ZERO RISK WEIGHTS AS PREDICTOR FOR RISK

STUDY ON THE INFLUENCE OF ZERO RISK WEIGHTS ON BANK SYSTEMIC RISK, CDS SPREADS, AND PROFITABILITY

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ABSTRACT

This study examines how the application of zero risk weights for sovereign debt, under the CRR/CRD IV, affects systemic risk, CDS spreads, and bank profitability for a panel dataset of 44 European banks between 2010 and 2015. The sovereign subsidy, introduced by Korte & Steffen (2015), is a measure for undercapitalization as a result of zero risk weights. I find that the sovereign subsidy positively affects systemic risk and negatively relates to bank profitability. The results show no relation between the bank CDS spreads and the sovereign subsidy. The results do not change during the ECBs LTRO. Furthermore, the results show that sovereign subsidy affects systemic risk solely in non-GIIPS countries.

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1 INTRODUCTION

Back in 2008, when the financial crisis hit the world's economy and resulted in the sovereign debt crisis in Europe, interconnectedness in the financial system, or systemic risk, played a critical role. The United States government, for instance, chose to rescue AIG and financially support other large banks in the United States. The reason for saving AIG and not for example, Lehman Brothers was because AIG was one of the biggest credit insurance providers in the United States, and therefore too inclined in the financial system. Other large banks and financial institutions, which held a lot of triple-A-rated collateralized debt obligations (CDOs), or subprime mortgage-backed bundles, hedged their credit risk by buying credit default swap securities (CDS) from AIG. [1] [2] Consequently, if AIG defaulted, many other large banks holding CDS´s would suffer significant losses.

The financial crisis in the United States propagated worldwide to the whole financial system through mortgage-backed securities (MBS) and highly leveraged debt structures (Arias & Wen, 2015).[3] This affected the performance of European commercial banks because these banks were owners of risky MBS's and CDOs. Poor performing European banks made governments and central banks decide to intervene and financially back banks. The Dutch government, for example, injected 7.39% (Stortenbeek, 2015) of the gross domestic product (GDP) into the financial system. By doing this, they prevented among others the ING Bank N.V. and ABN AMRO N.V. from bankruptcy.

As a result of the financial crisis, in 2010, the Basel Committee on banking supervision developed and implemented a set of reform measures which are called Basel III, the successor of Basel II. The goal of Basel III is to improve risk management and governance as well as strengthen banks' transparency and disclosures (Basel Committee, 2010). Furthermore, the banking sector should better absorb economic shocks arising from financial and economic distress. With these new standards, banks should be better protected against an unexpected recession. Under Basel III, banks are required to hold more capital and banks are exposed to maximum leverage and minimum liquidity ratios. Also, banks regulatory Tier 1 capital ratio increased (Basel Committee, 2010).

[1] A CDO is a way of packaging credit risk. Several classes of securities (known as tranches) are created from a portfolio of bonds and there are rules for determining how cash flows are allocated (Hull, 2010).

[2] A CDS is a bilateral contract where credit risk of a third party is transferred. The credit risk is transferred from the CDS buyer to de CDS seller.

[3] A MBS is a security created from the cash flows from mortgages (Hull, 2010).

Fundamentally important in this paper is the implementation of the Basel III accords in the European Union, which is the Capital Requirement Regulation (CRR) and the Capital Requirement Directive IV (CRD IV). The CRR and CRD IV contain the legislation on prudential requirements for credit institutions and investment and amending regulations (EU, 2013). According to article 114(4) of the CRR, "exposures to member states, central governments, and central banks denominated and funded in domestic currency of that central government and the central bank shall be assigned a risk weight of 0% under the standardized approach" (EU, 2013). Put differently, if banks and financial institutions within the European Union use the standardized approach to determining their risk-weighted assets, they do not have to hold any capital for their exposures in sovereign debt of members of the European Union. This regulation can lead to excessive risk taking by investing in risky sovereign debt which can result in undercapitalized banks. Comparing the risk weights for a triple B rated sovereign bond (0% risk weight) with the risk weights for triple-B-rated corporate bonds (100% risk weight) clarifies this statement.

In Europe, on average ten percent of the banks' balance sheet consists of sovereign debt from Euro-area Bonds. The total amount outstanding in 2014 was €2.43 trillion which increased to €2.73 trillion in 2015. These enormous piles of sovereign debt owned by banks increase interconnectedness between banks and the European countries (Christie & Glover, 2015). From a theoretical point of view, zero risk weights for sovereign debt in combination with significant exposures can lead to undercapitalized banks and increase risk. For that reason, I want to investigate how zero risk weights affect systemic risk, CDS spreads and bank profitability. The central research question is: How do zero risk weights influence systemic risk, CDS spreads and profitability? To come up with a well-grounded answer to this issue, I will answer the following three questions: first, how do zero risk weights affect bank CDS spreads? Second, what is the effect of zero risk weight on systemic risk and third, if zero risk weight indeed leads to higher CDS spreads and systemic risk, how does this influence the profit of banks?

In constructing a measure that quantifies bank risk-adjusted exposure to sovereign debt, I follow the methodology used in the paper Korte & Steffen (2015). Based on credit ratings and bank exposures in sovereign debt, Korte & Steffen construct a measure called " the sovereign subsidy." The sovereign subsidy is a proxy for undercapitalization as a result of zero risk weights for sovereigns under the CRR and CRD IV for banks.

Data on banks' sovereign exposure originates from the stress tests, transparency exercises and capital exercises conducted and published by European Banking Authority (EBA) between 2010 and 2015. Risk weights are derived from Moody's, S&P and Fitch. For systemic risk, I use two different proxies in this paper: Systemic Risk (SRISK), which is a proxy for long-term systemic risk and Marginal Expected Shortfall (MES) which is a short-term proxy for systemic risk. Data on SRISK and MES are both gathered via the Stern NYU Business University. The Theoretical Background, Data, and Methodology sections elaborate more on this. Return on average assets (ROAA) is the proxy for bank profitability.

The analysis shows that the sovereign subsidy positively influences bank systemic risk for banks located in non-GIIPS countries. This effect is not existing for banks located in GIIPS countries. The relation is weaker for the short-term systemic risk measure MES, but it is still present. The sovereign subsidy does not influence CDS spreads. Third, the results show that the sovereign subsidy negatively affects bank profitability. These results are in line with results found by Molyneux & Thornton (1992). They find a positive relationship between bank profitability and capital ratios. Finally, this paper investigates which component of the sovereign subsidy drives the results. It turns out that the positive influence of zero risk weights on systemic risk is mainly driven by sovereign debt exposure and that the relation between the sovereign subsidy and profitability is primarily driven by the weighted average risk weights of sovereigns in the sovereign portfolio of a bank.

The findings in this paper contribute to the literature studying the application of zero risk weights. New in this paper is how zero risk weights affect systemic risk, CDS spreads, and profitability. I provide evidence on how zero risk weights affect systemic risk in the financial system and how this deviates between banks located in GIIPS countries and non-GIIPS countries.

The results in this paper have important implications for bank regulators. While regulators are trying to improve financial stability through tighter bank regulation, e.g. Basel III, aiming to increase transparency and enabling banks to absorb better economic shocks, zero risk weights seem to effectuate the opposite. The results provided in this paper can help regulators to gain more insights in the effects of the application of risk weight which can contribute to a more stable financial banking sector. The benefits of a stable financial sector not only account for large banks and corporations but utmost for the ones who bear the crisis, the taxpayer. Besides regulators, the results of this study provide useful insights for bank directors. If banks are aware of the possible consequences zero risk weights entail during an economic crisis, they could change their policy concerning capital requirements and the application of zero risk weights.

The rest of this paper is built up as follows: in chapter two I discuss the theoretical background. First, I explain what systemic risk and marginal expected shortfall are and how they are computed. Chapter two then provides a brief overview of prior research on optimal capital ratios and how a bank's capital ratio relate to risk and profitability. The third chapter elaborates on the methodology. The fourth section includes the data and the data gathering process. Section five provides the results and I conclude in chapter 6.

2 THEORETICAL BACKGROUND

This section is divided into two parts. In the first part, I explain the rationales and computation behind the systemic risk measures SRISK and MES. Secondly, this section provides a brief overview of research already executed on risk and capital ratios.

2.1 Measurement of systemic risk and marginal expected shortfall

In reviewing the literature on systemic risk, various definitions can be found. Kaufman & Scott, (2003) describe systemic risk as the probability of a breakdown of the entire system, as opposed to breakdowns in individual parts of components, and is evidenced by co-movements among all the parts. In their definition the system could for example be the financial sector where the individual parts are financial organizations. Gregory, (2010, p. 8) defines systemic risk as follow: "systemic risk in financial terms concerns the potential failure of one institution that creates a chain reaction or domino effect on other institutions and consequently threatens the stability of the entire financial markets and even the global economy". Although a precise definition of systemic risk seems to be elusive, the meaning of systemic risk is evident.

Measuring systemic risk is considered to be a tougher task than defining it, and therefore, various methodologies and measures have been subjected to research. Giglio, Kelly & Pruitt (2016) evaluate 19 possible different measures of systemic risk as the predictor of crisis. Acharya, Pedersen, Philippon & Richardson (2010) show a model in which Systemic Expected Shortfall (SES) measures a financial institution's contribution to systemic risk. SES predicted the worst performing financial firms during the financial crisis in 2007-2008. Huang, Zhou, & Zhu (2009) construct a framework where they measure and assess the systemic risk of large financial institutions. They compute systemic risk based on ex-ante measures of risk-neutral probabilities and forecasted asset correlations. In this paper, I use MES and SRISK as measures of systemic risk derived by Brownlees & Engle (2012). The upcoming part of this paper explains the derivations of MES and SRISK.

2.1.1 Marginal Expected Shortfall

The first measure for systemic risk is the MES which is derived in Brownlees & Engle (2012). The MES is an extension of the Expected Shortfall (ES) (Acharya, Pedersen, Philippon, & Richardson 2010). It measures market shortfall conditional on the total market return. MES is defined as the expected equity loss for a specific financial institution when markets overall fall below a certain threshold. MES is defined as:

$$MES(R_i, p) = E(R_i | R_m < VaR(R_m, p)) \quad (1)$$

Here the MES for bank i is based on its expected daily stock return (Ri) conditional on the market portfolio return R_m, if the market return is below the Value at Risk (VaR) threshold p-percent quantile, e.g. a 95% VaR threshold (Gregory, Counterparty Credit Risk, 2010).

2.1.2 SRISK

The second measure is SRISK and is measured in euros in this paper. The SRISK euro amount is the amount of capital a financial institution needs to raise in case of a crisis to recover the target capital ratio. The SRISK measure takes three firm variables into account: size, leverage and MES and is computed conditionally on a drop in markets by more than 40% within a horizon of six months. Conceptually, the below shown SRISK calculations are similar to the stress tests. The major difference is that SRISK is computed with publicly available information and is therefore relatively simple and not expensive (Acharya, Engle, & Richardson, 2012).

The derivation of the SRISK measure is also based on Brownlees & Engle (2012). An important component of SRISK is the capital shortfall of a firm which is derived from the book value of debt and the market value of equity:

$$CS_{i,t} = k * \left(D_{i,t} + W_{i,t}\right) - W_{i,t} \quad (2)$$

Here $CS_{i,t}$ is the capital shortfall of bank i at time t, k is a prudential capital ratio set by regulators, $D_{i,t}$ is the book value of debt and $W_{i,t}$ is the market value of equity at time t. The capital shortfall is the market value of equity subtracted from the prudential capital level. A positive outcome for CS indicates a capital shortfall while an adverse outcome for CS indicates a capital buffer. Under Basel III, banks compute their capital requirements based on risk weights for individual asset classes. Although this approach would result in a more detailed calculation of capital needs, the lack of available data forces the use of a standard prudential capital ratio for the total assets.

SRISK is calculated using the capital shortfall conditional on a crisis in the following formula:

$$SRISK_{i,t,} = Max\ [\ E\left(CS_{i,t+1}\middle|Crisis\right), 0] \quad (3)$$

Here, SRISK for bank i at time t is the maximum of the expected capital shortfall at $t+1$ conditional on a crisis, and zero. Crisis is defined as E($R_{m,t;t+h} < B$) where $R_{m,t;t+h}$ is the market return between period t and $t+h$ and B is the drop in the markets with 40%. If SRISK for bank i at time t is negative, bank i would not suffer a loss in a crisis, so the loss is zero. A negative value indicates that banks take zero SRISK. Substituting formula (2) into formula (3) and rewriting it results in the formula (4):

$$SRISK_{i,t,} = Max\ [\ kE_t(D_{i,t+1}|Crisis) - (1-k)E_t(W_{t+1}|\ Crisis), 0] \quad (4)$$

One assumption made is that in the case of a systemic event or crisis, the outstanding debt does not change over the time horizon of this systemic event or crisis. This implies that $E_t\left(D_{i,t+1}\middle|Crisis\right) = D_{i,t}$. Substituting this assumption in formula (4) leads to equation (5):

$$SRISK_{i,t,} = Max\ [K * D_{i,t} - (1-k)\left(1 - LRMES_{i,t}\right) * W_{i,t}, 0] \quad (5)$$

Here LRMES is the long run marginal expected shortfall which is based on the long run return on equity from firm i conditional on a systemic event. LRMES can be written as follow.

$$LRMES_{i,t} = E_t\left(R_{i,t+1:t+h}\middle|Crisis\right) \quad (6)$$

The LRMES indicates how much the equity holders of bank i is expected to lose if the market declines by at least 40% the next six months. For a thorough derivation of the LRMES, I refer to the paper of Brownlees & Engle (2012). The LRMES is similar to the MES, which measures the shortfall over a period of one day.

SRISK for bank i in percentages of total systemic risk is defined as

$$SRISK\%_{i,t} = \frac{SRISK_{i,t}}{\sum_{i=1}^{I} SRISK_{i,t}} \quad (7)$$

Here the percentage SRISK for bank i is measured as bank i*'s* SRISK as a fraction of the sum of all institutions SRISK.

The total systemic risk arising from all financial institutions is the sum of all individual SRISK measures.

$$SRISK_t = \sum_{i=1}^{I} SRISK_{i,t} \quad (8)$$

In formula (5), three important variables influence SRISK: leverage, size, and the systemic event or crisis. A leverage ratio increase results in an increase in SRISK, i.e. a higher leverage ratio, increases the regulatory capital ratio a financial institution requires to hold. An increase in the size of a bank, keeping the leverage ratio constant, increases the regulatory capital and increases SRISK. SRISK is also higher for banks that are more sensitive to systemic events.

SRISK is important since it measures systemic risk at an institutional level. Banks can be assigned an individual value for SRISK. Looking at bank level systemic risk instead of looking at system level systemic risk allows researchers to discover what drives systemic risk on individual bank level.

2.2 Literature review

The effect of zero risk weights has not been studied much yet. Consequently, I expanded the literature review to how capital ratio's influence systemic risk, CDS spreads and firm performance.

As mentioned in the introduction, Korte & Steffen (2015) used zero risk weights to investigate whether the application of zero risk weights impairs financial stability, i.e. they examine the impact of non-domestic sovereign subsidy on sovereign default risk. They find that a larger sovereign subsidy increases the likelihood of a capital shortfall of the domestic financial sector in case a sovereign defaults, which is reflected in elevated sovereign CDS spreads. Different in this paper is that I investigate whether large exposures in sovereign debt influence systemic risk, CDS spreads and profitability.

2.2.1 Optimal capital ratio

After the financial crisis, the Basel Committee decided to come up with a new set of standards for banks and financial institutions (Basel III). An important change is the increase in capital requirements. According to the Basel Committee, better-capitalized banks reduce default risk and systemic risk. But do higher capital ratios indeed lower these risks and how does this relate to profitability?
Numerous researchers studied the optimal capital ratio for banks, but the results are ambiguous. Starting from a theoretical point of view, Miller & Modigliani (1958) came up with a proposition where, under perfect market conditions, the value of a company cannot be affected by how the company is financed. However, this theory depends on a lot of assumptions which do not always hold in practice. Tax deductible financing costs makes it cheaper for companies to take more leverage for example, making leverage more attractive.

Miles, Yang, & Marcheggiano (2013) analyzed the optimal capital ratio. They compared the economic costs of a financial crisis as a result of capital inadequacy with the costs for institutions of increasing the required bank capital level. The authors conclude that the optimal amount of capital is much larger than banks have used in recent years and than the standards proposed under the Basel III framework.

Furlong & Keeley (1989) examined the theoretical relationship between capital regulation and bank asset risk. They discovered for value-maximizing banks that incentives to increase asset risk decline if its regulatory capital requirements increases. However, Calem & Rob (1999) investigated the impact of regulatory developments under Basel II related to bank capital. They observed a U-shaped relation between risk-taking and capital requirements implying that increasing banks' capital first reduces risk and later increases risk. Furthermore, the results show that an increase in the capital requirements tend to lead to more risk-taking by well-capitalized banks.

2.2.2 Capital ratio and profitability

According to Härle, Lüders, Pepanides, Pfetch, Poppensieker, & Stegemann (2010), the pretax ROE of banks will decrease to a level of between 3.7% and 4.5% from the pre-crisis ROE level of 15% after full implementation of the Basel III accords in 2019. The Institute of International Finance noted in their report to the impact of proposed changes in the banking regulatory framework, that higher capital requirements can lead to an increase in the cost of borrowing which can negatively influence economic growth

(Finance, 2010). Berger & Bouwman (2009) investigated for United States banks the relation between capital and how banks performed during crises and found that small banks better survive market crises if they are well capitalized, and medium and large banks better survive banking crises. Higher capital ratios also influence the size of market share of banks positively during and after crises. Besides, their research shows that better-capitalized banks had higher stock market returns during the crisis. Demirguc-Kunt, Detragiache, & Merrouche (2010) found comparable results for banks worldwide. They also discovered that lower capital ratio positively influence the CDS spreads. Finally, Cox & Hutchison (2007) examined the relationship between bank capital and profitability for a panel dataset with more than 147.500 observations. They found that bank leverage positively relates with return on equity (ROE) and capital positively relates to return on assets (ROA).

3 METHODOLOGY

This chapter describes the methodology applied to study how zero risk weights affect systemic risk, CDS spreads, and profitability. First, an explanation shows how the sovereign subsidy is calculated. Secondly, this chapter provides the hypotheses that will be tested. Finally, this part explains the models used to provide an answer to the research questions.

3.1 Sovereign subsidy

Banks translate the riskiness of their asset classes into risk weights, which are used to calculate the risk-weighted assets. Banks hold a proportion of their risk weighted assets as required capital.[4] To measure how much banks are undercapitalized due to zero risk weights for sovereign debt, I compute the sovereign subsidy introduced by Korte & Steffen (2015). The sovereign subsidy is a proxy for banks' undercapitalization. The computation of the sovereign subsidy is as follow:

$$sovereign\ subsidy_{i,t} = \sum_{j=1}^{J} RW_{j,t} * sovereign\ exposure_{j,i,t} \quad (9)$$

The sovereign subsidy of bank i at time t is calculated by the sum of sovereign debt exposure for bank i at time t in country j multiplied with the corresponding risk weights of country j at time t. The computation of the risk weights follows a three steps procedure. First, sovereign credit ratings, which reflect the riskiness of sovereign debt,

[4] The proportion of risk-weighted assets that reflects required capital for banks in the European Union under the IRB is 8%.

are collected from three major credit rating agencies: S&P, Moody's and Fitch. Secondly, default probabilities (PD) for sovereigns are collected based on the credit ratings. The assumptions on DP per rating class made by the EBA during the stress tests are used. The average default probability from the three credit rating agencies is used as final default probability and are shown in Table 1. Finally, this study uses the Internal Rate Based (IRB) approach formula to calculate the corresponding risk weights[5]. Assumptions made in this approach are the loss given default (LGD) of 45% and 2.5 years maturity. These assumptions are the standard assumption in the IRB approach. Table 1 exhibits the default probabilities and the risk weights for the different credit ratings. Appendix A provides an exact computation of the risk weights based on the IRB approach.

3.2 Model

To answer the research questions, the sovereign subsidy is used as a predictor variable in panel regression models with time dummies for the different periods. Bank fixed effects are employed in the regression model to control for bank specific time-invariant factors that could affect the relation between the sovereign subsidy and the dependent variable. Examples of time-invariant bank factors are bank type and managerial quality. Using bank fixed effects is essentially the same as using dummy variables for each individual bank and adding these to the linear regression. Including bank fixed effects also controls for possible endogeneity, i.e. correlation between the errors and the predictor variables (Wooldrigde, 2010). Time dummies are included in the regression model to control for variation in the systemic risk and sovereign debt exposure over time. Finally, I add control variables to the regression models which can influence the results when they are omitted. To determine how zero risk weights influence SRISK, MES, CDS spreads and profitability, I use a predictive model, in which lagged values of the dependent variables are used. Consequently, by analyzing the effect of zero risk weights at time t, I use the value at $t+1$ of the dependent variable. The lag between t and $t+1$ is 3 months. The logic behind taking lagged values is that changes in the independent variables at time t might not directly, but over time affect the dependent variable.

3.2.1 SRISK MES

To analyze whether the amount of sovereign subsidy influences systemic risk, I test the following two hypotheses:

[5] The Basel III guidelines allow banks to use the standard approach or the internal ratings-based approach to calculate the regulatory capital requirements.

H1: The sovereign subsidy does not influence SRISK
Ha: The sovereign subsidy influences SRISK positively

H2: The sovereign subsidy does not influence MES
Ha: The sovereign subsidy influences MES positively

Since MES and SRISK are both proxies for systemic risk, both hypotheses are tested within a similar model. As already mentioned in the introduction, I expect that SRISK and MES are larger for banks with a higher sovereign subsidy. The following regression model is used to test these hypotheses.

$$\frac{SRISK_{i,t+1}}{Total\ assets_{i,t}} = \beta_0 + \beta_1 \frac{SovSub_{i,t}}{Total\ assets_{i,t}} + \sum_{j=1}^{5} \alpha_j\ Control_{j,i,t} + year\ dummies + \delta_{i,} + \varepsilon_{i,t} \quad (10)$$

SRISK of bank i at time *t+1* divided by total assets of bank i at time t is the dependent variable. β_0 is the constant term in the regression, β_1 is the coefficient for the sovereign subsidy of bank i at time t and α_j is the coefficient for control variable *j* for bank i at time t. The bank fixed effects are denoted with $\delta_{i,}$ and $\varepsilon_{i,t}$ is the error term. A positive significant value for β_1 indicates a rejection of the hypothesis.

A possible concern in this regression analysis is that larger banks are more inclined in the financial system and are therefore systemically riskier. The bankruptcy of a large bank would have a greater impact on the financial system than the bankruptcy of a small bank. To control for bank size, SRISK is divided by the total size of the firm, where total assets are used as a proxy for bank size. To remain consistent, the sovereign subsidy and other control variables (except for the impaired loans which are divided by net loans) are also divided by the total assets. Besides consistency, taking the control variables as a percentage of the total assets has another advantage: it makes it easier to draw conclusions from the regression results. In contrast to SRISK, MES is not divided by the total assets. Dividing the MES by the total assets would lead to small values because the average MES over assets is 0.0005%. The LN assets are included in the regression model to control still for bank size. Other control variables used in these regressions are liquid assets as a percentage of total assets, equity over total assets, impaired loans over net loans, return on average assets (ROAA), and Tier 1 capital over total assets. Based on Gauthier, He, & Souissi (2010), who show that more liquid assets, higher capital ratios, and less short-term liabilities reduces systemic risk, I expect the equity ratio, liquid assets and Tier1 capital to positively affect SRISK. These variables indicate how well banks are capitalized and better capitalized banks should be facing less problems during a systemic event or crisis. The impaired loans are an indicator of the quality of the assets. Therefore, I expect a positive relation between impaired loans and systemic risk. Finally, I expect that the ROAA indirectly relates to systemic risk, through bank capital. Holding capital buffers is expensive for banks for the reason that it cannot be invested in consumer loans or other profitable products (Alden, 2013). Consequently, this could reduce the profitability and therefore I expect the relation between ROAA and SRISK to be negative.

Performing this analysis with European Banks brings another concern about the location of the bank. Theoretically, the home bias suggests that investors prefer to invest at home (Horváth, Huizinga & Loannidou, 2015). This can lead to relatively high sovereign subsidy levels for banks located in less creditworthy countries what should result in a sovereign subsidy larger for these countries. I first analyze how much banks on average invest in domestic sovereign debt. Secondly, to find out how this influences the results, I add an interaction dummy variable to the regression model that interacts with the sovereign subsidy. This dummy variable is one for banks located in GIIPS countries (Greece, Ireland, Italy, Portugal and Spain) and zero otherwise. This group of countries is selected on their high indebtedness levels during the European sovereign debt crisis and is also used in Acharya & Steffen (2015) and Korte & Steffen (2015). For the reason that some large banks are located in different countries, I use the bank location provided by the EBA as home country. Besides the home bias, most of the systemically most important banks are not located in GIIPS countries but in non-GIIPS countries. Also these difference are captured in by this GIIPS interaction dummy.

A possible concern taken into consideration is the ECB's long-term refinancing operations (LTRO).[6] This action could affect the results, as the amount of outstanding debt at European banks increased after the LTRO. I first analyze if the amount of sovereign exposure significantly increased after the ECB launched its program. Secondly, I add a dummy for the LTRO that interacts with the sovereign subsidy. This dummy variable is one during the LTRO.

[6] The European Central Bank's long-term refinancing operations help to provide liquidity in the market by lending money to European commercial banks at a one percent interest rate. The operation was implemented December 2011 and February 2012. Additional funds for European bank should trigger banks to buy sovereign bonds resulting in more stable bond yields.

3.2.2 CDS spread and CDS spread changes

To analyze whether the amount of sovereign subsidy influences CDS spreads and the changes in CDS spreads, I test the following hypotheses:

H3: The sovereign subsidy does not influence the in CDS spreads.
Ha: The sovereign subsidy does influence the CDS spread positively.

H4: The sovereign subsidy does not influence the change CDS spread.
Ha: The sovereign subsidy does influence the change in CDS spread positively.
I expect the sovereign subsidy to negatively influence the CDS spreads, because a higher sovereign subsidy implies more undercapitalization and consequently a higher probability of default.

The following panel regression model is used to investigate the impact of the sovereign subsidy on the CDS spread:

$$CDSspread_{i,t+1} = \beta_0 + \beta_1 \frac{SovSub_{i,t}}{Total\ assets_{i,t}} + \sum_{j=1}^{7} \alpha_j\, Control_{j,i,t} + Year\ dummies + \delta_{i,} + \varepsilon_{i,t}$$

The CDS spread of bank i at time *t+1* is defined as the 50 days moving average CDS spread. By taking the 50 days average CDS spread I control for possible volatility in CDS spread prices. Again, β_0 is the constant term in the regression, β_1 is the coefficient for the sovereign subsidy of bank i at time t and $\beta_{i,x}$ is the coefficient for control variable x for bank i at time t. The bank fixed effects are denoted with $\delta_{i,}$ and $\varepsilon_{i,t}$ is the error term. As control variables I use bank size, bank leverage, impaired loans over net loans, ROAA, Tier 1 assets over total assets, liquid assets over total assets and a dummy for the Outright Monetary Transactions(OMT), which is one from June 2012 till December 2014.[7] Based on the finding presented in Hasan, Liu, & Zhang (2014), I expect the equity and Tier1 capital to negatively influence the CDS spreads and that impaired loans positively relates to CDS spreads. I also expect the liquid assets to be positively related to the CDS spreads and the CDS spreads are expected to be lower during ECB's OTM, since it aims to restore the high sovereign bond yields. As is done in the SRISK and MES shortfall regressions, I explore what impact the interaction dummies for the LTRO and the home bias have on the results.

[7] The ECB launched the OMT in August 2012 as program to purchase sovereign debt in the secondary market. The main goal of this program was to erase the unfounded anxiety of a Eurozone breakdown by purchasing 1-3 year sovereign debt, while concurrently countries agreed to reform and agreed to austerity measures.

3.2.3 ROAA

To study how zero risk weights influence bank profitability, once more, a similar regression model with the ROAA as dependent variable is used

$$ROAA_{i,t+1} = \beta_1 \frac{SovSub_{i,t}}{Total\ assets_{i,t}} + \sum_{j=1}^{6} \alpha_j\ Control_{j,i,t} + Year\ dummy + \delta_{i,} + \varepsilon_{i,t}$$

Again, β_0 is the constant term in the regression, β_1 is the coefficient for the sovereign subsidy of bank i at time t and a_j is the coefficient for control variable j for bank i at time t. The bank fixed effects are denoted with $\delta_{i,}$ and $\varepsilon_{i,t}$ is the error term. As control variables, I use bank leverage, bank size, impaired loans over assets, liquid assets over total assets, Tier 1 capital over assets and SRISK. The following hypothesis is tested:

H5: The sovereign subsidy does not influence ROAA.
Ha: The sovereign subsidy influences the ROAA negatively

Based on the findings Cox & Hutchison (2007) present, I expect the sovereign subsidy to negatively affect the profitability.

Bauman Miller & Conover (1998) studied the effect of small and large firms on stock returns. The authors compared the quartile performance between small and large companies and found in their sample that smaller companies were more profitable for investors. To control for the possibility that small banks are more profitable, I use the LN assets as a control variable. The LN of the total assets is used because total assets are log normally distributed. By taking the natural logarithm the data is normalized. A negative significant coefficient would mean that smaller banks are more profitable. As already mentioned in part 3.2.1, I expect Tier1 capital and equity to be negatively related with bank profitability, because it is relatively expensive for banks to hold capital. For the same reason, I expect systemically more risky banks to be more profitable, because they are usually less capitalized.

Finally, a question applied to all regressions and which is not discussed in the paper of Korte & Steffen (2015) is to what extent the effect of the sovereign subsidy on the dependent variables is determined by the risk weight component or the sovereign debt exposure component. To distinguish between a large exposure, low-risk weight sovereign subsidy and a similar sovereign subsidy with small exposure and a high-risk weight, I use weighted average risk weights and the total sovereign debt exposure over total assets per bank as predictor variables. This determines whether the results are driven by the risk component or the exposure component of the sovereign subsidy.

3.2.4 Multicollinearity

It is important to note that high correlation among predictor variables could lead to multicollinearity. The presence of multicollinearity within a model leads to high standard errors. Small changes in data or the model can result in significant changes of the coefficients. One way to observe multicollinearity is analyzing a correlation matrix of the predicting variables (Field, 2009). Correlations among predictor variables higher than 0.8 are described as being a concern. According to the correlation matrix exhibited in Table 3, the majority of the variables are not highly correlated. The highest correlation among predictor variables used in a single regression is 0.77. This is the correlation between Tier 1 capital over assets and Equity over assets. The reason for the high correlation is that Tier 1 capital includes shareholders equity, and retained earnings. The correlation is not higher than the benchmark 0.8, so both variables are included in the regression.

4 DATA

In this chapter, I first describe the data collecting process and the used data sources. Secondly, I describe the way I dealt with missing data. Finally, this chapter provides the descriptive statistics of the dataset.

4.1 Data collection

To investigate whether zero risk weights influence CDS spreads, systemic risk, and bank profitability, I construct a panel dataset of 44 European banks from 17 countries. The banks selected in this panel dataset had to meet two criteria. First, banks were either exposed to the EBA stress tests, the recapitalization exercise or the transparency exercise. The goal of these exercises is to assess banks to adverse market developments, and review and increase transparency of bank's capital positions (EBA European Banking Authority, 2016). During these exercises, the EBA discloses sovereign exposures at bank level which I use in this paper. Bank level sovereign exposures are available at nine points in time: December 2010, September 2011, December 2011, June 2012, December 2012, June 2013, December 2013, December 2014 and June 2015. Secondly, banks must be in the V-lab, which calculates the MES and the SRISK based on market available information, implying that SRISK and MES values are solely available for listed banks. SRISK and MES are both measured in dollars in the V-lab, but in order to be consistent I used the Euro/Dollar rate, gathered from Bloomberg, to convert SRISK and MES in euros. The V-lab provides monthly real-time measurements, modeling, and forecasts of financial volatility, correlations, and risk for a broad spectrum of assets (V-Lab). Appendix B provides a final list of the banks in used in this paper.

Since the number of banks conducted to the stress tests, transparency exercises and capital exercises differ at the different points in time, it is impossible to construct a well-balanced panel dataset. For example, only 65 banks were subjected to the EU-transparency exercise June 2012 and 123 banks have been submitted to the stress test of 31-12-2013. The EU-capital exercise from September 2011, December 2011 and June 2012 and the EU-transparency exercise from December 2014 and June 2015 do not take the Greek banks into their sample because those banks were undergoing a comprehensive assessment exercise conducted by the European Central Bank. Hence, the dataset misses Greek banks at the above-given points in time. To avoid the dataset to become too unbalanced, it contains only banks with at least four observations.

As explained in the methodology section, I use banks' sovereign debt exposures from the EBA to construct the 'sovereign subsidy'. The EBA publishes many values for sovereign debt exposures, e.g. gross direct long exposures, net direct positions and notional and fair value for direct and indirect exposures in derivatives. To determine the total sovereign debt exposure outstanding for a bank, I used the sum of the net direct positions, the fair values of the direct sovereign exposures in derivatives and the fair values of the indirect sovereign exposures in derivatives. To further complement the dataset I used Bank Scope and Thomson one Banker to obtain quarterly bank level data. Quarterly bank level data includes balance sheet measures, profitability measures, and financial ratios. SRISK and MES are retrieved from the 'V-lab' of the Stern NYU business university. I truncated negative values for SRISK into zero, hence, if values are negative, the bank will suffer zero loss, which implies a capital buffer. Finally, the CDS spreads are taken from Bloomberg. For the CDS spreads I use the 5-year senior CDS spreads because these represent 85% of the total CDS Market and are the most liquid (Jorion & Zhang, 2007). One drawback of using CDS spreads is the lack of available CDS spreads in the market. Consequently, not all banks in the dataset have a CDS spread.

4.2 Missing data

Since the size of the dataset is rather small, each single observation is important for the power of the results. To deal with missing control variables, I took a two-step procedure to find the right values or estimations of the right values. First, I went manually through the annual reports, semiannual reports and, if available, the quarterly report to obtain the missing values. In case the data was available, I added them to the dataset. Secondly, when the quarterly or semiannual reports were not available, I used the last available values as a proxy. Since not all banks publish their results quarterly, a lot of data points were missing for September 2011. In this case, I used the semiannual data from June 2011 as a proxy. In case this data was also missing, I used the data from 31 December 2010.

4.3 Descriptive statistics

Table 2 provides the summary statistics separated by dependent and predictor variables of the data used. The average SRISK is €18,229 million, and the MES is €2.70 million on average. The average sovereign debt exposure is €28,283 million, which is on 6.15% of the total assets. The average sovereign subsidy is €11,714 million, which is on average 4.98% of the total assets. Note that the daily CDS spread is almost equal to the 50 days moving average CDS spread. The mean CDS spread is 297 bps and the 50 days moving average CDS spread is 295 bps. Finally, the average ROA is 0.09% and the median is 0.25%.

Table 3 provides a correlation matrix of variables used in the paper. The correlation coefficient between the proxies for systemic risk is 0.7, suggesting that short-term and long-term systemic risk are strongly correlated. Furthermore, no excessive high correlations between the predictor variables are present, except for the correlation between Tier 1 capital and Equity/Assets, which is mentioned earlier.

Table 4 exhibits a summary of the total debt exposure over assets, the sovereign subsidy over assets, SRISK over assets, MES and CDS spread between GIIPS and non-GIIPS countries over time. Note that the average total debt exposure over assets declines from December 2010 till December 2011 and increases after December 2011. A possible explanation for the increase in sovereign debt exposure ECB's LTRO. Following the argumentation from by Krishnamurthy, Nagel, & Vising-Jorgensen (2014), the ECB aimed to lower bond yields by providing banks additional funds with the expectancy that banks would invest this in sovereign bonds.

The difference in the sovereign subsidy between banks in GIIPS countries and non-GIIPS is quite large. This difference could be explained by the home bias. Banks tend to invest most of their sovereign debt in their country of origin; this is supported by Horváth, Huizinga & Loannidou (2015) and by table 5. Table 5 provides the percentage sovereign bonds invested in the home country. Remark that the GIIPS countries have higher credit ratings which results in larger risk weights and thus higher sovereign subsidy. The average difference in sovereign debt exposure over total assets between the two groups is 2.87%, and the average sovereign subsidy over assets is more than twice as large for the banks located in GIIPS countries. Also, note that, as expected, the average CDS spreads, SRISK, and MES are smaller for banks located in non-GIIPS countries than for banks located in the GIIPS.

5 RESULTS

This chapter provides answers to the hypotheses documented in the Methodology part of this paper. In providing an answer to the questions, the same sequence is used as the hypotheses in the Methodology.

5.1 SRISK and MES

In this part of the chapter, I first provide the results for the regression with SRISK as the dependent variable and secondly, I provide the regression results with the MES as the dependent variable.

Table 7 reports the results of a fixed effects regression to test how the sovereign subsidy influence SRISK. Column (1) presents the baseline regression with one predicting variable, the SovSub/Assets. The regression results are significant ($F(52,304)=27.627$, $p<0,000$) with an R-squared of 0.450. The results show that SovSub/Assets positively influences SRISK/Assets. Both variables are divided by banks' total assets to correct for size. Larger banks are usually more inclined in the financial system than smaller banks and therefore more systemically risky. The coefficient implies that an increase in the SovSub/Assets with one percent leads, to an increase in SRISK/Assets with 0.076%.

In column (2), I add five control variables. First of all, the coefficient of the sovereign subsidy over assets decreased by a small fraction. As expected, Equity/Assets has a significant negative influence on SRISK/Assets. An increase of one percent Equity/Assets reduces SRISK/Assets by 0.101%. Furthermore, also the LiquidAssets/Assets negatively influences SRISK/Assets. This effect is significant at a 5% level. An increase in the LiquidAssets/Assets by one percent reduces the SRISK/Assets with almost 0.019%. Remarkably, the coefficient Impaired loans/Net loans is negative and significant at a 5% significance level, implying that more impaired loans lead to less SRISK/Assets, while the opposite was expected. A possible explanation could be that banks not report all their impaired loans. Aloisi (2014) states that prior to the ECB's balance sheet review, Italian banks were putting apart billions of euros to cover for bad loans that accumulated during the sovereign debt crisis. The fourth control variable is the percentage Tier1/Assets. Tier1/Assets has a negative impact on SRISK/Assets. The higher the Tier 1 ratio is, the better a bank is capitalized, and the lower the systemic risk is. The final control variable added in the regression is the ROAA. The ROAA negatively influences SRISK/Assets, where I expected a positive relation. An argument could be that well-performing banks, have sufficient capital buffers to withstand a crisis and are therefore systemically less risky. Besides, these results are in line with Berger & Bouwman (2009). The time horizon of this study is largely characterized by the sovereign debt crisis and they discovered that better capitalized banks perform better during a crisis.

Column(3) includes an interaction dummy for banks located in GIIPS countries and column (4) contains an interaction dummy for ECB's LTRO and an interaction dummy for banks located in GIIPS countries. The coefficient of the interaction term GIIPS*SovSub/Assets in column (3) is negative and significant, suggesting that for banks located in GIIPS countries, SovSub/Assets influences SRISK/assets less than for banks located in non-GIIPS countries. Remark that the relation between sovereign subsidy and SRISK in column (3) increased. There is thus a significant difference between the effect in GIIPS and non-GIIPS countries. These results could be explained by the fact that most of the largest and systemically most important banks are located in non-GIIPS countries.

The interaction dummy for the effect of ECB's LTRO is positive but not significant. This implies that the effect of SovSub/Assets on SRISK/Assets is not different during the LTRO. To conclude, according to these findings, zero risk weights for sovereign debt positively affect bank systemic risk. The more a bank is undercapitalized, the systemically riskier it is. These results only account for banks located in GIIPS countries. Hypothesis 1 could be rejected according to these findings.

Table 8 documents the results of the fixed effects regression conducted to test whether the sovereign subsidy influences the MES. The structure of Table 8 is similar to Table 7. The regression estimation shown in column (1) is significant ($F(52,304) = 35.017$, $p<0.000$) with an R-squared of 0.509. In contrast to SRISK/Assets, the relation between MES and the SovSub/Assets is not significant. After controlling for the control variables in column 3, the effect is still not significant. Surprisingly, none of the control variables are significant.

In the third regression, provided in column (3), the dummy variable for GIIPS countries is added. SovSub/Assets positively affects MES for banks located in non-GIIPS countries. For these banks, it applies that a higher value of the sovereign subsidy leads to a higher value for the MES. An increase of one percent SovSub/Assets results in an increase of in the MES of 6.327 million. The interaction term GIIPS*SovSub is negative and significant, suggesting that the effect of SovSub/Assets on MES is lower for banks located in GIIPS countries. The total effect for these banks is equal to the sum of the coefficients for SovSub/Assets and GIIPS*SovSub/Assets: 6.327-6.209 =-0.118. These results are consistent with the results as shown in Table 7. The only control variables significantly affecting the MES are Equity/Assets and ROAA. First, equity over assets is negatively correlated with the MES and significant at a five percent level. Higher Equity/Assets leads to a lower MES. Secondly, the ROAA is positively related to MES and significant at a 10% level. More profitable banks tend to have a higher short-term systemic risk. This effect is different than the effect found between the ROAA and SRISK. A possible explanation for this switch in effect could be that banks take more risk in the short-run to raise profitability, which is reflected in the MES.

Column (4) presents the regression results with an interaction dummy for ECB's LTRO and one for banks located in GIIPS countries. The interaction dummy for the LTRO is not significant, implying that the results remain similar to the regression results in column (3). To conclude, the effect of the sovereign subsidy on the short-term systemic risk is only significant when controlling for the location of banks. For this reason the H2 could not be rejected.

5.2 CDS spread

A fixed effect regression analysis is used to employ a model for predicting CDS spreads from the sovereign subsidy. Table 9 exhibits the results of the regression. Since CDS spreads are not available for all banks, the number of observation is reduced to 244. I expect the relation between the sovereign subsidy over assets and the CDS spread to be positive, i.e. higher undercapitalization due to zero risk weights possibly could lead to higher default probabilities and thus higher CDS spreads.

Again, the structure used in Table 9 is similar to Table 7 and Table 8. The regression provided in column (1) is significant ($F(40,203)=22.28$), $p<0.000$) with an R-squared of 0.497. Although SovSub/Assets positively influences the CDS spreads, the relation is not significant. The effect turns even negative after including the control variables in the regression (column 2). The relation changes after including the interaction dummy for GIIPS countries in column (3), but it is still not significant. The dummy variable for banks located in GIIPS countries is significant at a 10% level. This implies that the effect of the sovereign subsidy on the CDS spread is smaller for these banks. Note that the LnAssets, Liquid Assets/Assets, Impaired loans/Net loans and Equity/Assets are significant. According to the expectations, LiquidAssets/Assets and Equity/Assets are negative and significant. However, similar to the regression results shown in Table 7, the Impaired Loans/Net Loans negatively affect the CDS spread, indicating that a higher impaired loans percentage leads to a lower CDS spread.

In column (4), the interaction dummy LTRO*SovSub/Assets is added to the regression. The effect of SovSub/Assets on the CDS spread remain the same as in the other columns. The LTRO dummy is positive and significant, meaning that during the LTRO, the relation between the sovereign subsidy and the CDS spread was stronger than before and after the LTRO. During the LTRO, a 1% increase in the sovereign subsidy over assets resulted in a (32.104+13.610) 45.714 bps increase in the CDS spreads. Finally, the OTM dummy does negatively relate to the CDS spreads, but this result is not significant. According to the regression results as shown in Table 9, I could not reject the hypothesis which states that the sovereign subsidy does not influence CDS spreads. A significant effect is only found during the LTRO.

A fixed effects regression analysis was also conducted to test how the sovereign subsidy affects the change in CDS spread. Table 10 provides the results. Column (1) shows the fixed effects regression with the sovereign subsidy as the only predictor variable and with time dummies which allow the constant term to change over time. The regression is significant ($F(40,201)=47.182$, $p<0,000$) with an R-squared of 0.679. The coefficient for the sovereign subsidy is as expected positive, but not significant. Columns (2), (3) and (4) show the regression results with the inclusion of the control variables and the interaction dummy variables. The relation between the sovereign subsidy and the change in CDS spread does not changes after including interaction dummy for banks located in GIIPS countries. Based on these findings, I cannot reject the fourth hypothesis which states that the sovereign subsidy does not influence the change in CDS spread.
According to these results, the sovereign subsidy does not influence the CDS spreads and the changes in CDS spreads.

5.3 ROAA

A multiple regression analysis was also conducted to test how the sovereign subsidy influences bank profitability. Table 11 provides the results. Column (1) provides the regression results with the SovSub/Assets as only predicting variable. This regression is significant ($F(52,304)=5.706$, $p<0,000$) with an R-squared of 0.145. The R-squared is substantially lower than the R-squared from the prior regressions. A possible explanation for this is that bank profitability is stable over time. The coefficient of the SovSub/Assets is negative and significant at 1%, implying that banks with a higher sovereign subsidy are less profitable. The results are in line with Molyneux & Thornton (1992) and Cox & Hutchison (2007) who find a positive relation between capital and profitability.

In column (2) I added control variables. The influence of SovSub/Assets on ROAA decreases to -0.083, but it is still significant at a 1% level. Also, note that the control variable SRISK/Assets is also negative, implying a negative relation between systemic risk and profitability. To observe whether bank size affects the profitability, LN Assets is added as a control variable. The coefficient is positive and significant at a 10% level, meaning that larger banks are more profitable than smaller banks. This result is not supported by the small firm effect (Bauman, Miller, & Conover, 1998). In the third column I control for banks located in GIIPS countries. The influence of SovSub/Assets on ROAA is significantly lower for banks located in GIIPS countries. The total effect of the sovereign subsidy on the profitability for banks located in the GIIPS countries is equal to the sum of the two coefficients. The effect almost disappears (-0.210+0.212=0.002). Finally, in I also include a dummy variable for EBC's LTRO in column four. This dummy is not significant and quite small 0.015, implying that the LTRO does not influence the effect of the sovereign subsidy on the ROAA.

According to the regression results in columns (1)-(4), the hypothesis stating that the sovereign subsidy does not influence the profitability can be rejected. The sovereign subsidy negatively influences bank profitability.

5.4 Underlying the Sovereign Subsidy

In this part, I provide a profound analysis of the results found in section 5.1-5.3. Rather than analyzing the relationship between the sovereign subsidy and systemic risk, CDS spreads and profitability, this section provides more insight in what underlying factor of the sovereign subsidy drives the results. As mentioned in the methodology, the sovereign subsidy is a sum product of risk weights and exposure in different countries. For the reason that different combinations of risk weights and exposures can result in similar sovereign subsidies, this section deepens into which component drives the relation. First of all, Table 6 exhibits the average risk weights and the sovereign debt exposure over assets per quartile sovereign subsidy, where the first quartile includes the 25% observation with the smallest values for the sovereign subsidy and the last quartile includes the 25% observations with the largest values for the sovereign subsidy. The average sovereign debt exposure and the average weighted risk weight increase with the increase of the average debt exposure. According to the correlation matrix provided in Table 3, the correlation coefficients of debt exposure and the weighted-average risk weight is 0.7 and 0.84 with the sovereign subsidy respectively. Although there is are a large correlation between those variables and the sovereign subsidy, severe correlation, 0.3, is detected between the average risk weight and debt exposure. Multicollinearity does not seem to be a problem in combining these factors in a fixed effects regression.

Table 12 provides the regression results where I used the sovereign debt exposure over assets and the weighted average risk weights as predictor variables instead of the sovereign subsidy. The dummies used in the regressions are selected based on their significance in previous regressions.

Column (1) provides the regression results where SRISK is the dependent variable. The sovereign debt exposure relates positively and significantly to the SRISK, and the coefficient for the average risk weight is also positive, but not significant. The relation between SRISK and the sovereign subsidy appears to be motivated by the total debt exposure outstanding, independently of the average risk weight. Consistent with these results are the results in column (2) where the MES is the dependent variable. For both regressions applies that the relation is significantly different for banks located in GIIPS countries. The relation between the sovereign debt exposure and systemic risk is lower for these banks. Reducing the total exposure would be a more effective manner for banks to reduce their systemic risk.

Although the results do not show a significant relationship between the sovereign subsidy and the CDSspread, column (3) of Table 12 shows that the weighted average risk weight positively relates to the CDS spread. For banks located in GIIPS countries, this relationship is significantly lower. A possible explanation for this result is that the risk weights are based on credit ratings, and credit ratings correlate with CDS spreads because they both represent credit risk (Jacobs, Karagozoglu, & Peluso, 2010).

Column (4) provides the regression with ROAA as dependent variable. The relation between the sovereign subsidy and ROAA is mainly driven by the weighted average risk weight. The relation between the weighted average risk weight and ROAA is negative and significant. One percent increase in the average risk weight results in an -0.035% decrease in the bank profit. Also, note that this relation is different for banks located in GIIPS countries, i.e. the interaction term is positive and significant, implying that an increase in the average risk weights results in an increase in the ROAA.

6 CONCLUSION

In this paper, I examined the effect of zero risk weights for sovereign debt, determined in the CRR and CRD IV, on systemic risk, CDS spreads and profitability for a panel set of European Banks. The sovereign subsidy is calculated based on credit ratings and the IRB approach and measures banks' risk-weighted assets not reflected in the regulatory capital as a result of the zero risk weights. As proxies for systemic risk, I used SRISK and MES which measures long and short term systemic risk respectively. For the analysis, I performed a regression analysis with bank fixed effects and time dummies to correct for variation over time.

First, the results show that zero risk weights result in higher long and short term systemic risk. These results hold when controlling for other factors that influence systemic risk, for example the bank size, leverage, and Tier 1 capital quality. The results showed that the effect is smaller for banks located in GIIPS countries. I expected to find the effect of the zero risk weights to be larger during ECB's LTRO, but this was not supported by the results. Secondly, no relation was found between the sovereign subsidy and CDS spreads and the change in CDS spread.
Thirdly, zero risk weights negatively relate to bank profitability. This paper documents that better-capitalized banks are performing better. The results hold after controlling for control variables. This effect is significantly lower for banks located in GIIPS countries. Finally, this paper examines what component of the sovereign subsidy drives the results. The influence of the sovereign subsidy on systemic risk for GIIPS banks is mainly driven by the sovereign debt component. The influence of the sovereign subsidy on profitability is mainly driven by the weighted-average risk weight component.

The results of this study contribute to the literature studying the application of zero risk weights. New in this paper is how zero risk weights affect systemic risk, CDS spreads, and profitability. The results presented can have important implications for regulators. While regulators are trying to improve financial stability through tighter bank regulations (Basel III), which should increase transparency and should enable banks to better absorb economic shocks, zero risk weights seem to effectuate the opposite. Zero risk weights are established based on the assumption of risk freeness of sovereign debt. Regulators should reconsider whether these assumptions still apply for the financial situation nowadays. Furthermore, banks' using the standardized approach to calculate their risk-weighted assets should bear in mind that the consequences of zero risk weights during economic adverse developments could cause serious trouble. Better capitalization could reduce the impact of such economic adverse development.

This study has a number of limitations. A few comments can be made on the dataset of this study. The representation of the dataset on all banks in Europe is poor since this paper only captures European Listed banks. The average size of private banks is for example smaller than listed banks and private banks face fewer agency problems (Kwan, 2004). Whether results are different for private banks could be examined in future research. Although I find that the sovereign subsidy influences systemic risk CDS spreads and profit, it is not evident whether the banks in the sample apply the standardized approach and thus use zero risk weights for sovereign debt by determining their risk weighted assets. Banks could also use their IRB models and apply other risk weights on sovereign debt. This could also be investigated in future research. Finally, to investigate how the LTRO influences the regression outcome, I most preferably would have divided the dataset based on whether the bank took part in the LTRO. This is impossible since banks have no obligation to disclose participation in the LTRO.

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8 TABLES

TABLE 1

Table 1 exhibits credit ratings from S&P, Moody’s and Fitch and the corresponding probability of default(PD) and the Risk weights.

S&P	Moody's	Fitch	PD	Risk Weight
AAA	Aaa	AAA	0.03%	0.144
AA+	Aa1	AA+	0.03%	0.144
AA	Aa2	AA	0.03%	0.144
AA-	Aa3	AA-	0.03%	0.144
A+	A1	A+	0.26%	0.505
A	A2	A	0.26%	0.505
A-	A3	A-	0.26%	0.505
BBB+	Baa1	BBB+	0.64%	0.776
BBB	Baa2	BBB	0.64%	0.776
BBB-	Baa3	BBB-	0.64%	0.776
BB+	Ba1	BB+	2.67%	1.244
BB	Ba2	BB	2.67%	1.244
BB-	Ba3	BB-	2.67%	1.244
B+	B1	B+	9.71%	1.91
B	B2	B	9.71%	1.91
B-	B3	B-	9.71%	1.91
CCC+	Caa1	CCC+	36.15%	2.451
CCC	Caa2	CCC	36.15%	2.451
CCC-	Caa3	CCC-	36.15%	2.451
CC	Ca	CC	36.15%	2.451
C	C	C	36.15%	2.451
D	C	D	100.00%	2.451

TABLE 2

This table provides the descriptive statistics for the panel dataset used in this paper. The descriptive statistics are separated by the dependent variables and the independent variables used in the regression equations. The data shown in this paper is gathered from Bloomberg, Bankscope, V-lab and the European Banking Authority.

Variable	Unit	N	Mean	Median	St. Dev	Min	Max
Dependent variables							
Srisk	mln €	357	18,229	5,406	28,207	0	113,688
SRISKperc	%	357	1.67%	0.42%	3.38%	0.00%	49.00%
MES	mln €	357	2.70	2.73	1.47	0	6.94
ROAA	%	357	0.09%	0.25%	1.48%	-13.52%	7.79%
Δ CDS spread 50	%	242	-3.61%	-3.18%	18.05%	-49.51%	68.65%
Δ CDS spread	%	242	-5.87%	-5.68%	20.92%	-70.25%	96.71%
CDS spread	bps	244	297	187	276	40	1,648
CDS spread 50	bps	244	295	182	276	46	1,635
Predictor / Control variables							
SovSub	mln €	357	11,714	7,924	13,708	0	85,766
Total Assets	mln €	357	543,774	215,195	639,894	4,231	2,298,340
Total Equity	mln €	357	27,730	11,583	32,536	-2,324	179,975
Net Income	mln €	357	752	354	2,868	-13,583	13,869
Tier I Capital	mln €	357	22,758	10,138	25,625	120	142,484
Impaired Loans	mln €	357	16,144	10,729	17,211	171	82,141
Net Loans	mln €	357	222,819	128,482	218,501	1,830	852,576
Liquid Assets	mln €	357	139,066	28,118	208,325	218	957,639
Employees	#	357	56,020	21,567	65,493	844	307,000
RWA	mln €	357	191,922	84,279	215,811	2,294	1,066,401
Sov Debt Exp	mln €	357	28,283	18,673	28,059	-882	154,760
Sovdebt/Total Assets	%	357	7.96%	7.65%	5.42%	-4.14%	32.36%
Equity/Total Assets	%	357	6.15%	5.97%	2.69%	-3.30%	15.18%

TABLE 3

This table provides a correlation matrix of the variables used in the regression analysis.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Srisk/Assets	(1)	1											
MES	(2)	0.70	1										
CDS spread 50	(3)	0.36	0.19	1									
ΔCDS SPREAD 50	(4)	-0.03	-0.18	0.01	1								
ROAA	(5)	-0.24	0.04	-0.13	0.09	1							
SovSub/Assets	(6)	-0.05	-0.14	0.50	-0.07	-0.22	1						
SovDebt/Assets	(7)	-0.18	-0.23	0.21	0.10	-0.16	0.70	1					
Weigthed Average RW	(8)	0.04	-0.03	0.62	-0.17	-0.12	0.84	0.32	1				
Equity/Assets	(9)	-0.55	-0.37	-0.08	0.10	0.17	0.27	0.27	0.24	1			
ImpairedLoans/Netloans	(10)	-0.17	-0.13	0.39	-0.09	-0.26	0.60	0.36	0.59	0.43	1.00		
Tier1/Assets	(11)	-0.47	-0.30	0.34	-0.06	0.14	0.43	0.26	0.43	0.77	0.52	1.00	
LiquidAssets/Assets	(12)	0.20	0.23	-0.52	-0.01	0.12	-0.57	-0.51	-0.53	-0.41	-0.45	-0.46	1.00

TABLE 4

This table reports summary statistics per year and divided by banks located in GIIPS and non-GIIPS countries. Panel A shows the average sovereign debt exposure over total assets and the average sovereign subsidy over assets. Panel B shows the average SRISK over assets and the MES. Panel C shows the average 50 days moving average CDS spread and the percentage change in daily moving average CDS spread.

Panel A: Sovereign deb exp and sovereign subsidy over assets divided by GIIPS over time

	Sov Debt Exp/Assets			Sov Subsidy/Assets		
	Non GIIPS	GIIPS	Total	Non GIIPS	GIIPS	Total
December-10	6.81%	8.91%	7.77%	2.43%	4.09%	3.18%
September-11	5.52%	8.02%	6.44%	2.34%	3.51%	2.77%
December-11	5.39%	7.62%	6.23%	2.53%	4.38%	3.23%
June-12	5.06%	9.16%	6.61%	2.17%	7.04%	4.01%
December-12	6.37%	9.86%	7.90%	2.75%	10.79%	6.28%
June-13	6.52%	10.39%	8.22%	3.48%	10.54%	6.58%
December-13	8.06%	9.97%	8.90%	4.34%	9.86%	6.78%
December-14	8.72%	11.49%	9.74%	4.37%	8.84%	6.01%
June-15	8.66%	11.35%	9.65%	4.05%	8.54%	5.71%
Total	6.81%	9.65%	7.96%	3.17%	7.63%	4.98%

Panel B: SRISK over assets and MES divided by GIIPS over time

	SRISK/Assets			MES		
	Non GIIPS	GIIPS	Total	Non GIIPS	GIIPS	Total
December-10	2.23%	3.18%	2.66%	€ 1.88	€ 2.10	€ 1.98
September-11	3.22%	3.65%	3.38%	€ 2.87	€ 2.98	€ 2.91
December-11	2.87%	3.48%	3.10%	€ 2.77	€ 2.84	€ 2.79
June-12	2.84%	3.72%	3.17%	€ 3.42	€ 4.19	€ 3.71
December-12	3.14%	4.61%	3.79%	€ 3.15	€ 4.25	€ 3.63
June-13	2.54%	3.10%	2.79%	€ 2.65	€ 2.91	€ 2.76
December-13	2.15%	1.57%	1.89%	€ 2.15	€ 2.27	€ 2.20
December-14	1.94%	1.80%	1.89%	€ 2.09	€ 2.38	€ 2.20
June-15	1.92%	2.00%	1.95%	€ 2.12	€ 2.53	€ 2.27
Total	2.53%	3.02%	2.73%	€ 2.56	€ 2.92	€ 2.70

Panel C: CDS spread 50 DMA and change in CDS spread 50 DMA divided by GIIPS over time

	CDS spread 50 DMA			Change CDS spread 50 DMA		
	Non GIIPS	GIIPS	Total	Non GIIPS	GIIPS	Total
December-10	129	509	331	4.81%	10.88%	8.05%
September-11	284	754	491	21.78%	16.65%	19.52%
December-11	190	490	328	-25.28%	-35.41%	-29.93%
June-12	188	591	373	-22.27%	-11.45%	-17.31%
December-12	124	561	358	-10.32%	-10.15%	-10.23%
June-13	118	561	355	-2.23%	3.22%	0.69%
December-13	101	298	217	-7.65%	-20.97%	-15.46%
December-14	76	142	109	-3.75%	-2.92%	-3.30%
June-15	87	177	132	6.67%	17.06%	11.87%
Total	145	441	295	-3.84%	-3.39%	-3.61%

TABLE 5

This table reports the average domestic sovereign debt exposure per year divided by banks located in GIIPS and non-GIIPS countries.

	Non-GIIPS	GIIPS	Grand Total
31-Dec-10	52.32%	86.30%	67.76%
30-Sep-11	45.73%	84.22%	60.29%
31-Dec-11	52.25%	85.55%	65.20%
30-Jun-12	56.03%	87.90%	68.42%
31-Dec-12	58.27%	85.84%	70.37%
30-Jun-13	58.40%	85.12%	70.13%
31-Dec-13	56.25%	88.70%	70.59%
31-Dec-14	55.25%	81.63%	64.97%
30-Jun-15	55.52%	77.48%	63.61%
Total	54.46%	84.99%	66.96%

TABLE 6

Average sovereign debt over assets and average risk weight per quartile sovereign subsidy.

Sovsubsidy per quartile	Average of average rw	Average of sovdebt/assets
0-0.25%	19.53%	2.24%
0,25-0,5	28.00%	6.45%
0,5-0,75	64.77%	9.74%
0,75-1	100.58%	13.44%
Total	53.15%	7.96%

TABLE 7

Table 7 reports the results of the bank fixed effects regression where SRISK/Assets is regressed on the SovSubAssets. Column (1) reports the baseline regression. In column (2), (3) and (4), control variables and interaction dummies are included. The interaction dummies used are the sovereign subsidy*LTRO and the sovereign subsidy*GIIPS. The control variables included are Liquid assets/Assets, Impaired loans/Net loans, Equity/Assets, Tier1/Assets and ROAA. The regression also includes time dummies.

Model	(1)	(2)	(3)	(4)
Dependent variable		SRISK/Assets		
SovSub/Assets	0.076***	0.055***	0.123***	0.123***
	(4.492)	(3.214)	(5.228)	(5.178)
GIIPS*SovSub/Assets			-0.118***	-0.118***
			(-4.090)	(-4.080)
LTRO*SovSub/Assets				0.001
				(0.042)
LiquidAssets/Assets		-0.019**	-0.018**	-0.018**
		(-2.168)	(-2.155)	(-2.151)
ImpairedLoans/Netloans		-0.020**	-0.017**	-0.017**
		(-2.512)	(-2.201)	(-2.150)
Equity/Assets		-0.101***	-0.151***	-0.151***
		(-3.206)	(-4.566)	(-4.557)
Tier1/Assets		-0.098**	-0.111***	-0.111***
		(-2.270)	(-2.610)	(-2.604)
Roaa		-0.173***	-0.129***	-0.129***
		(-5.357)	(-3.892)	(-3.885)
Constant	0.024***	0.040***	0.043***	0.043***
	(20.539)	(14.908)	(15.831)	(15.805)
Bank fixed effects	Yes	Yes	Yes	Yes
R-squared within	0.450	0.614	0.634	0.634
P value	0.000	0.000	0.000	0.000
F statistic	27.627	33.951	34.469	32.206
Number of observations	357	357	357	357

Note: (*) (**) (***) implies the coefficient is significant at a 10%, 5% and 1% level respectively
The values between parentheses denote the t-values for the corresponding coefficients

TABLE 8

Table 8 reports the results of the bank fixed effects regression where MES is regressed on the SovSub/Assets. Column (1) reports the baseline regression. In column (2), (3) and (4), control variables and interaction dummies. The interaction dummies used are the sovereign subsidy*LTRO and the sovereign subsidy*GIIPS. The control variables included are Liquid assets/Assets, Impaired loans/Net loans, Equity/Assets, Tier1/Assets and ROAA. The regression also includes time dummies.

Model	(1)	(2)	(3)	(4)
Dependent variable		MES		
SovSub/Assets	1.196	2.642	6.327***	6.163***
	(0.863)	(1.618)	(2.719)	(2.625)
Ln Assets		0.288	0.352	0.346
		(1.134)	(1.386)	(1.359)
GIIPS*SovSub/Assets			-6.209**	-6.161**
			(-2.209)	(-2.188)
LTRO*SovSub/Assets				1.203
				(0.568)
LiquidAssets/Assets		-0.206	-0.214	-0.205
		(-0.247)	(-0.259)	(-0.248)
ImpairedLoans/Netloans		-1.316*	-1.169	-1.085
		(-1.707)	(-1.520)	(-1.385)
Equity/Assets		-4.093	-6.671**	-6.643**
		(-1.364)	(-2.083)	(-2.072)
Tier1/Assets		-2.958	-3.418	-3.556
		(-0.708)	(-0.822)	(-0.853)
Roaa		3.971	6.166*	6.124*
		(1.287)	(1.913)	(1.897)
Constant	1.939***	-5.142	-6.674	-6.512
	(20.033)	(-0.772)	(-1.003)	(-0.976)
Bank fixed effects	Yes	Yes	Yes	Yes
R-squared within	0.509	0.532	0.540	0.540
P value	0.000	0.000	0.000	0.000
F statistic	35.017	22.591	21.760	20.444
Number of observations	357	357	357	357

Note: (*) (**) (***) implies the coefficient is significant at a 10%, 5% and 1% level respectively
The values between parentheses denote the t-values for the corresponding coefficients

TABLE 9

Table 9 reports the results of the regression where the CDS spread is regressed on the sovereign subsidy over assets. Column (1) reports the baseline regression. In column (2), (3) and (4), control variables and interaction dummies are included. The interaction dummies used are the sovereign subsidy*LTRO and the sovereign subsidy*GIIPS. The control variables included are Liquid assets/Assets, Impaired loans/Net loans, Equity/Assets, Tier1/Assets and ROAA. The regression also includes time dummies.

Model	(1)	(2)	(3)	(4)
Dependent variable	CDS spread50 DMA			
SovSub/Assets	0.595	-3.943	31.932	32.104
	(0.128)	(-0.746)	(1.558)	(1.587)
Ln Assets		2.283***	3.169***	3.102***
		(2.721)	(3.277)	(3.249)
GIIPS*SovSub/Assets			-37.551*	-37.831*
			(-1.811)	(-1.848)
LTRO*SovSub/Assets				13.610**
				(2.464)
LiquidAssets/Assets		-5.572**	-5.558**	-5.781**
		(-2.424)	(-2.432)	(-2.560)
ImpairedLoans/Netloans		-10.114***	-8.986***	-8.445***
		(-4.129)	(-3.574)	(-3.389)
Equity/Assets		-40.829***	-42.831***	-40.404***
		(-3.955)	(-4.149)	(-3.946)
Tier1/Assets		-19.474	-14.630	-20.717
		(-1.240)	(-0.923)	(-1.308)
Roaa		11.170	9.366	10.105
		(0.773)	(0.650)	(0.710)
OMT				-0.564
				(-1.383)
Constant	3.137***	-53.070**	-77.028***	-75.166***
	-11.516	(-2.367)	(-2.971)	(-2.936)
Bank fixed effects	Yes	Yes	Yes	Yes
R-squared within	0.497	0.636	0.642	0.680
P value	0.00	0.00	0.00	0.00
F statistic	22.28	22.97	21.99	24.33
Number of observations	244	244	244	244

Note: (*) (**) (***) implies the coefficient is significant at a 10%, 5% and 1% level respectively
The values between parentheses denote the t-values for the corresponding coefficients

TABLE 10

Table 10 reports the results of the regression where the CDS spread change is regressed on the sovereign subsidy over assets. Column (1) reports the baseline regression. In column (2), (3) and (4), control variables and interaction dummies are included. The interaction dummies used are the sovereign subsidy*LTRO and the sovereign subsidy*GIIPS. The control variables included are Liquid assets/Assets, Impaired loans/Net loans, Equity/Assets, Tier1/Assets and ROAA. The regression also includes time dummies. This regression also includes a dummy variable for the OMT.

Model	(1)	(2)	(3)	(4)
Dependent variable	Δ CDS spread50 DMA			
SovSub/Assets	0.165	0.706	1.736	1.740
	(0.446)	(1.450)	(0.912)	(0.914)
Ln Assets		0.154**	0.179**	0.178**
		(1.988)	(1.996)	(1.974)
GIIPS*SovSub/Assets			-1.078	-1.086
			(-0.560)	(-0.564)
LTRO*SovSub/Assets				0.413
				(0.794)
LiquidAssets/Assets		-0.187	-0.187	-0.193
		(-0.883)	(-0.881)	(-0.909)
ImpairedLoans/Netloans		-0.243	-0.211	-0.195
		(-1.076)	(-0.902)	(-0.830)
Equity/Assets		1.014	0.958	1.029
		(1.067)	(0.999)	(1.068)
Tier1/Assets		-1.257	-1.118	-1.304
		(-0.869)	(-0.760)	(-0.875)
Roaa		0.039	-0.013	0.012
		(0.029)	(-0.010)	(0.009)
OMT				-0.110***
				(-2.798)
Constant	0.076***	-4.003*	-4.689*	-4.639*
	(3.470)	(-1.934)	(-1.947)	(-1.924)
Bank fixed effects	Yes	Yes	Yes	Yes
R-squared within	0.679	0.692	0.692	0.693
P value	0.000	0.000	0.000	0.000
F statistic	47.182	29.161	27.261	25.646
Number of observations	242	242	242	242

Note: (*) (**) (***) implies the coefficient is significant at a 10%, 5% and 1% level respectively
The values between parentheses denote the t-values for the corresponding coefficients

TABLE 11

Table 11 reports the results of the regression where the ROAA is regressed on the sovereign subsidy over assets. Column (1) reports the baseline regression. In column (2), (3) and (4), control variables, interaction dummies, and time dummies are included. The interaction dummies used are the sovereign subsidy*LTRO and the sovereign subsidy*GIIPS. The control variables included are Liquid assets/Assets, Impaired loans/Net loans, Equity/Assets, Tier1/Assets and SRISK/Assets. The regression also includes time dummies.

	(1)	(2)	(3)	(4)
Dependent variable		ROAA		
	-0.146***	-0.084***	-0.210***	-0.212***
SovSub/Assets	(-5.258)	(-2.857)	(-5.140)	(-5.143)
		0.009*	0.006	0.006
Ln Assets		(1.943)	(1.400)	(1.379)
			0.212***	0.213***
GIIPS*SovSub/Assets			(4.313)	(4.315)
				0.015
LTRO*SovSub/Assets				(0.395)
		-0.003	-0.001	-0.001
LiquidAssets/Assets		(-0.228)	(-0.086)	(-0.079)
		-0.019	-0.021	-0.020
ImpairedLoans/Netloans		(-1.368)	(-1.554)	(-1.449)
		0.055	0.150***	0.150***
Equity/Assets		(1.012)	(2.604)	(2.605)
		0.290***	0.299***	0.297***
Tier1/Assets		(3.932)	(4.160)	(4.119)
		-0.496***	-0.372***	-0.372***
SRISK/Assets		(-5.247)	(-3.869)	(-3.862)
	0.006***	-0.227*	-0.169	-0.167
Constant	(2.880)	(-1.908)	(-1.447)	(-1.426)
Bank fixed effects	Yes	Yes	Yes	Yes
R-squared within	0.145	0.346	0.384	0.385
P value	0.000	0.000	0.000	0.000
F statistic	5.706	10.498	11.586	10.882
Number of observations	357	357	357	357

Note: (*) (**) (***) implies the coefficient is significant at a 10%, 5% and 1% level respectively
The values between parentheses denote the t-values for the corresponding coefficients

TABLE 12

Table 12 reports the results of the regressions that explore whether the effects are driven by the exposure component or the risk weight component. Column (1), (2), (3) and (4) report the regression analysis with SRISK/assets, MES CDS spread and ROAA as dependent variables respectively. The regression includes the interaction dummies which were significant in section 5.1-5.3. The interaction dummies in these regressions are the LTRO*WeightedAverageRW, GIIPS*WeightedAverageRW, LTRO*SovDeb/Assets and the LTRO*SovDebt/Assets. The control variables in these regressions are LNAssets, Liquid assets/Assets, Impaired loans/Net loans, Equity/Assets, Tier1/Assets and SRISK/Assets. The regression also includes time dummies, where December 2010 is the base case.

Model	(1)	(2)	(3)	(4)
Dependent variable	SRISK/Assets	MES	CDSspread50	ROAA
SovDebt/Assets	0.061***	7.800***	-0.835	0.022
	(3.635)	(3.158)	(-0.098)	(0.715)
weigthed average RW	0.007	-0.473	10.604***	-0.035***
	(1.552)	(-0.942)	(5.062)	(-4.733)
Ln Assets		0.480*	1.221	0.009**
		(1.793)	(1.471)	(1.980)
LTRO*WeigthedAverageRW		-0.199	-7.163***	
		(-0.656)	(-8.517)	
GIIPS*WeigthedAverageRW	-0.009*	0.870*	-1.813	0.041***
	(-1.926)	(1.880)	(-0.844)	(5.168)
GIIPS*SovDebt/assets	-0.061**	-10.187***	-27.534***	-0.022
	(-2.159)	(-3.785)	(-3.465)	(-0.457)
LTRO*SovDebt/Assets		-0.375	6.612	
		(-0.193)	(1.306)	
LiquidAssets/Assets	-0.014	0.224	-4.734**	-0.003
	(-1.597)	(0.275)	(-2.413)	(-0.177)
ImpairedLoans/Netloans	-0.010	-0.935	-7.076***	-0.036**
	(-1.222)	(-1.142)	(-3.087)	(-2.548)
Equity/Assets	-0.158***	-6.488**	-48.925***	0.145***
	(-4.968)	(-2.153)	(-5.998)	(2.608)
Tier1/Assets	-0.103**	-2.649	-8.572	0.284***
	(-2.435)	(-0.653)	(-0.662)	(3.967)
Roaa	-0.151***	2.692	26.158**	
	(-4.572)	(0.857)	(2.138)	
Srisk/Assets				-0.435***
				(-4.580)
Constant	0.040***	-10.252	-26.788	-0.242**
	-13.376	(-1.464)	(-1.207)	(-1.979)
Bank fixed effects	Yes	Yes	Yes	Yes
R-squared within	0.631	0.565	0.753	0.388
P value	0.000	0.000	0.000	0.000
F statistic	29.794	19.005	29.305	10.370
Number of observations	357	357	244	357

Note: (*) (**) (***) implies the coefficient is significant at a 10%, 5% and 1% level respectively.
The values between parentheses denote the t-values for the corresponding coefficients

APPENDIX 1

Risk weight calculation based on F-IRB approach

Following the Basel accords, banks are allowed to use choose between the standardized approach and the IRB approach to calculate appropriate risk weights for different asset classes. As mentioned above, I use the IRB approach to calculate risk weights for sovereign exposures. The IRB approach takes four factors into account for calculating the required capital: default probability of default(PD), exposure at default (EAD), loss given default(LGD) or (1-recovery rate) and the maturity(M). The LGD is assumed to be 45%, following the standard assumptions, M is 2,5 years, the EAD is the exposure and the PD has to be estimated outside this model, which can be done by standard assumptions or market-based estimations. The PD used in this paper are based on the EBA's PD. The four factors are taken as input to calculate the capital requirement for each exposure. The capital requirement is computed as follow

$$k = \left[LGD * N \left\{ N^{-1} * (PD) * \sqrt{\frac{1}{1-\rho}} + N^{-1}(0{,}999) * \sqrt{\frac{\rho}{1-\rho}} \right\} - LGD * DP \right] * \frac{1 + (m - 2{,}5) + b(PD)}{1 - 1{,}5 * b * (PD)}$$

Here N is the standard normal distribution, N^{-1} the inverse normal distribution, ρ the asset correlation and the maturity adjustment. b And ρ are computed as follow:

$$\rho = 0{,}12 * \frac{1 - e^{(-50*PD)}}{1 - e^{(-50)}}$$

and

$$b = (0{,}11852 - 0{,}05478 * LN(PD))^2$$

The RW is derived from the minimum capital ratio of eight percent and the capital requirements. Multiplying the RW with the EAD results in the RWA.

$$RW = \frac{k}{0{,}08}$$

$$RWA = RW * EAD$$

An overview of resulted RW is provided in Table 1

APPENDIX 2

Appendix 2 provides the list of banks, country of the banks and the number of observations per bank.

Bankname	Country bank	Number of observations
Erste Group Bank AG	Austria	9
Dexia NV	Belgium	5
Bank of Cyprus Public Company Ltd	Cyprus	9
Danske Bank	Denmark	9
Jyske Bank	Denmark	9
Sydbank	Denmark	9
BNP Paribas	France	9
Groupe Crédit Agricole	France	9
Société Générale	France	9
Commerzbank AG	Germany	9
Deutsche Bank AG	Germany	9
Hypo Real Estate Holding AG	Germany	9
Alpha Bank	Greece	4
Eurobank Ergasias	Greece	4
National Bank of Greece	Greece	4
Piraeus Bank	Greece	4
OTP Bank Ltd	Hungary	9
Allied Irish Banks plc	Ireland	9
The Governor and Company of the Bank of Ireland	Ireland	9
Banca Monte dei Paschi di Siena S.p.A.	Italy	9
Banco Popolare - Società Cooperativa	Italy	9
Intesa Sanpaolo S.p.A.	Italy	9
UniCredit S.p.A.	Italy	9
Unione Di Banche Italiane Società Cooperativa Per Azioni	Italy	9
Bank of Valletta plc	Malta	9
PKO Bank Polski S.A.	Poland	9
Banco BPI	Portugal	9
Banco Comercial Português	Portugal	9
Espirito Santo Financial Group SA	Portugal	6
Nova Kreditna Banka Maribor d.d.	Slovenia	9
Banco Bilbao Vizcaya Argentaria	Spain	9
Banco de Sabadell	Spain	4
Banco Popular Español	Spain	9
Banco Santander	Spain	9
Bankinter	Spain	4
Caja de Ahorros y Pensiones de Barcelona	Spain	7
Nordea Bank AB (publ)	Sweden	9
Skandinaviska Enskilda Banken AB (publ) (SEB)	Sweden	9
Svenska Handelsbanken AB (publ)	Sweden	9
Swedbank AB (publ)	Sweden	9
Barclays plc	UnitedKingdom	9
HSBC Holdings plc	UnitedKingdom	9
Lloyds Banking Group plc	UnitedKingdom	9
Royal Bank of Scotland Group plc	UnitedKingdom	9