that enable to perform a stochastic analysis instead of a deterministic one. The forecast of the time series of the main macroeconomic variables are the result of a Monte Carlo simulation. The outcomes of the analysis are the following: the effects of Eurobond are material. For Greece and Portugal the presence of the Eurobond leads to a sustainable level of debt in the long run, even if the level is still higher than that one forecasted by the IMF, suggesting the importance of the structural reforms. For Ireland debt dynamics with or without the common debt instrument are quite similar. Thus, the authors argue that even if the introduction of the Eurobond is beneficial, it does not mean that the debt instrument is a substitute of the fiscal reforms.

The contribution to the literature provided by this paper is quite relevant because it is one of the few recent works in which the benefits of a hypothetical common debt instrument is really

[23] The authors are assuming that once the common debt instrument is introduced, the scheme by Delpla and von Weizsäcker (2010) is applied to the new debt issued. Instead, the old debt remains nationally guaranteed. On this point see ELEC (2010)-Part II.

assessed and not only claimed. But, it is focused on three small EZ countries whose economic structure, although it is different, is supposed not to influence the Eurobond interest rate. Actually, when the authors tailor the VAR model to the Eurobond scenario they assume the short and the long run interest rate would be close to the German one plus a stochastic error term, to be interpreted as shock to Eurobond rate. This approach can be considered too naïve since we know that macroeconomic fundamentals matter in the construction of the Eurobond scheme. In fact they are considered the main elements to take into account if we want to rule out the moral hazard problem and avoid that the fiscally sound countries incur in higher borrowing costs. Thus, the way in which this model is set up could not be applied at a more general level, i.e. when we are dealing with bigger countries, like Italy or Spain whose level of debt, deficit and growth can have a non-negligible impact on the Eurobond rate. However, it is the easiest scheme from a methodological point of view that can be analysed with the tools and information at our disposal. So even if it can be subject to strong criticism, it can give us a general idea of what could happen even to other European economies and assess whether it is a valuable solution. Moreover with a few improvements in the model specification, like considering as endogenous not only the non-fiscal variables, as the authors do, but even the fiscal ones, we can handle in a better way the existing interactions between the macroeconomic fundamentals and the interest rate.

Consequently what we want to do is to tailor the model set up by Tielens et al. (2014) to the big economies in Europe, i.e. Italy, France and Spain, and verify what happens in these cases to their debt evolution.

2.1 Preliminary steps

The first thing a debt evolution analysis requires is the definition of the fundamental law of motion of debt-to-GDP ratio.

In the classic literature it is derived starting from the government budget constraint defined as:

$$B_t - B_{t-1} = i_t B_{t-1} - (G_t - T_t) \qquad (1)$$

where B_t is the stock of debt at time t, B_{t-1} is the stock of debt at time *t-1*, i_t is the nominal interest rate, G_t is the government expenditure and T_t is the government revenues (i.e. taxes and net social contributions). Since we are interested in the ratio between debt and GDP, we divide all the terms by Y_t[24] and we obtain this law of motion of debt-to-GDP:

[24] Y_t is the nominal GDP which ca be written as follows: $Y_t = Y_{t-1}(1 + Y_t) = Y_{t-1}(1 + \pi_t)(1 + g_t)$

$$b_t = \frac{b_{t-1}}{(1+\pi_t)(1+g_t)} + int_t - pb_t \quad (2)$$

As we can see from equation (2), the debt-to-GDP ratio b_t is affected by four key variables: the interest expenditure-to-GDP ratio int_t; the inflation rate π_t; the real GDP growth rate g_t and the primary balance -to-GDP ratio pb_t[25].

This is the debt accumulation equation used by Tielens et al. (2014) in their work, who decide to diverge from the traditional debt equation[26], since they want to handle in a more sophisticated fashion the interest expenditure related to the issuance of government debt. In fact it is known that both the economic institutions and the literature always more frequently expand the traditional version of (2), in order to take into account more realistic features of the debt dynamics, such as the maturity structure of the debt and/or its different composition between national and foreign currency, the effect of the exchange rate, etc.[27].

However, the way in which we compute the interest expenditure is simpler than that one used in the paper we are referring to[28], since our interest expenditure-to-GDP ratio int_t is computed as the primary deficit (or surplus) minus the overall fiscal balance[29] (both measured in percentage value of GDP). Despite the simplicity of the computation, our interest expenditure has the merit of describing the interest payments exactly as we find them in the government balance sheet.

Another benefit from this computation of the interest expenditure is that we do not need to distinguish between short and long term maturity debt, because int_t already contains this information. Thus, this variable represents the average cost of debt in a more dynamic way: specifically, it embeds the actual interest expenditure a government must pay in term of GDP, when a certain amount of outstanding debt has to be redeemed at maturity. Due to the fact that outstanding debt is made up of different types of instruments, where each of them has its own

[25] The primary balance pb_t is defined as the net lending (+)/net borrowing (-) excluding interest payable. The net lending (+)/net borrowing (-) is computed as the difference between the total government revenues and the total government expenditure. It can be positive so we have a primary surplus which reduces the amount of debt, or it can be negative, so we have a primary deficit which instead increases the amount of debt. This is why pb_t enters the equation with a negative sign.

[26] The traditional debt equation is the following: $b_t = \frac{(1+i_t)}{(1+\pi_t)(1+g_t)} b_{t-1} - pb_t$, where i_t is the interest rate paid on the stock of debt.

[27] For different construction of the traditional debt equation see e.g. Berti (2013); Penalver and Thwaites (2006); Cline (2012).

[28] In the work by Tielens at al. (2014) the interest expenditure is computed as follows: $INT_t = \sum_{m=1}^{\theta} B_{t-m}^l i_{t-m}^l + B_{t-1}^s i_{t-1}^s$, where i_{t-m}^l and i_{t-1}^s represent the interest rate on newly issued long and short term debt in period *t-m* respectively. B_t^l and B_t^s are the long and the short fraction of borrowing requirement. In particular, $B_t^l = [\alpha_t^l]GBR_t$ and $B_t^s = [\alpha_t^s]GBR_t$ where GBR_t is the borrowing requirement and α_t^l, α_t^s are defined as $\alpha_t^l = [\mu]^i$ and $\alpha_t^s = 1 - [\mu]^i$. Thus, $0 \leq \alpha_t^l, \alpha_t^s \leq 1$; $\alpha_t^l + \alpha_t^s = 1; 0 < \mu < 1$

[29] The overall fiscal balance is the total government net lending(+)/net borrowing (-) and it may be decomposed as follows OB = PB – INT where OB is the overall fiscal balance, PB is the primary balance and INT is the interest expenditure. For further details see Fedelino et al. (2009).

maturity and interest rate, int_t enables to take into account the government past operations which have still an impact on the current level of debt. In this sense, this variable captures the past effects of the public debt management. For this reason one possible drawback of using it, is a possible seasonal effect. However a correct seasonal adjustment should be sufficient to eliminate this flaw[30].

Since we need the debt forecasts in order to analyse its evolution and reaction under multiple scenarios, this means that we need the projections of the macroeconomic variables (both fiscal and non-fiscal) entering (2). The methodology used to compute them is described in the next subsection.

2.2 The VAR Methodology

Traditionally, debt sustainability analysis is conducted using a series of reliable macroeconomics assumptions on the main variables affecting b_t over a certain time horizon. This deterministic approach creates a whole set of different scenarios (i.e. different debt paths), based on the macroeconomic assumptions formulated and then it tests them using a sensitivity analysis. This technique implies the introduction of macroeconomic shocks to the underlying assumptions which allows to create alternatives to the baseline scenario. This is a way to account for uncertainty in the underlying macroeconomic conditions, but it is very limited. In fact it generates a finite number of alternative scenarios and most importantly, it does not take into account the correlations between shocks, even when ad-hoc combinations of shocks are created.

So, besides the traditional deterministic methodology, in recent years stochastic approaches have been implemented in order to take into consideration the infinite number of alternative scenarios produced by possible macroeconomic shocks. Stochastic approaches allow to jointly evaluate the determinants of debt dynamics and simulate random shocks which can have an impact on all the variables, giving the possibility to assess not just a single debt path but rather a “fan” of debt trajectories with different probabilities to occur.

Among the different stochastic methodologies proposed by the recent literature on fiscal sustainability, we choose a VAR model approach because it allows us to treat jointly the macroeconomic variables entering (2), i.e. we deal only with endogenous variables. Moreover it allows us to construct the forecasts in a powerful and reliable way. Using this methodology

30 The issue of seasonality comes from the fact we will use quarterly data. In case of annual data, this drawback would not appear.

we highlight the stochastic nature of the variables and their strong correlation, but we do not seek or try to pin down any causal relationship. The classical VAR analysis (Granger causality, impulse response functions, variance decompositions) which can be useful in understanding whether there is more than simple correlation among the variables, is beyond the scope of this work. Nevertheless, we provide a brief overview about the impulse response functions of debt dynamics in order to have a complete picture of the analysis we are doing[31].

In its reduced form[32], a VAR model of order p is a multivariate autoregressive linear model, in which each of the n-variables is expressed in terms of its own past values up to p periods, as well as in terms of the past values of the remaining $n-1$ variables, plus a serially uncorrelated error term. Thus, the general VAR specification we will use is the following:

$$X_t = A_0 + A_1 X_{t-1} + A_2 X_{t-2} + \ldots + A_p X_{t-p} + U_t \qquad t = 0, 1, 2, \ldots, \qquad (3)$$

where X_t = an $(m \; x \; 1)$ vector containing each of the m variables included in the VAR

A_0 = an $(m \; x \; 1)$ vector of intercepts terms

A_i = $(m \; x \; m)$ matrixes of coefficients, with $i = 1,2,..p$

U_t = an $(m \; x \; 1)$ vector of uncorrelated white noise disturbances, that is, $E(U_t) = 0$, $E(U_t U'_t) = \sum_u$ and $E(U_t U'_s) = 0$ for $s \neq t$.

In order to conduct a correct inference, the VAR model is required to be stable. The stability condition in the VAR model is analogue to that of a univariate autoregressive model: in fact a VAR model is stable if all included variables are weakly stationary, i.e. (with stochastic initial condition) all the roots of the characteristic equation of the lag polynomial are outside the unit circle, i.e.

$$\det\left(I_k - A_1 z - A_2 z^2 - \ldots - A_p z^p\right) \neq 0 \text{ for } |z| \leq 1$$ [33]

In general it is useful to make an assumption regarding U_t distribution which determines the Y_t process: often U_t is assumed to be Gaussian white noise that is $U_t \sim N(0, \sum_u)$ for all t

[31] As Stock and Watson (2001) highlights VAR models are particularly useful in data description and forecasting. Instead, with respect structural inference and policy analysis, it is necessary imposing restrictions or economic assumptions about the relationship among the variables. This means that econometricians are required to distinguish between correlation and causation, and this is not always trivial. Since the main objective of our analysis is only obtaining forecasts through this tool, we are not interest in this distinction.

[32] See Stock and Watson (2001).

[33] Based on Kirchgassner and Wolters (2007) and Lütkepohl, H. (2005). The eigenvalues or characteristic values or characteristic roots of an $(m \times m)$ square matrix A are the roots of the polynomial in λ given by $\det(\lambda I_m - A)$. The determinant is sometimes called the characteristic determinant and the polynomial is called the characteristic polynomial of A. Thus, all eigenvalues of the $(m \times m)$ matrix A have modulus less than 1, if and only if $\det(I_m - \boldsymbol{A}z) \neq 0$ for $|z| \leq 1$, that is, the polynomial $\det(I_m - \boldsymbol{A}z)$ has no roots in and on the complex unit circle.

especially when the VAR model in unknown and a set of time series data are used to estimate the parameters. In order to estimate the VAR (p) process different estimation techniques can be used: we will use the traditional OLS estimation[34].

2.3 The baseline scenario

Given the general framework about the functioning of a VAR model, we can start analysing the time series of the macroeconomic variables of our interest, i.e. those involved in eq. (2).
We decide to treat in an endogenous way all the variables, both non-fiscal and fiscal. However, on this point the literature has different opinions, especially about the treatment of the fiscal variables, i.e. the primary balance, the interest expenditure and the lagged valued of debt. In fact some works recover the values of the primary balance through a fiscal reaction function[35], while others decide to treat it endogenously[36]. We have decided to follow this second approach because it helps us to keep simple the model, without creating an external function. Moreover it can convey the changes in fiscal policy directly to the other variables exploiting the interactions that the VAR model creates.
As regards the interest expenditure, this variable enters within the vector of the endogenous variables X_t, for the specific debt accumulation equation we have used and because in this way we avoid to compute the interest expenditure outside the VAR model. Inserting the interest expenditure directly in the vector of the endogenous variables, enable us to better capture some interactions between this variable and the others we use in the model specification. Instead, we do not insert the debt-to-GDP ratio, because inside X_t is already specified all the information we need to compute the debt evolution as described through eq. (2). Thus, using even this piece of information would have let our model over specified and the debt path would have been deterministically computed rather than stochastically. So, we use the VAR specification and expression (2) in two separate but subsequent steps: first we estimate (3), so that we can compute the forecasts of the macroeconomic variables and once obtained, we compute the projections of debt through (2), where the first lagged value is taken as given and it is equal to 136 percent of GDP, i.e. the last value of the Italian debt-to-GDP ratio recorded on the second quarter of 2015.

---

[34] For more detail about the estimation techniques see Lütkepohl, H. (2005). *New introduction to multiple time series analysis, ch. 3.*
[35] For the computation of the fiscal reaction function, see for example Galì and Perotti (2003) or Celasun at al. (2006).
[36] For the treatment of the fiscal variable in an endogenous way, see for example Garcia and Rigobon (2004), Tanner and Samake (2008) or Cherif and Hasanov (2012).

Moreover, in the vector of variables X_t we insert even the nominal interest rate of the 10 years Italian government bond, the so called Buono del Tesoro Poliennale (BTP). Even though it does not appear in the debt accumulation equation that we use, we need it because it has as strict relationship with the other variables, especially with the interest expenditure, the GDP growth rate and inflation. In particular it can be considered the benchmark among the different bonds offered in the market. It embeds the country risk factors and quickly reflects the changes in the monetary policy when they occur. So since the bond market associated with is the most liquid, it can be considered an instrument through which expectations and monetary policy changes are transmitted to the other variables.

Thus, we use the Italian quarterly data from 1999Q1 to 2015Q2[37] of:

- g_t, i.e. the seasonally adjusted GDP growth rate in percentage change on the same period of the previous year;
- π_t, i.e. the Harmonised Index of Consumer Prices (HICP) in percentage change on the same period of the previous year[38];
- i_t, i.e. the nominal interest rate of the 10 years Italian government bond (BTP);
- int_t, i.e. the interest expenditure as percentage of GDP;
- pb_t, i.e. the government primary deficit(-) or surplus(+) as percentage of GDP.

The starting period corresponds to the introduction of the Euro as "book money".
Data are taken form the OECD database (GDP growth rate, monthly HICP[39] and the nominal interest rate), the ECB Statistical Data Warehouse (primary balance) and Eurostat (total government net lending(+)/net borrowing(-), which we use to recover the interest expenditure[40]).

Before using the VAR model to produce the forecasts of the macroeconomic variables of our interest, we need to verify whether the time series used are weakly stationary, so that our

[37] We know that it could be possible perform this kind of analysis using time series data starting from 1998, because it is in this year that the European Council announces that Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Spain, and Portugal would have adopted the single currency. Thus, with this announcement financial markets and government already embed expectations about the future of the EZ. However, with respect the primary balance time series is not possible going back to 1998, because Eurostat does not provide the data. Thus, we are obliged to start our analysis from 1999Q1. The end date is chosen on the basis of the moment in which we have started to develop our model.

[38] We use the HICP because it is the official measure of the national consumer price inflation in the euro area. The HICP is compiled by Eurostat and the national statistical institutes in accordance with harmonised statistical methods. For further information see: https://www.ecb.europa.eu/stats/prices/hicp/html/index.en.html

[39] Quarterly data about HICP are computed as the arithmetic average of monthly data.

[40] See footnote 29.

estimates will be consistent. Thus, we test them for unit root[41], but before performing the ADF test we look at the series graphs (Figure A1)[42].
We can see that the GDP growth rate and the HICP present a strong reduction corresponding to the years of the global financial and economic crisis and this induces us to take into account the possibility of structural breaks when performing the ADF test[43]. As regards the primary balance and the interest rate expenditure series, they are seasonally adjusted before performing any kind of test and entering the VAR model[44].

Since all the series do not exhibit a clear increasing or decreasing trend but rather they seem to move around a nonzero mean, the alternative hypothesis we specify in the ADF test is that one that adds a constant to the model regression. The results of the ADF test showed in table A1 tell us that all the t-statistics are greater than the critical value, so we can reject the null hypothesis of unit root and accept the alternative of stationarity (for the HICP we accept the alternative at the 5% significance level). However, the nominal interest rate is I(1). Thus, using it in level could be a problem for the estimation of the VAR model. Consequently, for this reason, we prefer taking the first difference that eliminates unit roots as well as the serial correlation issue and using the variation of the interest rate to channel the effects of the monetary policy and investors' reactions to the country macroeconomic situation on the other variables.
Now that a preliminary analysis has been done, we can specify the VAR(p) process for our specific case as follows:

$$X_t = A_0 + A_1 X_{t-1} + A_2 X_{t-2} + A_3 X_{t-3} + A_4 X_{t-4} + \xi_t \quad (4)$$

$$X_t = [g_t, \pi_t, \Delta BTP_t, int_t, pb_t]'$$

$$E(\xi_t {\xi'}_t) = \Omega$$

$$\xi_t \sim N(0, \Omega)$$

We use the AIC criterion in the lag length selection.

Once the model is estimated we check the roots of the characteristic lag polynomial equation and we perform a VAR residual analysis in order to verify the Gaussian white noise

[41] For all the variables, the unit root presence is detected performing an ADF test. The test is performed using JMulTi software and the lag differences are chosen using the Schwartz criterion.
[42] From now on, all the figures and the table results are shown in the Appendix.
[43] The break date in the ADF test is chosen on the basis of economic events, rather than exploiting statistical tools.
[44] The seasonal adjustment we perform is based on a simple seasonal dummy method. Once we recover the seasonal component of the series, we apply a multiplicative decomposition. We know that there are others and more sophisticated seasonal adjustment methods like the X-12-ARIMA or the Tramo-Seats method, but for our purposes we think our adjustment is sufficient.

assumption. Thus we run a Ljung-Box-Q test for autocorrelation and a Jarque-Bera test for normality. Both tests accept the null hypothesis of no autocorrelation and normality, respectively.
Keeping with the literature we do not report the table of the estimated coefficients since they are of little interest, but we can report the contemporaneous correlation matrix of the residuals that could tell us something about the nature of the relationship among the variables.

Table A3 shows a negative correlation between the primary balance and all the other variables. Specifically there is a negative correlation with the GDP growth rate. The result is a consequence of the mathematical relationship which binds the two variables: since we have expressed the primary balance as percentage of GDP, when the latter increases the former decreases. However, besides the mere mathematical effect, this relationship is compatible with the idea that in case of a reduction in the GDP growth because of a crisis, the government has to increase its expenditure associated to the automatic stabilizers. What is interesting however is the fact that the primary balance seems to be quite sensitive to the contemporaneous changes in the GDP growth rate.
Then, as we might expected there is a positive correlation between the interest expenditure and the variation of the nominal interest rate, but it is not so significant. Even, the relation between the ΔBTP and the GDP growth rate, although positive, it is small. This means that the changes in the interest rate are associated with the state of the economy, i.e. when there is a positive (negative) variation in ΔBTP, the GDP growth is increasing (decreasing) that is what we expect, but the relationship has a low degree of sensitivity. This could be associated to the fact that some lags are necessary before the change has an impact on the real economy.
Finally, the correlation between ΔBTP and HICP is strongly positive meaning that a change in the interest rate has a not negligible impact on the inflation rate. This is the consistent with the application of the Taylor Rule[45] and the ECB monetary policy goals in maintaining the price stability: when inflation goes up, ECB applies a contractionary monetary policy and vice versa.

With the model coefficient estimations we can compute the forecasts of the variables of interest using a Monte Carlo simulation: we add to each quarter random shocks so that simulated paths of the variables in X_t are created. The simulation technique we adopted is a

[45] The Taylor Rule is expressed as follows: $i_t - i_s = \alpha(\pi_t - \pi^T) + \beta(y_t - y_e)$, where the i_s is the stabilizing interest rate, π_t is the actual inflation rate, π^T is the target inflation, y_t is the actual output level and y_e is the output equilibrium level. α and β reflect the Central Bank preferences about inflation and unemployment.

standard approach we can find in many stochastic debt analysis, like those performed by Garcia and Rigobon (2004) or Celasun et al. (2006). It simply consists on the creation of random vectors ξ_t, ξ_{t+1},…, ξ_T based on the Cholesky decomposition of the variance-covariance matrix of the residuals Ω which characterizes the joint statistical properties of the contemporaneous disturbances[46].

The forecast horizon is of 34 quarters ahead (from 2015:Q3 till 2023:Q4). Once the forecasts of the macroeconomic variables are produced, we can estimate the dynamics of the debt evolution through equation (2). The result is shown in Figure A2.

The graph depicts the multiple scenarios in which the Italian debt can evolve and thanks to the fan chart representation, we can evaluate even the overall risk surrounding the debt path. The solid black line inside the blue area represents the median forecast of the debt projection and it shows that that by the end of 2023 the Italian debt should converge to the 100 percent of GDP. During the period 2018-2019 we can see the debt trajectory slightly increases towards the 130 percent before starting again its declining path. This movement can be associated to the fact that during these years, the Italian government will have to repay its short term debt issued during the sovereign debt crisis[47].

However the "fan" of possible debt trajectories is quite wide: this can be perceived through the size of the confidence bands around the median projection (the areas coloured with different shades of blue). This means that debt results are highly uncertain depending on the mixture of shocks the system is affected by and that the debt sustainability is quite risky, despite we are dealing with a developed country[48].

Thus, the figure tells us that without a common debt instrument Italy should be able to manage the issue of a high level of debt in less than a decade, considering the median projection values. But the high uncertainty surrounding these forecasts induce us to be cautious. Nevertheless, what is clear it that the target of the 60 percent of GDP as required by the Stability and Growth pact is very hard to achieve, despite the contractionary policies approved in the last few years.

---

[46] We should be careful that in this context, where we are using the VAR only to produce the best predictor of our macroeconomic variables capturing a joint dynamics, the ordering of the variables in the VAR is irrelevant for the methodology applied, i.e. changing the sequence of the variables inside the vector Y_t does not affect the resulting forecasts. It would matter if we were interested in the causal relationship among the variables captured through the computation of the impulse responses. But at this stage we want to focus our attention only on the possible paths the Italian debt can have.

[47] It is empirical evidence that during period in which the long term cost of borrowing is too high, due to an increase in the country default risk, the maturity structure of debt is skewed towards the short term, since for investors short term debt instruments are less risky and thus they require a lower risk premium.

[48] As Penalver and Thwaites (2006) and Eller and Urvovà (2012) highlight, in general it is the emerging markets' debt sustainability to be riskier and more difficult to predict than that of developed countries. In fact, in emerging countries the macroeconomic variables affecting the debt dynamics present a higher degree of volatility.

Thus our questions is: with the presence of a Eurobond what would be the Italian debt evolution?

2.4 The Eurobond scenario

At the beginning of this section we stated that our goal was to compare the debt evolution between a situation without the presence of a Eurobond, like that presented in the previous subsection, and a scenario in which a common debt instrument is used. This comparison is useful in order to understand whether the application of such an instrument could be beneficial to EZ countries, in particular to those which are in financial distress. In fact, the common idea we easily find in literature and that we have widely discussed is that with such an instrument countries like Italy would be insulated from the contagion effects, which have been one of the main causes of the sovereign debt crisis, and would manage its debt without fear of market sentiment shift. The question is how much this insulation would be effective and above all how to construct this common debt instrument in a way that moral hazard is minimized. Answering to these questions is not so simple, as we have seen, since the causes of the global financial crisis and the subsequent sovereign debt crisis are many and correlated among them. So it is hard to quantify the benefits and the costs of something that does not exist and that should be introduced after the crisis has already broken up. As we know, Tielens et al. (2014) have tried to respond to this issue and even if their analysis in not comprehensive we will follow their approach. In other words we will perform a prospective analysis, i.e. we will try to assess what would happen if we introduced the instrument today and hypothetical shocks occur to the macroeconomic variables which affect the debt dynamics.

However, to perform this kind of comparison, it would be useful to construct a counterfactual model that is, constructing a VAR model which captures the effects of a hypothetical Eurobond for the countries under analysis as if this instrument had been introduced since the beginning of the history of EMU. It would enable us to perform a "what if" analysis and thus we would be able to answer to these questions: "how would have reacted the countries to the global financial and euro crisis if the common debt instrument had been implemented?" and "what would be the future perspectives under the counterfactual model?". However, creating such a counterfactual model is not so trivial. First of all, we would need to construct a proxy of the interest rate of the instrument. We could assume that this interest rate would be similar to that one of the German government bond, considering the interest rate convergence EZ countries have really experienced. But at the broke up of the crisis, how would have reacted this artificial interest rate to the market turbulences? It is hard to say. Thus, inserting the artificial interest rate into the VAR model and using the counterfactual model to simulate the behaviour of all the variables in (2) even for the period after the outset of the crisis, without knowing how to take into account the impact of this event on the hypothetical Eurobond interest rate, would be incorrect. Moreover, considering that the crisis have had an impact not only on the interest rate of some government bonds, but even on other non-fiscal variables, we think that the counterfactual VAR model would be subject to major structural changes on its parameters. This could produce biased estimations. Consequently, all these considerations deter us to put into practice this idea.

We know that the scheme of Eurobond adopted by the authors is the simplest one among those we have discussed and examined. In fact, the chosen design is the one in which the Eurobond is considered as a substitutive tool of the national government debt instruments with an interest rate that should be similar to that of the German bund. Even if, it is the weakest scheme considering the problem of moral hazard it carries with its implementation, if we assumed that the moral hazard issue could be prevented and managed imposing a series of constraints and strong controls, this substitution could be feasible at least in a situation in which there is not turmoil in the financial markets. Of course, nowadays this substitution could be considered a hazard from a political and economic perspective. But, if we go back to the beginning of the Euro era and we look at the interest rate movements of the 10 years government bonds of the European countries, the substitution can be considered quite reasonable. Why? Recall Figure 1: after the announcement of the introduction of a common currency the interest rate of the different government bonds started to converge to the German one and for the period 1998-2008 the spread between the bonds was close to zero. As explained by many authors, this result was a consequence of the fact that financial markets perceived the EZ government bonds as close substitutes.

Specifically, considering the case of Italy, we can focus our attention on the dynamics of the interest rate of the Italian BTP and of the German Bund (Figure A3).
As we can see, during the period 1998-2008 the two interest rates move very close to each other: this can be a first evidence, even if not strong enough, in favour of the experiment of substitution of the Italian BTP interest rate with the German Bund interest rate in the VAR model.

Tielens et al. (2014) in their work apply this substitution only exploiting the reasoning coming from the literature[49]. We do the same thing, but we add a little piece of evidence in the analysis to sustain this idea. In fact, while Tielens at al. (2014) are dealing with small economies, which are supposed not to influence the dynamics of the Eurobond interest rate, we are dealing with a large economy whose macroeconomic fundamentals, especially the fiscal ones, are supposed to have a not-negligible impact on the Eurobond rate. Impact which is captured through the presence of the fiscal variables inside the X_t vector. Consequently, the underlying meaning of this substitution is different and requires something more to be justified.

Thus, we run a simple OLS regression between the Italian BTP interest rate and the German Bund. We use the differenced series instead of the levels because in this way we can not only avoid the problem of unit roots and serial correlation when we compute the regression, but also we can better understand how much the quarterly changes in BTP are correlated to the quarterly changes in Bund. We expect that the correlation is positive and quite close to 1, at least in the subperiod 1998:Q1-2008:Q4.

In performing the regression we take 4 more observations than those we used when estimating the VAR model, so we can exploit a larger sample, given the availability of data for these time series[50].

Making a simple OLS regression in the form

$$\Delta BTP_t = \beta_0 + \beta_1 \Delta BUND_t + \varepsilon_t \qquad (5)$$

the results are presented in table A2.

As we can see the coefficient associated to $\Delta BUND_t$ is equal to 0.88 and it is statistically significant, meaning that the two series moved together during that period and that the variation of the Italian BTP can be almost completely explained by the variation in the German Bund.

Thus sustaining that, if the Eurobond had been introduced at the launch of the Euro it would have had the interest rate dynamics of the German Bund, it is not so unrealistic. One may argue that maybe the Eurobond interest rate would not have been exactly equal to the German Bund, but slightly higher, considering the country risk factors and the pooling of government debts. Nevertheless, we can think the German Bund interest rate as a kind of lower bound for

[49] We must remember the general idea presented in subsection 1.5 of this dissertation which can be summarized as follows: given the presence of the joint and general guarantees, financial markets would be induced to rate the Eurobond as a safe instrument whose interest rate would be very close to that of the German Bund.

[50] The fact we decide to enlarge the sample is associated to what we have pointed out in footnote 37.

our common debt instrument, i.e. the interest rate the Eurobond would have if the countries using it were perceived to share the same risks.

Of course, with the financial crisis things have changed and this correlation does not hold any more: running the same regression on the whole sample at our disposal shows us a reduction on the level of correlation and a positive evidence in favour of the hypothesis of structural break (the p-value in favour of the null hypothesis is equal to 0.7 percent-see Table A2). In fact performing a Chow test considering as break date the first quarter of 2009[51], the coefficient of the variation of the Bund rate for the subsample 2009Q1-2015Q2 is of opposite sign but quite similar in magnitude than the coefficient for the previous subsample. Specifically, it is equal to -0.81 and even in this case is statistically significant. This is a clear evidence of the reaction of the financial market to the sovereign debt crisis: Italian government bonds were not perceived as safe as before so investors decided to move to a safe harbour represented by the German Bund and a positive correlation is transformed into a negative one: when the Bund interest rate decreases because of a huge demand, the correlated BTP interest rate increases.

The results of the two regressions can be used to justify in a stronger way than Tielens at al. (2014) the tailoring of the VAR model with a simple switch in the interest rate variation entering (4) in order to construct this hypothetical Eurobond scenario. All the other variables remain the same. Despite one may object that the presence of the German rate influences the value of the other variables, we assume that, at least for the period before the crisis, the Italian public debt management has behaved as if it was issuing the German Bund. Thus the values of the time series involved would not have to change. However the problem may arise for the period during crisis: we are aware of this restraint of the model, but this is the best we can do[52].

The new model specification under the Eurobond scenario is construct as follows:

$$X_{EUt} = A_0 + A_1 X_{EUt-1} + A_2 X_{EUt-2} + A_3 X_{EUt-3} + A_4 X_{EUt-4} + \xi_{EUt} \qquad (6)$$

$$X_{EUt} = [g_t, \pi_t, \Delta BUND_t, int_t, pb_t]'$$

$$E(\xi_{EUt} \xi'_{EUt}) = \Omega_{EU}$$

$$\xi_{EUt} \sim N(0, \Omega_{EU})$$

[51] The choice of the break date is done looking at the economic events rather than using statistical tools.

[52] Despite the restraint, if we consider that the Italian public debt management, during the years of the sovereign debt crisis has tried to minimize the volatility of the interest rate in order to reduce the negative impact on the economy, it might be the case that the substitution is valid even during the crisis period.

Appling the same steps as before, we can first analyse the new correlation matrix between the residuals (see Table A4). The substitution of the ΔBTP with the $\Delta BUND$ does not affect too much the nature and the magnitude of the relationships. This can be considered as another element in favour of the assumption we use in order to justify the simple swap from the Italian interest rate to the German one in the vector of variables we use to compute the VAR.

Once the new VAR model is estimated and the new forecasts of the macroeconomic variables are produced, the debt accumulation equation under the Eurobond scenario gives us the results shown in the figure A4.

As before, we can see a steadily declining path of the Italian debt, but it is more evident than the no Eurobond scenario presented in the previous section. Here, we can clearly see that the median forecast converges towards a level close to the 85 percent of GDP. Thus, between the two scenarios at the end of the forecast period there is an estimated difference of 15 percentage points. If we isolate the median debt path in the two scenarios from the whole fan chart (Figure A5), the difference is clearly perceived. Thus, it seems that the presence of a Eurobond could help Italy in reducing its debt quickly. However, as in the no Eurobond scenario, the uncertainty surrounding the median projection is still very high and the target of the 60 percent debt-to-GDP is still far.

Looking at both fan charts we can see that the uncertainty surrounding the median projection increases at the end of the forecasting period. This a logical consequence of a forecast analysis: the longer the forecast period, the less precise the values are and consequently the higher the variability is. Thus, to see which of the two scenarios presents a lower degree of variability at the end of the projected time horizon and thus a lower degree of riskiness, we can compute the variance of the simulated debt projections for each quarters. What we find is that the variance associated to the baseline scenario at the end of 2023 is higher than that that we find for the Eurobond scenario. In some sense, it seems that despite the evident variability, the presence of the common debt instrument reduces the risk in the medium term, even if the difference is not so remarkable (see table C5 in the Appendix).

In order to have more clues about the possible future evolution of the debt under the two scenarios and to assess whether the Eurobond is useful, we make a further comparison. Among the 1000 scenarios we have created through the Monte Carlo simulation, for each quarter forecasted we single out the number of times that the debt reaches and overcomes a specific given threshold. Here, the idea is to compare the no Eurobond and the Eurobond scenario on specific debt level in a specified period in the future, in order to understand what is the probability to be above (or below) a certain value of debt. The underlying intuition is that with the common debt instrument, it should be less likely that the debt will take an explosive path and conversely it should be more likely to reach a more sustainable debt ratio. For example, we have said that at the end of the chosen forecast horizon, the median value for the Italian debt without the presence of Eurobond is around 100 percent of GDP while with the instrument it declines up to the 85 percent. But what is the probability that the debt is still at the 135 percent of GDP or even higher? Looking at the graph (Figure A6) we can say that the Italian debt has a probability of 20 percent to be higher than the 135 percent of GDP, while with the presence of the common debt instrument this probability declines to 7 percent. Thus, the risk that the Italian debt will be above this given threshold is strongly reduced in the Eurobond scenario, which in this case seems to be quite effective. We perform the same exercise for other selected threshold values of debt: 140, 150 and 160 percent of GDP, i.e. threshold values which can be associated to an explosive debt path. The results we find reassure us: the probability to reach these thresholds at the end of 2023 reduces significantly in both scenarios, but the difference is not negligible, i.e. the presence of the Eurobond is very helpful to strongly rule out the worst case scenarios.

Then, we run the opposite exercise: we choose the lowest values the debt can achieve in the simulated paths asking what the probability to be below the given threshold is. The chosen thresholds in this case are the 70, 80, 90 and 100 percent of GDP. Here, at the end of 2023, the probabilities are reverse: under the Eurobond scenario the probability to have a debt value below one of the selected threshold is higher than the no Eurobond scenario, but the probability to reach a low level of debt, say 70 percent of GDP, is rather small in both cases: 26 percent in the Eurobond scenario vs. 15 percent in the no Eurobond scenario. According to these results, it is highly likely for Italy to achieve a debt ratio between the 90 and the 100 percent of GDP. In fact even without the Eurobond, the probability to stay below the 100 percent threshold is close to the 50 percent.

These outcomes confirm our first impressions stemming from the analysis of the fan charts: reaching extreme values of the debt (in both directions) is not impossible but not even so likely. However, the presence of a Eurobond would bring about better results. Thus, in the light of these analysis, the Eurobond is worth even for a country like Italy.

2.5 Impulse response analysis

So far we have provided a stochastic evaluation of the Italian debt dynamics starting from the estimates of two distinct VAR models, computed for two different scenarios.

The main advantage of this technique is that the projections of the single macroeconomic variables entering (2) are based only on the variance-covariance matrix of the residuals without any kind of identifying assumptions or restrictions on the parameters. Moreover, defining the VAR model in such a way has allowed us to skip the research of a causal relationship among the variables, exploiting like this a higher degree of flexibility. Imposing ourselves to look for a causal relationship would be difficult given the economic environment in which we are working, where everything almost depends on everything, and the way in which the variables are bound together through eq. (2). However, the results obtained can be blamed to give us only a partial vision of the phenomenon under investigation.
What can be of interest at this point, even if it is not our primary objective, is trying to know more about the interactions between the variables our model relies on. Since we know for sure that there is correlation among the variables, we can try to construct what the response of one variable to an impulse/shock in another variable is, i.e. we can try to perform an impulse response analysis for our model. In this context, an impulse response analysis can give us some more specific clues not only about the nature of the relations between the variables but also on how these relations affect the debt dynamics. In fact, instead of having a mixture of contemporaneous random shocks, so that we cannot identify the original source but we can only see the final result, we can impose a single shock to a single variable and look at how all the other variables react. Moreover, with the shocked time series we can compute the impulse response of the debt accumulation and try to assess what the reaction of the Italian debt is under the two different scenarios. In other words, we should be able to obtain more information about the debt dynamics to better assess what the impact of the Eurobond is, i.e. verify how much the Eurobond is able to insulate the Italian debt from the effects of shocks which originate in the macroeconomic variables.

In its basic definition, the impulse response function measures the time profile of the effect of shocks at a given point in time on the (expected) future values of variables in a dynamic system. The traditional literature which presents impulse responses for dynamic model like ours uses the so called orthogonal impulse response functions, that is the impulse response is constructed "orthogonalizing" the variance-covariance matrix of residuals, so that it is possible to single out the effect of a given shock. For example, considering our specific case, we can be interested in singling out the effect of a shock associated to the interest rate or to the GDP growth rate in order to see how the debt reacts. But, since the residuals are correlated, we first need to transform them in a way in which they become contemporaneously uncorrelated. In general, the transformation applied to the variance-covariance matrix of the residuals is the Cholesky decomposition that imposes a recursive causal structure from the top variables to the bottom variables, but not the other way around. However, this methodology has one major drawback: it is sensitive to variables ordering, i.e. there are different Cholesky decompositions and consequently different impulse responses according to the sequence the variables have within the vector X_t. Thus, the results crucially depend on the imposed identification assumptions.

Now, the identification assumptions on the variables have to be done at priori, i.e. not on the basis of statistical methods but rather on the basis of ideas we may have about the nature of the relations, say for example we may think the GDP growth rate has a potential contemporaneous effect on all the other variables, while the HICP has an immediate impact on the other subsequent variables but not on the GDP growth rate and so on.

Since we do not want to impose a specific ordering to our five equations because we do not want to assume any at priori assumption that could not represent the real interactions, we do not perform the traditional impulse response function analysis based on the Cholesky decomposition. Instead, we apply the so called Generalized Impulse Response Functions (GIRF) as presented by Pesaran and Shin (1997) in their paper. Appling their approach to our two models we are able to produce impulse responses of the macroeconomic variables regardless their ordering.

The GIRF are defined as:

$$\boldsymbol{GI}_Y(n, \delta_j, \boldsymbol{\Omega}_{t-1}) = E(X_{t+n} \mid \varepsilon_{jt} = \delta_j, \boldsymbol{\Omega}_{t-1}) - E(X_{t+n} \mid \boldsymbol{\Omega}_{t-1}) \qquad (7)$$

where n is the time horizon

δ_j is the shock that hit the *j*th equation at time *t*

$\boldsymbol{\Omega}_{t-1}$ is the historical non-decreasing information set

The above expression means that we choose to shock one element of the model, say the *j*th element, and integrate out the effects of other shocks using assumed or historically observed distribution of error[53]. In a nutshell, the GIRF is equal to the difference between projections with and without an initial shock of size equal to one standard deviation[54].

Thus, through the estimated VAR models in the two scenarios, we compute the forecasts of the variables within X_t and X_{EUt} with and without shocks, where the shocks are generated starting from the estimated variance-covariance matrix of the residuals Ω. The generalized

[53] For further details on how to compute the GIRF see Koop, Pesaran and Potter (1996) and Pesaran and Shin (1997).

[54] Setting $\delta_j = \sqrt{\sigma_{jj}}$ the scaled GIRF is given by $\psi_j(n) = \sigma_{jj}^{-\frac{1}{2}} \boldsymbol{A}_n \Sigma \boldsymbol{e}_j$, $n = 0,1,2$ ... It measures the effect of one standard error shock to the *j*th equation at time *t* on expected values of Y at time *t*+*n*.

impulse responses of the macroeconomic variables are computed as the difference between projections with and without shocks. Since we impose shocks to each single variable at time, we obtain multiple impulse responses according to which variable has been shocked. For example, if we impose a shock of a standard deviation increase to the GDP growth rate variable we will obtain the impulse response of itself and of the HICP, the variation of the nominal interest rate, the interest expenditure and the primary balance under the effect of this shock. Instead, if we impose a shock of a standard deviation increase to the HICP variable we will obtain the impulse response of itself and of the GDP growth rate, the variation of the nominal interest rate, the interest expenditure and the primary balance under the effect of this new shock and so on. Thus, the idea is to construct the impulse responses for the two different scenarios and then we can compare them in order to understand how the variables react to a shock of the same size. For example we might be interested in the reaction of the variables to a one standard deviation increase on the variation of the interest rate.

The results we obtain are those shown in figure A8. What we see seems to be consistent with the economic theory: the GDP growth rate and the inflation rate decrease, while the variation of the interest rate and the primary balance increase, before they come back to initial position when the shock dies out. However, we can see that a quite odd behaviour is held by the impulse response of the interest expenditure. This could be explained with the seasonal nature of this variable, but it might not be a sufficient explanation. Moreover, the shock presents a certain degree of persistency. In fact it seems that it takes more than 35 quarters before it dies out. The outcome can be a signal that our model is not as robust as we have expected. This does not mean that the VAR models as we have constructed them are not useful. It only means that, we must be cautious when we interpret the outcomes, especially when they seems to sustain our hypothesis. Thus, it is with this caveat in mind that we compute the impulse response functions of debt in the two scenarios. Nevertheless, we can see that there is not so much difference between the response variable paths in the two scenarios. This is an element that can be interpreted as the result of the fact that the magnitude of shock to ΔBTP or $\Delta BUND$ is quite similar.

The debt impulse response functions have been constructed as follows: using the macroeconomic variable forecasts with and without shocks as they are obtained from the VAR models, we compute the debt using (2). Then we take the difference between the debt path, as resulted from shocked variables, and the debt path computed using the variables not affected by shocks. Since we create five different shocks, one for each variable of our model, the results are five different debt impulse responses, each of which is associated to the

specific shock we are analysing. This analysis can be useful to sustain or not our idea that the presence of a common debt instrument can insulate better countries like Italy with respect to particular shocks. The results are shown in Figure A9.
As it can be expected when there is an increase of one standard deviation in the GDP growth rate and on the HICP, the value of debt decreases both in the no Eurobond scenario and in the Eurobond scenario. However, the reduction in debt is higher in the baseline scenario, where debt records a fall of 7 percentage points in about 5 years. A similar story can be told looking at the debt impulse response to a HICP shock. Again, the no Eurobond scenario seems leading to a major reduction in debt than the Eurobond scenario. This result can be interpreted as follows: given the presence of the common debt instrument, both positive and negative shocks are smoothed and have a lower impact on the value of debt. This means that the Eurobond helps to contain the risk associated to changes in the GDP growth rate and HICP, making the debt ratio less vulnerable to sudden shocks. This is especially important if these changes are negative, like in case of a crisis.
When we consider the shock to the primary balance (i.e. an increase of one standard deviation in the primary deficit) as we might expect the debt increases, but in this case the presence of the Eurobond helps to curb this surge: in fact without the Eurobond the debt increases up to 2 percentage point more than the situation in which the common debt instrument is present[55]. A positive effect can be perceived even when we trace a shock on the variation of the nominal interest rate and interest expenditure. However the difference between the two scenarios is not so strong when is the ΔBTP or the $\Delta BUND$ to be shocked. This can be an evidence of the fact that the rate substitution does not affect too much the estimates of the model and consequently the reaction of debt to this kind of shock is quite similar. Instead, when it is the interest expenditure to receive a shock of one standard deviation increase, the debt increases but the difference between the scenario with and without the Eurobond is quite remarkable: the debt of the baseline scenario can grow up to 2 percentage points more than the Eurobond scenario. Thus, we see that when there is a direct shock on this fiscal variable, the Italian debt dynamics seems to be insulated from the negative impact coming from the sudden increase of the interest expenditure.

Consequently, it seems that the Eurobond helps to protect the Italian debt from shocks that originate from the macroeconomic variables underlying the debt dynamics. Nevertheless, as

[55] Given this result is might be the case that if implemented the Eurobond would induce a moral hazard behaviour in the countries not fiscally sound yet. Thus, it would be relevant to impose strict rules in the management of the fiscal policy, otherwise the expected benefits stemming from the Eurobond would be weakened.

in the case of the single variable we can see a certain degree of persistency of the shocks. But, even though in this case, the persistency could be explained through the fact the impulse response functions of debt are the result of the sum of all the cross effects, the overall impulse response analysis, where it appears that the degree of insulation stemming from the Eurobond is not so high, induce us to be more cautious about the actual usefulness of the common debt instrument.

Consequently, if on one side the forecasts seems to be reliable enough, we cannot turn a blind eye on the piece of information coming from this part of the analysis. The risk hedging role of the Eurobond is in some sense reduced, but it is not completely eliminated. Thus, with these results, we cannot say the Eurobond is ineffective.

3 Extension

In this section we repeat the same exercise we have done in section two for the other two big countries belonging to the EZ: France and Spain.

From an economical point of view France is much more similar to Germany, but in the last few years its economy has suffered more than the German one and it seems stuck in a stagnation period. In fact the recovery is slower than expected, the unemployment rate is quite high and the French government is blamed not to do enough to tackle the problem. As regards its fiscal position, at the end of 2015 officials have recorded a deficit-to-GDP at the 3.8 percent, even if it is expected to decline in the following years, and a debt-to-GDP ratio below but close the 100 percent level[56]. In September 2012, France received a downgrading from the rating agencies which considered the country no more as safe as before. The loss of the triple A has had a negative impact on the cost of borrowing, at least up to the moment in which the ECB has put in place the quantitative easing program.

Instead, Spain has dealt with the crisis in a completely different way than France: in fact after the big crash in economic growth because of the financial crisis and the subsequent increase in the unemployment rate up to a level of 26.1 percent in 2013, Spain has taken several reforms to enhance competitiveness, improve labour market regulations and contain public expenditure. This has given the country the possibility to overcome the economic crisis and regain trust and credit worthiness in the financial markets: if we look at the 10 years government bond yield, it was 1.77 percent in the second quarter of 2015. Of course part of the merit is attributable to the action of the ECB and its QE policy, but it is undoubted that the Spanish's growth performance of the last months are better than any other country of the EZ. The unemployment rate is still very high compared to the other countries but on a declining pace. Thus compared to Italy and France, Spain is recovering faster and the good results in economic growth can help the Spanish government to manage better its fiscal situation, where the debt-to-GDP ratio is similar to the French one but the deficit-to-GDP ratio is 0.7 percentage higher (4.3 percent at the end of 2015)[57].

Thus, considering the data at our disposal the debt-to-GDP level has become a burden for these countries even if none of them shares a debt-to-GDP ratio comparable to that of Italy,

[56] Since 2009 France is under the Excessive Deficit Procedure. According to France's 2015 Stability Program, the country should correct the excessive deficit by 2017 and its debt ratio is projected at 96.9 percent of GDP by the end of the same year.

[57] As France, even Spain is under the Excessive Deficit Procedure since 2009. According to its 2015 Stability Program the deficit should be corrected by 2016 and the debt ratio is projected to reach the 101.4 percent of GDP by the end of the year.

Greece excluded. Consequently even for France and Spain, it is worth assessing what the future debt evolution could be with or without the Eurobond.

3.1 The French case

We define the vector of endogenous variables for France in the two scenarios as follows:

- $X(France)_t = [g_t, \pi_t, \Delta OAT_t, int_t, pb_t]'$ for the no Eurobond scenario, where ΔOAT_t represents the interest rate variation of the French ten years government bond;
- $X(France)_{EUt} = [g_t, \pi_t, \Delta BUND_t, int_t, pb_t]'$ for the Eurobond scenario.

The substitution between the French and the German interest rate, in this case can be sustained in a stronger way than the Italian situation (see Figure B1), since the correlation between the variation of the two interest rates is higher both in the pre-crisis period subsample (1998:1-2008:4) and in the whole sample (1998:Q1-2015:Q2) at our disposal. In fact the correlation in the subsample is very close to 1 (the coefficient of $\Delta BUND_t$ is equal to 0.96 and it is statistically significant)[58], meaning that the variation in the French yield is almost completely explained by the variation in the German one (see Table B1). While in the whole sample period it only slightly declines, since that the $\Delta BUND_t$ coefficient is equal to 0.91. These results induce us to believe that the French OAT and the German Bund were considered something more than simple close substitutes, but rather quasi-perfect substitutes, even during the market unrest, due to the financial and sovereign debt crisis. Moreover the absence of structural break at the same chosen break date for the Italian data (the first quarter of 2009), but even for subsequent dates, deters us to say that financial markets have lost confidence in France as they did for Italy and even Spain, despite the downgrading. Specifically, for the break date 2009:Q1 the Chow test accepts the null hypothesis of no structural break with a p-value of 16.72 percent. There is a possible sign of structural break when the break date is on the first quarter of 2012, that corresponds to the moment in which Standard & Poor's officially downgrades France from triple A to AA+, but the division of the sample does not allow us to consider reliable this result, since the second time period has not enough observations compared to the first one. Consequently the OLS regression results lead us to claim that even the French government bond has been considered a sort of safe harbour during the crisis.

---

[58] We use the following OLS regression model: $\Delta OAT_t = \beta_0 + \beta_1 \Delta BUND_t + \varepsilon_t$.

Before setting up the usual VAR model specification, a brief analysis of the macroeconomic variables is required (see Figure B2). First of all we are obliged to reduce the sample period of our analysis because of lack of availability data related to the French primary balance time series. The French sample starts in 2002:Q1 instead of 1999:Q1. Nevertheless, this reduction in observations does not weaken our exercise.
Second, the path of the GDP growth rate and of the inflation rate is equal to that one of Italy, even if the scale changes when we look at the graph of the GDP growth rate: the Italian growth rate reaches a negative peak of -7.2 percent in 2009:1 compared to the same quarter of the previous year, while France in the same period halts its decline to a -4 percent. Given the paths of these time series even in this case, we decide to perform and ADF test with structural breaks to detect the presence of possible unit root. The results are in favour of the alternative both for the GDP growth rate and for the HICP (see Table B2).
Finally, the interest rate expenditure and the primary balance as for the Italian case present element of seasonality. So we perform a seasonally adjustment before these variables enter into the VAR model.
When we perform the lag length selection, the AIC criterion suggests to choose 3 lags instead of 4. Once the models for the two different scenarios have been estimated and the usual tests on residuals have been run, we briefly look at the correlation matrixes (see Tables B3-B4).

As in the Italian case the substitution between the French interest rate and the German one does not affect the nature and the magnitude of the relation among the variables. However, there are some differences between the two countries that might be worth highlighting. For example the relationship between the variation in the interest rate (in both scenarios) and the GDP growth rate is positive, but more significant than the Italian case. This is a sign that French economy reacts more to the contemporaneous variations of the interest rate. Instead the correlation between the primary balance and the GDP growth rate, although negative, as we expect, has a difference in magnitude with respect to the Italian correlation matrixes of residuals: -0.1242 vs -0.4609 in the no Eurobond scenario; -0.1296 vs -0.4204 in the Eurobond scenario. This not negligible difference tells us that the Italian primary balance is more sensitive than the French one to contemporaneous changes in GDP growth rate. As regards the relationship between the interest expenditure and the variation of the interest rate, the results shows us that in the no Eurobond scenario the correlation is almost equal to zero, while in the Eurobond scenario is positive and its value is close to the Italian ones. In the first case, the absence of correlation means that the interest expenditure reacts with some lags to these changes. Finally, even for France, as for Italy, the correlation between the $\Delta OAT_t/\Delta BUND_t$ and the HICP is positive and particularly significant.

Plotting the fan charts for the debt evolution of France (Figures B3:B5) the results show a median path that converges around the 95 percent of GDP in the no Eurobond scenario and around the 83 percent of GDP in the Eurobond scenario. As we can see, between the two scenarios the divergence in percentage values of the debt ratio is almost similar to the Italian case, but with a major difference: without the common debt instrument Italy is able to consistently reduce its debt ratio, while France continues to fluctuate around the actual value, without significant improvements. According to our estimates, France requires the presence of the common debt instrument to see a substantial reduction. This can be interpreted as a sign that the Italian fiscal policies, implemented after the years of the crisis, are going to be effective[59]. During the years 2018-2019, France sees its debt-to-GDP ratio moving back to the ending values of the historical data sample[60]. Once again the explanation we give is associated to an increase in interest payment, due to the expiration of the short term debt instruments issued by the government during the crisis period. Finally the uncertainty around the median projections is more or less the same that we have found for Italy. Thus, even in this case the sustainability of debt is rather risky, even if the Eurobond case seems reducing the variability (see Table C5).

Then, in order to have a better picture of what could be the future debt evolution, we compute the probabilities that a certain given threshold is reached at the end of the forecasted period (Figures B6-B7). When we choose the highest value the French debt can reach, we do not use the same thresholds employed in the Italian case, since the starting point of French debt position is different. So, we think that the probability to reach, say 160 percent of GDP, should be very close to zero. Thus, the selected threshold are the following: the 95, 120, 130 and 140 percent of GDP. The probability that the debt-to-GDP ratio stays close or above the 95 percent is quite high in both scenarios: 50 percent in the no Eurobond case vs. the 36 percent in the Eurobond scenario. Although the 130 and 140 percent can be seen as very extreme value for a country like France, the results tell us that we cannot exclude at priori the possibility to reach these values, at least for the 130 percent threshold. In fact, the probability

[59] Although we are not imposing any kind of parameter restriction on the primary balance variable, the data included in the VAR model are the result of the recent fiscal adjustments put in place by the Italian government. This means that we are able to take into account their effects on the other variables and consequently on the debt dynamics.

[60] The debt-to-GDP ratio in 2015:2 is equal to 97.7 percent.

to achieve this debt ratio is equal to the 19 percent no Eurobond vs. 9 percent Eurobond scenario. Instead it is less likely France will reach the 140 percent threshold since the probabilities associated to this debt ratio are 13 percent for the no Eurobond scenario vs. the 5 percent in Eurobond scenario. In any case, without the presence of the Eurobond we cannot completely rule out the possibility that the worst case scenarios will occur.

As regards the inverse exercise, i.e. looking at what is the probability to be below a given threshold, we maintain the same values we have selected for Italy. The results are the following: the probabilities to be below the 100 percent of GDP is equal to the 54 percent in the no Eurobond scenario and to the 69 percent in the Eurobond scenario. Even in this case, as for Italy, the presence of the common debt instrument helps to achieve a better debt ratio within the same time period. But even for France reaching the lowest threshold, the 70 percent of debt-to-GDP is rather difficult. In fact the probabilities associated to this case are equal to the 22 percent in the no Eurobond scenario and 35 percent in the Eurobond scenario.

Finally, we look at the generalized impulse response functions about the reactions of debt-to-GDP to different shocks[61] originating in a single variables (Figure B8). Here, we see there is not so much difference between the two scenarios when the shock originates in the GDP growth rate or in the HICP. The reaction is consistent with what we expect from an increase in GDP growth and HICP, i.e. the debt-to-GDP ratio tend to decline. However, the GDP growth shock does not affect too much the debt dynamics compared to the shock that originates in the HICP, because after three quarters the debt ratio starts to rise again. Thus, it seems that the GDP growth rate is not as permanent as the HICP shock, which instead leads the debt ratio to steadily reduce its value up to 4 percentage points.

Instead, when the shock originates in the variation of the interest rate, we expect an increase in the level of debt, hoping that the presence of the Eurobond curbs this increase. We first see a reduction and only after few quarters the ratio starts to increase. This could be interpreted as the fact the French debt reacts with some lags to the changes in the interest rate exactly as the economic reality suggests. However, under the Eurobond scenario the debt reacts more than a situation without the common debt instrument. Thus, it seems that in this case the Eurobond does not bring about the expected benefits, even if the difference between the two scenarios is not so high: no more than a 1 percentage point, as if the French debt would be not affected by the changes in the interest rate.

[61] The shocks created have to be considered equal to one standard deviation increase.

As regard the shock in the interest expenditure, here the result tells us that the Eurobond works for this kind of changes, at least in the long run. But, once again the difference between the two scenarios is not so remarkable.
Finally, looking at the debt dynamics when a shock to the primary balance occurs, we can see that the movement is opposite of what we have found in the Italian case: in fact, in both scenarios the debt decreases. This could be considered counterintuitive in light of the previous analysis, but indeed it tells us that the macroeconomic framework of the two countries is rather different. In particular, the response of debt to a primary balance shock, i.e. to an increase in the primary balance deficit, tells us that the expansionary fiscal policy in France leads to a boost of the GDP growth rate, which more than compensates the deficit produced by the government. Consequently, there is not a negative impact on debt (it does not increases but actually decreases of few percentage points), like in the Italian case, where instead an expansionary policy turns out to be ineffective and leads to a worsening of the debt dynamics.
Thus, the fundamental difference would stand in the sign of fiscal multipliers of the two countries. However, even if this response gives us further information about the structure of the French economy, the difference between the baseline and the Eurobond scenario is still not so evident.

Consequently, we find ourselves in the same situation we had for the Italian case: the forecast analysis tells us that the introduction of the Eurobond would be very useful. But given the small hedging effects provided against given shocks, this induces us to say that its effectiveness is somehow limited. However, in any case we can claim the Eurobond is completely useless.

Nevertheless, what is clear from the graphs is that France is required to put stronger effort to strengthen its fiscal position, because considering the actual values of its GDP growth and inflation it will be hard to achieve a good debt ratio without acting on this variable. In some sense, even if the French debt level is lower than the Italian one, France is struggling more or less with the same problems that Italy is facing. The presence of the Eurobond could be of help, but given the results obtained from the generalized impulse response functions in both countries, this instrument cannot work alone, i.e. it requires countries put in place a fiscal consolidation.

3.2 The Spanish case

Finally we conclude our analysis looking at Spain. We define the vector of endogenous variables for Spain using the variation of the 10 years government Spanish bond, $\Delta BONOS_t$. Thus:

- $X(Spain)_t = [g_t, \pi_t, \Delta BONOS_t, int_t, pb_t]'$ for the no Eurobond scenario;
- $X(Spain)_{EUt} = [g_t, \pi_t, \Delta BUND_t, int_t, pb_t]'$ for the Eurobond scenario.

Even in this case, in order to support the idea of substitution between the interest rates in the VAR model, we run the regression of the first difference of the Spanish Bonos on the German Bund for the period 1998:1-2008:4 and for the whole sample[62].

Looking at the coefficient of $\Delta BUND_t$ (see Table C1), the correlation for the subsample is very close to that found between France and Germany, rather than that between Italy and Germany: in fact it is equal to 0.94 vs. 0.88 of the Italian case. This result gives us not only the confirmation of the fact that even the variation of the Spanish government bond yield is almost completely explained by that of the German yield, but also that the co-movement between the two series is slightly better than the Italian case (see Figure C1), at least during the pre-crisis period. Thus we can say that between Spain and Italy, it is the former that has benefited more from the "close-substitute perception" the financial markets had during the first decade of the euro era.

However, differently from the French case but similarly to the Italian situation, we detect the presence of a structural break on the first quarter of 2009. In fact running the regression for the whole sample period (1998:1-2015:2) considering the structural break, the coefficient of $\Delta BUND_t$, from positive becomes negative: precisely, from 0.94 it passes to -0.75. This is exactly as in the Italian case: the Spanish government bond loses its appeal in favour of the safe heaven represented by the German Bund when the financial crisis breaks up and all the EZ imbalances come under attention of the financial markets.

We can now move to the usual time series analysis of our macroeconomic variables, before running the VAR analysis.

Looking at the graphs plotted in Figure C2, we can see how the paths of the GDP growth rate and of the HICP are quite similar to those already described for Italy and France: a huge decrease during the years of the financial crisis (2008-2009), a brief period of recovery (2010)

---

[62] For the Spanish case the OLS regression model is: $\Delta BONOS_t = \beta_0 + \beta_1 \Delta BUND_t + \varepsilon_t$

and then again a downturn associated to the sovereign debt crisis (2011-2013). But focusing our attention on the last observations of the GDP growth rate time series, we can see how Spain is overcoming the strong downturns better than France and Italy.
However, an odd behaviour is held by the interest rate expenditure. In fact it is rather different from the interest expenditure time series we have plotted for Italy and France. In these latter countries, the seasonal effects can be seen throughout the time window under investigation, while here, they are concentrated only during the years of the financial crisis. This is explained with a sudden change in the public debt management because of the financial and sovereign debt crisis which has led the country to ask the ESM fund for economic help[63]. In fact, these events have induced the country to issue short term instrument with a maturity between 2 and 10 months, so that the government has had to face a not negligible interest expenditure.

Thus, we proceed in the usual way: so first we perform the ADF test. Once again, for the GDP growth rate and the HICP we run the ADF test which takes into account the possibility of structural breaks, while for the other two series we conduct the traditional test, after we have done the seasonally adjustment. The results in this case (see Table C2) tells us that the interest rate expenditure is I(1). But, considering the method we have used to adjust the series and that the ADF test is very sensitive, i.e. it tends to accept the null hypothesis even in presence of near unit root, we decide to run the VAR model[64] anyway before throwing it away. Luckily, despite our concerns the model set up turns out to be stable.
Thus, we look at the correlation matrixes of the residuals (Tables C3-C4). They show us that the substitution does not imply significant changes on the nature and magnitude of the relationships among the variables. For example, the correlation between $\Delta BONOS$ and the interest expenditure is quite close to zero in the no Eurobond scenario, and even in the alternative scenario, the correlation between $\Delta BUND$ and the interest expenditure is not so significant. This means that the interest expenditure does not directly depends on the contemporaneous variation of the interest rate. We find a same behaviour, even if with opposite sign, looking at the correlation between the primary balance and the GDP growth rate. In fact in the former scenario the two variables are not contemporaneously correlated, while in the second one it slightly increases in magnitude, but it is still not so remarkable. As regards the relationship between the variation in the interest rate and the GDP growth rate the

[63] On 31 December 2013, the ESM financial assistance program for Spain expired. The ESM disbursed a total of €41.3 billion to the Spanish government for the recapitalization of the country's banking sector. For further information see http://www.esm.europa.eu/assistance/spain/
[64] Here the AIC criterion used in the lag length selection indicates to use a VAR (4).

variables seems not so correlated. The only remarkable correlation is once again that between the variation of the interest rate and the HICP, meaning that the HICP almost immediately reacts to monetary policy changes. Nevertheless, the fact that the contemporaneous correlation among the variables are not so significant is a sign that they tend to react with some lags and this consistent with the economic theory.

With the estimates of the VAR model we compute the forecasts under the 1000 simulated scenarios. The Spanish debt evolution in the two scenarios is depicted in figures C2:C4. The median projection of the debt ratio in the fan charts tell us that at the end of the forecast period, Spain would have the possibility to reach a debt-to-GDP ratio close to 60 percent under the no Eurobond scenario and even of the 50 percent with the presence of the common debt instrument. In our opinion, these are overoptimistic predictions even considering a steadily increasing pace of the GDP growth, a quite low interest expenditure thanks to the QE program and future consistent structural primary balance surpluses. Moreover the fan chart confidence bands around the median projections are larger than those we have seen for Italy and France. This means that the variability and thus the riskiness associated to the Spanish projections are higher than those of the other two countries, despite under the Eurobond scenario this variability is a little bit reduced (see Table C5), sign that the common debt instrument brings about some benefits.

Nevertheless, we are very dubious about the precision of the results. In fact, when we compute the probabilities of the Spanish debt ratio to be above or below a given threshold (Figures C8-C9), we can see that the probability to be below the 90 percent is higher than the probability to be below the 60 percent in both scenarios. In fact under the baseline scenario there is the 51 percent chance for the debt ratio to be equal or below the 60 percent threshold vs. the 74 percent to achieve the 90 percent or smaller values. The Eurobond scenario is slightly better, in the sense that the probability to converge towards levels below the 90 percent threshold is equal to the 80 percent, while the 60 percent threshold has a probability to be reached of 58 percent. Thus, these results tells us something different from the fan charts and revise upwards the projections. In other words, if the fan charts can be misleading, the probability analysis restore our confidence in the analysis and induces us to believe that it will be more likely for Spain to reach a debt ratio between the 80 and the 90 percent, rather than values lower the 70 percent. In any case, it will be quite unlikely (even if not completely impossible) that the Spanish debt will explode at the end of the forecast period. In fact the probabilities associated to the extreme higher threshold are rather low in both scenarios.

The conclusive analysis we do in order to assess whether the Eurobond is worth even for Spain is computing the generalized impulse response functions for debt.

Here, we can see that the presence of the Eurobond is quite effective in insulating the debt form the one standard deviation increase in the variation of the nominal interest rate. In fact without the common debt instrument the debt ratio would increase up to six percentage point more than the situation in which there is the Eurobond. When we impose a one standard deviation increase shock on the primary balance the behaviour held by the debt dynamics is similar to that one described in the French case because there is a decreasing debt path. Thus it is seems that among the three countries under analysis, an expansionary fiscal policy would be of held especially for France and Spain, rather than for Italy and this might be a consequence of the structural macroeconomic environment characterizing the three countries.

However, when we impose a one standard deviation increase shock on the interest expenditure the behaviour held by the debt dynamics is counterintuitive because instead of increasing it decreases, even up to 4 percentage point in presence of Eurobond. This is the only case in which the impulse response function moves in a way that is not consistent with our knowledge. Maybe, on this point further analysis would be useful.

As regards the response of debt to the GDP growth rate shock, it is exactly the same in the two scenarios, while the reaction against a shock on the HICP shows that the debt under the Eurobond scenario reacts more than the situation in which the common debt instrument is absent.

In light of our analysis, the Eurobond can help for sure to substantially reduce the debt level in the medium long run, but also it can help to insulate from shocks that originate from the macroeconomic variables affecting the debt dynamics, although its presence seems not to be so crucial. Thus, the general impulse response functions analysis do not support in a strong way the results coming from the forecast analysis and this leads us to be cautious about the real hedging effects stemming from the common debt instrument, especially in the Spanish case, where even the fan charts cannot consider as reliable as in the other two cases.

Appendix A

Figure A1: Time Series Graphs

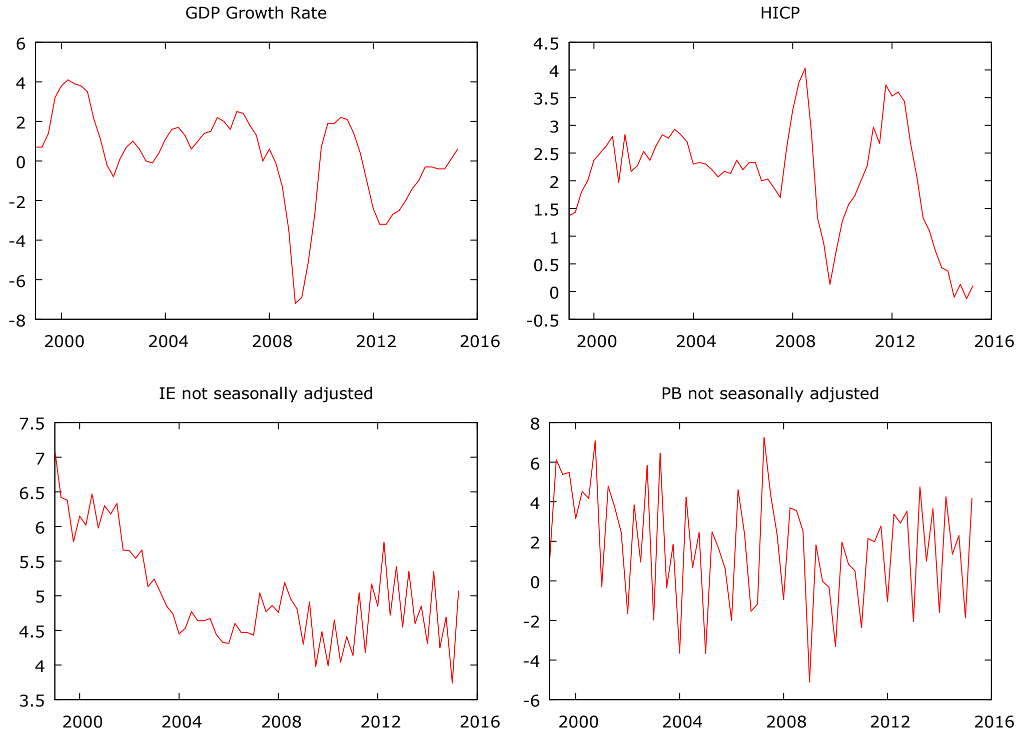


Table A1: ADF Test Results of the Italian macroeconomic time series

UR Test with structural break for series: GDP Growth Rate sample range: [2000 Q3, 2015 Q2], T = 60 number of lags (1st diff): 5 used break date: 2009 Q1 shift function: shift dummy critical values 1% 5% 10% -3.48 -2.88 -2.58 value of test statistic: -5.0609	**UR Test with structural break for series: HICP** sample range: [2000 Q4, 2015 Q2], T = 59 number of lags (1st diff): 6 used break date: 2009 Q1 shift function: shift dummy critical values 1% 5% 10% -3.48 -2.88 -2.58 value of test statistic: -3.0375
ADF Test for series: Interest Expenditure sample range: [1999 Q2, 2015 Q2], T = 65 lagged differences: 1 intercept, no time trend asymptotic critical values 1% 5% 10% -3.43 -2.86 -2.57 value of test statistic: -4.0386	**ADF Test for series: PB** sample range: [1999 Q2, 2015 Q2], T = 65 lagged differences: 1 intercept, no time trend asymptotic critical values 1% 5% 10% -3.43 -2.86 -2.57 value of test statistic: -8.8284
ADF Test for series: BTP sample range: [2000 Q1, 2015 Q2], T = 62 lagged differences: 3 intercept, no time trend asymptotic critical values 1% 5% 10% -3.43 -2.86 -2.57 value of test statistic: -2.3565	

Table A2: OLS Regression Results for the Italian case

```
Model 1: OLS, using observations 1998:2-2008:4 (T = 43)
Dependent variable: d_BTP

          coefficient   std. error   t-ratio    p-value        [95% Confidence Interval]
-----------------------------------------------------------------------------------------
const      0.0149651    0.0143487     1.043    0.3031         -0.0140127    0.0439430
d_BUND     0.882333     0.0478143    18.45     1.81e-021 ***   0.785770     0.978896

Mean dependent var  -0.015814   S.D. dependent var   0.281664
Sum squared resid    0.358072   S.E. of regression   0.093453
R-squared            0.892537   Adjusted R-squared   0.889916

LM test for autocorrelation up to order 20
Null hypothesis: no autocorrelation
Test statistic: LMF = 0.785418
with p-value = P(F(20, 21) > 0.785418) = 0.703755


Model 2: OLS, using observations 1998:2-2015:2 (T = 69)
Dependent variable: d_BTP

          coefficient   std. error   t-ratio   p-value        [95% Confidence Interval]
  ---------------------------------------------------------------------------------------
const      -0.0124808    0.0391947    -0.3184   0.7511         -0.0907138    0.0657522
d_BUND      0.596191     0.128608      4.636    1.70e-05 ***    0.339489     0.852893

Mean dependent var  -0.051449   S.D. dependent var   0.362760
Sum squared resid    6.775300   S.E. of regression   0.318000
R-squared            0.242853   Adjusted R-squared   0.231552

LM test for autocorrelation up to order 20
  Null hypothesis: no autocorrelation
  Test statistic: LMF = 1.07407
  with p-value = P(F(20, 47) > 1.07407) = 0.405333

Chow test for structural break at observation 2009:1
  Null hypothesis: no structural break
  Test statistic: F(2, 65) = 5.33972
  with p-value = P(F(2, 65) > 5.33972) = 0.00712695

Augmented regression for Chow test
OLS, using observations 1998:2-2015:2 (T = 69)
Dependent variable: d_BTP

              coefficient   std. error   t-ratio   p-value
  ---------------------------------------------------------
  const        0.0149651    0.0459405     0.3258   0.7457
  d_BUND       0.882333     0.153087      5.764    2.46e-07 ***
  splitdum    -0.117384     0.0781171    -1.503    0.1378
  sd_d_BUND   -0.813525     0.253684     -3.207    0.0021   ***


Mean dependent var  -0.051449   S.D. dependent var   0.362760
Sum squared resid    5.819210   S.E. of regression   0.299209
R-squared            0.349697   Adjusted R-squared   0.319683
```

Table A3: Correlation Matrix of Residuals_No Eurobond scenario

	GDP Growth	HICP	ΔBTP	IE	PB
GDP Growth	1				
HICP	0.3210	1			
ΔBTP	0.0816	0.4078	1		
IE	0.0182	0.3612	0.1224	1	
PB	-0.4609	-0.1034	-0.0139	-0.1039	1

Table A4: Correlation Matrix of the residuals_Eurobond Scenario

	GDP Growth	HICP	ΔBUND	IE	PB
GDP Growth	1				
HICP	0.3434	1			
ΔBUND	0.1413	0.3017	1		
IE	0.0749	0.4098	0.1709	1	
PB	-0.4204	-0.2170	-0.0536	-0.2576	1

Figure A2: Italian Debt-to GDP evolution under the no Eurobond scenario

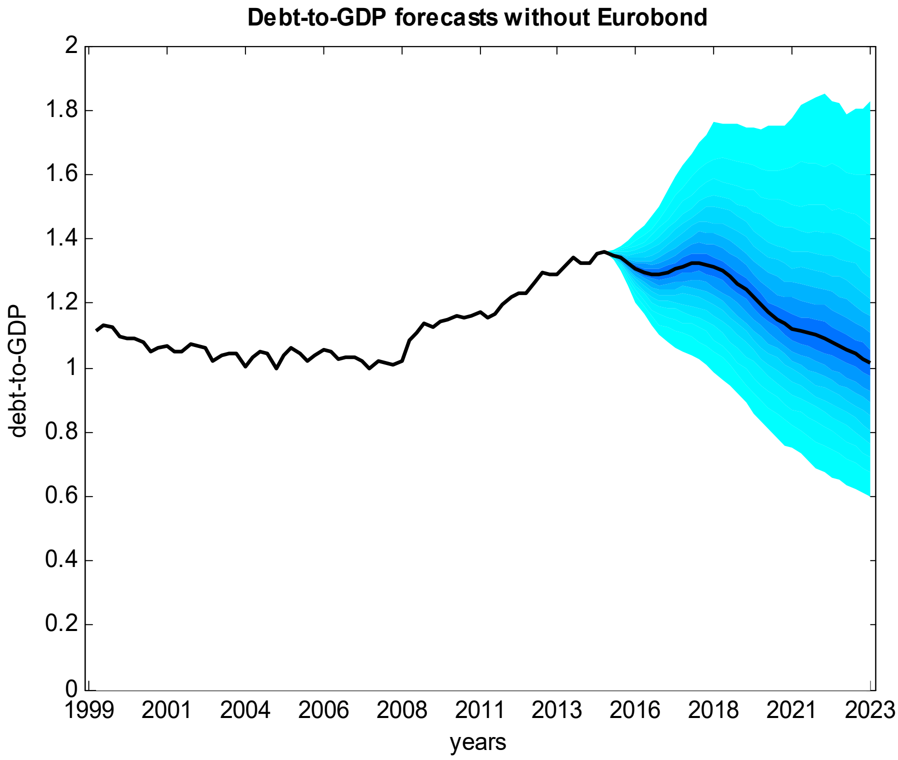


Figure A3: Long Term Interest Rate: 10 years BTP vs 10 years BUND

Figure A4: Italian Debt-to-GDP evolution under the Eurobond scenario

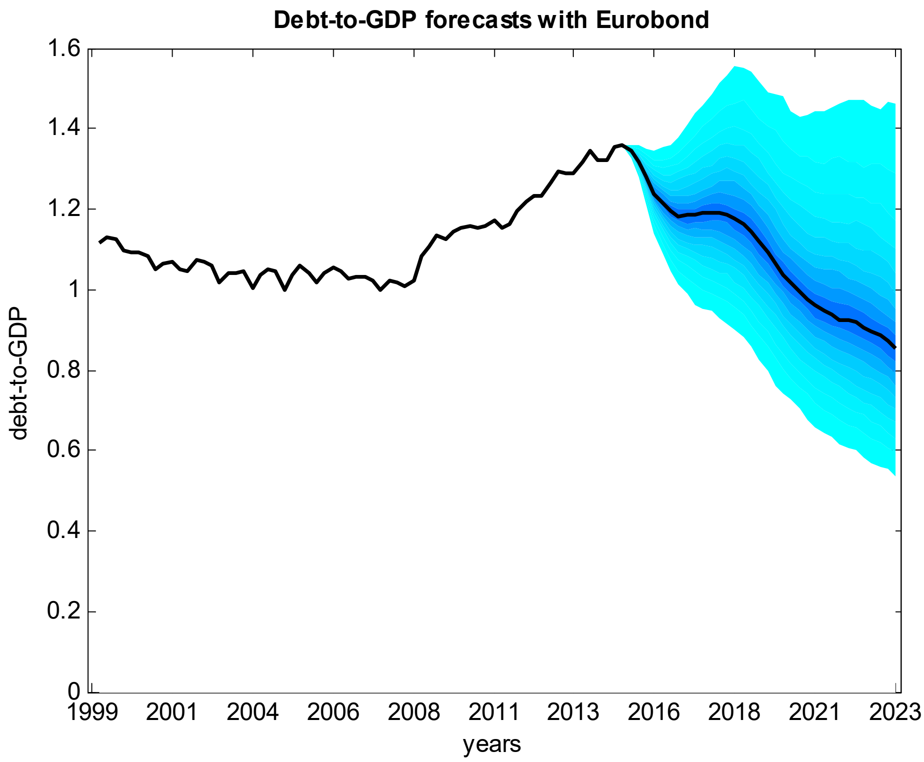


Figure A5: Italian median forecast debt-to GDP

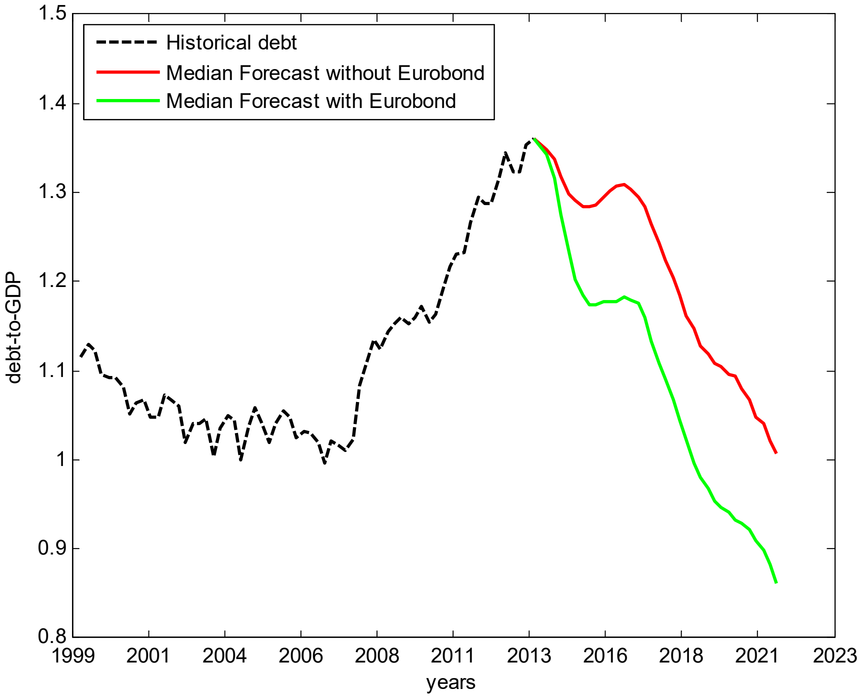


Figure A6: Probability of the Italian debt-to-GDP ratio reaching more than threshold in the following 8

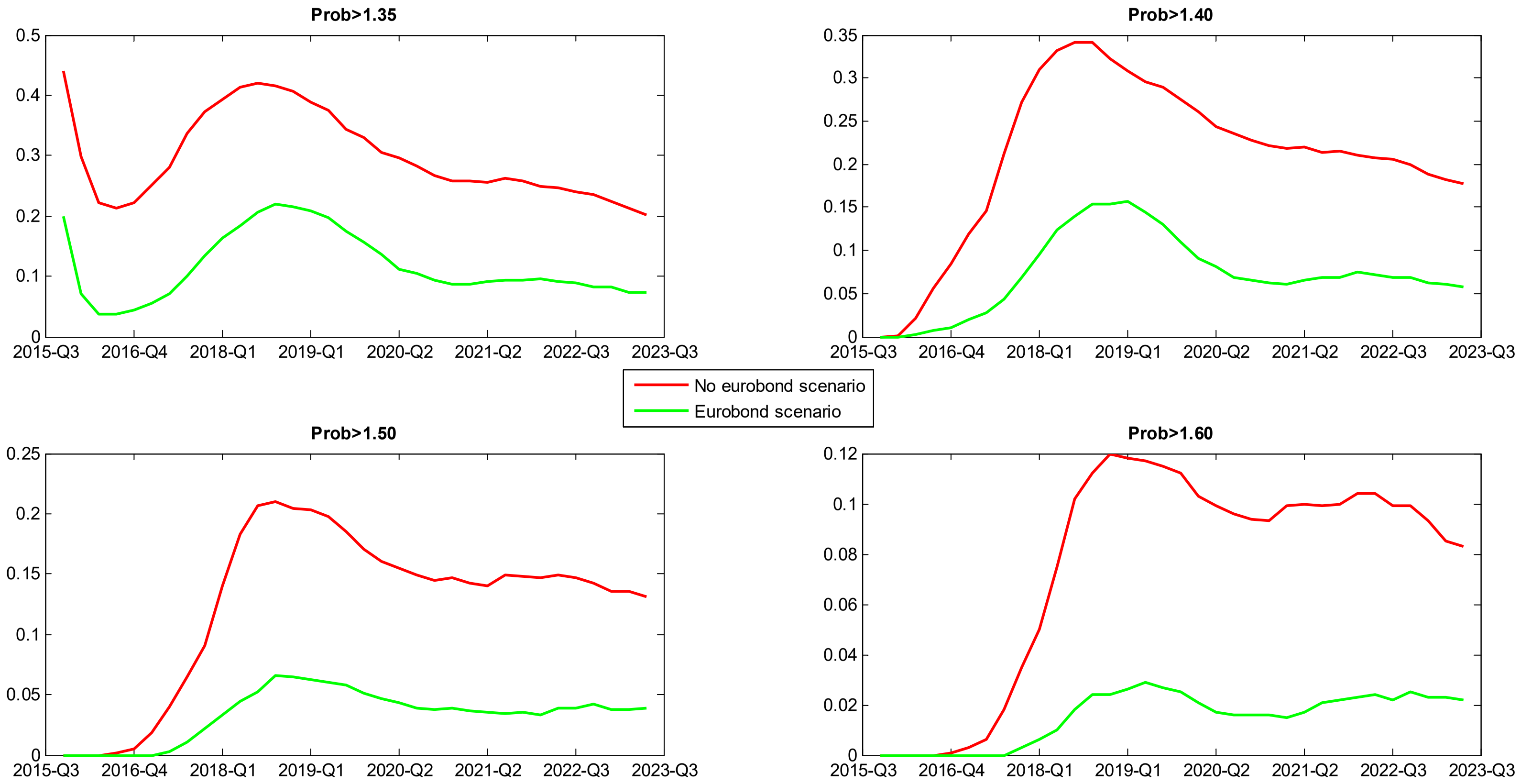


Figure A7: Probability of the Italian debt-to-GDP ratio reaching less than threshold in the following 8 years

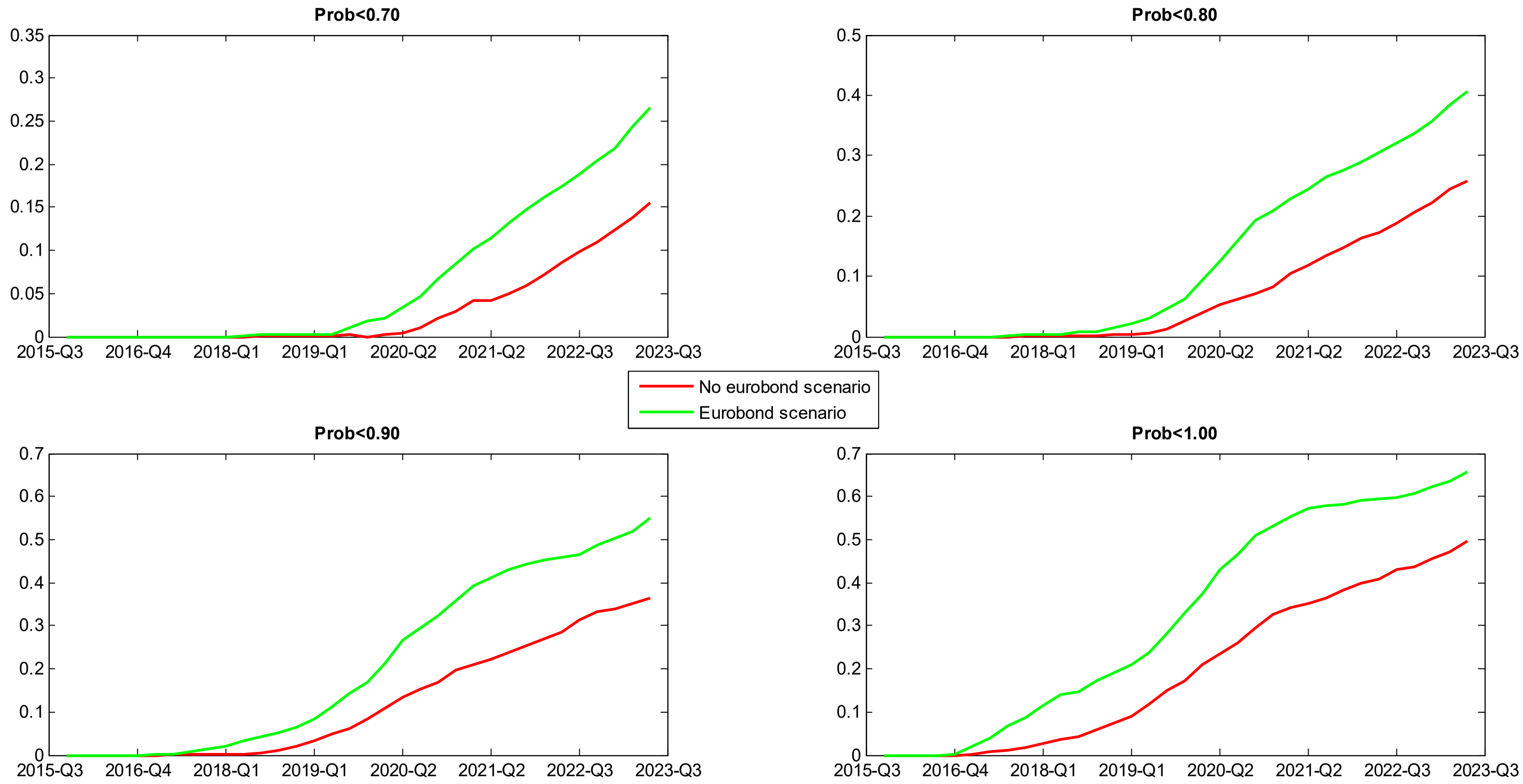


Figure A8: Generalized Impulse Responses of variables to a one standard deviation increase in the $\Delta BTP/\Delta BUND$

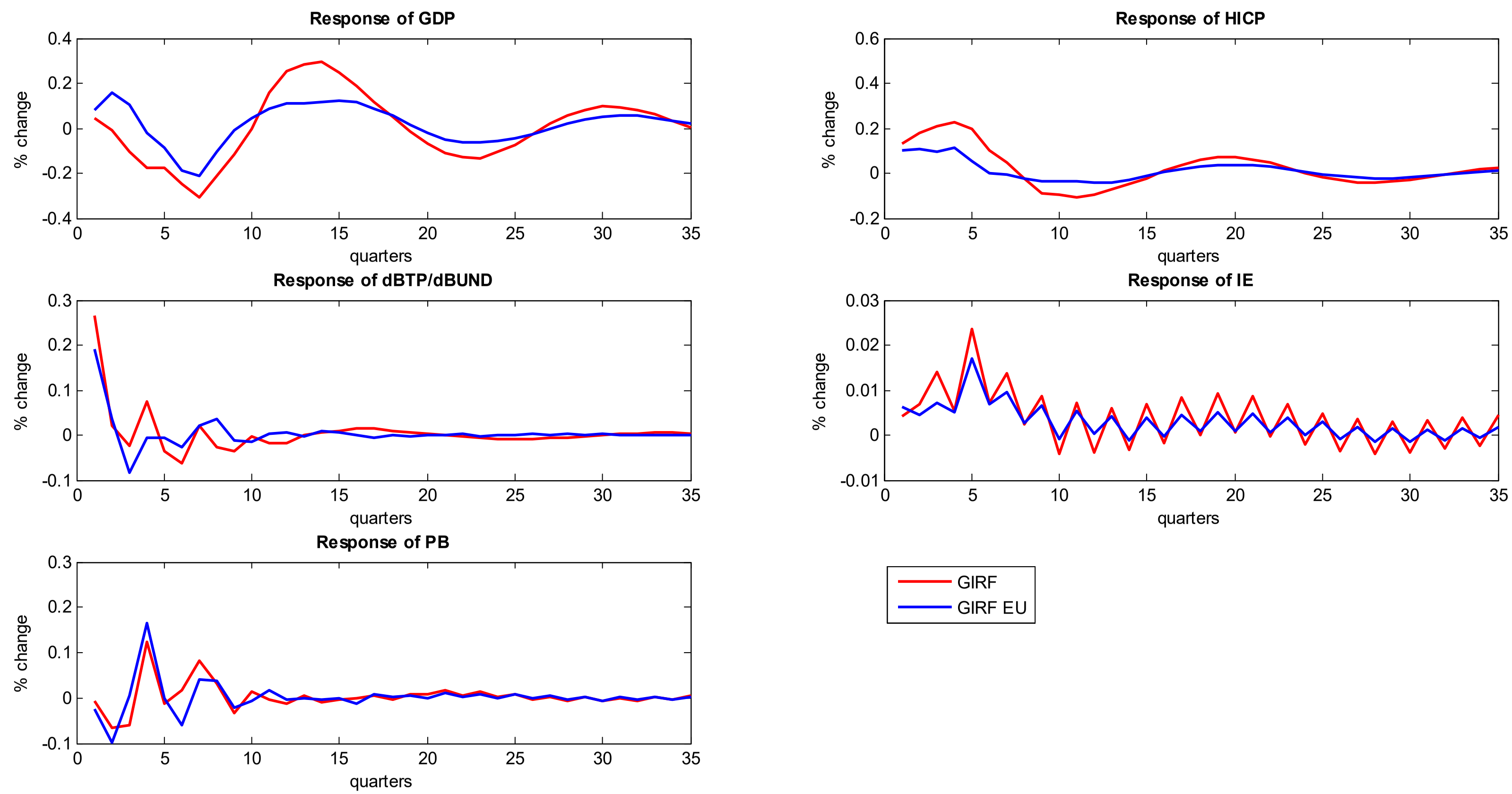
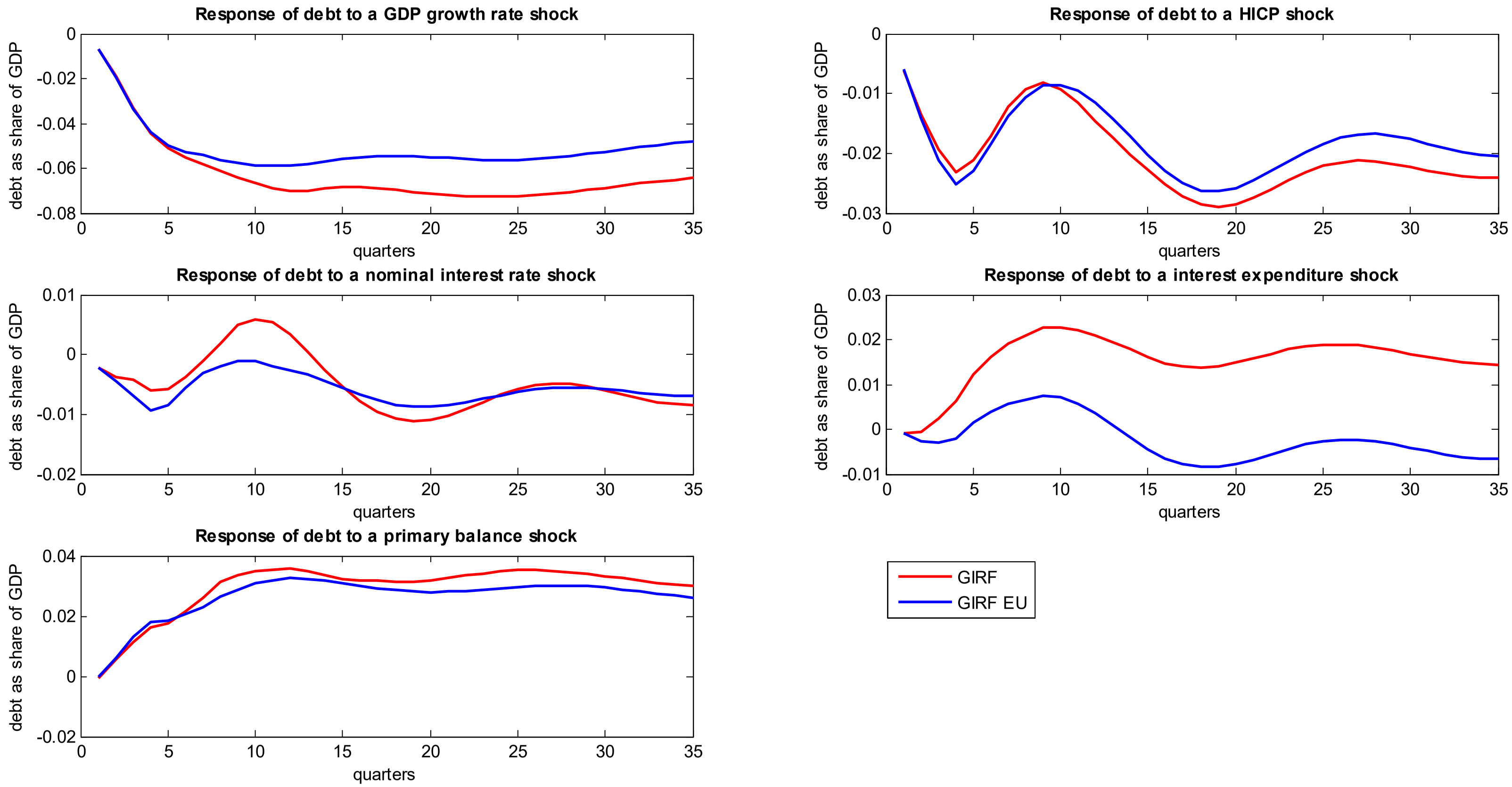


Figure A9: Generalized Impulse Responses of the Italian debt dynamics to macroeconomic variable shocks



Appendix B

Figure B1: Long Term Interest Rate: 10 years OAT vs 10 years BUND

Figure B2: Time series graph

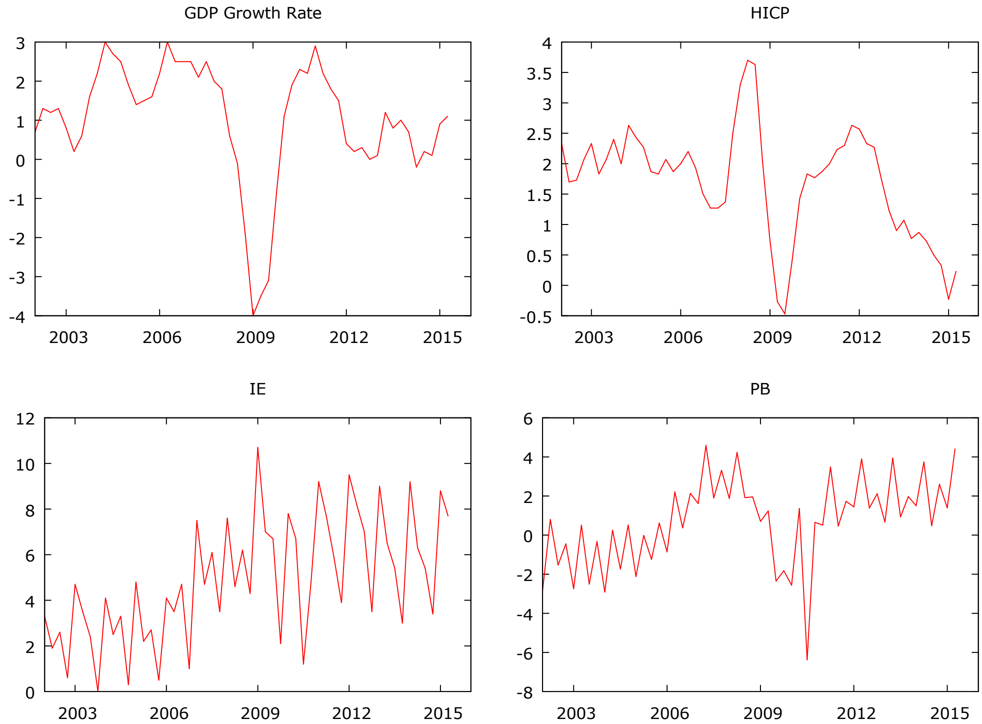


Table B1: OLS Regression Results for the French case

```
Model 1: OLS, using observations 1998:2-2008:4 (T = 43)
Dependent variable: d_OAT

           coefficient   std. error   t-ratio    p-value       [95% Confidence Interval]
-----------------------------------------------------------------------------------------
 const      0.00742399    0.00564090    1.316    0.1955         -0.00396805    0.0188160
 d_BUND     0.966154      0.0187972    51.40     7.45e-039 ***   0.928193      1.00412

Mean dependent var  -0.026279   S.D. dependent var   0.293631
Sum squared resid    0.055340   S.E. of regression   0.036739
R-squared            0.984718   Adjusted R-squared   0.984345

LM test for autocorrelation up to order 20
  Null hypothesis: no autocorrelation
  Test statistic: LMF = 1.5571
  with p-value = P(F(20, 21) > 1.5571) = 0.160729

Model 2: OLS, using observations 1998:2-2015:2 (T = 69)
Dependent variable: d_OAT

           coefficient   std. error   t-ratio     p-value      [95% Confidence Interval]
 ----------------------------------------------------------------------------------------
 const      -0.00107197   0.0133606    -0.08023   0.9363        -0.0277398    0.0255958
 d_BUND      0.910429     0.0438394    20.77      6.69e-031 ***  0.822925     0.997933

Mean dependent var  -0.060580   S.D. dependent var   0.293432
Sum squared resid    0.787270   S.E. of regression   0.108399
R-squared            0.865538   Adjusted R-squared   0.863531

LM test for autocorrelation up to order 20
  Null hypothesis: no autocorrelation
  Test statistic: LMF = 1.46325
  with p-value = P(F(20, 47) > 1.46325) = 0.141311

Chow test for structural break at observation 2009:1
  Null hypothesis: no structural break
  Test statistic: F(2, 65) = 1.83829
  with p-value = P(F(2, 65) > 1.83829) = 0.167265

Chow test for structural break at observation 2012:1
  Null hypothesis: no structural break
  Test statistic: F(2, 65) = 5.04566
  with p-value = P(F(2, 65) > 5.04566) = 0.00918367
```

Table B2: ADF Test Results of the French macroeconomic time series

UR Test with structural break for series: GDP Growth Rate sample range: [2003 Q1, 2015 Q2], T = 50 number of lags (1st diff): 2 used break date: 2009 Q1 shift function: shift dummy critical values 1% 5% 10% -3.48 -2.88 -2.58 value of test statistic: -4.2176	**UR Test with structural break for series: HICP** sample range: [2002 Q4, 2015 Q2], T = 51 number of lags (1st diff): 1 used break date: 2009 Q1 shift function: shift dummy critical values 1% 5% 10% -3.48 -2.88 -2.58 value of test statistic: -4.1855
ADF Test for series: Interest Expenditure sample range: [2002 Q4, 2015 Q2], T = 51 lagged differences: 1 intercept, no time trend asymptotic critical values 1% 5% 10% -3.43 -2.86 -2.57 value of test statistic: -3.6779	**ADF Test for series: Primary Balance** sample range: [2002 Q4, 2015 Q2], T = 51 lagged differences: 1 intercept, no time trend asymptotic critical values 1% 5% 10% -3.43 -2.86 -2.57 value of test statistic: -3.0084
ADF Test for series: OAT sample range: [2002 Q2, 2015 Q2], T = 53 lagged differences: 0 intercept, no time trend asymptotic critical values 1% 5% 10% -3.43 -2.86 -2.57 value of test statistic: -0.0984	

Table B3: Correlation Matrix of the residuals_No Eurobond scenario

	GDP Growth	HICP	ΔBUND	IE	PB
GDP Growth	1				
HICP	0.4015	1			
ΔBUND	0.2763	0.4215	1		
IE	-0.2681	-0.2291	0.00770	1	
PB	-0.1242	-0.0226	-0.3585	-0.0005	1

Table B4: Correlation Matrix of the residuals_Eurobond scenario

	GDP Growth	HICP	ΔBUND	IE	PB
GDP Growth	1				
HICP	0.3733	1			
ΔBUND	0.3715	0.3942	1		
IE	-0.2573	-0.1962	0.1359	1	
PB	-0.1296	-0.0127	-0.3579	-0.0162	1

Figure B3: French Debt-to-GDP evolution under the no Eurobond scenario

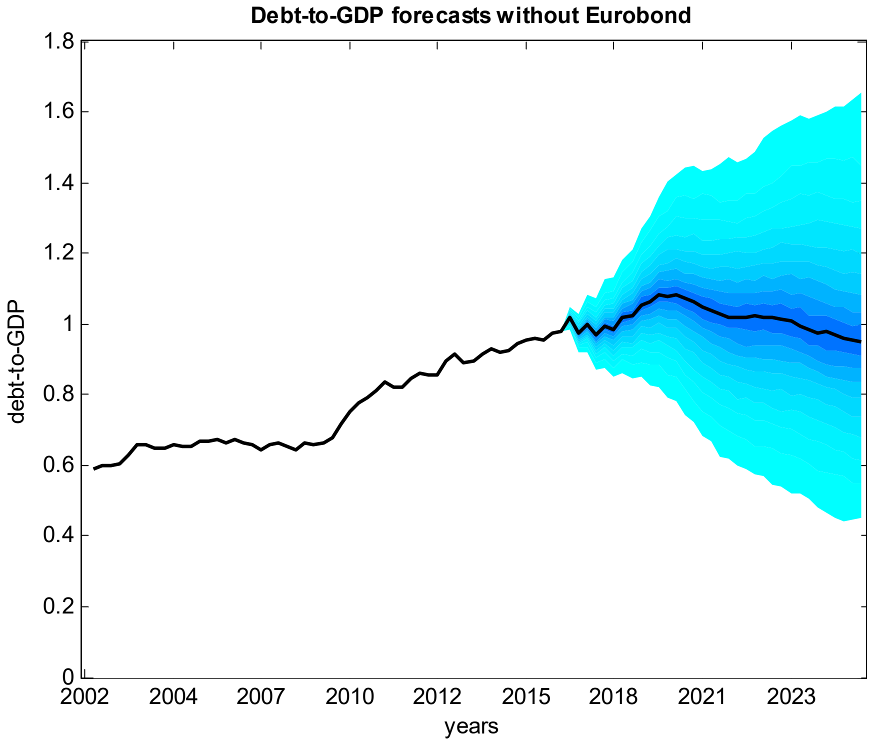


Figure B4: French Debt-to-GDP evolution under the Eurobond scenario

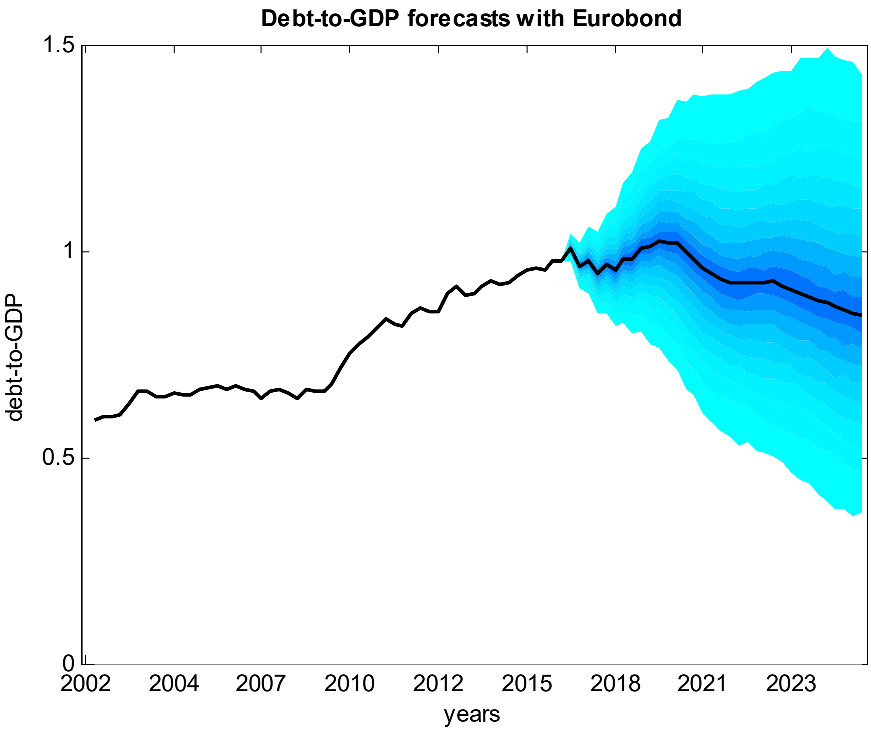


Figure B5: French median forecast debt-to-GDP

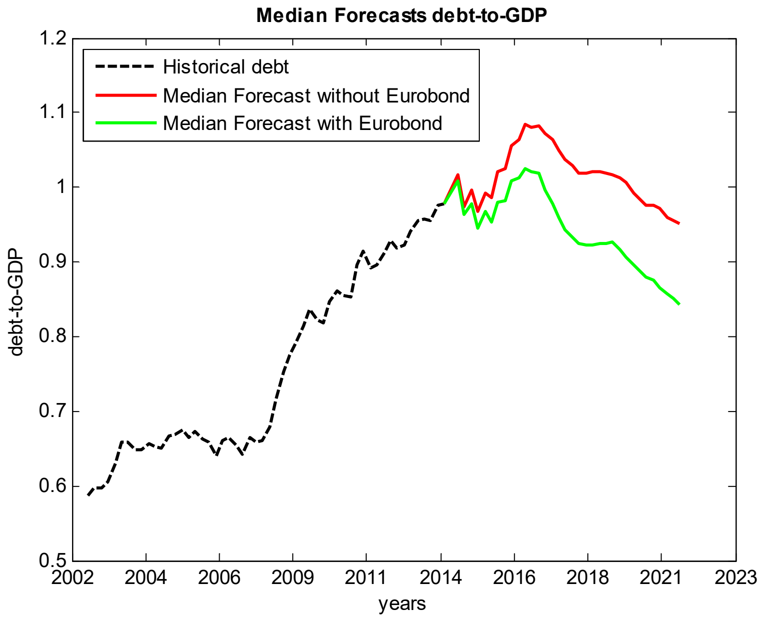


Figure B6: Probability of the French debt-to-GDP ratio reaching more than threshold in the following 8

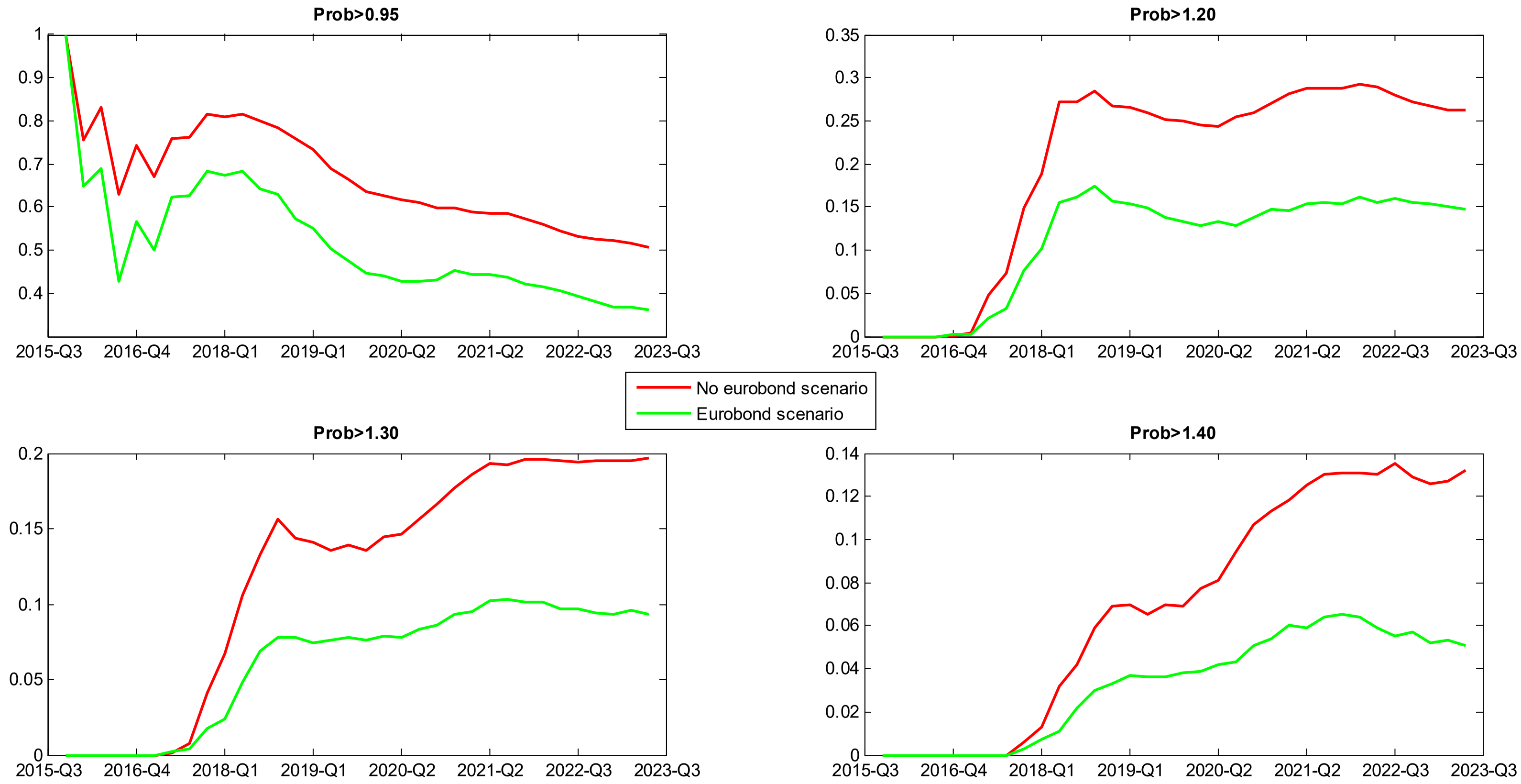


Figure B7: Probability of the French debt-to-GDP ratio reaching less than threshold in the following 8 years

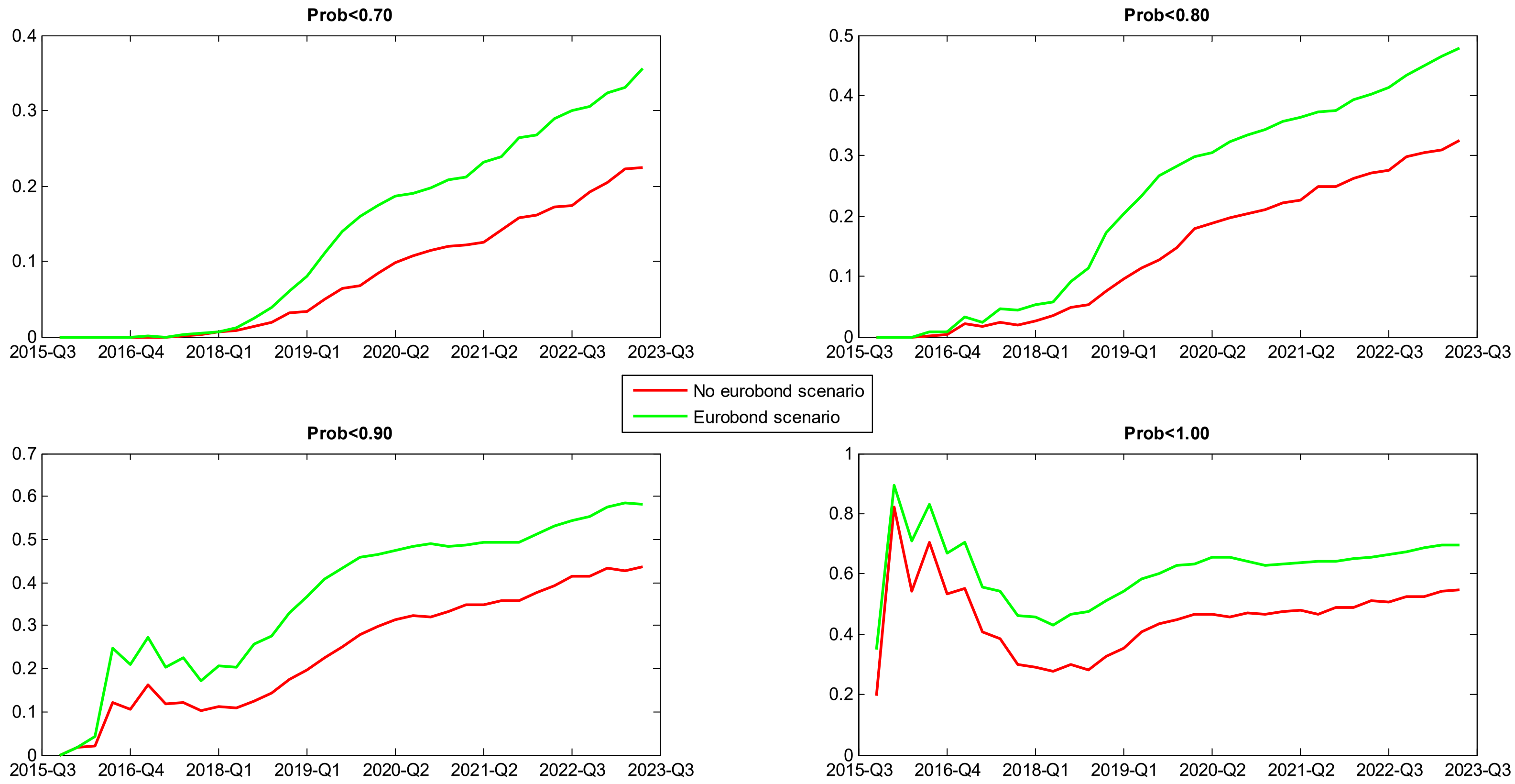
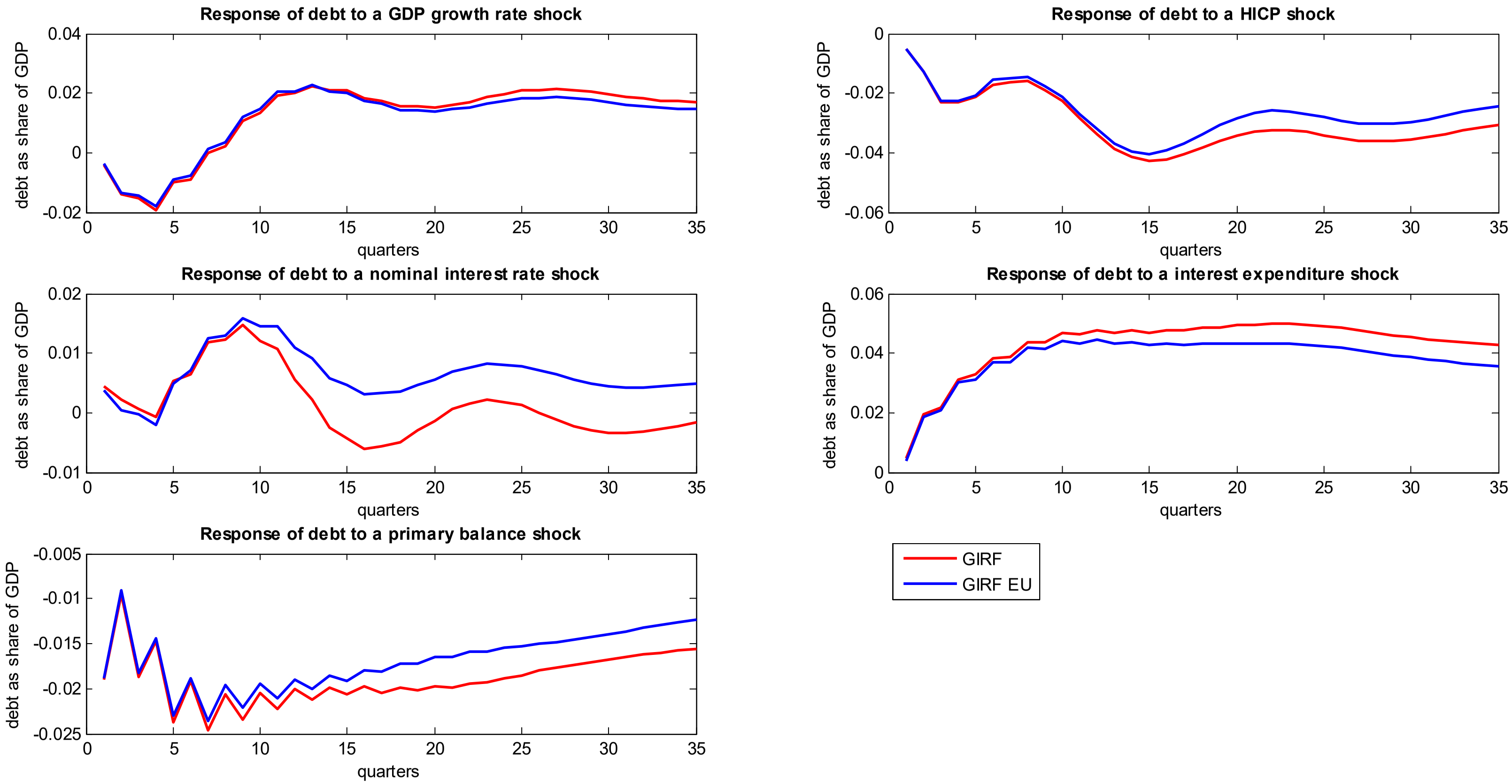


Figure B8: Generalized Impulse Responses of the French debt dynamics to different shocks



Appendix C

Figure C1: Long Term Interest Rate: 10 years BONOS vs 10 years BUND

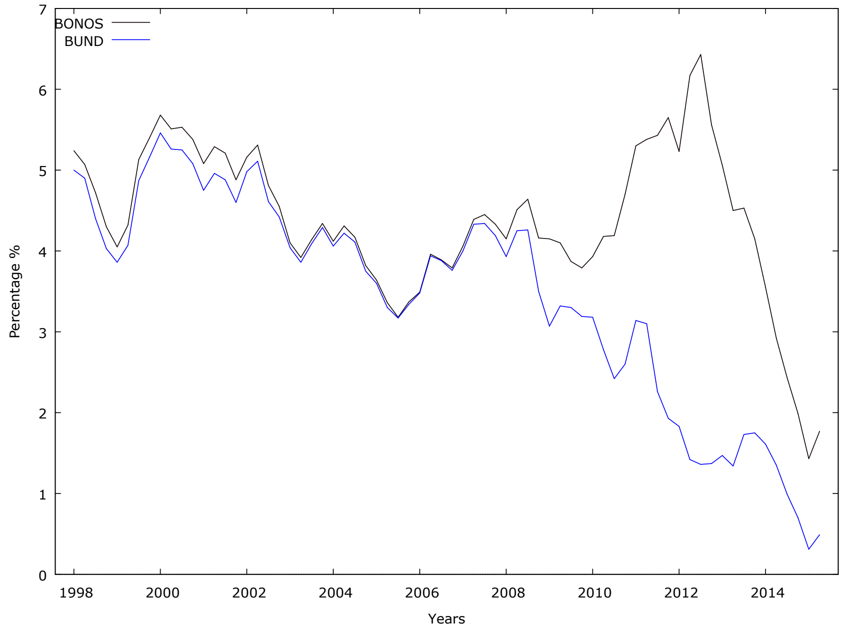


Figure C2: Time Series Graph

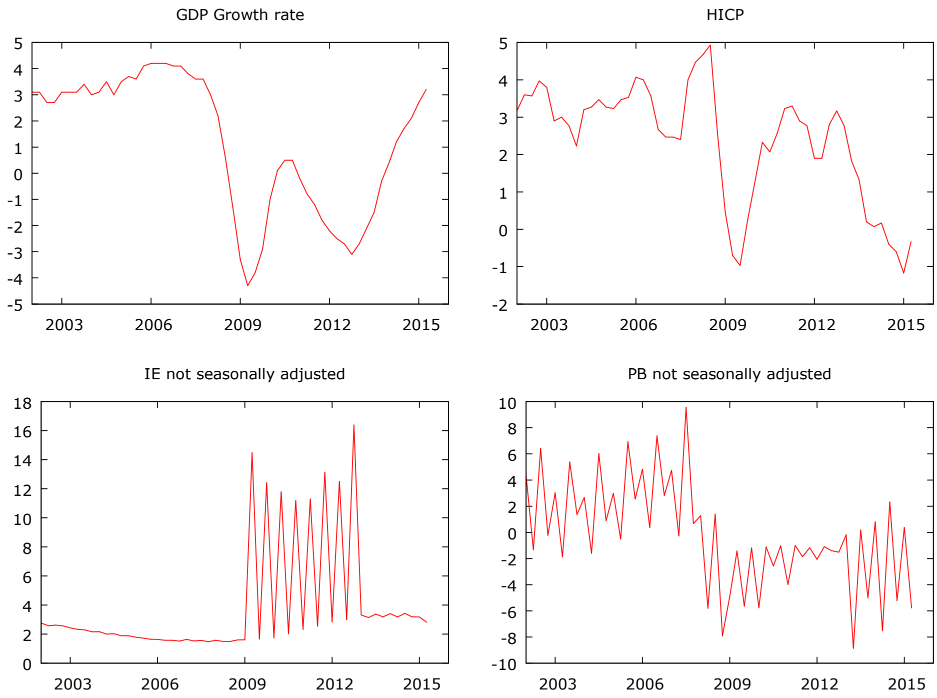


Table C1: OLS Regression Results for the Spanish case

```
Model 1: OLS, using observations 1998:2-2008:4 (T = 43)
Dependent variable: d_BONOS

           coefficient   std. error   t-ratio    p-value       [95% Confidence Interval]
  -------------------------------------------------------------------------------------
 const      0.00774341    0.00965240    0.8022   0.4270         -0.0117500    0.0272368
 d_BUND     0.941978      0.0321647    29.29     4.13e-029 ***   0.877020     1.00694

Mean dependent var  -0.025116   S.D. dependent var   0.290798
Sum squared resid    0.162037   S.E. of regression   0.062866
R-squared            0.954377   Adjusted R-squared   0.953265

LM test for autocorrelation up to order 20
  Null hypothesis: no autocorrelation
  Test statistic: LMF = 0.496459
  with p-value = P(F(20, 21) > 0.496459) = 0.938506


Model 2: OLS, using observations 1998:2-2015:2 (T = 69)
Dependent variable: d_BONOS

           coefficient   std. error   t-ratio   p-value        [95% Confidence Interval]
  -------------------------------------------------------------------------------------
 const      -0.00647819   0.0359252    -0.1803   0.8574        -0.0781852    0.0652288
 d_BUND      0.670289     0.117880      5.686    3.09e-07 ***   0.435001     0.905578

Mean dependent var  -0.050290   S.D. dependent var   0.352282
Sum squared resid    5.692086   S.E. of regression   0.291473
R-squared            0.325502   Adjusted R-squared   0.315435

LM test for autocorrelation up to order 20
  Null hypothesis: no autocorrelation
  Test statistic: LMF = 2.51578
  with p-value = P(F(20, 47) > 2.51578) = 0.00478657

Chow test for structural break at observation 2009:1
  Null hypothesis: no structural break
  Test statistic: F(2, 65) = 5.25815
  with p-value = P(F(2, 65) > 5.25815) = 0.0076447

Augmented regression for Chow test
OLS, using observations 1998:2-2015:2 (T = 69)
Dependent variable: d_BONOS

              coefficient   std. error   t-ratio   p-value
  ---------------------------------------------------------
  const        0.00774341   0.0421537     0.1837   0.8548
  d_BUND       0.941978     0.140469      6.706    5.72e-09 ***
  splitdum    -0.0778596    0.0716780    -1.086    0.2814
  sd_d_BUND   -0.753613     0.232774     -3.238    0.0019   ***

Mean dependent var  -0.050290   S.D. dependent var   0.352282
Sum squared resid    4.899414   S.E. of regression   0.274546
R-squared            0.419432   Adjusted R-squared   0.392636
```

Table C2: ADF Test Results of the Spanish macroeconomic time series

```
UR Test with structural break for series: GDP Growth Rate
sample range: [2002 Q4, 2015 Q2], T = 51
number of lags (1st diff): 1
used break date: 2009 Q1
shift function: shift dummy
critical values
1%          5%          10%
-3.48       -2.88       -2.58
value of test statistic: -2.6728
```

```
UR Test with structural break for series: HICP
sample range: [2002 Q4, 2015 Q2], T = 51
number of lags (1st diff): 1
used break date: 2008 Q4
shift function: shift dummy
critical values
 1%          5%          10%
1000        -3.48       -2.88       -2.58
value of test statistic: -3.6931
```

```
ADF Test for series: Interest Expenditure
sample range: [2002 Q4, 2015 Q2], T = 51
lagged differences: 1
intercept, no time trend
asymptotic critical values
1%          5%          10%
-3.43       -2.86       -2.57
value of test statistic: -1.7870
```

```
ADF Test for series: Primary Balance
sample range: [2002 Q3, 2015 Q2], T = 52
lagged differences: 1
intercept, no time trend
asymptotic critical values
1%          5%          10%
-3.43       -2.86       -2.57
value of test statistic: -9.3855
```

```
ADF Test for series: BONOS
sample range: [2002 Q4, 2015 Q2], T = 51
lagged differences: 1
intercept, no time trend
asymptotic critical values
1%          5%          10%
-3.43       -2.86       -2.57
value of test statistic: -1.3177
```

Table C3: Correlation Matrix of the residuals_No Eurobond scenario

	GDP Growth	HICP	ΔBUND	IE	PB
GDP Growth	1				
HICP	0.0897	1			
ΔBUND	0.0756	0.4092	1		
IE	-0.2184	0.1494	0.0031	1	
PB	-0.0277	-0.1661	-0.3385	-0.1116	1

Table C4: Correlation Matrix of the residuals_Eurobond scenario

	GDP Growth	HICP	ΔBUND	IE	PB
GDP Growth	1				
HICP	0.0737	1			
ΔBUND	0.1126	0.4779	1		
IE	-0.1089	0.2482	0.1283	1	
PB	-0.1547	-0.1292	-0.0594	-0.1564	1

Figure C3: Spanish Debt-to-GDP evolution under the no Eurobond scenario

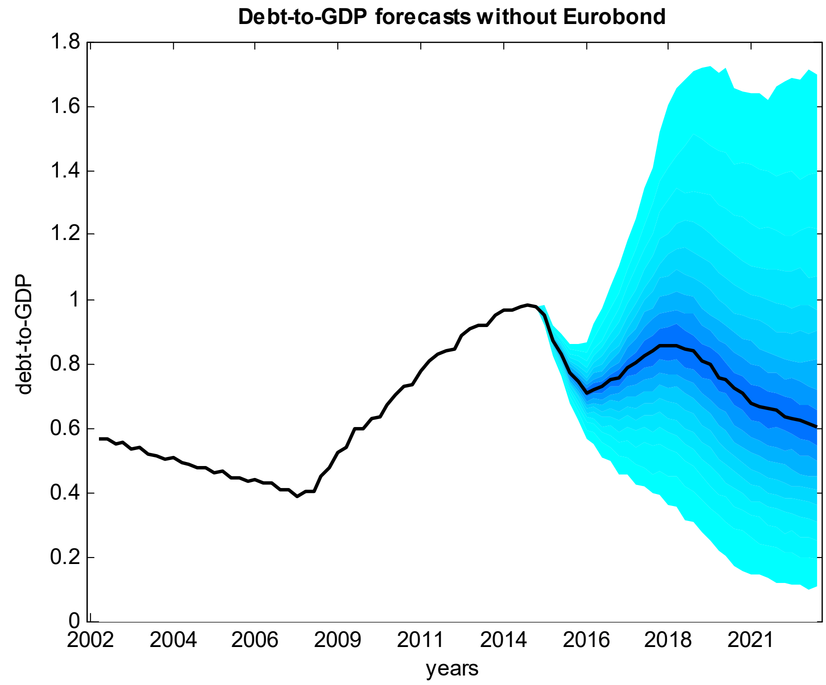


Figure C4: Spanish Debt-to-GDP evolution under the no Eurobond scenario

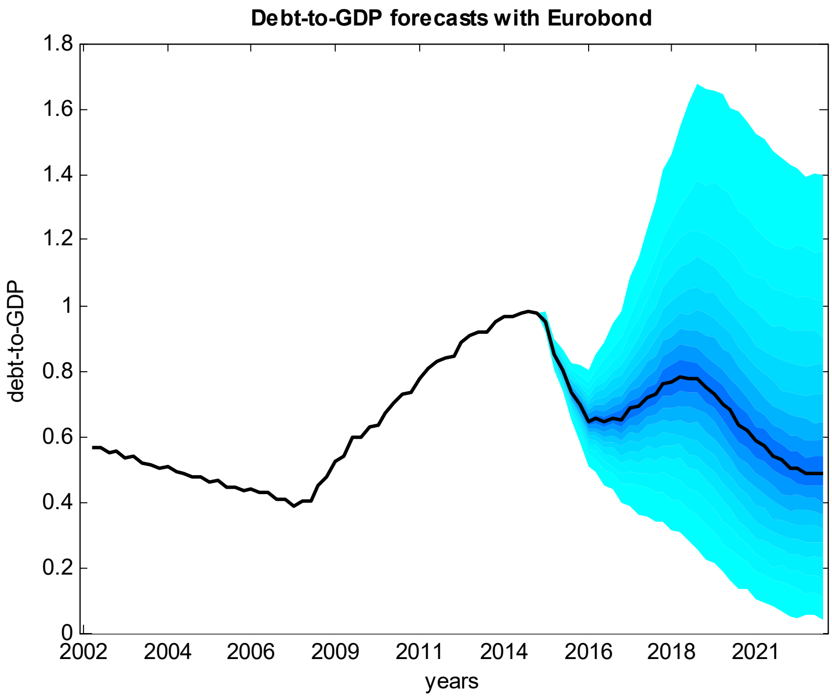


Figure C5: Spanish median forecast debt-to-GDP

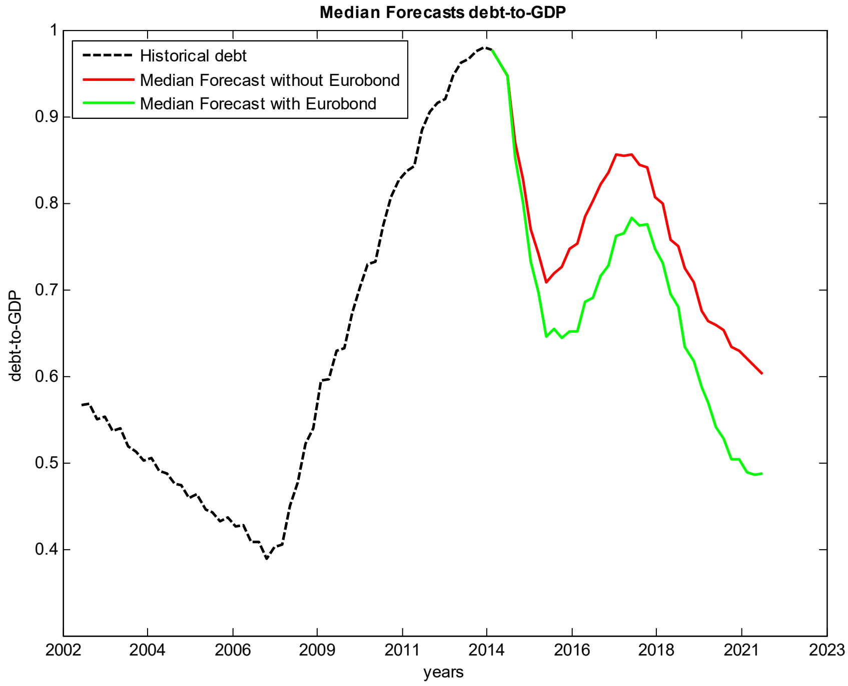


Figure C6: Probability of the Spanish debt-to-GDP ratio reaching more than threshold in the following 8

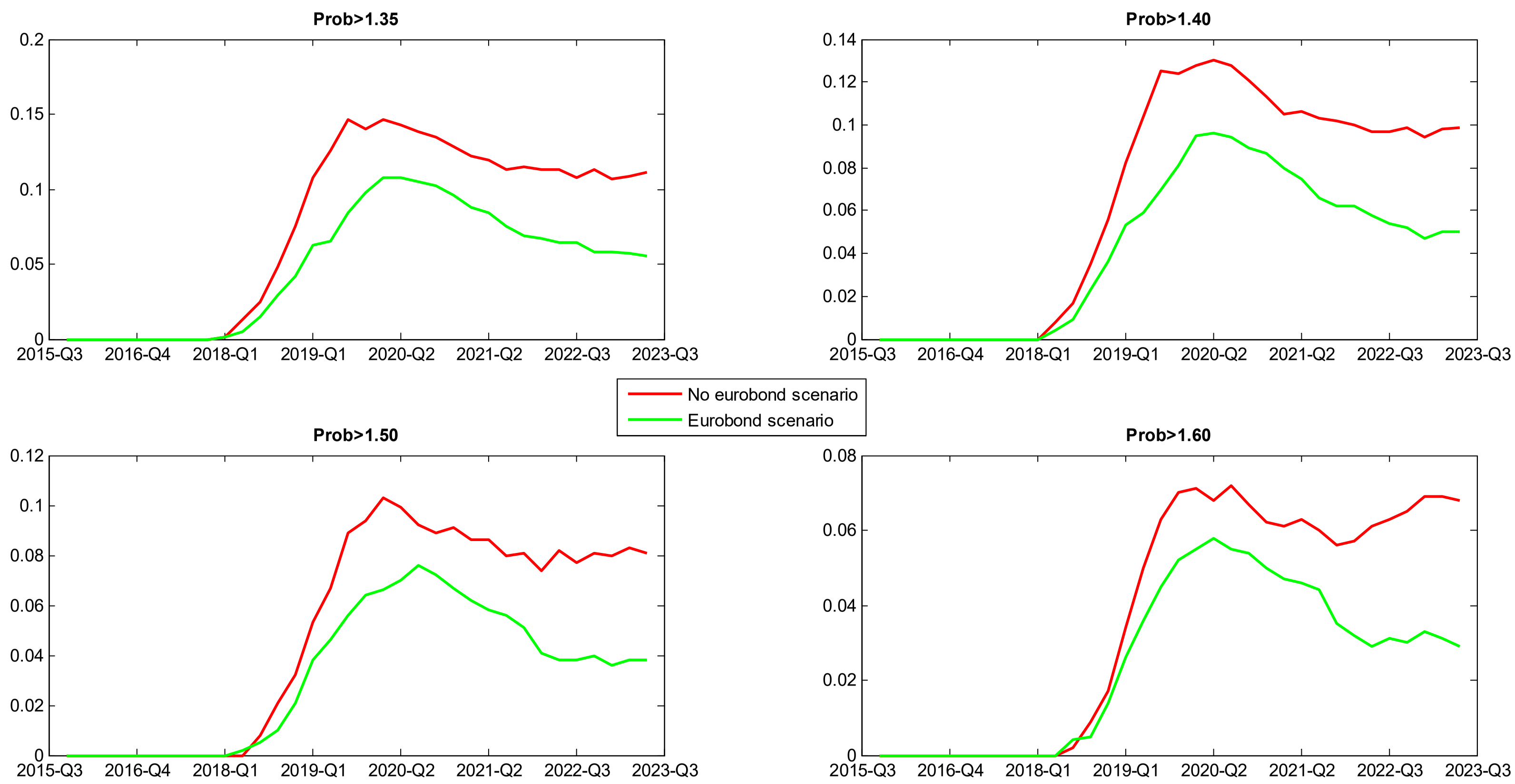


Figure C7: Probability of the Spanish debt-to-GDP ratio reaching less than threshold in the following 8 years

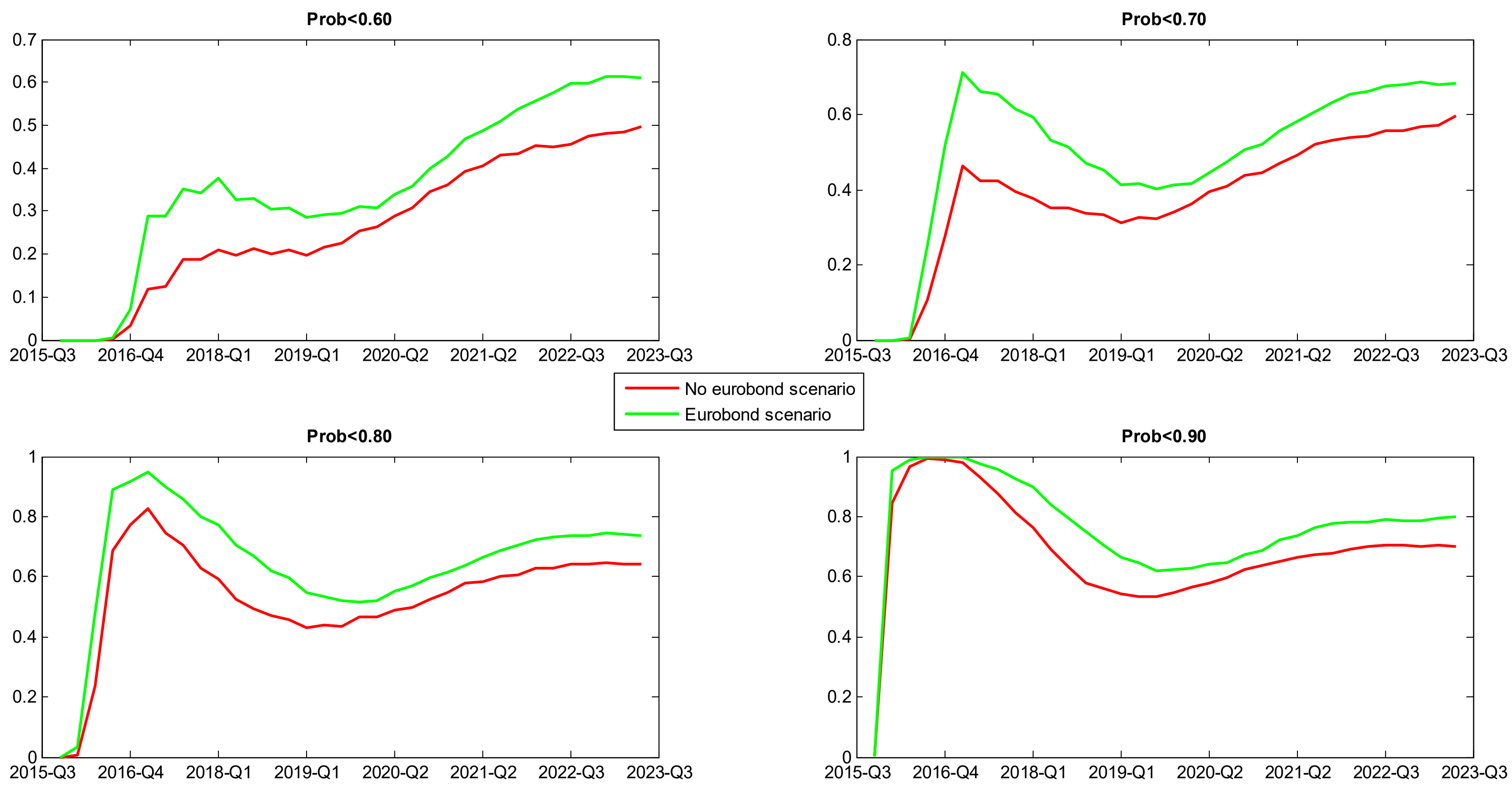


Figure C8: Generalized Impulse Responses of the Spanish debt dynamics to different shocks

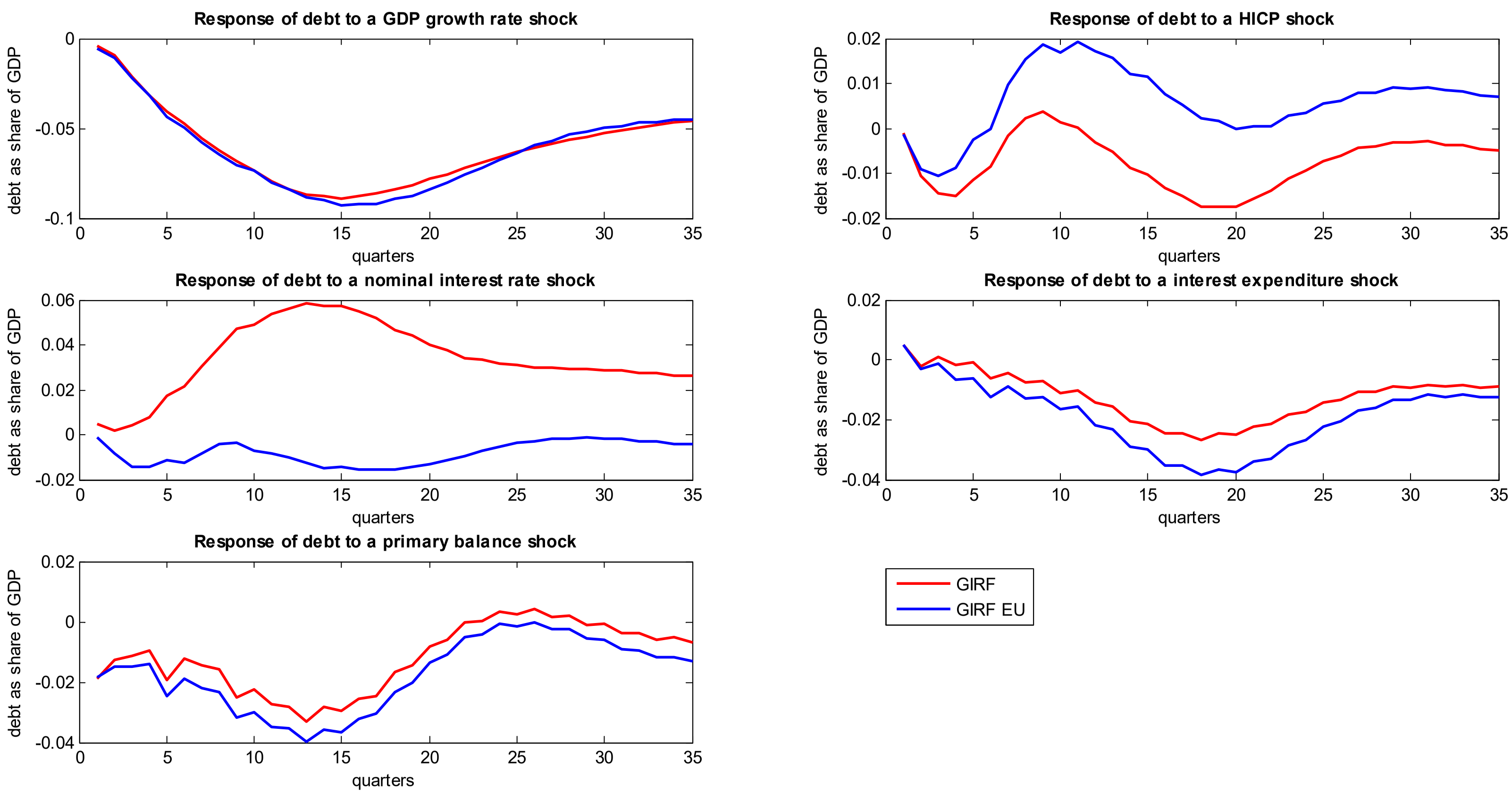


Table C5: Forecast Variance

	ITALY		FRANCE		SPAIN	
	No Eurobond	Eurobond	No Eurobond	Eurobond	No Eurobond	Eurobond
2015 Q3	0,0001	0,0001	0,0004	0,0004	0,0004	0,0004
2015 Q4	0,0005	0,0005	0,0011	0,0010	0,0009	0,0008
2016 Q1	0,0017	0,0018	0,0023	0,0022	0,0016	0,0017
2016 Q2	0,0040	0,0040	0,0038	0,0037	0,0029	0,0028
2016 Q3	0,0070	0,0065	0,0057	0,0059	0,0051	0,0054
2016 Q4	0,0104	0,0093	0,0080	0,0075	0,0083	0,0082
2017 Q1	0,0143	0,0124	0,0106	0,0100	0,0125	0,0123
2017 Q2	0,0190	0,0164	0,0135	0,0128	0,0186	0,0176
2017 Q3	0,0245	0,0209	0,0171	0,0164	0,0263	0,0254
2017 Q4	0,0307	0,0258	0,0215	0,0205	0,0355	0,0343
2018 Q1	0,0375	0,0302	0,0264	0,0255	0,0470	0,0455
2018 Q2	0,0446	0,0345	0,0320	0,0314	0,0611	0,0579
2018 Q3	0,0511	0,0383	0,0372	0,0370	0,0766	0,0742
2018 Q4	0,0575	0,0415	0,0421	0,0419	0,0944	0,0914
2019 Q1	0,0630	0,0442	0,0470	0,0462	0,1113	0,1108
2019 Q2	0,0682	0,0467	0,0516	0,0500	0,1271	0,1302
2019 Q3	0,0730	0,0489	0,0555	0,0533	0,1420	0,1497
2019 Q4	0,0774	0,0505	0,0592	0,0560	0,1543	0,1678
2020 Q1	0,0815	0,0516	0,0637	0,0587	0,1638	0,1836
2020 Q2	0,0859	0,0525	0,0677	0,0617	0,1725	0,1964
2020 Q3	0,0906	0,0536	0,0718	0,0645	0,1800	0,2057
2020 Q4	0,0961	0,0554	0,0773	0,0688	0,1842	0,2117
2021 Q1	0,1020	0,0577	0,0829	0,0733	0,1844	0,2139
2021 Q2	0,1086	0,0606	0,0895	0,0777	0,1849	0,2129
2021 Q3	0,1160	0,0640	0,0964	0,0826	0,1855	0,2094
2021 Q4	0,1243	0,0679	0,1026	0,0860	0,1864	0,2065
2022 Q1	0,1325	0,0717	0,1079	0,0896	0,1892	0,2046
2022 Q2	0,1390	0,0754	0,1118	0,0924	0,1927	0,2028
2022 Q3	0,1437	0,0784	0,1160	0,0949	0,1983	0,1989
2022 Q4	0,1473	0,0806	0,1182	0,0968	0,2012	0,1983
2023 Q1	0,1500	0,0821	0,1223	0,0987	0,2054	0,1978
2023 Q2	0,1516	0,0831	0,1257	0,1005	0,2116	0,1982
2023 Q3	0,1528	0,0840	0,1289	0,1020	0,2179	0,1994
2023 Q4	0,1545	0,0850	0,1335	0,1041	0,2224	0,2032

References

Andor, L. (2014). Labour mobility in the EU. Speech at University of Ghent. Brussels 25th September 2014

Angkinand, A., Permpoon, O. and Wihlborg, C. (2009). The Impact of EMU, Exchange Rate and Monetary Regimes on Trade Flows.

Annunziata, M. (2015). The ECB's QE decision *http://www.voxeu.org/article/ecb-s-qe-decision.*

Baldwin, R. and Giavazzi, F. (2015). The Eurozone crisis: A consensus view of the causes and a few possible solutions. E-book. London, CEPR Press

Benassy-Quere, A. (2015). Maastricht flaws and remedies *http://www.voxeu.org/article/maastricht-flaws-and-remedies*.

Berti, K. (2013). Stochastic Public Debt Projections using the Historical Variance-covariance Matrix Approach for EU Countries. *European Commission Economic Paper Series 480, Directorate General Economic and Financial Affairs.*

Blomstrom, M. (1998). EMU: Risky But Worth It. *https://www.project-syndicate.org/commentary/emu--risky-but-worth-it*.

Boonstra, W. (2011). Can Eurobonds solve EMU's problems? *Rabobank working paper*.

Boonstra, W. (2012). Conditional Euro T-Bills as a transitional regime. *Rabobank working paper*.

Bouvet, F., Brady, R. and King, S. (2013). Debt Contagion in Europe: A Panel-Vector Autoregressive (VAR) Analysis. *Social Sciences*, 2(4), pp.318-340.

Breuss, F. (2009). Ten Years of EMU-Achievements, Weaknesses, Challenges. *Austrian Economic Quarterly 1/2009*

Brunnermeir, M., Garicano, L., Lane, P., Pagano, M., Reis, R., Van Nieuwerburgh, S. and Vayanos, D. (2011). European Safe Bonds (ESBies). *Euronomis Group*.

Buti, M. and Gaspar, V. (2008). The first ten years of the euro *http://www.voxeu.org/article/first-ten-years-euro*.

Carlin, W. and Soskice, D. (2005). Macroeconomics: Imperfections, Institutions and Policies. *Oxford University Press.*

Celasun, O., Debrun, X. and Ostry, J. (2006). Primary Surplus Behavior and Risks to Fiscal Sustainability in Emerging Market Countries: A "Fan-Chart" Approach. *IMF Working Papers*, 06(67), pp.401-425.

Cherif, R. and Hasanov, F. (2012). Public Debt Dynamics: The Effects of Austerity, Inflation, and Growth Shocks. *IMF Working Papers*, 12(230), pp. 1-28

Claessens, S., Mody, A. and Valee, S. (2012). Paths to Eurobonds. *IMF Working paper n°172*.

Cline, W. (2012). Sovereign Debt Sustainability in Italy and Spain: A Probabilistic Approach. *SSRN Electronic Journal*.

De Grauwe, P. and Mosen, W. (2009). Gain for all: A Proposal for a common Eurobond. *CEPS Commentary*.

De Grauwe, P. (2011). Governance of a Fragile Eurozone. *CEPS Working Document n° 346/May 2011*.

De Grauwe, P. (2011). The European Central Bank as a lender of last resort *http://www.voxeu.org/article/european-central-bank-lender-last-resort*

De Grauwe, P. (2013). Design Failures in the Eurozone: Can They Be Fixed? *LSE 'Europe in Question' Discussion Paper Series.*

De Haan, J., Gilbert, N., Hessel, J. and Verkaart, S. (2013). Beyond the fiscal compact: How Well-Designed Eurobond May Discipline Governments. *Journal for comparative Government and European Policy*, 3(323-337).

De Haan, J., Hessel, J. and Gilbert, N. (2014). Reforming the Architecture of EMU: Ensuring Stability in Europe. *DNB Working Paper n°446*.

Delpla, J. and Von Weisacker, J. (2010). The Blue Bond Proposal. *Bruegel Policy Brief.*

Diamond, D. and Dybvig, P. (1983). Bank Runs, Deposit Insurance, and Liquidity. *Journal of Political Economy*, 91(3), pp.401-419.

Draghi, M. (2014). "Financial Integration and banking Union", speech at the conference for the 20th anniversary of the establishment of the European Monetary Institute, Brussels, February 12

ELEC, 2010. The creation of a common European bond market. *Cahier Comte Boël n°14*

ELEC, 2012. The ELEC 'Euro T-Bill Fund'. A proposal for a two years refinancing for all € bill/optional bond maturities until 2015.

Eller, M. and Urvovà, J. (2012). How sustainable are public debt levels in emerging Europe? *Focus Eur. Econ. Integr.* 4, pp.48-79.

Enders, W. (1995). Applied econometric time series. New York: Wiley.

European Economic Report, (1990). One Market, One Money. An evaluation of the potential benefits and costs of forming an economic and monetary union.

European Commission, (2007). One currency for one Europe. The road to the euro.

European Commission, (2011). Green Paper on the feasibility of introducing Stability Bonds.

European Commission, (2012). Report on the public consultation on the European Commission Green Paper on the feasibility of introducing Stability Bonds.

European Commission, (2014). Assessing Public Debt Sustainability in EU Member States: A Guide. *EC Occasional Paper Series, No. 200*.

European Commission, (2015). Assessment of the 2015 Stability Programme for France. *Note prepared by the DG ECFIN staff, Brussels 27 May 2015.*

European Commission, (2015). Assessment of the 2015 Stability Programme for Italy. *Note prepared by the DG ECFIN staff, Brussels 27 May 2015.*

European Commission, (2015). Assessment of the 2015 Stability Programme for Spain. *Note prepared by the DG ECFIN staff, Brussels 27 May 2015.*

Eurostat (2015). Statistics explained: Government finance statistics-quarterly data *http://ec.europa.eu/eurostat/statistics-explained/index.php/Government_finance_statistics_-_quarterly_data*

Favero, C. and Missale, A. (2012). Sovereign spreads in the Eurozone: which prospects for a Eurobond? *Economic Policy*, 27(70), pp.231-273.

Fedelino, A., Ivanova, A. and Horton, M. (2009). Computing Cyclically Adjusted Balances and Automatic Stabilizers. *IMF-Fiscal Affairs Department*

Feld L. P., Schmidt C. M., Schnabel I. and Wieland V. (2015). Divergence of liability and control as the source of over-indebtedness and moral hazard in the European Monetary Union *http://www.voxeu.org/article/divergence-liability-and-control-source-over-indebtedness-and-moral-hazard-european-monetary-union*

Gali, J. and Perotti, R. (2003). Fiscal Policy And Monetary Integration In Europe. *NBER Working Paper No. 9773, National Bureau of Economic Research*.

Garcia, M. and Rigobon, R. (2004). A Risk Management Approach to Emerging Market's Sovereign Debt Sustainability with an Application to Brazilian Data. *NBER Working Paper No. 10336, National Bureau of Economic Research*.

Gilbert, N., Hessel, J. and Verkaart, S. (2013). Towards a Stable Monetary Union: What Role for Eurobonds? *DNB Working Paper n°379*.

Giovannini Group, (2000). Report on Co-ordinated Issuance of Public Debt in the Euro Area" *http://ec.europa.eu/economy_finance/publications/publication_summary6374_en.htm*

Gros, D. (2011). Eurobonds are the wrong solution *http://www.voxeu.org/article/eurobonds-are-wrong-solution*

Heinz, F. and Rusinova, D. (2011). How flexible are real wages in EU countries? A panel investigation. *ECB Working paper n°1360*.

Ifo Institute, (2011). What will Eurobonds cost? *Press Release*.

Issing, O. (2008). The Euro: A currency without a state. *Centre for Financial Studies-Working Paper n° 2008/51*

Issing, O. (2009). Why a Common Eurozone Bond Isn't Such a Good Idea. *Centre for Financial Studies-White Paper n°3*.

Juncker, J. C., Tusk, D., Dijsselbloem, J., Draghi, M. and Schulz, M. (2015) Completing Europe's Economic and Monetary Union.

Kirchgassner, G. and Wolters, J. (2007). Introduction to modern time series analysis. Berlin: Springer.

Koop, G., Pesaran, M. and Potter, S. (1996). Impulse response analysis in nonlinear multivariate models. *Journal of Econometrics*, 74(1), pp.119-147.

Lin, J. Y., Treichel, V. (2012). The Crisis in the Euro Zone. Did the Euro Contribute to the Evolution of the Crisis? *The World Bank, policy research working paper n° 6127*

Lütkepohl, H. (2005). New introduction to multiple time series analysis. Berlin: New York.

Manasse, P. (2011). The trouble with the European Stability Mechanism *http://www.voxeu.org/article/trouble-european-stability-mechanism*.

Mckinnon, R. (1963). Optimum Currency Areas. *American Economic Review*, 53, pp.717-725.

Medeiros, J. (2012). Stochastic debt simulation using VAR models and a panel fiscal reaction function: results for a selected number of countries. *European Commission Economic Paper Series 459, Directorate General Economic and Financial Affairs.*

Micossi, S. (2015). The future of the Eurozone. *http://www.voxeu.org/article/future-eurozone-0*.

Mundell, R. (1961). A Theory of Optimal Currency Area. *American Economic Review*, 51 (4), pp.657-665.

Nitsch, V. and Pisu, M. (2008). How did the euro boost trade? Microeconomic evidence *http://www.voxeu.org/article/how-did-euro-boost-trade-microeconomic-evidence*

Penalver, A. and Thwaites, G. (2006). Fiscal Rules for Debt Sustainability in Emerging Markets: The Impact of Volatility and Default Risk. *SSRN Electronic Journal*.

Pesaran, H. and Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. *Economics Letters*, 58(1), pp.17-29.

Preston, R. (2012). France loses AAA rating as euro governments downgraded. *http://www.bbc.com/news/business-16552623*

Rose, A. (2001). Currency unions and trade: the effect is large. *Economic policy*, vol. 16, no. 33, p. 449-461.

Sims, C. (1980). Macroeconomics and Reality. *Econometrica*, 48(1), pp.1-48.

Stock, J. and Watson, M. (2001). Vector Autoregressions. *J. Econ. Perspect.* 15, pp.101-115.

Tanner, E. and Samake, I. (2008). Probabilistic Sustainability of Public Debt: A Vector Autoregression Approach for Brazil, Mexico, and Turkey. *IMF Staff Papers*, 55(1), pp.149-182.

Tielens, J., Van Aarle, B. and Van Hove, J. (2014). Effects of Eurobonds: A stochastic sovereign debt sustainability analysis for Portugal, Ireland and Greece. *Journal of Macroeconomics*, 42, pp.156-173.