UNIVERSIDAD COMPLUTENSE DE MADRID
FACULTAD DE CIENCIAS ECONÓMICAS Y EMPRESARIALES
DEPARTAMENTO DE FUNDAMENTOS DE ANÁLISIS ECONÓMICO II

TESIS DOCTORAL

The interaction of fiscal and financial risk in the Eurozone

La interacción del riesgo fiscal y financiero en el área euro

MEMORIA PARA OPTAR AL GRADO DE DOCTOR

PRESENTADA POR

Víctor Echevarría Icaza

DIRECTOR

Simón Sosvilla Rivero

Madrid, 2017

UNIVERSIDAD COMPLUTENSE DE MADRID
FACULTAD DE CIENCIAS ECONÓMICAS Y EMPRESARIALES
Departamento de Fundamentos de Análisis Económico II
(Economía Cuantitativa)

THE INTERACTION OF FISCAL AND FINANCIAL RISK IN THE EUROZONE

(La interacción del riesgo fiscal y financiero en el área euro)

Memory to opt for the title of PhD in Economics

presented by

Victor Echevarria Icaza

Thesis Advisor

Prof. Dr. Simón Sosvilla Rivero

Madrid, 2016

The interaction of fiscal and financial risk in the Eurozone

Author:

Victor Echevarria Icaza

Director:

Simón Sosvilla Rivero

April 2016

Contents

Tabla de contenido

Agradecimientos 11

Abstract 13

Resumen 15

Introduction: 19

Chapter 1: A Survey of the literature on the interaction between fiscal and financial risk 25

1.1 Fiscal fatigue: main aspects 26

1.1.2 Fiscal policy and the cycle 27

1.1.3 Impact of European Economic and Mometary Union (EMU) 28

1.1.4 Taking into account government decisions 28

1.1.5 Discretionary fiscal policy and automatic stabilizers 29

1.1.6. Political economy and fiscal policy 31

1.1.7 Cyclicality of the components 31

1.1.8 Debt sustainability: the fiscal limit 32

1.1.9. The determinants of sustainability: sovereign spreads 32

1.1.9.1. Studies on emerging countries 33

1.1.9.2. Contagion and spreads 34

1.1.9.3. Spreads in the euro area 36

1.2 The dynamics of financial crises 39

1.3. Interactions between banks and sovereigns 40

1.4. Banking and fiscal crisis 40

1.5. Sovereign-bank feedback loops 41

1.6. Regulation and the sovereign bank nexus 44

1.7. Connectedness: amongst financial firms and with sovereigns 46

1.8. Macroprudential policy 48

1.8.1. Objectives of macroprudential policy 49

1.8.2 Macroprudential tools 51

1.8.3. Analytical underpinnings 57

1.8.4 Assessing the systemic importance of individual financial institutions 60

1.8.5 Understanding the interaction between the financial system and the macroeconomy 62

1.8.6 Effectiveness of macroprudential tools 66

1.8.7. Coordination with monetary policy and governance 68

Chapter 2: Fiscal fatigue and debt sustainability: Empirical evidence from the Eurozone 1980-2013 71
2.1. Introduction 71
2.2. Literature Review 73
2.3. Data and Empirical Model 76
2.3.1 Data 76
2.3.2 Model specification 78
2.4. Empirical Results 80
2.5. Consequences for debt sustainability 84
2.6. Concluding remarks 89
Chapter 3: Demand for sovereign bonds in the periphery: a regime-switching approach 93
3.1. Introduction 93
3.2. The regulation of banks and other financial institutions 99
3.2.1. Capital requirements 99
3.2.2. Data 104
3.3. Specification 104
3.4. Results 107
3.5. Drivers of the change in bond demand 120
3.6. Concluding remarks 122
Chapter 4. Connectedness in EMU banks and sovereign bond CDS 125
4.1. Introduction 125
4.2. Connectedness analysis 128
4.2.1. Econometric methodology 128
4.2.2. Data 131
4.2.3. Static (full-sample, unconditional) analysis 131
4.2.4 Sub sample approach 134
4.3. Net pair-wise directional connectedness 137
4.4. Policy implications 139
4.4.1. bank-sovereign connectedness 139
4.4.2. Systemically important financial institution (SIFI) status 140
4.4.3. The role of sovereign debt holdings in sovereign-bank connectedness 148
4.5. Concluding remarks 151
Conclusions: Main findings and policy implications 152
References: 155

List of Figures

Figure 2.1: Output gap and primary balance in the Eurozone (1991-2013) 75
Figure 2.2: Government debt in the Eurozone (1991-2013)..... 75
Figure 2.3: Primary balance as a function of the level of debt to GDP (%)..... 81
Figure 2.4: Debt dynamics in the baseline IMF scenario 83
Figure 2.5: GDP Growth forecasts in the IMF scenario (%) and primary balance Model and IMF forecast, as a % of GDP) 85
Figure 2.6: Probability debt has not stabilized in 2019 (endogenous scenario, and current effective interest rate, both in %) 87
Figure 3.1: Sovereign debt holdings of domestic banks (as a % of total debt)..... 92
Figure 3.2 10-year yield on sovereign debt, key periphery countries (%) 93
Figure 3.3: Residuals of the cointegrating relationship 108
Figure 3.4: Regime switching results: Smoothed probability of being in each of the regimes. 111
Figure 4.1: Net pair-wise directional connectedness during the five sub-periods after breakpoint..... 131

Figure 4.2: Net direction connectedness from Germany to Italy, France and Spain..... 134
Figure 4.3: Net issuance of connectedness from banks to own sovereign..... 136
Figure 4.4: Total bank exposures and connectivity..... 138
Figure 4.5: Systemic capital requirement and contribution to systemic stress (%)..... 140
Figure 4.6: Systemic contribution of the CDS of Bank of Ireland and Unicredit (basis points). 142
Figure 4.7: Frequency distribution of 1000 draws of the BOI (right axis) and UNI CDS (draws taken using the historical average and standard deviation distribution of shocks) 143
Figure 4.8 Domestic bond holdings (orange line, million EUR) and sovereign-bank connectivity (blue line, right axis)..... 145
Figure 4.9: Correlation coefficient, sovereign-bank connectivity with sovereign CDS level and domestic bond holdings..... 146
Figure 4.10: Sovereign CDS, selected Eurozone countries (basis points)……146

List of Tables

Table 2.1. Residuals. Autocorrelation and Partial correlation 77
Table 2.2 Empirical results 79
Table 3 1. Chow breakpoint test results 105
Table 3.2: lag structure of the VECM 103
Table 3.3. Unit root test results 106
Table 3.4: Cointegration test results 106
Table 3.5. Cointegrating equation 107
Table 3.6: Spanish bond holdings by Spanish Monetary financial institutions, by residual maturity (Million EUR) 118
Table 3.7: Results of Probit on sovereign debt holding regime 118
Table 4.1: Schematic connectedness table 125
Table 4.2: Full-sample connectedness for senior CDS 129
Table 4.3: Full-sample connectedness for subrogated CDS 129
Table 4.4. CDS: baseline and stressed scenario 139
Table 4.5. Capital requirements and systemic risk 140
Table 4.6: System CDS 141

The difficulty lies not so much

in developing new ideas as in

escaping from old ones

John Maynard Keynes

No pressure, no diamonds

Robert Griffin III

Don´t go to bed mad, stay up and fight

Phyllis Diller

Agradecimientos

Esta tesis doctoral ha sido posible gracias a muchas personas. El apoyo recibido, así como lo que he aprendido de personas que he tenido a mí alrededor, ha sido esencial en la realización de la misma. Indudablemente, mi tutor, Simón Sosvilla, ha jugado un papel fundamental. Le debo agradecer no sólo su orientación y colaboración indispensable en la elaboración de la tesis, sino también que me transmitiera ánimos en momentos críticos. Además de ayudarme a realizar la tesis, me ha transmitido una curiosidad que me motiva para continuar investigando. A lo largo de la elaboración del documento, muchos compañeros investigadores me han ayudado con sus comentarios y contribuciones en algunas secciones del documento. En este apartado, se merecen una mención especial: Fernando Fernández Rodríguez por la ayuda con algunos cálculos, los asistentes al seminario realizado en el departamento, así como revisores anónimos de congresos y los miembros de la junta directiva de la aeefi.

Muchas de las ideas de esta tesis surgen de conversaciones, debates, y proyectos realizados a lo largo de mi trayectoria profesional y académica. Por tanto, agradezco sinceramente a las personas con las que he colaborado durante este tiempo: se trata de compañeros de trabajo, de máster, profesores y jefes que me han permitido formarme como economista. En este grupo destaca mi tutor de tesina, Rafael Fernández y varios profesores del máster. Mención especial se merece Luigi Speranza, por enseñarme cómo debe pensar un economista, la ambición que requiere realizar aportaciones al análisis económico y los sacrificios que se deben asumir para conseguir esas aportaciones.

Más allá de las contribuciones de índole profesional, mi entorno ha sido un factor esencial para que consiguiese hacer la tesis. Aita y ama, vuestro apoyo a lo largo de este proceso me ha aportado la confianza necesaria para pensar que esto era posible. Asimismo, Amaya, Leyre vuestro apoyo ha sido también fundamental en la consecución de este proyecto. Me habéis transmitido la convicción de que de alguna forma, esta tesis merecía la pena porque sería una contribución al conocimiento del conjunto de la sociedad. Buena parte de la motivación para realizar esta tesis se deriva de la convicción de que el servicio

público, en la medida que permite mejorar, aunque sea levemente, la existencia de los demás, merece la pena. Esa vocación de servicio público me la habéis instaurado vosotros y por eso esta tesis es también vuestra.

Un grupo de amigos reducido, pero cercano, me ha permitido desconectar de la tesis y otras obligaciones, y conectar con otras vidas, una parte esencial de vivir y que además me ha permitido mantener algo de cordura a lo largo de este proceso. Es por ello que os estoy profundamente agradecido.

Irma, tú más que nadie has sufrido los sacrificios personales que la elaboración de esta tesis ha supuesto. Sin tu apoyo y sin tu capacidad de comprensión, no me cabe la menor duda, este proyecto nunca se habría llevado a cabo. Asimismo, debo agradecerte que me enseñaras a pensar como un académico, a buscar las preguntas interesantes para la realización de esta tesis. Estoy convencido de que tu propia carrera académica será muy exitosa, espoleada por esa capacidad de discernir cuales las preguntas relevantes.

En este apartado de agradecimientos personales se merecen una mención especial Paula, Inés, Lucía y Alba. No os podremos reconocer lo suficiente la magnitud en la que nos habéis aportado alegría y, hasta cierto punto, un sentido a nuestra existencia que no estaba presente antes de que nacieseis. Por ello, os estoy profundamente agradecido.

Abstract

This thesis studies the developments in the Eurozone crisis from different perspectives. The first chapter studies the determinants of fiscal fatigue: the fact that some countries, after a period of implementing a fiscal adjustment may decide to stop adjusting if public debt keeps rising in spite of the adjustment. This result could reflect in part the fact that growth has a particularly damaging effect on the fiscal balance, so that in fact the effort needed to maintain debt sustainability becomes greater and difficult to achieve.

A key takeaway from the first chapter regards the limits of fiscal policy in the context of a country that is a member of a currency area struck by a financial crisis. In such a setting, non linearities emerge in the effect of growth on the fiscal balance and a previously sound fiscal position can spiral out of control quickly.

In order to limit this effect, it is essential to build sound institutions and fiscal room for manoeuver before the crisis. This is because fiscal policy can become quickly constraint in a crisis. Furthermore, as the market adjusts rapidly to the changes in debt sustainability, the deterioration of fiscal fundamentals and in particular the increase in the cost of funds can accelerate.

The results of this chapter suggest the ex-ante position and hence limiting the extent of the downturn becomes essential to navigate turbulent times. This is true not just in terms of the fiscal stance, but also regarding the institutional make up. By starting from a stronger starting point, sovereigns are better positioned to avoid negative debt dynamics during the downturn.

It is not just sovereigns that change their behavior when they are hit by a financial crisis. Banks also alter their behavior in times of financial stress. In the second chapter we explore the drivers of the rise in sovereign bond holdings in stressed Eurozone countries at the height of the sovereign debt crisis. The previous literature has considered that a rise in sovereign bond holdings deepens the downturn, by increasing the credit crunch and so detracting resources from the private sector.

Our analysis studies how the drivers of sovereign debt holdings are different in normal times to the dynamics during a financial crisis. Through the use of a

regime-switching equation, we find that banks change the sovereign bond demand function only in specific periods of particularly acute stress. Our analysis suggests the main driver of the rise in sovereign bond holdings was rising sovereign stress. Alternative hypotheses, such as search for yield or regulatory incentives did not seem to play a role in the rise of sovereign bond holdings. In fact, it is sovereign stress rather than a rise in yields that seems to cause the increase in sovereign holdings.

In a similar context, the third paper finds that the increase of sovereign holdings did not play a major role in the connectivity between banks and sovereigns. We find distress in the sovereign is much better correlated than holdings with connectivity amongst these two entities. This is found by employing the connectivity framework developed by Diebold and Yilmaz (2014), which shows how certain policy initiatives, and in particular, decisive action by the ECB had a substantial effect on the reduction of the sovereign – bank nexus.

The third paper shows that connectivity evolves during a crisis. As such, the appropriate policy response to the crisis can be quite difficult to implement. For instance, banks that do not seem systemic in normal times, and that do not have a substantial contribution to banking sector stress in tranquil times, can become a concern in stressful times and eventually have a systemic impact.

Overall, our thesis shows how the relationships between the sovereign and financial institutions change in crisis periods. As a result, both fiscal and prudential policy may become ineffective in such periods. Since the policy options available to mitigate the stress in the Eurozone are limited, the role of monetary policy becomes all the more important. To the extent that active monetary policy can mitigate financial stress, it can be quite useful first, in avoiding negative fiscal dynamics, second, reducing bank holdings of sovereign bonds during the periods of acute stress, and third, the increase in the bank-sovereign nexus.

Resumen

Esta tesis estudia la evolución de la crisis de la eurozona desde diferentes perspectivas. El primer capítulo estudia los determinantes de la fatiga fiscal: el proceso por el que algunos países, después de un período de ajuste fiscal sin conseguir la estabilización de la deuda, pueden decidir dejar de ajustar, ya que la sostenibilidad de la deuda deja de ser una prioridad. Este resultado puede darse, en parte, porque la falta de crecimiento económico tiene un efecto particularmente perjudicial sobre el saldo fiscal, de modo que el esfuerzo necesario para mantener la sostenibilidad de la deuda es más elevado.

Una conclusión esencial del primer capítulo es que los límites de la política fiscal se pueden alcanzar rápidamente en un país miembro de una unión monetaria y es golpeado por una crisis financiera. En un escenario de estas características, emergen no linealidades en el efecto del crecimiento sobre el saldo fiscal y por tanto una posición fiscal previamente sostenible puede deteriorase rápidamente.

Para limitar este efecto, es esencial la creación de instituciones sólidas y que se disponga de margen fiscal y político antes de la crisis. Esto se debe a que el margen para adoptar una política fiscal activa puede verse mermado rápidamente. Además, en la medida en que la posición fiscal se deteriora, el aumento de la prima de riesgo puede conducir a un empeoramiento adicional de la sostenibilidad de la deuda. Consecuentemente, en un contexto de estrés soberano, el deterioro del saldo fiscal y el aumento del coste de financiación del soberano pueden acelerar el empeoramiento de la dinámica de la deuda.

Los resultados de este capítulo sugieren que las condiciones de crecimiento y el punto de partida es un factor crucial para garantizar la sostenibilidad de la deuda. Esto es cierto no sólo en términos de la posición fiscal, sino también con respecto a la calidad institucional. Consecuentemente, desde un punto de partida más fuerte, los soberanos están mejor posicionados para evitar la dinámica negativa de la deuda durante la crisis.

No son sólo los soberanos los que cambian su comportamiento cuando se ven afectados por una crisis financiera. Los bancos también alteran su comportamiento en épocas de estrés financiero. En el segundo capítulo se exploran los determinantes del aumento de las tenencias de bonos soberanos

de las entidades financieras de países estresados en el peor momento de la crisis. La literatura ha considerado que un aumento en las tenencias de bonos soberanos profundiza de recesión, aumentando la contracción del crédito al sector privado y así privando de recursos al sector privado.

El análisis estudia cómo los determinantes de tenencias de deuda soberana cambian durante una crisis financiera. Mediante el uso de un modelo de cambio de régimen, encontramos que los bancos cambian su función de demanda de bonos soberanos sólo en periodos específicos de estrés particularmente agudo. Nuestro análisis sugiere que la estabilización del soberano ha desempeñado un papel central en el aumento de las tenencias de bonos. Hipótesis alternativas, como la búsqueda de rendimiento adicional o incentivos regulatorios no parece jugar un papel en los bonos soberanos de acumulación. Así, encontramos que el cambio hacia un régimen de mayores tenencias de bonos viene determinado, fundamentalmente, por el aumento del estrés del soberano, más que por un aumento de los tipos soberanos.

El tercer artículo concluye que el aumento de las tenencias de bonos soberanos no desempeñó un papel importante en la conectividad entre los bancos y los soberanos. Encontramos que el estrés del soberano está mucho más correlado con la conectividad entre el soberano y los bancos que las tenencias de las entidades financieras. Este resultado se halla empleando el análisis de conectividad desarrollado por Diebold y Yilmaz (2014), y muestra cómo algunas medidas de política económica, y en particular, una acción decidida por parte del BCE tuvo un efecto sustancial en la reducción del nexo soberano -bancario.

El tercer documento muestra los cambios en la conectividad entre entidades y soberanos durante la crisis de deuda soberana. Estos cambios dificultan el diseño de la respuesta adecuada a la crisis. Por ejemplo, los bancos que por sus características no parecen sistémicos en tiempos normales, y que no tienen una contribución sustancial al estrés bancario en épocas tranquilas, pueden convertirse en un motivo de preocupación en tiempos de estrés y eventualmente tener un impacto sistémico.

En general, esta tesis muestra cómo algunas dinámicas cambian en períodos de crisis. Esto afecta a las entidades financieras y al soberano. El resultado es que

el diseño de la política fiscal y prudencial es particularmente difícil en estos periodos. Dadas estas limitaciones, el papel de la política monetaria se convierte en el más importante. En la medida en que la política monetaria activa puede mitigar el estrés financiero, puede ser muy para evitar las dinámicas negativas descritas anteriormente.

Introduction:

The Global Financial Crisis set the course for a sharp change in economic dynamics at the world level. At the core of this change in economic dynamics was the Eurozone. Created in 1999, after a long period of relative stability, the financial turmoil has tested the foundations of the currency area.

In a currency area, a prolonged economic shock with an asymmetric impact on its members and its ramifications proved a challenge for which there was no easy solution. The challenge was also there for scholars, as the phenomena that characterized the euro crisis required changes to the usual framework in which the academic literature had studied the propagation of financial crises. This thesis is a contribution to the literature that has analyzed some of the aspects that were relevant to the management of stress in the euro area.

The first chapter examines the existence of fiscal fatigue. A literature that started in the 1980s found fiscal policy, on the whole, sustainable in developed countries. However, some recent contributions analyzed the Eurozone crisis, and found that fiscal policy could have two regimes, depending on the state of the economy, global finance and institutional indicators: in one of the regimes fiscal policy is sustainable, while in the other regime it is not.

A further step in this area was the concept of fiscal fatigue. Analogous to the traditional idea of reform fatigue, by which countries (originally developing countries that had been bailed out by the IMF and implemented reforms that were supposed to increase growth potential) applied sound policies. However, the difficulty and lags in achieving fiscal and financial stability and growth eventually led some to abandon those efforts.

Fiscal fatigue adapts that concept to fiscal adjustment: when faced with rising debt, countries usually increase their fiscal balances, a sign of responsible fiscal policy. However, if debt is quite large, which could be because past adjustment has failed, the adjustment needed is so large that countries do not carry it out.

We analyze the issue from the prospect of the delayed adjustment literature. In this literature, political decisions are characterized as a war of attrition game, in

which groups with different interests fight for one type of adjustment or another. This concept allows us shed light on the key question of the paper:

- Can certain institutional features have an effect on fiscal adjustment once the fiscal limit has been reached?

Secondly, a large number of papers have measured the effect of the cycle on the fiscal balance. Much of this has been used to understand the cyclical orientation of fiscal policy. In our case, the interest is not so much what the intention of the government is, but rather, whether there are non-linearities in the impact of the economic cycle on the fiscal balance.

Such nonlinearities may arise for different reasons, such as the progressivity of the tax code or a change in the orientation of fiscal policy that depends on the economic cycle. As a result, a downturn may have a larger impact on the fiscal balance than expected, and, consequently, debt sustainability could be compromised earlier than thought.

Chapter 1 will show that these non-linearities can have a significant effect on debt sustainability dynamics, as well as proposing the following research question:

- Are there non-linearities in the effect of the cycle on the fiscal balance?

A recurrent observation in crisis countries has been that once they experience financial stress, some of the dynamics of the financial sector enhance the sovereign-financial feedback loop. This entanglement of sovereign and financial risk can have negative consequences on economic activity. Some have attributed this entanglement to the rise in the holdings of sovereign bonds by domestic financial institutions. In some papers, like Broner et al. (2014) or Uhlig (2014), such increases in sovereign bond holdings arise because of changing incentives for banks. The consequence of the rise in the holdings is usually a decline in welfare, as resources that should be devoted to the economy are taken up by the sovereign. These dynamics will tend to deepen the downturn.

The aim of Chapter 2 is to shed light on the behavior of banks during the recent financial crisis in stressed countries. In particular, we try to understand the drivers of the increase in sovereign bond holdings. Our starting point is that if sovereign bond holdings increased because the economic downturn limited alternative

investment opportunities, and because the rise in yields was excessive, such that the risk reward of bonds was more favorable, then this should not be considered an inefficiency, but rather, banks acting normally given the change in fundamentals. So the relevant question is

- Did the sovereign bond demand function by banks change during the crisis? Or was the increase in bond holdings the natural consequence of the developments in the determinants of those holdings?

In order to answer that question, we set up a regime-switching Vector Error Correction Model (VECM). The idea is to capture whether banks moved, during the crisis, to a regime of high holdings of sovereign debt, while during the pre-crisis period they were in a low-holdings regime.

From a policy perspective, an issue that has been discussed is whether the regulation on required capital has played a key role in bank's resource allocation during the downturn. In particular, the 0 risk weight on the holdings of sovereign bonds may have given banks an incentive to hold more bonds, instead of lending to the economy. Some banks, facing capital shortfalls, and adverse market conditions, instead of adjusting their balance sheets may have switched to sovereign bonds, in an attempt to obtain an interest income without consequences on their capital ratio.

In order to understand the role played by risk-weighted assets (RWA) incentives, we use "Other Financial Institutions" (OFI) as a control group. This group is made up of investment, pension and other funds that do not have to hold capital on their assets: to the extent that they are only asset managers, they do not have to bear the credit risk on those assets. This entails the following research question:

- Did the 0 risk weight on the holdings of sovereign bonds lead to excessive holdings of government debt during the downturn?

Other reasons for the increase of sovereign bond holdings put forth by the literature have involved banks search for yield, moral suasion by the sovereign, or their own self-interest in saving the sovereign. The latter may arise because markets perceive that banks need the sovereign backstop to operate. Relatedly, a bank´s rating, and so, its access to market, is usually tied to that of its own

sovereign. Consequently, the bank will want to avoid a downgrade of its sovereign to a speculative grade, for instance.

In order to understand what may have triggered the change in the demand function of banks, we set up a probit model, where the dependent variable is a dummy that takes 1 when banks´ sovereign bond function is in crisis- mode (i.e., it holds more sovereign bonds than it would in normal times) and 0 when it is not. After controlling for factors like financial market volatility, we study the impact of two main variables: the level of the yield and its spread.

If the level of yield is the key determinant, this can be considered a sign of search for yield during the period concerned. However, if the spread is found to be the main driver in the change in the sovereign bond demand function, then the reason behind it can be either moral suasion (by which it is the government pushing the bank to increase its holdings) or banks self-interest in stabilizing debt markets in turbulent times. Our methodology would not allow us to explore which of the two is the actual driver:

- Was search for yield the driver of increased holdings of sovereign bonds? Or was it the stress in sovereign bond markets that drove this increase?

Of course, other factors may lead to market´s perception of an increase in the sovereign-bank feedback loop, not just banks´ direct exposures to the sovereign. For instance, the implementation of bank bailouts can change the directionality of the connectedness in sovereign-bank spreads.

The third paper is an attempt to understand connectedness amongst banks, between sovereigns and banks and amongst sovereigns from a market pricing perspective. Starting from the credit default swap (CDS) of the entities, using Diebold and Yilmaz (2014) measure of connectedness, we aim at understanding how connectedness changed over time and the effect of policy events on it.

This indicator controls for other relationships that could be affecting the results if one were just regressing the CDS of one entity on another. Another advantage is that the interpretation is such that it can be additive, and so allows us to break up the connectedness measure into groups: network connectedness can be divided into connectedness with banks and sovereigns, for instance.

The measures allow us to understand several aspects of the developments during the Global Financial Crisis. Note the link with the previous papers: if a sovereigns´ probability of default depends at least in part on its changing relationship with other sovereigns (for example, because of contagion, or perceived Eurozone breakup risk), then fiscal policy is far from being the only determinant of debt sustainability: in particular, if the CDS feeds through to sovereign bond yields, the interest rate on government debt can be subject to large swings, thus altering debt sustainability dynamics, even without an ex-ante change in fiscal policy or growth dynamics.

After describing how major policy events changed interconnectedness, we use the measure to answer several policy questions, the first being:

- How did the transmission of risk between banks and own sovereigns change during the crisis?

On this aspect, we find a confirmation of the results in the literature (see Acharya and Steffen, 2015), that the banking sector bailouts changed the directionality of the transmission of risk: in the early stages of the crisis, banks received from their own sovereign, however, after the bailouts in the early stages of the crisis they became net issuers of risk. The second policy question is:

- What determines a bank´s systemic impact?

This question has an essential importance, given the policy effort leading to tackle the issues of Systemically Important Financial Institutions (SIFI). Our starting point compares SIFI regulation and the surcharge required to SIFIs with their actual connectedness.

We illustrate how the changes in connectedness that take place during stressed periods can make it difficult to determine, ex ante, which banks are systemic. In particular, as an example, we show how the contribution of two banks to systemic risk can change. Given the usual shocks that these banks can be subject to, we show that the probability distribution of the shocks is such that banks that, ex ante, would have a smaller systemic impact, with a certain degree of probability can end up having a larger impact on the system than the bank that was considered non systemic.

From a policy perspective, the difficulties in assessing systemicity can serve as a word of caution. Once a crisis strikes, in all likelihood, risk may spread through entities that, ex ante, did not seem systemic. Therefore, the need for strong resolution mechanisms, with appropriate resources and the ability to act quickly and forcefully will hold the key to a systemic crisis. This leads to the following research question:

- How did connectedness amongst countries change during the crisis?

Much like the sovereign bank nexus, we find evidence of changes in the connectedness across sovereigns. In line with previous results in the literature (Gomez-Puig et al., 2014; Gomez-Puig and Sosvilla-Rivero, 2013 and Gomez-Puig and Sosvilla Rivero, 2014), in the first stages of the crisis, core countries had a net impact on periphery countries. However, in the height of the crisis, the direction of this net impact changed.

Our interpretation of this change is that markets started to price in a risk of fragmentation in the Eurozone, whether through a euro breakup or through a different channel. This would explain why core countries were no longer able to anchor default probabilities in the periphery.

The following chapter will survey the literature on the interaction of fiscal and financial risk. Chapter 2 will analyze fiscal fatigue focusing on the Eurozone in the period 1980-2013. Chapter 3 will model bank demand for sovereign bonds in the periphery, while the following chapter will estimate the connectedness between sovereigns and banks in the Eurozone. Finally, the conclusion will summarize the main findings and policy implications.

Chapter 1: A Survey of the literature on the interaction between fiscal and financial risk

This thesis is a contribution to the line of work on the interaction between fiscal risk and financial risk. The issue has gained prominence in the recent crisis, as the combination of a deterioration of the credit quality of sovereigns and a credit crunch led to heightened financial fragmentation and deepened the downturn in stress countries.

The relationship between fiscal policy, debt sustainability and financial crises has been around for a long time. In the 1980s, the key mechanism for developing a financial crisis was through unsustainable fiscal policies that would lead to monetary financing, and so, an unsustainable exchange rate (Flood and Marion, 1998). The seminal papers on the government´s intertemporal budget constraint are part of this strand of the literature (Trehan and Walsh, 1988).

As a result, this thesis deals with separate but related aspects of financial crises. Chapter 2 analyzes fiscal fatigue, the idea that a sovereign, which behaves responsibly in normal times, may, at some point stop adjusting its fiscal balance even as debt rises. This lack of adjustment can lead to the unsustainability of public debt. As a result, putting in place the mechanisms necessary to avert this scenario is crucial to safeguard debt sustainability. In Chapter 3, we analyze how the behavior of banks in sovereign debt crises may enhance sovereign-bank loops. By increasing their holdings of sovereign bonds, this link intensifies and output may be lower than expected. We study what may have driven the rise in sovereign bond holdings in the European periphery during the 2008-2015 period. Finally, the network approach proposed in Chapter 4 is used to shed light on the sort of links that arise in periods of distress. In particular, we test whether the developments in connectivity between stress in banks and in sovereign is related to the increase in the holdings of domestic sovereign bonds or, possibly, the questioning by investors of the willingness and ability of governments and central banks to support the banking sector.

1.1 Fiscal fatigue: main aspects

The idea of fiscal fatigue uses the framework set up by Bohn (1998), who analyzed whether fiscal policy in the US was sustainable, in the sense that it reacts to an economic shock that raises the debt to Gross Domestic Product (GDP) ratio by increasing its primary balance, which would eventually stabilize debt. A large part of the literature that has examined the issue is empirical, although a recent theoretical framework can be found in Ghosh et al. (2013).

Several studies have addressed this question via single country analysis (Bohn, 2008) and panel analysis, while others, like Canzoneri et al. (2001), employ a Vector Autoregressive (VAR) approach. In general, for developed countries, the literature finds that the primary balance reacts positively to an increase in the debt-GDP ratio.

Much of the literature deals with country or region-specific fiscal response functions. For instance, Ballabriga and Martinez-Mongay (2005) show that primary balances increase as a response to higher government debt in the European Union (EU).

Bohn´s (1998) paper showed that the reaction of the primary balance to a rise in government debt could be considered an indicator of the sustainability of the fiscal stance. If an economic shock that leads to an increase in the debt stock is followed by a strengthening of the primary balance, fiscal policy can be deemed sustainable.

Bohn (1998) results go in line with the finding in later research regarding developed countries: he finds fiscal policy in the United States of America (USA) in the 20th century reacted positively to rises in public debt, and so concludes that fiscal policy was, by that measure, sustainable.

Several authors have used the same methodology for European countries: see for instance Wyplosz (2006), and Staehr (2008). Piergallini and Postigliola (2012) use the methodology for Italy and De Mello (2008) for Brazil. They all find that fiscal policy reacted responsibly, in that it rose in response to an increase in debt.

1.1.2 Fiscal policy and the cycle

One of the main determinants of fiscal policy is the economic cycle. A classic result of this literature has been that fiscal policy usually is counter-cyclical in developed economies, while it is pro-cyclical in emerging economies (Ilzetzki and Vegh, 2008, Afonso, 2008). Staehr (2008) finds a similar result within Europe: according to his paper, fiscal policy is much more anticyclical in Western Europe than in Eastern Europe.

Egert (2014) confirms that fiscal policy is counter-cyclical in the Organisation for Economic Co-operation and Development (OECD), although this is less clear in the case of highly indebted countries. Similarly, Sutherland et al. (2010) find that the size of the counter-cyclical response of discretionary fiscal policy depends on the initial fiscal stance and debt level.

According to Wyplosz (2006), the cyclically-adjusted balance reacted more strongly to the business cycle before the countries entered the euro area than afterwards, while the discretionary component was procyclical prior to entry, as countries tried to meet the accession criteria, but became a-cyclical once countries joined the single currency.

Ilzetzki and Vegh (2008) argue that to the extent that tax revenues have a cyclical component, this introduces an automatic co-movement between government balances and the cycle. As a result, the procyclicality finding for developing countries may not reflect policy intentions but rather the fact that the structure of tax revenues is more cyclical there. They use a component analysis, looking at government consumption and revenues and correcting for the fact that tax revenues are endogenous to the cycle by using tax rates as instruments. They conclude that fiscal policy in emerging economies is less procyclical than had been found earlier.

Afonso (2008), using an EU panel, finds a counter-cyclical response of fiscal policy, with the primary balance improving with increases in the output gap. He also highlights that electoral budget cycles play a role in the determination of fiscal policy.

Other studies have found that the reaction to the cycle is often asymmetric: while counter-cyclical in downturns, it is either a-cyclical or mildly pro-cyclical in

upswings. As a result, debt accumulated during downturns is not fully paid back during good times (see. e. g., Lee and Sung, 2007; and Leigh and Stehn, 2009).

Many empirical studies have looked at the cyclical co-movements of fiscal variables in industrial and developing countries, such as Alesina and Tabellini (2005), Catao and Sutton (2002), Gavin and Perotti (1997), Kaminsky, et al. (2004) or Talvi and Vegh (2005). These studies document that primary balances are counter-cyclical in developed countries, and tend to be more procyclical in developing countries (Mendoza and Ostry, 2008).

1.1.3 Impact of European Economic and Monetary Union (EMU)

In order to derive policy conclusions, in particular regarding the effect of institutional changes, a number of studies examine how fiscal reaction functions change after an event that alters the economic structure of the country or the policymaking environment. This has been particularly the case in Europe, where several authors have analyzed the impact of the introduction of the Euro, and so the Stability and Growth Pact, on the government´s reaction function.

Gali and Perotti (2003) find that membership of the euro area did not cause discretionary fiscal policy to become less counter-cyclical when compared to the EU countries that did not seek to join the euro. Ballabriga and Martinez-Mongay (2005), similarly, conclude that fiscal policies changed little with the introduction of the euro.

1.1.4 Taking into account government decisions

Alternatively, fiscal reaction functions can be understood as a problem where policymakers minimize a loss function subject to constraints afforded by the economy, such as the reaction of other agents (the private sector) to different government policies. The key issue then is to determine whether the change in the fiscal balance triggered by debt or another event is intentional.

One aspect to take into account when assessing government´s policy intentions is the existence of persistence, over time, in the fiscal balance. This persistence component may be due to rigidities in the budget procedures, for instance stemming from the fact that part of a government´s spending in a given year has been pre-committed. This seems to be greater in advanced economies (Fatas

and Mihov, 2001; 2008). Paloviita (2012) finds that persistence has been lower in the peripheral countries than in the rest of the euro area. According to Afonso and Furceri (2010), persistence is determined by country income and public sector size.

In order to test for the importance of the government´s intentions, as opposed to realized outcomes that may be affected by contemporaneous shocks to the economy, a part of the literature has distinguished between planned and realized fiscal balances, using the former as an indicator of government intentions.

Some studies do this by isolating variables that reflect policy decisions such as tax rates or discretionary spending categories (Ilzetzki and Vegh; 2008, Darvas; 2010). Others use real-time data to provide a more realistic picture of fiscal policy-making (e.g. Bernoth and Wolff. 2008). Similarly, Castro et al. (2013) uses quarterly data.

1.1.5 Discretionary fiscal policy and automatic stabilizers

In order to obtain a measure of government´s policy intentions, the cyclical component must be removed from tax revenue and primary spending items, thus obtaining the cyclically-adjusted primary balance. One approach consists in regressing the fiscal policy variable on a measure of the cycle and to interpret the residuals as the discretionary policy component. For instance, Fatas and Mihov (2003) use this approach and find that the residuals of the fiscal policy reaction functions of euro area countries diminished over time, indicating less reliance on discretionary fiscal policy in the run up to entry into the Eurozone.

This strategy was criticized by Gali and Perrotti (2003): in their view, this only captured the non-systematic part of discretionary policy. Instead, using cyclically-adjusted spending and revenue by category (Giorno et al., 1995; André and Girouard, 2005) would provide a more reliable overall picture of the fiscal policy stance. In line with the results mentioned earlier, they conclude that discretionary fiscal policy became more counter-cyclical in the 1990s in most advanced countries. He discovers that the introduction of the euro led member countries to use a more countercyclical policy.

Fatas and Mihov (2009) notice that discretionary policy was slightly pro-cyclical in the euro area countries, while the United States pursued a strongly counter-

cyclical discretionary policy. Auerbach (2009) confirms their result, and finds that fiscal policy in the US was countercyclical. In his study, this result holds for both the expenditure and revenue side for a long time period (between 1984 and 2009). He suggests that spending responded more strongly than revenues. In contrast, the automatic stabilizers are found to react more strongly to the cycle in the euro area than in the United States.

Cimadomo et al. (2007) shows that discretionary fiscal policy intentions are counter-cyclical in OECD countries, especially during expansions, by looking at ex ante forecasts of cyclically-adjusted primary government balances. He also shows that the outcome of discretionary fiscal policy is pro-cyclical ex post. Beetsma et al. (2008) find that planned fiscal policy is counter-cyclical in non-EU OECD countries while it is a-cyclical in EU countries. Bernoth and Wolff (2008) show for euro area countries that fiscal policy is usually planned to be countercyclical, but biases in the execution of planned policies lead the fiscal stance to become pro-cyclical. Golinelli and Momigliano (2009) point out that the results reported above are sensitive to robustness checks, such as alternative measures of the output gap: in their setting, the finding that fiscal policy plans in the euro area are more counter-cyclical than final outcomes still holds.

Jaimovich and Panizza (2007) use foreign partners' GDP growth as an instrument of the domestic cycle, given the feedback loops between fiscal policy and the cycle. Their result overthrows the finding of a pro-cyclical fiscal policy for developing countries. Ilzetzki and Vegh (2008) assess the robustness of the finding that developing countries pursue pro-cyclical fiscal policies while developed OECD countries are less pro-cyclical or acyclical by controlling for endogeneity of the cycle variable through various methods (instrumental variables (IV), generalized method of moments (GMM), simultaneous equations and VAR models). Lee and Sung (2007), by also using an IV approach also find that government spending is strongly counter-cyclical in most OECD economies, with a few acyclical exceptions.

Strawczynski and Zeira (2009) take a different perspective and analyze the reaction of fiscal policy to temporary and permanent output shocks rather than to cyclical fluctuations. They show that the reaction of general government deficits

and spending to a temporary output shock is counter-cyclical. However, the reaction to a permanent shock is a-cyclical.

Based on an event study approach, Leigh and Stehn (2009) argue that the group of seven (G7) countries eased discretionary fiscal policy during downturns in a timely manner on a number of occasions. Nevertheless, they also show that fiscal policy in non-Eurozone countries responded quicker and more often to downturns than in Eurozone members of the G7. A further difference between the Eurozone and other countries is that discretionary fiscal easing occurs more often during economic recoveries in the former than in the latter.

1.1.6. Political economy and fiscal policy

Buti and van den Noord (2004) introduce political economy considerations in the fiscal framework and find that discretionary fiscal policy was influenced by political cycles after the introduction of the euro. Golinelli and Momigliano (2009) report similar results for those countries before the adoption of the euro. Elections seem to influence general government balances in other OECD countries over longer periods as well while government spending is not found to be influenced by electoral cycles (Strawczynski and Zeira, 2009). The main specification in Afonso and Hauptmeier (2009) also shows that elections are associated with a deterioration in primary government balances. Nevertheless, their result is not robust to alternative model specifications in which the coefficients either switch sign or become insignificant.

1.1.7 Cyclicality of the components

Lee and Sung (2007) report that total government revenues of OECD economies are countercyclical with respect to GDP growth and total government expenditure is mildly pro cyclical. At a higher level of disaggregation, current and capital expenditure and subsidies and transfers are found to be a-cyclical. On the revenue side, income and commodity taxes react counter-cyclically whereas social security contributions appear insensitive to the cycle.

Lane (2003) shows that the cyclical behavior of overall government spending in OECD countries hides a heterogeneous response of the different spending components to the cycle. While public transfers and debt interest payments are counter-cyclical, current spending is pro-cyclical and government investment is

pro-cyclical. In particular, government wages are more pro-cyclical than non-wage government consumption whereas government employment is a-cyclical. The cross-country variation in cyclical reactions is mostly explained by output volatility and institutional variables, in particular weak government support. Public sector wages are the main channel through which higher output volatility and lower government support lead to more pro-cyclicality in government spending.

1.1.8 Debt sustainability: the fiscal limit

The relationship between the fiscal reaction function and debt sustainability was originally related to the debate on the interactions between monetary and fiscal policy. Leeper (2013) postulated that to the extent that governments issue substantial debt, when such economies are approaching their fiscal limits, debt can be devalued through higher inflation. Based on this insight, he develops a model that suggests that the source of inflation is fiscal policy. Once the fiscal limit is approached, the government must finance its deficit by printing money. These dynamics may lead to episodes of hyperinflation.

As a result of his contribution, a body of the literature analyzed how the fiscal limit could be determined. In Bi (2012), the fiscal limit depends mainly on the size of the government, the degree of countercyclicality of the policy responses, economic diversity, and political uncertainty. They justify non linearities in the behavior of sovereign risk premia: once they are on the rise, they rise quickly. This, in turn, justifies the non-linearities in fiscal adjustment: little adjustment is carried out at low levels of debt, when the cost of additional adjustment does not seem to be justified, and then a rapid adjustment as the debt limit is approached.

1.1.9. The determinants of sustainability: sovereign spreads

For all the importance of the determinants of the primary balance, and the determinants of debt sustainability from fundamentals, a body of the literature has found that risk premia are often determined by factors not related to fiscal fundamentals. To the extent that adverse shocks, not related to a given country´s fiscal policy, can lead to shocks on the sovereign premia, and so alter debt sustainability dynamics, this can be thought of as a case of the interaction between financial markets and fiscal policy, and how the former can impact debt

sustainability, even if the fiscal policy stance (and, possibly, the underlying macroeconomic conditions) remains unchanged.

Sovereign spread determinants are typically decomposed into the default risk (which is dependent on the assessment of the fiscal health of a given sovereign) and risk aversion, which tends to be related to market perception not related to actual debt sustainability dynamics of a given country. Sovereign risk can also be measured by sovereign credit ratings, CDS premia and other rankings of the country risk or sovereign creditworthiness. At first, this literature focused on emerging economies, in particular following the 1980s. However, the advent of the Euro, and in particular the euro sovereign debt crisis brought about renewed attention to the issue from the perspective of developed countries.

1.1.9.1. Studies on emerging countries

Edwards (1986) estimates the determinants of bond spreads for a group of emerging countries using a panel of bond yield spreads spanning 1976-1980 and fixed effects estimates to reflect the date of issuance of the relevant bond. He finds that the debt to GNP ratio raises bond spreads, while investment, debt service to exports ratios, and the maturity of debt reduce sovereign bond spreads. In some cases the debt to exports ratio, the real effective exchange rate, and the oil price are all positively and statistically significantly correlated to spreads, while reserves and industrial production growth rate have a negative effect on sovereign risk. In other words, the original contribution to the literature on sovereign spreads suggests that country fundamentals play a dominant role.

Min (1998) finds for the early 90s a positive and significant effect of debt to GDP, debt service to exports, net foreign assets, exports growth, the real exchange rate, and inflation on one side, and negative effects of the terms of trade, foreign exchange reserves to GDP, maturity and imports growth on sovereign spreads.

Eichengreen and Mody (1998) conclude that a higher ratio of debt service to exports is associated with higher bond spreads. They also show the negative significance of the GDP growth rate, the issue size and the residual of a regression of the credit rating from fundamentals. The latter is one of the

pioneering efforts to capture issues that are not related to country-specific macro fundamentals.

Much like Edwards (1986) and Min (1998), Eichengreen and Mody (1998) do not control for global risk aversion individually as opposed to variables that relate to the state of world financial markets. In the early stages of this literature, the main concern seemed to be which fundamentals were better determinants of sovereign spreads, rather than the interactions between sovereign stress and financial markets.

Arora and Cerisola (2000) estimate the determinants of secondary market sovereign bond spreads for a sample of 11 large emerging countries in 1994-1999. They find a positive impact of the short-term US interest rate and of market volatility on spreads across all countries, in what can be considered a proxy for the effect of global risk aversion. Also, spreads are in large part explained by country-specific fundamentals, pertaining in particular to the external and fiscal position. They find a significant impact of the net foreign asset position, lower fiscal deficits and lower ratios of debt service to exports and debt service to GDP help decrease sovereign spreads.

Aronovich (1999) uses daily data on sovereign spreads to assess the determinants in the 1997-1998 period for three large Latin American countries. These are the implicit probability of default and the 30-year USTB rate, where the latter is used as a proxy of an exogenous change in global financial conditions.

1.1.9.2. Contagion and spreads

Baig and Goldfjan (2000) test whether there was contagion from the Russian crisis to Brazil in the late 1990s, using daily data. They find evidence supporting the contagion hypothesis and report a negative impact of the long-term American interest rate on spreads. Nogues and Grandes (2001) also find a negative effect on sovereign spreads for Argentina in the late 1990s. In their paper, there is evidence of contagion but also of the relevance of country-specific factors, like fiscal deficits, GDP growth, the debt service to exports ratio, and institutional priorities.

Ferrucci (2003) investigates the empirical relationship between emerging market sovereign spreads and a set of common macroeconomic fundamentals, using Emerging Markets Bonds Index (EMBI spreads over the period December 1991-March 2003. The estimation technique posits a dynamic error correction model that allows short-run parameters to vary across groups, while restricting long-run elasticities. Their results point to markets pricing in macro conditions in sovereign risk. In particular, indicators like external debt, openness and current account balance affect the pricing of sovereign spreads.

However, non-fundamental factors like global liquidity conditions and US equity prices also play a role. This result is obtained by controlling for global risk aversion by using the spread between low and high-rating US corporate bonds and finds a negative impact on emerging market sovereign spreads: higher junk bond spreads lead to lower emerging market spreads.

Gonzalez Rozada and Levy-Yeyati (2006) analyze the impact of interest rates of bonds issued by developed countries on emerging market spreads in 1993-2005. They find that a large part of the emerging market bond spreads is explained by global factors like risk appetite (the spread of high yield corporate bonds in developed markets), global liquidity and contagion from other financial crises. The link between emerging country spreads and global factors is shown to remain relatively stable since 1993. This finding is robust to the inclusion of country-specific factors, asymmetries, alternative risk appetite indicators or adjusted ratings, and helps provide accurate long-run predictions. Overall, the results highlight the critical role played by exogenous factors in the evolution of the borrowing cost faced by emerging economies. This is in line with Garcia-Herrero and Ortiz (2005) conclusions on the influence of global risk aversion on Latin American sovereign spreads.

Remolona *et al.* (2007) analyze the components of sovereign CDS spreads, decomposing the expected loss from default and the risk premium. They find that risk premia account for much of the spread (ranging from two thirds to four fifths of the change in the spread).

They also estimate the determinants of sovereign default risk using the rating-implied probability of default for a sample of emerging countries, on which they run a panel regression with fixed effects, using annual data from 1990 to 2005. They find a significant relationship with country size, inflation, development, the current account deficit, and external debt. These results hold when considering debt intolerance, original sin and currency mismatch. In their framework, country fundamentals do improve access to foreign financing.

There are other areas of study that can be mentioned. The first is on the determinants and dynamics of other measures of sovereign creditworthiness such as "distance to default", sovereign credit ratings, probabilities of default, analyzed by Rowland and Torres (2004) or Weigel and Gemmill (2006). Second, the strand of the literature that studies the relationship between sovereign spreads and currency risk (Domowitz *et al.,* 2001; Ahumada and Garegnani, 2005; Powell and Sturzenneger, 2000; Phillippon *et al.,* 2001). Third, the pass-through from US interest rates to emerging market spreads (Frankel, 1999; Frankel and Rose*,* 2000; Kamin and von Kleist, 1999).

1.1.9.3. Spreads in the euro area

While the main issue studied before the existence of the euro were the spreads in emerging countries, the creation of the single currency, and in particular, the sovereign debt crisis, led to an increase in the academic interest on sovereign spreads in the EMU. The setup is similar to that used previously for emerging economies, where the determinants used are country-specific risk factors, global risk aversion conditions and financial market-specific issues, like liquidity.

Some authors find a relevant role for monetary policy on risk aversion and spreads. D'Agostino and Ehrmann (2012) focus on credit risk and surprises on macroeconomic indicators, such as the deviations of the forecasts of the key macro variables. Maltritz (2012) considers openness and the terms of trade.

For example, Attinasi et al. (2010) find a role for bank rescue packages and the ensuing shifting of risk from the private sector to the public sector has played a key role. However, the elasticity of credit premia to fiscal fundamentals (a

measure of the price of credit risk) also increased during the crisis, partly owing to an increase in the degree of global risk aversion. Gerlach et al. (2010) finds that global risk interacts with country specific fundamentals. This interaction and its impact on spread changes over time.

The impact of liquidity

The last broad category of determinants of sovereign bond spreads relates to liquidity conditions in bond markets, usually proxied by overall outstanding amount of public debt, bid-ask spreads and trading volumes. Favero et al. (2010) propose a model with endogenous liquidity demand where liquidity and aggregate risk interact, leading to a negative dependence of spreads on the interaction of the latter source of risk and liquidity. Higher aggregate risk, by reducing the attractiveness of alternative investment opportunities, implies that less compensation for liquidity risk is required for sovereign bonds.

Beber et al. (2009) find that credit premia are generally more relevant than liquidity premia for euro area sovereign bonds but, in moments of heightened market uncertainty, liquidity considerations may prevail.

The euro area

Euro area sovereign bond markets initially attracted attention from academia as a way to assess whether the adoption of the single currency was leading to increased financial integration, as studied by Codogno *et al.* (2003), Baele *et al.* (2004), or Gomez-Puig (2006 and 2008). In these first studies, the standard definition of sovereign risk included its two main domestic components, market liquidity and credit risk, and an international risk factor which reflected investors' risk aversion. Some of the research then focused on systemic versus idiosyncratic risk. Geyer (2004) and Pagano and Von Thadden (2004) stressed the importance of systemic risk in the behavior of yield differentials in EMU countries, while others showed that the idiosyncratic risk component in the movements of spreads was generally more important than the systemic risk, as shown in Gomez-Puig (2009), Dotz and Fischer (2010) and Favero and Missale (2012). Some studies suggested that comovements across the Eurozone were a key determinant (Abad *et al.*, 2010).

However, the sovereign debt crisis in Europe which began in late 2009 has revived the literature on euro area sovereign spread drivers and attributed increasing importance to uncertainty and variables reflecting country-specific confidence and indicators of real activity (see, e.g. Georgoutsos and Migiakis, 2013). Favero and Missale (2012) find that credit risk has increased in importance as a determinant of sovereign bond spreads, while Buchel (2013) provides evidence that the market reacted to official statements during the crisis. Similar arguments can be found in other recent studies using data that extend beyond the crisis period such as Palladini and Portes (2011) or Beirne and Fratzscher (2013).

Many authors have stressed the importance of other fundamentals beyond the country's fiscal position to explain yield spread behavior after the outbreak of the crisis, as expressed in Mody (2009), Barrios *et al.* (2009), Bolton and Jeanne (2011) and Allen *et al.* (2011). Some studies have looked at the dynamic properties of sovereign spreads over time, testing whether there was a change in behavior during the crisis, as Pozzi and Wolswijk (2008), Gerlach et al. (2010), Aβmann and Boysen-Hogrefe (2012) and Bernoth and Erdogan (2012).

Sguerri and Zoli (2009) find that euro area sovereign risk premium differentials are mainly driven by a common factor, in line with the finding on the importance of global risk aversion. They do however highlight a change starting in October 2008, with markets becoming progressively more concerned about the fiscal stability of countries and in particular, reacting to the impact of the contingent liabilities arising from problems in the national banking sectors.

Gomez Puig et al. (2014) similarly show that the rise in sovereign risk in central countries can only be partially explained by the evolution of local macroeconomic variables in those countries. They find that the importance of global variables increased in this period.

So the fiscal balance may be important, but is not the only factor that can lead to financial stress, as shown in particular by recent research. In this context, the behavior of banks during periods of sovereign stress plays a central role in the propagation of the latter and as such has been studied amply by the literature.

1.2 The dynamics of financial crises

A key area of study is how such crises unfold. While the first generation of the literature emphasized the role played by sovereign debt sustainability, later on, triggered particularly by the Asian crisis in the late 90s, a large body of the literature has been devoted to analyze market panic and the behavior of financial institutions in this context.

Some authors (Radelet et al. 1998) emphasize the role of financial panic as an essential element of the Asian crisis. At the core of the crisis were bubble-like large foreign capital inflows into financial systems without the necessary regulatory and supervisory tools to manage them and so became vulnerable to panic.

In a similar vein, some authors have explained financial crises through the Minsky (Arestis and Glickman, 2002) explanation of instability inherent to the financial sector. This view is supported by the finding that threats to growth and employment from the financial sector are much intensified in open, liberalized and, especially, developing economies.

When financial crises unfold, financial sector vulnerability and sovereign debt vulnerability may reinforce each other. Some authors have emphasized how not having your own monetary policy can lead to more fragile bond markets. In particular, De Grauwe et al. (2013) show that part of the rise in sovereign bond spreads was not related to fundamentals. Secondly, some fundamentals, like sovereign debt, ignored before the crises, became significant during the crisis. However, this is a usual finding even for countries with their own central bank, as shown above.

De Grauwe and Ji (2013) compare that analysis with that of countries that had their own currency but similar fundamentals in terms of debt and fiscal space as Eurozone countries. In these countries, however, they do not find evidence of heightened significance of fiscal fundamentals. Therefore, this may be a sign that, indeed, markets priced in the absence of a lender of last resort: in the presence of such a lender, one would expect the capital outflow to have materialized in other aspects, like a further currency depreciation, which in turn could have more expansionary effects that the rise in yields.

1.3. Interactions between banks and sovereigns

The interactions of banks and sovereigns was first studied in the context of defaults by developing countries. Some authors have modeled debt rescheduling as a game where the two players are the banks and the sovereign. In Bullow and Rogoff (1987), debt rescheduling arises as the result of bank impatience because of the lost present value of their investments undermines their solvency and compromises their future, thus makes them willing to accept haircuts on debt payments. In this setting, strategic default arises naturally out of financial sector weakness and the corresponding lack of bargaining power by banks.

1.4. Banking and fiscal crisis

Reinhart and Rogoff (2009, 2011) find that financial crises are followed by fiscal crises. They conclude that sovereign debt ratios typically rise after a banking crisis. However, their use of annual data may hide more subtle interactions amongst the variables, as the interaction between banking risk and sovereign risk may take place within a year, and may change shape in that year.

In their setting, the rise in sovereign debt is not primarily due to the cost of rescuing the financial system, but the slower growth after a financial crisis leads to a rapid rise in the public debt ratios. The fact that slower growth follows financial crises has been documented by Abiad et al. (2011): low growth stems for the scarcity of credit which typically follows banking crises.

The approach of Acharya (2009) is slightly different: he considers slow growth as the result of a credit boom pre crisis, which masked the underlying low potential growth. Also, their use of annual data could explain the fact that they do not find a feedback loop from public debt to banking crises. This may downplay the effect that bank bailouts and the subsequent rise of public debt can have on the reinforcement of bank and sovereign weaknesses.

At the core of this literature lie the links between the financial sector and fiscal sustainability. The relationship between both has been extensively documented by Reihart and Rogoff. However, somewhat contrary to Reinhart and Rogoff (2009, 2011) the results of Mody and Scatigna (2005) show that it is not just public

debt that causes a financial crisis. Rather, large private debt and a deterioration of the credit quality of the sovereign can also cause the financial panic.

1.5. Sovereign-bank feedback loops

The characterization of sovereign-bank feedback loops has been studied by a large literature. The evidence on the links is quite varied.

Thukral (2013) uses a panel to study the role of financial sector variables on the determination of sovereign CDS spreads, and the results trigger his conclusion that there is bank dominance of sovereign financing conditions. Mody and Sandri (2012), using sub-periods similar to those in Acharya and Steffen (2015), find that the feedback between sovereign and bank risk changed. Instead of comparing CDS spreads, Mody and Sandri (2012) use sovereign spreads as the manifestation of sovereign fiscal risk, and the level of stock market capitalization of banks as a measure of banking system risk. They show that the euro crisis traces back to the Bear Stearns crisis. As bailouts of banks began to be priced in the market, sovereign spreads started to reflect higher fiscal solvency risk, especially in countries where growth was expected to slow down and had, as a starting point, high debt levels.

Candelon and Palm (2010) present further evidence that bailouts potentially undermine the sustainability of public finances. These financial rescues can enhance the transmission of risk from the banking sector to the sovereign through several channels, which include bailout disbursements, public deposits held with banks, the need for liquidity provisioning by the central bank acting as a lender of last result, the use of resources for bank recapitalization by the sovereign or, alternatively, the execution of public guarantees.

According to Honohan (2008), the link between banking crisis and sovereign risk may arise from the slowdown and the credit shortage that usually follows a banking crisis. Such events tend to be long crises (lasting 2.5 years on average), and lead to sharp rises in public debt. The authors estimate that the median fiscal cost of a banking crisis stands at 15.5% of GDP.

Kollmann and Roeger (2012) also study the macroeconomic effect of financial sector rescues. They find that bank rescue operations can help cut short a

financial crisis and improve macroeconomic performance. A key avenue of the recovery is that bank bailouts can help investment recover, consistent with Broner et al. (2014) or Popov and Van Horen (2014). However, they find evidence of a negative impact, as sovereign debt purchases by banks lead to a crowding out of private investment. In contrast, Gray and Jobst (2011) show the potentially high impact on fiscal risk associated to the existence of contingent liabilities.

A key transmission mechanism is that domestic banks tend to be particularly vulnerable to restructuring. Noyer (2010) argues that by holding non performing government bonds capital could be compromised and so threaten the solvency of weaker and more exposed institutions.

Erce (2013) suggests that the degree of bank intermediation and the banking system exposure to the sovereign strongly influence a debt crisis ripple effect on the real economy. In addition, the moral suasion of authorities may lead to excessive holdings of sovereign debt by domestic creditors at below market yields (Diaz-Cassou et al., 2008). While this helps the government keep financing conditions more favorable, a government default in this context would trigger a banking crisis.

There are other channels by which sovereign stress leads to banking stress, although many papers emphasize the role played by the holdings of sovereign debt by banks. In Darraq-Pires et al. (2013) the positive connection between sovereign and bank risk is due to banks investing in government securities. Along these lines, Angeloni and Wolff (2012) assess the impact of sovereign bond holdings on the performance of banks during the euro area crisis using individual bank data and sovereign bond holdings. They find that peripheral sovereign bonds affect banks' stock market valuations heterogeneously. While Italian, Irish and Greek debt appear to have negatively affected the market valuation of the banks holding them, such an effect is not significant for other peripheral sovereign debt of countries like Spain, suggesting that the specific characteristics of the banking sector (like its international presence) may also play a role.

Acharya et al. (2012), document the high exposure of their sample banks to their own sovereign, which according to their theory should be a main channel through which stress feeds back from the sovereign to banks.

Popov and Van Horen (2013) focus on the feedback from sovereign risk into banking risk by assessing the extent to which holdings of sovereign bonds detract the resources available for lending to the private sector. This channel enhances the feedback loop by limiting growth and so further weakening the health of the sovereign. They find evidence that this was particularly relevant in the periphery.

Finally, sovereign rating downgrades further limit banks' access to foreign financing, leading to sudden stops or higher borrowing costs (Reinhart and Rogoff, 2011)

Bank of International Settlements (2011) shows four main channels through which a deterioration in the creditworthiness of a sovereign can pass through to the banking system. One channel of transmission is banks' holdings of sovereign government debt. Second, higher sovereign risk reduces the value of collateral that domestic banks can be used for funding. Third, sovereign downgrades normally translate into lower ratings for banks located in the downgraded country. Lastly, increased sovereign risk reduces the value of the implicit/explicit government guarantees to banks.

Mody and Sandri (2012) show that sovereign spreads are affected by the domestic vulnerabilities of national banking sectors. Fiscal fundamentals can worsen the loop: the relationship seems stronger for countries showing large public debt.

Similarly, Pisani-Ferry (2012) shows that one reason that sovereigns may be sensitive to the domestic banking sector is that the sector´s size has become large relative to tax revenues. As a result, small problems in the banking system can become an issue for government solvency.

In periods of financial crisis, the implicit public guarantee on bank solvency is likely to become effective, so markets may price in this higher probability of payout by the sovereign (Gray and Jobst, 2011; Gerlachet al. , 2010; Pisani-Ferry, 2012), thus enhancing the link between the sovereign and banks.

Reinhart and Rogoff (2009) show that historically public debt-to-GDP ratios are higher following a country's banking crisis. The deterioration of sovereign creditworthiness is, however, only partly due to the cost of rescuing troubled

banks. The main explanation is the economic slowdown caused by the banking crisis

Merler and Pisani-Ferry (2012), for example, establish that the rise in domestic government debt raise the potential for negative feed-back loops between sovereign and banking stress. Mody and Sandri (2012) shows the supposed link between holdings of sovereign debt and banks' market valuations was not significant in the period July-October 2011 in Italy, Spain, Portugal and Ireland. Only a clear relationship between Greek holdings and bank market valuation was established.

Arghyrou and Tsoukalas (2010) posit that the mechanics of the EMU debt crisis are similar to those of a currency crisis: in this case, the systemic risk that would be seen in currency markets is diverted into the markets for sovereign bonds. As a result, sovereign bond spreads can be taken as an indication of stress that would eventually lead to abandonment of the currency regime.

Illing and Konig (2014) show that the absence of lender of last resort (LLR) can lead to self-fulfilling crises even when fundamentals are good. The perceived weakness of the sovereign can lead to a deterioration of the quality of the guarantee that it has given banks and so would justify the transfer of risk from the sovereign to banks.

The dynamics presented by the literature suggest that the absence of a central bank that is willing to act as a lender of last resort increases the likelihood, in stress, of sovereign defaults. In turn, the perceived lack of fiscal muscle leads investors to price in a bank default. While sovereign bond holdings may reinforce this loop, the transmission of stress can exist even if there are no sovereign bond holdings by the domestic banking sector.

1.6. Regulation and the sovereign bank nexus

Banking regulation has been blamed partially for reinforcing the bank-sovereign feedback loop. As is explained in chapter 3, bank holdings of sovereign debt are generally not subject to a risk weight in banks´ capital requirement ratio.

To the extent that sovereign debt´s riskiness arises from the expansionary bias in fiscal policy over the cycle, it can be avoided through more responsible fiscal

policy in the upturn, as described in Breton et al. (2012). A source of instability in the financial sector can be the fact that public debt is perceived as not being sustainable which can lead to a sell off and a resulting vicious cycle (Acharya and Steffen, 2015; Merler and Pisani-Ferry, 2012). This has been a particular concern recently, when the recent developments in the Eurozone crisis questioned the Reinhart and Rogoff (2009b) concept of graduation from serial default.

The sovereign stress has led to a number of proposals to change the regulatory treatment of sovereign debt: Hannoun (2012) argues that highly rated sovereign assets should receive a treatment consistent with their low risk. This would entail a differentiation amongst the different sovereign assets according to their creditworthiness.

However, instead of doing away with the Basel standards that use the 0 risk weight on domestic debt holdings, Hannoun (2012) calls for the introduction of enhanced supervision of sovereign risk through instruments like further and stricter stress tests.

Praet (2013) highlighted that a regulation that treats banks' holdings of sovereign debt according to the risk they pose to banks' capital will prevent said banks from excessive use of central bank liquidity, which, in a currency union, according to Uhlig (2014) can lead to perverse incentives. Weidmann (2013) suggests that by biasing the demand towards sovereign bonds the regulation distorts the relative prices of assets signaled by interest rates. However, others have considered that some shortcomings of the introduction of a risk weight on sovereign exposures, such as the procyclicality associated with capital requirement ratios call for a different treatment of sovereign exposures. In particular, Nouy (2012), considers using a Pillar II approach to extend sovereign risk, along the lines of Hannoun (2012), not least because the procyclicality of capital regulation can be especially problematic for sovereign bonds.

A key concern on this treatment is that the 0 risk weight has provided additional incentive to the exploitation of the carry trade (Acharya and Steffen, 2015). The absence of a capital requirement lowered incentives to lend to the real economy, particularly amongst the low-capitalized banks. As a result, the zero risk weight lets zombie banks continue operating, detracts resources from the economy and leads to perverse incentives in a currency union.

In this vein, Blundell-Wignall (2012) considers that the key may lie in the series of fiscal and structural policy measures being followed in the EU and aimed at tackling the underlying weaknesses of sovereign bond credit quality, which would eliminate the riskiness of those holdings and so the need for increasing its risk weight. The measures include credible fiscal consolidation plans, the enhancement of the European Central Bank (ECB)'s role as liquidity provider of last resort, and the creation of effective backstops.

Of course, the findings of the literature on fiscal fatigue and fiscal sustainability are particularly important to this end. As such, countries that present the fiscal, institutional and growth strategies that allow them to avert fiscal fatigue can have a virtuous cycle by which their debt can safely be considered a risk-free asset, relieving the balance sheet of domestic banks and allowing public debt to play its role as a safe asset in times of distress.

The need for a safe asset is inherent to the workings of a financial system. As Nakaso (2013) showed, this impact can be seen through several avenues: for instance, sovereign bonds act as a benchmark for other assets, as mentioned by Dunne *et al.* (2007), thus used as a reference rate from which the additional risk factors are compounded to determine the price of other assets. By serving as a safe and stable source of collateral in financial transactions, attracting lower haircuts and margin requirements, they allow markets to function smoothly (Giovannini et al., 2015).

Their role as an accepted source of collateral allows sovereign debt to play a similar role to that of fiat money in economies (Singh, 2013). In this way, sovereign debt posted as collateral can be used in other transactions, creating an effect which is similar to the monetary multiplier effect (Singh, 2013); and Claessens *et al.* (2012). Without an accepted, liquid, risk free asset, some financial transactions that require the use of collateral may never happen.

1.7. Connectedness: amongst financial firms and with sovereigns

Finally, and as expected given its key role in the work of financial markets, safe assets are also integral to prudential regulation. Prudential requirements use safe assets in order to limit or prevent excessive risk taking in normal times. One can think that to the extent that both sovereign debt and money are backed by a

country´s central bank, they should be exchangeable assets. Debt only becomes risky when a country stops being backed by its central bank.

Given the importance of financial stress, many resources have been devoted to understanding the workings of this event. A key area of analysis is how stress can propagate from one financial institution to the system, or to other institutions, or from the sovereign to financial system and vice versa. This played a key role in the start of the global financial crisis in 2008-2009: understanding which institutions are systemic and which aren´t is essential to understand the costs and benefits of the resolution of a given institution.

As a result, much literature and policy effort has gone into determining what a systemically important institution is and how it should be dealt with. The Basel Committee on Banking Supervision (BCBS) has been a key player. In order to enhance the regulation of SIFIs, the first step was to identify them. To this end, the BCBS selected a number of indicators that reflect many dimensions of a bank: size, interconnectedness, the lack of readily available substitutes for the services they provide, their global (cross-jurisdictional) activity and their complexity. The size, interconnectedness and substitutability categories are in line with the guidelines of the IMF/BIS/FSB report submitted to the G20 Finance Ministers and Central Bank (BIS, 2010).

A part of the literature has analyzed the need for such a regulation from a particular perspective: the implicit subsidy in being too big to fail. Some authors find that the subsidy is large enough to distort firms´ decisions, even beyond the banking sector (Baker and MacArthur, 2009).

Others (Thomson, 2009) take a more policy-oriented approach and not only propose a framework for identifying and supervising such institutions; they attempt to remove the advantages from being SIFIs and the perverse incentives that may arise. Size and interconnectedness would be the basic determinants for being considered a SIFI, and firms that are such by these two counts would be subject to the strictest regulations. In contrast, if a firm is highly correlated, it may not be subject to additional capital controls, but only to more strict disclosure arrangements. Finally, institutions that are neither large, nor interconnected or

correlated but have a particular impact on the workings of a particular region would be subject to enhanced supervision.

1.8. Macroprudential policy

The recent financial crisis has shown the need for new instruments to deal with the global build-up of financial imbalances, which can eventually have severe macroeconomic consequences. In particular, a major shortcoming in the run up to the crisis was the lack of understanding on how systemic risk builds up even when, from a microprudential perspective, the risks to the financial system may seem, ex ante, limited.

This lack of understanding was in part due to the confidence that the financial system would be able to adjust itself automatically. As a result, growing debt and leverage before the crisis, often related to house price booms, were not tackled. As a result, low volatility and risk premia and the excessive risk taking they could entail were not considered as large a risk to the system as they turned out to be. In this context, the role of financial innovation, deregulation and disintermediation in the creation of bubbles was not sufficiently recognized. In particular, the avenues through which the fallout from the bubble would spread were not identified.

The need to understand how interactions across firms develop means there is a need to complement the traditional, micro approach, with a macro approach in regulation and surveillance. This need for a macroprudential approach has led to several policy initiatives to implement macroprudential policies (see Gorton and Winton, 2003).

The policy debate is, as a result, evolving around the range of macroprudential tools available, how they can be implemented and their effectiveness. The effectiveness has been analyzed both in terms of the economic impact of the new tools and the interactions with other policies, in particular monetary policy.

A key issue is the interaction between monetary policy and other prudential policies. In particular, part of the reasoning focuses on the impact of monetary policy on financial stability, and so, the role that may be played by macroprudential policy as a complement to monetary policy. These interactions are not well understood, on account of the still nascent knowledge regarding

interactions between the real economy and the financial system. Macroprudential policy and the related literature can be seen as an attempt to bridge that gap.

Clement (2010) shows that the term macroprudential was first used in the meetings of the Cooke Commission (today the BCBS) in the 1970s. Borio (2009) shows that the term was used to emphasize the links between financial regulation and supervision and the economic status quo. Tucker (2009) and Mccauley et al. (1999) also show the purpose of macroprudential policy when it started, and, in particular, its focus on managing the risks that arise from an increase in leverage.

In BIS (1986), one can find references to the effect of regulation on the aggregate payments system and the financial system. This was followed by the insight that what appear as prudent from an individual perspective may be dangerous from a systemic perspective (Blunden, 2007). The need to understand the build-up of systemic risk was therefore present in the early literature 2000s (Crockett, 2000).

However, the focus on macroprudential issues has rocketed after the current crisis, as can be seen in the references to the issue coming from policymakers (e.g. Shirakawa, 2009, Nijathaworn, 2009, Tumpel-Gugerell, 2009, Bini-Smaghi, 2009, Kohn, 2009, and Brouwer, 2010). Some of the issues, in particular regarding the interaction of prudential policy and monetary policy, can be traced back to Borio et al. (2003), as acknowledged by Orphanides and Williams (2010).

1.8.1. Objectives of macroprudential policy

The emergence of the macroprudential debate came at a time when the academic literature seemed to have reached an agreement on what the target of monetary policy should be. The key target for central banks should be price stability over the medium term. In some cases, central banks had a dual mandate, such as for example the Federal Reserve, maximum sustainable employment. Given these targets, operative objectives were typically defined in terms of CPI inflation or some other measure of underlying price dynamics.

As of now, there is still little agreement on what the target of macroprudential policy should be. Financial stability is seen as a key target, but an operational definition of it remains elusive. There are two main camps on this matter: First, those that define financial stability as the resilience of the financial system when faced with exogenous shocks (e.g. Allen and Wood, 2006; and Padoa-Schioppa,

2003). Second, those who think that financial distress can be endogenous and so consider that the essence of financial stability lies in the ability to manage the imbalances within the system (e.g. Schinasi, 2004) or how those imbalances can make the system vulnerable even in the face of relatively usual shocks (Borio and Drehman, 2009a). At the heart of the debate lies on whether policymakers should prioritize ex-ante supervision and regulation or ex-post resolution and crisis management policies.

Regarding the specific targets of macroprudential policy, Brunnermeier and Pedersen (2009) suggest that it act to limit the financial system´s tendency to infraestimate risk in the downturn and overestimate it in the upturn. By leveling the measurement of risk through the cycle, regulation and policy may limit the magnitude of booms and busts. Bank of England (2009) shares this view and highlights that in avoiding such boom bust cycles, it will help the financial system provide services to the economy. As a result, if the boom bust cycle is not related to the provision of financial services and the supply of credit, it would be beyond the scope of macroprudential policy. Landau (2009), however, asserts that in practical terms it would probably be appropriate for macroprudential policies to take into account the creation of bubbles.

Borio and Drehmann (2009a) contend that the main role of macroprudential policy is to limit the materialization of system-wide risk that can have a significant macroeconomic cost. One must understand the differences of macro- and the micro prudential regulation in order to understand the possible effects of the policies implemented (Crockett, 2000). Table 2.1 lists the differences between macroprudential and microprudential perspectives suggested by Borio (2003).

Caruana (2010b) suggests that there are two elements to consider regarding macroprudential policy: the links across firms in a given point in time, and the exposures to similar risks and a more intertemporal dimension that should address the procyclicality of the financial system. From a more theoretical perspective, Perotti and Suarez (2009a) consider that macroprudential policy should tackle negative externalities of individual banks on the financial system: strategies that may be optimal from a bank´s individual perspective may end up being detrimental to the system as a whole.

Hanson et al. (2011) think macro prudential policy can complement microprudential policies, whose aim is to protect depositors by having banks internalize the losses they may incur in their assets. This behavior must be regulated because deposit guarantee schemes are subject to moral hazard. Alternatively, macroprudential policy should be designed to minimize the social costs of a general decline in the provision of banking services. The manifestation of this shrinkage of balance sheets can be found in credit crunches and fire-sales of assets.

1.8.2 Macroprudential tools

The broadening of the scope of financial policy in general introduces the question of how it may be instrumented. This is in contrast to monetary policy, which, at least in advanced economies, the debate on the instruments to be used had been broadly settled (at least until the advent of the global financial crisis). Short-term, interest rate was the primary instrument in monetary policy, and communication was an increasingly important complement (Blinder et al., 2008). Non-conventional tools (e.g. Bernanke and Reinhart, 2004; Gertler and Karadi, 2011; Motto et al., 2010; Curdia and Woodford, 2009; Lenza et al., 2010), are considered instruments outside the usual policy toolkit, to be used in specific periods of time, in which the zero lower bound becomes binding.

The research into the role of macroprudential policy being at an earlier stage, the conclusions remain far from obtaining the depth and the level of consensus on basic questions that has been achieved in monetary policy. To foster the debate in this area, the ECB has launched an initiative to facilitate academic research on aspects that could improve macroprudential supervision within the EU (Constâncio, 2010). A range of possible macroprudential measures have been investigated without identifying a primary instrument nor a standard taxonomy of instruments.

One important distinction in the debate is between macroprudential tools – defined as prudential tools set up with a macro (in the sense of system-wide/systemic) lens – and other macroeconomic tools that can support financial stability such as fiscal policy (see e.g. Blanchard et al., 2010; Borio, 2009). Hannoun (2010), gives an overview of alternative sets of tools geared towards

financial stability. Caruana (2010b) argues that financial regulatory policies are an essential part of the solution but they alone will not suffice to address systemic risk in all its complexity.

Part of the macroprudential literature is based on the attempt by emerging economies to deal with large incoming capital flows and reduce the domestic consequences of such flows. Some of these policies include limiting foreign exchange positions and constraining the type of foreign assets and magnitude of those purchases. Borio and Shin (2007) show that the build-up of financial imbalances was often accompanied by a growing share of net foreign-currency financing.

Market-based regulations that try to discourage capital inflows (Mohanty and Scatigna, 2005; Ghosh et al., 2008; Committee on the Global Financial System, 2009) and other tools aimed at controlling large capital inflows, some of which became increasingly popular in 2009-2010, are not considered within the scope of macroprudential regulation, but rather as tools that may have a prudential side effect (Ostry et al., 2010). While examples of such policies abound, many take the form of the tax on international debt described in Jeanne and Korinek (2010), which forces borrowers to internalize the costs of currency mismatches.

Bank for International Settlements (2010) provides a useful summary of macroprudential tools and instruments, their targets and their implementation. One can classify macroprudential tools according to their aim. For instance, some tools are geared towards addressing risks that may arise over time, particularly linked to the procyclicality in the financial system. Others consider the distribution of risk within the financial system, that is, the cross-sectional dimension of macroprudential risk, focusing on the systemic contribution of an individual firm or its exposure to a system wide risk event. The procyclicality of risk is the key concern of the time series dimension (Bank for International Settlements, 2001; Borio et al., 2001; Danielsson et al., 2009; Borio and Zhu, 2012; Brunnermeier et al., 2011, Brunnermeier and Pedersen, 2009; Shin, 2009).

Saurina and Trucharte (2007) and Repullo et al. (2009) show that capital requirement ratios are procyclical. Shin (2010) discusses ways of mitigating this procyclicality, and considers that countercyclical capital requirements, together

with forward-looking statistical provisioning schemes, can mitigate the harmful effects of excessive risk taking via securitization. Kashyap and Stein (2004) present a model where, if a social planner was to maintain credit during downturns and minimize the use of deposit insurance, then a time-varying capital requirement can be optimal. Hanson et al. (2011) argue that such a regulation may not be strong enough in downturns, when markets may find that the capital accumulated in good times may not be enough to convince to lend to the bank. These demands in bad times should be taken as a benchmark for the capital required in good times.

The valuation of collateral and loan-to-value ratios may also be a source of procyclicality, which can be addressed through maximum loan-to-value (LTV) ratios. Borio et al. (2001) analyzes how this can be dealt with.

The second macroprudential instrument that deals with the procyclicality of banks is loan loss provisions, which has been identified as a way of limiting the impact of the downturn in weakening banks' balance sheets and so reduce the ensuing amplification of the financial cycle. Borio et al. (2001) argue that the procyclicality of bank provision is amplified by accounting practices, tax constraints and methodological shortcomings. Fernandez de Lis et al. (2000) discuss how forward-looking provisioning would limit the observed strong procyclicality of loan provisions. Jimenez and Saurina (2005) suggest that forward-looking loan loss provision should take into account the credit risk profile of banks' loan portfolios along the business cycle.

The third is haircut-setting and margining practices in securities financing and over-the-counter derivatives transactions. Committee on the Global Financial System (2010a) highlights the system-wide impact of these practices during the financial crisis, and discusses policy options for reducing the procyclical effects of mark to market and haircut determination practices on financial markets. These include countercyclical variations in margins and haircuts, and higher and relatively stable through-the-cycle haircuts for securities financing transactions.

The cross-sectional dimension focuses on the distribution of risk in the financial system at a point in time. The idea is that linkages, common exposures, and herd behavior can introduce system-wide risk that needs to be reckoned with. There

is a rich literature on which analysis of the cross-sectional dimension can draw, such as studies of systemic aspects of risk management (see e.g. Hellwig, 1995) or theories of systemic risk (e.g. Acharya, 2009). Important elements within this perspective include market failures (e.g. Rabin, 1998; Calomiris, 2009) and propagation channels (e.g. Jensen, 1986; Calomiris and Khan, 1991; Caruana 2010b).

Short-term debt in banks' liabilities has been identified as a major source of vulnerability (Brunnermeier, 2009; Gorton, 2010; Shin, 2009; Hanson et al., 2011). These are often modeled as idiosyncratic shocks that are amplified across the system, as banking networks reinforce the systemic nature of the amplifications. The key to the amplifications lies in the presence of interdependencies across banks, be it regarding assets and liabilities or though the payments and settlement systems. The accelerator of the spillovers is usually the difficulties in discerning in real time, which institutions are solvent and which aren´t (e.g., Kiyotaki and Moore, 1997; Allen and Gale, 2000; Rochet and Tirole, 1996; Freixas and Parigi, 1998; McAndrews and Roberds, 1995; Aghion et al., 2000). In fact, as Martin et al. (2010) showed using an extended Diamond-Dybvig (1983) framework, financial institutions that are funded by short-term debt and hold financial assets can run with similar effects on solvency as traditional deposit runs. According to a model developed by Stein (2012), in the absence of regulation, money creation by banks can lead to financial system vulnerabilities, as banks will issue more debt than is socially desirable and so could lead to externalities that would make the banking system vulnerable to crises.

Given the prominence of balance sheet mismatch in the literature, it is natural that the key instruments that have been designed minimize the risks associated to this mismatch. Some examples of such tools are the net stable funding ratio or a liquidity coverage ratio (Basel Committee on Banking Supervision, 2009), which have an element of procyclicality. One way to overcome procyclicality, proposed by Perotti and Suarez (2009a, b, 2010), is discouraging short term funding through liquidity risk charges. Brunnermeier and Pedersen (2009) propose that a

capital surcharge be created that is proportional to the maturity mismatch of the financial institution.

The parallelism with monetary policy can also be found in the debate on whether there should be automatic, pre-specified rules or whether the supervisors must be afforded discretion and flexibility to enforce macroprudencial regulation (Borio and Shim, 2007).

In the academic literature, and in particular since the observation that discretion can have a time inconsistency and as the historical experience built up, the evidence seemed to favor the existence on rules that would enhance transparency and accountability, and would be superior in welfare terms than discretion-based decisions (Kydland and Prescott, 1977).

Rule-based macroprudential tools – e.g. automatic stabilizers – have, similarly, some interesting characteristics (Goodhart, 2004). Loan loss provisions, capital requirements/capital surcharges, or loan-to-value ratios can for example be designed in a rules-based way. One important built-in stabilizer are risk management practices that internalize the risk of the buildup of financial imbalances and their unwinding (Borio and Shim, 2007 or Sundaresan and Wang, 2010).

Midway between discretion and full flexibility, one finds contingent instruments, which try to have the best of both worlds, and can be considered rule-based tools that are state-dependent. Hanson et al. (2010) break up these instruments as those that are contingent reversible i.e. debt that is automatically converted into equity in times when a bank's capital buffer declines under a pre announced limit (Flannery, 2005; French et al., 2010; Pennacchi, 2010), and, on the other hand, capital insurance, which would take the form of a policy purchased by the bank which pays off if certain conditions of stress or capital shortfall for the bank take place (Kashyap et al., 2008).

While rule-based tools play an important role, in policy debates, other, more discretionary rules have also been highlighted. The reasoning behind this is that since the next crisis is likely to take a different form, the regulation may not be prepared to deal with it. As a result, discretion may play an important role. One

such instrument is the ability to issue warnings in speeches or in official publications. However, the use of warnings is far from uncontroversial: in fact, there may not be enough of them, as regulators could fear adverse effect, by triggering self-fulfilling dynamics (Libertucci and Quagliariello, 2010). An alternative could be levies or quantitative adjustments to prudential tools, so as to tackle the new forms of systemic risk that may arise (Hilbers et al., 2005).

Another aspect of the debate has been on whether the regulation should be instrumented through prices or quantities. Perotti and Suarez (2011) provide a theoretical treatment of the difference between price and quantity-based tools based on the model by Weitzman (1974), who shows that in the presence of externalities the two types of policy instruments can have different welfare outcomes if there is uncertainty about compliance costs. Price-based tools fix the marginal cost of compliance and lead to uncertain levels of compliance, while quantity-based tools fix the level of compliance but result in uncertain marginal costs.

Perotti and Suarez (2011) compare Pigovian taxes aimed at equating private and social liquidity costs to quantity regulations such as net funding ratios. They show that when regulators cannot target individual bank characteristics, the industry response to regulation depends on the composition of bank characteristics. Hence, depending on the dominant source of heterogeneity, the socially efficient solution may be attained with Pigovian taxes, quantity regulations or a combination of both.

Among quantity restrictions, Hanson et al. (2011) argue in favor of small increases in capital in absolute terms for trouble banks, instead of using the capital ratio, so as to avoid the incentive to shrink their balance sheets and lead to more procyclicality of regulation. According to Hanson et al. (2011) this can be implemented through the introduction of a capital ratio requirements in terms of the maximum of current and lagged assets.

Some studies also distinguish the context in advanced and emerging market countries. McCauley (2009) argued that emerging market central banks have been regular practitioners of macroprudential policy, without calling it by this name. As an example, he cited the Reserve Bank of India’s decision to raise the Basel I weights on mortgages and other household credit in 2005 (RBI, 2005).

Borio and Shim (2007) and Committee on the Global Financial System (2010b) provide an overview of emerging market economies' experience with macroprudential instruments. Agénor and Pereira da Silva (2009) examined the cyclical effects of capital requirements for banking sectors in developing countries, with a view to understanding the cyclical effects of Basel regulations in the prevention and/or amplification of the financial crisis. Brunnermeier and Sannikov (2014), Tucker (2009) and Borio (2004), Peston (1959) Bullard et al. (2009) also contributed to this literature.

1.8.3. Analytical underpinnings

Macroprudential policy requires, from an analytical perspective, an upgrade in an area that has been considered a weakness of macroeconomic models up to today, in particular, the interactions between the macroeconomy and the financial system.

Macroeconomic models and monetary policy analysis made use of a common framework of models, underpinned in the modelisation of micro fundamentals and rationality, and analyzed the dynamics at or near equilibrium. These models incorporated some sort of friction, from rigidities in the labor market or information. As a result, a monetary policy shock was found to have a tractable transmission mechanism, and a certain welfare consequence. The challenge was to incorporate and refine the interactions between the macroeconomy and the financial system.

Macroprudential policy is far from having a clear network of models. This is part because it is still a recent line of work, and the enhanced focus on financial stability is rather new. As a result, the methodological literature, and the fact that financial stability, at heart, deals with the one question to which the literature has not provided a clear framework (the interaction between the macroeconomy and the financial system), makes it particularly challenging. Note that the lack of a concise, well- delimited definition of macroprudential policy makes it all the more harder to develop a class of models suited to address all the issues involved.

Financial stability and systemic risk

Models that deal with financial stability typically take three different approaches, as shown by Borio and Drehmann (2009a). Diamond and Dybvig (1983), design

models where exogenous shocks can lead to multiple equilibria, in line with the sunspot literature. A second class of models starts from a negative shock (Allen and Gale, 2004), which in itself is not necessarily systemic, but when coupled with a propagation mechanism (such as the balance sheet linkages of Rochet and Tirole, 1996) leads to financial instability. Finally, Minsky (1982) and Kindleberger (1996) posit that financial instability arises from cyclical fluctuations.

De Bandt and Hartmann (2000) and De Bandt et al. (2009), consider the perspective of systemic weakness. While there is no clear definition of the concept (See Hutchinson and McDill, 1999; Kaminsky and Reinhart, 1999; Bell and Pain, 2000; Demirguç-Kunt and Detriagache, 2005; Davis and Karim, 2008; Dell'Arricia et al., 2008; Von Hagen and Ho, 2007). Definitions of systemic risk often evolve around the idea present in De Bandt and Hartmann (2000), by which systemic risk materializes when institutions that had a healthy starting point and were resilient to the first round of stress are vulnerable to a second (or ulterior) rounds of stress (See Borio and Drehmann, 2009a).

Perotti and Suarez (2009b) interpret systemic risk as propagation risk, by which initial shocks end up affecting other institutions and can thus have an impact on the macroeconomy that is not the consequence of the initial shock.

The literature analyzed above focuses on contagion as the mechanism that unearths financial instability. However, a line of literature focuses on how the interaction of financial decisions and the business cycle can lead to instability. The driver of this, according to Borio and White (2003), is that in boom times the financial sector overextends, and contracts in recessions, thus amplifying the cycle. In this context, risk and financial instability are endogenous to the macroeconomy, and have a dynamic, self-correcting element to it.

Danielsson et al. (2009) consider as a starting point the divergence between perceived risk and actual risk. As a result, market participants may, in good times, underestimate the actual risk they are facing, and so, an equilibrium level of risk arises, which could be excessive from a social point of view.

A key ingredient of the systemic risk literature has been the efforts at quantifying financial instability. A first such approach was the use of balance sheet structures. This was particularly popular over the past decade, where much effort has been

dedicated to the creation of indicators of financial distress (Carson and Ingves, 2003; Bordo et al., 2002). In terms of policy, the International Monetary Fund (IMF) upgraded its surveillance of the financial sector, creating a broad set of indicators that were meant to give an indication of the risks emanating from the financial sector (the Financial Soundness indicators; Moorhouse, 2004; International Monetary Fund, 2008) – and market indicators, such as those that use equity and credit-default-swap (CDS) or other derivative instruments (Illing and Liu, 2006; Tarashev and Zhu, 2006, 2008). While these indicators are increasingly used, they have important limitations (e.g. Fell, 2007). Most balance sheet indicators – such as loan loss provisions or non-performing loans – are typically backward looking (Bongini et al., 2002). Ratings of individual institutions are in principle forward-looking but in practice tend to incorporate new information only with a lag. Moreover, they are micro in nature and thereby fail to highlight vulnerabilities at the level of the whole financial system.

One line of literature that has attempted to draw conclusions from underlying dynamics in the financial system is the literature on early warning indicators. These studies predict financial stress from a set of leading indicators, which (Aikeman et al., 2011) are typically associated with financial stress, the key shortcoming from a macroprudential perspective is that they provide limited information on the interaction between the real sector and the financial sector, and usually do not give a structural view on how risks arise and are transmitted so as to cause financial instability, thus limiting the information they provide to policymakers

One are that is particularly interesting of this literature is that which looks at the interactions between credit growth and the consequences for asset price misalignments (Borgy et al., 2009; Borio and Lowe, 2002; Borio and Drehman, 2009b; Gerdesmeier et al., 2009; Alessi and Detken, 2009; Fornari and Lemke, 2009). Their theorical underpinning relies on endogenous cycles, which suggest that loose risk controls lead to excessive credit growth which, once asset prices turn round, lead to disorder which can have important macroeconomic consequences. Another advantage of these models is that they tend to spot financial instability over a longer horizon than other early warning models (Borio and Drehmann, 2009a, Borio and Lowe, 2002).

In terms of the econometric literature, VARs provide a method that can help understand the drivers, propagation mechanism and consequences of financial distress (Drehmann et al., 2006; Misina and Tessier, 2008). While flexible and tractable, they are purely empirical and are often highly stylized (Lucchetta and De Nicolo', 2009). They are perhaps, most useful, in comparing the conclusions that arise from the literature with the empirical models that bring the data to the theory.

Finally, macro stress testing provides a forward looking methodology for understanding the effect of macro shocks on the financial system. Of course, a limitation of these models is that they tend to rely on the existing knowledge of the macro and financial linkages, which is limited. Secondly, they tend to focus on large shocks, and usually do not consider the amplification of small initial shocks which can end up having systemic consequences. As result, they may not be particularly helpful to identify elusive connections between macroeconomic and financial variables. (Borio and Drehmann, 2009a). Alfaro and Drehmann (2009) emphasize that macroeconomic weakness was not at the heart of previous crises. As a result, traditional macro stress testing may be of limited use to predict future crisis.

1.8.4 Assessing the systemic importance of individual financial institutions

A main line of research involves understanding whether an individual firm can have systemic consequences, as described by Allen and Babus (2009).

A key contribution, in the wake of the crisis, was the conditional value at risk (CoVaR) by Adrian and Brunnermeier (2008), which measures the value at risk (VaR) of the financial system conditional on the financial market being under distress. They define an individual financial institution's marginal contribution to systemic risk as the difference between CoVaR and the financial system VaR.

From this starting point, one can analyze what makes a firm become systemic, which is crucial from a supervisory point of view. They find that leverage, size, and maturity mismatch are the key drivers of a high CoVar. CoVar must be thought of for an individual firm, as it is not additive across firms (Tarashev et al., 2010).

Buiter (2009a) notes that CoVar (which can be calculated through quantile regressions) do not necessarily measure causation, but rather correlation. Also, the CoVar does not consider that the Var may behave very differently in crisis times. Secondly, and crucially, the CoVar does not consider indirect effects, as it does not build the network of possible effects.

Segoviano and Goodhart (2009) define systemic impact as the probability of having at least one extra bank failure given a particular bank fails, thus using conditional probabilities.

Zhou (2010) proposed a "systemic importance index", which could be related to the number of bank failures caused by the failure of one particular bank. Zhu (2008) constructs market-based systemic risk indicators, defined as the insurance premium for a hypothetical protection on liability losses when the financial system as a whole is in distress. He posits a rule to allocate systemic risk contributions, the losses from a particular bank conditional to the banking system being in distress. It has the same additive property (i.e. systemic risk contribution of individual bank adds up to the system's risk) and incorporates size weight information and information on the bank's loss given default (LGD) in the simulation.

Gauthier et al. (2012) use data on individual banks' loan books, risk exposures, and on interbank linkages including over-the-counter (OTC) derivatives for the Canadian banking system to compare alternative mechanisms for allocating the overall risk of a banking system to its member banks. They explicitly take into account that overall risk as well as each bank's risk contribution change once bank capital requirements change. Gauthier et al. (2012) consider five different ways to compute contributions to systemic risk, namely component VaR, incremental VaR, two kinds of Shapley values, and CoVaRs. They find that all five risk allocation mechanisms give similar results in terms of improving financial stability due to macroprudential capital buffers based on them that are quite different from the ones proposed at the BCBS.

One literature strand on the interconnectedness of financial systems models them as complex systems (Hommes 2006, 2008, 2009; Hommes and Wagener, 2009; LeBaron and Tesfatsion, 2008).

Generally, the interconnections arise from exposures in the interbank market. These exposures can be modeled by estimating the actual network structure of the financial system (Lelyveld and Liedorp, 2006), which can then help understand the contagion risks. A typical result of this literature is that systemic risk only arises if the largest banks fail. Gai and Kapadia (2008) and Nier et al. (2007) construct artificial homogeneous networks of banks to test the results mentioned above. They find that connectivity has two opposing effects on contagion risk: on one hand, by favoring diversification, it helps reduce the probability of failure. However, the interconnections amongst firms facilitate the propagation of risk once failure affects one of the firms in the network.

Relatedly, one can identify a measure of systemic risk and then calculate the contributions of individual institutions to it (Tarashev et al., 2008, 2010). Policy should be directed at the firms and the connections that lead to the systemic risk (Huang et al., 2009).

Acharya et al. (2010) calculate the contribution of each individual financial institution to the social cost of a systemic failure, which is considered proportional to its size and to the percentage loss or negative return it suffers when the market is below this threshold. They propose a levy on banks depending on the average of this contribution (its Marginal Expected Shortfall, MES) multiplied by its weight in the economy.

1.8.5 Understanding the interaction between the financial system and the macroeconomy

The popularity of dynamic stochastic general equilibrium (DSGE) models in policymaking (Sbordone et al., 2010) made central banks vulnerable to three criticism. First, their unsatisfactory modeling of financial frictions (Bean, 2009). The Bank of England Quarterly Model, used as an input to its Monetary Policy Committee, is an example of this (Harrison et al., 2005). Second, DSGE models generally analyze the transition towards a steady state, so are not able to model the dynamics that generate financial booms and busts (see Buiter, 2009b; Bank of England, 2009 and Tovar, 2008).

These limitations have been tried to overcome in different ways. First, augmenting DSGE with financial frictions (Curdia and Woodford, 2009; Christiano

et al., 2011, Gerali et al., 2010; Dellas et al., 2010.). The origin of this literature can be found in the financial accelerator of Bernanke et al. (1999). Some papers explicitly use these models to examine the interaction between monetary policy and the macroeconomy during the crisis. Del Negro et al. (2010) for example introduce a model with credit frictions of the form suggested by Kiyotaki and Moore (2008), as well as nominal wage and price frictions to show that the non-standard monetary policies followed by the Federal Reserve during the crisis prevented a repeat of the Great Depression in 2008-09. The standard references are Bernanke and Gertler (2001), Goodfriend (2002), and, for an overview of the arguments, Giavazzi and Mishkin (2006).

Kannan et al. (2012) show that the reaction by monetary authorities to the financial accelerator that drive credit growth and asset prices can deliver financial and macroeconomic stability. In addition, a macroprudential instrument designed specifically to dampen credit market cycles would be useful. In their model, policy responses must be flexible, if it is not, they run the risk of lowering stability. Vlieghe (2010) suggests that monetary policy take into account the fact that credit frictions may lead to an inefficient allocation of resources.

This set of models usually examines the financial sector from the point of view of its ability to allocate resources to the right borrowers. The interactions amongst lenders (or intermediaries) as a source of financial instability is largely absent from these models.

The second strand investigates frictions related to financial intermediaries, and studies the role of bank capital in the monetary transmission mechanism. Goodfriend and McCallum (2007) analyze the different financial markets, and so eliminate the one interest rate hypothesis. By thus modeling the financial sector, they find that actual resource allocation and so optimal policy responses can deviate from the standard conclusions of the regular DSGE.

Other includes Cohen-Cole and Martinez Garcia (2008) and Gertler and Karadi (2011), who introduce balance sheet constraints of financial firms in a DSGE, and make use of Kiyotaki and Moore (2008)'s modeling of liquidity risk. However, Gertler and Kiyotaki (2010) is a real business-cycle (RBC) model without frictions, and so not a useful framework to study the effect of monetary policy, although it is valid for the analysis of credit policies. Jeanne and Korinek (2010) show that

as borrowers do not internalize their contribution to aggregate volatility and as a result take on excessive leverage, thereby leading to boom-bust cycles. To reign in excessive leverage, Jeanne and Korinek (2010) propose a Pigouvian tax on borrowing that induces agents to internalize their externalities they generate.

A set of papers has looked at the interaction between capital regulation and macroeconomic performance. Covas and Fujita (2009) calculate the effect of capital requirement ratios on the business cycle, in a banking model that mirrors Holmstrom and Tirole (1998). They find that Basel II capital requirements are procyclical and so increase output volatility. Zhu (2008) finds that a risk-sensitive capital standard leads to much higher capital requirements for small and riskier banks, and much lower requirements for large and less risky banks.

Repullo and Suarez (2013) show that countercyclical capital buffers would reduce the incidence of credit rationing over the business cycle without compromising the long-run solvency targets implied in the original regulation. N'Diaye (2009) finds that binding countercyclical prudential regulations can help reduce output fluctuations and allow monetary authorities to achieve the same outcomes.

Meh and Moran (2010) construct a DSGE model in which the balance sheet of banks affects the propagation of shocks. They find that economies whose banking sectors remain well-capitalized experience smaller reductions in bank lending and less pronounced downturns. Bank capital thus increases an economy's ability to absorb shocks and therefore affects the conduct of monetary policy.

Macroeconomic Assessment Group (2010) mainly consider macroeconomic models without a financial sector: the effect of stronger capital and liquidity requirements is mainly assessed by first modeling their effect on credit spreads, economy-wide lending volumes and lending standards, and then modeling the effect of these on macroeconomic outcomes using standard semi-structural macroeconometric models or DSGE models without a banking sector; but some DSGE models in which financial intermediaries and their balance sheets are modeled explicitly were also employed in the study. In Basel Committee on Banking Supervision (2010) the effect of a macroprudential overlay in the form of countercyclical capital buffers proposed under Basel III has not yet been analyzed.

Angeloni and Faia (2009) find that tighter monetary policy reduces bank leverage and risk, while a productivity or asset price boom increases it. They document that procyclical capital ratios are highly destabilizing. The best outcome is through mildly anticyclical capital ratios and a with monetary policy taking into consideration leverage and asset prices.

Angelini et al. (2010) develop a DSGE model, calibrated to the euro area and investigate whether a countercyclical capital requirements policy can usefully interact with monetary policy in achieving an inward shift of the output-inflation volatility trade-off. Policymakers' active management of capital requirements would improve the stabilization of economic activity.

Goodhart et al. (2005, 2006) De Walque et al. (2009, 2010) and Uhlig (2010) can also be considered attempts to include the banking sector in a macroeconomic model. Similarly, de Walque and Pierrard (2009) embed that same model into a DSGE model and examine the implications for monetary policy. They find that Taylor rules directly targeting some banking variables may perform better than standard Taylor rules targeting output.

Brunnermeier and Sannikov (2009) introduce the interactions between macroeconomic factors and the financial system in a model that does not necessarily evolve around a steady state. In this model, the financial sector does not internalize all the costs it generates, and so some aspects, particularly in the presence of securitization, can lead to excessive risk taking. In general, the main conclusion is that the financial sector can achieve inefficient outcomes.

Related work examines the impact of monetary policy and funding liquidity on credit supply. Brunnermeier and Pedersen (2009) point to the important role of liquidity, and how liquidity is correlated with market performance. As a result, it can suddenly disappear, leading to liquidity crises. Adrian and Shin (2009) point to the health of bank balance sheets as a key transmission mechanism of the macroeconomic outcome of monetary policy. In this vein, according to Adrian and Shin (2009), interest rates can affect bank valuations and creditworthiness, and so, risk taking. Geanakoplos (2010) introduces leverage in a DSGE framework. Freixas (2009), Freixas and Jorge (2008), and Ongena and Popov (2011) also analyze the interactions between funding conditions, bank health and the macroeconomy.

Borio and Zhu (2012) analyze the role of bank capital in the transmission of monetary policy, in particular through banks´ decisions of risk-taking. In particular, monetary policy affects banks´ perceptions of risk tolerance, and so the exposure to risk they are willing to hold in their portfolios. This in turns determines the funding and debt they use. They consider three avenues by which monetary policy affects risk: through its effect on valuations, search for yield and central banks perceived reaction function: more aggressive when stress emerges than when risk starts to build up (see Diamond and Rajan, 2009; Farhi and Tirole, 2012).

Dubecq et al. (2009), similarly, consider that risk taking is inversely proportional to the level of interest rate, which may in turn bias participants´ perception of risk. Disyatat (2011) considers that balance sheet strength and risk taking can affect the mechanics of the bank lending channel.

There have also been important contributions to the debate from a more empirical perspective. Adrian and Shin (2009) find, empirically, that the size of balance sheets depends on short term interest rates. Maddaloni et al. (2008), Ioannidou et al. (2009) and Jimenez et al. (2008) find that lower interest rates leads banks to increase risk, via lower standards in credit origination. This effect can be deepened by innovation (Rajan, 2005) and by a long period of expansionary monetary policy (Altunbas et al., 2009; Gambacorta, 2009).

The empirical literature has analyzed monetary policy´s role in the creation of bubbles. Some, like Taylor (2009), find that lower than optimal rates played a role in the formation of the housing bubble before the global financial crisis. However, others, including Dokko et al. (2009), do not find a central role for monetary policy in the formation of the housing bubble in those years.

Cecchetti et al. (2000) argue that monetary authorities should deflate asset bubbles Bean (2003, 2004, 2007, 2009) and Detken and Smets (2004) argue that bubbles and financial stability should be part of a central bank´s reaction function, but not necessarily be a formal target of monetary policy.

1.8.6 Effectiveness of macroprudential tools

The literature on the impact of macroprudential policies is at a relatively early stage (see Turner, 2010).

Some have studied the case of pre-crisis in Spain, as in Borio and Shin (2007), with particular emphasis on the role of dynamic provisioning. Empirical studies find it had a small impact on credit, although it may have helped build up buffers in the upturn (Caruana, 2005, Saurina, 2009a). Saurina (2009b) finds that dynamic provisions provided a backstop and a larger first line of defense for financial firms. Jimenez and Saurina (2006) find that credit standards change throughout the cycle, which become more lenient in good times and stricter in the downturn. Such behavior may be curtailed by cyclical loan provision scheme that considers banks´ risk appetite as an input. Fillat and Montoriol-Garriga (2010) find that had a dynamic provisioning system been in place, the need to use Troubled Asset Relief Program (TARP) funds by firms would have been much smaller.

Keys et al. (2009) conclude that lending standards were significantly determined by the law in mortgage brokering. Nadauld and Sherlund (2009) also find that capital requirements can reduce the size of bubble-formation. Their analysis focuses on the effect of a change in the law in 2004, which reduced some elements of capital requirements, which they find played a role in the granting of low quality loans which eventually defaulted.

Part of the effort of the literature has focused on the data needed for an effective macroprudential supervision. In this context, some authors have argued for the creation of an agency that collects more data from banks so as to have a fuller picture of their exposures to other institutions and to market events, like a rise in correlations (Lo, 2009;. Sibert, 2010). From Sibert´s (2010) point of view, while this data would be useful, the difficulty in understanding the driver of systemic risk would make them of limited use. The data are a starting point from which network effects and connectedness could be derived. One way of possibly overcoming this aspect (at least partially) would be through a timely collection of a wide array of data which would help researchers understand the risk of building up in the system, as proposed by Brunnermeier at al. (2011), although it would still require a deeper understanding of the emergence of systemic risk.

Using data on individual banks' loan books, risk exposures, and on interbank linkages including OTC derivatives for the Canadian banking system, as mentioned above, Gauthier et al. (2012) take data on Canadian banks, and their

exposures with other banks, as well as risk and loan books, and empirically calculate that a macroprudential capital buffer could reduce the probability of systemic stress by about 25%.

One controversial issue is the coordination of macroprudential policy across countries. This is particularly difficult in macroprudential policy (as in monetary policy) because leverage is usually not synchronized and regulatory arbitrage can undermine the effectiveness of the instruments used

Foreign currency exposures, at the heart of the wave of macroprudential policies that started in emerging economies in 2009 has also been the subject of much debate. Allen and Moessner (2010) show the foreign currency swaps put in place by the major central banks in the wake of the crisis played an essential role in saving several banking systems from severe distress. However, it remains to be seen whether central banks will be willing to accept such degree of foreign currency liquidity risk in the future, in an event of a lower magnitude.

Korinek (2011) uses the case of Indonesia to analyze the welfare implications of capital flows and risk taking. He finds that optimal taxes, which would target more volatile sources of funding could raise wellbeing significantly.

Bianchi (2011) uses a DSGE with credit frictions, calibrated to some features of emerging markets finds that an ex ante reduction in foreign currency debt can reduce the pressure on emerging economies, by reducing leverage and so the magnitude of the downturn when financing conditions worse. In contrast, Benigno et al. (2010) do not find a clear preference for crisis prevention over intervention once the crisis starts.

1.8.7. Coordination with monetary policy and governance

The consensus was traditionally that monetary policy should be geared towards price stability over the medium term. There were, however, some exceptions, that considered the need to use monetary policy to foster financial stability (e.g. Kent and Lowe, 1997; Borio and White, 2003; Filardo, 2004).

However, the crisis introduced the idea that financial stability is part of a central bank´s reaction function, as noted by Trichet (2009), and Bernanke (2010).

Loisely et al. (2009) propose a model in which asset bubbles are possible because of their behavior in investment. Monetary policy, by introducing a cost to entrepreneurs who create new investment opportunities, can reduce those risks taken by banks. The model calibrates when this limitations may be beneficial from a social perspective.

Agur and Demertzis (2009) consider a central bank that tries to preserve financial stability. In downturns, the central bank has more of an incentive to cut rates so as to reduce the probability of default of risky or illiquid projects. However, on average, though the cycle, interest rates will be higher, so as to avoid excessive risk taking during boom times. Borio and Drehmann (2009a) consider monetary policy can complement, and complete, macroprudential policy and prevent financial imbalances from arising or limiting their scope.

The key is then the coordination of monetary and macroprudential policy. Some authors suggest it is analogous to the coordination between fiscal and monetary policy, which is modeled as a game in Lambertini and Rovelli (2003).

Cecchetti (2009) shows that monetary policy and capital requirements are substitutes. Bean et al. (2010) study the issue in a New-Keynesian DSGE taken from Gertler and Karadi (2011). As a macroprudential tool they suppose regulators can directly affect the amount of capital that banks hold. As capital and leverage determine risk and lending, macroprudential policy can help monetary policy lean less against the wind and so have lower macroeconomic consequences. Macroprudential policy can be particularly useful if a country losses the ability to set rates (for instance because it enters a monetary union), as was the case of Spain upon entering EMU (Fernández and García Herrero, 2009).

Institutional set-up and governance issues

Part of the literature has considered whether regulation and monetary policy should be undertaken by separate institutions (Lastra, 2003; Goodhart and Schoenmaker, 1995). Blanchard et al. (2010) discuss that regulation and monetary policy may have to be set at separate institutions. The issues to consider when arranging the institutions charged with macroprudential policy are the possible spillovers from the central bank´s ability to monitor macroeconomic

developments, second, the avoidance of coordination problems, which can be problematic once a crisis strikes, and third, the internalization of macroprudential considerations in the monetary policy decisions.

The use of committees may provide better outcomes (see Blinder, 2009; Eslava, 2006 and Sibert, 2010) not least because macroprudential policy requires a wide array of expertise, for which different backgrounds would be useful.

Angelini, et al. (2012) shows that the macroprudential policies (such as LTV or capital requirement ratios that change over time) are helpful to counter financial shocks that lead the credit and asset price booms. In a similar way, Kannan et al. (2012) examines in a DSGE framework a monetary policy rule that reacts to deviations of prices, output and changes in collateral values with the possibility of using a macroprudential instrument (LTV). They find that the optimal policy response depends on the source of the imbalance.

To sum up, while rapidly developing, some aspects of the literature on the interaction of fiscal and financial risk remains in its early stages. More research is needed to understand the channels of transmission of stress, the changing nature of this interaction, the best indicators of stress and the appropriate policy response.

Chapter 2: Fiscal fatigue and debt sustainability: Empirical evidence from the Eurozone 1980-2013

2.1. Introduction

The sharp rise in debt and long fiscal consolidation process in Eurozone countries has led some authors to believe that fiscal fatigue could occur, such that at some point the primary balance stops adjusting after a certain level of debt, as countries are no longer willing to continue improving their primary balances in response to rising debt.

Generally, one can think the relationship between the level of debt and fiscal adjustment process goes through three phases. In the first phase, when debt is low, sovereigns may not adjust because increases in debt are considered irrelevant at those levels. Secondly, once rising debt reaches a certain size, so that for instance markets start reacting to it, sovereigns will start a fiscal consolidation process. The fiscal fatigue introduces the third phase of fiscal adjustment: when debt is so high for a long period of time, the required adjustment is large and the sovereign decides to stop adjusting.

This concept is related to the fiscal limit in the sense of Leeper (2013), by which governments, when debt reaches a certain level, no longer adjust. This can be either because markets do not deem further adjustment credible or, because the economic situation is so deteriorated that further cuts are not revenue-generating. Ghosh *et al.* (2013) focus on the former phenomenon, and calculate the level of debt at which markets would stop financing the government, as debt would become unsustainable.

This chapter tries to contribute by shedding light on what may halt fiscal consolidation efforts. According to the narrative above, once a country reached the debt limit, the other circumstances do not matter, and the government stops adjusting the primary balance, regardless of whether it is growing or not or the institutional circumstances at that point. These factors, which they control for, may change the debt limit in their setting, but they will not affect the policy reaction once the debt limit is reached.

Our contribution lies in testing whether the result holds if circumstances vary. In other words, reaching the debt limit may not entail the end of fiscal adjustment if at that point the economy is growing or if the institutional makeup that determines fiscal policy improves.

We enhance the fiscal reaction function, taking into account a wide set of factors that may bias the original result. The first issue we tackle are non linearities in the effect of the output gap on the primary balance. These non linearities arise for different reasons: for instance, it may be due to the fact that cutting spending in a downturn can be particularly damaging to the economy. Also, the asymmetry may stem from a government´s myopia, which leads to the fiscal balance not being neutral over the cycle.

Finally, the asymmetry could be due to the fact that agents change their behavior at different points in the cycle. For instance, they may increase the proportion of expenditure allocated to basic goods in the downturn. To the extent that these goods are less heavily taxed than regular goods, the result could be a more procyclical fiscal balance. Also, tax compliance has a cyclical component (Sancak et al., 2010): in a downturn, there may be more incentives to evade taxes than in an upturn, when the marginal cost in terms of welfare of paying taxes may be lower.

We consider how institutional issues may alter the fiscal fatigue result. We analyze the evidence regarding political cycles. In particular, we focus on whether the delayed fiscal adjustment (Alesina et al., 1991) can affect the fiscal fatigue result: governments that are strong enough to carry out a fiscal adjustment may only be willing to do it when they do not have any other option, as in general they want to avoid restrictive fiscal policies that may be electorally costly. In other words, reaching the debt limit may lead to fiscal adjustment if the government has enough backing to implement it at that point.

Our main result is that growth and institutional factors play a key role in determining whether a government reacts to debt. We do find some evidence that there is fiscal fatigue, in the sense that the higher the level of debt, at the margin, fiscal adjustment will be lower. However, this can be mitigated if the economy is

growing and if the government has broad parliamentary support and does not have to worry about elections when the debt limit is reached.

Our sample of countries is the Eurozone as a whole. However, from a policy perspective, currently, it is clear that the fiscal fatigue results are important for countries with high debt and that have gone through large fiscal adjustments. In order to check the impact of our results on debt sustainability, we will run an exercise in which we create different debt forecasts for the Eurozone periphery. In these scenarios, we assume that the fiscal balance follows the enhanced fiscal reaction function we introduce in the study, and we compare those results with a baseline scenario, composed of forecast from the IMF World Economic Outlook as of end 2014. This exercise will illustrate the importance of strong growth for debt sustainability.

The rest of the chapter is organized as follows. Section 2 reviews the relevant literature. Section 3 introduces the data and the model we use, while the Section 4 analyzes the results. Section 5 shows the impact of the enhanced fiscal reaction function on debt sustainability. Finally, Section 6 offers some concluding remarks.

2.2. Literature Review

There are several strands of the literature that are relevant to this chapter. First of all, the fiscal reaction function literature which usually models the primary balance as a function of growth, particularly of the output gap, while also controlling for inflation

The idea of Bohn's (1998) approach rests on the analysis of how the primary fiscal balance (i.e. fiscal balance excluding the interest payments on public debt) reacts to sovereign debt. He considers fiscal policy is sustainable once the government reacts systematically to a change in public debt by adjusting the primary fiscal balance: if a fiscal policy is considered sustainable prior to a certain economic shock, the absence of any systematic policy reaction to this shock would cause the additionally issued debt to be uncovered by future surpluses, thus violating the no-Ponzi condition. Therefore, the government has to react systematically to the extended debt-to-Gross Domestic Product (GDP) ratio by increasing the primary surplus-to-GDP ratio, in order to maintain fiscal sustainability.

Bohn (1998) finds significant response coefficients for the period 1916 – 1995 as well as for the period 1793 – 2003 and thus concludes that U.S. fiscal policy has been in line with sustainability for these particular periods. Similarly, Semmler *et al.* (2007) investigate whether several Euro Area countries (Germany, France, Italy and Portugal) have restored their fiscal imbalance by appropriately adjusting their fiscal policy. Applying Bohn's approach on annual fiscal data over the period 1960-2003 they find positive and robust response coefficients, thus concluding that fiscal policy in these European countries follows a sustainable path.

Sustainability in the hard sense would require perfect knowledge of the future distribution of sovereign debt across different states of nature (Bohn, 1995). Therefore when testing sustainability with fiscal reaction functions, we define it in a weak sense, i.e. as a policy which responds to surges in sovereign debt with increases in primary balance. This approach leaves out the unfortunate case when government's response is too weak to avoid sovereign debt accumulating up to the level, where there is a serious risk of default.

An essential contribution in the literature on fiscal fatigue has been Ghosh et al. (2013), who consider that fiscal fatigue appears when debt reaches a certain level, and so elaborate the concept of debt limit: a level of debt that marks when governments stop adjusting. They find evidence of fiscal fatigue in highly indebted countries in the past few years in the Eurozone.

Fatas and Mihov (2010) find no evidence of fiscal fatigue in the Eurozone, as measured by the impact of debt on the fiscal balance. However, they do not consider the crisis period.

In these papers, the output gap tends to affect the primary balance linearly. However, some of the literature has found that the reaction of the primary fiscal balance to the cycle does not behave this way. Sancak et al. (2010) shows that tax evasion is countercyclical and that consumer habits tend to change in downturns, so that their consumption of primary goods, which tend to be taxed at a lower rate, is greater. Also, the mere progressivity of the tax code can lead tax revenue to decline more than proportionally in downturns.

Secondly, when prices decline, households have an incentive to save more, while business can postpone investment decisions. As a result, one would expect,

ceteris paribus, that a decline in inflation would have a negative impact on the fiscal balance, not just through the nominal growth channel described earlier, but also because deflation will lead to an increase in savings, which tend to be taxed at a lower rate than consumption Sancak et al. (2010).

A large literature has analyzed the impact of institutions on the primary balance.

Note that the impact of the institutional independence variables on the primary balance is not a given. Some studies find that it tends to worsen the primary balance, as shown by Eslava (2006). A strong judiciary may strike down certain spending cuts, or may pander more to pressure groups, that have the resources to appeal to them, unlike the median voter. However, the bureaucracy theory (Litan and Nordhaus, 1983) suggests that governments that have the possibility of increasing spending discretionarily will use it. Our model will shed light on which effect dominates in the Eurozone.

Alesina and Drazen (1991) ´s war of attrition model shows why a government may implement delayed fiscal adjustment. In this literature there is little evidence that a strong government is more willing to undertake a fiscal adjustment upon entering office.

However, they do find evidence that adjustments are more likely to occur in times of crisis, when new governments take office, or when they are strong, in the sense that they are unified or have a large majority.

They think these facts are explained by their war-of-attrition model, which concludes that stabilizations are more likely to happen in crisis periods with a “strong” government. In their setting, delays in the stabilization emerge from political conflict between two different groups in this society. These could be social groups with different preferences that are represented by different political parties.

The groups have different views on how to allocate the cost of the stabilization; each group would like the other to pay for the bulk of the fiscal adjustment.

In their model, each group can veto the adjustment and is uncertain about the impact of the fiscal adjustment on the other group: they know the cost of waiting for stabilization but they do not know the other group´s cost function.

In this set up, the passage of time will reveal which of the two groups is weaker, in the sense that waiting is costlier for them. At this point, the key decision will be determined by the marginal cost of waiting vs the marginal benefit of waiting. The marginal cost is the cost of not having the stabilization for another period—that is, of living in an unstable economy for another instant. The marginal benefit is the probability that in the next period the opponent group concedes.

The game ends when, for one of the groups, the marginal benefit becomes less than the marginal cost, and this will occur sooner for the group with the higher cost of waiting. So, in the end, the weaker group (that is, the one that suffers more from the delays) will concede. But resolution is in general not immediate because the passage of time is needed to reveal which of the groups is the weaker. Delaying a stabilization is costly for society as a whole, and it is Pareto inferior to immediate stabilization, but it is individually rational for each of the two groups.

In terms of the effect of institutions, a key debate has been on rules vs institutions, some papers (Fatas and Milhov, 2010) have considered that rules are less important than institutions. The drawback of rules are that they tend to oversimplify, as a fiscal adjustment depends on a number of variables, and they are difficult to enforce. In contrast, appropriate institutions can have a positive impact, if they manage to affect the source of biases in fiscal policy: to the extent that institutions lead to a fiscal policy that is more aligned with the general interests and less prone for instance to be captured by interest groups, it will have a positive impact on the fiscal balance.

Overall the literature tends to find that first, fiscal policy is procyclical, particularly in downturns. Secondly, that procyclical nature may depend on the debt level: for high debt levels, fiscal policy tends to be procyclical, while it is countercyclical for low debt levels.

2.3. Data and Empirical Model

2.3.1 Data

Our model will use annual data, for the period 1980-2013 for the Eurozone member countries. The key macroeconomic variables: output gap, debt to GDP ratio and the primary balance are taken from the International Monetary Fund's

World Economic Outlook (WEO) database. As Figures 2.1 and 2.2 show for the Eurozone as a whole, the recent period stands out as a time or large negative output gap and increasing government debt, in spite of the improvement in the primary balance.

Figure 2.1: Output gap and primary balance in the Eurozone (1991-2013)

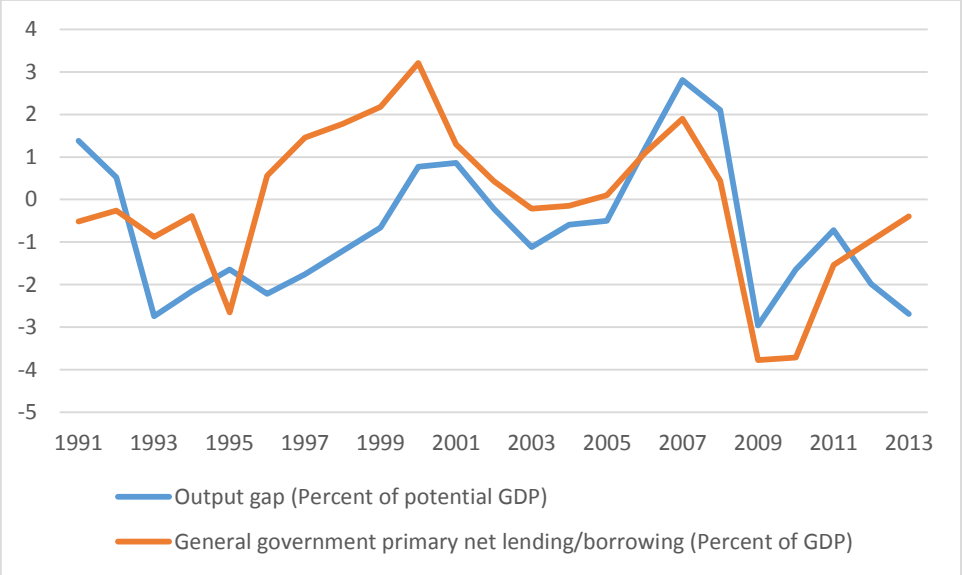
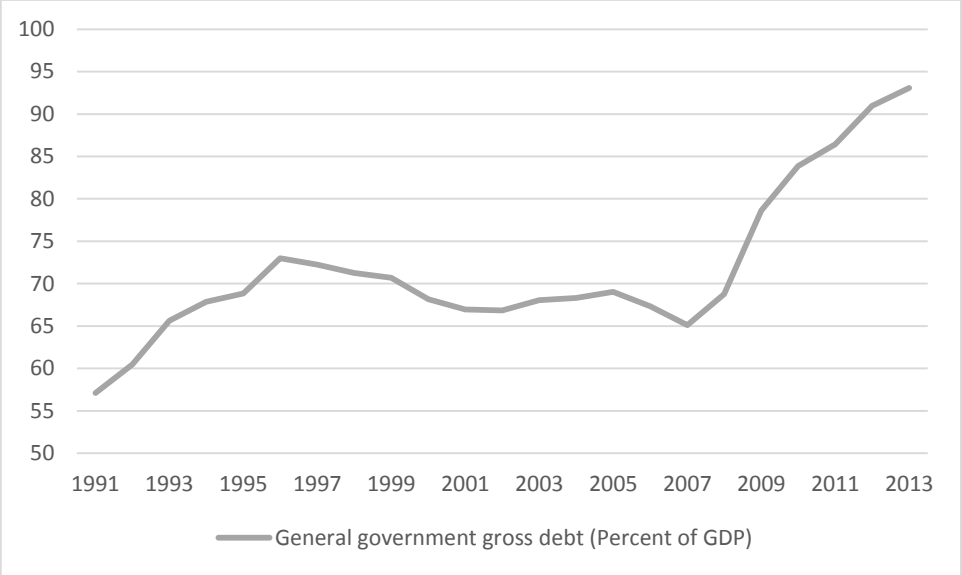


Figure 2.2: Government debt in the Eurozone (1991-2013).



Source: IMF WEO

Secondly, we use the support that a government has. The variable is measured as the percentage of members of Parliament that have voted for a government in a given date. The literature tends to show a positive relationship between the

primary balance and the degree of support for a government, which is explained by two aspects: first, the fact that governments with broad support may be able to afford being more farsighted, and, secondly, governments that have broad support do not need to please a wide variety of pressure groups through a giveaways (Roubini and Sachs, 1989).

According to the political cycle theories (Alesina et al., 1997 or Goeminne and Smolders, 2014), governments tend to increase spending ahead of elections. The variable we use will be the number of government changes in a given year. This indicator will enter the equation with a lead, to capture the forward looking effect described by the literature. This is taken from the comparative political data sets of Bern University.

We also consider the impact on the type of government ruling the country. In particular, we distinguish whether the governing party has a large stable majority or not. The results refer to the existence of a multiparty minority government, which, in the classification we use, the weakest type of government.

2.3.2 Model specification

In the fiscal reaction function, the primary balance is a function of the previous level of debt, and then a series of controls such as the output gap and inflation and institutional variables as controls. Implicitly, the fiscal fatigue literature considers that the primary balance reacts linearly to changes in growth.

The equation to be estimated is the following:

$$y_{i,t} = \beta_0 + \beta_1 d_{i,t-1} + \beta_2 og_{i,t} + \beta_3 \pi_{i,t} + \beta_4 ins_{i,t} + \varepsilon_{i,t} \qquad (1)$$

where *y* denotes the primary balance, *d* is the debt-GDP ratio, *og* is the output gap (measured as the difference between actual and potential GDP[1]), π is inflation (measured as the rate of change in the consumer price index) and *ins* represents the institutional variables.

[1] Potential GDP is estimated using the IMF WEO method, which draws upon several approaches and judgment by country desk officers. However, the institution checks that the methodology is robust and consistent across countries (De Masi, 1997).

As can be see, we start from the classic fiscal reaction function. This is estimated as a panel of current Eurozone countries, using annual data for the period 1980-2013.

Regarding the possible endogeneity of the primary balance, it is corrected by the introduction of an autoregressive (AR) term as a regressor, and using the lagged debt. One of the issues that must be considered is that debt depends on past values of the primary balance. As can be seen in Table 2.1, which shows the autocorrelation function of the residual, we do have reason to believe that there is autocorrelation. As a result, we model the error term as an AR(1) process, which corrects for the autocorrelation, and so endogeneity that arises from the persistence in the error term, which arises even though debt is in lagged. This is useful, as it corrects for the fact that some of the error of the regressions is reflecting what is not captured of the effect of the primary balance on debt, so past errors could affect present primary balance (we introduce the debt variable with a lag of one period). We introduce the AR term to control for the persistence in past errors that could be reflecting endogeneity.

Table 2.1. Residuals. Autocorrelation and Partial correlation

Lags	Autocorrelation	Partial Autocorrelation
1	0.668	0.668
2	0.407	-0.070
3	0.184	-0.108

An endogeneity issue arises from the fact that specific country characteristics may be captured by the impact of debt on the primary balance. These countries have heterogeneous institutional makeups, social welfare systems and tax systems, as a result, a given rise in debt may not have the same effect in a country as in another. While some of this may be captured by our institutional controls, we introduce fixed effects in the regression. This is supported by the Hausman test (see Table A2.1 in the Annex).

Finally, in order to check for endogeneity, and as a robustness check, we employ the methodology developed by Arellano and Bover (1997), which uses orthogonal deviations and tends to give more robust results that the original estimation

method proposed by Arellano and Bond (1991). Note that the coefficients are similar to those obtained in the other regressions.

We explore the impact of growth and the impact of the cyclical position: just like downturns will impact revenues more than proportionally, recoveries should be more revenue intensive, as they capture the effect of consumer changing their habits back to normal.

Our main contribution regards the correct specification of growth in the fiscal reaction function. This accounts for the exponential effect that growth can have on the primary balance according to the literature on fiscal revenues. Since we consider it in quadratic form and we want to explore non-linearities, the standard fiscal reaction function is no longer valid, as we cannot just control for inflation linearly, to the extent that the exponential impact of nominal growth could be related to either the price or the growth factor. In particular, we explore whether it is output growth or inflation that generate the particular primary balance dynamics.

We run the regression using the output gap separating when it is positive and negative equation. This piecewise approach implemented in the literature by Egert (2014) is an alternative way of correcting for the non linearities in the response of the fiscal balance to changes in the cycle.

From the first regressions we will replicate the fiscal fatigue literature and calculate the debt limit (i.e. the debt level at which the government stops adjusting). At that point, we will interact the debt limit with a series of variables to analyze whether the state once you reach the debt limit is significant: variables that may or may not play a role in the whole period may be significant when interacted with the debt limit.

2.4. Empirical Results

Table 2.2 reports the estimated coefficients and the associated p-values obtained from a fixed effects panel regression of the variables on the primary balance, for the current Eurozone countries in the period 1980-2013.

Table 2.2 Empirical results

	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.
OUTGAP	0.31	0.00	0.35	0.00		
OUTGAP^2			-0.05	0.00		
OGNEG					0.78	0.00
OGPOSITIVE					-0.07	0.61
GOVGROSSDEBT(-1)	-0.14	0.04	-0.18	0.01	-0.12	0.04
GOVGROSSDEBT(-1)^2	0.00	0.04	0.00	0.01	0.00	0.04
GOVGROSSDEBT(-1)^3	-0.20	0.05	0.00	0.11	0.00	0.15
GOV_SUP	0.03	0.23	0.03	0.18	0.02	0.29
GOVCHAN	-0.54	0.09	-0.47	0.13	-0.73	0.02
C	0.16	0.93	0.40	0.84	1.39	0.44
R^2	0.69		0.70		0.70	
number of countries	15		15		15	
observations	324		324		324	
AR(1) coefficient	0.80		0.80		0.80	
DW	2.08		1.99		1.98	
Prob (F-statistic)	0.00		0.00		0.00	

Variable	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Coefficient	Prob.	Arellano Bover	Prob.
OUTGAP	0,35	0,00	0,53	0,00	0,34	0,00	0,35	0,00	0,14	0,07	0,32	0,00
OUTGAP^2	-0,05	0,00	-0,06	0,00	-0,05	0,00	-0,04	0,00	-0,07	0,00	-0,10	0,00
GOVGROSSDEBT(-1)	-0,06	0,02	-0,06	0,02	-0,08	0,00	-0,06	0,03	-0,23	0,00	-0,13	0,00
GOVGROSSDEBT(-1)^2	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
DEBTLIM	-0,04	0,00	-0,06	0,00	-0,05	0,00	-0,04	0,00	-0,03	0,01	-0,07	0,00
DEBTLIM*OGNEG			-0,40	0,00								
DEBTLIM*RGROWTH					0,06	0,00						
DEBTLIM*GOVCHAN(1)							-0,08	0,06				
MULTIMIN*DEBTLIM									-0,06	0,02		
GOVCHAN(1)	0,50	0,11	-0,52	0,08	-0,38	0,20	-0,78	0,01	-0,81	0,01	2,47	0,27
C	0,83	0,39	0,85	0,37	1,22	0,19	0,87	0,38	3,89	0,00		
inflation	0,18	0,30	0,18	0,30	0,18	0,30	0,18	0,30				
R^2	0,72		0,73		0,73		0,73		0,73			
number of countries	15		15		15		15		15			
observations	324		324		324		324		324			
AR(1) coefficient	0,75		0,76		0,76		0,76		0,76			
DW	2,03		2,02		2,00		2,05		2,05			
Prob (F-statistic)	0,00		0,00		0,00		0,00		0,00			

The tables above show the results of the OLS regression. The dependent variable is the primary balance to GDP ratio. OGNEG and OGPOSITIVE are, respectively, the outputgap when negative and positive. GOV_SUP is the variable of government support, GOVCHAN indicates the number of government changes in a given year, OUTGAP the output gap as a % of GDP, DEBTLIM the debt limit and MULTIMIN indicates the existence of a multi party minority government. Prob shows the p value of each variable.

As can be seen, our regression analysis shows that the relationship between the fiscal balance and debt is not as clear cut as the traditional fiscal fatigue result shows. In particular we present evidence that, first, there are non linearities on the impact of the cycle on the primary balance (Lee et al., 1993), and, secondly,

institutional aspects can have a significant impact. Furthermore, the debt limit result can be altered if, when a sovereign reaches that point, it is growing or it has enough political strength to act.

Regarding the reaction of the fiscal balance to the cycle, when using a piecewise explanatory variable, it turns out that the elasticity of the primary balance to the cycle is entirely driven by the observations with a negative output gap. When the output gap is positive, it does not have a significant impact on the primary balance.

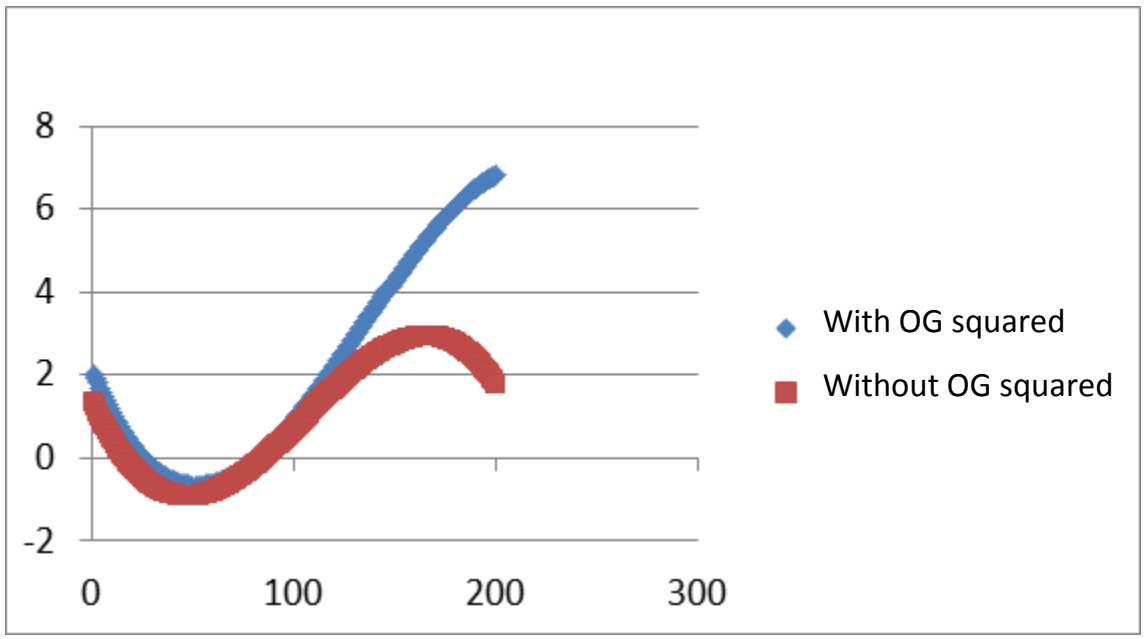
This result is consistent with the asymmetric adjustment in the primary balance in the literature and suggests that standard fiscal reaction functions will underestimate the impact that recessions have in the primary balance: by not separating the output gap into a positive and negative component, the resulting elasticity may be capturing some of the lack of impact from the positive output gap.

Similarly, the significance of the squared output gap term is evidence then that the primary balance will deteriorate more than expected when in recession. In addition, a subject of interest, particularly at this point in the Eurozone, is the reaction of the primary balance in recoveries. As we show by the squared term of the output gap, the improvement in the fiscal balance is even greater, which would be consistent with the elasticity of the fiscal balance increases in recoveries. This could be because countries tighten policy in the downturn (procyclical fiscal policy, in line with the results in Alesina et al., 2008) and then do not loosen when they are growing again, but rather wait until the output gap is positive. So as we overestimate the primary balance in the downturn, we are likely to underestimate the primary balance in a recovery.

Further, in this case the coefficient on the cubed debt becomes insignificant or very low, so that it only becomes relevant when growth is not taken into account (Figure 2.3). As can be seen, when we take account of these non linearities, the fiscal fatigue result disappears. This result suggests that the classic fiscal fatigue result is due to not accounting well for the impact of growth in the fiscal balance, so that the fatigue result may be more likely in the case of the sharp recessions.

Our results point to a larger sensitivity of the primary balance to growth in certain conditions, such as a recession, or when inflation is negative. What this means is that the primary balance can be expected to be more procyclical.

Figure 2.3: Primary balance as a function of the level of debt to GDP (%)



Source: Author´s calculations

Note that we do not distinguish explicitly the orientation of fiscal policy and automatic stabilizers (although the latter may be proxied by the reaction of the fiscal balance to the output gap). As a result, the impact on growth may be due to the consumption habits discussed above, but also from the fact that in recessions, fiscal multipliers tend to be higher, so that a government that wants to stabilize output would do well to post higher deficits. This would be the way of stabilizing output.

A key question remains whether once the supposed debt limit is reached, institutional and growth aspects can help a country avert the fiscal fatigue result. In order to test this, we use interaction terms, to test whether aside from their whole sample effects, when at the debt limit, the effect is negative.

First, as can be expected, the debt limit itself has a negative effect on the primary balance. However, importantly, when the debt limit is interacted with institutional strength or growth, we find that this mitigates the debt limit effect. Finally, when

the debt limit is coupled with a negative output gap, the impact on the primary balance is even more negative. Note that this is even true for some variables like government support, which are not significant determinants in the whole sample, but when coupled with the debt limit, they are significant.

We now test whether fiscal adjustment speeds up after a certain point, and then, whether it slows down after debt reaches its tipping point. This is the path of fiscal adjustment as suggested by the cubed form of debt in the fiscal reaction function In order to do this, we first calculate, from our canonical equation, the low point and high point of debt to fiscal adjustment for each country, taking on board the country fixed effects. Secondly, we calculate the debt limit. We also show that when there is a weak government, as captured by the existence of a multiparty minority government, the interaction with the debt limit worsens the primary balance.

A key takeaway from our results is that the debt limit can be avoided through other factors, growth being a prominent counterbalance to rising debt, or an improvement in the political situation. As a result, estimates for debt sustainability in the long term could be wrong if they do no model adequately the impact of these variables on growth.

2.5. Consequences for debt sustainability

Our results suggest that in recoveries, growth will be more revenue-enhancing than in normal times. One important point is that this may offset the effect from fiscal fatigue in countries where debt has risen after a downturn but are now recovering.

Since growth plays such a fundamental role in the determination of the primary balance, low growth may lead to unsustainable dynamics because the fiscal adjustment may not be enough to compensate the lack of nominal growth. Therefore, the debt limit is more related to growth than to the level of debt.

We incorporate these effects into a debt sustainability analysis. This can be interesting because the results will be different depending on which are the drivers of the debt sustainability dynamics: those countries that are growing well, and escape deflation, can be expected to have more positive dynamics than

those that are not growing as much but have for instance a lower interest rate burden.

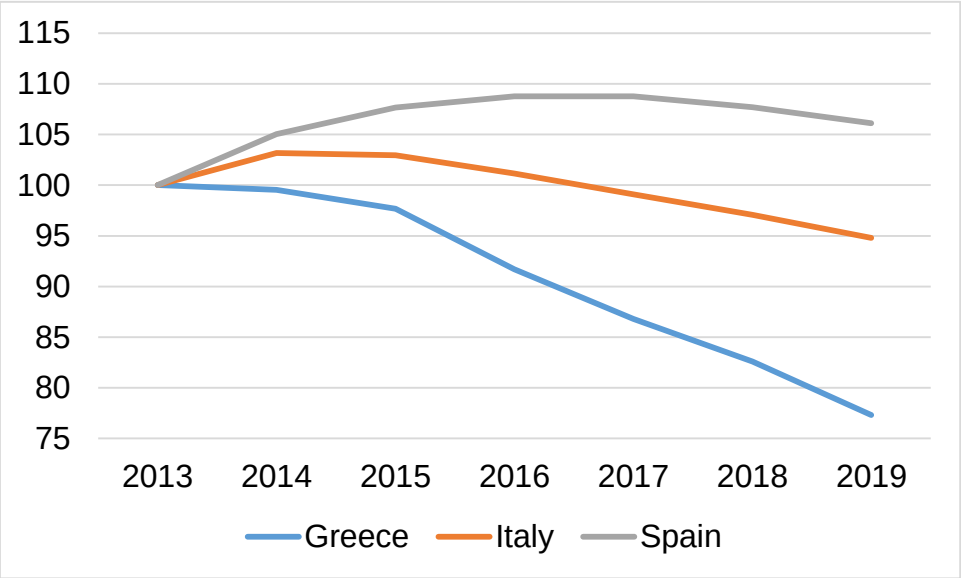
We input the results from the fiscal reaction function into our debt sustainability equation. We use IMF forecast for growth, while interest rate forecasts are determined endogenously. In particular, the risk premium over the risk free rate is equal to the probability that debt will not stabilize in the time horizon (i.e., to 2019).

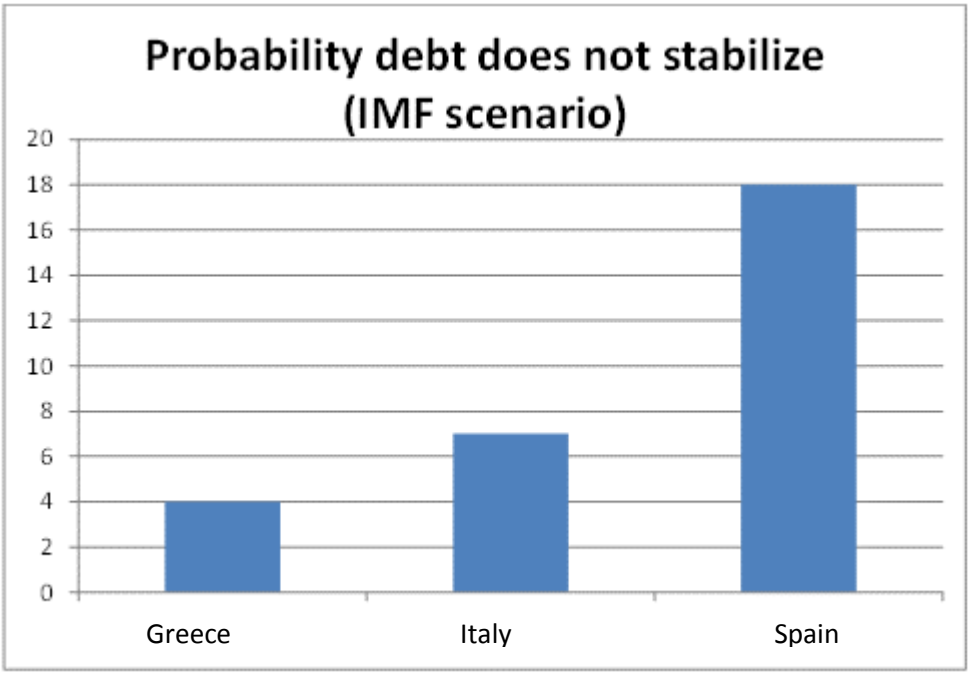
We run the stochastic process: we calculate shocks to our baseline scenario based on the probability distribution of the shocks that took place in the past. The distribution is based on a normal distribution, with mean the mean of the variable in the past, the variance the historical variance, and the covariance between all three determinants. As a result, we obtain different paths for debt and a probability associated to each of these paths. The risk premium is determined by these paths and in particular the probability that debt will follow a path in which it does not stabilize by 2019.

We illustrate this exercise for Spain, Italy and Greece. We consider that the comparison will allow us to understand the effects we are showing with respect to a baseline, which we consider to be the IMF´s debt scenario.

As shown in Figure 2.4, the debt dynamics for Spain and Italy are similar in the baseline scenario. This is due, however, to the different drivers of the debt path. While in Spain, growth will be favorable and provide a key source to reduce the debt ratio, its high primary deficit is the main driver of debt. In Italy, the key driver of better dynamics is the primary balance, while growth is expected to remain slow going forward, according to the IMF forecasts. Finally, the debt forecasts for Greece are extremely favorable, owing to the expected high growth and primary balances, combined with a low interest burden (relative to the size of its debt). The result is that in the baseline IMF scenario, debt declines substantially.

Figure 2.4: Debt dynamics in the baseline IMF scenario





As can be seen, the endogeneisation of the interest rate is particularly problematic for Greece. Given that a large share of its debt is in official hands and has been restructured, its interest rate burden is lower than would be suggested by the probability of not stabilizing debt. Note that to the extent that most of Greece´s debt is in official hands, this can be thought of as a counterfactual: what Greece´s cost of funding would be in this benevolent macroeconomic scenario, if it financed its debt at market conditions.

When these considerations are added to our debt equation, this points to a better behavior of Spain relative to the other countries, and , of course, a worse behavior

of Greece, which is in part due to a worse primary balance than expected in the baseline WEO scenario.

While in Spain versus Italy the relative difference reflects the importance of growth, this does not apply to Greece, which according to the WEO October 2014 forecasts was expected to growth the most. However, still, our fiscal reaction function leads to a lower primary balance that expected and the probability of default to a higher interest rate burden. These effects worsen the debt dynamics in Greece, although the favorable growth forecasts mean that it is still the country where debt declines the most (although the large variance of the distribution of shocks means that the probability of debt stabilization in lower than for instance in Span, even if the point forecast is better).

Figure 2.5: GDP Growth forecasts in the IMF scenario (%) and primary balance Model and IMF forecast, as a % of GDP)

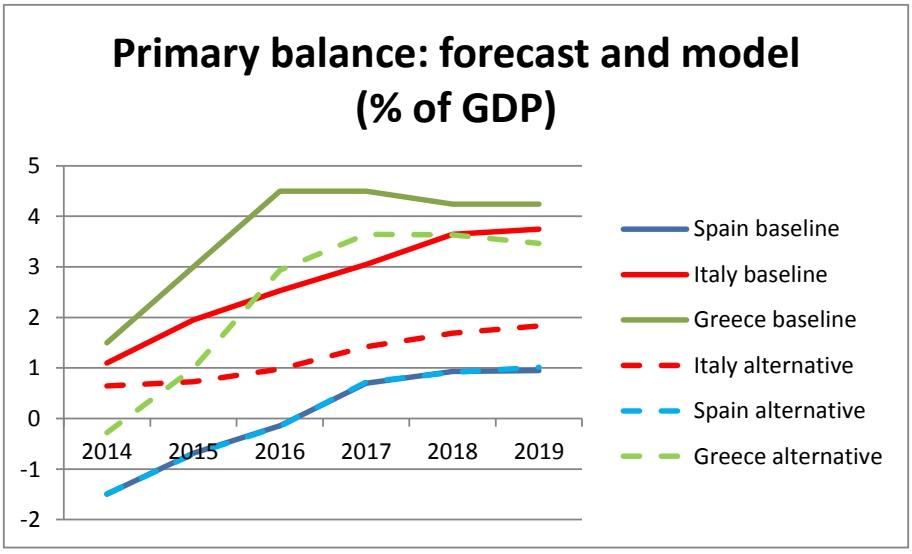
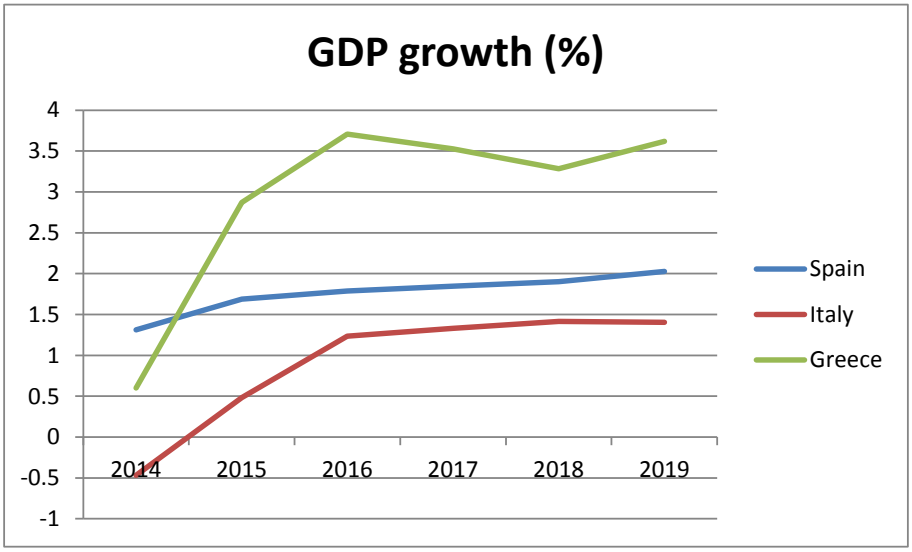
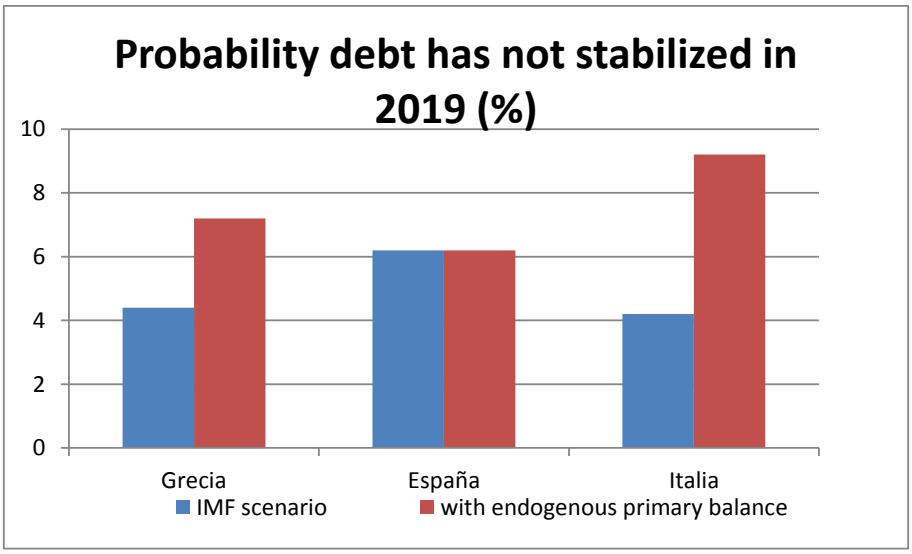
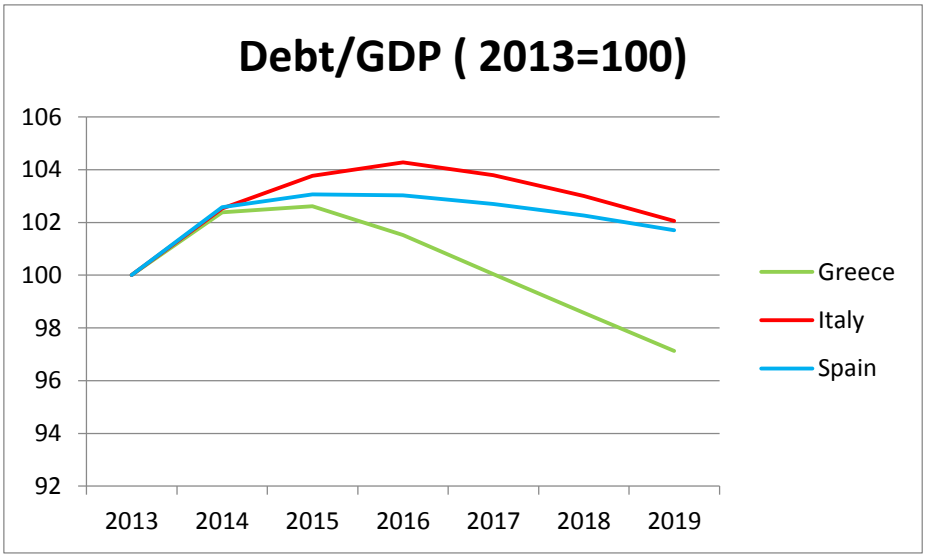


Figure 2.5 (continued)

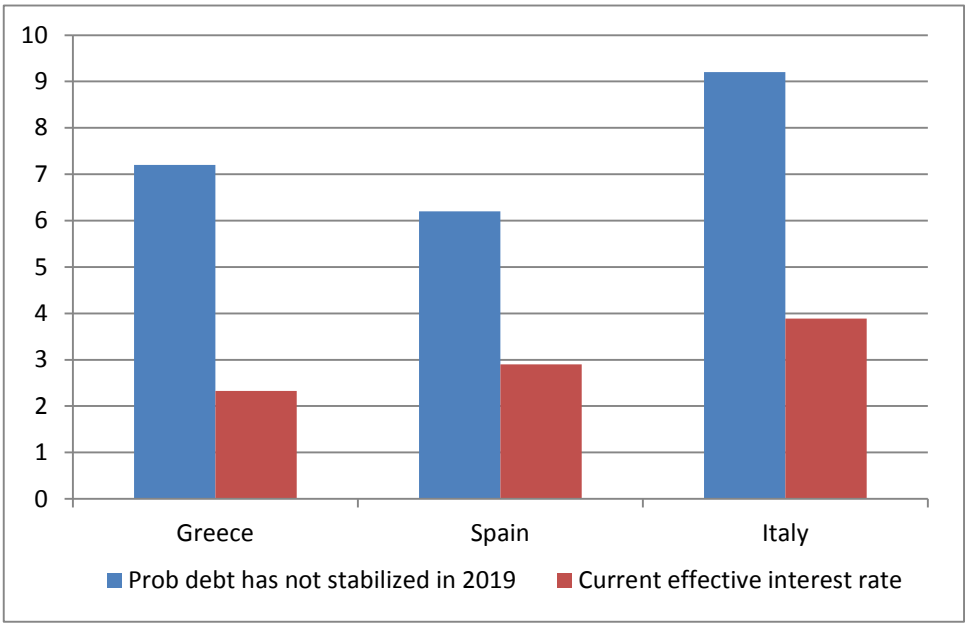






Source: IMF, author´s calculations

Figure 2.6: Probability debt has not stabilized in 2019 (endogenous scenario, and current effective interest rate, both in %)



Source: IMF, author´s calculations

2.6. Concluding remarks

This chapter has analyzed the determinants of the primary balance, and the impact of taking these determinants into account when analyzing debt sustainability. A key result from the previous section is the role that growth plays in determining the fiscal balance, both in a downturn and in a recovery. Taking this into accounts can be essential when forecasting debt dynamics: a low growth economy is more likely to stop adjusting than an economy which, in spite of rising debt, is growing.

Secondly, and relatedly, downturns will be more damaging to debt sustainability that would be suggested by a linear relationship. As has been shown above, growth has an exponential impact on the primary balance. Therefore, recessions could have a severe impact on debt dynamics.

Also, our results show that institutions, and inflation, play an important role. In general, our results hold policy lessons for both downturns and good times.

First, when output is growing above potential, governments would do well to have larger surpluses, as the primary balance is likely to overshoot in the downturn.

Secondly, having appropriate political institutions that foster government stability can be of use.

This second result is true not only at all times, but can be particularly useful in times of distress. A government that has the power to implement a stabilization program at times of stress will help with the needed adjustment.

One avenue of research that stems from these results is the feedback loop between political results, fiscal fatigue, and the deterioration of fundamentals. In particular, if a government with a worse economic performance is more likely to be voted out, and replaced by a fragmented government, then the overall result can be reinforcing a vicious cycle: the worsening economic environment deteriorates a government´s ability to implement an adjustment, and the worsening in economic times further limits the government´s room for maneuver in stressful times (Coppedge, 1997).

In terms of policies to be implemented in a downturn, the key lesson is that the non linearities call for a pre-emptive approach from debt sustainability: these non linearities in the relationship between the output gap and the fiscal balance can lead to a rapid deterioration in the balance. When the market then incorporates this worsened balance into its analysis of debt sustainability, it is more likely to increase the cost of funding, which in itself can contribute to the unsustainability of debt.

These mechanisms call for swift action in downturns. Particularly, the promotion of growth can be effective in averting the negative spiral. Our study does not analyze which growth-enhancing measures are best, however, it does suggest that a strong, pre-emptive approach to a downturn is appropriate. Given that fiscal space will often be limited, demand is likely to have to be promoted through other instruments, like monetary policy.

APPENDIX TO CHAPTER 2:

Table A2.1. Hausman test results

Correlated Random Effects - Hausman Test

Equation: PRIMBAL

Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	7.915194	7	0.03

Residual unit root test and correlogram

Panel unit root test: Summary

Series: RESID01

Date: 08/23/15 Time: 13:14

Sample: 1 720

Exogenous variables: Individual effects

User-specified lags: 1

Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-Sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.92328	0.0000	18	422
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.74896	0.0000	18	422
ADF - Fisher Chi-square	82.9549	0.0000	18	422
PP - Fisher Chi-square	83.0413	0.0000	18	441

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Chapter 3: Demand for sovereign bonds in the periphery: a regime-switching approach

3.1. Introduction

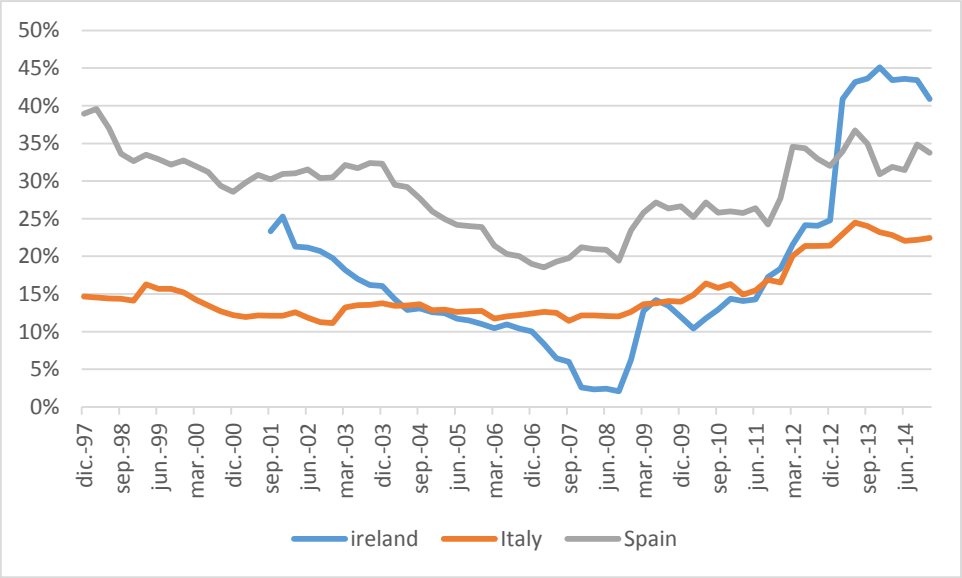
One of the characteristics of the recent financial crisis was the large rise in banks´ exposure to domestic sovereigns. As Battistini et al. (2014) mention, part of this retrenchment is common to many crisis, when financial institutions, worried possibly about redenomination risks of their assets, hold only domestic bonds to be protected from such risks (to the extent that most of their liabilities are in the domestic currency). In addition, in times of stress, since ultimately the sovereign is the backstop for bank capital, it could be optimal for the banks to tie the knot with the sovereign: at the end of the day, it is the sovereign´s well-being that guarantees the banks existence, so the latter has an incentive to pre-emptively bail out the former.

This behavior can be particularly problematic in a currency union. As Abascal et al. (2013) show, the rise in financial fragmentation within the Eurozone can have a negative impact on financing conditions. Secondly, Broner et al. (2014) point out that the increase in the holdings of sovereign debt can take resources away from the economy, as banks prefer to buy bonds instead of lending to the private sector, thus deepening the downturn. In addition, within country fragmentation can shut out parts of the banking system from normally functioning markets. According to Abascal et al. (2013), during the recent crisis, fragmentation in the interbank market has been, on average, higher in the peripheral countries than in the core ones and it has increased particularly during periods of financial stress. Among the most significant factors that contributed to the high fragmentation levels observed are counterparty risk and financing costs (overall factors), and country-specific factors such as banking sector openness, the debt–to-GDP and the relative size of the financial sector. One of the manifestations of this fragmentation was the rise in banks´ home bias.

The pattern of buying up domestic sovereign bonds was particularly intense in the 2012-2013 period in Eurozone countries that were undergoing financial

stress, and was a lot less intense in Eurozone countries that were not going through stress (Figure 3.1). This then begs the question: when the rise in yields and the associated increase in the riskiness of the bonds was leading foreign investors away from those assets, what led domestic banks to increase their holdings of sovereign bonds.

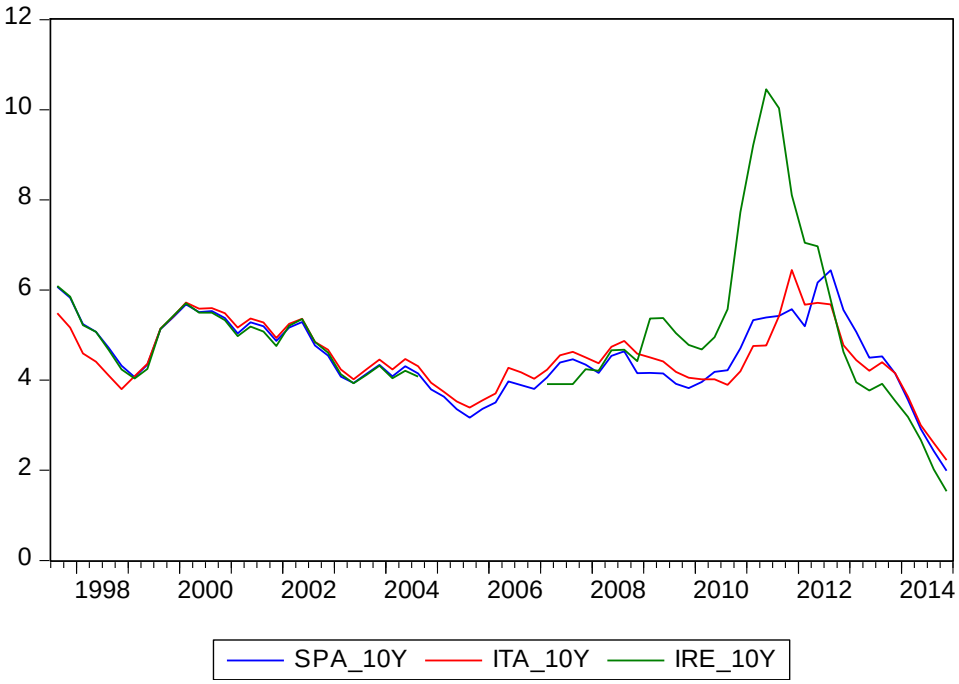
Figure 3.1: Sovereign debt holdings of domestic banks (as a % of total debt)



Source: National central banks, author´s calculations, Bruegel

At the same time as those countries were undergoing major financial stress, with rising yields on bonds. As can be seen in figure 3.1, holdings of domestic sovereign bonds rose at the start of the downturn in the three countries following the first round of stress in 2008-2009. These holdings accelerated in 2011-2012, as renewed tensions emerged in the Eurozone periphery (Figure 3.2).

Figure 3.2 10-year yield on sovereign debt, key periphery countries (%)



Note: Spa_10Y is the 10 year yield on Spanish debt, ITA_10Y the yield on Italian bond and IRE_10Y the yield on Italian debt. Source: Bloomberg.

This behavior has spurred a large literature on the matter. In general, the explanations of the behavior can be separated into two groups.

First, the group that considers that the driver of the increase in sovereign bond holdings was the lack of investment alternatives in the home country. In a context of rising non-performing loans (NPLs) and economic uncertainty, banks preferred to hold the safest domestic asset available, government bonds, instead of lending to the private sector for which the solvency prospects had deteriorated. According to this view, the key to determining the determinants of sovereign bond holdings lies in disentangling the impact of the downturn from the impact of the rise in yields. Both happened broadly in tandem, but Castro and Mencia (2014) find, for the case of Spain, that the main driver was the economic downturn, and do not find evidence of search for yield by Spanish banks.

A second set of explanations suggests that the rise in yields was the driver of the rise in sovereign bond holdings. The key debate evolves around what made sovereign bonds so attractive in bad times. In bad times certain distortions can

alter bank behavior and lead them to hold more bonds than they would in normal times, given the underlying conditions.

The first such distortion can be moral suasion. By this count, governments in stress that have difficulty financing their deficits in the market ask domestic banks to hold government assets, and they do so even if a certain government bond is not particularly attractive to them. Acharya and Steffen (2015) test the moral suasion hypothesis by looking at whether intervened or non-intervened banks were more likely to increase their holdings, assuming that the sovereign only exerts real influence over the intervened banks. However, this is unconvincing: the sovereign has broad powers to affect non intervened banks, so the fact that home bias affected the non-intervened banks should not exclude the use of moral suasion.

A second possibility is that this was due to regulatory incentives: since sovereign debt holdings carry a 0 risk weight in the calculation of banks´ capital requirement ratio, banks may have preferred to hold that asset over others. Of course, banks consider the capital impact of their investments at all times, not just during stress times, so this bias would be present at all times. However, if rising NPLs lead to capital shortages and equity market valuations decline, raising capital could be particularly difficult. As a result, the deterioration in banks' balance sheet may lead it to want to hold more sovereign bonds than before, when the capital adequacy ratios of the banks were broadly stable. Acharya and Scheffen (2015) find that low capitalized banks were the more likely to be involved in carry trade, which lends some support to this hypothesis.

The distinction between holding government bonds just because there are no investment alternatives or whether it is due to biases in banks´ investment decisions has important welfare consequences.

As Broner et al. (2014) show, by detracting resources from the wider economy, holdings of sovereign bonds are problematic. Of course, banks continually value the risk-return tradeoff in their investment decisions, so the particularly negative consequence arises because during a downturn because there is a distortion, arising from the fact that, according to Broner et al. (2014), sovereign debt holdings provide an extra yield to domestic banks. This extra yield can take many

forms: one can be the fact that banks have an interest in bailing out the government, as a banks´ access to markets tends to be related to its sovereign´s financial health.

Also, in a monetary union, as Uhlig (2014) shows, the perverse incentives can lead to a greater exposure of banks to their own sovereign. According to Uhlig (2014), banks use domestic debt to obtain liquidity at the central bank in repurchase operations, with the implicit backing of the state. In Uhlig (2014) ´s model, a safe sovereign has an incentive to limit these operations to solvent banks, as it does not want to bail out insolvent banks. However, a risky sovereign has an interest in these operations, as it knows that if the bank fails, the sovereign will ultimately fail and so will not have to honor the guarantee. In other words, financial fragmentation in a monetary union can lead to increased holdings of government debt in risky countries.

The literature also provides a number of reasons for which banks may be biased towards holding more sovereign bonds than other institutions in normal times, such as the liquidity of bonds, or their role as market makers in sovereign bond markets. If these arguments hold, this should be visible not only by looking at whether bond holdings increased in a given period, but rather whether banks changed their sovereign bond demand function at a time of stress (which could be the extra yield that domestic banks obtain a certain point mentioned by Broner et al., 2014).

Our contribution is two-fold. First, we analyze the difference between the sovereign bond demand function in crisis and in normal times, and we look at what changed in the demand function in crisis times. The distortion should show not in changes in sovereign bond holdings but rather in the sovereign bond demand function.

Secondly, we test whether the behavior of banks was the same as investment funds: while the latter have some restrictions on own funds, they are not subject to the regulatory capital restrictions of banks, so that they have no incentive to increase sovereign holding in their optimal asset allocation. However, they are subject to moral suasion: to the extent that they also change their behavior during

the crisis, it would undermine the role played by regulatory arbitrage, and would signal that other factors may have been at play.

Our strategy to test changes in sovereign bond demand and the reasons for it is the following: we use a time series since 2000, on which we calculate the cointegrating relationship between sovereign bond holdings, bond yields and the state of the economy (that we proxy through the European Commission´s consumer confidence indicator). By using a relatively long time series, we overcome the problems that arise from the short time period used in other papers, in which cointegrating relationships may be spurious (see Castro and Mencia, 2014).

The yield can be thought of as the market valuation of the asset. Banks could have a structural advantage/disadvantage in buying bonds which would be different from other market participants, so there could be a long term relationship between yield and bank holdings. Some of these benefits that banks obtain from their holdings of sovereign bonds can be found in Castro and Mencia (2014) or in Nakaso (2013), and they include, for example, liquidity provision. This should be present in the long run determinants of bond holdings.

In a second step, we calculate the adjustment equation for sovereign debt holdings of the Vector Error Correction Model (VECM) as a regime switching equation, where the regime switching parameter is the constant. This way, we first obtain a long run relationship, and then we test whether the adjustment towards that long run relationship between bank holdings, sovereign yields and underlying economic conditions changed during the crisis period. The higher the constant, the larger the response from sovereign holdings to a shock in any of the determinants.

We find evidence that while there was a change in the demand function of banks, favoring domestic sovereign bonds more than in the pre-crisis period, and other financial institutions displayed a similar behaviour, which signals that the driving force of this home bias was probably not due to regulatory incentives in those countries. While in the 2008-2009 turmoil the behavior of both was similar, we find some evidence for Spain the increase in home bias was a bank-specific phenomenon. However, evidence from a probit model suggests that the

sovereign bond bias was sparked by stress in the sovereign, rather than a search for yield.

The rest of the chapter is organized as follows: first we will review the capital requirement regulation for banks and other financial institutions. Next, we will introduce the model to determine the holdings of sovereign bond by both types of institutions. We will then discuss the results and offer some concluding remarks.

3.2. The regulation of banks and other financial institutions

Microprudential regulation is used to prevent and mitigate risks in individual banks' balance sheets. In this section we summarize the treatment of sovereign exposures in Basel and European Union (EU) regulation.

3.2.1. Capital requirements

Capital requirements are calculated based on either a simple Standardized approach, which draws upon Credit Rating Agencies ratings, or based on banks' internal credit ratings, the Internal Ratings Based (IRB) approach. Pillar 1 capital requirements are calculated either way and complemented with supervisory review (Pillar 2) and banks' disclosures requirements (Pillar 3).

The standardized approach (SA) calculates sovereign debt exposures according to their external rating. However a domestic sovereign carve-out means that national supervisors may apply a lower risk weight to banks' exposures to their own sovereign (when denominated in domestic currency and funded in that currency). In practice, in the EU a 0% risk weight is assigned under the SA to exposures to member states´ central governments.

In addition, banks that use an IRB approach may apply a partial use of the standardized approach for central government exposures in the EU. As a result, a bank using the IRB approach can end up applying the standard 0% risk weight for exposures within the EU, regardless of the risks associated with a given sovereign. As Nouy (2012) points out, the partial use of the SA is justified by the fact that the calculation of the key risk parameters is difficult for sovereign portfolios from advanced economies, as sovereign defaults by advanced countries are rare events.

As a result, the application of IRB models would lead to very low capital requirements for sovereign exposures. In fact, the lack of sovereign defaults leads banks to use external ratings even under the IRB. As a result, strict IRB estimates would be similar to the 0% risk weight allowed under the carve out.

In order to avoid excessive exposures that may escape the risk-weighted minimum capital requirements, the Basel Committee has introduced a leverage ratio that limits overall bank leverage, regardless of the risk weighting of specific exposures. This ratio, indirectly, limits the exposure of banks to their sovereign. The Capital Requirements Directive and Regulation (CRD4/CRR), a reporting requirement to supervisory authorities for the leverage ratio, was introduced starting in 2014 with the idea of migrating to a binding harmonized requirement in 2018.

Asset managers, as of yet, are not bound by the requirement to hold capital against their exposures. However, there are calls to revise the regulation on account of their growing prominence in financial markets, and, consequently, their ability to have an impact on the functioning of markets. In particular, large holders of a given asset may be prone to fire sales in times of rising tensions, which can lead to an increase in market turmoil (Financial Times, 2015).

A. Market risk

Similarly to the credit risk treatment, market risk (to which asset managers may be subject, see below), may also be calculated through two methods, a standardized one and one based on internal models. The standardized method allows national supervisors to apply a lower specific risk charge to sovereign debt denominated in the domestic currency and funded by the bank in the same currency (Basel Committee, 2006).

A deeper redefinition of the entire framework is being envisaged in the “Fundamental review” of the trading book framework (Basel Committee, 2014).

Basel II.5 includes sovereigns in the Value at Risk (VaR) and Stressed-VaR calculations under the Internal Models Approach. The shortcomings of VaR approach in calculating the market risk of illiquid products are dealt with by the

introduction of a risk capital charge on migration risk, which includes sovereign exposures.

B. Liquidity risk

Another change in the regulation has been the introduction of the Liquidity Coverage Ratio (LCR), which requires banks to hold a minimum buffer of unencumbered high-quality liquidity assets against their stress net cash outflows over a 30 days' time window.

The composition of the liquidity buffer is divided into two tiers. The first tier comprises those assets of highest quality in the pool of eligible assets, like cash and highly rated Sovereign debt (AAA-AA). The LCR also includes a "carve-out" for domestic sovereigns, considering them Tier I assets even if rated below AA-.

Basel III also requires banks to meet the Net Stable Funding Ratio (NSFR), designed to ensure that there is a minimum amount of stable funding available in relation to the liquidity characteristics of banks' assets . The NSFR is not a binding requirement in the EU yet. But the CRD4/CRR provides for a reporting obligation to national supervisory authorities. And national authorities are also allowed to apply provisions in the subject even before the specific regulation is passed.

C. Concentration risk

Diversification requirements (i.e. concentration risks) could lead to a regime of limits to large exposures, by which exposures exceeding 10% of capital will be subject to a mandatory reporting requirement, with a limit of exposures of 25% of capital. Sovereign exposures have been excluded both in the Basel Committee on Banking Supervision (BCBS) and in the Capital Requirements Directive IV (CRD IV) from the large exposures limit.

D. Recent proposals

Given the relevance of the debate on sovereign exposures, European Systemic Risk Board (2015) proposed avenues to reduce the incentive of banks to holding domestic sovereign bonds. These proposals cover the broad set of instruments available to regulators.

First, stricter Pillar 1 capital requirements for sovereign exposures could be achieved by removing the domestic carve-out in the standardized approach,

introducing a non-zero risk-weight floor for sovereign exposures in the standardized approach. Also, they propose reducing the reliance on external credit ratings in the standardized approach (although the methodological difficulties of the alternatives exposed above deem this problematic). Finally, they propose the use of overcoming the lack of observations by setting a minimum (regulatory) floor in the internal ratings-based (IRB) approach.

Diversification requirements could be implemented by fully or partially removing the exemption of sovereign exposures from the large exposures regime and introducing a capital requirement for concentration risk. Or, alternatively, coverage of sovereign exposures in macro-prudential regulation, a flexible tool that would introduce changes to the capital requirement on sovereign debt to vary over the cycle.

As a result, in the current discussions, sovereign bonds may be left out of the solvency ratio but included in other ratios, such as the large exposures ratio. This is intended to reduce the procyclicaclity of the regulation (as Repullo and Suarez, 2013, capita requirement ratios tend to have undesired procyclical consequences) has , while at the same time discouraging banks to being too exposed to a certain sovereign.

Recently, the financial regulation community has started to debate the role played by asset manager in financial markets (see financial times, 2015). Asset managers are playing an ever larger role in financial markets, in part covering some functions that used to be carried out by banks, which have been deleveraging and faced adverse market conditions and higher capital requirements. One aspect currently on the table is the possible special treatment of the largest asset managers. This special treatment could lead to heightened supervision or to capital surcharges.

As of now, however, the own funds requirements regulation deals with some aspects related to asset managers: first, they must hold enough capital to be able to continue business in bad times (this justifies holding capital against fixed overheads) and secondly, they must have rules for a smooth winding down of business. Finally, they must hold capital for the market risk they may face in their

operations. Typically, however, capital, is a small fraction of the assets they manage.

In this context, the risk weighting of the underlying assets is usually not an issue for asset managers, and holding sovereign debt will only have a marginal benefit from a market risk perspective. This is all the more are true given that around half of asset managers in Europe do not execute the transactions themselves, but rather use a third party, typically an investment bank, to carry out the execution of the transaction, so they do not incur in market risk.

A final aspect to consider is the prudential regulation regarding banks´ participation in asset managers, typically the so called look-through approach. This means that banks must treat their equity participation in asset managers as if it was their own, so it does not provide a significant advantage. However, to the extent that the asset manager does not bear the risk on the underlying asset, the bank does not have to treat the asset as if it was on its balance sheet.

In any case, own funds requirements are barely a constraint for asset managers, so that they are relatively free to hold the assets they want to within their mandate, without affecting the own funds they need to hold to back them. Given the signs that this regulation could change, this chapter tries to contribute to the debate by shedding some light on how these institutions behave.

In particular, own funds requirements of investment firms are fixed as a percent of fixed overheads. The approach for calculating fixed overheads is the subtractive approach, by which variable cost items are deducted from the total expenses as calculated in the firms´ accounting. The subtractive approach ensures that changes to the accounting framework are automatically taken into account, limiting the leeway for firms to change the accounting of fixed overheads. It is also easier to be calculated by firms that do not follow the IFRS.

The difference in the regulation of holdings by banks and investment funds provides an opportunity to shed light on whether the regulatory motive was the driving force of bank´s increase in bond holdings, or whether it was some other aspect (Angeloni and Wolff, 2012): if funds behave like banks in increasing home bias in the downturn, it can be a sign that home bias was driven by other factors and not regulatory arbitrage by banks.

3.2.2. Data

We analyze the determinants of sovereign holdings for Spain, Italy, Greece and Ireland. These are four countries that suffered stress during the crisis, for which we have found comparable data. The period used is 2000-2015 with quarterly data.

Sovereign bond holdings by banks and other financial institutions refer to the logarithm of sovereign bond holdings by monetary financial institutions and other financial institutions in each of their countries, as reported by the national central banks.

Secondly, we use consumer confidence as a proxy for domestic economic conditions. This is the indicator published on a monthly basis by the European Commission.

Finally, the 10 year yield on sovereign bonds is used as a proxy for the yield on all banks´ sovereign bond holdings. This is consistent with the fact that the bulk of bank holdings tend to be around that remaining maturity, and that it is typically one of the more liquid benchmarks.

3.3. Specification

Our baseline model is a VECM, in line with the standard literature on the holdings of bonds of the domestic sovereign, which allows us to disentangle causality amongst the various drivers and short term effects from long term relationships. However, as mentioned before, our modeling strategy is designed to overcome two difficulties common in the literature: the fact that the crisis period had too short a time span to test long term relationships and, secondly, testing specifically the role played by regulatory incentives during the crisis period.

In order to test whether the behavior changed at certain points in the crisis, we employ a regime switching error correction model, in line with Alizadeh et al. (2008). We proceed in the following way: first, we determine the stationarity properties of the variables. This is done through the unit root tests that determine that the null of the existence of a unit root cannot be rejected. However, none of the variables have a unit root test in first differences, signaling that they are all integrated of order 1.

Secondly we analyze whether the variables are cointegrated. Some papers in the literature have used this approach for a sample of just the crisis period, which has been subject to the criticism of Mencia and Castro (2014) of having too short a time span. Furthermore, by taking just the crisis period, understanding the counterfactual can be elusive, as the cointegrating relationship may or may not be driven by anomalies specific to that period.

We solve this problem by using a longer sample. In the long run, one can think of banks as having a different bond demand function than other market participants: as discounting to obtain liquidity in the central bank, or in order to keep safe assets in the balance sheet, sovereign bonds can be more attractive to banks than to other businesses. Secondly, since banks are large holders of sovereign bonds, they may act as automatic stabilizers in financial markets, trying to reduce the volatility of market prices so as to reduce the impact on their portfolio (El Erian, 2010).

The lag structure of the VECM is based on the Wald test criteria (Dolado and Lutkepol, 1996), which suggests we use two lags in the cointegrating relationship and the corresponding adjustment equations (Table 3.1).

Table 3.1: lag structure of the VECM

	Spain	Italy	Ireland
DLag 1	36.89	15.35	27.66
	[0.00]	[0.08]	[0.00]
DLag 2	16.45	11.07	36.80
	[0.06]	[0.07]	[0.00]

Statistic and in brackets, the p value of the Wald lag test

Therefore, we estimate the following equation, by which we will obtain the long term relationship between the variables and the short run dynamics

$$\begin{aligned}\Delta holding_t =\propto [holding_{t-1} + \beta' cconf_{t-1} + \beta'' yield_{t-1}] + \beta_2 d(holding_{t-1}) \\ + \beta_3 d(holding_{t-2}) + \beta_4 d(cconf_{t-1}) + \beta_5 d(cconf_{t-2}) \\ + \beta_6 d(yield_{t-1}) + \beta_7 d(yield_{t-2}) + u_t + c\end{aligned}$$

where *holding* is the log of sovereign bond holdings, *cconf* the consumer confidence index, *yield* the 10 year yield on sovereign bonds d is the first difference operator, and u is an error term, while c is a constant.

Note that the equation describes the adjustment process of the variable holding. the first term of the right hand side of the equation shows the speed of correction from the cointegrating relationship, the second term the dependence on own lags, the third term the dependence on the lags of other variables and finally, the residual. The cointegrating relationship is obtained through the Johansen (1988) method.

The $\propto$ coefficient on the previous equation is the error correction term, and describes how the holdings of sovereign bonds react when there is a shock to the long run relationship. The higher the absolute value of the coefficient, the quicker holdings revert back to their long run relationship.

We estimate the VECM equation that describes the adjustment process of all the determinants in the cointegrating relationship, and focus on the adjustment path of bond holdings. Note that this equation can be estimated using Ordinary Least Squares (OLS): all variables on the right hand side are exogenous and stationary, as it is composed of the lags of the determinants in differences and the lag of the error in the cointegrating equation.

The equation above can be modeled as a first order Markov chain. The stochastic process for generating the unobservable regimes is an ergodic Markov chain, defined by the transition probabilities: The probability of being in a certain regime will be state-dependent. Specifically, we will estimate c using the following conditions.

$$c = \begin{cases} c_1 \; if \; s_t = 1 \\ c_2 \; if \; s_t = 2 \end{cases}$$

$$p_{ij} = \Pr(s_{t+1} = j \; s_t = i) \, , \sum_{j=1}^{2} p_{ij} = 1$$

Evidence that there could be a regime change in the cointegrating relationship during the crisis can be found in the shape of the residuals. As can be seen above, in practically all the countries, for some periods in the 2008-2014 period, there is evidence that the cointegrating relationship does not capture all the effects. Our regime- switching approach will attempt to capture the specific issues that arose in this period.

In order to further examine whether a regime switching process is appropriate, we can run parameter stability tests on the error correction equation. Table 3.2 shows the results for the Chow breakpoint test used for different periods of time. As can be seen, for different dates we find a breakpoint which may warrant the use of a regime switching equation.

Table 3 2. Chow breakpoint test results

	Spain	Ireland	Italy
F-statistic	5,02	2,65	2,19
Log likelihood ratio	19,61	15,08	9,28
Wald Statistic	20,07	13,25	8,75
	2012Q2	2008Q1	2012Q1
Prob. F(4,57)	0,00	0,05	0,08
Prob. Chi-Square(4)	0,00	0,01	0,05
Prob. Chi-Square(4)	0,00	0,02	0,07

The bottom three lines show the p values associated to the breakpoint in the date shown. The null hypothesis of not break at the specified breakpoint can be rejected for all of them

3.4. Results

First, using the Augmented Dickey–Fuller (ADF) test, we find that the variables tend to be I(1), as seen in Table 3.3. This result is robust to the use of the alternative Phillips and Perron's (1988) method for determining whether there is a unit root (not shown)[2]. As a result, we search for the existence of a cointegrating vector. We model the cointegrating vector as freely as possible, using the option for which we do find that such a vector exists, according to the Johansen (1988)

[2] Results available upon request

method (Table 3.4) and obtain an estimation of the cointegrating equation (Table 3.5).

Table 3.3. Unit root test results

		ADF statistic	
		levels	first differences
Spain	bond holdings	2,5	-7,888 ***
	10 year bond yield	-1,8	-5,66 ***
	consumer confidence	-2,4	-5,08 ***
Italy	bond holdings	0,77	-7,11 ***
	10 year bond yield	-2,7	-6,08 ***
	consumer confidence	-1,7	-7,61 ***
Ireland	bond holdings	0,77	-6,799 ***
	10 year bond yield	2,54	-3,86 ***
	consumer confidence	-1,67	-7,56 ***

*** indicates significanca at the 1% level, ** at the 5% and * at the 10%.
An asterisk would indicate rejection of the null that the variable has a unit root.

Table 3.4: Cointegration test results

Country	Variable used	Number of CE	Trace statistic	p-value
Spain	Banks	None *	44,52	0,00
		At most 1	4,27	0,88
		At most 2	0,02	0,90
	OFI	None *	44,33	0,04
		At most 1	1,94	0,26
		At most 2	0,02	0,90
Italy	Banks	None *	32,37	0,02
		At most 1	7,03	0,57
		At most 2	0,13	0,71
	OFI	None*	22,25	0,04
		At most 1	4,26	0,67
		At most 2	0,35	0,62
Ireland	Banks	None *	30,14	0,05
		At most 1	10,17	0,27
		At most 2	2,78	0,10
	OFI	None *	36,37	0,01
		At most 1	9,13	0,35
		At most 2	3,17	0,07

*Marks rejection of null hypothesis at the 5% level

Table 3.5. Cointegrating equation

	GREECEBANKH	GREECEOFIH	LSPBANK	LSPOFI	LIRBANK	LIROFI	LITBANK	LITOFI
10 year yield	0,10 *	-0,61 **	3,30 **	-0,19 **	0,12 **	-0,18	2,50 ***	-0,71 *
Consumer confidence	0,03 **	-0,40	-0,34 **	-0,36 *	-0,09 *	-0,90 **	-0,30 *	0,04 *
Constant		-10,80	15,48	-0,31	18,35	5,30	3,67	-8,36

*** indicates significanca at the 1% level, ** at the 5% and * at the 10%.

Figure 3.3: Residuals of the cointegrating relationship

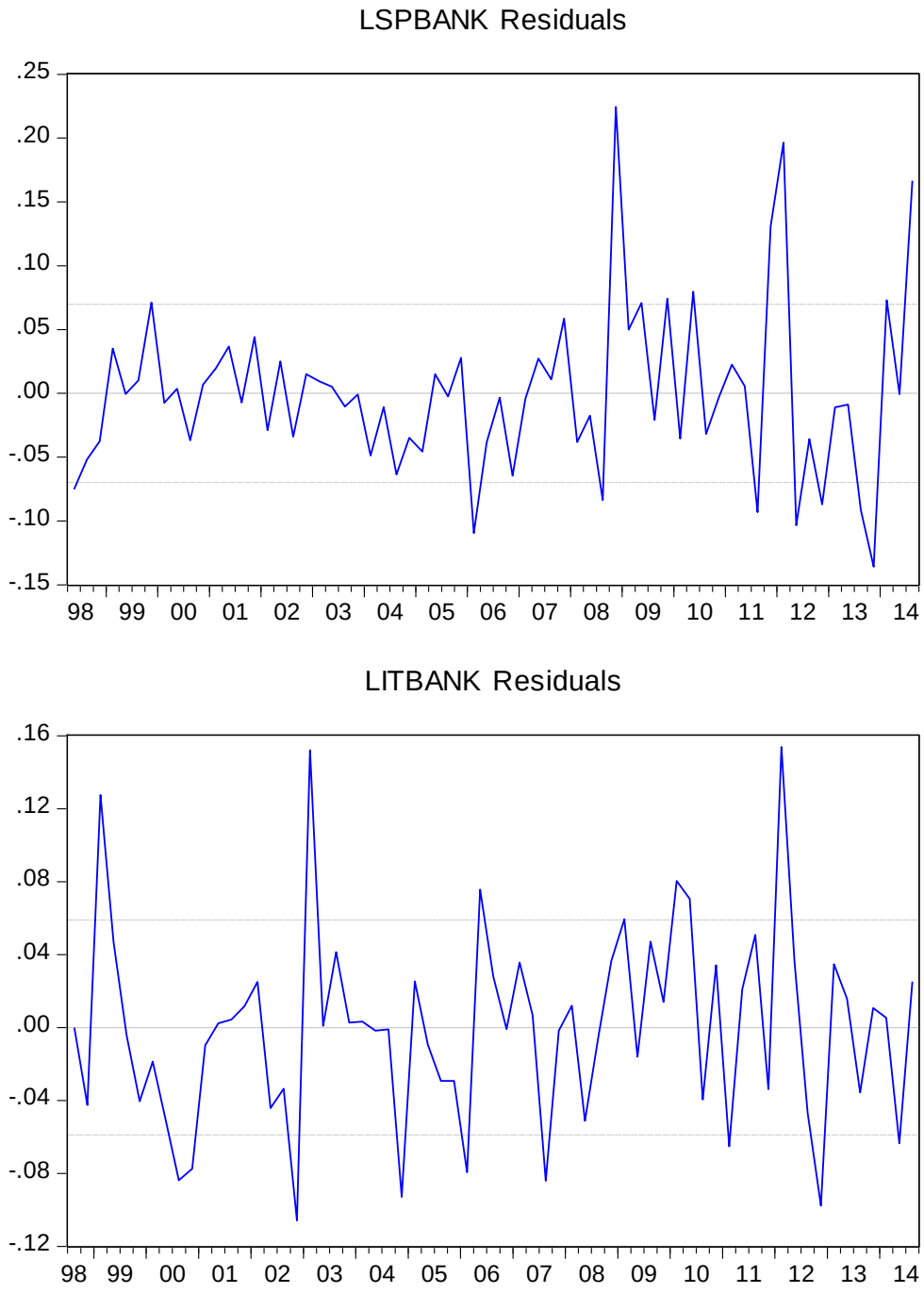
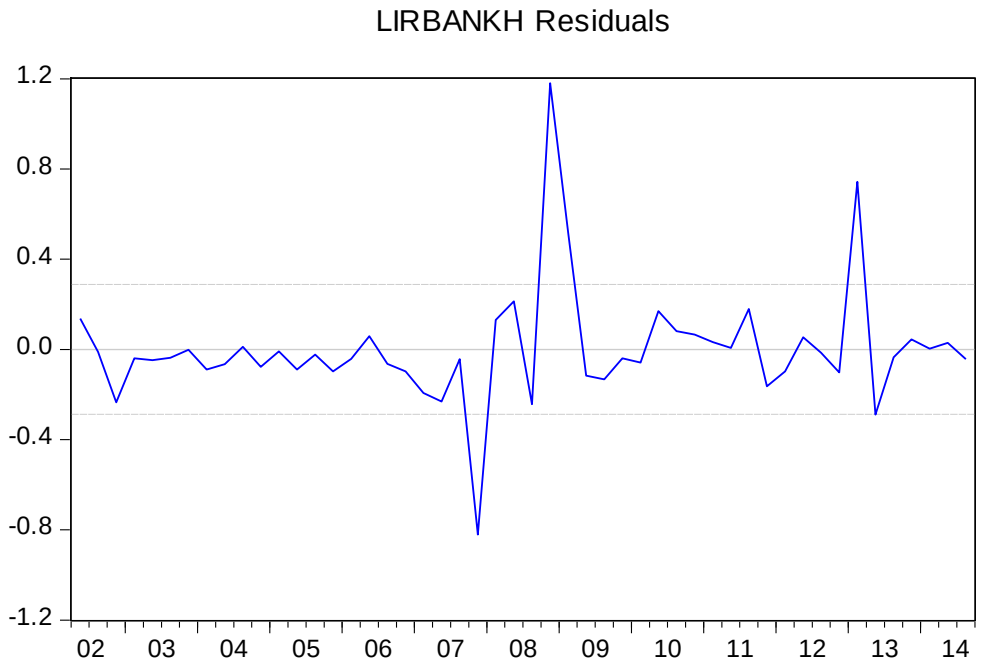


Figure 3.3 (continued)



Note: LIRBANKH, LITBANK and LSPBANK indicate the log of the holdings of domestic sovereign debt by Irish, Italian and Spanish banks. Source: author´s calculations

As can be seen, we find a negative long term relationship between bond holdings and consumer confidence in all countries excep Greece: when growth prospects are good, we can expect holdings to decline, as more investment opportunities may exist. This is consistent with the view that banks turn to domestic bonds in bad times, forced possibly by the absence of other investment alternatives.

With these facts in mind, we must examine the behavior during the crisis period: The key question we are trying to shed light on, is whether the demand for sovereign bonds function changed during the crisis period, reflecting some of the afore-mentioned distortions. Note that even if banks´ demand function had remained the same as in good times, the increase in yield and the recession would have led to an increase in holdings. The fact we explore is whether that demand function changed during the crisis.

The evidence that the behavior changed during the crisis can be first noticed in the residuals from the cointegrating equation (Figure 3.3). These residuals suggest that bank demand and reacted different in the crisis period than in normal times.

The regime switching approach can help us identify whether the peak in the residuals was due to a change in the sovereign demand function, which would be captured by the constant term.

Figures 3.4 show how the demand function changed for both banks and other institutions at the height of financial stress. The higher constant means that the holdings of domestic bonds increased more as banks reacted to shocks in either of the determinants than in the pre-crisis period.

Figure 3.4 Regime switching results: Smoothed probability of being in each of the regimes

Figure 3.4a: Spanish Banks

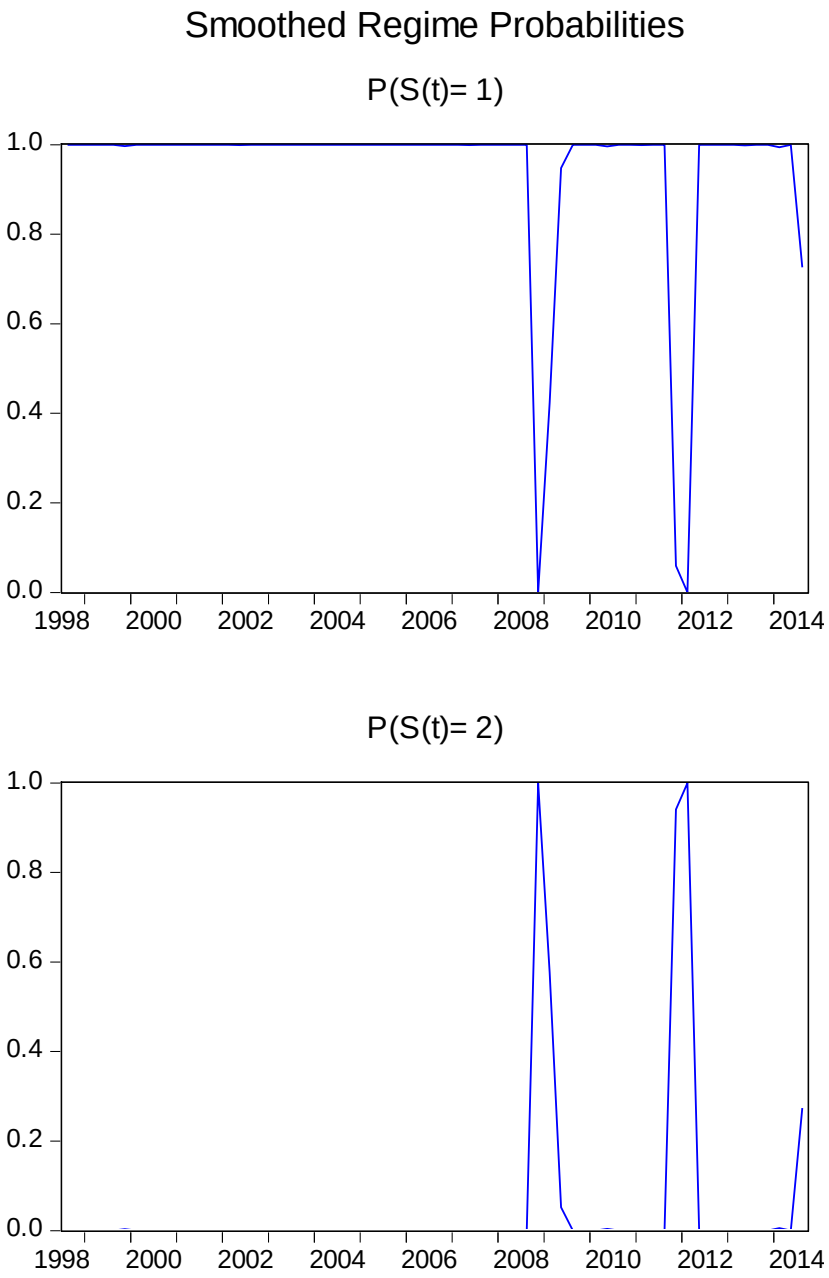


Figure 3.4b: Spanish other financial institutions

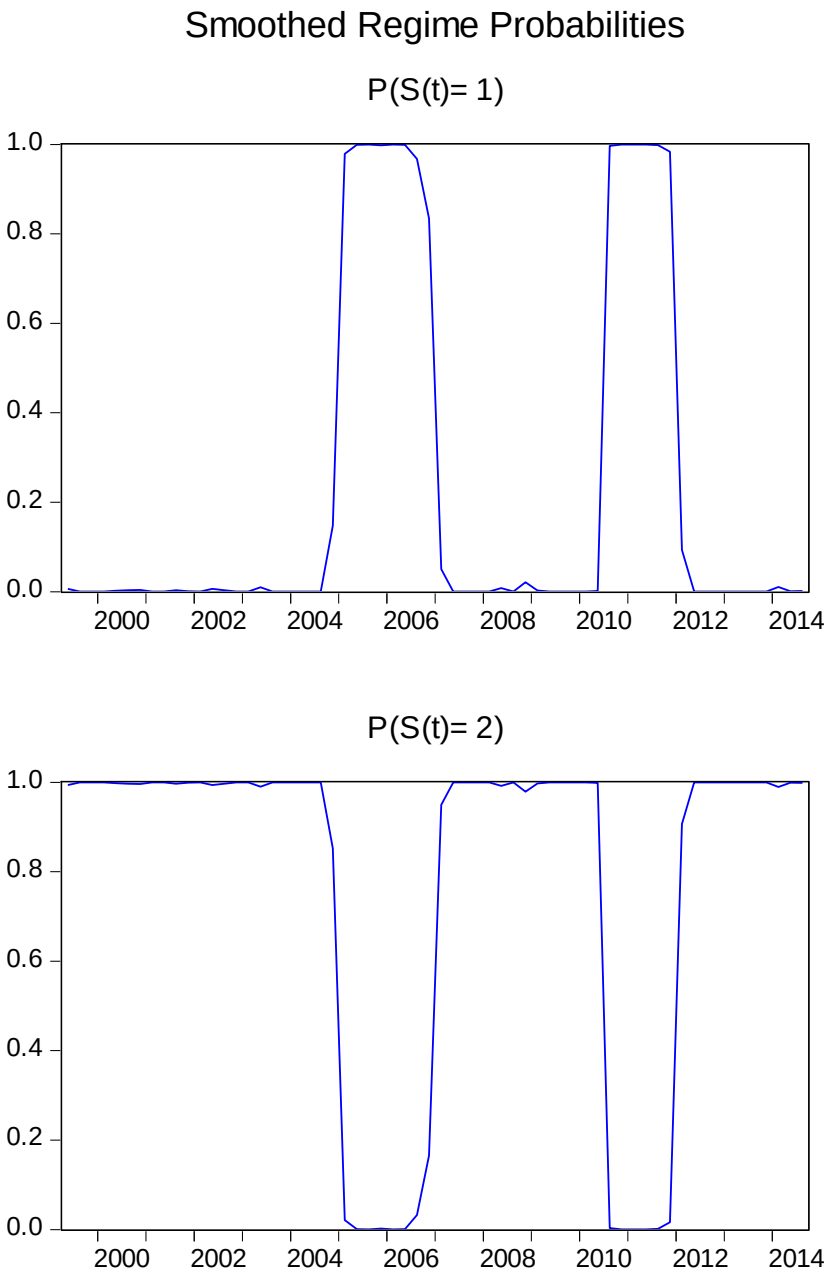


Figure 3.4c: Italian banks

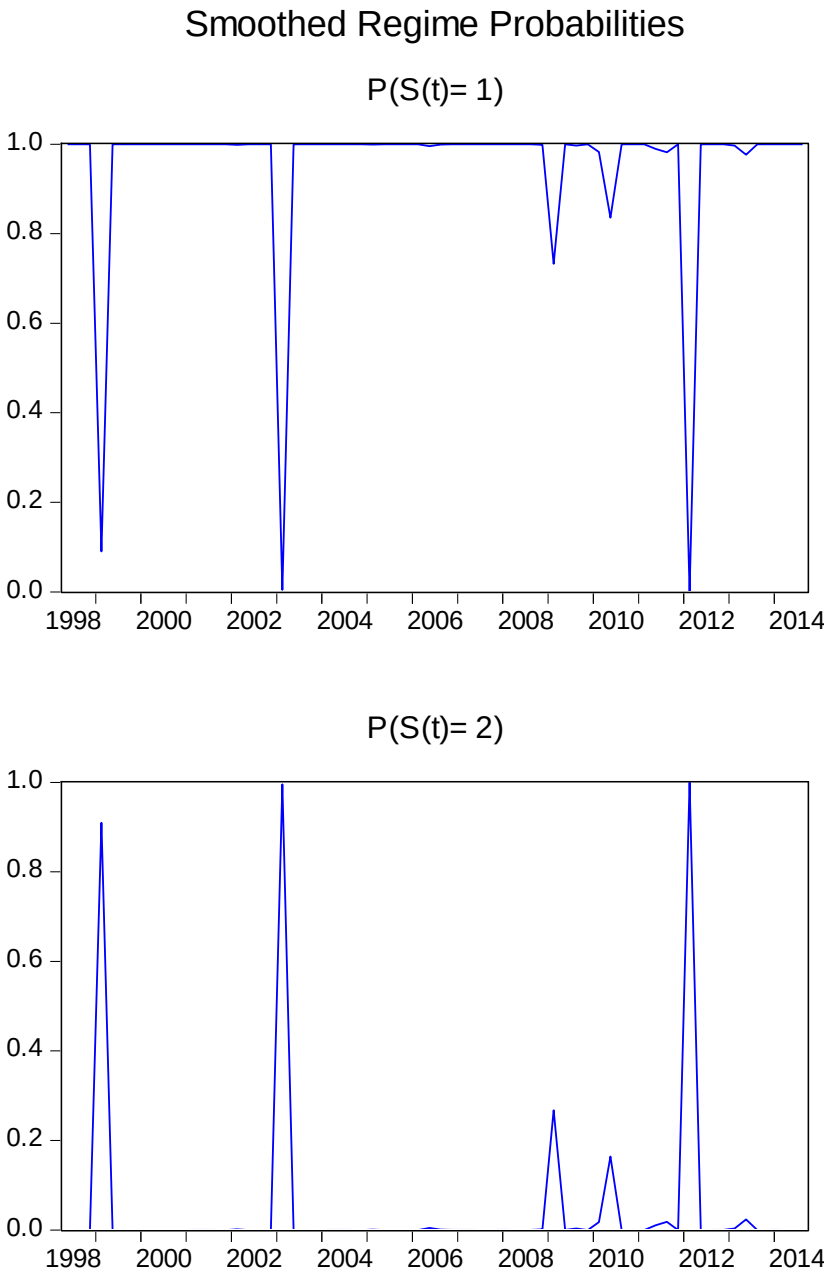


Figure 3.4d: Italian other financial institutions

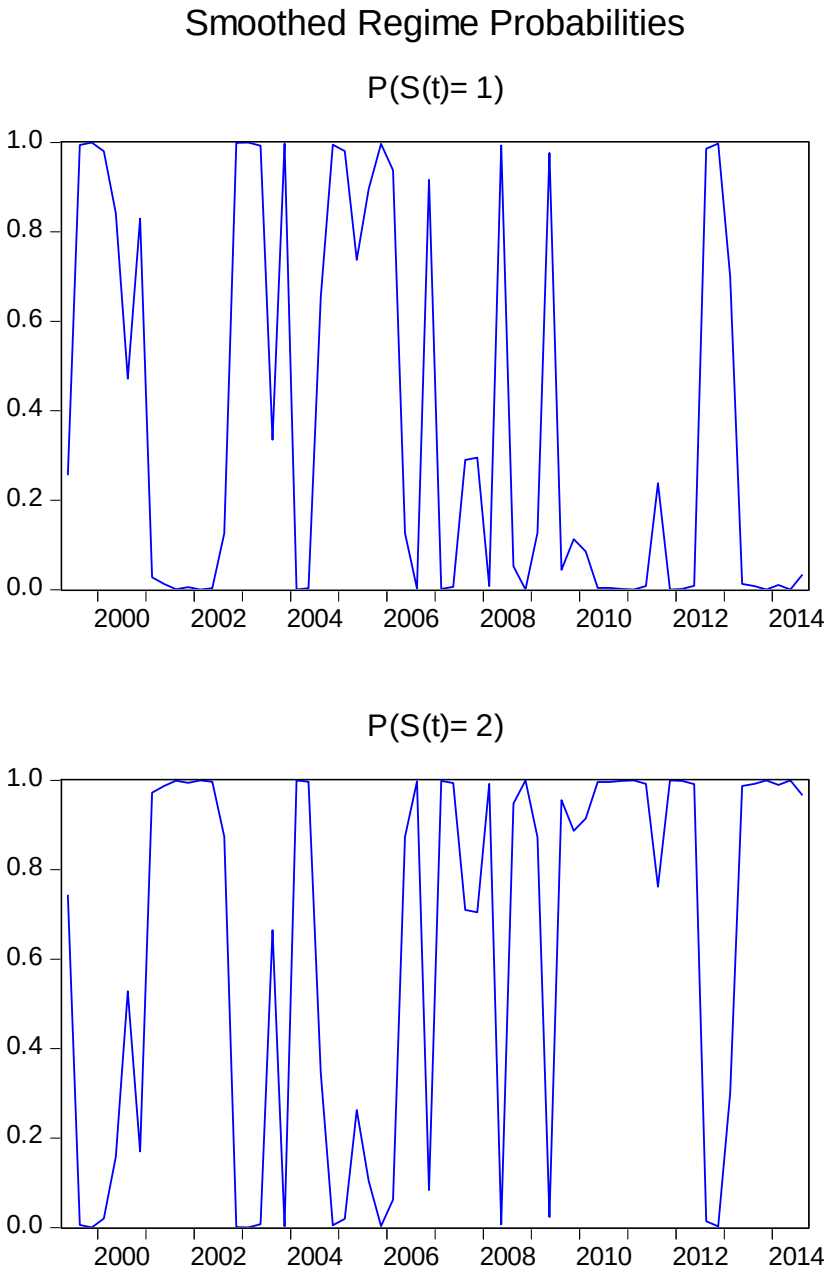


Figure 3.4e: Irish other financial institutions

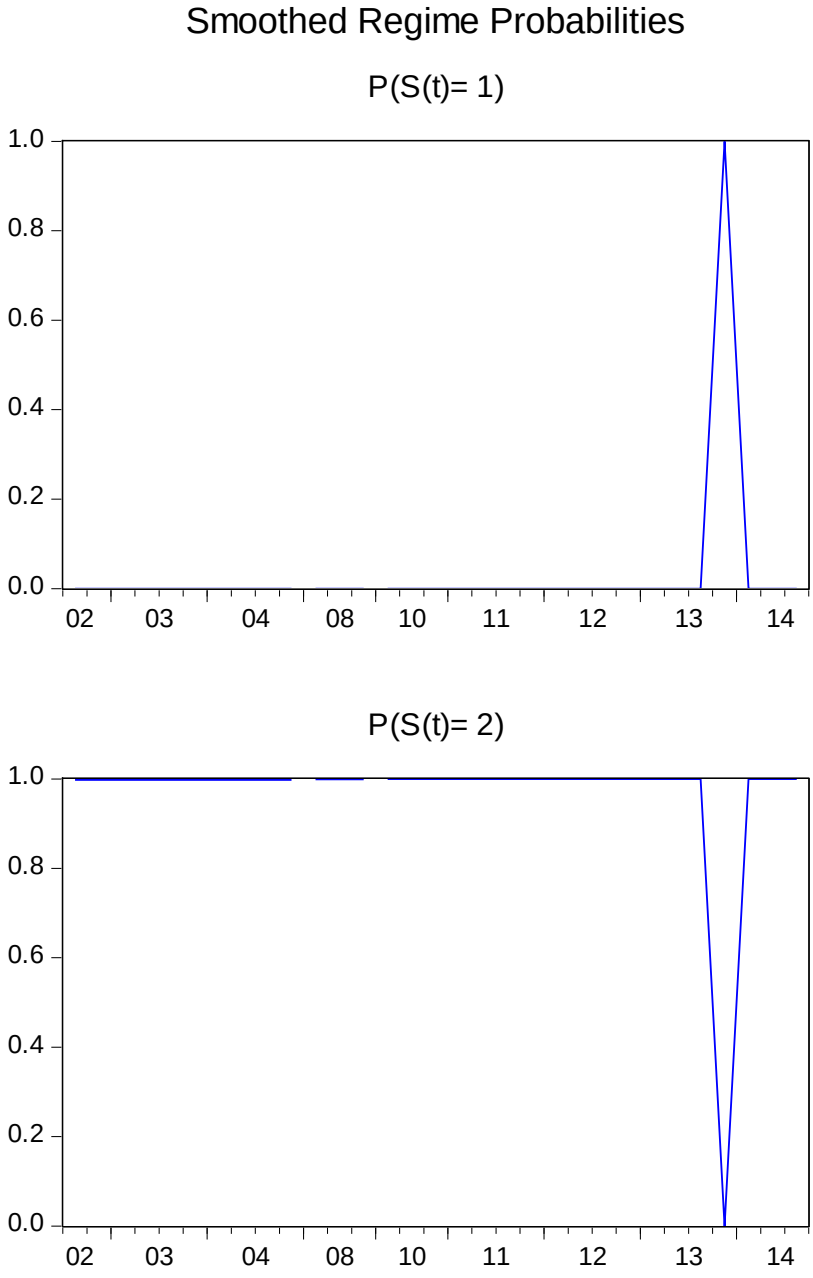
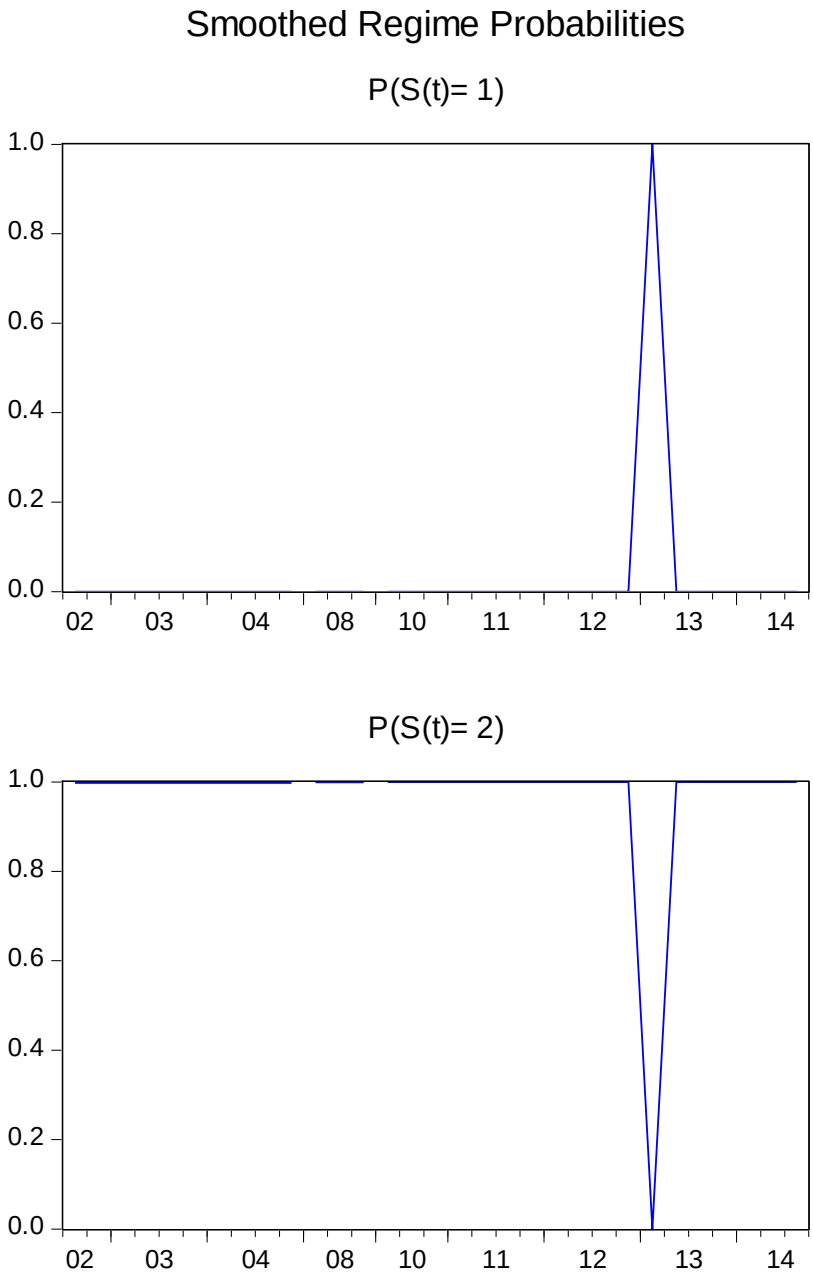


Figure 3.4f: Irish banks



The charts show the probability of each of the different regimes. The equation of each regime is shown in table 3.7.

Our interpretation of that result is that, indeed, in the height of the crisis, the banks´ holdings of sovereign bonds were larger than would be predicted by the long run sovereign bond demand function. This was driven by a larger reaction to shocks to yields and economic conditions.

The comparison with other financial institutions suggests that there were two differentiated episodes. In the 2008-2009 period, and around 2012-2013, both

banks and other financial institutions preferred sovereign bonds. In this period, regulatory incentives do not seem to play a role, as both types of institutions show a change in their demand function for sovereign bonds (towards increased holdings of bonds as a reaction to any of the exogenous variables). The reason could be related to banks protecting themselves from redenomination risk, as explained by Acharya (2013) and Battistini (2013)

A key aspect of the results is that the regime with high demand for sovereign bonds is short lived. This can be seen in the regime probabilities, and also in the expected duration of each regime and the probability of switching a regime once we are in that regime: when the starting regime is the low demand one, the probability of continuing in that regime is high, while when banks and other financial institutions are in a high demand for sovereign bonds regime, the probability of switching is high, which suggests that this is indeed a ‘crisis mode’ regime rather than a persistent result.

Table 3.6: Regime switching equations

Table 3.6: Regime switching equations

	Spain banks		Spain OFI		Italy		Italy OFI		Ireland		Ireland OFI	
	regime 1	regime 2			regime 1	regime 2			regime 1	regime 2	regime 1	regime 2
C	0.01	0.19 ***	0.07 ***	0.00	0.00	0.15 *	-17.90 ***	13.33 ***	0.00	0.19 ***	2.60 ***	-0.10
COINTEQ01	-0.01 ***		-0.02 **		-0.02		4.44		-0.03 **		-0.02	
D(CONSCON	0.00		0.002 **		0.05		-1.30 ***		0.00		-0.01	
D(10Y(-1))	-0.03		0.02 **		0.05 *		7.70		0.02 **		0.15 *	
LOG(SIGMA)	-2.95 ***		-3.7 ***		-3.20 ***		2.42 ***		-2.48 ***		-1.27 ***	
P11-C	3.25 ***		1.66 **		2.46 **		0.39		4.2 **		-22.50	
P21-C	0.28		-3.17 ***		24.5		-1.18 **		18.1		-3.36 ***	
* indicates significance at the 10% level, ** at the 5% level and *** at the 1% level												
AIC	-2.56		-3.72		-2.75		8.83		-1.24		1.16	
DW	2.09		1.66		1.97		1.92		2.08		1.91	
Expected du	26.96	1.75	6.28	24.79	12.79	2.3	2.48	4.24	2.7	29.8	2.1	27.8
In all cases, switching variable confidence intervals do not overlap even at the 10% confidence level												
Transistion probabilities												
P11	0.96		0.95		0.87		0.76		0.97		0.97	
P12	0.04		0.04		0.13		0.23		0.03		0.03	
P22	0.42		0.84		0.1		0.59		0.03		0.03	
P21	0.57		0.16		0.9		0.41		0.97		0.97	

3.5. Drivers of the change in bond demand

We take a closer look at what may have driven the switch in regime for Spanish banks. The behavior is similar for both banks and other financial institutions in the different countries, which may exclude the role played by regulatory incentives exclusive to banks, however, we see a change in the demand function, so we must explore the drivers of that change in behavior.

We set up a probit model, where the dependent variable is a dummy defined by sovereign bond demand function being in a crisis mode. The determinants are two different factors: first, the level of the 10 year yield, and, second, the 2 year and 10 year spread.

Our interpretation is the following: if banks moved to a higher holdings regime in the height of the turmoil, the motivation would show in the determinant of the higher holdings: in particular, if the motivation is to obtain a larger carry trade, banks should react to a rise in the yield of those assets of which they increased holdings. If the motivation was bailing out the sovereign, the determinant was probably the spread between the sovereign and the risk free asset (the German yield in this case. We add international risk aversion, as captured by Chicago Board Options Exchange Volatility Index (VIX), as a control variable.

In contrast, if banks hold more sovereign bonds because they want to save the sovereign (the motivation being, either, moral suasion, or the fact that their own rating and survival is linked to their sovereign), they would increase their holdings in response to heightened worries of the solvency of the sovereign. This would show not so much in the yield of the bonds, but in the spread. This effect would be present both in shorter and longer maturities.

Table 3.7: Results of Probit on sovereign debt holding regime

Dependent variable: high sovereign debt demand regime			
SPA_10YSPREAD			0,65 **
SPA_10Y		0,69	
SP2YSPRE	0,61 **		
VIX	0,11 ***	0,11 **	0,13 ***
C	-5,18 ***	-7,69 ***	-6,13 ***
McFadden R-squared	0,52	0,38	0,56
AIC	0,32	0,39	0,30
Schwarz	0,42	0,49	0,41

* indicates a p-value of 0,1, ** of 0,05 and *** of 0,01

This is related to the debate on regulatory incentives: banks wanting to use the carry trade to save their balance sheet from capital shortages would be more likely to react to a rise in the 10y yield, which would offer the better carry trade opportunities. Note that our analysis does not look at individual banks: it could be that the lower capitalized institutions would do the carry trade, but this does not show in the aggregate because the driver of the holdings of the larger institutions was different.

As can be seen in the results of the probit model, the explanatory factor was the spread, either at the short end of the curve or on the 10 year, which is evidence that the motivation for holding more sovereign bonds was, on aggregate, more related to relieving the stress of the sovereign that the carry trade.

3.6. Concluding remarks

Our analysis suggests that the retrenchment during the crisis periods did stem from a change in the sovereign demand function of banks and other financial institutions. However, the crisis mode demand, by which banks and other financial institutions responded to shocks in the yield or consumer confidence by holding more bonds suggests, was short lived in most cases. Therefore, the impact on the recovery of the detraction of resources from the private sector was probably rather small, by this count.

Second, in the countries studied, the behavior of banks and other financial institutions were similar, suggesting that regulatory incentives (in particular, the

0% risk weight on the holdings of sovereign debt) did not play a significant role. This suggests other factors, like moral suasion, or banks´ incentives to safeguard the sovereign´s stability at certain specific points in time may have played a more important role. This is emphasized by our finding that the key driver of the crisis-mode sovereign demand function was more the spread (and so the risk attached to it by the markets) than the yield on the assets.

The policy conclusions are significant. First, the results suggest that the introduction of a risk weight on sovereign bond holdings would not make much of a difference. This is because the other drivers of sovereign spread are the likely reasons for the rise in the holdings of sovereign bonds.

The key response would probably lie in avoiding sovereign stress in the first place. Given the particularly damaging consequences of sovereign stress in a monetary union, enhancing (or completing) the monetary union with instruments that may avoid sovereign stress, and so, financial fragmentation, should be a priority.

Chapter 4. Connectedness in EMU banks and sovereign bond CDS

4.1. Introduction

The transmission of stress between banks and sovereigns has been the subject of a large literature. Papers often use a panel approach between the credit default swap (CDS) of banks and sovereigns, or a cross section approach with different states, so as to assess the role that, for example, bank bailouts had in the transmission of risk between banks and sovereigns.

Other papers analyse the connections amongst financial institutions, in order to understand their systemic importance. However, a network approach is usually only used to understand connections in the exposures amongst firms. This, however, has usually not been applied to price indicators.

In this study we will focus on the interconnection between sovereign debt markets and banks in the European Economic and Monetary Union (EMU) by applying Diebold and Yilmaz (2014)'s measures of connectedness (both system-wide and pair-wise). The results will shed light on the drivers of the bank-sovereign nexus, the effect of key policy decisions during the sovereign debt crisis and how a bank´s impact on the banking system as a whole changes in crisis times.

A substantial amount of literature uses different extensions of Diebold and Yilmaz (2012)'s methodology to examine spillovers and transmission effects in stock, foreign exchange, or oil markets in non-EMU countries. Awartania et al. (2013), Lee and Chang (2013), Chau and Deesomsak (2014) and Cronin (2014) apply this methodology to examine spillovers in the United States' markets; Yilmaz (2010), Zhou et al. (2012) or Narayan et al. (2014) focus on Asian countries; Apostolakisa and Papadopoulos (2014) and Tsai (2014) examine G-7 economies, and Duncan and Kabundi (2013) centre their analysis on South African markets. However, few papers to date have looked at the connectedness and spillover effects within euro area sovereign debt markets, let al.one between banks and sovereigns, even though quantifying the spillover risk is a very important tool in order to assess whether the benefits of a sovereign or bank bailout may outweigh its costs.

Some exceptions that have looked at sovereign bond spillovers are Antonakakis and Vergos (2013), who examined spillovers between 10 euro area government yield spreads during the period 2007-2012; Claeys and Vašicek (2014), who examined linkages between 16 European sovereign bond spreads during the period 2000-2012; Glover and Richards-Shubik (2014), who applied a model based on the literature on contagion in financial networks to data on sovereign CDS among 13 European sovereigns from 2005 to 2011; and Alter and Beyer (2014), who quantify spillovers between sovereign credit markets and banks in the euro area. While the above authors apply Diebold and Yilmaz's methodology, Favero (2013) proposes an extension to Global Vector Autoregressive (GVAR) models to capture time-varying interdependence between EMU sovereign yield spreads.

This paper presents an analysis of the connectedness in sovereigns' market with other sovereigns and including in the same framework banks. By including such a network, our study controls for indirect linkages amongst banks and sovereigns. Therefore, our analysis provides a methodological contribution and relevant empirical insights to the assessment of financial stress transmission in EMU sovereign bond and bank CDS.

Diebold and Yilmaz (2014) showed that the connectedness framework was closely linked with both modern network theory (see Glover and Richards-Shubik, 2014) and modern measures of systemic risk (see Ang and Longstaff, 2013 or Acemoglu et al., 2015). The degree of connectedness, on the other hand, measures the contribution of individual units to systemic network events, in a fashion very similar to the conditional value at risk (CoVaR, see, e. g., Adrian and Brunnermeier, 2008).

After explaining the methodology that will be used in the empirical analysis, we will proceed in four stages. First, in order to estimate system-wide connectedness, we will undertake a full-sample (static analysis) that is not only of intrinsic interest, but will also prepare the way for the second stage, where we analyse connectedness in several subperiods that are of interest because they are marked by different stages in the EMU crisis. Finally, in the last stage we will analyse the implications of the results for several aspects of the literature: the

ability to determine ex ante which institutions are systemic, and understanding how the connectedness between banks and sovereigns has evolved over time.

Overall, our results confirm the finding that the positive influence exerted by economically sound core countries over peripheral ones in the stability period suddenly vanished with the outbreak of the crisis, when investors disavowed the shelter that peripheral countries could find in central countries and turned their attention to the major imbalances that they presented. Part of this increase in sovereign risk, we find, was due to an increase in the connectedness from banks to sovereigns in the height of the crisis. Secondly, we find that a bank´s connectivity with its own sovereign changed, as sovereign stress rose and as bank bailouts were announce. Third, starting from the calculation of a bank´s systemic impact, we show how difficult it can be to determine ex ante which banks are systemic, as connectedness changes during crises. Finally, we find that the connectedness between banks and own sovereign is not particularly related to the bank holdings of sovereign bonds.

Consequently, during the period of stability, beside the slight differences in yield behavior (all followed the evolution of the German bund, and spreads moved in a very narrow range) it was the central countries that triggered net connectedness relationships; in the crisis period, however, there was a major shift and this role was now played by peripheral countries. In addition, bank connectedness to sovereigns changes in crisis periods, and seems to be unrelated to the actual exposures of the banks. Therefore, according to our results, in a context of increased cross-border financial activity in the euro-area, the concern that in turbulent times a shock in one country might have spillover effects into others may be well founded, and global financial stability may be threatened.

The rest of the chapter is organized as follows. Section 2 presents Diebold and Yılmaz (2014)'s methodology for assessing connectedness in financial market volatility, and the empirical results (both static and dynamic) obtained for our sample of EMU sovereign and bank CDS. In Section 3 we report the empirical results regarding the evolution of connectedness in different subperiods from the outset of the global financial crisis. Section 4 examines the policy implication and our interpretation of the key results. Finally, Section 5 summarizes the findings and offers some concluding remarks.

4.2. Connectedness analysis

4.2.1. Econometric methodology

The main tool for assessing connectedness is based on a decomposition of the forecast error variance, which results from the following steps:

1. Fit a standard vector autoregressive (VAR) model to the series.

2. Using series data up to and including time *t*, establish an *H* period-ahead forecast (up to time *t* + *H*).

3. Decompose the error variance of the forecast for each component with respect to shocks from the same or other components at time *t*.

Let us denote by d^{H}_{ij} the *ij*-th *H*-step variance decomposition component (i.e., the fraction of variable *i*'s *H*-step forecast error variance due to shocks in variable *j*). The connectedness measures are based on the "non-own", or "cross", variance decompositions, d^{H}_{ij}, $i, j = 1, \ldots, N$, $i \neq j$.

Consider an *N*-dimensional covariance-stationary data-generating process (DGP) with orthogonal shocks: $x_t = \Theta(L)u_t$, $\Theta(L) = \Theta_0 + \Theta_1 L + \Theta_2 L^2 + \ldots$, $E(u_t, u_t') = I$. Note that Θ_0 need not be diagonal. All aspects of connectedness are contained in this very general representation. Contemporaneous aspects of connectedness are summarized in Θ_0 and dynamic aspects in $\{\Theta_1, \Theta_2, \ldots\}$. Transformation of $\{\Theta_1, \Theta_2, \ldots\}$ via variance decompositions is needed to reveal and compactly summarize connectedness. Diebold and Yilmaz (2014) propose a connectedness table such as Table 4.1 to understand the various connectedness measures and their relationships. Its main upper-left *NxN* block, which contains the variance decompositions, is called the "variance decomposition matrix," and is denoted by $D^H = [d_{ij}]$. The connectedness table increases D^H with a rightmost column containing row sums, a bottom row containing column sums, and a bottom-right element containing the grand average, in all cases for $i \neq j$.

Table 4.1: Schematic connectedness table

	x_1	x_2	...	x_N	Connectedness from others
x_1	d_{11}^H	d_{12}^H	$\cdots$	d_{1N}^H	$\sum_{j=1}^{N} d_{1j}^H, j \neq 1$
x_2	d_{21}^H	d_{22}^H	$\cdots$	d_{2N}^H	$\sum_{j=1}^{N} d_{2j}^H, j \neq 2$
.	.	.	.		
.	.	.	.		
.	.	.	.		
x_N	d_{N1}^H	d_{N2}^H	$\cdots$	d_{NN}^H	$\sum_{j=1}^{N} d_{Nj}^H, j \neq N$
Connectedness to others	$\sum_{i=1}^{N} d_{i1}^H$ $i \neq 1$	$\sum_{i=1}^{N} d_{i2}^H$ $i \neq 2$	$\cdots$	$\sum_{i=1}^{N} d_{iN}^H$ $i \neq N$	$\frac{1}{N}\sum_{i,j=1}^{N} d_{iN}^H$ $i \neq N$

The off-diagonal entries of D^H are the parts of the *N* forecast-error variance decompositions of relevance from a connectedness perspective. In particular, the *gross pair-wise directional connectedness* from *j* to *i* is defined as follows:

$$C_{i \leftarrow j}^H = d_{ij}^H .$$

Since in general $C_{i \leftarrow j}^H \neq C_{j \leftarrow i}^H$, the *net pair-wise directional connectedness* from *j* to *i,* can be defined as:

$$C_{ij}^H = C_{j \leftarrow i}^H - C_{i \leftarrow j}^H .$$

As for the off-diagonal row sums in Table 4.1, they give the share of the *H*-step forecast-error variance of variable x_i coming from shocks arising in other variables (all others, as opposed to a single other), while the off-diagonal column sums provide the share of the *H*-step forecast-error variance of variable x_i going to shocks arising in other variables. Hence, the off-diagonal row and column sums, labelled “from" and “to" in the connectedness table, offer the total directional connectedness measures. In particular, total directional connectedness from others to *i* is defined as

$$C_{i\leftarrow\bullet}^{H} = \sum_{\substack{j=1 \\ j\neq i}}^{N} d_{ij}^{H},$$

and *total directional connectedness* to others from *i* is defined as

$$C_{\bullet\leftarrow i}^{H} = \sum_{\substack{j=1 \\ j\neq i}}^{N} d_{ji}^{H}.$$

We can also define *net total directional connectedness* as

$$C_{i}^{H} = C_{\bullet\leftarrow i}^{H} - C_{i\leftarrow\bullet}^{H}.$$

Finally, the grand total of the off-diagonal entries in D^H (equivalently, the sum of the

“from" column or “to" row) measures *total connectedness*:

$$C^{H} = \frac{1}{N} \sum_{\substack{i,j=1 \\ j\neq i}}^{N} d_{ij}^{H}.$$

For the case of non-orthogonal shocks, the variance decompositions are not as easily calculated as before, because the variance of a weighted sum is not an appropriate sum of variances; in this case, methodologies for providing orthogonal innovations like traditional Cholesky-factor identification may be sensitive to ordering. So, following Diebold and Yilmaz (2014), a generalized VAR decomposition (GVD), invariant to ordering, proposed by Koop *et al.* (1996) and Pesaran and Shin (1998) is used. The *H*-step generalized variance decomposition matrix is defined as $D^{gH} = \left[d_{ij}^{gH} \right]$, where

$$d_{ij}^{gH} = \frac{\sigma_{jj}^{-1}\sum_{h=0}^{H-1}\left(e'_i \Theta_h \Sigma e_j\right)^2}{\sum_{h=0}^{H-1}\left(e'_i \Theta_h \Sigma \Theta'_h e_j\right)}$$

In this case, e_j is a vector with *j*th element unity and zeros elsewhere, Θ_h is the coefficient matrix in the infinite moving-average representation from VAR, Σ is the covariance matrix of the shock vector in the non-orthogonalized-VAR, σ_{jj} being its *j*th diagonal element. In this GVD framework, the lack of orthogonality means that the rows of d_{ij}^{gH} do not have sum unity and, in order to obtain a generalized connectedness index $\tilde{D}^g = \left[\tilde{d}_{ij}^g\right]$, the following normalization is necessary: $\tilde{d}_{ij}^g = \frac{d_{ij}^g}{\sum_{j=1}^{N} d_{ij}^g}$, where by construction $\sum_{j=1}^{N} \tilde{d}_{ij}^g = 1$ and $\sum_{i,j=1}^{N} \tilde{d}_{ij}^g = N$

The matrix $\tilde{D}^g = \left[\tilde{d}_{ij}^g\right]$ permits us to define similar concepts as defined before for the orthogonal case, that is, *total directional connectedness*, *net total directional connectedness*, and *total connectedness.*

4.2.2. Data

We use daily data of CDS spreads built on data collected from the Bloomberg database for six EMU countries: Germany, France, Italy, Spain, Portugal and Ireland. We also use data for the two large banks in each jurisdiction that quote CDS: Deutsche Bank, Commerzbank, Societe Generale, BNP Paribas, BBVA, Santander, ISP, Unicredito, Banco Espirito Santo, BCP, Bank of Ireland and Allied IrishBank. Our sample begins on December 30 2008 and ends on 12 August 2014 (i.e., a total of 1,652 observations), spanning the key events since the start of the global financial crisis.

4.2.3. Static (full-sample, unconditional) analysis

The full-sample connectedness tables appear as Table 4.2 and Table 4.3 for senior and subrogated CDS, respectively. As mentioned above, the *ij*th entry of the upper-left 18x18 assets submatrix gives the estimated *ij*th pair-wise

directional connectedness contribution to the forecast error variance of asset *i*'s yields coming from innovations to asset *j*. Hence, the off-diagonal column sums (labelled TO) and row sums (labelled FROM) gives the total directional connectedness to all others from *i* and from all others to *i* respectively. The bottom-most row (labelled NET) gives the difference in total directional connectedness (to-from). Finally, the bottom-right element (in boldface) is total connectedness.

Table 4.2: Full-sample connectedness for senior CDS

	GER	CMB SNR	DB SNR	FRA	BNP SNR	SGEN SNR	ITA	ISP SNR	UNI SNR	SPA	SAN SNR	BBVA SNR	POR	BES SNR	BCPSNR	IRE	BOI SNR	AIBSNR	Contribution From Others
GER	20.4603	4.7301	4.5182	12.2666	6.6317	6.6314	8.2766	5.3162	5.6580	3.1234	6.2735	6.1966	2.9160	0.7722	1.0346	4.5265	0.5318	0.1362	79.5397
CMB SNR	4.6800	13.5396	5.7271	6.6549	9.2014	8.2286	6.6858	7.4859	8.7482	1.7605	9.1905	8.7908	2.5327	1.5924	1.8251	2.7168	0.6187	0.0211	86.4604
DB SNR	7.5405	7.7660	20.9839	6.2413	6.1046	5.9420	5.0538	4.5534	5.2607	3.0692	7.4675	6.5947	2.7041	2.8664	2.7129	3.9477	1.1665	0.0247	79.0161
FRA	9.5280	5.4233	2.9758	17.0165	8.1613	7.4531	10.1516	6.1698	6.2929	2.4798	7.2821	7.3786	3.4215	0.9334	0.9933	3.7232	0.4700	0.1458	82.9835
BNP SNR	5.3129	7.9046	3.4902	8.2522	12.4400	10.1791	8.5387	7.9522	8.2225	1.8335	8.9115	9.1909	2.7388	0.8385	1.1437	2.3957	0.6320	0.0231	87.5600
SGEN SNR	5.1039	7.8541	3.3357	8.2215	11.2022	12.8059	8.0539	7.8198	7.9030	2.2217	8.7033	8.7393	2.7086	0.9410	1.2139	2.5363	0.6308	0.0051	87.1941
ITA	5.8543	5.5231	2.4905	8.3142	7.1362	6.9356	16.0414	7.2365	6.9304	4.3044	8.2331	8.2512	4.4154	1.2279	1.7881	4.8277	0.4815	0.0084	83.9586
ISP SNR	3.9734	7.1193	2.6533	6.7437	8.7562	7.9030	8.7749	12.4902	11.1327	2.0725	10.2053	10.0718	2.5442	1.1485	1.4273	2.5275	0.4414	0.0148	87.5098
UNI SNR	4.0973	7.1624	2.7762	6.5120	8.6807	7.7739	8.5662	10.7837	14.1188	1.7192	9.9519	9.7082	2.2046	1.3628	1.4545	2.6229	0.4844	0.0204	85.8812
SPA	3.4823	3.8928	2.2785	4.1390	4.3730	4.5415	9.0174	5.1689	4.1541	25.8566	8.7410	9.3592	4.6907	1.6305	2.0111	5.5859	0.9623	0.1153	74.1434
SAN SNR	3.5856	6.9621	3.5652	6.2096	7.8449	7.1486	7.1862	8.4502	7.6625	3.3551	14.7021	13.4474	2.8503	1.6093	1.7762	3.0504	0.5722	0.0219	85.2979
BBVA SNR	3.4775	6.7722	3.4461	6.1961	8.0023	7.0589	7.4299	8.2827	7.4969	3.4891	13.4255	14.7099	3.0303	1.7310	1.7837	3.1233	0.5236	0.0211	85.2901
POR	3.8746	4.6174	2.0288	6.8361	5.5850	5.7133	8.0393	7.0407	4.3339	3.8201	5.7619	7.0415	21.1986	1.6633	1.9387	8.9360	1.3061	0.2646	78.8014
BES SNR	1.8333	4.1420	4.2586	3.2595	4.7497	4.7238	5.0417	5.7836	5.0103	2.8383	7.5279	7.6683	4.6257	22.4666	10.1161	4.0926	1.3927	0.4691	77.5334
BCPSNR	2.4820	4.2069	3.5851	3.6575	5.8990	5.3910	6.4464	5.6719	4.6459	2.4321	7.6338	7.5582	4.4651	9.5228	19.7408	5.0432	1.5550	0.0632	80.2592
IRE	4.6511	4.1258	2.8575	6.7139	4.0717	4.6030	8.3323	5.3591	4.6384	4.3414	5.9387	6.7588	8.6356	1.4782	2.7600	21.5681	2.1096	1.0568	78.4319
BOI SNR	1.3896	1.8726	1.8443	1.8526	2.2860	2.2927	1.5456	1.7985	2.2605	1.0519	3.7763	2.6962	2.9545	1.9308	1.9964	6.6524	61.7556	0.0434	38.2444
AIBSNR	0.4100	1.1071	0.5371	0.4618	0.1449	0.3005	2.2878	1.4807	0.8945	0.9142	1.2361	1.0466	5.5833	0.9124	2.7982	7.5400	0.2970	72.0477	27.9523
Contribution To Others	77.6967	87.0708	71.3929	85.7661	89.7420	88.9247	88.1587	89.4902	87.7616	63.4189	89.8580	89.8698	74.8295	58.8736	66.2636	77.3957	18.6688	3.2950	**77.0032**
Net Contribution (To-From) Others	**-1.8430**	**0.6104**	**-7.6231**	**82.9835**	**2.1820**	**1.7306**	**4.2001**	**1.9805**	**1.8803**	**-10.7244**	**4.5600**	**4.5797**	**-3.9719**	**-18.6598**	**-13.9956**	**-1.0361**	**-19.5756**	**-24.6573**	

Notes: GER, FRA, ITA, SPA, POR and IRE stand for Germany, France, Italy, Spain, Portugal and Ireland respectively. BBVA SNR, SANSNR, UNISNR, ISPSNR, SGEN SNR, BNP SNR, DBSNR, CMB SNR, AIB SNR, BOI SNR, BCP SNR and BES SNR stand for senior CDS for Banco Bilbao Vizcaya Argentaria, Santander, Unicredito, Intesa San Paolo, Societe Generale, BNP Paribas, Deutsche Bank, Commerzbank, Allied Irish Bank, Bank of Ireland, BCP and Banco Espirito Santo

Table 4.3: Full-sample connectedness for subrogated CDS

	GER	CMB SUB	DB SUB	FRA	BNP SUB	SGEN SUB	ITA	ISP SUB	UNI SUB	SPA	SAN SUB	BBVA SUB	POR	BES SUB	BCP SUB	IRE	BOI SUB	AIB SUB	Contribution From Others
GER	22,8148	4,9836	5,4796	12,7287	5,8190	6,4945	8,2236	5,1067	5,0405	3,1703	5,7658	5,3766	2,9721	0,3564	0,8661	4,6520	0,1239	0,0258	77,1852
CMB SUB	5,4661	13,6752	8,3104	7,1581	8,3926	8,7977	5,7990	7,6375	8,7495	1,4828	8,4180	8,4281	2,0946	1,3097	1,8295	2,1701	0,1908	0,0902	86,3248
DB SUB	6,7750	8,4739	13,0819	6,8296	7,7474	8,6296	6,2122	7,4815	8,3135	1,9006	8,4613	8,5406	2,3334	0,6554	1,7213	2,6114	0,1670	0,0644	86,9181
FRA	10,9069	4,8748	4,9930	17,6803	7,0206	7,2456	10,0402	5,7750	6,0303	2,3307	6,6664	7,2381	3,6882	0,4319	1,2714	3,7473	0,0317	0,0276	82,3197
BNP SUB	5,5779	6,8785	7,1084	7,8456	11,9440	10,8052	7,5863	7,7812	8,4978	2,1457	8,3758	8,4985	2,5396	0,5174	1,3882	2,3281	0,0900	0,0918	88,0560
SGEN SUB	5,2434	6,8828	7,2104	7,7833	9,9351	13,4237	7,3816	7,4408	8,2999	2,4410	8,4506	8,1520	2,9011	0,5029	1,1917	2,4654	0,1086	0,1856	86,5763
ITA	6,6411	4,5032	5,0285	8,6464	6,8740	7,1915	16,7943	6,7298	6,4942	4,4013	7,4571	7,7699	4,6947	0,5110	1,6894	4,4997	0,0600	0,0140	83,2057
ISP SUB	4,9335	6,8813	6,7438	6,7826	7,9181	8,3965	8,3602	11,0018	10,5159	2,0631	9,3496	9,2958	2,9278	0,6347	1,5402	2,4577	0,1759	0,0214	88,9982
UNI SUB	5,3253	6,6565	6,6331	6,6733	7,6827	8,5480	7,7472	8,9140	13,4510	2,0595	9,2858	9,1798	2,7242	0,7386	1,6301	2,5714	0,1624	0,0170	86,5490
SPA	3,5291	3,0917	3,4458	3,9693	4,7232	5,1144	8,9970	5,5415	4,3496	28,1018	7,3168	8,1631	4,6332	1,3699	1,9882	5,4481	0,1007	0,1165	71,8982
SAN SUB	4,6589	6,6648	6,6298	6,2588	6,8882	7,5208	7,1453	7,2006	7,8317	3,2723	14,1260	12,6819	3,1255	0,9880	2,0181	2,7724	0,1005	0,1166	85,8740
BBVA SUB	4,3304	6,3322	6,2278	6,6862	6,9892	7,1337	7,2699	7,2208	7,6600	3,5163	12,4656	14,7905	3,2898	1,1816	1,8094	2,9204	0,0526	0,1237	85,2095
POR	4,2428	4,3034	4,0229	6,9069	5,5085	6,2601	7,2419	7,0122	5,0738	3,5714	6,1238	6,8479	20,3210	1,3835	1,7280	9,0569	0,2548	0,1401	79,6790
BES SUB	2,2938	5,8290	3,9516	3,0160	3,6596	4,0079	3,5001	4,8284	4,5097	3,3377	6,7024	7,2492	4,0226	31,3668	7,4895	3,8248	0,3594	0,0517	68,6332
BCP SUB	3,0532	5,3040	4,5440	3,3644	3,8852	5,6002	4,9058	5,1271	4,6873	3,0327	6,5202	6,9682	4,2823	9,1105	22,5750	5,6206	1,2884	0,1309	77,4250
IRE	5,5142	3,3643	3,5819	6,9413	4,0255	5,1551	6,9572	4,9896	4,6594	4,2805	5,2447	6,1949	9,1836	1,3735	2,9773	24,0712	0,2489	1,2369	75,9288
BOI SUB	1,4621	1,0148	2,3669	0,3930	0,0908	0,8762	0,1564	1,1861	1,7918	0,0275	1,6338	1,4569	2,0044	1,3051	2,7045	3,5833	76,9325	1,0140	23,0675
AIB SUB	0,3761	1,0692	0,8030	0,4775	1,4877	1,9347	0,7853	0,6976	0,7731	0,5110	0,7130	0,8846	0,8907	0,0995	0,2072	0,9949	5,6826	81,6122	18,3878
Contribution To Others	77,8807	86,4311	86,9394	85,2837	89,1999	89,0985	86,5757	90,1481	88,4768	60,7769	89,3851	89,2602	74,1558	41,7368	60,1324	71,9436	10,6795	4,0764	**75,1242**
Net Contribution (To-From) Others	**0,6956**	**0,1063**	**0,0213**	**82,3197**	**1,1439**	**2,5221**	**3,3700**	**1,1499**	**1,9277**	**-11,1212**	**3,5111**	**4,0507**	**-5,5232**	**-26,8965**	**-17,2925**	**-3,9852**	**-12,3880**	**-14,3114**	

Notes: GER, FRA, ITA, SPA, POR and IRE stand for Germany, France, Italy, Spain, Portugal and Ireland respectively CMB SUB, DB SUB, BNP SUB, SGEN SUB, ISP SUB, UNI SUB, SAN SUB, BBVA SUB, BES SUB, BCP SUB, BOI SUB, AIB SUB stand for subrogated CDS for Commerzbank, Deutsche Bank, BNP Paribas, Societe Generale, Intesa San Paolo, Unicredito, Santander, Banco Bilbao Vizcaya Argentaria, Banco Espirito Santo, BCP, Bank of Ireland and Allied Irish Bank.

As can be seen, the diagonal elements (own connectedness) are the largest individual elements in the tables, but total directional connectedness (from others or to others) tends to be much larger for both banks and sovereigns.

Regarding pair-wise directional connectedness (the off-diagonal elements of the upper-left 11 × 11 submatrix), the highest observed pair-wise connectedness is from BBVA to Santander, and vice versa. In general, the highest value of pair-wise directional connectedness is amongst banks of the same country (ISP and UNI, Santander and BBVA, BNP and SocGen), a sign that, for the whole sample, financial fragmentation in the Eurozone was an issue.

The total directional connectedness from others is highest in Italian, French and Spanish banks. As for the direction connectedness to others, it is also highest in these banks, led by Santander, ISP and BNP, although closely followed by the Italian sovereign.

Finally, for the countries involved, we obtain that connectedness is usually higher amongst countries (this is true of Germany, France, Italy and Spain, whose highest connectors, both in to and from connectedness are other countries), than between countries and banks. However, in the case of the two bailed out countries that received a full sovereign bailout (Portugal and Ireland), the highest connectedness is with their own banks.

4.2.4 Sub sample approach

The full-sample connectedness analysis provides a good characterization of "unconditional" aspects of the connectedness measures. However, it does not help us to understand the connectedness dynamics. This section presents an analysis of connectedness in each of the subperiods identified.

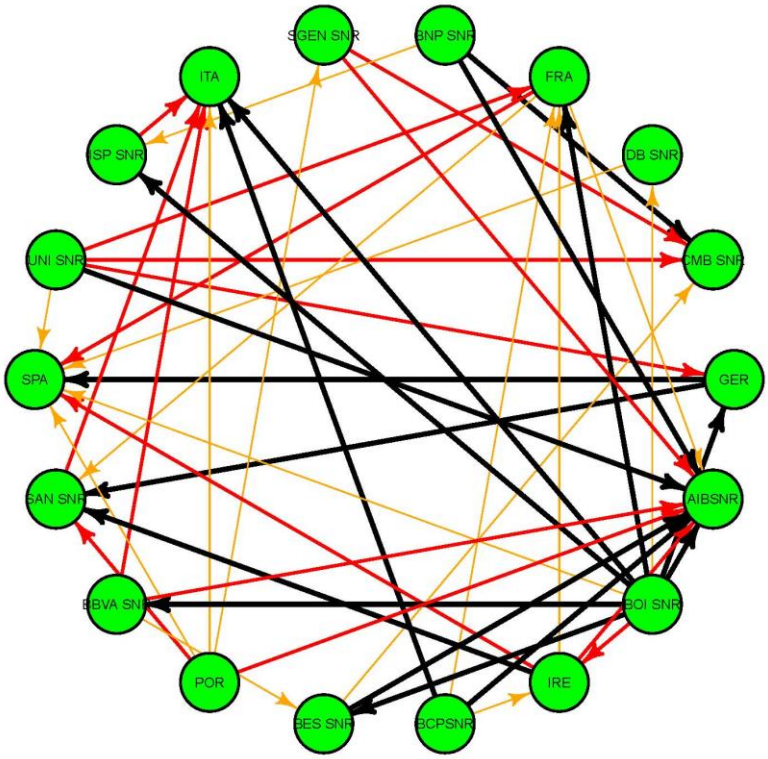
The dynamic connectedness analysis starts with total connectedness, and then moves on to net directional connectedness across countries in Section 3.

4.2.4.1. Total connectedness

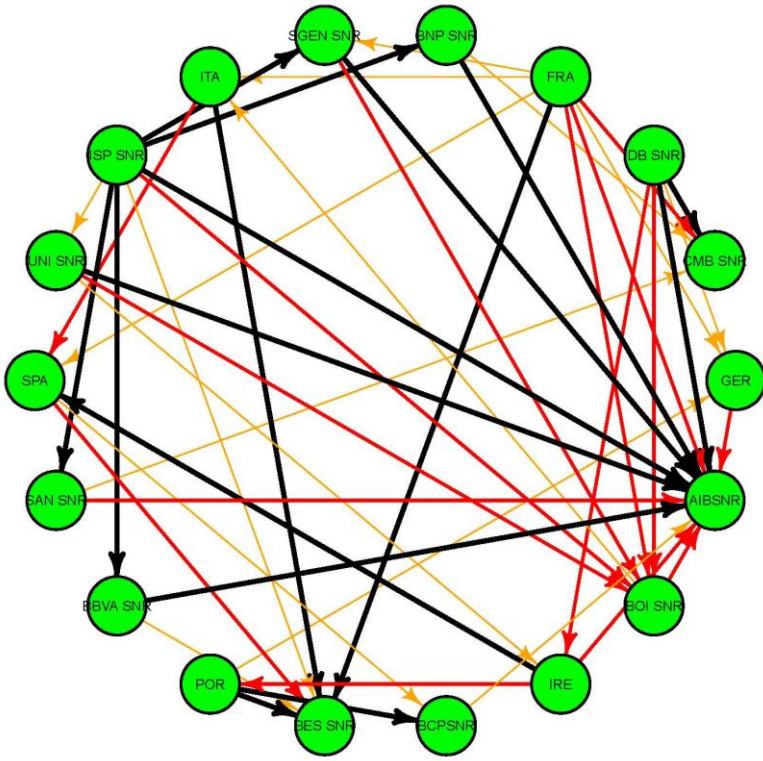
As can be seen in Figure 4.1, total connectedness changed abruptly in the subsamples studied. In particular, total connectedness declined as market turbulences deepened, and only slowed down in superiod 5, after Draghi´ whatever it takes speech and the implementation of the OMTs. In subperiod 6, possibly related to the Greek bailout, total connectedness declined slightly again.

Figure 4.1: Net pair-wise directional connectedness during the five sub-periods after breakpoint

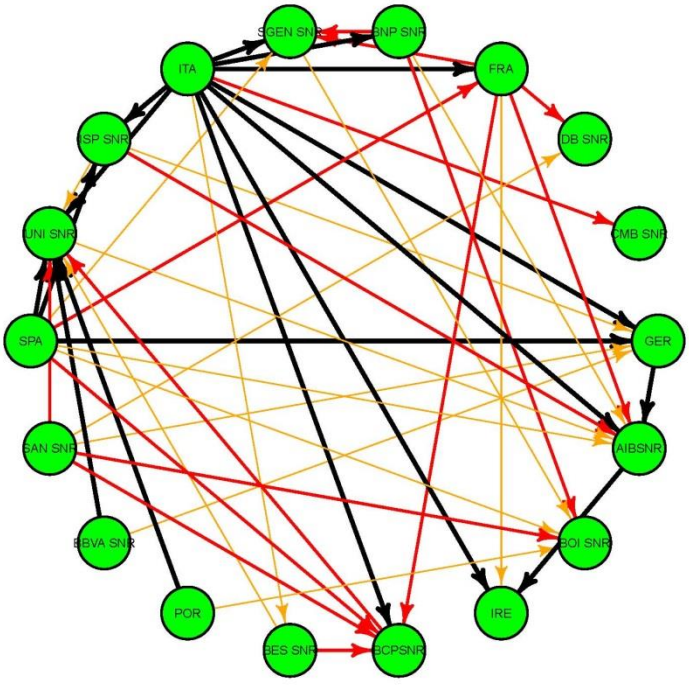
Sub-period 1: 12/30/2008 to 03/18/2009



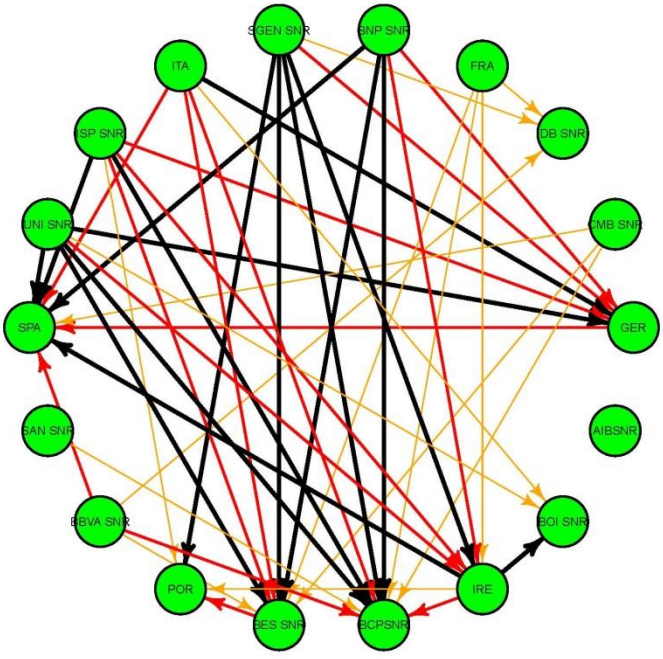
Sub-period 2: 03/19/2009 to 04/22/2010



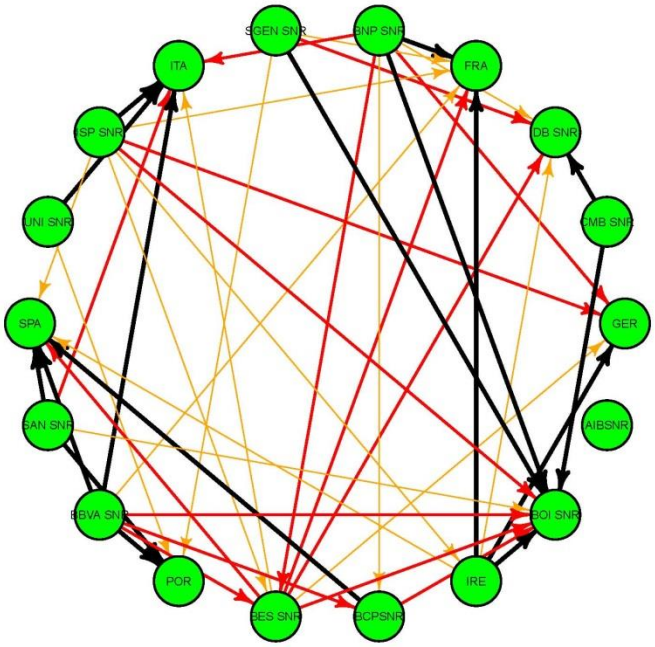
Sub-period 3: 04/23/2010 to 10/07/2011



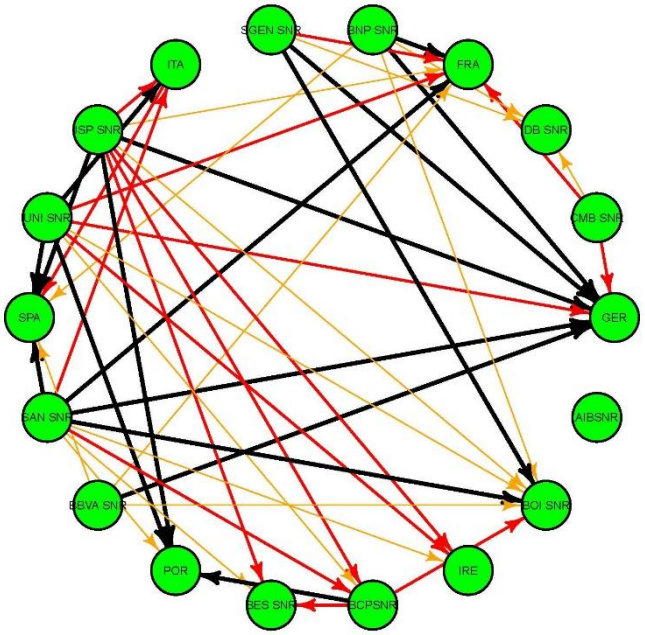
Sub-period 4: 10/08/2011 to 07/26/2012



Sub-period 5: 07/27/2012 to 03/23/2013



Sub-period 6: 03/24/2013 to 12/08/2014



Notes: We show the most important directional connections among the 55 pairs of the 10-year bond yields under study. Black, red and orange links (black, grey and light grey when viewed in grayscale) correspond to the tenth, twentieth and thirtieth percentiles of all net pair-wise directional connections. GER, FRA, ITA, SPA, POR and IRE stand for Germany, France, Italy, Spain, Portugal and Ireland respectively. BBVA SNR, SANSNR, UNISNR, ISPSNR, SGEN SNR, BNP SNR, DBSNR, CMB SNR, AIB SNR, BOI SNR, BCP SNR and BES SNR stand for senior CDS for Banco Bilbao Vizcaya Argentaria, Santander, Unicredito, Intesa San Paolo, Societe Generale, BNP Paribas, Deutsche Bank, Commerzbank, Allied Irish Bank, Bank of Ireland, BCP and Banco Espirito Santo

The first sub-period (1), which spans from December 2008 to march 2009, can still be defined as a pre-crisis period, since the downtrend in the total level of connectedness in euro area sovereign debt markets is suddenly reversed. However, during in the following sub-periods the downtrend in connectivity deepens. Indeed, sub-period 3– from April 2010 to October 2011 – was a time of turbulence in EMU sovereign debt markets: rescue packages were lent to Greece (May 2010), Ireland (November 2010) and Portugal (April 2011), and at the end of it (August 2011) the European Central Bank (ECB) announced its second covered bond purchase program. As noted, the uncertainty continued in European debt markets during sub-period 4 (August 2011 - July 2012). During this phase, Italy was in the middle of a political crisis and the main rating agencies lowered the ratings not only of peripheral countries but of Austria and France as

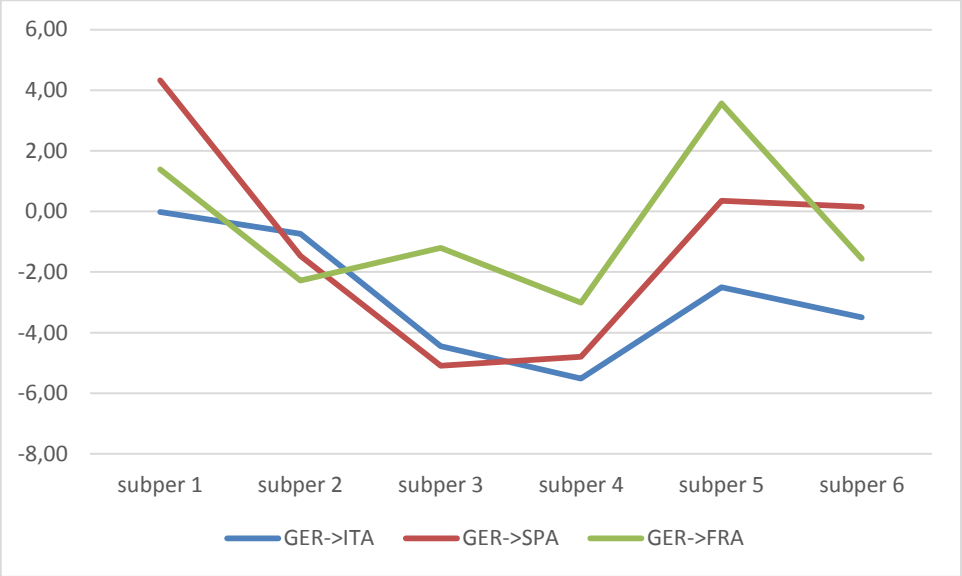
well. In this context of financial distress and huge liquidity problems, the ECB responded by implementing nonstandard monetary policies – that is, policies that went further than setting the refinancing rate. In particular, the ECB's principal means of intervention were the so-called long term refinancing operations (LTRO) [3]. In November 2011 and March 2012, the ECB provided banks with a sum close to 500 billion Euros for a three-year period. However, in March 2012 the second rescue package to Greece was approved, and in June 2012 Spain requested financial assistance to recapitalize its banking sector. This was the backdrop to the ECB's President Mario Draghi's statement that he would do "whatever it takes to preserve the euro". Sub-period 5, which starts after that statement in July 2012, clearly reflects the healing effects of Draghi's words since a substantial increase in the level of total connectedness can be observed in EMU sovereign debt markets. Nonetheless, our indicator definitely registered a new slowdown in March 2013, when Cyprus requested financial support. Therefore, the last sub-period (6) spans from that date to the end of the sample (December 2014).

4.3. Net pair-wise directional connectedness

Connectedness rose and then fell. It peaked when 'whatever it takes' was announced, thanks exclusively to a rise in the bank sovereign connectedness. However, this was not driven by a rise in the connectedness between periphery banks and sovereign. The sovereign connectedness rose in the period prior to 'whatever it takes', partly driven by a rise in the bank-sovereign connectedness (Figure 4.2).

[3] When the crisis struck, big central banks like the US Federal Reserve slashed their overnight interest-rates in order to boost the economy. However, even cutting the rate as far as it could go (to almost zero) failed to spark recovery. The Fed then began experimenting with other tools to encourage banks to pump money into the economy. One of them was Quantitative Easing (QE). To carry out QE, central banks create money by buying securities, such as government bonds, from banks, with electronic cash that did not exist before. The new money swells the size of bank reserves in the economy by the quantity of assets purchased—hence "quantitative" easing. In the euro area, the principal means of intervention adopted by the ECB was the LTRO, which differed notably from the QE policies of the Federal Reserve, in which the Fed purchased assets outright rather than helping to fund banks' ability to purchase them. The LTRO is not the only non-standard monetary policy to have been implemented by the ECB since the crisis. Other measures were the narrowing of the corridor, the change in eligibility criteria for collateral, interventions in the covered bonds market and, most importantly, the ECB's launch of the security market program in 2010 involving interventions in the secondary sovereign bond market. The latter program was discontinued in 2011.

Figure 4.2: Net direction connectedness from Germany to Italy, France and Spain



Source: author´s calculations

In particular, while the number of significant pairwise connectedness rose from 33 (subperiod 1) to 87 (subperiod 5), this was mainly driven by an increase in the bank-sovereign connectedness in period 5. Also, note that there is a rise in connectivity amongst peripheral countries that recedes in the last period, a sign that investors start to differentiate amongst specific countries in the periphery, given the differences in their stress levels.

Finally, a measure of the disconnect between the periphery and Germany (which we consider a safe asset throughout the period) may give an indication of the level of transfer of risk between the stressed Eurozone countries and the periphery. This transfer of risk can be considered an indication of the resilience of the Eurozone. Note for instance that in the case of Italy, net directional connectedness with Germany turned negative as soon as stress started (in particular, periods 4 and 5, meaning that instead of Germany anchoring Italian CDS, Italian CDS were driving German CDS higher), however, it recovered in subperiod 5, in the wake of 'whatever it takes', and then worsened, although slightly, in period 6, when some worries about specific periphery countries resurfaced. The results for the Spanish CDS are similar.

4.4. Policy implications

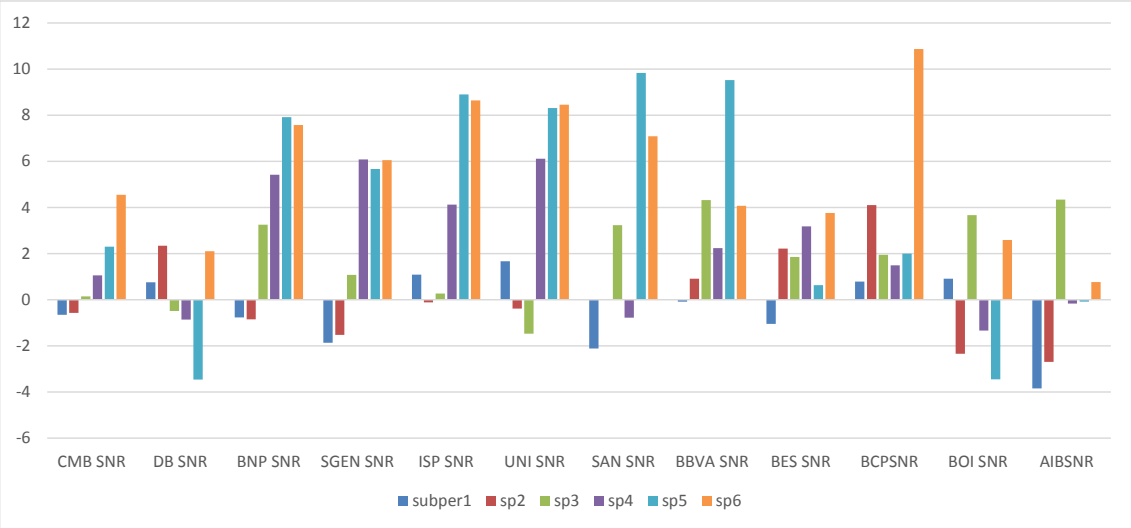
The indicator developed in the above sections has a number of implications for policy. In this section, we use the results from the previous section to shed light on three aspects that have been debated in the academic and policy literature. First, the change in the direction of the spillovers from sovereigns to own country banks. Secondly, we show the difficulty in regulating SIFIs in normal times, as institutions that may not seem SIFIs in normal times can become systemic in times of stress. Finally, we analyse how connectedness between sovereigns and own country banks has strengthened over time, and test two usual determinants: global risk aversion or the increase in the demand for sovereign bonds.

4.4.1. bank-sovereign connectedness

Acharya (2009) and others show that bank bailout programmers implemented in 2008 led to a change in the risk transfer between sovereigns and banks: before the bailouts, the sovereigns transferred risk to the banks, but once the market perceived there was a blanket guarantee from the sovereigns to the banks, the directions of causality was the opposite, with the banks being net issuers of stress to the sovereigns, and the latter going from being net issuers to net receivers. This result has been confirmed by others like Erce (2013).

Figure 4.3 shows the net issue of stress for each bank in the sample to its sovereign: in most cases banks went from being net receivers of risk to being net senders of risk from their sovereigns, which is consistent with the hypothesis mentioned above. This was particularly true in period 5, although in some cases, in core countries like France the process started in period 3. What´s more, Figure 4.3 suggests a relatively similar trend for the banks in a given country, which may be a sign that the connectivity with the sovereign is a function of policies implemented by the latter. This is in line with the finding that the bailouts of the banking sector effectively transferred their risk to their sovereign.

Figure 4.3: Net issuance of connectedness from banks to own sovereign



Source: author´s calculations

4.4.2. Systemically important financial institution (SIFI) status

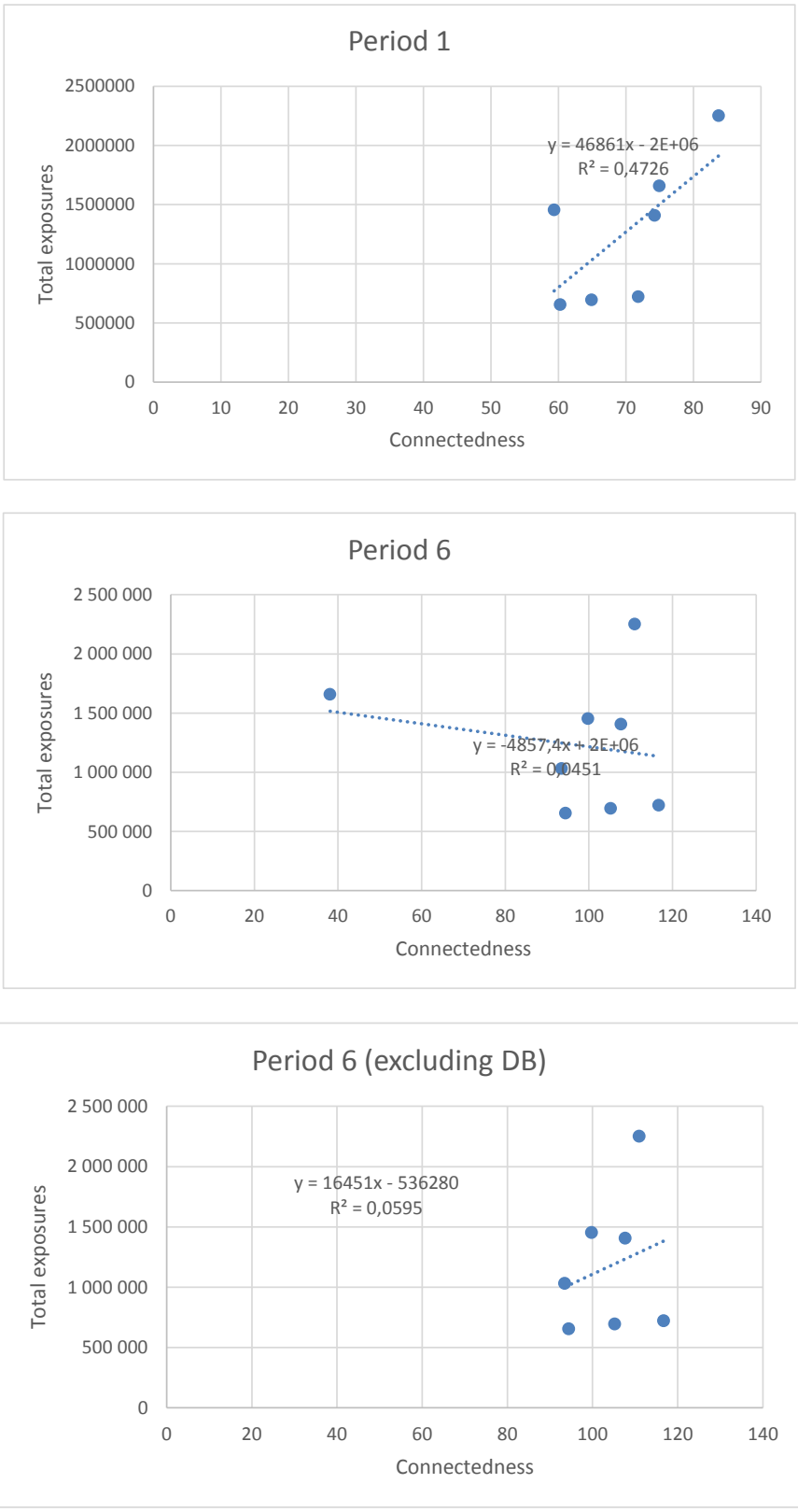
Another aspect that may be analysed in this framework is whether the Basel III SIFI regulation is appropriate in preparing the banking system for a future downturn. The regulation identifies firms that may have a negative externality on the system because of the systemicity. The interconnectedness of the firms with the system is a key ingredient of SIFI status. As a result, firms that qualify as SIFIs are required to hold extra capital, so as to make the failure of one of these banks, which is deemed particularly costly from a social perspective, less likely.

We test the regulation in three ways, although the robustness of the relationships are limited by the short sample of banks that are both included in our exercise and the data made available under regulatory disclosures. First, we compare the total exposures, the key indicator of systemicity, with a firm`s connectedness with the system: this will test whether exposure based indicators of systemicity are good indicators of actual contributions to systemic risk. Secondly, we compare the contribution to systemic risk to the SIFI capital surcharge that firms are subjected to. Finally, we run a simulation, where we show that even for a firm that the systemic contribution in the crisis was rather low, the prevalence of shocks is such that there is a high probability that its contribution to global risk may be larger than that of a SIFI.

Figure 4.4 displays the relationship between the systemic impact and total exposures of the entities. In normal times or in the initial phase of the crisis, there is a positive relationship, such that the banks with a larger exposure are the ones considered more systemic, and so the ones holding more capital on this account. While there are some divergences, overall, the result points to the fact that the more systemic institutions are the ones that have to hold more capital, meaning that, overall, SIFI regulation is well targeted.

After a few years of the crisis and after the broad declines in the connectivity of institutions (e.g. the period 6), the relationship between total exposures and the systemic capital surcharge changes completely: the total exposure is no longer a good predictor of connectivity. Note that the R^2 is low even when an apparent outlier is taken out of the simple. Therefore, the current regulation of SIFIs might not be appropriate in times of crisis, when a relatively small bank can have systemic consequences once crisis mode sets in and the systemic impact becomes less related to bank exposures.

Figure 4.4: Total bank exposures (Mln Euros) and connectedness



Source: author´s calculations

These results suggest that the changing nature of connectivity makes the ex-ante determination of which bank is systemic difficult. In other to further research this point we compare the impact on financial system stress of a given institution during the global financial crisis with the capital surcharge that is meant to internalize the costs of the contribution to systemic stress (Table 4.4).

Table 4.4. CDS: baseline and stressed scenario

	Initial CDS	Stressed CDS	% of stress caused by banks
CMB SNR	86,5	361,8	9,9
DB SNR	101,078189	186,79	6,7
BNP SNR	70,5	354,24	10,1
SGEN SNR	107,5	426,2	10,0
ISP SNR	112	607,89	10,2
UNI SNR	124	678,31	10,2
SAN SNR	103	490	10,1
BBVA SNR	99	513,5	10,1
BES SNR	94	1277,02	8,1
BCP SNR	104	1878,54	8,9
BOI SNR	245	2218,702	5,0
AIB SNR	206	19483,279	0,8

Initial CDS is the CDS value in the first period, while stressed CDS is the maximum value attained. The % of stress caused by a banks results of the calculation and normalization of our connectedness results for each bank with the whole system.

Secondly, we calculate the additional capital that Basel III regulation requires SIFIs to hold on accounts of their systemicity (Table 4.5).

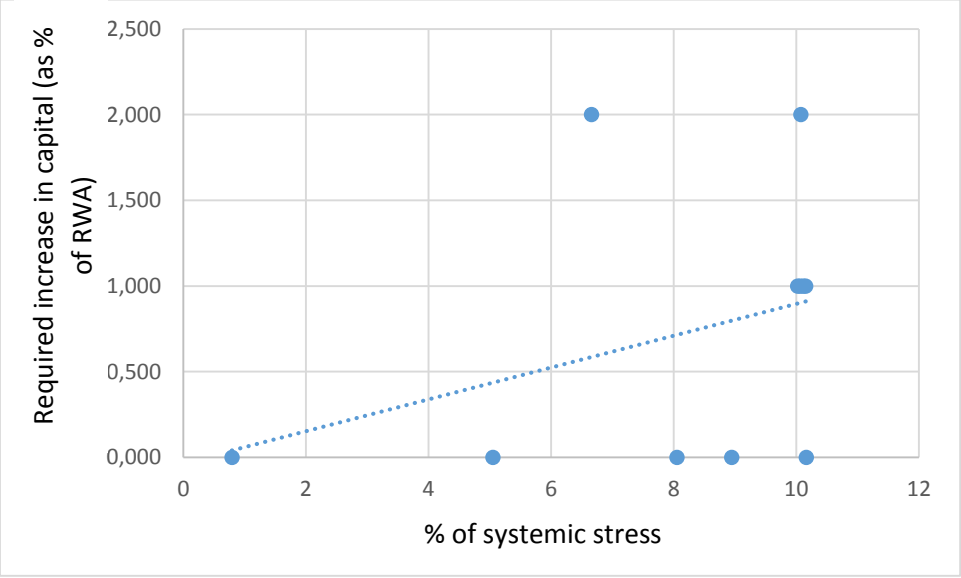
Table 4.5. Capital requirements (Mln Euros) and systemic capital surcharge

	Aditional capital	% of RWA of additional CEQ
CMB SNR	0	0
DB SNR	7458,16	2
BNP SNR	11551,18	2
SGEN SNR	345,07	1
ISP SNR	0	0
UNI SNR	4477,34	1
SAN SNR	5586,07	1
BBVA SNR	3320,34	1
BES SNR	0	0
BCP SNR	0	0
BOI SNR	0	0
AIB SNR	0	0

Source: European Banking Authority, 2015.

As Figure 4.5 illustrates, firms that had a substantial systemic impact on stress will not be considered systemic, while other with a similar impact will be considered systemic.

Figure 4.5: Systemic capital requirement and contribution to systemic stress (%)



The above analysis shows that first, the institutions that have a systemic impact in stress may be different to those in normal times, and, secondly, the current SIFI systemic capital requirement regulation would treat firms that in 2008 had a similar systemic impact differently. The question that emerges is whether there can be indicators that can be more reliable.

In order to answer this question, we run a simulation to test the circumstances under which a non-systemic institution may become systemic. In order to do this, we test the probability of systemic stress of a not SIFI is superior to a SIFI systemic stress.

We analyze two firms: BOI and Unicredito. The first generates 5.5% of the stress of the system, the second a 10.15%, as measured by our systemic indicator. The first is not SIFI according to the classification used by Basel III, the second is. In this case, one could argue that this classification is correct, given the large difference in their contribution to systemic risk. However, even in such cases, the systemic contribution is similar enough that the possibility of a shocks that is large enough to Unicredito cannot be ruled out.

We assume that an increase in the CDS of Unicredito of 1% increases on average the CDS from the system in 0,1015% (the CDS of the system being a synthetic measure of system-wide risk). In the second case this figure is 0,055%. This is the interpretation of the result that 5.5% of the stress of the system is because BOI-10.15% to UNI (Table 4.6).

Table 4.6: System CDS

1% shock	Start	Finish
to BOI	100	105
to UNI	100	110

Source: author´s calculations

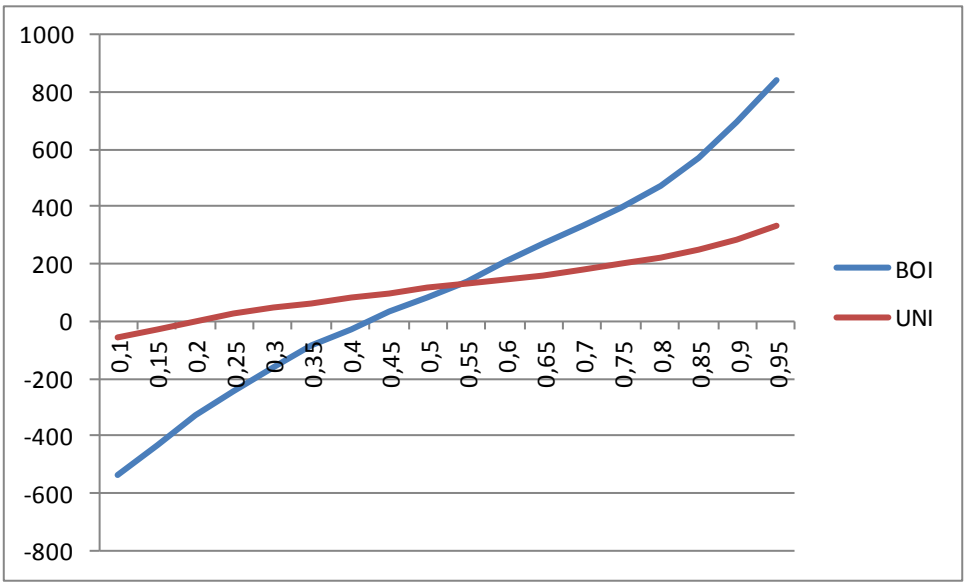
Where start and end are the system risk before each bank is shocked and finish system risk after a shock to each of the banks studied. In one case and another, to shock: a worsening of the BOI CDS increases the system CDS 5 and UNI CDS

increased increases the CDS from the system by 10%, in line with the results obtained previously.

We assume that the BOI and UNI CDS that generated this increased systemic risk are subject to a large number of shocks, with the probability distribution of each shock corresponding to the historical probability distribution of the shock to the average CDS. From this distribution, we can obtain the probability that BOI suffers a shock such that their CDS contributes to the system more than the shock from UNI.

Figure 4.6 presents the systemic contribution of each of the banks, when subjected to shocks. The probability distribution of a given shock (shown here as a certain contribution to system risk) is shown in the chart. As can be seen in the graph, there is a 45% chance of that contribution to systemic risk of BOI is greater than the Unicredito. Where start and end are the CDS of the system in one case and another, to shock. This results from the fact that while in the central scenario the shock to BOI is less systemic than the shock to Unicredito, the stardad deviation of BOI shocks is so large that one cannot rule out a shock that is so large that its systemic impact is larger than that of Unicredito.

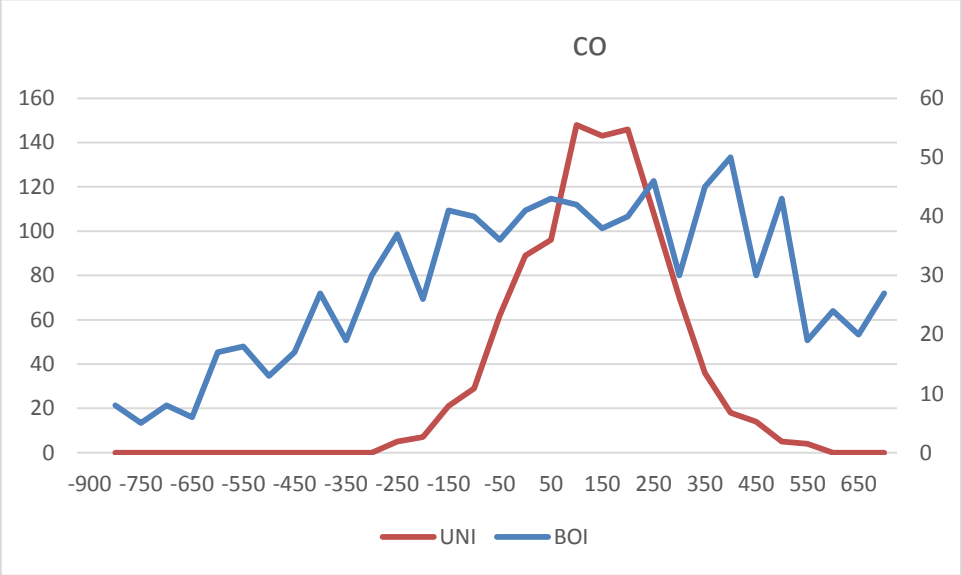
Figure 4.6: Systemic contribution of the CDS of Bank of Ireland and Unicredit (basis points) under scenarios weighted by the probability of ocurring



Source: author´s calculations

This exercise shows that even banks that a priori have a very different systemic importance, can be subject to shocks such that, with a probability close to 50%, the non-systemic institution has more systemic impact than the a priori systemic institution. This is due to the large differences in the probability distribution of the shocks: in this case, BOI has a much large standard deviation, which results in a different frequency distribution of the shocks (Figure 4.7).

Figure 4.7: Frequency distribution of 1000 draws of the BOI (right axis) and UNI CDS (draws taken using the historical average and standard deviation distribution of shocks)



Source: author´s calculations

The difficulty in determining ex-ante the systemic institution, as shown in the examples above, can be taken as evidence that a non-systematic approach to SIFI may be warranted. Alternatively, the focus can be set on swift bank resolution rather than the ex-ante determination of which institutions are systemic. The difficulties of this approach have already been highlighted by Chen (2010), and Brownlees (2011).

4.4.3. The role of sovereign debt holdings in sovereign-bank connectedness

Finally, an aspect that our indicator can help us shed light on is the role of home bias. Much has been written about the retrenchment of capital in crisis times. Some have argued that this retrenchment, articulated through banks´ increased holdings of sovereign bonds, is at the root of the reinforcement of the bank-sovereign nexus, which is costly in that it creates an inefficient allocation of resources and that it leads to perverse incentives (Uhlig, 2014; Broner, 2013).

In order to test this, we compare our connectedness indicator, which can be considered an indicator of market perception of sovereign-bank connectedness, and actual holdings of government bonds.

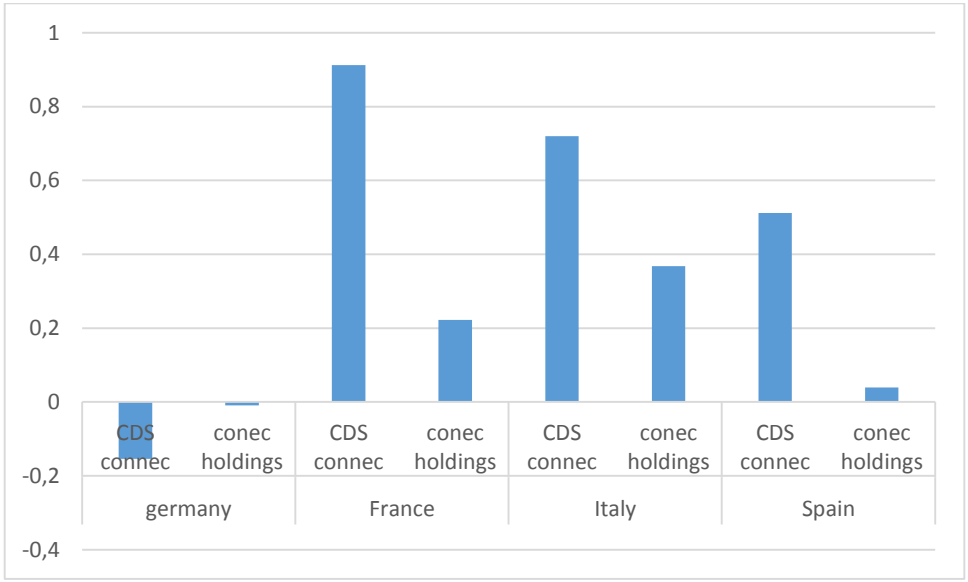
As Figure 4.8 shows, there does not seem to be a clear relationship between the holdings of sovereign debt and the connectivity with its own bank. As can be seen in the chart, the holdings of sovereign bonds seem to follow a rising path, while connectivity between Banks and sovereigns peaks around 2013. This suggests that there could be other driving forces of connectedness. For instance, the absence of a lender of last resort could reinforce the nexus. In this light, the ability of the ECB to quell stress in the 2013-2014 (and its lack of intervention in the early stages of the crisis), thus reducing the perceived probability of default, may be a more robust explanation.

Figure 4.8 Domestic bond holdings (orange line, million EUR) and sovereign-bank connectivity (blue line, right axis)

Source: author´s calculations, European Banking Authority

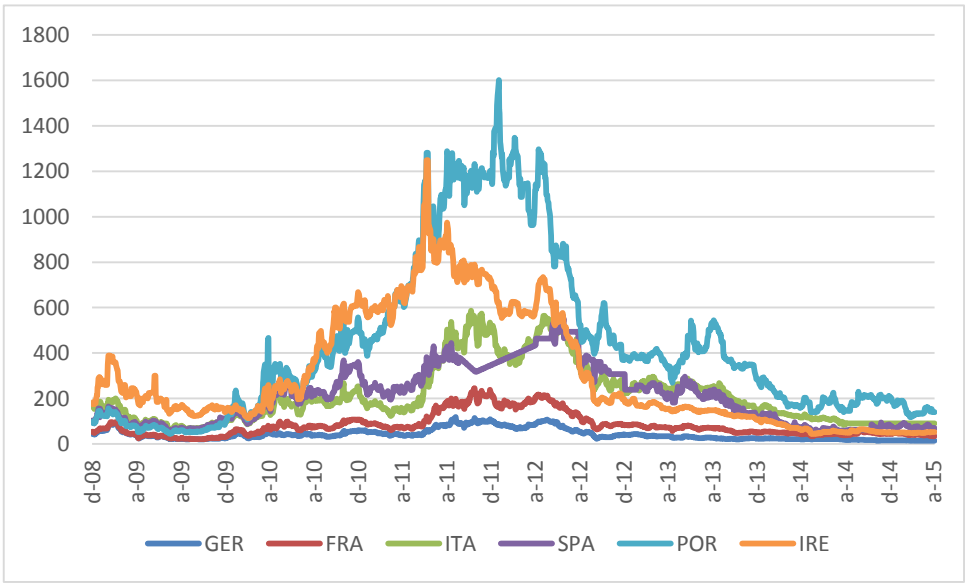
Indeed, the driver of connectedness could be volatility or the deterioration in sovereign solvency conditions: to the extent that banks and sovereigns become healthier, the probability of a bank rescue that leads to the bankruptcy of both the bank and the sovereign becomes lower. As can be seen in Figure 4.9, connectedness is more correlated with country stress indicators (in this case, the CDS), than with domestic bond holdings.

Figure 4.9: Correlation coefficient, sovereign-bank connectivity with sovereign CDS level and domestic bond holdings



Source: author´s calculations

Figure 4.10: Sovereign CDS, selected Eurozone countries (basis points)



Source: Bloomberg

4.5. Concluding remarks.

The analysis above sheds light on interconnectedness across banks and sovereigns in the Eurozone. The results show the importance of the links both between banks and sovereigns and across sovereign in determining the developments in sovereign risk. The main takeaways are, first, the role played by the transmission of risk between core and periphery countries, and secondly, the changing importance of banks in relation to their own sovereign. It is important to note that even when controlling for bank CDS, the pattern between core and periphery remains similar to those of other studies (like Singh *et al.*, 2016).

Furthermore, the elaboration of a connectedness indicator shows, first, the difficulty involved in determining ex-ante the systemic impact of banks. Second, it suggests that the link between banks and sovereigns is probably more related to stress in the sovereign than to other factors, like increased bank holdings of sovereign debt.

From a policy perspective, the main takeaways, are, therefore, that the characterization of the EMU sovereign debt crisis as a crisis of confidence in the Eurozone is appropriate, but this was solved by upgrading the role of the ECB in this context. Secondly, in a more pessimistic note, while our results show that bank stress can be quite significant in determining sovereign stress, they suggest that it is difficult to determine which banks are systemic, and as a result, require higher capital for these institutions, which in turn should minimise their negative impact on sovereign risk.

One way of dealing with this uncertainty is to deepen the current workings of the EMU. By creating a true banking union, the nexus between a bank and its own sovereign should decline. Secondly, the difficulty in assessing systemicity calls for a quick, structured framework for bank resolution after a crisis. Assuring that resolution authorities have the resources and the mandate to tackle issues from wherever they might arise can be essential, given the difficulties in understanding the origins of systemic risk.

Conclusions: Main findings and policy implications

This section summarises the main conclussions from the analysis that have carried out throught the thesis and the main policy implications that derive from them.

This thesis has studied the developments in the Eurozone from different perspectives. A key takeaway from the previous chapters regards the limits of fiscal policy in the context of a single currency struck by a financial crisis. In such a setting, a previously sound fiscal position can spiral out of control quickly. Some main questions also emerge from our analysis.

Given the issues associated with a currency union, it is essential to build up sound institutions and political room for maneuver. The growth and inflation environment emerge from the first paper as a key driver of fiscal policy in distressed times. In particular, it seems pre-existing policies may help a government deliver during stress. Also, slower growth can have a higher impact on debt sustainability than one would expect.

A key consequence of this is that fiscal policy can become quickly constraint. When one adds the possibility that interest rates rise non-linearly when debt sustainability is in question, the ability of fiscal policy to adjust so as to make debt sustainable will be limited. In addition, a new angle regarding contractionary fiscal policy can be found in this first chapter: aside from the worsening of growth due to the fiscal consolidation in a recession, the fact that the government balance reacts more than one-to-one to growth suggests debt dynamics will worsen further.

In our view, these results suggest two avenues to avoid distress: first, a good starting position not just in terms of the fiscal stance, but also in terms of the institutional make up. The flexibility afforded by this position will be essential in the downturn. A possible avenue for further research would analyze how the interaction of sound policies and fiscal room help debt dynamics by helping countries avoid fiscal fatigue.

Second, once financial stress sets in, the dynamics that emerge may have different implications and drivers than would seem apparent at first sight. In

particular, the rise in the holdings of sovereign bonds, considered generally as a destabilizing factor in the downturn that deepens the credit crunch may not have been as negative.

In particular, the evidence we find suggests banks increase in holdings of sovereign domestic debt only in specific periods of times. In addition, the stabilization of a distressed sovereign was probably the driver of the rise in holdings. Our analysis suggests alternative hypotheses, such as search for yield or regulatory incentives did not quite play a role in the build up of sovereign bonds. Further research is therefore required to understand the overall welfare implications of the 0 risk weight: aside from the negative implications regarding the sovereign-bank nexus and the bias of banks away from other investment opportunities, banks may act as stabilizers in sovereign debt markets, while sovereign bonds, in turn, provide banks with a liquid, risk-free asset that avoids worsening the crisis.

Indeed, the build up of sovereign holdings did not play a major role in the connectivity between banks and sovereigns. We find distress in the sovereign is much better correlated than holdings with connectivity amongst these two entities.

Given the limits to active contractiony fiscal policy in the downturn, and the fact that sovereign stress leads to negative dynamics such as the reinforcement of the bank sovereign nexus and renders countercyclical fiscal policy more difficult, greater emphasis should be placed in other policy levers or on those levers that may accommodate the fiscal expansion.

An important research question regards the use of alternative policy levers during a downturn. In particular, the expansionary effects of monetary policy may be enhanced to the extent that it is used to lower financial fragmentation. Other levers, such a countercyclical prudential policy may be appropriate. To the extent that bank profitability shocks may lead to more switches in bank demand towards sovereign bonds (like those found, for small periods, in the third chapter), lower capital requirements may boost lending to the private sector. However, such a policy has limits: if by reducing capital buffers investors perceive that banks are weak, such banks will come under pressure, which could, as a result, enhance

the sovereign-bank nexus and deliver a worse outcome. Understanding the appropriate policy mix in a downturn, given that fiscal policy could be constraint, requires a deep understanding of the determinants of bank-sovereign nexus and can be subject of fruitful further research.

References:

Abad, P., Chuliá, H., & Gómez-Puig, M. (2010). EMU and European government bond market integration. *Journal of Banking & Finance*, *34*(12), 2851-2860.

Abascal, M., Alonso, T., & Mayordomo, S. (2013). *Fragmentation in European Financial Markets: Measures, Determinants, and Policy Solutions* (No. 1322).

Abiad, A. G., Li, B. G., & Dell'Ariccia, G. (2011). Creditless recoveries. *IMF Working Papers*, 1-30.

Acemoglu, D., Ozdaglar, A., & Tahbaz-Salehi, A. (2015). Systemic Risk and Stability in Financial Networks. *American Economic Review*, *105*(2), 564-608.

Acharya, V, L Pedersen, T Philippon and M Richardson (2009), "Regulating Systemic Risk". NYU Stern School Working Paper.

Acharya, V. V. (2009). A theory of systemic risk and design of prudential bank regulation. *Journal of financial stability*, *5*(3), 224-255.

Acharya, V. V., & Steffen, S. (2015). The "greatest" carry trade ever? Understanding eurozone bank risks. *Journal of Financial Economics*, *115*(2), 215-236.

Acharya, V. V., Brownlees, C., Engle, R., Farazmand, F., Richardson, M., Cooley, T. F., & Walter, I. (2010). Measuring Systemic Risk. *Regulating Wall Street: The Dodd-Frank Act and the New Architecture of Global Finance*, 85-119.

Acharya, V., Engle, R., & Richardson, M. (2012). Capital shortfall: A new approach to ranking and regulating systemic risks. *The American Economic Review*, 59-64.

Adrian, T and H Shin (2009), "Financial intermediaries and monetary economics", *Federal Reserve Bank of New York Staff Reports*, no 398.

Adrian, T. and Brunnermeier, M. (2008) CoVaR. Staff Report 348, Federal Reserve Bank of New York.

Afonso, A. (2008). Ricardian fiscal regimes in the European Union. *Empirica*,*35* (3), 313-334.

Afonso, A., & Furceri, D. (2010). Government size, composition, volatility and economic growth. *European Journal of Political Economy*, *26*(4), 517-532.

Afonso, A., & Hauptmeier, S. (2009). Fiscal Behaviour in the European Union: Rules. *Fiscal Decentralization and Government Indebtedness, Paper*, (1054).

Agénor, P. R., & da Silva, L. P. (2010). Reforming international standards for bank capital requirements: a perspective from the developing world.*International Finance Review*, *11*, 191-254.

Aghion, P., Bolton, P., & Dewatripont, M. (2000). Contagious bank failures in a free banking system. *European Economic Review*, *44*(4), 713-718.

Agur, I and M Demertzis (2009), "A Model of Monetary Policy and Bank Risk Taking", Mimeo, De Nederlandsche Bank, December.

Ahumada, H. A., & Garegnani, M. L. (2005). Testing the Exogeneity of Argentine Devaluation and Default Risks in Retrospect*. *Oxford Bulletin of Economics and Statistics*, *67*(5), 647-672.

Aikman, D., Alessandri, P., Eklund, B., Gai, P., Kapadia, S., Martin, E., ... & Willison, M. (2011). Funding liquidity risk in a quantitative model of systemic stability. *Central Banking, Analysis, and Economic Policies Book Series*, *15*, 371-410.

Alesina, A., & Drazen, A. (1991). Why Are Stabilizations Delayed?. *The American Economic Review*, *81*(5), 1170-1188.

Alesina, A. F., & Tabellini, G. (2005). Why do Politicians Delegate?. *Harvard Institute of Economic Research Discussion Paper*, (2079).

Alesina, A., Campante, F. R. and Tabellini, G. (2008). Why is fiscal policy often procyclical? *Journal of the European Economic Association* **6**:1006–1036.

Alesina, A., Roubini, N., & Cohen, G. D. (1997). *Political cycles and the macroeconomy*. MIT press.

Alessi, L., & Detken, C. (2011). Quasi real time early warning indicators for costly asset price boom/bust cycles: A role for global liquidity. *European Journal of Political Economy*, *27*(3), 520-533.

Alfaro, R and M Drehmann (2009), “Macro stress tests and crises: what can we learn?”. BIS Quarterly Review, December, pp. 29-41.

Alizadeh, A. H., Nomikos, N. K., & Pouliasis, P. K. (2008). A Markov regime switching approach for hedging energy commodities. *Journal of Banking & Finance*, *32*(9), 1970-1983.

Allen, F., & Babus, A. (2009). Networks in Finance. *The Network Challenge: Strategy, Profit, and Risk in an Interlinked World*, 367.

Allen, F., & Gale, D. (2000). Financial contagion. *Journal of Political Economy*,*108*(1), 1-33.

Allen, F., & Gale, D. (2004). Financial fragility, liquidity, and asset prices. *Journal of the European Economic Association*, *2*(6), 1015-1048.

Allen, F., Carletti, E., & Corsetti, G. (2011). *Life in the Eurozone With or Without Sovereign Default?*. FIC Press.

Allen, W. A., & Moessner, R. (2010). *Central bank co-operation and international liquidity in the financial crisis of 2008-9*. Bank for International Settlements, Monetary and Economic Department.

Allen, W. A., & Wood, G. (2006). Defining and achieving financial stability.*Journal of Financial Stability*, *2*(2), 152-172.

Alter, A., & Beyer, A. (2014). The dynamics of spillover effects during the European sovereign debt turmoil. *Journal of Banking & Finance*, *42*, 134-153.

Altunbas, Y., Gambacorta, L., & Marques-Ibanez, D. (2009). Securitisation and the bank lending channel. *European Economic Review*, *53*(8), 996-1009.

André, C., & Girouard, N. (2005). *Measuring cyclicallyadjusted budget balances for OECD countries* (No. 434). OECD Working Papers.

Ang, A. and Longstaff, F.A. (2013) Systemic sovereign credit risk: Lessons from the US and Europe. *Journal of Monetary Economics*, 60, 493-510.

Angelini, P, S Neri and F Panetta (2010), “Macroeconomic Stabilization Policies: Grafting Macroprudential Tools in a Macroeconomic Framework”. Mimeo, Banca d’Italia.

Angelini, P., Neri, S., Panetta, F., (2012), Monetary and macroprudential policies, Working Paper Series 1449, European Central Bank.

Angeloni, C., & Wolff, G. B. (2012). *Are banks affected by their holdings of government debt?* (No. 2012/07). Bruegel working paper.

Angeloni, I., & Faia, E. (2009). *A tale of two policies: Prudential regulation and monetary policy with fragile banks* (No. 1569). Kiel working paper.

Antonakakis, N. and Vergos, K. (2013) Sovereign bond yield spillovers in the Euro zone during the financial and debt crisis. *Journal of International Financial Markets, Institutions and Money*, 26, 258-272.

Apostolakisa, G. and Papadopoulos, A. P. (2014) Financial stress spillovers in advanced economies. *Journal of International Financial Markets, Institutions and Money*, 32, 128-149.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The review of economic studies*, *58*(2), 277-297.

Arestis, P., & Glickman, M. (2002). Financial crisis in Southeast Asia: dispelling illusion the Minskyan way. *Cambridge Journal of Economics*, *26*(2), 237-260.

Arghyrou, M. G., & Tsoukalas, J. D. (2010). *The option of last resort: A two-currency EMU* (No. E2010/14). Cardiff Economics Working Papers.

Aronovich, S. (1999). Country risk premium: Theoretical determinants and empirical evidence for Latin American countries. *Revista Brasileira de Economia*, *53*(4), 463-498.

Arora, M. V. B., & Cerisola, M. M. D. (2000). *How does US monetary policy influence economic conditions in emerging markets?* (No. 0-148). International monetary fund.

Aßmann, C., & Boysen-Hogrefe, J. (2012). Determinants of government bond spreads in the euro area: in good times as in bad. *Empirica*, *39*(3), 341-356.

Attinasi, M. G., Checherita-Westphal, C., & Nickel, C. (2009). *What explains the surge in euro area sovereign spreads during the financial crisis of 2007-09?*(No. 1131). European Central Bank.

Auerbach, A. J. (2009). Implementing the New Fiscal Policy Activism. *American Economic Review*, *99*(2), 543-49.

Awartania, B., Maghyerehb, A.I. and Al Shiabc, M. (2013) Directional spillovers from the U.S. and the Saudi market to equities in the Gulf Cooperation Council countries. *Journal of International Financial Markets, Institutions and Money*, 27, 224-242.

Baele, L., Ferrando, A., Hördahl, P., Krylova, E., & Monnet, C. (2004). 14 "Measuring Financial Integration in the Euro Area" by. In *ECB Occasional Paper*.

Baig, M. T., & Goldfajn, M. I. (2000). *The Russian Default and the Contagion to Brazil* (No. 0-160). International Monetary Fund.

Baker, D., & McArthur, T. (2009). The value of the "too big to fail" big bank subsidy. *Center for Economic and Policy Research Issue Brief. September*.

Ballabriga, F. C., & Martinez-Mongay, C. (2005). *Sustainability of EU public finances* (No. 225). European Commission, Directorate-General for Economic and Financial Affairs.

Bank for International Settlements (1986), "Recent innovations in international banking", Report prepared by a Study Group established by the central banks of the Group of Ten countries, Basel, April (Cross Report).

Bank for International Settlements (2008), "Addressing financial system procyclicality: a possible framework". Note for the FSF Working Group on Market and Institutional Resilience, September.

Bank for International Settlements (2010), "Group of Central Bank Governors and Heads of Supervision reinforces Basel Committee reform package", BIS press release, 11 January 2010 (http://www.bis.org/press/p100111.htm).

Bank of England (2009), "The role of macroprudential policy", Bank of England Discussion Paper, November.

Barrios, S., Iversen, P., Lewandowska, M., & Setzer, R. (2009). Determinants of intra-euro area government bond spreads during the financial crisis. *Economic papers*, (388), 1-26.

Basel Committee for Banking Supervision (2009), “International Framework for Liquidity Risk Measurement, Standards and Monitoring”. Bank for International Settlements, Basel, December (http://www.bis.org/publ/bcbs165.htm).

Basel Committee on Banking Supervision (2006). International Convergence of Capital Measurement and Capital Standards, BIS, June.

Basel Committee on Banking Supervision (2010), “An assessment of the long-term economic impact of stronger capital and liquidity requirements”, August.

Basel Committee on Banking Supervision (2014). Fundamental review of the trading book: A revised market risk framework, BIS, January.

Basel Committee. (2011). Global systemically important banks: assessment methodology and the additional loss absorbency requirement.

Battistini, N., Pagano, M., & Simonelli, S. (2014). Systemic risk, sovereign yields and bank exposures in the euro crisis. *Economic Policy*, *29*(78), 203-251.

Bean, C R (2003), “Asset prices, financial imbalances and monetary policy: are inflation targets enough?” in Asset Prices and Monetary Policy (eds. A. Richards and T. Robinson), pp. 48-76. Reserve Bank of Australia: Sydney.

Bean, C R (2007), “Globalisation and Inflation”. World Economics, vol. 8(1), pages 57-73, January

Bean, C. (2004), “Asset prices, financial instability, and monetary policy”, *American Economic Review* 94(2), p. 14-18.

Bean, C. (2009), “The Great Moderation, the Great Panic and the Great Contraction”, Schumpeter Lecture delivered at the the Annual Congress of the European Economic Association, Barcelona, 25 August.

Bean, C., Paustian, M., Penalver, A. and T. Taylor (2010), “Monetary policy after the fall”, paper presented at the Federal Reserve Bank of Kansas City Annual Conference, Jackson Hole, Wyoming, 28 August 2010.

Beber, A., Brandt, M. W., & Kavajecz, K. A. (2009). Flight-to-quality or flight-to-liquidity? Evidence from the euro-area bond market. *Review of Financial Studies*, *22*(3), 925-957.

Beetsma, R., Giuliodori, M., & Klaassen, F. (2008). The effects of public spending shocks on trade balances and budget deficits in the European Union. *Journal of the European Economic Association*, *6*(2-3), 414-423.

Beirne, J., & Fratzscher, M. (2013). The pricing of sovereign risk and contagion during the European sovereign debt crisis. *Journal of International Money and Finance*, *34*, 60-82.

Bell, J and D Pain (2000), "Leading Indicator Models of Banking Crises – A Critical Review", Bank of England Financial Stability Review, December, pp 113–29.

Benigno, G., Chen, H., Otrok, C., Rebucci, A. and E. Young (2010), "Revisiting Overborrowing and its Policy Implications", mimeo.

Bernanke, B (2010), "Monetary Policy and the Housing Bubble". Speech at the Annual Meeting of the American Economic Association, Atlanta, 3 January 2010. (http://www.federalreserve.gov/newsevents/speech/bernanke20100103a.htm)

Bernanke, B. S., & Gertler, M. (2001). Should central banks respond to movements in asset prices?. *The American Economic Review*, *91*(2), 253-257.

Bernanke, B. S., & Reinhart, V. R. (2004). Conducting monetary policy at very low short-term interest rates. *The American Economic Review*, *94*(2), 85-90.

Bernanke, B., Gertler, M. and S. Gilchrist (1999), "The financial accelerator in a quantitative business cycle framework", in J. Taylor and M. Woodford (eds.), Handbook of Macroeconomics, North Holland, p. 1341-1393.

Bernoth, K., & Erdogan, B. (2012). Sovereign bond yield spreads: A time-varying coefficient approach. *Journal of International Money and Finance*, *31*(3), 639-656.

Bernoth, K., & Wolff, G. B. (2008). Fool the markets? Creative accounting, fiscal transparency and sovereign risk premia. *Scottish Journal of Political Economy*, *55*(4), 465-487.

Bi, H. (2012). Sovereign default risk premia, fiscal limits, and fiscal policy. *European Economic Review*, *56*(3), 389-410.

Bianchi, J. (2011). Overborrowing and Systemic Externalities in the Business Cycle. *American Economic Review*, *101*, 3400-3426.

Bini Smaghi, L (2009), “Macro-prudential supervision”. Speech at the CEPR/ESI 13th Annual Conf. on "Fin.l Supervision in an Uncertain World", European Banking Center at Venice Intern. University, Venice, 25-26 Sept. 2009 (http://www.bis.org/review/r090929e.pdf).

Blanchard, O, G Dell’Ariccia, and P Mauro (2010), “Rethinking Macroeconomic Policy”. IMF Staff Position Note SPN/10/03, 12 February.

Blinder, A, M Ehrmann, M Fratzscher, J De Haan and DJ Jansen (2008), “Central Bank Communication and Monetary Policy: A Survey of Theory and Evidence”. Journal of Economic Literature, vol. 46(4), pp 910-45.

Blinder, A. S. (2009). Making Monetary Policy by Committee*. *International Finance*, *12*(2), 171-194.

Blundell-Wignall, A. (2012). Solving the financial and sovereign debt crisis in Europe. *OECD Journal: Financial Market Trends*, *2011*(2), 201-224.

Blunden G (2007), “Supervision and Central Banking”. Bank of England Quarterly Bulletin, August.

Bohn, H. (1995). The sustainability of budget deficits in a stochastic economy. *Journal of Money, Credit and Banking*, 257-271.

Bohn, H. (1998). The behavior of US public debt and deficits. *Quarterly journal of economics*, 949-963.

Bohn, H. (2008). The sustainability of fiscal policy in the United States. In: R. Neck and J. E. Sturm (Eds.) *Sustainability of Public Debt*, Cambridge, MA: MIT Press, 15–49.

Bolton, P., & Jeanne, O. (2011). Sovereign default risk and bank fragility in financially integrated economies. *IMF Economic Review*, *59*(2), 162-194.

Bongini, P., Laeven, L., & Majnoni, G. (2002). How good is the market at assessing bank fragility? A horse race between different indicators. *Journal of Banking & Finance*, *26*(5), 1011-1028.

Bordo, M. D., Dueker, M. J., & Wheelock, D. C. (2002). Aggregate price shocks and financial instability: A historical analysis. *Economic Inquiry*, *40*(4), 521-538.

Borgy, V, L Clerc, and JP Renne (2009), "Asset-price boom-bust cycles and credit: what is the scope of macro-prudential regulation?". Banque de France Working paper 263, December (http://www.banque-france.fr/gb/publications/telechar/ner/DT263.pdf).

Borio, C (2004), "Market distress and vanishing liquidity: anatomy and policy options". BIS Working Papers No 158, July.

Borio, C and M Drehman (2009b), "Assessing the risk of banking crises – revisited", BIS Quarterly Review, March, pp. 29-46

Borio, C and M Drehmann (2009a), "Towards an operational framework for financial stability: 'fuzzy' measurement and its consequences", BIS Working Papers, no 284, June.

Borio, C and P Lowe (2002), "Assessing the risk of banking crises". BIS Quarterly Review, December, pp. 43-54.

Borio, C and Packer, F (2004), "Assessing new perspectives on country risk". BIS Quarterly Review, December.

Borio, C, C Furfine and P Lowe (2001), "Procyclicality of the financial system and financial stability: issues and policy options". In "Marrying the macro- and micro-prudential dimensions of financial stability", BIS Papers, no 1, March, pp 1–57.

Borio, C, W English and A Filardo (2003), "A tale of two perspectives: old or new challenges for monetary policy?". BIS Working Paper No 127, February.

Borio, C. (2009), "Implementing the macroprudential approach to financial regulation and supervision", Banque de France Financial Stability Review No. 13, September.

Borio, C. (2012). towards a Macroprudential Framework for Financial supervision and regulation?. *New Perspectives on Asset Price Bubbles*, 243.

Borio, C. and Shim, I. (2007), "What can (macro-)prudential policy do to support monetary policy?", BIS Working Paper No. 242.

Borio, C., & White, W. R. (2003). Whither monetary and financial stability: the implications of evolving policy regimes. In *Proceedings-Economic Policy Symposium-Jackson Hole* (pp. 131-211). Federal Reserve Bank of Kansas City.

Borio, C., & Zhu, H. (2012). Capital regulation, risk-taking and monetary policy: a missing link in the transmission mechanism?. *Journal of Financial Stability*,*8*(4), 236-251.

Bover, O., & Arellano, M. (1997). Estimating dynamic limited dependent variable models from panel data. *investigaciones economicas*, *21*(2), 141-165.

Breton, R., Pinto, C., & Weber, P. F. (2012). Banks, moral hazard and public debts. *Financial Stability Review*, *16*, 57-70.

Broner, F., Erce, A., Martin, A., & Ventura, J. (2014). Sovereign debt markets in turbulent times: Creditor discrimination and crowding-out effects. *Journal of Monetary Economics*, *61*, 114-142.

Brouwer, H (2010), "Challenges in the design of macroprudential tools". Introductory speech at the workshop on "Concrete macroprudential tools" hosted by DNB, the IMF and the Duisenberg School of Finance, Amsterdam, 13 January 2010.

Brownlees, C., Engle, R., & Kelly, B. (2011). A practical guide to volatility forecasting through calm and storm. *The Journal of Risk*, *14*(2), 3.

Brunnermeier, M. K. (2009). Deciphering the Liquidity and Credit Crunch 2007-2008. *Journal of Economic Perspectives*, *23*(1), 77-100.

Brunnermeier, M. K., & Pedersen, L. H. (2009). Market liquidity and funding liquidity. *Review of Financial studies*, *22*(6), 2201-2238.

Brunnermeier, M. K., & Sannikov, Y. (2014). A Macroeconomic Model with a Financial Sector. *American Economic Review*, *104*(2), 379-421.

Brunnermeier, M. K., Gorton, G., & Krishnamurthy, A. (2011). Risk topography. In *NBER Macroeconomics Annual 2011, Volume 26* (pp. 149-176). University of Chicago Press.

Büchel, K. (2013). Do words matter? The impact of communication on the PIIGS'CDS and bond yield spreads during Europe's sovereign debt crisis. *European Journal of Political Economy*, *32*, 412-431.

Buiter, W (2009a), “Regulating the new financial sector”, FT/maverecon blog, available at http://blogs.ft.com/maverecon/2009/02/regulating-the-new-financial-sector/

Buiter, W (2009b), “The unfortunate uselesness of much of ‘state of the art’ academic monetary economics”, ft/maverecon blog, http://blogs.ft.com/maverecon/2009/03/the-unfortunate-uselessness-of-most-state-of-the-art-academic-monetary-economics/ .

Bullard, J, C J Neely and D C Wheelock (2009), “Systemic Risk and the Financial Crisis: A Primer”. Federal Reserve Bank of St. Louis Review, September/October.

Bulow, J., & Rogoff, K. (1989). A Constant Recontracting Model of Sovereign Debt. *The Journal of Political Economy*, *97*.

Buti, M., & van den Noord, P. (2004). Fiscal policy in EMU: Rules, discretion and political incentive. *Economic papers*, (206), 1-40.

Calomiris, C (2009), ‘Banking crises and the rules of the game’, NBER Working Paper no. 15403, October.

Calomiris, C. W., & Kahn, C. M. (1991). The role of demandable debt in structuring optimal banking arrangements. *The American Economic Review*, 497-513.

Candelon, B., & Palm, F. C. (2010). Banking and debt crises in Europe: The dangerous Liaisons?. *De Economist*, *158*(1), 81-99.

Canzoneri, M. B., Cumby, R. E., & Diba, B. T. (2001). Fiscal discipline and exchange rate systems. *The Economic Journal*, *111*(474), 667-690.

Carson C S and Ingves S (2003), “Financial soundness indicators”, IMF Board Paper, May.

Caruana, J (2005), “Monetary policy, financial stability and asset prices”, *Occasional Papers*, 0507, Bank of Spain.

Caruana, J (2010a), “Basel III: towards a safer financial system”. Speech at the 3rd Santander International Banking Conference, Madrid, 15 September 2010.

Caruana, J (2010b), “Macroprudential policy: working towards a new consensus”. Remarks at the high-level meeting on “The Emerging Framework for Financial Regulation and Monetary Policy” jointly organised by the BIS’s Financial Stability Institute and the IMF Institute, Washington DC, 23 April.

Castro, C., & Mencıa, J. (2014). Sovereign risk and financial stability. *Revista de Estabilidad Financiera*, *26*, 73-107.

Castro, F., Pérez, J. J., & Rodríguez-Vives, M. (2013). Fiscal data revisions in Europe. *Journal of Money, Credit and Banking*, *45*(6), 1187-1209.

Catão, L., & Sutton, B. (2002). *Sovereign Defaults: The Role of Volatility* (Vol. 2). International Monetary Fund.

Cecchetti, S, H Genberg, J Lipsky and S Wadhwani (2000), “Asset Prices and Central Bank Policy”. Geneva Reports on the World Economy 2, International Centre for Monetary and Banking Studies.

Cecchetti, S. (2009), “On the similarities of capital adequacy and monetary policy”, presentation at the Thirteenth Annual Conference of the Central Bank of Chile, 19 November.

Cecchetti, S., Gyntelberg, J. and M. Hollanders (2009), “Central counterparties for over-the-counter derivatives”, BIS Quarterly Review, September, p. 45-58.

Chan-Lau, J A (2010), “Balance Sheet Network Analysis of Too-Connected-to-Fail Risk in Global and Domestic Banking Systems”, IMF Working Paper.

Chau, F. and Deesomsak, R. (2014) Does linkage fuel the fire? The transmission of financial stress across the markets. *International Review of Financial Analysis*, forthcoming.

Christiano, L. J., Trabandt, M., & Walentin, K. (2011). Introducing financial frictions and unemployment into a small open economy model. *Journal of Economic Dynamics and Control*, *35*(12), 1999-2041.

Cimadomo, J., Garnier, J., & Schalck, C. (2007, August). Time varying fiscal policy rules for five OECD countries. In *Proceedings of the ESEM Conference* (pp. 26-31).

Claessens, S., Kose, M. A., & Terrones, M. E. (2012). How do business and financial cycles interact?. *Journal of International economics*, *87*(1), 178-190.

Claeys, P. and Vašicek, B.(2014) Measuring bilateral spillover and testing contagion on sovereign bond markets in Europe. *Journal of Banking and Finance*, 46, 151-165.

Clement, P (2010), "The term "macroprudential": origins and evolution". BIS Quarterly Review, March.

Codogno, L., Favero, C., & Missale, A. (2003). Yield spreads on EMU government bonds. *Economic Policy*, *18*(37), 503-532.

Cohen-Cole, E. and E. Martinez-Garcia (2008), "The balance sheet channel", Federal Reserve Bank of Boston Working Paper No. QAU08-7.

Committee on the Global Financial System (2009), "Capital flows and emerging market economies". CGFS Papers No 33, January.

Committee on the Global Financial System (2010a), "The role of margin requirements and haircuts in procyclicality". CGFS Papers No 36, March.

Committee on the Global Financial System (2010b), "Macroprudential instruments and frameworks". CGFS Papers No 38, May.

Constâncio, V (2010), "Macro-prudential supervision in Europe". Speech at the ECB-CFS-CEPR conference on "Macro-prudential regulation as an approach to containing systemic risk: economic foundations, diagnostic tools and policy instruments" at Frankfurt am Main, 27 September (http://www.ecb.int/press/key/date/2010/html/sp100927_3.en.html#4).

Constâncio, V. (2012) Contagion and the European debt crisis. *Financial Stability Review*, 16, 109-119.

Coppedge, M. (1997). District magnitude, economic performance, and party - system fragmentation in five Latin American countries. *Comparative Political Studies*, *30*(2), 156-185.

Covas, F and S Fujita (2009), “Time-varying capital requirements in a general equilibrium model of liquidity dependence”. Working Papers 09-23, Federal Reserve Bank of Philadelphia.

Crockett, A. (2000), “Marrying the micro- and macroprudential dimensions of financial stability”, BIS Speeches, 21 September.

Cronin, D (2014) The interaction between money and asset markets: A spillover index approach. *Journal of Macroeconomics*, 39, 185-202

Cúrdia, V and M Woodford (2009), “Conventional and Unconventional Monetary Policy”. Federal Reserve Bank of New York Staff Reports No. 404, November.

D'Agostino, A., & Ehrmann, M. (2012). *The pricing of G7 sovereign bond spreads–the times, they are a-changin* (No. 40604). University Library of Munich, Germany.

Danielsson, J, J P Zigrand and H S Shin (2009), “Risk Appetite and Endogenous Risk”. Mimeo, London School of Economics.

Darracq Pariès, M., Maurin, L., & Moccero, D. (2014). *Financial conditions index and credit supply shocks for the euro area* (No. 1644). European Central Bank.

Darvas, Z. (2010). The impact of the crisis on budget policy in Central and Eastern Europe. *OECD Journal on Budgeting*, *10*(1), 1-42.

Davis, E. P., & Karim, D. (2008). Comparing early warning systems for banking crises. *Journal of Financial stability*, *4*(2), 89-120.

De Bandt, O and Hartmann, P (2000), “Systemic Risk: A Survey”, ECB Working Paper No. 35.

De Bandt, O, P Hartmann and J L Peydró (2009), “Systemic risk: An update”. In Berger et al. (eds.), Oxford Handbook of Banking, Oxford University Press.

De Grauwe, P., & Ji, Y. (2013). Self-fulfilling crises in the Eurozone: An empirical test. *Journal of International Money and Finance*, *34*, 15-36.

De Masi, M. P. (1997). *IMF Estimates of Potential Output: Theory and Practice (EPub)* (No. 97-177). International Monetary Fund.

De Mello, L. (2008). Estimating a fiscal reaction function: the case of debt sustainability in Brazil. *Applied Economics*, *40*(3), 271-284.

Lucchetta, M., & De Nicoló, M. G. (2010). *Systemic Risks and the Macroeconomy* (No. 10-29). International Monetary Fund.

De Walque, G, O Pierrard and A Rouabah (2009), "New Keynesian models, banking sector and monetary transmission", mimeo, Central Bank of Luxembourg.

De Walque, G., Pierrard, O., & Rouabah, A. (2010). Financial (in) stability, supervision and liquidity injections: A dynamic general equilibrium approach*.*The Economic Journal*, *120*(549), 1234-1261.

Del Negro, M, G Eggertsson, A Ferrero and N Kiyotaki (2010), "The Great Escape? A Quantitative Evaluation of the Fed's Non-Standard Policies". Mimeo, New York Fed.

Dell'Ariccia, G, D Igan and L Laeven (2008), "Credit Booms and Lending Standards: Evidence from the Subprime Mortgage Market". IMF WP/08/106

Dellas, H, B Diba, O Loisel (2010), "Optimal Policy Responses to Financial Shocks". Mimeo, Banque de France, 8 January 2010.

Demirguç-Kunt, A and E Detriagache (2005), "Cross-Country Empirical Studies of Systemic Bank Distress: A Survey". IMF Working Paper 05/96.

Detken, C. and F. Smets (2004), "Asset price booms and monetary policy". In Sibert, H (ed.) Macroeconomic Policies in the World Economy. Springer, Berlin.

Diamond, D and R Rajan (2009), "Illiquidity and interest rate policy" NBER Working Paper No 15197.

Diamond, D. W., & Dybvig, P. H. (1983). Bank runs, deposit insurance, and liquidity. *The Journal of Political Economy*, 401-419.

Díaz-Cassou, J., Erce, A., & Vázquez-Zamora, J. J. (2008). Recent episodes of sovereign debt restructurings: a case-study approach. *Banco de Espana Occasional Paper*, (0804).

Diebold, F. X and, Yilmaz, K (2014) On the network topology of variance decompositions: Measuring the connectedness of financial firms. *Journal of Econometrics*, 182, 119–134.

Diebold, F. X. and Yilmaz, K. (2012) Better to give than to receive: Predictive directional measurement of volatility spillovers. *International Journal of Forecasting*, 28, 57-66.

Disyatat, P. (2011). The bank lending channel revisited. *Journal of money, Credit and Banking*, *43*(4), 711-734.

Dokko, J, B Doyle, M Kiley, J Kim, S Sherlund, J Sim, and S Van den Heuvel (2009), "Monetary policy and the housing bubble," Finance and Economics Discussion Series 2009-49. Washington: Board of Governors of the Federal System, December.

Dolado, J. J., & Lütkepohl, H. (1996). Making Wald tests work for cointegrated VAR systems. *Econometric Reviews*, *15*(4), 369-386.

Domowitz, I., Glen, J., & Madhavan, A. (2001). Liquidity, volatility and equity trading costs across countries and over time. *International Finance*, *4*(2), 221-255.

Dötz, N., & Fischer, C. (2010). *What can EMU countries' sovereign bond spreads tell us about market perceptions of default probabilities during the recent financial crisis?* (No. 2010, 11). Discussion Paper Series 1: Economic Studies.

Drehmann, M (2009), "Macroeconomic Stress Testing Banks: A Survey of Methodologies", in Stress Testing the Banking System: Methodologies and Applications (ed M Quagliariello), Cambridge, Cambridge University Press.

Drehmann, M, A Patton and S Sorensen (2006), "Corporate defaults and macroeconomic shocks: non-linearities and uncertainty", mimeo, Bank of England.

Dubecq, S, B Mojon and X Ragot (2009), "Fuzzy Capital Requirements, Risk-Shifting and the Risk Taking Channel of Monetary Policy". Banque de France Document de Travail N. 254.

Duncan, A. S. and Kabundi, A. (2013) Domestic and foreign sources of volatility spillover to South African asset classes. *Economic Modelling*, 31, 566-573.

Dunne, P. G., Moore, M. J., & Portes, R. (2007). Benchmark Status in Fixed-Income Asset Markets. *Journal of Business Finance & Accounting*, *34*(9-10), 1615-1634.

Edwards, S. (1986). The pricing of bonds and bank loans in international markets: An empirical analysis of developing countries' foreign borrowing. *European Economic Review*, *30*(3), 565-589.

Égert, B. (2014). *Fiscal Policy Reaction to the Cycle in the OECD: Pro-or Counter-cyclical?* (Vol. 167, No. 3, pp. 35-52). De Boeck Supérieur.

Eichengreen, B., Hausmann, R., & Panizza, U. (2003). Currency mismatches, debt intolerance, and the original sin: Why they are not the same and why it matters. In *Capital controls and capital flows in emerging economies: Policies, practices and consequences* (pp. 121-170). University of Chicago Press.

Eichengreen, B., & Mody, A. (1998). *What explains changing spreads on emerging-market debt: fundamentals or market sentiment?* (No. w6408). National Bureau of Economic Research.

El-Erian, M. A. (2010). New Normal. *Finance & Development*, 45.

Erce, A. (2013). Sovereign debt restructurings and the IMF: implications for future official interventions. *Globalization and Monetary Policy Institute Working Paper*.

Erce, A., & Diaz-Cassou, J. (2012). Selective sovereign defaults. *Globalization and Monetary Policy Institute Working Paper*, *127*.

Eslava, M. (2006) The political economy of fiscal policy: survey. Working Paper 583, Inter-American Development Bank.

European Central Bank (2009), Financial Stability Review, Section IVC “Is Basel II pro-cyclical? A selected review of the literature”, December.

European Systemic Risk Board (2015). Report on the Regulatory Treatment of Sovereign Exposures, March.

Farhi, E., & Tirole, J. (2012). Collective Moral Hazard, Maturity Mismatch, and Systemic Bailouts. *American Economic Review*, *102*(1), 60-93.

Fatás, A., & Mihov, I. (2001). *The effects of fiscal policy on consumption and employment: theory and evidence* (Vol. 2760). Centre for Economic Policy Research.

Fatas, A., & Mihov, I. (2003). On constraining fiscal policy discretion in EMU. *Oxford Review of Economic Policy*, *19*(1), 112-131.

Fatas, A., & Mihov, I. (2008). The Euro and the Growth and Stability Pact.

Fatás, A., & Mihov, I. (2009). Why fiscal stimulus is likely to work. *International Finance*, *12*(1), 57-73.

Fatás, A., & Mihov, I. (2010). The euro and fiscal policy. In *Europe and the Euro* (pp. 287-324). University of Chicago Press.

Favero, C. A. (2013). Modelling and forecasting government bond spreads in the euro area: a GVAR model. *Journal of Econometrics*, *177*(2), 343-356.

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

Favero, C., Pagano, M., & von Thadden, E. L. (2010). How Does Liquidity Affect Government Bond Yields?. *Journal of Financial and Quantitative Analysis*, 107-134.

Fell, J. (2007), “Micro data needs for financial stability analysis”. Panel intervention at the workshop on the use of corporate balance sheet data. 25 October 2007

Fernández de Lis, S. and A. García Herrero (2009), “The Spanish Approach: Dynamic Provisioning and other Tools”, BBVA Working Paper No. 0918.

Fernandez, S., J. Pages and J. Saurina (2000), “Credit Growth, Problem Loans and Credit Risk Provisioning in Spain”. Bank of Spain Working Paper 18.

Ferrucci, G. (2003). Empirical determinants of emerging market economies' sovereign bond spreads.

Filardo, A (2004), “Monetary policy and asset price bubbles: calibrating the monetary policy trade-offs”. BIS Working Paper No. 155, June.

Fillat J and J Montoriol-Garriga (2010), “Addressing the pro-cyclicality of capital requirements with a dynamic loan loss provision system”. Federal Reserve Bank of Boston Working Papers, QAU10-4.

Financial Stability Board (2009), “Progress since the Pittsburgh Summit in Implementing the G20 Recommendations for Strengthening Financial Stability”, Report of the Financial Stability Board to G20 Finance Ministers and Governors, November.

Financial Times, 2015. Fund managers to escape 'systemic' label - FT.com retreived august 2015

Flannery, M (2005), “No Pain, No Gain? Effecting Market Discipline via “Reverse Convertible Debentures”. In Capital Adequacy beyond Basel: Banking, Securities, and Insurance, (Oxford University Press), pp. 171-197.

Flood, R., & Marion, N. (1998). *Perspectives on the recent currency crisis literature* (No. w6380). National Bureau of Economic Research.

Forbes, K. and Rigobon, R. (2002) No contagion, only interdependence: Measuring stock market comovements. *Journal of Finance*, 57, 2223-2261.

Fornari, F, and W Lemke (2009), “A Simple Model for Predicting Economic Activity in Main Economic Areas”, mimeo, ECB.

Frankel, J. A. (1999). *No single currency regime is right for all countries or at all times* (No. w7338). National Bureau of Economic Research.

Frankel, J. A., & Rose, A. K. (2000). *Estimating the effect of currency unions on trade and output* (No. w7857). National Bureau of Economic Research.

Freixas, X., & Jorge, J. (2008). The role of interbank markets in monetary policy: A model with rationing. *Journal of Money, Credit and Banking*, *40*(6), 1151-1176.

Freixas, X., & Parigi, B. (1998). Contagion and efficiency in gross and net interbank payment systems. *Journal of Financial Intermediation*, *7*(1), 3-31.

French, K R, M N Baily, J Campbell, J H Cochrane, D W Diamond, D Duffie, A K Kashyap, F S Mishkin, R G Rajan, D S Scharfstein, R J Shiller, H S Shin, M J

Slaughter, J C Stein and R M Stulz (2010), The Squam Lake Report: Fixing the Financial System (Princeton University Press).

Gai, P., & Kapadia, S. (2010). Contagion in financial networks. *Proceedings: Mathematics, Physical and Engineering*, 2401-2423.

Galí, J., & Perotti, R. (2003). Fiscal policy and monetary integration in Europe.*economic policy*, *18*(37), 533-572.

Gambacorta, L (2009), "Monetary policy and the risk-taking channel", BIS Quarterly Review, December, p. 43-53.

Garcia-Herrero, A., & Ortiz, A. (2005). The role of global risk aversion in explaining Latin American sovereign spreads. *Banco de Espana Documento de Trabajo*, (0505).

Gauthier, C., Lehar, A., & Souissi, M. (2012). Macroprudential capital requirements and systemic risk. *journal of Financial Intermediation*, *21*(4), 594-618.

Gavin, M., & Perotti, R. (1997). Fiscal policy in latin america. In *NBER Macroeconomics Annual 1997, Volume 12* (pp. 11-72). Mit Press.

Geanakoplos, J (2010), "The Leverage Cycle". In D. Acemoglu, K. Rogoff and M. Woodford, eds., NBER Macroeconomic Annual 2009, vol. 24, pp. 1-65.

Georgoutsos, D. A., & Migiakis, P. M. (2013). Heterogeneity of the determinants of euro-area sovereign bond spreads; what does it tell us about financial stability?. *Journal of Banking & Finance*, *37*(11), 4650-4664.

Gerali, A., Neri, S., Sessa, L., & Signoretti, F. M. (2010). Credit and Banking in a DSGE Model of the Euro Area. *Journal of Money, Credit and Banking*, *42*(s1), 107-141.

Gerdesmeier, D, B Roffia and H-E Reimers (2009), "Monetary Developments and Asset Prices", ECB Working Paper 1068.

Gerlach, S., Schulz, A., & Wolff, G. B. (2010). Banking and sovereign risk in the euro area. Unpublished.

Gertler, M., & Karadi, P. (2011). A model of unconventional monetary policy.*Journal of monetary Economics*, *58*(1), 17-34.

Gertler, M., & Kiyotaki, N. (2010). Financial intermediation and credit policy in business cycle analysis. *Handbook of monetary economics*, *3*(3), 547-599.

Geyer, M. (2004). Policy issues in the urban South. *Contributions to Economic Analysis*, *266*, 803-836.

Ghosh, A, M Goretti, B Joshi, U Ramakrishnan, A Thomas and J Zalduendo (2008), “Capital inflows and balance of payments pressures – tailoring policy responses in emerging market economies”, IMF Policy Discussion Paper, PDP/08/2.

Ghosh, A. R., Kim, J. I., Mendoza, E. G., Ostry, J. D., & Qureshi, M. S. (2013). Fiscal fatigue, fiscal space and debt sustainability in advanced economies. *The Economic Journal*, *123*(566), F4-F30.

Giavazzi, F., and F. Mishkin (2006), “An Evaluation of Swedish Monetary Policy between 1995 and 2005”. Report published by the Riksdag (Swedish parliament) Committee on Finance.

Giorno,C., et al. (1995), "Estimating Potential Output, Output Gaps and Structural Budget Balances",*OECD Economics Department Working Papers*, No. 152, OECD Publishing, Paris.

Giovannini, A., Mayer, C., Micossi, S., Di Noia, C., Onado, M., Pagano, M., & Polo, A. (2015). Restarting European Long-Term Investment Finance. *Green Paper Discussion Document, Centre for Economic Policy Research (CEPR)*.

Glover, B., and Richards-Shubik, S., (2014) Contagion in the European Sovereign Debt Crisis. Working Paper No. 20567, National Bureau of Economic Research.

Goeminne, S., & Smolders, C. (2014). Politics and Public Infrastructure Investments in Local Governments: Empirical Evidence from Flemish Municipalities (1996–2009). *Local Government Studies*, *40*(2), 182-202.

Goldstein, I. and Pauzner, A. (2004) Contagion of self-fulfilling financial crises due to diversification of investment portfolios. *Journal of Economic Theory*, 119, 151–283.

Golinelli, R., & Momigliano, S. (2009). The Cyclical Reaction of Fiscal Policies in the Euro Area: The Role of Modelling Choices and Data Vintages*. *Fiscal Studies*, *30*(1), 39-72.

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

Gómez-Puig, M. (2008) Monetary integration and the cost of borrowing. *Journal of International Money and Finance*, 27, 455-479.

Gómez-Puig, M. (2009). Systemic and Idiosyncratic Risk in EU-15 Sovereign Yield Spreads after Seven Years of Monetary Union. *European Financial Management*, *15*(5), 971-1000.

Gómez-Puig, M. and Sosvilla-Rivero, S. (2013) Granger-causality in peripheral EMU public debt markets: A dynamic Approach. *Journal of Banking and Finance*, 37, 4627-4649.

Gómez-Puig, M. and Sosvilla-Rivero, S. (2014) Causality and contagion in EMU sovereign debt markets. *International Review of Economics and Finance*, 33, 12-27.

Gómez-Puig, M., Sosvilla-Rivero, S. and Ramos-Herrera, M.C. (2014. An update on EMU sovereign yield spreads drivers in times of crisis: A panel data analysis. *North American Journal of Economics and Finance,* 30, 133-153.

González-Rozada, M., & Yeyati, E. L. (2008). Global factors and emerging market spreads*. *The Economic Journal*, *118*(533), 1917-1936.

Goodfriend, M (2002), "Interest Rate Policy Should Not React Directly to Asset Prices", in Asset Price Bubbles: The Implications for Monetary, Regulatory and International Policies, (eds. William Hunter, George Kaufman and Michael Pomerleano), MIT Press, pp.427-444.

Goodfriend, M. and B. McCallum (2007), "Banking and Interest Rates in Monetary Policy Analysis: A Quantitative Exploration", *Journal of Monetary Economics* 54.

Goodhart, C A E (2004), Some New Directions for Financial Stability?, The Per Jacobsson Lecture, Zürich, Switzerland, 27 June.

Goodhart, C and D. Schoenmaker (1995), “Should the Functions of Monetary Policy and Banking Supervision be Separated?”, Oxford Econ. Papers Vol 47, p. 539-560.

Goodhart, C., Surinand, P. and D. Tsomocos (2005), “A risk assessment model for banks”, *Annals of Finance* 1(2), p. 197-224.

Goodhart, C., Surinand, P. and D. Tsomocos (2006), “A model to analyze financial fragility”, *Economic Journal* 27(1), p. 107-42.

Gorton, G and A Winton (2003), “Financial Intermediation: A Survey”. In Constantinides, G, M Harris, and R Stulz (eds.) Handbook of the Economics of Finance.

Gorton, G B (2010), Slapped by the Invisible Hand: The Panic of 2007. Oxford University Press).

Gray, D. F., & Jobst, A. A. (2011). Modelling systemic financial sector and sovereign risk. *sveriges riksbank economic review*, 2.

Hannoun, H (2010), “Towards a global financial stability framework”. Speech at the 45th SEACEN Governors' Conference, Siem Reap province, Cambodia, 26-27 February 2010.

Hannoun, H. (2012, February). Monetary policy in the crisis: testing the limits of monetary policy. In *Speech delivered at the 47th SEACEN Governor’s Conference, Seoul, Korea* (pp. 13-14).

Hanson, S. G., Kashyap, A. K., & Stein, J. C. (2011). A Macroprudential Approach to Financial Regulation. *The Journal of Economic Perspectives*,*25*(1), 3.

Harrison, R., Nikolov, K., Quinn, M., Ramsay, G., Scott, A. and R. Thomas (2005), “The Bank of England Quarterly Model”, Bank of England.

Hellwig, M. (1995). Systemic Aspects of Risk Management in Banking and Finance. *Swiss Journal of Economics and Statistics (SJES)*, *131*(IV), 723-737.

Hilbers, P, I Otker-Robe, C Pazarbasioglu and G Johnsen (2005), “Assessing and managing rapid credit growth and the role of supervisory and prudential policies”, IMF Working Papers, no 05/151, July.

Holmstrom, B., & Tirole, J. (1998). Private and Public Supply of Liquidity. *The Journal of Political Economy*, *106*(1), 1-40.

Hommes, C.H. (2006), “Heterogeneous Agent Models In Economics and Finance”. In: Hand-book of Computational Economics, Volume 2: Agent-Based Computational Economics, Edited by L. Tesfatsion and K.L. Judd, Elsevier Science B.V., 2006, 1109-1186.

Hommes, C.H. (2008), “Interacting agents in finance.” New Palgrave Dictionary of Economics, 2nd Edition, edited by L. Blume and S. Durlauf, Palgrave Macmillan.

Hommes, C.H. (2009), “Bounded Rationality and Learning in Complex Markets”. In: Handbook of Economic Complexity, Edited by J. Barkley Rosse, Jr., Cheltenham: Edward Elgar, in press.

Hommes, C.H. and Wagener, F.O.O. (2009), “Complex Evolutionary Systems in Behavioral Finance”. In: Handbook of Financial Markets: Dynamics and Evolution, Edited by T. Hens and K.R. Schenk-Hoppé, Elsevier – North Holland, pp.217-276.

Honohan, P. (2008). Cross-country variation in household access to financial services. *Journal of Banking & Finance*, *32*(11), 2493-2500.

Huang, X, H, Zhou and H Zhu (2009), “Assessing the Systemic Risk of a Heterogeneous Portfolio of Banks during the Recent Financial Crisis”, Finance and Economics Discussion Series 2009-44. Washington: Board of Governors of the Federal Reserve System.

Hutchison, M., & McDill, K. (1999). Are all banking crises alike? The Japanese experience in international comparison. *Journal of the Japanese and International Economies*, *13*(3), 155-180.

Illing, G., & König, P. J. (2014). The European Central Bank as lender of last resort. *DIW Economic Bulletin*, *4*(9), 16-28.

Illing, M and Y Liu (2006), “Measuring financial stress in a developed country: An application to Canada”, Journal of Financial Stability, vol 2(3), pp 243–65.

Ilzetzki, E., & Végh, C. A. (2008). *Procyclical fiscal policy in developing countries: Truth or fiction?* (No. w14191). National Bureau of Economic Research.

IMF (2008), Financial Soundness Indicators, IMF.

Ioannidou, V, S Ongena and J Peydrò (2009), "Monetary policy and subprime lending: a tall tale of low federal funds rates, hazardous loans and reduced loan spreads", *European Banking Centre Discussion Paper,* no 2009–04S.

Jaimovich, D., & Panizza, U. (2007). Procyclicality or reverse causality?. IADB mimeo.

Jeanne, O., & Korinek, A. (2010). *Managing credit booms and busts: A Pigouvian taxation approach* (No. w16377). National Bureau of Economic Research.

Jensen, M. C. (1986). Agency cost of free cash flow, corporate finance, and takeovers. *Corporate Finance, and Takeovers. American Economic Review*,*76*(2).

Jiménez, G., & Saurina, J. (2005). *Credit cycles, credit risk and prudential regulation* (No. 0531). Banco de España.

Jiménez, J., S. Ongena, J.-L. Peydró-Alcalde and J. Saurina (2008), "Hazardous Times for Monetary Policy: What do Twenty-Three Million Bank Loans Say About the Effects of Monetary Policy on Credit Risk?". Working Paper 0833, Banco de España. Also CEPR Discussion Paper 6514.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of economic dynamics and control*, *12*(2), 231-254.

Kamin, S. B., & Von Kleist, K. (1999). The Evolution and Determinants of Emerging Market Credit Spreads in the 1990s. *International Finance Working Paper*, (653).

Kaminsky, G L and C M Reinhart (1999), "The Twin Crises: The Causes of Banking and Balance of Payments Problems," American Economic Review 89 (3), 473–500.

Kaminsky, G., Reinhart, C., & Végh, C. (2004). When it rains, it pours: Procyclical macropolicies and capital flows. *NBER Macroeconomics Annual*,*2004*, 11-53.

Kannan, P., Rabanal, P., & Scott, A. M. (2012). Monetary and macroprudential policy rules in a model with house price booms. *The BE Journal of Macroeconomics*, *12*(1).

Kashyap, A, R Rajan and J Stein (2008), "Rethinking Capital Regulation". In Maintaining Stability in a Changing Financial System, Federal Reserve Bank of Kansas City, 431-471.

Kashyap, A. K., & Stein, J. C. (2004). Cyclical implications of the Basel II capital standards. *Economic Perspectives-Federal Reserve Bank Of Chicago*,*28*(1), 18-33.

Kent, C and P Lowe (1997), "Asset-price Bubbles and Monetary Policy", Reserve Bank of Australia Research Discussion Paper 9709.

Keys, B, T Mukherjee, A Seru, and V Vig (2009), "Financial Regulation and Securitization: Evidence from Subprime Loans," *Journal of Monetary Economics*, Vol. 56, pp. 700-20.

Kindleberger, C (1996), Maniacs, Panics and Crashes, Cambridge University Press.

Kiyotaki, N. and J. Moore (2008), "Liquidity, business cycles and monetary policy", mimeo, Princeton University.

Kiyotaki, N., & Moore, J. (1997). Credit Cycles. *The Journal of Political Economy*, *105*(2), 211-248.

Kohn, D (2009), "Policy challenges for the Federal Reserve". Speech at the Kellogg Distinguished Lecture Series, Kellogg School of Management, Northwestern University, Evanston, Illinois, 16 November 2009 (http://www.bis.org/review/r091117e.pdf).

Kollmann, R., & Roeger, W. (2012). Fiscal Policy in a Financial Crisis: Standard Policy versus Bank Rescue Measures. *The American Economic Review*,*102*(3), 77-81.

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

Korinek, A. (2011). Regulating Capital Flows to Emerging Markets: An Externality View. *SSRN Working Paper Series*.

Kydland, F. E., & Prescott, E. C. (1977). Rules rather than discretion: The inconsistency of optimal plans. *The journal of political Economy*, 473-491.

Lambertini, L. and R. Rovelli (2003), "Monetary and Fiscal Policy Coordination and Macroeconomic Stabilization. A Theoretical Analysis ", mimeo.

Landau, JP (2009), "Bubbles and macroprudential supervisor". Remarks at the Joint conference on "The Future of Financial Regulation"; Banque de France and Toulouse School of Economics (TSE), Paris, January 28th, 2009.

Lane, P. R. (2003). The cyclical behaviour of fiscal policy: evidence from the OECD. *Journal of Public Economics*, *87*(12), 2661-2675.

Lastra, R. (2003), "The governance structure for financial regulation and supervision in Europe", *Columbia Journal of European Law*, Vol. 10, p. 49-68.

LeBaron, B., & Tesfatsion, L. (2008). Modeling macroeconomies as open-ended dynamic systems of interacting agents. *The American Economic Review*,*98*(2), 246-250.

Lee, H. C. and Chang, S.L. (2013) Finance spillovers of currency carry trade returns, market risk sentiment, and U.S. market returns. *North American Journal of Economics and Finance*, 26, 197-216.

Lee, T. H., White, H., & Granger, C. W. (1993). Testing for neglected nonlinearity in time series models: A comparison of neural network methods and alternative tests. *Journal of Econometrics*, *56*(3), 269-290.

Lee, Y., & Sung, T. (2007). Fiscal Policy, Business Cycles and Economic Stabilisation: Evidence from Industrialised and Developing Countries*. *Fiscal Studies*, *28*(4), 437-462.

Leeper, E. M. (2013). Fiscal limits and monetary policy. *Central Bank Review*, *13*(2).

Leigh, D., & Stehn, S. J. (2009). Fiscal and monetary policy during downturns: Evidence from the G7. *IMF Working Papers*, 1-21.

Lelyveld, I. V., & Liedorp, F. (2004). Interbank contagion in the Dutch banking sector. *Journal of Banking and Finance*, *29*, 99-133.

Lenza, M., Pill, H., & Reichlin, L. (2010). Monetary policy in exceptional times.*Economic Policy*, *25*(62), 295-339.

Libertucci, M and M Quagliariello (2010), “Rules vs discretion in macroprudential policies”. VoxEu, 24 February (http://www.voxeu.org/index.php?q=node/4670).

Litan, R. E., & Nordhaus, W. D. (1983). *Reforming federal regulation*. Yale University Press.

Lo, A. (2009), “The Feasibility of Systemic Risk Measurements”, written testimony for the House Financial Services Committee on Systemic Risk Regulation, October.

Loisely, O, A Pommeretz and F Portierx (2009), “Monetary policy and herd behavior in new-tech investment”. Mimeo, Banque de France, November.

Macroeconomic Assessment Group (2010), **“**Assessing the macroeconomic impact of the transition to stronger capital and liquidity requirements”, Interim Report of group established by the Financial Stability Board and the Basel Committee on Banking Supervision, August.

Maddaloni A., J Peydró and S Scopel (2008), “Does monetary policy affect bank credit standards?”, ECB mimeo, August 2008.

Maltritz, D. (2012). Determinants of sovereign yield spreads in the Eurozone: A Bayesian approach. *Journal of International Money and Finance*, *31*(3), 657-672.

Martin, A, D Skeie and E L von Thadden (2010), “Repo runs”. Mimeo Economics Department, Mannheim University (http://vonthadden.vwl.uni-mannheim.de/fileadmin/ user_upload/thadden/research/reporuns.pdf).

McAndrews, J. J., & Roberds, W. (1995). Banks, payments, and coordination.*Journal of Financial Intermediation*, *4*(4), 305-327.

McCauley, R (2009), “Macroprudential policy in emerging markets”. Paper presented at the Central Bank of Nigeria‘s 50th Anniversary International Conference on “Central banking, financial system stability and growth”, Abuja, 4-9 May

McCauley, R, J Ruud and F Iacono (1999), “Policy and asset inflation” in Dodging bullets: changing US corporate capital structure in the 1980s and 1990s, Cambridge: MIT Press, pp 289-326.

Meh, C. A., & Moran, K. (2010). The role of bank capital in the propagation of shocks. *Journal of Economic Dynamics and Control*, *34*(3), 555-576.

Mendoza, E. G., & Ostry, J. D. (2008). International evidence on fiscal solvency: Is fiscal policy “responsible”?. *Journal of Monetary Economics*, *55*(6), 1081-1093.

Merler, S., & Pisani-Ferry, J. (2012). *Sudden stops in the euro area* (No. 2012/06). Bruegel Policy Contribution.

Min, H. G. (1998). *Determinants of emerging market bond spread: do economic fundamentals matter?* (Vol. 1899). World Bank Publications.

Minsky, H P (1982), “Can “it” happen again?”, Essays on Instability and Finance, Armonk: M E Sharpe.

Misina. M and D Tessier (2008), “Non-Linearities, Model Uncertainty, and Macro Stress Testing”. Working Papers 08-30, Bank of Canada

Mody, A. *From Bear Stearns to Anglo Irish: how eurozone sovereign spreads related to financial sector vulnerability*. No. 9-108. International Monetary Fund, 2009.

Mody, A., & Sandri, D. (2012). The eurozone crisis: how banks and sovereigns came to be joined at the hip. *Economic Policy*, *27*(70), 199-230.

Mohanty, M S and M Scatigna (2005), “Has globalisation reduced monetary policy independence?”. In “Globalisation and monetary policy in emerging markets”. BIS Papers No 23, May.

Moorhouse, A. (2004), “An introduction to financial soundness indicators”, Bank of England (www.bankofengland.co.uk/statistics/ms/articles/art1feb04.pdf).

Motto, R., Rostagno, M., & Christiano, L. J. (2010). Financial factors in economic fluctuations. In *2010 Meeting Papers* (No. 141). Society for Economic Dynamics.

Nadauld, T, and S Sherlund (2009), "The role of the securitization process in the expansion of subprime credit," Finance and Economics Discussion Series 2009-28.

Nakaso, H. (2013). Financial crises and central banks' lender of last resort function. *Remarks, Washington, DC, April*, *22*.

Narayan, P.K. Narayan, S.and Prabheesh K.P. (2014) Stock returns, mutual fund flows and spillover shocks. *Pacific-Basin Finance Journal*, 29, 146-162.

N'Diaye, Papa M'B. P. (2009), "Countercyclical Macro Prudential Policies in a Supporting Role to Monetary Policy". IMF Working Paper No. 09/257.

Nier, E., Yang, J., Yorulmazer, T., & Alentorn, A. (2007). Network models and financial stability. *Journal of Economic Dynamics and Control*, *31*(6), 2033-2060.

Nijathaworn, B (2009), "Rethinking procyclicality – what is it now and what can be done?". Presentation by Mr Bandid Nijathaworn, Deputy Governor of the Bank of Thailand, at the BIS/FSI-EMEAP High Level Meeting on "Lessons Learned from the Financial Crisis – An International and Asian Perspective", Tokyo, 30 November 2009 (http://www.bis.org/review/r091210d.pdf).

Nogués, J., & Grandes, M. (2001). Country risk: economic policy, contagion effect or political noise?. *Journal of Applied Economics*, *4*(1), 125-162.

Nouy, D. (2012). Is sovereign risk properly addressed by financial regulation?. *Banque de France Financial Stability Review*, *16*, 95-106.

Noyer, C. (2010). Sovereign crisis, risk contagion and the response of the central bank. *BIS Review*, (84).

Orphanides, A., & Williams, J. C. (2012). Monetary Policy Mistakes and the Evolution of Inflation Expectations. In *The Great Inflation: The Rebirth of Modern Central Banking* (pp. 255-288). University of Chicago Press.

Ostry, J D, A R Ghosh, K Habermeier, M Chamon, M S Qureshi and D B S Reinhardt (2010), "Capital Inflows: The Role of Controls". IMF Staff Position Note SPN/10/04

Padoa-Schioppa, T (2003), “Central Banks and Financial Stability: Exploring the Land in Between”, in The Transmission of the European Financial System, V Gaspar, P Hartmann and O Sleijpen (eds), European Central Bank, Frankfurt.

Pagano, M., & Von Thadden, E. L. (2004). The European bond markets under EMU. *Oxford Review of Economic Policy*, *20*(4), 531-554.

Palladini, G., & Portes, R. (2011). Sovereign CDS and bond pricing dynamics in the euro-area (No. w17586). National Bureau of Economic Research.

Paloviita, M. (2012). Real time uncertainty in fiscal planning and debt accumulation in the euro area. *Bank of Finland Research Discussion Paper*, (35).

Pennacchi, G (2010), “A Structural Model of Contingent Bank Capital”. FRB of Cleveland Working Paper No. 10-04.

Perotti E and J Suarez (2009a), “Liquidity risk charges as a macroprudential tool”. Mimeo, University of Amsterdam, October.

Perotti E and J Suarez (2009b), “Liquidity insurance for systemic crises”, Testimonial at the Select Committee on Economic Affairs for Banking Regulation and Supervision, House of Lords, February 24 (http://www.publications.parliament.uk/pa/ld200809/ldselect/ldeconaf/101/9022405.htm).

Perotti, E., & Suarezb, J. (2011). A Pigovian Approach to Liquidity Regulation.*International Journal of Central Banking*.

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

Peston, M (1959), “A view of the aggregation problem”, Review of Economic Studies, Vol. 27, No. 1, pages 58-64.

Philippon, M. T., Zettelmeyer, M. J., & Borensztein, M. E. (2001). *Monetary Independence in Emerging Markets: Does the Exchange Rate Regime Make a Difference?* (No. 1). International Monetary Fund.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335-346.

Piergallini, A., & Postigliola, M. (2012). Fiscal policy and public debt dynamics in Italy, 1861-2009. *Rivista italiana degli economisti*, *17*(3), 417-440.

Pisani-Ferry, J. (2012). *The euro crisis and the new impossible trinity* (No. 2012/01). Bruegel Policy Contribution.

Popov, A., & Ongena, S. (2011). Interbank market integration, loan rates, and firm leverage. *Journal of Banking & Finance*, *35*(3), 544-559.

Popov, A., & Van Horen, N. (2014). Exporting sovereign stress: Evidence from syndicated bank lending during the euro area sovereign debt crisis. *Review of Finance*, rfu046.

Powell, A., & Sturzenegger, F. (2000). Dollarization: the link between devaluation and default risk. *Central Bank of Argentina, Buenos Aires*.

Pozzi, L., & Wolswijk, G. (2008). Have euro area government bond risk premia converged to their common state?. Mimeo. SSRN Working Paper series.

Praet, P. (2013). Forward Guidance and the ECB. *Forward Guidance: Perspectives from Central Bankers, Scholars and Market Participants, Vox eBook*.

Rabin, M. (1998). Psychology and economics. *Journal of economic literature*,*36*(1), 11-46.

Radelet, S., Sachs, J. D., Cooper, R. N., & Bosworth, B. P. (1998). The East Asian Financial Crisis: Diagnosis, Remedies, Prospects. *Brookings Papers on Economic Activity*, *1998*(1), 1-90.

Rajan, R (2005), “Has financial development made the world risker?”, Jackson Hole Conference Proceeding, p. 313-69, Federal Reserve Bank of Kansas City.

Reinhart, C. M., & Rogoff, K. (2009). *This time is different: eight centuries of financial folly*. princeton university press.

Reinhart, C. M., & Rogoff, K. S. (2011). The Forgotten History of Domestic Debt. *The Economic Journal*, *121*(552), 319-350.

Remolona, E. M., Scatigna, M., & Wu, E. (2007, October). The dynamic pricing of sovereign risk in emerging markets: fundamentals and risk aversion. In *20th Australasian Finance & Banking Conference*.

Repullo, R J Saurina and C Trucharte (2009), “Mitigating the Procyclicality of Basel II”, in Macroeconomic Stability and Financial regulation: Key Issues for the G20, edited by M. Dewatripont, X. Freixas and R. Portes. RBWC/CEPR.

Repullo, R., & Suarez, J. (2013). The procyclical effects of bank capital regulation. *Review of Financial Studies*, *26*(2), 452-490.

Reserve Bank of India (2005), Report on trend and progress of banking in India, 2004-05, Mumbai.

Rochet, J. C., & Tirole, J. (1996). Interbank lending and systemic risk. *Journal of Money, credit and Banking*, *28*(4), 733-762.

Roubini, N., & Sachs, J. D. (1989). Political and economic determinants of budget deficits in the industrial democracies. *European Economic Review*, *33*(5), 903-933.

Rowland, P., & José Luis Torres T. (2004). *Determinants of Spred and Creditworthiness for Emerging Market Sovereign Debt: A Panel Data Study*. Banco de la República. Subgerencia de Estudios Económicos.

Rudebusch, G. D. (1995). Federal Reserve interest rate targeting, rational expectations, and the term structure. *Journal of monetary Economics*, *35*(2), 245-274.

Sancak, C., Velloso, R., & Xing, J. (2010). Tax revenue response to the business cycle. *IMF Working Papers*, 1-21.

Saurina, J (2009b), “Dynamic Provisioning. The experience of Spain.” Crisis Response. Public Policy for the Private Sector. Note Number 7. July. The World Bank.

Saurina, J. (2009a), “Loan loss provisions in Spain. A working macroprudential tool”, Bank of Spain Financial Stability review No. 17, p. 11-26.

Saurina, J., & Trucharte, C. (2007). An assessment of Basel II procyclicality in mortgage portfolios. *Journal of Financial Services Research*, *32*(1-2), 81-101.

Sbordone, A. M., Tambalotti, A., Rao, K., & Walsh, K. J. (2010). Policy analysis using DSGE models: an introduction. *Economic policy review*, *16*(2).

Schinasi (2004) “Safeguarding financial stability, theory and practice”, International Monetary Fund.

Schoenmaker, D. and Wagner, W. (2013) Cross-Border Banking in Europe and Financial Stability. *International Finance*, 16, 1–22

Segoviano, M and C. Goodhart (2009), “Banking Stability Measures”. IMF Working Paper, January.

Semmler, W., Greiner, A., Diallo, B., Rezai, A., & Rajaram, A. (2007). Fiscal policy, public expenditure composition, and growth theory and empirics. *World Bank Policy Research Working Paper Series*.

Sgherri, S., & Zoli, E. (2009). Euro area sovereign risk during the crisis. *IMF Working Papers*, 1-23.

Shin, H S (2010), “Financial intermediation and the post-crisis financial system”. BIS Working Papers No 304, March.

Shin, H. S. (2009). Reflections on Northern Rock: The bank run that heralded the global financial crisis. *The Journal of Economic Perspectives*, *23*(1), 101-120.

Shirakawa, M (2009), “Macroprudence and the central bank”. Speech by Mr Masaaki Shirakawa, Governor of the Bank of Japan, at the Seminar of the Securities Analysts Association of Japan, Tokyo, 22 December 2009 (http://www.bis.org/review/r091223a.pdf).

Sibert, A. (2010), “A systemic risk warning system”. VoxEU, 16 January 2010 (http://www.voxeu.org/index.php?q=node/4495).

Singh (2013). *Collateral and monetary policy,* IMF Working Paper, WP/13/186.

Singh, M. M., & Stella, M. P. (2012). *Money and collateral* (No. 12-95). International Monetary Fund.

Staehr, K. (2008). Fiscal policies and business cycles in an enlarged euro area. E*conomic Systems*, *32*(1), 46-69.

Stein, J. C. (2012). Monetary Policy as Financial Stability Regulation*. *Quarterly Journal of Economics*, *127*(1).

Strawczynski, M., & Zeira, J. (2009). Cyclicality of Fiscal Policy: Permanent and Transitory Shocks. *SSRN Working Paper Series*.

Sundaresan, S., & Wang, Z. (2010). *Design of contingent capital with a stock price trigger for mandatory conversion* (No. 448). Federal Reserve Bank of New York.

Sutherland, D., Hoeller, P., Egert, B., & Roehn, O. (2010). Counter-Cyclical Economic Policy. *SSRN Working Paper Series*.

Talvi, E., & Vegh, C. A. (2005). Tax base variability and procyclical fiscal policy in developing countries. *Journal of Development economics*, *78*(1), 156-190.

Tarashev, N and H Zhu (2006), "The pricing of portfolio credit risk," BIS Working Papers, no 214, September.

Tarashev, N and H Zhu (2008), "Market perceptions of systemic risk in the banking industry", BIS Quarterly Review, March, pp 6–8.

Tarashev, N, C Borio and K Tsatsaronis (2010), "Attributing systemic risk to individual institutions", BIS Working Papers No 308, May.

Taylor, J (2009), "The financial crisis and the policy responses: an empirical analysis of what went wrong", *NBER Working Papers*, no 14631.

Thomson, J. B. (2009). On systemically important financial institutions and progressive systemic mitigation. *FRB of Cleveland Policy Discussion Paper*, (7).

Thukral, M. (2013). 1 Bank dominance: Financial sector determinants of sovereign risk premia. mimeo

Tovar, C. E. (2008). DSGE Models and Central Banks. *Economics Discussion Paper*, (2008-30).

Trehan, B., & Walsh, C. E. (1988). Common trends, the government's budget constraint, and revenue smoothing. *Journal of Economic Dynamics and Control*, *12*(2), 425-444.

Trichet, J.C. (2009), "Credible alertness revisited". Intervention at the symposium on "Financial stability and macroeconomic policy", sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, 22 August 2009.

Tsai, I.C. (2014) Spillover of fear: Evidence from the stock markets of five developed countries. *International Review of Financial Analysis*, 33, 281-288.

Tucker, P (2009), “The Debate on Financial System Resilience: Macroprudential Instruments“. Speech at Barclays Annual Lecture in London, 22 October (http://www.bankofengland.co.uk/publications/speeches/2009/speech407.pdf).

Tumpel-Gugerell, G. (2009), “The road less travelled: exploring the nexus of macro-prudential and monetary policy”. Speech at the conference “Learning from the financial crisis: financial stability, macroeconomic policy and international institutions” Rome, 12 November 2009 (http://www.bis.org/review/r091116e.pdf).

Turner, A (2010), “What do banks do, what should they do, and what public policies are needed to ensure best results for the real economy?”. Speech at Cass Business School, London, 17 March 2010.

Uhlig, H. (2010). A model of a systemic bank run. *Journal of Monetary Economics*, *57*(1), 78-96.

Uhlig, H. (2014). Sovereign default risk and banks in a monetary union. *German Economic Review*, *15*(1), 23-41.

Upper, C (2007), “Using counterfactual simulations to assess the danger of contagion in interbank markets”, BIS Working Papers No 234, August.

Vlieghe, G (2010), “Imperfect credit markets: implications for monetary policy”, Bank of England Working Paper No. 385.

Von Hagen, J., & HO, T. K. (2007). Money market pressure and the determinants of banking crises. *Journal of Money, Credit and Banking*, *39*(5), 1037-1066.

Wagner, W. (2010) Diversification at Financial Institutions and Systemic Crises, *Journal of Financial Intermediation*, 19, 373–86.

Weidmann, J. (2013). Banking Union, Properly Structured. *The International Economy*, *27*(1), 42.

Weigel, D. D., & Gemmill, G. (2006). What drives credit risk in emerging markets? The roles of country fundamentals and market co-movements. *Journal of International Money and Finance*, *25*(3), 476-502.

Weitzman, M. L. (1974). Prices vs. quantities. *The review of economic studies*,*41*(4), 477-491.

Wyplosz, C. (2006). European Monetary Union: the dark sides of a major success. *Economic Policy*, *21*(46), 208-261.

Yilmaz, K. (2010) Return and volatility spillovers among the East Asian equity markets. *Journal of Asian Economics*, 21, 304-313.

Zhou, C. (2010). Are Banks Too Big to Fail? Measuring Systemic Importance of Financial Institutions. *International Journal of Central Banking*.

Zhou, X., Zhang, W. and Zhang, J. (2012) Volatility spillovers between the Chinese and world equity markets. *Pacific-Basin Finance Journal*, 20, 247-270.

Zhu, H (2008), "Capital Regulation and Banks' Financial Decisions", *International Journal of Central Banking*, 4(1), pp. 165-211.