UNIVERSITA' DEGLI STUDI DI PADOVA

DIPARTIMENTO DI SCIENZE ECONOMICHE ED AZIENDALI "M.FANNO"

CORSO DI LAUREA MAGISTRALE IN ECONOMICS AND FINANCE

TESI DI LAUREA

"A bi-faced Eurobond to immunize the European Monetary Union from exogenous shocks: a counterfactual exercise"

RELATORE:

CH.MO PROF. GRECO LUCIANO

LAUREANDA: CHITARIN ELISABETTA

MATRICOLA N. 1179667

ANNO ACCADEMICO 2019 –2020

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.

The candidate declares that the present work is original and has not already been submitted, totally or in part, for the purposes of attaining an academic degree in other Italian or foreign universities. The candidate also declares that all the materials used during the preparation of the thesis have been explicitly indicated in the text and in the section "Bibliographical references" and that any textual citations can be identified through an explicit reference to the original publication.

Firma dello studente

_____

Contents

Introduction

This dissertation aims at verifying the effectiveness of a debt mutualization mechanism (Eurobond) to immunize the European Monetary Union from exogenous shocks.

The first section presents the flaws of the EMU project that became clear with the surge of the sovereign debt crisis in 2009, when the interventions of the European institutions proved to be insufficient. After a literature review of all kind of Eurobonds proposed in the last twenty years, the need for a mechanism designed to tackle the tradeoff between debt stabilization and the necessity to minimize the scope for moral hazard emerges.

In order to address this duplicity, we propose a bi-faced Eurobond (named Janus) that trades on the markets at a unique interest rate and charges differentiated financing costs based on fiscal fundamentals of Member states.

The second section deals with the determinants of government bond yields presenting the time-varying role of each component of risk: global aggregate risk, risk aversion, liquidity risk, country-specific risk (including a focus on different measures of credit risk) and contagion risk. This overview gives theoretical and empirical foundation to the design of the Janus Eurobond.

The third section sets up a model for debt dynamics; using quarterly data in a Vector Auto Regressive model we study the interaction in the macroeconomic system for the time lapse (2000Q1 – 2019Q2) between five variables: interest expenditure, growth, inflation, primary balance and nominal interest rate. The VAR output lets us forecast future values for the endogenous variables. Subsequently we use an equation describing debt evolution to find the implicit forecast of debt dynamics for three countries: Italy, France and Germany, representing respectively a peripheral, an intermediate and a core country of the EMU. The analysis is repeated introducing the Janus Eurobond scenario. The comparison between median forecasted values in the two scenarios finds an important benefit for Italy in the latter one and no significant difference for France and Germany. The forecasted variability is

always lower in the Janus Eurobond scenario. Afterwards, the model is extended considering the primary budget position adjusted for cycle; debt dynamics seems quite robust to this extension. The following paragraph presents a focus on interest expenditure, aiming at understanding the debt dynamics in the different scenarios.

The last section verifies whether the Janus Eurobond could immunize debt dynamics from exogenous monetary, real and fiscal shocks. A rise in inflation, a growth slowdown and an increased expansive fiscal policy are considered in the baseline and Janus Eurobond scenario. Results support the suitability of the Janus Eurobond as an immunizing instrument for the European Monetary Union.

1. The stability problem of the European Monetary Union

The surge of the European sovereign debt crisis in 2010 pointed out the weaknesses of the monetary union. It had been clear since the beginning of the project that the elimination of monetary policy and foreign exchange policy at national level would represent an important challenge when dealing with negative macroeconomic and financial shocks (Feldstein 1997 and Wyplosz 1997). According to Lane (2012), the institutional design of the euro increased fiscal risk in the pre-crisis period and amplified fiscal dynamics once the crisis occurred.

During the first phase of the monetary union, spreads on government bonds between different European countries were almost null: less virtuous nations benefitted of the positive externality that being part of the monetary union represented. When macroeconomic and financial conditions changed a few years later, markets' judgments became stricter than before 2007 crisis[1] (Caggiano and Greco 2012).

After the 2007 financial crisis boomed, the European banking system suffered: banks' balance sheets teemed with rotted securities on the asset side. Consequently, the European governments increased expenditure in order to support the banking system and boost real economy. This contributed to exacerbate fiscal disorders. Between 2009 and 2010, some countries faced difficulties financing themselves on the markets. Financial markets started worrying about fiscal imbalances, and they required compensation for the increased default risk. In fact, the spreads of government yields between disciplined and undisciplined countries increased.

The surge in interest expenditure contributed to deteriorating the fiscal position of countries, which were already suffering, leading to a proper sovereign debt crisis.

---

[1] See Section 2.3 The determinants of government bond yields, Country-specific risk

The crisis was such that all the euro system was in danger; if one country defaulted, it was not clear if the euro system could survive the shock. Moreover, the failure of the monetary union could represent the failure of the whole project of integration between member states; the problem could spread from the economic to the political plan.[2]

Crisis conditions highlighted the fragility of the monetary union, in absence of a banking union and other European-level buffer mechanisms (Lane, 2012). Unfortunately, European regulation was not clear about the procedures to adopt, however an intervention seemed necessary.

1.1 The EFSF and ESM programmes

In 2010, Greece lost the capability to finance itself on the markets. Despite general efforts to ensure stability during the previous years, no institutional solution existed. The immediate reaction was the Greek Loan Facility: euro area members granted a loan to the Greek citizens on a bilateral basis.

In June 2010, the European Financial Stability Facility (EFSF), a public limited liability company under Luxembourg law, was born as a temporary solution. Its main function was to signal European commitment to the integrity of the monetary union. Member states established a Framework Agreement to govern EFSF and its €440 billion guarantee structure. One of EFSF's main tasks was to keep credit rating the highest possible; therefore its lending capacity was back-guaranteed by highly rated entities. In June 2011, its maximum guarantee commitment reached €780 billion by decision of euro zone Heads of State and Government. In addition to this, the new agreement increased the number of available instruments to the EFSF, expanding its operational flexibility. The palette of instruments included loan facilities,

---

[2] "If the euro fails, Europe fails." The German Chancellor Angela Merkel made clear her point in September 7th, 2011 speech. At the time member states feared that country specific difficulties to access financial markets could make the whole euro system collapse.

which provided recapitalisation to financial institutions through loans to governments, market facilities, purchase of government bonds on primary and secondary market, and precautionary facilities. The precautionary credit line, which included both a Precautionary Conditioned Credit Line (PCCL) and an Enhanced Conditions Credit Line (ECCL), demanded specific but lighter requirements and active monitoring. They consisted in a loan or primary market purchase and initially lasted for one year, renewable twice for six month each time. The EFSF financial assistance relied on a Memorandum of Understanding (MoU) with the involved country.

In practice, the most commonly implemented has been the loan facility. In order to receive all kind of financial support, countries had to meet eligibility criteria. They regarded the sustainability of public debt and commitment to the Stability and Growth Pact (SGP) and the excessive deficit procedure (EDP). Moreover, other criteria regarded capital markets access, external position and banking system stability.

In October 2012, the European Stability Mechanism (ESM) followed, as a permanent solution, the EFSF, which still exists as a legal entity but no longer active. Countries that face difficulties accessing financial markets can ask to enter the program and, if eligible, borrow financial resources. The ESM, as the EFSF, works on a cash-for-reform-basis, a structural and financial reforming plan is required when signing a deal with the ESM. The palette of instruments at its disposal is the same as the one described for the EFSF. So far, EFSF and ESM have disbursed €254.5 billion to five countries: Ireland (February 2011), Portugal (June 2011), Greece (March 2012, August 2015), Spain (December 2012) and Cyprus (May 2013); easing the debt burden, given lower interest rates and larger repayment periods. Cyprus, Ireland, Portugal and Spain successfully exited the program without a follow-up arrangement. Greece instead is the only still active program.

Both these mechanisms served their mandates: helping in crisis resolution and rebuilding confidence and financial stability in the euro area (ESM, 2017). Both of them acted in a

professional and neutral manner, achieving credibility in the eyes of market agents. In fact, the programmes' activities satisfied both creditors and borrowers.

However ESM and EFSF functioning present some limits. First, the delay of the intervention in some cases increased the financing needs to regain debt sustainability. These solutions were set up in crisis conditions, when countries that could no longer finance themselves on the markets requested an intervention. The burden of the administrative system, the definition of eligibility criteria and related assessment, unavoidably delayed the rescue. Secondly, monitoring activity on structural reforms implementation usually require longer time horizons and larger administrative capacity to be effective.

Although these programs have undoubtedly been necessary and somehow successful, it is clear that these measures alone were not sufficient to support the monetary union under financial and macroeconomic instability.

1.2 European Central Bank's intervention

The European Central Bank had been injecting liquidity to support the European banking system since the 2007 financial crisis. This action became insufficient when some countries lost market access to finance themselves. ECB intervention included both conventional and unconventional actions. It mainly focused on interest-rate reduction, enhanced credit support, securities purchase on the secondary market. In May 2010, the 209 billion euros Securities Market Programme (SMP) initiated. The euro area central banks were empowered to purchase marketable debt instruments denominated in euro. They were allowed to act on the secondary markets for securities issued by the central governments or public entities of the Member States; both on primary and secondary market when the issuer was a private entity incorporated in the euro area (Governing Council of the European Central Bank, 2010). Officially, the programme tried to address the malfunctioning of securities markets and restore an appropriate monetary policy transmission mechanism (ECB Press Office, 2010). In

practice, it was an attempt to help governments whose sovereign securities traded at unsustainable interest rates on financial markets (Lionello, 2015).

After the setting up of the European Stability Mechanism, the ECB initiated a more structured asset purchasing policy on the secondary market. The former ECB president, Mario Draghi, in his speech at the Global Investment Conference in London, July 2012, stated the irreversibility of the single currency and his engagement to preserve it[3]. This announcement demonstrated the determination of the ECB to keep euro area integer (Clayes, 2014).

In September 2012, the ECB set up a new program, the Outright Monetary Transactions (OMT), which are outright transactions in secondary sovereign bond markets. It assured unlimited monetary support conditional to the implementation of reforms of macroeconomic adjustment under ESM supervision. A necessary condition for the programme to be active is the attachment to an EFSF/ESM programme. Transactions had to focus on the shorter part of the yield curve, purchasing sovereign bonds with maturity from one to three years. OMT had no ex-ante size limit, but the ECB guaranteed its commitment to a certain degree of transparency, with the weekly publication of holdings and related market value. As the SMP, the OMT required full sterilisation of the liquidity injected in the market.

Even if it was never active nor effective during its first year of existence, the OMT programme announcement had positive effects: the commitment of the ECB to the single currency stabilization helped contain speculation on financial markets. Market agents thought this announcement was credible, because pressure on the euro decreased. The announcement of such commitment convinced market agents; ECB's move was a success in this perspective. OMT stopped speculation against euro but was not effective in adverting the risk of deflation, therefore on January 22nd, 2015, the ECB pursued Quantitative Easing. The Governing

---

[3] The ECB president Mario Draghi made a clear point in 2012 August 2nd press conference when he made the statement: "It is pointless to bet against the euro. It is pointless to go short on the euro. [...] It is pointless because the euro will stay and it is irreversible." Market agents thought this announcement was credible, because pressure on the euro decreased. The announcement was a success.

Council of the ECB announced an expanded asset purchase programme, aimed at fulfilling its mandate of price stability. It added the purchase of sovereign bonds to the existing private sector asset purchase programmes in order to face the risk of deflation that was threatening the euro area. The ECB Quantitative Easing injected liquidity in the financial system purchasing bonds for 60 billion euros until September 2016. According to the ECB press release of the time, the central bank had to pursue its objectives in "an unprecedented economic and financial environment" and claimed that its decisions were in full compliance with the EU Treaties.

These actions altogether seemed to bear out a new interpretation of the ECB mandate, namely monetary policy and price stability.

1.3 The Gauweiler case

The ECB's behaviour has been criticised and the legality of its action questioned. The main objection has been that ECB's actions aimed at supporting the public finances of some member states, while it should pursue only monetary policy objectives according to a strict interpretation of the Maastricht Treaty and ensuing legislation. The debate did not only stick to the academic field. In January 2014 the German Constitutional Court, prompted by a group of German citizens (Gauweiler and others), raised a preliminary question before the European Court of Justice. The case was made of two fundamental questions. First, whether the OMT programme could qualify as a monetary or economic policy measure, conflicting with the ECB mandate in the latter case. Second, whether this programme infringed Art. 123 TFEU (Treaty on the Functioning of the European Union) which prevents the ECB from providing monetary financing to member states (Lionello, 2015).

According to the Advocate General of the Court of Justice of the EU, the real objective of ECB actions was monetary policy, protecting its main transmission mechanism in order to maintain price stability. It was therefore necessary to do actions in order to keep the monetary

union safe, otherwise, if the monetary system collapsed, there would not be any scope for price stability and regular ECB objectives. In this perspective, safeguarding the single currency and the stability of the system are ancillary objectives to the ones for which the ECB has explicit mandate.

Moreover, in the Advocate General's view, in case of implementation of OMT the ECB should distance itself from the economic policy and fiscal requirements of the ESM, which clearly fall under the definition of economic and fiscal policy. Finally, the ECB should introduce detailed regulation for the OMT programme not to infringe the principle of proportionality.

Secondly, it seems clear to the AG that an asset purchase programme on the secondary market, when prices already stabilized, is not conflicting with the non-financing member states restriction. In this perspective, ECB actions do not necessarily alter fiscal discipline.

The ECB eventually won the case: the interdependence between monetary policy and economic objectives made it clear that the monetary policy instruments used by the ECB had unavoidable economic consequences (Tridimas, 2016).

Nevertheless, this case highlighted the unsustainable asymmetry between economic union and monetary union. Moreover, it became clear that some factors contributed to the eruption of sovereign debt crisis; the economic union fragmentation, the lack of common debt guarantees or effective coordination of budgetary policies. Under financial adverse conditions and institutional weakness the survival of the single currency itself is in danger, consequently all efforts towards price stability would be ineffective. For this reason, the ECB intervened to reduce financial instability, transforming its role, acting as a guarantor of stability of the monetary union as a whole. Provisionally the ECB has taken charge of the role of conditional lender of last resort for the euro zone banking system and sovereign debt market. It is in this framework that some permanent solutions seem essential in order to improve financial stability of the monetary union and prevent future crisis.

1.4 A structural remedy: the Eurobond

Considering the narrative of the euro zone crisis briefly described above, it seems clear that the absence of fiscal union or at least an effective fiscal coordination is a problem for the monetary union. The level of debt in euro zone countries is nothing exceptional compared to other economies across the world (Boonstra, 2011); the weakness of the EMU comes from the fact that monetary policy is constrained, therefore it is an inadequate instrument to relieve debt burden. If we reverse the point of view, the BCE does not have explicit mandate to buy Euro Zone sovereign debt instruments. The European Monetary Union needs a neutral corrective instrument to heal its structural weakness, a European safe asset. This instrument may satisfy the need for a monetary policy tool, in order to perform open market operations and protect financial stability of the EMU keeping member countries' debt levels on a sustainable path. Moreover, some economists theorized that this safe asset could become an alternative to US Treasury Bonds on the international markets, empowering the euro as reserve currency (Claessens *et al.*, 2012).

The Giovannini Group (2000) was the first to advance the Eurobond proposal, as a strong instrument of debt management cooperation, increasing market integration and liquidity. A Eurobond is a security emitted by an institution on behalf of the monetary union. Part of the debt burden countries are currently bearing would be relieved, theoretically increasing the protection from flight to safety and volatile market sentiments. The pooling of risks should ideally enhance risk-sharing, giving investors the opportunity to buy an almost-safe asset. The current fragmentation of the European bond market gives rise to frictions and inefficiencies. A unique bond market could provide protection against cooling episodes on the markets and liquidity crisis. Furthermore, a European bond would be a completely neutral monetary policy transmission tool at disposal of the ECB. Currently when the ECB needs to conduct open market operations, it can only buy or sell country-specific bonds and has to intervene in more markets in order to observe some impartiality constraints, often compelling it to operate

inefficiently. Nevertheless, the Eurobond project never came to light. It has been strongly criticized by many authors (Issing 2009 and Ifo Institute 2011). Firstly because its realization presents considerable political barriers. The unique interest rate would give the chance to fiscally undisciplined countries to finance themselves cheaply. The scope for moral hazard would be high; the risk of creating bad incentives is worth consideration. The Eurobond subscription may imply "joint and/or several" guarantees burdening on involved states: if a member country defaults, the others have to pay to satisfy creditors. Germany and other northern countries strongly opposed to the Eurobond fearing it implied additional financing costs and risk for their country, while the countries in fiscal troubles would benefit from it. In other words, they thought fiscally virtuous countries would subsidize undisciplined ones. In any case, the political implementation of such mechanism seemed difficult. Gros (2011) highlighted Europe's lack of fiscal integration; he claimed that the Eurobond would make sense only if the United States of Europe existed.

The design of the debt mutualization mechanism crucially influences the feasibility and success of the project.

During the last twenty years, many Eurobond proposals tried to deal with the limits presented. De Grauwe and Mosen (2009) proposed a collective debt instrument that may contain moral hazard. They designed a world in which the European Investment Bank, whose shareholders are member countries of the European Union, manages the emission of Eurobonds. These securities trade at a unique interest rate on the market, calculated as the weighted average of interest rates on member states' bonds. Shareholders transfer part of their public debt to the EIB, receiving financial resources on which they pay a differentiated spread according to their fiscal position and behaviour, the same they would pay on the financial markets. This design protects member countries from shifts in market sentiments and contagion effects in case of liquidity crisis, preserving correct incentives to fiscal discipline.

This approach was criticized arguing that if the spreads payed to receive financial resources were the same as on the markets, interest expenditure for many countries would remain

unsustainable, therefore the stability issued would not be settled (Boonstra, 2011).

A different proposal is the "Blue Bond-Red Bond" mutualization scheme (Delpla and von Weizsäcker, 2010). It is a voluntary program and it consists in splitting a nation's debt into two tranches: a senior tranche up to 60% of the total stock, emitted in Blue bonds, which are safe and guaranteed at European level; the remaining part has only a national guarantee, thus Red Bonds, as they are riskier. This scheme should let the markets differentiate the cost of borrowing of individual States, avoiding the convergence to a unique interest rate, which is something the most disciplined countries cannot accept. According to the authors, this mechanism should provide isolation from the risk of contagion from countries facing difficulties in refinancing on the markets. Theoretically, market discipline applied to the residual stock of debt should keep incentives unaltered and moral hazard under control. Unfortunately, the reliance on market discipline was one of the main downsides of this proposal; Boonstra (2011) points out that markets completely mispriced national bonds in the decade 2000-2010, just to make an example. Moreover, since participation is voluntary, the most stable countries may not join the program and, if one country decided to exit it, the whole system would suffer. Boonstra (2012) advanced the proposal of the transitional regime of Euro-Treasury Bills: collectively guaranteed (cross-guarantee) short-term Eurobonds. The participation to the program is subject to solvency condition: those countries that already need financial support do not qualify. Insolvent countries can pursue their reorder path as agreed with the EFSF/ESM. Once stabilized their finances, they might apply to join the program. Participating countries can finance themselves over a period of four years through collectively guaranteed short-term (maximum maturity is two years) bonds issued by a new agency, the EMU Fund. States cannot issue other short-term bonds, while they manage issuance of long-term securities singularly.

Financing costs may vary from country to country: States whose budget deficit exceeds 3% and/or with a national debt/GDP ratio exceeding 60% will have to pay a premium on top of the necessary costs to finance the agency. The premium is a weighted average of the

deviations to target debt and deficit levels. The relative size of each component would be the result of a political bargaining process. Part of the resources collected through this process become as reserves in the EMU Fund balance sheet. This element together with the strict criteria that constrain participation and the cross-guarantees ensure that Euro-T Bills will reassure the markets. The author envisages also a liquidity premium given the dimension of the market and low-interest rates.

The temporary nature of the program is an advantage firstly because it is fast to introduce, secondly because it gives the opportunity to experience a "trial period". It gives member states the time and opportunity to design carefully a permanent solution. Its structure encourages states to design long-term oriented policies and reorder their finances. Moreover, it has a very strong disciplinary effect: the moral hazard issue is contained differentiating financing costs through the mechanism mentioned above. In addition to this, its sanctions are credible because if states do not respect the requirements they shut out of the programme or the follow-up.

However, the exclusion of an undisciplined member state would imply non-negligible effects on the stability of the mechanism. Another limit of the mechanism is that weaker participating countries may not be able to issue long-term maturity bonds; financing debt only to short-term securities may increase the sensitivity to interest rate. Finally, the political decision process assigning relative weights of debt and deficit deviations to targets may encounter some frictions.

De Haan et al. (2013) present a scheme in which the European budget authority is in charge of emitting bonds on the markets on behalf of euro zone countries. Member countries qualify only if they prove to keep their fiscal position on a sustainable path as defined in the Maastricht Treaty or according to monitored adjustment programs followed by the ESM.

This proposal has criticized because it would require a deep degree of fiscal integration between state members, therefore the times do not seem mature for this kind of solution, which would need a long process to restructure the EMU and create a proper fiscal union.

Going beyond the need of additional fiscal integration between member states, Brunnermeir *et al.* (2012) present the European Safe Bond system. The European Debt Agency is the institution in charge for the purchase of national bonds according to some size-related fixed weights and the emission of two kinds of securities: the ESBies (senior tranche) and a junior one. The main advantage is that there is no need to overturn the structure of the EMU designed by the Treaties.

During this decade many other proposals have been advanced; each and every one of them is an attempt to provide Euro Zone countries with a mechanism that increase liquidity in government bond markets, thus decreasing financing costs and keeping debt levels on a sustainable path, while containing moral hazard and dealing with imperfect fiscal integration of the union. It is clear from the analysis above, that this challenge presents some trade-offs.

The EMU did not implement any of these proposals. It is not clear whether this happened for political reasons rather than for economic ones. Nonetheless, each proposal mentioned presented some limits.

1.5 A bi-faced Eurobond proposal

The previous analysis of Eurobond versions highlighted an intrinsic trade-off: the necessity to reduce the debt and interest expenditure burden for European countries against the need to contain moral hazard. Redistribution is unacceptable for most virtuous countries, which are not willing to subsidize others. Therefore, it seems necessary to design a mechanism that could reproduce market incentives and, at the same time, support countries that face difficulties in refinancing themselves for the sake of European Monetary Union's stability.

In order to tackle the trade-off we imagined a model for a European mechanism whose design is twofold. Our idea exploits the intuitions De Grawe and Mosen (2009) and Boonstra (2012). The first ones proposed a Eurobond carrying a unique financial interest on the markets and a mechanism to replicate the same financing costs that every member country would pay on its

specific bond market, keeping market incentives theoretically unaltered. On the pros side, creating unique market for Eurobond could provide the European Central Bank with a completely neutral instrument to perform open market operations, without passing through the single-country central banks and government bond markets. The limit is that, as highlighted before, for some States, interest expenditure would be unsustainable. The second one proposes a mechanism to apply differentiated financing costs on a fiscal incentives basis: i.e. countries deviating from a target level of debt-to-GDP and deficit-to-GDP pay more to finance themselves through the Eurobond.

Our Eurobond proposal combines these two features: a unique interest-bearing Eurobond and a discipline mechanism based on fiscal ratios.

Every member country could decide to allocate part of its debt to a European Debt Fund, who is in charge of the emission of Eurobond on the markets. The same institution would supervise fiscal behavior of member States and charge differentiated financing costs.

We decided to name this Eurobond *Janus*. The name comes from Latin mythology, Janus was the God of Beginnings; he was capable of looking both at the past and the future at the same time. In fact, in every representation he had with two faces. Similarly, the Janus Eurobond, is characterized by duplicity traits, which lie in the construction of the interest-rate. Janus Eurobond should trade at a unique interest rate on a new, large market for European government bonds; this is the "basis interest". Furthermore, each country will pay an additional differentiated spread, according to specific parameters based on fiscal fundamentals. The differentiated financing costs should reduce the scope for moral hazard and safeguard the right incentives. Member countries would be encouraged to keep their fiscal balances on a sustainable path.

Before moving to an empirical simulation of the Eurobond we imagined, we look at risk determinants of government bond yields. Our intent is to create a system in which institutional discipline replaces market discipline. Market discipline has the flaw that it can

expose the whole EMU to financial instability[4]. The main objective of the Janus Eurobond proposal is to create an instrument that protects and stabilizes the Eurozone and at the same time keeps the correct incentives for member countries. This is the reason why next section has a focus on markets, how do they price risk and their implicit discipline.

---

[4] The problem of instability of the European Monetary Union lies in the fact that it is highly exposed to market sentiment and erratic movements; moreover its current structure is characterised high degree of contagion risk.

2. The determinants of government bond yields

In this section, we focus on the main drivers that explain spreads, the differences between government bonds yields in order to be able to build a model, aimed at keeping moral hazard under control, charging specific financing costs to each country.

There are several elements affecting government bond yields, we will aggregate them into the following macro components: aggregate global risk, risk aversion and liquidity risk, country specific risk and contagion risk. The paragraph about country specific risk includes a sub-section analyzing alternative ways to measure credit risk: Credit Default Swaps and credit ratings.

Literature on European government bond yields is not unanimous attributing weights to these different determinants and the time series analyzed present a structural break after the 2007 global financial crisis. In this review, we will go over models specifying whether they are suitable for the period before during and after the crisis.

2.1 Aggregate global risk

The global component of risk incorporates the uncertainty on the markets across the world; it captures the level of perceived risk and its unit price. In crisis conditions, it reflects the loss of mutual trust between market agents. Typically, it is measured with the spread between corporate triple B US bonds and the Treasury bills as in Codogno et *al.* (2003), Gerlach et *al.* (2010), De Santis (2012). In other cases, US VIX, the stock market volatility index, was a reliable measure. Prior to 2007 financial crisis, international risk was an important factor in government bond yields and spread determination. Codogno *et al.* (2003) provided evidence that movements in yield differentials between government bonds explained by international risk fluctuations are more evident for Italian and Spanish government bonds. Geyer *et al.* (2004) conducted a research focused on joint dynamics of government yield spreads in EMU;

they found out that corporate bond spreads and swap spreads had an important and significant impact, meaning that bond yield movements were in line with market aggregate fluctuations. For the years of the crisis, Barrios *et al.* (2009) present an empirical analysis pointing out the importance of global aggregate factors in investors' risk perception and, at the same time, highlight the non-negligible incidence of regional determinants, especially risk aversion interacted with macroeconomic fundamentals. Perfectly in line with the previous results, Sgherri and Zoli (2009) confirm that government bond yields in euro area tend to move together, following a common time-varying factor, which represents international risk perception. In addition to this, they provide evidence that since October 2008 markets started concerning more about other country-specific factors, such as national fiscal fragility and debt dynamics, which we will deeper analyze in the following section. Also Favero *et al.* (2010) find a common trend in yield differentials, correlated with a measure of aggregate risk, coherent with previous findings. The relation between aggregate global risk and government bond yields movements seemed stronger during crisis time, especially for countries that already had high levels of public debt. (Haugh *et al.*, 2009).

According to Gerlach *et al.* (2010) the aggregate global component is the main driver of bond yields, especially when interacted with the bank system dimension. This happens because when banking system faces difficulties governments may want to intervene, increasing public debt and fiscal imbalances. During the crisis aggregate global risk remained an important factor; nonetheless macroeconomic and fiscal variables started to gain more importance. According to Zaja *et al.* (2018), who conducted a research on Croatian bond market movements before during and after the crisis, during the second period of the crisis, financial and political variables played an important role, while in recovery period macroeconomic variables were the most significant.

In summary global aggregate risk was the most important factor determining the fluctuations of government bond yields in the years before 2007; subsequently, the tightening of international financial conditions made markets agents more concerned also about other

determinants.

2.2 Risk aversion and liquidity risk

Risk aversion and liquidity are highly interrelated: when investors perceive a high level of risk, the phenomenon of *flight to liquidity* or *flight to safety* may occur, Schwarz (2014). Risk aversion continuously adjusts in investors' preference function. In bad times investors' risk aversion and demand for risk premium increase, their willingness to take risks decreases. Their preferences may shift towards the safest bonds in terms of credit risk and liquidity.

Liquidity has to do with the probability to value and trade assets at any time. European national bond markets differ in terms of liquidity. Liquidity movements follow pro-cyclical patterns, based on transaction intensity in a given time lapse. Factors that determine liquidity are market breadth and market depth. The first depends on the volume of buy and sell orders issued by market participants in a given time lapse, while the latter is affected by the impact that large volume transactions may have on market price. Moreover, the volume of issuance and the presence of futures or other hedging instruments influence market liquidity.

Literature is heterogeneous when assessing the importance of liquidity issues in the determination of government bond yields in the euro zone. Again, this is due to the structural break that the crisis created.

According to Codogno *et al.* (2003), Bernoth *et al.* (2004), Pagano and von Thadden (2004), Jankowitsch *et al.* (2006), liquidity factors play a smaller role as a spread determinant. All these papers analyzed the period prior to the crisis, when markets agents had enough confidence in EMU's stability not to be concerned about liquidity issues.

After the crisis boomed, liquidity became a core component in sovereign bond yield determination; Gomez-Puig (2006) studied the relative importance of domestic component of euro zone sovereign yield spreads since the start of EMU: the results show a change in value of liquidity, measured as market size. Beber *et al.* (2009) tried to verify whether investors

chase more for credit quality or liquidity; their findings show that usually credit quality is what matters, though liquidity plays a non-trivial role, especially for low credit risk countries. In times of market stress and heightened uncertainty, liquidity is the variable that counts the most to determine sovereign bond yields. Perfectly in line with previous findings Manganelli and Wolswijk (2009) state that liquidity risk components are significant in their econometric model explaining euro system short-term interest rates.

Nonetheless Favero *et al.* (2011) take distance from mainstream research, providing empirical evidence that liquidity factors, approximated by bid-ask differentials, turn out to be insignificant when considered in isolation.

Monfort and Renne (2013) measured risk aversion using the spread between Kreditanstalt fur Wiederaufbau bank bond and the German Bund. The German government secures both bonds, so default risk is the same and the spreads reflects the different liquidity perception investors have towards these assets. According to their model, liquidity variables account for a sizeable share of sovereign bond yields fluctuations. Schwarz (2014) focuses her research on liquidity issues finding that liquidity component weights up to two thirds of sovereign spreads.

To sum up, liquidity and risk aversion weight differently according to the external macroeconomic and financial conditions; it seems that in crisis period investors pay more attention to these factors. From a policy-maker point of view, the issue is far from being irrelevant. If liquidity has sizeable weight in the determination of bond yields, there is scope for improving efficiency unifying bond markets at European level. Otherwise, policy-makers would better focus on internal factors such as political or fiscal stability in order to stabilize the European Monetary Union.

2.3 Country specific risk

This component includes both default risk and credit risk spread.

Default risk is the probability that the issuer fails to meet his obligations: the coupon payment or capital repayment at maturity.

Credit risk spread represents the risk that price of the bond performs on the market worse than comparable quality securities; it is the probability that the value of the bond declines more than the value of comparable bonds.

The literature consistently supports the idea that sovereign credit risk weight in government bonds yield depends on the financial and macroeconomic framework. For the years prior to the crisis, according to Codogno *et al.* (2003) it was a small but important component. Bernoth *et al.* (2004) conducted a study on euro area and US sovereign bonds: they found that fiscal factors, such as debt, deficit and debt-to-service ratio, partly explained spreads. Consequently, Ardagna, Caselli and Lane (2007) investigated the effects of fiscal imbalances (debt and deficit) on long-term sovereign interest rates using a panel of 16 OECD countries. They find that a 1% increase in the deficit-to-GDP ratio increases contemporaneous long-term interest rates by approximately 10 basis points. Moreover, according to their results the relationship between debt-to-GDP ratio and sovereign interest rate is non-linear.

For the crisis period Attinasi *et al.* (2009) and Barrios *et al.* (2009) both support the idea that internal macroeconomic factors such as debt-to-GDP or deficit-to-GDP ratios, external position, growth indicators, industrial production, or borrowing capacity on the primary market played a key role. Gerlach *et al.* (2010) found out that debt-to-GDP current value was significant in the determination of bond yields; while for deficit-to-GDP ratio, future projections were significant variables. Similarly, Aizenman *et al.* (2011) using data from both inside and outside the EMU, analyzed spread behavior of the weakest economies following fiscal fundamentals. They find out that PIIGS' (Portugal, Ireland, Italy, Greece and Spain) spreads were too low before 2007 and too high during the financial crisis. Before the crisis, investors' confidence in the stability of the EMU outmatched fiscal fundamentals, while in the following period they incurred in the backlash of the loss of confidence. Default risk was based not only on current fiscal fundamentals but also and mostly on the projections of future

fiscal position. This means that the surge in spreads after 2007 revealed markets negative expectations about the resolution of the crisis. Moreover, according to Attinasi *et al.* (2009), during the crisis, the impact on spread was very significant when fiscal ratios were higher than expected; in other words markets reacted enhancing the demand for risk premium when fiscal position gets worse than projected.

Another important aspect to consider is the role of domestic banking sector. Candelon and Palm (2010) investigated the liaison between the sub-prime crisis and the sovereign debt crisis: it turned out that the banking sector's fragility had a key role in the contagion for three reasons. First, shortages in banks' liquidity contracted credit to private sector, provoking a recession, the slowdown of real economy and the increase of fiscal imbalances. Second, in some cases banks bailouts were necessary: governments had to intervene recapitalising banks' balance sheets, raising further public liabilities. Third, the announcement of the bailout itself, if perceived as financed through future taxation, reduces the incentive to invest in the real sector, lowering growth and future tax revenues. Gerlach *et al.* (2010), whose research found a significant coefficient for the interaction variable between aggregate risk factor and the size and structure of national banking sector, find coherent results.

Achrya et al. (2011) deeply investigated the relationship between financial sector bailout and sovereign credit risk using CDS (Credit Default Swap) data for Euro Zone countries for the period 2007-2010: they showed that the bailout announcement had an immediate effect widening sovereign spreads. Gomez-Bengoechea and Arahuetes (2019) studied the relationship between sovereign risk and macroeconomic fundamentals for twelve Euro zone countries[5] for the period 2000-2012. They prove the existence of a country-sentiment effect that affect the relationship between macroeconomic indicators and sovereign risk.

---

[5] The authors constructed an unbalanced panel with quarterly data from 2000 to 2012 for the 12 Eurozone countries: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Luxembourg, Italy, The Netherlands, Portugal and Spain. They proposed a model that explains spreads through the main categories of variables observed in the literature.

For what concerns the second period after the crisis, Anzoategui (2018) studied the effect of fiscal contraction that characterised Eurozone since 2010, with a focus on the Spanish case. His results showed that, contrary to policy-makers' expectations, austerity did not decrease current spreads in sovereign bond yields nor debt-to-GDP ratios. Nonetheless, according to the long run model, Spain is more likely to present lower level of debt and spreads. In other words, current fiscal and macroeconomic fundamentals correlate to future sovereign bond yields. This fact may be due to two reasons: first because austerity may have negative effects on growth, exacerbating fiscal imbalances in some cases; second because it may have taken some time for markets to rebuild confidence after the twofold crisis, financial and, subsequently, sovereign.

In summary, for the pre-crisis period macro-fundamentals did not matter much, with the exception of expected budgetary deficits. After 2007, fiscal imbalances became more relevant, also interacted with international risk factors. As a reaction, during the crisis markets seemed to penalise fiscal and other macroeconomic imbalances much more heavily than before, even more than some models predicted. These became the main drivers of spread heterogeneity in the post-crisis period. After the global crisis, during the surge of sovereign debt crisis, fiscal fundamentals lost some weight in the determination of spreads, mostly because markets preferred to act rather conservatively, keeping spreads unaltered in most cases.

In the last twenty years economists encountered heterogeneity in markets' response to fiscal and internal country-specific factors; parameters show instability according to financial and macroeconomic framework.

2.3.1 Approaches to measure credit risk

In the following section, we will go through the instruments to measure credit risk. They are fundamentals, credit default swaps and credit ratings.

2.3.1.1 Fundamentals

Credit risk is affected both by fiscal and macroeconomic fundamentals.

Fiscal ratios as debt-to-GDP and deficit-to GDP ratios are the most commonly used measures to proxy debt sustainability. It is important to highlight that usually fiscal variables are included in the model as expected values, because investors look at the capability of the issuer to meet its obligations in the future, at maturity time; therefore, market's expectations must be taken into consideration. This strategy is common to many studies in literature, including Attinasi *et al*. (2009), Sgherri and Zoli (2009), Gerlach *et al.* (2010) and Favero and Missale (2011).

Debt-to-GDP is a fiscal ratio expressing the amount of public debt accumulated by the issuer as a percentage to Gross Domestic Product. Deficit-to GDP ratio is the ratio expressing the relative dimension of deficit (or surplus) accumulated in one year over the amount of GDP.

A high amount of debt and the accumulation of deficits can make investors doubt about the issuer's capability to meet all its obligations. In this case, the issuer pays a premium for risk (higher yield).

Another important aspect is the functional form between Debt-to-GDP and sovereign bond yields: some authors claim it is non-linear and convex, a quadratic factor of the fiscal ratio is usually introduced between the explanatory variables, following the suggestions of Bernoth *et al.* (2004), Bernoth and Erdogan (2010), De Grawe and Ji (2012) and Di Cesare *et al.* (2013).

Macroeconomic fundamentals play an important role when assessing the credit quality of country's issuance. The most important ones are inflation rate, real effective exchange rate and GDP growth rate.

Inflation is an important variable to evaluate an economy's health conditions. In this perspective, it can have an impact on the perceived riskiness of sovereign bonds. In particular, inflation shocks are found to affect government bond yields: according to Poghosyan (2012) this is mainly due to the "surprise effect". Moreover, a rise in inflation can be a signal for

government's fiscal undiscipline, therefore higher inflation can be associated with higher political instability and sovereign bond yields (Guler and Talasli, 2012). This dynamic reverses in case of deflation.

Another important element is the logarithm of the real effective exchange rate; it should capture credit risk caused by general macroeconomic disequilibrium, moreover it is a specific measure of external competitiveness. According to Arghyrou and Tsoukalas (2011), a real exchange appreciation reduces markets' perception of credit risk, and, therefore, spreads. Arghyrou and Kontonikas (2012) confirmed the result. Real exchange rate expresses a ratio relative to a single currency; in order to capture external competitiveness vis à vis the rest of the world, Di Cesare *et al.* (2013) used a trade-weighted mean of real exchange rates calculated against the country's main trading partners.

Di Cesare *et al.* (2013) approximate the growth rate of a country using the growth rate of its industrial production,. According to Bernoth *et al.* (2004) sovereign debt becomes riskier in phases of economic slowdown: growth usually helps contain debt, for this reason an increase in growth performance improves credit worthiness and reduces government bond yields.

2.3.1.2 Credit Default Swaps

An alternative approach to fundamentals is the credit default swap (CDS). It is a credit derivative contract, is a financial derivative that allows investors to offset their credit risk with the one of another investor. A credit default swap transfers the credit exposure of fixed income products between two or more parties. In a CDS, the buyer of the derivative regularly pays to the swap's seller a payment, which takes the name of spread, until the maturity date of the contract. In return, the seller agrees to reimburse in case of default or another credit event the security's value and all interest payments until maturity date. From another perspective, a CDS works as an insurance contract between two parties, the protection buyer and the seller of the contract, against a credit event involving a reference entity. (Byström 2005) The reference entity can be a bond or a loan issued by a financial entity or a sovereign institution;

the reference's credit risk unavoidably affects the value of the CDS (Jacobs et al., 2010).

The CDS contract includes every counterparty risk, its spread is determined both by the probability of any credit event of the reference entity and the correlation between this entity and the protection seller (Giglio, 2010). Consequently, according to Noeth and Sengupta (2012), CDS spread movements are useful to understand how markets price default risk of sovereign reference entity. Moreover, Zhan *et al*. (2005) prove CDS are a good estimator of how markets price default risk in the short run because they respond more promptly to credit conditions changes compared to credit ratings, which usually take time to adjust. This could explain why Callen *et al*. (2007) observe rather wide variation in CDS spreads. Credit ratings cannot fully explain their variation, even if the correlation is strong. The first to the relationship between CDS markets and credit ratings were Hull *et al*. (2004), who investigated the extent to which corporate CDS markets anticipate credit rating events. They find that anticipation of negative events by the markets is significant and that CDS spreads fully reflect the new information the day after a negative event. They do not find any significant result for positive events.

Going beyond these findings, Flannery *et al*. (2010) tried to verify whether CDS spreads could replace credit ratings. There is a structural break in their results: before summer 2007, CDS spreads were not very significant about credit risk of the reference entity, while after the crisis they started reflecting disclosure, becoming a valid alternative to credit ratings. In line with previous research, Jacobs *et al*. (2010) examined the relationship between CDS spreads and credit ratings' roles clarifying how markets price risks. They ran a survey on Bloomberg data about 391 five years CDS contracts over the time lapse 2003-2008; they investigated the dependent factors affecting the variation scope of spreads, controlling for ratings. Empirical results show that after controlling for market returns, market volatility and interest rates, CDS spreads increase with the subordination of the debt instrument, the put-implied volatility or deteriorating credit quality of the reference entity.

More recently, Augustin (2018) highlights the importance of the sign of the slope of CDS

spread term structure to signal the effect of global and domestic risk factors on sovereign risk. Analysing cross-country heterogeneity across 44 countries, he finds that global risk shocks affect CDS spreads if the term structure is positively sloped, while domestic determinants matter more when the slope is negative.

CDS spreads and credit quality of the issuer are strictly related, as literature proved in many ways; unfortunately they trade on the markets where episodes of financial speculation are not so rare and it is sometimes difficult to distinguish between the "market effect" and the "credit quality effect". For this reason, CDS often serve as a benchmark, a tool to use to compare to traditional methodologies (aka fundamentals approach), to evaluate credit quality of an issuer, because market experts do not perceive it as enough reliable.

2.3.1.3 Credit ratings

The third approach exploits credit rating. Rating agencies base their assessment on the issuer's credit quality using both public information available on the market and reserved information at their exclusive disposal. The best-known rating agencies that market agents take into consideration are Standard & Poor's, Moody's, Fitch and DBRS. The downgrade risk is the probability of a credit rating agency worsening an issuer's valuation.

In normal times, rating agencies assess issuers' credit quality on a six-monthly basis. Once a rating agency has analyzed an issuer's credibility, its valuation consists of three "actions". The most commonly known is the rating, which is the valuation of credit quality expressed through a specific scale. The rating comes with the outlook, which is almost as important; it consists in three possible results: positive, negative or neutral. It expresses a valuation on the future projection of the issuer's credit quality, meaning that it embodies the expectations of the rating agency on future ratings. A negative outlook means that the rating agency envisages a future downgrade with a discrete probability. The third action is putting on an issuer the "under observation" label, which means that the rating agency has negative expectations about future ratings.

All these actions and announcement may have an impact on market perception of issuers' credit quality and, therefore, market prices.

Theoretically, the intuition that ratings can explain price movements is controversial. If ratings and market participants had the same information, prices and ratings would incorporate the same information, mostly based on fiscal fundamentals. Nonetheless, most econometric researches find a causality nexus between rating and prices. This happens because market participants look at ratings when making investment decisions or review their market allocation afterwards. Moreover, institutional investors are compelled to hold securities of a certain level of seniority, depending on their rating. Banks' balance sheets need to keep investment grade assets as collaterals in order to receive loans by other institutions.

The literature is homogeneous supporting the idea that a causal nexus between credit ratings and market prices exists: De Santis (2012) provided evidence that in empirical models explaining spreads, credit ratings are statistically significant and economically sizeable.

Altman *et al.* (2004) focused on clarifying the process and timing through which rating agencies formulate their judgments. Ratings are measures that tend to be rather stable over time; this happens because they aim to be long run oriented. According to the authors, long run factors count the most. Ratings change only if the difference between current credit rating and the one the models envisage exceeds a certain threshold.

Moreover, the causality issue along different dimensions as direction and intensity interested researchers. Afonso *et al.* (2012) provided two important results, working on data from Standard & Poor's, Moody's and Fitch at European level. First, spreads react to rating downgrading mostly in the first two weeks after the shock; second, the causality is large and significant in both directions: ratings affect government bond yields and vice versa. Ferri *et al.* (1999), studying East Asian countries, investigated double-sided causality, which can trigger pro-cyclical patterns. According to their results, downgrading had a more than expected negative effect, basing the analysis only on fiscal fundamentals, so they claim that the consequent international capital flight exacerbated the crisis. Another important point

worth highlighting is the fact that rating agencies failed to envisage the crisis coming; consequently, in the following years, their judgments became quite conservative in order to regain lost credibility.

Nonetheless pro-cyclical behavior of the price-rating relationship was questioned by Mora (2006), claiming that ratings are rather sticky. In the pre-crisis period, they have been higher than expected, during the crisis they remained almost the same, and poorly increased in post-crisis phase. Moreover, they found out that ratings react to non-macroeconomic factors such as lagged spreads. Therefore, the author argues that ratings cannot have pro-cyclical effects if they only react to available macroeconomic and market information.

2.4 Contagion risk

The last determinant of government bond yields is contagion risk which has no unique definition in literature; some economists say it is the covariance of some variables under specific external conditions and measures the transmission of a negative shock (e.g., from one country to another) Caporin, Pelizzon, Ravazzolo, Rigobon (2014). Some others claim contagion is the different propagation of a shock and try to quantify its effects. Gande and Parsley (2005) studied contagion effect based on credit ratings on the time lapse 1991-2000 for thirty-four countries[6]. Their results showed the presence of asymmetric contagion, meaning that positive shifts in ratings had no effect on spreads, while negative ones had a significant impact, measured around twelve base points per step of rating.

Arghyrou and Kontonikas (2012) found evidence of contagion effect in the euro zone,

---

[6] The only criterion for inclusion in their data set was the existence of publicly traded U.S. dollar denominated sovereign debt as of March 2001. The thirty-four countries meeting this criterion were Argentina, Austria, Belgium, Brazil, Canada, Chile, China, Columbia, Denmark, Finland, Greece, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Korea, Lebanon, Malaysia, Mexico, New Zealand, Panama, Philippines, Poland, South Africa, Spain, Sweden, Thailand, Tunisia, Turkey, United Kingdom, Uruguay, and Venezuela.

especially among periphery countries. In particular, they show that in the first phase of the crisis, contagion originated mainly from Greek sovereign risk, while the following period is characterised by multiple sources.

Arezki *et al.* (2012) made an interesting point: "contagion effect is more important and persistent the lower the rating grade of the concerned country". This result suggests a non-linear relationship between the variables. When they examined contagion effect after a downgrade in Euro Zone for the period 2007-2010, they found it significant across countries and financial markets. The dimension of the impact varies according to country and rating agency. Lastly, they found that downgrading to "speculative grade" gives rise to systemic contagion.

Contagion is certainly imputable to the high degree of financial integration lacking a euro denominated safe asset that characterizes the European Monetary Union, as Brunnermeir *et al.* (2011) highlighted. When banks needed safe assets as collaterals, because of Basel regulation, they demanded for highly rated sovereign bonds of euro zone countries. As long as investors had confidence in governments' capabilities to fulfil their obligations the EMU kept in good equilibrium. With the advent of the crisis markets started concerning about governments' creditworthiness, weakening also European banking system stability. A tight relationship between governments and banking systems was established, the so-called "doom loop" mechanism. Empirical studies found evidence of this link.

According to Acharya *et al.* (2014) sovereign and bank credit default swaps tend to co-move and influence each other more than models based on common factors, such as market volatility or financial and macroeconomic conditions. Moreover, the size of sovereign and bank CDS spreads and their correlation is higher in fiscally weaker countries, meaning that the link is tighter in highly indebted countries. Furthermore, in most models the link is two-way and contagion is stronger in countries with larger financial sector and higher share of highly bank-intermediated finance. Bottero *et al.* (2016) proved that the higher the share of sovereign assets in banks' balance sheets, the stronger is contagion effect.

Sensoy *et al*. (2019) investigated the dynamic integration and network structure of the EMU sovereign bond markets; they uncovered a high degree of integration before the 2007 financial crisis, while segmentation emerged afterwards.

3. A model for debt dynamics

Despite the fact that the Eurobond project came to the light, the debate about this proposal has never really terminated among economists. In the recent years, the main question about the topic was whether the introduction of a debt mutualization instrument could help stabilize debt across Euro Zone[7]. Our objective is to move beyond fiscal stabilization *per se*, as we try to build a model showing that the Janus Eurobond can play an important role in the immunization of the European Monetary Union to exogenous shocks. In our perspective, it is particularly interesting to assess whether the introduction of a debt mutualization instrument, in the Janus Eurobond form, could reduce the expected variance of simulated debt levels, increasing EMU's resilience to exogenous shocks.

In our analysis, we will partly follow the strategy of Tielens *et al.* (2014) who assessed the impact of a Eurobond[8] on debt dynamics of three peripheral states: Greece, Ireland and Portugal. In particular, they showed the simulated gains under a "full-fledged Eurobond scenario" compared to the "baseline scenario".

In the following, we will set up a model describing debt dynamics in two different scenarios, namely a baseline scenario, which fits historical data, and its counterfactual, the Janus Eurobond scenario. We will run the model in both scenarios for three countries: Italy France and Germany. These represent of each "macro-fiscal area" in the Euro Zone; which are

---

[7] Baglioni and Cherubini (2016) showed the possibility to reduce the overall cost of servicing the public debt, splitting it into senior and junior tranches and coupling it with cross-guarantees across Euro Zone countries. Van Aarle *et al.* (2018) compared debt stabilization in the monetary union under two scenarios: a national fiscal discipline regime against a Eurobond regime, in both regimes financial markets impose a risk premium based respectively on each country's government debt level in the first case; on the average debt level in monetary union in the latter.

[8] In their model, the Eurobond has the structure suggested by Delpla and von Weizsäcker (2010). For further details see paragraph 1.4.

respectively the periphery, the intermediate and the core area.

3.1 The model framework

The first element to define when building a model for debt dynamics is a law of motion of debt. The classical structure of the government budget constraint in the literature is the following:

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

Where B_t is the stock of debt at time t, B_{t-1} is the stock of debt at t-1, i_t is the nominal interest rate at time t, G_t is government expenditure and T_t is government revenues, both at time t.

Dividing each element of this formulation by $(1 + Y_t)$[9], we get the law of motion of debt-to-GDP ratio.

$$b_t = b_{t-1} / [(1 + \pi_t) (1 + g_t)] + int_t - pb_t \qquad (2)$$

Where:

- b_t is the debt-to-GDP ratio at time t
- π_t is the inflation rate at time t
- g_t is the rate of growth of GDP at time t
- int_t is the interest expenditure, calculated as percentage to GDP, at time t
- pb_t is the primary balance, calculated as percentage to GDP, at time t

Equation (1) shows that debt-to-GDP dynamics depend both on macroeconomic and fiscal variables. It diverges from the traditional formulation of debt equation where the product of the stock of debt and the nominal interest rate appears. In the formulation above, instead, the interest expenditure captures the average cost of debt, which depends on the maturity of the sovereign bonds emitted, and its long run dynamics depending on public debt management.

---

[9] $(1 + Y_t) = [(1 + \pi_t) (1 + g_t)]$

The interest expenditure is computed as the difference of the primary balance and the overall fiscal balance (both measured as percentage to GDP), from a budget identity[10]. This way we avoid the problem of the average cost of debt estimation, which crucially depends on the maturity structure of emitted debt.

3.2 The VAR methodology

In order to be able to design the debt dynamics of different Eurozone countries under different scenarios we need an econometric model allowing us to capture the co-movements of the variables in the economic system. A suitable strategy when modeling and explaining the interactions among a group of time series variables is the Vector Auto Regressive method. Multivariate time series analysis is very common in quantitative macroeconomics, as it allows to treat jointly all the endogenous variables entered in the model. The model's output highlights the correlation between the variables without seeking for a causal link; it simply describes the interactions and co-movements of the variables in a system. For this reason, it is particularly useful in data description and forecasting future values of the variables in the system, Stock and Watson (2001).

A VAR model of order p is a multivariate autoregressive linear model[11], in which each of the n-variables is function of its lagged values up to p periods, as well as in terms of the lagged values of the remaining n-1 variables, plus a serially uncorrelated error term. Thus, its general specification is:

$$Y_t = A_0 + A_1 Y_{t-1} + A_2 Y_{t-2} + ... + A_p Y_{t-p} + U_t \qquad (3)$$

With $t = 0, \pm 1, \pm 2...$

---

[10] The overall fiscal balance is the total government net lending (+)/net borrowing (-). The overall fiscal balance is the difference between primary balance and is the interest expenditure. Reversing this formulation we obtain INT = PB –OB. For further details see Fedelino *et al.* (2009).

[11] For further details see Stock and Watson (2001).

Where:

- Y_t is an (m x 1) vector containing each of the m variables of the VAR

- A_0 is an (m x 1) vector of intercepts terms

- A_i is an (m x m) matrixes of coefficients, with $i = 1,2,...,p$

- $U_t = (m$ x $1)$ vector of uncorrelated white noise disturbances, with $E(U_t) = 0,$

  $E(U_t U'_t) = \sum_u$ and $E(U_t U'_s) = 0$ for $s \neq t$.

The model is required to be stable in order to conduct correct inference. The stability condition is analogue to the univariate autoregressive case: all included variables need to be weakly stationary, i.e. with stochastic initial condition all the roots of the characteristic equation, or eigenvalues[12], of the lag polynomial are outside the unit circle.

$$\det(I_k - A_1 z - A_2 z^2 - ... - A_p z^p) \neq 0 \text{ for } |z| \leq 1$$

In general the process U_t is assumed to be Gaussian white noise that is $U_t \sim (0, \sum_u)$ for all t. In order to estimate the VAR (p) process and its parameters we will use the traditional OLS estimation.

3.3 The baseline scenario

Now that the general framework of a VAR model is set up, we can proceed applying it to the time series of the variables of interest. Data were collected from 2000-Q1, introduction of the Euro as "book money" to 2019-Q2.

A dataset was with the following quarterly time series:

- GDP GROWTH RATE in percentage change on the same period of the previous year

- HICP the Harmonised Index of Consumer Prices in percentage change on the same period of the previous year

- IRT is the nominal interest rate of the 10 years Italian government bond (BTP)

---

[12] For further details see Kirchgassner and Wolters (2007).

- IE is the interest expenditure as percentage of GDP

- PB is the primary balance as percentage of GDP

The GDP growth rate, the HICP and the nominal interest rate are taken from the OECD database, Primary Balance from the ECB Statistical Data Warehouse and the Interest Expenditure is calculated using the Overall Balance[13] (total government net lending (+) / net borrowing (-)) provided by Eurostat.

In line with the literature, we prefer to treat all the five variables in the model endogenously, in order to account for any kind of interaction between them. Moreover, we will include the nominal interest rate of the 10-years government bonds of the country involved; this choice is defendable even if the nominal interest rate does not appear in equation (2) directly, it proved to be a very significant factor affecting the other variables of the macroeconomic system whose interactions are the object of our research. Tielens *et al.* (2014) used this approach; according to the authors, inserting the nominal interest rate in the vector of the endogenous variables directly, would enable us to capture some interactions between this variable and the others we use in the model specification. Instead, the debt-to-GDP ratio is excluded because, given eq. (2), the information we put in the model already embodies debt dynamics. Thus, including the fiscal variable would over-specify the model, not allowing for a stochastic estimation of debt dynamics, otherwise it would be deterministic.

Figure A.1 shows the time paths of Interest Expenditure, Primary Balance, Inflation rate (HICP) and Growth rate. Before running the Vector Auto Regressive model, we perform the Augmented Dickey-Fuller test on the time series in order to exclude any unit root issue, which would compromise weak stationary condition, which is necessary for the model's stability. The ADF test's null hypothesis is that of unit root of the time series.

Figure A.2 displays the unit root tests for the variables mentioned above. We reject the null

---

[13] See note 10.

for growth, inflation, Primary Balance at 1% significance level while for Interest Expenditure, at 5% significance level. In the case of nominal interest the test fails to reject the null hypothesis of unit root; therefore we take the first difference of this variable[14] to rule out any stationarity issue due to unit root problems.

Before setting up the VAR model, we run some lag-length selection tests; the AIC criterion[15] suggests to include two lags in the specification.

We proceed specifying the baseline VAR model:

$$Y_t = A_0 + A_1 Y_{t-1} + A_2 Y_{t-2} + \varepsilon_t \tag{4}$$

$$Y_t = [IntExp_t, PB_t, Inf_t, Gro_t, Fdirt]\,'$$

$$E\,(\varepsilon_t, \varepsilon_t\,') = \Omega$$

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

After the model's estimation, we need to check whether all the roots of the characteristic lag polynomial equation lie inside the unit circle, i.e. if their modulus are lower than one. The model proves to be stable. Other post-estimation diagnostics involve residuals: we have to test for autocorrelation and normality. For the Lagrange-multiplier test, we accept the null hypothesis of no evidence of residual autocorrelation at lag order. Similarly, we accept the null hypothesis of normality running the Jarque-Bera test.

The VAR estimation lets us examine the contemporaneous and retarded interactions of the variables involved in the system. It captures the co-movements without the constraints of a

---

[14] "Fdirt" in table A.3 stands for first differenced nominal interest rate.

15 The Akaike information criterion (AIC) is an estimator of out-of-sample prediction error. It is useful to evaluate the relative quality of statistical models for a given set of data. It is defined as follows: $AIC = 2k - 2\ln(L_{max})$, where k is the number of estimated parameters in the model and L_{max} is the maximum value of the likelihood function of the model.

causal analysis.

An interesting way of seeing how the variables influence each other over time is the Impulse Response Function analysis. IRFs highlight the reaction of a given variable to the movement of the same or another variable in the model. *Figure A.3* shows the responses, estimated for eight periods ahead, to any variable's impulse for the Italian case.

The first difference of the nominal interest rate seems quite resilient to its own and other variables' shocks. We go through a few of the most interesting ones, just to have an insight on how the model evaluates the time interactions between the endogenous variables and we try to interpret the model's predictions.

GDP growth reacts quite negatively to increases in *Fdirt*, *Inf*, while it is positively correlated with the Primary Balance. These results are coherent with economic theory: when the nominal interest rate grows, *ceteris paribus*, we expect interest expenditure to rise, increasing Deficit and accumulated Debt, threatening future perspective of growth. A rise in Inflation, considering its erosion effect on consumers' purchase power, may imply a future slowdown of GDP growth. On the other side, a rise in Primary Balance may represent an increased availability of resources to invest in the real sector.

Inflation rate reacts positively to an increase in growth rate: when aggregate demand grows faster than supply, prices tend to increase.

Interest Expenditure responds to an *Fdirt* impulse firstly with a slight decrease, then a few years of clear positive trend and then it stabilizes.

Relying on the implicit assumption that our VAR model captures the functioning of the macroeconomic system for the given set of variables and that its parameters will remain constant for the future years, we allow it to forecast the values of the endogenous variables for 42 quarters ahead (until Quarter 120, the end of 2029).

Once forecasted the endogenous variables future values and standard deviation, we used equation *(2)* to compute the forecast of debt dynamics and its variance, which is a function of

every component's variance and the cross-correlations. With all these elements at disposal, we can now show the estimated dynamics of Debt/GDP ratio for Italy (*figure A.4*), France (*figure A.6*) and Germany (*figure A.8*).

The time lapse considered, as mentioned before, is from January 2000 to June 2019 for the historical estimation of the model, then we will forecast for 42 quarters ahead, from July 2019 to December 2029.

The baseline scenario of the model forecasts a stable path for the Italian Debt-to-GDP ratio: a slight initial decrease followed by a moderate increase. When considering the estimated confidence interval of the distribution, which has a range of about 100 percentage points at the end of the time period considered, we clearly see that the analysis is nothing but conclusive about future paths of Italian debt; it could decrease, stabilize or get on an explosive path.

As far as France is concerned, we can be much more confident that its Debt-to-GDP ratio will not follow an explosive trend. The graph shows a clearly decreasing median forecasted value; the confidence interval takes into account also the states of the world in which French debt does not decrease, but remains on a stable path with a 95% significance level.

The forecast we computed highlight that Germany could extinguish its debt in a few years: negative values of the Debt-to-GDP ratio lie inside the confidence interval. Nonetheless, it is much more probable that the German government will try to keep debt stable, and reinvest the accumulated resources. In any case, this graph shows that the German fiscal and macroeconomic system lies on a stable paths.

We now set up the Janus Eurobond scenario, taking into account the introduction of a debt mutualization mechanism at the beginning of the European monetary Union.

3.4 The Janus Eurobond scenario

We now proceed setting up a model for Janus Eurobond scenario to compare to the baseline one: the comparison between the two should let us evaluate if the introduction of a common debt instrument could be beneficial to Euro Zone countries increasing the immunization of the system to contagion effects after exogenous shocks.

In an ideal world, we would be able to go back in time to the beginning of the European Monetary Union and create a debt mutualization mechanism in the form we envisaged. The entire macroeconomic system would change somehow. Building a counterfactual VAR model *strictu sensu* it could be possible to capture how the Janus Eurobond could affect debt dynamics. Unfortunately, this is clearly impossible, but it is useful to think of this as a benchmark to try to get the closest possible to.

Our approach to build the Janus Eurobond scenario follows the suggestion of Tielens *et al.* (2014). The authors, when setting up the Eurobond scenario, considered the fact that at the beginning of the European Monetary Union the 10-years government bonds interest rates were very similar across Europe. Markets confidence in the stability of the EMU created the conditions we could assimilate to a "virtual Eurobond", i.e. the situation was similar to that we imagine if the common debt instrument existed. In other words, macroeconomic conditions were such that international risk factors could explain interest rates levels, while country- specific macroeconomic and fiscal variables affecting credit risk had an almost negligible weight.[16] Figure 1 shows the spreads on German Bund across some Euro Zone countries for the period 1990-2011. Before 2000, spreads differentiated, taking into account country-specific the macroeconomic, fiscal and political framework. After the beginning of the European Monetary Union this differences in spreads disappeared; the "EMU effect" was such that most countries payed the interest German rate on their debt.

History proved markets wrong: after 2007 crisis, confidence in the stability of the EMU

---

[16] See section 2.1 and 2.2.

started to falter, and spreads began to rise.

Figure 1: 10 years government bond spreads on German Bund (%)
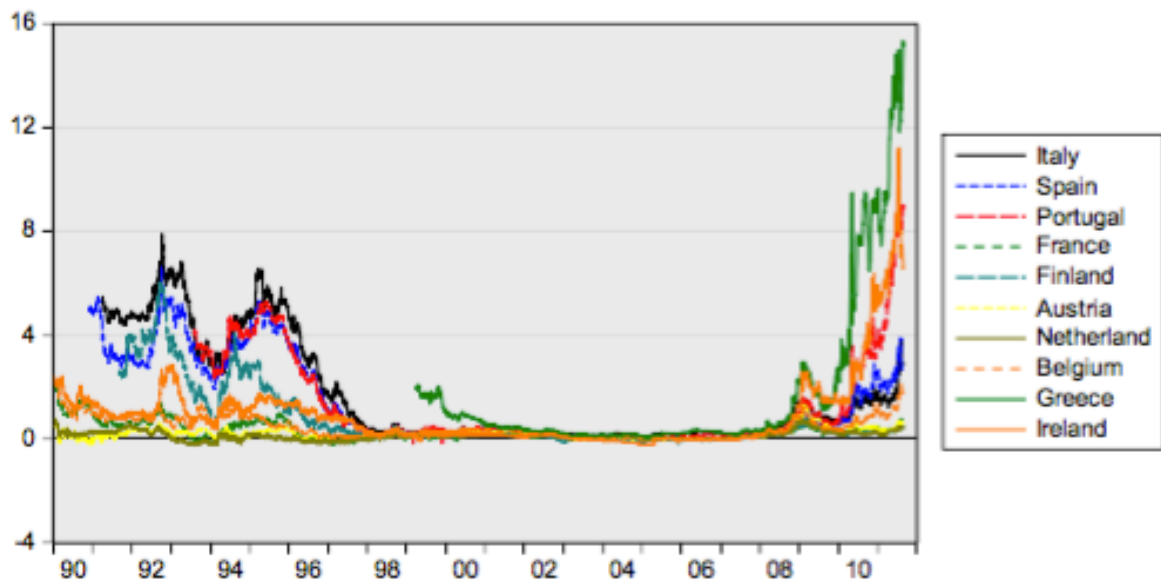
The EMU in its original design was not enough immune to shocks; its internal weakness became clear to every market agent and, in the following years, some countries faced a proper sovereign debt crisis.

According to Tielens *et al.* (2014) the spread situation in the years 2000-2007 should reflect what would happen in a Eurobond scenario: in fact, the situation was such that all Euro Zone countries payed a unique interest rate: the German rate on Bund.

Therefore, in their opinion the most accurate proxy for the Eurobond basis interest is the Bund rate, because markets perceive it as the safest asset in Europe.

Their Eurobond scenario is set up substituting the country's sovereign bond rate with the rate on 10 years German government bond. This action is justified by the argument above and the fact that the rate of the Eurobond, which is an instrument built to become a safe-asset, will be reasonably close to that of the German Bund. The approach used by Tielens *et al.* (2014) is that of running a VAR model, leaving all other variables unchanged. The straightforward objection is that the other variables never really interacted with the Eurobond rate, thus the VAR would be trying to capture some interactions that never existed. Despite this limit is

certainly justified, we can partially overcome it for the years before 2007 crisis: during those times, each country in the euro zone was emitting debt almost at the German rate. For the years following 2007, this argument is no longer true, but we have to accept the restraint of this model.

Tielens *et al.* (2014) evaluate the effect of a Eurobond in the form of Delpla and von Weizsäcker (2010)[17], so their model evaluates the scenario in which all debt belongs to the senior tranche.

Instead, we will build a model set up for Janus Eurobond, which better controls for moral hazard issues.[18] We will use their approach to proxy the basis interest, which is the rate at which the Janus Eurobond would trade on the markets, and we will add a country-specific Premium. The sum of these two components will become one of the endogenous variables in the VAR model, substituting the nominal interest rate (*IRT*).

The premium's design is inspired to the Maastricht fiscal rules[19] requiring EMU members not to exceed 60% of Debt/GDP ratio and 3% of Deficit/GDP ratio. It is the weighted average of the deviations to the fiscal parameters of the *Treaty on European Union* (1992).

We chose weights looking at the estimated coefficients for fiscal variables in the literature analysing the determinants of spreads. We find particularly suitable for our setting the work of Favero and Missale (2012) because they regress the spread to the Bund rate of ten Euro Zone countries on a set of deviations to the German variables, including fiscal ratios, using weekly data for the period June 2006 - June 2011. At that time, markets had a disciplining role on Euro Zone countries, and fiscal ratios had a significant weight.

We take the average of the coefficients of the countries analysed in the paper: Austria, Belgium, Finland, France, Greece, Ireland, Italy, Netherlands Spain and Portugal.

---

[17] See section 1.4.

[18] See section 1.5.

[19] See the document: Council and Commission of the European Communities. (1992). *Treaty on European Union*. Office for Official Publications of the European Communities. Luxembourg.

Conceptually we build a synthetic measure of markets' discipline based on fiscal ratios, exploiting the contribution of literature.

We define the Premium (P) as follows:

$$P_t = 0.0475*(Debt_{t-4}/GDP_{t-4} - 60\%) + 0.0022*(Deficit_{t-4}/GDP_{t-4} - 3\%) \quad (5)$$

Now we proceed adding to the 10 years German government bond rate, the Premium, the sum obtained represents the effective Janus Eurobond interest rate.

Then we run the ADF test for the newly built variable *Janusrt*, which, similarly to the nominal interest rate of the baseline scenario, suffers a unit-root condition. Therefore, we prefer to include in the set of our explanatory variables the first difference of the Janus Eurobond rate (*Fdjanusrt*).

The VAR model's specification for the Janus Eurobond scenario is:

$$Y_t = A_0 + A_1 Y_{t-1} + A_2 Y_{t-2} + \varepsilon_t \quad (6)$$

$$Y_t = [IntExp_t, PB_t, Inf_t, Gro_t, Fdjanusrt_t]'$$

$$E(\varepsilon_t, \varepsilon_t') = \Omega$$

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

In the German case, the baseline scenario and the Janus Eurobond scenario virtually coincide, because the effective Janus Eurobond interest rate would be equal to the 10 years nominal government bond yield.[20] Therefore, we set up only two VAR models: for Italy and France. Right after running the VAR model we need to check its stability: all the roots of the characteristic lag polynomial equation lie inside the unit circle.

As far as residuals' diagnostics tests are concerned, again we can accept the null hypothesis of no autocorrelation at lag order (Lagrange multiplier test) and of normality (Jarque-Bera). We do not find any issue running the diagnostic tests for each of them.

---

[20] If we ran the Janus Eurobond model for Germany we get: *Janusrt_t = IRT_t (Bund)* + P_t (Germany). The Premium would be null because of its design, therefore we get: *IRT_t (Bund) = Janusrt_t*. The baseline and the Janus Eurobond models coincide for Germany.

Once checked the suitability of the Janus Eurobond VAR models, we apply the technique previously used in the baseline scenario. We compute the forecast of the endogenous variables for 42 quarters ahead. Then, using equation *(2)* we obtain the forecast of debt-to-GDP dynamics for the three countries. *Table 1* shows the comparison of the last median forecasted value of debt-to-GDP (Q4-2029) and last Confidence Interval, for the two scenarios.

Table 1: Baseline vs. Janus Eurobond _ last observation

	Baseline value	Janus value	CI Baseline	CI Janus Eurobond
Italy	135,9%	57,6%	100,8%	83,6%
France	44,6%	44,5%	78,4%	72,9%
Germany	23%	.	103,4%	.

Figure A.5a displays the estimated path for Italian Debt-to-GDP ratio in the Janus Eurobond scenario, i.e. under the hypothesis that a bi-faced mutualization debt instrument has been operative since the beginning of the EMU project. When comparing the two scenarios, we see that the Janus Eurobond would have a twofold effect on debt dynamics. First on the median forecasted value of debt-to-GDP; in the latter case Italian debt would follow a decreasing and sustainable path. A reduced Interest Expenditure may be one of the main causes, even if the Janus Eurobond rate accounts for credit risk in the Premium equation, it is reasonable that a peripheral country as Italy would pay less than in the baseline scenario, benefitting from the stability of the safe asset. However, the main result we are interested in is the estimated variance of forecasted values; in the Janus Eurobond scenario, the Confidence Interval is 17,2 %smaller than in the baseline scenario. This simple comparison seems supporting the theoretical argument according to which the common debt instrument would increase immunization in the European Monetary Union, helping prevent contagion across Euro Zone countries.

The French case (*figure A.7a*) shows very little difference between the two scenarios in the

median forecasted values of debt, which was already stable in the baseline one.

Coherently with the Italian results, the confidence interval of the fiscal ratio is smaller in the Janus Eurobond scenario. Again this is explicable considering the fact that the design of the European safe asset could help insulate spreads dynamics from the erratic movements of sovereign bond yields, which are due to markets' sentiments and fears, instead of fundamentals and rationality.

3.5 An Extension: Premium corrected for growth

In this section we will consider an extension of the Janus Eurobond model, taking into account a Premium corrected for Growth. The necessity to build a Premium that accounts for GDP growth comes from the fact that EU institutions monitors the dynamics of structural budget positions across Member states. The structural budget balance is a nominal budget balance adjusted by a cyclical component, excluding one-shot and temporary policy measures. The cyclical component is the product of the output gap[21] and a parameter reflecting the automatic reaction of the government balance to an output gap change. In other words it is a way to express the expected budget position if the economy was at full potential, (Economic Governance support Unit, 2019).

In our previous analysis we built the Premium using the deviation of primary balance to the 3% threshold of Maastricht criteria.

We extend the formulation of the Premium adding a penalisation for Growth, which will have a positive weight in the formulation because a positive value of growth represents the possibility for a government to use the resources coming from economic growth to stabilize its debt dynamics. In this perspective, adding to the Premium a penalisation for growth is in line with the idea of the structural budget position.

We define the Adjusted Premium (AP) as follows:

---

[21] Output gap is the difference between actual and potential GDP, as percentage of GDP.

$$AP_t = 4{,}75\% * (Debt_{t-4} / GDP_{t-4} - 60\%) + 0{,}22\% * (Deficit_{t-4} / GDP_{t-4} - 3\%) + \gamma * (Gro_{t-4} - Gro_{t-5})$$

$$(7)$$

Therefore we account for Growth using an additive term function of the first difference of growth. In this context, the value of the coefficient γ is of little interest; the main objective is to evaluate the model's reaction and test whether previous results are robust to the adjustment. We tried different weights, finding homogeneous and consistent results. We now present the results model of the extension with $\gamma = 10\%$.

Table 2: Baseline vs. Janus Eurobond b (Premium Adjusted for Growth)_ last observation

	Baseline value	Janus b	CI baseline	CI Janus b
Italy	135,9%	57,9%	100,8%	95,3%
France	44,6%	45,3%	78,4%	79,2%

Figure A.5b shows the evolution of the Italian debt-to-GDP forecasted value; the median value follows the same trend of the unadjusted case, with a clear decreasing trend, leading the Italian fiscal position to a sustainable path. The confidence interval is larger than the unadjusted case, but it remains smaller than the baseline scenario.

The French debt-to-GDP (*figure A.7b*) has a very similar evolution of the median forecasted value in all three scenarios: Baseline, Janus Eurobond and Janus Adjusted. The confidence interval is slightly larger for the Janus Adjusted scenario.

This extension showed that the evolution of debt for the Eurobond scenario does not substantially change when the Premium accounts for growth. Therefore, using the structural budget position instead of the primary balance in the Premium equation would not radically change our conclusions about the effectiveness of the Janus Eurobond as an instrument for immunization of the European Monetary Union.

3.6 A focus on interest expenditure

A significant critique to the Janus design could be that charging lower interest rates would represent an implicit transfer from core Euro Zone countries to intermediate and periphery. For this reason, we now focus on the dynamics of the interest expenditure in the two scenarios for Italy and France.

For the Italian case (*figure A.9*), Interest Expenditure in the Janus Eurobond scenario is permanently lower than in Baseline. As far as standard deviation is concerned (*figure A.10*), it remains consistently lower in the debt mutualization mechanism scenario. This considered, one may object that main determinant of the difference between the debt dynamics in baseline and Janus Eurobond scenario (*figure A.4* versus *figure A.5*) is the difference in Interest Expenditure; meaning that Italian debt stabilizes only as a result of an implicit transfer from other countries.

In order to verify this hypothesis, we run a reversed exercise: we upward change the weights[22] of the fiscal determinants in the Premium, so that Interest Expenditure increases. We repeat the substitution until we find a coefficient that brings Interest Expenditures close to the baseline one's value (*figure A.9c*). Computing the new debt dynamics, we can evaluate the effect of Janus design, without taking into account a reduction of Interest Expenditure.

Table 3: Baseline vs. Janus Eurobond c (Modified Premium)_ last oservation

	Baseline value	Janus c	CI baseline	CI Janus b
Italy	135,9%	61,9%	100,8%	83,6%

Figure A.5c and *table 3* show that Italian debt stabilizes in the "Modified Premium" scenario, even if it decreases at a slower rate than the regular Janus Eurobond scenario. In any case, the

---

[22] The computed coefficients are the original values of coefficients in equation *(5)*,multiplied by 1,14, so we obtain the Modified Premium:

$MP_t = 0.05415*(Debt_{t-4}/GDP_{t-4} – 60\%) + 0.002508*(Deficit_{t-4}/GDP_{t-4} – 3\%)$.

.

variability remains considerably lower than the baseline scenario; therefore, we conclude that the Janus design is effective even without necessarily implying a lowered interest expenditure. This is exactly what happens in the French case, where Interest Expenditures (*figure A.11*) follow opposite patterns for the first 4 years (until Quarter 96), then they converge to a unique and stable value, with the Janus Interest Expenditure slightly higher than the baseline one. Nonetheless, *figure A.12* shows that the estimated standard deviation of the Interest Expenditure in the Janus scenario remains consistently lower than the baseline standard deviation of Interest Expenditure.

This considered, we conclude that the Janus Eurobond may be effective stabilizing debt levels, even without implying transfers from core or intermediate countries to peripheral ones. For this reason, the Janus Eurobond proposal could be an attractive programme also from a political perspective. Clearly, Euro Zone countries would be willing to implement a debt mutualization scheme on condition that it represents a Pareto-improvement for each participant. The results we found seem pointing out the possibility to build a Janus Eurobond whose design does not imply more favourable interest conditions for peripheral countries.

4. Comparative statics

In the following section, we will focus on the main object of interest: the variance of the estimated variables. *Table 1* showed that the confidence intervals are consistently lower for the Janus Eurobond scenario; this seems supporting our theory according to which the Janus Eurobond could help immunize the EMU from shocks. However, the difference in estimated variance simply reflects the difference in the error of estimation, while we are interested in the variability of the forecasted variable in the system. These two quantities undoubtedly correlate; nonetheless, the comparison between the estimated standard error may not be the most adequate method to evaluate differences in variability. We will run the models previously built exposing them to exogenous shocks. In particular, we will try to evaluate the degree of immunization of the European Monetary Union in the different scenarios.

4.1 Monetary shock

The first shock we consider is a rise in inflation. We consider a permanent shock whose dimension is a standard deviation for each period t so that the effects on debt dynamics are more relevant looking and the graphs.

The expected response of the debt dynamics models after a rise in inflation is a decrease in the median estimated value of debt-to-GDP ratio; this result is straightforward from equation *(2)*.

Table 4: Baseline vs. Janus Eurobond responses to monetary shocks_ last observation

	Baseline value	Janus value	Baseline CI	Janus CI
Italy	97,8%	41,5 %	100,8%	83,6%
France	38,6%	34,2%	78,4%	72,9%
Germany	18%	.	103,4%	.

Figure A.13 and *A.14* confirm our prediction: in both scenarios, the Italian Debt-to-GDP median forecasted value takes values, which are lower than the no-shock case presented in the

previous chapter.

The main result we are interested in is the reaction of the confidence interval to the shock: the baseline scenario presents an estimated variability of results that reaches 100,8%, while in the Janus Eurobond scenario it is 83,6%.

The French case (*figure A.15* and *A.16*) presents consistent results: in both scenarios the debt-to-GDP ratios estimates are lower after the monetary shock than in the no-shock case; the median shocked forecasted values are close, however, the estimated variabilities are respectively 78,4% for the baseline and 72,9% for the Janus Eurobond.

Though its limited utility for our comparative analysis, we shocked also the German model (*figure A.17*), which confirms that a rise in inflation would help reduce even more the debt-to-GDP ratio.

4.2 Real shock

The second shock we consider is a GDP growth slowdown. Once again, we consider a permanent shock whose dimension is a standard deviation for each period t.

From a theoretical perspective, we expect to see a deterioration of debt conditions.

Table 4: Baseline vs. Janus Eurobond responses to real shocks_ last observation

	Baseline value	Janus value	Baseline CI	Janus CI
Italy	258%	105,6%	101%	84,1%
France	65,5%	64,6%	78,2%	73,3%
Germany	49,4%	.	102,6%	.

In fact, *figure A.18* shows an explosive path for the median forecasted value of Italian debt-to-GDP, while in the Janus Eurobond scenario (*figure A.19*) it is high, but it keeps stable around the interval 100% - 120%. The variability of estimates is, once again, lower for the second scenario: respectively 101% against 84,1%.

For the French case (*figure A.20* and *A.21*), the trend of the median values almost coincides: the reduction of debt-to-GDP ratio forecasted in the no-shock case is (partially) slowed down. Again, the variability is slightly lower in the Janus scenario: 78,2% against 73,3%.

As far as Germany is concerned (*figure A.22*) a permanent reduction in GDP growth, keeps its debt dynamics steadily around 50%.

4.3 Fiscal shock

The third shock considered is an expansive government policy, which decreases the Primary Balance. Homogeneously to the previous cases, we consider a permanent shock whose dimension is a standard deviation for each period t.

The expectations after a negative fiscal shock are those of a deterioration of debt dynamics (*equation 2*).

Table 4: Baseline vs. Janus Eurobond responses to fiscal shocks_ last observation

	Baseline value	Janus value	Baseline CI	Janus CI
Italy	165,5%	87%	100,5%	84,3%
France	62,6%	62%	78,7%	72,4%
Germany	107,8%	.	103,4%	.

Italian debt dynamics after a fiscal shock consistently differ in the two scenarios: in the baseline (*figure A.23*) debt ratio follows explosive paths of indefinite growth, while in the Janus Eurobond scenario (*figure A.24*), it shows a decreasing trend and seems stabilizing.

As before, estimated variability is higher for the baseline scenario: 100,5% against 84,3%..

For the French case (*figure A.25* and *A.26*) the debt dynamics react homogeneously to the fiscal shock; in both scenarios, debt-to-GDP decreases at a slower rate than estimated in the no-shock scenario, returning back to its values in the first quarters of years 2000. The estimated variability is slightly higher in the baseline scenario: 78,7% against 72,4%.

Lastly, in *figure A.27* we see German reaction after the shock: the value of debt-to-GDP ratio starts growing at a consistent rate, even if the estimated variability is so large that we cannot rely on the median forecasted value

5. Conclusions

In this dissertation we proposed a design for Eurobond aimed at increasing the stability of the European Monetary Union while containing the scope for moral hazard.

The limit of this analysis lies in the construction of the counterfactual scenario, which stands on the assumption that the macroeconomic environment did not significantly deviate from historical after the introduction of the Eurobond, which is reasonable only for the years before 2007. A possible future extension of this work may overcome this limit creating a synthetic counterfactual building a Eurobond version for all the macroeconomic and fiscal variables combining all the information at disposal.

In our framework, the Janus Eurobond revealed its effectiveness immunizing the European Monetary Union from exogenous shocks. The positive effect is the most significant for peripheral countries as Italy, while for intermediate countries as France it is only slightly beneficial. For core countries, our model does not allow us to capture the true dynamics, because the effect is virtually null. Nonetheless, we can imagine an advantage due to the increased stability of the system.

Beside the verified Pareto-improvement for the monetary union in the stabilization of the macroeconomic system, a proposal of bi-faced Eurobond may be politically implementable, because it does not imply significant redistributive effects between Member states. Other advantages include the creation of a neutral tool for monetary policy that may be used by the European institutions to pursue monetary policy and perform open market operations in a much smoother way.

Furthermore the structure and features of the Janus Eurobond are highly flexible, as they are institutionally designed; therefore the pursuing of EMU long-term stabilization may be paired with other short-term objectives.

Appendix

Figure A.1: Italy_Time series graphs
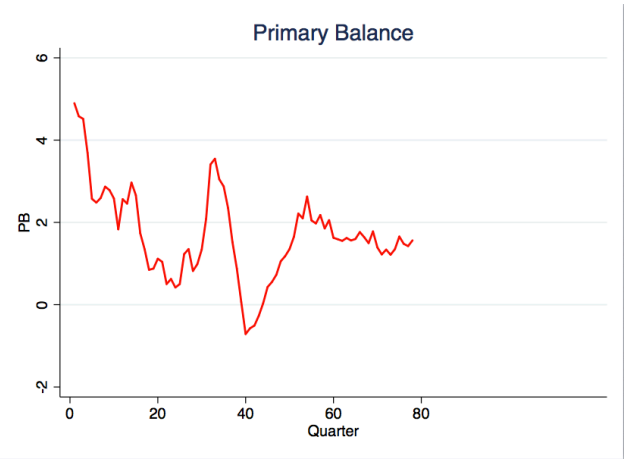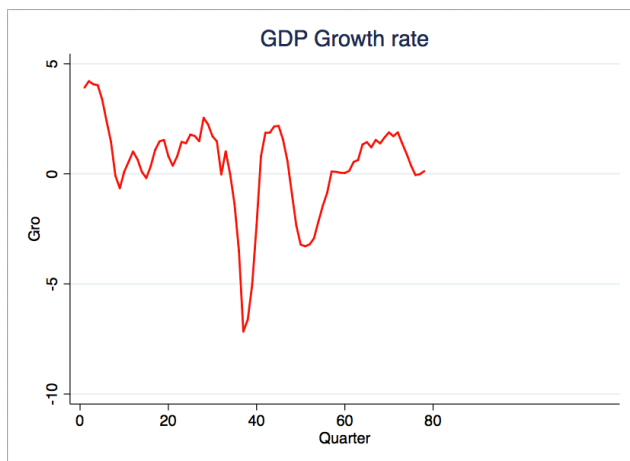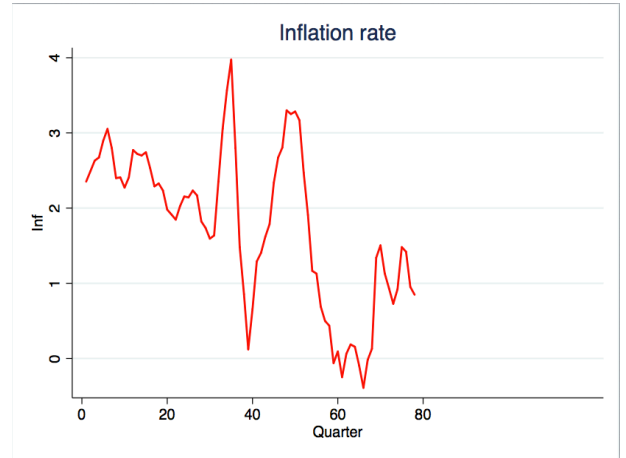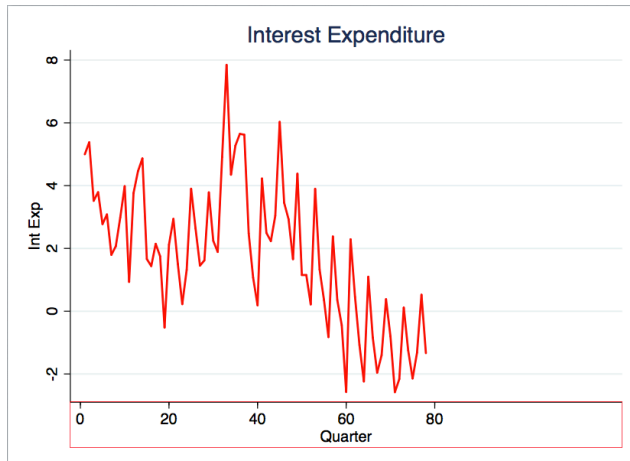
Figure A.2: Italy_ADF unit root tests

```
Augmented Dickey-Fuller test for unit root         Number of obs   =       75

                            ————————— Z(t) has t-distribution —————————
                  Test       1% Critical      5% Critical       10% Critical
                  Statistic     Value            Value             Value

    Z(t)          -2.152       -2.380           -1.667            -1.294

p-value for Z(t) = 0.0174
```

D.IE	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
IE						
L1.	-.2215111	.1029376	-2.15	0.035	-.4267629	-.0162593
LD.	-.2818482	.1227649	-2.30	0.025	-.5266345	-.037062
L2D.	-.2865078	.1141395	-2.51	0.014	-.5140955	-.0589201
_cons	.282683	.2727826	1.04	0.304	-.26123	.8265961

```
Augmented Dickey-Fuller test for unit root         Number of obs   =       75

                            ————————— Z(t) has t-distribution —————————
                  Test       1% Critical      5% Critical       10% Critical
                  Statistic     Value            Value             Value

    Z(t)          -3.875       -2.380           -1.667            -1.294

p-value for Z(t) = 0.0001
```

D.PB	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
PB						
L1.	-.173668	.0448183	-3.87	0.000	-.2630332	-.0843028
LD.	.3150729	.1077795	2.92	0.005	.1001667	.529979
L2D.	.1348899	.1092493	1.23	0.221	-.0829471	.3527269
_cons	.2587602	.0851346	3.04	0.003	.0890066	.4285139

```
Augmented Dickey-Fuller test for unit root         Number of obs   =       75

                            ————————— Z(t) has t-distribution —————————
                  Test       1% Critical      5% Critical       10% Critical
                  Statistic     Value            Value             Value

    Z(t)          -2.749       -2.380           -1.667            -1.294

p-value for Z(t) = 0.0038
```

D.HICP	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
HICP						
L1.	-.1156922	.0420841	-2.75	0.008	-.1996054	-.0317789
LD.	.4949332	.1125299	4.40	0.000	.270555	.7193115
L2D.	.0157916	.1192997	0.13	0.895	-.2220853	.2536684
_cons	.1892714	.0849192	2.23	0.029	.0199473	.3585955

```
Augmented Dickey-Fuller test for unit root          Number of obs   =        75

                          ————————— Interpolated Dickey-Fuller —————————
                 Test        1% Critical      5% Critical      10% Critical
             Statistic          Value            Value            Value

Z(t)          -4.301          -3.545           -2.910           -2.590

MacKinnon approximate p-value for Z(t) = 0.0004
```

D.Gro	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Gro						
L1.	-.1896314	.0440865	-4.30	0.000	-.2775373	-.1017254
LD.	.5806572	.1054018	5.51	0.000	.3704919	.7908225
L2D.	.0933214	.1153175	0.81	0.421	-.1366152	.323258
_cons	.0426279	.0836877	0.51	0.612	-.1242406	.2094965

```
Augmented Dickey-Fuller test for unit root          Number of obs   =        74

                          ————————— Interpolated Dickey-Fuller —————————
                 Test        1% Critical      5% Critical      10% Critical
             Statistic          Value            Value            Value

Z(t)          -3.890          -3.546           -2.911           -2.590

MacKinnon approximate p-value for Z(t) = 0.0021
```

D.Fdirt	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Fdirt						
L1.	-.7789302	.2002493	-3.89	0.000	-1.178315	-.3795456
LD.	-.1722644	.1633825	-1.05	0.295	-.4981205	.1535917
L2D.	-.212632	.118028	-1.80	0.076	-.4480314	.0227674
_cons	-.031842	.0469245	-0.68	0.500	-.1254299	.0617459

```
Augmented Dickey-Fuller test for unit root          Number of obs   =        70

                          ————————— Interpolated Dickey-Fuller —————————
                 Test        1% Critical      5% Critical      10% Critical
             Statistic          Value            Value            Value

Z(t)          -5.275          -3.552           -2.914           -2.592

MacKinnon approximate p-value for Z(t) = 0.0000
```

D.Djanusrt	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
Djanusrt						
L1.	-1.070058	.2028516	-5.28	0.000	-1.475065	-.6650521
LD.	.2836815	.1525592	1.86	0.067	-.0209129	.5882758
L2D.	-.0094335	.1211294	-0.08	0.938	-.2512763	.2324092
_cons	-.071579	.0349218	-2.05	0.044	-.1413026	-.0018553

Figure A.3: Impulse Response Function_Italy_baseline
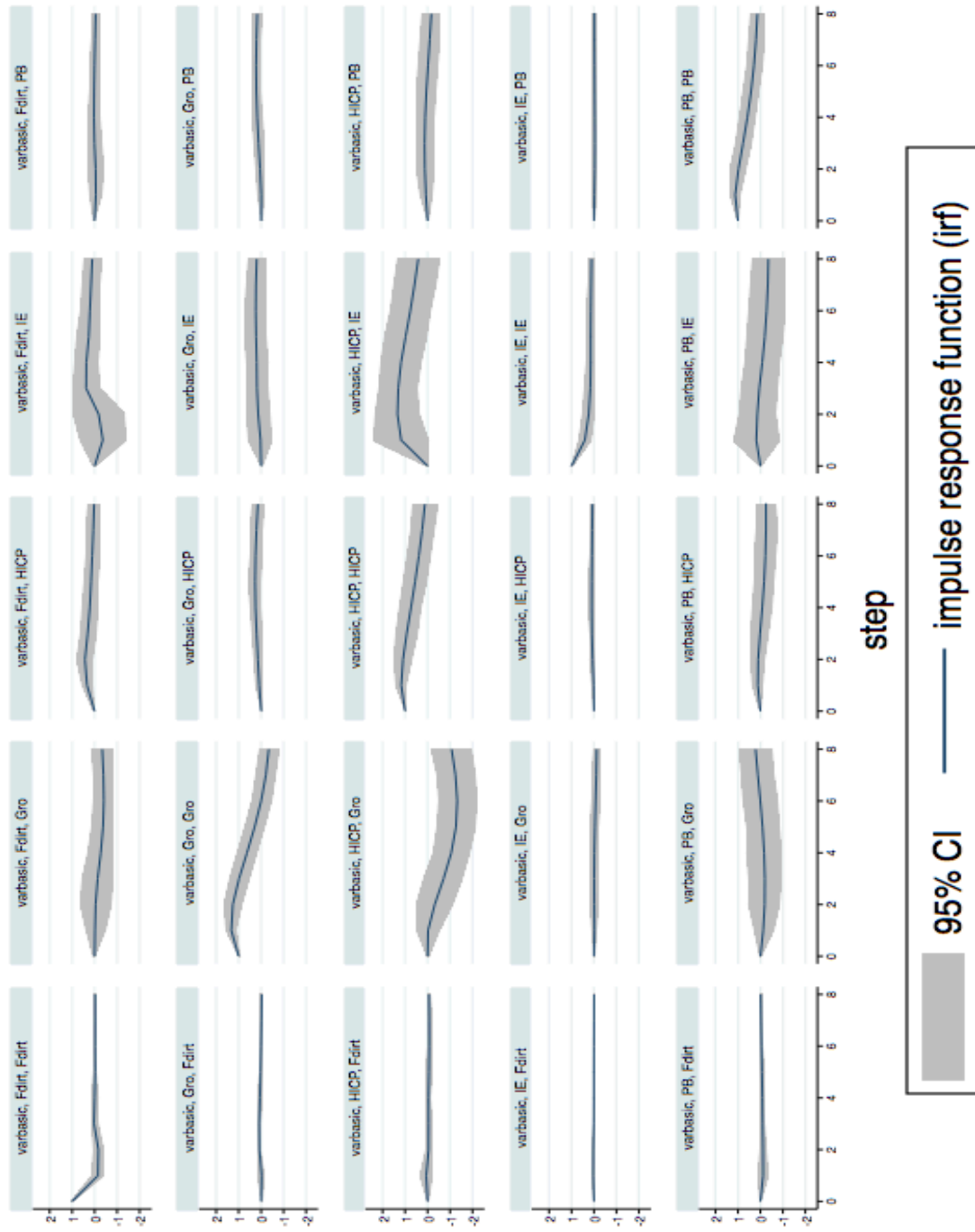
Figure A.4: Italy_baseline scenario
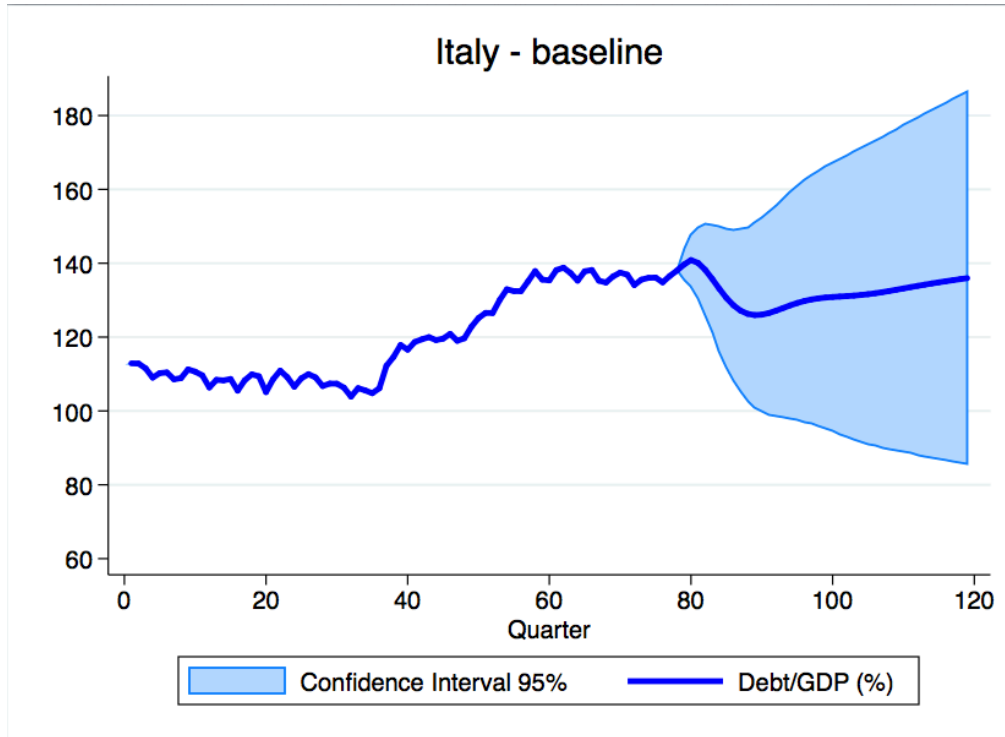
Italy - baseline

Figure A.5: Italy_Janus Eurobond scenario

Italy - Janus Eurobond
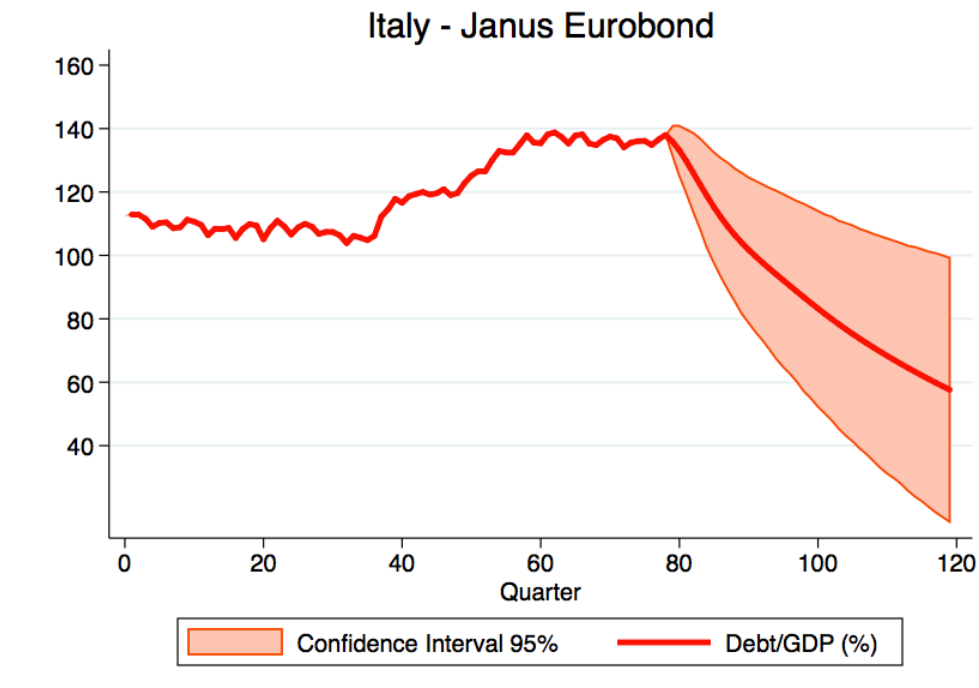
Figure A.5b: Italy_Janus Eurobond_ Growth Adjusted

Italy - Adjusted Premium
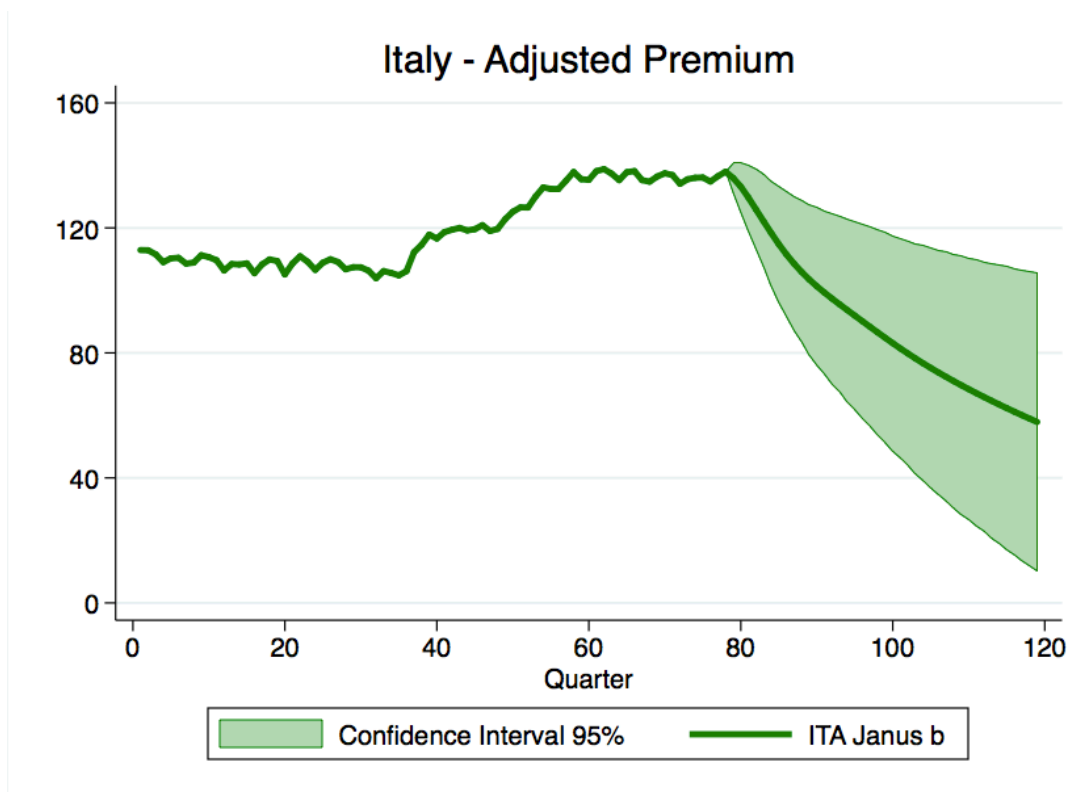
Figure A.5c: Italy_Janus Eurobond_ Modified Premium

Italy - Modified Premium
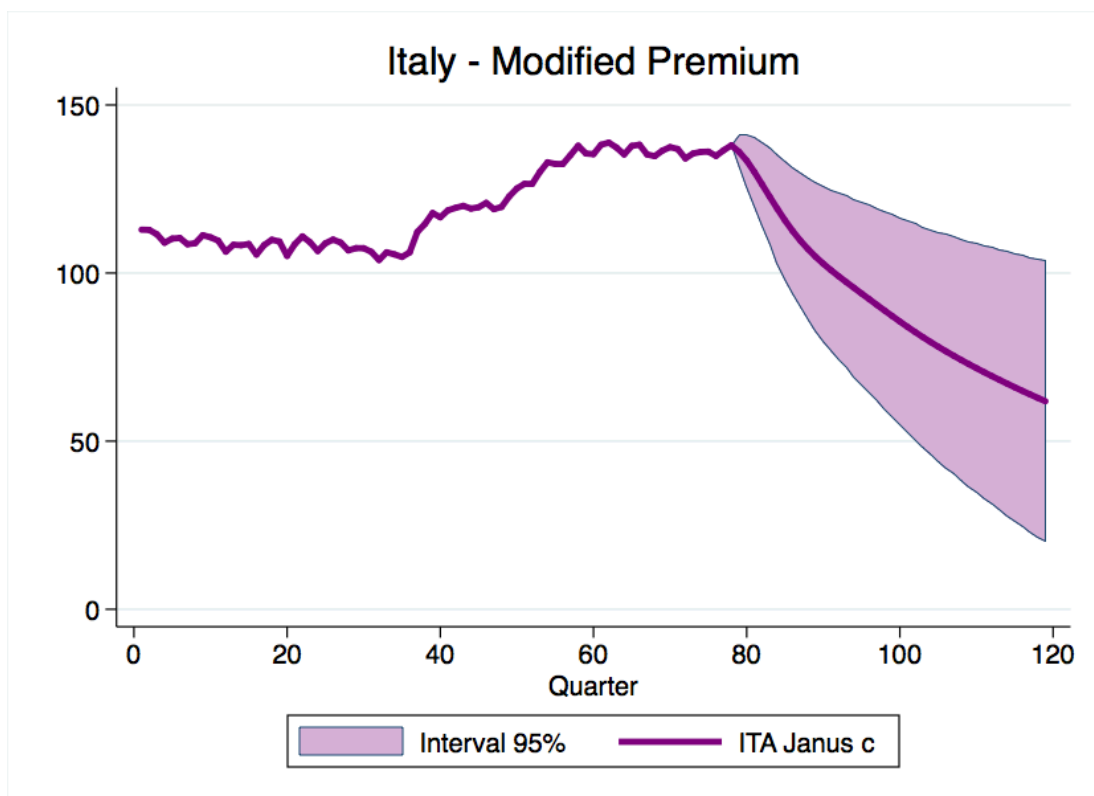
Figure A.6: France_baseline scenario
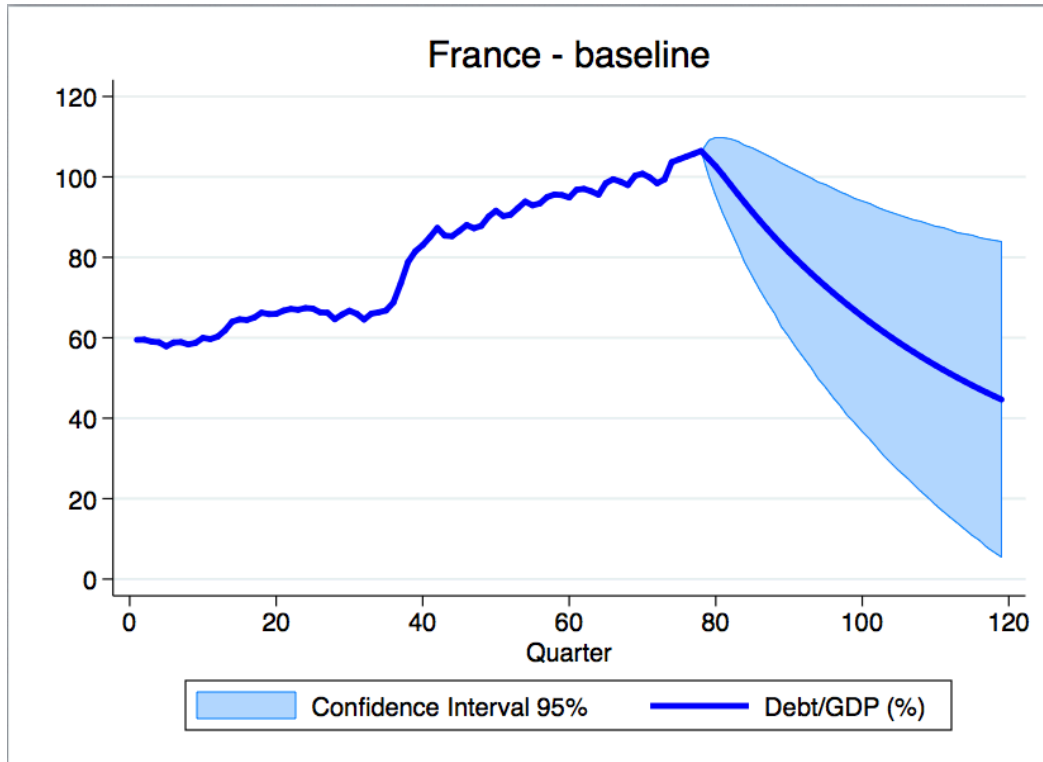
France - baseline

Figure A.7: France_ Janus Eurobond scenario

France - Janus Eurobond
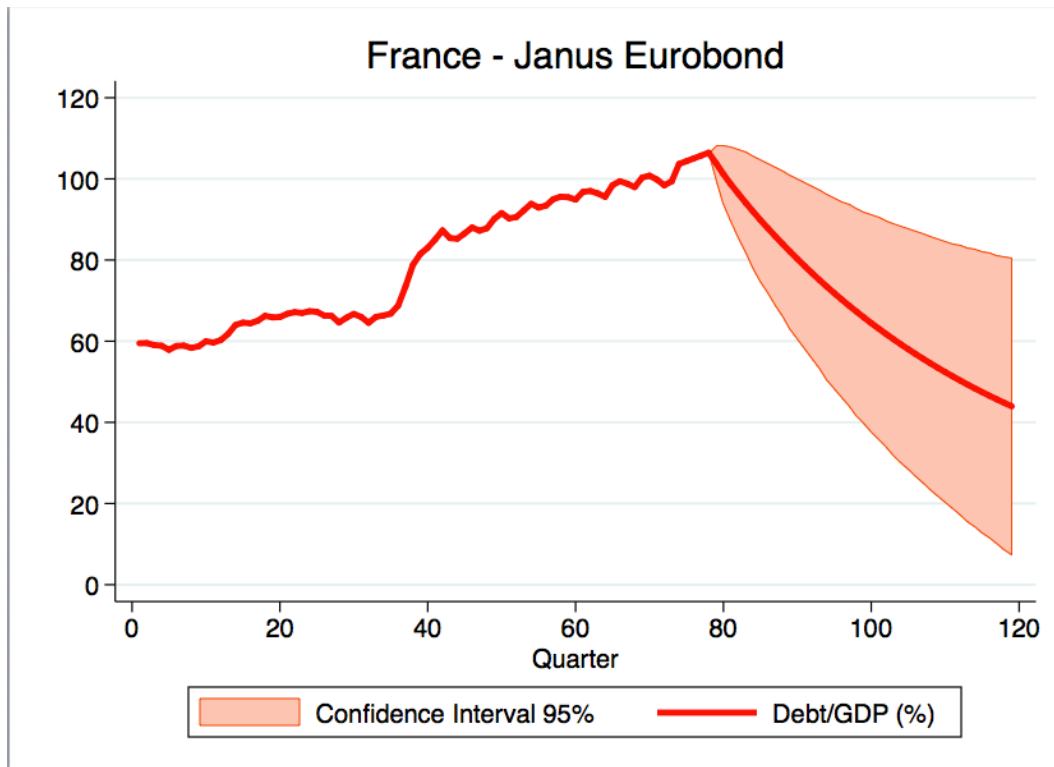
Figure A.7b: France_Janus Eurobond_ Growth Adjusted

France - Premium Adjusted for growth
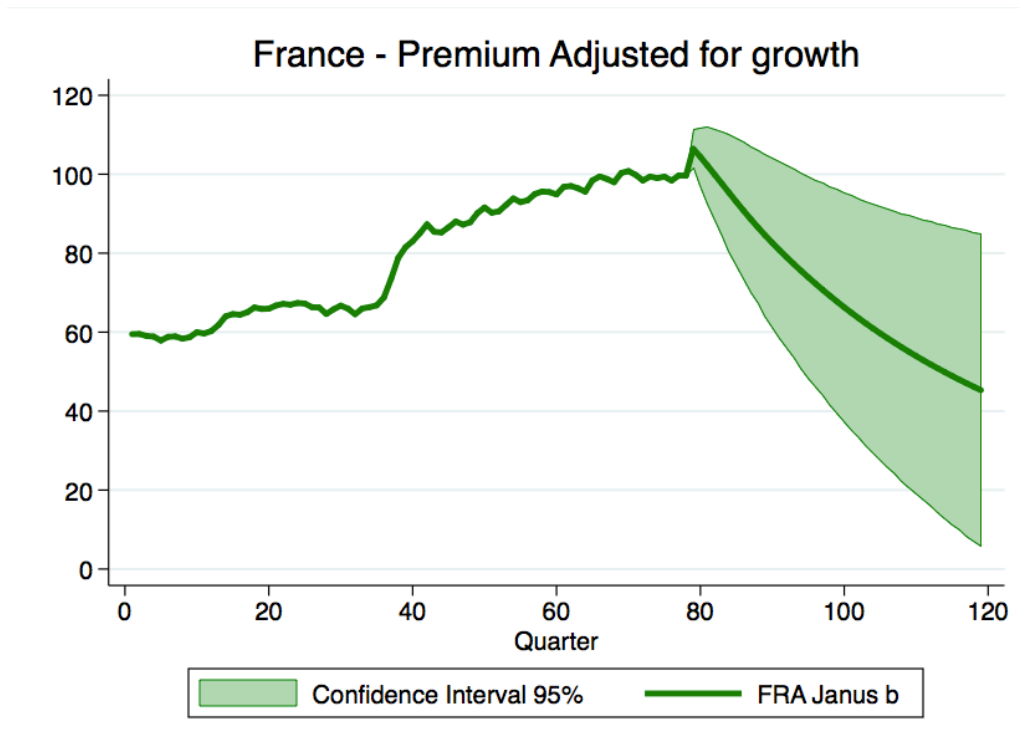
Figure A.8: Germany_ baseline scenario

Germany - baseline
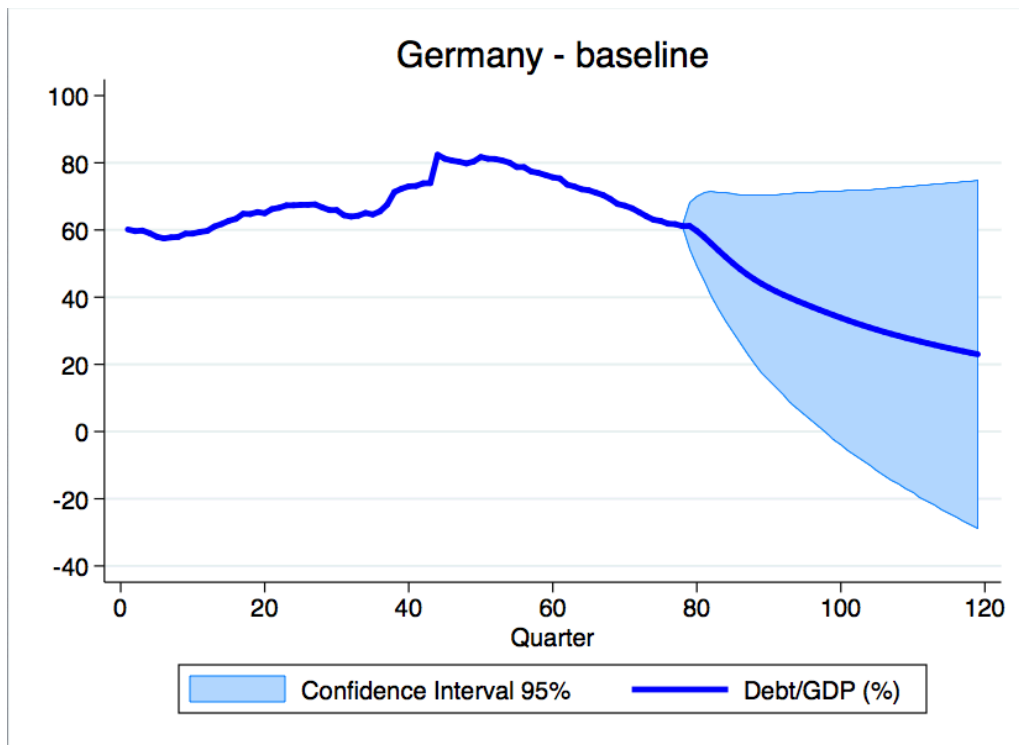
Figure A.9: Italy_ Interest Expenditure

Italy - Interest Expenditure
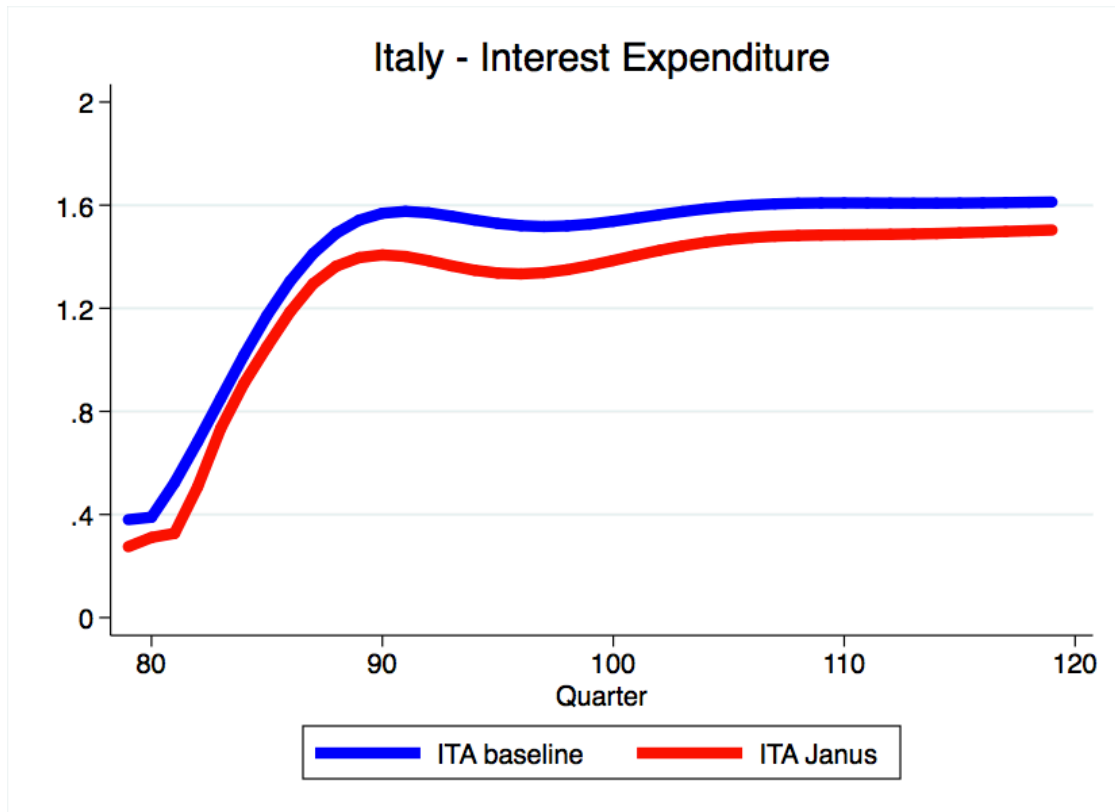
Figure A.9c: Italy_ Interest Expenditure

Italy - Modified Premium
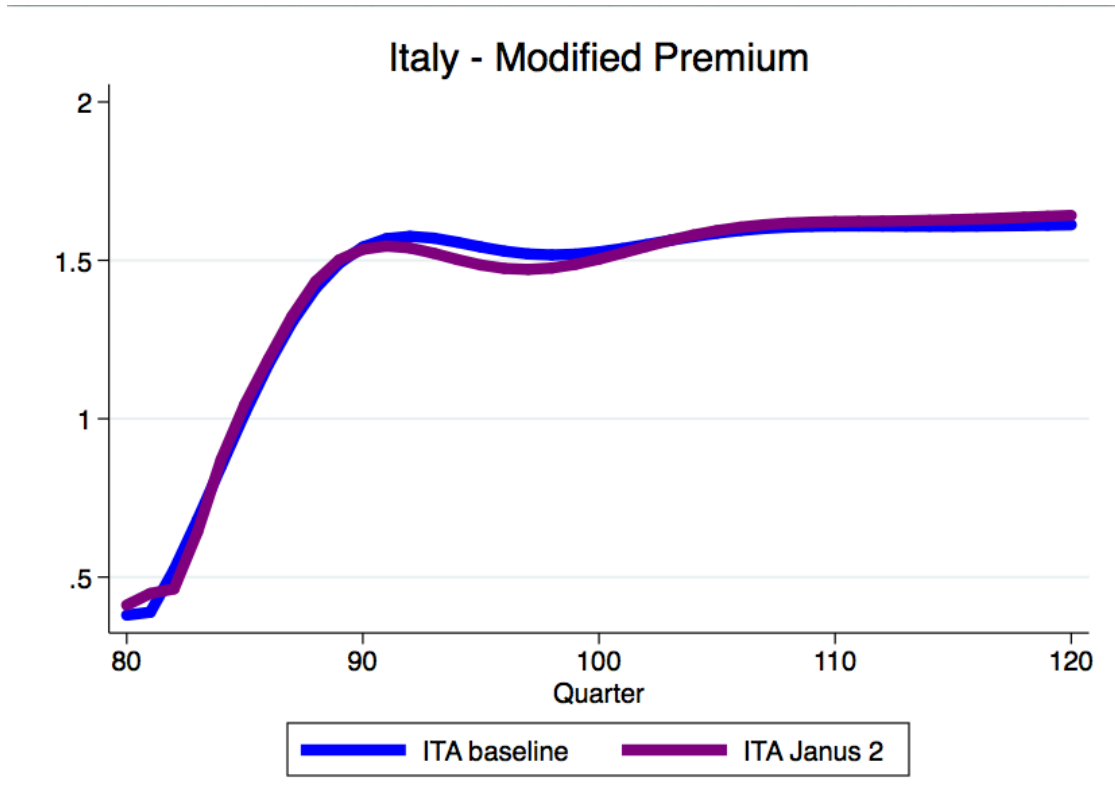
Figure A.10: Italy _ Standard deviation of Interest Expenditure
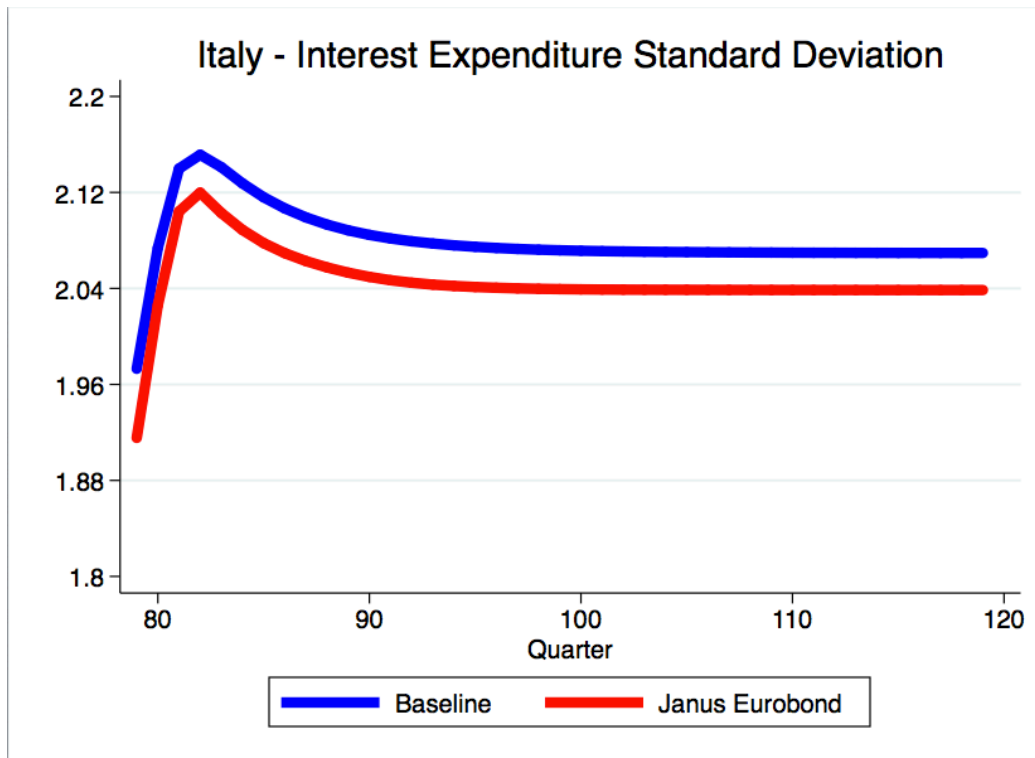
Figure A.10c: Italy _ Modified Premium_ Standard Deviation of Interest Expenditure
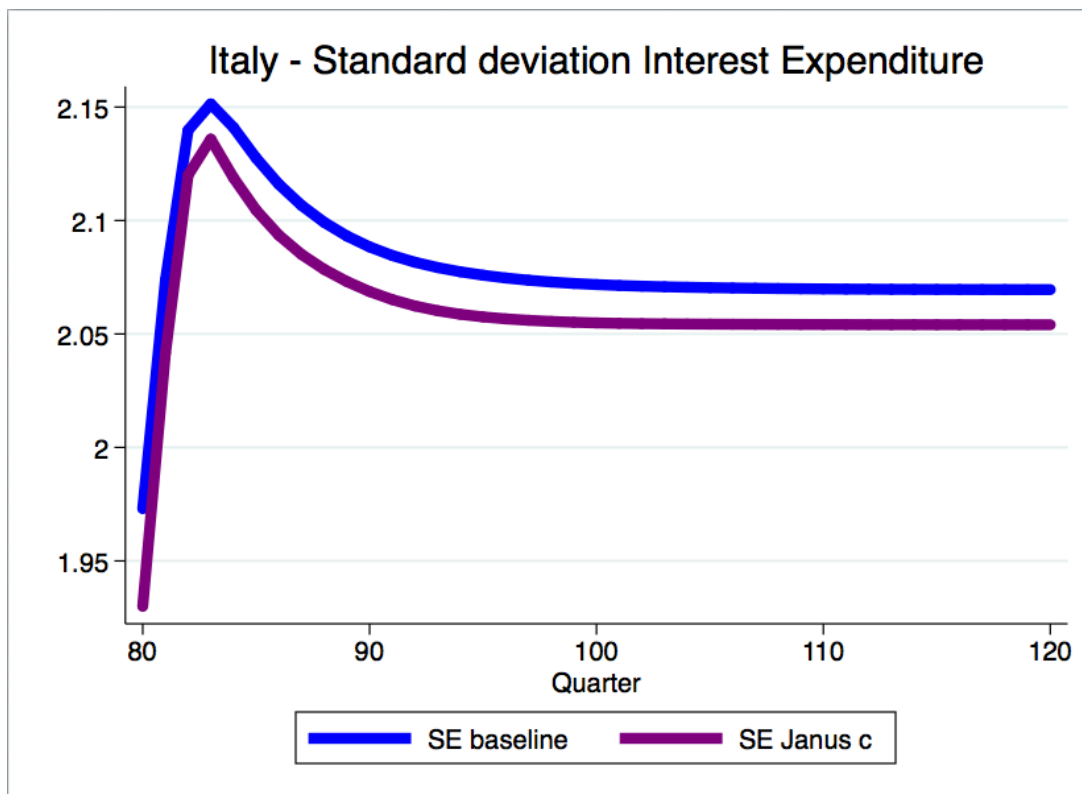
Figure A.11: France _ Interest Expenditure
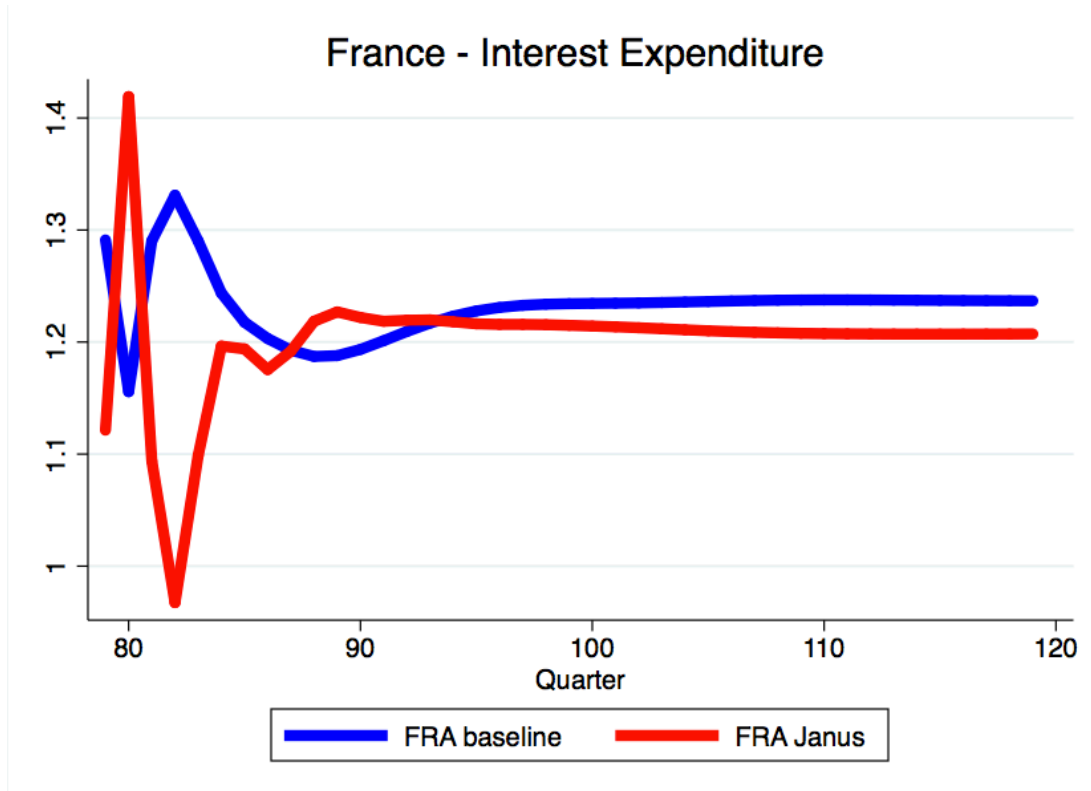
Figure A.12: France _ Standard deviation of Interest Expenditure
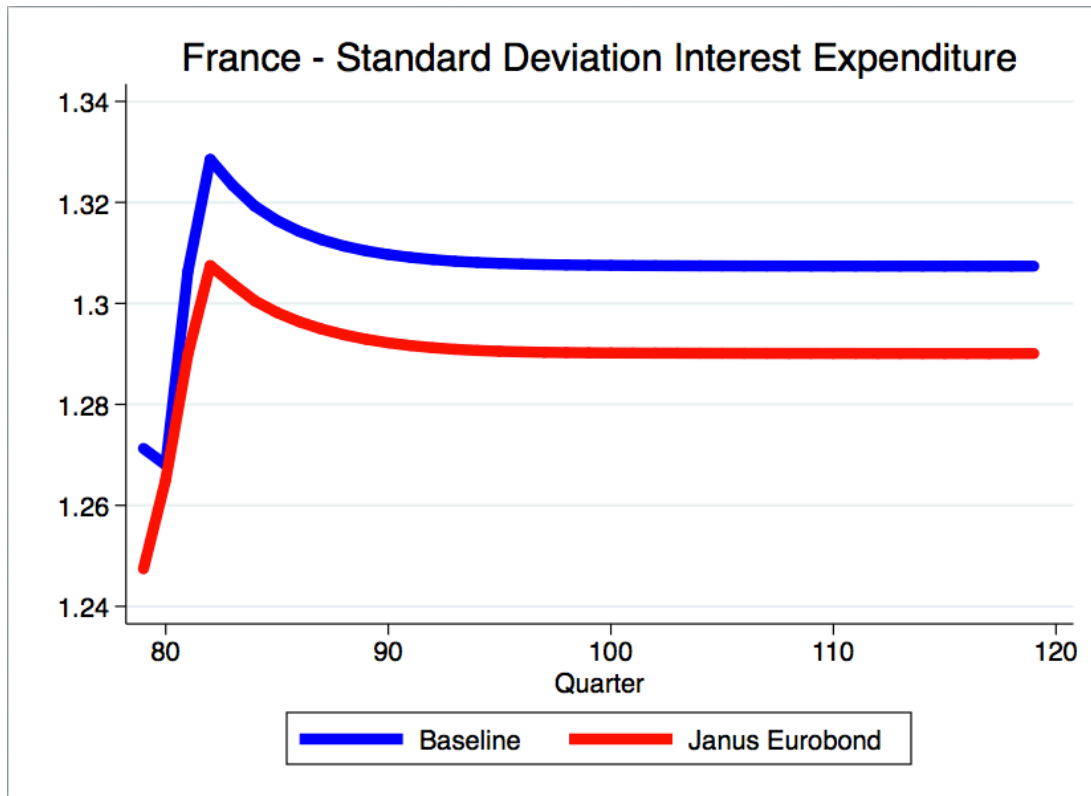
Figure A.13: Italy _ monetary shock_ baseline

Italy - monetary shock

Confidence Interval 95%   ITA baseline
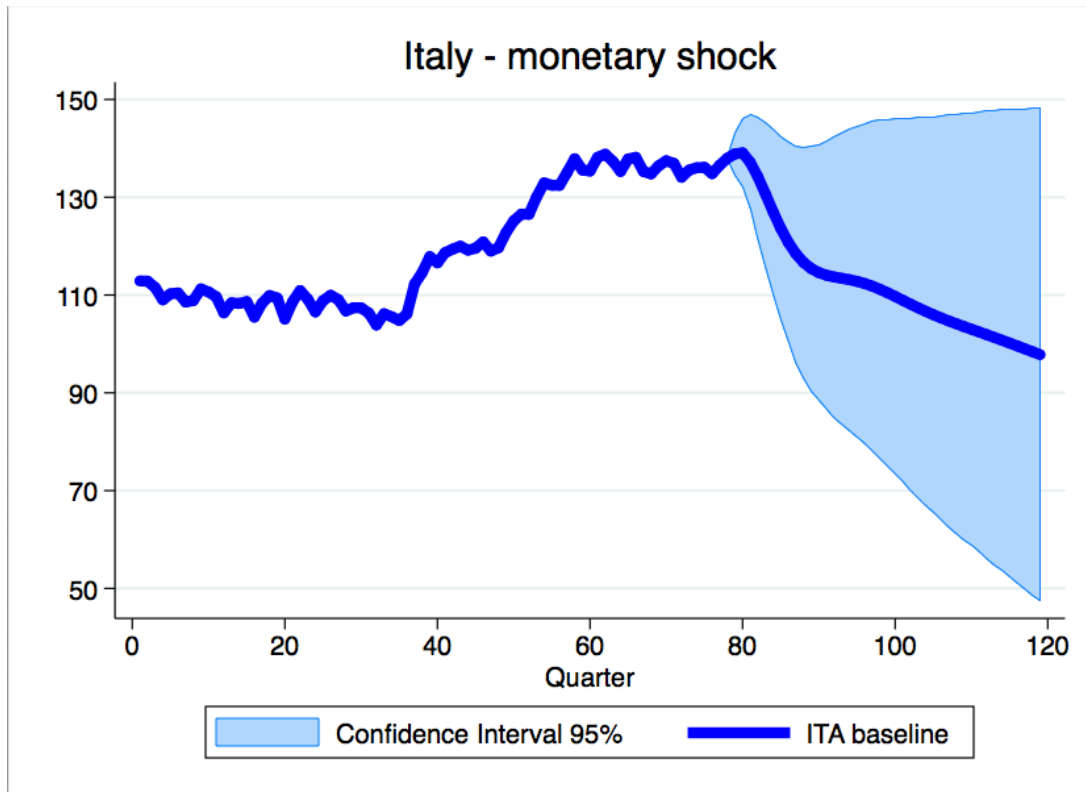
Figure A.14: Italy _ monetary shock_ Janus Eurobond

Italy - monetary shock

Confidence interval 95%   ITA Janus Eurobond
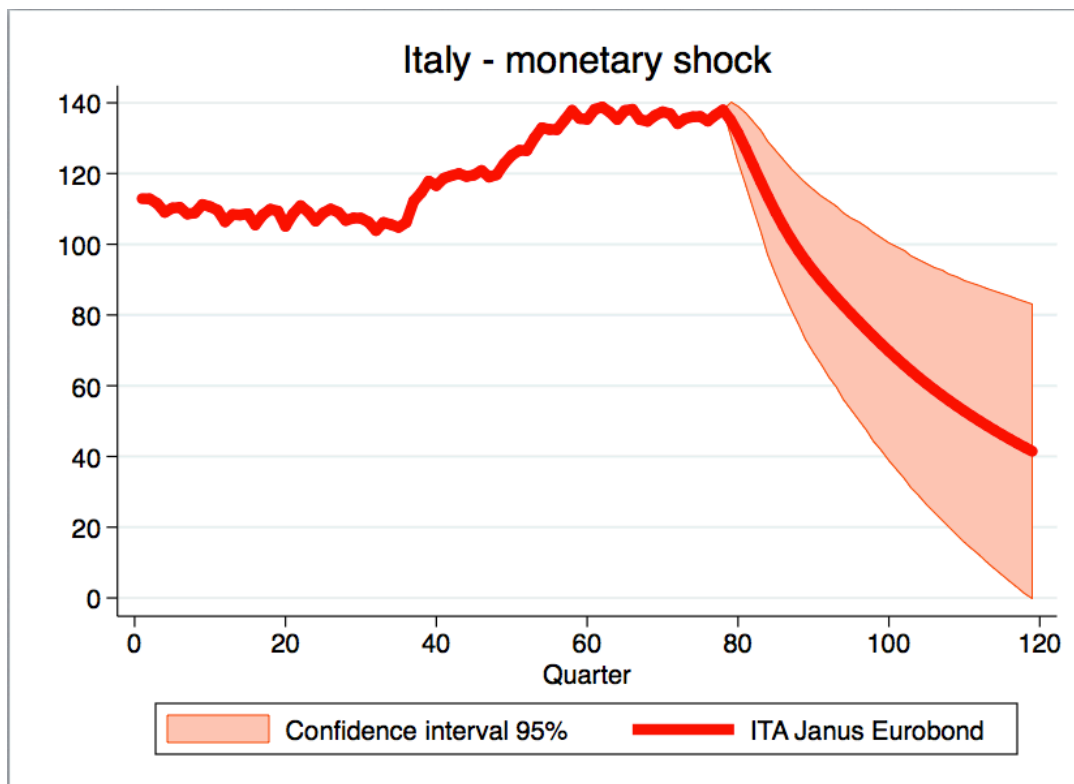
Figure A.15: France _ monetary shock_ baseline
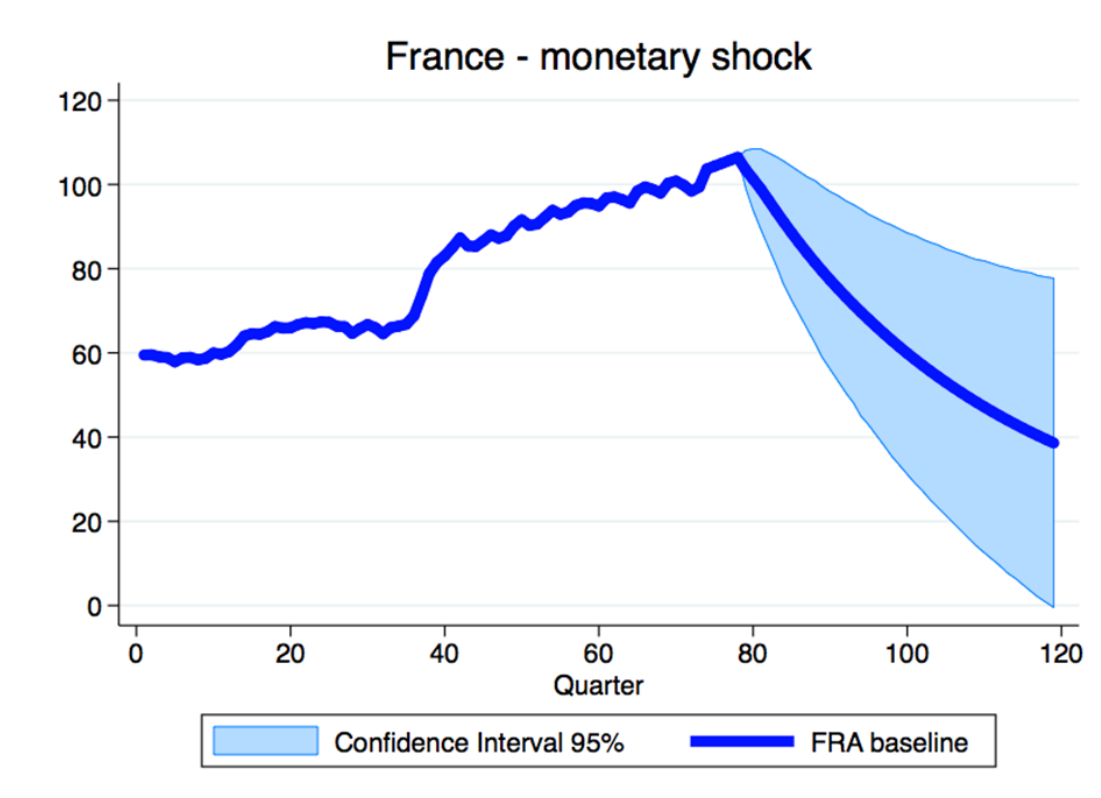
Figure A.16: France _ monetary shock_ Janus Eurobond
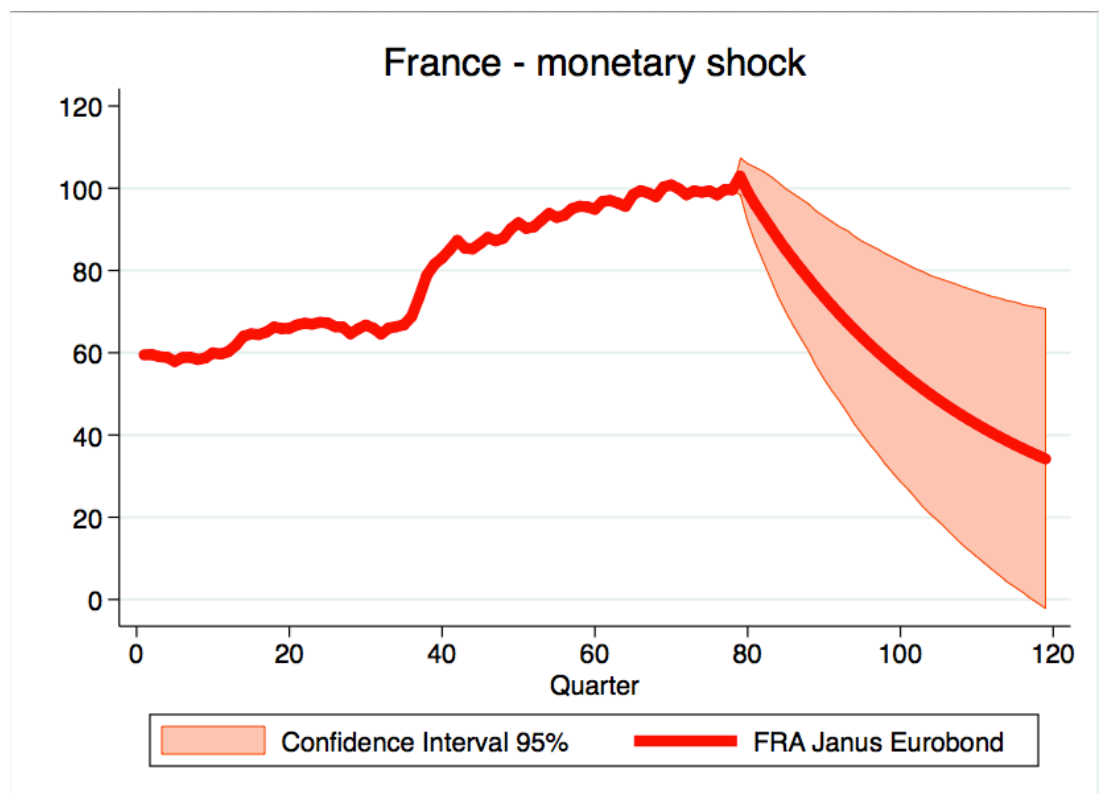
Figure A.17: Germany _ monetary shock_ baseline

Germany - monetary shock
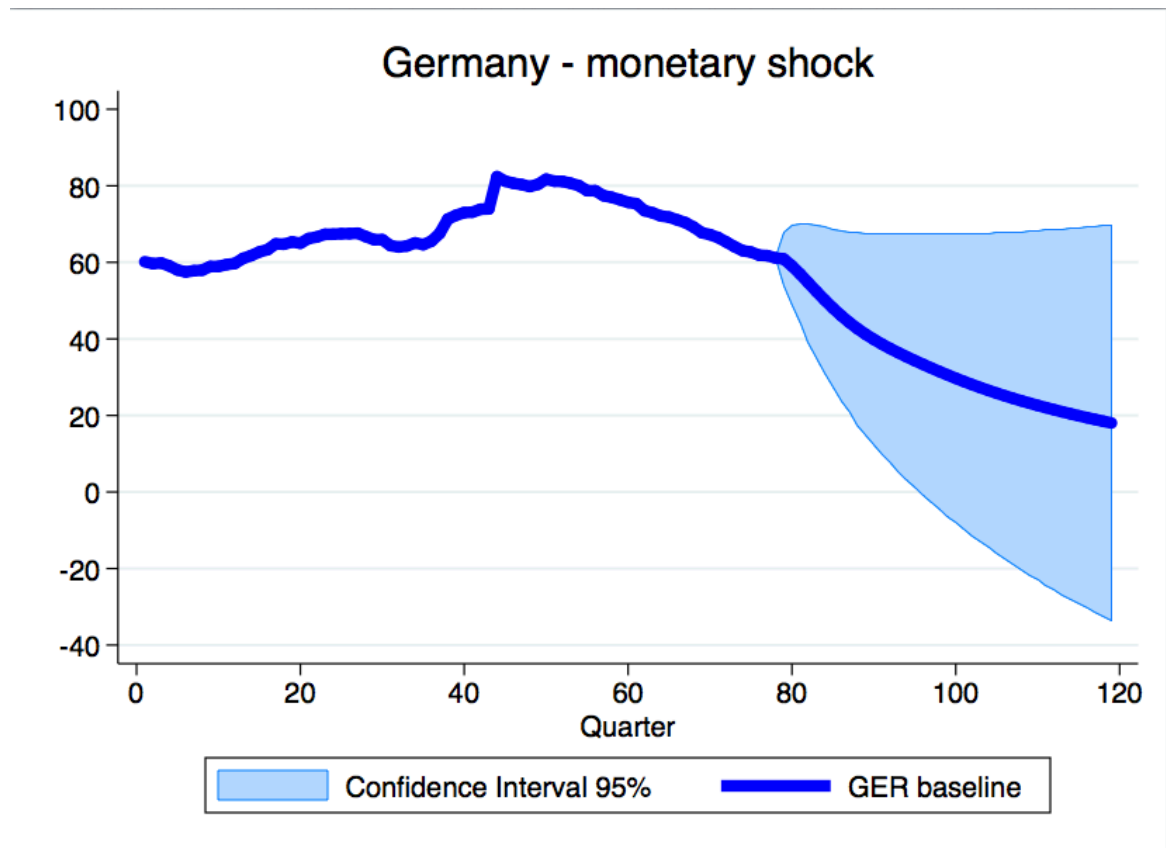
Figure A.18: Italy _ real shock_ baseline

Italy - growth slowdown

Legend: Confidence Interval 95% — ITA baseline
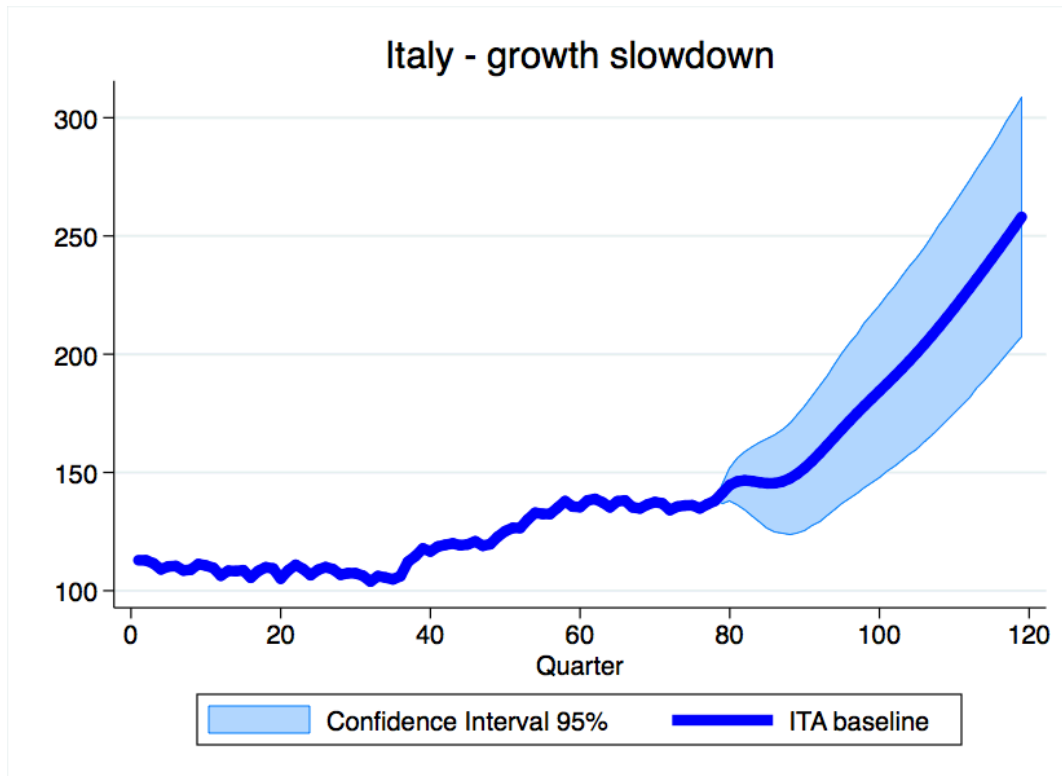
Figure A.19: Italy _ real shock_ Janus Eurobond

Italy - growth slowdown

Legend: Confidence Interval 95% — ITA Janus Eurobond
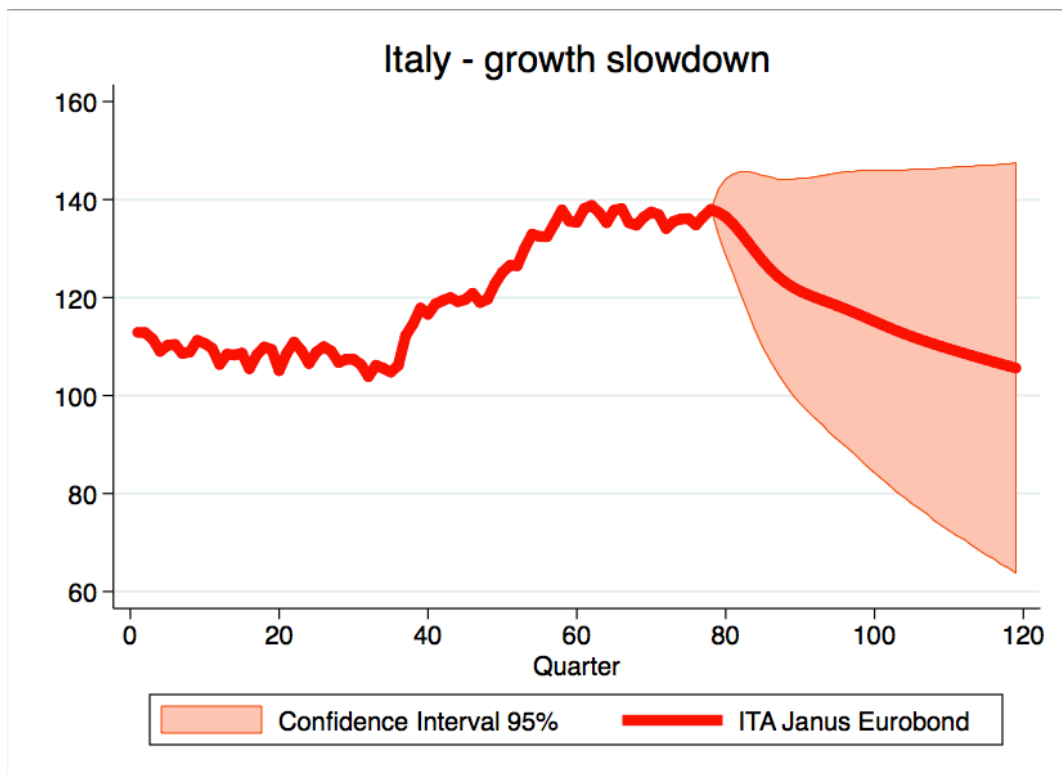
Figure A.20: France _ real shock_ baseline

France - growth slowdown
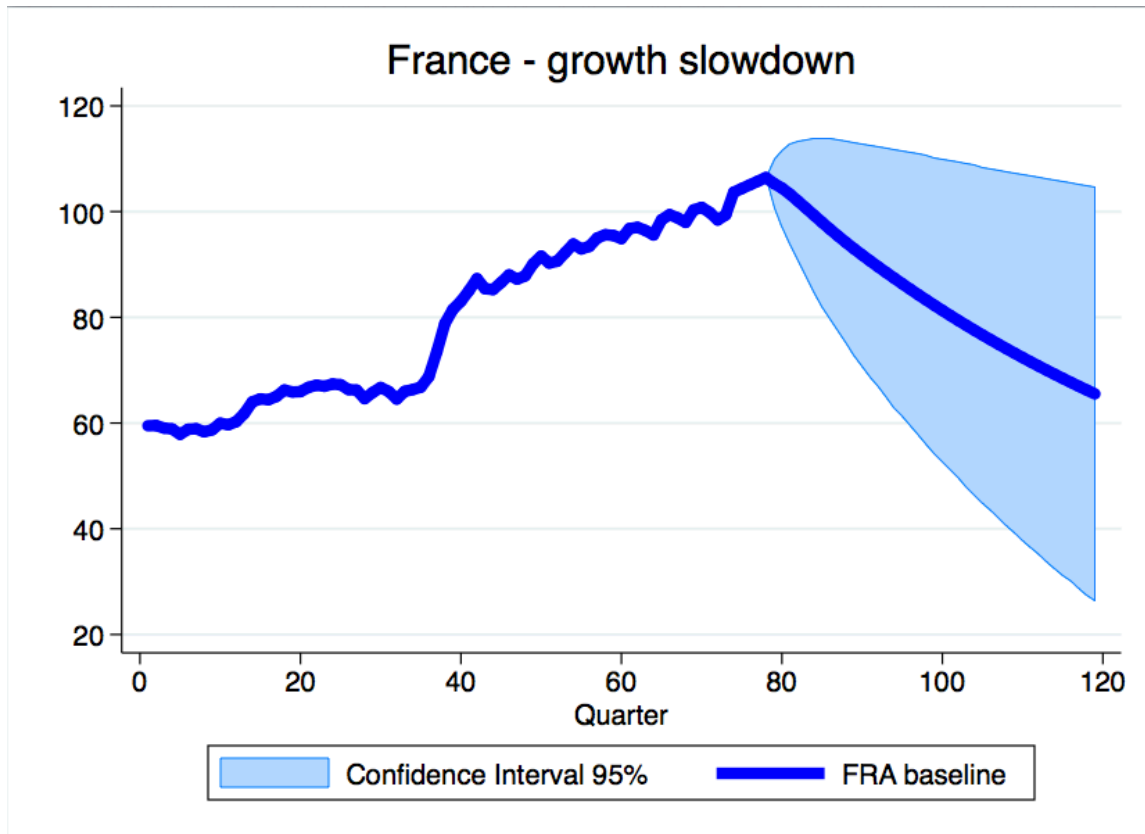
Figure A.21: France _ real shock_ Janus Eurobond

France - growth slowdown
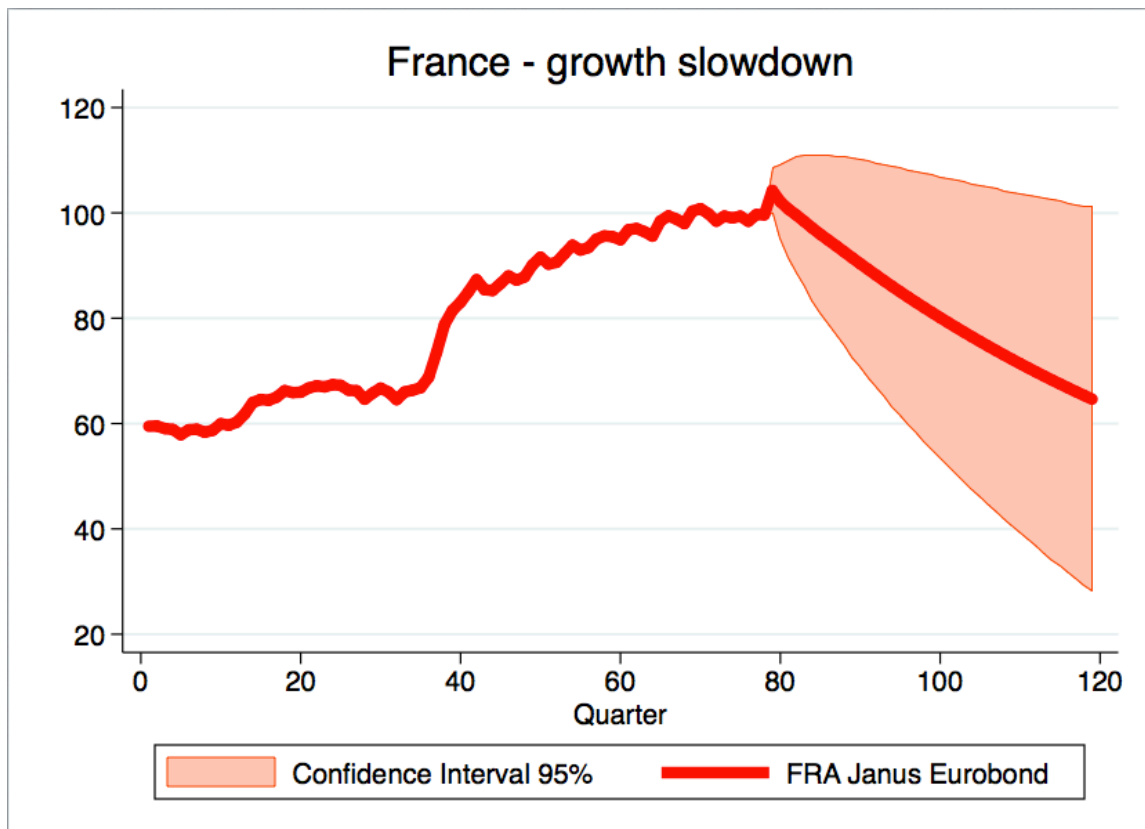
Figure A.22: Germany _ real shock_ baseline

Germany - growth slowdown
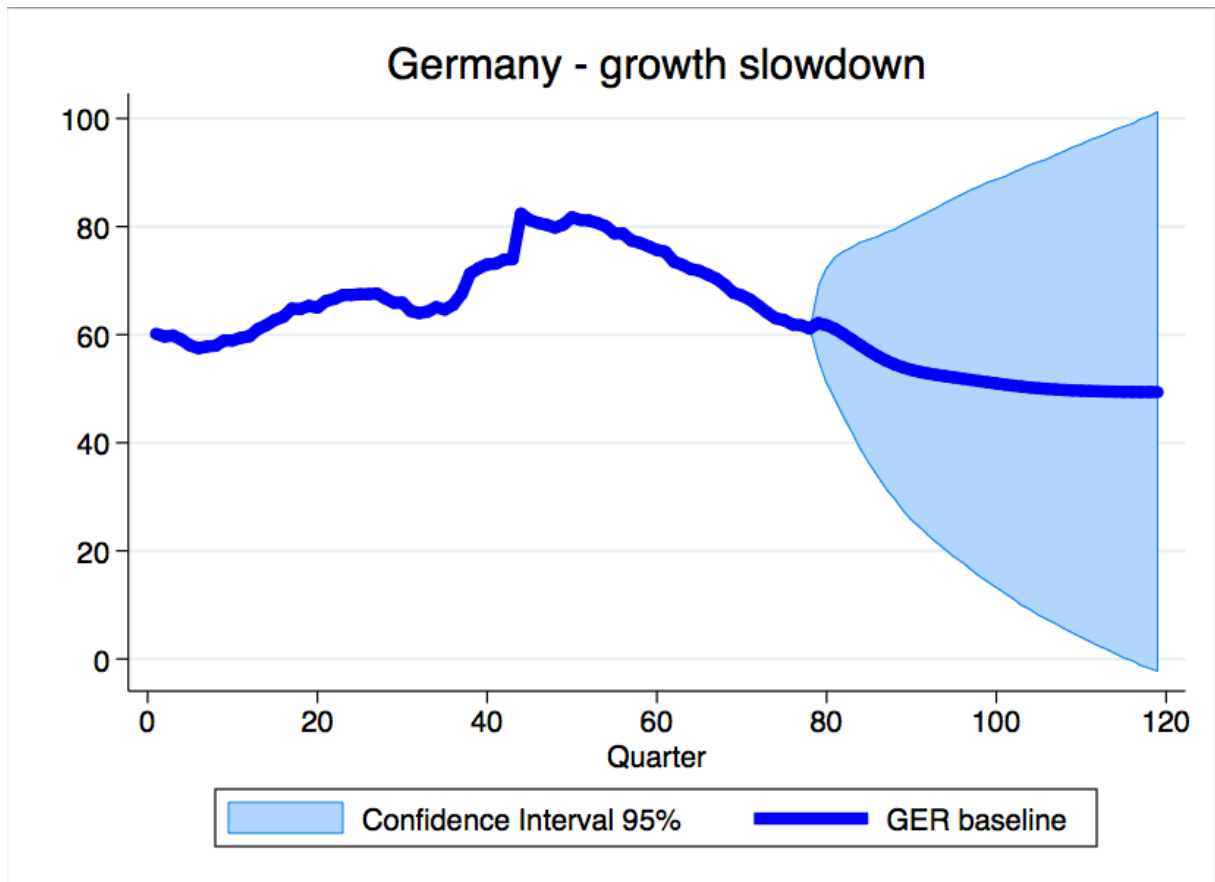
Figure A.23: Italy _ fiscal shock_ baseline
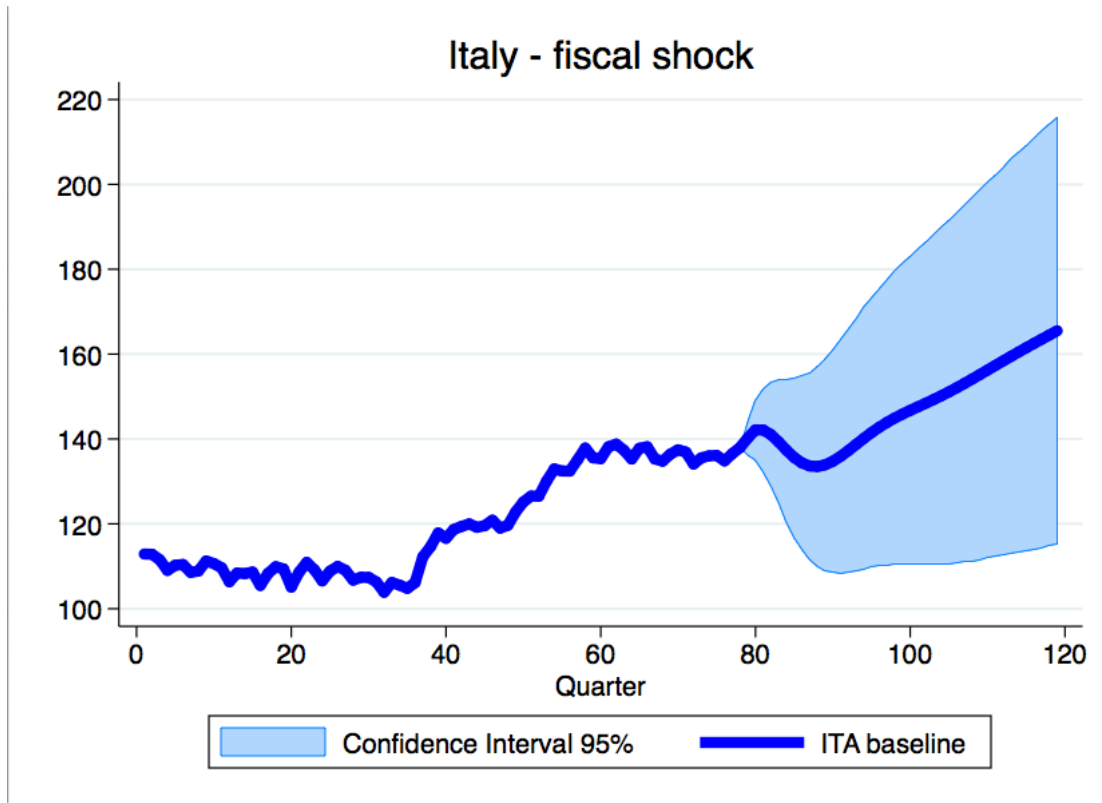
Italy - fiscal shock

Figure A.24: Italy _ fiscal shock_ Janus Eurobond
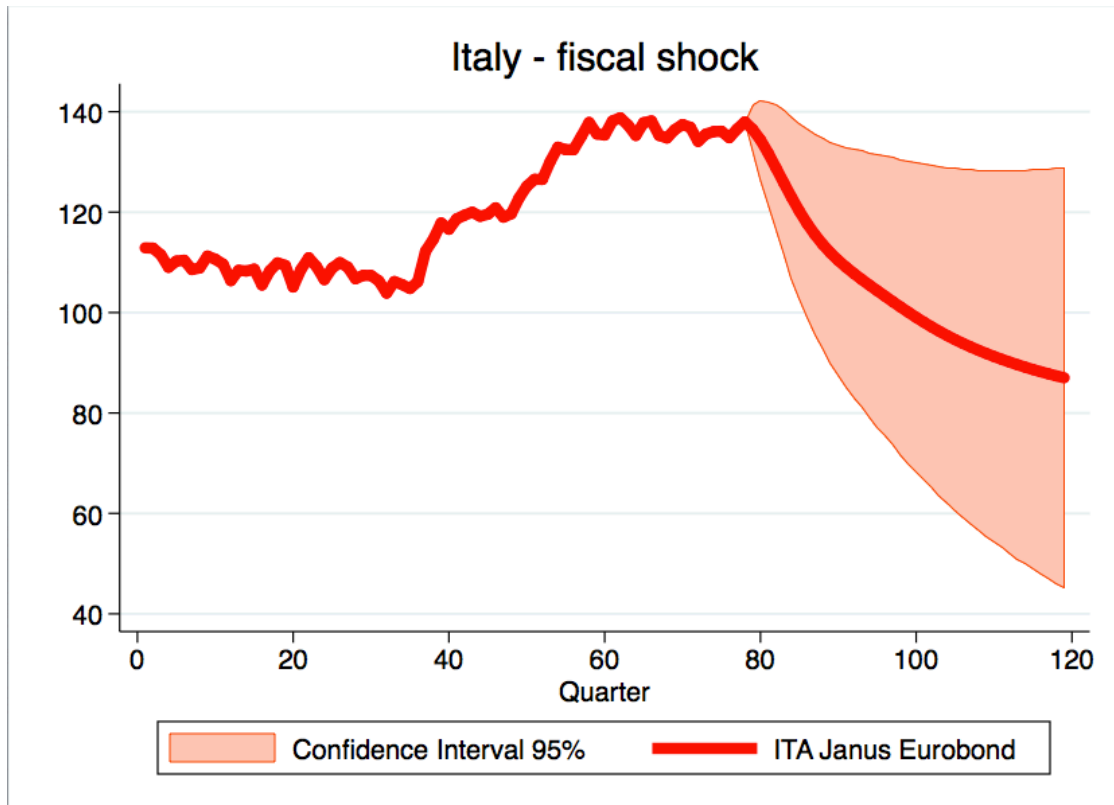

Italy - fiscal shock

Figure A.25: France _ fiscal shock_ baseline
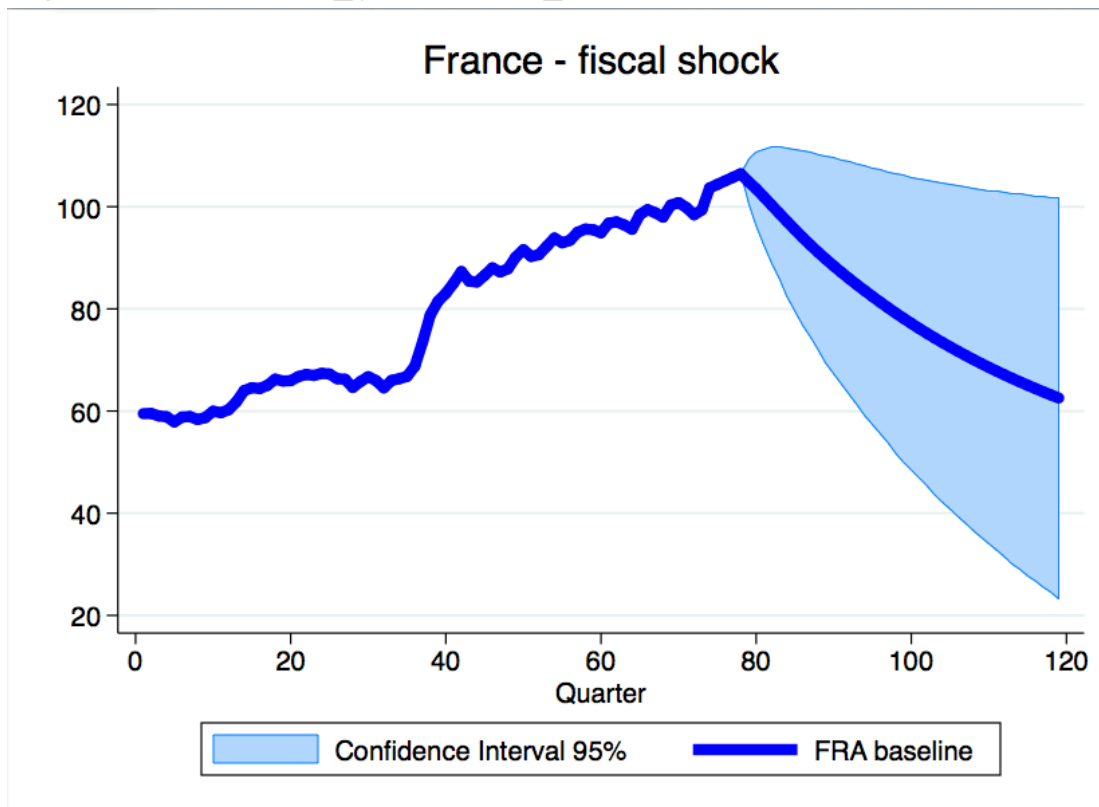
Figure A.26: France _ fiscal shock_ Janus Eurobond

Figure A.27: Germany _ fiscal shock_ baseline
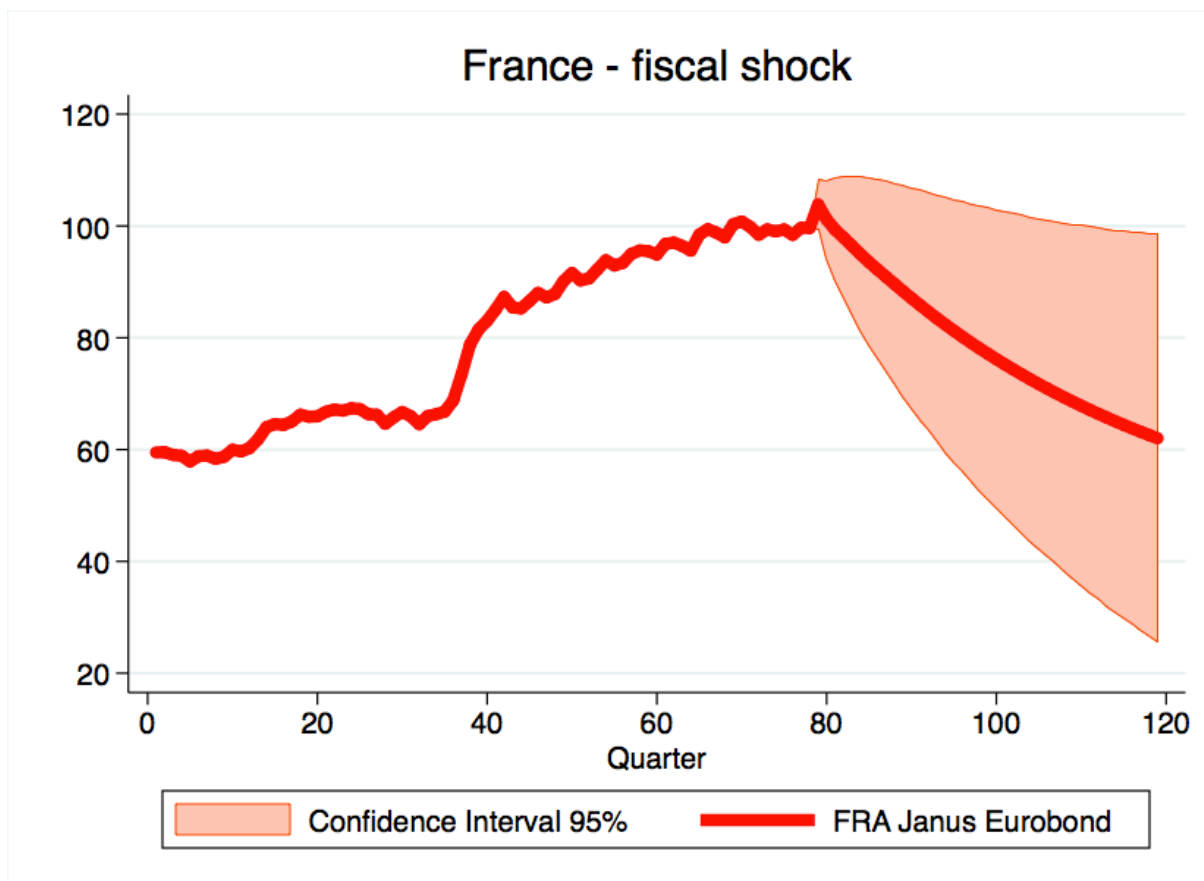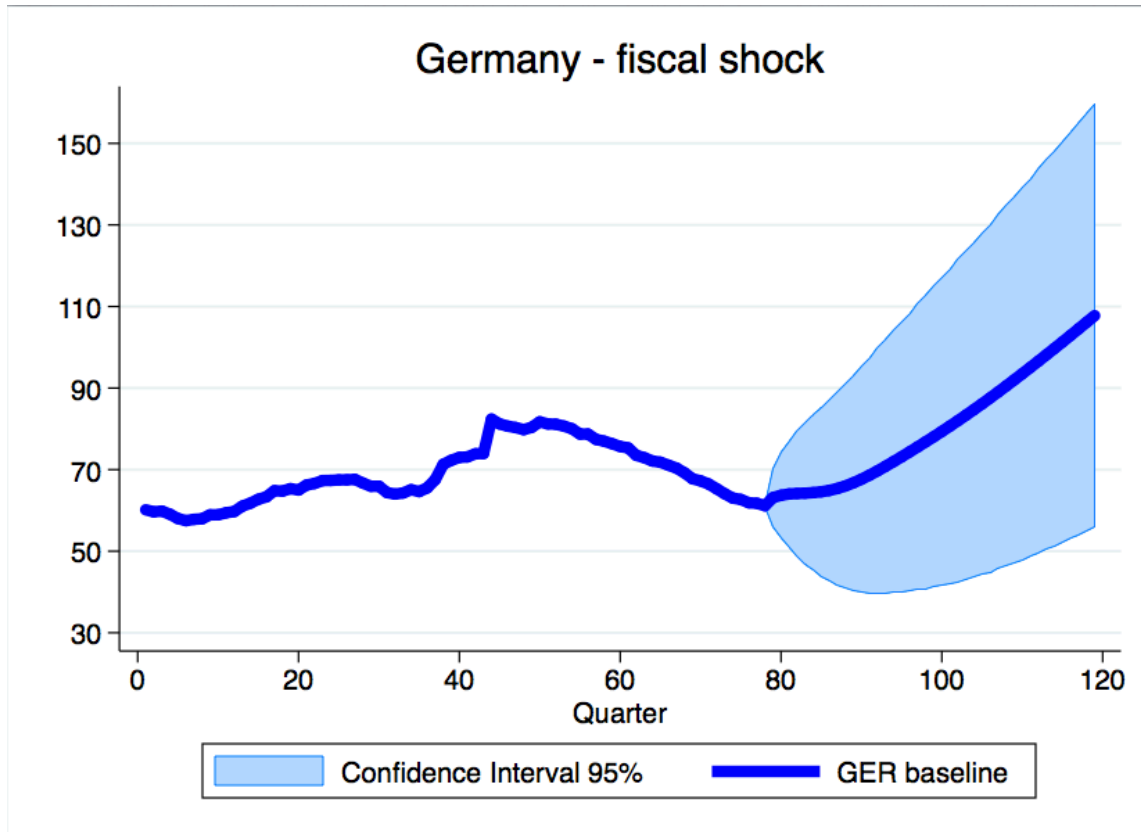

Germany - fiscal shock

References

Acharya, V.V., Drechsler, I. and Schnabl, P. (2011). *A Pyrrhic victory? – Bank bailouts and sovereign credit risk.* NBER Working Paper 17136.

Afonso, A., Furceri, D. Gomes, P. (2012). *Sovereign credit ratings and financial markets linkages: application to European data.* Journal of International Money and Finance, 2012, vol. 31, issue 3, 606-638.

Aizenman, J., Hutchison, M., Jinjarak, Y. (2011). *What is the risk of european sovereign debt defaults? Fiscal space, cds spreads and market pricing of risk.* Journal of International Money and Finance, Elsevier, vol. 34(C), pages 37-59.

Altman, E.I., Rijken, H.A. (2004). *How rating agencies achieve rating stability.* Journal of Banking and Finance, volume 28: 2679-2714.

Anzoategui, D. (2018). *Sovereign Debt and the Effects of Fiscal Austerity.* Mimeo, Rutgers University.

Ardagna S., Caselli, F., Lane, T. (2007). *Fiscal discipline and the cost of public debt service: Some estimates for OECD countries.* The B.E. Journal of Macroeconomics, 7 (1), Article 28.

Arezki, R., Candelon, B., Sy, A. (2011). *Sovereign rating news and financial markets spillovers: Evidence from the European debt crisis.* IMF Working Paper Series, n.11/68.

Arghyrou, M.G., Tsoukalas, J. (2011). *The Greek debt crisis: Likely causes, mechanics and outcomes.* The World Economy, 34, 173-191.

Arghyrou, M.G. and Kontonikas, A. (2012). *The EMU sovereign debt crisis: Fundamentals, expectations and contagion.* Journal of International Financial Markets, Institutions and Money, 22, 658-677.

Attinasi M.G., Checherita, C., Nickel, C. (2009). *What explains the surge in Eurozone*

sovereign spreads during the financial crisis of 2007-09? ECB Working Paper no. 1131/2009.

Augustin, P. (2018). *The term structure of CDS spreads and sovereign credit risk.* Journal of Monetary Economics, Elsevier, vol. 96(C), pages 53-76.

Baglioni, A., Cherubini, U. (2016). *Eurobonds: a quantitative approach.* Review of Law and Economics, Volume 12, Issue 3.

Balassone F., Franco, D., Giordano, R. (2004). *Market-induced fiscal discipline: Is there a fall- back solution for rule failure?* Banca d'Italia, Sixth workshop on public finance, Perugia, 1–3 April.

Barrios, S., Iversen, P., Lewandowska, M., Setzer, R. (2009). *Determinants of intra-euro-area government bond spreads during the financial crisis.* European Commission, Directorate General for Economic and Financial Affairs, Economic Papers, N. 388.

Beber, A., Brandt, M. and Kavajecz, K. (2009). *Flight-to-quality or flight-to-liquidity? Evidence from the euro-area bond market.* Review of Financial Studies, 22, 925- 957.

Ben Salem, M., Castelletti, B. (2017). *The determinants of sovereign bond yields: the role of* fiscal and external imbalances. Rue de la Banque, Banque de France, issue 53, December.

Berndt, A., Douglas, R., Duffie, D., Ferguson, M., Schranz, D. (2008). *Measuring Default Risk Premia from Default Swap Rates and EDFs*. Working Paper, Cornell University.

Bernoth, K., Erdogan, B. (2010*). Sovereign bond yield spreads: A time-varying coefficient approach*. DIW Berlin discussion paper 1078. German Institute for Economic Research.

Bernoth, K., von Hagen, J., Schuknecht, L. (2004). *Sovereign risk premia in the European government bond market*. ECB Working Paper 369.

Bis. (2016). *Towards a financial stability-oriented fiscal policy*. Bis Annual Economic Report

26 June 2016.

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

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

Bottero, M., Lenzu, S., Mezzanotti, F. (2016). *Sovereign debt exposure and the bank lending channel impact on credit supply and the real economy.* Harvard University, working paper, January 2016.

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

Byström, H. (2005). *Credit Default Swaps and Equity Prices: The iTraxx CDS Index Market".* Working Paper. University of Lund, Lund.

Caceres, C., Guzzo, V., Segoviano, M. (2010). *Sovereign spreads: Global risk aversion, contagion or fundamentals?* IMF Working Paper 10/120.

Caggiano G., Greco L. (2012). *Fiscal and Financial Determinants of Eurozone Sovereign Spreads.* Marco Fanno Working Paper n.148-2012.

Callen, J. L., Livnat, J. Segal, D. *The Impact of Earnings on the Pricing of Credit Default Swaps* (February 15, 2007). Available at SSRN: http://ssrn.com/abstract=949322

Candelon, B., Palm, F.C. (2010). *Banking and debt crises in Europe: the dangerous liaisons?* CESifo Working Paper 3001.

Caporin, M., Pelizzon, L., Ravazzolo, F.,Rigobon, R. (2014). *Measuring Sovereing Contagion in Europe.* SAFE Working Paper Series 103, Research Center SAFE - Sustainable Architecture for Finance in Europe, Goethe University Frankfurt.

Checcherita, C., Attinasi, M., Nickel, C. (2010). *What explains the surge in euro-area sovereign spreads during the financial crisis of 2007-09?* Working Paper Series 1131, European Central Bank.

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

Clayes, G. (2014). *The (not so) Unconventional Monetary Policy of the European Central Bank since 2008.* Policy Department A: economic and scientific policy. http://www.europarl.europa.eu/studies.

Codogno, L., Favero, C., Missale, A. (2003). *Yield spreads on EMU government Bonds.* Economic Policy, 18: 503-532.

Council and Commission of the European Communities. (1992). *Treaty on European Union.* Office for Official Publications of the European Communities. Luxembourg.

De Grauwe, P. (2009). *Why should we believe the market this time?* ECMI Commentary No. 22, 23 February.

De Grauwe P., Ji, Y. (2012). *Mispricing of sovereign risk and multiple equilibria in the Eurozone.* CEPS Working Documents, No. 361.

De Grauwe, P., Moesen, W. (2009). *Gains for All: a proposal for a common Eurobond.* Intereconomics 44(3), May.

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 Santis, R. (2012). *The euro area sovereign debt crisis: Safe haven, credit rating agencies and the spread of the fever from Greece, Ireland and Portugal.* ECB Working Paper 1419.

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

Di Cesare, A., Grande, G., Manna, M., Taboga, M. (2013). *Recent estimates of sovereign risk premia for euro-area countries*. No 128, Questioni di Economia e Finanza (Occasional Papers), Bank of Italy, Economic Research and International Relations Area.

Di Dio, F. (2016). *Eurobond and Fiscal Sustainability in the Eurozone: A Stochastic Analysis of Italy, Spain and France*. Università degli Studi di Padova, Master thesis.

Dimic, N., Kiviaho, J., Piljak, V., & Äijö, J. (2016). *Impact of financial market uncertainty and macroeconomic factors on stock–bond correlation in emerging markets*. Research in International Business and Finance, 36, 41-51.

Engwerda, J., van Aarle, B., Anevlavis, T. (2019). *Debt stabilization games in a monetary union: What are the effects of introducing eurobonds*? Journal of Macroeconomics Volume 59, March 2019, Pages 78-102.

European Central Bank Governing Council. (2010). *Decision of the European Central Bank of 14 May 2010 establishing a securities markets programme*. Official Journal of the European Union.

ECB Press Office. (2010). *ECB decides on measures to address severe tensions in financial markets*.

ECB Press Office. (2012*). Technical features of Outright Monetary Transactions*. 6 September, Press Release. https://www.ecb.europa.eu/press/pr/date/2012/html/pr120906_1.en.html

ECB Press Office. (2015). *ECB announces expanded asset purchase programme*. 22 January, Press Release. https://www.ecb.europa.eu/press/pr/date/2015/html/pr150122_1.en.html

Economic Governance and Support Unit. (2019). *Structural budget balances in EU Member States - November 2019*. Directorate-General for Internal Policies PE 587.388 - November 2019.

European Stability Mechanism. (2017). *Evaluation Report.* Publications Office of the European Union, Luxembourg.

European Stability Mechanism. (2019*). Safeguarding the euro in times of crisis-The inside story of the ESM*. Publications Office of the European Union, Luxembourg. https://www.esm.europa.eu/sites/default/files/safeguarding-euro-times-crisis-inside-story-esm.pdf

Faini, R. (2006). *Fiscal policy and interest rates in Europe. Economic Policy*. vol. 21, issue 47, 443-489.

Favero, C., Missale, A. (2011). *Sovereign Spreads in the Euro Area. Which Prospects for a Eurobond*? Economic Policy 27, November.

Favero, C., Pagano, M., von Thadden, E.-L. (2010). *How does liquidity affect government bond yields?* Journal of Financial and Quantitative Analysis, 45, 07-134.

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

Feldstein, M. 1997. *The Political Economy of an European Economic and Monetary Union: Political Sources of an Economic Liability.* Journal of Economic Perspectives 11(4): 23–42.

Ferri, G., Liu, L., Stiglitz, J.E. (1999). *The procyclical role of rating agencies: Evidence from* the east Asian crisis. Economic Notes, 28: 335-355.

Flannery, M. J., Houston, J.F., Partnoy, F. (2010). *Credit Default Swap Spreads as Viable Substitutes for Credit Ratings*. University of Pennsylvania Law Review,158, 1– 40.

Gande, A., Parsley, D. (2005). *News spillovers in the sovereign debt market*. Journal of Financial Economics, 75: 691-734.

Geyer, A., Kossmeier, S., Pichler, S. (2004). *Measuring systemic risk in EMU government yield spreads*. Review of Finance, 8, 171-197.

Gerlach, S., Schulz, A., Wolff, G. (2010). *Banking and Sovereign Risk in the Euro area.*

CEPR Discussion Paper, n. 7833.

Giglio, S. (2010). *CDS spreads and Systemic Financial Risk.* Working Paper, Harvard University, Boston, USA.

Giordano, L., Linciano, N., Soccorso, P. (2012). *The Determinants of Government Yield Spreads in the Euro Area*. CONSOB Working Papers No. 71.

Giovannini Group Report (2000). *Co-ordinated Public Debt Issuance in the Euro Area.* November.

Gomez-Bengoechea, G., Arahuetes, A. (2019). *The importance of being earnest: Macroeconomic determinants of sovereign bond yield spreads in the Eurozone*. Journal of Financial Economic Policy, Vol. 11 No. 1, pp. 121-138.

Gomez-Puig, M. (2006). *Size matters for liquidity: Evidence from EMU sovereign yield spreads.* Economics Letters, 90, 156-162.

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

Guler, H., Talasli, A. (2012). *Determinants Of Sovereign Bond Spreads A Comparative Analysis During The Global Financial Crisis*. MPRA Munich Personal RePEc Archive.

Haugh, D., Ollivaud, P., Turner, D. (2009). *What drives sovereign risk premiums? An analysis of recent evidence from the euro area*. OECD Economics Department Working Paper No. 718.

Hull, J., Predescu, M.,White, A. (2004). *The Relationship Between Credit Default Swap Spreads, Bond Yields, and Credit Rating Announcements*. Journal of Banking & Finance 28, 2789– 2811.

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

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

Jacobs, M. Jr., Karagozoglu, A. K., Peluso, C. M. (2010). *Measuring Credit Risk: CDS Spreads vs. Credit Ratings*. Working Paper, FMA Meetings, New York, USA.

Jankowitsch, R., Mosenbacher, H., Pichler, S. (2006). *Measuring the liquidity impact on EMU government bond prices*. European Journal of Finance, 12, 153-169.

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

Lane, P. R. (2012).*The European Sovereign Debt Crisis*. Journal of Economic Perspectives. Volume 26, Number 3, Pages 49–68. DOI: 10.1257/jep.26.3.49.

Lionello, L. (2015). *The new role of the ECB in the European sovereign debt crisis*. The Federalist, Pavia.

Manganelli, S., Wolswijk, G. (2009). *What drives spreads in the euro-area government bond market?* Economic Policy, 24, 191-240.

Mody, A. (2009). *From Bear Sterns to Anglo Irish: How Eurozone sovereign spreads related to financial sector vulnerability*. IMF Working Paper 09/108.

Monfort, A., Renne, J.-P. (2013). *Decomposing Euro Area Sovereign Spreads: Credit and Liquidity Risks*. Review of Finance 18(6):2103-2151, September.

Mora, N. (2006). *Sovereign credit ratings: Guilty beyond reasonable doubt?* Journal of Banking and Finance, 30: 2041-2062.

Noeth, B., Sengupta, R. (2012). *A Look at Credit Default Swaps and Their Impact on the European Debt Crisis*. The Regional Economist, April 2012, Federal Reserve Bank of St. Louis, pp. 10-11.

Pagano, M., von Thadden, E.L. (2004). *The European bond markets under EMU*. Oxford Review of Economic Policy, 20, 531-554.

Panageotou, S. (2017). *Disciplining Greece: Crisis Management and Its Discontents. Review of Radical Political Economics*. https://doi.org/10.1177/0486613417703971.

Poghosyan, T. (2012). *Long-Run and Short-Run Determinants of Sovereign Bond Yields in Advanced Economies*. Economic Systems 38 (1), November 2012.

Regling,K. (2018). *The future of the Economic and Monetary Union and the role of the ESM*. Frankfurt am Main. 33rd international ZinsFORUM 2018.

Schwarz K., 2014. *Mind the gap: disentangling credit and liquidity in risk spreds.* SSRN Electronic Journal , October.

Sensoy, A., Nguyen, D.K., Rostom, A. et al. (2019*). Dynamic integration and network structure of the EMU sovereign bond markets*. Ann Oper Res 281, 297–314.

Sgherri, S. and Zoli, E. (2009*). Euro-area sovereign risk during the crisis*. IMF Working Paper WP/09/222.

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

Tielens, J., Van Aarle, B., 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.

Tridimas, T., Xanthoulis,N. (2016). *A legal analysis of the Gauweiler case. Between Monetary Policy and Constitutional Conflict*. Maastricht Journal of European and Comparative Law. https://doi.org/10.1177/1023263X1602300102.

Van Aarle, B., Engwerda, J., A Weeren, A. (2018). *Effects of debt mutualization in a monetary union with endogenous risk premia: Can Eurobonds contribute to debt stabilization?* Structural Change and Economic Dynamics, Volume 44, March 2018, Pages

100-114.

Von Hagen, J., Schuknecht , L., Wolswijk, G. (2011). *Government bond risk premiums in the EU revisited: The impact of the financial crisis.* European Journal of Political Economy, vol. 27, issue 1, 36-43.

Wyplosz, C. (1997). *EMU: Why and How It Might Happen.* Journal of Economic Perspectives 11(4): 3–22.

Wyplosz, C. (2006). *European Monetary Union: The Dark Sides of a Major Success.* Economic Policy 21(46): 207–261.

 Zaja, M. M., Jakovčević, D., Višić, L. (2018). *Determinants of the Government Bond Yield: Evidence from a Highly Euroised Small Open Economy*. International Journal of Economic Sciences, 8 (2018).