Bank Bailouts and Sovereign Credit Risk

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Abstract

The following Seminar paper is based on an article called "A Pyrrhic Victory?" Bank Bailouts and Sovereign Credit Risk" published by The Journal of Finance. Main focus of this Seminar paper is to show a loop between sovereign and bank credit risk. European financial crisis is the example on which this loop was explained. Increased sovereign credit risk in turn weakens the financial sector by eroding the value of its government guarantees and bond holdings. We will observe the data of bank and sovereign CDS from three different time periods: pre-bailout, during-baiout and post-bailout period.

Contents

1 Introduction

1.1 What is Sovereign Credit risk?

Risk of a government becoming unwilling or unable to meet its loan obligations is called Sovereign Credit risk.
There are five key factors that affect the probability of sovereign debt leading to sovereign risk:

- debt service ratio
- import ratio
- investment ratio
- variance of export revenue
- domestic money supply growth.

1.2 Financial Crisis 2008

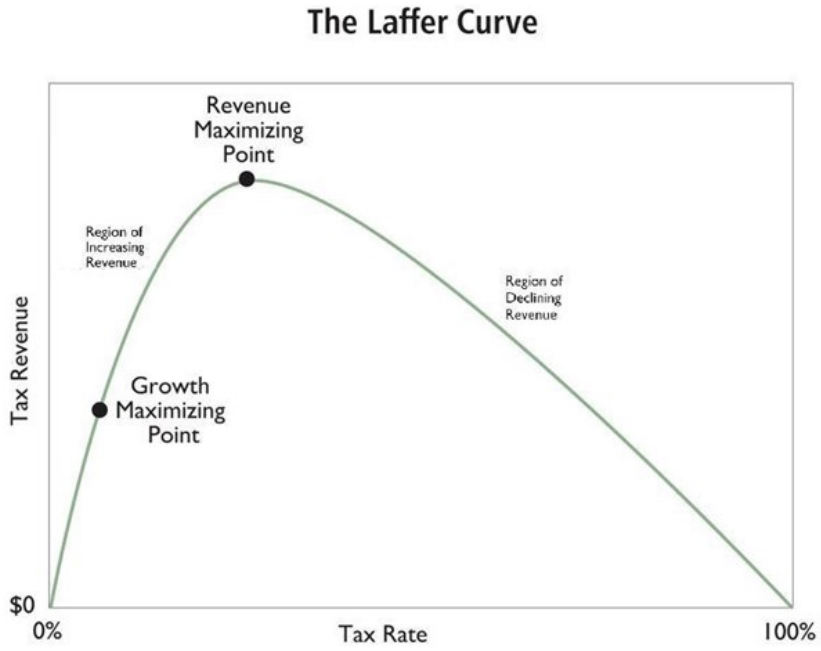
To understand better what Sovereign Credit risk actually means, best way is to have a look at the Financial Crisis that hit the world in 2008.
"A government can spand only as much as it collects in takis. Anything abov that ammount it has to borrow." - this is called Deficit spending.
Before Euro, contries like Greece not only had to pay high interest rates to borrow but could only borrow so much. Lenders weren't confident lending them too much money. As soon as they became a part of euro area's new united monatory policy things have drastically changed.
Greece had access to credit like never before. Interest rate that was about 18% went down to the same one that Germany has to pay. Lenders now believed that if Greece was unable to pay back the money, Germany would step in and repay them.
With the new abundance of cheap credit, Greece and other EU countries like Italy, Ireland and Spain were able to adjust their fiscal policies and increse spending to previously impossible levels. After a short time, debt was so deep that it couldn't be repayed with taxis. That is why they started repaying old debts with the new borrowed money. Things continued this way until credit was available but spurred by a collapse in the US housing market a credit crisis swept the globe in 2008 bringing borrowing to a halt. Suddenly the

Greek economy couldn't function as it couldn't borrow money to pay for all the new jobs and benefits or repay old debts. The reason why this quickly became problem for whole Europe is that the debtor countries borrow money from banks, investors and other governments through out the Europe. As the debtor countries get closer to default, everyone who lent them money becomes weaker, so became Europe.

2 Model

In order to answer the question why the financial sector bailouts were an integral factor in igniting the rise of the sovereign credit risk in the developed economies we will examine the country- and bank-level data and have a look at the model.

Theoretical model consists of three economic sectors: non financial or corporate, financial, and government. The financial and corporate sector work dependently. Financial sector invests in intercession, helping the corporate sector to invest more which will enhance the return with a ceratin interest rate. Government is responsible for the economic situation in the countriy. If the financial sector is leveraged and underinvests, government may undertake a bailout. This means that the certain ammount will be transfered from the rest of the economy which will reduce financial sectors debt. This must be funded in the future through taxes that the corporate sector payes when it invests. This will induce an underinvestment on the side of the non financial sector. Taxes that are used to fund the bailout have a Laffer curve property.



Laffer curve shows that there are two contraints on the bailout size: the greater is the existing debt of the government, the lower is its ability to undertake a bailout; the announcement of the bailout lowers the price of government debt due to the anticipated dilution from additional debt issuance which could cause collateral demage for the financial sector.
If we mark tax rate as θ_0 and the expected tax revenue as $\theta_0 V(K_1)$, considering the condition for investment of the nonfinancial sector:
$(1-\theta_0)V'(K_1) - 1 = 0$, we can see that the raising taxes has two effects. Higher tax rate θ_0 captures larger proportion of the future value of the nonfinancial sector, thereby raising tax revenues. On the other hand, high tax rate leads to an underinvestment of the non non-financial sector and thereby reducing $V(K_1)$.

Mentioned model looks like following:

The model shows coherence of two parts of productive economy, financial and non-financial sector, together with the government.

2.1 Financial sector

Starting with the financial sector, at $t = 0$ the amount of financial services to be supplied are chosen. Financial sector tends to maximize the expected payoff at $t = 1$, therefore net of the effort cost required to produce these services looks like:

$$maxE_0[(w_s s_0^s - L_1 + A_1 + A_G + T_0) \times 1_{\{-L_1+A_1+A_G+T_0>0\}}] - c(s_0^s)$$

s_0^s is the amount of financial services supplied by the financial sector at $t = 0$.
w_s is the rate per unit of financial service supplied.
$c(s_0)$ represents a cost measured in units of consumption good that the manager of financial sector incurs to produce s_0
L_1 are liabilities of the financial sector which are mature at time $t = 1$, which means that the financial sector receives revenues from supplying financial services only if the value of assets at time $t = 1$ exceeds L_1. Therefore we have a condition: $-L_1 + A_1 + A_G + T_0 > 0$.
A_G is the value of the financial sector's holdings of the existing stock of government bonds.
A_1 is the value at $t = 1$ of all other assets held by the financial sector.
T_0 is the value of the transfer made by the government at time $t = 0$.

2.2 Nonfinancial sector

At time $t = 0$ corporate sector has existing capital stock K_0.
Objective is to maximize the sum of the expected values of net payoffs at time $t = 1$ and $t = 2$ and therefore we get the following:

$$maxE_0[f(K_0, s_0^d) - w_s s_0^d + (1 - \theta_0)\tilde{V}(K_1) - (K_1 - K_0)]$$

Function f takes capital stock and amunt of financial services demanded by the nonfinancial sector and produces cosumption good at t=1.
$w_s s_0^d$ is the interest rate that has to be payed for the services of the financial sector.

2.3 Government

Government's task is to balance the economy. The more investments corporate sector makes, the more taxes government recieves. As corporate sector needs supplies from the financial sector, therefore government reduces the debt overhang problem of the financial sector. This means that the nonfinacial sector recieves more supplies, which leads to the increased output. To do so, government issues new bond at $t = 0$ and transfers them to the balance sheet of the financial sector. All bonds have to be repaid with the tax revenues generated by the nonfinancial sector. Government faces the following problem:

$$maxE_0[f(K_0, s_0^d) + \tilde{V}(K_1) - c(s_0) - (K_1 - K_0) - 1_{def}D + A_1]$$

We denote N_D as the number of the bonds that the government has issued in the past and N_T as new bonds. P_0 is the price of government bonds at $t = 0$. At t=2 realized taxes are received and used to pay bondholders $N_t + N_D$. If tax revenues fall short of $N_t + N_D$ then the bondholders receive all the tax revenues, but the government defaults on its debt which creates a fixd deadweight loss of D.

2.4 Conclusion

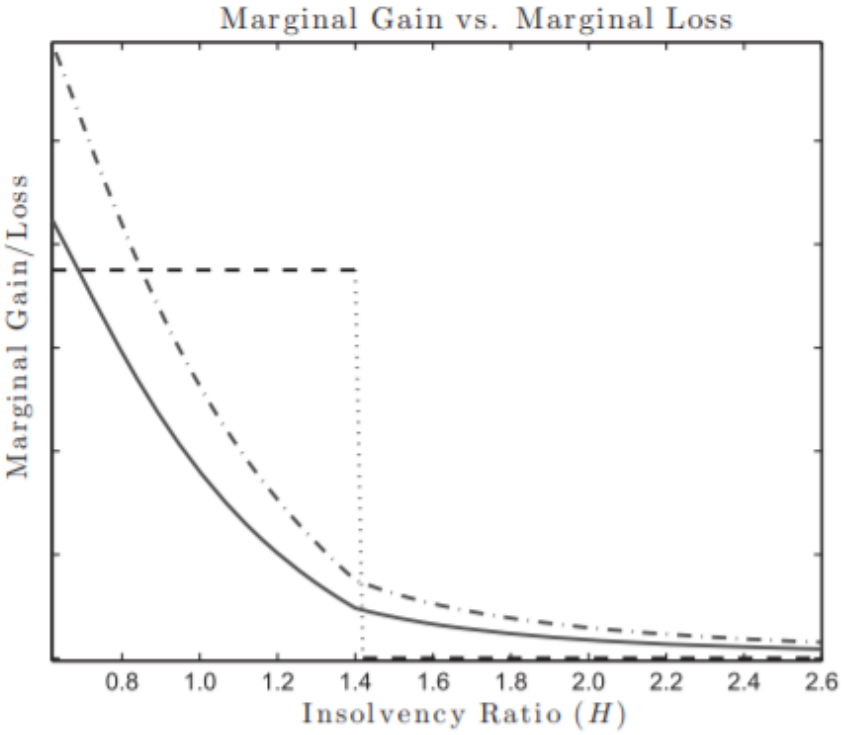
Compering these three problems, we can clearly see the dependence of these three economic sectors. This is the reason why the Sovereign credit risk is a very complicated topic. Optimization of just one sector is not possible and therefore economy of a country can be improved only with considering all factors and potential risks.

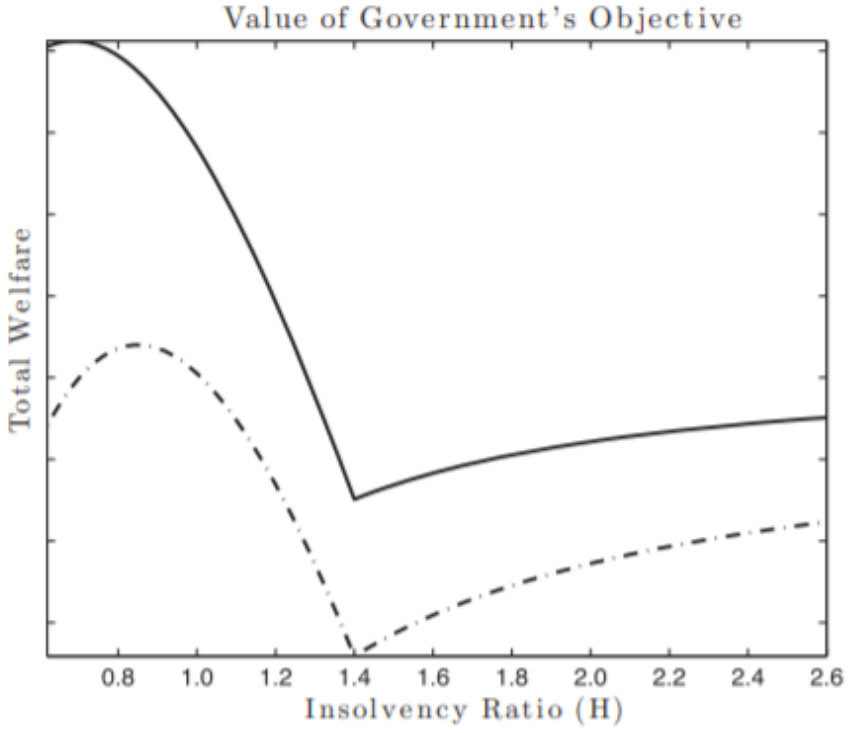
3 Default and Uncertainty

A sovereign default is the failure or refusal of the government of a sovereign state to pay back its debt in full.
We will now examine what would happen if we allow government to default. Fist we need to define some variables:
$\theta_0 V(K_1)$- the expected tax revenue is denoted by τ
$H = \frac{N_T + N_D}{\tau}$ - this is a useful variable in ensuring analysis to map a decision on how much new debt to issue which is equal to the ratio of the total face value of dent to expected tax revenue. It is also called the sovereign's insolvency ratio.
When there is no uncertainty, default occurs if the government increases H above a value of one. Benefit of this is that the increasing H generates a larger transfer by diluting the claim of existing debt on tax revenues. Government is now allowed to increas the transfer without increasing taxis and incurring huge underinvestment. However the burden of this is that the deadweight default loss D. There are different factors that can affect the value of sovereign defaulting. An increase in the financial sectorâs debt overhang increases the marginal gain from the transfer and, as defaulting enables the sovereign to generate a larger transfer, raises the benefit to defaulting. An increase in the amount of existing government debt also implies a larger benefit from defaulting by freeing up more resources for the optimal transfer and by decreasing the optimal tax rate and associated underinvestment. Finally, an increase in the fraction of existing sovereign debt held by the financial sector makes default less attractive since defaulting causes greater collateral damage to the financial sector balance sheet.
Let's now denote:
$\tilde{V}(K_1) = V(K_1)\tilde{R}_V$ where $\tilde{R}_V$ is the shock to output growth and is always $\geq$ with the expected value 1 and positive variance and is independent of the other variables in the model. With the uncertainty the sovereign no longer faces a binary decision of default or non default. Probability of default and the sovereign bond price are continuous functions of the inslovency ratio H. Government has to choose both the optimal value tax revenue and insolvency ratio. The first order condition for H is

$$\frac{d\varsigma}{dT_0}\frac{dT_0}{dH} - D\frac{dp_{def}}{dH} = 0$$

Raising H dilutes existing bondholders. By capturing a greater fraction of taxes, bigger transfer is generated without the need to underinvestment. This raises the sovereign's probability to default. Following illustration is showing this trade-off. The top panel shows that the marginal gain and loss of increasing H, holding τ fixed. If H is increased, the expected deadweight default cost is increased as well. The dash-dot line shows the impact of an increase in financial sector debt overhang on the marginal gain curve.
The second panel shows that for the given configuration, the optimum occurs at the intersection of the gain and loss curves. Objective function start to raise once H exceeds the upper end of the support $\tilde{R}_V$. Once the debt issuance is large enough that the default is certain, it is optimal to fully dilute existing bondholders and capture all tax revenues for the transfer.


Marginal Gain vs. Marginal Loss
Marginal Gain/Loss
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
Insolvency Ratio (H)


Value of Government's Objective
Total Welfare
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
Insolvency Ratio (H)

4 Statistics

In this section we will have a look at the statistic data that covers all banks with publicly traded credit default swaps in Schengen.

	Obs.	Mean	Std. Dev.	50th percentile	5th percentile	95th percentile
Panel A: Cross-Section (1/1/2008)						
Assets (Euro billion)	36	498.6	462.2	333.2	58.6	1,427.80
Equity (Euro billion)	36	19.7	16.2	14.1	2.3	56.5
Equity ratio (%)	36	4.7%	2.0%	4.2%	2.5%	10.0%
Short-term debt share (%)	36	12.6%	11.0%	9.8%	0.3%	33.8%
Long-term debt share (%)	36	33.1%	12.2%	31.5%	11.7%	57.7%
Deposit share (%)	36	49.5%	11.1%	49.2%	30.8%	70.7%
Credit rating	33	3.1	1.3	3	2	6

First table is showing bank characteristics as of 01.01.2008. In the table Short-term Debt share is a short term debt as a share of assets. Same meaning has a long-term Debt share but of course for long-term debt as share of assets.
Credit Rating is Moody's credit rating (AAA=1, AA+ =2, and so on).
This year is chosen because of the financial crisis that hit Europe in 2008. As we can see in this table, the average bank had assets of 498.6 bilion euros and book equidity of 19.7 bilion euros. The main sources for funding were equity, short and long term debt and deposits (49.5%)

In the second table we can see the statistics of bank and sovereign credit risk split in pre-bailout, during-bailout and post-bailout periods.
Pre-bailout is period that started on 1. January 2007 and ended on 25. September 2008.
This period captures increase in bank credit risk and Lehman bankruptcy on 15. September 2008.
During-bailout period is covering period from 26. September 2008 until 21.October 2008.
Post-bailout period starts when during-bailout period is finished and lasts until 30.April 2011.

Pre-bailout (1/1/2007 to 9/25/2008)						
Bank CDS (bp)	11,352	64.0	58.1	54.5	7.0	166.0
Sovereign CDS (bp)	11,352	13.8	12.3	9.5	1.7	39.8
Δ Log(Bank CDS)	11,352	0.7%	20.7%	0.0%	−11.6%	11.9%
Δ Log(Sovereign CDS)	11,352	0.4%	25.2%	0.0%	−14.0%	17.6%
Bank Equity Return	11,352	−0.2%	2.7%	−0.1%	−4.2%	4.0%
Δ Log(Foreign Exposure CDS)	11,352	0.5%	23.5%	0.1%	−15.0%	17.5%
Bailout (9/26/2008 to 10/21/2008)						
Bank CDS (bp)	561	147.0	87.6	123.5	65.0	325.0
Sovereign CDS (bp)	561	45.7	20.6	42.5	13.7	79.2
Δ Log(Bank CDS)	561	−2.1%	15.9%	−0.4%	−26.2%	20.8%
Δ Log(Sovereign CDS)	561	5.0%	10.7%	3.3%	−9.7%	22.9%
Bank Equity Return	561	−2.4%	11.9%	−0.9%	−18.1%	11.2%
Δ Log(Foreign Exposure CDS)	561	4.6%	10.3%	3.1%	−8.0%	27.0%
Post-bailout (10/22/2008 to 30/4/2011)						
Bank CDS (bp)	22,291	183.5	200.1	131.4	63.9	467.7
Sovereign CDS (bp)	22,291	111.7	98.8	78.6	24.4	300.6
Δ Log(Bank CDS)	22,291	0.1%	4.8%	0.0%	−6.6%	7.1%
Δ Log(Sovereign CDS)	22,291	0.1%	4.8%	0.0%	−7.3%	7.8%
Bank Equity Return	22,291	0.0%	4.4%	0.0%	−5.9%	5.8%
Δ Log(Foreign Exposure CDS)	22,291	0.1%	5.4%	0.0%	−7.1%	7.6%

In the bailout period, we can see a significant rise in sovereign and bank credit risk with the average CDS 147 bps and 46 bps comparing to the pre-bailout period where the average of bank and sovereign CDS were 64 bps and 14 bps. Things got worse in post-bailout period where the average bank and sovereign CDS attains 184 bps and 112 bps.
So high levels of CDS were the key to indicate the emergence of significant bank and sovereign credit in Europe.

Third table is showing the statistics of all banks that participated in the European stress test.

A bank stress test is an analysis conducted under hypothetical unfavorable economic scenarios, such as a deep recession or financial market crisis, designed to determine whether a bank has enough capital to withstand the impact of adverse economic developments. Bank stress tests were widely put in place after the 2007-2009 global financial crisis, the worst in decades.The ensuing Great Recession left many banks and financial institutions severely undercapitalized or revealed their vulnerability to market crashes and economic downturns. As a result, federal and financial authorities greatly ex-

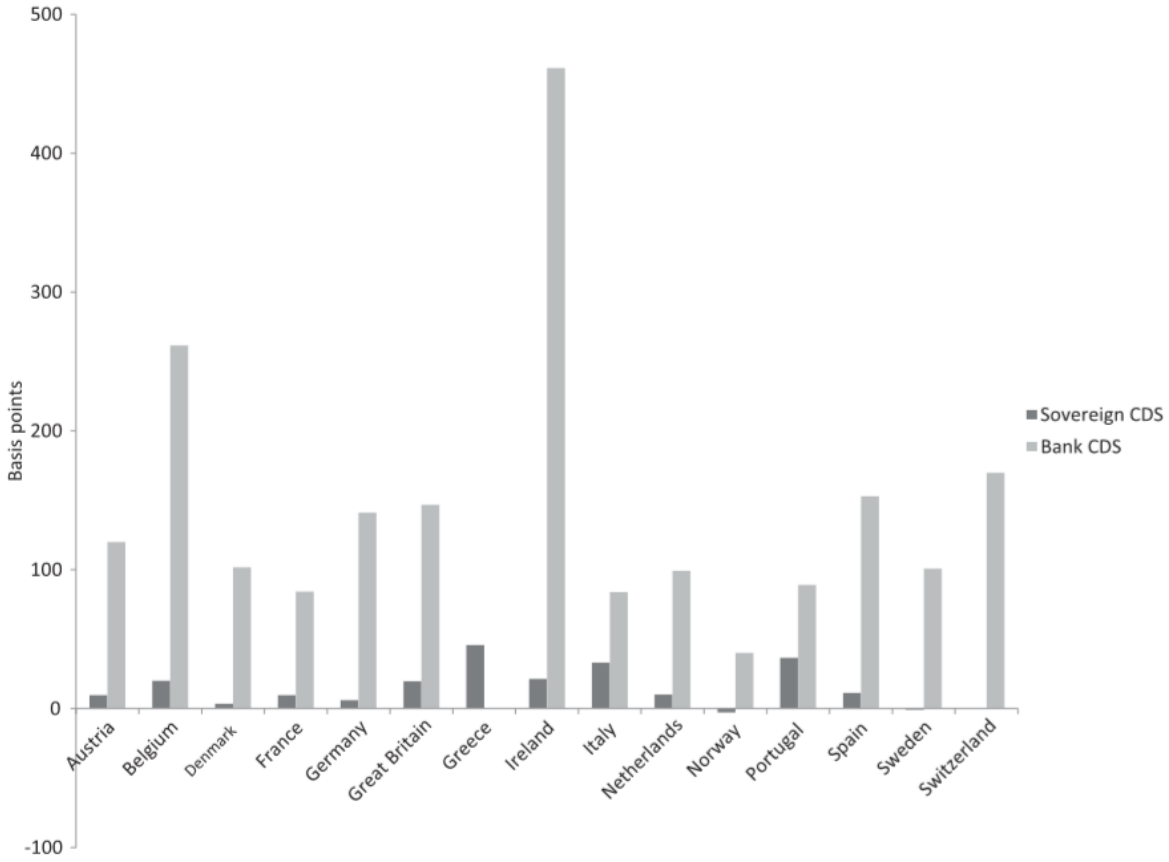
[0]Definition of the stress test was taken from https://www.investopedia.com/terms/b/bank-stress-test.asp

panded regulatory reporting requirements to focus on the adequacy of capital reserves and internal strategies for managing capital. Banks must regularly determine their solvency and document it. To determine banks' financial health in crisis situations, stress tests focus on a few key areas, such as credit risk, market risk, and liquidity risk. Using computer simulations, hypothetical crises are created using various criteria from the Federal Reserve and International Monetary Fund (IMF). The European Central Bank (ECB) also has strict stress testing requirements that cover approximately 70% of the banking institutions across the Eurozone. Company-run stress tests are conducted on a semiannual basis and fall under strict reporting deadlines. Banks then use the next nine quarters of projected financials to determine if they have enough capital to make it through the crisis.

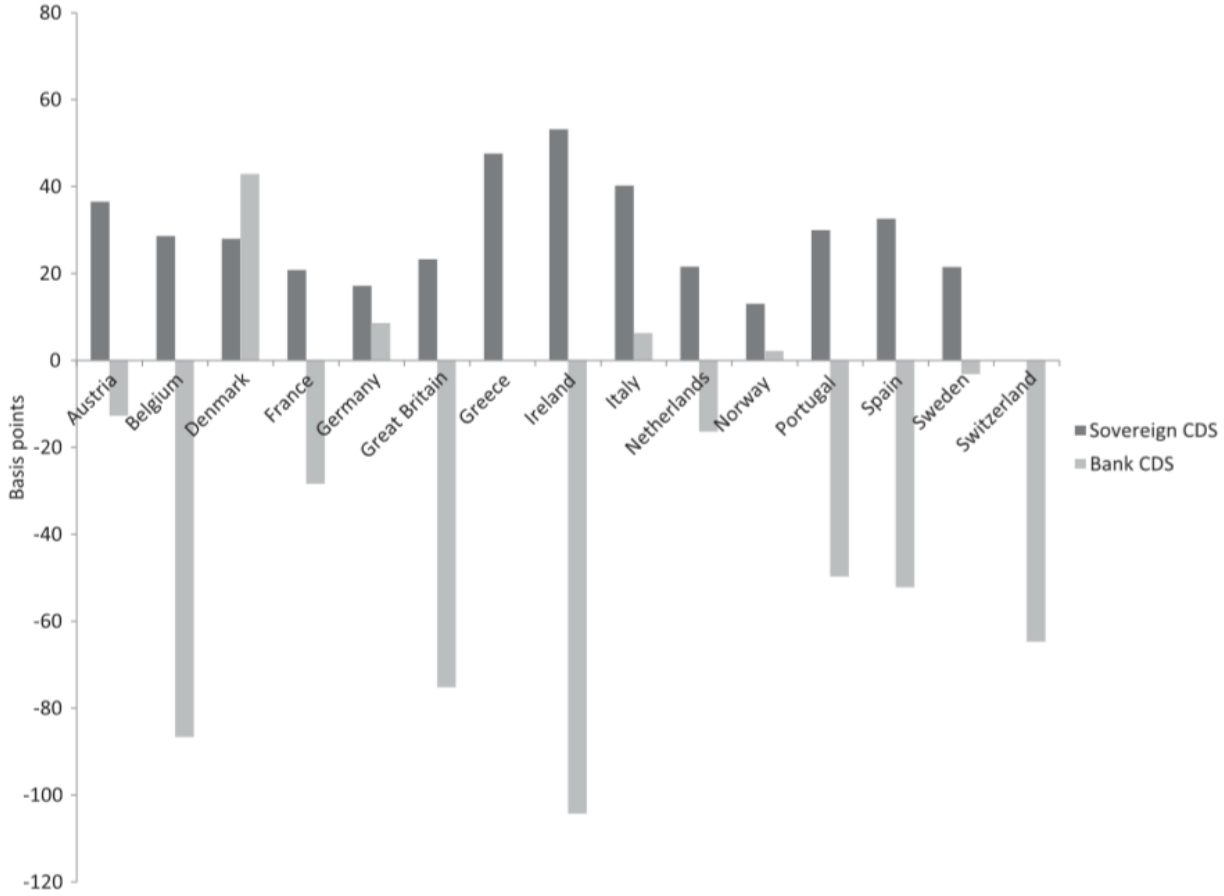
	Obs.	Mean	Std. Dev.	50^{th} percentile	5^{th} percentile	95^{th} percentile
Panel C: European Bank Stress Tests (3/31/2010)						
Risk-Weighted Assets (Euro billion)	91	126.3	179.1	63.4	3.3	493.3
European Sovereign Bond Holdings (Euro billion)	91	20.6	27.9	7.9	0.1	81.7
Home Sovereign Bond Holdings (Euro billion)	91	11.5	14.4	5.7	0.2	42.8
Home Share (%)	91	69.4%	30.0%	81.6%	18.9%	100.0%
Share Banking Book (%)	91	84.9%	19.9%	92.2%	35.4%	100.0%

Sovereign bond holdings constitute a significant share of a bank's assets, but as of March 2010 the average bank holds about one-sixth of risk-weighted assets in sovereign bonds. Most of the bonds are held in the bank books, which indicates that banks wants to hold them for an extended period. This means that the banks are exposed to the sovereign risk through their holding of sovereign bonds. Now we should have a look at the grafs in order to better understand the change in bank and sovereign CDS and how they had an impact on one-another.

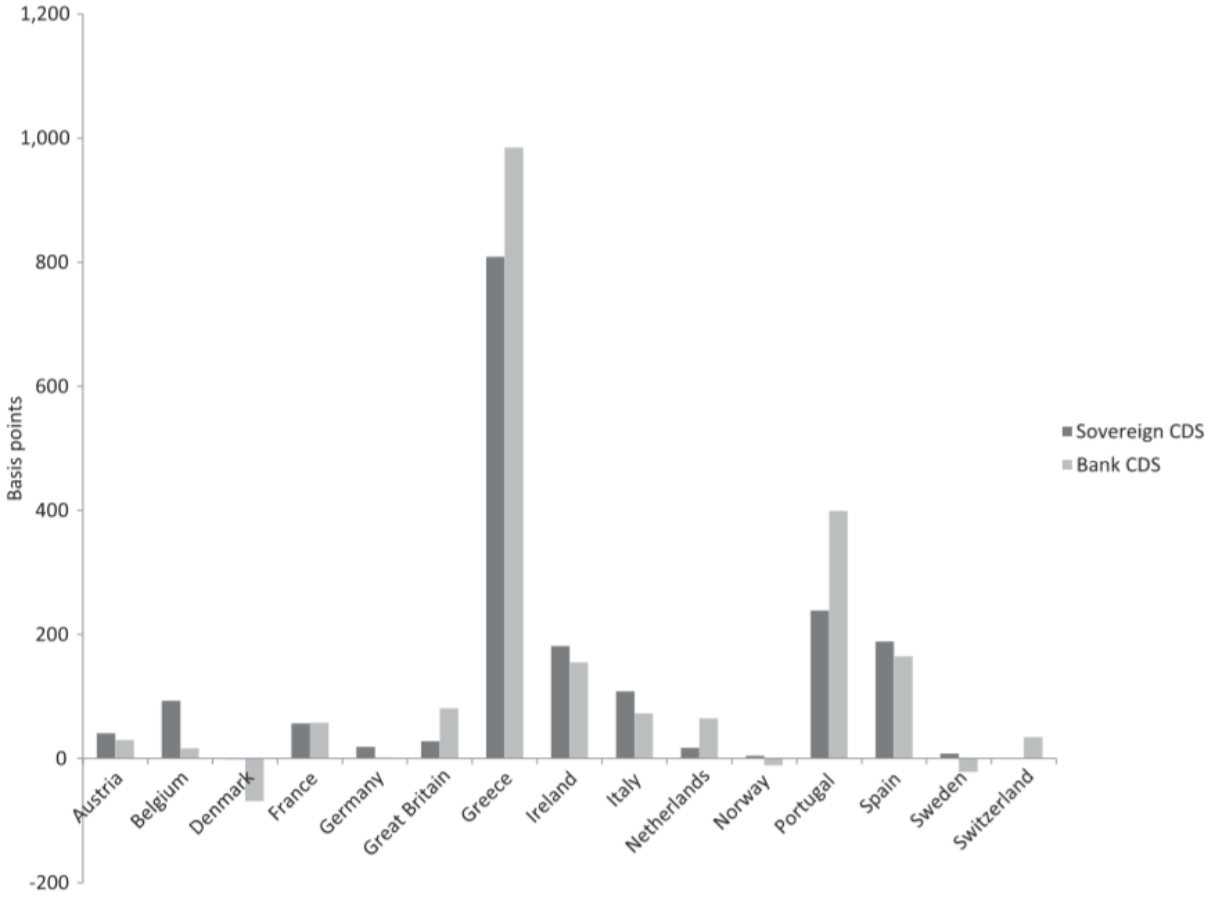
Following graf represents the change of bank and sovereign CDS in the pre-bailout period.



In the pre-bailout period a large increase in the bank CDS happened because of the increase in the credit risk of the financial sector, but there was almost no change in sovereign CDS. This story completely changed within one month. For most countries, bank CDS decreased in during-bailout period while sovereign CDS increased.



In the third period we can again see a completely different picture. Now, both sovereign CDS and bank CDS increased across most countries and magnitudes of the changes are similar.



When the sovereign opens itself up to credit risk due to bailouts,the price of its debt becomes sensitive to macroeconomic shocks. Moreover, our model indicates that subsequent changes in the sovereignâs credit risk should impact the financial sector's credit risk through its effect on the values of: ongoing bailout payments and subsidies, direct holdings of government debt, and explicit and implicit government guarantees. In empirical analysis, the aggregate effect of the two-way feedback loop between sovereign and bank credit risk can be estimated. The main challenge in establishing a direct feedback loop between sovereign and financial sector credit risk is that there may be another (unobserved) factor that affects both bank and sovereign credit risk. Such a factor could explain comovement between sovereign and bank credit risk without there necessarily being an underlying direct channel

between sovereign and bank credit risk. For example, sovereign credit risk reflects changes in expectations about macroeconomic fundamentals, such as employment, economic growth, and productivity. These fundamentals also have a direct effect on the value of bank assets such as mortgages or bank loans. Hence, changes in macroeconomic conditions may generate a correlation between sovereign and bank credit risk even in the absence of a direct feedback mechanism.

References

[1] http://assets.press.princeton.edu/chapters/reinert/15articlesillsovereign.pdf

[2] https://www.investopedia.com/terms/b/bank-stress-test.asp

[3] https://en.wikipedia.org/wiki/Sovereign_credit_risk

[4] https://en.wikipedia.org/wiki/Credit_risk

[5] The journal of finance
A Pyrrhic Victory? Bank Bailouts and Sovereign Credit Risk

[6] https://www.investopedia.com/terms/c/creditdefaultswap.asp

[7] https://www.ecb.europa.eu/pub/economic-research/resbull/2018/html/ecb.rb181218.