Sovereign Subsidy under Basel III

The economic implications of zero-risk weight assurance for European Union banks and countries examined

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Master Thesis in Financial Economics

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Abstract

This thesis examines the implications of the sovereign subsidy for banks' regulatory capital ratios, which bank characteristics are associated with a low/high level of sovereign subsidy (bank-level regression), and whether the sovereign subsidy negatively affects the real economy (country-level regressions). This paper makes a distinction throughout the research between non-PIIGS and PIIGS banks and countries. The results of this thesis indicate first of all that the sovereign subsidy of many PIIGS banks significantly increased over the period 2010-2015, whereas that of many non-PIIGS banks did not. Furthermore, the results reveal that the majority of the PIIGS banks would have to increase its regulatory capital ratios significantly, when the sovereign subsidy ceases to exist. Another important finding, resulting from the bank-level regression, is that the higher the non-performing loan ratio of a bank is, the higher the level of sovereign subsidy becomes. The country-level regressions, investigating whether the sovereign subsidy negatively affects the real economy, do not result in proof that the sovereign subsidy negatively affects the real economy.

Keywords: financial economics, Basel Accords, sovereign bonds, capital requirements, risk analysis.

Preface

With due pride, I hereby present my thesis on the current Basel regulation, focussing on the sovereign subsidy in particular. This thesis forms the closing piece of my master in Financial Economics at Erasmus University Rotterdam.

I would like to express my sincere gratitude towards my thesis supervisor Dr. Eisert. In the first block of the master Dr. Eisert was teaching the course Financial Risk Management, and Dr. Eisert immediately sparked my enthusiasm for the topics discussed. I realized that the sovereign subsidy, a rule included in the Basel Accords, intrigued me the most. Therefore, I decided to write my master thesis about this specific subject.

I would like to thank Dr. Eisert for his excellent guidance during the process of writing my thesis. His inspiration, advice and suggestions helped me a lot in finishing my thesis.

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1. Introduction

1.1 Relevance

Worldwide regulation for banks is constructed by the Basel Committee. This Basel regulation is revised several times, the latest revision is the Basel III Accord, which is currently valid. The Basel Accords do not only apply to banks, but extend to other financial institutions as well.

Proper banking regulation could have arguably prevented huge crises, such as the 1929 stock market crash or the more recent financial crisis of 2008. Its purpose is to guarantee a stable financial system. The Basel committee develops such banking regulation. The first Basel Accord (Basel I) started in 1988. Basel I contained minimum capital requirements, mainly due to the existence of deposit insurance. This governmental insurance serves depositors up until a certain amount of money, to maintain depositors' trust in the financial system. However, this insurance could also create a moral hazard, because banks might lower their effort to prevent default, since their depositors are partially backed by the government via the deposit insurance. This can lead to banks taking too much risk or holding too little equity.

Minimum capital requirements are the foundation of the Basel regulation. However, every revision of the regulation has made the rules more complex. Nowadays Basel III is in place, but the Basel committee is already working on Basel IV. Not only regulators interfere in the process of making this regulation, it is also (largely) affected by politicians and the financial sector itself. To give an example, the European Banking Federation (EBF) states in a letter to the Basel Committee that the new Basel regulation forms an important restriction for the economic growth in Europe (Horde, 2016). The financial sector, which is frightened by the higher capital requirements that the new regulation might introduce, interferes in the process of creating this new regulation.

As stated above, there are political influences as well. A clear example hereof is the so called "sovereign subsidy", which means that banks in OECD countries are allowed to hold sovereign debt in the domestic currency of their country against a risk weight of zero. This is noteworthy, since these days even the most highly rated OECD countries are not considered risk-free anymore (Hannoun, 2013). Let alone examples such as Greece, which was on the brink of a financial disaster not too long ago (Hoikkala & Schwartzkopff, 2017). Acharya & Steffen (2015) state in this context that peripheral nations' debt receiving a risk weight of zero is unjust, since this sovereign debt is not risk-free at all.

The notable sovereign subsidy is even more striking when one adds up that banks are allowed to hold an exposure of more than 100% of their core capital ratio; there are no concentration limits at all. This policy results in banks investing in risky sovereign debt, thereby accruing risk without any consequences for their capital requirements. The risks of these exposures already led to concerns about the health of certain European banks. In particular in Portugal and Spain banks own so much sovereign bonds that their health seriously worsens if the value of these bonds decreases (Thomas, 2011).

Proper banking regulation is extremely important for the stability of and the confidence in the financial system. Korte & Steffen (2014) qualify the sovereign subsidy as "one of the most apparent flaws in banking regulation". They also state that the exposure to sovereign debt of banks increased after the start of the sovereign debt crisis, in 2009 (Acharya & Steffen, 2015). It is evident that the sovereign

subsidy forms a threat for the financial system and is most dangerous when sovereign bond values decline. When a sovereign debt crisis arises, this could therefore dramatically increase the likelihood of a financial crisis.

That the current system needs changing is recognized by the Dutch and German finance ministers, which expressed this during the European finance ministers meeting in April 2016. The ministers proposed more realistic risk weights of European Union sovereign debt, as well as concentration limits for banks. On this matter there seem to be two sides: North-European countries such as Germany and The Netherlands are pitted against the rest of the European Union member states.

Two other public bodies that acknowledge the sovereign subsidy being a threat to the financial system are the European Central Bank (ECB) and The Swedish Financial Supervisory Authority. The ECB states that in the long-term one must realize that the zero-risk weights applied to government debt "cannot hold a reality check" (Mersch, 2017). The Swedish Financial Supervisory Authority decided to oblige the four largest Swedish banks to use internal risk-based models, instead of applying the zero-risk weight rule to sovereign debt holdings (Hoikkala & Schwartzkopff, 2017). Skandinaviska Enskilda Banken, one of the large Swedish banks, was the first one to increase its risk weighted assets, thereby admitting that governments can go bankrupt.

Implementing the changes proposed by the Dutch and the Germans would probably mean that in some peripheral European countries average capital ratios will get below the minima that are required. For some of these countries such a change could therefore lead to catastrophic results. Examples hereof are public anxiety about whether or not certain banks are healthy enough or banks that cannot meet their obligations when the economic circumstances deteriorate. Both examples can lead to serious financial instability, which is often very costly for society. Autonomous called the changes "necessary", but also stated they would be "too painful" (Jenkins, 2016).

The European Commission sees the handling of sovereign debt holdings of banks as a "politically and economically complex issue", which in case it is done wrongly would cause a destabilizing effect on the financial sector (Dombrovskis & Moscovici, 2017). The Commission proposes the introduction of "Sovereign Bond-Backed Securities" (SBBS). These securities consist of different sovereign debt from European Union member states, they can be seen as baskets consisting of sovereign debt of various European Union countries. With this proposal the European Commission aims at introducing a so-called Safe Bond that enables member states to diversify when it comes to sovereign debt (European banks often have a relatively high proportion of national sovereign debt and are therefore heavily exposed to country-specific risk). The result of these Safe Bonds should be a breach of the "diabolic loop" (European banks consistently obtaining domestic government debt), which is considered to be a risky phenomenon (Giugliano, 2017).

1.2 Research Question and Hypotheses

This paper compares the size of the sovereign subsidy of multiple European banks. Moreover, it examines the implications of the sovereign subsidy for the health of banks and for the real economy of European Union countries.

Due to the strong criticism to the zero-risk weight assigned to OECD sovereign debt, expressed in the first part of the introduction, this research will investigate whether this rule is tenable or not. The research question is therefore:

"Does the sovereign subsidy have to be eliminated in Basel IV?"

To answer this question, this research will initially determine the size of the sovereign subsidy. Thereafter, it investigates the effects of the sovereign subsidy on the risk of the banks and the financial system as a whole. Subsequently, this paper focusses on the bank characteristics that go hand in hand with high (or low) levels of sovereign subsidy. Lastly, this paper examines the consequences for the real economy of European Union countries.

The accompanying hypotheses are as follows:

1. The current exposure to sovereign debt and the sovereign subsidy of banks in PIIGS countries has increased significantly compared to the level of exposure at the start of the sovereign debt crisis, in contrast to that of banks in non-PIIGS countries;
2. The sovereign subsidy increases the required capital banks of PIIGS and non-PIIGS countries must hold significantly;
3. Troubled banks have relatively high sovereign subsidies, since these banks in particular are looking for profitable investments that concern assets with relatively low risk weights;
4. The sovereign subsidy negatively affects the real economy of European countries, at least in PIIGS nations.

The PIIGS countries are Portugal, Italy, Ireland, Greece, and Spain. Non-PIIGS countries are the remaining European Union countries, such as Germany, Sweden, and The Netherlands. In this paper non-PIIGS, PIIGS banks, and countries from the European Banking Authority (EBA) stress tests, transparency, and capital exercises are compared with each other. The time period taken into account for this paper is 2010-2015 (from start of the sovereign debt crisis onwards).

By means of the first hypothesis, the levels of sovereign debt over time of both PIIGS countries will be mapped out and compared to each other. Moreover, the size of the actual sovereign subsidy will be calculated. The expectation is that the sovereign subsidy increased significantly over the last years for PIIGS countries, while that of non-PIIGS countries is expected to have stayed equal, based on the findings of Korte & Steffen (2014) (Appendix A & B).

Thereafter, for the purpose of answering the second hypothesis, there will be examined whether this subsidy significantly increases the risk of banks. Expected is that, since the zero-risk weight of European Union sovereign debt is perceived as unjust by multiple researchers (e.g. Battinisti, Pagano, & Simonelli, 2014), the required capital that banks are obliged to hold significantly increases when applying an adequate risk weight (due to a higher level of risk they face).

In order to answer the third hypothesis, this paper investigates the bank characteristics corresponding to a high (or low) sovereign subsidy. Troubled banks will probably have a higher sovereign subsidy. The reason for this prediction is that these banks are looking for the highest risk to return ratio, which can often be found in high-risk sovereign bonds. These bonds have relatively high returns and there is no required capital for a bank to hold (further explained in the literature review, section 2.2).

Consequently, this research focusses on the effects of the subsidy on the real economy in European Union countries. The expectation is that this effect will be negative, because the zero-risk weight for sovereign bonds can strongly diminish the lending supply to private firms, which negatively affects the real economy of a country. The reason for this decline in lending supply is that domestic sovereign bonds have a relatively large return (at least in PIIGS countries), which can diminish the lending supply

to private firms (further explained in the literature review, section 2.3). Subsequently, the lower lending supply can negatively influence the real economy.

By answering these questions this paper offers a representation of the scale of the sovereign subsidy and its effects on the financial sector and real economy. After discussing all four hypotheses, this paper provides an answer to the research question.

This paper will continue as follows. In the next passage this paper discusses the relevant literature. Thereafter, this research examines the dataset, names the data sources, and outlines the descriptive statistics. Consequently, this paper explains the methodology for each hypothesis separately. In the subsequent section this research shows the results accompanied with the discussion thereof. Ultimately, this paper points out the conclusion.

2. Literature Review

2.1 The Sovereign Subsidy and its Risks

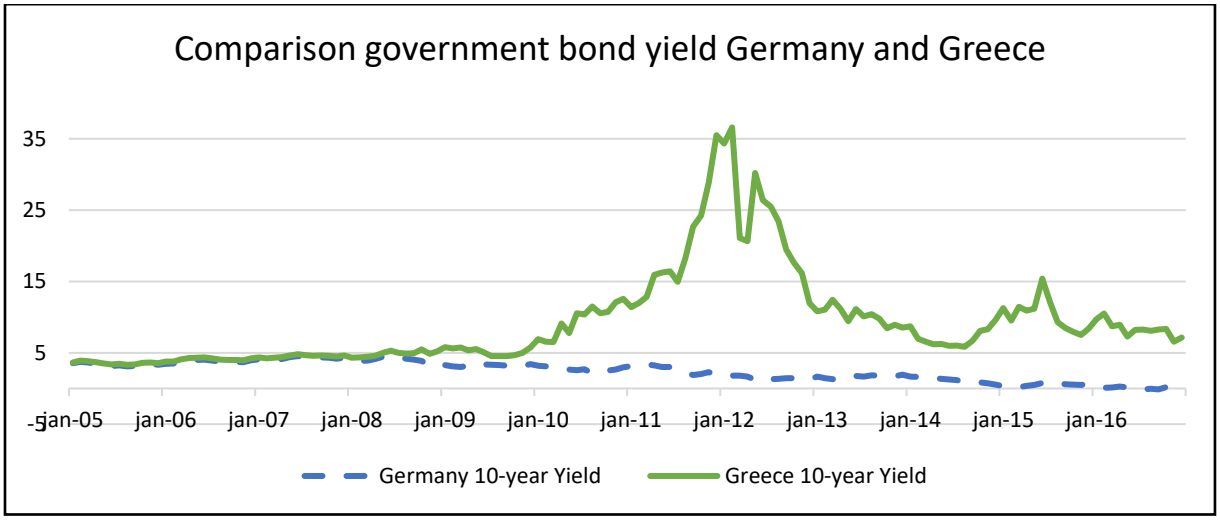
As explained in the introduction, the sovereign subsidy is a rule that enables banks that are headquartered in OECD nations to hold sovereign debt in the domestic currency of their country against a zero-risk weight. Moreover, banks are able to do this without a concentration limit: banks are allowed to have sovereign debt holdings of over 100% of their core capital ratio.

Banks look for a strong return to risk ratio. When the risk of OECD sovereign debt is artificially set to zero, while it clearly is not zero, the return to risk ratio is much more attractive: the risk is lowered artificially, making the ratio higher. This ratio is increased most for the sovereign debt with the highest risk, which is often the sovereign debt of PIIGS countries.

Acharya & Steffen (2015) show that the risks of banks when it comes to sovereign debt consist of a carry trade. They collect short-term capital, which they then use to obtain long-term (and mostly PIIGS) sovereign debt holdings. In the positive scenario this would mean that banks could benefit from the so called "carry", which is the spread[1] between their short-term capital on the one hand, and the long-term (PIIGS) sovereign debt holdings on the other hand.

However, in the negative scenario the spreads between these two financial instruments diverge even more. This can lead to huge losses on the sovereign debt holdings for banks, but can also cause solvency and liquidity problems, which occurred in practice in 2010. Namely, although the spreads of non-PIIGS countries and PIIGS countries were relatively low then (the correlation of sovereign bond yields of non-PIIGS countries such as Germany and PIIGS countries were over 95%), this changed in 2010. One can observe the change between non-PIIGS and PIIGS countries in the graph below, in which the yield of 10-year German government debt is compared to Greece sovereign debt (Investing.com, 2017).

Figure 1: Comparison government bond yield Germany and Greece (non-PIIGS vs. PIIGS)



[1] The spread is the difference in yield on two financial products with maturities and risks that differ from each other. The spread can be computed by subtracting the yield of the first financial product from that of the second.

Due to the sovereign debt crisis, it became harder and harder for banks to collect capital to invest in risky sovereign debt, which caused significant declines in market value of European banks and a major increase in the demand of long-term sovereign bonds of countries such as Germany.

The carry trade in the European Union was, according to Acharya & Steffen, essentially banks betting on the economic convergence of European Union countries (which also lead their spreads to converge) (Battistini, Pagano, & Simonelli, 2014). This betting strategy of banks is extremely risky, but above all unwelcome when it comes to stability of the financial system.

2.2 Banking Characteristics

Acharya & Steffen (2015) as well as Buch et al. (2016) show that banks that have relatively low capital ratios tend to acquire more sovereign bonds than banks with higher capital ratios. The findings of Battinisti et al. (2014) could be interpreted in a way in which non-PIIGS banks, since they can borrow money relatively cheap from the ECB, acquire large amounts of sovereign debt because of the high yield. These so-called “carry trades” could lead to higher (lower) capital ratios for those banks, when the value of the sovereign bonds increases (decreases). This is a very dangerous phenomenon, which can be prevented in two different ways: (1) by giving a reasonable risk weight to sovereign bonds (instead of zero), or (2) by introducing concentration limits. As already stated in the introduction, regulators did not take any of these measures (yet).

Besides this, Battistini et al. (2014) note that some bankers who are working in Europe think that if their sovereign defaults, their bank also goes bankrupt, meaning that they can ignore the default risk of their sovereign. This line of reasoning could (partially) explain why these carry trades happen more in PIIGS countries than non-PIIGS nations (because of the default risk of PIIGS countries being larger than that of non-PIIGS). This assumption is rational from the perspective of a bank, but not from the perspective of the financial system as a whole: it not only leads to PIIGS banks exposing themselves disproportionately to their own sovereign risk, but it also increases their vulnarability of having to request a bailout in case of rising domestic yields.

Moreover, Battinisti et al. (2014) propose to gradually obligate banks to diversify in the field of sovereign bonds. They suggest the introduction of a concentration limit, which then has to be lowered over time. Furthermore, the researchers advocate that there is a possibility to excuse banks from this concentration limit, yet only if they buy a special, diversified portfolio of European Union sovereign debt.

This thesis can further underpin the statement of Acharya & Steffen (2015), Buch et al. (2016), and Battinisti et al. (2014) by mapping out differences in sovereign subsidy between PIIGS and non-PIIGS banks. Moreover, this thesis examines what the effect is of the sovereign subsidy on a bank’s capital ratios and which bank characteristics go hand in hand with a high (or low) sovereign subsidy.

2.3 Real Economy

Acharya et al. (n.d.) investigate how the shrinkage in lending supply, caused by the sovereign debt crisis, affected European firms. One potential way of the sovereign debt crisis influencing the lending supply is via the balance sheets of banks. Losses for banks due to their (relatively large) sovereign debt holdings lead to deleveraging and could therefore lead to a lower lending supply to private firms.

Another potential way of affecting the lending supply is risk-shifting, for which Acharya & Steffen (2015) find evidence in their paper. This risk-shifting exists because of the relative large return of domestic sovereign bonds in a good economy. Moreover, the European Union bonds have a risk weight of zero, implying there is no capital required to hold these bonds. Subsequently, Acharya et al. state that this phenomenon can strongly diminish the lending supply to private companies, which forms a negative influence for the real economy.

Moreover, Acharya et al. (n.d.) state that, after GIIPS banks became much riskier due to losing on their substantial government bond holdings, an incentive materialized for less well-capitalized GIIPS banks to start with risk-shifting, meaning accruing more and more risky government debt. This process of risk shifting disturbs the corporate lending of these banks (Crosignani, 2014).

A third option is the so-called “moral suasion hypothesis”, which is also addressed in the paper of Battistini et al. (2014). This hypothesis entails that governments might exert pressure on banks to ensure that banks take on more sovereign debt. This could be the case when a country has problems refinancing its debt. In addition, it could be a reason for a lower lending supply and therefore it could, in turn, negatively influence the real economy of a nation.

The paper of Acharya et al. demonstrates that the moral suasion hypothesis did not seem to have affected the lending supply. Nonetheless, the researchers do find evidence for the risk-shifting behaviour as well as the weakened balance sheets of banks due to losses on their sovereign bond holdings having affected the lending supply negatively.

This thesis contributes to the literature by researching the effect sovereign subsidies of banks have on the real economy of various European Union member states.

2.4 Solutions

Presently, the mix of zero-risk weights for sovereign debt, the lack of concentration limits, and the access to enormous amounts of money from the ECB against low interest rates forms a threat to the financial stability of the Eurozone. The carry trades executed by European banks therefore have to be discouraged.

For this to happen there are two obvious choices: (1) introducing realistic risk weights for sovereign debt, or (2) announcing concentration limits (which causes banks to diversify when it comes to sovereign debt). Nevertheless, as Battistini et al. (2014) state, these two regulatory adjustments can easily cause problems. The researchers call attention to the possibility that, in case that the profitability of the carry trades is high enough, the introduction of risk weights turns out to be fruitless. When concentration limits are being forced into power, this could mean that a substantial number of European banks have to drastically alter the composition of their sovereign debt portfolio. Consequently, this phenomenon could lead to large fluctuations in European sovereign bond yields.

However, according to Battistini et al. (2014), there are alternatives. One option is to steadily enforce a concentration limit for government debt. Still, there is another alternative that does not involve introducing a concentration limit: the European Union Safe Bond (or Safe Asset). This bond is a diversified portfolio consisting of multiple Eurozone countries’ sovereign debt.

The concept of the Safe Bond works as follows. An intermediary is established, called the “European Debt Agency”, which is able to buy sovereign debt of European Union member states (the amount per country would be weighed against GDP). This intermediary then creates two financial assets, Safe Bonds and “European Junior Bonds”. Safe Bond holders receive the first claim on payments from the sovereign issuers represented in the Safe Bond, whereas the European Junior Bond holders are entitled to the second claim. This leads to a situation in which the holders of European Junior Bonds will foot the bill in case of losses on any of the sovereign bonds the European Debt Agency holds. Due to the degree of diversification of state-specific risk Safe Bonds and the right of the first claim, the risk of Safe Bonds practically is none. For this reason, the European Safe Bond could be a realistic solution to the current problems caused by the existence of the sovereign subsidy.

3. Data

3.1 Sources of Data & Sample Construction

This paper uses a panel dataset including data from 2010 to 2015. The reason for this is that the European Banking Authority (EBA) started with stress testing and performing transparency and capital exercises from 2010 onwards. Furthermore, this paper investigates the development and the implications of the sovereign subsidy from the start of the sovereign debt crisis (starting in 2009 (Acharya & Steffen, 2015)) until now.

The data needed for this research comes from three databases: the EBA database, Datastream, and the annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs (Ameco).

This paper obtains the sovereign debt exposures of banks from the EBA database. To determine a bank's sovereign debt exposure, the total gross direct long exposures are used. The EBA data consists of end-of-year data for the years 2010-2015 (European Banking Authority, n.d.)[2]. There are 37 banks the EBA reported on in all six subsequent years. These 37 banks form the basis of this research, since including banks with missing data makes comparing impossible. This group of banks consists of 27 non-PIIGS banks and 10 PIIGS banks (Appendix C). These banks are located in fourteen different countries, of which three PIIGS countries and eleven non-PIIGS countries.

Datastream provides the remaining bank data. This data consists of various variables: risk weighted assets, Tier 1 capital ratio, Tier 2 capital ratio, total assets, return on equity, return on assets, net profit margin, debt percentage, non-performing loans percentage, stock volatility, stock return, and the beta of the stock.

This researches also uses the following macro-economic variables from the Ameco database: gross domestic product (GDP) per head of the population, consumption per head of the population, short-term and long-term interest rate, consumer and business confidence index, exchange rate, consumer price index, unemployment rate, government expenditures, gross public debt, import, and export.

The dataset exists of yearly end-of-year data, since the EBA data consists of end-of-year values. The variables in the final dataset are the following:

[2] For the year 2011 there is no end-of-year data available. Therefore, data of 30 September 2011 is used for this year. For the year 2016 there is no end-of-year data available (yet), the latest data is of 30 June 2016. For this reason, and due to the fact that using 2016 data leads to losing five banks because of missing data, 2016 is not taken into account.

Table 1: Variables and definition per hypothesis

Variables	**Definition**
Hyp1	
SovDebtExpDom	Exposure of a bank to domestic sovereign debt (*€1 million)
SovDebtExpTot	Exposure of a bank to total OECD sovereign debt (*€1 million)
SovSubB	Sovereign subsidy of a bank (risk weight * exposure) (*€1 million)
Hyp2	
SovSubB	Sovereign subsidy of a bank (risk weight * exposure) (*€1 million)
RWA	Risk weighted assets of a bank (*€1 million)
Hyp3	
SovSubB	Sovereign subsidy of a bank (risk weight * exposure) (*€1 million)
Tier1	Actual Tier 1 capital ratio (actual Tier 1 capital divided by RWA (in %)
Tier12	Actual Tier 1 and Tier 2 capital ratio combined (actual Tier 1 and 2 capital divided by actual risk weighted assets (in %)
TA	Total assets (*€1 million)
ROE	Return on equity on a yearly basis (in %)
ROA	Return on assets on a yearly basis (in %)
NM	Net margin on a yearly basis (in %)
D	Debt relative to capital (in %)
NPL	Non-performing loans (non-performing loans amount relative to total loan amount) (in %)
VOL	Stock volatility on a yearly basis (in %)
RET	Stock return on a yearly basis (in %)
BET	Beta of the stock on a yearly basis
Hyp4[3]	
SovSubC1	Sovereign subsidy on a country-level (*€1 million)[4]
SovSubC2	Sovereign subsidy on a country-level (*€1 million)[5]
GDPH	GDP per head of population (*€1 thousand) (Ameco: RVGDP)
GDPG	Growth in GDP per head of the population
CONH	Private consumption expenditure per head of population (*€1 thousand) (Ameco: HCPHP)
IRST	Short-term interest rate (nominal) (in %)
IRLT	Long-term interest rate (nominal) (in %)
CCI	Consumer Confidence Index
BCI	Business Confidence Index
ER	Exchange rate (annual average; units of currency per EUR) (Ameco: XNE)
CPI	Consumer price index (harmonized) (Ameco: ZCPIH)[6]
UN	Unemployment (% of active population) (Ameco: ZUTN)
GEXP	Government consumption expenditures (*€1 billion) (Ameco: UCTG)
GDE	Gross public debt (*€1 billion) (Ameco: UDGG)
IMP	Total import of goods (*€1 billion) (Ameco: DMGT)
EXP	Total export of goods (*€1 billion) (Ameco: DMGT)

[3] for non-Euro countries variables will be converted into Euros yearly.

[4] SovSubC1 is calculated as the total sovereign subsidy of all the sample banks located in the specific country.

[5] SovSubC2 is calculated as the total sovereign subsidy that the country itself has issued to the sample banks.

[6] CPI is harmonized, which is useful when comparing different countries.

The sovereign subsidy is the level of risk weighted assets not funded by capital. This paper computes the sovereign subsidy of a bank (SovSubB) by using the following formulas (Kirschenmann, Korte, & Steffen, 2016):

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

In this formula i specifies the domestic country, j represents the amount of sovereign debt exposure, and t denotes the time (in this paper end-of-year values).

The risk weights calculations are as follows:

(2) $$Risk\ weight = 12.5 * Capital$$

(3) $$Capital = LGD * (WCDR - PD) * MA$$

(4) $$MA = \frac{1+(M-2.5)*b}{1-1.5*b}$$

(5) $$b = (0.11852 - 0.05478 * \ln(PD))^2$$

(6) $$WCDR = N\left(\frac{N^{-1}(PD)+\sqrt{\rho}N^{-1}(0.999)}{\sqrt{1-\rho}}\right)$$

(7) $$\rho = 0.12(1 + e^{-50*PD})$$

The risk weighted assets represent the total sovereign subsidy. The adequate risk weight is based on the credit ratings of a country (Appendix H). The third formula consists of the loss given default (LGD), the worst-case default rate (WCDR), the probability of default, and the maturity adjustment. For the computation of the risk weights per country, see Appendix I.

Since only those banks that are present in the six years of EBA data are included in the sample, the real total sovereign subsidy of a country cannot be computed. To be able to compare the six years of data, it is therefore, just as when comparing bank-level sovereign subsidies, necessary to exclude banks for which there is less than six years of data available.

The sovereign subsidy of a country (SovSubC) is calculated in two ways:

a) based on the party that *issues* the sovereign subsidy. The sovereign debt holdings of the banks in the sample can be broken down into the different nations this debt is from. This debt is assigned to the country it is from, hereafter the sovereign subsidy is calculated (by multiplying the total amount of debt by the country's risk weight). This value is called SovSubC1;
b) based on the party that *holds* the sovereign subsidy. When for example a Spanish bank holds sovereign debt of four different nations, the sovereign subsidy belonging to this particular debt amount is assigned to the country Spain. This value is named SovSubC2.

In order to compare these two ways of calculating the country-level sovereign subsidy, the same set of countries is used for both measures. This means the set of fourteen countries represented by the 37 banks in the sample for this thesis (see beginning of this section). Since the Ameco database only has data on European Union member states, one of these fourteen countries is left out: Norway. As a result, three PIIGS and ten non-PIIGS countries are left (Appendix D).

3.2 Descriptive Statistics

The descriptive statistics of all the variables mentioned in the previous section are as follows:

Table 2: Descriptive statistics

Variable	Mean	Median	St. Dev.	Minimum	Maximum	Skewness	Kurtosis	Obs.
SovDebtExpDom	21015	14398	19286	0	82977	1.11	3.60	222
SovDebtExpTot	41528	31527	38335	0	213287	1.22	4.40	222
SovSubB	15578	8120	17488	0	84012	1.59	4.96	222
RWA (rounded)	632000	296000	1370000	51600	8310000	4.42	22.12	162
Tier1	0.1288	0.1223	0.0366	0.0369	0.2887	0.50	4.91	162
Tier12	0.1597	0.1556	0.0341	0.0936	0.3028	1.06	5.02	156
TA (rounded)	2580000	829000	653000	100000	50500000	5.02	30.39	178
ROE	2.41	5.82	17.16	-149.70	20.19	-5.25	41.81	171
ROA	0.63	0.71	0.92	-5.78	2.48	-2.57	18.38	147
NM	3.08	6.18	23.65	-200.86	38.64	-4.78	36.89	172
D	80.08	83.84	12.70	32.21	94.53	-1.67	5.45	172
NPL	7.76	5.04	7.72	0.46	36.28	1.67	5.58	131
VOL	30.57	30.52	8.64	4.61	55.24	-0.21	4.81	150
RET	0.02	0.02	0.31	-0.93	0.99	-0.03	3.48	150
BET	1.83	1.79	0.74	0.16	3.78	0.24	3.33	150
SovSubC1	37128	11147	58382	1452	229651	2.16	6.45	78
SovSubC2	43971	14114	54144	88	181004	1.18	3.01	78
GDPH	30.84	33.88	10.83	9.39	49.28	-0.84	2.77	78
IRST	3.08	2.73	1.91	0.50	9.60	1.09	3.95	78
IRLT	1.14	0.57	1.58	-0.20	8.05	2.43	9.04	78
CCI	100.05	100.13	1.28	96.91	104.26	0.35	3.75	78
BCI	100.07	100.18	0.74	98.49	101.83	-0.03	3.01	72
ER	24.84	1.00	78.12	1.00	310.00	3.18	11.17	78
CPI	97.65	99.03	2.88	89.47	100.83	-1.08	3.11	78
UN	9.54	8.40	4.62	4.60	26.10	2.02	7.04	78
GEXP	156.53	70.69	173.59	7.00	583.70	1.33	3.26	78
GDE	687.43	261.20	770.04	77.49	2204.90	1.10	2.46	78
IMP	267.62	155.63	234.92	47.71	947.63	1.37	4.33	78
EXP	283.50	149.31	274.65	52.44	1195.82	1.88	6.16	78
CONH	16.42	17.85	5.04	5.15	22.55	-1.28	3.40	78

One can observe from the table above that the average bank in the sample has just over €21 billion exposure to its own government's debt, and €41.5 billion exposure to sovereign debt in total. The accompanying sovereign subsidy of this average bank is approximately €15.5 billion. The average level of risk weighted assets is €632 billion.

The Tier 1 and Tier 1 & 2 ratio combined are respectively 12.9% and 16.0% on average. The lowest Tier 1 ratio was approximately 3.7% (Landesbank Baden-Württemberg in 2010). The ROE is 2.4% on average, with a minimum of -149.7%, belonging to Allied Irish Banks plc in 2010. In the same year this bank arrived at a net margin of just over -200%, which is the lowest net margin in the database. The debt relative to capital ratios vary from 32% to almost 95%.

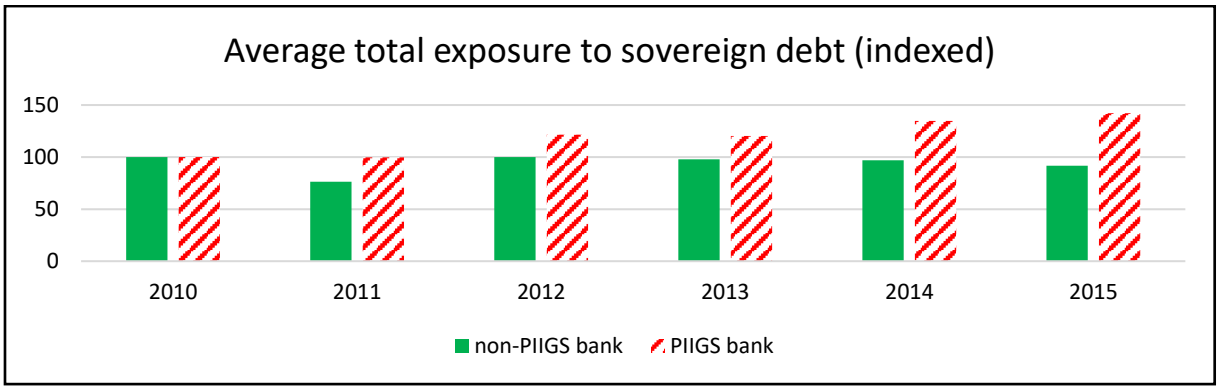
The average GDP per head is over €30.000 and the unemployment rate varies between 4.6% (Austria 2011 and Germany 2015) and 26.1% (Greece 2013).

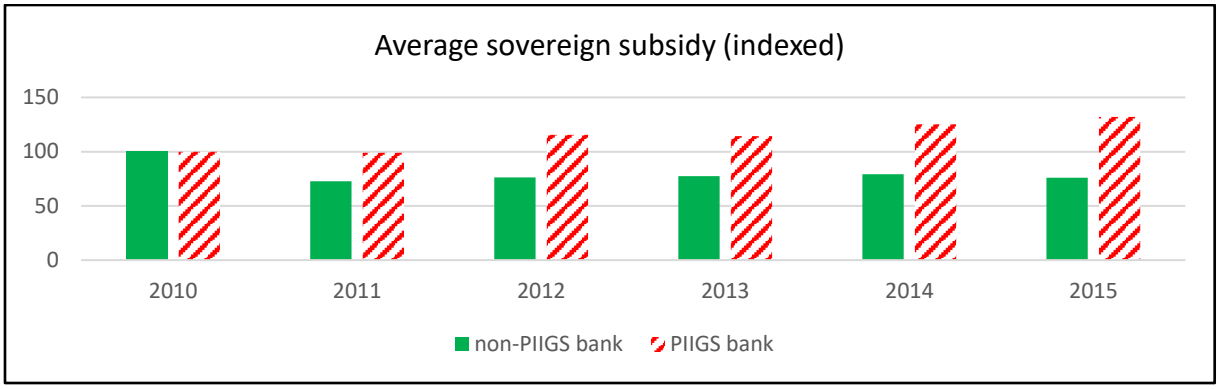
In order to present a more extensive view of the data and to show the differences between non-PIIGS and PIIGS banks when it comes to sovereign debt exposures and the sovereign subsidy, several figures will be elucidated.

Table 3: Average total sovereign debt exposure and sovereign subsidy

Average total sovereign debt exposure (in mln)	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
non-PIIGS bank	€43,451	€33,116	€43,411	€42,583	€42,126	€39,874
PIIGS bank	€36,405	€36,338	€44,272	€43,826	€49,005	€51,762
Average sovereign subsidy (in mln)	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
non-PIIGS bank	€13,299	€9,667	€10,145	€10,309	€10,532	€10,091
PIIGS bank	€25,206	€24,913	€29,087	€28,822	€31,594	€33,292

Figure 2: Average total sovereign debt exposure and sovereign subsidy (index numbers) (Appendix E)

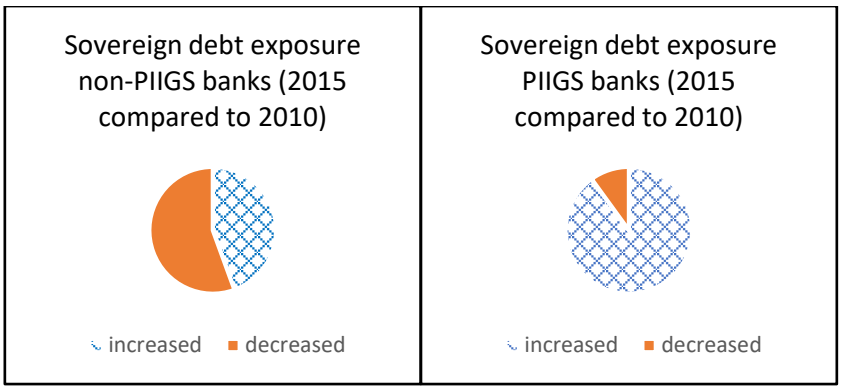




One can clearly see the difference between non-PIIGS banks on the one hand, and PIIGS banks on the other hand. Whereas the sovereign debt exposure of non-PIIGS banks has decreased with almost 10% over a period of six years, that of PIIGS banks almost went up 50%.

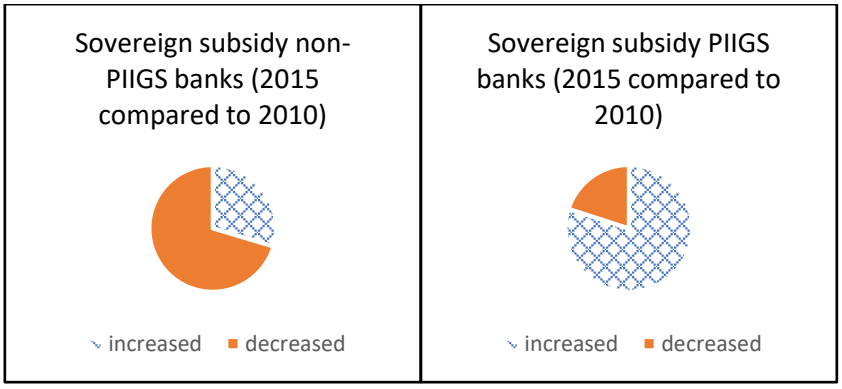
The same pattern is applicable to the sovereign subsidies of the banks. However, the difference between non-PIIGS and PIIGS banks is even larger. For non-PIIGS banks there was a substantial decline in the average sovereign subsidy: 24%. On the contrary, the average sovereign subsidy of PIIGS banks increased with one third of the value at the end of 2010.

Figure 3: Total sovereign debt exposure (non-PIIGS vs. PIIGS) (Appendix F)



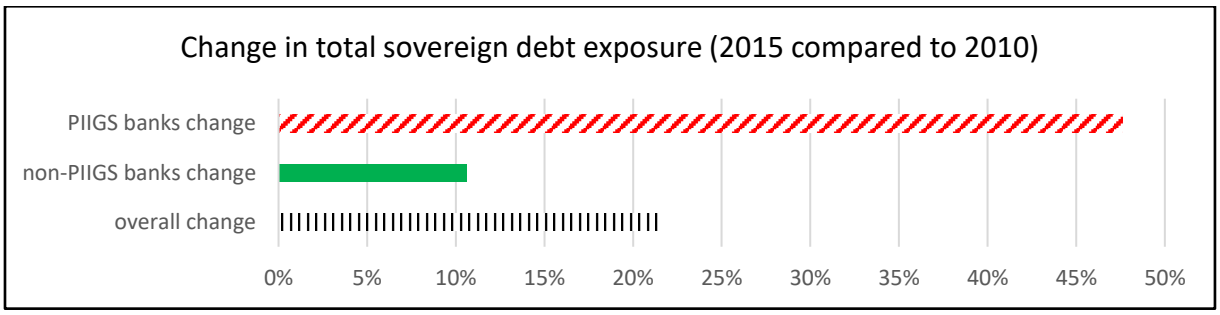
The figure above depicts whether the sovereign debt exposure of the banks in the sample increased or decreased between the end of 2010 and the end of 2015. On the left hand, the movements for the group of non-PIIGS banks are demonstrated. The majority of the non-PIIGS banks decreased their sovereign debt exposure. However, only 10% of the PIIGS banks did so.

Figure 4: Total sovereign subsidy (non-PIIGS vs. PIIGS) (Appendix F)



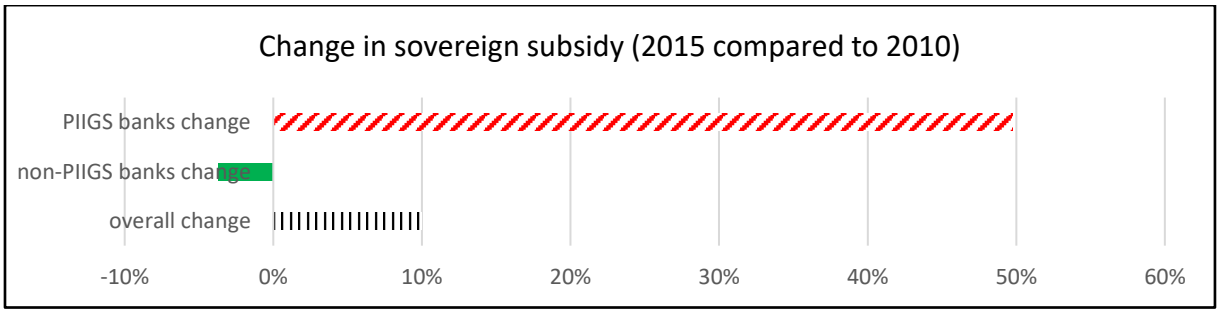
The changes in sovereign debt exposures of both non-PIIGS and PIIGS banks look very similar to that of the sovereign subsidies. Almost 75% of these banks saw their sovereign subsidy decrease. The changes for the PIIGS banks are quite different. Remarkably, the sovereign subsidy of over 75% of these banks increased.

Figure 5: Change in total sovereign debt exposure (non-PIIGS vs. PIIGS) (Appendix F)



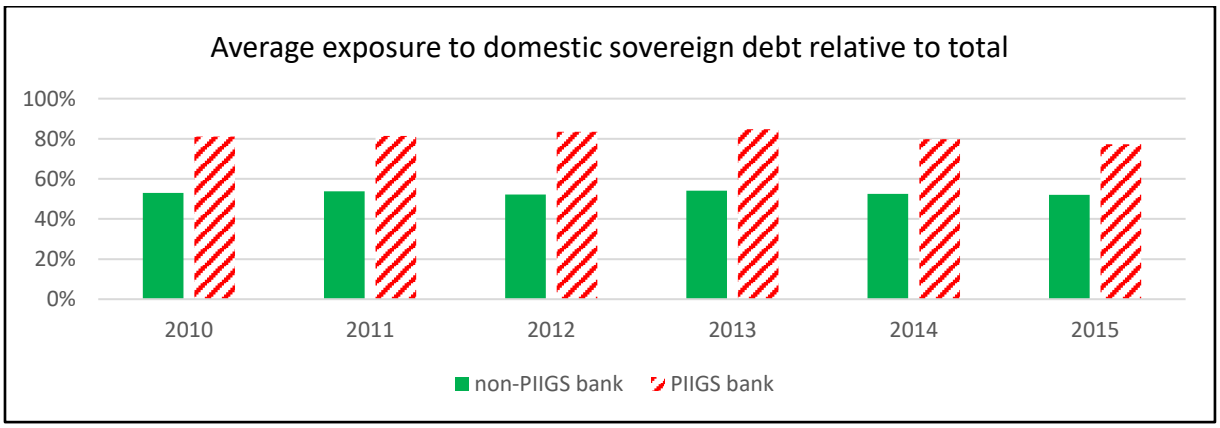
The overall percentage change in sovereign debt exposure amounts to 21%. It is once again important to distinguish between PIIGS and non-PIIGS banks: for PIIGS banks the sovereign debt exposure increased with a stunning 48%, while that of non-PIIGS banks only rose 11%.

Figure 6: Change in sovereign subsidy (non-PIIGS vs. PIIGS) (Appendix F)



The overall percentage increase in sovereign subsidy is lower than that of sovereign debt exposure: 10%. Separating non-PIIGS and PIIGS banks indicates that also for the sovereign subsidy there is a vast difference between the two. Whereas the non-PIIGS banks saw their sovereign subsidy decrease with 4% over six years, the PIIGS banks increased their sovereign subsidy with over 50%.

Figure 7: Average total domestic sovereign debt exposure and sovereign subsidy (index numbers) (Appendix E)



Another important descriptive statistic is the degree to which non-PIIGS and PIIGS banks acquire domestic sovereign debt. In the figure above these percentages are shown year by year. The figure shows that for PIIGS banks the amount of domestic sovereign debt holdings relative to their total government debt holdings is substantially higher (approximately 80%) than that of non-PIIGS banks (just above 50%).

As discussed in section 3.1, there are two different calculations of the sovereign subsidy on a country level. In the following graphs the first and second measure are plotted for non-PIIGS countries and PIIGS countries.

It must be noted that the numbers of sovereign subsidy on a country-level could very well (substantially) deviate from the real country-level sovereign subsidies, since the sample only consists 37 European Union banks and therefore the country-level sovereign subsidies are calculated based on the information available of these banks. Since there are many more European Union banks, the levels that are calculated in this paper deviate almost by definition from the real sovereign subsidies for the relevant countries. Nonetheless, the computed values can give a good representation of the differences between countries on this matter, as well as the changes in country-level sovereign subsidy over time.

Figure 8: Sovereign subsidy on country-level (non-PIIGS countries) (Appendix M)

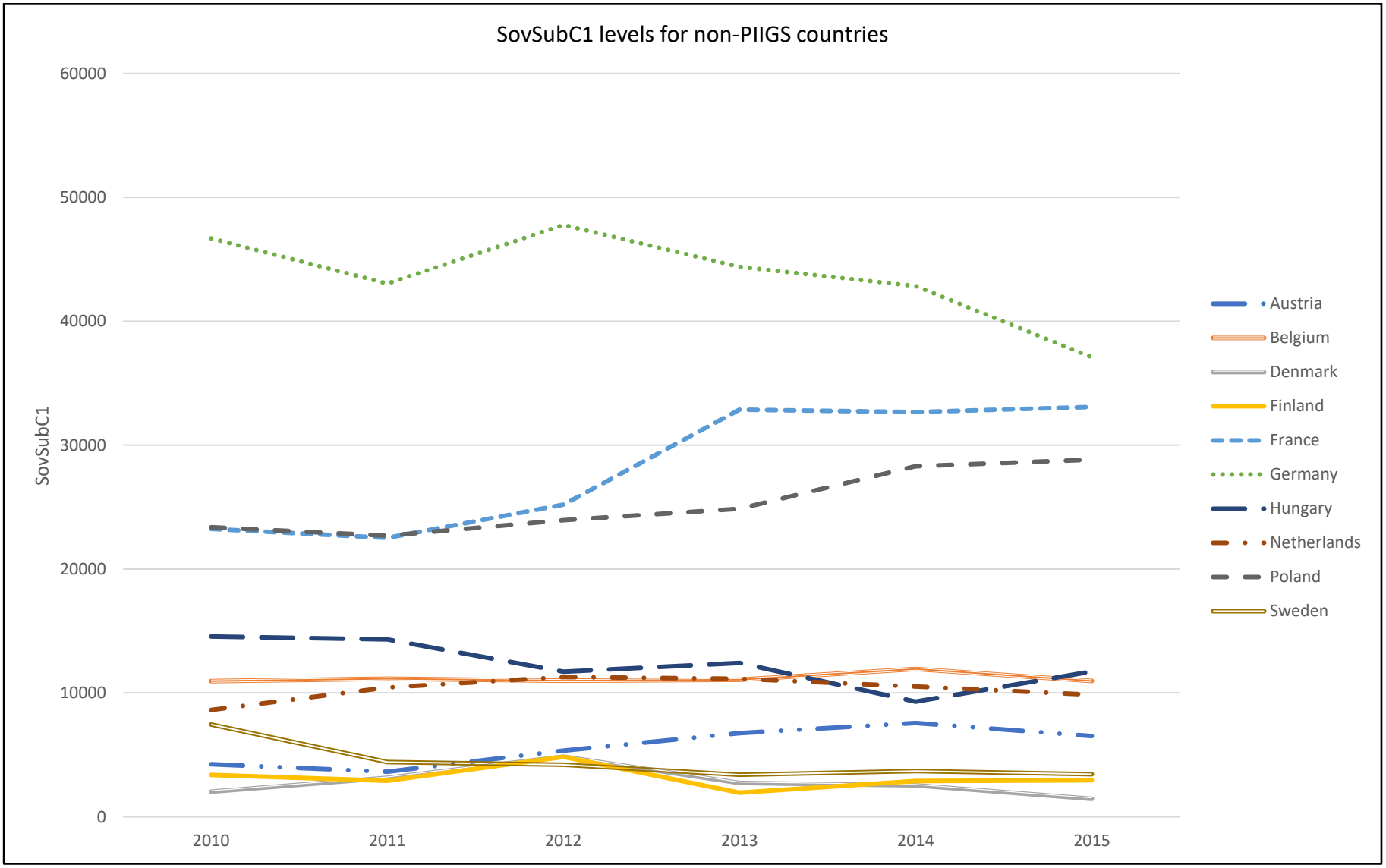
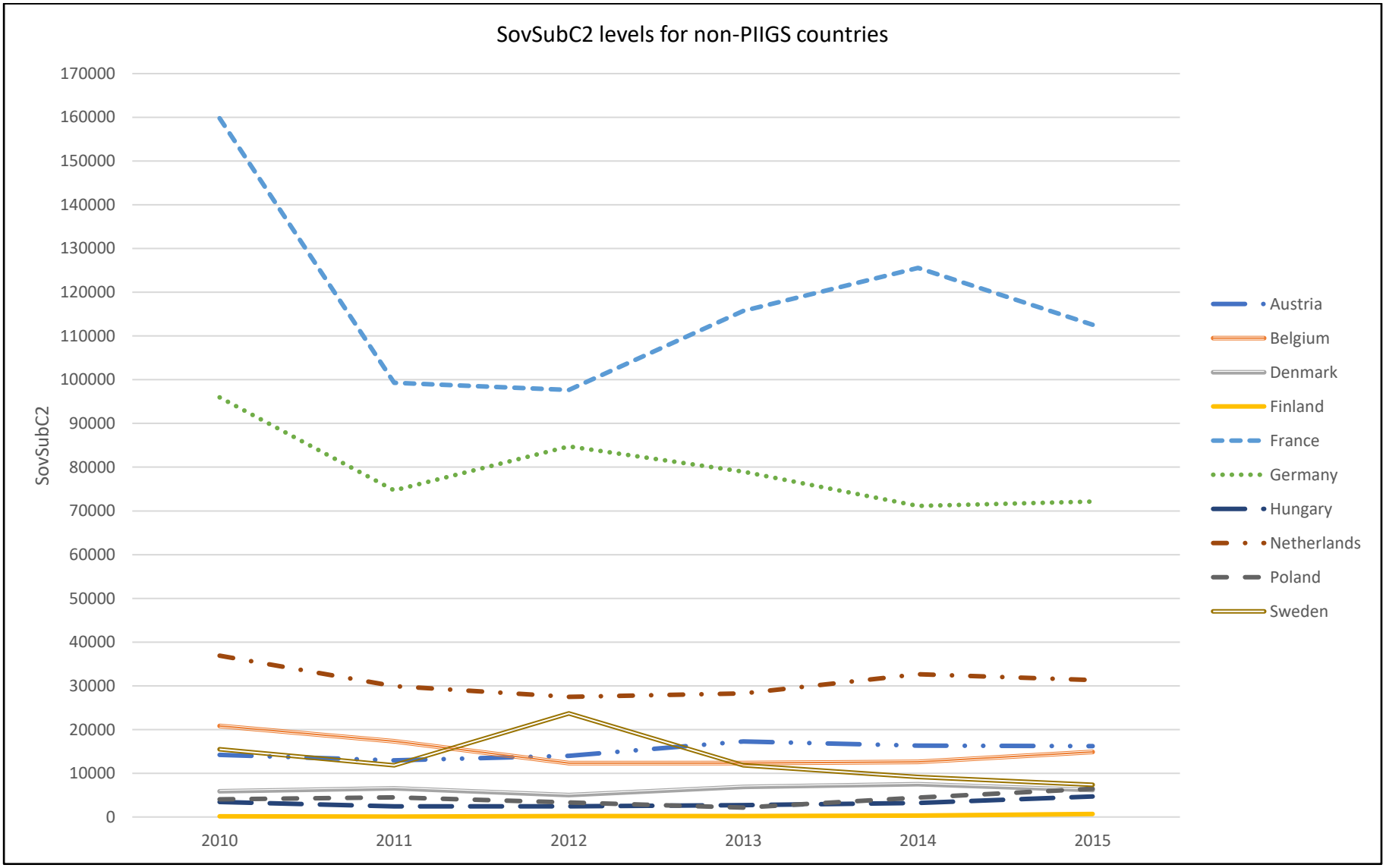


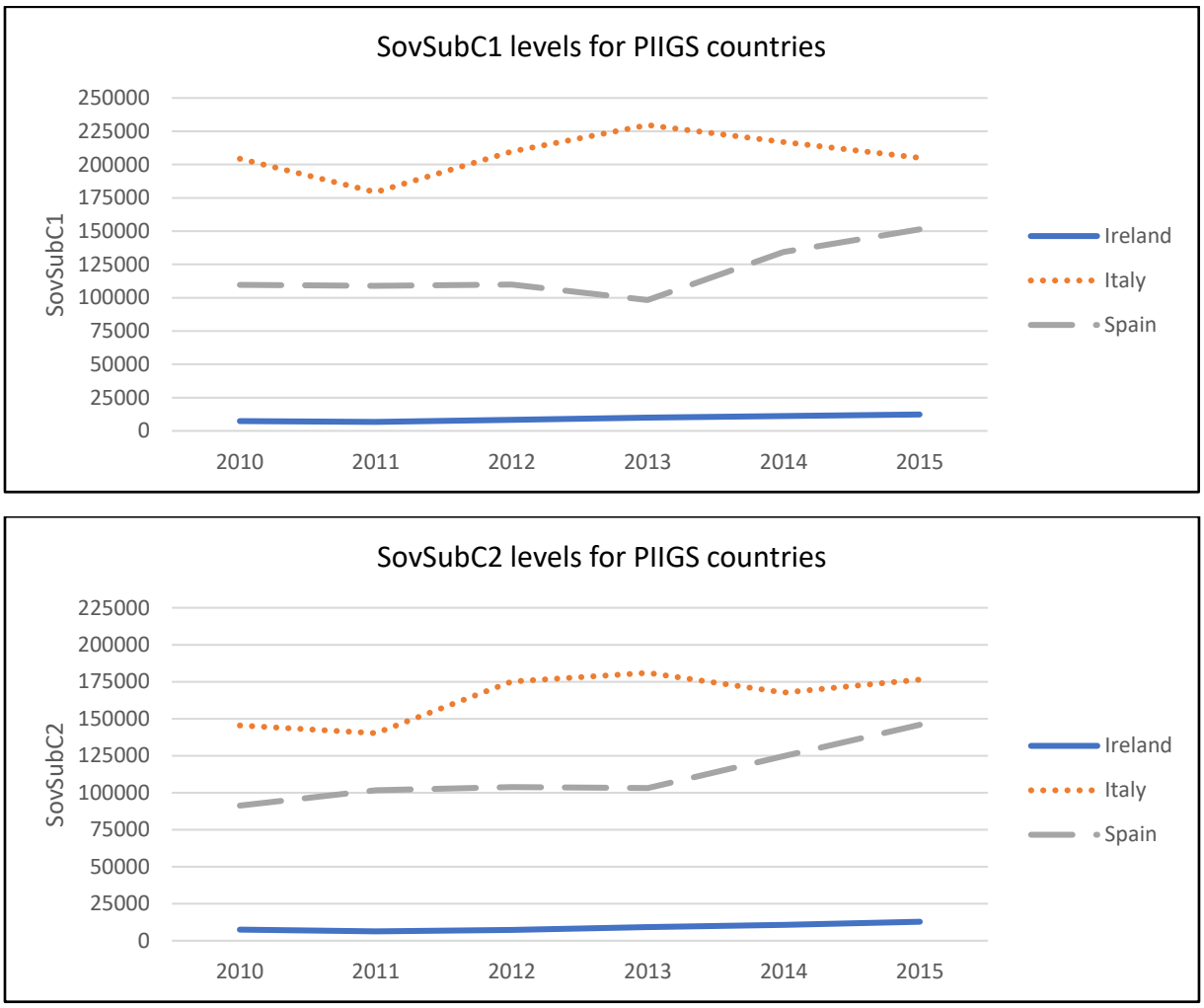
Figure 8: Sovereign subsidy on country-level (non-PIIGS countries) (Appendix M) (continued)



For both computations of the country-level sovereign subsidy the numbers for Germany and France are the largest. The level of sovereign subsidy issued by Germany and France in 2015 (SovSubC1) is for both countries between €30 and €40 billion. The majority of the countries in the sample created less than €15 billion sovereign subsidy.

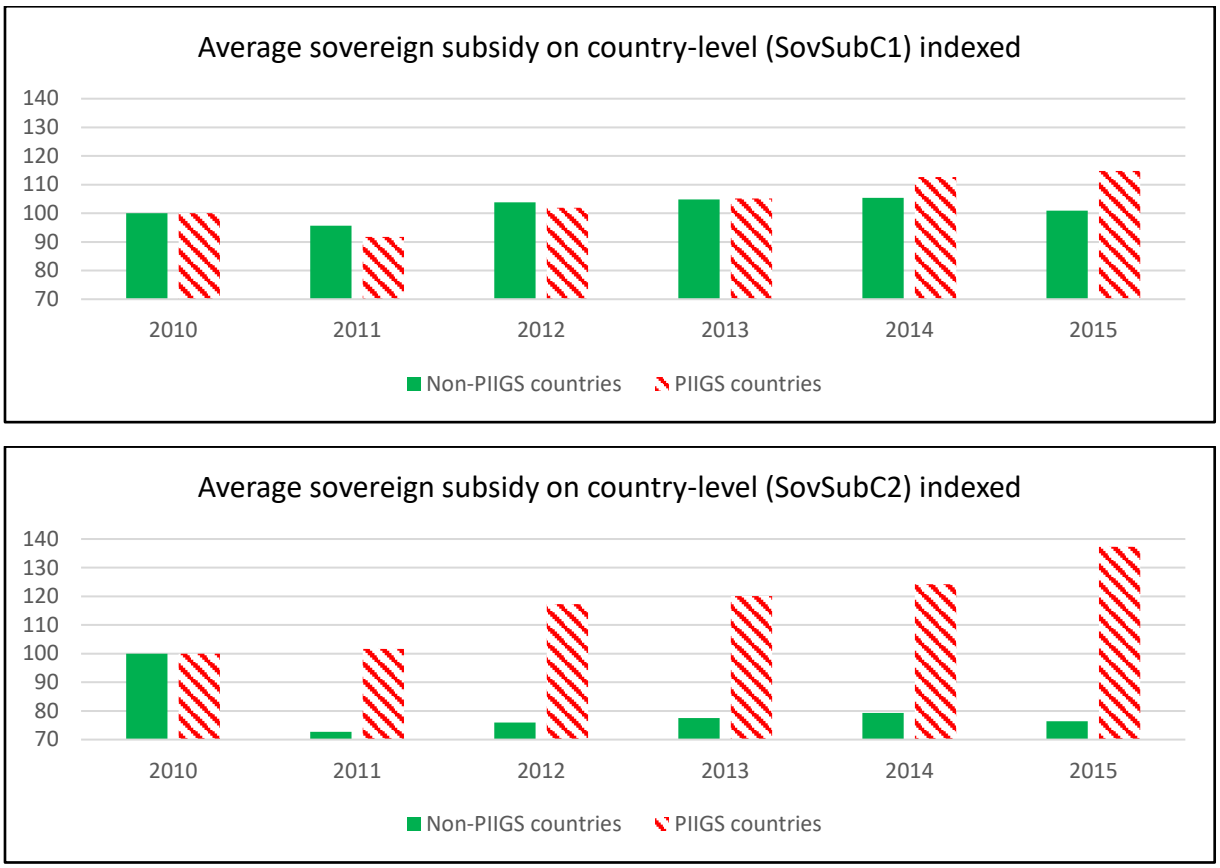
For the second measure of sovereign subsidy on a country-level, which focusses on the sovereign subsidy that banks hold that are headquartered in a specific country, the numbers are much larger. Respectively just over €110 billion and €70 billion of sovereign subsidy is attributed to Germany and France in 2015. The values for the remaining countries are all below €35 billion in 2015.

Figure 9: Sovereign subsidy on country-level (PIIGS countries) (Appendix M)



It can be seen from the graphs for PIIGS countries that Italy is the PIIGS country with the highest sovereign subsidy. Italy has the highest value for issued sovereign subsidy (SovSubC1) and also the highest value for the sovereign subsidy it holds (SovSubC2), respectively €200 billion and €175 billion in 2015. Remarkably, these numbers are respectively five and two and a half times larger than the values for Germany. Ireland's sovereign subsidy is relatively low compared to that of Italy and Spain. The sovereign subsidy of Spain increased the most over time (in absolute terms).

Figure 10: Average sovereign subsidy on country-level (SovSubC1 and SovSubC2) indexed (Appendix M)



When one compares the average sovereign subsidies of non-PIIGS and PIIGS nations it is clear that there is a vast difference between these two classes. Whereas the average issued sovereign subsidy (SovSubC1) of non-PIIGS countries remained almost the same over 2010 until 2015, that of PIIGS countries rose by approximately 15%.

Looking at the second computation of sovereign subsidy, which is concentrated at the party that holds the sovereign subsidy (SovSubC2), there is a stronger divergence. Non-PIIGS nations decreased their sovereign subsidy with almost 25%, while PIIGS nations saw their sovereign subsidy increase with more than 35%.

4. Methodology

4.1 Hypothesis 1

"The current exposure to sovereign debt and the sovereign subsidy of banks in PIIGS countries has increased significantly compared to the level of exposure at the start of the sovereign debt crisis, in contrast to that of banks in non-PIIGS countries"

This hypothesis is answered by comparing the exposure of sovereign debt at the end of 2010 with that of 2015. A similar comparison is made for the levels of sovereign subsidies of banks. In these two comparisons, the overall difference is reported (see below) and often a distinction is made between PIIGS and non-PIIGS banks.

Exposure sovereign debt		Exposure sovereign debt
	↔	
(end-of-year 2010)		(end-of-year 2015)

Sovereign subsidy		Sovereign subsidy
	↔	
(end-of-year 2010)		(end-of-year 2015)

First of all, it must be made clear whether there is a significant increase/decrease in sovereign debt exposure and sovereign subsidy per bank. Since there only are six observations per bank (years 2010-2015), the condition of normally distributed data must be met.

To check whether the data for each bank is normally distributed or not, all banks' sovereign debt exposure and sovereign subsidy have been tested on normality. This normally distribution check has been exectued by analysing the descriptive statistics. When the skewness is higher than 1.96 or smaller than -1.96, it is significantly different from zero (with alpha being 5%). The skewnesses are all between these two boundaries, which means the data is normally distributed. This means that a T-test is applicable.

The interpretation of the first hypothesis is as follows. Results are in line with the hypothesis when:

- Non-PIIGS banks do *not* show a *significant increase in* sovereign debt exposure/sovereign subsidy when comparing 2015 stress test results with 2010 stress test results;
- PIIGS banks show a *significant higher* sovereign debt exposure/sovereign subsidy when comparing 2015 stress test results with 2010 stress test results.

This paper uses the following T-test formula, based on an alpha of 5% (Alwan, Craig, Duckworth, McCabe, & Moore, 2011):

(8) $$T - value = \frac{x - \mu_0}{s \,/\, \sqrt{n}}$$

with x being the sovereign debt exposure or sovereign subsidy in 2015 and μ_0 the sovereign debt exposure or sovereign subsidy 2010. The s stands for the standard deviation calculated over the values

for sovereign debt exposure or sovereign subsidy of the years 2010-2015. The number of observation is represented by n and the degrees of freedom is $(n-1)$.

The tests are both one-tailed, since for non-PIIGS (PIIGS) banks the expectation is that the sovereign subsidy is lower (higher). The degrees of freedom amount to five, meaning T-values above 2.015 is defined as significantly higher and under -2.015 represents significantly lower.

4.2 Hypothesis 2

"The sovereign subsidy increases the required capital banks of PIIGS and non-PIIGS countries must hold significantly"

For this hypothesis the research examines whether there is a significant increase when the sovereign subsidy is added to the risk weighted assets, and thereby indirectly to the minimum required capital ratios (Tier 1 and Tier 1 and 2 combined).

The calculations are as follows. A bank can "choose" how much RWA it backs with Tier 1 capital, in a range of 4% to 8% (what is left is then backed with Tier 2 capital). This paper uses the most conservative capital ratio (the minimum of 4% as required Tier 1 capital ratio), because using a percentage above this number would be arbitrary. The minimum for the Tier 1 and 2 capital ratio combined amounts to 8% of the bank's risk weighted assets. Once again, this research applies the most conservative capital ratio of 8%.

The next step consists of determining whether there is a significant increase in Tier 1 capital ratio and Tier 1 and 2 capital ratios combined per bank. A limitation for this test is the amount of observations. Since there are only six data points (years 2010-2015), these need to be normally distributed.

All banks minimum required Tier 1 capital ratio and Tier 1 and 2 capital ratios combined are tested on normality, in a similar way this is done for the first hypothesis. All skewnesses are all between 1.96 or -1.96, meaning the T-test is applicable (with alpha being 5%).

This paper uses the following T-test formula (Alwan, Craig, Duckworth, McCabe, & Moore, 2011):

(9) $$T-value=\frac{x_1-x_2}{\sqrt{\frac{s_1^2}{n_1}+\frac{s_2^2}{n_2}}}$$

with x_1 being the average required Tier 1 capital ratio or Tier 1 and 2 combined capital ratio *without* the sovereign subsidy in the years 2010-2015 and x_2 being the average required Tier 1 or Tier 1 and 2 combined capital ratio *with* the sovereign subsidy in the years 2010-2015 (consistent with the current Basel regulation). The standard deviation calculated over the values used to compute x_1 is represented by s_1, while s_2 is the standard deviation calculated over the values used to compute x_2. Subsequently, n_1 (n_2) is the number of observations of x_1 (x_2) and degrees of freedom amounts to $(n-1)$.

Again, the tests are both one-tailed, since for both non-PIIGS and PIIGS banks the expectation is that the capital ratios will increase significantly. The degrees of freedom amount to five. Therefore, the T-values above 2.015 are defined as significantly higher.[7]

[7] When alpha is 10%, T-values higher than 1.476 are significant.

4.3 Hypothesis 3

"Troubled banks have relatively high sovereign subsidies, since these banks in particular are looking for profitable investments that concern assets with relatively low risk weights"

The word "troubled" here means either one or more of the following characteristics: high amount of non-performing loans (NPL), high debt levels (D), low capital ratios (Tier1), low return on equity (ROE), low/negative stock returns (RET).

The following bank-level regression equation is used to answer the third hypothesis:

(10) $$Sovereign\ subsidy = \alpha + (troubled)\ bank\ characteristics_{t-1} + control\ variables_{t-1} + country\ fixed\ effects + year\ fixed\ effects + \varepsilon$$

There are 37 banks included in the regression (Appendix C). The time period is 2010-2015.

To avoid omitted variable bias, or at least to lower this bias as far as possible, control variables are included in the regression. A bias that needs to be controlled for is bank size. Berger and Bouwman (2013) control for bank size by adding the logarithm of total assets to their regression analysis. Bank size can create a bias problem because large banks are more likely to have higher sovereign debt holdings and therefore on average higher sovereign subsidies. Also, Idier et al. (2014), highlight the fact that size could possibly bias coefficients, they also take the logarithm of total assets to adjust for size. Acharya et al. (2016) also use the control variables volatility and beta besides size (for which they use the logarithm of total assets). Volatility is measured as the "annualized daily individual stock return volatility" whereas beta is the "covariance of a firm's stock returns with the market divided by variance of market returns" . Therefore, this research controls for the volatility (VOL), the beta (BET), and size (TA) in the regression analysis.

In some regressions researchers control for country fixed effects (see for example Di Tella et al. (2001)). In this regression controlling for country fixed effects and year fixed effects is necessary, because country fixed effects capture the systematic difference between the financial systems. Year fixed effects capture the influence of time-series trends.

The variables are converted into natural logarithms for interpretation purposes and to correct for non-normality. Only those variables that are already expressed in percentages (Tier 1 ratio, return on assets, debt ratio, non-performing loans ratio, stock volatility, stock return) are not converted (due to negative values).

After removing the variables which could cause multicollinearity (Appendix K), the regression looks as follows:

(11) $$SovSubB = \alpha + Tier1_{t-1} + ROE_{t-1} + D_{t-1} + NPL_{t-1} + RET_{t-1} + BET_{t-1} + VOL_{t-1} + TA_{t-1} + country\ fixed\ effects + year\ fixed\ effects + \varepsilon$$

There are 37 banks included in the regression (Appendix C). The time period is 2010-2015.

The independent variables and control variables have a lag of one year. In this way the predictionary power of the model increases, since bank characteristics in year $(t-1)$ will more likely have an influence on the sovereign subsidy in year t than in $(t-1)$.

There are clusters of observations, each cluster consists out of the six years of one bank in the sample. By using clusters one emphasises that the observations could be correlated in these clusters, but the independence of observations between the clusters is also assumed. Clustering reduces the problem of heteroscedasticity and it corrects for autocorrelation (also known as serial correlation) as well.

4.4 Hypothesis 4

"The sovereign subsidy negatively affects the real economy of European countries, at least in PIIGS nations"

Firstly, the variables for this regression are turned into natural logarithms for interpretation purposes and to correct for non-normality. Only those variables that are already expressed in percentages or index numbers (short-term interest rate, long-term interest rate, consumer confidence index, business confidence index, consumer price index, GDP growth, unemployment) are not converted (due to negative values).

The regression is as follows:

(12) $$Real\ economy = \alpha + sovereign\ subsidy_{t-1} + interaction\ term\ (sovereign\ subsidy * dummy\ GIIPS)_{t-1} + control\ variables_{t-1} + (country\ fixed\ effects) + year\ fixed\ effects + \varepsilon$$

There are 13 countries included in the regression (Appendix D). The time period is 2010-2015.

Similar to the regression for hypothesis three, the independent variables and control variables have a lag of one year.

Real economy is expressed as GDP growth per head of the population (GDPG), unemployment (UN), and consumption per head of the population (CONH). Buch & Neugebauer (2010) use GDP growth per head of the population as proxy for real economy. Van Ark et al. (2010) use consumption and (un)employment as measure for real economy, they argue these are better benchmarks than GDP. Due to the relatively large amount of negative values, the GDP growth per capita values are not transformed into natural logarithms.

Just as for the third hypothesis, the observations are clustered and country and year fixed effects are included in the regressions.

The independent variable is sovereign subsidy on a country-level (in contradiction to the third hypothesis, for which the sovereign subsidy on a bank-level is used). As explained in the data section of this paper, this sovereign subsidy is calculated in two ways:

a) based on the party that *issues* the sovereign subsidy. The sovereign debt holdings of the banks in the sample can be broken down into the different nations this debt is from. This debt is assigned to the country it is from, hereafter the sovereign subsidy is calculated (by multiplying the total amount of debt by the country's risk weight). This value is called SovSubC1;
b) based on the party that *holds* the sovereign subsidy. When for example a Spanish bank holds sovereign debt of four different nations, the sovereign subsidy belonging to this particular debt amount is assigned to the country Spain. This value is named SovSubC2.

Multiple regressions are performed with the two independent variables for the country-level sovereign subsidy (SovSubC1 and SovSubC2). In some regressions either only SovSubC1 or SovSubC2 is included, in other regressions both variables are included. Therefore, it is possible to compare whether the influences on the real economy of the two are similar or not.

Several macro-economic variables are included in the regression, for the purpose of reducing the influences of certain macro-economic factors on the dependent variable as much as possible (preventing omitted variable bias). These variables are: the short-term interest rate (IRST), the long-term interest rate (IRLT), the consumer confidence index (CCI), the business confidence index (BCI), the consumer price index (CPI), the government expenditures (GEXP), the gross public debt (GDE), the imported goods (IMP), and the exported goods (EXP).

Taking into account the variables left out due to multicollinearity problems (Appendix L), the regressions will look as follows:

(13) $$GDPG = \alpha + SovSubC1_{t-1} + SovSubC1PIIGS_{t-1} + SovSubC2_{t-1} + SovSubC2PIIGS_{t-1} + IRST_{t-1} + CCI_{t-1} + BCI_{t-1} + CPI_{t-1} + GEXP_{t-1} + IMP_{t-1} + (country\ fixed\ effects) + year\ fixed\ effects + \varepsilon$$

(14) $$UN = \alpha + SovSubC1_{t-1} + SovSubC1PIIGS_{t-1} + SovSubC2_{t-1} + SovSubC2PIIGS_{t-1} + IRST_{t-1} + CCI_{t-1} + BCI_{t-1} + CPI_{t-1} + GEXP_{t-1} + IMP_{t-1} + (country\ fixed\ effects) + year\ fixed\ effects + \varepsilon$$

(15) $$CONH = \alpha + SovSubC1_{t-1} + SovSubC1PIIGS_{t-1} + SovSubC2_{t-1} + SovSubC2PIIGS_{t-1} + IRST_{t-1} + CCI_{t-1} + BCI_{t-1} + CPI_{t-1} + GEXP_{t-1} + IMP_{t-1} + (country\ fixed\ effects) + year\ fixed\ effects + \varepsilon$$

There are 13 countries included in the regression (Appendix D). The time period is 2010-2015.

The first two regressions are level-log regressions, since GDPG and UN are expressed in percentages and the sovereigns subsidy variables are converted to natural logarithms. The third regression is a log-log regression, since the consumption per capita is converted into natural logarithms.

A dummy was created that takes on the value of 0 for non-GIIPS countries and 1 for GIIPS countries. Thereafter two interaction terms were made: SovSubC1 times the dummy and SovSubC2 times the dummy. In this way, one can make a distinction between the effect of the sovereign subsidy on a non-GIIPS country's real economy and that of a GIIPS country.

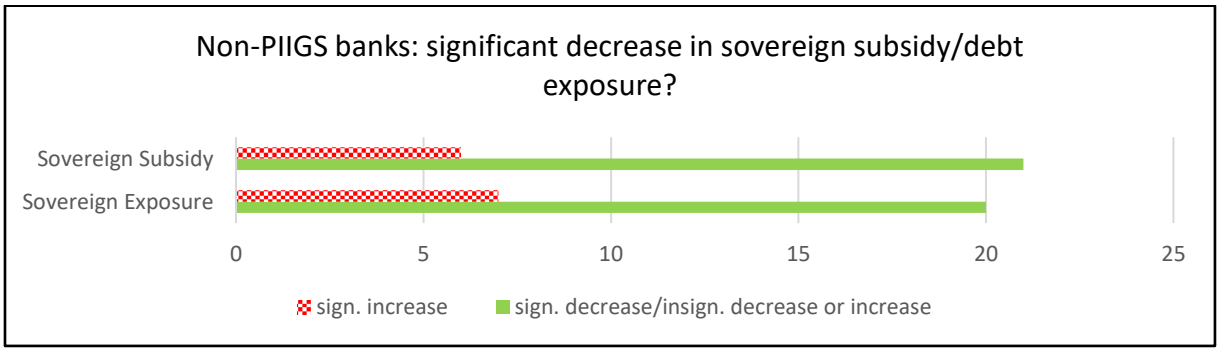
5. Results & Discussion

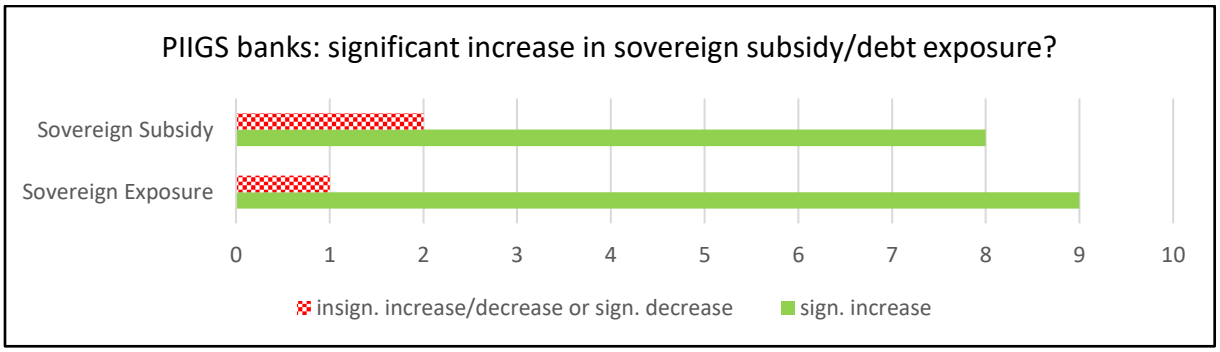
5.1 Hypothesis 1

"The current exposure to sovereign debt and the sovereign subsidy of banks in PIIGS countries has increased significantly compared to the level of exposure at the start of the sovereign debt crisis, in contrast to that of banks in non-PIIGS countries"

Below the changes in sovereign debt exposure and sovereign subsidy are displayed between the end of 2010 and the end of 2015. The first figure distinguishes for non-PIIGS banks between a significant decrease, insignificant decrease or insignificant increase (all consistent with the hypothesis) and a significant increase. The second figure distinguishes for PIIGS banks between a significant increase (consistent with the hypothesis) and a significant decrease, an insignificant increase or an insignificant decrease.

Figure 11: (In)significant increases or decreases in sovereign debt exposure and sovereign subsidy (non-PIIGS vs. PIIGS)





These results lead to the following conclusions:

Table 4: Results concerning first hypothesis (non-PIIGS vs. PIIGS)

	Sovereign debt exposure	**Sovereign subsidy**
In line with hypothesis – non-PIIGS banks	20	21
Not in line with hypothesis – non-PIIGS banks	7	6
Amount of non-PIIGS banks	*27*	*27*
In line with hypothesis – PIIGS banks	9	8
Not in line with hypothesis – PIIGS banks	1	2
Amount of PIIGS banks	*10*	*10*

The vast majority of PIIGS banks significantly increased its total exposure to sovereign debt as well as the sovereign subsidy. Only 20% of the PIIGS banks did not increase its sovereign subsidy significantly and 90% of them increased their sovereign debt holdings significantly.

Only 25% of the non-PIIGS banks increased their total exposure to sovereign debt significantly between the end of 2010 and 2015. A little less than 25% of these banks saw their sovereign subsidy increase significantly and 60% of the non-PIIGS banks decreased their sovereign subsidy significantly. In other words, roughly 75% of the non-PIIGS banks had more or less the same levels of sovereign debt exposure and sovereign subsidy, or saw these numbers decrease significantly.

The outcomes for the sovereign debt exposure and the sovereign subsidy are in line with the hypothesis. Therefore, the hypothesis can be accepted; the vast majority of the PIIGS banks increased their sovereign debt exposures and sovereign subsidy, whereas the vast majority of the non-PIIGS banks managed to not let these values increase significantly.

5.2 Hypothesis 2

"The sovereign subsidy increases the required capital banks of PIIGS and non-PIIGS countries must hold significantly"

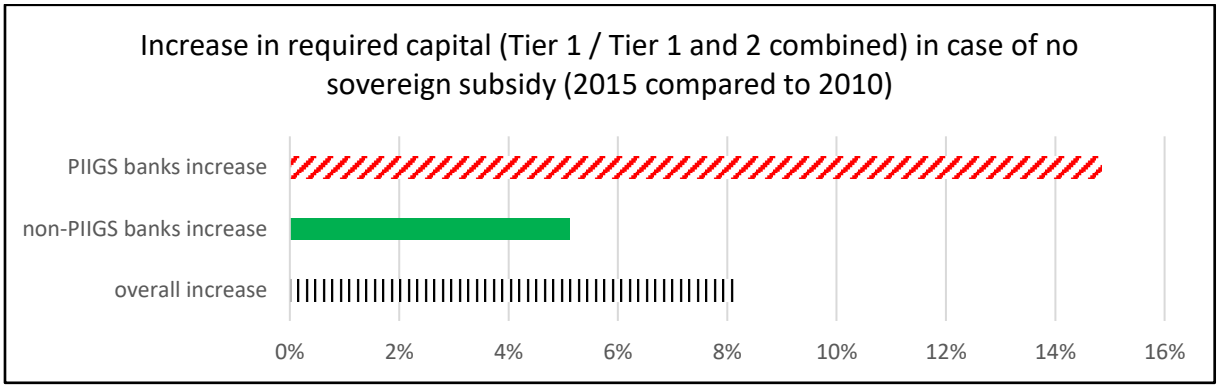
For this hypothesis the current situation, with the sovereign subsidy in place, is compared to the situation in which there is no such rule, meaning risk weights of sovereign debt are applied to sovereign debt exposure of banks. The increases in required capital ratios are shown in percentages.

Table 5: Increase in required capital ratios in case of no sovereign subsidy (non-PIIGS vs. PIIGS)[8]

Increase in required capital in case of no sovereign subsidy (2015 compared to 2010)	**Tier 1**	**Tier 1 and 2 combined**
overall increase	**8.18%**	**8.18%**
Amount of observations / banks	*162 / 28*	*162 / 28*
non-PIIGS banks increase	**5.12%**	**5.12%**
Amount of observations / non-PIIGS banks	*111 / 19*	*111 / 19*
PIIGS banks increase	**14.84%**	**14.84%**
Amount of observations / PIIGS banks	*51 / 9*	*51 / 9*

[8] Not every bank has data available for every year this paper studies, due to which the amount of observations and amount of banks is lower.

Figure 12: Increase in Tier 1 capital ratio/ Tier 1 and 2 capital ratios combined in case of no sovereign subsidy (non-PIIGS vs. PIIGS)



It is evident that on average there is a substantial increase in the capital ratios when the zero-risk weight of OECD sovereign debt is replaced by realistic risk weights. The average increase in capital buffers would be over 8%. There is an enormous difference in effects for non-PIIGS banks and for PIIGS banks. While the increase for non-PIIGS banks is limited to just 5%, the PIIGS banks would have to reserve an extra 15% compared to their original required buffers.

Performing the T-tests leads to the following results:

Table 6: Results concerning second hypothesis (non-PIIGS vs. PIIGS) with alpha = 5%[9]

Tier 1 Capital Ratio	**increased significantly**	**increased insignificantly**
non-PIIGS banks	3	16
PIIGS banks	5	3
Tier 1 and 2 Capital Ratios combined	**increased significantly**	**increased insignificantly**
non-PIIGS banks	4	15
PIIGS banks	5	3

The table above illustrates the results of the T-tests with an alpha of 5%. It is obvious that the most banks would have to hold higher required capital ratios, but for many banks this increase is insignificant. Only for three non-PIIGS banks the Tier 1 ratio would increase significantly without the sovereign subsidy. Looking at the Tier 1 and 2 ratios combined this number increases to four banks.

The amount of PIIGS banks for which the capital ratios significantly increase is five (out of eight). This number is quite high, therefore it is a meaningful finding. The difference between non-PIIGS and PIIGS banks is, similar to the results of the first hypothesis, crystal clear. Whereas 62.5% of the PIIGS banks would have had to increase its capital ratios significantly without the sovereign subsidy, only 16% (or 21% for both capital ratios combined) of the non-PIIGS banks would have to do so.

For non-PIIGS banks the hypothesis has to be rejected. There are some non-PIIGS banks for which the capital ratio(s) shift to significantly higher levels, but for the majority of the banks this increase is insignificant. For PIIGS banks, however, the hypothesis can be accepted, because of the vast majority of these banks would have experienced a significantly higher amount of required capital to hold.

[9] Due to data availability (see footnote six), there are T-tests performed for 19 of the 27 non-PIIGS banks and nine of the ten PIIGS banks in the sample.

The findings related to this hypothesis are very important, because capital ratios are one of the fundaments of the worldwide banking system. When the sovereign subsidy is abolished, this means certain banks will have to increase their capital ratios with substantial amounts of money. To give some examples of PIIGS banks: Banca Monte dei Paschi die Siena would have had to increase its Tier 1 ratio over the period 2010-2015 with almost 30% on average to comply with the minimum capital requirements, for Unione Di Banche Italiane S.p.A. this would have amounted to almost 20%, and for Unicredit this percentage lies just below 15% (Appendix J).

5.3 Hypothesis 3

"Troubled banks have relatively high sovereign subsidies, since these banks in particular are looking for profitable investments that concern assets with relatively low risk weights"

The results of the regression performed according to the methodology explained in section 4.3 are displayed in Table 7 (see next page).

Looking at the results, one can see there is one significant coefficient, which is significant with alpha being 5%. The coefficient, non-performing loans, can be interpreted as follows: a 1% increase in this ratio will increase the sovereign subsidy of a bank by 0.1%. This is intuitive, since the higher the non-performing loans ratio is, the less healthy a bank is. The less healthy a bank is, the higher its sovereign subsidy will be (see section 2.2). Contradictory, banks that lower their non-performing loans ratio become healthier and are therefore likely to have a relatively low sovereign subsidy.

The R-squared is a measure that denotes to what extent the regression explains the relationship between the independent variables and the dependent variable. The R-squared of this regression is, especially for banking regressions, fairly high (46%).

The coefficient for non-performing loans is consistent with the third hypothesis. The higher the percentage of non-performing loans, the more troubled a bank is, the higher the sovereign subsidy is on average (due to carry trade behaviour, see section 2.2).

This is also consistent with the data. The sovereign subsidy of PIIGS banks is on average higher than that of PIIGS banks (see table 3 and figure 2). The percentage of non-performing loans is also evidently higher for PIIGS banks than for non-PIIGS banks. While the non-PIIGS banks non-performing loans percentage remains enormously stable just below 5%, the PIIGS banks' percentage increased to just under 20% since the level of 2010.

Figure 13: Average percentage of non-performing loans (non-PIIGS vs. PIIGS) (Appendix G)

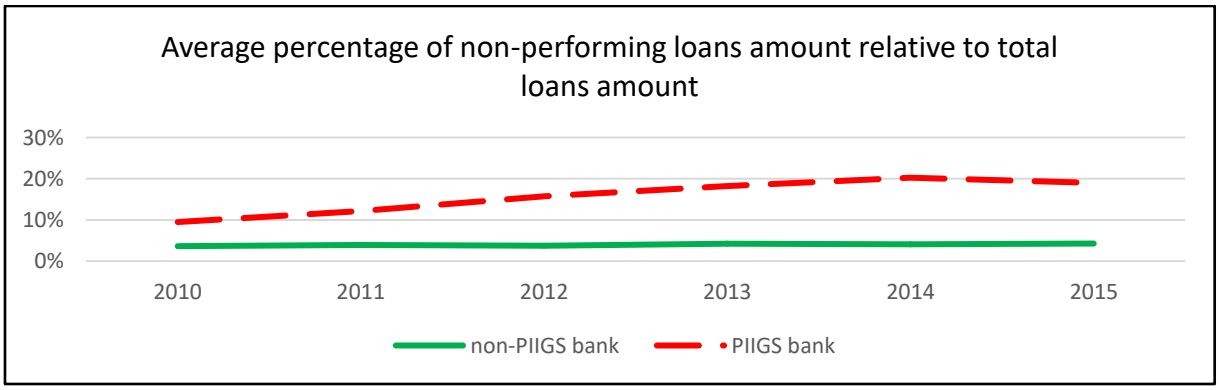


Table 7: Results of regression third hypothesis

	(1)
Independent variables	Ln Sovereign Subsidy (bank-level)
Tier 1 ratio	-5.85
	(0.43)
Return on assets	0.00
	(-0.25)
Debt ratio	0.00
	(0.03)
Non-performing loans ratio	0.10**
	(2.10)
Stock return	0.79
	(0.84)
Control variables	
Ln Stock beta	-1.07
	(-0.87)
Stock volatility	0.01
	(0.08)
Ln Total assets	1.15***
	(6.16)
R^2	0.46
N	98
Country dummies	YES
Year dummies	YES

Table 7 shows the results of the bank-level regression. The dependent variable is the sovereign subsidy of the banks involved. The independent variables are the Tier 1 capital ratio, the return on assets, the debt ratio, the non-performing loans ratio, and the stock return. The control variables are the stock beta, the volatility of the stock, and total assets. All independent and control variables are lagged by one year. See table 1 for a full definition of each variable. In this regression country and year fixed effects are included. The variables are converted into natural logarithms for interpretation purposes and to correct for non-normality. Only those variables that are already expressed in percentages (Tier 1 ratio, debt ratio, non-performing loans ratio, stock return, stock volatility) are not converted (due to negative values). The sample is clustered at the bank-level. In principle all 37 banks are included in this regression, however, the amount of observations is reduced because of missing data. The T-values are in the parentheses. Significance: *** with an alpha of 1%, ** with an alpha of 5%, * with an alpha of 10%.

5.4 Hypothesis 4

"The sovereign subsidy negatively affects the real economy of European countries, at least in PIIGS nations"

The regressions that are performed have different dependent variables: growth in GDP per head of the population, unemployment, and consumption per head of the population. The regression tables are displayed at pages 34 until 37.

Looking at the first six regressions, for which the proxy for real economy is GDP growth, there are two independent variables with significant coefficients. Both are the second measure of sovereign subsidy on a country-level for PIIGS countries.

The first one is significant with an alpha of 10% and is in the fourth regression, in which only the second measure of country-level sovereign subsidy is included as independent variable. This variable can be interpreted as follows. A 1% increase in the sovereign subsidy of a PIIGS nation leads to a 0.0264% increase in GDP growth.[10]

The second significant coefficient also finds itself in a regression in which country fixed effects are absent. Except now, the first way of computing the country-level is included as independent variable as well. The effect of sovereign subsidy here is even higher: a 1% increase in the sovereign subsidy of a PIIGS nation leads to a 0.0515% increase in GDP growth.

The R-squared of the fourth and sixth regression are respectively around 66% and 68%.

For the regressions with unemployment as dependent variable, there are two significant coefficients for independent variables in the last regression (12). Both the coefficients for PIIGS countries independent variables are significant with an alpha of 1%.

The first significant coefficient, belonging to the variable which represents the party issuing the sovereign subsidy, demonstrates a diminishing influence on the unemployment. In case of a 1% increase in the issued sovereign subsidy of a nation, the unemployment declines with 0.3325%.

However, the effect of the variable representing the party holding the sovereign subsidy contradicts this. When the amount of sovereign subsidy a country holds is increase by 1%, this leads to a rise of the unemployment by 0.2208%.

The R-squared of this regression is almost 92%, which is relatively high.

Moving on to the regressions with private consumption per capita as dependent variable, one sees that in two of the regressions in which is not controlled for country fixed effects there are significant coefficients.

In regression fourteen the coefficient belonging to the variable representing issued country-level sovereign subsidy is significant (with alpha being 1%). The variable can be interpreted as follows. An increase by 1% of issued sovereign subsidy is followed by a decrease in consumption of 0.32%.[11]

The very last regression (18) contains three significant coefficients. The first one is again the coefficient of the variable that represents issued sovereign subsidy by a country, which is significant with an alpha

[10] As this is a level-log regression, β_1 has to be divided by 100 to retrieve the increase in units of GDP growth.
[11] As this is a log-log regression, the change of the independent variable by 1% leads to a change in the dependent variable of β_1%.

of 5%. The effect is almost equal to that of the same variable in regression fourteen, namely a decrease in consumption per head of the population of 0.29% when the issued sovereign subsidy increases by 1%.

The second coefficient that is significant in the last regression belongs to the issued country-level sovereign subsidy for PIIGS nations. In case of a 1% increase in issued sovereign subsidy by a PIIGS country, the consumption per capita decreases by 1.66%.

The last significant coefficient is for the second measure of country-level sovereign subsidy for PIIGS countries. It is significant with an alpha of 10%. In contradiction to the variable representing the issuance of sovereign subsidy, the measure representing the party holding the sovereign subsidy has a positive influence on consumption. A 1% increase in sovereign subsidy is followed by a 1.40% higher consumption per capita.

The R-squared of the fourteenth and eighteenth regression are approximately 93%.

An overview of the significant coefficients of the independent variables for the fourth hypothesis looks as follows:

Table 8: Overview of significant results of fourth hypothesis and the implications for real economy proxies in case of a 1% increase

	GDP growth	Unemployment	Consumption per capita
SovSubC1	-	-	0.32% and 0.29% ↓
SovSubC1PIIGS	-	0.3325% ↓	1.66% ↓
SovSubC2	-	-	-
SovSubC2PIIGS	0.0264 and 0.0515% ↑	0.2208% ↑	1.40% ↑

The decrease in consumption per head of the population after an increase in country-level sovereign subsidy (SovSubC1) is in line with the hypothesis. This result is also in line with the literature on effects to the real economy of the sovereign subsidy. Risk-shifting behaviour of banks, for which Acharya & Steffen (2015) find evidence, leads to a shrinkage of the lending supply to private firms. This affects the real economy negatively. Although this variable is about the sovereign subsidy issued by nations, it is known that domestic banks accrue a large part of this sovereign subsidy (see figure 7; for non-PIIGS banks this is more than 50%). Looking at the results one can interpret these as risk-shifting by banks leading to a lower private consumption per capita.

Consequently, the second independent variable (SovSubC1PIIGS), also reports a significant negative coefficient with consumption per capita as dependent variable. This is again in line with the hypothesis, for the same reason explained in the previous paragraph. This independent variable also has a decreasing influence on unemployment, which is not in line with the hypothesis, since this entails a positive impact on the real economy.

Moving on to the last independent variable (SovSubC2PIIGS), one can see it has a significant coefficient in one regression of each of the three dependent variables. The result of extra sovereign subsidy acquired by banks in a PIIGS country is an increased GDP growth. This is not in line with the hypothesis. The same goes for the higher private consumption per capita. The higher unemployment on the contrary, is in line with the hypothesis, as this negatively affects the real economy.

As is shown in the descriptive statistics section (figure 7), 80% of the PIIGS banks' sovereign debt holdings concerns domestic government debt. Thus, when a PIIGS government issues sovereign debt, it is likely that a domestic bank accrues the largest part of this debt.

One can derive from the table above that when a PIIGS country issues sovereign subsidy to a bank which is headquartered within its own borders, the diminishing effect of issuing to the unemployment (-0.3325%) is partially wiped out, due to the fact that the variable of holding the sovereign subsidy is accompanied by a positive coefficient (+0.2208%). Since it is likely that a domestic bank will lend money to its government, the diminishing effect of issuing will in most cases be reduced by the positive coefficient of the variable representing the party that holds the sovereign subsidy (at least in PIIGS nations).

Just as for unemployment as dependent variable, it should be noted that when a PIIGS country issues sovereign subsidy to a bank which is headquartered within its own borders, the positive effect of the party holding this subsidy to the consumption (+1.40%) is overshadowed by the negative effect of issuing sovereign subsidy (-1.66%).

All things considered, there are eight significant coefficients of independent variables, of which four are in line with the hypothesis and four are not. In other words, the regressions performed lead to contradicting results.

There can be various reasons for these contradicting results. They can for example be caused by the sample of banks. As mentioned in the descriptive statistics section, the real country-level sovereign subsidy cannot be computed, due to the sample only consisting of 37 European Union banks. Another reason could be that the coefficients of the independent variables are biased. Although there are control variables included and this paper controls for year fixed effects and (in half of the regressions) country fixed effects, bias could always be present. Especially in macro-economic regressions such as these, because there are so many (economic) factors influencing real economy proxies such as GDP growth, unemployment, and private consumption per capita.

Table 9: Results of regressions fourth hypothesis

	(1)	(2)	(3)	(4)	(5)	(6)
Independent variables	GDP growth	GDP growth	GDP growth	GDP growth	GDP growth	GDP growth
Ln SovSubC1	0.44	0.10			0.45	0.19
	(1.11)	(0.72)			(1.08)	(1.50)
Ln SovSubC1PIIGS	0.17	1.36			-1.75	-2.16
	(0.97)	(1.39)			(-0.79)	(-1.31)
Ln SovSubC2			0.24	0.03	0.16	0.04
			(0.65)	(0.54)	(0.45)	(0.93)
Ln SovSubC2PIIGS			0.84	2.61*	2.36	5.11*
			(0.74)	(2.14)	(0.97)	(2.20)
Control variables						
Short-term interest rate	0.04	-0.10	0.00	-0.08	0.01	-0.15
	(0.34)	(-1.00)	(0.01)	(-1.30)	(0.08)	(-1.47)
Consumer confidence index	0.05	0.07	0.01	0.08	0.07	0.06
	(0.45)	(0.66)	(0.06)	(0.73)	(0.64)	(0.48)
Business confidence index	0.14	0.31	0.25	0.26	0.15	0.26
	(1.03)	(1.30)	(1.27)	(1.05)	(0.90)	(1.03)
Consumer price index	0.13	0.19*	0.11	0.21*	0.13	0.19*
	(1.13)	(1.93)	(0.99)	(2.10)	(1.32)	(1.98)
Ln Government expenditures	-8.03*	-0.27	-7.91**	-0.33*	-6.94*	-0.30*
	(-2.19)	(-1.54)	(-2.34)	(-2.15)	(-2.04)	(-1.84)
Ln Import	2.85	0.12	3.13	0.22	3.48	0.00
	(1.44)	(0.74)	(1.63)	(1.42)	(1.66)	(-0.01)
R^2	0.7885	0.63225	0.7822	0.6568	0.7978	0.6772
N	60	60	60	60	60	60
Country dummies	YES	NO	YES	NO	YES	NO
Year dummies	YES	YES	YES	YES	YES	YES

Table 10: Results of regressions fourth hypothesis (continued)

	(7)	(8)	(9)	(10)	(11)	(12)
Independent variables	Unemployment	Unemployment	Unemployment	Unemployment	Unemployment	Unemployment
Ln SovSubC1	1.18	0.58			1.20	0.86
	(1.31)	(0.93)			(1.24)	(1.04)
Ln SovSubC1PIIGS	0.72	-16.83			-2.89	-32.39***
	(0.51)	(-2.49)			(-0.57)	(-3.64)
Ln SovSubC2			0.50	0.12	0.36	0.07
			(0.82)	(0.24)	(0.61)	(0.15)
Ln SovSubC2PIIGS			1.94	-13.09	4.42	22.15***
			(0.58)	(1.38)	(0.59)	(3.40)
Control variables						
Short-term interest rate	0.89**	0.41	0.76**	0.47*	0.83**	0.24
	(2.31)	(1.70)	(2.29)	(1.90)	(2.27)	(0.67)
Consumer confidence index	-0.31	-0.11	-0.42	0.01	-0.28	-0.19
	(0.86)	(-0.18)	(-1.05)	(0.02)	(-0.72)	(-0.38)
Business confidence index	0.46	-1.05*	0.73*	-1.33*	0.49	-1.17
	(1.20)	(-2.05)	(2.07)	(-2.01)	(1.38)	(-1.90)
Consumer price index	0.03	0.50	0.00	0.70*	0.04	0.48
	(0.12)	(1.41)	(0.00)	(1.81)	(0.17)	(1.38)
Ln Government expenditures	6.92	-0.12	6.72	-1.11	9.02	-0.18
	(0.93)	(-0.10)	(0.80)	(-0.82)	(1.00)	(-0.15)
Ln Import	-16.65**	-0.51	-16.26*	0.74	-15.46*	-0.85
	(-2.27)	(-0.43)	(-2.17)	(0.63)	(-1.85)	(-0.58)
R^2	0.9851	0.9081	0.9840	0.8811	0.9856	0.9198
N	60	60	60	60	60	60
Country dummies	YES	NO	YES	NO	YES	NO
Year dummies	YES	YES	YES	YES	YES	YES

Table 10: Results of regressions fourth hypothesis (continued)

	(13)	(14)	(15)	(16)	(17)	(18)
Independent variables	Ln Consumption	Ln Consumption	Ln Consumption	Ln Consumption	Ln Consumption	Ln Consumption
Ln SovSubC1	0.00	-0.32***			0.00	-0.29**
	(-0.11)	(-3.33)			(-0.30)	(-2.92)
Ln SovSubC1PIIGS	0.01	-0.42			0.03	-1.37**
	(0.30)	(-0.97)			(0.44)	(-2.30)
Ln SovSubC2			0.01	0.06	0.01	0.01
			(1.70)	(1.71)	(1.71)	(0.54)
Ln SovSubC2PIIGS			-0.01	0.29	-0.03	1.39*
			(-0.43)	(0.43)	(-0.55)	(2.09)
Control variables						
Short-term interest rate	-0.01**	-0.17***	-0.01**	-0.30***	-0.01*	-0.19***
	(-2.68)	(-6.11)	(-2.91)	(-7.94)	(-2.03)	(-6.20)
Consumer confidence index	0.00	0.01	0.00	-0.01	0.00	0.00
	(-0.43)	(0.13)	(-0.35)	(-0.26)	(-0.43)	(0.05)
Business confidence index	-0.01**	0.02	-0.01**	-0.04	-0.01	0.00
	(-2.47)	(0.30)	(-2.39)	(-0.52)	(-1.75)	(0.06)
Consumer price index	0.00	-0.03	0.00	-0.04	0.00	-0.03
	(0.75)	(-1.46)	(0.64)	(-1.13)	(0.52)	(-1.56)
Ln Government expenditures	0.11	0.15*	0.12	0.01	0.12	0.14*
	(1.08)	(2.01)	(1.30)	(0.14)	(1.20)	(2.03)
Ln Import	0.19***	0.13	0.19***	-0.13	0.18***	0.10
	(5.21)	(0.95)	(7.53)	(-1.14)	(6.38)	(0.58)
R^2	0.9998	0.9263	0.9998	0.8751	0.9998	0.9321
N	60	60	60	60	60	60
Country dummies	YES	NO	YES	NO	YES	NO
Year dummies	YES	YES	YES	YES	YES	YES

Table 10 shows the results of the country-level regression. The dependent variables are respectively GDP growth, unemployment, and consumption per capita. The independent variables are the two computations of country-level sovereign subsidy (SovSubC1 and SovSubC2) and interactions terms of the two with a PIIGS dummy. Various macro-economic variables function as controls: the short-term interest rate, the consumer and business confidence indices, the consumer price index, government expenditures, and import. See table 1 for a full definition of each variable. In all regressions year fixed effects are included, in half of the regressions country fixed effects are present. The variables are turned into natural logarithms for interpretation purposes, and in order to correct for non-normality. Only those variables that are already expressed in percentages (GDP growth, unemployment, short-term interest rate, consumer and business confidence indices, consumer price index, unemployment) are not converted (due to negative values). This makes that the first twelve regressions are level-log regressions, whereas the last six are log-log regressions. The sample is clustered at the country-level. In principle all 13 countries are included in this regression, however, the amount of observations is reduced slightly due to missing data. The T-values are in the parentheses. Significance: *** with an alpha of 1%, ** with an alpha of 5%, * with an alpha of 10%.

6. Conclusion

In this paper the sovereign subsidy and its implications for the financial system and countries' real economies are examined. Firstly, the changes in non-PIIGS and PIIGS banks' sovereign subsidy are shown. Thereafter, the consequences for regulatory capital ratios of banks are studied in case the policy of assigning zero-risk weights to OECD sovereign debt ceases to exist. Thirdly, a regression is performed as to show which bank characteristics go with a high (or low) level of sovereign subsidy. Finally, multiple regressions are executed in order to conclude whether real economies of EU countries are negatively affected by the sovereign subsidy.

Firstly, the results indicate that most PIIGS banks increased their sovereign debt exposures and sovereign subsidy significantly, while most non-PIIGS banks did not. These findings are in line with those of Korte & Steffen (2014).

The research conducted for the second hypothesis led to the conclusion that all banks will have to increase their capital ratios without the sovereign subsidy. For PIIGS banks 62.5% would have had to raise their capital ratios significantly. However, for non-PIIGS banks this was only 20%. This means that abandoning the sovereign subsidy would be far more disastrous for PIIGS banks than it would be for non-PIIGS banks. This finding is consistent with the literature (section 2.2).

The bank-level regression produced to one significant coefficient of an independent variable, namely the non-performing loans ratio. This coefficient can be interpreted as the higher the percentage of non-performing loans is, the higher the sovereign subsidy of a bank becomes. This is intuitive, because from figure 13 and Appendix G can be derived that PIIGS banks have a substantial higher percentage of non-performing loans (19%) than non-PIIGS banks (4%). Table 3 and figure 2 show that on average PIIGS banks have higher levels of sovereign subsidy than non-PIIGS banks.

The country-level regressions generated to contradicting results. Therefore, in general, it cannot be said whether sovereign subsidies affect the real economy of EU countries negatively or positively.

The political rule of assigning zero-risk weights to OECD sovereign debt makes it more attractive for banks to hold this government debt, especially that of the economically weaker sovereigns, since the yield on this debt is high. The risk is also substantial, but this is being neglected by the zero-risk weight assigned to this debt. Economically, this rule is far from instinctive: a bank holds risky sovereign debt, while not having its regulatory capital ratios increased.

The research question of this thesis is as follows:

"Does the sovereign subsidy have to be eliminated in Basel IV?"

From an economical perspective, the answer to this question should be positive. Moreover, the related literature shows that the sovereigns subsidy forms a threat to the financial stability of the Eurozone. Based on the research conducted in the light of this thesis, the sovereign subsidy should also have to be removed from the new Basel regulation, despite the fact it cannot prove that the sovereign subsidy negatively affects the real economy.

Firstly, the research reveals that the often weaker PIIGS banks have increased their sovereign subsidy levels significantly, which makes weaker banks riskier. Secondly, the majority of the PIIGS banks would have to boost its regulatory capital ratios significantly, which indicates the risk of the sovereign subsidy to the financial system as a whole. Thirdly, the bank-level regression illustrates that the higher the non-performing loan ratio is, the higher the level of sovereign subsidy becomes. This, again, confirms that the weaker banks become, the more they increase their sovereign subsidy, which makes them even riskier than they were beforehand.

The results of this thesis contribute to the literature on the sovereign subsidy. This paper elucidates the changes in levels of sovereign debt and sovereign subsidy from the sovereign debt crisis onwards, thereby distinguishing between non-PIIGS and PIIGS banks. Furthermore, this thesis assesses the consequences of eliminating the favourable treatment of OECD sovereign debt by demonstrating the implications of this event to the regulatory capital ratios of banks. The bank-level regression on what type of bank characteristics are associated with high (or low) sovereign subsidy levels and the country-level regressions on the effects of the sovereign subsidy to real economies also contributes to the existing literature.

This paper is also useful for financial regulators such as the Basel Committee. Regulators aim for a more stable banking system. However, assigning zero-risk weights to OECD sovereign debt (which does contain risk), only leads to a less stable financial system. Because of this rule, banks can become over-exposed to risky sovereign debt, for which they do not hold any capital at all. Therefore, the sovereign subsidy should be left out in the new Basel accord. However, as Battinisti et al. (2014) point out, adjusting or leaving out the sovereign subsidy can cause problems as well. The introduction of the European Union Safe Bond could be the alternative which causes the least financial pain (see section 2.4).

There are some limitations to this paper. A serious shortcoming is the number of banks in the sample. This is not so much a shortcoming for the first three hypotheses, but it is for the last one. The two methods of calculating the sovereign subsidy on a country-level do not contain all data that is needed, due to the lack of various banks in the sample. Future research can for instance focus on examining the effect of the sovereign subsidy on the real economy with a larger dataset of banks.

The credit ratings of countries used form another limitation. Since the historic credit ratings of all countries in the dataset were not available, this paper has used the most recent credit ratings. However, this does, in all probability, not inflate the results of this research. The reason for this is that most economies are healthier now than they were in the previous years, which positively influences their credit rating, lowers the risk weights of a country and generates lower levels of sovereign subsidy.

A recommendation for further research is to examine the implications of the sovereign subsidy with more data available. Ideally, the data of all OECD countries bank's sovereign debt holdings are accessible. Only then, a fully representative picture can be drawn of the sovereign subsidy and its consequences to the financial system and the real economy.

Further research could also focus on the implementation of solutions to the problems caused by the sovereign subsidy. It could for instance compare the introduction of European Union Safe Bonds with the introduction of concentration limits and/or risk weights for OECD sovereign debt.

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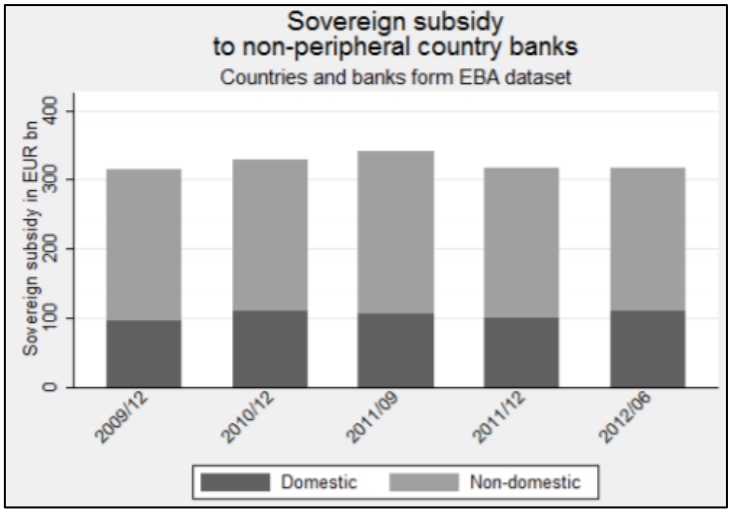
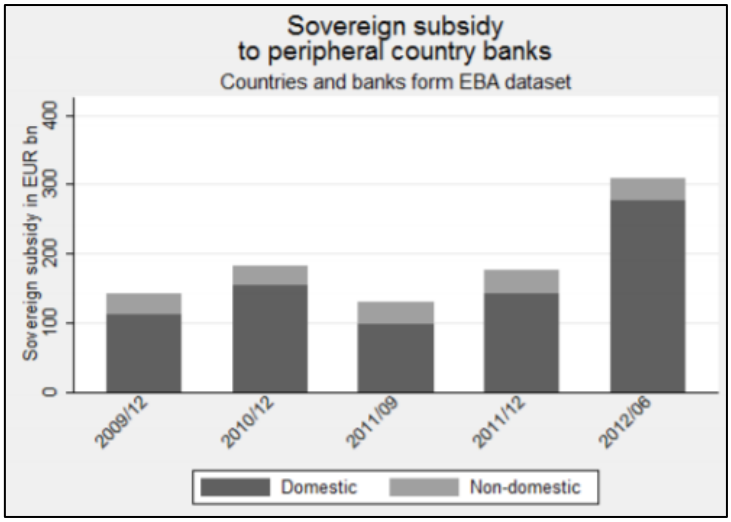
8. Appendices

Appendix A: Sovereign subsidy to non-peripheral country banks



Reference: (Korte & Steffen, 2014).

Appendix B: Sovereign subsidy to peripheral country banks



Reference: (Korte & Steffen, 2014).

Appendix C: List of banks, the country of their headquarters (non-PIIGS or PIIGS)

Bank	**Country**	**PIIGS?**
Erste Group Bank AG	Austria	
Raiffeisen-Landesbanken-Holding GmbH	Austria	
KBC Group NV	Belgium	
Bayerische Landesbank	Germany	
Commerzbank AG	Germany	
DekaBank Deutsche Girozentrale	Germany	
Deutsche Bank AG	Germany	
Landesbank Baden-Württemberg	Germany	
Norddeutsche Landesbank Girozentrale	Germany	
Danske Bank	Denmark	
Jyske Bank	Denmark	
Nykredit Realkredit	Denmark	
Banco Bilbao Vizcaya Argentaria S.A.	Spain	PIGGS
Banco Popular Español S.A.	Spain	PIGGS
Banco Santander S.A.	Spain	PIGGS
OP Osuuskunta	Finland	
BNP Paribas	France	
Groupe BPCE	France	
Groupe Crédit Agricole	France	
Société Générale S.A.	France	
OTP Bank Nyrt.	Hungary	
Allied Irish Banks plc	Ireland	PIGGS
The Governor and Company of the Bank of Ireland	Ireland	PIGGS
Banca Monte dei Paschi di Siena S.p.A.	Italy	PIGGS
Banco Popolare - Società Cooperativa	Italy	PIGGS
Intesa Sanpaolo S.p.A.	Italy	PIGGS
UniCredit S.p.A.	Italy	PIGGS
Unione Di Banche Italiane Società Per Azioni	Italy	PIGGS
ABN AMRO Group N.V.	Netherlands	
Coöperatieve Centrale Raiffeisen-Boerenleenbank B.A	Netherlands	
ING Groep N.V.	Netherlands	
DNB Bank Group	Norway	
Nordea Bank - group	Norway	
Powszechna Kasa Oszczędności Bank Polski SA	Poland	
Skandinaviska Enskilda Banken - group	Sweden	
Svenska Handelsbanken - group	Sweden	
Swedbank – group	Sweden	

Appendix D: List of countries (non-PIIGS or PIIGS)

Country	**PIGGS?**
Austria	
Belgium	
Denmark	
Finland	
France	
Germany	
Hungary	
Ireland	PIGGS
Italy	PIGGS
Netherlands	
Poland	
Spain	PIGGS
Sweden	

Appendix E: Total sovereign debt exposure and sovereign subsidy average amounts (non-PIIGS vs. PIIGS)

Average total sovereign debt exposure (indexed)	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
non-PIIGS bank	100	76	100	98	97	92
PIIGS bank	100	100	122	120	135	142
Average sovereign subsidy (indexed)	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
non-PIIGS bank	100	73	76	78	79	76
PIIGS bank	100	99	115	114	125	132
Average domestic sovereign debt exposure to total sovereign debt holdings	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
non-PIIGS bank	53%	54%	52%	54%	53%	52%
PIIGS bank	81%	81%	83%	85%	80%	77%

Appendix F: Total sovereign debt exposure and sovereign subsidy increases and percentage changes (non-PIIGS vs. PIIGS)

Total sovereign debt exposure & sovereign subsidy (2015 compared to 2010)	**Total sovereign debt exposure**	**Sovereign subsidy**
Increases	21	16
Decreases	16	21
Amount of banks	*37*	*37*
Increases non-PIIGS	12	8
Decreases non-PIIGS	15	19
Amount of non-PIIGS banks	*27*	*27*
Increases PIIGS	9	8
Decreases PIIGS	1	2
Amount of PIIGS banks	*10*	*10*
Overall percentual change	21%	10%
Percentual change non-PIIGS	11%	-4%
Percentual change PIIGS	48%	50%

Appendix G: Descriptive statistics (non-PIIGS vs. PIIGS)

Descriptive Statistics	**Banks**	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*
Average non-performing loans to total loans amount	non-PIIGS	4%	4%	4%	4%	4%	4%
	PIIGS	9%	12%	16%	18%	20%	19%
Average Tier 1 capital ratio	non-PIIGS	12%	12%	14%	14%	14%	15%
	PIIGS	8%	11%	12%	12%	12%	13%
Average Tier 1 and 2 capital ratio combined	non-PIIGS	16%	15%	17%	17%	17%	19%
	PIIGS	12%	14%	15%	15%	14%	15%
Average return on equity	non-PIIGS	8%	6%	6%	7%	5%	8%
	PIIGS	-12%	-9%	-11%	-7%	-7%	7%
Average return on assets	non-PIIGS	0.91%	0.80%	0.80%	0.76%	0.59%	0.85%
	PIIGS	0.32%	0.26%	-0.02%	0.01%	0.60%	0.91%
Average debt percentage relative to capital	non-PIIGS	80%	82%	81%	80%	80%	79%
	PIIGS	84%	82%	81%	78%	78%	77%
Average stock volatility	non-PIIGS	30%	32%	31%	29%	28%	27%
	PIIGS	30%	33%	34%	34%	33%	33%
Average stock return	non-PIIGS	3%	-29%	6%	39%	8%	13%
	PIIGS	-19%	-43%	-17%	14%	23%	-3%

Appendix H: Credit ratings for countries

	2011 Jan 1			2014 Jan 1			2016 Jan 1		
Country	**S&P**	**Moody's**	**Fitch**	**S&P**	**Moody's**	**Fitch**	**S&P**	**Moody's**	**Fitch**
Austria	AA+	Aa1	AA+	AA+	Aa1	AA+	AA+	Aa1	AA+
Belgium	AA	Aa3	AA-	AA	Aa3	AA-	AA	Aa3	AA-
Czech Republic	AA-	A1	A+	AA-	A1	A+	AA-	A1	A+
Denmark	AAA	Aaa	AAA	AAA	Aaa	AAA	AAA	Aaa	AAA
Estonia	AA-	A1	A+	AA-	A1	A+	AA-	A1	A+
Finland	AA+	Aa1	AA+	AA+	Aa1	AA+	AA+	Aa1	AA+
France	AA	Aa2	AA	AA	Aa2	AA	AA	Aa2	AA
Germany	AAA	Aaa	AAA	AAA	Aaa	AAA	AAA	Aaa	AAA
Greece	B-	Caa3	CCC	B-	Caa3	CCC	B-	Caa3	CCC
Hungary	BBB-	Baa3	BBB-	BBB-	Baa3	BBB-	BBB-	Baa3	BBB-
Iceland	A	A3	BBB+	A	A3	BBB+	A	A3	BBB+
Ireland	A+	A3	A	A+	A3	A	A+	A3	A
Italy	BBB-	Baa2	BBB	BBB-	Baa2	BBB	BBB-	Baa2	BBB
Luxembourg	AAA	Aaa	AAA	AAA	Aaa	AAA	AAA	Aaa	AAA
Netherlands	AAA	Aaa	AAA	AAA	Aaa	AAA	AAA	Aaa	AAA
Norway	AAA	Aaa	AAA	AAA	Aaa	AAA	AAA	Aaa	AAA
Poland	BBB+	A2	A-	BBB+	A2	A-	BBB+	A2	A-
Portugal	BB+	Ba1	BB+	BB+	Ba1	BB+	BB+	Ba1	BB+
Slovakia	A+	A2	A+	A+	A2	A+	A+	A2	A+
Slovenia	A	Baa3	A-	A	Baa3	A-	A	Baa3	A-
Spain	BBB+	Baa2	BBB+	BBB+	Baa2	BBB+	BBB+	Baa2	BBB+
Sweden	AAA	Aaa	AAA	AAA	Aaa	AAA	AAA	Aaa	AAA
UK	AA	Aa1	AA	AA	Aa1	AA	AA	Aa1	AA
US	AA+	Aaa	AAA	AA+	Aaa	AAA	AA+	Aaa	AAA
Japan	A+	A1	A	A+	A1	A	A+	A1	A
Australia	AAA	Aaa	AAA	AAA	Aaa	AAA	AAA	Aaa	AAA
Canada	AAA	Aaa	AAA	AAA	Aaa	AAA	AAA	Aaa	AAA
Switzerland	AAA	Aaa	AAA	AAA	Aaa	AAA	AAA	Aaa	AAA
Latvia	A-	A3	A-	A-	A3	A-	A-	A3	A-

Reference credit ratings: (Trading Economics, 2017).

Appendix I: Calculation of risk weights for sovereign debt

Country	PD	LGD (standard)	Maturity (standard)	ρ	b	MA	WCDR	K	Risk weight
Austria	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
Belgium	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
Czech Republic	0,18%	45%	2,5	0,2295	0,2150	1,48	0,0522	0,0335	0,4185
Denmark	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
Estonia	0,18%	45%	2,5	0,2295	0,2150	1,48	0,0522	0,0335	0,4185
Finland	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
France	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
Germany	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
Greece	27,46%	45%	2,5	0,1200	0,0358	1,06	0,6924	0,1987	2,4836
Hungary	0,64%	45%	2,5	0,2071	0,1562	1,31	0,1120	0,0620	0,7756
Iceland	0,39%	45%	2,5	0,2189	0,1788	1,37	0,0841	0,0494	0,6170
Ireland	0,26%	45%	2,5	0,2254	0,1977	1,42	0,0658	0,0404	0,5050
Italy	0,64%	45%	2,5	0,2071	0,1562	1,31	0,1120	0,0620	0,7756
Luxembourg	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
Netherlands	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
Norway	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
Poland	0,39%	45%	2,5	0,2189	0,1788	1,37	0,0841	0,0494	0,6170
Portugal	2,67%	45%	2,5	0,1516	0,1005	1,18	0,2145	0,0995	1,2438
Slovakia	0,26%	45%	2,5	0,2254	0,1977	1,42	0,0658	0,0404	0,5050
Slovenia	0,39%	45%	2,5	0,2189	0,1788	1,37	0,0841	0,0494	0,6170
Spain	0,64%	45%	2,5	0,2071	0,1562	1,31	0,1120	0,0620	0,7756
Sweden	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
UK	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
US	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
Japan	0,26%	45%	2,5	0,2254	0,1977	1,42	0,0658	0,0404	0,5050
Australia	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
Canada	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
Switzerland	0,03%	45%	2,5	0,2382	0,3168	1,91	0,0138	0,0116	0,1444
Latvia	0,26%	45%	2,5	0,2254	0,1977	1,42	0,0658	0,0404	0,5050

* the calculations are identical for 2010-2015, since credit ratings are the same

Appendix J: Average increases in capital ratios per bank (over 2010-2015)

Bank	PIIGS?	Tier 1 ratio	Tier 1 and 2 ratio
Erste Group Bank AG		10.3%	10.3%
Raiffeisen-Landesbanken-Holding GmbH		7.4%	7.4%
KBC Group NV		16.3%	16.3%
Bayerische Landesbank			
Commerzbank AG		11.9%	11.9%
DekaBank Deutsche Girozentrale			
Deutsche Bank AG		7.5%	7.5%
Landesbank Baden-Württemberg		9.8%	9.8%
Norddeutsche Landesbank Girozentrale			
Danske Bank		0.7%	0.7%
Jyske Bank		0.2%	0.2%
Nykredit Realkredit			
Banco Bilbao Vizcaya Argentaria S.A.	PIGGS		
Banco Popular Español S.A.	PIGGS	15.6%	15.6%
Banco Santander S.A.	PIGGS	8.9%	8.9%
OP Osuuskunta			
BNP Paribas		8.1%	8.1%
Groupe BPCE			
Groupe Crédit Agricole		7.2%	7.2%
Société Générale S.A.		7.6%	7.6%
OTP Bank Nyrt.		0.0%	0.0%
Allied Irish Banks plc	PIGGS	8.5%	8.5%
The Governor and Company of the Bank of Ireland	PIGGS	5.7%	5.7%
Banca Monte dei Paschi di Siena S.p.A.	PIGGS	28.8%	28.8%
Banco Popolare - Società Cooperativa	PIGGS	14.4%	14.4%
Intesa Sanpaolo S.p.A.	PIGGS	18.6%	18.6%
UniCredit S.p.A.	PIGGS	14.3%	14.3%
Unione Di Banche Italiane Società Per Azioni	PIGGS		
ABN AMRO Group N.V.			
Coöperatieve Centrale Raiffeisen-Boerenleenbank B.A			
ING Groep N.V.		6.4%	6.4%
DNB Bank Group		0.2%	0.2%
Nordea Bank - group		0.4%	0.4%
Powszechna Kasa Oszczędności Bank Polski SA		2.9%	2.9%
Skandinaviska Enskilda Banken - group		0.5%	0.5%
Svenska Handelsbanken - group		0.5%	0.5%
Swedbank – group		0.1%	0.1%

Appendix K: Correlation matrix third hypothesis

	SovSubB	Tier1	Tier12	ROE	ROA	NM	D	NPL	RET	BET	VOL	TA
SovSubB	1.00											
Tier1	-0.26	1.00										
Tier12	-0.20	0.92	1.00									
ROE	-0.12	0.36	0.25	1.00								
ROA	-0.18	0.33	0.24	0.92	1.00							
NM	-0.16	0.35	0.25	0.95	0.93	1.00						
D	-0.06	0.11	0.11	-0.10	-0.01	-0.05	1.00					
NPL	0.22	-0.27	-0.25	-0.36	-0.39	-0.46	-0.20	1.00				
RET	-0.07	0.31	0.23	0.36	0.33	0.35	-0.05	-0.23	1.00			
BET	0.01	-0.31	-0.24	-0.31	-0.30	-0.40	-0.20	0.24	-0.06	1.00		
VOL	0.15	-0.34	-0.24	-0.46	-0.50	-0.57	-0.20	0.71	-0.29	0.65	1.00	
TA	-0.12	0.39	0.32	0.35	0.35	0.39	-0.14	-0.62	0.34	-0.14	-0.56	1.00

Correlations between variables that exceed 0.75 (or are smaller than -0.75) can be seen as a concern when it comes to multicollinearity. In order to prevent multicollinearity from occurring, the following variables are removed from the third regression:

- Tier12, due to its high correlation with Tier1;
- NM, due to its high correlation with ROE and ROA;
- ROA, due to its high correlation with ROE.

Appendix L: Correlation matrix fourth hypothesis

	CONH	GDPG	UN	SovSubC1	SovSubC2	IRST	IRLT	CCI	BCI	CPI	GEXP	GDE	IMP	EXP
CONH	1.00													
GDPG	0.08	1.00												
UN	-0.26	-0.15	1.00											
SovSubC1	-0.25	-0.15	0.56	1.00										
SovSubC2	0.21	0.00	0.28	0.72	1.00									
IRST	-0.73	-0.09	0.37	0.33	-0.06	1.00								
IRLT	-0.80	0.04	0.04	-0.02	-0.34	0.79	1.00							
CCI	0.14	0.55	-0.27	-0.33	-0.19	-0.37	-0.14	1.00						
BCI	-0.09	0.49	-0.16	0.12	0.24	-0.02	0.03	0.56	1.00					
CPI	0.03	-0.23	0.18	0.10	0.11	-0.41	-0.30	-0.07	-0.18	1.00				
GEXP	0.41	0.09	-0.58	0.13	0.39	-0.40	-0.31	0.02	0.17	0.01	1.00			
GDE	0.28	-0.11	0.22	0.78	0.86	-0.15	-0.43	-0.24	0.12	0.11	0.57	1.00		
IMP	0.22	-0.04	0.04	0.65	0.81	-0.18	-0.35	-0.18	0.22	0.09	0.62	0.91	1.00	
EXP	0.23	-0.02	-0.03	0.61	0.79	-0.21	-0.34	-0.13	0.26	0.10	0.64	0.88	0.99	1.00

Correlations between variables that exceed 0.75 (or are smaller than -0.75) can be seen as a concern when it comes to multicollinearity. In order to prevent multicollinearity from occurring, the following variables are removed from the fourth regression:

- IRLT, due to its high correlation with CONH and IRST;
- EXP, due to its high correlation with IMP;
- GDE, due to its high correlation with SovSubC1, SovSubC2, IMP, and EXP.

Appendix M: Sovereign subsidy on country-level

	Sovereign subsidy on country-level *(SovSubC1)* (*€1 million)						Sovereign subsidy on country-level *(SovSubC2)* (*€1 million)					
Non-PIIGS countries	2010	2011	2012	2013	2014	2015	2010	2011	2012	2013	2014	2015
Austria	4,242	3,640	5,338	6,757	7,571	6,512	14,228	12,954	14,001	17,273	16,343	16,226
Belgium	10,953	11,151	10,993	11,072	11,931	10,961	20,825	17,325	12,340	12,336	12,595	14,901
Denmark	2,029	3,137	4,853	2,728	2,546	1,452	5,907	6,569	5,009	6,904	7,498	6,144
Finland	3,382	2,918	4,840	1,946	2,883	2,955	162	88	225	213	343	690
France	23,230	22,514	25,191	32,862	32,669	33,080	159,799	99,282	97,660	115,757	125,559	112,571
Germany	46,687	43,030	47,770	44,393	42,838	37,096	95,965	74,670	84,746	78,980	71,135	72,115
Hungary	14,556	14,323	11,707	12,412	9,294	11,734	3,433	2,448	2,445	2,716	3,236	4,694
Netherlands	8,624	10,440	11,283	11,144	10,511	9,855	36,896	29,933	27,475	28,272	32,628	31,292
Poland	23,371	22,689	23,941	24,863	28,295	28,826	4,049	4,477	3,351	2,153	4,458	6,458
Sweden	7,449	4,425	4,197	3,394	3,692	3,436	15,506	11,816	23,692	11,841	9,140	7,368
PIIGS countries	2010	2011	2012	2013	2014	2015	2010	2011	2012	2013	2014	2015
Ireland	7,377	6,760	8,207	10,053	11,121	12,333	7,504	6,318	7,377	9,182	10,775	12,812
Italy	204,363	179,277	209,819	229,651	216,920	205,099	145,402	140,236	175,131	181,004	167,692	176,486
Spain	109,709	109,018	109,784	98,263	134,224	151,378	91,302	101,721	103,867	103,128	124,746	145,944
	Average *SovSubC1* (*€1 million)						Average *SovSubC2* (*€1 million)					
Non-PIIGS countries	14452	13827	15011	15157	15223	14591	35677	25956	27094	27644	28294	27246
PIIGS countries	107150	98352	109270	112656	120755	122937	81403	82759	95459	97771	101071	111747
	Sovereign subsidy on country-level *(SovSubC1)* indexed						Sovereign subsidy on country-level *(SovSubC2)* indexed					
Non-PIIGS countries	100	96	104	105	105	101	100	73	76	77	79	76