The relation between systemically important financial institutions and sovereign risk:

Evidence from the Netherlands and Belgium

Master Thesis

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Abstract

I studied the impact of global systemically important banks (G-SIBs) on sovereign bond spreads in the Netherlands and Belgium since 2002. The size of G-SIBs is indirectly, by interacting with a global risk factor, a determinant of the Dutch spread. When global risk increases, a larger size of systemically important banks in the Netherlands leads to a widening in its yield spreads. This suggests that financial markets perceive a larger risk that the government will have to rescue these banks with public money and therefore increasing sovereign risk. On the contrary, government's funding conditions in Belgium seem to improve with the size of systemically important banks.

Contents

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1. Introduction

Since the monetary union, EMU countries are much more interconnected through the financial system. They are therefore more exposed and vulnerable to foreign risk and consequently, implicit and explicit burden sharing is one of the most important issues in Europe during and after the financial and European debt crisis. It is likely that the EMU will implement a fiscal union and/or Eurobonds in the near future with these issues already on the agenda of the politicians today. One aspect that is then particularly important is the contribution of different countries based on their sovereign risk. This paper focuses on one of the determinants of sovereign risk, namely banking.

In the last couple of years, the interlinkage between the banking sector and sovereign risk has become increasingly tight especially after the financial crisis when almost all EMU governments had to help their banks by using large financial rescue packages and guarantees. There is a number of research done (Gerlach et al. 2010, and Aktug et al. 2010) that provides empirical evidence for the size of the banking sector as an important determinant for sovereign risk. However, they all evaluate the banking sector as a whole, neglecting an important issue of the last decades. The financial liberalization across the world has led to more international business operations by banks. This liberalization process is often seen as a driver of economic growth (Bekaert et al. 2005), but at the same time it led the banking sector grow as well. Some banks have become so big, complex and systemically so important that they can be considered too big to fail (FSB, 2010). These banks are labelled by the Financial Stability Board as global systemically important banks (G-SIBs). Distress of these banks could have a significant impact on economic activity and financial system vulnerability, which is most evident today in Europe. Sovereign spreads[1] in Europe have increased significantly in the wake of the financial crisis. Isolating systemically important financial institutions from the rest of the banking sector and evaluating their impact on sovereign risk will be a contribution to the existing literature. These systemically important banks are likely to have a significant impact on sovereign risk.

[1] Sovereign spread is the difference in government bond yield (of different countries) for bonds with the same maturity.

In this paper I will focus on determinants of sovereign bond yield spreads in the euro area, and will emphasize on the impact of systemically important banks on sovereign spreads. The research question for this paper is:

What is the impact of systemically important banks on sovereign risk?

I this paper I focus on two key factors of these systemically important banks, namely size and vulnerability. The potential for losses of these banks depends on their size, so I expect a positive relation between the size of these systemic banks and sovereign risk. The size of these banks will be measured as total assets-to-GDP. Sovereign risk could also be affected by the probability that a bailout will be necessary, so the vulnerability of these banks could also be a determinant of sovereign risk. Generally, banks with higher equity ratios are better able to absorb losses and are less likely to need government support. I will use the equity-to-asset ratio to measure the impact of the vulnerability of systemically important banks on sovereign risk. Previous research suggests that the impact of the banking sector on sovereign risk depends on the state of the economy and global risk aversion. When the economy is doing well, the banking sector could be a driver of economic growth, but in times of financial distress it is obvious that the banking sector could be a source of risk for governments.

Sovereign risk in this paper will be measured by the sovereign yield spreads. Next to the two banking factors, also fiscal variables, liquidity variables and global risk aversion will be used to determine the impact on sovereign risk. This paper focuses on 10-year government bonds for the Netherlands and Belgium for the period after the dot.com crisis until 2012 (2002-2012). Main data sources are Datastream and Citibank Global Markets Ltd. The results for both countries are quite different. Whereas for Belgium, fiscal variables and liquidity impact its sovereign spread, for the Netherlands both the size of a systemic bank and the risk aversion factor are determinants of its sovereign spread. This paper contributes to the literature on the relation between banking risk and sovereign risk and by focusing on individual institutions it makes a distinction with comparable papers.

This paper is structured as follows. In the following section I will give a short summary of recent economic and financial developments in Europe. The next section provides a brief review of relevant literature on the determinants of sovereign bond yield spreads. Section 4

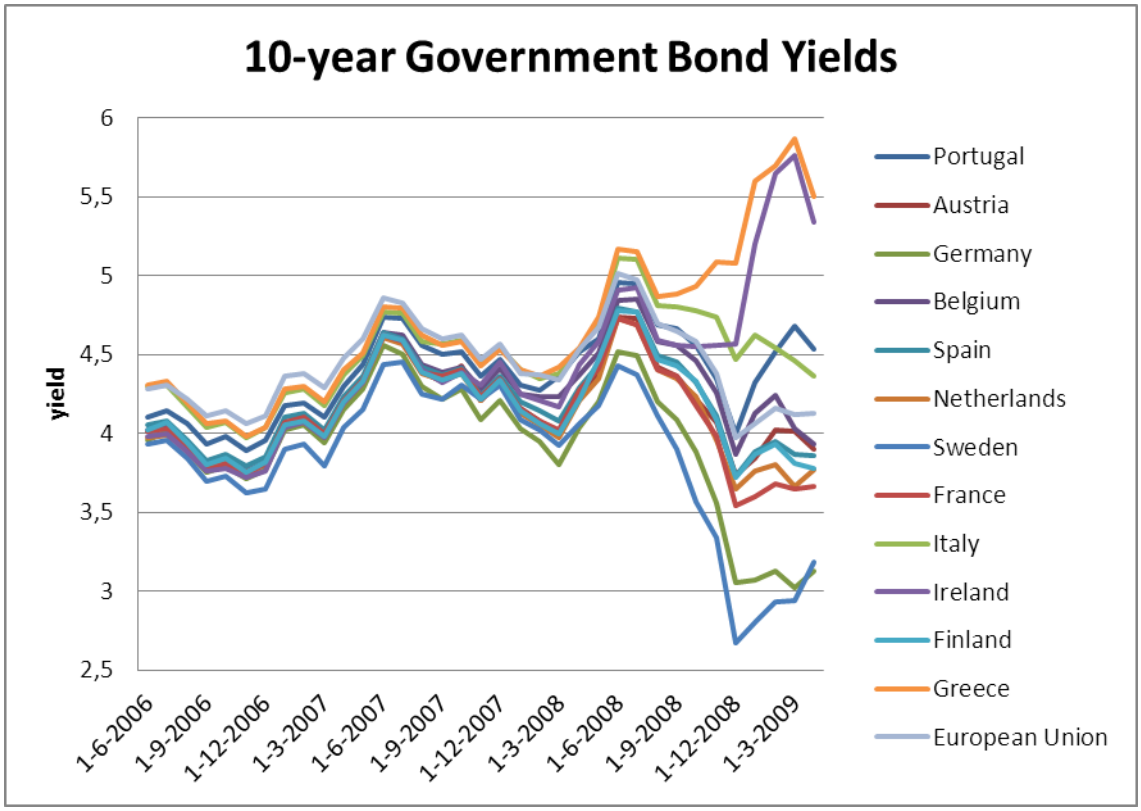
describes globally systemically important banks. After that the empirical model used for testing the hypothesis will be discussed, followed by data description, the empirical results and the conclusion.

2. Macro Developments in Europe

2.1 Financial problems in Europe

Since the onset of the financial crisis, economic, political and financial stability are the most important issues in Europe. These issues are all related to credit risk. Changes in a country's credit risk should be reflected in sovereign yield spreads, sovereign credit default swap (CDS) spreads or the sovereign rating, as all of these are a measure of the creditworthiness. Recent years there has been a significant change in sovereign credit risk pricing. Figure 2.1 shows 10-year bond yields of euro area countries from May 2007 – April 2009. After the fall of Lehman Brothers in September 2008, especially Greek and Irish bond yields have increased significantly. Also the yields for Portugal and Italy have increased significantly.

Figure 2.1: 10-year government bond yields, monthly averages (15-06- 2006 until 15-05- 2009)

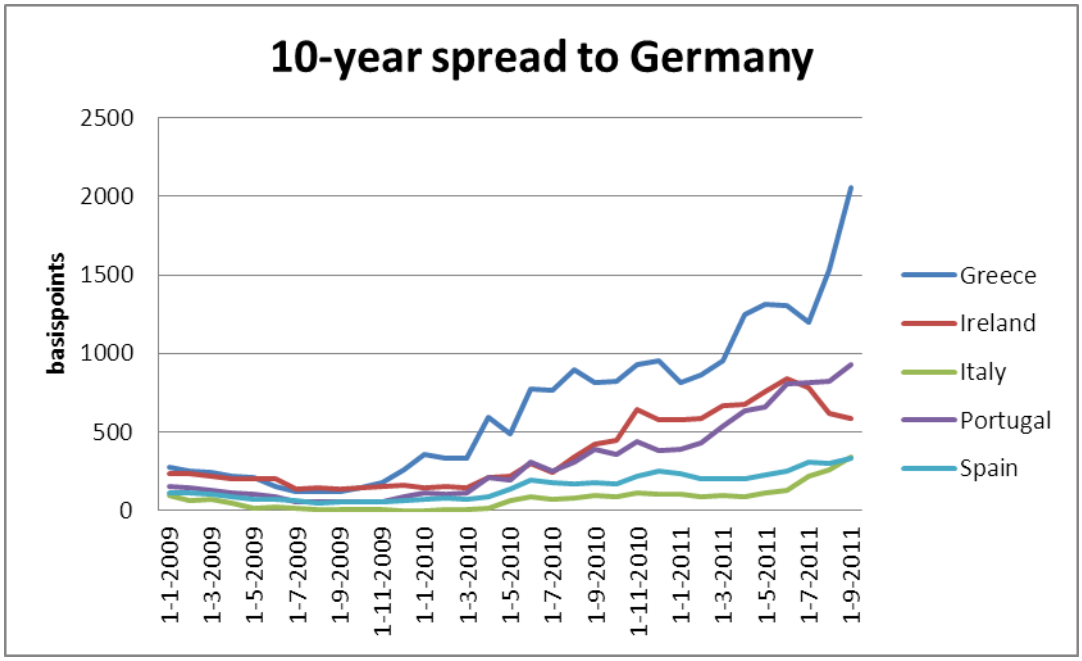


Source: Datastream

According to the IMF (2010), the financial crisis triggered 4 phases of credit repricing in the European government bond and swap markets. The first phase, 'Financial Crisis Buildup' (July 2007 – September 2008), caused an increase in global risk aversion and flight to quality, which benefited the core and widened the spreads of the periphery in Europe. Germany and

France for example are considered less risky countries, which is reflected in their low level of sovereign bond yield compared to periphery countries, see figure 2.1. The second phase, 'Systemic Outbreak' (October 2008 – March 2009), was triggered by the collapse of Lehman Brothers. This phase had a serious impact on countries in which the financial sector had been hit hard by the financial crisis. In figure 2.1 it is shown that Ireland, with its large financial sector as a percentage of GDP, saw a dramatic increase in its 10 year bond yield during this second phase. In the third phase, 'Systemic Response' (April 2009 – October 2009), governments supported their banking system with extraordinary policy actions. This led to a reduction of risk aversion and narrowed yield spreads which benefited the periphery. Figure 2.2 shows yield spreads for the GIIPS[2] countries during this phase.

Figure 2.2: 10-year government bond yield spreads (basis points) to Germany for the GIIPS countries (15-01-2009 until 15-09-2011)



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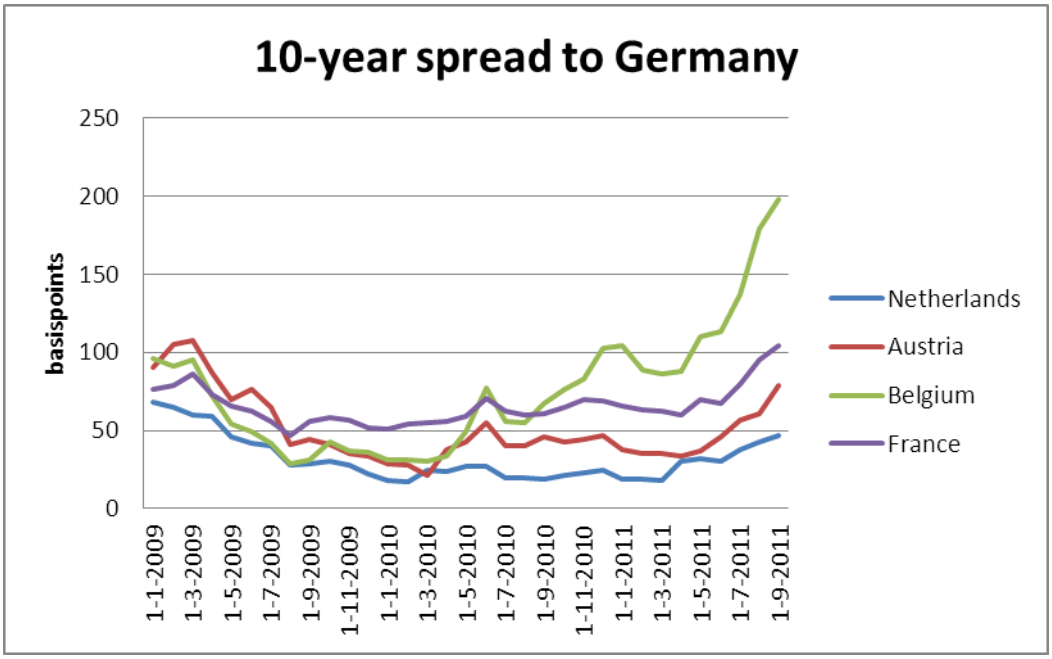
Rescue packages became effective and have calmed the markets. However, since November 2009 concerns about countries with weak public finances and financial strains have triggered the European debt crisis and spreads started to widen again. This fourth phase, 'Sovereign Risk' (November 2009 – present), not only affected the periphery but also some core countries, which was mainly due to the large rescue packages which deteriorated public finances. Although these tensions are most evident in Greece, where the government revised

[2] GIIPS countries: Greece, Ireland, Italy, Portugal and Spain.

their deficit forecast and was downgraded by all rating agencies, also Belgium, France and Austria saw their yields increasing.

Figure 2.3: 10-year government bond yield spreads (basis points) to Germany for Austria, Belgium, France and the Netherlands (15-01-2009 until 15-09-2011)



Source: Datastream

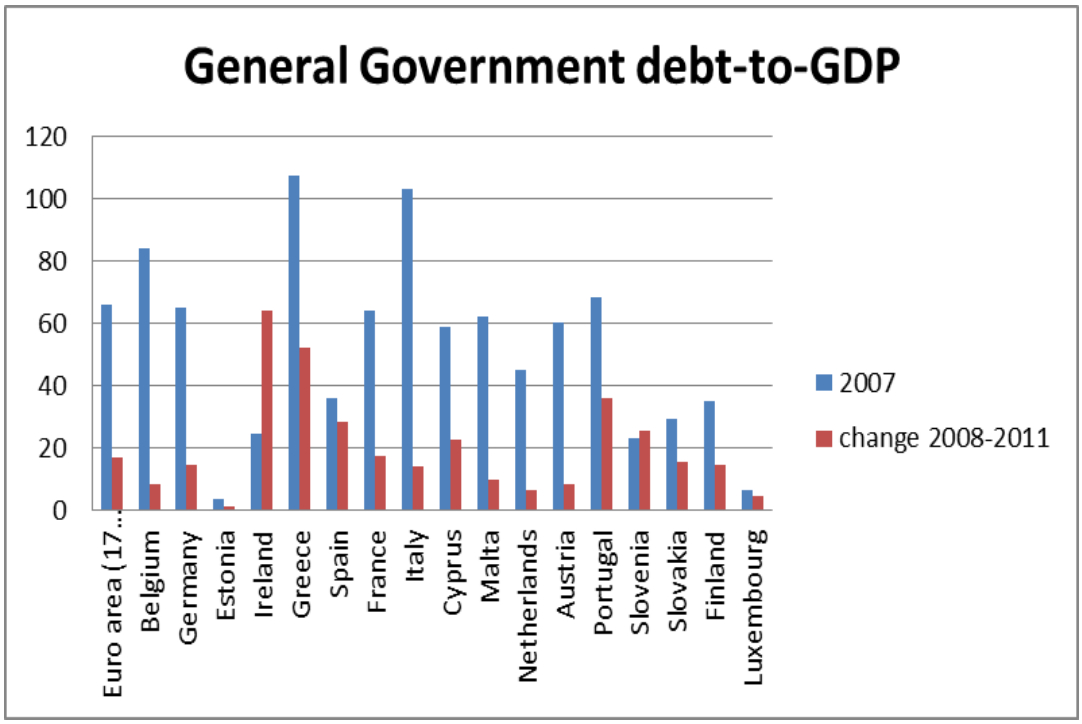
Figure 2.3 shows that also these core countries saw their spreads widening against German Bunds from the end of 2009 onwards. Financial markets shifted their concerns from financial sector vulnerabilities to fiscal vulnerabilities of sovereigns, among other things as a consequence of the large rescue packages. Liquidity in sovereign credit markets have increased during this crisis. Before the crisis, markets mainly focused on corporate (private sector) credit markets. So the focus on sovereign risk and sovereign debt markets has increased. The weak fiscal outlooks and financial strains in Europe caused a reassessment of sovereign risk.

2.2 Sovereign problems

Two main aspects have caused an increase in the budgets deficits and debt ratios in most of the euro area countries since the start of the financial crisis. Because of weak economic growth, tax revenues decreased in most euro area countries and also large public spending in the wake of the crisis have caused large debt and deficit ratios. Since the introduction of the euro, sovereign debt ratios in euro countries were pretty stable until the start of the financial

crisis. Figure 2.4 shows debt-to-GDP ratios for euro area countries from 2007-2011. Especially the GIIPS countries, with the exception of Italy, saw a large increase in the change of their debt-to-GDP ratio, but they also have the highest debt-to-GDP ratios in the euro area, with the exception of Spain.

Figure 2.4: General Government debt-to-GDP ratios (percentages) in the euro area countries (2007-2011)



Source: Eurostat

The significant deterioration of public finances in Europe caused a fear of a sovereign debt crisis. The situation in Greece not only had a contagious effect on other GIIPS countries but also on the core, where large private sector institutions have significant exposure to Greece and Italy for example. With the fear of a debt crisis and possible contagious effects, sovereign risk premia have increased and higher yields increased financing costs for sovereigns, making the crisis even worse. With the introduction of the euro, yields on sovereign bonds in Europe converged significantly. During the 'Great Moderation', no significant outliers in yield spreads could be detected in euro area countries. Since the onset of the crisis, yields on sovereign bonds have significantly increased. However, Germany has experienced a fall in their yield as investors searched for a 'flight to quality'. While 10-year yield spreads to the German Bund averaged 18 basis points in the period from 1999 to mid-2007, they averaged

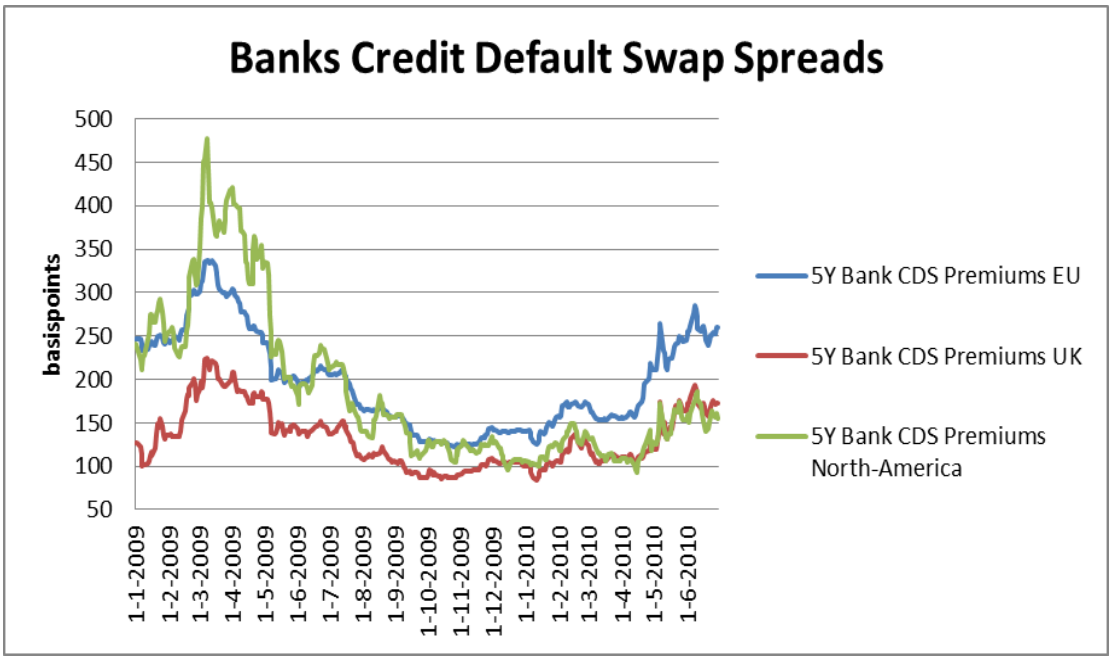
56 basis points since August 2007 and 99 basis points since October 2008 (Barrios et al., 2009).

2.3 Financial sector

The current economic and financial crisis started in the financial sector. Banks were highly leveraged and had to write down losses on subprime mortgages which damaged investor confidence. The default of Lehman Brothers accelerated the problems in the financial sector. The possible consequences of Lehman's collapse caused a significant rise in default risk among banks (Buiter, 2010). Financial institutions did not trust each other anymore and this led to a credit crunch. These market developments led to an increase in the risk of financial institutions, which is shown in figure 2.5.

As mentioned earlier, in order to avoid a systemic collapse of the financial system, governments bailed out financial institutions with the help of rescue packages, guarantees and asset purchases. These actions caused a risk transfer from the banking sector to the governments, thereby reducing bank risk (Ejsing and Lemke, 2010). Figure 2.5 shows that in the third phase, starting in April 2009 with government responses to the crisis, bank CDS spreads narrowed down until problems for sovereigns came into light in November 2009.

Figure 2.5: 5 year CDS premiums of Banks for EU, UK and North-America (01-01-2009 until 30-06-2010)



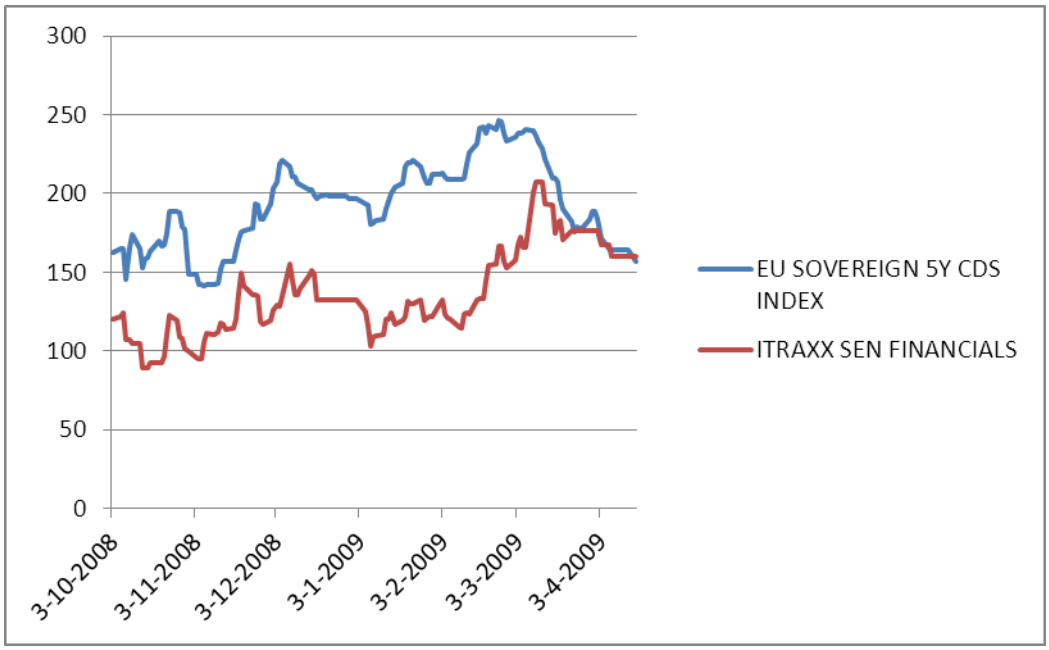
Source: Datastream

2.4 Risk transferring

As already mentioned, risk was transferred from the private sector to the public sector during the crisis. Literature on the relation between banking and sovereign crisis is still scarce (Candelon and Palm, 2010). Most papers on this relation focused on emerging economies crises, because developed countries were considered to be risk-free. However, recent financial events caused an acceleration of the number of papers regarding this topic and mainly focus on the European debt crisis (see for example Acharya et al. 2011, Attinasi et al. 2009 and Dieckmann and Plank 2011).

Attinasi et al. (2009) show that announcements of bank rescue packages led to a reassessment of sovereign credit risk, where risk is transferred from the financial sector to the public sector. Acharya et al. (2011) show that risk transfer between the financial sector and the sovereign is two-sided, which is reflected in a strong co-movement of bank and sovereigns CDS spreads. The authors test the relation between bank bailouts and sovereigns credit risk during the recent financial crisis. A bailout is viewed as a risk transfer from the financial sector to the sovereign, thereby triggering a widening in sovereign CDS spreads and a narrowing in bank CDS spreads. However, the bailouts are funded by diluting existing government bondholders, therefore deteriorating the sovereign creditworthiness. Since banks have large holdings of (domestic) government bonds, this deterioration will reduce the value of its guarantees and will affect its ability to use these bonds as collateral. As a consequence, risk is transferred back from the sovereign to the financial sector. The authors test this consequence (reverse risk transfer) by regressing bank CDS spreads on sovereign CDS spreads plus some control variables. They found a significant relation, hence, an increase in sovereign risk positively affect bank credit risk. Thus bank bailouts not only lead to higher sovereign credit risk but also to higher cost of borrowing. Figure 2.6 shows that after the government interventions in April 2009, the iTraxx index of financials decreased quickly and the gap with sovereign CDS premia started to widen again, which is a reflection of the risk transfer from the private to the public sector.

Figure 2.6: 5 year EU sovereign CDS Index and iTraxx Senior Financials Index (october 2008-april 2009)



Source: Datastream

Ejsing and Lemke (2011) also focus on the relation between financial sector and sovereign risk. The authors documented that a large part of variation in the corporate and sovereign CDS spreads can be explained by a single common factor ('crisis factor'). This common factor is a variable that measures the effect of global risk aversion and gives a prediction about how positive investors are about the macroeconomic future. Because global risk aversion cannot be measured directly, different articles used different proxies for this common risk factor. In their article it is measured by the iTraxx index of non-financial CDS premiums. The authors also find evidence for one of the results of Acharya et al. (2011), namely a strong co-movement of private and public risk. Furthermore, the authors highlight that the increase in bank risk premiums slowed down after financial rescue packages, while the sensitivity of sovereign risk premiums to the common risk factor increased after these rescue packages. These developments suggest that banking risk is an important determinant of sovereign risk. In the next section I briefly review some relevant literature on the determinants of sovereign yield spreads, followed by a section about a particular important part of the banking sector, namely the systemically important banks.

3. Literature

This section provides a short review of relevant literature on determinants of sovereign risk yield spreads. The literature mainly focused on country-specific credit risk (fiscal fundamentals), global risk, country-specific liquidity risk and more recently also on the banking/financial sector.

Financial sector

Starting with the financial sector, Mody (2009) shows that after the rescue of Bear Sterns in March 2008, the domestic financial sector has become a driver of sovereign risk. Dieckmann and Plank (2011) focus on determinants of sovereign risk in advanced economies. Their paper shows that sovereign risks in those countries have a strong co-movement and the risks have severely increased since the onset of the financial crisis. They document that both the world and domestic financial system have strong explanatory power for sovereign risk, by regressing on different local and global variables.

Mody and Sandri (2011) argue that sovereign yield spreads reflect domestic vulnerabilities of national banking sectors. They argue that this feature has a more severe impact on countries with high debt-to-GDP ratios. Gerlach et al. (2010) also test for the vulnerability of the banking sector as a factor that drove sovereign bond yield spreads in the euro area for the period 1999-2009. The authors use the equity-to-asset ratio as a measure of risk that banks will ask for government support. They argue that banking sectors with larger equity-to-asset ratio are better able to absorb losses and are less likely to need support, hence, less sovereign risk. They conclude that countries where bank equity buffers are small have to pay larger country risk premiums. These findings suggest that sovereign risk is associated with the vulnerability of the banking sector, but the authors emphasize that the effect of the banking sector vulnerability on sovereign spreads, depends on global risk (measured by risk aversion).

Another financial sector determinant is the size of the banking sector. Aktug et al. (2010), show that a larger banking sector is crucial in lowering sovereign risk. They measure the size of the banking sector as equal to the claims of deposit money banks as a share of GDP and the sovereign risk by its credit rating from Standard & Poor's. They argue that efficient local financial markets reduce the need to borrow internationally. Being able to borrow in terms of local currency rather than foreign currency reduces sovereign risk and enables international

debt to be obtained on better terms (Aktug et al. 2010, p. 23). Regarding the size of the banking sector, Gerlach et al. (2010) argue that the potential for banks' losses depends on their size; hence, banking size should have an effect on sovereign risk. Their conclusion is that the size of the total banking sector is an important determinant of sovereign spreads for euro area countries relative to Germany. When global risk increases, countries with larger banking sectors face higher yields. So the interaction with the global risk factor determines the impact of the size of the banking sector on sovereign spreads.

Fiscal fundamentals

Turning to country-specific credit risk, Attinasi et al (2009) study the development of sovereign bond yield spreads against Germany for some euro area countries. The authors argue that concerns about fiscal fundamentals have contributed to higher government bond yield spreads relative to Germany. All fundamentals were relevant, but especially the size of the budget deficits relative to Germany is a key determinant for explaining the higher government bond yield spread. Furthermore, based on their findings, the authors argue that not merely the size of support, but the credibility of the government's commitment to extend banking sector support has a significant effect on sovereign bond spreads. The overall conclusion of this paper is that countries with better expected fiscal positions could benefit from lower borrowing costs in times of crisis, hence, have less difficulty with rescuing banks. Bernoth et al. (2004) also study the European bond market in the period 1992-2002 and find that debt and deficits have a positive impact on sovereign bond spreads. On the other hand, Schulz and Wolff (2009) find only weak evidence for the impact of fiscal fundamentals on German Bunds. A recent study of Sgherri and Zoli (2009) also find that sovereign bond spreads became significantly more sensitive to projected debt changes since September 2008. The authors analyze the evolution of sovereign spreads and make a link to debt concerns of the public and private sector. They suggest that euro area sovereign risk premium differentials tend to co-move over time and are driven by a common time-varying factor, reflecting global risk repricing. This brings us to the next determinant of sovereign risk, a common international risk factor which is common across countries but varies over time.

Global risk

Codogno et al. (2003) study the determinants of observed yield differentials in the euro-zone government bond market. Their paper provides evidence that international risk factors, as measured by banking and corporate risk premiums in the US, are the most significant

determinant for explaining movements in yield differentials of euro-zone government bonds, in the period from 1992 to 2002. These international risk factors affect government bond spreads because they change the perceived default risk of sovereign bonds in the euro-zone. The authors provide evidence that yield spreads of Austria, Italy and Spain, relative to Germany, are explained by their debt-to-GDP ratios relative to Germany. For other euro-zone countries, yield differentials are affected by international risk factors, however, not by their debt-to-GDP ratios. Favero et al. (1997) also show that yield spreads for Italy and Spain against Germany are driven by international risk factors, which also determine a large part of the variation of the spreads. Barrios et al. (2009) show that a common sovereign risk factor explains 95% of the variation cross-country correlation of sovereign spreads in Europe. Longstaff et al. (2007) find similar relations between sovereign risk and global risk factors, but they study sovereign CDS instead of sovereign yield spreads.

Liquidity

In the literature liquidity is also a determinant of sovereign risk. This variable is often measured as the Bid-Ask spread of the specific sovereign bond (or CDS). So what is meant by liquidity is the liquidity of the bond market(s). Favero et al. (2010) provide evidence for liquidity as a determinant of sovereign yield spreads. But the role of liquidity is only significant in combination with the global risk factor. When global risk is high, the effect of liquidity on sovereign bonds spreads becomes smaller, because investors stick to bonds in times of high aggregate risk. However, Beber et al. (2009) show that liquidity plays a bigger role in the determination of sovereign spreads in times when global risk is high. Codogno et al. (2003) on the contrary find that liquidity factors play a relative small role in explaining movements in yield differentials in the euro-zone government bond market.

Overall, the literature suggests that global risk (risk aversion), fiscal fundamentals, liquidity and the size and vulnerability of the banking sector have an effect on sovereign yield spreads. Gerlach et al. (2010) used the whole banking sector in their study to show the impact of the banking sector. But at the same time, they recognize that it is an interesting avenue to study the impact of large international banks on sovereign risk, especially in the light of burden sharing (Gerlach et al. 2010, p.26). Banks that are considered too big to fail have an important effect on the vulnerability of the banking sector and on the real economy (BCBS, 2011). Therefore it is likely that these banks affect sovereign risk. In this paper I will focus on the role of these large international banks as a determinant of sovereign risk. The focus will be on

the role of systemically important banks. Next I will describe these systemically important banks.

4. Systemically Important Financial Institutions

4.1 What are systemically important financial institutions?

Financial distress or weaknesses at large and complex financial institutions played a key role in triggering financial crises throughout history. Failures in managing risk of these institutions could have significant disruptive effects on activities in the financial system, but also in many other sectors of the economy. During the recent financial crisis, distress at a number of large, global financial institutions caused financial instability in the global financial system which, in turn, harmed the real economy. To avoid a catastrophe, authorities often had no choice but to forestall the failure of such institutions through public solvency support. As became evident from the current crisis, this public support had significant deleterious consequences for public finances, hence, sovereign risk increased. The costs of these interventions and the associated increase in moral hazard call for additional measures in order to reduce the likelihood and severity of problems that arise from the failure of systemically important financial institutions (SIFIs).

The Basel Committee on Banking Supervision (BCBS) has, in response to the crisis, adopted a series of reforms to improve the resilience of banks and banking systems. The Basel III framework include raising the required quality and quantity of capital in the banking system, improving risk coverage, introduction of a leverage ratio, and countercyclical buffers as well as a global standard for liquidity risk. A number of the policy measures will have a particular impact on global systemically important banks (G-SIBs), who generally placed greater emphasis on trading and capital markets related activities, which are most affected by the enhanced risk coverage of the capital framework (BCBS, 2011). The rationale for adopting additional policy measures for G-SIBs is based on the cross-border negative externalities created by systemically important banks which current regulatory policies do not fully address and also to protect the system from wider spillover risks of G-SIBs.

The negative externalities (moral hazard, information contagion, interbank linkages and counterparty exposures etc.) associated with institutions that are perceived as too big to fail due to their size, interconnectedness, complexity, lack of substitutability or global scope are well recognised. In maximising their private benefits, individual financial institutions may rationally choose outcomes that, from a system-wide level, are sub-optimal because they do

not take into account these externalities (BCBS, 2011). Moreover, the moral hazard costs associated with implicit government guarantees can be seen as a funding advantage that distorts market competition.

At recent summits, G20 leaders asked the Financial Stability Board (FSB) to develop a policy framework to address the systemic and moral hazard risk associated with systemically important financial institutions (FSB, 2011). According to the FSB (2011), systemically important financial institutions are *''financial institutions whose distress or disorderly failure, because of their size, complexity and systemic interconnectedness, would cause significant disruption to the wider financial system and economic activity''*.

4.2 Identifying systemically important banks

The BCBS has developed a measurement approach to measure the systemic importance of banks and its aim is to identify systemically important banks on the basis of a system-wide concept. This work of the Basel Committee forms part of the effort of the FSB to reduce moral hazard at G-SIBs. The proposed methodology is based on an indicator-based measurement approach and consists of the following five indicators:

- Bank size
- Interconnectedness
- Availability of substitutes for services provided by the banks
- Cross-border activity
- Complexity

These indicators are approximate measures to identify the potential impact of a failure of one of these banks on the global financial system and wider economy. Each category is given an equal 20% weight in the methodology, see table 4.1. With the exception of size, each indicator consists of a number of sub-indicators. Indicators that measure the likelihood of failure of a bank are not used by the BCBS, since this approach is captured in the Basel III framework. To develop the methodology, the BCBS came up with a sample of 73 global banks for which end-2009 data was collected. This sample of 73 banks was chosen from the world's largest banks on the basis of size and supervisory judgment of the member authorities of the Basel Committee (BCBS, 2011).

Table 4.1

Indicator-based measurement approach

Category (and weighting)	Individual Indicator	Indicator Weighting
Cross-jurisdictional activity (20%)	Cross-jurisdictional claims	10%
	Cross-jurisdictional liabilities	10%
Size (20%)	Total exposures as defined for use in the Basel III leverage ratio	20%
Interconnectedness (20%)	Intra-financial system assets	6.67%
	Intra-financial system liabilities	6.67%
	Wholesale funding ratio	6.67%
Substitutability (20%)	Assets under custody	6.67%
	Payments cleared and settled through payment systems	6.67%
	Values of underwritten transactions in debt and equity markets	6.67%
Complexity (20%)	OTC derivatives notional value	6.67%
	Level 3 assets	6.67%
	Trading book value and Available for Sale value	6.67%

Source: BCBS, 2011

The sample banks will be monitored on an on-going basis. This sample is to be reviewed every three years. After using the BCBS assessment methodology, the FSB and BCBS have identified in 2011 an initial group of 29 global systemically important banks, listed in alphabetical order in Appendix A. As banks change their behaviour in response to the incentives of the G-SIB framework, this list will be updated annually.

In the definition of capital, Basel III emphasizes on Common Equity Tier 1 as an important element. It is the highest quality component of a bank's capital as it is capable of fully absorbing losses whilst the bank remains a going concern (BCBS, 2011). A higher ratio requirement of Common Equity Tier 1 reduces the funding advantages of G-SIBs that arise from expectations of public sector support. Therefore, the Basel Committee considers the use of Common Equity Tier 1 to be the simplest and most effective way for G-SIBs to meet their additional loss absorbency requirement. When capital levels fall below these minimum buffers, banks face constrains on distribution of earnings as dividends and bonus payments.

Having shown the dimension of systemically important banks, I suggest that these banks are, based on their size, complexity and interconnectedness an important factor of the banking sector, particularly for the vulnerability of the banking sector. These banks' characteristics really distinguish the G-SIBs from banks which are much smaller, less complex and less interconnected. The current crisis has shown that the banking sector could have deleterious consequences for public finances; hence, I argue that G-SIBs could have a significant positive impact on sovereign risk. Therefore, I will test the following hypothesis.

Hypothesis 1: *The size of G-SIBs in a country has a positive impact on the sovereign bond yield spreads of that country.*

The sovereign bond yield spreads reflect sovereign risk. The higher the spread, the higher the sovereign risk. According to the literature, the size of the banking sector is a determinant of sovereign spreads. As mentioned above, G-SIBs could have serious consequences for the vulnerability of a country's banking sector. The bigger the size of these banks, the bigger the potential for losses, hence, the bigger the potential sovereign risk.

Hypothesis 2: *The more vulnerable G-SIBs are, the higher the sovereign bond yield spreads.*

The vulnerability of G-SIBs reflects the ability of G-SIBs to absorb losses from bad assets. Generally, as previous research has shown, banking sectors with higher vulnerabilities are more likely to need government support. The potential cost of a bailout reflects sovereign risk. Again, the higher the spread, the higher the sovereign risk. I use the equity ratio as a measure of the risk that G-SIBs will need a bailout.

The research methodology will be described in the next section.

5. Methodology and Data

5.1 Regression model

In the literature on sovereign yield spreads several studies focus on the sovereign yield spreads for euro area countries against German Bunds. According to Sgherri and Zoli (2009), empirically, spreads on the 10-year government bond yield over Bunds for euro area countries are assumed to be simultaneously determined within a multivariate generalized autoregressive conditional heteroskedasticity framework. Furthermore, according to the literature there is a high persistency in movements of sovereign yield spreads where spreads are believed to depend upon their past according to an AR(1) process.

Given the high persistency in the dependent variable (the bond yield spread today depends also on its past values), Attinasi et al. (2009) used a dynamic panel model to explain 10-year sovereign yield spreads over Germany. They used daily and monthly data, both as robustness check and to mitigate the persistency in the dependent variable. The Feasible Generalised Least Squares estimator was used in their model, corrected for heteroskedasticity across panels and panel-specific AR(1) autocorrelation. The authors wanted to test the effect of announcements of bank rescue packages on the yield spreads. Besides they used variables for fiscal fundamentals, liquidity and international risk.

Gerlach et al. (2010) also used a dynamic panel model, in which the authors tried to show the impact of the banking sector on sovereign yield spreads relative to Germany. In contrast with Attinasi et al. (2009), their paper used also an interaction term which allows country-specific default risk to vary with international risk. Because the coefficients appeared to be broadly similar across countries, pooling the data in a dynamic setting is appropriate. Therefore, the random coefficients model of Pesaran and Smith (1995) was estimated, which allows coefficients to differ across countries but assumes that they are drawn from a common distribution (Gerlach et al. 2010, p.6). Schulz and Wolff (2008) also performed a panel regression analysis, in which the yield spread of German federal state *i* against the Bund is regressed on risk aversion, liquidity and debt per capita.

Codogno et al. (2003) used the relative asset swap spread (RAS) as the dependent variable in an empirical model in which they tried to identify the relevance of liquidity and credit-related factors for government bond yield differentials in the euro area, with monthly data. Their model allows for a slow dynamic adjustment to a long-term equilibrium value of RAS, with first order autocorrelation. Like Attinasi et al. (2009), their paper also used variables for

global risk and fiscal fundamentals. The variable of global risk is entered both linearly and in the interaction term with the debt-to-GDP ratio. The interaction term allows the authors to assess the risk-relevance of debt indicators. For their sample of daily observations, an equivalent model was used but with the yield spread against Germany as the dependent variable.

Barrios et al. (2009) used an econometric approach to distinguish between liquidity risk, credit risk and risk aversion in the euro area sovereign bond market. Their dependent variable is the change in bond yield spreads against Germany. To avoid spurious regressions, their model was estimated in first differences. Ordinary Least Squares estimation was used separately for each country, adjusted for clustered standard errors.

In this paper I will use an approach to distinguish between risk coming from G-SIBs in the euro area sovereign bond market, global risk, liquidity risk and fiscal fundamentals. I use the following AR(1) model.

$$SPREAD_{i,t} = \theta SPREAD_{i,t-1} + \beta_{1,i}\, G\text{-}SIB_{i,t} + \beta_{2,i}\, EQUITY_{i,t} + \beta_{3,i}\, RISK\ AVERSION_{t} + \beta_{4,i}\, LIQUIDITY_{i,t} + \beta_{5,i}\, DEBT_{i,t} + \beta_{6,i}\, DEFICIT_{i,t} + \beta_{7,i}\, G\text{-}SIB_{i,t} * RISK\ AVERSION_{t} + \beta_{8,i}\, EQUITY_{i,t} * RISK\ AVERSION_{t} + \varepsilon_{i,t}$$

$$\text{where } \beta_{j,i} = (1-\theta)b_{j,i} \text{ for } j = 1,\ldots,8.$$

5.2 Variable choice

Dependent variable

- ***SPREAD*** is the bond yield spread of the 10-year government bond of country *i* benchmarked against the yield of 10-year German Bund at time *t*, and it is a proxy for sovereign risk.

$$SPREAD_{i,t} = I_{i,t} - I_{g,t}$$

where $I_{i,t}$ is the yield of country *i* and $I_{g,t}$ is the yield of German Bunds.

German Bunds are used as a benchmark in this study because they are most common used in previous research on sovereign risk for European countries (see for example Favero et al. 1997, Codogno et al. 2003 and Gerlach et al. 2010). Dunne et al. (2007) provide evidence for

the benchmark role of the Bund for bonds with 10 year maturity. In the model, $SPREAD_{i,t}$ depends on its lagged value ($SPREAD_{i,t-1}$).

Independent variables

- ***G-SIB*** reflects the size of G-SIBs in country *i*, measured by total assets relative to GDP.

As mentioned in section 4, G-SIBs could have significant impact on the financial system and the real economy, especially when these banks are in distress. Distress of these banks is most likely in times of financial turmoil, thus when common risk is high. It was also mentioned in section 4 that these banks could have deleterious consequences for public finances in times of crisis. The potential for losses in the banking sector depends on its size. Therefore I expect a positive relation with the dependent variable.

- ***EQUITY*** stands for the equity-to-assets ratio of the G-SIBs and is a proxy for the vulnerability of the banking sector.

As already mentioned in section two, government interventions were needed in 2008 and 2009 to recapitalize banks. These interventions had significant consequences for sovereign debt. The equity-to-asset ratio reflects the ability of banks to absorb losses from bad assets; it says something about the probability that bank rescue packages are needed. The higher the ratio, the more likely these banks are able to absorb losses, the less likely they need government support. Therefore I expect a negative relation with sovereign risk.

Control variables

- ***RISK AVERSION*** is the risk aversion factor and is measured by the Macro Risk Index (GRAMI) of Citigroup. This variable is the proxy for global common risk.

This variable says something about the willingness of investors to take risk. Risk-return preference functions are adjusted continuously. In times of financial distress, risk aversion among investors increases and they will rebalance their portfolios towards less risky assets. Investors then search for the safest and most liquid assets. German Bunds are perceived as the safest (default-free) among euro area government bonds. So when risk aversion is high, flows to German government bonds are more likely than flows to other government bonds. I expect that risk aversion has a positive relation with the yield spread against German Bunds.

- ***LIQUIDITY*** is a control variable for liquidity of the specific bond and its proxy is the Bid-Ask spread of the specific bond.

A liquid bond market gives investors the opportunity to value and trade position at any time. In a liquid market large transactions do not have a significant effect on prices and there is always a large volume of sellers and buyers. Liquidity in national bond markets is determined by the issuing volume and issuing policy of the specific country. In times of distress investors seek a flight to liquidity which boosts bonds of less riskier countries. In this perspective, a liquidity variable is relevant. I expect this variable to have a positive relation with sovereign risk, because better liquidity conditions (lower Bid-Ask spread in this paper) in the bond market should lead to lower bond yields spreads.

- ***DEBT*** and ***DEFICIT*** are the country-specific expected debt-to-GDP and expected deficit-to-GDP ratios respectively.

These two credit risk variables are used in most studies on sovereign bond spreads. Deterioration of fiscal positions due to massive financial rescue packages and fiscal stimulus during the crisis raised questions about the sustainability of public finances. Rating agencies downgraded several euro area countries. Many investors are constrained in their investment decisions based on credit ratings and portfolio allocations could therefore be biased towards less risky bonds, hence, sovereigns bond spreads could be influenced. Generally, a higher ratio implies a higher probability of facing difficulties with servicing the debt, hence, higher sovereign credit risk. Therefore I expect a positive relation with the yield spread for these two variables.

- The interaction terms are used because the impact of G-SIBs on sovereign risk varies with aggregate international risk. In good economic times, these banks could be a driver of the economy (Aktug et al. 2010), however in times of financial distress, the banking sector could have an important impact on a governments' fiscal position, hence, on sovereign risk (Gerlach et al. 2010).

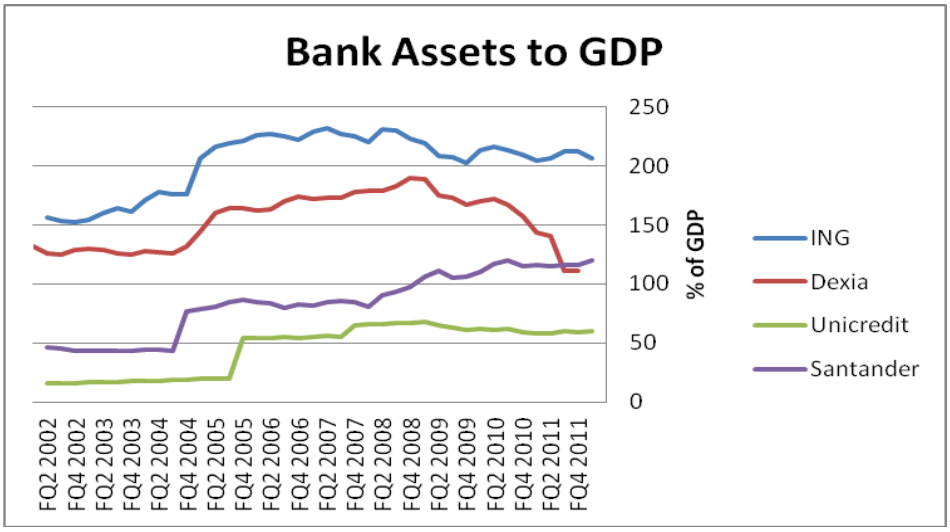
- $\boldsymbol{\theta}$ is the autoregressive parameter and ε is the error term.

5.3 Data and sample size

Sovereign spread and G-SIBs

I use quarterly data on sovereign bonds yields of euro area countries with G-SIBs. Data source is DataStream. I focus on bonds with a maturity of 10 years and use Germany as the benchmark. In the euro area there are five countries with G-SIBs, i.e. in total 7 banks: **Belgium** (Dexia), **France** (BNP Paribas, Group Credit Agricole and Societe General), **Netherlands** (ING), **Italy** (Unicredit Group) and **Spain** (Santander). Since banks publish quarterly, the data on the bank's assets-to-GDP and equity-to-asset ratios, are measured quarterly. Other institutions, like the ECB or other Central Banks do provide data of financial institutions (MFI's) on a monthly basis, but not for individual institutions, only on an aggregate level because of confidentiality. That means that I am restricted to quarterly data for the bank variables, therefore I am forced to use a sample period of at least 10 years. However the concept of G-SIBs is quite new and did not exist before the current crisis. Unfortunately, I could not get enough data on the French banks, so I had to exclude France and its G-SIBs from my sample. Figure 5.1 shows that the size of Santander relative to GDP was not very stable during the last 10 years, varying between 43% and 120%. The same is true, but to a lesser extent, for Unicredit Group which saw its assets relative to GDP varying between 16% and 60% the last 10 years. Dexia's assets relative to GDP varied between 111% and 190% and ING's assets between 152% and 230%.

Figure 5.1: Assets of G-SIBs as percentage of GDP (Q2 2002 until Q4 2011)



Source: Citibank Global Markets Ltd.

The fact that the value of assets relative to GDP increased during the last 10 years for all these banks is logical. The economy has been significantly financialised and during a financial asset

boom the economy's credit flows shift progressively away from the real economy and increasingly to financial asset markets (Bezemer 2009). Both Dexia's and ING's assets remained significantly higher than their countries' GDP, which is not the case for Santander and Unicredit Group. Judging on size I assume that both Dexia and ING were systemically important during the last 10 years and Santander and Unicredit Group were not, and therefore I excluded Santander and Unicredit Group from the sample. I use a sample period of 10 years to start after the dot.com crisis of 2000-2002 and in the early stages of the build up to and including the current crisis. Therefore, for the Netherlands I use the sample period between the second quarter of 2002 up to and including the first quarter of 2012. Since Dexia has been nationalised in the last quarter of 2011, I use the sample period between quarter one of 2002 up to and including the fourth quarter of 2011 for Belgium.

Risk aversion

Because risk aversion is not directly measurable, just as in previous research, a proxy is used. The most used proxy for risk aversion in comparable literature is the corporate bond spread, which is the yield differential to US treasuries (see for example, Favero et al. 1997, Codogno et al. 2003 and Bernoth et al. 2004). Since the US spread is the most liquid corporate bond market, this spread gives a good indication whether investors are willing to invest in projects and to take on risk (Gerlach et al., 2010 and Codogno et al., 2003). However, I will use another proxy as the main measure of risk aversion. Like Sugihara (2010) I will use the Citi Global Risk Aversion Macro Index (GRAMI), which is composed of (equally weighted) developed & Emerging Markets sovereign spreads and US credit spreads to capture credit risk, the TED spread to capture counterparty risk and implied FX, equity and swap volatility to capture price risk across different asset classes. The rationale for using this index is to have a broader measure of risk aversion across asset classes and it is therefore a good measure of risk aversion in global financial markets. The corporate bond spread, which is a credit spread, is also included in the basket. A higher GRAMI means higher risk aversion and vice versa. Data is monthly and data source is Citibank Global Markets Ltd.

Liquidity

To assess liquidity risk, I follow Gerlach et al. (2010) and use the Bid-Ask spread as the measure of liquidity. The size of the Bid-Ask spread is influenced by the liquidity in the market. The smaller the Bid-Ask spread the more liquid the market. According to Barrios et al. (2009), for measures of liquidity in bond markets, Bid-Ask spreads are better indicators

than traded volumes, because data on trading volume can be affected by several trading operations between bank's affiliates to meet balance sheet requirements. Thus, big variations in volumes might have little effect on actual liquidity. Gomez-Puig (2006) show that the Bid-Ask spread plays a role in the widening of sovereign bond spread since the EMU. Barrios et al. (2009) show, based on their Bid-Ask measure, a worsening in liquidity in government bond markets since the beginning of the current financial crisis onwards. I use quoted 20-day Bid-Ask spreads for each 10-year sovereign bond. Data are on a daily basis and sourced from Bloomberg.

Debt and Deficit ratios

Several studies (Attinasi et al. 2009, Barrios et al. 2009, Gerlach et al. 2010 and Sgherri and Zoli 2009) use expected fiscal variables in explaining sovereign bond spreads in the euro area. I follow them by using expected government budget debt and deficit ratios as measures of fiscal variables. These expectations give investors a signal about the sustainability of a country's fiscal position, hence, also on a country's credit risk and this change at each point in time together with the available information at that time. Another reason to use forecasts rather than historical data is the fact that bond yields are forward looking. Data on the expected debt and deficit ratios are on a semi-annual basis and sourced from the European Commission Economic forecasts.

I took averages for the variables with data of a higher frequency than quarterly, and for those with a lower frequency than quarterly, I interpolated these to quarterly. All variables that are relative to GDP, for example total assets of G-SIBs relative to GDP or debt-to-GDP, are given in percentages. Also the equity ratio is in percentages of total assets.

5.4 Descriptive statistics

Table 5.2 provides descriptive statistics for the Netherlands. The average yield spread for the Netherlands is 0.15%, with a maximum of 64 basis points. Average size of the Dutch G-SIB is more than twice the country's GDP during the last decade, with a minimum of 152.03% of GDP. The equity-to-asset ratio for the G-SIB averaged 3.18%, far below the required common equity ratio of 4.5% of Basel III.

The Bid-Ask spread, the proxy for liquidity, showed a maximum of 1.49 basis points. This spread remained quite high during the last two months of 2011. These numbers are averages, the original data showed a higher maximum.

Looking at the statistics of the fiscal variables, the debt ratio of the Netherlands had a decent average of 55.73% of GDP, with a maximum of 73.43%, during the first quarter of 2012. The deficit ratio reached a high of 9.96% of GDP. Of course, one has to be aware of the fact that these two statistics were interpolated. Furthermore, no real remarkable statistic can be found.

Table 5.2: Descriptive statistics Netherlands

Variables	Mean	St.Dev	Minimun	Q1	Median	Q3	Maximum
Spread	0.15	0.17	-0.033	0.03	0.09	0.25	0.64
G-SIB	202.95	25.19	152.03	177.27	212.41	223.07	232.13
Equity Ratio	3.18	0.48	1.86	2.99	3.18	3.40	4.14
GRAMI	0.11	1.04	-1.01	-0.78	-0.08	0.74	3.39
Bid-Ask	0.67	0.32	0.34	0.39	0.53	0.96	1.49
Debt	55.73	6.34	42.4	51.89	54.13	59.80	73.43
Deficit	-2.54	2.27	-9.96	-3.86	-1.82	-1.12	1.40

Notes: The spread is the 10-year government bond yield spread against Germany, given in percentages. The size of the G-SIB is measured as total assets-to-GDP. The equity ratio of the G-SIB is measured as total equity-to-total assets. The Citi GRAMI Index is used as a proxy for risk aversion and the higher the Index the higher risk aversion. The Bid-Ask spread of the specific 10-year government bond is used as a proxy for liquidity, given in basis points. Debt is the country's expected debt-to-GDP ratio and deficit is the country's expected deficit ratio.

Table 5.3 shows the correlation coefficients of all the variables. The spread is highly correlated with all other variables, except the equity ratio. This is consistent with the findings in previous papers (see section 3). What stands out is the low and insignificant correlation with the equity variable, suggesting that the equity ratio of the G-SIB is not directly related to the sovereign yield spread. Another remarkable finding is the negative correlation with the deficit variable, suggesting that a higher deficit leads to a lower spread for the Netherlands. According to the literature, sovereign risk increases positively with debt and deficit ratios.

Also important is the global risk aversion variable, which is significantly correlated with all other variables. The literature already suggested that it should be correlated with the bank

variables. The fact that this variable has a strong and positive correlation with the spread is not surprising, since higher risk aversion reflects higher economic uncertainty and a flight to safety, i.e. German Bunds.

Table 5.3: Correlation coefficients the Netherlands

Variables	Spread	G-SIB	Equity	GRAMI	Bid-Ask	Debt	Deficit
Spread	1						
G-SIB	0.2228*	1					
Equity	-0.0059	-0.0563	1				
GRAMI	0.8969**	0.2440*	-0.2005*	1			
Bid-Ask	0.7946**	0.1456	0.1600*	0.7323**	1		
Debt	0.5297**	0.0045	0.7364**	0.3721**	0.6541**	1	
Deficit	-0.4849**	0.0548	-0.6931**	-0.3430**	-0.7297**	-0.9554**	1

Notes: The spread is the 10-year government bond yield spread against Germany. The size of the G-SIB is measured as total assets-to-GDP. The equity ratio of the G-SIB is measured as total equity-to-total assets. The Citi GRAMI Index is used as a proxy for risk aversion. The Bid-Ask spread of the specific 10-year government bond is used as a proxy for liquidity. Debt is the country's expected debt-to-GDP ratio and deficit is the country's expected deficit ratio. The correlations are significant at the *10% or **5% significance level.

Table 5.4 provides descriptive statistics for Belgium. Average yield spread is 0.31%, with a maximum of 2.32% (or 232 basis points), much higher than that of the Netherlands. The average size of the G-SIB is, with 153.51% of GDP, lower than that of the Dutch G-SIB. The minimum size of 111.35% during the sample period is much higher than Belgium's GDP. The average equity ratio is also much lower than that of the Dutch G-SIB and is also far below the required common equity ratio of 4.5% of Basel III.

Liquidity, calculated by the Bid-Ask spread of the bond, is lower than the liquidity for the Dutch 10-year sovereign bond. The Bid-Ask spread has a higher mean and a higher maximum. Throughout 2011 this spread staid quite high and was very volatile. It reached its maximum during November 2011, when Dexia was nationalised.

The debt ratio for Belgium is on average close to 100%. The rule of thumb in economics for the maximum sustainable debt ratio for governments is 60% of GDP. With such a high debt ratio, it is likely that investors ask higher risk premia from Belgium.

Table 5.4: Descriptive statistics Belgium

Variables	Mean	St.Dev	Minimun	Q1	Median	Q3	Maximum
Spread	0.31	0.52	-0.20	0.00	0.16	0.45	2.32
G-SIB	153.51	23.36	111.35	128.71	162.55	172.73	189.72
Equity	2.39	0.84	-0.08	1.82	2.71	3.05	3.39
GRAMI	0.09	1.04	-1.01	-0.78	-0.12	0.73	3.40
BID-Ask	0.97	0.97	0.32	0.48	0.64	1.13	5.75
Debt	93.99	6.88	79.01	89.25	95.54	97.94	105.60
Deficit	-1.51	2.31	-8.36	-2.54	-0.50	-0.10	1.50

Notes: The spread is the 10-year government bond yield spread against Germany, given in percentages. The size of the G-SIB is measured as total assets-to-GDP. The equity ratio of the G-SIB is measured as total equity-to-total assets. The Citi GRAMI Index is used as a proxy for risk aversion and the higher the Index the higher risk aversion. The Bid-Ask spread of the specific 10-year government bond is used as a proxy for liquidity, given in basis points. Debt is the country's expected debt-to-GDP ratio and deficit is the country's expected deficit ratio.

The correlation coefficients for the variables of Belgium are provided in table 5.5. The spread is again significantly correlated with most variables, which is consistent with the literature. However, the spread is very low and not significantly correlated with the size of the G-SIB. Again, also for Belgium the risk aversion variable is significantly correlated with almost all variables. What stands out is the high and significant negative correlation with the equity ratio, suggesting that the equity ratio is a determinant of the sovereign yield spread for Belgium. The negative sign is logical and consistent with previous papers, because a higher equity ratio of the G-SIB should reflect lower sovereign risk.

Table 5.5: Correlation coefficients Belgium

Variables	Spread	G-SIB	Equity	GRAMI	Bid-Ask	Debt	Deficit
Spread	1						
G-SIB	-0.0970	1					
Equity	-0.8222**	-0.1197	1				
GRAMI	0.5833**	0.3428*	-0.8819**	1			
Bid-Ask	0.8366**	-0.2857**	-0.7220**	0.4333**	1		
Debt	-0.2732*	-0.4704**	-0.0952	-0.0386	-0.3766**	1	
Deficit	-0.5354**	-0.3571*	0.6804**	-0.7674**	-0.1192	-0.1996	1

Notes: The spread is the 10-year government bond yield spread against Germany. The size of the G-SIB is measured as total assets-to-GDP. The equity ratio of the G-SIB is measured as total equity-to-total assets. The Citi GRAMI Index is used as a proxy for risk aversion. The Bid-Ask spread of the specific 10-year government bond is used as a proxy for liquidity. Debt is the country's expected debt-to-GDP ratio and deficit is the country's expected deficit ratio. The correlations are significant at the *10% or **5% significance level.

6. Results

6.1 Netherlands

Table 6.1 presents the regression results for the Netherlands. The residuals of all the models are (approximately) normally distributed. All regressions include a lagged dependent variable and the yield spreads are persistent, with the autoregressive coefficient being highly significant in all estimations.

The coefficient of the risk aversion factor, as measured by the GRAMI Index, is (highly) significant in all regressions. Regressions A, C and D indicate that if the GRAMI Index increases, the sovereign bond spread for the Netherlands relative to the German benchmark also increases.

Unfortunately I did not find significant results for the Bid-Ask spread of the 10-year government bond of the Netherlands as factor which affects its sovereign bond spread. So I cannot state that liquidity plays a role in determining the sovereign yield spread for the Netherlands.

In regressions A and B I included the size of the G-SIB relative to GDP, which is insignificant on its own, but becomes significant when interacted with the risk aversion factor. Thus it seems that the marginal effect of the size of the G-SIB on sovereign bond spreads is a function of the risk aversion factor. Although the effect seems small, there is an impact of the size of G-SIB(s) on the government's funding conditions in the Netherlands.

To asses further the effect of G-SIBs on sovereign bond yield spreads I also incorporated the equity ratio of the G-SIB in the regressions. I defined the equity ratio as equity to total assets. An increase in this ratio corresponds to less banking sector risk, since more equity is available, hence, possibly decreasing sovereign risk. Thus I expected a negative sign for this variable. Regressions C and D show that a lower equity ratio leads indeed to a higher sovereign bond spread for the Netherlands relative to Germany. However, both coefficients are insignificant. This suggests that markets regard a low equity ratio for the Dutch G-SIB not as a significant determinant of higher sovereign risk.

Table 6.1: Regression results for the Netherlands

Regressor	A	B	C	D
Yield Spread (-1)	0.41***	0.58***	0.41***	0.47***
	(3.65)	(4.51)	(4.13)	(4.46)
G-SIB	0.00	0.00		
	(0.12)	(1.19)		
GRAMI*G-SIB		0.001**		
		(2.29)		
Equity			-0.06	-0.04
			(-1.36)	(-0.78)
GRAMI*Equity				-0.03
				(-1.48)
GRAMI	0.08***	-0.25*	0.07***	0.15**
	(5.04)	(-1.73)	(3.78)	(2.48)
Bid-Ask	0.04	-0.08	0.01	-0.02
	(0.51)	(-0.88)	(0.06)	(-0.25)
Debt	0.01	0.01	0.01	0.01
	(1.19)	(1.07)	(1.51)	(1.21)
Deficit	0.02	0.01	0.01	0.00
	(0.94)	(0.39)	(0.60)	(0.22)
Intercept	-0.46	-.35	-0.53*	-0.57**
	(-1.28)	(-1.08)	(-1.78)	(-1.97)
Summary Statistics				
SER	0.002	0.002	0.002	0.002
Adjusted R2	0.925	0.936	0.929	0.934
N	39	39	39	39

Notes: The dependent variable is the yield spread to German Bunds. The size of the G-SIB is measured as total assets-to-GDP. The equity ratio of the G-SIB is measured as total equity-to-total assets. The Citi GRAMI Index is used as a proxy for risk aversion. The Bid-Ask spread of the specific 10-year government bond is used as a proxy for liquidity. Debt is the country's expected debt-to-GDP ratio and deficit is the country's expected deficit ratio. T-values are given in parentheses under coefficients. The individual coefficient is statistically significant at the *10%, **5% or *** 1% significance level.

Summarizing these results for the Netherlands, the size of a Dutch G-SIB is a determinant of the sovereign spread for the Netherlands. However, the effect depends on the interaction with the risk aversion factor. The higher the common risk, the higher the probability of bank defaults and possible bailouts. Hence, less appetite to invest in sovereign bonds and, as a consequence, sovereign risk increases. Furthermore, a higher risk aversion (common risk) factor is on its own a determinant of sovereign risk premia for the Netherlands. Thus holders of Dutch government bonds demand higher premia for a given risk.

6.2 Belgium

Table 6.2 presents the regression results for Belgium. The residuals of all the models are (approximately) normally distributed. All regressions include a lagged dependent variable, but the yield spreads are not persistent, with the autoregressive coefficient being highly insignificant in all estimations.

The coefficient of the risk aversion factor, as measured by the GRAMI Index, is insignificant in regressions A and B but highly significant in regressions C and D. What is surprising is the negative sign for the coefficient of the risk aversion variable. Regressions C and D indicate that if the GRAMI Index increases (higher risk aversion), the sovereign bond spread for Belgium relative to the German benchmark decreases. This result suggests that investors who seek for a flight to safety, when economic uncertainty is high, prefer Belgium bonds more than German bonds. This is inconsistent with the literature.

Furthermore, all the regressions indicate that the Bid-Ask spread for the 10-year government bond of Belgium as a factor which affects the sovereign bond spread, is highly significant. An increase of the Bid-Ask spread (lower liquidity), increases the yield spread, indicating that liquidity effects are relevant in Belgium.

In regressions A and B, I included the size of the G-SIB. The size is highly significant in both specifications. Although not expected, the effect of the size is negative even when interacted with the risk aversion factor. The effect on its own is highly significant, but insignificant when interacted with the risk aversion factor. Thus it seems that the marginal effect of the size of the G-SIB on sovereign bond spreads depends on the risk aversion factor. Furthermore, government funding conditions for Belgium does improve with the size of G-SIB(s), even when interacted with the risk aversion factor.

To asses further the effect of G-SIBs on sovereign bond yield spreads I also incorporated the equity ratio of the G-SIB in the regressions. I defined the equity ratio as equity to total assets. An increase in this ratio corresponds to less banking sector risk, since more equity is available, hence, possibly decreasing sovereign risk. Therefore I expected a negative sign for this variable. Regressions C and D show that a lower equity ratio leads indeed to a higher sovereign bond spread for Belgium relative to Germany. However, the effect of the equity

ratio is insignificant even when interacted with the risk aversion factor. Thus the equity ratio of Belgium's G-SIB is not a determinant of the Belgium's government bond yield spread.

Table 6.2: Regression results for Belgium

Regressor	**A**	**B**	**C**	**D**
Yield Spread (-1)	0.01	0.003	0.11	0.10
	(0.10)	(0.03)	(0.86)	(0.78)
G-SIB	-0.01**	-0.01**		
	(-2.43)	(-2.37)		
GRAMI*G-SIB		-.001		
		(-1.22)		
Equity			-0.09	-0.09
			(-0.74)	(-0.72)
GRAMI*Equity				0.01
				(0.15)
GRAMI	-0.09	0.17	-0.22***	-0.23**
	(-1.67)	(0.78)	(-3.10)	(-2.40)
Bid-Ask	0.31***	0.29***	0.41***	0.42***
	(4.29)	(3.96)	(5.78)	(5.37)
Debt	-0.03***	-0.03***	-0.01**	-0.01*
	(-3.15)	(-3.14)	(-2.01)	(-1.91)
Deficit	-0.17***	-0.17***	-0.17***	-0.17***
	(-6.40)	(-6.35)	(-5.67)	(-5.30)
Intercept	3.13*	3.30**	2.26	2.35
	(1.95)	(2.07)	(1.25)	(1.21)
Summary Statistics				
SER	0.019	0.018	0.022	0.021
Adjusted R2	0.945	0.948	0.936	0.936
N	39	39	39	39

Notes: The dependent variable is the yield spread to German Bunds. The size of the G-SIB is measured as total assets-to-GDP. The equity ratio of the G-SIB is measured as total equity-to-total assets. The Citi GRAMI Index is used as a proxy for risk aversion. The Bid-Ask spread of the specific 10-year government bond is used as a proxy for liquidity. Debt is the country's expected debt-to-GDP ratio and deficit is the country's expected deficit ratio. T-values are given in parentheses under coefficients. The individual coefficient is statistically significant at the *10%, **5% or *** 1% significance level.

Furthermore, other than I expected, both fiscal variables have a negative sign, which basically means that government funding conditions in Belgium improve with higher debt and deficit ratios.

Summarizing the results for Belgium, I state that the size of the G-SIB is, on its own, a determinant of the spread for Belgium, but not when interacted with risk aversion. Although not expected, government's funding conditions improve with the size of the G-SIB.

Moreover, both fiscal variables and the Bid-Ask spread of the bond are meaningful determinants of the spread.

7. Conclusion and Discussion

7.1 Conclusion

Previous research has shown that when global risk increases, countries with large banking sectors with low equity ratios experience a widening in their yield spreads (Gerlach et al. 2010). In this paper I focused on the impact of systemically important banks rather than the total banking sector. I examined 10-year government bond yield spreads of the Netherlands and Belgium relative to Germany. The research question of this paper was the following:

What is the impact of systemically important banks on sovereign risk?

The proxy for sovereign risk are the yield spreads. I regressed the size and equity ratio of these banks against their sovereign spreads with a AR(1) model. The results show that the size of G-SIBs, measured by its assets-to-GDP ratio, is a determinant of the Dutch sovereign yield spread relative to Germany. In times when risk aversion is high, financial markets demand a premium for Dutch government bonds relative to German bonds because of the size of its G-SIBs. I also showed that holders of Dutch government bonds demand higher premia, relative to Germany, for a given risk. Changes in global risk aversion are a main driver of the Dutch spread. To reduce taxpayer's risk arising from systemically important banks, the Dutch government could require its G-SIB(s) to reduce in size or to require them to better withstand global risk aversion.

The size of G-SIBs in Belgium is a determinant for Belgium's spread relative to Germany, but does not depend on risk aversion. However, contrary to the Netherlands, Belgium's funding conditions improve with the size of G-SIBs. Fiscal variables, measured by debt and deficit ratios, play also a strong role in determining the spread of Belgium. The findings are a bit strange, because the results suggest that Belgium's funding conditions improve with higher government debt and deficit ratios. Furthermore, liquidity is also priced in Belgium's government bond market.

Comparing the results of both countries, I state that country-specific risk factors contribute to sovereign spreads in both countries. Apart from liquidity risk, Belgium's sovereign spread is highly determined by its fiscal policy. For the Netherlands, the size of its G-SIBs contributes

to its sovereign spread, but only when interacted with the risk aversion factor. Moreover, this common risk factor explains a large part of the sovereign spreads for the Netherlands. The size of G-SIBs do not contribute significantly to Belgium's sovereign spread when interacted with risk aversion, but on it own, the size is a significant determinant.

The results of this paper imply that both hypotheses can be rejected for Belgium. A larger size of systemically important banks in Belgium does not lead to a widening in its yield spreads. The impact of the size of these banks on the spread is low and only significant on its own. Furthermore, the vulnerability of systemically important banks in Belgium does not have an effect on its sovereign yield spreads. On the other hand, this paper shows evidence that the first hypothesis cannot be rejected for the Netherlands. When risk aversion is high, a larger size of systemically important banks in the Netherlands leads to a widening in its yield spreads. This suggests that financial markets perceive a larger risk that the government will have to rescue these banks, increasing sovereign risk. However, the impact of the size on the spread is quite low. On the other hand, the vulnerability of systemically important banks in the Netherlands, measured by the equity ratio of the G-SIB, does not have an impact on its sovereign risk.

7.2 Limitations and future research

Before drawing up conclusion on the results, it is important to notice that this study had some serious limitations. The number of observations in this study is only 39. In finance studies, higher frequencies are more appropriate and would probably lead to more robust findings. Moreover, this paper lacks some robustness checks, which would help diagnose possible misspecification and give the results more evidence of structural validation.

Furthermore, the phenomenon of G-SIB did not exist before the current financial crisis. Therefore, being forced to use a sample period of 10 years could undermine the findings of this paper.

Research on the relation between banking sector risk and sovereign risk is relatively new and has been growing since the onset of the financial crisis. The number of research on this topic will probably grow in the future. As far as I know, research regarding the relation between large individual financial institutions and sovereign risk is not conducted before. This paper has contributed to the literature on the relation between banking risk and sovereign risk and

by focusing on individual institutions it made a distinction with comparable papers. More research on the effect of individual institutions could be relevant contributions to the existing literature. However, financial regulators and supervisors could also contribute to research on this topic by providing more frequent the data of these individual financial institutions.

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Appendix

A. List of G-SIBs (2011)

Bank of America
Bank of China
Bank of New York Mellon
Banque Populaire CdE
Barclays
BNP Paribas
Citigroup
Commerzbank
Credit Suisse
Deutsche Bank
Dexia
Goldman Sachs
Group Crédit Agricole
HSBC
ING Bank
JP Morgan Chase
Lloyds Banking Group
Mitsubishi UFJ FG
Mizuho FG
Morgan Stanley
Nordea
Royal Bank of Scotland
Santander
Société Générale
State Street
Sumitomo Mitsui FG
UBS
Unicredit Group
Wells Fargo

B. Table of variables

Variables	Description
Spread	(Dependent variable) Government bond yield spreads, of bonds with a maturity of 10-years, relative to German government bonds with the same maturity.
G-SIB	(Independent variable) Total assets-to-GDP ratio of all global systemically important banks in the specific country.
Equity	(Independent variable) Equity-to-Assets ratio of all global systemically important banks in the specific country.
Risk Aversion	(Control variable) Global risk aversion, measured by the Macro Risk Index of Citigroup. The higher the index, the higher the risk aversion.
Liquidity	(Control variable) The liquidity of the specific government bond, measured by its Bid-Ask spread.
Debt	(Control variable) The expected Debt-to-GDP ratio of the specific country.
Deficit	(Control variable) The expected Deficit-to-GDP ratio of the specific country.